# APPLICATION

## Study field "Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science" for assessment

| | |
|---|---|
| Study field | *Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science* |
| Title of the higher education institution | *Latvijas Universitāte* |
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# Self-evaluation report

Study field "Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science"

University of Latvia

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# 1. Information on the Higher Education Institution/College

## 1.1. Basic information on the higher education institution/ college and its strategic development fields,.

**University of Latvia** (hereinafter – UL) dates back to 16(28) May 1861, when the Russian emperor Alexander II approved the regulations on the Riga Polytechnic University.

**Riga Polytechnic University** (in German: *Polytechnikum zu Riga*, Russian: *Рижское политехническое училище*) existed from 1861 to 1896 when it was transformed into Riga Polytechnic Institute. The beginnings of this university can be traced back to several Latvian universities, including the Latvia University of Agriculture (1938), Riga Stradiņš University (1950), Riga Technical University (1958).

In the 19th century, the centre of education in the Governorate of Livonia was the University of Tartu, but it did not train technical specialists. The committee of Riga Bourse and the Riga Town Hall proposed the establishment of a technical university in Riga, which was supported by the Baltic Governor-General A. Suvorov.

In 1861, the University Council was elected, to which representatives were delegated by the chivalry of Estonia, Courland, Livonia and Saaremaa Island, Riga Town Hall, Large and Small Guild, Tallinn city, Tallinn and Riga Bourses. It originally functioned as a private higher education institution maintained primarily by the gentry of the Baltic governorates. Any citizen (male) of the Russian Empire was allowed to study at the university, starting studies without entrance exams. The studies were for a fee and were conducted in German.

**Riga Polytechnic Institute** (Russian: *Рижский политехнический институт*) was a technical university that was founded on the basis of Riga Polytechnic University base by transforming it from a private university with the German language of instruction into a state university with the Russian language of instruction, while still maintaining internal autonomy.

During the First World War, the institute was evacuated to Moscow, where it operated until 1918. Later, in 1917, Riga was occupied by German troops, in 1918 and 1919, Baltic Technical University (*Baltic Technische Hochschule*) operated on the basis of the institute. During the Latvian Socialist Soviet Republic, on 8 February 1919, it was reorganized to become the Higher School of Latvia with the Latvian language of instruction, but in 1923, during the Republic of Latvia, it was renamed the University of Latvia.

With the change of power, the name of the university also changed – Latvian State University (USSR occupation 1940-1941), Universität in Riga (German occupation 1942-1944), Latvian State University and Pēteris Stučka Latvian State University (USSR occupation, 1944-1958 and 1958-1990, respectively), until it regained its name given by the Republic of Latvia, i.e., University of Latvia.

During the Latvian Soviet Socialist Republic, in 1958, technical faculties were separated from the Latvian State University and Riga Polytechnic Institute (1958-1990) was established, which was renamed Riga Technical University in 1990.

**University of Latvia** as a national university **was founded on 8 February 1919**, and it is the largest wide-profile university in Latvia, which has an important place not only in the development of the entire education system, but also in the growth of the overall national economy.

The University of Latvia is the only classical university in Latvia, maintaining the status of the largest higher education institution in the country in terms of the number of students in 2021. UL is a science university that combines and develops the country's main study and scientific research potential in the fields of natural, technical, humanitarian, and social sciences.

The University of Latvia (hereinafter - UL) was founded in 1919 and is the only classical university in Latvia, retaining its status as the largest higher education institution in the country in terms of the number of students in 2021. The University of Latvia is a university of science, incorporating and developing the country's main study and scientific research potential in the field of humanities, natural, technical, and social sciences.

**Mission**: The mission of the University of Latvia is expressed in its motto *Scientiae et Patriae* (For Science and Fatherland). The University of Latvia (UL) contributes to global science, higher education, knowledge, technology transfer and innovation, and ensures the growth of Latvian democracy and culture, the development of the Latvian language and the prosperity of the national economy.

**Vision**: Space for excellence, environment for development, time for responsibility. The UL is a university of science of high international standing. The UL creates an interdisciplinary, open and innovation-oriented, excellent work and study environment. The activities of the University of Latvia form the basis for the sustainable development and economic transformation of the Republic of Latvia.

**Values**:

- University community,
- Excellence,
- Science-based development,
- Openness,
- Cooperation,
- Academic freedom.

The University plays an important role not only in the development of the higher education system in Latvia, but also in the growth of the country's economy, providing cutting edge studies and research, based on the unity of higher education and science. The University actively participates in solving topical problems of the state and society, and is the centre of intellectual life in Latvia, where new knowledge is created, while nurturing the national language, culture and promoting the development of the state and society. The University of Latvia focuses its efforts on providing quality studies and developing scientific excellence, creating structures open to interdisciplinary and transdisciplinary research and studies, ensuring high return on invested resources, sustainable and environmentally friendly use of resources. The University is evolving as a modern international academic centre, creating an environment and infrastructure for excellence in studies, research and innovation

The study process at the University of Latvia is implemented at 13 faculties, 7 branches (only in Latvian) and 3 medical colleges. Research activities are also performed at 18 research institutes, and various research, training and consultancy activities are conducted in 28 study centres. The UL Regional Centre (only in Latvian) coordinates and supervises the activities of the UL branches, as well as promotes cooperation between the University and local authorities in the fields of human resources development, education and interdisciplinary research. The UL has more than 230 bilateral cooperation agreements with universities in 51 countries. The UL Culture Centre (only in Latvian) is represented by 21 amateur arts groups - choirs, dance groups, vocal ensembles, early music ensembles, theatre, a brass band and a ceramics studio. The UL Sports Centre organises UL

sports activities for up to 40 different sports classes in 11 sports - basketball, wrestling, group fitness classes, football, floorball, table tennis, kendo, general fitness, volleyball, cheerleading and self-defence.  The activities of the UL are also performed by the UL Museum, the UL Botanical Garden, the UL Rhododendron Nursery "Babīte", the UL Academic Publishing House, and the UL Baldone Observatory (only in Latvian).The UL Foundation and the Alumni Club (only in Latvian) have also been operating successfully.

As of 1 October 2021, the UL has 3,250 employees, including 1,420 UL academic staff and 1,830 UL general staff. The UL financial performance is characterised by a turnover of EUR 81 million and an equity ratio of 73%. The main activities of the University take place in Riga, at 19 Raiņa Boulevard and UL Academic Centre in Torņkalns, as well as in several locations in Riga and in the UL regional branches in Aluksne, Bauska, Cesis, Jēkabpils, Kuldīga, Madona and Tukums.

The UL is ranked 601-800 in the Times Higher Education World University Ranking of 2021, its academic staff and students publish more than nine hundred scientific publications annually in the Scopus and Web of Science databases.

The UL offers study programmes at all levels, covering 28 branches of science and 22 fields of study. The UL 13 faculties offer 140 study programmes. See Table 1 for the fields of study, the number of study programmes and the accreditation periods.

*Table I-1*

Study fields, number of study programmes and accreditation periods (02.11.2021.)

| No | Study fields | Number of study programmes | Accreditation period |
|---|---|---|---|
| | Architecture and Construction | 1 | 08.06.2022-09.06.2028. |
| | Wildlife Sciences | 3 | 29.05.2013-31.12.2023. |
| | Economics | 8 | 08.09.2021-09.09.2027. |
| | Physics, Materials Science, Mathematics and Statistics | 7 | 29.05.2013-31.12.2023. |
| | Geography and Earth Sciences | 6 | 24.04.2017-24.04.2023. |
| | Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management, and Computer Science | 5 | 29.05.2013-22.08.2023. |
| | Internal security and Civil defence | 3 | 05.06.2013-31.12.2024. |
| | Information and Communication Sciences | 5 | 16.06.2021-17.06.2023. |
| | Education, Pedagogy and Sports | 24 | 12.06.2013-31.12.2024. |

| No | Study fields | Number of study programmes | Accreditation period |
|---|---|---|---|
| | Chemistry, Chemical engineering and Biotechnology | 3 | 24.05.2013-31.12.2023. |
| | Arts | 1 | 24.11.2021-25.11.2027. |
| | Psychology | 3 | 21.06.2019-21.06.2025. |
| | Sociology, Political science and Anthropology | 9 | 12.06.2013-31.12.2024. |
| | Social Welfare | 2 | 14.09.2022-13.09.2028. |
| | Religion and Theology | 3 | 22.05.2013-31.12.2023. |
| | Law | 4 | 21.06.2019-21.06.2025. |
| | Translation | 2 | 14.05.2013-31.12.2024. |
| | Management, Administration and Real estate management | 8 | 29.00.2021-30.09.2027. |
| | Language and Culture studies, Native language studies and language programmes | 21 | 26.06.2013-31.12.2024. |
| | Healthcare | 13 | 31.05.2013-31.12.2022. |
| | History and Philosophy | 6 | 24.05.2013-31.12.2023. |
| | Environmental protection | 3 | 05.06.2013-31.12.2024. |

UL study programmes in several fields of study are also available in seven UL branches located in the regions of Latvia. In the academic year 2021/2022, 11 different fee study programmes in 3 study fields, ranging from first-level (college) higher education study programmes, professional bachelor's study programmes to master's study programmes, are being implemented in the branches. See Table I-2 for the number of study fields and study programmes in the branches.

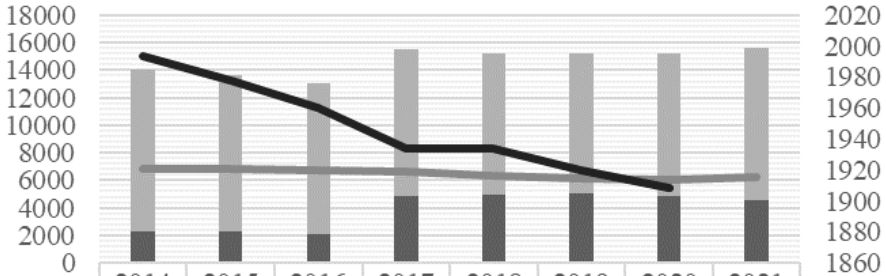
*Table I-2*

Number of study fields and study programmes implemented in the regional branches of the University of Latvia, data as of 2021

| Branches | Alūksne (founded 1997) | Bauska (founded 1997) | Cēsis (founded 1995) | Jēkabpils (founded 1996) | Kuldīga (founded 1996) | Madona (founded 1997) | Tukums (founded 1996) |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of study fields | 3 | 1 | 2 | 1 | 2 | 1 | 1 |
| Number of study programmes | 5 | 3 | 7 | 4 | 9 | 3 | 6 |
| Number of students | 75 | 146 | 428 | 99 | 302 | 99 | 333 |

As of 1 October 2021, the total number of students studying at the University of Latvia is 15 590, 40% of whom are financed from the state budget. Around 10% of students study at UL branches. In total, almost five thousand new students are enrolled every year. See Fig.I-1.




| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|
| Number of students studying full-time at LU | 11715 | 11360 | 10967 | 10630 | 10203 | 10240 | 10457 | 11054 |
| Number of students studying part-time at LU | 2305 | 2240 | 2133 | 4870 | 4997 | 5010 | 4803 | 4536 |
| Number of students studying on budget | 6837 | 6784 | 6768 | 6583 | 6359 | 6181 | 6029 | 6253 |
| Population in Latvia (millions) | 1994 | 1978 | 1960 | 1934 | 1934 | 1920 | 1908 | |

*Fig.I-1. Number of students at the University of Latvia against the population of Latvia, 2014-2021*

The UL medium-term development strategy for the period from 2021 to 2027 (UL Strategy 2021-2027) was approved on June 28, 2021, by the Senate decision No.2-3/ 90. With the cooperation of the involved parties and the analysis of the national and international competitiveness of the University of Latvia, the mission of the University of Latvia has been revised and strategic goals have been defined in six development directions - three in each - in the core business and institutional areas. Development goals have been set for science, studies, public education, as well as in the domains of staff and organizational culture, environment and governance. The UL Strategy 2021-2027 envisages the further development of the University as an internationally recognised science centre, the development of unique study and lifelong learning programmes, as well as the offer of competitive working and study conditions. The University continues the work initiated in the previous strategic period to achieve the highest level of scientific excellence, as well as to promote student-oriented studies and develop a modern study environment. The involvement and contribution of the University to the society of Latvia is being purposefully promoted. The University is improving the working conditions and environment necessary for talent development. Sustainable growth is playing an increasingly important role and is becoming a cross-cutting principle in all its areas of activity. Significant attention is paid to ensuring academic integrity and strengthening the value-oriented organisational culture of the

University. See Table I-3 for the current strategic goals and development directions of the University.

*Table I-3.*

*UL Strategic Goals Map, 2021-2027*

| *Development directions* | *Strategic goals* |
|---|---|
| **Development of principal activities** | |
| 1.V. Scientific excellence | 1.M. Internationally recognized research university |
| 2.V. Development of studies | 2.M. Unique study offer and high competitiveness of graduates |
| 3.V. Contribution to society | 3.M. University activities as a basis for the growth of Latvia |
| **Institutional development** | |
| 4.V. Talent development | 4.M. Development- and excellence-oriented HR policy |
| 5.V. Environment and governance | 5.M. Green thinking, attractive, sustainable university environment and effective administrative support |
| 6.V. Organisational culture | 6.M. Inclusive, cooperation- and innovation-focused culture |

The outcomes of the implementation of the UL Strategy 2021-2027 will be measured by twenty-one performance indicators, five of which have been designated as UL Key Performance Indicators (KPIs). - These are: research funding from foreign sources per full-time equivalent of academic staff in EUR, co-publications with foreign partners in SCOPUS and Web of Science databases (%), the percentage of graduates who are satisfied (rated at least "good") with the quality of their studies (%); the percentage of foreign students at UL (%), as well as the commercialization revenue (EUR/thousands).

**1.2. Description of the management structure of the higher education institution/ college, the main institutions involved in the decision-making process, their composition (percentage depending on the position, for instance, the academic staff, administrative staff members, students), and the powers of these institutions.**

The main decision-making bodies of the UL are the Constitutional Assembly, the Senate, the Council, the Rector, and the Academic Arbitration Court. See Table 1.2.1 for the proportion of the

composition of the main decision-making bodies of the UL and the terms of the elections.

*Table 1.2.1*

Characterisation of the terms of election, proportion of the composition, and authority of the main decision-making bodies of the UL

| Decision-making Body | Term of Election | Total Number of Participants | Representation of Academic Staff | Representation of General staff | Student Representation |
|---|---|---|---|---|---|
| Constitutional Assembly | 3 years | 200 | 65% | 10% | 25% |
| Council | 4 years | 11 | 45.5% | | |
| Senate | 3 years | 50 | 76% | 4% | 20% |
| Rector | 4 years | 1 | 100% | | |
| Academic Arbitration Court | 3 years | 5 | 80% | | 20% |

For characterisation of the authority of the main UL decision-making bodies, for information on the governance structure of the UL, its composition and competences, see Section 1.2 of the Annex I-1. UL Quality Management Handbook.

The most important documents can be found in Latvian https://www.lu.lv/par-mums/dokumenti/ and English https://www.lu.lv/en/about-us/documents/ , as well as in Annex I-2.

The structural chart of the management of the LU can be found in Annex I-3, as well as on the website of the LU in Latvian https://www.lu.lv/par-mums/struktura/strukturshema/ and English https://www.lu.lv/en/about-us/structure/university-structure/.

**1.3. Description of the mechanism for the implementation of the quality policy and the procedures for the assurance of the quality of higher education. Description of the stakeholders involved in the development and improvement of the quality assurance system and their role in these processes.**

The quality policy of the University is a continuous evolution towards excellence to ensure balanced and sustainable outcomes that meet the needs of all stakeholders. The UL Quality Policy and the resulting UL Quality Action Policy (see Fig. I-2) are a set of quality-related principles, objectives and the actions necessary for their achievement, implemented by the University in accordance with internationally recognised standards in higher education and organisational governance.

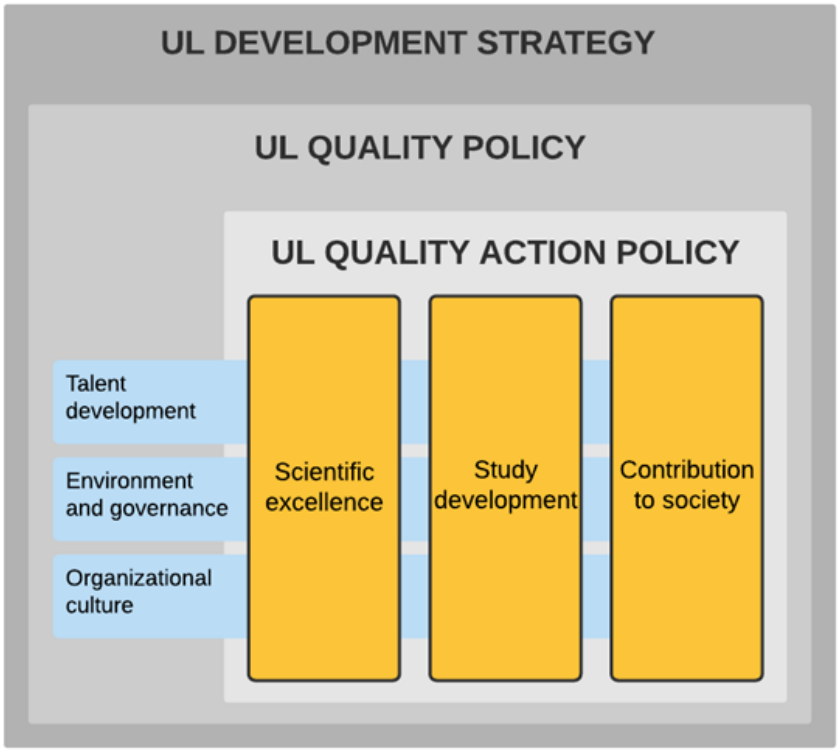



*Figure I-2. Hierarchy of Quality Policy and Action Policies at the University of Latvia*

The Quality Policy aims to contribute to the achievement of the mission, strategic objectives and sustainable development of the University by setting out guidelines and principles that can be used to ensure a consistently high quality of performance. The Quality Policy and the Quality Action Policy, together with other policies and processes, ensure the coherent planning and implementation of the activities of the University. The Quality Policy and Quality Action Policy are an integral part of the Quality Management System, which is applied to all areas of UL activity and envisages its implementation at all levels of UL governance. Quality is defined as a measure of excellence that characterises the ability of the UL to meet and exceed the foreseeable and future needs of its stakeholders, and to ensure that its processes comply with industry regulatory and standard requirements. The UL  provides a set of activities and methods by which quality is planned, implemented, systematically assessed and continuously enhanced, thereby contributing to the achievement of the UL's stated objectives and to meeting the needs of its stakeholders.

Quality management has been implemented at the University since 2010. The **quality management system** of the University is implemented in accordance with the principles of *Total Quality Management* (TQM), integrating the approach of excellence into the corporate culture of the University. For the implementation of Total Quality Management, the UL uses an internationally recognised and practically applicable quality management methodology - the EFQM (*European Foundation of Quality Managemen*t) Excellence Model.  The quality management system is enhanced in the core activities areas by developing **internal quality assurance systems** integrated into the quality management system and based on current sectoral standards and frameworks. The internationally recognised *Results - Approach - Deployment - Assessment and Refine* (RADAR) methodology is used to ensure the cyclicality and continuity of quality management at the UL, and the Plan - Do - Check - Act (PDCA) approach is used in quality assurance systems. Figure I-3 provides a diagram of a quality management system with an integrated quality assurance system for studies. For a more detailed description of the UL Quality Management System, see Section 2.1 of the UL *Quality Management Handbook*.

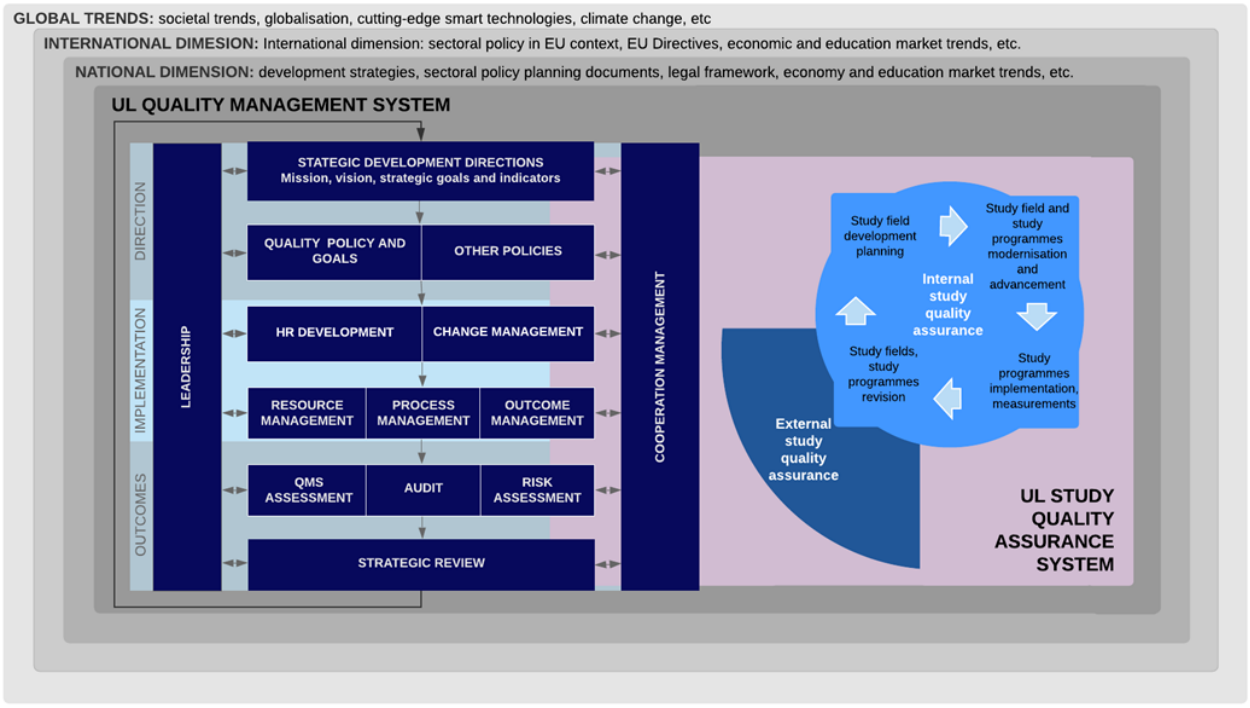



*Figure I-3. UL Quality Management System and Principles of the Quality Assurance System*

To ensure the quality of higher education, the University of Latvia implements the **Quality Assurance System for Studies**, which includes procedures for planning, ensuring, measuring and evaluating the quality of higher education in accordance with the requirements of national legislation, the *European Standards and guidelines for quality assurance in the European Higher Education Area* (ESG), as well as for internal needs. The University of Latvia provides planning for the development of the study field and improvement of the existing study programmes for a period of 6 years. The procedure for the implementation of study programmes is laid down in the internal legal acts of the University, including the development of new study programmes, admission requirements, matriculation and registration for studies, development, implementation and review of study courses and modules, planning, implementation and assessment of study internship placements, organization of examinations and final examinations, rotation, the principles of academic integrity and their observance, matriculation, issuance of diplomas and certificates, recognition of previous education or professional experience, the procedure for conducting surveys, submission of student proposals and complaints, contestation of administrative decisions, doctoral dissertation promotion process, etc. The University ensures that the measurements and data necessary for quality assessment and improvement are collected and used for both immediate corrective action and regular evaluation and planning of further improvement. The 6-year study field development plan is monitored annually, the measurements are analysed, and the SWOT is discussed, if necessary, by introducing changes to the operational study programme implementation plans, to the study field plan or, when assessing the overall development of study fields within the framework of the UL Strategic Control, to the UL Strategic Action Plan. For more information on quality assurance of studies, see Section 3.1 of the UL *Quality Management Handbook*. For the breakdown of responsibilities for quality management and assurance, see Section 2.5 of the UL *Quality Management Handbook*.

The UL quality assurance system is based on the participation of key stakeholders in the quality assessment and improvement of the University's activities. Stakeholders of the UL are natural or legal persons, domestic and international, who use the services of the UL or whose socio-economic situation is affected by the activities of the UL. The main stakeholders are defined in point 12 of the UL *Quality Action Policy*. For the description and examples of the roles of key stakeholders in quality

management, see Section 3.2, sub-section 1.2 (Table 3.6) of the UL *Quality Management Handbook*.

**1.4. Fill in the table on the compliance of the internal quality assurance system of the higher education institution/ college with the provisions of Section 5, Paragraph 2(1) of the Law on Higher Education Institutions by providing a justification for the given statement. In addition, it is also possible to refer to the respective chapter of the Self-Assessment Report, where the provided information serves as justification.**

| | | |
|---|---|---|
| 1. | The higher education institution/ college has established a policy and procedures for assuring the quality of higher education. | The University has formulated Quality Policy in line with its Strategy, which is detailed in the Quality Action Policy.<br><br>For quality assurance of higher education, the Studies Quality Assurance System (in compliance with ESG) has been implemented and integrated into the Quality Management System (in compliance with EFQM). For more information, see Part I, Section 1.3 of this document and Section 3.1 of the UL Quality Management Handbook.<br><br>The establishment, maintenance and improvement of the UL quality management system at the University of Latvia are performed by the management and heads of core structural units (deans of faculties) and their delegated employees. The Academic Department is responsible for the establishment, implementation and improvement of the study quality assurance system, in close cooperation with the heads of study fields and directors of study programmes. Two collegiate committees have been established for quality assessment with the participation of the UL stakeholders: The Quality Advisory Committee and the Study Programme Quality Assessment Committee. For more information, see Section 2.5 of the UL Quality Management Handbook. |
| 2. | A mechanism for the creation and internal approval of the study programmes of the higher education institution/ college, as well as the supervision of their performance and periodic inspection thereof, has been developed. | The establishment and internal approval of study programmes are stipulated in the Regulations of the University of Latvia on Study Programmes and Continuing Education Programmes (UL Senate Decision No 102 of 24.04.2017). For more information, see Section 2.4 of this report, as well as sub-section II of Section 3.1 the UL Quality Management Handbook.<br>Periodic quality review of study programmes is stipulated in the "Procedure for Preparation of Annual Reports on UL Study Fields" (UL Order No.1/290 of 14.07.2020). For more information see Section 2.4 of this report, Section 3.1, sub-sections IX and X of the UL Quality Management Handbook. |

| | | |
|---|---|---|
| 3. | The criteria, conditions, and procedures for the evaluation of students' results, which enable reassurance of the achievement of the intended learning outcomes, have been developed and made public. | Information related to learning outcomes, including assessment, is contained in course descriptions, the preparation and updating of which, as well as the rules for their publication, are stipulated in the UL course development and updating procedure. The conduct and assessment of entrance and final examinations, as well as the assessment and recognition of learning outcomes achieved in previous education or professional experience, are regulated by the relevant regulations of the University.<br><br>The expected ethical and fair conduct and justice are ensured at the University of Latvia by internally regulating issues related to academic freedom and academic integrity, electing and ensuring the Academic Arbitration Court, and ensuring the operation of the Academic Ethics Committee, as well as regulating the principles of protection of intellectual property rights. For more information see Quality Management Handbook, Section 3.2, sub-section 2.1. |
| 4. | Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed. | The principles of personnel management at the University of Latvia in the areas of personnel selection, labour relations, motivation system, and personnel development are defined in the UL Personnel Management Policy. Accordingly, the development of academic staff is planned for the medium term, and training plans are drawn up for the year. The qualification requirements of the staff are defined in the internal regulatory enactments of the University of Latvia in accordance with the external regulatory enactments, and the requirements for ensuring the quality of work - within the framework of regular staff appraisal, including the analysis of students' satisfaction with the delivered study courses, as well as the results of scientific activity. For more information on attracting, engaging, developing, and retaining staff: see the UL Quality Management Handbook, Section 3.2, sub-section 3.2. |

| | | |
|---|---|---|
| 5. | The higher education institution/ college ensures the collection and analysis of the information on the study achievements of the students, employment of the graduates, satisfaction of the students with the study programme, efficiency of the work of the academic staff, the study funds available, and the disbursements thereof, as well as the key performance indicators of the higher education institution/ college. | Information on students' achievements is accumulated in the information system LUIS of the University of Latvia and analysed in the framework of study course implementation (including student-centred approach) and study programme improvement. Satisfaction of students and graduates with the study programme is monitored through communication activities of staff involved in the implementation of study programmes, representation of students and graduates in decision-making and advisory bodies, as well as by conducting surveys in accordance with the Procedure for the Organisation of Regular Surveys to Evaluate the Study Process at the University of Latvia (UL Order No.1/334 of 22.08.2016). For more information on the involvement of stakeholders in quality assurance see Section 3.2, sub-section 1.2 of the UL Quality Management Handbook. Issues related to the efficiency of academic staff, available study resources and their costs are monitored in the core structural units (faculties, institutes, etc.) as well as centrally. For more information on study information management, see Section 3.1, sub-section VII of the UL Quality Management Handbook.<br><br>The UL performance management system introduced and implemented at the University of Latvia monitors key performance indicators of the University of Latvia on the basis of which further strategic decisions are made. For more information, see Section 3.2, sub-section 7 of the UL Quality Management Handbook. |
| 6. | The higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study field whilst implementing their quality assurance systems. | The development of each study field is planned in accordance with the 6-year development strategy of the University. The monitoring of the plan and the evaluation of its effectiveness are carried out within the framework of the annual self-assessment of the study field. These processes take place at the level of the Study Field Council, the core structural unit(s) implementing the study field (a study field may be implemented by several faculties), as well as at the level of the administration and the Senate.<br><br>The UL provides the external evaluation required by the legislation, obtaining additional external quality certificates for individual programmes. For more information, see Part II, Section 2.4 of this report.<br><br>To promote the quality and competitiveness of the study programmes of the University of Latvia, the University of Latvia creates and finances internal grant projects (University of Latvia Study Quality Improvement Fund), as well as attracts external funds. |

# 2.1. Management of the Study Field

**2.1.1. Aims of the study field and their compliance with the scope of activities of the higher education institution/ college, the strategic development fields, as well as the development needs of the society and the national economy. The assessment of the interrelation of the study field and the study programmes included in it.**

The objectives of the field of study and their compliance with the objectives and directions of the strategic development of the UL are shown in table II-1.

*Table II-1. Compliance of the goals of the field of study to the directions of the strategic development of the UL*

| No. | UL development directions | UL strategic objectives | Objectives of the field of study |
|---|---|---|---|
| **Development of core activity** | | | |
| M1. | Excellence in science | The university as an internationally recognized centre of science | To ensure international recognition of the research of the field of study and the international recognition of the study programmes |
| M2. | Study development | Unique study offer and high competitiveness of graduates | To implement individualized, inclusive, student-centred, and science-based studies |
| M3. | Contribution to society | University activity as the basis of Latvia’s growth | To create a field of study as a knowledgeable, reliable, and supportive partner for Latvian society |
| **Institutional development** | | | |
| M4. | Talent development | Human resource policy oriented towards development and excellence | To direct the staff to excellence and cooperation in science, industry, teaching, and training of educators |
| M5. | Environment and governance | Green thinking, an attractive, sustainable university environment and efficient administrative support | To provide an open, collaborative, and creative study and research environment |
| M6. | Organizational culture | An inclusive, collaborative, and innovative culture | To promote innovations for the development of studies and research |

The field of study includes study programmes shown in the Table II-2.

*Table II-2. Study programmes included in the field of study*

| No. | Level and name of the study programme | LRI code | Duration and scope (CP) | Type and form of studies | Language/s of instruction | Degree and/or qualification | Requirements set when starting the study programme | Place(s) of conducting | Notes |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | First level (short cycle) professional higher education study programme “Programming and Computer Network Administration” | 41483, 41484 | *Full-time regular studies – 2 years 6 months; 100 CP* | *Full-time regular studies* | Latvian | Programmer or Administrator of computer systems and computer networks | *Secondary education* | *UL Faculty of Computing* | |
| 2. | Academic Bachelor’s study programme “Computer Science” | 43483 | *Full-time regular studies – 4 years; Part-time regular studies – 4 years 6 months; 160 CP* | *Full-time or part-time regular studies* | Latvian, English | Bachelor of Natural Sciences in Computer Science* | *Secondary education Studies in English require English proficiency of at least B2 level.* | *UL Faculty of Computing* | |
| 3. | Academic Master’s study programme “Computer Science” | 45483 | *Full-time regular studies – 2 years; Part-time regular studies – 2 years 6 months 80 CP. Full-time regular studies* 40 CP | *Full-time or part-time regular studies* | Latvian, English | Master of Natural Sciences in Computer Science* | *For 80 CP in specializations “Computer Science”, “Software Engineering”, “Information Technologies”, “Information Systems”, “Computer Engineering”: bachelor’s degree or second-level professional higher education in computer science; bachelor’s degree or second-level professional higher education in mathematics, engineering, management science or equivalent higher education and entrance examination. For 80 CP in specialization “Bioinformatics”: bachelor’s degree or second-level professional higher education in computer science. For 40 CP studies: Bachelor's degree in natural sciences in the field of computer science and informatics with a total duration of studies of no less than 4 years or 160 CP; or a bachelor's degree or second-level professional higher education in the field of computer science and informatics with a total duration of study of no less than 4 years or 160 CP and an entrance exam. Studies in English require English language skills of least at B2 level.* | *UL Faculty of Computing and UL Faculty of Biology faculty* | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4. | Doctoral studies "Computer Science and Mathematics" | 51483<br>51460<br>51523 | *Full-time regular studies – 4 years; 192 CP* | *Full-time regular studies* | Latvian, English | *Doctoral Degree of Science Doctor of Science (Ph.D.) in Natural Sciences Doctoral Degree of Science Doctor of Science (Ph.D) in Engineering and Technology* | *Master's degree in computer science or mathematics, master's degree of engineering in computer science or information technology, or equivalent higher education to the above-mentioned master's degrees, and entrance examination.<br>Master's degree or equivalent higher education in another field with work experience in the field of information technology or mathematics and entrance examination.<br>Studies in English require English language skills at least at B2 level.* | *UL Faculty of Computing, UL Faculty of Physics, Mathematics and Optometry* | *Within the framework of the ongoing project 8.2.1.0/18/A/015 "Design of internationally competitive study programmes promoting the development of the national economy of Latvia in the University of Latvia"<br>The programme has received a license and its implementation started in October 2021.* |
| incl. | | | | | | | | | |
| incl. study programmes closed or to be closed during the reporting period: | | | | | | | | | |
| 5. | 1St[st] level professional higher education study programme "Programming and Computer Network Administration" | 41483 | *Full-time studies – 2 years; Part-time course – 2 years 6 months; 80 CP* | *Full-time studies* | Latvian | *Programmer or Administrator of computer systems and computer networks* | *Secondary education* | *Faculty of Computing of UL* | *Not included in the current accreditation sheet.<br>Closed by the decision of the Council of the Faculty of Computing of October 11, 2021 No. 28-2/65 and the decision of November 12, 2021 of UL Study Program Quality Assessment Commission No. 34.* |
| 6 | Doctoral studies "Computer Science" | 51483 | *Full-time studies – 3 years; Part-time course – 4 years 144 CP* | *Full-time studies* | Latvian, English | *scientific degree of doctor of computer science (until 31/12/2019); scientific doctoral degree doctor of science (Ph.D.) in computer science and informatics; scientific doctoral degree doctor of science (Ph.D) in electrical engineering, electronics, information and communication technologies (from 01/01/2020);* | *master's degree in computer science, mathematics or a higher education diploma corresponding to the mentioned master's degrees* | *Faculty of Computing of UL* | *The programme is scheduled to close in 2022.* |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Academic bachelor's study programme "Computer Science and Organizational Technologies" | 43483 | *Full-time studies – 4 years; 160 CP* | *Full-time studies* | English | *Bachelor of Natural Sciences in Computer Science and Computer Management* | *Secondary education* | *RTU Riga Business School* | *Pursuant to the decision of the meeting of Council of the Faculty of Computing of 07.01.2022 No. 28- 2/3 is undergoing the process of closing.*<br><br>*Not included in the accreditation application.* |

** Since the launch of computer studies in LU in 1992, the degree to be awarded in Bachelor's and Master's programmes has been "Bachelor/Master of Sciences in Computer Science." Such a degree name is consistent with the Bachelor/Master in Computer Science, which has been distributed abroad since 1969. Such a name was also included in the relevant 2017 self-assessment report and was accepted without comment, thus valid until the expiry of the accreditation sheet in 2023 on August 23.*
*The current UNESCO classifier ISCED-2013 requires that computer/computer science be classified in a separate sector 06 information and Communication technologies, also classified at the next level as 061 Information and Communication technologies.*
*The leading professional association of the industry LIKTA has submitted a request to the IZM to immediately restore code 481 computer science to the education classifier of Latvia.*

**LRI code of the study programmes included in the accreditation application 3.-5. the numbers 483 should be changed to 481 (Computer Science). Logical justification – 483 and 484 are conceptually intended for the level of vocational secondary schools or Latvian colleges, 482 for primary education and secondary general education, and 481 for the higher education level. Code 481 has been deleted from the Latvian education classification system due to a technical error, and Latvian Information and Communications Technology Association (LIKTA) has submitted a call to the Ministry of Education and Culture to correct this error as soon as technically possible.**

Since similar study programmes are offered in 10 and several higher education institutions in Latvia, we have to address the question of what makes ours unique.

1. Bachelor's (with integrated first-level professional higher education programme) and Master's programmes "Computer Science" are the only *Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science* fields of study in Latvia, which have accredited at the European level (see https://eqanie.eu/quality-label/accredited-programmes/); even more – as accredited at the European level as of 2012, they are the oldest programmes that have still preserved this accreditation.
2. The "Computer Science" Bachelor's programme has been recognized as the most recommended for secondary school graduates in the annual surveys of Latvian employers in the past five years (see https://www.prakse.lv/study/44/latvijas universitate/datorzinatnes-bakalaura-studiju-programma (only in Latvian) and https://www.df.lu.lv/par-mums/zinas/zina/t/66836/ (only in Latvian)).
3. Both the first and second level Computer Science programmes include all five disciplines of the ACM/IEEE Computing Curricula: Computer Science, Software Engineering, Information Systems, Information Technology and Computer Engineering, in addition, the sixth discipline – Bioinformatics (in cooperation with the UL Faculty of Biology) can be studied in the Master's programme.
4. All major programmes of the field of study are vertically integrated in content, thus forming a maximally compact joint structure of all four levels of higher education. Such a joint structure allows rational use of the meagre state budget funding, reaching the largest thematic coverage, which is very important in the case of a small country.

5. Since 2021, in cooperation with the University of Lincoln in the United Kingdom, students are given the opportunity to obtain a Bachelor's degree from the University of Lincoln simultaneously with a Bachelor's degree from UL.
6. The coordination of the agreement with Blekinge Institute of Technology (Sweden) continues, which will allow obtaining two Master's degrees at the same time.

Taking into consideration the social aspect, students sign their first work contracts as early as during the internship in undergraduate studies, while graduates easily find jobs within a few years after obtaining their first diploma, where they receive a higher salary than their professors (see Table II-3, data from the Ministry of Education and Culture). In addition, unemployment is not observed in the sector of the national economy – information and communication technology (for example, see *www.likeit.lv* (only in Latvian)).

*Table II-3. Graduates Monitoring Data*

| Years of monitoring | | Number | | Employment structure (constitutes 100%) | | | | | Income | |
|---|---|---|---|---|---|---|---|---|---|---|
| Taxation year | Graduation year | Graduates, number | Employed, number | Employed % | Unemployed % | Emigrants % | Economically inactive % | NA, employed % | Average weighted income in EUR | Median, weighted EUR |
| **2018** | **2017** | 209 | 183 | 87.6 | 1.9 | 1.0 | 8.1 | 1.4 | 17980.5 | 17352.2 |
| **2019** | **2017** | 209 | 185 | 88.5 | 1.9 | 1.9 | 5.3 | 2.4 | 24538.7 | 21752.0 |
| | **2018** | 233 | 205 | 88.0 | 3.0 | 0.4 | 8.2 | 0.4 | 20290.3 | 17963.4 |
| **2020** | **2017** | 209 | 177 | 84.7 | 2.4 | 0.5 | 8.1 | 4.3 | 30968.4 | 27228.9 |
| | **2018** | 233 | 206 | 88.4 | 3.4 | 0.9 | 6.4 | 0.9 | 26354.3 | 24037.3 |
| | **2019** | 205 | 176 | 85.9 | 2.4 | 0.0 | 8.8 | 2.9 | 22500.1 | 18851.3 |

| Taxation year | Graduation year | Employed & studying, number | Employed & studying, % | Established companies, % | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2018** | **2017** | 94 | 51% | | | | | | |
| | | | | | **2019** | **2017** | 44 | 24% | 2.87 |
| **2018** | 118 | 58% | 4.72 | | | | | | |
| | | | | **2020** | | **2017** | 29 | 16% | 13.40 |
| **2018** | 44 | 21% | 9.01 | | | | | | |
| | | | | | **2019** | 94 | 53% | 9.27 | |

The proportion and number of graduates who founded companies is growing significantly, which can perhaps be explained as the response of higher education graduates to the crisis, i.e., opportunities are searched in a crisis situation.

The information and communication technology (ICT) sector has experienced rapid growth both in the world and in Latvia.

According to the data of the industry association LIKTA, in 2021 the share of the ICT sector in GDP was 6%, 7,050 companies operated in the ICT sector in Latvia, employing more than 38.4 thousand

workers, the turnover of the companies exceeded 4.3 billion euros, personnel costs – 913 million euro. As an exporter, ICT was in 3rd place in the country among all the sectors. The export of ICT products was 1.5 billion euros, export of ICT services – 849 million euros. ICT exports exceed domestic turnover. The industry is constantly experiencing a shortage of skilled labour.

The goals and objectives of the field of study correspond to and are designed in accordance with the Sustainable Development Strategy of Latvia until 2030, the National Development Plans 2014-2020 and 2021-2027, the European Growth Strategy Europe 2020, as well as the European Sustainable Development to the requirements of the strategy, to the regulations of the Cabinet of Ministers "On priority directions in science in 2018-2021". In government declarations, the industry has been repeatedly declared a national priority. The science base and "forge of talents" of this economic sector is principally computer science, as well as electronics and automation.

In the given report, in accordance with the regulations of the Cabinet of Ministers (MK) on the classification of Latvian education (13.06.2017, No. 322), the word 'datorika' is used as the Latvian equivalent of the English term 'computing'. By definition, the term 'computing' is used to denote a branch of knowledge, which includes the following branches: computer science, information technologies, information systems, software engineering and computer engineering.

The field of study is developed in accordance with the Strategic Plan of the University of Latvia 2010-2020 (approved on 24.05.2010 at the meeting of the Senate, decision No. 370), the Strategic Plan of the University of Latvia 2021-2027 (approved at the meeting of the Senate of the University of Latvia on 28.06.2021, decision No. 2-3/90), the regulation of the Cabinet of Ministers of October 14, 2013 No. 486 "Information Society Development Guidelines 2014-2020" and the regulations of the Cabinet of Ministers of July 7, 2021 No. 490 "Digital Transformation Guidelines for 2021-2027", as well as "Education Development Guidelines for 2021-2027 "Future Skills for Future Society"" (approved by the Saeima on April 21, 2021) to the extent that the insufficient state budget funding allows.

The **common objective** of the four study programmes offered at the Faculty of Computing (1st level professional higher education/ Bachelor's/Master's/Doctoral computer science study programmes) is:

1. to prepare highly qualified exportable specialists for practical work in companies and state institutions, who would be able to not only design and development complex information systems, but also manage projects and independently learn new technologies in a rapidly changing environment across the spectrum of the ICT sector;
2. to provide the industry with academically educated specialists prepared for scientific work who would be able to conduct research in computer science and mathematics in Latvia, as well as perform the functions of experts in the evaluation of new technologies and systems and work as university professors.

The mentioned two requirements are in mutual dialectical contradiction, because academic higher education is based on science, whereas the knowledge needed by practitioners is typical of engineering science and is based on the acquisition of production processes. The field of study combines the fulfilment of both requirements.

Within two and a half years the **field of study** prepares specialists capable of working in the ICT industry, who are ready to learn new technologies in a rapidly changing environment and can participate in:

1. the development of applications and information systems (for the Software Engineering sub-programme),
2. creating computer networks and administering computer networks and computer systems

(for the IT sub-programme);

**over the next two and a half years** – prepares specialists who are able to design and develop complex applications and information systems;

**over the next year and a half** – prepares specialists who are able (depending on the chosen specialization) to model and analyse large and complex systems, develop large and complex software systems, information systems and computer networks, manage large projects and groups of specialists, work in the field of research and teaching;

**in next four years** – prepares doctoral-level specialists who could work both in science (as researchers and lecturers), and also participate and manage the implementation of technically complex projects in the programming industry.

The proposed solution for the training of IT specialists has been conceptually approved at several meetings attended by leading specialists of manufacturing companies and representatives of universities (in 2000 with the participation of the Ministers of Economy, Education and Science, at the LIKTA conference in November 2004, the meeting organized by Exigen in March 2005 and other). The focus on satisfying the Latvian economy's demand for qualified IT specialists is a significant difference from the natural science programmes at the University of Latvia, which focus on the training of scientific staff and teachers.

The national economy has permanent and real possibilities to influence the content of the programmes: five industry professionals work in the UL Computer Science Study Programme Council (since 2019, in the council of UL field of study "Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science"), which examines and approves any amendments to the content of the programmes, as well as the annual self-evaluation reports.

At one time, the president of the Latvian Information and Communications Technology Association and the executive director of the NGO "IT Cluster", the president of the Latvian Open Technology Association, and currently a member of the board of the Latvian Open Technologies Association, have worked in the Council of the Faculty of Computing.

The **field of study** provides training of specialists at three levels of higher education (including short-cycle), offering studies in six computer science specializations:

- **Computer Engineering (CE)**, which includes the design and manufacture of electronic equipment,
- **Computer Science (CS)**, including mathematical foundations of computer science, system modelling and artificial intelligence problems,
- **Information Systems (IS)** devoted mainly to the so-called business informatics, database management systems, design, implementation and maintenance of information systems,
- **Information Technology (IT)**, including design and operation of computer networks and clusters, sound and image processing,
- **Software Engineering (SE)**, focusing on programming and software production,
- **Bioinformatics (BI)**, providing, in addition to the core of computing, the essential knowledge and skills of a biologist (only a specializations of the Master's programme).

At the fourth level – doctoral studies – training of specialists of the highest level must be ensured in two subprogrammes: **Computer Science** and **Mathematics**.

Since 2012, within the **study programme results planning** we have introduced formulating of learning outcomes from the student's point of view, determining what a student will know and be able to do after successfully completing a specific study course and study programme. In the

description of each study course, the course developer formulates 3-6 achievable results. The combination of these results from all completed courses describes the actual learning outcome of every successful student.

As we admit 260 students annually to state-budget funded undergraduate studies, despite a real competition (2021 – 411 first priority applications), their previous knowledge and abilities are very different. For new students whose grades in the centralized high school mathematics exam are relatively low (below 70%), we offer a remedial course in high school mathematics. For those who are able and want to learn more or more deeply than the programme envisions, we offer so-called excellence studies (see https://www.df.lu.lv/studijas/izcilibas-studijas/ (only in Latvian)).

The required learning outcome is also determined by external requirements.

- In all level studies we are guided by the achievable results determined in the descriptions of knowledge, skills and competences corresponding to the respective levels of the European Qualifications Framework (EQF) (Regulation of the Cabinet of Ministers No. 322 "Regulations on the Classification of Education Domains", version of 13.06.2017).
- The achievable results of the professional study programme "Programming and Computer Network Administration" are determined by the professional standards of the 4$^{th}$ professional qualification level "Programmer" and "Computer system and computer network administrator".
- The knowledge and skills to be acquired in Bachelor's and Master's studies are determined by the document "Framework standards and accreditation criteria for informatics programmes", which was approved by the organization "European Quality Assurance Network for Informatics Education" (EQANIE) on June 2, 2009 (last amendment: 12.10.2015). Each study course description indicates which knowledge, skills, and other competences indicated in the mentioned document are promoted by the given study course.
- The results to be achieved in doctoral studies are determined in the Regulations of the Cabinet of Ministers No. 1001 "Procedure and criteria for awarding (promotion) of the doctoral scientific degree" (27.12.2005).

The implementation of study programmes at the UL Faculty of Computing is organized in accordance with the "Education Law", "Law on Higher Education Institutions", "Law on Scientific Activity", Regulations of the Cabinet of Ministers No. 141 of 20.03.2001 "Regulations on the national standard of first-level professional higher education" (ver. 01.06.2007), Regulations of the Cabinet of Ministers No. 240 of 13.05.2014 "Regulations on the standard of national academic education", Regulations of the Cabinet of Ministers No. 1001 of 27.12.2005 "Procedure and criteria for awarding (promotion) of a doctoral degree" (with amendments until April 28, 2020), UL Constitution, "Regulations on the management of fields of study of the University of Latvia" approved by the UL Senate (decision No. 70 of UL Senate of 27.01.2020 ) and regulations "Doctoral studies at the University of Latvia" (decision No. 169 of UL Senate of 26.05.2003).

**2.1.2. SWOT analysis of the study field with regard to the set aims by providing explanations on how the higher education institution/ college expects to eliminate/ improve weaknesses, prevent threats, and avail themselves of the given opportunities, etc. The assessment of the plan for the development of the study field for the next six years and the procedure of the elaboration thereof. In case there is no development plan elaborated or the aims/ objectives are set for a shorter period of time, information on the elaboration of the plan for the development of the study field for the next assessment period shall be provided.**

In the reporting period since 2015/2016 the most visible achievements are as follows:

- The Bachelor's programme "Computer Science" has been the most recommended study programme by Latvian employers for 5 years in a row.
- We have started the implementation of the Bachelor's programme "Computer Science" in English for foreign students, the first graduations are expected in the summer 2023. The English version of the programme has made it possible to significantly increase the number of guest students in mobility programmes (Erasmus+, etc.).
- We have signed an agreement with the University of Lincoln (England) on the implementation of dual award programmes (legally – within the programme of the Bachelor's programme "Computer Science") from autumn 2021, enrolling 7 students in the first year of studies.
- At the request of the economic partners, we have created two modules, i.e., in the Master's degree "Big Data Analyst", in the undergraduate studies – "Basics of Software Development". A total of around 200 students graduated from the programmes.
- In the world student team programming competition in 2017, 2018, 2019 and 2021 (2020 finals), UL teams entered the world finals and ranked at the top places of the results table. (More than 50,000 participants from more than 3,000 universities from all over the world take part in ICPC competitions every year. About 120 of the strongest teams make it to the world finals.)
- In the annual national competition for the best IT Bachelor's and Master's theses, 6 first, 5 second and 4 third places were won during the reporting period (3 Bachelor's and 3 Master's theses are awarded annually).

The SWOT analysis of the field of study is presented in Table II-3.

*Table II-3. SWOT analysis*

| Internal factors | |
|---|---|
| Strengths | Weaknesses |

1. The strongest team of computer science lecturers in Latvia (2 Latvian Academy of Science academicians, 4 corresponding members, around 40 Doctors of Sciences).
2. Compliance of programmes with recommendations and relevant EU and US study programmes. The Bachelor's programme (with the integrated first-level professional higher education programme) and the Master's programme have obtained the quality marks of the European informatics programmes – Euro-Inf Quality Label.
3. The statistics of recent years show that the Bachelor's programme is the most popular in Latvia in the field of computer science (calculated by the first priority applications in the unified admission).
4. Undergraduate and Master's programmes include so-called excellence studies, which allow those students who are willing and able to have an in-depth study of the course.
The first year of study, however, includes a remedial course in high school mathematics for students with relatively lower knowledge. Thus, the emphasis is put both on the strongest and the weakest students.
5. The work of lecturers on globally relevant scientific topics and scientifically-based projects of national importance raises the quality of programmes through the use of the latest achievements in the field of IT.
6. New prospective specialists are accepted as teaching staff, whose further growth will largely determine the future of the Faculty Computing.
7. The lecturers have close contacts with both scientific institutions and ICT companies. Particularly close cooperation continues with the leading scientific institute of the industry, i.e., the UL Institute of Mathematics and Computer Science. Cooperation with the Institute of Electronics and Computer Science is expanding.
8. A wide selection of e-courses ensures individual acquisition of study of course materials and communication with lecturers.
9. Modern technical facilities of programmes, communications, software and auditoriums supports the high-quality implementation of study programmes.
10. Dozens of lecturers also have great experience in the industry, which ensures a better choice of teaching content and gives an opportunity to analyse the subject through real-life examples.
11. As early as in the 5$^{th}$ semester, students go on a 16-week production internship, become able to enter the labour market, are better able to choose a specialization in the 6$^{th}$ semester of the Bachelor's programme, and better understand the practical importance of what they are to learn in the courses to come.
12. Already after 2.5 years, a student obtains the first university diploma, knowledge, skills, and competencies corresponding to the 4$^{th}$ level professional qualification.
13. A student does not need to choose a specialization immediately upon entering the University. This can be done at the beginning of the 4$^{th}$ semester or the 6$^{th}$ semester when the student has better awareness and understanding of his/her abilities and preferences.
14. The programmes along with the specializations cover all the main areas of computer science and the programmes have a large number of different study courses, compared to other programmes in Latvia, which are more specialized in a narrower field of computing.
15. The field of study institutionally also includes Cognitive Sciences, thus making us the only institution that implement interdisciplinary research and academic activity in this field in the Baltic States.
16. Graduates of other Bachelor's programmes are also admitted to the Master's programme (about 25%), the specialization "Bioinformatics" is implemented together with the Faculty of Biology.
17. In fulfilling the requirements set for universities by the Law of Higher Education Institutions, the faculty
a) in cooperation with the University of Vilnius, the University of Agriculture of Latvia, the University of Liepāja, Vidzeme University of Applied Sciences and the UL Institute of Mathematics and Computer Science publishes a periodical open-access electronic journal "Baltic Journal of Modern Computing" (indexed in Web of Science Core Collection and SCOPUS);
b) involved 2 visiting professors from European Union universities (Vytautas Magnus University of Kaunas, Stockholm University) in teaching the course;
c) since 2015 only doctors of science are elected to pedagogical academic positions (the law requires at least 65%).

1. A large annual dropout rate, which is largely related to the lack of selection, as there is generally no competition for IT study places financed by the state budget in Latvia.
2. Lower publication intensity compared to the world's leading universities.
3. Insufficient sending of students to exchange programmes with foreign universities (reason – practically all students work and do not want to lose their jobs), even though the number of foreign visiting students is increasing year by year.
4. Insufficient scientific visits of lecturers in foreign universities (many are hindered by their involvement in research projects or in the national economy).
5. There could be a bigger involvement in the study programmes of other study programmes (although currently the lecturers of the Faculty of Computing also teach separate study courses in the Faculty of Biology, Faculty of Physics, Mathematics and Optometry, Faculty of Geography and Earth Sciences, Faculty of Humanities, Faculty of Chemistry and Faculty of Social Sciences).
6. Several PhD students are working on a job unrelated to the thesis topic and it is not clear whether they can devote sufficient time to the thesis.
7. Lack of permanent postdoctoral positions in the country.
8. Low PhD scholarships that do not cover daily needs, let alone support a family.
9. Reluctance of leading researchers of the Institute of Electronics and Computer Sciences to get involved in teaching study courses.
10. The administrative separation of the UL Faculty of Computing and UL Institute of Mathematics and Computer Science divides the already small resources of researchers.

| External factors | |
|---|---|
| ***Opportunities*** | ***Threats*** |
| 1. Continue to expand cooperation with foreign and Latvian universities and research institutes.<br>2. Structurally combine computer science studies and research at the University of Latvia (it is not possible unless other structures and institutions want it) | 1. Acutely and chronically insufficient funding for the entire education system of Latvia, which is one of the smallest both in absolute and relative terms in the entire European Union.<br>2. The social insecurity of students (only one in eight receives a pitiful amount of state scholarships), which forces them to work a disproportionately large workload.<br>3. A chronically unclear future vision of science funding after the end of the currently implemented projects.<br>4. Some of the most outstanding school graduates start choosing to study at leading American and European universities.<br>5. Students are in high demand in the labour market, many students work simultaneously with their studies, which increases the average study time.<br>6. Unwanted changes in legislation affecting all levels of education.<br>7. Since computer science programmes prepare specialists for IT companies, the training requires the acquisition of modern technologies. Unfortunately, these technologies are often impossible to purchase and use by university due to their high costs and training. For the time being, this problem can be solved by allowing lecturers to participate in the development of projects of IT companies, which contradicts the requirement for lecturers to work full-time at the university.<br><br>8. For some of the lecturers, the direct connection with the industry is decreasing, i.e., even a partial workload in ICT companies. A disconnect between theory and real life can develop.<br>9. Due to the demographic situation, the number of secondary school graduates in Latvia continues to decrease, which means either a reduction in the number of students with a corresponding decrease in funding, or the students' abilities and preparation will differ even more, and this will require a rearrangement of programmes and teaching methods.<br>10. In order to maintain the quality of the programmes, cooperation with foreign partners must be intensified. Unfortunately, the traineeship of young lecturers abroad may lead to their shifting to better-paid jobs, which the Faculty of Computing will practically not be able to delay. In several cases, this has already happened. |

Analysis — weaknesses

V1, 7, 8, 10 are not preventable at the level of the study direction.

V2 the Faculty of Computing, in collaboration with Vilnius University and several higher education institutions in Latvia, publishes a scientific journal “Baltic Journal of Modern Computing” indexed on the Web of Science and SCOPUS, thus making publishing opportunities more convenient; however, this does not compensate for insufficient public funding for research.

V3 We do not see a good solution, because all students applying for exchange studies get this opportunity under the Erasmus programme.

V4 one possible solution is short-term exchange visits under the Erasmus programme; the incentive mechanism here is the criterion for the election of government regulations to the position of professor or associate professor.

V5 one possible solution – training of teachers of other faculties in teaching study courses related to information technologies.

V6 is actually linked to V7.

V9 we look forward to the new generation of emerging doctors doing research at the Institute of Electronics and Computer Sciences, but currently finishing doctoral work with the support of the ERDF Project Fellowship, working part-time as teaching staff.

Analysis - threats

D1-6 is not an avoidable threat at the level of the study direction.

D7 succeeds in partially compensating for the involvement of leading IT companies in the special seminar system as well as the sponsorship of hardware.

D8 succeeds in partially compensating for traineeships by trainers in IT companies.

D9 we are already forced to pursue a equalising course in high school math.

D10. We've lost about 10 doctors of science who now live in the UK, Denmark, Italy, the Netherlands, Spain, Germany, and there's no talk of emigrating during the 1990ths. As one way out, there could be de facto joint study programmes, such as a collaboration with Lincoln University (UK) launched in 2021.

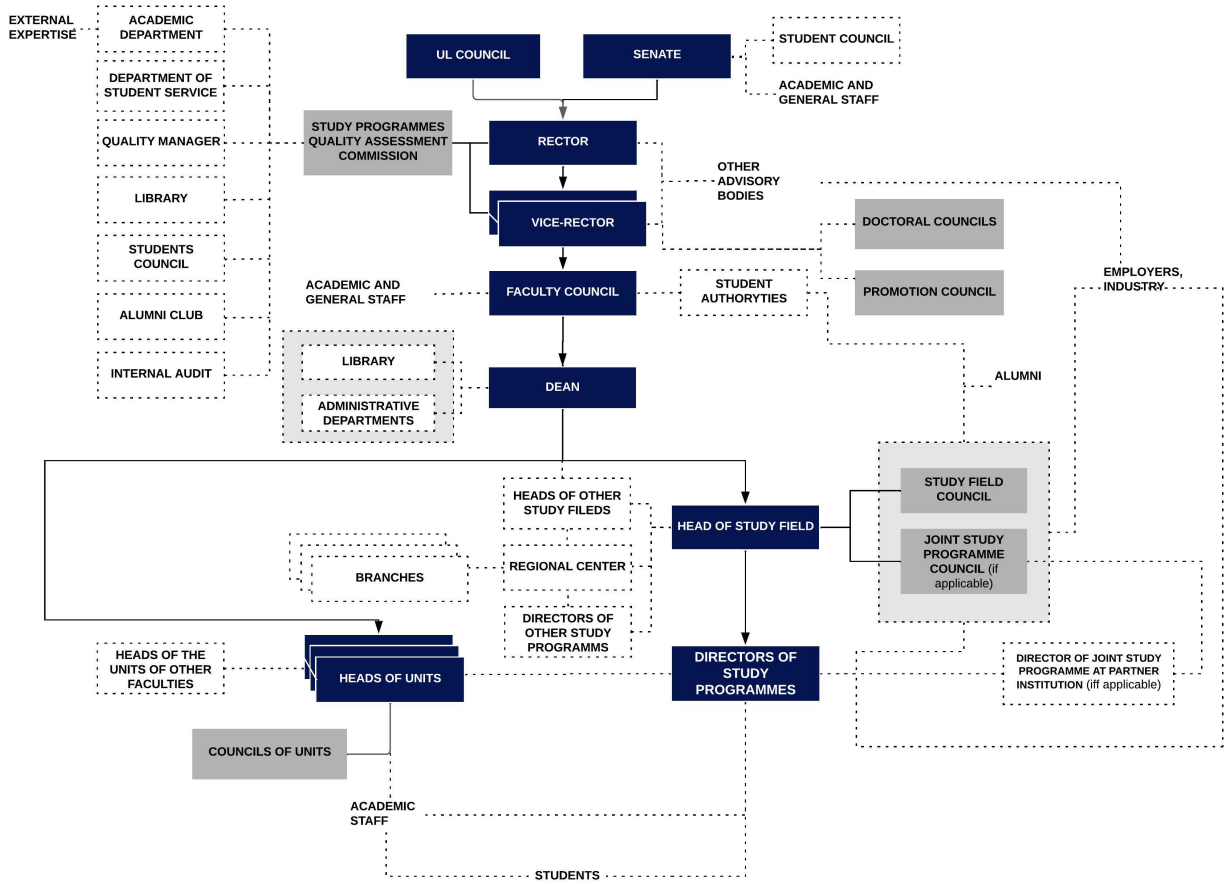
The development plan of the field of study (found in Appendix II-1) was developed in the council of the field of study, taking into account the plan of the Faculty of Physics, Mathematics and Optometry, thus integrating the ideas of the FPMO Mathematics Department into the implementation of the Mathematics subprogramme of the Computer Science and Mathematics doctoral study programme. A significant contribution to the development and discussion of the plan was made by the representatives of employers in the direction council of the field of study, for example by supplementing the plan with section 4.3. The student representatives agreed to participate in the implementation of points 2.1.3, 2.2.1, 2.3.2, 3.1.2, 6.1.1.

The factors identified in the SWOT analysis in the sections “Weaknesses” and “Threats” are reflected in the development plan of the field of study, as far as actions to compensate for them are within the competence of the field of study.

**2.1.3. The structure of the management of the study field and the relevant study programmes, and the analysis and assessment of the efficiency thereof, including the assessment of the role of the head of the study field and the heads of the study programmes, their responsibilities, and the cooperation with other heads of the study programmes, as well as the assessment of the support by the administrative and technical staff of the higher education institution/ college provided within the study field.**

The collegial responsibility in the management of the field of study rests with the decision-making bodies of the UL – the Senate, UL Study Programme Quality Assessment Commission (led by vice-rectors), faculty councils and Councils of Fields of Study, which assess the quality of studies and make decisions on measures to ensure the quality of studies. The management of UL is responsible for the quality of studies, delegating the responsibility for the functioning of the study quality assurance system to the Academic Department. The responsibility for the quality of the field of study and the study programmes implemented within it rests with the head of the field of study and the dean, directors of study programmes, as well as heads of sub-programmes. Each member of the teaching staff is responsible for the quality of the content of the course they teach and its implementation, research activity and professional development. The students’ responsibility is defined in their rights and duties to promote the implementation of the objectives of the University of Latvia and excellence in studies by participating in the UL collegial institutions and regularly expressing their opinion in student surveys. For the management structure of the UL field of study and its study programmes, see Fig. *II-1*.

*Fig. II-1. The management structure of the UL field of study and its study programmes*




The procedures for the management, quality assurance and development of UL fields of studies, the functions and operating principles of the council of the fields of study, the qualification requirements, duties and rights of the head of the fields of study and the director of study programmes of the course and the head of sub-programmes are set forth in the *Regulations on the University of Latvia Study Field Management (approved by the decision No. 70 of the Senate of 27.01.2020.).*

Each UL study programme has **director of the study programme**, who leads the development and implementation of this study programme. The director of the study programme is approved by the Senate upon the proposal of the council of the faculty representing the relevant branch of science. The director of the study programme is a member of the council of the field of study of the relevant branch and coordinates his/her activities with the head of the field of study and council of the field of study. The director of the study programme is responsible for his/her activities to the dean of the faculty. The responsibilities of the directors of the study programmes include ensuring the operation of a successfully functioning, sustainable study programme in accordance with the procedures established by the UL and other duties. If the study programme includes several sub-programmes, for each sub-programme there can be **a head of the sub-programme** who shall be approved with the decision of the faculty council. The head of the sub-programme is approved by the faculty council. If several faculties are involved in the implementation of the study programme, the head of the sub-programme is approved upon the proposal of the faculty deans by the council of the faculty that awards the corresponding degree or qualification. The head of the sub-programme is a member of the relevant council of the study programme. The head of the sub-programme is responsible for his/her activities to the director of the study programme. The responsibilities of the head of the study sub-programme include, in cooperation with the director of

the study programme, organizing and managing the development and implementation of the sub-programme, as well as preparing the necessary documentation for approval, licensing and accreditation of the sub-programme, and other duties.

**Head of the field of study** (hereinafter "the head of the course") is responsible for ensuring the management and development of the field of study. The head of the course is approved by the rector upon the proposal of the dean of the faculty. The head of the course is responsible to the council of the course and the dean. Heads of the course, in cooperation with the directors of the study programmes and the director of the UL Regional Centre, in cases where the programmes included in the field of study are carried out in UL branches, ensure the revision of the study programmes included in the field of study, as well as development planning and implementation. Heads of the field of study organize the work of the councils of the field of study, as well as regularly organize the development and submission of the annual report of the field of study for review and approval by the council of the field of study and the Faculty Council. Heads of the field of study, in cooperation with the directors of the study programmes included in the field of study and the UL Study Department, ensure the accreditation and re-accreditation of the field of study, and perform other duties.

The **Council of the Field of Study** (hereinafter – the Council of the Course) is a collegial management institution of the field of study, which supervises academic, professional (including residencies) and doctoral study programmes of all levels corresponding to the field of study. The council of the field of study composes of the head of the study course, all directors of the study programmes corresponding to the field of study, representatives of students of relevant programmes (not less than 20% of the composition of the council of the field of study, promoting the representation of all levels of the study programmes, as well as the greatest possible representation of the number of study programmes; candidacies are proposed by the student self-government), representatives of employers and cooperation partners of the field of study (candidates are proposed by heads of structural units, heads of fields of study, directors of study programmes and heads of sub-programmes). The composition the council of the field of study can be complemented with graduates of the field of study studies who are not involved in the implementation of the field of study, as well as with professors of the field, associate professors, and other qualified specialists (candidates are proposed by heads of structural units, heads of fields of study and directors of study programmes). The council of the study courses approves the study programme development strategy, evaluates, and submits new study programme concepts to the Study Programme Quality Assessment Commission for approval, evaluates and submits to the Faculty Council for approval the annual reviews of fields of study reviews, as well as changes in study programmes.

**For the composition of the council of study direction, see https://www.df.lu.lv/en/about-us/faculty-council-and-other-councils/.**

**Faculty Councils**, which consists of representatives of the academic and general staff, who are elected for three years, and student representatives, whose number is not less than 20 percent of the councillors, decides on the faculty's academic work, as well as economic, financial, and other operational issues, which fall within the competence of the faculty or are submitted further to the Senate.

The learning outcome of the UL fields of study and study programmes is evaluated by, and proposals to the faculty council and the UL management regarding the further development of the programmes are submitted by **Study Programme Quality Assessment Commission** (hereinafter – STQAC). This commission examines and gives opinions on study programmes, incl. evaluation of applications for the concept of new study programmes, new study programmes and

proposals for closing programmes, significant changes in accredited fields of study that require an approval of the STQAC, as well as applications for new study modules and sub-programmes. When evaluating new study programme concepts, study programmes and annual reports of fields of study, SPQAC relies on anonymous, independent expert opinion. SPQAC consists of vice-rectors, the chairman of the Academic Commission of the Senate or his authorized person, a representative of the Academic Department, a representative of the Student Services Department, an internal auditor, a quality manager, a representative of the UL Library, a delegated representative of the Student Council and a delegated representative of the UL Alumni Club.

**Expert recommendations and the internal quality system (proposals for improvements) established by the Faculty of Computing are the mechanisms that contribute to the development of the study process. More than 60 improvement proposals were implemented during the reporting period. Overall the study management process of the University is too cumbersome, requires a lot of unnecessary work, which has no real connection with the study process itself. This is lamented by faculty and pointed out by external experts in a previous accreditation review.**

Upon launching the implementation of the UL Strategy 2027, based on the effectiveness audit of the administrative units carried out in 2021, in November 2021, the UL Administration was significantly reorganized, thus strengthening the strategic and quality management functions in the administrative units. One of the most significant changes is the integration of the UL Study Department and the UL Science Department, forming the Academic Department, thereby strengthening the unity of higher education and science. The UL Administration includes the following structural units: Academic Department, Department of Study Service, Communication Department, Legal Department, Department of Human Resources, Information Technology Department, Finance and Accounting Department, Document Management Department, Infrastructure Management Department, Real Estate Revenue Department, Institutional Data Analysis Centre, Project Support Centre, Academic Centre Development Programme, Programme for the Development and Management of Studies. The administration also includes UL chancellor, internal auditor, quality manager, head of work safety system, and information technology security manager. Also, the study process is supported by the basic structural units under the supervision of the Head of Administration, i.e., Culture Centre, Sports Centre and Pre-Study Training Centre. **The Academic Department** has the most important role in the management of the field of study. The Academic Department consists of the Academic Policy Department, Science Projects Department, Study Quality Assurance Department and Lifelong Learning Department. The competence of the Academic Department is to monitor the requirements of the laws and regulations in force in the Republic of Latvia and their changes, national and European Union development policy documents, as well as standards and good practices in the fields of academic activity and lifelong learning, and ensures the development of functional strategy, policy and normative regulations corresponding to it and UL Strategy as well as provides the monitoring of their implementation in these areas, to ensure the development, implementation, monitoring and continuous improvement of quality assurance systems (or processes) for studies and science. It ensures academic and lifelong learning processes and risk assessment, regular review of methods and procedures, necessary controls and the identification and provision of preventive measures in accordance with the practice implemented by the UL, ensures analytical identification of the outcome of academic activity and lifelong learning and opportunities for their improvement, development of proposals for the UL Management. The Study Quality Assurance Department monitors compliance with the internal regulation of all study levels and lifelong learning, coordinates the medium-term plan of studies and lifelong learning development in cooperation with the faculties, oversees its implementation, supervises and provides methodical support in the development of new study programmes and the implementation and improvement of existing programmes, organizes internal quality assurance

processes in studies and lifelong learning, organizes and coordinates external quality assurance, ensures centralized administration of doctoral student admission, doctoral and doctoral studies, provides support in the implementation process of all levels of studies and lifelong learning and their improvement, evaluates the outcome and competitiveness of study and lifelong learning programmes, as well as engages in resource evaluation. **Department of Study Service** consists of the Academic Services Department, Admissions Department and Mobility Department, whose competence is to organize and ensure the matriculation and exmatriculation of Latvian and foreign students, the circulation of study documents and their keeping, maintain the register of graduation documentation (qualifications), including the register of diplomas and graduates, provide students with social, cultural and other support functions, as well as provide consultations and information to students about social security, informing potential students and applicants about the study process and study organization, as well as ensure the administration and implementation of mobility programmes. The development, maintenance, implementation, evaluation and improvement of the study quality management system is also supported by the UL quality manager and internal auditor. (*The regulation of UL Administration (only in Latvian) p. 50-51., approved by the decision of UL Senate No. 1-4/559 of 15.11.2021.)*. According to the new Regulations of UL Administration, the Department of Human Resources will also consist of **UL Academic Competence Development Centre**, whose functions will include developing and improving staff development, career and succession planning systems, implementing measures for staff growth promotion, as well as providing methodical management of UL structural units in matters of academic staff management.

An important role in study management is played by the cooperation with **faculty student self-government**, which represents the interests of students in the activities of the faculty, including solving issues of the academic, social and cultural environment. Members of the student self-government are represented in **UL Student Council**, thereby participating in the management of the UL.

**The student self-government of the faculty coordinates the senior system of the field of study, raising the faculty management about the students' study process and its problems and the students' awareness of the most current information on the self-government and the university. The composition of the self-government is proportional to the number of students in the programmes, therefore a larger number of members from first- and second-year students can be observed.**

The learning outcome of the UL fields of study and study programmes is evaluated by, and proposals to the faculty council and the UL management regarding the further development of the programmes are submitted by **Study Programme Quality Assessment Commission** (hereinafter – STQAC). This commission examines and gives opinions on study programmes, incl. evaluation of applications for the concept of new study programmes, new study programmes and proposals for closing programmes, significant changes in accredited fields of study that require an approval of the STQAC, as well as applications for new study modules and sub-programmes. When evaluating new study programme concepts, study programmes and annual reports of fields of study, SPQAC relies on anonymous, independent expert opinion. SPQAC consists of vice-rectors, the chairman of the Academic Commission of the Senate or his authorized person, the head and representatives of the Academic Department, a representative of the Student Services Department, internal auditor, quality manager, representative of the UL Library, delegated representative of the Student Council and delegated representative of the UL Alumni Club.

### 2.1.4. Description and assessment of the requirements and the system for the admission of students by specifying, inter alia, the regulatory framework of the admission

**procedures and requirements. The assessment of options for the students to have their study period, professional experience, and the previously acquired formal and non-formal education recognised within the study field by providing specific examples of the application of these procedures.**

The internal regulatory framework, which defines the procedure and requirements for student admission, as well as the regulatory framework governing recognition procedures, is available on the University of Latvia website.

***Student admission procedures and requirements***

- Terms of admission at University of Latvia
- Admission requirements and criteria for undergraduate studies (only in Latvian)
- Admission requirements and criteria for higher level studies (only in Latvian)
- Admission requirements and criteria for doctoral level studies (only in Latvian)

***Regulatory framework governing recognition procedures***

- Regulations on the recognition of knowledge, skills, competence acquired outside of formal education or in professional experience, recognition of study results achieved in the previous education, and referencing of academic activity at the University of Latvia
- University of Latvia procedure for recognition of competencies developed outside formal education or through professional experience and learning outcomes achieved in previous education

The admission process at the UL and, therefore, also for study programmes within the given field of study are regulated by the Admission Regulations and subordinate orders, which determine the procedures for the specific academic year:

1. admission requirements and criteria in undergraduate programmes,
2. admission requirements and criteria in higher level study programmes,
3. admission requirements and criteria in doctoral study programmes,
4. admission requirements and criteria in residency study programmes,
5. registration fee estimate,
6. tuition fees in programmes,
7. number of study places available for admission,
8. procedure for preparation of entrance examination materials,
9. composition of the admission commission,
10. composition of entrance examination commissions,
11. time and place of entrance examinations.

Admission procedures differ by study level. **Admission to undergraduate studies** takes place centrally using *Unified admission in undergraduate programmes* (only in Latvian), which combines enrolment in 12 Latvian universities. The competition for study places is based on the results of the Centralized exams or on the attestation marks – for persons who obtained secondary education before 2004, who were exempted from centralized exams or obtained secondary education abroad. In study programmes that do not have appropriate centralized exams, additional requirements for certain attestation marks are added, in programmes that require special skills or compliance, an additional entrance exam is organised. As a result of the competition, the applicants are ranked according to the obtained points. In the programmes, advantages may be determined for the winners of national subject contests and other competitions (for more information on admission

requirements, see the description of each study programme).

**In the undergraduate programmes of the field of study, preference is given to the winners of the first three places of the previous year's national and international contests.**

**The admission to Master's level study programmes** takes place in a decentralized manner, in each faculty, but at the same dates. Admission is based on grades obtained during undergraduate studies. In programmes where previous education in different fields is allowed, an entrance test is used to determine the relevance of the applicant's prior knowledge to the field of the study programme. **In the case of the computer science Master's degree programme, entrance exams have been replaced by entrance interviews.**

**Admission to doctoral studies** takes place centrally. An applicant must submit the thesis topic and agree upon it with the supervisor. The suitability of the applicant is evaluated by the doctoral council of the field. **As to the degree programme, there was no real competition in Master's and doctoral studies during the reporting period. The social insecurity of students, as well as the lack of permanent postdoctoral positions, is an acute and chronic problem.**

The requirements and criteria in the study programmes are reviewed and updated every year and are published on UL website until November 1 in accordance with Article 46 of the Law on Higher Education Institutions. UL provides an opportunity to start studies also in later study stages, according to *Procedures for starting studies in later stages of studies at the University of Latvia (only in Latvian) (UL order No. 1-4/332 of 07.06.2022*.). A prerequisite for starting studies in later study stages is the recognition of previously completed study courses or knowledge, skills, competences acquired outside of formal education or acquired in professional experience, study results achieved in previous education, which is regulated at the UL by *Regulation on recognition of knowledge, skills, competences acquired outside of formal education or acquired in professional experience, study results achieved in previous education and recognition of academic activity at the University of Latvia (UL Senate decision No. 2-3/86 of 28.06.2021*) and *Regulations on recognizing knowledge, skills and competences acquired outside of formal education or professional experience and study results achieved in previous education at the University of Latvia (UL order No. 1-4/543 of 04.11.2021).* Based on the student's application, the possibility of recognizing study courses taken at another Latvian higher education institution, a university abroad or during the previous study period at the UL is considered. According to paragraph 8 of the Regulations, previously completed study courses can be recognized at the same or lower study level. **During the reporting period, 1174 students were recognized in the degree programme.**

When applying to start studies at later stages, the application must be filled out and the necessary documents must be attached thereto. The UL Commission for recognition of knowledge, skills, competences acquired outside of formal education or through professional experience or studies completed in previous education (hereinafter – the recognition commission) or the director of the programme, if the student renews enrolment in the same University programme, evaluates and recognizes the previously completed study courses, the results of which correspond to the study results of the UL study programme. Study courses are recognized if their amount in credit points in both comparable study programmes is the same or the number of credit points in the respective study course previously completed is greater. The total amount of additional study courses to be taken may not exceed 20 credit points. Taking additional study courses or tests is a paid service. For students from another university or college, when they start their studies at the UL in later study stages, the budget funding for their studies is not preserved. Final exams passed at other universities are not recognized.

Upon the applicant’s application, the UL also evaluates and recognizes the knowledge, skills, competences acquired outside of formal education or acquired through professional experience, as well as study results achieved in previous education. When applying, documents confirming the obtained study results must be attached – certificates, employer’s statements, recommendations, project results, job descriptions, etc. The study results achieved through professional experience can only be recognized as far as the relevant study programme that consists of internship, or the achievable results of the study course or study module of a study programme which confirm the acquired practical knowledge. In certain cases, in order to recognize the knowledge, skills and competences acquired through professional experience as relevant course results of the study programme, the applicant may be required to take tests provided for in the relevant study course or part of it.

**During the reporting period, no person applied to the Faculty of Computing with a request to recognize knowledge, skills, competences acquired outside of formal education or through professional experience.**

In the Bachelor’s study programme, study courses are most often recognized in the following cases – when a student returns from an exchange programme (ERASMUS or other), as well as persons who are enrolled in the Bachelor’s study programme, may request to recognize the study courses completed during the previous studies if their scope and content are relevant to the existing course of a study programme. Students have every opportunity to have their courses recognized if they have not managed to complete the studies started at another higher education institution. In these cases, the recognition commission compares the scope and content of the previously completed study courses and decides on the possibility of recognizing the study courses. In certain cases, previously completed study courses are recognized for students for whom the studies in study programmes of a degree programme are second or further higher education programme. For example, if a student completed the civil defence course while studying in the computer science Bachelor’s study programme, he or she does not need to take this course one more time in the computer science Master’s study programme. Also, when resuming studies after a study break, courses are recognized due to changes in the study programme curriculum.

In Master's programmes, however, the recognition of study courses is most often carried out when students have returned from mobility programme studies, participated in various projects, such as a summer school, or have enrolled to this programme from other Latvian higher education institutions where they failed to complete their studies. In these cases, the head of the programme or recognition commission compares the scope and content of the previously completed study courses and decides on the possibility of recognizing the study courses.

**On a massive scale, in more than 100 cases every year, previously obtained credit points in first-cycle professional higher education are automatically recognized when continuing studies in a Bachelor’s programme. In the case of exchange programmes, an average of 10 students must do this every year.**

**During the reporting period, there were no problems with the recognition of the obtained credit points in the degree programme.**

There is also an opportunity to recognize previously completed study courses in the doctoral study programme. In this programme, however, such applications are rarely received, and recognition of study courses was related to returning from ERASMUS+ studies or to changes made in the study programme plan. In addition, the academic activity performed outside the doctoral study programme can also be recognized to match the requirements of UL doctoral study programme. The criteria and procedure for this recognition are also set forth in the Regulations.

**There were no such cases during the reporting period.**

The opportunity to recognize study results obtained in previous education (including life-long learning programmes) or through professional experience is less often used.

**There were no such cases in the degree programme during the reporting period.**

For UL students who use the opportunity to study or do an internship within the framework of various international exchange programmes, the recognition of study results acquired during the mobility programme is carried out in accordance with the above-mentioned UL regulations governing recognition, and the regulations of *On the procedure of organizing mobility of the ERASMUS+ programme at UL* (only in Latvian) (UL order No. 1/363 of 18.12.2014; see Appendix II-2). According to these regulations, the recognition of the study results acquired in mobility programmes takes into account: 1) compliance of the study results learned and obtained during the mobility with the conditions of international exchange programmes and 2) compliance of the study results learned and obtained during the mobility with the requirements of the UL study programme. The recognition of study results learned and obtained during mobility programmes is carried out by the director of the relevant study programme or the recognition commission, based on transcripts from the partner university or confirmation from the place of internship. After evaluation, the recognized study results are included in the student's fulfilled academic obligations.

All students participating in exchange programmes agree with the programme director the preliminary mobility study course or internship plan before going on a mobility programme. If changes are made to this plan during the exchange, they are agreed with the director of the study programme. The preliminary study or internship plan also mentions the process of recognition, the director of the study programme approves the student's chosen study courses at a foreign university and notes which study course from the UL student's study plan at it will replace or correspond to. If a student participates in mobility internship, before going on mobility programme, the student agrees with the director of the relevant study programme how the internship will be recognized. If the UL study plan provides for an internship, the mobility internship is recognized as an internship within the UL programme.

**During the reporting period, there were no problems with the recognition of the credit points obtained in exchange programmes.**

All procedures are made public and available in the UL Normative Acts system, which is available to every UL employee and student after registering with an assigned username and password.

**Data on recognition of study results during the reporting period are shown in Table II-4.**

*Table II-4. Number of students with recognized study courses*

| Study programme | Number of students whose study courses have bee recognized since 23.08.2017(the previous accreditation period) |
|---|---|
| Master's programme "Computer Science" | 43 |

| | |
|---|---|
| Bachelor's programme "Computer Science" | 993 |
| First level professional higher education study programme "Programming and Computer Network Administration" | 138 |
| **TOTAL** | **1174** |

### 2.1.5. Assessment of the methods and procedures for the evaluation of students' achievements, as well as the principles of their selection and the analysis of the compliance of the evaluation methods and procedures with the aims of the study programmes and the needs of the students.

In accordance with the "Law on Higher Education Institutions" of the Republic of Latvia, the internal regulations of the UL entitled *Procedure for developing and updating study courses of the University of Latvia (Appendix II-4),* have been developed, which stipulate that information on the conditions for starting the study at each study course, its purpose, objectives, requirements for obtaining credit points, content of the study course, the organization of the study process in contact classes, organization and tasks of students' independent work, planned learning outcome (knowledge, skills, competence) and their verification methods and assessment criteria, must be included in all study course descriptions that are available to students in the UL Information System (LUIS) and the UL e-study platform. The registration and keeping of the evaluations of student results takes place in the e-learning platform of the corresponding study course. For each study programme and each study course at UL, the study results are formulated as a set of knowledge, skills, and competence. The study programme courses have been developed following the principles of gradation and continuity. To ensure this, study programmes have mapped the planned learning outcome at the study programme level and at the study course level.

**The mapping results and their analysis are given in the description parts of the respective study programmes.**

At the beginning of the studies, students are informed about the organization and implementation of the studies in the relevant study programme, but when starting the study of each individual study course, the lecturers inform about the course organization, content, learning requirements, planned learning outcome, tests and evaluation criteria, as well as explain the role of the study course in achieving the overall learning outcome of the programme. Students can familiarize themselves with the criteria and conditions for evaluating students' performance and the binding procedures in the study course descriptions and in the e-learning platform; moreover, at the beginning of each study course in the first classes, when each lecturer introduces the students to the organization of the course, requirements, and briefly describes the requirements of midterm exams and final exams, assessment criteria and examination procedure without changing these requirements and assessment criteria during the semester.

The organization of study course examinations and the assessment of students achievements are carried out in accordance with *The procedure for organizing study course examinations at the University of Latvia (only in Latvian) (UL Senate decision No. 211 of 29.06.2015)*, which is compliant with the Law on Higher Education Institutions and the UL Constitution, and is applicable to the evaluation of the learning outcome of full-time and part-time students registered in all levels of UL

study programmes.

There are two types of tests in each study course: mid-term tests (the total grade of the mid-term tests is not less than 50% of the total grade) and the final test of the study course (the grade is not less than 10% of the total grade). Examinations can be conducted in a written or oral form, or in a combined form (written and oral). For the assessment of student achievements, the form and methods of tests are chosen, which correspond to the teaching methods used in the study process in contact classes and in the organization of students' independent work.

Taking the exam is a mandatory requirement to obtain credit points for completing the study course. The evaluation procedure and criteria of the mind-term tests are determined by the responsible structural unit according to the specifics of the study course. The grade for the study course is calculated in the UL's centralized system for registering results according to the algorithm specified in the course description, considering the grades obtained in the mid-term tests and the exam, and recorded in the test report.

The types of intermediate tests are as follows: test, independent work, practical work, laboratory work, report, paper and other types of work according to the specifics of the study course. The number and type of mid-term tests are specified in the study course description. For a student to get a grade for the course completion, the grade obtained in the exam must be successful. Completion of the course can be evaluated as successful even if the exam has been passed unsuccessfully and such a possibility is specified in the description of the study course. The overall grade for the course is calculated in the UL e-learning platform according to the algorithm specified in the course description, considering the grades obtained for the mid-term tests and the exam.

According to the specifics of the study course, requirements for class attendance can also be determined.

At the end of each study course, there is a final test of the study course: exam or defence (for the course work, final work project, semester work, field course, internship). The procedure for defending and evaluating the course work, final work, and internship is determined in the UL regulations.

Learning outcomes are evaluated on a 10-point scale. If it is allowed by external regulatory acts, after receiving the permission of the UL vice-rector, the learning outcomes can be evaluated as "passed" or "failed". The course is considered to have been completed successfully, i.e., the grade is successful if the grade on a 10-point scale is not lower than "4" (almost satisfactory) or is "passed". In this case, a student gets credit points for studying the specific course.

For the evaluation of students' knowledge, skills and competence in each study course in a 10-point system, the previously described learning outcomes criteria are used. In formulating the criteria, the learning outcomes formulated in each study course and the explanation of the evaluations are used as a basis (see *Table II-5.*), which are published in *Procedure for developing and updating study courses of the University of Latvia*.

*Table II-5. Explanation of grades in the 10-point system*

| Assessment | Grade (in words) | Explanation (in accordance with the Regulations of the Cabinet of Ministers of the Republic of Latvia No. 141, No. 512 No. 240 and the decision of the UL Senate No. 211 of 29.06.2015) |
|---|---|---|
| **very high level of acquisition** | **10 (outstanding)** | knowledge, skills and competence exceed the requirements of a study programme, study module or study course, demonstrates the ability to carry out independent research and deep understanding of the problems |
| | **9 (excellent)** | knowledge, skills, and competence fully comply with the requirements set for the study programme, study module or the study course; they possess the ability to use independently the knowledge acquired |
| **high level of acquisition** | **8 (very good)** | the requirements of the study programme, study module or the study course are completely met, though in certain issues they do not have understanding deep enough to use the knowledge independently for solving more complex problems |
| | **7 (good)** | in general, the requirements of the study programme, study module or the study course are met but sometimes the inability to use the acquired knowledge independently is detected |
| **average level of acquisition** | **6 (almost good)** | the requirements of the study programme, study module or the study course are met, but there is a lack of deep understanding of the problem and inability to use the acquired knowledge |
| | **5 (satisfactory)** | in total, the study programme, the study module, or the study course is acquired but there is insufficient knowledge of certain issues and inability to use the acquired knowledge |
| | **4 (almost satisfactory)** | in total, the study programme, the study module, or the study course is acquired, however, there is insufficient understanding of some basic concepts and there are considerable difficulties in practical application of the acquired knowledge |
| **low level of acquisition** | **3 (weak)** | the knowledge is superficial and incomplete; the student is unable to use it in specific situations |
| | **2 (poor)** | there is superficial knowledge of only some issues; most of the study programme, study module and the study course are not acquired |
| | **1 (very poor)** | there is no understanding of the fundamentals of the course and there is almost no knowledge of the study programme, study module or the study course |

The conformity of evaluation methods and procedures to the fulfilment of study programme goals and the needs of students is analysed and improved, considering the experience of lecturers, comparatively analysing the learning outcomes achieved by students and the results of surveys in several academic years. In surveys, students admit that it is very important for studying to have clearly formulated planned learning outcomes and defined evaluation criteria, as well as receiving

regular feedback on student achievements during the study process. To this end, lecturers systematically analyse their experience, cooperate with colleagues, analyse student achievements, and improve course descriptions and the e-learning platform by developing evaluation criteria corresponding to the planned learning outcomes, thus providing evaluation justification.

When evaluating the study results, the basic evaluation principles regulations formulated in the Cabinet of Ministers of the Republic of Latvia No. 141 (20.03.2001) "Regulations on the state standard of first-level professional higher education", No. 240 (13.05.2014) "Regulations on the state standard of academic education" are observed, i.e.:

- **the principle of openness of evaluation** — according to the stated goal and objectives of the study programme, as well as the goal and objectives of the study courses, the university has determined a set of requirements for the evaluation of learning outcomes,
- **the principle of the possibility of revision of the evaluation** — the university has determined the procedure for reviewing the obtained assessment,
- **the principle of obligation of evaluation** — it is necessary to obtain a successful evaluation for the acquisition of the entire content of the study programme,
- **the principle of variety of test methods used in evaluation** — different types of tests are used in the evaluation of the study programme,
- **the principle of evaluation relevance** — in the test work, the student is given the opportunity to demonstrate knowledge, skills and competence in relevant tasks and situations. The content to be included in the tests corresponds to the content specified in the course programmes.

The basic criteria for the evaluation of theses are determined in the *Requirements for developing and defending final theses (Bachelor's, Master's, diploma and qualification theses) at the University of Latvia (only in Latvian)(UL. order No. 1/38 of 03.02.2012*). Additional criteria may be set for the evaluation of final theses, which are approved by the faculty council after the proposal of the relevant programme council. **In the case of the degree programme, they refer to some nuances of the design, which are described in the study programme sections of this report.**

### 2.1.6. Description and assessment of the academic integrity principles, the mechanisms for compliance with these principles, and the way in which the stakeholders are informed. Specify the plagiarism detection tools used by providing examples of the use of these tools and mechanisms.

In its activities, UL observes the principles and standards of honest and responsible behaviour, which are described in the *Academic Ethics Codex of the University of Latvia (LU Senate decision No. 2-3/46 of 26.04.2021)* and in the *Regulations for academic integrity at the University of Latvia (LU Senate decision No. 2-3/48 of 26.04.2021*), these rules are publicly available to every employee and student of the UL. The commitment to observe and fulfil the Academic Ethics Codex of the University of Latvia and the Regulations for academic integrity at the University of Latvia is included in every study contract. Before the test, the teaching staff always reminds what materials and sources are/are not allowed.

In order to prevent violations of the principles of academic integrity, UL created the Unified computerized plagiarism control system (hereinafter – the System) *(UL order No. 1/125 of 22.04.2014)*. The system is used to check students' final and doctoral theses. A procedure has also

been developed to describe the next steps to be taken *(Appendix of UL Order No. 1/125 of 22.04.2014; see Appendix II-5)*, in cases where signs of plagiarism are detected.

UL, as the developer and maintainer of this system, regularly improves it and offers the opportunity for other Latvian universities to use this system on the basis of a cooperation agreement. Currently, seven Latvian universities, i.e., University of Daugavpils, University of Liepāja, Latvia University of Life Sciences and Technologies, Riga Stradiņš University, Rēzekne Academy of Technology, EKA University of Applied Sciences, as well as RISEBA University of Applied Sciences use this system based on a cooperation agreement.

The system automatically compares theses uploaded in these university systems, incl. materials available on the Internet, and in case the matching of fragments of works reaches a certain percentage, the directors of study programmes are sent a report on these test results, where the same fragments of texts in the works of different authors can be viewed simultaneously. The directors of study programmes pass this information for initial evaluation to the supervisor and reviewer of the relevant final thesis, and if there is a suspicion of a violation of academic integrity, the results of this analysis are then forwarded to the final examination commission for review and final decision.

**In the case of Bachelor's and Master's theses, so far the anti-plagiarism tool has not detected a single case of plagiarism, but teaching staff - supervisors and reviewers - have discovered several cases of plagiarism in the form of translation of English publications available on the Internet into Latvian. The last case was in 2021 in the Bachelor's thesis, and the student was expelled without a diploma.**

**A more common violation is the use of unauthorized sources during the test and the "creative" reworking of open access sources in homework. In the case of detection of a violation, the necessary action is determined in the Procedure for organizing study course examinations at the University of Latvia (only in Latvian). An explanation is requested from the violator and he is warned of expulsion in case of repeated violation. Unfortunately, such violations happen every year, especially among first-year students.**

## 2.2. Efficiency of the Internal Quality Assurance System

### 2.2.1. Assessment of the efficiency of the internal quality assurance system within the study field by specifying the measures undertaken to achieve the aims and outcomes of the study programmes and to ensure continuous improvement, development, and efficient performance of the study field and the relevant study programmes.

The operation of a successfully functioning, sustainable study programme corresponding to the goals of the degree programme and study programme at the UL is ensured by systematically determining and implementing quality assurance procedures, including ensuring continuous monitoring and analysis of the implementation of the study programme, the use of measurements for the prompt implementation of preventive and improvement measures. The provision of the management levels involved in ensuring the quality of the study programme allows the implementation of programmes in a predetermined form according to predetermined procedures, promptly responding to possible changes in the situation, making quality-related decisions collegially or based on the distribution of competencies. An important methodical tool in quality

assurance is the UL Quality Management Handbook, which, *inter alia*, identifies in detail the UL practice in the implementation of ESG. The assessment of the effectiveness of the internal quality assurance system during the reporting period within the degree programme is, in general, **positive**.

Centralized achievements: updated regulations, improved procedures, improved surveys, introduced systems, staff provided with training, and other benefits, for example, increased survey response rates, increased student involvement, improved overall satisfaction in specific issues, etc.

**The Faculty of Computing has achieved an absolute level of survey response rates, as the description of the study course specifies that filling out the evaluation questionnaire is a mandatory prerequisite for receiving a grade, without affecting the grade level.**

**In 2012, the Faculty of Computing introduced the register of improvement proposals** (see https://www.df.lu.lv/en/about-us/quality-assessment/ (the register only in Latvian)), **which practically provides the necessary feedback in quality systems. More than 60 improvements were implemented during the reporting period.**

**For example, one can mention the study programme in cooperation with the University of Lincoln in England, as well as the modules "Big Data Analyst" and "Basics of Software Development" that were developed and implemented for employees of national economy partners. About 200 students have already graduated from the latter. The programme (legally from the point of view of the Faculty of Computing, it is a specialization in the already existing Bachelor's programme "Computer Science") was designed in cooperation with University of Lincoln in such a way that the first 3 years of the programme in the Faculty of Computing cover the content of the first two years of the University of Lincoln (Lincoln programme is a three-year programme), but the last year of study is identical in both universities.**

Cooperation is ensured between the lecturers involved in the implementation of the study programmes, including regular evaluation of the teaching staff. **Not less than once during the election period, the open lecture of the applicant for the position is evaluated. In annual self-evaluation reports, teaching staff analyse the results of student surveys and make improvements in justified cases.**

At the same time, maintenance of a continuous feedback is ensured to inform the involved parties about the learning outcomes and competence achieved by the students and graduates. **Most of the examination commissions for the defence of qualification is made up of industry professionals. At the end of the defence session, the programme director discusses the necessary improvements with the commission members. Specific proposals are recorded in the Register of Improvement Proposals.**

Current issues of the quality assurance of the degree programme and the results of the study programmes contained in it, the annual report, changes in the study programmes, etc. are regularly considered and discussed in the council of the degree programme and the faculty council. 4 study programmes are implemented in one faculty within the degree programme, and from the academic year 2021/2022 the doctoral programme "Computer Science and Mathematics" has been added to the degree programme, with the sub-programme "Mathematics" that is implemented in the Faculty of Physics, Mathematics and Optometry. The directors of all programmes, the dean, 5 ICT industry professionals and 3 students are represented in the degree programme council, the latter representing undergraduate, Master's and doctoral study programmes. Representatives of students (5) and industry strategic partners (2) are also involved in the work of the faculty council.

The regular reviews, changes and accreditation self-evaluations of the degree programme are

evaluated by the council of the degree programme and the faculty council, the UL Study Programme Quality Assessment Commission (QAC), including independent experts from the academic staff of the UL, who evaluate the documentation before approval by the UL Senate.

**In order to assess the status of the degree programme in the implementation of a student-centred approach,** we used the questionnaire "Student-Centred Learning: Toolkit for students, staff and higher education institutions", which was developed in 2010 by "Educational International" and "The European Students' Union" within the framework of the project "Time for a New Paradigm in Education: Student Cantered Learning", financed by the European Commission. **Of the 45 aspects included in the questionnaire, we could mark 36 as fulfilled (Annex II-6, pp. 13-16).**

**Of the 40 recommendations of local and foreign experts identified in the previous accreditation, 36 have been implemented, three have been implemented within the available resources, and one is a University-level recommendation, which has been repeatedly reminded to the management of the UL, the last time to the Director of the Academic Department in January 2022. All recommendations made during the licensing of doctoral study programme "Computer Science and Mathematics" have been implemented.**

**Overall, the internal quality system of UL/Faculty of Computing has stimulated the development of the study programmes.**

### 2.2.2. Analysis and assessment of the system and the procedures for the development and review of the study programmes by providing specific examples of the review of the study programmes, the aims, and regularity, as well as the stakeholders and their responsibilities. If, during the reporting period, new study programmes have been developed within the study field, describe the procedures of their development (including the process of the approval of study programmes).

The quality of the degree programme and its study programmes is managed using Plan-Do-Check-Act or the Deming cycle, planning the development and improvement of the degree programme for a six-year period, cascading its goals and objectives to the level of each study programme and regularly monitoring the requirements, needs and initiators of the parties involved, in accordance with the UL Strategy, taking into account the national and international policies and trends of industries, as well as the impact of global environmental trends on the operation of the UL up to the level of study programmes.

Within the framework of the **quality assessment and improvement systems of the degree programme and its study programmes** (see Figure II-2), the development of the degree programme and the interconnection of its study programmes, creation of new study programmes, as well as the results of the implementation of each existing study programme are planned, controlled, evaluated and reviewed, ensuring the involvement of the responsible persons of all levels of management of the degree programme as well as the representatives of the main stakeholders in ensuring the quality of studies. The review of study programmes is regulated by *The procedure for preparation of the annual reports of the fields of study at the University of Latvia (UL order No. 1/255 of 13.07.2018).*

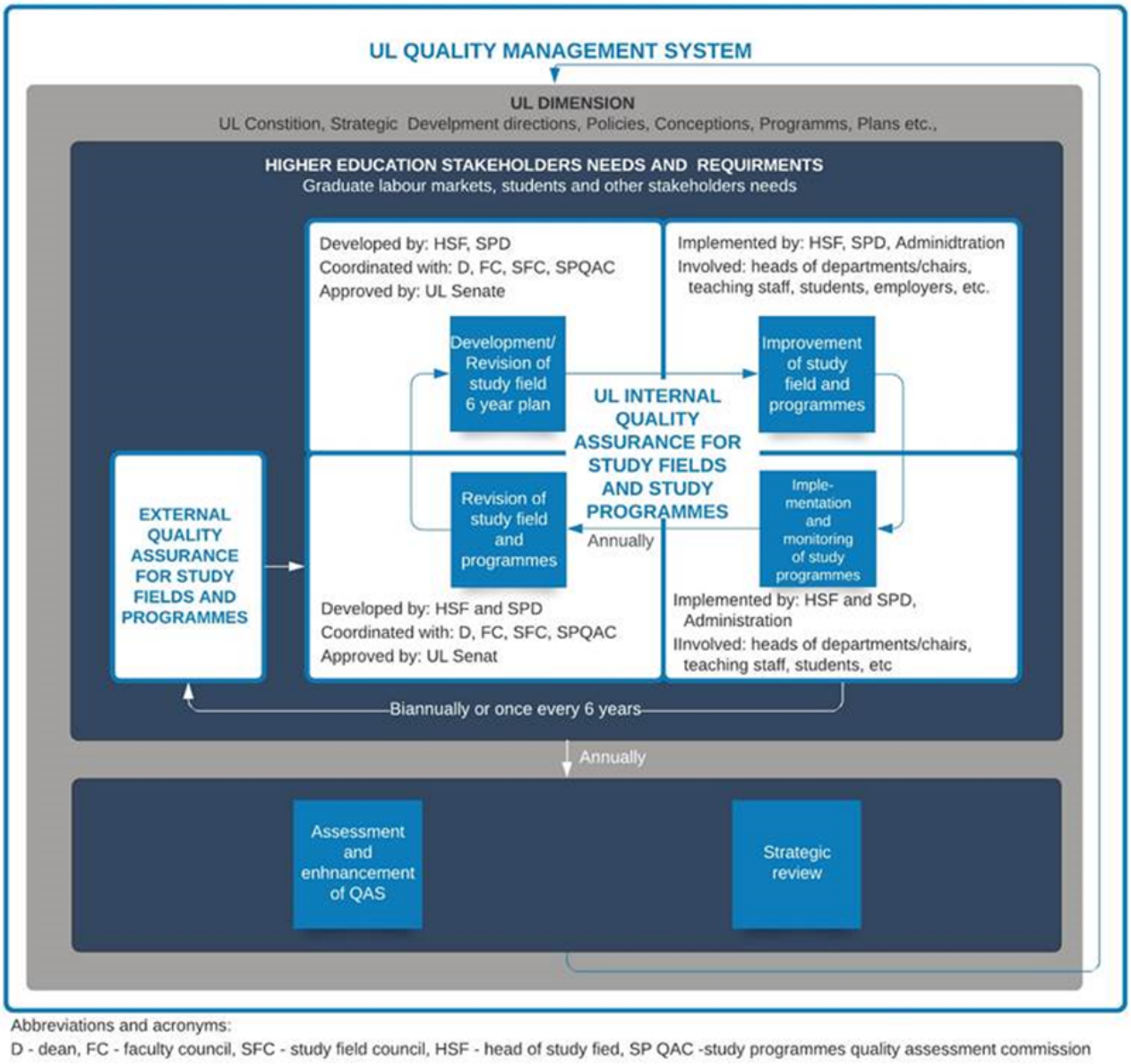



*Fig. II-2. The system of quality assurance of the degree programmes implemented by the UL and their study programmes*

The development of new study programmes is regulated by the *Regulation of the study programmes and life-long education programmes at the University of Latvia* (approved by the UL Senate decision No. 102 of 24.04.2017), it is implemented in several stages, including two-fold coordination and evaluation at all administrative levels involved in ensuring the quality of studies – coordinating and approving the study programme concept, as well as coordinating and approving the characteristics of the study programme at the end of the process. For a detailed description of the programme development and concept content, see *Quality Management Handbook* in Section II of Chapter 3.1.

In the process of self-evaluation and evaluation of the development of new study programmes, the responsibilities are divided between study programme directors, the head of the degree programme, Council of the Degree Programme, Faculty Council, Academic Department and Study Program Quality Assessment Commission, as well as the Senate.

Heads of degree programmes of th UL, in cooperation with directors of study programmes, prepare reports of the degree programme (hereinafter - Self-evaluation) every academic year. Self-evaluations are approved by faculty councils and submitted to the Academic Department. The Academic Department evaluates the relevance of self-assessments and submits self-evaluations for

review to the STQAC, which consists of all the vice-rectors of the UL fields, the chairman of the Academic Commission of the UL Senate, the representative of the UL students, the representative of the UL Alumni Club, the representative of the UL Library, Internal Auditor, as well as the representatives of other UL departments, i.e., the Academic Department, Student Service Department. The self-evaluation reports reflect the implementation of programmes, updates, programme changes and the improvement process, the evaluation of interested parties – both the results of student surveys and the evaluation of employers. In the process of self-evaluation of study programmes, as well as in the process of developing a new study programme, the Academic Department also provides independent expertise, whose proposals, which are justified and has been reviewed at the meeting of the STQAC, are implemented in a planned manner. Accreditation self-assessment reports are prepared using annual self-assessment results. The recommendations of the accreditation and licensing evaluation expert group and the study quality commission are evaluated in the council of the degree programme, which prepares the implementation plan of the experts' recommendations, which is coordinated by the STQAC. For more information on the content of self-assessment of study programmes and the process of ensuring external accreditation see Section IX and X of Chapter 3.1 of *UL Quality Management Handbook.*

**In the Faculty of Computing, all improvement proposals, including recommendations of internal and external experts, are recorded in the register of improvement proposals (https://www.df.lu.lv/en/about-us/quality-assessment/(the register only in Latvian). Analysis of the proposals included in the register and control of their implementation is carried out by the head of the degree programme.**

**During the reporting period, two new study programmes were developed.**

**Academic Bachelor's study programme "Computer Science and Organizational Technologies" (licence obtained on April 23, 2019). The programme is not being submitted for accreditation. In 2019, a license was received for the undergraduate study programme "Computer Science and Organizational Technologies", which was planned to be conduct jointly with Riga Technical University and State University of New York at Buffalo. RTU also received a similar license for a programme with the same name and similar content. Thus, legally, each university is responsible for its own programme. Between UL and RTU in 2019 an ill-conceived agreement was signed that both programmes would be administered and conducted by RTU Riga Business School. Although the students signed a single study agreement with both universities, the participation of the UL was actually limited to the delegation of some lecturers to teach at the Riga Business School. Students do not appear in the premises of the UL at all. The programme (legally – programmes), which was intended mainly for foreigners, within 3 years has not reached either the originally planned number of students or the orientation towards foreigners. Instead of the planned minimum of 100 admitted students per year, a total of 65 students are currently studying in the three study years, among whom there is not a single foreigner. Although the signed contract and the actual administrative cooperation significantly limited the opportunities of the dean and the director of the study programme to influence and improve the process, it must be recognized that both could have done more.**

**Simultaneously with the preparation of the above-mentioned study programme for licensing, as a backup option, the Faculty of Computing started the implementation of its Bachelor's programme "Computer Science" also in English. The dean conducted negotiations with several UK universities about possible cooperation, which resulted in the agreement signed in May in 2021 with the University of Lincoln for the dual award studies. Thus, 57 students are currently studying in English, including 40 from 15**

**foreign countries. A situation has arisen where two programmes of the faculty compete for the same audience, and one is undoubtedly more successful than the other. This is neither logical nor economical. Therefore, the faculty has submitted a proposal to the management of the University of Latvia to close the UL study programme "Computer Science and Organizational Technologies". This will not affect the study process at RTU Riga Business School.**

**The academic doctoral study programme "Computer Science and Mathematics", by reorganizing (merging) the doctoral study programme "Computer Science" and the doctoral programme "Mathematics" (license received on September 6, 2021), has been launched. The merging of the programmes took place when the University complied with the Ministry of Education and Culture's decision to reduce the number of study programmes implemented in Latvia by a third. Data on this programme are included in Section VI and the programme is being advanced for accreditation. All students of the previous two doctoral programmes "Computer Sciences" and "Mathematics" have been transferred to the reorganised doctoral programme "Computer Sciences and Mathematics" from February 2022. The existing programmes are ready for elimination.**

**Thus, during the reporting period, there has been a significant development of the study programmes at all study levels.**

### 2.2.3. Description of the procedures and/or systems according to which the students are expected to submit complaints and proposals (except for the surveys to be conducted among the students). Specify whether and how the students have access to the information on the possibilities to submit complaints and proposals and how the outcomes of the examination of the complaints and proposals and the improvements of the study field and the relevant study programmes are communicated by providing the respective examples.

Pursuant to the principles of democracy and equality, as well as in accordance with the quality management policy of the UL, the participation of applicants and students in the evaluation of the study process of the UL is ensured at all stages of the study process, starting from admission to the final thesis. In matters concerning the admission procedure, the candidates of the UL have the right to submit complaints to the chairman of the admission commission. The rights of UL candidates to submit complaints about violations in the admission procedure are specified in the *Admission rules at the University of Latvia (UL Senate decision No. 2-3/68 of 31.05.2021),* which determines the procedure for submitting a complaint, its examination and appealing the decision. What is more, to improve the quality of studies, students have the right to submit proposals and complaints about the study process, incl. on evaluation of tests and final theses. In order to ensure the quality of the study process, UL has developed and implemented *Order of submitting and examining proposals and complaints of the students (only in Latvian) (UL order No. 1-4/501 of 28.09.2022)*. The procedure determines in what form students individually or collectively can submit proposals and complaints in writing, as well as the procedure for their registration and evaluation. Proposals and complaints about the study process can be submitted to the deans of the faculties (on the class schedule, the organization of studies at the faculty, the quality of studies conducted by the faculty and its improvement, non-fulfilment of the duties of faculty employees, etc.). Responses to the

proposals and complaints must be provided within 15 days or within 30 days if additional information is required. Importantly, Clause 17 of the mentioned order explicitly states that: “At the end of each academic year, the dean of the faculty must submit to the management of the UL an overview of the complaints received in the previous academic year and the decisions made in this regard.” This indicates the cyclical monitoring of internal control mechanisms and complaint submission, decision-making, respect for students’ rights and interests, which is important in ensuring the proper functioning of this system and also its possible improvement. For a complete evaluation of the study processes the UL has developed and implemented the *Procedure for organizing study course examinations at the University of Latvia (only in Latvian)(UL Senate decision No. 211 of 29.06.2015)*, in which the right of students to submit complaints about the procedural or evaluation process of mid-term examinations and tests of the degree programmes and the procedure for reviewing these complaints is determined. The student has the right to submit an application to the lecturer who has evaluated the test within five working days of the registration of the grade in LUIS (under the condition that the student has requested the justification of the grade from the lecturer before submitting the complaint). The lecturer must review the application within 5 working days. If the lecturer believes that the student’s application is not justified, he or she submits the application to the head of the department for examination and decision-making. Regarding the final works, the UL has adopted the *Regulation on Graduation Examinations at the University of Latvia (UL Senate decision No. 183 of 27.12.2011)*, which stipulates that students have the right to file an appeal if the dean has not given them permission to take final exams or about the procedure of the final examination.

The University of Latvia has established the Academic Court of Arbitration, the regulation of which provide for the possibility to appeal to this collegial institution on any issue related to studies, including control of compliance with evaluation principles. Students have the right to contest the order on exmatriculation that has been adopted according to the *Procedures for competition (rotation) of study places financed by the state budget at the University of Latvia (UL Senate decision No. 381 of 24.05.2010; see Appendix II-7). The Study Fee Relief Procedure (UL order No. 1/89 of 14.04.2009)* stipulates that the students have the opportunity to challenge the decisions regarding the granting or non-granting of tuition fee remission within a month from the notification of the decision to the student by submitting a written application addressed to the rector of the UL, which must be reviewed by the rector within a month. *Procedure for Granting an Academic Leave of Absence in the University of Latvia (UL Senate decision No. 178 of 01.12.2008),* however, provides for the right to challenge the dean’s decision on the refusal to grant a study break to the student. Moreover, the *Procedures for starting studies in later stages of studies at the University of Latvia (only in Latvian) (UL order No. 1-4/332 of 07.06.2022.)* provides for the right to contest the decisions made by the dean within a certain period.

Respecting the rights of students also outside the study process, for those students who use UL students’ dorms, *Internal rules of the University of Latvia students’ dorms (UL order of 30.06.2009 No. 1/171; see II-8. appendix)* stipulates the rights and obligations of students, incl. the right to file complaints about problems in student dorms. Such issues are resolved by the senior of the student dorm.

Every student has the right not only to use the rights provided for in *The Academic Ethics Codex of the University of Latvia (UL Senate decision No. 2-3/46 of 26.04.2021)* to appeal to the Academic Ethics Commission of the UL for possible ethical violations, but also to submit proposals for the improvement of the code and its implementation to the Academic Ethics Commission of the UL.

Proposals and complaints of all procedures are registered in the structural units or commissions to which they are submitted, as well as notes are made on the results of the complaint review and the decisions made.

At the regulatory level UL has defined through *Rules for guest students from Latvian universities at the University of Latvia (UL order No. 1/17 of 25.01.2006; see Appendix II-9)* has defined the principle that guest students also have the same rights and obligations in the study process at UL as UL students, which means that the system of submitting and reviewing complaints and proposals is equally applicable to these students as well.

From the above, it can be concluded that the centralized segment of the UL complaints and proposal submission and review system covers all components of the study life of every student, as it applies both to admission to the UL, studies throughout the cycle, as well as final exams.

**In the Faculty of Computing, all improvement proposals, including recommendations of internal and external experts, are recorded in the register of improvement proposals (https://www.df.lu.lv/en/about-us/quality-assessment/ (only in Latvian)). Analysis of the proposals included in the register and control of their implementation is carried out by the head of the degree programme.**

**Complaints (only on paper and signed, non-anonymous) are registered with the faculty secretary.**

### 2.2.4. Provide information on the mechanism for collecting the statistical data, as developed by the higher education institution/ college. Specify the type of data to be collected, the regularity of collection, and the way the information is used to improve the study field. Describe the mechanism for obtaining and providing feedback, including with regard to the work with the students, graduates, and employers.

To control, analyse and forecast the dynamics of the number of students, the University twice a year collects data on:

- data characterizing the number of candidates and enrolled students and their profile, such as secondary education institution, year of graduation from the institution, grade obtained in secondary education examinations, age, gender, previously obtained higher education and the assessment obtained in their examinations,
- number of students broken down by faculties, study programmes, study levels, years of study, study forms and types, source of study funding, study status – exmatriculated as having failed to fulfil academic obligations, exmatriculated as not having fulfilled financial obligations, exmatriculated as having obtained a degree (graduate), on study break.

In order to control the progress of the students' studies and the implementation of the programme, the UL collects data on:

- mid-term and final evaluations of students' study courses broken down by types of tests, final results of final tests, average weighted grade; data is collected once a semester,
- completion of the study programme, according to the conditions of acquiring the programme broken down by study semesters, parts of the programme (compulsory part, part of limited choice, part of free choice and others, according to the structure of the programme); data is collected once a semester,
- students' academic debts in credit points broken down by study semesters, parts of the programme, study courses; data is collected once a semester,
- fulfilment of the study fee payment schedule provided for in the student agreement, broken down by study programmes and semesters.

To obtain information for planning and efficient use of study resources, the following statistical information is collected in connection with study programmes:

- financing of study places, broken down by state budget-financed, UL-financed and student-paid study places,
- the number of recipients of student grants and student loans, and the number of recipients of student loans.

To prevent violations of the principles of academic integrity in the final and doctoral theses of UL students, the UL ensures automatic checking of all student final and doctoral theses submitted for defence with the help of the Unified computerized plagiarism control system, by comparing the works with the final theses of the UL and other universities stored in the System.

To assess the satisfaction of students, graduates and employers with the quality of studies and its results, as well as to carry out the necessary improvement measures, UL organizes and collects data on the following surveys:

- survey at the start of studies (see example in Appendix II-24), which is carried out electronically once a year. The objective of the survey is to obtain information for the improvement of student attraction measures. The tasks of the survey are: (1) to identify students' motivation in choosing a university and study programme, (2) to identify the sources of obtaining information about studies at UL, (3) to get an assessment of the application and registration process and (4) to identify the socio-demographic portrait of the respondents who have started their studies. Data for each study programme is collected in LUIS, but data about UL as a whole is collected and analysed by the Academic Department. The results of the survey are presented to the UL management, departments and faculty management, and the necessary improvement measures are proposed by the UL management, faculty management and programme directors in cooperation with the Study Department,
- survey of students of the first year of studies about their study experience (see example in Appendix II-25), which is also carried out electronically once a year. The purpose of the survey is to obtain information for improving the study environment and promoting student adaptation. The tasks of the survey are: (1) to identify the students' opinion about various aspects of studies and (2) to identify the student' opinion about the type of support needed when starting studies. Data for each study programme is collected in LUIS, but data about UL as a whole is collected and analysed by the Academic Department. The results of the survey are presented to the UL management, departments and faculty management, and the necessary improvement measures are proposed by the UL management, faculty management and programme directors in cooperation with the Study Department,
- in order to identify the students' opinion about the content of the study courses and to get an evaluation of the teaching staff's work, each semester a survey on study courses (see Appendix II-26) is conducted in an electronic form, that also including a survey, about study internship (for example, see Appendix II-30), about course work and final theses (for example, see Appendix II-29). Data on each study programme is collected in LUIS and is available to teaching staff, programme directors and the dean of the faculty, the Academic Department. Data analysis is carried out by the programme directors, the dean, the necessary improvement measures are initiated by the programme director, the dean, and the degree programme council. The results are used in the preparation of the annual reports of the degree programmes, as well as in the preparation of study programme development plans,
- in order to obtain students' evaluation of the study programme for its further development, improvement of the study process, improvement of quality and study environment, survey of

students of the last study year about the overall study programme (for example, see Appendix II-27) is carried out. The survey is conducted in electronic form once per each study programme. Data for each study programme is collected in LUIS and is available to programme directors and the dean of the faculty. Data analysis is carried out by the programme directors, the dean, the necessary improvement measures are initiated by the programme director, the dean and the degree programme council. The results are used in the preparation of the annual reports of the degree programmes, self-evaluation reports of degree programmes for accreditation and reaccreditation as well as in the preparation of study programme development plans,

- in order to identify the main reasons for dropping out of studies and to promote the reduction of student dropouts, a survey for students who have expressed a desire to drop out their studies or have already stopped their studies is carried out. The survey is conducted throughout the academic year electronically (in some cases in a paper form). Data is collected and analysed by the Academic Department once a semester. The results of the survey are presented to the management of the UL and the management of the faculty,
- graduate surveys aim at obtaining an assessment of the graduates' satisfaction regarding the quality of the studied programme, knowledge, skills and competences acquired at the UL, contribution of the completed study programme to their employment, as well as plans to continue their studies. The survey is conducted by programme directors at their discretion using a survey questionnaire prepared by the Academic Department,
- employer surveys (see Appendix II-10) the aim of which is to find out how employers assess the compliance of the knowledge, skills and competences acquired by the graduates of the University of Latvia with the requirements of the labour market. The survey is conducted by programme directors at their discretion using a survey questionnaire prepared by the Academic Department.

**Throughout 2021 the average evaluation of the spring courses was**

**>6 – 58 in study courses**

**>5 – 11 in study courses**

**>4.53 – 3 in study courses**

**Participation in the evaluation of the courses in the Faculty of Computing is mandatory.**

**Throughout 2021 the average evaluation of the lecturers was**

**>6 – 42**

**>5 – 17**

**4.15 – 1 (no longer works at the faculty)**

**Participation in the evaluation of lecturers is not mandatory, so the results cannot be considered representative for all teaching staff.**

Every year, the head of the field of study, in cooperation with the study programme directors, prepares a report on the activities of the field of study and its programmes during the academic year. In the preparation of the report, the collection and analysis of statistical data is carried out, and the obtained information is used for the evaluation and improvement of the degree programme. The report includes the following statistical data, which are collected and analysed annually:

- the number of students in the programmes, indicating the total number, number matriculated in the 1st year of study, the number of graduates, dropouts, separately indicating different study forms, types, languages,
- outgoing and incoming mobility of students, their participation in exchange programmes,
- the composition of teaching staff, indicating the position, number of academic staff with a doctorate degree, mobility of teaching staff,
- number of students and teaching staff ratio
- the number of employers working in the sector who are involved in the implementation of the programme,
- summary and analysis of the results of the student survey on study courses and the programme as a whole.

The successful cooperation with employers in the industry is confirmed by the employer survey conducted in 2021. Out of 30 sent questionnaires, 14 returned without any reminder or special plea (see Appendix II-10).

Since all students in the third year of undergraduate studies undergo a semester-long production practice, during which or at the end of which they usually get their first employment contract, the opinion of employers is applicable to graduates of undergraduate studies. In the employers' survey, two findings dominate about the graduates of the Faculty of Computing.

1) After a short training/introduction to the workplace, they were able to perform their job responsibilities (5).

2) They were well theoretically prepared, but they had insufficiently acquired practical skills (4).

**For us, educators, the high assessment of graduates' ability to acquire new knowledge and skills by employers is important. Comments worth noting: "Graduates who have started work demonstrate high theoretical knowledge and also practical work skills, thanks to the UL internship policy. After a short training and on-the-job training, they are ready to do independent work."**

**It is worth noting that for the last 5 years, in the survey supported by the Confederation of Employers of Latvia, the Bachelor's programme "Computer Science" takes the first place in absolute evaluation as the most recommended for high school graduates (see https://www.prakse.lv/top (only in Latvian)).**

**The results of the graduate and student surveys are described in programmes` descriptions.**

### 2.2.5. Specify the websites (e.g., the homepage) on which the information on the study field and the relevant study programmes is published (in all languages in which the study programmes are implemented) by indicating the persons responsible for the compliance of the information available on the website with the information published in the official registers (State Education Information System (VIIS), E-platform).

UL website's https://www.lu.lv/en/ (hereinafter referred to as "the website") target audience is prospective and current students, employees, cooperation partners, scientists, and general public.

The website is designed to provide availability and storage of public information, an opportunity for its visitors to familiarize themselves with information about the activities of the UL in digital form in

the Internet environment.

The website consists of the following sections:

- CAROUSEL – important UL information using the UL visual image identity, which has certain parameters, and which strengthens the image of the university and promotes its recognition in the digital environment.
- NEWS AND EVENTS – UL news and planned events. The information is prepared by UL structural units and the Department of Communication and Innovation.
- DISCOVER UL – information about studies, life outside studies, science.
- STUDIES – with subsections:
    - Professional study programmes
    - Bachelor's study programmes,
    - Master's study programmes,
    - Doctoral study programmes,
    - Residency (post-graduate medical training).

The information is prepared and posted on the website by the Department of Communications and Innovation in cooperation with the Academic Department and the Student Service Department.

In the STUDIES section, in Latvian, you can find information about programme objectives, tasks, learning outcomes, programme scope and duration, programme study language, information about job opportunities after graduation, as well as programme study plans. In case of questions, contact information is provided for further information. Moreover, in this section one can find useful information for studies published under the subsection STUDY GUIDE – academic calendar, lists of lectures, consultation times, the most important documents and sample forms, information on mobility opportunities in foreign universities, on recognition of experience/education, lifelong learning opportunities, as well as directions to UL e -study website and LUIS information system.

The section contains information about the offer of the UL Libraries, information from the Career Centre and information about Student Council activities.

Two sub-sections STUDENT LIFE and MORE THAN STUDIES inform both current and prospective students about student dorms, catering, car and bike parking, mentor support, as well as information for people with special needs. There is a wide range of information about opportunities to enrich your extracurricular life with sports and culture.

ADMISSION section contains information for both prospective and current students. In this section, high school students can familiarize themselves with events and creative competitions organized by the faculty, in which it is possible to get additional points for admission by participating and successfully starting. For those who want to study, the website publishes information about programmes of all levels, their admission requirements, information about loans and scholarships, as well as the possibility of resuming studies. Prospective students can obtain information about the most frequently asked questions and answers, get information about the activities of the Career Centre, preparatory courses and classes for high school students.

Other sections – Science, Cooperation, About us. They provide more information about UL activities in research, projects, conferences, cooperation partners, regulatory acts, strategy.

On the website www.lu.lv/par-mums/dokumenti/pasnovertejuma-zinojumi/ (only in Latvian) one can find the annual self-evaluation reports and reviews of the field of study.

On the websites of structural units (faculties), information is presented about the programmes offered by the specific faculty, scientific activity of the faculty. The content blocks are exactly the same as on the official website of the UL with more specific information about the faculty's

activities.

From the UL website, you can go to the faculty's website via the faculty's business card (https://www.df.lu.lv/ ).

Heads of UL structural units are responsible for preparing information on the website within the competence of their structural units, its correctness and updating. The content administrators of the structural units' websites are responsible for maintaining the website, posting information and updating it on a regular basis. For a particular faculty, the person responsible for posting content is a marketing or public relations specialist or coordinator who oversees the existing website, or a staff member who has completed a short TYPO 3 content posting training course under Department of Information Technology.

**The website of the faculty with identical sections is also available in English https://www.df.lu.lv/en/. Here, information is published in English and adapted to the needs of foreign students.**

**If the information submitter submits a text for publication in a foreign language other than English, a Latvian translation of the text or a short summary must be attached.**

Heads of UL structural units are responsible for preparing information on the website within the competence of their structural units, its correctness and updating. The content administrators of the structural units' websites are responsible for maintaining the website, posting information and updating it on a regular basis. **The faculty marketing specialist is responsible for posting content about the Faculty of Computing.**

## 2.3. Resources and Provision of the Study Field

**2.3.1. Provide information on the system developed by the higher education institution/ college for determining and redistribution of the financial resources required for the implementation of the study field and the relevant study programmes. Provide data on the available funding for the scientific research and/or artistic creation activities, its sources and its use for the development of the study field.**

The UL system for financing the degree programme and corresponding study programmes is built based on the Law on Higher Education Institutions, Regulations of the Cabinet of Ministers No. 994 of 12.12.2006 "Procedure in which universities and colleges are financed from state budget funds", Regulations of the Cabinet of Ministers No 445 of 05.07.2016 "Regulations on teachers' remuneration" and other external and internal regulatory enactments.

For the successful implementation of the degree programme, the UL must provide sufficient financial resources for the entire study process, including the remuneration of teaching staff, library and other resources related to the implementation of studies, as well as the development of the study programme. The main costs related to the implementation of the study process are the salary of teaching staff and costs related to the organization of the study process.

The remuneration of teaching staff includes:

- Costs of contact hours (for example, lectures, seminars, practical and laboratory work),
- Costs of conducting independent work, consultations, and exams,

- Costs of methodical work (preparation for classes, preparation of new courses, etc.),
- Costs of supervision and evaluation of student papers, including costs of reviewing,
- Costs of managing and organizing internships,
- Costs of scientific work of teaching staff to ensure the development of new study materials.

The regulations for the formation of teaching staff remuneration (regulations for the planning and registering of academic staff's workload) are determined by a rector's order for the entire university. Considering the specifics of the studies and the available resources, the management of the faculties can set different regulations in coordination with the vice-rector of the relevant field.

Costs related to the organization of the study process:

- Costs of the general personnel include the costs of salary of the study implementation support staff, the organization and provision of the faculty's activities,
- Other costs, i.e., the remaining direct costs related to the specific study programme, such as external services, rental of premises, additional equipment, rental of transport, etc.,
- Costs of infrastructure – costs of premises, including utility payments, repairs and maintenance,
- Costs of goods and services include the material-technical and methodological aids of the study programme, including technical equipment, visual materials, professional development (experience exchange trips, training), etc.,
- Indirect costs include the cost of providing the University's overall operation (IT, finance, personnel, marketing, etc.) and investments in development.

In order to estimate the amount of funds required for financing, the UL calculates the cost price for each study programme according to the methodology developed by the UL, which takes into account all the above-described costs of ensuring the study process and information about the plan of a specific study programme, teaching staff involved, planned number of students, and other aspects, thus ensuring the reliability of the forecasts.

**Financing of studies at UL – sources of financing**

To provide the funds necessary for the organization of studies, the UL uses (1) a state budget grant (considering the basic funding determined by the Ministry of Education, the level of the programme and the field of study) from the Ministry of Education and Science and (2) tuition fees.

Tuition fees are determined by UL taking into account:

- the cost of the study place, including all the costs of the study process,
- tuition fees for similar programmes at other universities,
- interest of potential tuition fee-paying students in the study programme,
- estimated funding from the state budget for the study place,
- the opinion of UL students self-government,

Tuition fees are determined at the end of each year for the following academic year to ensure timely availability of information. The tuition fee for the student does not change during the studies, except if the fees differ by year in the programmes, but even in that case they are all determined at the beginning of the studies.

Income from lifelong learning or other services, as well as the accumulated financial resources of the structural unit, can also be used for the development of study programmes (development of new courses, improvement of existing ones, improvement of methodological support and development of other aspects of the programme). If necessary, financial support can be received from the UL study quality improvement fund, where an amount is reserved in the UL budget every year for solving various issues of the faculties, including the development of new study

programmes and the development of existing study programmes.

**Indirectly, the sources of research funding intended for academic staff are also directed to the development of study programmes, for example, carrying out scientific activities, participating in international projects, publishing scientific articles, preparing international project applications, organizing scientific events at the UL, implementing scientific activity development projects and fulfilling long-term obligations, etc. By participating in the mentioned events, the academic staff increases their professional and research competence, often involving students as well (practically all doctoral students and outstanding Master's students are involved in projects of UL Faculty of Computing, UL Institute of Mathematics and Computer Science or Institute of Electronics and Computer Science), which positively affects the quality of the study process.**

**State budget funding for research (so-called science base and performance) has recently been around 140 thousand Euro per year (around 2.8 thousand per teaching staff elected to an academic position). On average, around 750,000 Euro per year (around 30,000 Euro per teaching staff elected to an academic position) are obtained in European or national level competitions. The most significant part of this funding is attributed to the field of theoretical quantum computing, where it supports the study of discrete mathematics, but there are also projects related to the IT Competence Centre (modelling of transaction processes) and computational linguistics (developing language technologies) and cognitive sciences. It is to be hoped that the situation will improve with the ongoing doctoral and postdoctoral reforms.**

**Within the degree programme there is a system for financing scientific research has been defined and implemented and it is effective:**

1. **the funding of research and development projects, after deducting a certain part for the UL and the faculty (usually 5% and 5%), goes to the project manager, who uses it for the remuneration of the project participants, purchase of materials, hardware, and software necessary for the project,**
2. **up to 200 hours per year from the funding of the state study base are paid to an elected faculty member for scientific publications in publications indexed by Web of Science or SCOPUS;**
3. **a certain part of the base funding of the national science budget determined by the Faculty Council is paid to elected academic staff for scientific publications in publications indexed by Web of Science or SCOPUS.**

**Of course, this system cannot solve the acute and chronic shortage of funding for science from the state budget, but it gives a clear perspective on the return on research work and is effective in that sense.**

It can be added that more than 10 teaching staff representatives elected to academic (pedagogical) positions have been elected to academic (scientific) positions at the UL Institute of Mathematics and Computer Science. Their research funding is not included in the degree programme.

Data on the available funding for a specific study programme can be found under the 1st level professional study programme "Programming and Computer Network Administration" in section 3.3.3, Bachelor's study programme "Computer Science" in section 3.3.3, Master's study programme "Computer Science" in section 3.3.3, Doctoral study programme "Computer science and mathematics" in section 3.3.3.

**Financing of studies at UL – redistribution of received funding**

All income received from the state budget and tuition fees, as well as from other sources used to finance the study process, after making indirect expenses deductions for centralized expenses in accordance with the current redistribution procedure, is directed by the UL for the use by the faculties.

Within the framework of the current year's budget, the faculties use the received funding independently. The dean and executive director of the faculty, who perform operational financial management, are responsible for the rational use of financial resources.

The accounting of the actual profitability at the faculty level takes place without separating the results of each programme or specific degree programme. At the same time, the management of the faculty observes the result of the study process, the dynamics of the number of students and the factors affecting them, the balance of the actual cost of the specific programme with the state budget grant and tuition fees and, if necessary, makes permissible corrections in the organization of the study process in order to ensure the long-term viability of the faculty's degree programme and its development.

**2.3.2. Provide information on the infrastructure and the material and technical provisions required for the implementation of the study field and the relevant study programmes. Specify whether the required provision is available to the higher education institution/ college, available to the students, and the teaching staff.**

**A uniform system and procedures for the development and purchase of facilities and aids, methodical materials, information:**

1. **the necessary study literature is ordered by the lecturer of the relevant study course through LUIS, but funding for purchase from centralized or faculty funds is approved by the dean, vice-dean or executive director,**
2. **within the scope of the project funds required in the research project the project manager orders the necessary aids for the executive director,**
3. **in other cases, any employee can initiate the necessary purchase for the executive director, but the decision is made by the executive director in communication with the dean.**

The study programmes of the Faculty of Computing (FC) of the University of Latvia are implemented in the premises of the University of Latvia at Raiņa Boulevard 19 and at the University of Latvia – Institute of Mathematics and Computer Science at Raiņa Boulevard 29, as well as on a very limited scale – at the University Academic Centre at Jelgavas Street 1 and 3.

The study process at the Faculty of Computing of the University of Latvia is provided in rooms of different sizes and functionality:

1) 5 medium-sized auditoriums (from 80 to 130 seats),

2) 3 seminar rooms (from 10 to 50 seats),

3) 4 computer classrooms (from 20 to 25 places),

4) computer science methodical laboratory – Linux centre (20 places),

5) "DF LAB" project studio.

The faculty carries out total study, scientific and administrative work in 2148 square meters. The number of student workplaces in auditoriums, seminar rooms and computer classrooms is 880. The area of such premises and the number of student workplaces are sufficient for the time being to implement the study programme in the existing scale.

Auditoriums, seminar rooms and computer classrooms are fully equipped with projectors, portable computers, desktop computers, wireless Internet, sound system, electricity connection points for student workplaces (partially). The technical equipment of the auditoriums and three of the five computer classrooms were completely renovated in 2018. In order to provide remote lectures, in 2020 the faculty purchased three sets of mobile video cameras for providing studies and conferences.

To ensure the study process, the Faculty of Computing uses the following software in computer classrooms: MS Office, MS Teams, Android Studio, Python, Eclipse, Codeblocks, ADOBE Creative Suite. The Linux centre or laboratory was specially created for the study process, where students use MikroTik, Cisco, HP network devices (managed switches, routers) in laboratory and practical work to learn their use and control. Linux lab hosts several Dell, Supermicro, HP servers. The latter is HP Proliant 380 Gen10, purchased in 2020, which is used for computer system emulations.

In addition to the servers in the Linux laboratory, the following servers are also available at the Faculty of Computing: SQL Database server used in study courses and SuperMicro R422BG – 22 Superserver with five Tesla V100 cards used for machine learning purposes.

One of the computer classrooms/laboratories is equipped with equipment for making prototypes used for the study process – research: 3D scanner, 3D printer, Festool tools – trimming saw, plunge saw, electric planer, router/trimmer with modular multifunctional workbench, stationary drill, soldering station for microelectronics. Moreover, various types of sensors are available for laboratory work, i.e., air quality (Aranet4Pro), Harvest ph, pressure, light sensor, KIO RTLS 2D/3D indoor positioning system tool sets for object tracking.

The DF LAB project studio helps students carry out various types of practical research and laboratory work during or outside of their studies. The following technical resources are available in the project studio:

- 3D printers: MakeBot and Ultimaker2 – for making parts of different sizes,

- Speedy400 laser cutter,

- Soldering station,

- 3D virtual reality headsets,

- 25 psc. of Raspbery P4 microcomputers for controlling electronic devices of various projects, including monitor wall control,

- 4 psc. of 43-inch Philips touch monitor wall that works with the support of an Android operating system control app. It is used for large-format video broadcasting - modelling.

- 20 psc. of 23 inch Dell monitor wall with Raspberry P4 microcomputer for large format video control and streaming.

The available infrastructure at 19 Raiņa Boulevard includes laboratories for computer engineering and visual perception research. Doctoral students also have access to European research infrastructures in which UL participates, for example CLARIN (Common Language Resources and Technology Infrastructure) in the field of computational linguistics.

In order to ensure a competitive and future-oriented study environment in the fast-growing

information technology sector, the faculty must regularly update technical equipment in computer classrooms, laboratories and auditoriums.

Two sub-programmes – Master's study programme “Computer Science” sub-programme “Bioinformatics” and Dosctoral study programme “Computer Science and Mathematics” – are implemented in cooperation with the Faculty of Biology and the Faculty of Physics, Mathematics and Optometry. These faculties are located in the Academic Centre of the University in Torņakalns, on Jelgavas Street 1 and Jelgavas Street 3, respectively. The sub-programmes are small in number, so they do not necessarily burden the resources of the Academic Centre.

In general, the infrastructure and technical equipment of the degree programme is satisfactory.

**2.3.3. Provide information on the system and procedures for the improvement and purchase of the methodological and informative provision. Description and assessment of the availability of the library and the databases to the students (including in digital environment) and their compliance with the needs of the study field by specifying whether the opening times of the library are appropriate for the students, as well as the number/ area of the premises, their suitability for individual studies and research work, the services provided by the library, the available literature for the implementation of the study field, the databases available for the students in the respective field, the statistical data on their use, the procedures for the replenishment of the library stock, as well as the procedures and possibilities for the subscription to the databases.**

***General characteristics of the UL Library***

The UL Library is included in the Library Register of the Ministry of Culture (BLB1000) and accredited as a library of national importance until 2022.

***Access to information resources and services of the UL Library, working hours***

The basic principle of the library’s operation is the availability of its services to every user.

The services are provided in 8 branch libraries of the UL Library in accordance with the rules of use of the UL Library (UL Rector's Order No. 1-4/9 of 07.01.2021). the services can be used in compliance with the rules by students, teaching staff, personnel, other libraries, students of other universities, as well as any resident. UL Library provides free basic services and paid services.

The working hours of branch libraries are adapted to the convenience of users. On working days from 9.00-20.00, in some branch libraries from 9.00-18.00, on Saturdays from 9.00-17.00 The Library of Natural Sciences and the Library of the House of Science are available 7 days a week, 24 hours a day. Libraries of the three branches are open to visitors all year round, including during the summer period.

The premises of the library on Raina Boulevard, which houses the information technology, computer engineering, electronics, telecommunications, computer control and computer science industry collection, are open to students at a convenient time 68 hours a week. An open access repository is available to users. The library on Raiņa Boulevard is located in 7 rooms, the total area of which is 485.7 m².

138 workplaces are available to users in the library on Raina Boulevard, incl. 18 workplaces for working with a computer.

During the Covid-19 pandemic, the library's working hours and services are provided in accordance with the legislation in force in Latvia.

***Literature available in the library for the implementation of the degree programme***

According to the data as of October 1, 2021, the literature available in the collection of the UL Library of the degree programme "Information technologies, computer engineering, electronics, telecommunications, computer management and computer science" includes 5,737 titles of printed information resources in 13,584 copies, mostly in English, Russian and Latvian (see Table II-6).

*Table II-6. Printed media*

| **Printed information resources for the UL degree programme "Information technology, computer engineering, electronics, telecommunications, computer management and computer science" (total in the collection of the UL Library as of 01.10.2021)** | | | | | | |
|---|---|---|---|---|---|---|
| Printed editions (titles/copies) | | | Breakdown by language (title/copy) | | | |
| Books | *Periodicals* | Other publications | Latvian | English | Russian | Other languages |
| **5,327** titles **9,277** copies | **168** titles **3,879** copies | **242** titles **428** copies | **646** / **2,614** | **2,469** / **5,285** | **2,350** / **5,278** | **272** / **407** |

**Total 5,737** titles / **13,584** copies

The available literature provides information for all levels of studies at the UL – Bachelor's, Master's, Doctoral, as well as scientific research fields. There is a tendency to decrease the range of printed periodicals by shifting to online publications. The acquisition of e-resources has been a priority in resource-building in recent years.

***Level of resource digitization***

The UL Library, in cooperation with the UL Information Technology Department, provides visitors with free online access to the UL e-resources repository http://dspace.lu.lv. A mobile version of the repository is also offered to users. In the UL e-resources repository the UL Library, authors of publications, UL structural units or representatives of UL publications regularly place electronic versions of their publications, digitized information resources with cultural and historical value, doctoral theses of UL teaching staff and their summaries to ensure free and perpetual online access to UL scientific achievements.

Digitalized editions subject to copyright are offered to be used locally in the reading rooms of the branch libraries.

Currently, the e-resources repository contains more than **2,684** publications relevant to the UL degree programme "Information technology".

Additional information on the resources and services of the UL Library can be found in Appendix II-21. Unfortunately, there is no technical way to find out the intensity of the library's resources and services directly from the students of the degree programme.

**The total collection of the library corresponds to the implementation of the studies and**

**the development of scientific research in the degree programme "*Information technology, computer engineering, electronics, telecommunications, computer management and computer science*", because every year it is supplemented with the most current information resources in accordance with the informational needs of the academic staff and students.**

### 2.3.4. Provide a description and assessment of information and communication technology solutions used in the study process (e.g., MOODLE). If the study programmes within the study field are implemented in distance learning, the tools specially adapted for this form of study must also be indicated.

The pandemic has increased the need for ICT solutions. Modern ICT provides great opportunities for the development of the educational process, which allows the implementation of new projects and the introduction of new systems so that the study process is as successful as possible. The use of ICT in the educational process is one of the ways to increase learning motivation.

The IT Department of the University of Latvia provides UL students and employees with the MS Office 365 software package, which is a cloud-based technological solution. Office 365 provides the students and employees with the best tools for modern studies, such as Outlook, Forms, OneNote, Sway, as well as the Office package, which includes Word, Excel and Powerpoint programmes.

In addition to MS Office 365, UL students and employees are provided with software such as SPSS, Question Pro, Autodesk, MathWorks MatLAB, Esri ArcGIS, etc.

One of the Office 365 online applications, i.e., Microsoft Teams, is used to ensure the remote study process and distance learning programmes, which provides both the opportunity to conduct lectures online, record lectures, and communicate with students online.

In addition to the MS Teams programme for the remote study process, UL offers its students and employees the UL information system BigBlueButton (hereinafter referred to as the BBB system), which is an open-source web-based online video conferencing system. BBB provides the UL an opportunity to organize online events for UL staff, including students and visitors to UL events, and can be used as an integrated solution both in the e-study system (only users that are registered in the course) and outside the e-study system, where connection to the UL web conference server is required in a web browser https://bbb.lu.lv

UL has two e-studies environments available – estudijas.lu.lv and edu.lu.lv. The e-studies environment estudijas.lu.lv is designed to ensure and manage the study process, and the e-learning platform edu.lu.lv is designed for e-learning projects, events and courses, as well as distance learning programmesmes.

For both e-learning environments, the open source e-study environment MOODLE is used, which is a modular object-oriented dynamic learning environment, and is currently not only the most methodically and pedagogically effective, but also the most economically advantageous e-study solution. Courses have been created in the Moodle e-study environment, in which students have access to the necessary study materials and activities. The teaching staff has the opportunity to evaluate students as well as to register students' participation.

For data storage during the study process for both students and employees, UL provides the Office 365 cloud service OneDrive in the amount of 1TB. OneDrive is Microsoft cloud service that connects

all of the user's files. It allows its users to save and protect files, share them with other users and access them from anywhere on all their devices.

For data transfer, UL offers its students and employees a large file transfer system store.lu.lv. This system allows to send files that cannot otherwise be sent by email due to their size but is not intended for long-term file storage.

**Already in the previous reporting period, the Faculty of Computing had placed study materials in the MOODLE e-study system for all study courses. In exceptional circumstances, the MS Teams system must be used for the conducting of classes, and in some cases also ZOOM. Not in all cases does it allow to achieve the level of quality of face-to-face classes due to weak feedback. All study programmes are licensed for face-to-face only, so the distance learning format is not allowed under normal conditions, and such a format would require disproportionately large expenses for the preparation of materials, which the scarce funding of the study places does not allow.**

### 2.3.5. Provide information on the procedures for attracting and/or employing the teaching staff (including the call for vacancies, employment, election procedure, etc.), and the assessment of their transparency.

There are roughly three groups of teaching staff at the UL: teaching staff who work in elected academic positions, teaching staff who perform responsibilities of the elected academic positions (principals and advisers), as well as lecturers.

Regarding the elected academic positions, as well as those who perform their responsibilities, the selection and recruitment are carried out accordingly to the *Regulations on academic and administrative positions at the University of Latvia* (only in Latvian).. According to the regulations, the following academic positions exist at the UL: professor, associate professor, assistant professor, leading researcher, lecturer, researcher, assistant, scientific assistant.

Decisions on the need to create certain positions are made in the faculties. Competitions for elected academic positions are announced openly. Information about the competition, including job tasks, is published on the UL website, as well as in the official publication "Latvijas Vēstnesis". Any person who meets the requirements of the Law on Higher Education Institutions can apply for the competition.

Applicants for academic positions are required to conduct an open lecture, which is evaluated by two reviewers who give their opinion. The election procedure is carried out either by the decision-making body of the corresponding structural unit (in the case of assistants, research assistants, researchers, leading researchers, lecturers, and teachers – by the faculty council), and in the case of associate professors and professors – by the council of professors of the corresponding field. Elections must take place no later than three months from the date of the competition announcement.

According to the regulations of the University of Latvia, the minimum requirements set for all applicants for academic positions are defined, i.e., knowledge of the national language in accordance with the requirements of regulatory acts, knowledge of foreign languages at a level necessary for fulfilling the duties of an academic position and continuous improvement of one's academic and scientific qualifications. The other requirements differ depending on the specific academic position, for example, in order to apply for the position of assistant professor, a doctoral

degree is required, while for associate professors these requirements are even higher, i.e., one must have significant academic and pedagogical experience, a wide number of publications and experience in participating in scientific projects.

If, following the proposal of the structural unit, the Senate decides not to announce a competition for the position, a guest lecturer may be hired, while if a lecturer is more suitable for the development plans and needs of the faculty, a contract is concluded with this lecturer for a certain period (usually for the duration of conducting the course). In these cases, decisions related to the selection, interviewing, and hiring of candidates are made by structural units, i.e., faculties. In these cases, is only control is centralized, which ensures that the remuneration set by the structural unit complies with internal and external regulatory enactments.

The Rector of the University of Latvia concludes an employment contract with the person elected to the academic position for the entire term of the election, with the possibility for professors and associate professors to switch to an open-ended contract.

**In the reporting period, one professor, 9 associate professors and 10 assistant professors were elected to academic positions for the first time. The faculty does not practice election to academic positions of candidates without a doctoral degree. A total of 49 teaching staff were elected to academic (pedagogical) positions at the end of the reporting period. Thus, over the course of 6 years, one-fifth of the elected teaching staff has gained newcomers, while another one-fifth has been elected to higher academic positions. This pace of development is sufficient to renew the composition of all elected teaching staff within 30 years.**

**2.3.6. Specify whether there are common procedures for ensuring the qualification of the academic staff members and the work quality in place and provide the respective assessment thereof. Specify the options for all teaching staff members to improve their qualifications (including the information on the involvement of the teaching staff in different activities, the incentives for their involvement, etc.). Provide the respective examples and specify the way the added value of the possibilities used for the implementation of the study process and the improvement of the study quality is evaluated.**

The UL  Strategy 2021-2027 emphasizes that the goal of a development and excellence-oriented personnel policy is to ensure the development, growth and renewal of academic and general personnel, create a performance-based personnel management system that will also include competitive and motivating personnel remuneration, improve academic career development opportunities for staff, create a system for attracting local and foreign academic staff, as well as new talent, and promote international mobility.

The professional development of the academic staff of the University of Latvia is organized in accordance with the Regulations of the Cabinet of Ministers of the Republic of Latvia No. 569 of 11.09.2018 *Regulations on Necessary Teacher Education, and Professional Qualifications, and Procedure for the Improvement of Professional Competences,* paragraph 16 of which states: “Until the end of the term of election to the academic position, university and college educators must complete professional development programmes on innovations in the higher education system, university didactics or educational work management in the amount of 160 academic hours (including at least 60 contact hours). Professional development may include international mobility

and participation in conferences and seminars, which is confirmed by the submitted documents", which is compliant with the purpose of professional development as well as the Regulations of the Cabinet of Ministers No 129 of 25.02.2021 *"Procedure for evaluating the scientific and pedagogical qualifications or artistic creative work results of an applicant for the position of professor or associate professor and an existing professor or associate professor".*

Qualification requirements and tasks of UL academic staff are included in the Regulations on academic and administrative positions at the University of Latvia(only in Latvian), while the quality/performance of the academic staff of the UL is evaluated in connection with *UL academic work remuneration regulations (UL Senate decision No. 14 of 30.05.2016)* and *Regulations on determining the remuneration of scientific personnel of the University of Latvia (only in Latvian)(LU Senate decision No. 71 of 27.01.2020).*

UL Academic Department, Adult Pedagogical Education Centre (APEC) of the UL Faculty of Pedagogy, Psychology and Art (FPPA) provides informative, consultative, and methodical support to UL lecturers in the field of university didactics on a daily basis. UL FPPA APEC offers the academic staff the opportunity to learn the professional development programme "Higher education didactics: modern theories and practice", as well as further education programmes "Pedagogical aspects of study programme development in higher education institutions", "Professional development of student curator competence", etc.

After completing the life-long learning programme "Methodology for formulating and evaluating learning outcomes", programme directors and academic staff update their study courses and map the results of study programmes and study courses.

The UL academic staff can supplement their English language skills in the further training programme of the UL Faculty of Humanities Centre for Applied Linguistics "Improving Academic Staff's Scientific and Academic Capacity in English".

Young lecturers and doctoral students of various UL doctoral study programmes are more and more actively using the opportunity to learn the further training programme "Introduction to the work of a lecturer" every spring semester.

To promote the collegial learning of lecturers and the recognition of good practice in pedagogical work, the further training programme "Promoting the collegial learning experience of academic staff" has been developed and implemented, in which the academic staff carry out collegial internships, thus the targeted exchange of pedagogical experience of lecturers is promoted, and the development of UL as an organization that learns.

Lecturers who work with first-year students are designated as a special target group in the further training of lecturers at UL, therefore they are offered the further training programme "Professional development for work with first-year students".

Lecturers especially appreciate further training programmes for the opportunity to model the study process, try out new teaching methods, and share experiences with each other.

With the funding of the European Union, in the period from 2018 to 2022, several training programmes for lecturers have been implemented:

1. Online learning development and digitization of learning content (target group – academic staff),
2. Innovations for improving the quality of the learning process (target group – academic staff),
3. Academic honesty (target group – directors of degree programmes and study programmes).

All the programmes have been developed by analysing the professional development needs of

lecturers in the context of higher education development trends. Within the framework of the implementation of the professional development system of the academic staff of the University of Latvia, the Department of Studies of the University of Latvia conducted an electronic survey of the UL academic staff, thus gaining information on the current professional development needs of the lecturers of all the faculties, as well as several lecturers expressed their willingness to participate in the development of further training content and offering it to their colleagues in accordance with professional and didactic development needs.

After the implementation of each programme, a survey of its participants and evaluation of the results is carried out. Participation in further training programmes is voluntary for lecturers or with a recommendation from the faculty management. It is typical that the faculties also organize thematic seminars for their academic staff on topics relevant to the development of lecturers.

Professional development activities of the academic staff of UL were included in the Academic Staff Development Plan of the University of Latvia for 2018 – 2020 and are included in the Academic Staff Development Activities Plan of the University of Latvia for 2018-2023 (see Appendix II-22 (only in Latvian)).

In order to identify the professional development needs of the academic staff of the UL in the field of pedagogical activity, the UL Department of Studies at the end of 2017 and the study development and management improvement programme of the University of Latvia in the 1st quarter of 2020, as well as in the spring of 2021, carried out a survey among the academic staff, incl. heads of degree programmes and directors of study programmes, the results of which were taken into account when developing a training plan for the development of academic staff competencies, also within the framework of 1st phase “Renewal of academic staff and improvement of competences at the University of Latvia”, 2nd phase “Motivated, modern and competitive academic staff of the University of Latvia degree programme “Education, pedagogy and sports”” and 3rd phase “Strengthening the capacity of UL doctoral studies in the new doctoral study model ” of the project’s operational programme “Growth and employment” 8.2.2. in order to effectively plan and ensure the improvement of academic staff competencies. Planned achievable results until December 2023:

- an improved system of attraction and recruitment of academic staff of the University of Latvia,
- the average age of teaching staff reduced, and the age structure approaches the EU average level[1], reaching the indicator that at least 1/3 of the academic staff is in the age group from 35 to 49 years,
- improved indicators of scientific activity,
- developed and implemented a system model for renewal and succession of academic and scientific personnel,
- developed and implemented a professional development system for the UL academic staff.

When planning the renewal and development of the academic staff, the UL pays equal attention to the identification of the most capable students in the UL study programmes and their motivation to engage in academic work already during their studies (related to both teaching and research). In this context, UL has developed the requirements and selection conditions for the recruitment of new doctoral students within the 1st phase “Renewal of academic staff and improvement of competences at the University of Latvia", 2nd phase “Motivated, modern and competitive academic staff of the University of Latvia degree programme “Education, pedagogy and sports”” and 3rd phase “Strengthening the capacity of UL doctoral studies in the new doctoral study model” (the purpose of the specific support “To strengthen the higher education institution in the areas of strategic specialization of the academic staff”) within the project activity programme “Growth and

employment" 8.2.2.:

1. A doctoral student studying in the last year of an accredited doctoral study programme, as well as a Latvian national doctoral student studying outside of Latvia in an accredited doctoral study programme, and an applicant for a scientific degree,
2. Successfully acquisition of the required number of credit points in the first two/three years of studies/ for a scientific degree applicant – successfully completed doctoral studies,
3. Participation in an international scientific conference with a presentation/report,
4. Publication of at least one scientific article in an international publication,
5. English language skills at least at C1 level,
6. Successful completion of the doctoral exam in English,
7. Positive feedback from the thesis supervisor about the doctoral student as a potential lecturer,
8. Leadership traits and interest in UL research and course teaching.

Thinking about the renewal and development of foreign academic staff, UL has developed requirements and selection conditions for attracting foreign academic staff:

1. Persons who, during the previous five years, were employed in an academic position at one of a foreign accredited higher education institutions,
2. A doctoral degree in the relevant field of science or an equivalent doctoral scientific degree,
3. Scientific and academic work experience relevant to the position,
4. Ability to work in the e-study internet environment,
5. Participation in at least three international conferences with a presentation/report,
6. Published monographs and scientific articles, including in international editions with calculated citations (at least three),
7. Co-participation or participation in research projects,
8. Excellent knowledge of foreign languages, especially English, ability to use them in academic and methodical work.

For the successful and uniform implementation of study programmes at UL, a special training programme was developed for directors of degree programmes and study programmes, its implementation took place from 12.10.2021 to 28.10.2021, the training was conducted by an international accreditation expert from Poland and representatives of the Latvian Quality Agency for Higher Education.

**In the reporting period, within ESF project SAM 8.2.2 at the Faculty of Computing (the project continues until 2023, the resulting indicators may be achieved until 2024):**

1. **one degree applicant obtained a doctoral degree and was elected as an assistant professor,**
2. **three lecturers from foreign universities (Lithuania, Sweden and Turkey) worked in the degree programme and at the end of the reporting period are in working relations with the University of Latvia in the positions of visiting professor, visiting associate professor and elected associate professor, respectively (the arrival of 3 more visiting lecturers is expected in the autumn semester of 2022),**
3. **20 teaching staff members have improved their English language skills,**
4. **3 teaching staff members have completed leadership competence development for academic staff,**
5. **4 teaching staff members have completed scientific publication skills training for academic staff,**
6. **1 teaching staff members graduated from the digital skills development course for academic staff,**

7. **2 teaching staff members have completed commercialization training,**
8. **1 teaching staff member has completed the development of technological pedagogical skills for providing studies in the digital environment,**
9. **3 teaching staff members have completed the Moodle e-learning environment training,**
10. **6 teaching staff members have completed public speech training,**
11. **1 teaching staff member have completed remote lesson planning courses training,**
12. **1 teaching staff member has completed the practical advice while working in the digital environment,**
13. **4 teaching staff members have completed internship in computer system development in commercial companies (100 hours).**

**As part of a state-funded project (unofficial name - "Project 3000"), 6 teaching staff members have studied for one semester each at the New York State University at Buffalo in the USA (2 more teaching staff members are going to the USA in the 2021/2022 academic year).**

**A further 11 teaching staff members have updated their qualifications elsewhere.**

**There has not been such a large-scale promotion of the growth of teaching staff in the recent past.**

[1]Eurydice report "Modernisation of Higher Education in Europe: Academic Staff – 2017"

**2.3.7. Provide information on the number of the teaching staff members involved in the implementation of the relevant study programmes of the study field, as well as the analysis and assessment of the academic, administrative (if applicable) and research workload.**

**The teaching staff involved in the degree programme meet the requirements set forth in external legal acts. Since 2015 only Doctor of Science are elected to academic (pedagogical) positions.**

In 2021, a total of 90 teaching staff members taught in all study programmes, moreover, teaching staff members of the Faculty of Computing were elected to 45 academic positions (see Appendix II-11).

In undergraduate studies, study courses were conducted by 18 professors, 11 associate professors, 17 assistant professors, 4 non-elected academic doctors and 11 masters (including one economic professional).

In the Master's degree programme, 20 professors, 8 associate professors, 8 assistant professors, 2 non-elected doctors, 2 masters (in the Bioinformatics sub-programme, teaching staff of the Faculty of Biology) conducted the study courses.

Only professors have worked in doctoral studies.

The data in Appendix II-17 show that practically all teaching staff in the degree programme have also been involved in research work (only a few economics professionals have no scientific publications). It should be noted that this research work is carried out not only in the Faculty of Computing, but also in other faculties of the University of Latvia, as well as in the UL Institute of

Mathematics and Computer Science and the Institute of Electronics and Computer Sciences. Due to the protection of personal data, data is not available for a detailed analysis of workloads, not only for research work, but also the analysis of the pedagogical work of employees of other faculties and institutes outside the Faculty of Computing.

It can be roughly estimated that 45 full-time equivalent teaching staff were involved in the implementation of study programmes, on average one per every 15-20 students. This proportion is sufficient.

The academic and research load of the teaching staff is balanced in the sense that every faculty teaching staff member can agree with the dean on full-time or part-time work, also determining the proportions of the teaching and research workload. The peculiarity of Latvia's academic organizational system is that pedagogical and research work can be carried out in legally independent institutions. This has both positive and negative consequences. On the one hand, it is possible to involve high-quality academic or economic professionals in the study work for conducting individual study courses, thus expanding the subject matter of the study programmes. On the other hand, these employees of other institutions are rarely involved in work outside the direct teaching of study courses, and their research results cannot be included in the achievements of the degree programme as they are not financed from the funds of the degree programme. Thus, the sum of the research results of the degree programme turns out to be significantly lower than the sum of the research results of the teaching staff involved in the degree programme.

The proportionality of the academic, administrative and research workload of the teaching staff is considered as positive.

The Dean and Vice–Dean have the largest administrative workload (0.5 load). The administrative workload of the programme directors reaches 0.3 and is compatible with the tasks of a lecturer and researcher. Most of the teaching staff are mainly employed in teaching work, the workload mainly consists of classes, students' tests, consultations, improvement of study courses and participation in the supervison of final study thesis. Faculty members usually are additionally elected to a scientific position as leading researchers or researchers. The intended tasks of teaching and research work shall be balanced and form a positive link between teaching and research in the work of lecturers.

Basic information about the teaching staff involved in the implementation of the degree programme, the resume of the teaching staff (in Curriculum Vitae Europass format), a statement signed by the head of the field of study that the knowledge of the state language of the teaching staff involved in the implementation of the study programme corresponding to the degree programme complies with the regulations on the extent of knowledge of the state language and the procedure for testing the state language proficiency for the performance of professional and work duties are included in **Appendix II-12, II-13, II-13a.**

### 2.3.8. Assessment of the support available for the students, including the support provided during the study process, as well as career and psychological support by specifying the support to be provided to specific student groups (for instance, students from abroad, part-time students, distance-learning students, students with special needs, etc.).

The University of Latvia provides academic support, career development support and psychological

support for students.

The purpose of academic support is to provide students with information and advice on study issues throughout the study period. Academic support includes the implementation of the support programme for the first year of study, consultations on the study process (content of the study programme, choice of study courses, documents regulating the study process of the UL), informing about the consultations of course lecturers, consultations and seminars on learning study skills (taking notes, reading scientific literature, active listening, exam anxiety, time management and using library and internet resources).

Academic support for students in academic matters is provided centrally by the UL Study Service Department and the responsible persons in the faculties: the study programme director, curator, mentor, desk clerk, study course lecturers, as well as the Student Council and student self-government of the faculties. Consultations on the use of library and Internet resources are provided by the UL Library. Table II-7 shows examples of the main tasks performed by student support units/staff.

*Table II-7. Examples of main tasks performed by student support units/staff*

| **Structural units/personnel** | **Main tasks** |
|---|---|
| Faculty student self-government | At self-government's discretion: Represents and defends the rights and interests of faculty students in matters of academic, material, and cultural life. Contributes to the improvement of the study process of the faculty and helps students to solve their academic and social problems. Organizes both educational and extracurricular events. |
| Curator | Informs students about current events in the study process, provides individual support to those students who have difficulty fitting into the academic environment of the University of Latvia and initiates adaptation measures. |
| Desk clerk, study advisor | Provides study consultations, helps with daily issues related to the study process, organizes study records, advises on the information system of the University of Latvia (LUIS). |
| Mentor | A senior student who helps first-year students adapt to the study environment and shares his or her experience. |
| Student Council (SC) | The purpose of SC is to represent the students of the University of Latvia and defend their rights and interests. SC represents the interests of students in academic matters by electing student representatives to the decision-making bodies of the UL, examining issues related to the study process and its improvement. |

| | |
|---|---|
| Director of the study programme | Organizes and manages the development of the study programme in accordance with the requirements of the specific science or economic sector, cooperates with employers and internship in study content-related matters, evaluates and approves the individual study modules and individual study plans chosen by the students, etc. |
| Study Services Department | Organizes the admission process, advises faculties and students on mobility programmes, study, social and cultural issues, advises and organizes training on career issues. Organizes student adaptation measures, provides training of curators, mentors, organizes cooperation with employers, etc. |

The purpose of career development support is to us different support measures to give an individual the opportunity to identify their interests, abilities, skills, and experiences throughout their lives, to make informed decisions about the choice of education and/or profession, and to organize and manage the learning of their individual life paths, work and other areas. Career development support is provided by the Career Centre of the UL Study Service Department in cooperation with the faculties.

The Career Centre provides the following services to students:

- Individual counselling on the choice of future studies and profession, development of an individual career plan, provision of support for the transition between different levels of education and from education to the labour market,
- Seminars on the development of career planning skills ("Improving career planning and development skills", "My first job interview", "Stress management", etc.),
- Internet resource – Career Centre website (information available in both Latvian and English) https://www.karjera.lu.lv/ and https://www.karjera.lu.lv/eng/ provides up-to-date information on career planning issues, information on professions and the labour market,
- Electronic resource "E-career" https://ekarjera.lu.lv/lv/login, which provides an opportunity for students to find an internship and a job in a short time by placing their CV in the database and for employers to find employees by placing information about vacancies in the company in the database.

Psychological support is provided by the Study Service Department. A psychologist-consultant provides psychological support to students in solving any personal and educational problems that arise during their studies (relationship problems, conflict resolution, emotional difficulties). The psychologist provides individual and telephone consultations.

Special events are held for abroad students in cooperation with ESN (*Erasmus Student Network*) to get to know local students, Latvian culture and traditions.

In cooperation with "Apeirons" association, infrastructure survey has been carried out on the accessibility for persons with special needs. The obtained results are considered both in the construction of the new infrastructure and in the creation of facilities of study programmes.

**The undergraduate studies of the Faculty of Computing take place at 19 Raiņa Boulevard. The building has a built-in elevator up to the 3rd floor, which allows access to study spaces for persons with mobility impairments. Several such persons have successfully studied at the faculty. A deaf-mute guy – an excellent programmer – also graduated from the faculty. There are similar elevators in the UL Academic Centre, where separate classes are held in the MSP sub-programme "Bioinformatics" and in the**

**DSP sub-programme “Mathematics”.**

One of the computer classrooms/laboratories is equipped with equipment for making prototypes used for the study process – research: 3D scanner, 3D printer, Festool tools – trimming saw, plunge saw, electric planer, router/trimmer with modular multifunctional workbench, stationary drill, soldering station for microelectronics. Moreover, various types of sensors are available for laboratory work, i.e., air quality (Aranet4Pro), Harvest ph, pressure, light sensor, KIO RTLS 2D/3D indoor positioning system tool sets for object tracking.

The DF LAB project studio helps students carry out various types of practical research and laboratory work during or outside of their studies. The following technical resources are available in the project studio:

- 3D printers: MakeBot and Ultimaker2 – for making parts of different sizes,

- Speedy400 laser cutter,

- Soldering station,

- 3D virtual reality headsets,

- 25 psc. Raspbery P4 microcomputers for controlling electronic devices of various projects, including monitor wall control,

- 4 psc. of 43-inch Philips touch monitor wall that works with the support of an Android operating system control app. It is used for large-format video broadcasting – modelling,

- 20 psc. of 23 inch Dell monitor wall with Raspberry P4 microcomputer for large format video control and streaming.

The available infrastructure at 19 Raiņa Boulevard includes laboratories for computer engineering and visual perception research. Doctoral students also have access to European research infrastructures in which UL participates, for example CLARIN (Common Language Resources and Technology Infrastructure) in the field of computational linguistics.

**The degree programme has been identifying the support for students and a functioning support system has been established.**

**As it has already been established in previous review periods that the biggest problems for first-year students are insufficient knowledge in high school mathematics, all first-year students with a high school centralized exam mathematics grade below 7 are offered to write a diagnostic test. Those who have passed the exam below a certain level must participate in additional remedial classes until an acceptable level is reached in the repeated diagnostic test. For example, in 2018, there were 151 participants of the remedial courses out of 260.**

**In solving everyday problems, students are supported by study methodologists, but in non-standard cases by study programme directors and the dean. The same support is provided to foreign students in English.**

**The Student Council of the faculty also participates in student support. In 2021, the head of its academic commission gave the following description in December (quoted in full):**

“**The mentor programme maintained by the UL SC allows students who are starting their studies to apply to a mentor or a senior student. The purpose of the programme is to promote the inclusion of first-year students in the study environment. The mentor**

**helps students learn about the procedures of the faculty and the university as well as answers their questions. Mentors can also take a 2-credit worth C course "Psychological Aspects of Peer Mentoring", where they can learn the principles and approaches of mentoring.**

**The Faculty Student Self-Government (FSS) is a student-elected, independent university institution of student representation. FSS participates in representing the university by electing student representatives in further institutions such as UL SC, Faculty Council, and others. FSS helps to elect course elders, who represent the opinion of their course in various instances and help them in solving problems. By popularizing the students' opinion, monthly meetings of the dean with the seniors of the course are held, where students can express their problems, questions, and comments to the faculty management for their further consideration. The self-government helps in the implementation of the mentor programme by organizing adaptation and academic events for the programme participants, as well as monitors its activity. The FSS is divided into the Academic, Communication and Culture and Sports Commission through which its operation is divided and optimized."**

## 2.4. Scientific Research and Artistic Creation

**2.4.1. Description and assessment of the fields of scientific research and/or artistic creation in the study field, their compliance with the aims of the higher education institution/ college and the study field, and the development level of scientific research and artistic creation (provide a separate description of the role of the doctoral study programmes, if applicable).**

**The scientific and applied research of the degree programme corresponds to the objectives and scientific level of the UL and the degree programme.** This is evidenced by the projects implemented in the scientific laboratories of the Faculty of Computing **according to UL's priority line of research "Innovative information technologies"** (see CF websites https://www.df.lu.lv/en/ section Research) and publications in editions that are indexed in respective categories of *Web of Science* or *SCOPUS*, which anyone can easily verify by logging in to *SCOPUS* and entering the surname and initials of a specific person. As it is well known, publication indexing on *Web of Science* or *SCOPUS* confirms that it publishes only articles that correspond to the current level of scientific development. This level is also included in the Regulation of the Council of Ministers No. 129 (February 25, 2021) "Procedure for evaluating the scientific and pedagogical qualifications or artistic creative work results of an applicant for the position of professor or associate professor and an existing professor or associate professor".

Teaching staff of the degree programme also conduct research in the UL Institute of Mathematics and Computer Science, Institute of Electronics and Computer Science, etc.

The UL has developed mechanisms to promote the involvement of teaching staff in scientific research, they function and are effective in such sense that the Academic Department regularly sends messages addressed to all UL researchers about the possibility of applying to Latvian and international project competitions. Since such applications must contain in-depth scientific information, their preparation rests largely on the shoulders of research laboratory managers,

depriving them of time for creative work.

At the level of the Faculty of Computing, a procedure has been implemented to stimulate the involvement of teaching staff in scientific research by diverting part of the study funding and the state science budget funding for writing scientific publications.

There is no doubt that scientific research is stimulated by the requirements of the Cabinet of Ministers for the evaluation of professors and associate professors.

The doctoral study programme is substantially based on the research conducted in the mentioned three institutions and is one of the two most productive sources of doctoral degrees in the given degree programme in Latvia (about 40%).

A more detailed presentation can be found in the description of doctoral programme`s section 3.4.4 of this document, as well as in Appendix II-12 of the teaching staff's CV.

**Taking into account the chronically and acutely insufficient state funding for science, postdoctoral studies and scholarships for doctoral students, which is regularly emphasized by foreign experts, the research productivity of the degree programme can be recognized as at least satisfactory.**

### 2.4.2. The relation between scientific research and/or artistic creation and the study process, including the description and assessment of the use of the outcomes in the study process.

**The connection of scientific research of the degree programme with the study process is defined, ensured and effective.**

In the degree programme, scientific and applied research is closely connected with the study process. It is common for full-time teaching staff members to teach at least one required course as well as one or more elective courses. The latter are usually from the teaching staff member's research area. For example, prof. Andris Ambainis and assoc. prof. Aleksandr Belov, who work in theoretical quantum computing research, in addition to mathematics courses, teach courses in quantum computing. Professors Jurģis Šķilters, Guntis Bārzdiņš, Jānis Bičevskis, Ģirts Karnītis, Laila Niedrīte, Inguna Skadiņa, Juris Vīksna and other teaching staff members also include their research results in the study courses. The results of the work of the Information Technology, Telecommunications and Electronics Subcommittee of the Terminology Commission of the Latvian Academy of Sciences, which have its seat in the Faculty of Computing, are immediately implemented in the study process.

**Scientific research and its results are integrated into the study process in study programmes of all levels**. This is natural process, as most full-time teaching staff members teach at all three study levels and use the results of their research in the relevant study courses. It is understandable that the inclusion of such information increases with the level of study.

Within the limits of financial possibilities, students are also involved in the projects, mainly at the doctoral level. For example, at the time of writing this document, 14% of the employees of the Faculty of Computing were students.

All final theses are developed on current research topics. For more details see bachelor and master programme`s section 3.2.4. and doctoral programme`s section 3.2.6.

**2.4.3. Description and assessment of the international cooperation in the field of scientific research and/or artistic creation by specifying any joint projects, researches, etc. Specify those study programmes, which benefit from this cooperation. Specify the future plans for the development of international cooperation in the field of scientific research and/or artistic creation.**

International cooperation in scientific research is ensured and strategically developed within the degree programme and corresponding study programmes. This cooperation takes place within the framework of the degree programme and its programmes.

International scientific cooperation takes the form of:

1. joint scientific projects mainly in the field of theoretical quantum computing (with the Centre for Quantum Software "QuSoft" in Amsterdam and the Paris Centre for Quantum Computing, each of which includes several universities and institutes of the corresponding city; during the reporting period there have been 2 joint research projects with these institutions within the EU programme "Horizon 2020" and 4 more joint project applications to EU programmes (one of which has been approved); other institutions with which there have been joint projects or approved project applications are Free University of Brussels, University of Bristol, University of Copenhagen, Free University of Berlin, Institute of Telecommunications (Lisbon), National Institute for Nuclear Physics (Italy), Zuse Institute Berlin (Berlin), Wigner Institute (Budapest) and the company "Atos Bull" (France); several Master's and doctoral students are involved in these research projects;
2. jointly organized scientific conferences (biannual DB&IS with Vilnius University, Vilnius Gediminas Technical University, Tallinn Technical University and Tartu University);
3. the annual Estonian-Latvian Computer Science Days,
4. the jointly published international scientific journal "Baltic Journal of Modern Computing" (with Vilnius University and several Latvian universities),
5. the cognitive sciences seminar organized jointly with Riga Stradiņš University, with the participation of prominent experts of the field from abroad, such as prof. Baingio Pinna, University of Sassari, Italy; prof. Elizabeth R. Chrastil/Alina Tu (University of California, Irvine, USA); Dr. Iva Brunec (Temple University, University of Pennsylvania, USA); Prof. Aina Puce (University of Indiana, Bloomington, USA); Dr. Jamie A. Ward (Goldsmiths College, University of London, United Kingdom).

After the start of dual award studies, opportunities for scientific cooperation with the University of Lincoln in the United Kingdom are being considered.

There is a jointly organized annual international conference MMA (Mathematical Modelling and Analysis) (together with Vilnius Gediminas Technical University, Vilnius University, Tartu University and Tallinn Technical University).

The scientific conference PODE2016 (Progress on Difference Equations, Riga, 2016) was organized jointly with ISDE (International Society for Difference Equations); the scientific conference ESCIM2018 (European Symposium on Computational Intelligence and Mathematics, Riga, 2018) was organized jointly with Hungarian Fuzzy Association, University of Cádiz.

The academic mobility measures are implemented by providing lectures/seminars/consultations for doctoral and Master's students (e.g., University of Ostrava, Slovak University of Technology in Bratislava, University of the Balearic Islands).

The doctoral student is involved in the activities of international organizations (e.g., EUSFLAT (European Society for Fuzzy Logic and Technology), EURO (European Operational Research Societies), ISDE (International Society for Difference Equations)).

**It can be concluded that there is quite extensive cooperation at the Baltic, European and global level.**

### 2.4.4. Specify the way how the higher education institution/ college promotes the involvement of the teaching staff in scientific research and/or artistic creation. Provide the description and assessment of the activities carried out by the academic staff in the field of scientific research and/or artistic creation relevant to the study field by providing examples.

The foundation of LU's international reputation and competitiveness is based on scientific advances and their integration into studies. Basic and applied research of the study direction conforms to the objectives of the LU and the study direction and the level of scientific development. This is evidenced by projects carried out by teachers and researchers involved in the study (see Annexe II-16) and publications in editions indexed in the Web of Science or SCOPUS (see Annexe II-14). With the initiative of Professor Juris Borzovs of the Faculty of Computing, since 2013 the University of Latvia, in collaboration with Vilnius University in Lithuania, the Institute of Mathematics and Informatics of the University of Latvia, the Latvian University of Agriculture, the University of Liepaja and Vidzeme Higher School, publishes a scientific journal *Baltic Journal of Modern Computing* indexed in the Web of Science and SCOPUS. Since 1994 The Faculty of Computing, in collaboration with Vilnius University, Vilnius Gediminas Technical University, Tallinn Technical University and Tartu University, organizes an international scientific conference DB&IS every two years.

In essence, the course of study should be considered as an integrated transversal from various sectors of science and economy, such as information and communication technology, computer, computer science, discrete mathematics, bioinformatics, cognitive sciences, electronics, telecommunications, theoretical quantum computing, linguistic computing, etc. Teaching staff instructing in the study direction performs research work in the Faculty of Computing of the LU (including the Quantum Computing Centre (headed by Full Member of the Latvian Academy of Sciences, Prof. Andris Ambainis), the Laboratory of Perception and Cognitive Systems (headed by Prof. Jurģis Šķilters), the Lingvocomputer laboratory (headed by Dr Andrejs Vasiļjevs), the LU Institute of Mathematics and Informatics, SIA Tilde and SIA DATA Group, at the Institute of Computer Sciences and Electronics, and the Terminology Commission of the Latvian Academy of Sciences.

The following are the fields of research in which the teachers of the study direction operate:

Theoretical quantum computer science

Perceptual and cognitive sciences

Mathematics

Automated processing of natural languages

Deep machine learning

Automation of business processes

Autonomous computer systems

Wireless sensor networks

Cloud computing

Latvian ICT terminology

etc.

The Academic Department of LU provides support by regularly sending information to researchers about the possibilities to apply for international and Latvian research project competitions. It would be useful to obtain similar information on contractual works. Elected teachers are paid up to 200 hours per year from the study budget for the performance of research work.

In an international evaluation of scientific institutions in 2019, the Faculty of Computer Science, as part of the LU Natural Sciences Cluster, won 3 of 5 points in the overall ranking, while 4 of 5 points in the scientific quality ranking. The LU Institute of Mathematics and Informatics also obtained 3 in the same assessment and Institute of Electronics and Computer Sciences won 4. According to the evaluation methodology, this indicates a very good quality of science and institutions as strong international players. Theoretical quantum computer sciences, as well as interdisciplinary research into automated processing of cognitive sciences and natural languages, can be highlighted from the wide range of topics.

**Analysis**

During the reporting period, the academic staff involved in the degree programme published more than 1150 scientific articles, conference theses and articles to popularize science (the academic staff of the Faculty of Computing – more than 450), participating with presentations in at least 550 international scientific conferences (Faculty of Computing – more than 300). See **Appendix II-14, where the publications of the teaching staff of the degree programme are presented in order of importance. It should be noted that the publication tradition in the given degree programme is different from that of Natural Sciences – full-length articles are included in conference publications, while relatively fewer are published in journals.**

Thus, during the reporting period, one faculty member elected to an academic position at the Faculty of Computing on average participated in 6 international scientific conferences with a presentation and a published article and published an average of 5 scientific articles. For the study direction, these indicators are 6 and 9, respectively.

In Annex II-15 one can find a compilation of quantitative data on scientific and/or applied research activities relevant to the study direction during the reporting period, Appendix II-16, however, shows the participation of the teaching staff in research projects (in order of importance).

You can see a list of the results of the scientific activity of each teaching staff member involved in the degree programme in Appendix **II-17.**

**Considering the state budget funding for science, which lags behind the EU average by at least three times, these indicators can be considered at least satisfactory.**

**2.4.5. Specify how the involvement of the students in scientific research and/ or applied research and/or artistic creation activities is promoted. Provide the assessment and description of the involvement of the students of all-level study programmes in the relevant study field in scientific research and/ or applied research and/or artistic creation activities by giving examples of the opportunities offered to and used by the students.**

The association of LU scientific research with the study process is implemented in several ways:

• students (in particular masters and doctoral students) have opportunities to participate in research carried out by the academic staff of direction as participants in research, thus better familiarising the research process (see details of specific study programmes);

• students are involved in research work during the development of course work, bachelor's work, master's work and doctoral thesis, as well as the possibility to work in research projects in case of availability of adequate funding;

• teachers use the results of both their own and colleagues' research and insights in shaping study course content;

• academic staff members create new study courses based on theoretical knowledge and newly created knowledge developed in research projects.

The common principles of the LU are fully implemented in the study direction “information technology, computer hardware, electronics, telecommunications, computer management and computer science”. For example, several of the best students were involved in the scientific project “Modelling multilingual human-computer communication using artificial intelligence techniques.” Students supervised by Prof. Jānis Bičevskis and Prof. Juris Borzovs have presented the results of their Bachelor's and Master's works in international scientific conferences and published them in publications indexed by SCOPUS.

Students of Bachelor's and Master's studies programmes shall perform research activities by developing Bachelor's and Master's theses under the guidance of qualified academic and scientific staff. The scientific novelty is a mandatory part of Master's work. Every year, dozens of students receive the Letter of Recognition from the LU Rector for developing an excellent bachelor or master's job. For more details on the subject and assessments of Bachelor's and Master's works, see study programme section.

The results and findings of all research projects implemented by academic and scientific staff of the study direction (see Annexes II-16) are used for the creation and updating of the content of study courses. Prof. Guntis Bārzdiņš, for example, has incorporated the results of his research into the study course DatZ6056 Deep machine learning (4 credits).

For more detailed information regarding the utilisation of the results and findings of research projects implemented by academic and scientific staff of the study direction in the creation and updating of the content of study courses and the creation of new study courses, see study programme section.
**During the reporting period, at least 65 students published one or more scientific articles.**

**Overall – scientific research of the study direction is linked to the study process, the provision thereof is regular and efficient. Scientific research is integrated into the study process in all programmes of the study direction.**

**2.4.6. Provide a brief description and assessment of the forms of innovation (for instance, product, process, marketing, and organisational innovation) generally used in the higher education institution, especially in study field subject to the assessment, by giving the respective examples and assessing their impact on the study process.**

In order not to focus only on remedial studies for relatively weaker freshmen, **for almost 10 years we have been implementing so-called excellence studies** – https://www.df.lu.lv/en/studies/excellence-studies/ . They are intended for undergraduate and graduate students who want and are able to acquire more knowledge and skills in the time allotted for a specific study programme than the programme provides. Excellence studies are understood as a special, individually chosen study path within the existing study programmes.

The main goal of excellence studies is achieved as follows:

1. By in-depth teaching of course content, which can be implemented in different ways – at the teacher's discretion. The requirements for the content of courses of increased difficulty and the requirements for receiving high grades are determined by the subject instructor and are included in the specific course description.
2. With the opportunity for the most capable students to learn the simpler topics faster, devoting the time saved to learning more complex topics.
3. With participation in special seminars, ensuring their attendance throughout the study period.
4. By engaging in joint scientific or innovative projects with lecturers or leading IT specialists.
5. By cooperation with lecturers and IT experts (mentors), who offer students problems to be solved within the scope of their competence.

Excellence studies include:

- in-depth learning of study content,
- excellent student or i-student status, which gives certain privileges,
- certificate of excellence, which is issued by the faculty upon graduation from the study programme.

The certificate of excellence certifies the student's excellence in a part of the study programme, without requiring an excellent grade in all study courses, as is the case with the so-called red diploma (diploma with distinction). This motivates students who, during their studies, received an insufficient grade to obtain so called the red diploma in a separate study course. During the reporting period, the following masters received certificates of excellence: in 2013, one graduate of the Master's programme received the first FC certificate of excellence, in 2014 – one, in 2015 –

four, in 2016 – five, in 2017 – one, in 2018 – two, in 2019 – three, in 2020 – three, in 2021 – three. The certificate of excellence in undergraduate was obtained so far by: in 2014 – two, 2015 – one, 2016 – one, 2017 – one, 2018 – two, 2019 – two, 2020 – one, 2021 – five students.

## 2.5. Cooperation and Internationalisation

**2.5.1. Provide the assessment as to how the cooperation with different institutions from Latvia (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study field contributes to the achievement of the aims and learning outcomes of the study field. Specify the criteria by which the cooperation partners for the study field and the relevant study programmes are selected and how the cooperation is organised by describing the cooperation with employers. In addition, specify the mechanism for the attraction of the cooperation partners.**

The cooperation partners suitable for the degree programme and study programmes are selected based on several aspects, which are also reflected in the partner attraction mechanism that we use and want to use in the future, including (a) previous successful cooperation experience in research and academic cooperation, (b) the partner's suitability to any of the academic or research directions corresponding to the degree programme or study programmes, (c) mutual interest in forming sustainable cooperation, (d) the partner's research or academic qualifications (most of the partners are among the leading research or academic institutions in the world in their field).

The Faculty of Computing represents the University of Latvia in the professional associations LIKTA (Latvian Information and Communication Technology Association) and LATA (Latvian Open Technologies Association), Latvian IT cluster, as well as SIA "IT Kompetences centrs". A member of LATA board is a member of the Faculty Council. Five experienced representatives of commercial companies work in the council of the degree programme.

Faculty of Computing on behalf of UL together with UL Institute of Mathematics and Computer Science, University of Agriculture of Latvia, University of Liepāja and Vidzeme University of Applied Sciences is a co-publisher of an open access electronic journal *Baltic Journal of Modern Computing* – https://www.bjmc.lu.lv/en/ , which is indexed in *Web of Science* and *SCOPUS*.

In cooperation with Riga Technical University, since 1994, every six years, we have been organizing a biennial scientific conference in Riga *International Baltic Conference on Digital Business and Intelligent Systems* (DB&IS). In 2022, the conference was held in Riga again – https://dbis2022.lu.lv/ . In 2016, UL FC together with UL Institute of Mathematics and Computer Science and Tilde organized the Baltic HLT conference, which takes place every other year in one of the Baltic countries (in cooperation with Vytautas Magnus University and University of Tartu).

**Within the degree programme, there is a unified system for the provision and organization of internships**. Every year, all undergraduate students go on a mandatory 18-week internship in ICT companies or relevant departments of institutions (more details about internship – https://www.df.lu.lv/en/studies/internship/ ; for internship contracts, see Appendix II-18).

Also, everyone develops and defends qualification papers/projects. The majority of the qualification commission is formed by dozens of professionals from the ICT industry; however the reviewers and

chairmen and deputies of the commissions are only industry professionals. At the end of the defence of the qualification works, the programme director identifies the evaluations and recommendations of the commission members.

The successful cooperation with the commercial companies of the sector is also confirmed by the employer survey conducted in 2021. Out of 30 sent questionnaires, 14 were returned without any reminder or special plea (see Appendix II-10). In the employers' survey about the graduates of the Faculty of Computing, two findings dominate:

1) After a short training/introduction to the workplace, they were able to perform their job responsibilities (5).

2) They were well theoretically prepared, but they had insufficiently acquired practical skills (4).

For us, educators, the high assessment of graduates' ability to acquire new knowledge and skills by employers is important. Comments worth noting: "Graduates who have started work demonstrate high level of theoretical knowledge and also practical work skills, thanks to the UL internship policy. After a short training and on-the-job training, they are ready to do independent work."

We need to highlight that **for the past 5 years, in a survey supported by the Employers' Confederation of Latvia, the Bachelor's programme "Computer Science" has taken the first place in absolute evaluation as the most recommended for high school graduates** (see https://www.prakse.lv/top (only in Latvian)).

Research projects have been implemented in cooperation with SIA Tilde, SIA DIVI group, Accenture Latvia, Scientific Institute of VSIA "Paula Stradiņa Klīniskā universitātes slimnīca", Latvian Biomedical Research and Study Center.

The financial support of Latvian and foreign legal and natural persons to the faculty and the events taking place there, such as the scientific conferences DB&I''2016, CCC'2017, the international summer school ESSLLI'2019, the preparation of student programming teams and participation in the world competition ICALP, should not go unmentioned. During the reporting period, financial support was provided by SIA "Mikrotīkls", Accenture Latvia, SIA "SQUALIO cloud consulting", SIA "Datakom", VISMA group companies in Latvia, Honorary Consul of Latvia in the state of Illinois Roberts Blumbergs, SIA "EazyOne", AS "RIX Technologies", SIA "TestDevLab", SIA "ZZ Dats", Honorary Consul of Latvia in Michigan Andris Lācis, Galenieks family in USA, SIA "EazyBI", Baltic Child Neurology Association, SIA "WeAreDots", Association for Symbolic Logic, European Mathematical Society, Association for Computational Logic, Baltic-American Freedom Foundation, Polish Embassy in Latvia, US Embassy in Latvia, German Embassy in Latvia, SIA "Tilde", Baidu, Inc, Andrejs Eglīte, Tim Martin, Sarah Martin, Clive Cookson, Caroline Davidson, British Embassy Riga, The UK Science and Innovation Network , Valmiermuiža, Bliss Gelato, Innocent PRO/illy, Latvia BIO and especially Inese Luka-Indā, Charity organization "Friends of the University of Latvia".

Cooperation also takes place on an individual level. Its professors Juris Borzovs and Juris Vīksna are members of the promotion council at the Latvia University of Life Sciences and Technologies, while prof. Māris Vītiņš at Riga Technical University. Juris Borzovs is also a member of RTU professors council, while the respective council of UL includes professors from Riga Technical University, Latvia University of Life Sciences and Technologies and Institute of Transport and Communications.

Individual study courses at other universities are taught by: RTU Riga Business School prof. Leo Seļāvo, lecutrers Kalvis Apsītis and Valdis Vītoliņš, prof. Inguna Skadiņa taught in the Linguistics doctoral programme of the University of Liepāja and Ventspils University of Applied Sciences, Dr. Māris Alberts taught at Vidzeme University of Applied Sciences, Dr. Mārcis Pinnis taught at EKA University of Applied Sciences. Several of our employees give lectures at the "Alfa" camp for

talented students every year. (https://www.visc.gov.lv/lv/jaunums/dabaszinatnu-joma-augstakos-sasniegumus-guvusie-skoleni-latvija-tiksies-izglitojosa-nometne-valka) (only in Latvian).

Unfortunately, the otherwise very good cooperation with Riga Technical University in the joint implementation of the parallel Bachelor's programme "Computer Science and Organization Technologies" turned out to be unsuccessful.

**2.5.2. Provide the assessment as to how the cooperation with different institutions from abroad (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study field contributes to the achievement of the aims and learning outcomes of the study field. Specify the criteria by which the cooperation partners suitable for the study field and the relevant study programmes are selected and how the cooperation is organised by describing the cooperation with employers. In addition, specify the mechanism for the attraction of the cooperation partners.**

The foreign cooperation partners suitable for the degree programme and study programmes are selected based on several aspects, which are also reflected in the partner attraction mechanism that we use and want to use in the future, including (a) previous successful cooperation experience in research and academic cooperation, (b) the partner's suitability to any of the academic or research directions corresponding to the degree programme or study programmes, (c) mutual interest in forming sustainable cooperation, (d) the partner's research or academic qualifications (most of the partners are among the leading research or academic institutions in the world in their field).

The Faculty of Computing represents UL in the international association "Informatics Europe" – https://www.informatics-europe.org/.

In the period from 2010 until 2017, prof. Juris Borzovs worked in the Accreditation Committee of the EQANIE agency (European Quality Assurance Network for Informatics Education) for quality assessment of European informatics programmes – https://eqanie.eu/gallery (see picture Accreditation Committee, April 2011).

Together with Latvian universities and Vilnius University UL participates in co-publishing of a magazine *Baltic Journal of Modern Computing*. The main co-editors are academician Gintautas Dzemyda from Vilnius University and academician Jāks Vilo from University of Tartu.

The biennial scientific conference DB&IS is alternately organized by UL and Riga Technical University, Vilnius University and Vilnius Gediminas Technical University, Tallinn University of Technology and University of Tartu.

In the field of quantum computing, there is a long-standing collaboration with the Quantum Software Centre "QuSoft" in Amsterdam and the Paris Centre for Quantum Computing, each of which includes several universities and institutes in the respective cities. During the reporting period, there have been 2 joint research projects with these institutions within the EU programme "Horizon 2020" and 4 more joint project applications in EU programmes (one of which has been approved). Other institutions with which there have been joint projects or approved project applications are Free University of Brussels, University of Bristol, University of Copenhagen, Free University of Berlin, Institute of Telecommunications (Lisbon), National Institute for Nuclear Physics

(Italy), Zuse Institute Berlin (Berlin), Wigner Institute (Budapest) and the company “Atos Bull” (France). Several Master’s and doctoral students are involved in these research projects.

Every year, UL and Estonian universities (University of Tartu and Tallinn University of Technology) alternately organize Estonian-Latvian Computer Science Theory Days, i.e., a scientific conference with 40-60 participants.

An agreement has been concluded with the University of Lincoln (United Kingdom) on the dual award studies (see Appendix II-19) and the first six students started the studies in autumn 2021.

### 2.5.3. Specify the system or mechanisms, which are used to attract the students and the teaching staff from abroad. Provide the assessment of the incoming and outgoing mobility of the teaching staff in the reporting period, the mobility dynamics, and the issues which the higher education institution/ college faces with regard to the mobility of the teaching staff.

A system and procedures have been established for the attraction of foreign teaching staff and students within the degree programme, the procedures are effective and contribute to the improvement of the study process.

Prospective foreign students, as they themselves indicate on the admissions platform DreamApply, obtain information about study programmes mostly from the website www.studyinlatvia.lv, UL and faculty websites (presumably through a browser) or from acquaintances studying in Latvia. Numbers in Table II-8 (see also Appendix II-28) shows a convincing growing trend, but it could be stopped by restrictions caused by Covid-19.

During the reporting period, also using the funding of ESF project SAM 8.2.2., courses in the degree programme were taught by a Turkish citizen (as an associate professor elected at the University of Latvia), a visiting professor from Vilnius University and a visiting associate professor from Stockholm University. In the autumn semester 2022 (outside the reporting period), within the framework of the mentioned project, the full-time work of 3 foreign (Belarus, Brazil, Pakistan) visiting lecturers is planned, which, in case of mutual consent, can develop into a longer-term cooperation leading up to the election to an academic position at the UL.

*Table II-8. Foreign students and teaching staff*

| | | 2015/2016 | 2016/2017 | 2017/2018 | 2018/2019 | 2019/2020 | 2020/2021 |
|---|---|---|---|---|---|---|---|
| | **Total number of foreign students** | 8 | 6 | 8 | 17 | 62 | 62 |
| | incl. for obtaining a Bachelor’s degree | 2 | 3 | 2 | 8 | 25 | 34 |
| | incl. in exchange programmes (Bach./Mast.)* | 6 (5/1) | 3(3/0) | 6(5/1) | 25(22/3) | 37(27/10) | 28(16/12) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Total number of teaching staff** | 3 | 4 | 3 | 4 | 8 | 3 |
| | permanent | 3 | 3 | 3 | 3 | 3 | 3 |
| | exchange programmes | 0 | 1 | 0 | 1 | 5 | 0 |

*Including visiting students who have taken a course in the programme of the degree programme.

The number of outgoing students (Erasmus+ programme) (see Table II-9) showed an increasing tendency, but it was stopped by the restrictions of Covid-19. During the reporting period, all successful students who applied for exchange studies were given such an opportunity. However, it must be stated that both in absolute numbers and in relation to other faculties of the University of Latvia, the number of outgoing students is small. This is understandable as in the second year of study, students have internships, at the end of which most of them already get their first employment contracts, which they do not want to lose.

Teaching staff also have a similar problem, as many employers have main jobs in scientific institutes or commercial companies or are involved in research projects. Good result in the study year 2018/2019 (see Table II-9) was achieved thanks to state funding, which allowed teaching staff to spend a semester at the University of Buffalo in the USA.

*Table II-9. Outgoing students and teaching staff*

| | 2015/2016 | 2016/2017 | 2017/2018 | 2018/2019 | 2019/2020 | 2020/2021 |
|---|---|---|---|---|---|---|
| **The number of outgoing FC students** | 4 | 4 | 3 | 10 | 9 | 2 |
| 1st level prof. | 0 | 1 | 0 | 0 | 0 | 0 |
| Bachelor’s programme | 3 | 1 | 3 | 2 | 6 | 2 |
| Master’s programme | 1 | 2 | 0 | 8 | 3 | 0 |
| Doctoral programme | 0 | 1 | 0 | 0 | 0 | 0 |
| **The total number of outgoing FC teaching staff** | 0 | 2 | 2 | 7 | 4 | 1 |

**There is no doubt that the exchange of students and teaching staff, as well as the attraction of foreign teaching staff, internationalizes the study environment and provides new experiences for its development. Attracting teaching staff makes it possible to expand the thematic range of the study courses (for example, prof. Eric Schneider from Stockholm University teaches a study course in the field of his research “Internet search technologies”, and Vladislavas Fominas from Vilnius University teaches**

**the course “E-commerce and ICT infrastructure”, which would be narrower based only on own resources.**

**During the reporting period, the mobility of teaching staff and students (especially foreigners) has significantly increased.**

## 2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures

**2.6.1. Assessment of the fulfilment of the plan regarding the implementation of the recommendations provided by the experts during the previous accreditation of the study field, as well as the assessment of the impact of the given recommendations on the study quality or the improvement of the study process within the study field and the relevant study programmes.**

An overview of the execution of the recommendations received both in the previous accreditation in 2017 and in the licensing and/or change assessment procedures and/or the procedure for including the study programme in the accreditation page of the degree programme (in 2021), is included in **Appendix II-20**. **In total, 52 direct and indirect recommendations have been identified, of which 48 have been fully implemented, 3 have been implemented within the available resources, and one, which was addressed to the University, is in the process of implementation at the Academic Department with deadline 2023. The implementation of recommendations has made it possible to significantly improve the implementation of study programmes, especially towards the internationalization of studies - significant increase of incoming students mobility. First international graduates are expected in the bachelor program in 2023.**

**2.6.2. Implementation of the recommendations given by the experts during the evaluation of the changes to the study programmes in the respective study field or licensed study programmes over the reporting period or recommendations received during the procedure for the inclusion of the study programme on the accreditation form of the study field (if applicable).**

In 2019, a license was received for the undergraduate study programme “Computer Science and Organizational Technologies”, which was planned to be conduct jointly with Riga Technical University and State University of New York at Buffalo. RTU also received a similar license for a programme with the same name and similar content. Thus, legally, each university is responsible for its own programme. Between UL and RTU in 2019 an ill-conceived agreement was signed that both programmes would be administered and conducted by RTU Riga Business School. Although the students signed a single study agreement with both universities, the participation of the UL was limited to the delegation of some lecturers to teach at the Riga Business School. Students do not appear in the premises of the UL at all. The programme (legally – programmes), which was intended mainly for foreigners, within 3 years has not reached either the originally planned number

of students or the orientation towards foreigners. Instead of the planned minimum of 100 admitted students per year, a total of 65 students are currently studying in the three study years, among whom there is not a single foreigner. Although the signed contract and the actual administrative cooperation significantly limited the opportunities of the dean and the director of the study programme to influence and improve the process, it must be recognized that both could have done more.

Simultaneously with the preparation of the above-mentioned study programme for licensing, as a backup option, the Faculty of Computing started the implementation of its Bachelor's programme "Computer Science" also in English. The dean conducted negotiations with several UK universities about possible cooperation, which resulted in the agreement signed in May in 2021 with the University of Lincoln for the dual award studies. Thus, 57 students are currently studying in English, including 40 from 15 foreign countries. A situation has arisen where two programmes of the faculty compete with each other for the same audience, and one is undoubtedly more successful than the other. This is neither logical nor economical. Therefore the faculty has submitted a proposal to the management of the University of Latvia to close the UL study programme "Computer Science and Organizational Technologies". This will not affect the study process at RTU Riga Business School.

The academic doctoral study programme "Computer Science and Mathematics", by reorganizing (merging) the doctoral study programme "Computer Science" and the doctoral programme "Mathematics" (license received on September 6, 2021), has been launched.

The merging of the programmes took place when the University complied with the Ministry of Education and Culture's decision to reduce the number of study programmes implemented in Latvia by a third. The expert recommendations received during the licensing process have been implemented (see **Appendix II-20)**. In February 2022 all students of the two previous separate study programmes have been transferred to the reorganised programme. Data on this programme are included in Section VI of the self-evaluation report and the programme is being advanced for accreditation

# Annexes

| I - Information on the Higher Education Institution/ College | | |
|---|---|---|
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| List of the governing regulatory enactments and regulations of the higher education institution/ college | I-2. annex. List of the main internal normative acts and regulations of the University of Latvia-2022-08-25.docx | I-2. pielikums. Saraksts ar galvenajiem LU iekšējiem normatīvajiem aktiem un regulējumiem-2022-08-25.docx |
| The management structure of the higher education institution/ college | I-3. annex. LU Structure_EN_01.jpg | I-3. pielikums. LU-strukturshema-2022.jpeg |
| II - Description of the Study Field - 2.1. Management of the Study Field | | |
| Plan for the development of the study field (if applicable) | II-1._annex. The development plan of the field of study.docx | DFA_II-1._Studiju_virziena_ATTĪSTĪBAS_PLANS-DF_v.2022-06-13-fin.docx |
| The management structure of the study field | II-31. annex. Management scheme of the study field.jpeg | II-31. pielikums. Studiju virziena pārvaldības shēma.jpeg |
| A document certifying that the higher education institution or college will provide students with opportunities to continue their education in another study programme or another higher education institution/ college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated. | II-33. annex. Agreements with RTU on students takeover in case of cancel of study programmes.zip | II-33. pielikums. Vienošanās ar RTU par studentu pārņemšanu.zip |
| A document certifying that the higher education institution or college guarantees compensation for losses to students if the study programme is not accredited or the study programme license is revoked due to actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme. | II-32. annex. Proof of compensation by the Rector.docx | II-32. pielikums. Rektora apliecinājums par kompensāciju.edoc |
| Standard sample of study agreement | II-3.annex. Templates of study agreements.zip | II-3.pielikums. Studiju līgumi.zip |
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| II - Description of the Study Field - 2.3. Resources and Provision of the Study Field | | |
| Basic information on the teaching staff involved in the implementation of the study field | II-11. annex. Teaching staff in the study direction 2021. X.edoc | II-11. pielikums. Virzienā docējošie mācībspēki 2021. X.edoc |
| Biographies of the teaching staff members (Curriculum Vitae in Europass format) | II-12. annex. CV_ENG.rtf | II-12. pielikums, CV_LV .pdf |
| A statement signed by the rector, director, head of the study programme or field that the knowledge of the state language of the teaching staff involved in the implementation of the study programmes within the study field complies with the regulations on the state language knowledge and state language proficiency test for professional and official duties. | II-13. annex. Certificate of the Head of the study direction regarding state language proficiency of teaching personnel.edoc | II-13. pielikums. Studiju virziena vadītāja apliecinājums par mācībspēku valsts valodas prasmi.edoc |
| A statement of the higher education institution/ college on the respective foreign language skills of the teaching staff involved in the implementation of the study programme at least at B2 level according to the European Language Proficiency Assessment levels (level distribution is available on the website www.europass.lv, if the study programme or part thereof is implemented) | II-13a. annex.Certificate of the Head of the study direction regarding English language proficiency of teaching personnel.edoc | II-13a. pielikums.Studiju virziena vadītāja apliecinājums par mācībspēku angļu valodas prasmi (3).edoc |
| II - Description of the Study Field - 2.4. Scientific Research and Artistic Creation | | |
| Summary of quantitative data on scientific and/ or applied research and / or artistic creation activities corresponding to the study field in the reporting period. | II-15 annex Staff publications_participation in conferences _and_projects.docx | II-15. pielikums Personāla publikācijas, dalība konferencēs un projektos.docx |
| List of the publications, patents, and artistic creations of the teaching staff over the reporting period. | II-14. annex. Publications by academic staff members (2).xlsx | II-14. pielikums. Publikācijas sadalījumā pa mācībspēkiem.xlsx |
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| Statistical data on the incoming and outgoing mobility of students (by specifying the study programmes) | II-28 annex. Incoming students mobility by programmes 2015-2022.xls.xlsx | II-28.pielikums. Ienākošā-izejošā studentu mobilitāte pa programmām.xlsx |
| Statistical data on the incoming and outgoing mobility of the teaching staff | II-35. annex. Incoming and outgoing mobility of teaching staff (2).docx | II-35. pielikums. Mācībspēku ienākošā un izejošā mobilitāte (4).docx |
| II - Description of the Study Field - 2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures | | |
| Report on the implementation of the recommendations received both in the previous accreditation and in the licensing and/ or change assessment procedures and/ or the procedures for the inclusion of the study programme on the accreditation form of the study field. | II-20.annex. Execution of the implementation plan of the experts recommendations.docx | II-20. pielikums. Rekomendāciju izpildes pārskats.docx |
| An application for the evaluation of the study field signed with a secure electronic signature | Application for accreditation-2022.docx | Iesniegums AIC par studiju virziena "Informācijas tehnoloģija, datortehnika, elektronika, telekomunikācijas, datorvadība un datorzinātne" novērtēšanu (J.Borzovs).edoc |
| III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme | | |
| Sample of the diploma and its supplement to be issued for completing the study programme | | |
| For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable) | | |
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| Compliance with the study programme with the State Education Standard | EN-IV-3.Annex. Compliance-with_education-standard-bac.docx | IV-3.pielikums.atb-izgl-stand-bak.docx |
| Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable) | | |
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| Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme | | |
| The curriculum of the study programme (for each type and form of the implementation of the study programme) | | P9 magistri.zip |
| Descriptions of the study courses/ modules | | |
| Description of the organisation of the internship of the students (if applicable) | | |
| III - Description of the Study Programme - 3.4. Teaching Staff | | |
| Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable) | | |
| Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable) | | |

# Other annexes

| Name of document | Document |
|---|---|
| Aptauja uzsākot studijas_2021_rezultātu kopsavilkums | II-24. pielikums. Aptauja uzsakot studijas_2021_rezultatu kopsavilkums_VISI.xlsx |
| Pirmā studiju gada studējošo aptauja par pirmo pieredzi studijās | II-25. pielikums. Pirmā studiju gada studējošo aptauja par pirmo pieredzi studijās.docx |
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| Sadarbības līgumi | II-19. pielikums-annex Sadarbības līgumi-Collaboration agreements .zip |
| Akadēmiskā personāla attīstības pasākumu plāns 2018_2023. | II-22. pielikums. Akadēmiskā personāla attīstības pasākumu plāns 2018_2023.docx |
| Mācībspēku dalība projektos iezīmētos pēc nozīmības | II-16. Mācībspēku dalība projektos iezīmētos pēc nozīmības .docx |
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| Dienesta viesnīcu iekšējās kārtības noteikumi | II-8. pielikums. Dienesta viesn. iekš.kārt.not..pdf |
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| II-17. annex. Publications of teaching staff in the study direction sorted by importance | II-17. annex. Publications of teaching staff in the study direction sorted by importance (2).xlsx |

# Programming and computer network administration (41483)

| | |
|---|---|
| Study field | *Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science* |
| ProcedureStudyProgram.Name | *Programming and computer network administration* |
| Education classification code | *41483* |
| Type of the study programme | *First level professional higher education study programme* |
| Name of the study programme director | *Jānis* |
| Surname of the study programme director | *Zuters* |
| E-mail of the study programme director | *janis.zuters@lu.lv* |
| Title of the study programme director | *Dr.sc.comp./Dr.dat.* |
| Phone of the study programme director | *29470187* |
| Goal of the study programme | *To educate ICT professionals ready to learn new technol-ogy in a fast-changing environment and can participate in:*<br>*1. the development of applications and information sys-tems (for the Software Engineering sub-programme), or*<br>*2. development and administration of computer networks and computer systems (for the IT sub-programme).* |
| Tasks of the study programme | *1. provide theoretical knowledge in the basics of mathematics of computer science, and software development, computer networks and other information and communication technologies, as well as ICT industry standards and business foundations,*<br>*2. build skills in software development, computer network configuration, system documentation and other ICT activities, as well as group work and mutual communication according to good practice,*<br>*3. to provide specialists with such an academic and theoretical basis that they have both motivation and opportunities to continue their studies in a Bachelor's study programme.* |

| | |
|---|---|
| Results of the study programme | *1. Knowledge:*<br>*1.1. describes the basic concepts of mathematics and computer science theory,*<br>*1.2. explains the principles and methods of applying application development and database management systems,*<br>*1.3. explains system analysis, design, work organization and selection and application of technical measures in the development of computer systems,*<br>*1.4. explains the principles and methods in creating and implementing nontrivial algorithms (for Software Engineering sub-programme),*<br>*1.5. explains the principles and methods in the construction and administration of computer networks and computer systems (for the IT sub-programme).*<br>*2. Skills:*<br>*2.1. applies information and communication technologies,*<br>*2.2. applies software development and computer system configuration tools,*<br>*2.3. uses the acquired knowledge in developing computer systems/constructing and administering computer networks, evaluating results, and creating appropriate documentation,*<br>*2.4. communicates in different forms to solve problems,*<br>*2.5. works in teams, coordinates, and plans activities,*<br>*2.6. develops an individual large-scale (programming or computer network/computer system administration) project.*<br>*3. Competencies:*<br>*3.1. independently obtains, analyses, and interprets information from various information sources,*<br>*3.2. makes decisions about the application of organizational and technical methods and tools for productive problem solving.* |
| Final examination upon the completion of the study programme | *Qualification thesis* |

# Study programme forms

**Full time studies - 2 years, 6 months - latvian**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *2* |
| Duration in month | *6* |
| Language | *latvian* |
| Amount (CP) | *100* |
| Admission requirements (in English) | *Secondary education* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | – |
| Qualification to be obtained (in english) | *Programmer or Computer Systems and Computer Network Administrator* |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

## 3.1. Indicators Describing the Study Programme

### 3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

According to the application of the LU for evaluation of the study direction (see Annex "Application for accreditation-2022.docx"), the Education Classification Code (EQC) is planned to be changed, adding code 41484 to the existing code 41483 (which was approved in the previous accreditation) – thus:

- for both sub-programmes the first part of the code (41) corresponds to the first level professional higher education,
- the second part of code (483) – computer systems, databases and computer networks (code 41483 therefore corresponds to the sub-programme "Information technologies" (IT, professional qualification "Administrator of computer systems and computer networks"),
- the second part of code (484) – programming (code 41484 therefore corresponds to the sub-programme "Software engineering" (SE, professional qualification "Programmer").

If only one code could be accepted, then the already existing 41483 is regarded to be more relevant, since the second part of the code, 483 (computer systems, databases and computer networks), is more general and includes programming.

In the previous accreditation period, the implementation of the programme in English was started for the first time. As the implementation of the programme in English had already been started in the Bachelor's study programme, in which this programme is integrated, the conversion of the content of the respective study courses into English, as well as the provision of the teaching staff for teaching in English, had already been completed.

Changes in the content of the programme, compared to the previous accreditation, are related to a wider offer of optional courses, as well as compatibility with the Bachelor's study programme – a new optional course has been added: "Business platforms" (2 CP), as well as several new courses that had already been available in the undergraduate study programme: "Administration of computer networks" (2 CP), "Data structures and algorithms" (4 CP), "Linux system programming" (4 CP), "Databases II" (2 CP).

The programme includes two sub-programmes – "Software Engineering" (SE, professional qualification "Programmer") and "Information Technologies" (IT, professional qualification "Administrator of computer systems and computer networks"), and starting from this period the course "Software Testing" (2 CP) will be a mandatory part of the SE sub-programme (previously it was an optional course).

In the previous accreditation, the possibility of the extramural implementation of the study programme was also included, with an appropriate study plan for extramural studies. The implementation of the extramural studies was not started, and this accreditation does not include extramural implementation.

**3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.**

*In **Appendix III-1** there is attached a sample of the diploma issued for completing the study programme and its annexes in accordance with the Regulations of the Cabinet of Ministers of 16.04.2013 No. 202 "The procedure for issuing state-recognized documents certifying higher education".*

*In **Appendix II-3** there is attached a study contract sample according to the Regulations of the Cabinet of Ministers of 23.01.2007 No. 70 "Terms and conditions that must be included in the study contract".*

The 1st level professional higher education programme "Programming and computer network administration" has been implemented for 2 years and 6 months and its goal is to prepare industry professionals, as well as prepare specialists at a level that allows them to immediately continue their studies in the 6th semester of the Bachelor's study programme "Computer Science".

The programme code according to the classification of education in Latvia (Regulations of the Cabinet of Ministers No. 322, "Regulations on the classification of education in Latvia", 13.06.2017, https://likumi.lv/doc.php?id=291524) is either 41483 (for sub-programme IT) or 41484 (for sub-programme SE). The codes correspond both to the conditions for admission to the programme – the requirement for completed secondary education, and to the duration of 2 years and 6 months. The codes also correspond to the educational thematic group of the programme (Natural Sciences, Mathematics and Information Technologies), the educational thematic area (Computing) and the educational programme group (Computer Systems, Databases and Computer Networks or Programming, respectively); all of the above also correspond to the name of the programme – 1st level professional higher education programme "Programming and computer network administration". The qualification that is awarded in the study programme is one of two: "Programmer" or "Administrator of computer systems and computer networks".

The objective of the study programme is to educate ICT professionals ready to learn new technology in a fast-changing environment and can participate in:

- the development of applications and information systems (for the SE sub-programme), or
- development and administration of computer networks and computer systems (for the IT sub-programme).

The objective of the study programme determines both

- the joint part of the sub-programmes – to prepare ICT sector specialists, and it is ensured by the courses, which are mainly common to both programmes, and
- the distinctive part – by providing specific knowledge and skills of the sub-programme in specific courses of sub-programmes and, to a greater extent, in the sub-programme specific internship and qualification work.

According to the purpose and objective of the programme, the results of the study programme are defined in accordance with the following guidelines:

- Knowledge, skills and competences that correspond to level 5 of the Latvian Qualifications Framework (LKI) and the European Qualifications Framework (EKI),
- According to the student's chosen degree programme (software engineering or information technology), the learning outcomes are also derived from the following two professional standards:
    - Programmer professional standard. Agreed on at the meeting of the tripartite cooperation sub-council of vocational education and employment on June 8, 2022, protocol no. 3.
    - Computer systems and computer network administrator professional standard. Agreed on at the meeting of the tripartite cooperation sub-council of vocational education and employment on June 8, 2022, protocol no. 3.

Applicants with secondary education are admitted to the study programme, while the criteria for the admission competition are CE in Latvian, CE in Mathematics, and CE in a Foreign Language (English, French or German). To achieve the goal of the programme, applicants' preparation in high school mathematics is essential. Good knowledge of foreign languages, however, is important for achieving other programme results in terms of communication, independent literature studies etc. The requirement to include a CE in the Latvian language in the admission is determined for all study programmes at the University of Latvia, it is also essential for the fulfilment of the condition for writing the final theses in the state language.

In regards to admission to studies in the English version of the programme for persons who have obtained secondary education abroad has, there are following admission rules: 1) a secondary education document must show a successful assessment in mathematics (or an average grade in algebra and geometry); 2) the results of international English language tests, which are confirmed by a document issued within the last five years (except for cases where secondary education was obtained in English) with a certain level of language proficiency indicated for each of the accepted tests.

The duration of the study programme is 2 years and 6 months (100 credit points respectively). The 1$^{st}$ level professional higher education programme "Programming and computer network administration" is integrated with the academic Bachelor's study programme "Computer Science" with a duration of 4 years. The content of the first two years of the studies is created by harmonizing the study courses of the Bachelor's programme and the 1$^{st}$ level professional programme.

This is followed by Internship (17 CP). It should be noted that the study plan includes study courses Internship I and Internship II in the amount of 18 CP in total, where 1 CP is intended for face-to-face lessons at the University of Latvia on the issues of the internship, while internship in industry, which is covered by the Internship Regulations, is in the amount of 17 CP.

Overwhelmingly, most of the study courses, internship, and qualification work of the programme "Programming and computer network administration" relate to the ICT sector and its mathematical foundations, so the study programme corresponds to the study field "Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science".

The inclusion of extensive internship in the programme is justified by the fact that it is performed in various companies of the IT industry and provides the opportunity to gain valuable practical experience corresponding to the interests of each student. At the same time, it is possible to learn the latest and current technologies for companies, to get acquainted with the tasks that companies solve and work in project teams, as well as to gain an insight into how the knowledge acquired in previous studies can be applied practically. The study programme ends with the development and

defence of the qualification thesis, with the final examination commission consisting mostly of representatives of the IT industry.

In the winter of 2021, in cooperation with the IT company Accenture Latvia, a group of students with the English language of instruction was admitted with the intended training – one study year, which because of a technical misunderstanding was formed as a group of this programme. Now, there are no English students in the programme, and the implementation variant in English of the programme is not being brought to the accreditation anymore.

### 3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

According to the European Commission's 2019 report, based on the Digital Economy and Society Index (DESI) on the digital competitiveness of the member states, the number of ICT specialists in Latvia has slightly increased since 2017, however, their percentage in the Latvian labour market is lower than in the EU as a whole. The report notes that the number of university graduates in the field of ICT in Latvia is increasing, reaching 4.8% of all graduates, and exceeds the EU average (3.5%). However, the number of trained ICT specialists lags behind the growing demand in the labour market.

Also in the medium-term policy planning document "Digital transformation guidelines 2021-2027" (https://likumi.lv/ta/id/324715-par-digitalas-transformacijas-pamatnostadnem-2021-2027-gadam, only in Latvian) several courses of action have been defined, the result of which would be highly qualified ICT specialists in Latvia who are able to develop excellent digital solutions and the shortage of labour force in the field of ICT would be reduced.

Just to ensure the natural replacement of the generations employed in the industry and to maintain at least the current number of the employed, at least the current number of graduates of computer science programmes at Latvian universities is necessary. Along with the shortage of labour in the field of ICT, there is no threat to the availability of jobs in the foreseeable future.

Almost all participants of the study programme are employed in the industry, at least starting from the 2$^{nd}$ year, when they do an internship in a company. A large number of graduates remain working in the workplaces where they started working during their studies, usually while continuing their studies in a Bachelor's study programme.

Since almost all students of the Bachelor's study programme temporarily come to this programme to receive a diploma, the total number of graduates in the programme is 79-116, including:

- ~5% (2-10) – in sub-programme "Information Technologies" (IT),
- ~95% – in sub-programme "Software Engineering" (SE).

The 2020 data on the 2017, 2018 and 2019 graduates of the study programme and their employment show that 84% of the 2017 graduates, 90% of the 2018 graduates and 86% of the 2019 graduates are working, the distribution of the rest of the graduates is given in the table below:

| Graduation year | Number of graduates* | Graduates, employed, number | Graduates, unemployed, number | Graduates, economically inactive, total | Graduates, emigrated, number | Graduates, no data on employment, number |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 2017 | 97 | 81 | 2 | 9 | 0 | 5 |
| 2018 | 103 | 93 | 3 | 6 | 1 | 0 |
| 2019 | 106 | 91 | 3 | 10 | 0 | 2 |
| 2020 | 3 | | | | | |
| 2021 | 79 | | | | | |

** the last full graduation of graduates in the old programme was in June 2019, and the first graduation in the new programme took place in January 2021, which explains that there were no regular graduates in the programme in 2020.*

The analysis of the employment data for 2017, 2018 and 2019 graduates by industry, using the NACE classification, shows that industries in which at least 5 graduates from one of the years are employed, are as follows: NACE-C Manufacturing, NACE-J Information and Communication, NACE-K Finance and Insurance activities, NACE-M Professional, scientific and technical activities and NACE-P Education. Most of the employed graduates of the programme are employed in the ICT sector: 70% of the employed graduates of 2017, 77% of the employed graduates of 2018, and 73% of the employed graduates of 2019.

### 3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

*Statistical data on students during the reporting period are shown in* ***Appendix III-5.***

Every year, admission to this programme takes place together with the Bachelor's study programme in which this programme is integrated, admitting 260 students financed by the state budget, of which 40 are intended for this programme. Every year all places are fully filled.

Until 2017 and including, students were admitted to the 2-year study programme but starting from 2018 they are admitted to the newly accredited 2.5-year programme, respectively, the last full graduation of graduates in the old programme was in June 2019, and the first graduation in the new programme took place in January 2021, which explains that there were no regular graduates in the programme in 2020.

With an admission of 40 students each year, the total number of students in the programme ranges from 66 to 82.

Since almost all students of the Bachelor's study programme temporarily come to this programme to receive a diploma, the total number of graduates in the programme is 79-116, including:

- ~5% (2-10) – in sub-programme "Information Technologies" (IT),
- ~95% – in sub-programme "Software Engineering" (SE).

Several fee-paying students are also matriculated every year, which can be explained by

resumption of studies in later study years, since fee-paying places are not announced in admissions in the 1st year. At the same time, the statistics show a higher number of fee-paying students compared to the above, as typical students become fee-paying students due to rotation. Out of the total number of students, fee-paying students are on average around 10% during the reporting period.

Since admission to the programme takes place together with the Bachelor's programme, and almost all students of the Bachelor's study programme temporarily come to this programme to receive a diploma, the dropout rate should be viewed together with the Bachelor's study programme. It can be seen that out of the 260 students admitted (together with the Bachelor's programme), 94-116 received the diploma of the programme, i.e., 36-45% (while there was a 2-year study programme up to and including the 2018/2019 study year), but in the 2020/2021 study year, when there was already a 2.5-year study programme the diploma was awarded to 78 students, i.e., 30%. Considering the fact that part of the students of the Bachelor's study programme do not transfer to this programme to receive a diploma, the dropout rate is slightly lower than the visible 55-70%, however, historically, the dropout rate is still very high and does not tend to change significantly over the years. The reasons for dropping out have been analysed for a long time, but the main ones are two in a mutual combination – the popularity of the programme, including the perspective of later employment opportunities, together with the specificity and difficulty of the programme, i.e., the programme is relatively difficult, which requires additional motivation from the students.

In the winter of 2021, in cooperation with the IT company Accenture Latvia, a group of students with the English language of instruction was admitted with the intended training – one study year, which because of a technical misunderstanding was formed as a group of this programme, even though it was not such in nature, therefore it is not included in the statistics. Now, there are no **English** students in the programme, and the implementation variant in English of the programme is not being brought to the accreditation anymore.

Historically, only undergraduate study programme students have participated in student mobility, so there is no mobility in this programme.

**3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).**

## 3.2. The Content of Studies and Implementation Thereof

**3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether**

**the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.**

*The table on the compliance of the study programme with the national education standard is shown in* ***Appendix III-6.***

*Tables on the compliance of the study programme with professional standards are shown in* ***Appendix III-7.***

*The mapping of study courses for achieving the learning outcomes of the study programme are shown in* ***Appendix III-8.***

*Study programme plan is shown in* ***Appendix III-9.***

*Description of study courses (modules) of the study programme (information included in study courses/modules) is shown in* ***Appendix III-10.***

The programme includes two sub-programmes – "Software Engineering" (SE, professional qualification "Programmer") and "Information Technologies" (IT, professional qualification "Administrator of computer systems and computer networks"), which differ in terms of the content of part of the mandatory courses (2-6 CP), as well as internship and qualification thesis (total – 26 CP).

The programme consists of:

- compulsory courses – 62-66 CP (depending on the sub-programme),
- internship and qualification thesis – 26 CP (different content for each sub-programme),
- limited elective courses – 6-10 CP (depending on the sub-programme),
- unlimited elective courses – 2 CP.

Compulsory courses that are common to both sub-programmes can be structured into several thematically related groups.

- Programming courses: DatZ1165 Algorithms and programming (6 CP); DatZ1166 Software development fundamentals (5 CP); DatZ1031 Web Technologies I (2 CP); DatZ2019 Web Technologies II (2 CP)
- Software development and project management: DatZ2072 Software Engineering (6 CP)
- Computer hardware and computer networks: DatZ1164 Computer Architecture and computer engineering fundamentals I (3 CP); DatZ1170 Computer networks I and insight into industry (3 CP)
- Operating systems: DatZ1053 Operating systems (2 CP)
- Databases and information systems: DatZ1139 Databases and Information Systems Fundamentals (3 CP).
- Classical Mathematics: Mate1009 Algebra (2 CP); Mate2005 Analytical geometry (2 CP); DatZ1143 Discrete mathematics for computers; Mate1014 Calculus I (2 CP); Mate2012 Probability theory and mathematical statistics (2 CP)
- Mathematical Foundations of Computer Science: DatZ1037 Automata theory (2 CP); DatZ2029 Formal Grammars (2 CP); Mate3044 Mathematical Logic (2 CP)
- General courses: Chemistry1059 Civil protection (1 CP); Ekon1006 Principles of Economics (2 CP); SDSK1067 Internet, Netiquette and Legal Regulation (2 CP); VadZ1091 Introduction to management (4 CP); VidZ1032 Environmental Protection (1 CP)
- The **specific compulsory courses of the sub-programmes** (for other sub-programme,

they are the limited elective courses respectively):
    - The field-specific course of the “Software Engineering” (SE, professional qualification “Programmer”) sub-programme: DatZ3038 Software testing (2 CP),
    - Field-specific courses of the “Information Technology” (IT, professional qualification “Administrator of computer systems and computer networks”) sub-programme: DatZ2159 Computer Architecture and computer engineering fundamentals II (2 CP): DatZ1039 Computer Networks II (2 CP); DatZ2076 Computer Networks Administration (2 CP).

The content of internship is **different** for each **sub-programme**:

- a student of the sub-programme “Software Engineering” (SE) does programmer's job in real software development conditions,
- a student of the sub-programme “Information Technologies” (IT) does computer systems and network administrator's job in real computer network conditions.

The result of qualification thesis is **different** for each **sub-programme**:

- for the sub-programme “Software Engineering” (SE) – independently created software product,
- for the sub-programme “Information Technologies” (IT) – independently performed computer network structure administration work starting from analysis to maintenance, modification planning and eventual implementation.

According to the Regulations of the Cabinet of Ministers No. 322 (adopted on 13.06.2017) “Regulations on Latvian Education Classification”, after successfully completion of the study programme, the qualification holder must demonstrate knowledge, skills and competences that comply with the Latvian Qualifications Framework (LQF) and the European Qualifications Framework (EQF) for level 5:

1. Knowledge (knowledge and understanding):
   The student is able to demonstrate comprehensive and specialized knowledge and understanding of facts, theories, laws and technologies relevant to the professional field.
2. Skills (ability to use knowledge, communication, general skills): The student is able, based on an analytical approach, to perform practical tasks in the relevant profession, demonstrate skills that allow finding creative solutions to professional problems, discuss and give reasoned opinions on practical issues and solutions in the relevant profession with colleagues, clients and management, learn further with an appropriate degree of independence, improving their competencies. The student is able to evaluate and improve their own and other people’s performance, work in cooperation with others, plan and organize work to perform specific tasks in their profession, perform or supervise such work activities in which unpredictable changes are possible.
3. Competence (analysis, synthesis, and evaluation):
   The student is able to formulate, describe and analyse practical problems in their profession, select the necessary information and use it to solve clearly defined problems, participate in the development of the professional field, show that they understand the place of the relevant profession in a wider social context.

According to the student’s chosen degree programme (software engineering or information technology, IT), the learning outcomes are also compatible with the following two professional standards:

- Programmer professional standard. Agreed on at the meeting of the tripartite cooperation sub-council of vocational education and employment on June 8, 2022, protocol no. 3.

- Computer systems and computer network administrator professional standard. Agreed on at the meeting of the tripartite cooperation sub-council of vocational education and employment on June 8, 2022, protocol no. 3.

Upon completion of the first-level higher professional education study programme “Programming and computer network administration”, students have acquired the following knowledge, skills, and competences.

1. Knowledge:
    - describes the basic concepts of mathematics and computer science theory,
    - explains the principles and methods of applying application development and database management systems,
    - explains system analysis, design, work organization and selection and application of technical measures in the development of computer systems,
    - explains the principles and methods in creating and implementing nontrivial algorithms (for Software Engineering sub-programme),
    - explains the principles and methods in the construction and administration of computer networks and computer systems (for the IT sub-programme).
2. Skills:
    - applies information and communication technologies,
    - applies software development and computer system configuration tools,
    - uses the acquired knowledge in developing computer systems/constructing and administering computer networks, evaluating results, and creating appropriate documentation,
    - communicates in different forms to solve problems,
    - works in teams, coordinates, and plans activities,
    - develops an individual large-scale (programming or computer network/computer system administration) project.
3. Competencies:
    - independently obtains, analyses, and interprets information from various information sources,
    - makes decisions about the application of organizational and technical methods and tools for productive problem solving.

The analysis of the learning outcomes of the study courses and the mapping of the learning outcomes of the programme as shown in Appendix III-8, shows that the weakest learning outcome covered is “2.6. develops an individual large-scale (programming or computer network/computer system administration) project”, which is covered only by the final thesis, while all other learning outcomes of the study programme are covered by several courses (at least 6).

Supplementing and updating the content of the study programme in relation to current industry demand or scientific trends, related to a wider offer of optional courses, a new optional course was added during the accreditation period, i.e., “Business platforms”, as well as several new courses that were already available in the Bachelor’s study programme: “Administration of computer networks”, “Data structures and algorithms”, “Linux system programming”, “Databases II”. The opportunity to offer new topical content has been preserved through the courses “Special Seminar II” and “Special Seminar III”, within which special workshops have been announced covering the following topics such as “Blockchains”, “Language technologies and artificial intelligence”, “Getting things done with Python”, “Artificial Intelligence and Society: Opportunities, Risks, Challenges”, and other.

Along with the introduction of the new study courses in the study programme, there is reason to

claim that the content of the programme has been updated according to the latest trends in computer science and the demand in IT industry companies.

**3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).**

**3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.**

Various implementation methods are used in the studies: lectures, seminars, laboratories and practical works, tests, and homework, which must also be implemented using various software. If it suits the objectives of the degree programme, guest lectures from industry companies are invited to show students the unity of theory and practice. For example, for several years in a row, Accenture Latvia specialists conducted the guest lecture "SAP system" within the "Databases and information systems" course. Special Seminars should be mentioned as a special form of study, which are mostly organized in the last semesters of the Bachelor's study programme but are also available in this programme. For example, in 2019/2020 academic year, two special seminars were conducted by industry representatives: "Clean Code, or what you are not told at university" (manager from DIVI group) and "Modern approach and technologies for IT product development" (manager from Accenture Latvia). Special seminars are also offered to English-speaking students, e.g., "Getting things done with Python". Special seminars are a way to make the latest industry trends available to students as quickly as possible, their offer changes every semester, see https://www.df.lu.lv/en/studies/bachelors-and-professional-studies/special-seminars/. Participation in special seminars also promotes students' presentation and discussion skills, while research-oriented special workshops provide an opportunity to find an interesting research topic, thus promoting the development of students' research competence.

Lecturers use various methods to teach study courses, e.g., practical tasks, individual and group work, project development, emphasis is placed on the use of methods in which students themselves must actively work, communicate, solve problems concerning current industry problems, different types of software should be used for the implementation of tasks. For example, in the Software Engineering course there are both theory lectures and individual control works, and in the practical work there is work in groups, which work on the specification and design of one project, which is performed throughout the semester in several assignments, presenting the results of each assignment to other groups of students and defending their project in the exam. The course

simulates a real situation in the software development process in a company.

In the study process, information technologies are used to a large extent. An integrated e-study environment has been created for each study course (Moodle e-courses and MS Teams corresponding course channels), where lesson materials, lecture slides and video recordings, assignments and tests are available. In Moodle, students also receive evaluations of the submitted solutions and comments as well as justification for the grade as feedback. Accordingly, students can follow their progress, which learning outcomes and to what extent they have achieved. Study results and conditions for obtaining a course evaluation are publicly available in the course descriptions, which are regularly updated. The above promotes students' understanding and co-responsibility for their learning, self-assessment and ensures understanding of the received assessment in accordance with the principles of a student-centred approach. The evaluation process takes place throughout the semester, stimulating regular study work. Midterm tests (papers, tests, and other forms) are chosen to achieve the course goals and learning outcomes. Mid-term tests make up at least 50% of the final grade for the course. All courses have a final exam at the end, which makes up no less than 10% of the course grade.  Both oral, written and combined study evaluation methods are used during study courses and exams.

The study process is regularly improved based on the results of student and graduate surveys. For example, in the 2020 survey of the graduates of the study programme, the possibility to start planning one's career during the studies and the opportunity to participate in the improvement of the quality of the study programme were most highly valued, while the most critically evaluated was the fact that simultaneous work takes away time for studies. However, although it is objectively evaluated that it is difficult to combine studies with work, the graduates also admitted that work in the profession, as is typical for computer science students, at the same time helps to understand what was taught during the studies.

To evaluate the study courses, at the end of each semester, students fill out a survey for each course, the results are visible to the lecturers, as well as to the programme director. The results of the survey are analysed in order to improve the situation in study courses in which the overall rating is below 5 points (out of 7). Poorly rated aspects of the course, such as content or delivery, are analysed in detail and improvements are discussed with the appropriate course lecturer.

Students gladly express their suggestions for the improvement of the study programme in meetings with lecturers and the programme director, as well as regularly express their suggestions in meetings with the dean, thus helping to promptly improve the study process. Self-evaluation reports of the study programmes, which also include the analysis of surveys of the study courses, are also available to the student self-government. Students also have the opportunity to submit appeals and complaints, which are sometimes used by students; for example, in 2021 there was one appeal for the defence of theses.

The study programme has two sub-programmes – "Software engineering" (SE, professional qualification "Programmer") and "Information technologies" (IT, professional qualification "Administrator of computer systems and computer networks"), and the **choice of the sub-programme** is carried out the following way:

- initial choice – at concluding the study agreement (subject to change later)
- final choice – at the beginning of the 4$^{th}$ semester, as internship and qualification paper (in semesters 4 and 5) are sub-programme specific, and almost all sub-programme specific courses are scheduled in semester 4.

**3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).**

***Appendix III-2*** *contains a description of the student internship organization (internship rules)*

***Appendix II-18*** *contains internship contracts.*

The objective of the internship is to practically perform the duties of a programmer in real programme development conditions under the supervision of an experienced programmer or the duties of a computer systems and computer network administrator in real computer network conditions under the supervision of an experienced computer systems and computer network administrator. According to the objective of the internship, students should participate in the development of software products or the design, installation and operation of computer networks.

The content of internship is different for each sub-programme:

- a student of the sub-programme “Software Engineering” (SE) does programmer's job in real software development conditions,
- a student of the sub-programme “Information Technologies” (IT) does computer systems and network administrator's job in real computer network conditions.

The duration of the internship is 680 hours (17 CP). It should be noted that the study plan includes study courses Internship I and Internship II in the amount of 18 CP in total, where 1 CP is intended for face-to-face lessons at the University of Latvia on the issues of the internship, while internship in industry, which is covered by the Internship Regulations, is in the amount of 17 CP. The internship is performed in the fourth and fifth semesters during 17 weeks in full-time mode. A student can start an internship earlier and complete it in a part-time manner. In the fourth semester, five weeks are planned for practice in the industry, and twelve weeks in the fifth semester

Internship for programmers can held in organizations where the intern could get acquainted with high-quality, disciplined software development that corresponds to good practice. As part of software product development, an intern can participate in any work necessary for the implementation of the basic processes, supporting processes or organizational processes of software product development, including independently developing programme code, participating in specifying and documenting software requirements, software design, and performing various levels of testing work. Internships for computer system and computer network administrators should be completed in companies where the trainee could get acquainted with high-quality, disciplined computer network design, installation, and operation, which corresponds to good computer network practice.

Internships are offered to students in accordance with the agreements on student internships, which the Faculty of Computer Science has concluded with companies. Students may also offer another possible internship, in which case its compliance with the requirements for internships mentioned in the internship rules is evaluated, and in the positive case, an agreement is concluded. Students are ascribed an internship supervisor from the University of Latvia is approved, as well as

an internship manager appointed by the organization, whose duties are stipulated in the internship regulations.

During the internship, students carry out individual internship tasks in consultation with both the internship manager in the company and the internship manager at the UL, regularly fill out the internship journals and send it electronically to the UL internship manager once a month to update the progress of the internship.

At the end of the internship, the student submits the internship journal, a review from the company's internship manager, and an evaluation on the quality of the student's work. The internship supervisor's assessment makes up 70% of the final assessment. The final assessment of the internship is given by the internship supervisor from the faculty, based on the internship diary, the feedback of the organization's internship manager and the student's oral report.

Information and documents about the internship are available on the faculty's website: https://www.df.lu.lv/en/studies/internship/ where internship regulations, internship agreements and journals templates are available – information and templates are available in both Latvian and English.

The number of managers and companies involved in supervising and providing internship is significant. Information on internships is also available on the website indicated above – lists by year of companies with which internship agreements have been concluded, as well as number of students (i.e., also the number of internship agreements) who have performed internship at the respective company. In 2020, 113 internship agreements were concluded, internships took place in 57 companies, in 2019 – 118 internship agreements, 62 companies; in 2018 – 107 internship agreements, 55 companies; in 2017 – 99 internship agreements, 52 companies; in 2016 – 147 internship agreements, 65 companies.

As an example of internships in companies, one of the years, i.e., 2020, will be examined more closely. In 2020, 113 internship agreements were concluded. Internships took place in 57 companies. One student completed an internship in two companies. The largest number of interns (24) completed the internship at the Accenture Latvian branch, followed by Wonderland Media (11) and TestDevLab (7). In two companies, EMERGN and the Institute of Mathematics and Informatics of the University of Latvia, 4 interns performed internships in each of them. Both Collective Intelligence Research Centre and Visma Labs successfully cooperated with 3 interns. Seven companies accepted 2 interns each and provided internships – DELFI, CGI IT Latvia, Creative IT Development, DIVI grupa, iSoft Solutions, Tet and ZZ Dats. All other companies accepted one intern.

In 2020, internship in the English-speaking group was organized for the first time. The English-speaking group had six internship agreements, 5 of with the UL Institute of Mathematics and Computer Science and one with SIA "Retain". In 2021, internships for the English-speaking group were provided at the Accenture Latvia branch, which has an international work environment, therefore communication is also in English.

### 3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

### 3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

The topic of the qualification thesis is chosen at the beginning of the last semester (5th, and 4th in the previous version of the programme), during the time when there is still production internship in companies. Part of the topics are developed from the activities carried out during internship, however, students mostly choose a different topic for the qualification thesis – apparently, not all internship activities can be presented in the format of the qualification thesis.

In addition to internship, the activities to be carried out for the qualification thesis are also closely related to the chosen sub-programme, i.e., a computer programme must be developed and described (sub-programme SE, usually about 95% of the students) or a computer and computer network system must be constructed and described (sub-programme IT, usually about 5% of the students).

Although most of the topics are not directly related to work performed during the internship, the role of external supervisors in qualification thesis is significant – more than 50%, as can be seen in the following table (except for the 2020/2021 academic year, when it is slightly less than half, which could be associated with a pandemic). As one of the main indicators of the excellence of the qualification work is the implementation of the work in real use.

The table shows indicators for qualification thesis supervisors who are not employees of the Faculty of Computing; external managers can be employees of scientific institutes and other universities, as well as employees of IT industry companies with higher education. The table also shows companies in the IT industry whose employees have supervised Bachelor's theses in computer science in different years. Some of the companies are mentioned more than once, such as SIA ZZ Dats, Accenture Latvija, DIVI Grupa, Accenture Latvia and others. The total number of external supervisors is variable, in general this choice of students is supported, the evaluations of the defended Bachelor's theses do not differ significantly when supervised by external supervisors.

| *Academic year* | *Number of graduates* | *Students with external supervisors* | *IT Industry companies with the most supervised theses* |
|---|---|---|---|
| *2015/2016* | *116* | *67* | *Exigen Services Latvia, Accenture Latvia, Datorikas institūts DIVI, Tieto Latvija, Galeo Consulting, ZZDats, BALTA AAS, Datu tehnoloģiju grupa SIA* |
| *2016/2017* | *94* | *64* | *Galeo Consulting, Exigen Services Latvia, Accenture Latvia, SIA C.T.Co, MAKIT SIA, TestDevLab SIA* |
| *2017/2018* | *107* | *56* | *ZZDats, Exigen Services Latvia, Sapiens Software Solutions (Latvia), Accenture Latvia* |
| *2018/2019* | *103* | *55* | *ZZDats, Sapiens Software Solutions (Latvia), Tieto Latvia, Visma Labs, Tilde* |
| *2019/2020* | *3* | *1* | *Scandiweb* |

| | | | |
|---|---|---|---|
| *2020/2021* | *79* | *34* | *Accenture Latvia, Scandiweb* |

Below are examples of topics that received an excellent grade for the defence in different academic years, but which were supervised by external supervisors.

In 2016: “Image processing tool for computer vision algorithms”, “Development of an elliptic curve-based cryptographic framework”, “Improvements of the user interface of the ambulatory record of the “Ārsta Birojs” system”

In 2017: “Improvement of the collection system”, “Telephone accounting in the SAP R/3 system”, “Analysis of Boolean gene regulation networks”

In 2018: “Improvements of the insurance calculation framework eRate”, “Development of the database level components of the Register of Large Families (DAUDZIS) of the City of Riga and the e-service”

In 2019: “Development of a domain-specific language editor”, “Supplementing of the “SALARY” module of the resource management system “G-VEDIS” with a report on costs for non-residents and preparation for submission to the Electronic Declaration System of the State Revenue Service”

In 2021: “Speech extraction in audio using deep machine learning”, “Panoramic image labelling tool”, “Liability insurance premium comparison and insurance policy issuing system”

After the analysis of the topics of the qualification theses that were supervised by employees of the Faculty of Computing, the theses defended in 2021 have been selected for illustration; selected works with excellent ratings:

- Windows game “Pocket Dungeon”,
- Development of a system for creating advertising banners,
- “Diet Helper” Android app for filtering the composition of food products,
- Syntax-based substitution for graphical languages,
- Development of a secure identification system for mobile devices,
- Car wash terminal support system: front end system,
- Anti-money laundering risk monitoring and management platform,
- Evaluation framework for recurrent neural networks.

Evaluation analysis.

In accordance with the requirements for the development and defence of final theses at UL, the evaluation takes into account the quality of the thesis (the topicality of the topic, the analysis of previous research findings, innovation), the report of the author of the thesis (the ability to present the research carried out in a scientific, focused and reasoned manner, formulate conclusions, indicate possible future research fields and the answers given to the commission’s questions and the ability to debate). However, it is essential that a sufficiently large-scale practical task be carried out for the qualification thesis. The evaluations of the commission for the defence of qualification theses by academic years is shown in the table below. Each year there are excellent theses, a total of 67 for the period, in some years there were also theses evaluated with a failing grade – a total of two theses during the whole period. The average grade (excluding the 2019/2020 academic year, when there was no regular defence) ranged from 7.64 to 7.97.

| *Academic year/ grades* | *10* | *9* | *8* | *7* | *6* | *5* | *4* | *3* | *Average grade (excluding those who failed)* | *Number of graduates* |
|---|---|---|---|---|---|---|---|---|---|---|
| *2015/2016* | *16* | *20* | *32* | *19* | *21* | *7* | *1* | | *7.71* | *116* |
| *2016/2017* | *9* | *19* | *27* | *25* | *5* | *7* | *2* | | *7.71* | *94* |
| *2017/2018* | *14* | *23* | *28* | *10* | *19* | *10* | *3* | *1* | *7.64* | *107* |
| *2018/2019* | *15* | *20* | *21* | *27* | *10* | *5* | *5* | | *7.69* | *103* |
| *2019/2020* | | | *1* | | | | *2* | *1* | *5.33* | *3* |
| *2020/2021* | *13* | *16* | *26* | *13* | *5* | *3* | *3* | | *7.97* | *79* |

## 3.3. Resources and Provision of the Study Programme

**3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.**

The description of the resources available for the implementation of the 1st level professional higher education study programme “Programming and computer network administration” and the achievement of learning outcomes can be found in sections 2.3.1 Financing, 2.3.2. Infrastructure and facilities and 2.3.3. Methodological and information resources of the report.

Since the resources for the implementation of Computer Science study programmes are used in an integrated manner at all study levels, both the same premises and different material resources are used, it is reasonable to refer to the general description of the degree programme.

The facilities are sufficient for the implementation of the study programme; it creates prerequisites for achieving the learning outcomes, ensures the specific nature of computer science, for example, in terms of computer classes and computer technology, as well as in terms of informational resources in the field of computer science. If necessary, provision of resources is developed.

**3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).**

**3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).**

To provide financing necessary for implementing the programme "Programming and computer network administration" of the 1st level professional study programme the UL uses:

- state budget grant from the Ministry of Education and Science (MES), which in the 2021/2022 academic year is 2445 EUR for full-time regular studies,
- tuition fees:
  - studies in Latvian – 2450 EUR/year.
  - studies in English – 2900 EUR/year.

Now, there are **no English** students in the programme, and the implementation variant in English of the programme is not being brought to the accreditation anymore.

The study programme has two sub-programmes – "Software engineering" (SE, professional qualification "Programmer") and "Information technologies" (IT, professional qualification "Administrator of computer systems and computer networks"), and the study plans in terms of the set of courses differ not much, however the contents of internship and qualification work are different:

- one course is limited elective for SE sub-programme (DatZ3038 Software testing, 2 CP), for other sub-programme (IT) it is free elective,
- three courses are limited electives for IT sub-programme (DatZ2159 Computer Architecture and computer engineering fundamentals II, 2 CP, DatZ1039 Computer networks II, 2 CP, DatZ2076 Computer Networks Administration, 2 CP) – 6 CP in total, for other sub-programme (SE) it is free elective,

differences between the sub-programmes for the compulsory courses is 6 CP or 6% of the programme, which doesn't significantly affect the costs.

Candidates to the studies the 1st level professional study programme "Programming and computer network administration" every summer can apply to the 1st year only for a state budget funded study place. Only those who have not passed the study semester successfully become fee-paying students. Thus, the faculty receives basic income and implements the study programme with a state budget grant from the Ministry of Education and Science. Taking into account the above, the total budget of the study programme is expected to be 166 thousand EUR/year.

**Programme costs**

In order to estimate the amount of funds required for financing, the UL calculates the cost price for study programmes according to the methodology developed by the UL, which takes into account all the costs of ensuring the study process described in section "2.3.1. Financing" and information about the plan of a specific study programme, teaching staff involved, planned number of students, and other aspects, thus ensuring the reliability of the forecasts.

**Full-time regular studies** costs

The programme is implemented only in the form of full-time regular studies. For calculations, the implementers of the 1st level professional study programme “Programming and computer network administration” use the data of the state budget funded students in the academic year 2021/2022 (there are 68 students of full-time regular studies), the existing plan of the study programme planned for accreditation and the existing structure of the involved academic staff. Taking into account the above, the calculated cost of the full-time programme is 2,343 EUR per student per year, and the total cost of the programme is 159,324 EUR per year. A more detailed percentage distribution of costs is shown in Table III-6.

*Table III-6.*

*Percentage distribution of costs of the study programme*

| **Expenditure item** | **% of the total** |
|---|---|
| Teaching staff expenditures | 38.6% |
| General staff | 27.1% |
| Other expenditures | 0.0% |
| Infrastructure expenditures | 5.3% |
| Goods and services | 3.0% |
| Indirect costs | 26.0% |
| **TOTAL COSTS** | **100%** |

Figure III-1 shows the cost of the study programme depending on the number of students and a comparison with the proposed study fee and state budget grant.

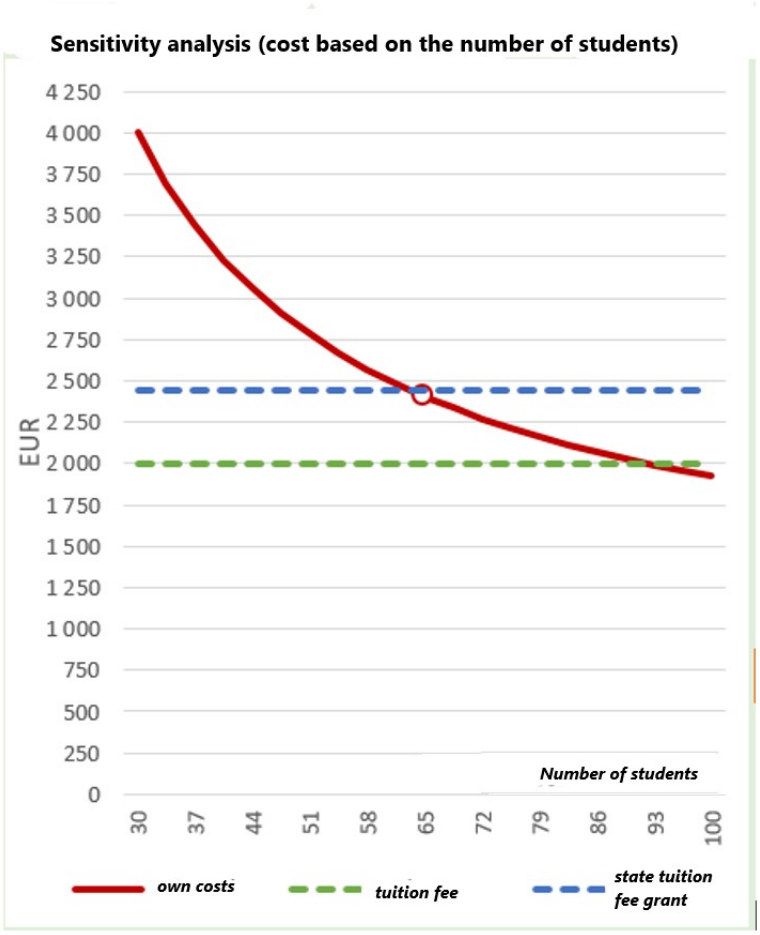


*Figure III-1. Cost of the 1st level professional study programme "Programming and computer network administration" based on the number of students.*

The calculation shows that with the allocated state budget grant for 68 state budget funded study places, the Faculty of Computer Science can ensure a profitable and high-quality study process (the intersection of the red (own costs) and blue (state tuition fee grant) lines is projected onto the 'x' axis). On the other hand, if there were only fee-paying students in the programme, their number should be at least 90 and more at the currently determined tuition fee of 2450 EUR per year. The minimum number of students in the first year is prescribed to be 25.

**Summary of programme revenues and costs**

After summing up the revenues (state grant) of the 1st level professional study programme "Programming and computer network administration", i.e., 166,260 EUR, and programme costs, i.e., 159,324 EUR, for 68 budget students, the result of the study programme is positive.

The data mentioned above clearly show that the UL has sufficient funds to implement the study programme and ensure its further development. In addition, the development of the programme can be improved and financed from the income from fee-paying students, if the faculty decides to open admission for fee-paying study places in the future, as well as from the financial resources accumulated by the structural unit, if such arise from students who become fee-paying students due to academic debts. In the foreseeable future, the faculty should revise the tuition fee so that its level reaches and is no less than the level of the state grant.

## 3.4. Teaching Staff

**3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.**

The professionalism of the academic staff involved in the study programmes is high enough for the implementation of high-quality studies.

The implementation of the study programme is ensured by 14 professors, 5 associate professors, 12 assistant professors, 3 lecturers, 7 teachers (1 of them with a doctor's degree). A total of 41 lecturers participates in the implementation of the programme, 32 of them with a doctor's degree, 9 with a master's degree.

In the programme, the courses are also taught by academic staff from other faculties (7 out of 41) – 1 professor, 1 associate professor, 3 assistant professors, 2 lecturers who teach individual courses in the relevant field, for example – in economics, mathematics, chemistry (Civil Defence course) and geography (Environmental protection course). Among the lecturers from other faculties, there are 5 lecturers with a doctor's degree and 2 with a master's degree.

Of the lecturers who are from the Faculty of Computing, a total of 26 PhDs currently teach in the Computer Science programme (all elected to academic positions). Both industry professionals and doctoral students are recruited as lecturers. Since May 2015, only PhDs have been elected to pedagogical academic positions in the Faculty of Computing (there are no lecturers and assistants in the faculty).

When analysing the composition of lecturers by age, it should be mentioned that the average age of all lecturers teaching in the programme is 49 years.

In the breakdown by academic positions, the average age of elected lecturers at the Faculty of Computing who teach in the programme is as follows: assistant professors – 40 years, associate professors – 44 years, professors – 58 years. When analysing the study programme lecturers elected from the Faculty of Computing by age groups, data on the youngest and oldest age groups should be pointed out: "<30", which has one elected lecturer, and "30-40" – 7 elected lecturers, as well as the age group ">60", which has 4 elected lecturers. This distribution reflects a natural renewal of the teaching staff, which is ensured by the possibility to be elected to an academic post after obtaining a degree and engaging in the teaching work. The involvement of doctoral students in teaching appears in the data on non-elected lecturers – currently 4 lecturers with a Master's degree are involved, they are both doctoral students and PhD candidates (with a doctoral thesis not yet defended).

The involvement of many university lecturers is justified by the fact that lecturers teach study courses that correspond to their field of research, thus providing students with current study course content, while in study courses related to the latest technologies, lecturers use their practical experience in projects or industry. Thus, the qualifications and experience of the lecturers allow to ensure the learning outcomes of the study course and, accordingly, the study programme.

It must be concluded that the qualifications of the academic staff fully correspond to the implementation of the study programme in both Latvian and English.

**3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.**

The qualifications of the teaching staff are assessed upon election to academic positions. In the previous section, statistics on all university lecturers (including from other faculties) were analysed, however, changes in the composition of lecturers related to the election to academic positions will be analysed within the faculty, so it should be highlighted that this programme is taught by professors (14), associate professors (5), assistant professors (12) elected at the Faculty of Computing. Of all the academic staff elected in the reporting period, professors (4), associate professors (5), assistant professors (5) were elected to the respective position for the first time. During the reporting period, there were also 2 cases where lecturers showed good results in teaching and met the qualifications, i.e., during the reporting period, they were elected for the first time to the position of assistant professor, and later also to the position of associate professor. Initially, at the Faculty of Computing university lecturers start teaching a course of the programme as teaching staff, and after the evaluation of teaching results, possibilities for election to the position are considered; doctoral students, however, usually get involved during their doctoral studies, thus gaining experience, and after obtaining the degree, they can already candidate to be elected to the position of an assistant professor.

**3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).**

**3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).**

**3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between**

**the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).**

When preparing a new study course, its author consults the programme director about the prior knowledge for the course, as well as about possible overlaps with other courses in the programme. It is evaluated, which semester of the study programme the course should be included in, based on the necessary prior knowledge. In addition to the course developers, the responsible teaching staff are also involved in the preparation of the content of the study courses and the relevant description, and this cooperation takes place not only in the case of the developing of a new course, but also when updating the content of the study courses, which takes place at least once every three years, but if necessary, also before each study semester. The programme consists of several study courses, which are taught by several members of the teaching staff, not including the lecturers involved in conducting practical work or correcting students' tests. For example, within the courses "Computer Architecture I" (2 lecturers), "Databases and Information Systems Fundamentals" (2 lecturers), "Software Engineering" (2 lecturers), "Basics of Software Development" (3 lecturers), the topics taught by each lecturer, the evaluation criteria of the course, the sequence of the content and presentation of topics are agreed upon.

In the 2020/2021 academic year 78 students studied in the programme at the beginning of the academic year. The ratio of students to teaching staff is 78/41, i.e., approximately 2 students per 1 lecturer, which is a small amount, however, since the study programme is integrated with the Bachelor's study programme in Latvian, it would be more meaningful to consider both streams together in the first three years, thus the ratio is (473+78)/41 = 551/41, which is more than 13 students per lecturer.

# Annexes

| III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme | | |
|---|---|---|
| Sample of the diploma and its supplement to be issued for completing the study programme | EN-III-1.annex-dipl_1.level.7z | III-1. pielikums 1.līm. dipl-piel.7z |
| For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable) | | |
| Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable) | | |
| Statistics on the students in the reporting period | EN-III-5.annex-student-stats-kol.docx | III-5.pielikums-st-statistika-kol.docx |
| III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof | | |
| Compliance with the study programme with the State Education Standard | EN-III-6.annex-compl-national-edu-std-kol (1).docx | III-6.pielikums-atb-izgl-stand-kol (003).docx |
| Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable) | EN-III-7.annex-compl-prof-std-kol .docx | III-7.pielikums-atb-prof-stand-kol.docx |
| Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable) | | |
| Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme | EN-III-8.annex-map-kol.docx | III-8.pielikums-karte-kol.docx |
| The curriculum of the study programme (for each type and form of the implementation of the study programme) | EN-III-9.annex-st-plan-kol.docx | III-9.pielikums-plans-kol.docx |
| Descriptions of the study courses/ modules | EN-III-10.annex-course-synopsis-kol.docx | III-10.pielikums-kursu-apraksti-kol.docx |
| Description of the organisation of the internship of the students (if applicable) | EN-III-2.annex Regulation_on_Internship.pdf | III-2.pielikums. Prakses_nolikums.pdf |
| III - Description of the Study Programme - 3.4. Teaching Staff | | |
| Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable) | | |
| Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable) | | |

# Computer Science (45483)

| | |
|---|---|
| Study field | *Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science* |
| ProcedureStudyProgram.Name | *Computer Science* |
| Education classification code | *45483* |
| Type of the study programme | *Academic master study programme* |
| Name of the study programme director | *Kārlis* |
| Surname of the study programme director | *Podnieks* |
| E-mail of the study programme director | *karlis.podnieks@lu.lv* |
| Title of the study programme director | *Profesors, matemātikas doktors* |
| Phone of the study programme director | *+371 67224363* |
| Goal of the study programme | *To prepare highly qualified export-capable IT specialists and managers for practical work in business companies and state institutions, to provide the industry with academically educated specialists prepared for scientific and pedagogical work in the following specialisations (branches of study):*<br>*80 CP studies:*<br>*• Computer Science (CS) – researchers and lecturers,*<br>*• Software Engineering (SE) – leading programmers and software project managers,*<br>*• Information Technologies (IT) – leading computer network specialists and project managers,*<br>*• Information Systems (IS) – leading database and information systems specialists and project managers,*<br>*• Computer Engineering (CE) – leading specialists and project managers of embedded systems,*<br>*• Bioinformatics (BI) – leading specialists in bioinformatics,*<br>*40 CP studies:*<br>*• Advanced Programming (AP) – developers and programmers of complicated algorithms.* |
| Tasks of the study programme | *To achieve its goal, the programme envisages the following tasks:*<br>*1. provide in-depth knowledge in the computer industry in general and in the selected specialisation (branch of study);*<br>*2. provide knowledge, develop skills necessary for modelling and analysis of large and complex systems;*<br>*3. provide knowledge, develop and improve skills necessary for the design and implementation of large and complex systems in the selected sub-programme;*<br>*4. provide knowledge and acquire skills necessary for managing projects and groups of specialists;*<br>*5. to develop the skills of scientific research work, which will allow to participate in research projects, start teaching work, continue studies in doctoral studies;*<br>*6. develop and improve the skills necessary for independent education for continuing students, to renew knowledge and professional development.* |

| | |
|---|---|
| Results of the study programme | *1. Knowledge (knowledge and understanding):*<br>*1.1.Graduates of the programme can demonstrate in-depth or extended knowledge and understanding, some of which corresponds to the latest developments in the relevant field of computer science and information technology [covered by EQANIE results section EM1] and which provide a basis for creative thinking or research, including working at the confluence of different fields [EM3].*<br><br>*2. Skills (ability to use knowledge, communication, general skills):*<br>*2.1.Graduates of the programme can independently use theory, methods and problem-solving skills to carry out research activities or highly qualified professional functions [EM2].*<br>*2.2.Able to give reasoned explanations and discuss complex or systemic aspects of the computer science and information technology industry with both specialists and non-specialists [EM6].*<br>*2.3.Able to independently advance the improvement and specialization of their competences, be accountable for the results of the work of personnel groups and their analysis, carry out business, innovations in the computer science and information technology industry or profession, carry out work, research or further learning in complex and unpredictable conditions and, if necessary, transform them, using new approaches [EM5, EM6].*<br><br>*3. Competence (analysis, synthesis and evaluation):*<br>*3.1.Graduates of the programme are able to independently formulate and critically analyse complex scientific and professional problems, justify decisions and, if necessary, perform additional analysis [EM3].*<br>*3.2.Can integrate knowledge from different fields, contribute to the creation of new knowledge, development of research or professional activity methods, demonstrate understanding and ethical responsibility for the possible impact of scientific results or professional activity on the environment and society [EM4].* |
| Final examination upon the completion of the study programme | *Master's Thesis in Computer Science* |

# Study programme forms

**Full time studies - 2 years - latvian**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *2* |
| Duration in month | *0* |
| Language | *latvian* |
| Amount (CP) | *80* |

| | |
|---|---|
| Admission requirements (in English) | *For specializations “Computer Science”, “Software Engineering”, “Information Technologies”, “Information Systems”, “Computer Engineering”: bachelor’s degree or second-level professional higher education in computer science; bachelor’s degree or second-level professional higher education in natural sciences, mathematics, engineering, management science or equivalent higher education and entrance examination. For specialization “Bioinformatics”: bachelor’s degree or second-level professional higher education in computer science.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Master of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Part time studies - 3 years - latvian**

| | |
|---|---|
| Study type and form | *Part time studies* |
| Duration in full years | *3* |
| Duration in month | *0* |
| Language | *latvian* |
| Amount (CP) | *80* |
| Admission requirements (in English) | *For specializations “Computer Science”, “Software Engineering”, “Information Technologies”, “Information Systems”, “Computer Engineering”: bachelor’s degree or second-level professional higher education in computer science; bachelor’s degree or second-level professional higher education in natural sciences, mathematics, engineering, management science or equivalent higher education and entrance examination. For specialization “Bioinformatics”: bachelor’s degree or second-level professional higher education in computer science.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Master of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Full time studies - 2 years - english**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *2* |
| Duration in month | *0* |
| Language | *english* |

| | |
|---|---|
| Amount (CP) | *80* |
| Admission requirements (in English) | *For specializations “Computer Science”, “Software Engineering”, Information Technologies”, “Information Systems”, “Computer Engineering”: bachelor’s degree or second-level professional higher education in computer science; or entrance exam and bachelor’s degree or second-level professional higher education in natural sciences, mathematics, engineering, management science or equivalent higher education. For specialisation “Bioinformatics”: bachelor’s degree or second-level professional higher education in computer science. Studies in English require English language skills at least at B2 level.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Master’s Degree of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Part time studies - 3 years - english**

| | |
|---|---|
| Study type and form | *Part time studies* |
| Duration in full years | *3* |
| Duration in month | *0* |
| Language | *english* |
| Amount (CP) | *80* |
| Admission requirements (in English) | *For specializations “Computer Science”, “Software Engineering”, “Information Technologies”, “Information Systems”, “Computer Engineering”: bachelor’s degree or second-level professional higher education in computer science; bachelor’s degree or second-level professional higher education in natural sciences, mathematics, engineering, management science or equivalent higher education and entrance examination. For specialization “Bioinformatics”: bachelor’s degree or second-level professional higher education in computer science. Studies in English require English language skills at least at B2 level.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Master of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Full time studies - 1 years - latvian**

| | |
|---|---|
| Study type and form | *Full time studies* |

| | |
|---|---|
| Duration in full years | *1* |
| Duration in month | *0* |
| Language | *latvian* |
| Amount (CP) | *40* |
| Admission requirements (in English) | *Bachelor of natural sciences in computer science or informatics sciences with a total study duration of at least 4 years or 160 CP; or a bachelor's degree or second-level professional higher education in the field of computer science or informatics sciences with a total study duration of at least 4 years or 160 CP and entrance examination.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Master of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | - |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

## 3.1. Indicators Describing the Study Programme

### 3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

The Master's study programme "Computer Science" is not a new programme that has recently been developed to meet the specific needs of the industry. It is a classic academic computer science programme that has been operating for 30 years (since 1992). Similar academic Master's programmes in computer science are implemented in many other universities in Latvia and abroad.

In the academic Master's programme, the emphasis is not so much on the acquisition of certain specific knowledge, skills and competences for immediate use in the workplace, but on the acquisition of the theoretical basis of the industry, which allows graduates to learn new technologies and fields of activity faster.

The framework of the programme's objective, tasks and learning outcomes, compared to the existing version of the programme, **have not been changed**.

An innovative approach to teaching methods is relevant for lower-level programmes, but not for Master's programmes with 23-25-year-old students with a completed Bachelor's education, who are aware of their study goal. Successful completion of a classic academic Master's programme is ensured by the already mentioned traditional methods.

During the pandemic, valuable experience has been gained with hybrid lectures: in the fall of 2020, we tried to introduce the voluntary principle in regular face-to-face learning, ensuring the broadcasting of all lectures on the Internet and saving of records in the archive. Students could assess the health risks themselves, deciding whether to come and participate in person or do it remotely – from their workplace or home. It turns out that after only a few lessons, the number of attending students in the course dwindles to a few or even to zero. It seems that (at least in the Master's programme) the benefits of 100% remote learning (saving travel time, which is especially important for working students, lower risk of infection) far outweigh the losses (breaking an outdated psychological habit, at the beginning – less intensive contacts with lecturers). It is assumed that extensive practice of remote lectures will remain in the programme even after the end of the pandemic.

The programme is a sought-after classic computer science Master's programme that has been running for 30 years. Changes in the national economy affect it only in longer periods, not every 2 or 6 years. And yet, from the fall of 2017 to the fall of 2021, several (from the industry's point of view) valuable innovations were introduced into the programme.

In the fall of 2017, in response to the proposal of the company *Accenture Latvia*, the programme offered the possibility (during or outside of studies) to obtain *Big Data Analyst Certificate*. By June 2021, 24 such certificates were issued – 18 to students and 6 to paying course participants of the industry. The certificate is issued by the Faculty of Computing (it bears the signatures of the Chairman of the Faculty Council and the dean). To receive the certificate, the following study courses of the programme must be successfully completed (each in the amount of 4 CP): Data

processing systems (optional introductory course), Data mining algorithms, Selected topics in mathematical statistics for computer science, Selected Topics about Data Warehouses, Big data technologies, Deep machine learning. The experience so far shows that students can complete this set of courses in 2 or 3 semesters, and paid course participants from the industry – in 4 or more semesters.

Starting from the spring of 2018, the Master's programme has offered a new industry-relevant course "DatZ6082 Big Data Technologies" (4 CP). The topics of the course correspond to the field of the research work of both course lecturers.

From the fall of 2018, the programme has offered a new sub-programme, which is unique in Latvia, i.e., "Bioinformatics", which is implemented in cooperation with the UL Faculty of Biology and is intended as a continuation of the Computer Science Bachelor's programmes. Students of this sub-programme learn a set of specially selected biology courses in the amount of 30 CP, computer science courses in the amount of 26 CP, as well as defend a Master's coursework and a Master's thesis on bioinformatics. The number of students enrolled in the sub-programme: In 2018 – 7 students, in 2019 – 7 students, in 2020 – 1 student, in 2021 – 12 students. The number of graduates: In 2020 – 1 student, in 2021 – 5 students.

Starting from the spring of 2020, the Master's programme has offered a new industry-relevant course "DatZ6090 Computer security and vulnerabilities" (4 CP).

Starting from the autumn of 2021, the Master's programme has offered a new industry-relevant course "DatZ7101 Open Government Data in a data-driven world" (2 CP). The topics of the course correspond to the field of research of the course lecturer's research work (including the recently defended doctoral thesis).

Starting from the 2022/2023 academic year amendments are planned to the compulsory part of the programme:

a) the course "DatZ5057 Data Processing Systems" is included to replace the courses "DatZ6009 Software Quality" (2 CP) and "DatZ6015 Applied Cryptography" (2 CP). The mentioned two courses have proved to be too difficult for students coming from non-computing undergraduate programmes.

b) the entire compulsory part in the amount of 24 CP is also allocated to the sub-programme "Bioinformatics". In the existing version of the programme, only 8 CPs out of 24 were allocated to this sub-programme. This amendment has a serious drawback, i.e., now only 2 CP remain for the free elective part of the specialisation.

**Part-time regular studies**

In the new version of the program, we offer a part-time regular studies (NLK) option. The admission requirements for NLK will be identical to those for full-time regular (PLK) studies. The decision to announce admission to NLK studies has not yet been made, but this decision will not affect the operation of the program and will not cause additional costs, because in the NLK study version we offer, students will study and complete all study courses together with PLK students. No specific course versions will be needed for NLK. NLK and PLK will use common lecture schedules for the fall and spring semesters. Only the study plans differ, in which the study load in PLK is divided into 4 semesters, while in NLK - the same study load is divided into 6 semesters. The load of one NLK semester is then 12 CP (in the first five semesters), which would be more convenient for working students than the 20 CP semester load of PLK. The exception is the sixth semester, when a master's thesis in the amount of 20 CP must be developed. See details. in Annex V-9.

Thus, in the NLK studies the number of contact hours in study courses corresponds to PLK, but the

total number of CP in the academic year is less than 40 CP and the number of contact hours is less than 40 academic hours per week.

If budget studies were allowed at NLK, there is no doubt that (due to the more favorable workload) this form of study would be chosen by the majority of working students. We would like to invite you to allow budget studies also for the NLK form.

Three new, just developed study courses have been included into the new of the programme: "DatZ6103 Practical combinatorial optimization" (2 CP, industry relevant), "DatZ6105 Blockchaines for Business" (4 CP, industry relevant), "DatZ7079 Program correctness" (4 CP).

A unified study process (i.e., common lecture schedule) for full-time and part time students will increase the number of groups of students studying together, making studying in the master's programme more convenient.

This is the only available way to ensure the implementation of part-time studies with the existing available teachers and study rooms – no study course will have to be conducted twice.

**One-year studies**

In the new version of the programme, we also offer a one-year full-time regular study option in Latvian. The volume of studies has been reduced to 40 CP, including 20 CP for developing a master's thesis. Only one specialization is provided, i.e. "Advanced Programming", which is focused on the development and programming of complex algorithms. In such one-year studies, we will admit only the graduates of a **four-year** bachelor programmes in the field of computer science. From the students' perspective, the study plan of this specialization (see **Annex V-9**) is composed of "heavy" subjects. Therefore, those students who will succeed in them will really have obtain the same master's degree as graduates of two- and three-year specializations.

**3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.**

***Annex V-3*** *contains a sample of the diploma issued for completing the study programme and its annexes in accordance with the Regulations of the Cabinet of Ministers of 16.04.2013 No. 202 "The procedure for issuing state-recognized documents certifying higher education".*

*A study contract sample according to the Regulations of the Cabinet of Ministers of 23.01.2007 No. 70 "Terms and conditions that must be included in the study contract" are attached in* ***Annex II-3.***

*The opinion of the Council of Higher Education in accordance with the Article 55 Section 2 of the Law on Higher Education Institutions is attached in* ***Annex V-11.***

Our Master's study programme is a classic academic computer science programme. Similar programmes are implemented in many foreign universities and will always be relevant. From time to time (in the past it was mandatory in every re-accreditation) we review the relevant Master's programmes in Computer Science (informatics) of the technical universities of Berlin and Munich,

and thus make sure that we “keep up” with them.

**Entry exam procedure**

It should be especially noted that the approved admission conditions provide the opportunity to study in the programme not only for computer science bachelors, but also for bachelors of other related fields, i.e., mathematicians, physicists, engineers, management scientists, economists, etc. First, we ask candidates to read this information: https://www.df.lu.lv/fileadmin/user_upload/LU.LV/Apaksvietnes/Fakultates/www.df.lu.lv/mag_progr_saturs_2022.pdf (only in Latvian).

and get familiar with detailed information about studies in the programme, and to assess their own interest and adequacy for the studies. After that, through meetings we discuss the main question: whether the applicant’s previous education and/or work experience in the three main areas (mathematics, programming and working with databases) is sufficient for successful studies in the programme. If the student still wishes to study despite insufficient competence, the missing competences must be obtained either before or simultaneously with the studies in the programme.

A special situation is in the specialisation “Bioinformatics” - we admit only students with Bachelor degree in Computer Science. The study plan of this specialisation includes biology study courses in the amount of 30 CP (classes are held at the UL Faculty of Biology) and computer science courses in the amount of only 26 CP. Only Bachelors of Computer Science can apply for this degree, but not bachelors of related fields who would have completed only 26 CP of computer courses.

There is also a special situation in the one-year study version – in it we plan to admit only graduates of four-year computer science bachelor’s programmes.

The composition and content of the programme’s study courses clearly shows that it is a classic academic master’s programme in the field of computer science, therefore it corresponds to the field of study for which its accreditation has been applied for.

Therefore, the interconnection of the programme name, code, obtainable degree, objectives, tasks and learning outcome is easy to determine. All specializations are created from a common set of study courses. Firstly, the compulsory part in the amount of 24 CP was separated from this set, which covers all classic topics of computer science and must be studied in all specializations (except for the one-year course). This vast common compulsory part also confirms that all specializations belong to the same study programme. One of the compulsory part courses is “IT Project Management”, which confirms our ambition to train project managers.

Then each specialization has its own specific compulsory part in the amount of 12-16 CP from the common set of courses. The exception is the specialization “Bioinformatics”, the specific mandatory part of which is 34 CP, including biology courses in the amount of 30 CP.

For example, the specific compulsory part of “Software Engineering” includes the following courses in the amount of 14 CP:

DatZ5006: Design and analysis of efficient algorithms (4 CP), DatZ5010: System design (4 CP), DatZ5013: Software Testing (4 CP), DatZ6009: Software Quality (2 CP).

On the other hand, the specific compulsory part of “Information Systems” includes the following courses in the amount of 12 CP:

DatZ5010: System design (4 CP), DatZ5038: Enterprise information systems (4 CP), DatZ6054: Selected Topics about Data Warehouses (4 CP).

For detailed information on the other specializations, see the study plans in **Appendix V-9**.

Another non-trivial aspect is linking the learning outcomes of the programme and study courses. The mapping of study courses for achieving the learning outcomes of the study programme is presented in **Appendix V-8.**

The amount of content to be learned in the two-year full-time studies of the programme is adapted to the maximum duration studies established by law (2 years, 4 semesters, each 20 CP must be obtained, the last semester is intended for the development of a master's thesis). In the studies of the part-time programme, the same amount of content must be learned, spreading it over a longer period of study. We have chosen 3 years (6 semesters, 12 CP to be obtained in each, except for the last semester, when a master's thesis in the amount of 20 CP must be developed).

A special situation is in the one-year studies, in which out of the total 40 CP, 20 CP are ascribed to the development of the master's thesis, therefore only 20 CP remain for distribution among the study courses. Due to such a volume, it was possible to compile study courses for only one serious specialization – "Advanced Programming". All other options turned out to be too "lightweight" to be able to issue the same diploma as in 80 CP studies.

### 3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

The Master's study programme "Computer Science" has been operating for 30 years. During the entire 30 years, graduates have had no problems with getting a job. Most students remain in the companies and organizations where they were working during their studies.

More accurate data for 2017 and 2018 can be obtained from the table compiled in March 2021 by the Ministry of Education and Science (programme code 45481, fiscal year – 2019):

2017: 43 graduates of the programme, 40 of them employed, 0 unemployed, average annual income – 32,910 EUR.

2018: 43 graduates of the programme, 40 of them employed, 0 unemployed, average annual income – 29 879 EUR.

From the results of the employer survey conducted in 2021:

Five of the 13 interviewed ICT companies described graduates of the field as follows: "After a short training/introduction to the workplace, they were able to perform their job responsibilities". Four more companies pointed out: "They were well theoretically prepared, but they had insufficiently acquired practical skills". One of the comments said: "UL graduates relatively easily learn new technologies and practices needed to work in real projects".

These conclusions are well in line with the formulated objective of the programme (as an academic Master's programme): the emphasis is on theoretical preparation, as it ensures faster acquisition of new technologies.

The general economic context of ICT education is described in the relevant section 3.1.3 of the bachelor's programme. Within this context, the the objective of the Master's study programme is "to prepare highly qualified export-capable IT specialists and managers for practical work in business companies and state institutions, to provide the industry with academically educated specialists prepared for scientific and pedagogical work". The demand of the industry and the labour market for such employees and managers seems obvious, but we have not studied it

quantitatively. However, the consistently high number of applicants for the programme and positive feedback from employers about our graduates confirm that the content of the programme meets this demand.

### 3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

Statistical data on students during the reporting period are shown in **Annex V-5.**

The popularity of the programme (the number of matriculated students per year) does not decrease; we have been accepting 100 or more students for the last few years. The exception is the last two years, when the number of matriculated students decreased. This could be explained by the impact of the pandemic.

**Foreign students** have not studied full-time in the programme yet and are not studying in it now. In rare cases, a foreign national takes individual programme courses from those available in English.

There is a stable and high dropout rate after the 1st year – in the 2nd year, an average of 60 out of 100 admitted students remain. Students who have not earned any credit points or who have earned very few credits in the first semester are mostly expelled.

The number of graduates has decreased to the current stable level – an average of 35 graduates per year.

Basically, the 1st semester serves us as an “extended entrance exam”, which tests students’ motivation, ability to study intensively (while simultaneously working in industry), as well as previous preparation in computer science and mathematics.

In principle, this dropout rate could be reduced by admitting fewer students, i.e., by creating a real competition for state-budget funded places, by introducing certain requirements for applicants’ grades received in the Bachelor’s programme. It would also be possible to abandon the current practice of admitting not only Bachelors of Computer Science programmes, but also mathematicians, physicists, management scientists, engineers, etc., because the dropout rate is even higher in this category of students. However, we have refused to do so, because students from all categories “drop out”, and people from all categories also successfully graduate from the programme. We believe that it is better to give non-computer-related students the opportunity to start their studies after consultation with the programme director, but ultimately “on their own responsibility”.

Ourselves, we could identify the reasons for withdrawal from the studies only in respect to those ~10% who withdraw by submitting a written application. The rest are expelled without their consent as having not fulfilled the obligations of the study contract, because they do not answer to e-mails and phone calls of the study methodologist. Those who withdraw upon their written an application, mention the following reasons for withdrawal:

- it is difficult to combine work with studies 30%
- I have academic debts, I will enrol again (and they enrol) 50%
- I realized that this is not what I would like to study 5%

- I go to work (often – sent by the employer) abroad 15%.

Some of those who drop out due to academic debt and re-enrol a year later and complete their studies successfully.

Data about reasons of withdrawal of 39 students during the period from autumn 2018 until spring 2022 (table received 20/12/2022 from UL Academic department):

Reasons / Noted as significant by

| | |
|---|---|
| I cannot pass the academic obligations | 79% |
| Limited financial funds to cover study or living expenditures | 54% |
| Lost state-financed study place | 39% |
| Unable to combine studies with job | 31% |
| Lack of motivation to continue studies | 26% |
| At the beginning of studies there was no programme in which I was interested | 18% |
| No interest in the chosen study programme | 5% |
| Misconception about the content of programme | 5% |
| Insufficient previous knowledge and background for studies | 5% |
| Insufficient learning skills | 5% |
| Unsatisfied with lecturers' attitude towards students | 5% |
| Conflicts with lecturer(-s) | 5% |
| Unsatisfied with the overall programme quality | 3% |
| Personal reasons (family, health or other conditions) | 3% |

The number of graduates of the **sub-programmes** by year:

| Year | BI | CE | CS | IS | IT | SE |
|---|---|---|---|---|---|---|
| 2017 | 0 | 0 | 1 | 18 | 6 | 16 |
| 2018 | 0 | 0 | 4 | 8 | 3 | 20 |
| 2019 | 0 | 4 | 5 | 7 | 4 | 11 |
| 2020 | 1 | 2 | 5 | 3 | 5 | 22 |
| 2021 | 5 | 0 | 4 | 5 | 2 | 15 |

The number of students enrolled in sub-programmes in 2021:

| Year | BI | CE | CS | IS | IT | SE |
|---|---|---|---|---|---|---|
| 2021 | 14 | 2 | 20 | 24 | 6 | 24 |

It can be observed that the sub-programme SE is consistently strong, and the sub-programmes BI and CS are “gaining momentum”, but CE remains consistently small. A new phenomenon is the “decline” of IS in terms of the number of graduates. Without a more detailed analysis of student data, it is difficult to explain this phenomenon for the time being.

We did not retain admission statistics for sub-programmes,  only graduation statistics has been retained (see above).

**3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).**

## 3.2. The Content of Studies and Implementation Thereof

**3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.**

*The table on the compliance of the study programme with the national education standard is shown in* ***Annex V-6***

*Study programme plan (for each type and form of study programme implementation) is attached in* ***Annex V-9****.*

*Descriptions of the study courses (modules) of the study programme (information included in study courses/modules) is shown in* ***Annex V-10.***

*The mapping of study courses for achieving the learning outcomes of the study programme are shown in* ***Annex V-8.***

To achieve the common objective of the programme, compulsory study courses in the amount of 24 CP are provided.

To achieve the specific goals of spcialisations, courses of the compulsory part of specialisation in

the amount of 12-16 CP are provided for each of them (the exception is “Bioinformatics”, in which the compulsory part has 34 CP, including biology courses in the amount of 30 CP).

In addition to learning the compulsory subjects, students are also provided with: a limited elective part in the amount of 18-22 CP (the exception is “Bioinformatics”, in which the limited elective part has 0 CP) as well as a free elective part in the amount of 2 CP.

For study plans, where all this is implemented, see **Annex V-9**.

In the descriptions of study courses (see **Annex V-10**) the results of each course are mapped with special codes (EMxx, emxx) to the programme results. The code EMxx means that the relevant study course outcome *considerably support* the achievement of programme outcome EMxx. The code emxx, on the other hand, means that the corresponding result of the study course *promotes* the achievement of programme outcome EMxx.

We have chosen this coding system (see the programme parameters section “Achievable learning outcomes”), because in parallel with the accreditation of the programme in Latvia, we plan to accredit it also in the EQANIE network, where this system is mandatory.

For example, in the learning outcomes of the course “Data Mining Algorithms” (4 CP) we can, *inter alia*, see:

Skills: 2) Practically solves data mining tasks using free access software (analysis EM23, implements EM32, em33).

In the programme outcomes classification, however, we can see:

EM32: fully specifies extremely complex, incompletely defined or unusual computing tasks,

EM33: use the best existing or innovative methods for solving tasks, possibly involving the methods of other disciplines,

Thus, the learning outcome Nr. 2 of the data mining course supports the achievement of the programme outcome EM32, and contributes to the achievement of the programme outcome EM33.

A complete mapping of the study course outcomes for achieving programme outcomes is shown in **Annex V-8**.

We use this mapping only as a test and analysis tool. For example, in the tables of Appendix V-8, one can observe the only case where some of the programme outcomes are not covered, i.e., in the “Bioinformatics” specialisation:

EM41: demonstrate an understanding that a high level of professional and ethical behaviour is required in computing,

EM62: assess the skills needed to work with (and lead) teams made up of people of different backgrounds and skill levels.

These outcomes could be achieved by those students who would choose the course “Selected Topics about Data Warehouses” (4 CP) and/or the course “Web Programming” (4 CP) in the B (limited elective) part. Unfortunately, the “Bioinformatics” does not have a limited elective option.

**Program update**. The programme includes six new (among them - four are industry-relevant) study courses, which are described in section 3.1.1. Moreover:

The course “DatZ6111 Information Technology Project Management (4 CP)” has been modernized and replaced with a new course “DatZ6089 IT Project Management (2 CP)”.

The course “DatZ6008 Component-based software development (4 CP)” has been excluded from

the programme as an outdated course.

Due to low popularity, the course “DatZ6088 Universal and domain specific modelling languages (4 CP)” has been excluded as unsuccessful.

See Section 3.1.2 for examples of parameter differences between specialisations. For detailed information on all specialisations see study plans in **Annex V-9**.

### 3.2.2. In the case of master’s and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

Programme has been operating for 30 years, and this is already its sixth accreditation. Similar classical Master’s programmes operate in other universities in Latvia and abroad. Thus, to justify “whether the awarding of degrees is based on the achievements and findings of the relevant field of science of artistic creation” in this case means to compare the composition of the courses studied in the programme with other universities.

The composition of the courses studied in the classic academic Master’s programmes in computer science (informatics) is similar in all higher education institutions. We used to be able to make sure of this regularly, because in the first four accreditations we were required to make a detailed comparison with at least two foreign universities. We chose German and French universities. In the fifth accreditation, instead, only a cursory comparison with “competing” Latvian universities was required.

We would like to claim that the situation has not changed in this sense even today. The programme is constantly updated with new, industry-relevant study courses (see section 3.1.1). Since we regularly advise our ERASMUS exchange students on which study courses they should take from the relevant foreign university, we see that the topics of the offered courses are similar to ours, differing only in approaches and emphases.

Example. For exchange studies in the 2nd semester at the Polytechnic University of Madrid, the student has chosen a very good set of software engineering courses in the amount of 30 ECTS:

Software Quality Management (4 ECTS), Software Design (4 ECTS), Correctness by Construction (6 ECTS), Experimental Software Engineering (6 ECTS), Software Architecture (4 ECTS), Agent Based Software Engineering (6 ECTS).

Upon his return to Riga, we will count this set as having completed the following courses of our program:

Software Quality (3 ECTS), Software Testing (6 ECTS), System Design (6 ECTS), Parallel algorithms (3 ECTS), Web programming (6 ECTS), Knowledge Engineering (6 ECTS).

### 3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study

**programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.**

Being a classic academic computer science programme, our programme is implemented using traditional methods: lectures, practical and laboratory work, seminar classes with student papers, tests during the semester and during the exam session, larger or smaller homework projects (including those that require the use of special software of the relevant profile).

The evaluation process of learning outcomes is spread throughout the semester (homework and midterm evaluations make up at least 50% of the final grade of each course, and the exam – no less than 10%). This distribution encourages students to work throughout the semester, not just during exam sessions.

A specific and innovative approach to teaching and evaluating is necessary in Bachelor's study programmes, but in Master's programmes there are 23-25-year-old students with a completed Bachelor's education, who are aware of their study goal. Successful completion of a classic academic Master's programme is ensured by the already mentioned traditional methods of teaching and evaluating.

The use of e-study environment can no longer be considered an innovation (the UL uses *Moodle*), in which students have access to lecture materials, in addition to study materials related to course topics, as well as course tasks (tests, homework, seminars). All study course midterm and final exam evaluations with grade justification are recorded and are available to students in the e-study environment.

The pandemic has introduced distance learning of study courses using environments such as *MS Teams* and *Zoom*. In many courses, students can choose which lectures to participate in person, and which to listen to at home or at the workplace, without wasting time on transportation. These environments also provide access to recordings of classes and consultations. Experience shows that students use these records to a large extent.

The observance of student-centred teaching principles is most pronounced in three study courses: "Knowledge Engineering", "Systems Design", "Software Testing". In these courses, a significant part of the course material is acquired in the form of reports-discussions: individual students are instructed to independently study reference and prepare reports about them. The reports are read by their authors during the classes and its content is discussed immediately afterwards. Students get extra points to the final grade of the course for preparing reports and participating in discussions.

Another variant of the student-centred approach is used in the course "Data Mining Algorithms", i.e., after each lecture, homework is assigned, in which the material presented in the lecture must be used to solve specific tasks with the help of appropriate free access software.

**Student mobility**. Students use opportunities for outgoing mobility, and what they learned during mobility is recognized. The number of outgoing students (within ERASMUS+) in the programme is small, because almost all students work full-time during their studies, therefore they are not able to go on study visit. For statistics by year and country, as well as trend analysis, see section 2.5.3. Students spend one semester (first, second or third) in foreign universities. The credit points of the

completed courses are recognized either by equated to the courses of the programme, or by registering them as having no counterpart in the programme. The equating is not always exact, as there are universities where the typical course value is 7.5 ECTS (5 CP), which does not match our course value (2 CP or 4 CP). In such cases, we equate not individual courses, but groups of courses. For an example, see Section 3.2.2.

When concluding the study agreement, a student chooses the specialization in which to study. 20 CP must be obtained in each of the 4 semesters. The exception is the specialization "Bioinformatics", in which the distribution of credit points by semester is slightly different: 19, 19, 22, 20. This deviation has arisen by coordinating the study plans with the Faculty of Biology of the University of Latvia, which provides us with biology courses in the amount of 28 CP.

**3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).**

**3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).**

**3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.**

Through the analysis of 95 Master's theses that were defended in the spring sessions of 2019, 2020 and 2021, we can divide them into three categories:

1. Theoretical computer science (mainly mathematically oriented theses with the development of new algorithms and theorem proving, for example in the field of quantum computing).
2. Experimental computer science (testing, analysing, and comparing system software tools, software prototyping and experimental evaluation, and other experiments).
3. Applied research (analysis of real business processes, software development and operation processes in specific companies in order to improve them, development of systems and software components for real use in a specific company or to offer on the market, etc.).

Examples of titles of theses:

*Theoretical:* Sub-Quadratic Algorithm for the Tree Path Subsequence Problem, Classical and

quantum algorithms for particle tracking, Quantum algorithms for graph treewidth.

*Experimental:* Natural Language Deep Neural Network Transformer GPT-2 Performance on Latvian and English Language, Business process concurrent execution, Execution of visual semantic queries over relational databases.

*Applied:* Cloud service provider comparison for "TIA" insurance system, Analysis of change implementation within a highly regulated environment in a large enterprise, Automated selection of structural parameters for insulated glass units, Use and implementation of software development methods in compliance check of IT general controls.

The so-called "relevance of topics" during the defence of the theses did not raise doubts in any of the 95 cases.

Of the 95 analysed Master's theses, 7 were included in the theoretical category, 58 in the experimental category, and 30 in the applied category (by year, respectively: 2019 – 3, 20, 8, 2020 – 0, 21, 15, 2021 – 4, 17, 7). The predominance of experimental theses among Master's theses can be considered a very healthy trend. But applied research is also not forgotten – it makes up a third part of all the theses.

The following grades were given for the analysed works: outstanding – 12 (12%), excellent – 21 (22%), very good – 34 (36%), good – 20 (21%), almost good – 4 (4%), satisfactory – 3 (3%), almost satisfactory – 1 (1%). The proportion of the weakest grades is low because most of the students who did not manage to prepare a high-quality thesis for the spring session continue their work and successfully defend their thesis in January of the following year.

The assessment of the relevance in the "labour market" is not applicable to the final theses of students of the academic master's programme. The scientific and practical relevance for the industry is evaluated by reviewers, all of whom are at least doctors of science. During the mentioned period, there was no case where the mark for the work had to be lowered due to an outdated topic. In rare cases, the student did not sufficiently study the achievements of the field and chose an outdated method or approach to solve the problem.

## 3.3. Resources and Provision of the Study Programme

### 3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

Up to now, the on-site classes of the programme took place in the UL Institute of Mathematics and Computer Science, Raiņa Boulevard 29. The exception is the lectures of prof. L. Seļāvo and prof. S. Zariņa, which take place in the building at Raiņa Boulevard 19, and prof. V. Fomins' classes, which take place remotely, because the visiting professor holds them being located at Vilnius University. Three rooms are available for programme classes in the UL Institute of Mathematics and Computer Science: Auditorium 413 (up to 70 seats, equipped with a video camera for web transmission), Auditorium 414 (up to 40 seats) and Room 210 (up to 20 seats for seminars). Computer classrooms

are not used by students of our programme (there are none in the UL Institute of Mathematics and Computer Science building; computer classrooms could be used in the building in Raiņa Boulevard 19, but there is no such need). In the computer engineering courses conducted by L. Seļāvo, his laboratory equipment is used in the building on Raiņa Boulevard 19.

The literature available in UL libraries provides information necessary for research, course preparation and studies. However, there is a tendency to decrease the use of printed sources by shifting to online publications: course materials developed by instructors, specified online resources.  This could be due to the specificity of computing as a field of science and industry. For LU library details, see Section 2.3.3.

Both in terms of auditoriums and information, the needs of the programme are fully met.

Due to the transfer of a large group classes of other programmes from the faculty's premises on Raina bulv. 19 to the buildings of the Academic Centre of the University of Latvia in Torņakalns, the facilities have been freed up. Therefore, starting with the autumn semester of 2022/2023 academic year, all programme classes have been moved to the premises of the faculty on Raina bulv. 19.

Thus, from now on, the description of the resources available for the implementation of studies and achievement of learning outcomes can be found in sections 2.3.1 Financing, 2.3.2. Infrastructure and facilities and 2.3.3. Methodological and information resources of the report.

Since the resources for the implementation of Computer Science study programmes are used in an integrated manner at all study levels, both the same premises and different material resources are used, it is reasonable to refer to the general description of the de-gree programme.

The facilities are sufficient for the implementation of the programme; it creates prerequisites for achieving the learning outcomes, ensures the specific nature of compu-ter science, for example, in terms of computer classes and computer technology, as well as in terms of informational resources in the field of computer science. If necessary, pro-vision of resources is developed.

**3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).**

**3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).**

The programme uses only the state budget financing through the budget places allocated to it. For the 2021/2022 academic year 121 state-budget funded places have been allocated. In some

semesters, students who have academic debts study using their personal financing. These tuition fees do not play a major role in the operation of the programme.

Until now, studies in the programme were conducted only on a full-time regular basis and in Latvian, in a unified study process for all sub-programmes. No study course was conducted twice. Therefore, it was not necessary to account for the costs of each sub-programme separately.

The planned three-year part-time regular studies and one-year full time studies in the Latvian language will also take place in a single unified study process with the current two-year full-time regular studies, without singling out specialisations. No study course will be conducted twice. One should only expect a larger number of students in the classrooms, taking tests and for checking of individual work.

Minimum number of students for profitability of the programme:

PLK (2 years, Latvian) – 121 students (the specified number of state-funded study grants),

PLK (2 years, English) – 68 students,

NLK (3 years) – 45 students,

PLK (one year, Latvian) – 25 students.

Tuition fee:

PLK (2 years, Latvian) – 3670 EUR/year,

NLK (3 years, Latvian) - 2000 EUR/year,

PLK (2 years, English) – 4500 EUR/year,

NLK (3 years, English) – 3000 EUR/year,

PLK (one year, Latvian) – 3670 EUR/year.

The minimum number of students for admission to the 1st year in all study forms and types: 10 students.

For a detailed calculation, see **Annex V-7**.

## 3.4. Teaching Staff

**3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.**

*Confirmation that the academic staff of the academic study programme meets the requirements Article 55 Section 1 Paragraph 1 the Law of Higher Education Institutions is attached in* ***Annex***

***IV-10.***

The study courses of the programme are currently taught by 38 teachers, including: elected professors (13), associate professors (5) and assistant professors (8) of computer science, as well as 1 visiting professor of computer science. In the “Bioinformatics” sub-programme, biology courses are taught by 3 professors, 2 associate professors and 3 lecturers (1 with a doctor'' degree, 2 with a master's degree) of biology. Some courses are also taught by 1 professor of mathematics, 1 professor of philosophy and 1 professor of arts.

During the reporting period, there were only two episodes during one semester, when the course was taught by a recent doctor of computer science, who was immediately elected to the position of assistant professor upon teaching results.

Such composition of teaching staff of the programme far exceeds the requirements of regulatory acts. In particular, in all variants, the compulsory part of the programme is taught exclusively by professors and associate professors.

The qualifications of the teaching staff are thoroughly assessed upon election to academic positions of the faculty. Therefore, no additional ‘adequacy assessment’ is required.

Almost all the study courses of the programme are taught by the authors, co-authors of these courses or successor teachers prepared by them. In our opinion, this is the best way that the qualification of teaching staff can help to achieve study results. Competitions for teaching positions for already prepared study courses do not take place within the programme, competitions are held in the faculty only for positions in departments.

### 3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

During the reporting period, two senior professors (at the age of 76 and 80, respectively) ended their teaching activities. In a timely manner, several years earlier, younger teaching staff was allocated to the courses taught by these professors who taught the courses together with the professors. Several other professors of the older generation (71, 73, 73 and 76 years old respectively) continue to be active by teaching study courses and holding leading positions in the faculty. The oldest of them involved younger colleagues in teaching his courses, thus preparing his replacement. The age of the other teaching staff of the programme does not exceed 59 years. During the reporting period, five new, newly elected assistant professors started teaching the programme courses. This process is natural, and so far, there has been no need to manage it in any special way.

The teaching staff has changed for the following courses: “Knowledge Engineering” (the professor retired, replaced by a younger professor, both are research colleagues), “System Design” (the professor conducts the course together with an assistant professor – his research colleague, who will take over the course from him), “IT Project Management” (the professor passed the course to an associate professor – now already a full professor, who has radically modernized it), “UNIX Operating System” (the professor passed the course to an assistant professor – the faculty’s main computer network specialist), “Game Theory” (the course of a deceased professor was taken over by his former doctoral student, now an assistant professor).

**3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).**

**3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).**

**3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).**

The idea to prepare a new study course usually comes from the programme director or the potential course author. If the programme director (through consultations with the other professors of the programme) accepts the idea, the course authors consult with the programme director about the necessary prior knowledge for the course (including the difficulties that might arise for students who have not studied in the UL Faculty of Computing Bachelor's programme "Computer Science") and potential points of overlap with other programme courses. If necessary, the new course includes a small revision of the background material, or students are instructed on where to find such material.

Within the programme, the ratio of the number of students and teaching staff (in physical units) as of 01.10.2021: 160/36, i.e., approximately 4.5 students per 1 teacher (computer science teachers: 160/27, or approximately 6 students per 1 teacher). These average numbers are not particularly important, since a large number of the programme's instructors also work in the Bachelor's programme in Computer Science.

It would be more significant to examine the number of students in study courses. For example, in the 2021/2022 academic year, a total of 50 study courses were held in the programme. The number of registered students in the courses was distributed as follows:

| 50+ students | 25-49 | 10-24 | 5-9 | 2-4 |
|---|---|---|---|---|
| 4 courses | 16 | 19 | 9 | 2 |

Despite the very small number of students (2-4), the last two courses took place anyway, as they are compulsory courses of the CE sub-programme.

Interlinking of courses is handled by the programme director at the beginning of the preparation of each new or upgraded course. The analysis is performed on which learning outcomes of other courses the new course can rely on. To make the courses accessible to students from non-computer bachelor programmes, it is often necessary to include repetitions of study materials, or to reserve time for students' independent work for acquiring the missing study content.

The lecturers who conduct the joint courses cooperate with each other: a group of five lecturers for the course "Mathematics for Computer Science I, II" and three groups of two lecturers each for the courses "Knowledge Engineering", "System Design", "Big Data Technologies". In one of these cases, the professor works together with a university lecturer who will take over the teaching of the course from him.

# Annexes

| III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme | | |
|---|---|---|
| Sample of the diploma and its supplement to be issued for completing the study programme | Annex V-3. Diploma with annexes.zip | Pielikums V-3. Diploms ar pielikumiem.zip |
| For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable) | Annex V-11. Decision of the Council of Higher Education.docx | Pielikums V-11. AIP atzinums par maģistra programmu.pdf |
| Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable) | | |
| Statistics on the students in the reporting period | Annex V-5. Student Statistics V2.docx | Pielikums V-5. Studentu statistika V2.docx |
| III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof | | |
| Compliance with the study programme with the State Education Standard | Annex V-6. Compliance with education standard V2.docx | Pielikums V-6. Atbilstība valsts izglītības standartam V2.docx |
| Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable) | | |
| Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable) | | |
| Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme | Annex V-8 Mapping of learning outcomes V3.xlsx | Pielikums V-8 Studiju rezultātu kartējums V3.xlsx |
| The curriculum of the study programme (for each type and form of the implementation of the study programme) | Annex V-9. Study plans V3.zip | Pielikums V-9. Studiju plāni V3.zip |
| Descriptions of the study courses/ modules | Annex V-10. Course Descriptions V2.docx | Pielikums V-10. Kursu apraksti V2.docx |
| Description of the organisation of the internship of the students (if applicable) | | |
| III - Description of the Study Programme - 3.4. Teaching Staff | | |
| Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable) | | |
| Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable) | IV-10. Certification by the Head of Direction.edoc | IV-10. Virziena vadītāja apliecinājums.edoc |

# Computer Science (43483)

| | |
|---|---|
| Study field | *Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science* |
| ProcedureStudyProgram.Name | *Computer Science* |
| Education classification code | *43483* |
| Type of the study programme | *Academic bachelor study programme* |
| Name of the study programme director | *Zane* |
| Surname of the study programme director | *Bičevska* |
| E-mail of the study programme director | *Zane.Bicevska@lu.lv* |
| Title of the study programme director | *Dr.sc.comp./Dr.dat.* |
| Phone of the study programme director | |
| Goal of the study programme | *The objective of the Bachelor's programme in Computer Science is to pre-pare specialists who are able to design and develop complex applications and information systems* |
| Tasks of the study programme | *1. to provide basic knowledge in the computer industry in general and in the chosen degree programme,*<br>*2. to provide basic knowledge in the foundations of mathematics of com-puter science,*<br>*3. to provide knowledge, develop skills necessary for the design and devel-opment of complex applications and information systems,*<br>*4. to develop the first skills of scientific research work, which will allow to participate in research projects, to continue studies in the Master's degree,*<br>*5. to develop skills necessary for independent continuation of education, renewing knowledge and professional development.* |

| | |
|---|---|
| Results of the study programme | *The requirements of learning outcomes are detailed in the document "Euro-Inf Framework Standards and Accreditation Criteria for Informatics Programs. New Programme Outcomes" (last update – 12.10.2015), which was approved by the organization "European Quality Assurance Network for Informatics Education" (EQANIE).*<br>*Each study course description indicates which knowledge, skills, and other competences indicated in the mentioned document are promoted by the given study course.*<br>*"Euro-Inf Framework Standards and Accreditation Criteria for Informatics Programmes. New Program Outcomes" defines the following learning out-comes:*<br><br>*EB1 Underlying Conceptual Basis for Informatics. Graduates of the pro-gramme are able to:*<br>*EB11 describe and explain the essential facts, concepts, theories and math-ematical methods relevant to computing, computing equipment, computer communication and informatics applications as appropriate to their pro-gramme of study,*<br>*EB12 outline the characteristics of relevant state-of-the-art hardware and software and their practical application,*<br>*EB13 outline relevant historical and current developments in informatics and show insight into possible future trends and developments,*<br>*EB14 apply and integrate knowledge and understanding of other informat-ics disciplines in support of study in their own specialist area(s),*<br>*EB15 demonstrate awareness of the need for deep domain knowledge when creating informatics applications in other subject areas.*<br><br>*EB2 Analysis. Graduates of the programme are able to:*<br>*EB21 use a range of techniques to identify the requirements of real-world problems, analyse their complexity and assess the feasibility of their solu-tion using informatics techniques,*<br>*EB22 describe a problem and its solution at varying levels of abstraction,*<br>*EB23 select and use relevant analytic, modelling and simulation methods,*<br>*EB24 choose appropriate solution patterns, algorithms and data structures,*<br>*EB25 analyse the extent to which an informatics system meets the criteria defined for its current use and future development.*<br><br>*EB3 Design and implementation. Graduates of the programme are able to,*<br>*EB31 specify and design computing/network hardware/software which meet specified requirements,*<br>*EB32 describe the phases involved in different life cycle models used for specifying, building, testing and commissioning new systems and for maintaining existing systems,*<br>*EB33 select and use appropriate process models, programming environ-ments and data management techniques for projects involving traditional applications as well as emerging application areas,*<br>*EB34 describe and explain the design of systems and interfaces for human-computer and computer-computer interaction,*<br>*EB35 apply relevant practical and programming skills to the creation of computer programmes and/or other informatics artefacts.*<br><br>*EB4 Economic, legal, social, ethical, and environmental context. Graduates of the programme are able to:*<br>*EB41 demonstrate awareness of the need for a high level of professional and ethical conduct in informatics and a knowledge of professional codes of conduct,*<br>*EB42 explain how commercial, industrial, economic and social contexts affect informatics practice,*<br>*EB43 identify relevant legal requirements governing informatics activities, including data protection, intellectual property rights, contracts, product safety and liability issues, personnel issues and health & safety,*<br>*EB44 explain the importance of information privacy and security issues in relation to the design, development, maintenance, monitoring and use of informatics-based systems.*<br><br>*EB5 Informatics practice. Graduates of the programme are able to:*<br>*EB51 demonstrate an awareness of appropriate codes of practice and industry standards,*<br>*EB52 describe and explain management techniques appropriate to the de-sign, implementation, testing, deployment and maintenance of informatics systems, including project management, configuration management, change management, etc., and including relevant automated techniques,*<br><br>*EB53 identify risk issues, including security, health & safety, environmen-tal and commercial risk, and explain risk assessment, risk reduction and risk management techniques,*<br>*EB54 undertake literature searches and reviews using databases and other sources of information;*<br>*EB55 design and conduct appropriate practical investigations (e.g., of sys-tem performance), to interpret data and draw conclusions.*<br><br>*EB6 Other Professional Skills and Competences Graduates of the pro-gramme are able to:*<br>*EB61 organise their own work independently, demonstrate initiative and exercise personal responsibility,*<br>*EB62 communicate effectively both verbally and using a variety of com-munications media to a variety of different audiences,*<br>*EB63 plan self-learning and improve personal performance as a foundation for lifelong learning and ongoing professional development,*<br>*EB64 identify different ways of organising teams and the various roles within a team,*<br>*EB65 participate effectively in informatics group-working.* |

| | |
|---|---|
| Final examination upon the completion of the study programme | *Bachelor thesis in computer science* |

# Study programme forms

### Full time studies - 4 years - latvian

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *4* |
| Duration in month | *0* |
| Language | *latvian* |
| Amount (CP) | *160* |
| Admission requirements (in English) | *Secondary education* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Bachelor of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

### Places of implementation

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

### Full time studies - 4 years - english

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *4* |
| Duration in month | *0* |
| Language | *english* |
| Amount (CP) | *160* |
| Admission requirements (in English) | *Secondary education Studies in English require English language skills at least at B2 level.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Bachelor of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

### Places of implementation

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

### Part time studies - 4 years, 6 months - latvian

| | |
|---|---|
| Study type and form | *Part time studies* |
| Duration in full years | *4* |
| Duration in month | *6* |
| Language | *latvian* |
| Amount (CP) | *160* |
| Admission requirements (in English) | *Secondary education* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Bachelor of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

### Places of implementation

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Part time studies - 4 years, 6 months - english**

| | |
|---|---|
| Study type and form | *Part time studies* |
| Duration in full years | *4* |
| Duration in month | *6* |
| Language | *english* |
| Amount (CP) | *160* |
| Admission requirements (in English) | *Secondary education Studies in English require English language skills at least at B2 level.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Bachelor of Natural Sciences in Computer Science* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

# 3.1. Indicators Describing the Study Programme

### 3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

In **Annex "Līgums ar Linkolnas Universitati_Agreement with University of Linkoln"** one can find Cooperation Agreement with the University of Lincoln

The Bachelor's study programme is divided into specializations, where each specialization is defined by sets of limited elective courses that determine the specific of the respective specialization. The specializations names and content that we chose are based on ACM Computing Curricula recommendations. Pursuant to the previous accreditation the Bachelor's programme in Computer Science consisted of 6 specializations in the reporting period:

CS – Computer Science (researchers and lecturers),

CE – Computer Engineering (specialists in embedded software, sensor networks),

SE – Software Engineering (programmers and software project managers),

IT – Information Technologies (computer network specialists and project managers),

IS - Information Systems (database and information systems specialists and project managers),

CD – Mathematics and computer science didactics (teachers of mathematics and computer science).

Mathematics and computer science didactics specialization was included in the previous accreditation, but was not started to be implemented, because the UL guidelines on the preparation of pedagogues had changed by concentrating it in the Faculty of Pedagogy, Psychology and Arts. According to these guidelines, the Mathematics and computer science didactics specialization is not included in the new accreditation.

The languages of instruction in the study programme are planned to be Latvian and English.

In the previous accreditation, the possibility of the part-time implementation of the study programme was also included, with an appropriate study plan for part-time studies. The implementation of the part-time studies was not started, because the resources were concentrated on starting the implementation of the programme in English. The planning in the previous accreditation was for all specializations.

In this accreditation, a part-time plan has been developed and is planned to be implemented for the most requested specialization – Software Engineering.

6 specializations are planned in the new accreditation period: Computer Science, Computer Engineering, Software Engineering, Information Technology, Information Systems, Computer Science [Lincoln].

A new specialization Computer Science [Lincoln] is included in the next accreditation period. The specialization was developed in cooperation with the University of Lincoln (Great Britain). The

content and achievable learning outcomes of the Bachelor's study programmes in Computer Science of both universities were compared and evaluated. It was found that the content of the 1st-3rd years of the UL Bachelor's programme in Computer Science (duration 4 years) covers the content of the first two years of the Lincoln study programme (duration 3 years). The 4th year of the specialization Computer Science [Lincoln] was developed in correspondence with the plan of the Bachelor's programme of Lincoln. Students in the Computer Science [Lincoln] specialization will have the opportunity to learn both the study courses of the UL Bachelor's programme in Computer Science, as well as some new courses included in the Bachelor's programme in Computer Science, courses were developed according to the study course descriptions of the University of Lincoln, and at the end of the studies, students who have completed the Computer Science [Lincoln] specialization, will also receive a diploma from University of Lincoln. Computer Science [Lincoln] is not a joint study programme with University of Lincoln within the meaning of the Low on Higher Education Institutions, but it is implemented as a specialization of the BA Computer Science programme of the University of Latvia, on the basis of the cooperation agreement with University of Lincoln (see **Annex "Līgums ar Linkolnas Universitati_Agreement with University of Linkoln"**).

In order to ensure the implementation of the Computer Science [Lincoln] specialization in the next accreditation period, the following study courses are included in the Bachelor's study programme in Computer Science, each amounting to 5 CP: Big Data, Machine Learning (University of Lincoln), Parallel Programming, Cloud Computing, Cross-Platform App Development, Cyber Security.

In the previous accreditation period, the implementation of the programme in English was started for the first time, accordingly it was necessary to change the content of the study courses in the study plan of the programme into English, as well as to ensure the teaching staff for teaching in English. The internship included in the programme had to provide the opportunity for students to do it in places of practice that provide an international environment and communication in English.

Changes in the content of the Computer Science Bachelor's study programme, compared to the previous accreditation, are related to a wider offer of optional courses, i.e., new optional courses were added: "Database Practice", "Applied Deep Learning", "Business Platforms". The opportunity to offer new topical content has been preserved through the courses "Special Seminar I" – "Special Seminar IV", within which special seminars have been announced covering topics such as "Blockchains", "Language technologies and artificial intelligence" etc. (for full list of special workshops, see: https://www.df.lu.lv/en/studies/bachelors-and-professional-studies/special-seminars/). Special seminars have been used to offer elective courses to the students of the English version of the programme, e.g., "Getting things done with Python", "Artificial Intelligence and Society: Opportunities, Risks, Challenges", and other.

**3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.**

*In **Appendix IV-1** there is attached a sample of the diploma issued for completing the study programme and its annexes in accordance with the Regulations of the Cabinet of Ministers of 16.04.2013 No. 202 "The procedure for issuing state-recognized documents certifying higher education".*

*In **Appendix II-3** there is attached a study contract sample according to the Regulations of the Cabinet of Ministers of 23.01.2007 No. 70 "Terms and conditions that must be included in the study contract".*

The academic Bachelor's study programme in the field of "Computer Science" represents the Bachelor's level. The study programme prepares both industry professionals for work in the IT industry and well-prepared Bachelor's level graduates for further studies at the Master's level.

The planned programme code is 43483. Pursuant to the classification of education in Latvia (Regulations of the Cabinet of Ministers No. 322, "Regulations on Latvian Education Classification", 13.06.2017, https://likumi.lv/doc.php?id=291524(only in Latvian)) the code meets both the admission conditions of the programme, i.e., the requirement for completed secondary education, and the duration of 4 years. The code also corresponds to the educational thematic group of the programme (Natural Sciences, Mathematics and Information technologies) for the educational thematic field (Computer Science), as well as the aforementioned correspond to the name of the programme – Bachelor's academic study programme "Computer Science". The awarded degree in the study programme remains unchanged from the previous accreditation – "Bachelor of Natural Sciences in Computer Science". Samples of the diploma and the diploma supplement are attached in **Appendix IV-1**. A study agreement sample according to the Regulations of the Cabinet of Ministers of 23.01.2007 No. 70 "Terms and conditions that must be included in the study contract" are attached in appendix (**Appendix II-3.** Study agreement samples).

According to the objective of the programme, i.e., to prepare specialists who are able to design and develop complex applications and information systems, and the tasks of the programme, the results of the study programme are defined in accordance with the document entitled "Euro-Inf Framework Standards and Accreditation Criteria for Informatics Programmes. New Programme Outcomes" (last update in 2015) issued by the international organization *European Quality Assurance Network for Informatics Education* (EQANIE).

In the review report "*Referencing of the Latvian Education System to the European Qualifications Framework for Lifelong Learning and the Qualifications Framework for the European Higher Education Area"* (available at: http://www.nki-latvija.lv/content/files/LQF_evaluation_of_situation_2013.pdf) it is noted that LQF levels were developed in accordance with QF-EHEA *(the Qualifications Framework of European Higher Education Area*), where LQI level 6 corresponds to QF-EHEA cycle 1.

The EQANIE *(European Quality Assurance Network for Informatics Education*) document entitled *"EURO-INF FRAMEWORK STANDARDS AND ACCREDITATION CRITERIA FOR INFORMATICS DEGREE PROGRAMMES, 2016*" (https://eqanie.eu/wp-content/uploads/2019/09/Euro-Inf-Framework-Standards-and-Accreditation-Criteria-V-2016-10-24.pdf), formulates programme learning outcomes for graduates of accredited first and second cycle informatics study programmes, according to QF-EHEA.

Therefore, it is justified to state that this learning outcomes classification system meets the requirements of LQI, and they are fulfilled, it corresponds to the requirements of level 6 of LQI. As the study programme has previously been and will be internationally accredited, the definition of the learning outcomes of the Bachelor's study programme in Computer Science using the learning outcomes defined by EQANIE is both justified and meets the requirements.

To achieve the outcomes of the programme, for the outcomes of all the study courses of the programme it is also indicated which of the criteria of this document the specific study course promotes.

Applicants with secondary education are admitted to the study programme, while the criteria for the admission competition are CE in Latvian, CE in Mathematics, and CE in a Foreign Language (English, French or German). To achieve the goal of the programme, applicants' preparation in high school mathematics is essential. Good knowledge of foreign languages, however, is important for achieving other programme results in terms of communication, independent literature studies etc. The requirement to include a CE in the Latvian language in the admission is determined for all study programmes at the University of Latvia, it is also essential for the fulfilment of the condition for writing the final theses in the state language.

In regards to admission to the studies in the English version of the Bachelor's programme for persons who have obtained secondary education abroad has, there are following admission rules: 1) a secondary education document must show a successful assessment in mathematics (or an average grade in algebra and geometry); 2) the results of international English language tests, which are confirmed by a document issued within the last five years (except for cases where secondary education was obtained in English) with a certain level of language proficiency indicated for each of the accepted tests.

The duration of the study programme is 4 years (160 credit points respectively). The Bachelor's study programme is integrated with the 1st level professional study programme "Programming and computer network administration" with a duration of 2.5 years. The content of the first two years of the studies is created by harmonizing the study courses of the Bachelor's programme and the 1st level professional programme. This is followed by Internship (17 CP), since it is included in the 1st level professional programme. It should be noted that the study plan includes study courses Internship I and Internship II in the amount of 18 CP in total, where 1 CP is intended for face-to-face lessons at the University of Latvia on the issues of the internship, while internship in industry, which is covered by the Internship Regulations, is in the amount of 17 CP.

The inclusion of extensive internship in the Bachelor's programme is justified by the fact that it is performed in various companies of the IT industry and provides the opportunity to gain valuable practical experience corresponding to the interests of each student. At the same time, it is possible to learn the latest and current technologies for companies, to get acquainted with the tasks that companies solve and work in project teams, as well as to gain an insight into how the knowledge acquired in previous studies can be applied practically.

After completing the internship, students of the specializations CS, SE, IT, IS, CE are given the opportunity to defend their qualification thesis and receive a diploma for first-level professional higher education and one of two 4th-level professional qualifications – Programmer or Computer Systems and Computer Networks Administrator. If the students of the mentioned specializations do not choose to receive a diploma for first-level professional higher education, they defend the qualification project instead of the qualification thesis.

The Bachelor's study programme is divided into specializations, where each specialization is actually defined by sets of limited elective courses that determine the specific of the respective specialization. 3 semesters in the 3rd and 4th year of the studies are planned for the completion of the specific elective courses of the specializations.

Students of the Bachelor's programme must choose one of the specializations – the initial choice is made at the beginning of the 2nd semester, but later, at the beginning of the 6th semester, when the specializations' specific courses are mainly offered, the specialization can be changed to another,

based on the previous experience gained in the internship and according to individual student interests. Within the Computer Science [Lincoln] specialization, the choice is made as early as when entering the 1st year; it is implemented in English.

When evaluating the usefulness of the implementation of the computer science study programme in English, it should be noted that these are paid studies. Since the implementation of the programme in English is being started and while it is gaining international recognition, the number of students is still not large, compared to the programme in Latvian. Since there is s demand for new employees in the industry, the attraction of English-speaking foreign students will in the long run give the expected results in terms of a larger number of graduates. There are also indirect benefits to the internationalization of the study environment and also to the expansion of the number of exchange students, as the offer of study courses in English is expanded. In the first 2 years, since the implementation in English began, the small number of admissions is balanced by gaining experience by the lecturers; the experience in popularizing the study programme has been gained, and in the 3rd year (2020/2021) there are already 42 students in total in the programme in the English group studying for a degree (excluding exchange students), 25 students were admitted to the 1st year in 2021, which is already a relatively good result.

### 3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

According to the European Commission's 2019 report, based on the Digital Economy and Society Index (DESI) on the digital competitiveness of the member states, the number of ICT specialists in Latvia has slightly increased since 2017, however, their percentage in the Latvian labour market is lower than in the EU as a whole. The report notes that the number of university graduates in the field of ICT in Latvia is increasing, reaching 4.8% of all graduates, and exceeds the EU average (3.5%). However, the number of trained ICT specialists lags behind the growing demand in the labour market.

Also in the medium-term policy planning document "Digital transformation guidelines 2021-2027" (only in Latvian) several courses of action have been defined, the result of which would be highly qualified ICT specialists in Latvia who are able to develop excellent digital solutions and the shortage of labour force in the field of ICT would be reduced

Just to ensure the natural replacement of the generations employed in the industry and to maintain at least the current number of the employed, at least the current number of graduates of computer science programmes at Latvian universities is necessary. Along with the shortage of labour in the field of ICT, there is no threat to the availability of jobs in the foreseeable future.

Almost all participants of the study programme are employed in the industry, at least starting from the 2nd year, when they do an internship in a company. A large number of graduates remain to work in the workplaces where they started working during their studies, and there is no problem finding another workplace if there is a desire for career growth.

The data on the 2017 , 2018 and 2019 graduates of the Computer Science Bachelor's programme and their employment, which were collected in 2022 by the Ministry of Education and Science (fiscal year - 2020), show that 85% of the 2017 graduates, 85% of the 2018 graduates, and 88% of the 2019 graduates are working, the distribution of the rest of the graduates is shown in the table below (see Table IV-2). The mentioned 2022 annual report of the Ministry of Education and

Science does not contain more recent data.

*Table IV-2. Employment of Computer Science Bachelor Programme Graduates*

| Graduation year | Number of graduates | Graduates, employed, number | Graduates, unemployed, number | Graduates, economically inactive, total | Graduates, emigrated, number | Graduates, founder of companiest, number |
|---|---|---|---|---|---|---|
| 2017 | 67 | 57 | 1 | 6 | 1 | 10 |
| 2018 | 87 | 74 | 2 | 9 | 1 | 7 |
| 2019 | 60 | 53 | 1 | 4 | 0 | 4 |

The analysis of the employment data for 2017, 2018 and 2019 graduates by industry, using the NACE classification, shows that industries in which more than 1 graduate is employed are as follows: NACE-C Manufacturing, NACE-J Information and Communication, NACE-K Finance and Insurance activities, NACE-M Professional, scientific and technical activities. Most of the employed graduates of the programme are employed in the ICT sector: 70% of the employed graduates of 2017, 77% of the employed graduates of 2018, and 79% of the employed graduates of 2019.

### 3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

***Appendix IV-2*** *shows statistical data on students in the reporting period*

The programme conducted in Latvian

Every year, admission to 220 state budget funded study places is announced in the Bachelor programme of Computer Science, which are filled every year, and the demand is characterized by, for example, statistics for the year 2020: the total number of applications was 901, and there were 317 applications with the first priority. The competition rate, calculated by the number of 1$^{st}$ priority applications, is 1.44 in 2020 and the indicator remains around 1.5 applications per 1 study place throughout the reporting period. According to the number of 1$^{st}$ priority applications, the Computer Science study programme is among the 5 most popular study programme at the University of Latvia every year.

Every year a number of fee-paying students, 1 or 2, are also matriculated, which can be explained by resumption of studies in later study years, since fee-paying places are not announced in admissions in the 1$^{st}$ year. The exception is 2018/2019 academic year with 12 fee-paying students matriculated. At the same time, the statistics show a higher number of fee-paying students compared to the above, as typical students become fee-paying students due to rotation. Of the total number of students, fee-paying students on average make up around 10% in the reporting period (except for the 2018/2019 academic year, in which there were 108 students, which made up 18%).

Number of students. The total number of students in the programme in Latvian ranges from 573 to 603. There is a tendency of high dropout rates (almost half of those enrolled in the 1$^{st}$ year), but in

the following years of the studies the number stabilizes, and the dropout rate is small. Among those who dropped out in the later years, a part resumes studies and arranges the completion of differences in study plans and still obtains the diploma, while among those who dropped out in the 1st year, a part tends to re-enrol, but there are more who do not actually start the studies, or do not pass the first exam session. The dropout rate in the 1st year can be explained by an ill-considered choice of the programme and lack of motivation, in the later years, however, by the problems of fully combining studies with work and personal reasons, thereby having academic debts and, after rotation, being shifted to paid study places, which not all students are able to pay for.

The number of graduates is variable. In four year period the number of graduates is over 80 (the largest number – 88 graduates in 2019/2020 academic year), unfortunately in two-year period this number is smaller, e.g., in 2018/2019 academic year there were 60 graduates.

The programme conducted in English

Studies in the English group were launched starting from the 2018/2019 academic year. The number of matriculated students changed from 13 students in 2018/2019 to 28 enrolled students in 2020/2021 academic year, thus showing an increase in enrolment in the 1st year, but it should be noted that a tendency has appeared that some Latvian citizens also choose to study in the English group. There have been no graduates from the English programme yet because the last year of study has not yet been reached in the reporting period.

The number of students in the programme in English changed from 18 in the first year of implementation to 48 (2020/2021 academic year), including exchange students. Dropout can be observed, and the trends are similar to the programme in Latvian, i.e., students mostly drop out in the 1st year of study. All students studying for a degree in this programme are self-funded, except for exchange students who are included in the total number.

Thanks to the implementation of the programme in English, starting from the 2018/2019 academic year, throughout the period of three years, and thanks to offering more and more study courses, the number of exchange students is also increasing, which was typically 1 to 3 students per year before, up to 17 exchange students in the 2019/2020 academic year.

The countries that are represented are very diverse, for example, the distribution of all foreign students by country (data from the last two academic years):

2019/2020 academic year: citizen of India (6), citizen of Turkey (4), citizen of Uzbekistan (7), citizen of Russia (2), citizen of Azerbaijan (6), citizen of Armenia (1), citizen of China (1), citizen of Italy (1), citizen of Israel (1), citizen of Ukraine (1), citizen of Kyrgyzstan (1), citizen of Sri Lanka (1), citizen of Portugal (2), citizen of the Republic of Korea (1), citizen of Spain (2), citizen of Pakistan (1), citizen of Cameroon ( 1), US citizen (1), citizen of Germany (2).

2020/2021 academic year: citizen of Russia (10), citizen of Uzbekistan (5), citizen of Azerbaijan (5), citizen of Ukraine (4), citizen of Pakistan (2) , citizen of Iran (2), citizen of Albania (2), citizen of China (1) , citizen of India (1), citizen of Cameroon (1) , US citizen (1) citizen of Estonia (1), citizen of Honduras (1), citizen of Sri Lanka (1), citizen of the Republic of Korea (1), citizen of Turkey (1), citizen of Nigeria (1), citizen of Kazakhstan (1).

Statistics on specializations.

Since the 6th, 7th and 8th semesters are basically planned for the study of specialization courses, but the data is available only for a specific moment of the creation of the report, then as of December 2022 the only autumn semester from the mentioned is the 7th semester, respectively the 4th Study Year,  the distribution of students of 7th semester by specialization is as follows: DI (4 students), DZ (2 students), IS (11 students), IT (7 students), PI (74 students).

**3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).**

## 3.2. The Content of Studies and Implementation Thereof

**3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.**

*The table on the compliance of the study programme with the national education standard is shown in* ***Appendix IV-3.***

*The mapping of study courses for achieving the learning outcomes of the study programme are shown in* ***Appendix IV-4.***

*Study programme plans (for each type and form of study programme implementation) are attached in* ***Appendix IV-5.***

*Description of study courses (modules) of the study programme (information included in study courses/modules) is attached in* ***Appendix IV-8.***

*EQANIE learning outcomes are attached in* ***Appendix IV-9.***

The objective of the Bachelor's programme in Computer Sciences is to prepare specialists who are able to design and develop complex applications and information systems.

To achieve its objective, the programme envisages the following tasks:

1. to provide basic knowledge in the computer industry in general and in the chosen degree programme,
2. to provide basic knowledge in the foundations of mathematics of computer science,
3. to provide knowledge, develop skills necessary for the design and development of complex applications and information systems,
4. to develop the first skills of scientific research work, which will allow to participate in research projects, to continue studies in the Master's degree,
5. to develop skills necessary for independent continuation of education, renewing knowledge and professional development.

To achieve the common objective of the programme, compulsory study courses in the amount of 102 CP are provided.

The amount of the restricted  elective part of the programme is 52 CP, part of it consists of the specific courses of each specialization in the amount of 28-42 CP (42 CP is for the new Lincoln specialization, which is determined by the need to harmonize the content with the corresponding study programme of University of Lincoln).

The amount of the free elective part in the programme is 6 CP.

For the evaluation of the compliance of the computer science study programme with the national education standard, see **Appendix IV-3**.

For the study plans of the computer science study programme, see **Appendix IV-5:**

- Full time.from_2022. Study programme plans_all specializations – contains programme plans by specializations, including the new Lincoln specialization – planning and study courses as provided after accreditation;
- Full time. until_2022. Study programme plans_all specializations – contains programme plans by specializations, which were conducted during the reporting period until accreditation.
- Part time. from_2022. Software Engineering specialization Plan – contains the Software Engineering specialization plan for part-time studies to be implemented after accreditation.

The requirements of learning outcomes of the Bachelor's study programme in Computer Science are detailed in the document "Euro-Inf Framework Standards and Accreditation Criteria for Informatics Programs. New Program Outcomes" (last update – 12.10.2015) which were approved by the organization "European Quality Assurance Network for Informatics Education" (EQANIE) (see **Appendix IV-9** EQANIE Learning Outcomes codes).

Learning outcomes of each study course in the description of each study course indicates which knowledge, skills, and other competences indicated in the mentioned document are promoted by the given study course. Since the knowledge, skills and competences defined in the mentioned document are marked with the codes EBxx, the same symbols are used in the descriptions of the study courses, providing also mapping of the learning outcomes of the study programme. The study course descriptions use 2 level designations EBxx and ebxx, which respectively means that the outcome of the EBxx study course considerably supports the achievement of the outcome of the study programme EBxx, while the designation ebxx means that the corresponding outcome of the study course *promotes* achieving the corresponding outcome of the study programme.

For example, the learning outcomes of the Web Technology I course are formulated as follows.

Knowledge
1. Awareness of the most popular web development technologies has been achieved (EB11, eb12)

Skills
2. Ability to identify the required tools for development of specific functionality (eb21)
3. Ability to analyze the structure of a web page sketch and to provide adequate means for page layout (eb21, eb31, EB34)

Competence

4. Some practical competency of web development is achieved, a simple (one or several page) web sites without server-side solutions can be mastered (eb31, EB34, eb35)

The programme outcomes classifier shows that (some code transcripts are provided here):

EB1– Underlying Conceptual Basis for Informatics. Graduates of the programme are able to:

EB11 describe and explain the essential facts, concepts, theories and mathematical methods relevant to computing, computing equipment, computer communication and informatics applications as appropriate to their programme of study,

EB12 outline the characteristics of relevant state-of-the-art hardware and software and their practical application.

Comparing, for example, the learning outcomes of this course description with the outcomes of the programme, it can be identified that it considerably supports the outcome EB11 of the programme and contributes to the achievement of the outcome EB12 of the programme.

Full mapping of the outcomes of the study course for achieving the learning outcomes of the programme, as well as a full list of EB codes with descriptions are given in the appendices (**Appendix IV-4.** Mapping of study courses and **Appendix IV-9.** EQANIE Learning Outcomes codes)

Analysing the learning outcomes of the study courses and the mapping of the outcomes of the programme in the appendix, it can be observed that the following objectives of the programme are least covered:

EB41 Economic, legal, social, ethical, and environmental context. Graduates of the programme demonstrate awareness of the need for a high level of professional and ethical conduct in informatics and a knowledge of professional codes of conduct,

EB53 Informatics practice. Graduates of the programme are able to identify risk issues, including security, health & safety, environmental and commercial risk, and explain risk assessment, risk reduction and risk management techniques.

Study programme courses (see **Appendix IV-8**), according to the programme plans (see **Appendix IV-5**), are divided into compulsory part, restricted elective and free elective courses. The compulsory part courses are the same for all specializations.

The compulsory part courses can be characterized by combining them in several thematically related groups according to their content.

State examination and internship: 1. DatZN008 Bachelor Paper in Computer Science (12 CP); 2. DatZR002 Practice I [DAT6] (6 CP); 3. DatZR001 Practice II [DAT12] (12 CP). The courses Practice I and Practice II are in the amount of 18 CP in total, where 1 CP is intended for face-to-face lessons at the University of Latvia on the issues of the internship, while internship in industry, which is covered by the Internship Regulations, is in the amount of 17 CP.

Course projects and workshops: 4. DatZ3169 Qualification Project (8 CP)

Programming courses: 5. DatZ1165 Algorithms and Programming (6 CP); 6. DatZ1166 Software Development Fundamentals (5 CP); 7. DatZ1031 Web Technologies (2 CP); 8. DatZ2019 Web Technologies II (2 CP).

Software development and project management: 9. DatZ2072 Software Engineering (6 CP); 10. DatZ4023 Information Technology Project Management (2 CP).

Computer hardware and computer networks: 11. DatZ1164 Computer Architecture and computer engineering fundamentals II (3 CP); 12. DatZ1170 Computer networks I and Insight into Industry (3 CP).

Operating systems: 13. DatZ1053 Operating Systems (2 CP).

Databases and information systems: 14. DatZ1139 Databases and Information Systems

Fundamentals (3 CP).

Classical Mathematics: 15. Mate1009 Algebra (2 CP); 16. Mate2005 Analytical Geometry (2 CP); 17. DatZ1143 Discrete Mathematics for computing 18. Mate1014 Calculus I (2 CP); 19. Mate2012 Probability Theory and Statistics (2 CP).

Mathematical Foundations of Computer Science: 20. DatZ1037 Automata Theory (2 CP); 21. DatZ2029 Formal Grammars (2 CP); 22. Mate3044 Mathematical Logic (2 CP).

General courses: 23. Ķīmi1059 Civil protection (1 CP); 24. Ekon1006 Principles of Economics (2 CP); 25. SDSK1067 Internet, Netiquette and Legal Regulation (2 CP); 26. KomZ3120 Communication and Cognitive Sciences (2 CP); 27. VadZ1091 Introduction to management (4 CP); 28. VidZ1032 Environment protection (1 CP).

Lists of specialization courses by specializations, which are offered in the restricted elective part, and which directly determine the specifics of each specialization, can be found in the appendices, where study programme plans are attached (**Appendix IV-5**).

Supplementing and updating the content of the Computer Science Bachelor's study programme in relation to current industry demand or scientific trends, related to a wider offer of elective courses; new elective courses were added during the accreditation period: "Database Practice", "Practical Deep Machine Learning", "Business Platforms". The opportunity to offer new topical content has been preserved through the courses "Special Seminar I" – "Special Seminar IV", within which special workshops have been announced covering the following topics such as "Blockchains", "Language technologies and artificial intelligence", "Getting things done with Python", "Artificial Intelligence and Society: Opportunities, Risks, Challenges", and others (a full list of special seminars by year is available at: https://www.df.lu.lv/en/studies/bachelors-and-professional-studies/special-seminars/ ).

In the next accreditation period, due to the implementation of the specialization Computer Science [Lincoln], the following study courses have been included in the Bachelor's study programme in Computer Science, each amounting to 5 CP: Big Data, Machine Learning (University of Lincoln), Parallel Programming, Cloud Computing, Cross-Platform Development and Cyber Security.

Along with the introduction of the new study courses in the study programme, there is reason to claim that the content of the programme has been updated according to the latest trends in computer science and the demand in IT industry companies.

For the descriptions of the Bachelor's study programme in Computer Science, see appendix (**Appendix IV-8.** Course descriptions)

**3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).**

**3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to**

**the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.**

Various implementation methods are used in the studies: lectures, seminars, laboratories and practical works, tests and homework, which must also be implemented using various software. If it suits the objectives of the degree programme, guest lectures from industry companies are invited to show students the unity of theory and practice. For example, for several years in a row, Accenture Latvia specialists conducted the guest lecture “SAP system” within the “Databases and Information Systems Fundamentals” course. Special seminars should be mentioned as a special form of study. For example, in 2019/2020 academic year, two special seminars were conducted by industry representatives: “Clean Code, or what you are not told at university” (lecturer from DIVI group) and “Modern approach and technologies for IT product development” (lecturer from Accenture Latvia). Special seminars are also offered to English-speaking students, e.g., “Getting things done with Python”. Special seminars are a way to make the latest industry trends available to students as quickly as possible, their offer changes every semester, see https://www.df.lu.lv/en/studies/bachelors-and-professional-studies/special-seminars/. Participation in special seminars also promotes students’ presentation and discussion skills, while research-oriented special workshops provide an opportunity to find an interesting research topic, thus promoting the development of students’ research competence.

Lecturers use various methods to teach study courses, e.g., practical tasks, individual and group work, project development, emphasis is placed on the use of methods in which students themselves must actively work, communicate, solve problems concerning current industry problems, different types of software should be used for the implementation of tasks. For example, in the Software Engineering course there are both theory lectures and individual control works, and in the practical work there is work in groups, which work on the specification and design of one project, which is performed throughout the semester in several assignments, presenting the results of each assignment to other groups of students and defending their project in the exam. The course simulates a real situation in the software development process in a company.

In the study process, information technologies are used to a large extent. An integrated e-study environment has been created for each study course (Moodle e-courses and MS Teams corresponding course channels), where lesson materials, lecture slides and video recordings, assignments and tests are available. In Moodle, students also receive evaluations of the submitted solutions as well as comments and justification for the grade as feedback. Accordingly, students can follow their progress, which learning outcomes and to what extent they have achieved. Study results and conditions for obtaining a course evaluation are publicly available in the course descriptions, which are regularly updated. The above promotes students’ understanding and co-responsibility for their learning, self-assessment and ensures understanding of the received assessment in accordance with the principles of a student-centred approach. The evaluation process takes place throughout the semester, stimulating regular study work. Midterm tests (assignments, tests and other forms) are chosen to achieve the course goals and learning outcomes. Mid-term tests make up at least 50% of the final grade for the course. All courses have a final exam at the end, which makes up no less than 10% of the course grade.  Both oral, written and combined study evaluation methods are used during study courses and exams.

Since the Bachelor's programme in Computer Science also has an English version, all the information described above also applies to the studies in English, in addition to this, for many courses Moodle has created a separate e-course for the English group, in which all content and the study process are provided in English, thus making it easier for students to navigate the course materials more effectively

By observing the study principles of student-centred education, student mobility is promoted, ensuring the recognition of learning outcomes. 17 students of the Bachelor's programme have used the opportunity of study mobility within the ERASMUS exchange programme. Students can see the information available at the faculty website (Studies and internship abroad/ERASMUS (lu.lv)) on the application procedure and the faculty's partner universities. Depending on interests and language skills, the student must choose and contact the host university; afterwards a study contract is agreed, which includes the courses chosen by the student at a foreign university and recognition conditions, which guarantee that successfully completed courses will be recognized upon returning to the UL. This is in line with the principles of a student-centred approach. Students generally choose various elective courses, expanding the possibilities to learn what is not offered by the UL Bachelor's programme in Computer Science. Students also choose language and culture courses of the respective country in the free elective part.

The number of students using the ERASMUS programme is variable, the number of students by academic year is as follows: 2015/2016 – 1; 2016/2017 – 4; 2017/2018 – 2; 2018/2019 – 6; 2019/2020 – 2; 2020/2021 – 2.  One of the students of the English group also used the exchange study opportunities. An increase in the interest in exchange studies is noticeable, except for a decrease in the 2020/2021 academic year due to pandemic restrictions. Eight students studied at the University of Groningen (Netherlands); students also studied in Italy, Croatia, Germany, Great Britain, Portugal, Spain and Lithuania. In order to promote mobility, a meeting is organized for students at the beginning of each semester, in which information is provided about exchange study opportunities and procedures, students who have been in the ERASMUS exchange programme have spoken about their experience at the open day event to potential students at the Faculty of Computing (for example, 2021 – about experience at the University of Groningen).

It should be noted that there is another opportunity for students to gain significant experience and knowledge in addition to their study courses. Students can get involved in the lecturers' research, thus applying the knowledge gained in their studies in practice. For example, students worked on the projects of the State Research Program "To mitigate the consequences of Covid-19"; the results obtained together with the lecturers were also presented at the UL conference in the report "Contact tracing to reduce the risk of infection". Another example of student involvement in research is the participation of 2021 graduate  in the "Deep machine learning of algorithms" project, developing an innovative machine learning algorithm and scientific article.

The study process is regularly improved based on the results of student and graduate surveys. For example, in the 2020 survey of the graduates of the study programme, the possibility to start planning one's career during the studies and the opportunity to participate in the improvement of the quality of the study programme were most highly valued, while the most critically evaluated was the fact that simultaneous work takes away time for studies. However, although it is objectively evaluated that it is difficult to combine studies with work, the graduates also admitted that work in the profession, as is typical for computer science students, at the same time helps to understand what was taught during the studies. There are no graduates in the group with English as the language of instruction, the graduation is scheduled in spring 2022, therefore there has not been a survey yet.

Employers' evaluation of the graduates of the Bachelor's study programme is expressed by the fact

that for five years in a row the Bachelor's study programme in Computer Science of the University of Latvia has been recognized as the most recommended study programme by employers in the survey of employers conducted by the Confederation of Employers of Latvia (LDDK) and the career portal Prakse.lv. https://www.df.lu.lv/par-mums/zinas/zina/t/66836/ (only in Latvian).

To evaluate the study courses, at the end of each semester, students fill out a survey for each course, the results are visible to the lecturers, as well as to the programme director. The results of the survey are analysed in order to improve the situation in study courses in which the overall rating is below 5 points (out of 7). Poorly rated aspects of the course, such as content or delivery, are analysed in detail and improvements are discussed with the appropriate course lecturer.

Students gladly express their suggestions for the improvement of the study programme in meetings with lecturers and the programme director, as well as regularly express their suggestions in meetings with the dean, thus helping to promptly improve the study process. Self-evaluation reports of the study programmes, which also include the analysis of surveys of the study courses, are also available to the student self-government. Students also have the opportunity to submit appeals and complaints, which are sometimes used by students; for example, in 2021 there was one appeal for the defence of theses.

The Bachelor's study programme also offers excellence studies. The faculty offers the excellence studies to those students of the Bachelor's programme who want and are able to acquire more knowledge and skills in the time allotted for the programme than the programme provides. Excellence studies are understood as a special, individually chosen study path within the existing study programmes (https://www.df.lu.lv/en/studies/excellence-studies/). During the reporting period, a total of 13 students of the Bachelor's programme received a document certifying the completion of excellence studies.

In the undergraduate study program, students have to choose to study one of several specializations (DI, DZ, IT, IS, PI), the initial choice is made at the beginning of the 2nd semester, when some elective courses are offered, but later, at the beginning of the 6th semester, when basically courses specific to specializations are offered, specialization may be changed to another. In the restricted elective part, students have to study 2 types of courses – specialization-specific courses, the selection of which takes place immediately upon choosing the specialization, and courses, independent of specialization, where students can choose courses from other specializations or courses offered directly in the restricted elective part – for students of all specializations. Thus, students are provided with wide opportunities to choose courses of interest.

**3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).**

***Appendix III-2*** *contains a description of the student internship organization (internship rules).*

The objective of the internship is to practically perform the duties of a programmer in real

programme development conditions under the supervision of an experienced programmer or the duties of a computer systems and computer network administrator in real computer network conditions under the supervision of an experienced computer systems and computer network administrator. According to the objective of the internship, students should participate in the development of software products or the design, installation and operation of computer networks.

The duration of the internship is 680 hours (17 CP). It should be noted that the study plan includes study courses Internship I and Internship II in the amount of 18 CP in total, where 1 CP is intended for face-to-face lessons at the University of Latvia on the issues of the internship, while internship in industry, which is covered by the Internship Regulations, is in the amount of 17 CP. The internship is performed in the fourth and fifth semesters during 17 weeks in full-time mode. A student can start an internship earlier and complete it in a part-time manner. In the fourth semester, five weeks are planned for practice in the industry, and twelve weeks in the fifth semester

Place to conduct internship for programmers can be organizations where the intern could get acquainted with high-quality, disciplined software development that corresponds to good practice. As part of software product development, an intern can participate in any work necessary for the implementation of the basic processes, supporting processes or organizational processes of software product development, including independently developing programme code, participating in specifying and documenting software requirements, software design, and performing various levels of testing work. Internships for computer system and computer network administrators should be completed in companies where the trainee could get acquainted with high-quality, disciplined computer network design, installation, and operation, which corresponds to good computer network practice.

Internships are offered to students in accordance with the agreements on student internships, which the Faculty of Computer Science has concluded with companies. Students may also offer another possible internship, in which case its compliance with the requirements for internships mentioned in the internship rules is evaluated, and in the positive case, an agreement is concluded. Students are ascribed an internship supervisor from the University of Latvia is approved, as well as an internship manager appointed by the organization, whose duties are stipulated in the internship regulations.

During the internship, students carry out individual internship tasks in consultation with both the internship manager in the company and the internship manager at the UL, regularly fill out the internship journals and send it electronically to the UL internship manager once a month to update the progress of the internship.

At the end of the internship, the student submits the internship journal, a review from the company’s internship manager, and an evaluation on the quality of the student’s work. The internship supervisor’s assessment makes up 70% of the final assessment. The final assessment of the internship is given by the internship supervisor from the faculty, based on the internship diary, the feedback of the organization’s internship manager and the student’s oral report.

Information and documents about the internship are available on the faculty’s website: https://www.df.lu.lv/en/studies/internship/ where internship regulations, internship agreements and journals templates are available – information and templates are available in both Latvian and English.

The number of managers and companies involved in supervising and providing internship is significant. Information on internships is also available on the website indicated above – lists by year of companies with which internship agreements have been concluded, as well as number of students (i.e., also the number of internship agreements) who have performed internship at the

respective company. In 2020, 113 internship agreements were concluded, internships took place in 57 companies, in 2019 – 118 internship agreements, 62 companies; in 2018 – 107 internship agreements, 55 companies; in 2017 – 99 internship agreements, 52 companies; in 2016 – 147 internship agreements, 65 companies.

As an example of internships in companies, one of the years, i.e., 2020, will be examined more closely. In 2020, 113 internship agreements were concluded. Internships took place in 57 companies. One student completed an internship in two companies. The largest number of interns (24) completed the internship at the Accenture Latvian branch, followed by Wonderland Media (11) and TestDevLab (7). In two companies, EMERGN and the Institute of Mathematics and Informatics of the University of Latvia, 4 interns performed internships in each of them. Both Collective Intelligence Research Centre and Visma Labs successfully cooperated with 3 interns. Seven companies accepted 2 interns each and provided internships – DELFI, CGI IT Latvia, Creative IT Development, DIVI grupa, iSoft Solutions, Tet and ZZ Dats. All other companies accepted one intern.

In 2020, internship in the English-speaking group was organized for the first time. The English-speaking group had six internship agreements, 5 of with the UL Institute of Mathematics and Computer Science and one with SIA "Retain". In 2021, internships for the English-speaking group were provided at the Accenture Latvia branch, which has an international work environment, therefore communication is also in English.

### 3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

### 3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

The process of choosing the subject of the Bachelor's thesis for students begins as early as with the coursework (in the amount of 4 CP) planned for the autumn semester of the last year of studies in the Bachelor's study programme, when the students choose the topic of the coursework with the consideration that the coursework can serve can serve as a path to the Bachelor's thesis, which is developed in the spring semester. Both before choosing the topic of the coursework and the Bachelor's thesis, a seminar is organized for students at the beginning of the relevant semester, during which they are introduced to both the options for choosing the topic and the conditions for developing the thesis.

Students are not bound to the chosen specialization while choosing the topics of the Bachelor's thesis, however, often the study of specialization subjects and the topics and lecturers they get to know serve as an incentive for choosing topics and supervisors. During the four years of study, students have a wide range of study courses also in the part of elective courses, including the opportunity for everyone to participate in four special seminars (every year a total of 10 seminars is offered) and with a very wide and current range of topics. Accordingly, students have had the opportunity to get an idea of the topics they are interested in so that they are able to choose a

suitable topic in cooperation with the addressed potential supervisor.

It should be noted the situation with working students, who often choose to solve a problem relevant to the workplace in their Bachelor's thesis. The advantage of such Bachelor's thesis is that it solves current problems, and the results are implemented in practice. Supervisors of such Bachelor's theses tend to be from different IT companies.

Table IV-3 shows indicators for Bachelor's thesis supervisors who are not employees of the Faculty of Computing; external managers can be employees of scientific institutes and other universities, as well as employees of IT industry companies with at least Master degree. The table also shows companies in the IT industry whose employees have supervised Bachelor's theses in computer science in different years. Some of the companies are mentioned more than once, such as SIA ZZ Dats, Accenture Latvija, DIVI Grupa, Microsoft Latvija and others. The total number of external supervisors is variable, in general this choice of students is supported, the evaluations of the defended Bachelor's theses do not differ significantly when supervised by external supervisors.

*Table IV-3. Analysis of supervisors of Bachelor's theses in Computer Science from IT industry*

| Graduation year | Number of graduates | Students with external supervisors | Institutes and other universities (workplaces of supervisors) * | IT industry companies (workplaces of supervisors) |
|---|---|---|---|---|
| 2021 | 80 | 7 | 1students (LU CFI) | Printful SIA, Accenture Latvija, SIA ZZ Dats, Microsoft Latvija, MAK IT SIA |
| 2020 | 88 | 25 | 11 students: EDI, LUMII, RSU, RTU, University of Tokyo | Printful Latvia AS, AS "Latvenergo", AS EMERGN, Intrum Global Technologies, SIA "Mak IT", SIA ZZ Dats, Sapiens Software Solutions (Latvia), SIA Alto 4.0, SIA Glaive.pro, Accenture Latvija |
| 2019 | 60 | 9 | 1 student (Institute of Electronics and Computer Science) | SIA ZZ Dats, SIA Tilde, ERNEST DC, SIA "DIVI grupa", Accenture Latvia, Microsoft Latvia |
| 2018 | 87 | 19 | 6 students (EDI, LUMII) | SIA Lattelecom Technology, SIA "knowledgeprice.com", Exigen Services Latvia, Tilde, SIA ZZ Dats, SIA "OPG", DIVI Grupa, Tieto Latvia, SQUALIO Cloud Consulting, Accenture Latvija, SIA "MAPON" |
| 2017 | 68 | 6 | 2 students (EDI, LUMII) | SIA "Mondot", DIVI Grupa |
| 2016 | 83 | 14 | 5students (EDI) | |

*Abbreviations: LU CFI (UL Institute of Solid State Physics), EDI (Institute of Electronics and Computer Sciences), LU MII (UL Institute of Mathematics and Computer Science), RSU (Riga Stradiņš University), RTU (Riga Technical University). It should be noted that in the case of LUMII, supervisors are considered only if the supervisor does not work at the UL simultaneously to LUMII.*

Since many different institutes and companies have been involved in the supervision of Bachelor's theses, the topics of the developed Bachelor's theses are also very diverse. Below are examples of topics that received an outstanding or excellent grade for the defence in different academic years, but which were supervised by external supervisors.

Among the topics developed under the supervision of LUMII and EDI staff, the following examples of topics of Bachelor's theses (defended with a grade of 9 or 10) in 2020 can be mentioned: "Evaluation of the alternative JSON encoding of the AES70-OCP.1 protocol", "Skateboard trick classification methods using machine learning with IMU sensor data", "Development of a network condition configuration solution in Docker virtualization platform for real-time communications software testing"; form 2019 Bachelor theses one can mention "Algorithms for vehicle cruise control".

Among the topics of recent years with supervisors from IT companies, the following examples can be mentioned (defended with a grade 9 or 10) in 2021 "Integrating the document signing service "eSignature" into a web application"; in 2020: "Deepfake detection". "Centralized task tracking system implementation opportunities in the company", "Dynamic web solution development with the Ruby on Rails framework, using the WebSocket technology"; in 2019" "Mobile app for car orientation game with map and GPS functionality", "Development of thermoregulation system for smart house", "Cyclist trajectory analysis using iOS Vision image recognition", "Implementation of digital collaboration tools in organization".

The analysis of the topics of the Bachelor's theses, whose supervisors are employees of the Faculty of Computing, the Bachelor's theses defended in 2021 have been chosen for illustration; the selected works obtained outstanding or excellent grade and are divided into several groups to present an overview of the topicality of the topics:

- Artificial Intelligence: "Drawing classification with neural networks", "Music transcription with neural networks", "Solving the Travelling Salesman Problem Using Neural Networks";
- Quantum Computer Science: "Speedups of parameterized algorithms for a quantum computer", "Quantum algorithms for dividing points along lines", "Quantum algorithms for string problems";
- Safety: "Use of OSINT tools for detecting vulnerable databases and analysing available information for the Baltic states in the context of various databases", "Identification and analysis of security risks of the Information system and website",
- Web technologies, mobile apps: "Improving the usability of Kingfisher framework in iOS app development",
- Internet of Things: "IoT gateway and architecture developing for Realtime Location Systems", "Analysis of environmental rhythms with the IoT system",
- Language technologies: "Mapping Word Senses Between WordNets",
- Interdisciplinary (Cognitive Sciences): "Development of a cognitive ability testing tool for diagnostic purposes of neural functions", "Influence of visual grouping on emotions in interface environment", "Interfaces for the involvement of different perceptual modalities: principles of information visualization and their experimental testing", "Perception of spatial depth and shape properties in a virtual reality environment".

The topicality and quality of the topics of the Bachelor's theses are also confirmed by the results of the Bachelor's theses of the students of the UL Faculty of Computing Computer Science Bachelor's study programme in the "ZIBIT" student final theses competition, which is organized by the Riga Technical University Development Fund in cooperation with the Latvian branch of "Accenture". Every year, the three best Bachelor's and three Master's theses in the IT sector from Latvian higher education institutions are nominated for the competition; moreover, since the 2019/2020 academic year, students themselves can also apply to participate in the final thesis competition. In 2021, 30 works were submitted to the competition – 20 of them in the Bachelor's theses category. The results of the students of the UL Faculty of Computing Bachelor's programme in the competition have been very good, one of the first places has been obtained almost every year, there have been even two winners in some years, the topics have been both research and solving current practical

problems. Below are the laureates of the ZIBIT competition:

In 2021:  2nd place – bachelor thesis  “Integrating the document signing service “eSignature” into a web application”; 3rd place – bachelor thesis “Music transcription with neural networks”.

In 2020, 3rd place – bachelor thesis “Shuffle-Exchage networks – new neural network architectures for wide range of tasks”

In 2018: 2nd place – bachelor thesis “Classification of television content” ; 3rd place – bachelor thesis “Single page web application performance”

In 2017, 3rd place – bachelor thesis “Automated texture generation”

In 2016, 1st place – bachelor thesis “Applications of elliptic curve cryptosystems”

In accordance with the requirements for the development and defence of final theses at UL, the evaluation takes into account the quality of the thesis (the topicality of the topic, the analysis of previous research findings, innovation), the report of the author of the thesis (the ability to present the research carried out in a scientific, focused and reasoned manner, formulate conclusions, indicate possible future research fields and the answers given to the commission’s questions and the ability to debate). The evaluations of the commission for the defence of Bachelor’s theses by academic years is shown in the Table IV-4. Each year there are excellent theses, a total of 31 for the period, in some years there were also theses evaluated with a failing grade – a total of three theses during the whole period. The average grade ranged from 7.65 to 7.91.

*Table IV-4. Grades for Bachelor’s theses in Computer Science*

| Academic year/grades | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | Average grade | Number of graduates |
|---|---|---|---|---|---|---|---|---|---|---|
| 2020/2021 | 10 | 19 | 21 | 16 | 12 | 2 | 1 | 2 | 7.7349398 | 80 |
| 2019/2020 | 5 | 28 | 22 | 18 | 8 | 3 | 4 | 0 | 7.7613636 | 88 |
| 2018/2019 | 2 | 18 | 16 | 19 | 0 | 3 | 2 | 0 | 7.7666667 | 60 |
| 2017/2018 | 2 | 28 | 24 | 16 | 8 | 6 | 3 | 0 | 7.6551724 | 87 |
| 2016/2017 | 8 | 20 | 18 | 11 | 6 | 2 | 2 | 1 | 7.9117647 | 68 |
| 2015/2016 | 4 | 24 | 24 | 19 | 8 | 3 | 1 | 0 | 7.8072289 | 83 |

Bachelor’s theses have not yet been developed in the English group of the Bachelor’s study programme.

## 3.3. Resources and Provision of the Study Programme

**3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.**

The description of the resources available for the implementation of studies and achievement of learning outcomes can be found in sections 2.3.1 Financing, 2.3.2. Infrastructure and facilities and 2.3.3. Methodological and information resources of the report.

Since the resources for the implementation of Computer Science study programmes are used in an integrated manner at all study levels, both the same premises and different material resources are used, it is reasonable to refer to the general description of the degree programme.

The facilities are sufficient for the implementation of the Bachelor's Computer Science study programme; it creates prerequisites for achieving the learning outcomes, ensures the specific nature of computer science, for example, in terms of computer classes and computer technology, as well as in terms of informational resources in the field of computer science. If necessary, provision of resources is developed.

**3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).**

**3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).**

**Programme revenues**

In order to provide the funds necessary for the implementation of the Bachelor's study programme "Computer Science", the UL uses:

- state budget grant from the Ministry of Education and Science (MES), which in the 2021/2022 academic year is 2445 EUR for full-time regular studies,
- tuition fees, taking into account all the factors mentioned in the section "2.3.1. Financing", which in the 2021/2022 academic year is 2000 EUR per year for full-time regular studies.

Candidates to the Bachelor's study programme every summer can apply to the 1$^{st}$ year only for a state budget funded study place. Only those who have not passed the study semester successfully become fee-paying students. Thus, the faculty receives basic income and implements the study programme with a state budget grant from the Ministry of Education and Science. Considering the above, the total budget of the study programme is expected to be 929 thousand EUR/year.

**Programme costs**

To estimate the amount of funds required for financing, the UL calculates the cost price for study programmes according to the methodology developed by the UL, which takes into account all the costs of ensuring the study process described in section "2.3.1. Financing SV" and information

about the plan of a specific study programme, teaching staff involved, planned number of students, and other aspects, thus ensuring the reliability of the forecasts.

**Full-time regular** studies costs

The programme is implemented only in the form of full-time studies. For calculations, the implementers of the Bachelor's study programme "Computer Science" use the data of the state budget funded students in the academic year 2021/2022 (there are 380 students of full-time regular studies), the existing plan of the study programme planned for accreditation and the existing structure of the involved academic staff. Considering the above, the calculated cost of the full-time programme is 2441 EUR per student per year, and the total cost of the programme is 927,580 EUR per year. A more detailed percentage distribution of costs is shown in Table IV-5.

*Table IV-5.*

*Percentage distribution of costs of the study programme*

| **Expenditure item** | **% of the total** |
|---|---|
| Teaching staff expenditures | 38.6% |
| General staff | 27.1% |
| Other expenditures | 0.0% |
| Infrastructure expenditures | 5.3% |
| Goods and services | 3.0% |
| Indirect costs | 26.0% |
| **TOTAL COSTS** | **100%** |

Figure IV-1 shows the cost of the study programme depending on the number of students and a comparison with the proposed study fee and state budget grant.

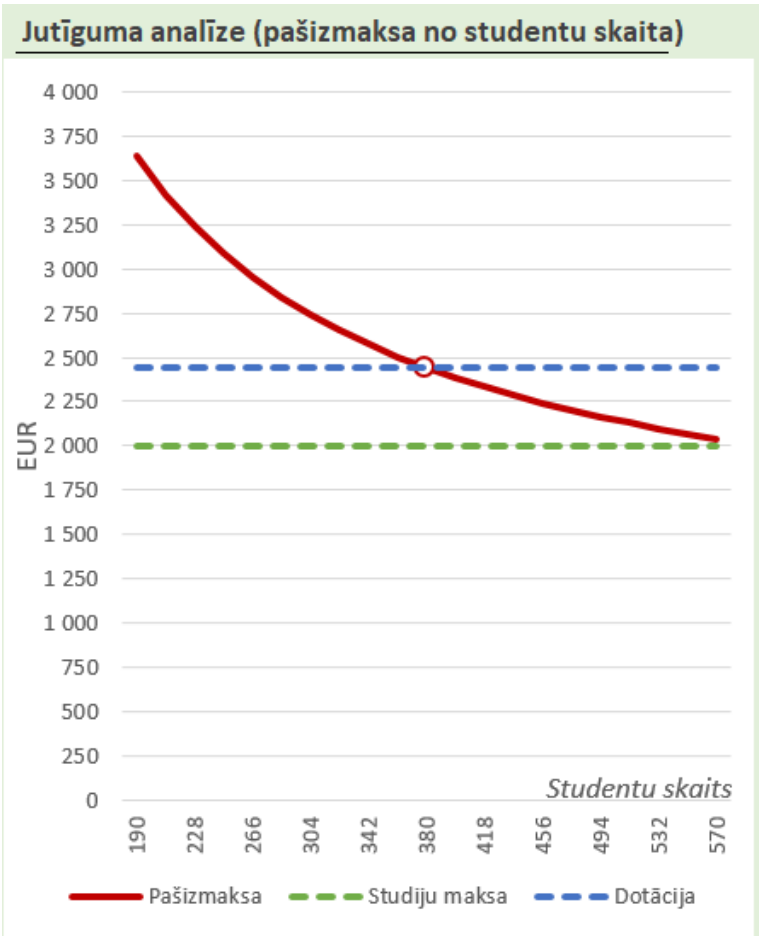


*Figure IV-1. Cost of the Bachelor's study programme "Computer Science" based on the number of students.*

The calculation shows that with the allocated state budget grant for 380 state budget funded study places, the Faculty of Computer Science can ensure a profitable and high-quality study process (the intersection of the red (own costs) and blue (state tuition fee grant) lines is projected onto the 'x' axis). On the other hand, if there were only fee-paying students in the programme, their number should be at least 570 and more at the currently determined tuition fee of 2000 EUR per year.

**Summary of programme revenues and costs**

After summing up the revenues (state grant) of the Bachelor's study programme "Computer Science", i.e., 929,100 EUR, and programme costs, i.e., 927,580 EUR, for 380 budget students, the result of the study programme is positive.

The data mentioned above clearly show that the UL has sufficient funds to implement the study programme and ensure its further development. In addition, the development of the programme can be improved and financed from the income from fee-paying students, if the faculty decides to open admission for fee-paying study places in the future, as well as from the financial resources accumulated by the structural unit, if such arise from students who become fee-paying students due to academic debts. In the foreseeable future, the faculty should revise the tuition fee so that its level reaches and is no less than the level of the state grant.

Taking into account the agreement concluded by the Ministry of Education and Science and the University of Latvia on the number of study places provided by the state budget for the study

program "Computer Science", the minimum number of students in the study program (in Latvian) of the Faculty of Computer Science is 380 places from the state budget.

The minimum number of students in the 1st year of the study program in both Latvian and English is set - 25 students.

The tuition fee is determined as follows:

"Computer science" (Latvian) - 2450 EUR/year,

"Computer Science" (English) - 2900 EUR/year,

"Computer Science" (Lincoln, English) – 4200 EUR/year.

The number of specializations in the "Computer Science" study program does not significantly affect the costs of the program implementation, because the specialization of the study program is implemented only if at least 25 students choose it, as well as the part of free-choice study courses is 6 CP or 3.75% of the total CP of the entire study program.

## 3.4. Teaching Staff

**3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.**

*Confirmation that the academic staff of the academic study programme meets the requirements of Article 55 Section 1 Paragraph 3 of the Law of Higher Education Institutions is attached in* ***Appendix IV-10.***

The professionalism of the academic staff involved in the study programmes is high enough for the implementation of high-quality studies.

The implementation of the Bachelor's study programme Computer Science in Latvian and English groups together is ensured by 18 professors, 10 associate professors, 19 assistant professors, 3 university lecturers, 11 teachers (6 of them with a doctor's degree). One visiting associate professor from the Royal University of Technology (Sweden) also participates in the implementation of the studies. A total of 63 university lecturers participates in the implementation of the programme, 55 of which with a doctor's degree, 8 with a master's degree.

In the Bachelor's programme, the courses are also taught by academic staff from other faculties (9 out of 63) – 1 professor, 1 associate professor, 4 assistant professors, 3 lecturers who teach individual courses in the relevant field, for example – in economics, mathematics, physics, chemistry (Civil protection course) and geography (Environment protection course). Among the lecturers from other faculties, there are 6 lecturers with a doctor's degree and 3 with a master's degree.

Of the lecturers who are from the Faculty of Computing, a total of 49 PhDs currently teach in the Computer Science Bachelor's programme (6 of the PhDs are assigned to teach individual courses as university lecturers, and 43 PhDs are elected to academic positions). Both industry professionals and doctoral students are recruited as lecturers. Since May 2015, only PhDs have been elected to pedagogical academic positions in the Faculty of Computing (there are no lecturers and assistants in the faculty).

During the reporting period, the implementation of the Bachelor's programme in English was started, therefore the composition of teachers for the English group is analysed separately. The basic principle for attracting lecturers was to first offer the teaching of the relevant course in English to the course lecturer in the Latvian group, thus the composition of a large part of the lecturers overlaps, and also ensures the same quality of content and teaching quality in the way it has developed over the years in the Latvian group of the Bachelor's programme of Computer Science. Fewer lecturers are involved in the implementation of the programme than in the Latvian group of the programme, because only one of the specializations "Software Engineering" is provided to the students of the English group. In total, 39 lecturers teach in the English group (including 7 lecturers from other faculties), i.e., 10 professors, 8 associate professors, 9 assistant professors, 2 university lecturers, as well as 8 instructors (3 of the instructors have a doctor's degree). It should be noted that seven (7) of the mentioned university lecturers teach only in the English group, but not in the Latvian group (5 of them have a doctor's degree).

When analysing the composition of lecturers by age, it should be mentioned that the average age of all the lecturers who teach in the Bachelor's programme in Computer Science is 49 years (48 years if only lecturers from the Faculty of Computing are taken into account).

In the breakdown by academic positions, the average age of elected lecturers at the Faculty of Computing who teach in the Latvian group of the Bachelor's programme is as follows: assistant professors – 41 years, associate professors – 44 years, professors – 56 years. When analysing the Computer Science Bachelor's programme lecturers elected from the Faculty of Computing by age groups, data on the youngest and oldest age groups should be pointed out: "<30", which has one elected lecturer, and "30-40" – 9 elected lecturers, as well as the age group ">60", which has 5 elected lecturers. This distribution reflects a natural renewal of the teaching staff, which is ensured by the possibility to be elected to an academic post after obtaining a degree and engaging in the teaching work. The involvement of doctoral students in teaching appears in the data on non-elected lecturers – currently 5 lecturers with a Master's degree are involved, they are both doctoral students and PhD candidates (with a doctoral thesis not yet defended). The implementation of the Bachelor's programme in English also offers new opportunities for new lecturers to be engaged in academic work.

Most of the academic staff of the Faculty of Computing know English at a level that allows them to implement the studies in English. English language skills in some study courses were the reason for changing instructors to teach the course in the English group.

The involvement of many university lecturers is justified by the fact that lecturers teach study courses that correspond to their field of research, thus providing students with current study course content, while in study courses related to the latest technologies, lecturers use their practical experience in projects or industry. Thus, the qualifications and experience of the lecturers allow to ensure the learning outcomes of the study course and, accordingly, the study programme.

The qualifications of the lecturers are confirmed by their participation in various research projects. The experience obtained in the projects and the new knowledge gained are used to improve the courses. For example, Professor Andris Ambainis, who is the head of the Centre for Quantum Computer Science and several projects related to the quantum field (for example, the ERAF project

"Quantum algorithms: from complexity theory to experiment"), teaches the course "Quantum computing" in the Bachelor's study programme. Professor Jurģis Šķilters, who leads Laboratory of Perceptual and Cognitive Systems and scientific projects (for example, "Perception in Modality Diversity and Valence"), teaches the courses "Human-Computer Interface" and "Communication and Cognitive Sciences" to students of the Bachelor's study programme in Computer Science. Similar examples can be mentioned about other professors, thus the implementation of the Bachelor's programme in Computer Science uses the latest scientific knowledge in computer science as well as related fields in interdisciplinary research, such as cognitive sciences or mathematics.

It must be concluded that the qualifications of the academic staff fully correspond to the implementation of the study programme in both Latvian and English.

When evaluating the composition of lecturers in relation to the requirements specified in the Article 55 Section 1 Paragraph 3 of the Law on Universities, which stipulates that "Not less than five professors and associate professors altogether, who are elected to academic positions in the relevant higher education institution, shall take part in the implementation of the compulsory part and the limited elective part of academic study programmes", it can be concluded that this requirement is met in the case of the computer science programme (see **Appendix IV-10**).

### 3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

The qualifications of the teaching staff are assessed upon election to academic positions. In the previous section, statistics on all university lecturers (including from other faculties) were analysed, however, changes in the composition of lecturers related to the election to academic positions will be analysed within the faculty, so it should be highlighted that Bachelor's study programme in Computer Science is taught by professors (17), associate professors (10), assistant professors (14) elected at the Faculty of Computing. Of all the academic staff elected in the reporting period, professors (5), associate professors (10), university lecturers (6) were elected to the respective position for the first time. During the reporting period, there were also 2 cases where lecturers showed good results in teaching and met the qualifications, i.e., during the reporting period, they were elected for the first time to the position of assistant professor, and later also to the position of associate professor. Initially, at the Faculty of Computing university lecturers start teaching a course of the Bachelor's study programme in Computer Science as teaching staff, and after the evaluation of teaching results, possibilities for election to the position are considered; doctoral students, however, usually get involved during their doctoral studies, thus gaining experience, and after obtaining the degree, they can already candidate to be elected to the position of an assistant professor.

### 3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff

**included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).**

**3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).**

**3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).**

When preparing a new study course, its author consults the programme director about the prior knowledge for the course, as well as about possible overlaps with other courses in the programme. It is evaluated, which semester of the study programme the course should be included in, based on the necessary prior knowledge. In addition to the course developers, the responsible teaching staff are also involved in the preparation of the content of the study courses and the relevant description, and this cooperation takes place not only in the case of the developing of a new course, but also when updating the content of the study courses, which takes place at least once every three years, but if necessary, also before each study semester. The Bachelor's study programme consists of several study courses, which are taught by several members of the teaching staff, not including the lecturers involved in conducting practical work or correcting students' tests. For example, within the courses "Computer Architecture I" (2 university lecturers), "Databases and Information Systems Fundamentals" (2 university lecturers), "Software Engineering" (2 university lecturers), the topics taught by each lecturer, the evaluation criteria of the course, the sequence of the content and presentation of topics are agreed upon.

When both groups – Latvian and English – are taken into account, there are a total of 621 students in the computer science Bachelor's programme as of December 1, 2021. The ratio of students to teaching staff is 621/63, i.e., approximately 10 students to 1 teacher.

# Annexes

| III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme | | |
|---|---|---|
| Sample of the diploma and its supplement to be issued for completing the study programme | IV-1. annex Dipl_pielik.zip | IV-1. pielikums Dipl_pielik.zip |
| For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable) | | |
| Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable) | | |
| Statistics on the students in the reporting period | EN-IV-2.Annex.Statistics_stud_bac.docx | IV-2.pielikums.Statistika_stud_bak.docx |
| III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof | | |
| Compliance with the study programme with the State Education Standard | EN-IV-3.Annex. Compliance-with_education-standard-bac.docx | IV-3.pielikums.atb-izgl-stand-bak.docx |
| Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable) | | |
| Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable) | | |
| Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme | EN-IV-4..Annex-map-bac.xlsx | IV-4.pielikums.karte_bak.xlsx |
| The curriculum of the study programme (for each type and form of the implementation of the study programme) | EN-IV-5.Annex.Study plans - all specializations-bachelor-full time and part time.zip | IV-5.pielikums.Studiju-progr-plani-visas-specializacijas-visas-formas.zip |
| Descriptions of the study courses/ modules | EN-IV-8.Annex.Course_desc-bac.docx | IV-8.pielikums.kursu-apraksti-bak.docx |
| Description of the organisation of the internship of the students (if applicable) | III-2. annex Regulation_on_Internship_EN.pdf | III-2..pielikums. Prakses_nolikums.pdf |
| III - Description of the Study Programme - 3.4. Teaching Staff | | |
| Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable) | | |
| Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable) | IV-10. Certification by the Head of Direction.edoc | IV-10. Virziena vadītāja apliecinājums.edoc |

# Computer Science and Mathematics (51483)

| | |
|---|---|
| Study field | *Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science* |
| ProcedureStudyProgram.Name | *Computer Science and Mathematics* |
| Education classification code | *51483* |
| Type of the study programme | *Doctoral study programme* |
| Name of the study programme director | *Andris* |
| Surname of the study programme director | *Ambainis* |
| E-mail of the study programme director | *andris.ambainis@lu.lv* |
| Title of the study programme director | *Dr.sc.comp./Dr.dat.* |
| Phone of the study programme director | *+371 22311875* |
| Goal of the study programme | *The purpose of the doctoral study programme "Computer Science and Mathematics" is to provide opportunities for the growth of scientific workers and teaching staff in the fields of computer science and mathematics, promoting the preparation of such professionals for fundamental and applied research, work in the national economy or public administration, whose knowledge, skills and competence meet the Latvian and international requirements of highest-level specialists in the fields of computer science and mathematics. The main components of the quality of research-based education are the management of modern research methodologies in the industry, skills necessary to perform research work, a world view based on science, competences in research management and pedagogical work.* |

| | |
|---|---|
| Tasks of the study programme | *1. To ensure the acquisition of in-depth knowledge and understanding of the problems of computer science and mathematics, to promote in-depth acquisition of the theories and methodologies of the field of science, to ensure the achievement of high competence of doctoral students in the chosen field of science. To provide knowledge of the relations between computer science, mathematics and other branches of science that provide interaction between them.*<br>*2. To develop and improve the skills of scientific research work, to promote the acquisition of the latest theoretical approaches and research methods and their application in practice, which will allow doctoral students to reach new scientific results in the chosen field of computer science or mathematics.*<br>*3. To promote the acquisition of the theory and practice of university pedagogy, to develop the pedagogical skills necessary for successful work as a teaching staff after completing the doctorate.*<br>*4. To develop analysis of scientific literature and scientific communication skills, to promote the development of creative and critical thinking, as well as reasoning abilities and skills to enrich the country's intellectual potential.*<br>*5. To provide opportunities for improving information and data processing technology skills and presentation competences. To promote the participation of doctoral students with papers at conferences, seminars, doctoral schools, etc.*<br>*6. To provide opportunities for doctoral students to publish the results of research work and theoretical insights in generally recognized peer-reviewed scientific publications and scientific publications of the field.*<br>*7. To promote the preparation and pre-defence of a doctoral dissertation.* |

| | |
|---|---|
| Results of the study programme | *Knowledge:*<br>*1. understands the theory of the scientific field, manages research methodology and navigates the development trends of theoretical and applied concepts,*<br>*2. understands the theoretical concepts of the research field, research methods, development trends,*<br>*3. understands the principles of research organization,*<br>*Skills:*<br>*4. puts forward a hypothesis, defines research goals and tasks, organizes and conducts research in the chosen field of science,*<br>*5. evaluates and chooses appropriate methods for scientific research, to independently solve essential tasks of fundamental and applied research in the chosen field of science,*<br>*6. communicates both orally and in writing about his/her field of scientific activity in the academic environment and society in general,*<br>*Competencies:*<br>*7. solves important research or innovation tasks, independently proposes a research idea by performing critical analysis, synthesis, and evaluation,*<br>*8. contributes to the expansion of the boundaries of knowledge and creates a new understanding of the existing knowledge and its application in practice by carrying out a significant amount of original research at the level of internationally cited publications,*<br>*9. gets involved in the international academic environment and integrates into the global scientific research environment,*<br>*10. raises their scientific qualifications and improves their teaching skills in a motivated and independent manner.* |
| Final examination upon the completion of the study programme | *Doctoral examinations, Doctoral thesis* |

# Study programme forms

**Full time studies - 4 years - latvian**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *4* |
| Duration in month | *0* |
| Language | *latvian* |
| Amount (CP) | *192* |
| Admission requirements (in English) | *Master's degree in computer science or mathematics, master's degree of engineering in computer science or information technology, or equivalent higher education to the above-mentioned master's degrees, and entrance examination. Master's degree or equivalent higher education in another field with work experience in the field of information technology or mathematics and entrance examination.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Doctoral Degree of Science Doctor of Science (Ph.D.) in Natural Sciences* |

| | |
|---|---|
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Full time studies - 4 years - latvian**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *4* |
| Duration in month | *0* |
| Language | *latvian* |
| Amount (CP) | *192* |
| Admission requirements (in English) | *Master's degree in computer science or mathematics, master's degree of engineering in computer science or information technology, or equivalent higher education to the above-mentioned master's degrees, and entrance examination. Master's degree or equivalent higher education in another field with work experience in the field of information technology or mathematics and entrance examination.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Doctoral degree of Science Doctor of Science (Ph.D.) in Engineering and Technology* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Full time studies - 4 years - english**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *4* |
| Duration in month | *0* |
| Language | *english* |
| Amount (CP) | *192* |
| Admission requirements (in English) | *Master's degree in computer science or mathematics, master's degree of engineering in computer science or information technology, or equivalent higher education to the above-mentioned master's degrees, and entrance examination. Master's degree or equivalent higher education in another field with work experience in the field of information technology or mathematics and entrance examination. Studies in English require English language skills at least at B2 level.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Doctoral Degree of Science Doctor of Science (Ph.D.) in Natural Sciences* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

**Full time studies - 4 years - english**

| | |
|---|---|
| Study type and form | *Full time studies* |
| Duration in full years | *4* |
| Duration in month | *0* |
| Language | *english* |
| Amount (CP) | *192* |
| Admission requirements (in English) | *Master's degree in computer science or mathematics, master's degree of engineering in computer science or information technology, or equivalent higher education to the above-mentioned master's degrees, and entrance examination. Master's degree or equivalent higher education in another field with work experience in the field of information technology or mathematics and entrance examination. Studies in English require English language skills at least at B2 level.* |
| Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english) | *Doctoral Degree of Science Doctor of Science (Ph.D.) in Engineering and Technology* |
| Qualification to be obtained (in english) | --- |

**Places of implementation**

| Place name | City | Address |
|---|---|---|
| University of Latvia | RĪGA | RAIŅA BULVĀRIS 19, CENTRA RAJONS, RĪGA, LV-1050 |

# 3.1. Indicators Describing the Study Programme

### 3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

The doctoral study programme “Computer Science”, which was accredited in the previous accreditation, was merged with the doctoral study programme “Mathematics” as part of the consolidation of study programmes, thus creating a new doctoral study programme “Computer Science and Mathematics” (hereinafter referred to as DSP “Computer Science and Mathematics”).

On September 8, 2021, the University of Latvia was issued a DSP “Computer Science and Mathematics” license, with three study programme codes: 51460 (Mathematics and statistics), 51483 (Computer systems, databases and computer networks) and 51523 (Electronics and automation). These three codes correspond to three branches of science in which Ph.D. can be awarded after the graduation: 51460 - mathematics, 51483 - computer science and informations, 51523 - electronics, electrical engineering and information and communication technology.

After the license was issued, the awarded degree has been changed, in accordance with the changes to The law about research activities (Zinātniskās darbības likums) that came into force on 29.07.2022 and the regulations of the Cabinet of Ministers from 27.09.2022 "Regulations on groups of branches of science, branches and subbranches of science" which determine that the degree of a doctor of science (Ph.D.) is awarded in the groups of branches of science.

In accordance with these regulations, DSP "Computer science of mathematics" will award one of two degrees:

Doctoral degree of Science - Doctor of Science (Ph.D.) in Natural Sciences - to students who specialize in mathematics or computer science and informatics.

Doctoral degree of Science - Doctor of Science (Ph.D.) in Engineering and Technology - to students who specialize in electrical engineering, information and communication technologies.

The range of study courses in the limited elective part was expanded to include the following courses:

DatZ7070 Data Mining Algorithms (4 CP)

DatZ7101 Open Government Data in a data-driven world (2 CP)

DatZ7031 Virtual Environments (2 CP)

DatZ7032 Wireless Sensor Networks (4 CP)

DatZ7034 Digital design (4 CP)

The programme incorporates a free elective part in the amount of 2 credit points, correspondingly reducing the limited elective part by 2 CP.

**3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.**

Students of the programme can develop a Ph.D. thesis in one of the three branches of science: computer science and informatics, electrical engineering, electronics, information and communication technologies, or mathematics. The study programme has three codes corresponding to these three branches of science: 51483 (“Computer systems, databases and computer networks”), 51523 (“Electronics and automation”) and 51460 (“Mathematics”). After defending a Ph.D. thesis in computer science and informatics or in mathematics, a degree of doctor of science (Ph.D.) in natural sciences is awarded.  After defending a Ph.D. thesis in electrical engineering, electronics, information and communication technologies, a degree of doctor of science (Ph.D.) in engineering and technology is awarded.

As an interdisciplinary programme, DSP “Computer Science and Mathematics” is related to both the bachelor’s study programme “Computer Science” and the master’s study programme “Computer Science” included in the field of study “Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science”, as well as the bachelor’s and master’s programmes “Mathematics” included in the study field “Physics, Material Science, Mathematics and Statistics”. DSP “Computer Science and Mathematics” gives students of these programme the opportunity to continue their education at the highest level, developing previously acquired knowledge and skills. Inclusion in the study field “Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science” is justified by the fact that 75% of the students of the programme specialize in topics belonging to this field.

DSP “Computer Science and Mathematics” was created using the experience of countries of the European Union in the implementation of doctoral level studies, the priority fields of science recognized in Latvia and the traditions of academic education existing at the University of Latvia (hereinafter referred to as UL). The objective of doctoral studies is to prepare highly qualified specialists for independent work in science, higher education and economy. The study programme was created by consolidating the previously existing UL doctoral study programmes “Computer Science” and “Mathematics” to ensure a unified, interdisciplinary approach to the preparation of new specialists, the acquisition of generally applicable competencies, the promotion of cooperation between individual fields of science, as well as the efficient use of funds.

The goal of the doctoral study programme “Computer Science and Mathematics” is to provide opportunities for the growth of scientific workers and teaching staff in the fields of computer science and mathematics, promoting the preparation of such professionals for fundamental and applied research, work in the national economy or public administration, whose knowledge, skills and competence meet the Latvian and international requirements of highest-level specialists in the fields of computer science and mathematics. The main components of the quality of research-based education are the management of modern research methodologies in the industry, skills necessary to perform research work, a world view based on science, competences in research management and pedagogical work.

The study programme has tasks and study results typical for doctoral study programmes. Tasks and study results are defined in the section for the parameters of the programme.

The outcomes of the study programme are formulated, based on the recommendations for the 8th level of the European Qualifications Framework (EQF) and the Latvian Qualifications Framework (LQF) and the third cycle qualification level of the Qualifications Framework for the European Higher Education Area.

DSP “Computer Science and Mathematics” is considered to have been successfully completed if the doctoral student has obtained 192 credit points (KP) within 4 years by studying the study courses included in the study programme, successfully passing two doctoral exams (an exam in a foreign language and an exam in the field of sciences), as well as developing a research paper of the doctoral dissertation and submitting it for defence to the doctoral council. A dissertation or thesis, a monograph, and a set of at least three thematically unified scientific publications published in Scopus and/or Web of Science indexed journals are considered doctoral research.

According to Article 57 of the Law on Higher Education Institutions, the duration of the doctoral study programme can be 3 or 4 years. DSP “Computer Science and Mathematics” has a duration of 4 years so that the doctoral student has enough time to learn an interdisciplinary topic and develop a doctoral dissertation within it.

DSP “Computer Science and Mathematics” has the following specified admission requirements: master’s degree in computer science, master’s degree in mathematics, master’s degree in engineering in computer science or information technology, or a diploma of at least five years of higher education corresponding to the above-mentioned master’s degrees; master’s degree in another field or a diploma corresponding to a master's degree with work experience in the field of information technology or mathematics (at least 3 years); successfully passed entrance exams.

The interdisciplinarity of the doctoral programme means that the doctoral students studying in it can have different previous education. The three most typical prior educations are a master’s degree in computer science, a master’s degree in mathematics, a master’s degree in engineering in computer science or information technology, but computer science and mathematics are used in many other industries and are also used by professionals with a higher education in another field who learned computer science or mathematics through practical work. In order to give such professionals the opportunity to develop a doctoral dissertation, applicants with a master’s degree in another field with work experience in the field of information technology or mathematics (at least 3 years long) are allowed to be admitted to the programme, while in each case the work experience and the number of technically complex cases worked on is individually evaluated. Such applicants are most often found in the field of cognitive sciences (which combines computer science and psychology), as well as in research directions related to management science and didactics.

### 3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

The information and communication technology (ICT) sector is experiencing rapid growth both in the world and in Latvia. The turnover of the Latvian ICT industry in 2019 reached 2.02 billion EUR and the number of employees in the industry is 31 thousand. ICT professional skills such as algorithmic thinking, data analysis and programming are useful today not only for ICT companies, but practically in all sectors of the economy.

As Latvia's ICT industry develops, the demand for highly qualified specialists who know computer science and mathematics as branches of science and are able to navigate research results is growing. Such skills are particularly important for ICT managers and the demand for ICT managers is expected to be one of the fastest growing with an increase by 50% over the next decade.

Research directions are increasingly developing where knowledge of both scientific branches is required (for example, artificial intelligence research is based on complex mathematics, big data research uses statistics). DSP "Computer Science and Mathematics" will promote the development of such joint research, promoting interdisciplinarity and expanding the knowledge of doctoral students about other branch of science, while maintaining and strengthening research work and specialization in accordance with the direction of doctoral work in the fields of science that form the programme.

There are various examples of doctoral studies in the world that combine computer science and mathematics. For example, Carnegie Mellon University and the Georgia Institute of Technology in the US have doctoral programmes "Algorithms, Combinatorics and Optimization" that combine mathematics-related research areas in computer science with corresponding research areas in mathematics. This will be the first study programme of its kind in the Baltic region.

The competitiveness of the study programme in both Latvian and Baltic contexts is based on the quality of the previously existing doctoral programmes "Computer Science" and "Mathematics", which is evidenced by the high level of doctoral theses, the completion of studies with publications included in the world's leading databases of scientific literature, the academic activities of new doctors of science indicators and competitiveness in the labour market of EU countries.

The perspective job market for graduates of the programme includes both academic work in Latvian universities (UL, RTU, University of Daugavpils, Latvia University of Life Sciences and Technologies, University of Liepaja, Ventspils University of Applied Sciences and others), research institutes (UL Institute of Mathematics and Computer Science, Institute of Electronics and Computer Science, and others), as well as work in national economic enterprises (Accenture, Emergn, Tilde, Whitecryption, etc.) and in the state administration (Bank of Latvia, Central Statistical Bureau of Latvia). In all these places, advanced knowledge of computer science and mathematics is useful. New PhDs of science who graduated from University are highly ranked in the research organizations of the EU and other countries (For example, PhDs in computer science prepared by the UL have worked or are working at the prestigious Massachusetts Institute of Technology (MIT) in the USA, University of Bristol in the UK, University of Bozen-Bolzano in Italy, Ålesund University in Norway and elsewhere abroad).

In economics, the graduates of DSP "Computer Science and Mathematics" will be interesting for companies that create innovative products and technologies. This includes both large companies trying to occupy more technologically complex niches (such as Accenture) and highly innovative small and medium-sized companies (such as Tilde, which is actively involved in Europe-wide research programmes in the field of language technology). It can be argued that the current demand from the academic environment, the economy and the state administration significantly exceeds the number of PhDs and the labour market will not be saturated in the near future.

The monitoring data of Ministry of Education and Science on graduates is available for graduates with doctoral degrees received in 2017 and 2018 and covers a fairly small number of graduates. In 2017 and 2018, 5 graduates of the doctoral study programmes "Computer Science" and "Mathematics" obtained their doctorate degrees. Among these graduates, 4 are employed in Latvia, one has emigrated. Out of the 4 employed graduates, two work in the "Education" sector and 1 graduate in the "Information and communication services" and 1 graduate in "Professional, scientific and technical services" sector. The average income of the employed graduates is 52,678

EUR per year.

### 3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

The programme consists of two subprogrammes "Computer science and electronics" and "Mathematics" which correspond to different fields of science. The subprogramme "Computer science and electronics" corresponds to fields of science "Computer science and informatics" (natural sciences) and "Electrical engineering, electronics, information and communication technologies" (engineering sciences). The subprogramme "Mathematics" corresponds to the field of science "Mathematics" (natural sciences).

Since the programme was created by combining two previously existing doctoral study programmes in 2021, we analyze statistics about these programmes. The former DSP "Computer science" corresponds to the subprogramme "Computer science and electronics". The former DSP "Mathematics" corresponds to the subprogramme "Mathematics".

During the reporting period, the number of students in DSP “Mathematics” fluctuated between 13 and 18, and between 31 and 38 in DSP “Computer Science”, with a slight downward trend. The decrease can be explained by the fact that until autumn 2015, ESF-financed scholarships for doctoral students were available. With the end of this funding, interest in doctoral studies decreased among candidates who are no longer working in research projects at universities or scientific institutes. If the funding for doctoral studies improves (for example, through the planned support for the new doctoral model), it is expected that the interest in the studies will grow again.

During the last 6 years, the average number of doctoral students enrolled in the “Computer Science” study programme is 7.33 doctoral students per year (the largest number: 10 per year, the smallest: 6), the average number of graduates – 5.14 graduates per year (the largest: 7 per year, the smallest: 3). The number of dissertations defended is 16 doctoral dissertations within 6 years – 2.67 PhDs per year. Thus, 37% of those who enrol in the doctoral programme obtain a PhD. The average number of doctoral students enrolled in the study programme “Mathematics” in the last 6 years is 4.2 (the largest: 5 per year, the smallest: 3), the average number of graduates – 2 graduates per year (the largest: 3 per year, the smallest: 1). The number of dissertations defended is 6 doctoral dissertations within 6 years (on average 1 graduate per year). Thus, on average only a fourth of those who enrol in the doctoral programme obtain a PhD. The main reason for student dropout in both study programme is the lack of funding for doctoral studies, which is complicated due to the facts that the development of a doctoral dissertation takes a long time and the lack of funding at one stage creates a risk that the dissertation will not be completed.

During the last 6 academic years, 19 applicants enrolled in the DSP “Computer Science”, who graduated from the MSP “Computer Science” (9% of the graduates of the master’s programme during this period). Another 5 newly admitted doctoral students graduated from MSP “Computer Science” in previous years, 5 obtained a master’s degree in another field at the University of Latvia, 6 obtained a master’s degree at other Latvian universities (RTU, Transport and Telecommunication Institute, Ventspils University of Applied Sciences), 5 obtained a master's degree abroad.

During the last 6 academic years, 17 applicants who graduated from MSP “Mathematics” (39% of

the graduates of the master's programme during this period) enrolled in DSP "Mathematics". 2 more newly admitted doctoral students obtained a master's degree in another field at the University of Latvia, 1 obtained a master's degree abroad.

Studies are conducted only as full-time regular studies. DSP "Computer Science" has been studied by 2 foreign doctoral students, 1 from Austria (state budget funding, with support from a Marie Curie project financed by the Horizon 2020 programme) and Aliya Khadieva from Russia (personal funding). DSP "Mathematics" has also been studied by 2 foreign doctoral students: 1 from India (personal funding; PhD thesis defended in 2020) and 1 from Germany (state budget funding). During the six-year period, another 7 foreign doctoral students have studied in DSP "Computer Science" and DSP "Mathematics" within the framework of various mobility programmes (Erasmus, bilateral programmes or programmes financed by the country of origin of the doctoral student).

Planned activities for attracting foreign doctoral students in the future:

1. Use the possibilities of EU Marie Curie programmes (e.g., Innovative Training Networks),
2. Use the resources of the Quantum Computing and Computer Linguistics Centres to be established with the financing of the European Recovery Fund,
3. Advise lecturers to announce international competitions for doctoral student positions within projects.

**3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).**

## 3.2. The Content of Studies and Implementation Thereof

**3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.**

The structure of DSP "Computer Science and Mathematics" consists of two sub-programmes ("Computer Science" and "Mathematics") with the common structure of the compulsory part, specialization seminars and research methods course corresponding to each sub-programme, as well as the limited elective theoretical courses corresponding to each sub-programme.

These two sub-programmes provide the opportunity to specialize in three branches of science. When studying in the sub-programme "Computer Science", it is possible to specialize in the field of

natural sciences “Computer Science and Informatics” (programme code: 51483) or in the related field of engineering “Electrical engineering, electronics, information and communication technologies” (programme code: 51523). Specialization in these two sectors is provided through elective courses and sector-specific thesis topics. While studying in the sub-programme “Mathematics”, it is possible to specialize in the field of natural sciences “Mathematics” (programme code: 51460).

In accordance with the regulation of study programmes and further training programmes of the University of Latvia, the size of DSP “Computer Science and Mathematics” is 192 CP. The programme is conducted as full-time studies, with students acquiring 24 CP in each of the eight semesters. The regulation states that the compulsory part of the doctoral study programme consists of studies and the development of a doctoral thesis (literature analysis, conducting research, presenting results at conferences, preparing scientific publications), the general skills module, doctoral exams, as well as participation in the doctoral schools of the UL or equivalent experience.

The credit point value of the compulsory part of DSP “Computer Science and Mathematics” is 178 CP. It consists of:

- development of a doctoral dissertation (134 CP),
- two doctoral exams (16 CP) – an exam in the speciality (12 CP) and an exam in English (4 CP),
- participation in a specialization seminar (14 CP), which is equivalent to participation in a doctoral school,
- general skills module (14 CP) – assisting in study courses (4 CP), supervision of student research (4 CP), study courses on research methods (4 CP) and publishing research papers (2 CP).

Specialization seminars and the study course on research methods are conducted separately for subprogrammes "Computer science and electronics" and "Mathematics". Thus, the content is adjusted to different needs and interests of the students in different subprogrammes.

The value of the limited elective part of DSP “Computer Science and Mathematics” is 12 CP, it consists of the theoretical courses corresponding to each sub-programme (the list of courses is provided in the study plan in Appendix VI-9, course descriptions are attached in Appendix VI-10). For students specializing in engineering field “Electrical engineering, electronics, information and communication technologies”, courses such as "Digital signal processing" (4 CP) and "Wireless sensor networks" (4 CP) are offered. For students specializing in natural science field "Computer science and informatics", courses such as "Computational complexity" (2 CP) and "Mathematical foundations of cryptography" (2 CP) are offered. Courses that are important to both specializations are offered to students of both specialization.

The elective offering for the subprogramme "Mathematics" is largely different from the subprogramme "Computer science and informatics" but courses of general nature (for example, the cognitive science course) are offered to both subprogrammes together.

Free elective part is 2 KP.

Courses of study programmes of an appropriate level, which doctoral students have completed or passed at other universities, can be recognised as both the compulsory and the limited elective part, if the participation in these courses and the received confirmations (certificates etc.) have been accepted by the doctoral council of the branch of science.

The content of the doctoral examination is determined by the doctoral council of the branch of

science. The mandatory doctoral exam is conducted in a foreign language, which confirms the doctoral student's knowledge and abilities to prepare scientific publications in a foreign language, as well as orally present the results of your research for approval at international conferences. At the doctoral student's request, the doctoral council may agree to conduct all doctoral examinations in a foreign language.

The mapping of the study courses included in the programme (Appendix VI-8) shows how individual study courses ensure the achievement of the learning outcomes of the study programme. The study courses are designed in such a way that there is no duplication of their content. The mapping results (Annex VI-8) show that the planned outcomes of the courses included in the study programme correspond to the achievable learning outcomes of the study programme. Therefore, it can be concluded that upon graduating from the study programme, the doctoral student will have achieved all the planned learning outcomes of the DSP "Computer Science and Mathematics".

The content of the study programme and its study courses was developed in 2020-2021, taking as a basis the development trends of the scientific fields and the labour market, and therefore has not lost its relevance.

**3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).**

Doctoral studies must ensure excellence in research in the relevant topic of the doctoral thesis, mastering the latest research methods and their successful application, skills in the organization of research work. Doctoral studies must prepare specialists who are competitive in both the Latvian and EU labour markets not only for research at academic institution, but also for the branches of national economy, which correspond to smart specialisation directions RIS3, are able to develop innovative solutions required by the national economy. The DSP "Computer Science and Mathematics" combines the strengths of the previously existing DSP "Computer Science" and "Mathematics" in this field, as their graduates work both in research (both in Latvia and in other EU countries), as well as in the programming industry and public administration. The quality of the previously existing DSP "Computer Science" and "Mathematics" is evidenced by the high level of doctoral theses, the completion of studies with publications included in the world's leading databases of scientific literature, the academic activities of new doctors of science indicators and competitiveness in the labour market of EU countries. After the merger of the two doctoral study programmes, the capacity of the academic staff involved in the doctoral study programme, as well as the range of potential cooperation partners have increased. Doctoral dissertations will be supervised by researchers from the Institute of Mathematics and Computer Sciences and the Institute of Electronics and Computer Sciences of the University of Latvia which are two main scientific institutions in respective fields in Latvia. This will allow for more efficient cooperation and joint use of existing resources, with the doctoral study programme becoming a centre around which scientific excellence is created.

DSP "Computer Science and Mathematics" develops cooperation between computer science and mathematics as branches of science. Such cooperation is becoming more and more important for both branches of science. Research directions are increasingly developing where knowledge of both

scientific branches is required (for example, artificial intelligence research is based on complex mathematics, big data research uses statistics). DSP “Computer Science and Mathematics” promotes the development of such joint research, promoting interdisciplinarity and expanding the knowledge of doctoral students about other branch of science, while maintaining and strengthening research work and specialization in accordance with the direction of doctoral work in the fields of science that form the programme. Computer science accumulates increasingly large amounts of data from various sources (including sensors that collect data from the physical world) and the processing of this data requires increasingly diverse mathematical methods. This process also changes mathematics as a science, motivating new research topics and new directions. DSP “Computer Science and Mathematics” will allow Latvian scientists to participate in this interdisciplinary cooperation to the greatest possible extent.

The main directions of research include quantum computing, language technologies and machine learning, computer engineering and cyber-physical systems, cognitive science. Among those, quantum computing, language technologies and machine learning belong to the field of natural science "Computer science and informatics". Computer engineering and cyber-physical systems belong the to the field of engineering science "Electrical engineering, electronics, information and communication technology". Cognitive science is an interdisciplinary field that is more connected to computer science and informatics.

In quantum computing, doctoral students are involved in research at the UL Quantum Computer Science Centre (including projects within the framework of the EU programme Horizon 2020), developing new computing methods for quantum computers, and researching other topics related to quantum algorithms. Language technology research is carried out in cooperation with UL Institute of Mathematics and Computer Science and SIA Tilde in which both text and speech processing are studied, especially regarding small languages. Also in this field, doctoral students have participated in several Horizon 2020 projects. Machine learning research occurs in the context of language technology, image processing etc. Research in computer engineering and cyber-physical systems is mostly conducted in the Institute of Electronics and Computer Science, where PhD students can study topics such as signal processing, embedded systems, robotics, autonomous cars and smart sensors. Doctoral students contribute to EU research projects that are carried out in cooperation with large European companies in the relevant fields.

Cognitive science, which studies the thinking process, should be noted as a new interdisciplinary field of research. These studies are carried out in the Laboratory of Perceptual and Cognitive Systems of the Faculty of Computing of the University of Latvia. A better understanding of the thinking process is one of the great problems of science and is closely related to the fields of artificial intelligence and machine learning, which are very important to computer science, and uses diverse mathematical fields. DSP “Computer Science and Mathematics” includes cognitive science as a field and will offer a cognitive science course for PhD students of both computer science and mathematics.

In subprogramme "Mathematics", the main research directions are mathematical modelling, differential equations, category theory and mathematical statistics. In modelling, we particularly note a recent research project on modelling neural networks, creating a new connection between the two subprogrammes of DSP "Computer science and mathematics". In statistics, there is a number of projects for state institutions and companies which allow to obtain a practical experience. There is also a collaboration between statistics and cognitive science, with a published joint paper.

**3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.**

In accordance with the goals and achievable learning outcomes of the study programme and study courses, teaching staff choose the best teaching methods and forms. The study forms of the doctoral study programme are related to the purpose and tasks of this programme.

1) Lectures – a systematic presentation of the basic questions of the course. In the doctoral study programme courses they are used to present essential introductory information, the requirements for obtaining credit points and important scientific innovations. The largest share of lectures is in the theoretical courses of B part, where in-depth specialized knowledge is provided in specific sub-fields of the doctoral studies. Various forms of lectures are used, e.g., introductory lectures, interactive lectures, summary lectures, problem-oriented lectures. Practitioners and professionals from various institutions are invited to teach individual lectures in the study courses in order to promote the unity of theory and practice.

2) Scientific seminars – in-depth discussions of certain theoretical issues, discussion of debatable positions. Doctoral students prepare for seminars independently, using literature (mainly scientific journals, which are provided through the UL library and internet databases offered through the libraries), justify, and defend their opinion in the seminar class. Students' speaking, presentation and discussion skills are promoted in the seminars.

3) Independent studies, research work and literature research – the most important form of study in computer science and mathematics doctoral studies. This form of study is of special importance in the preparation of scientific papers and publications, in the various stages of the development of a doctoral thesis.

4) Independent research – depending on the topic of the dissertation, the doctoral student's independent work can take different forms.

In the subprogramme "Mathematics", independent work typically consists of formulating and proving hypotheses, forming accurate mathematical judgements.

In the subprogramme "Computer science and electronics" may take a variety of forms. Software engineering research may involve creating experimental computer programmes to test hypotheses or new programming principles. Research in the management aspects of computer science and the cognitive sciences may involve the organization and analysis of surveys.

Research in subfields of electrical engineering, electronics, information and communication technology (for example, computer engineering and cyberphysical systems) is similar in nature but involves creating not only new computer programmes but also development of hardware components.

An important element of independent research is the preparation of scientific publications and conference papers.

5) The doctoral dissertation is original research carried out by a doctoral student in the chosen sub-branch or field of science, the results of which are presented in perfect literary language in accordance with the requirements of scientific objectivity, argumentation and ethics, and they are of fundamental importance in science. The preparation, defence and submission of the doctoral dissertation to the doctoral council is the most important outcome of the doctoral student's studies.

In order for students to achieve their learning outcome, i.e., acquire and strengthen knowledge, skills and develop competence, the study process is dominated by methods in which student activity is significant. Students' communication skills are encouraged in the performance of study tasks, in which they solve real industry problems and model situations. Doctoral students are also involved in teaching study courses, supervising, and reviewing coursework and bachelor's theses, thus developing the skills and competences of doctoral students necessary for pedagogical work. Within the framework of the study programme, the research-related mobility of doctoral students is promoted in order for doctoral students to gain experience working in various teams, so that they can both conduct research and present and defend the results of their research on the international arena.

The physical environment of the study is also gradually changing: the auditoriums can be easily transformed to suit group work, individual work, students can use digital technologies. University lecturers mostly use methods that encourage students' active participation, critical thinking and reflection. The e-study environment will be used in the study process and to promote independent studies. For each study course an e-study environment (Moodle) is created, in which students have access to lesson materials, task descriptions, additional study materials related to study courses, as well as study tasks (tests, forums, seminars, conferences, etc.). All study course midterm and final exam evaluations with grade justification are recorded and are available to students in the e-study environment.

The student-centred approach is observed when updating the study programmes and their study courses, paying special attention to the meaningful formulation of the learning outcomes, thus promoting the dialogue between lecturers and students about the study content, organizational forms, and methods. Correctly formulated learning outcomes, on the other hand, promote students' understanding and co-responsibility for their learning, self-evaluation and understanding of the received grade.

During the study process, students receive support and feedback from lecturers. The evaluation criteria for certain grades are made public in advance. Assessment gives students the opportunity to demonstrate the extent to which they have achieved the expected learning outcomes.

By observing the study principles of student-centred education, students engage in research initiated by academic staff and social activities, thus gaining significant experience by using what they have learned in their studies in practice. By implementing the internal quality assurance policy, study programmes are implemented in such a way that students are encouraged to actively participate in the improvement of the study process. There are rules and procedures in place for submitting student proposals, resolving complaints, and reviewing student appeals. The results of student surveys are evaluated and taken into account in the improvement of the study process. Students gladly express their suggestions for the improvement of the study programmes and processes in discussions with lecturers and programme directors.

The study process takes into account the diversity of study needs of doctoral students. In the creation and implementation of the study programme, an individual approach to each doctoral student is of great importance, which manifests itself in several aspects, for example, the creation of an individual study plan (corresponding to the topic of the doctoral thesis), the possibility of individual consultation with each teaching staff member at certain consultation times.

**3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).**

**3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).**

The supervision of the doctoral work is provided by the scientific supervisor of the work. Among the lecturers of DSP "Computer science and mathematics", there are many highly qualified scientists who are able to supervise doctoral theses in a range of topics, in computer science and informatics, electrical engineering, electronics and information and communication technologies, and mathematics. The high scientific qualification of DSP teaching staff is confirmed by CV of the lecturers in the Annex II-12 and lists of publications (Annex II-14 and II-15). It is also possible to be supervised by other academic staff of the Faculty of Computer Science and the Department of Mathematics of UL or researchers of the Institute of Mathematics and Informatics of UL or the Instititute of Electronics and Computer Science with the status of LZP expert. This gives a wide selection of highly competent supervisors.

Several lecturers of DSP "Computer Science and Mathematics" have research projects in which it is possible to employ doctoral students, providing financial support for the process of developing a doctoral thesis (see the list of projects in Appendix VI-13). Financial support is also offered by the UL through doctoral scholarships, for example from EU structural funds for the implementation of the new doctoral model. The director of the doctoral program oversees the doctoral programme development project, from which it is possible to pay for trips to scientific conferences, ensuring the growth of the doctoral student.

The supervision of the process is provided by one of the two doctoral study councils (Doctoral Council of Computer Science or Doctoral Council of Mathematics), which evaluates the progress of doctoral students every semester and gives recommendations to the doctoral student and his supervisor.

Students of DSP “Computer Science and Mathematics” are provided with the opportunity to defend their doctoral dissertation with one of two doctoral councils:

- UL Computer Science and Informatics Promotion Council,
- UL Mathematics Promotion Council.

The powers of the Faculty of Mathematics Sciences Promotion Council have been approved until 2025. The council promotes and awards scientific doctoral degree: Doctor of Science (Ph.D.) in Natural Sciences.

The powers of the Computer Science and Informatics Promotion Council have been approved until 2024. The council promotes and awards scientific doctoral degrees in two groups of branches of science:

- Doctor of Science (Ph.D.) in Natural Sciences,
- Doctor of Science (Ph.D.) in Engineering and Technology.

### 3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

21 doctoral theses were defended in the reporting period within the previously implemented DSP "Computer Science" and "Mathematics".

| No. | Title of the dissertation | Promotion Council | Year of defence |
|---|---|---|---|
| 1. | Information Security Awareness System for an Everyday Computer User | Computer Science | 2015 |
| 2. | Terminology Integration in Statistical Machine Translation | Computer Science | 2015 |
| 3. | Structure of Recurrent Words: Resistance and Measure of Proximity | Mathematics | 2016 |
| 4. | Aggregation of Fuzzy Structures Based on Equivalence Relations | Mathematics | 2016 |
| 5. | Unconventional Finite Automata and Algorithms | Computer Science | 2016 |
| 6. | Runtime Verification of Business Processes | Computer Science | 2016 |
| 7. | Mobile Applications Testing | Computer Science | 2017 |
| 8. | Future Processor Hardware Architectures for the Benefit of Precise Particle Accelerator Modelling | Computer Science | 2017 |
| 9. | Tools for Analysing the Semantics of the Latvian language | Computer Science | 2017 |
| 10. | User's Model-based Personalized Adaptive e-Learning System | Computer Science | 2018 |
| 11. | Modelling Latvian language for automatic speech recognition | Computer Science | 2019 |
| 12. | Hybrid machine translation by combining output from multiple machine translation systems | Computer Science | 2019 |
| 13. | Transition function complexity of finite automata | Computer Science | 2019 |
| 14. | Probabilistic computation and verification beyond Turing machines | Computer Science | 2019 |
| 15. | Limitations of Quantum Walks and Randomized Algorithms | Computer Science | 2019 |
| 16. | Approaches to an equivalent reduction of multidimensional image spectral bands for object classification | Computer Science | 2019 |
| 17. | Volterra integral equations on time scales | Mathematics | 2020 |
| 18. | Automated Mapping of Tree Crowns for Forest Inventory Using Remote Sensing Data Processing | Computer Science | 2020 |
| 19. | Definition and evaluation of data quality | Computer Science | 2020 |
| 20. | Parameter optimization and pattern recognition for combustion and reaction kinetics applications | Mathematics | 2021 |
| 21. | Empirical Likelihood Method for a Location Parameter Using Some Robust Estimators | Mathematics | 2022 |

16 of these doctoral theses were defended before the Computer Science Doctoral Council. The most common thematic fields of research are:

- quantum computing and mathematical computer science: 4,

- language technologies: 4,

- software and data quality and testing: 3,

- image processing: 2,

- IT security: 1,

- high performance computing: 1,

- e-learning technologies: 1.

These topics correspond to fields of research of active current interest. In quantum computing, the UL Quantum Computer Science Centre is among Europe's leading research institutions in this field. Doctoral theses in language technologies are developed in cooperation with the Institute of Mathematics and Computer Science of the University of Latvia and SIA Tilde, and both organizations are involved in European-wide research projects. In the field of software quality and testing, UL has had experience since the 1980s (Prof. J. Bičevskis, Prof. J. Borzovs) and there is cooperation with several IT companies. Research in image processing and high-performance computing is carried out in cooperation with the Institute of Electronics and Computer Sciences and the Ventspils International Radio Astronomy Centre.

Among the doctoral theses defended before the Computer Science Promotion Council, 8 are primarily attributable to the branch of science "Computer Science and Informatics", 6 are primarily attributable to the branch of science "Electrical engineering, electronics, information and communication technologies" and 2 theses can be attributed to any of these branches.

During the reporting period, 5 doctoral theses were defended with the Mathematics Promotion Council. Distribution of doctoral theses by sub-fields of mathematics:

- differential equations: 1,

- discrete mathematics and mathematical informatics: 1,

- mathematical analysis and functional analysis: 1,

- mathematical modelling: 1,

- probability theory and mathematical statistics: 1.

Research topics are topical and correspond to the priority fields of research. Three defended doctoral theses were developed within the framework of projects financed by the EU Structural Funds in the laboratories of the UL Institute of Mathematics and Computer Science. The following cooperation partners were involved in the implementation of the projects – Riga Technical University and the UL Institute of Physics.

## 3.3. Resources and Provision of the Study Programme

### 3.3.1. Assessment of the compliance of the resources and provision (study provision,

**scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.**

DSP “Computer Science and Mathematics” is implemented by two UL faculties: Faculty of Computing and Faculty of Physics, Mathematics and Optometry In addition, 3 teaching staff members from other faculties are involved with teaching the study courses “English for research documentation and presentation”, “Scientific ethics” and “Latvian language for foreign doctoral students”.

In the Faculty of Physics, Mathematics and Optometry, the structural units of the Mathematics Department are involved in the implementation of DSP “Computer Science and Mathematics”:

1) Department of Differential Equations and Approximate Methods,
2) Department of Mathematical Analysis,
3) Department of General Mathematics,
4) Laboratory of Statistical Research and Data Analysis.

In the Faculty of Computing, 4 departments and 4 scientific laboratories are involved in the implementation of DSP “Computer Science and Mathematics”:

1) Department of Computer Science,
2) Department of Programming,
3) Department of Mathematical Foundations of Computer Science,
4) Department of Lifelong Education Informatics,
5) Quantum Computer Science Centre,
6) Laboratory of Perceptual and Cognitive Systems,
7) Laboratory of Computational Linguistics,
8) Laboratory of Innovative Information Technologies.

The secretaries of the doctoral programme are providing necessary services for doctoral students (student registration issues, assistance to students in arranging formalities with other structural units), as well organizing the work of the doctoral council.

The facilities, which apply to all the study programmes, are described in Part II Section 2.3.2, and the library resources are described in Part II Section 2.3.3. If a doctoral student needs scientific literature that is specific to their field of science, its purchase can be paid for from the faculty’s funds.

Since the DSP “Computer Science and Mathematics” is an interdisciplinary programme which is implemented by two faculties, its implementation takes place both in the UL premises at Raiņa Boulevard 19 (the facilities of which are described in Part II) and in the recently built House of Science at Jelgavas Street 3.

The House of Science was commissioned in 2019. The total indoor area is 20,018 $m^2$, it has a total of 15 auditoriums, 8 seminar rooms, 78 scientific and teaching laboratories and 430 workplaces for

scientific and academic staff. These resources are jointly used by two UL faculties (Faculty of Physics, Mathematics and Optometry and Faculty of Medicine) and 6 scientific institutes. Wireless computer network is available in all rooms. The premises are modern, the technical support is sufficient. During the Covid-19 pandemic, the rooms were equipped with web cameras to enable teaching in remote or hybrid mode (where some students participate in person and others remotely). It is planned to use these opportunities even after the end of the pandemic to conduct joint seminars with researchers from other universities.

Among the infrastructure available at Raiņa Boulevard 19, the laboratories for computer engineering and visual perception research, as well as the project studio "DF Lab" and the Linux Centre with servers with "GPU Computing" computing resources, are especially important for doctoral students. The computer engineering laboratory is used for conducting the courses "Wireless Sensor Networks", "Digital Signal Processing" and "Virtual Environments" and for the development of dissertations on topics related to computer hardware. The laboratory of visual perception can be used for the development of doctoral theses in the field of cognitive sciences and for conducting the course "Theories of cognitive sciences in the context of computing and mathematics". The project studio is useful for the development of doctoral theses in various fields that require equipment for quick prototyping. The resources of the Linux Centre can be used for the development of doctoral theses in the field of computer networks and in areas that require larger computing resources (for example, quantum computing or machine learning calculations).

Doctoral students also have access to European research infrastructures in which UL participates, for example CLARIN (Common Language Resources and Technology Infrastructure) in the field of computational linguistics. These resources are useful for the development of doctoral theses in language technologies and topics where high-performance computing is useful.

Significant one-time investments in infrastructure are not required in the foreseeable future. Regular and planned maintenance and modernization of the facilities is necessary in accordance with the trends of technical development and changes in the study content.

The doctoral students' scientific work for a significant number of students takes place at the Institute of Mathematics and Computer Science (LU MII Raiņa Boulevard 29) and the Institute of Electronics and Computer Sciences (EDI, Dzērbenes Street 14). Doctoral students working in these institutes are able to use the infrastructure of these institutes, such as high-performance computing (HPC) resources of LU MII and tests for the Internet of Things and wireless sensor networks EDI.

The University of Latvia finances an annual doctoral study programme development project (with funding between 30 and 40 thousand EUR), which can be used to support small investments in the programme's infrastructure, doctoral students' trips to scientific conferences and summer schools to present research results and gain experience, guest lecturers, etc. for the development of the activity programme.

In general, the facilities (including the resources available at LU MII and EDI) can be assessed as very good. Doctoral students have the opportunity to access a large part of the resources of their field of science, which are available in Latvia. These facilities have been sufficient for the development of many doctoral theses in the last 6 years.

See also Section 2.3.1.

**3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).**

As described in more detail in Section 3.3.1 of the report on this programme, the study base of DSP “Computer Science and Mathematics” consists of two faculties (UL Faculty of Computer Science and UL Faculty of Physics, Mathematics and Optometry), which are academic and scientific leaders in their fields in Latvia and where Latvia's leading teaching staff work in computer science and mathematics. The infrastructure of these faculties is also described in detail in the previous section and in Part II of the report.

The scientific base consists of these two faculties, the Institute of Mathematics and Computer Science and the Institute of Electronics and Computer Science. Together, these institutions offer research opportunities in a wide range of topics.

The UL Faculty of Computing is known for its research in quantum computing (UL Quantum Computer Science Centre is one of the leaders in this field in Europe and the world), cognitive sciences (where international summer schools and conferences with high-level guest speakers are regularly organized), data processing systems and software project management. The faculty has a well-developed cooperation with the programming industry. Cooperation with SIA “Tilde”, which conducts innovative research in computer linguistics and is involved in several EU framework programme research projects in this field, is particularly important for the doctoral study programme. The Department of Mathematics of the UL Faculty of Physics, Mathematics and Optometry is known for research in mathematical analysis, statistics, and other branches of mathematics.

The UL Institute of Mathematics and Computer Science conducts diverse research in computer science and mathematics in cooperation with both participating faculties. Many of the institute’s leading researchers are also faculty teaching staff members, providing a link between studies and research at UL Institute of Mathematics and Computer Science. Doctoral students can develop their doctoral dissertation at the UL Institute of Mathematics and Computer Science in such research areas as system modelling, computational linguistics or artificial intelligence. The Institute of Electronics and Computer Science conducts research in computer engineering, embedded systems, sensor networks, and other areas related to information technology, computing, electronics, telecommunications, and computer control. Both institutes actively participate in EU Framework Programmes and many state-funded research projects.

UL Faculty of Computing, UL Faculty of Physics, Mathematics and Optometry, UL Institute of Mathematics and Computer Science and Institute of Electronics and Computer Science together form a very powerful academic and scientific base, which includes most of Latvia’s leading scientists in these fields.

**3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).**

**Program revenues**

To provide the funds necessary for the implementation of the doctoral study programme “Computer Science and Mathematics”, the UL uses a state budget grant from the Ministry of Education and Science (IZM), which in 2021/2022 was 7,335 EUR per student for full-time regular studies.

Candidates to the doctoral study programme “Computer Science and Mathematics” every summer can apply to the 1st year for both state budget funded and self-funded study places. The faculty receives basic income and implements the study programme with a state budget grant from the Ministry of Education and Science. Taking into account the above, the total budget of the study programme is expected to be 322 thousand EUR/year.

**Programme costs**

To estimate the amount of funds required for financing, the UL calculates the cost price for study programmes according to the methodology developed by the UL, which takes into account all the costs of ensuring the study process described in section “2.3.1. Financing SV” and information about the plan of a specific study programme, teaching staff involved, planned number of students, and other aspects, thus ensuring the reliability of the forecasts.

**Full-time regular studies** costs

For calculations, the implementers of the DSP “Computer Science and Mathematics” use the data of the state budget funded students in the academic year 2021/2022 (there are 44 students of full-time regular studies), the existing plan of the study programme planned for accreditation and the existing structure of the involved academic staff. Considering the above, the calculated cost of the full-time programme is 7,132 EUR per student per year, and the total cost of the programme is 313,808 EUR per year. A more detailed percentage distribution of costs is shown in Table VI-2.

*Table VI-2. Percentage distribution of costs of the study programme*

| Expenditure item | % of the total |
|---|---|
| Teaching staff expenditures | 38.6% |
| General staff | 27.1% |
| Other expenditures | 0.0% |
| Infrastructure expenditures | 5.3% |
| Goods and services | 3.0% |
| Indirect costs | 26.0% |
| **TOTAL COSTS** | **100%** |

There is no substantial difference in the costs for different subprogrammes, because the part that is different for different subprogrammes (restricted elective or B part) is only 7.3% of the size of programme in credit points. Also, the costs are similar for programmes in Latvian and English language because the biggest components of the costs (work of the research advisor on advising Ph.D. thesis and indirect costs) are independent of the language in which the programme is implemented. Therefore, the tuition is equal for Latvian and English language studies.

Figure VI-1 shows the cost of the study programme depending on the number of students and a comparison with the proposed study fee and state budget grant.

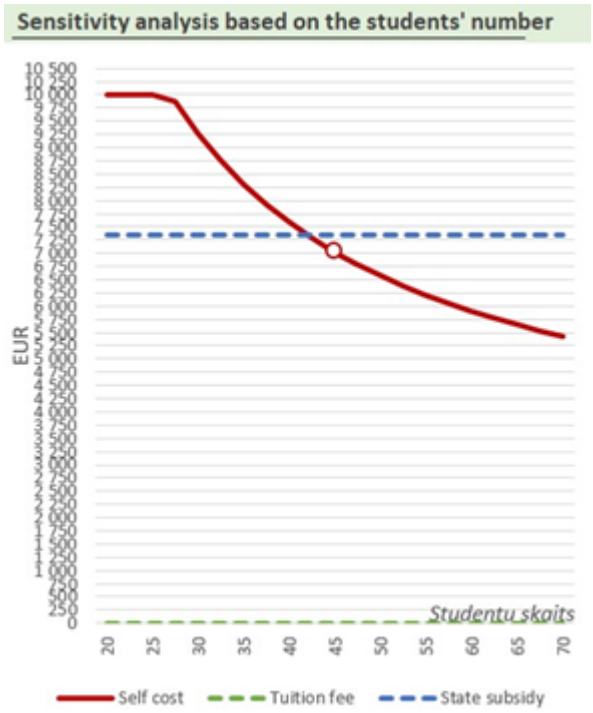


*Figure VI-1. Cost of the DSP "Computer Science and Mathematics" based on the number of students.*

The calculation shows that with the allocated state budget grant for 44 state budget funded study places, the Faculty of Computer Science can ensure a profitable and high-quality study process (the intersection of the red (own costs) and blue (state tuition fee grant) lines is projected onto the 'x' axis).

**Summary of programme revenues and costs**

After summing up the revenues (state grant) of the DSP "Computer Science Mathematics", i.e., 322,740 EUR, and programme costs, i.e., 313,808 EUR, for 44 budget students, the result of the study programme is positive.

The data show that the UL has sufficient funds to implement the study programme and ensure its further development.

## 3.4. Teaching Staff

**3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.**

26 representatives of academic staff are involved in the implementation of DSP “Computer Science and Mathematics”. The list of staff involved in the implementation of the study programme is attached in **Appendix II-11**, indicating the academic degree, position, and implemented study courses of the teaching staff. In addition, **Appendix II-12** contains CVs of all the teaching staff.

All the faculty members involved have doctoral degree. 23 of 26 academic staff work in the branches of science corresponding to DSP “Computer Science and Mathematics” (16 are professors, 4 associate professors, 2 leading researchers and 1 acting professor), 3 work in other fields of science (English, research ethics).

8 academic staff members hold current expert status of the Latvian Council of Science in Mathematics, 9 academic staff member have expert status in Computer Science and Informatics,4 have expert status in Electrical Engineering, Information and Communication Technologies (some staff members have expert status in two fields, detailed information is given in section 3.4.3).

The knowledge of the English language of the teaching staff involved in the implementation of the programme allows for teaching study courses in English as well. The knowledge of the state language of the academic staff involved in the study programme complies with the regulations on the level of the state language and the procedure for testing the state language proficiency for the performance of professional and official duties, and allows for teaching of study courses in the state language.

According to the information available in the Scopus database, a total of 357 scientific publications of the teaching staff involved in the implementation of the study programme were in the period from 2015 to 2021 (the number of publications of each teaching staff for the last 6 years is shown in the table in section 3.4.3, the list of publications is attached in **Annex II-14**). The teaching staff involved in the implementation of the study programme participate in the implementation of scientific projects both at the international and national level (the list of projects can be seen in section 3.4.4). The list of papers presented by the teaching staff involved in the implementation of the programme at international conferences and congresses is impressive (see CV of the teaching staff members in **Appendix II-12**).

Taking into account the above, it can be safely stated that the teaching staff involved in the implementation of the programme ensures the acquisition of high-quality theoretical knowledge and research skills in the fields of computer science and mathematics, which gives students the opportunity to successfully engage in solving various research problems.

### 3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

In the period from the 2015/2016 academic year the changes in the composition of the teaching staff involved in the study programme (compared with the previously implemented DSP “Computer Science” and “Mathematics”) were mainly related to two factors, i.e., changes in the structure and content of the study programme, including new study courses, and the change of generations of teaching staff .

New courses of the study programme will be taught by assoc. prof. A. Belovs, assoc. prof. A. Yakaryilmaz (in the “Computer Science” sub-programme), assoc. prof. I. Uļjane. and lead researcher

J. Bajārs (in the “Mathematics” sub-programme). Prof. J. Bārzdins and prof. D. Šmite (former teaching staff of DSP “Computer Science”), prof. H. Kalis and prof. A. Reinfelds (former teaching staff of DSP “Mathematics”) will no longer continue their work. It can be concluded that changes in the structure of teaching staff involved in the study programme do not negatively influence the level of study quality, as the qualifications and experience of the teaching staff involved in academic work are suitable for achieving the overall learning outcomes of the study courses and the programme.

Strategy for attracting new teaching staff, including staff from abroad:

1. Use EU funds available to UL for the internationalization of academic staff.
2. Announce an international competition for at least 1 teaching position at the Centre for Quantum Technologies, which is being created within the framework of the European Recovery Fund.
3. Maintain contact with the graduates of the University of Latvia who are studying abroad in doctoral studies or working in academic work, try to encourage some of them to return to Latvia.
4. Attract researchers from partner organizations – Institute of Mathematics and Computer Science, Institute of Electronics and Computer Science.

**3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).**

For the number of publications of teaching staff involved in the implementation of the doctoral study programme “Computer Science and Mathematics” (2015-2021), see the table below:

*Table VI-3. Number of publications of the teaching staff*

| | Name/surname | SCOPUS | Web of Science | Total number of publications |
|---|---|---|---|---|
| 1. | Andris Ambainis | 36 | 34 | 36 |
| 2. | Svetlana Asmuss | 20 | 19 | 24 |
| 3. | Jānis Bajārs | 13 | 12 | 13 |
| 4. | Guntis Bārzdiņš | 12 | 5 | 13 |
| 5. | Aleksandrs Belovs | 22 | 16 | 22 |
| 6. | Jānis Bičevskis | 28 | 20 | 28 |

| | | | | |
|---|---|---|---|---|
| 7. | Juris Borzovs | 10 | 9 | 10 |
| 8. | Inese Bula | 7 | 5 | 11 |
| 9. | Jānis Buls | 3 | 3 | 3 |
| 10. | Andrejs Cibulis | 1 | 3 | 10 |
| 11. | Kārlis Čerāns | 33 | 14 | 33 |
| 12. | Abuzers Jakarilmazs | 31 | 32 | 32 |
| 13. | Ģirts Karnītis | 16 | 11 | 16 |
| 14. | Laila Niedrīte | 25 | 11 | 29 |
| 15. | Anastasija Ņikiforova | 4 | 8 | 27 |
| 16. | Kārlis Podnieks | 1 | 3 | 8 |
| 17. | Leo Seļāvo | 9 | 8 | 9 |
| 18. | Uldis Strautiņš | 16 | 8 | 18 |
| 19. | Jurģis Šķilters | 10 | 10 | 91 |
| 20. | Aleksandrs Šostaks | 26 | 20 | 26 |
| 21. | Ingrīda Uļjane | 10 | 10 | 11 |
| 22. | Jānis Valeinis | 10 | 11 | 11 |
| 23. | Juris Vīksna | 14 | 9 | 14 |

For teaching staff involved in the implementation of the doctoral study programme “Computer Science and Mathematics” with a status of an expert of the Latvian Council of Science (LCS) in the fields of Mathematics, Computer Science and Informatics, Electrical Engineering, Electronics, Information and Communication Technologies, see the table below.

*Table VI-4. LCS experts*

| | Name/surname | Expiration date of the expert’s rights | Branches of science |
|---|---|---|---|
| 1. | Andris Ambainis | 24.03.2023 | Computer Science and Informatics, Mathematics |
| 2. | Svetlana Asmuss | 04.05.2025 | Mathematics |
| 3. | Jānis Bajārs | 01.09.2024 | Mathematics |
| 4. | Jānis Bičevskis | 03.11.2024 | Computer Science and Informatics |
| 5. | Juris Borzovs | 02.12.2023 | Electrical Engineering, Electronics, Information and Communication Technologies |
| 6. | Inese Bula | 01.12.2024 | Mathematics |

| | | | |
|---|---|---|---|
| 7. | Kārlis Čerāns | 17.06.2023 | Computer Science and Informatics, Electrical Engineering, Electronics, Information and Communication Technologies |
| 8. | Abuzers Jakarilmazs | 24.03.2023 | Computer Science and Informatics |
| 9. | Ģirts Karnītis | 06.10.2024 | Computer Science and Informatics |
| 10. | Laila Niedrīte | 02.12.2023 | Computer Science and Informatics, Electrical Engineering, Electronics, Information and Communication Technologies |
| 11. | Anastasija Ņikiforova | 06.01.2024, 30.06.2024 | Computer Science and Informatics, Electrical Engineering, Electronics, Information and Communication Technologies |
| 12. | Uldis Strautiņš | 31.03.2024 | Mathematics |
| 13. | Jurģis Šķilters | 19.02.2023 | Computer Science and Informatics |
| 14. | Aleksandrs Šostaks | 04.05.2025 | Mathematics |
| 15. | Ingrīda Uljane | 04.05.2025 | Mathematics |
| 16. | Jānis Valeinis | 01.12.2024 | Mathematics |
| 17. | Juris Vīksna | 19.02.2023 | Computer Science and Informatics |

**3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).**

The participation in the projects of teaching staff involved in the implementation of the doctoral study programme “Computer Science and Mathematics” (2015-2021) is summarized in Appendix VI-13 (see also teaching staff’s CV in **Appendix II-12**).

Over the past 6 years, the programme’s instructors have participated in 12 projects of EU Framework Programmes (7th Framework Programme and Horizon 2020), 5 projects financed by other EU and foreign programmes, 16 projects financed by EU Structural Funds, 9 projects of the Latvian Council of Science, 3 state research programmes, 11 project commissioned by companies and state institutions and 6 UL projects.

**3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).**

Teaching staff of all the departments and scientific laboratories of the Faculty of Computing and Faculty of Physics, Mathematics and Optometry Department of Mathematics, as well as invited experts according to the research direction chosen by the doctoral students, are involved in the

implementation of the study programme. Forms of scientific cooperation of teaching staff are mainly related to jointly implemented projects (see section 3.4.4), regular seminars, organized conferences.

Many of the teaching staff of the Faculty of Computing who are involved in the implementation of the programme conduct research work at the Institute of Mathematics and Computer Science of the University of Latvia and participate in the institute's scientific seminars in various fields (for example, a system modelling seminar or a machine learning seminar). Lecturers and participants from other UL faculties and abroad regularly participate in cognitive sciences seminars. At sessions of the annual UL Scientific Conference in Computer Science and Information Technology are organized jointly by all research directions of UL Faculty of Computing and Institute of Mathematics and Computer Science in order to promote interaction between different fields of science. For example, at the 2021 the at two sessions of Computer Science at UL Scientific Conference, 16 papers on quantum computing, big data, cognitive science, biomedicine, language technology, data quality and machine learning were presented with a wide range of topics included in each session.

Two regular scientific conferences, which take place together with scientists from other Baltic countries, DBIS (Digital Business and Intelligent Systems) conference in applied computer science and the Estonian-Latvian computer science Theory Days in Mathematical Computer Science, also play an important role. The teaching staff of the programme are part of many international collaborative projects (listed in teaching staff members' CVs and section 3.4.4), especially in the fields of quantum computing, cognitive science, and language technology. Many studies are conducted in cooperation with Latvian IT companies. For example, the research project "Multilingual human-computer communication modelling using artificial intelligence methods" (J. Borzovs) was carried out in cooperation with SIA "Tilde", while the project "Scalable Understanding of Multilingual Media" (G. Bārzdiņš) was carried out in cooperation with LETA and several foreign research institutions.

The Department of Mathematics has four scientific seminars: Discrete Mathematics and Algebra, Multivalued Mathematical Structures and Their Applications, Discrete and Continuous Dynamical Systems, Statistical Research and Data Analysis Laboratory Seminar. The Department of Mathematics organizes five sections within the annual UL Scientific Conference. During the reporting period, several international scientific conferences were organized with the active participation of teaching staff and doctoral students of the Department of Mathematics: 20th international conference Mathematical Modelling and Analysis (MMA, 2015, Sigulda), 10th international conference Progress on Difference Equations (PODE, 2016, Riga), 10th international symposium European Symposium on Computational Intelligence and Mathematics (ESCIM, 2018, Riga) , 23rd international conference Mathematical Modelling and Analysis (MMA, 2018, Sigulda), International Workshop on Fuzzy and Rough Mathematical Structures (FARMS, 2019, Riga).

The ratio of the number of students and teaching staff within the programme on 01.01.2022: 1.54 students per 1 teacher.

# Annexes

| III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme | | |
|---|---|---|
| Sample of the diploma and its supplement to be issued for completing the study programme | VI-1 Annex. Example of a diploma issued for completing the study programme.zip | VI-1 pielikums. Par studiju programmas apgūšanu izsniedzamā diploma paraugi.zip |
| For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable) | VI-11. annex. Statement of Higher Education Council.docx | VI-11 pielikums. AIP atzinums par doktora programmu.docx |
| Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable) | | |
| Statistics on the students in the reporting period | VI-5 Annex, Statistics about students during the reporting period.docx | VI-5 pielikums. Statistikas dati par studējošajiem pārskata periodā.docx |
| III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof | | |
| Compliance with the study programme with the State Education Standard | | |
| Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable) | | |
| Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable) | Compliance to requirements for doctoral programme.docx | Doktora studiju programmas atbilstība prasībām.docx |
| Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme | VI-8 Annex Study course mapping_Labots_v2.docx | VI-8 pielikums. Studiju kursu kartējums_Labots_v2 (1).docx |
| The curriculum of the study programme (for each type and form of the implementation of the study programme) | VI-9 Annex. Study plan of the programme.docx | VI-9 pielikums. Studiju programmas plāns.docx |
| Descriptions of the study courses/ modules | VI-10 Annex Descriptions of study courses of the study programme.docx | VI-10 pielikums. Studiju programmas studiju kursu apraksti_LV.docx |
| Description of the organisation of the internship of the students (if applicable) | | |
| III - Description of the Study Programme - 3.4. Teaching Staff | | |
| Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable) | VI-7. annex. Certification of Head of Study Direction (1).edoc | VI-7. pielikums. Virziena vadītāja apliecinājums.edoc |
| Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable) | IV-10. Certification by the Head of Direction.docx | IV-10. Virziena vadītāja apliecinājums.edoc |