University *of Ljubljana*
Faculty *of Computer and Information Science*
Faculty *of Mathematics and Physics*

FIRST CYCLE

INTERDISCIPLINARY UNIVERSITY STUDY PROGRAMME

COMPUTER SCIENCE AND MATHEMATICS

HANDBOOK

Ljubljana, 2017

CONTENTS

Overview of the study programme

1. General information

Study cycle
First cycle.

Mode of study
Full-time study. Classes are conducted in Slovenian.

Professional title
- diplomirani inženir računalništva in matematike (UN),
- diplomirana inženirka računalništva in informatike (UN)

Abbreviated to: dipl. inž. rač. in mat. (UN).

Duration:
3 years (6 semesters), a total of 180 ECTS.

Area of study to which the programme belongs (ISCED): The basic field is "computer science (48)"; and "mathematics (46)" classified in the ISCED.

Scientific disciplines underlying the programme (according to the Frascati classification): The programme falls within the scope of "technology and natural sciences and mathematics".

Classification in the national qualifications framework, the European Higher Education Qualifications Framework and the European Qualifications Framework: Levels of SQF, EQF and EHEQF: Slovenian Qualifications Framework (SQF) 7; European Qualifications Framework (EQF) 6; European Higher Education Qualifications Framework (EHEQF) First cycle

2. Main objectives and skills acquired in the programme

The aim of the interdisciplinary programme of Computer Science and Mathematics is to provide training in the theoretical foundations of computer science and the related modern branches of discrete mathematics and computing. Graduates acquire a wide range of knowledge in the basics of computer and information science, enabling them to understand and later on develop new achievements in this area. Furthermore, this study programme continues to produce highly-qualified experts who are trained to work with new technologies yet to be developed, whilst continuing and expanding research and discoveries in computer science and computer mathematics. Graduates also have a good grasp of background knowledge and can work in new interdisciplinary fields where they can apply their expertise both in theoretical computer science and the relevant mathematical support fields, such as certain disciplines of biotechnology (e.g. genetics and bioinformatics), biomedical sciences, theoretical chemistry and so on.

General competences acquired through the programme

Graduates are qualified to work in the development of information technologies and research in mathematics and computer science. Their solid foundation also serves them in acquiring new skills

in the rapidly evolving field of computer science. Graduates acquire the following general competences:

- Problem abstraction and analysis;
- The ability to synthesise and critically assess results;
- The ability to apply knowledge in practice;
- The ability to communicate knowledge, expert spoken and written communication;
- The ability to find resources and critically assess information;
- The ability to work independently as well as in a team (international team),
- The ability to develop professional responsibility and work ethics.

Subject-specific competences acquired through the programme

- Fundamental competence in the field of theoretical computer science, logic and discrete mathematics, which comprises basic and advanced theoretical knowledge, and practical skills essential both for computer science and mathematics;
- Translation of practical problems into mathematical language and theoretical computer science, and performing a qualitative analysis of the obtained mathematical problems;
- Designing algorithms to solve problems, implementing advanced algorithms in relevant software;
- Analysis and presentation of results;
- Understanding and applying computer and information science skills to other engineering fields or relevant fields of expertise (economics, financial mathematics, organisational sciences etc.)
- Applying practical skills in software, hardware and information technologies;
- First cycle graduates are able to independently perform less demanding as well as complex engineering and organisational development tasks in their selected fields;
- Basic skills in computer and information science, allowing the continuation of studies in the second study cycle.

Employment opportunities

Graduates can undoubtedly find employment in most commercial and non-profit sectors, given that computer technology is indispensable in today's society. In particular, they are trained for positions which require good knowledge of computer science, especially programming, and positions that require expert mathematical skills. We believe that our graduates, with their sound knowledge of theoretical mathematics, will be recruited in information technology and sciences where they will demonstrate the ability to quickly master new insights and advanced results.

3. Admission requirements and limited enrolment criteria

Candidates meeting the following criteria can enrol in the interdisciplinary study programme:

a) A completed Matura exam,
b) A completed vocational Matura in any secondary programme and a Matura exam subject in Mathematics; if candidates have already completed this for the vocational Matura

exam, then they must complete any of the other Matura exam subjects that they have not yet completed for the vocational Matura.

c) Any four-year secondary school study programme completed before 1 June 1995.

In the event of a decision limiting enrolment, candidates referred to in points a) and c) will be selected according to:

- The GPA in the Matura exam or the secondary school final exam   60%;
- The GPA of Year 3 and 4 of secondary school   20%;
- The GPA of Year 3 and Year 4 in Mathematics   20%.

Candidates referred to in point b) will be selected according to:

- The GPA in the vocational Matura exam   30%;
- The grade of the Matura exam subject   30%;
- The GPA of Year 3 and 4 of secondary school   20%;
- The GPA in Mathematics in Year 3 and Year 4   20%.

4. Requirements for progressing to a higher year

To enrol in Year 2, students must complete requirements amounting to at least 53 ECTS. To enrol in Year 3, students must complete all requirements from Year 1 and at least 53 ECTS from Year 2.

5. Requirements for repeating a year

To be able to repeat a year, students must complete the following:

- At least half of the requirements from the study programme of the year in progress (30 ECTS);
- All of the exams from previous years.

Students can only repeat a year once during their course of study; changing the study programme is also considered as repeating a year, because of uncompleted requirements of the previous study programme.

6. Requirements for completing the study programme

To complete the study programme, students must complete all exams and other study requirements, including the Diploma seminar, in a total of 180 ECTS.

7. Criteria for recognising knowledge and skills acquired prior to enrolment

Students can obtain recognition of skills acquired through various forms of informal education that correspond to the course syllabus of the interdisciplinary study programme of Computer Science and Mathematics. The recognition of skills acquired prior to enrolment is decided by the Study Committee on the basis of the student's submitted written application with enclosed certificates and other documents certifying the acquired knowledge and its subject content. The recognition process is based on the following criteria:

- Comparability of the scope of education in relation to the scope of the course for which knowledge is being recognised;
- Adequacy of the subject content of previous education in relation to the course for which knowledge is being recognised.

In the event that the Committee determines that the acquired knowledge can be recognised, it will be evaluated with the same number of credits according to the ECTS system as the number of credits of the course. The evaluation uses the Rules for the recognition of knowledge and skills obtained prior

to enrolment in the programme, as adopted by the University of Ljubljana Senate at its meeting on 29 May 2007:
http://www.ul.si/o_univerzi_v_ljubljani/organizacija__pravilniki_in_porocila/predpisi_statut_ul_in_pravilniki/2013071116244099/

8. Assessment methods

Assessment methods are defined individually for each course in the syllabus. The general rules for assessment methods are regulated by the Study Rules and Regulations for Bologna Study Programmes FRI and the FMF Assessment Rules. For all courses, knowledge is assessed through a written and/or oral exam. Assessment methods can include: lab tutorial written exams, lab tutorial oral exams, seminars and project work and their oral defences. The grading scale follows the Statutes of the University of Ljubljana. All types of assessments are graded on a scale from 1 to 10, where 6 – 10 are passing grades and 1 – 5 failing grades.

For most courses, the grading scale is as follows:

	grade
50–59 %	6
60–69 %	7
70–79 %	8
80–89 %	9
90–100 %	10

9. Transferring from other study programmes

Transferring is, in accordance with the Criteria for Transferring between Programmes, possible from study programmes which upon completion guarantee similar competences and which enable the recognition of at least half of the obligations based on the European transfer credit system (ECTS) from the first study programme that are related to obligatory courses of the second study programme.
Transferring from other programmes is possible after the first year of study.
The requirements for transferring to the 1st cycle interdisciplinary university study programme of Computer Science and Mathematics from other programmes are:
- Completed requirements for enrolment in the programme;

- The appropriate authority defines, on the basis of a comparison of the two programmes, the requirements to be recognised and the year in which the candidate can enrol, and consequently issues a decision.

Transferring is possible on the basis of the provisions applicable to such programmes.

Transferring from programmes offered at the Faculty of Mathematics and Physics
Transferring is possible after Year 1 and Year 2 of studies at FMF.
After Year 1, transferring is possible if candidates have completed the following courses in the Mathematics university study programme: Analysis 1, Algebra 1, Logic and Set Theory, Introduction to Programming and the Computer Practicum. Within one year, candidates must also pass exams for
the following courses: Discrete Structures 2, Introduction to Digital Circuits and Computer Systems Architecture in the Computer Science and Mathematics university study programme.
After Year 2, transferring is possible if candidates have completed all of the above-mentioned courses from Year 1 of the Mathematics university study programme, as well as Analysis 2a, Analysis 2b (or Analysis 2), Programming 1, Programming 2 and Discrete Mathematics 1. Within one year, candidates must also pass exams for the following courses: Computer Systems Architecture 1, Computer Systems Architecture 2, Optimisation Methods, Principles of Programming Languages, Fundamentals of Databases, Computability and Computational Complexity and Computer Communications in the Computer Science and Mathematics university study programme.

Transferring from other programmes offered at the Faculty of Computer and Information science
Transferring is possible after Year 1 and Year 2 of studies at UL FRI.
After Year 1, transferring is possible if candidates have completed the following courses in the Computer and Information Science university study programme: Programming 1, Analysis 1, Discrete Structures, Introduction to Digital Circuits, Programming 2, Linear Algebra, Computer Communications and Computer Systems Architecture. Within one year, candidates must also pass exams for the following courses: Analysis 2 and Discrete Structures 2 in the Computer Science and Mathematics university study programme.

After Year 2, transferring is possible if candidates have completed all of the above-mentioned courses from Year 1 of the Computer and Information Science university study programme, and the joint courses from Year 2 (Computer Systems Architecture1, Computer Systems Architecture 2, Fundamentals of Databases, Computability and Computational Complexity, and Principles of Programming Languages) in the Computer Science and Mathematics university study programme. Within one year, candidates must also pass exams for the following courses: Analysis 3, Combinatorics and Optimisation Methods in the Computer Science and Mathematics university study programme.

10. Syllabus

Legend:
L = number of lectures
S = number of seminar exercises

T = number of theoretical and tutorial exercises
ECTS = number of ECTS points.

Each Semester lasts 15 weeks.

YEAR 1

Code	Course	1st semester L/S/T	2nd semester L/S/T	ECTS
27201	Analysis 1	45/0/45		7
27202	Discrete Structures 1	45/0/45		6
63204	Introduction to Digital Circuits	45/0/30		6
63277	Programming 1	45/0/30		6
27203	Linear Algebra	30/0/30	30/0/30	10
27204	Analysis 2		45/0/45	7
27205	Discrete Structures 2		45/0/45	6
63278	Programming 2		45/0/30	6
63212	Computer Systems Architecture		45/0/30	6

YEAR 2

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
27207	Analysis 3	30/0/30		5
27208	Combinatorics	45/0/45		7
63279	Algorithms and Data Structures I	45/0/30		6
63208	Fundamentals of Databases	45/0/30		6
63283	Computability and Computational Complexity	45/0/30		6
27209	Topics in Mathematics		30/0/30	5
27210	Optimisation Methods		45/0/45	7
63220	Principles of Programming Languages		45/0/30	6
63280	Algorithms and Data Structures I		45/0/30	6
63209	Computer Communications		45/0/30	6

YEAR 3

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
27215	Numerical Methods	45/0/45		7
63214	Introduction to Artificial Intelligence	45/0/30		6
27216	Probability and Statistics	30/0/30	30/0/30	10
63282	Diploma Seminar			4
	Module	90/0/60	45/0/30	18
	Specialist electives		45/0/30	5
	General electives		60/0/60	10

Module
Students choose one out of eight offered modules in the Computer and Information Science programme. Each module consists of three different courses on the same topic presenting a specific branch of computer science. Students who achieve an 8.5 GPA in the first two years and do not retake a year can choose any of the module courses.

I. Information Systems

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63249	Electronic Business	45/0/30		6
63250	Organisation and Management		45/10/20	6
63251	Introduction to Data Mining	45/20/10		6

II. Management of Information Science

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63252	Information Systems Development	45/20/10		6
63226	Data Management Technologies	45/10/20		6
63253	Informatics Planning and Management		45/0/30	6

III. Software Development

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63254	Software Development Processes	45/10/20		6
63255	Web programming	45/20/10		6
63287	Platform Based Development		45/0/30	6

IV. Computer Networks

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63257	Computer Networks Modelling	45/10/20		6
63258	Communication Protocols	45/0/30		6
63259	Mobile and Wireless Networks		45/10/20	6

V. Computer Systems

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63260	Digital Design	45/10/20		6
63261	Distributed Systems	45/10/20		6
63262	Computer Systems Reliability and Performance		45/20/10	6

VI. Algorithms and System Utilities

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63263	Compilers	45/10/20		6
63264	System Software	45/10/20		6
63265	Computation Complexity and Heuristic Programming		45/0/30	6

VII. Artificial Intelligence

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63266	Intelligent Systems	45/6/24		6
63267	Machine Perception	45/10/20		6
63268	Development of Intelligent Systems		45/0/30	6

VIII. Media Technologies

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
63269	Computer Graphics and Game Technology	45/10/20		6
63270	Multimedia Systems	45/10/20		6
63271	Introduction to Graphic Design		45/0/30	6

Specialist elective courses

Students choose one of the courses offered from the Mathematics or Financial Mathematics study programmes, in order to also acquire knowledge in geometry, financial or numerical mathematics.

Code	Course	1st Semester L/S/T	2nd Semester L/S/T	ECTS
27217	General Topology	30/0/30		5
27218	Algebraic Curves		30/0/30	5
27219	Introduction to Geometrical Topology		30/0/30	5
27220	Affine and Projective Geometry		30/0/30	5
27221	Coding Theory and Cryptography		30/0/30	5
27222	Financial Mathematics 1		30/0/30	5
27223	Game Theory	45/0/45		6
27224	Mathematical Modelling		30/0/30	5
27225	Numerical Methods 2		30/0/30	5

General elective courses

The general elective course section amounts to 10 ECTS, which students can transfer from any accredited university programme of the University of Ljubljana.

11. Course descriptions
Course descriptions are available on the website.