

# Education and Examination Regulations 2021–2022

## Master's in Computing Science

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## **PART I    GENERAL PROVISIONS**

### **Section 1. General provisions**

#### **Article 1.1    Applicability of these regulations**

1. These Education and Examination Regulations (EER) apply to the Master's programmes (the degree programme in which the student is enrolled is hereinafter referred to as 'the programme'), including all their components, of the Faculty of Science. These EER outline the applicable procedures, rights, and obligations concerning teaching, interim examinations, and final examinations.
2. The present regulations apply to all students enrolled in the programme in the 2021–2022 academic year. Students who started the degree programme before 1 September 2016 and have been continuously enrolled in this programme may appeal to the EER that was active at the time of their initial enrolment in the programme.
3. Course components provided by different faculties or institutions are subject to the rules applicable at the faculty or institution in question. Components offered by the Faculty of Science are subject to the regulations described in at least one of the EERs of the Faculty of Science at all times.
4. The faculty offers the following 120-EC Master's programmes:
  - a. Biology;
  - b. Chemistry (being phased out);
  - c. Computing Science;
  - d. Mathematics;
  - e. Medical Biology;
  - f. Molecular Life Sciences (being phased out);
  - g. Molecular Sciences
  - h. Physics and Astronomy;
  - i. Science (being phased out);
5. The faculty offers the following 60-EC Master's programmes:
  - a. Information Sciences.
6. All degree programmes are offered exclusively as full-time programmes.
7. The programmes are taught in English. The exception to this is the educational components of the Faculty of Science Education and Science specialisations that are taught in Dutch.

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## **Article 1.2 Executive Board Guidelines**

1. In view of the organisation and coordination of the provisions in these regulations, the Executive Board has established the following guidelines: The guidelines can be found in the Appendix:
  - a. Guideline for regulations on academic distinctions;
2. In addition to the above guidelines, the Executive Board has established a number of temporary guidelines for the 2021–2022 academic year in response to the coronavirus measures. These guidelines are available at <https://www.ru.nl/nieuws-agenda/nieuws/coronavirus-radboud-universiteit/coronarichtlijnen/>.

## **Article 1.3 Definition of terms**

1. The terms used in these EER, which are also used in the Higher Education and Research Act (Wet op het hoger onderwijs en wetenschappelijk onderzoek, hereinafter, 'the Act') will have the same meaning as in the Act.
2. Apart from the terms referred to in clause 1, the terms below are understood to have the following meanings:
  - a. Degree programme: the Master's degree programme referred to in Article 7.3a, clause 1 of the Act;
  - b. Component: an educational unit as referred to in Article 7.3 paragraphs 2 and 3 of the Act;
  - c. Student: anyone enrolled at Radboud University for participation in a degree programme or in the partial examinations or final examinations of a programme;
  - d. Academic year: the period from 1 September in a given year until 31 August of the following year;
  - e. Practical: a practical exercise as referred to in Article 7.13 clause 2 under D of the Act;
  - f. Interim examination: an examination testing the knowledge, understanding or skills of the student in relation to a certain unit of study, as well as the assessment of the results of this examination, which is administered by at least one examiner designated by the Examining Board. For the purpose of these regulations, a partial examination or a resit is also considered an interim examination;
  - g. Partial examination: an examination of the knowledge, insight and skills of the student, as well as the assessment of the results of the examination, which, in conjunction with one or more other partial examinations, constitute the interim examinations as referred to under clause f. In these regulations, when the term 'examination' is used, this can also be read as 'partial examination', unless explicitly indicated otherwise;
  - h. Resit: a new opportunity to retake a particular examination as referred to in Article 7.10 clause 1 of the Higher Education and Research Act (WHW). In these regulations, when the term 'examination' is used, this can also be read as 'resit', unless explicitly indicated otherwise;

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- i. Final examination: an assessment, on the basis of which the Examining Board determines whether all the components pertaining to the Master's programme have been completed successfully. The Examining Board may decide that the final examination also includes an investigation by the Examining Board into the knowledge, insight and skills of the candidate, as well as the assessment of the outcomes of that investigation (in accordance with Article 7.10 WHW);
- j. Fraud: any deliberate act or omission by a student that makes forming an accurate opinion of their knowledge, understanding and skills partially or entirely impossible. The Regulations on Fraud during Interim Examinations and Examinations are included as an appendix to these EER;
- k. Examining Board: the examining board of a degree programme, established in accordance with Article 7.12 of the Act. Also see the Radboud University Structural Regulations;
- l. Examiner: the person designated by the Examining Board to administer the interim examinations, in accordance with Article 7.12 of the Act;
- m. EC: European Credits, i.e. the study load unit in accordance with the European Credit Transfer
- n. System;
- o. Specialisation: a coherent programme within the Master's programme that has been approved as such by the faculty board;
- p. Work day: Mondays to Fridays, with the exception of official holidays and any other days designated by Radboud
- q. University as collective holidays;
- r. Awarding of the degree certificate: the formal confirmation that all the examination requirements have been met;
- s. Prospectus: the guide for a particular Faculty of Science degree programme,
- t. containing specific information regarding the Master's degree programme;
- u. The University: Radboud University;
- v. The faculty: The Faculty of Science;
- w. The education institute: the organisational unit responsible for the degree programme;
- x. Free elective: a freely-selected, academic, assessable component.
- y. Rules and regulations: the rules in which the Examination Board explain how it works in accordance with the Education and Examination Regulations.

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## **PART II    GENERAL PART**

### **Section 2. Admission to the degree programme and education**

#### **Article 2.1 Admission and admission requirements**

1. Decisions regarding admission are made by the education institute on behalf of the dean.
2. The programme-specific part of these EER lists the admission requirements students must meet to be admitted to the degree programme.

#### **Article 2.2 Language requirements**

1. A sufficient command of the English language is required to participate in the programme and to sit examinations in English. This requirement is met if the student:
  - a. comes from one of the following countries: Australia, Canada (with the exception of Quebec),
  - b. Ireland, New Zealand, Singapore, the United Kingdom, the United States or South
  - c. Africa; or
  - d. is in possession of a pre-university education (VWO) diploma; or
  - e. is in possession of a pre-university education diploma obtained at an English-language institution in the Netherlands or elsewhere; or
  - f. has a pre-university education diploma obtained at a German secondary education institution, with English as *Grundkurs*; or
  - g. has a Bachelor's diploma from a university of applied sciences (HBO); or
  - h. has a Bachelor's diploma from a Dutch university; or
  - i. meets the requirements in the opinion of the programme; or
  - j. has achieved a sufficient score on one of the following English language tests:
    - i. the TOEFL with a score of 575 or higher for the paper version;
    - ii. the TOEFL with a score of 90 or higher for the Internet version with none of the sub-scores below 20;
    - iii. the IELTS with a score of 6.5 or higher, where none of the sub-scores are below
    - iv. 6.0;
    - v. the Cambridge CAE or CPE with a score of C or higher.
2. A sufficient command of Dutch is required to participate in the programme and to sit examinations in Dutch. Non-Dutch students have met the language requirement for sufficient proficiency in Dutch if they have passed the state examination of Dutch as a second language, level 2.

In certain cases, the education institute may assess whether a student is sufficiently proficient in Dutch.

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## Section 3. Structure and design

### Article 3.1 Final examination, degree and distinctions

1. The degree programme is concluded by the Master's final examination.
2. Students who pass the examinations of the Master's degree programme will be awarded a Master of Science (MSc) degree.
3. The degree referred to in the second clause is exclusively awarded if the student has earned at least half of the EC for their degree programme at this University.
4. The Examining Board can award distinctions to students who have successfully passed the degree programme examination. The rules for awarding a distinction can be found in Article 4.7 of these EER.

### Article 3.2 General learning outcomes

The degree programme has the following learning outcomes for students:

1. Acquire knowledge, skills and insights in the relevant field of study;
2. Develop academic competences;
3. Prepare for further study or a future career;
4. Strengthen qualifications in the area of independent academic research.

### Article 3.3 Curriculum

1. The programme comprises the total of the components as described in the programme-specific part of these regulations and is aimed at the realisation of well-defined objectives regarding the knowledge, understanding and skills that students are expected to possess upon successful completion.
2. For each section, the lecturer must make a course guide available prior to the course, which includes a description of the course, tests with weighting factors and deadlines. This guide may coincide with the course description in the study guide.
3. The programme has research specialisations and societal specialisations. The specialisations are described in the programme-specific part.
4. Each degree programme includes a component that is philosophical in nature with a minimum study load of 3 EC, a free elective space of 6 EC and a component to aid reflection on study performance, study planning, and professional orientation with a study load of 0 or 1 EC.
5. The elective courses cannot have substantial overlap in content with courses from the mandatory or elective components of the programme. It is not possible to receive an exemption for the elective component based on a Bachelor's course.
6. The composition of the Master's programme compiled by the student must be presented to the Examining Board for approval no later than three months before the expected examination date. The Examination Board will decide whether to grant approval within a month of receiving the submitted programme.



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7. Students can only participate in components provided by the Radboud Teachers Academy of Education after the disciplinary internship has been completed. Students can only participate in the Science, Management and Innovation final research project after the student has passed the thematic components and NWI-FMT019 Methods in Societal Research: Science, Management & Innovation. Students can only participate in the Science in Society research project after 12 EC have been obtained from the SiS curriculum.
8. Students are permitted to add components to the examination programme. These components are considered extra-curricular and do not count towards the determination of the distinction.
9. If a student can choose between components within the curriculum and the student has passed more than one of these components, then the student can decide which components will count towards their distinction.

### **Article 3.4 Types of interim examination**

1. Each component of the degree programme is concluded by an interim examination. Interim examinations may comprise more than one modular partial examination, and may consist of the following assessment forms:
  - a. Written test and/or
  - b. Oral test;
  - c. Presentation;
  - d. Skill test and/or the creation of a discipline-specific product and/or assignment.
2. Prior to the commencement of the academic year, information will be provided in the prospectus for each individual component regarding the way in which the interim examinations will be administered. At the request of the student or the examiner, the Examination Board may allow an interim examination to be administered in a form other than stated above, if this is not to the detriment of the student.
3. In cases where an interim examination has admission requirements, the admission requirements will be published in the prospectus before the start of the academic year, see Article 3.3 paragraph 6. This requires permission from the programme coordinator. Contrary to the above provisions, the admission requirements for the courses completed in the fourth period may still be changed up until the start of the second period, with permission from the programme coordinator.
4. There are no admission requirements for interim examinations; if students are enrolled in a component, they are admitted to all sub-components, including the interim examination.
5. Students with disabilities are given the opportunity to take interim examinations in a manner appropriately suited to their disability. The Examining Board, if necessary, shall seek expert advice and counsel prior to reaching its decision. If the students in question require certain facilities for their interim examinations or resits, they must request these from the Education and Examination Administration of the faculty no later than two weeks before the interim examination or resit.

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6. During oral examinations, no more than one person is tested at a time, unless decided otherwise by the Examination Board.
7. Oral interim examinations are not public, unless the Examining Board has deemed otherwise in exceptional cases. All oral examinations are recorded. A second examiner or a designated observer may be present as an alternative to recording.

### **Article 3.5 Exemptions**

1. At the request of the student and having heard the examiner involved, the Examination Board may exempt a student, either partially or fully, from sitting for an interim examination if the student:
  - a. Has completed a course in a relevant subject at a university or institute of higher vocational education (HBO);
  - b. Demonstrates that they have adequate knowledge and skills regarding the component in question as a result of relevant work experience or professional experience.
2. If the degree programme allows group exemptions, then these are included in the programme-specific part of these regulations.
3. Only one grade for each course may be registered for a single degree programme. If a course is also part of another examination programme, this course will be listed on the diploma as an exemption.
4. Students who were first enrolled on or after 1 September 2017 can never have more exemptions than a quarter of the total study load of the programme expressed in EC, as stated in clause 1.
5. All results for a degree programme achieved before the date of the first enrolment are stated as exemptions on the degree programme's diploma. These exemptions do not count towards the EC as stated in clause 4 if the courses are only included in a one examination programme.
6. Exemptions as referred to in paragraphs 1 and 2 cannot be granted for final examination assignments.

### **Article 3.6 Term of validity for successfully completed interim examinations**

1. The term of validity of successfully completed interim examinations is unlimited.
2. Results obtained for interim examinations are valid until the end of the academic year at least. Lecturers can decide to extend the term of the validity of the result obtained for a partial examination.

### **Article 3.7 Elective programmes**

The programme Examination Board shall decide on a request for authorisation to follow a free education programme as referred to in Article 7.3d WHW. The Examination Board will verify whether the programme fits within the domain of the degree programme under the authority of the Examination Board, whether it is sufficiently cohesive, and whether the level is adequate in the context of the programme's exit qualifications.

## **Section 4. Testing**

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#### **Article 4.1 Frequency of interim examinations**

1. Students are given the opportunity to take the examinations at least twice per academic year per interim examination.
2. Contrary to the provisions of paragraph 1, a degree programme coordinator may decide to only offer one opportunity for an interim examination or partial examination. If only one opportunity is given to take an interim examination or partial examination, this is stated in the programme study guide before the start of the academic year.
3. Notwithstanding the provisions in the first clause, there will be at least one opportunity in the following year to take an interim examination for a course that was taught for the final time in a particular academic year.
4. If a certain component is not given in a particular academic year, the opportunity to take the corresponding examination will be offered once in that academic year, as long as the interim examination is administered in written or oral form.

#### **Article 4.2 Registration for course examinations**

1. Students who register through Osiris for a component are automatically registered for the first interim examination opportunity in the relevant academic year. This does not apply to students whose enrolment in the degree programme has not yet been completed.
2. Students can register for an examination right up until 23:59 on the day prior to a period of five working days before the date of the examination. Registration is no longer possible after this date, unless the head of Education Centre decides otherwise in special cases on behalf of the dean. A successfully passed examination may be taken again.
3. If a student resits an interim examination, the most recent result will determine the final result.

#### **Article 4.3 Confirmation of examination results**

1. The result of an interim examination is determined by an examiner in the form of a grade on a scale from 1 to 10 (with 10 being the highest possible grade), consisting exclusively of whole numbers or half numbers. However, a grade of 5.5 is never given. When rounding off between 5 and 6, the rule is that a grade lower than 5.5 is rounded down to a five (5), which is an insufficient grade, meaning the educational component has not been successfully completed; a 5.5 and higher is rounded up to a six (6), meaning that the educational component has been successfully completed. In addition to results in the form of a grade, the assessments 'completed', 'not completed', 'satisfactory', 'not satisfactory', and 'good' may also be awarded.
2. Notwithstanding the provisions of clause 1, partial examinations may also be graded with one decimal point on a 10-point scale. Only the final grade is rounded off.

#### **Article 4.4 Publication of results**

1. The examiner shall determine the result of the final project within 15 working days after the presentation of the final project has taken place and after the final project has been submitted in <http://thesissubmission.science.ru.nl>.

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2. The examiner shall determine the result of an interim examination within 15 working days of the date it was administered. Here, the precondition applies that there must be at least ten working days between the date of the publication of the result in Osiris and the date of the resit.
3. Contrary to the provisions in paragraph 2, the examiner shall determine the result of an interim examination in the fourth period no later than nine days before the scheduled date of the corresponding resit. The lecturer always has at least five working days after the written examination to determine the result.
4. Contrary to the provisions set out in paragraph 2, the examiner shall determine the result of an oral examination within two working days of the date it was administered.
5. In special cases, the Examination Board may extend the term in which the result must be determined as referred to in paragraph 2 and 3 by a maximum of ten working days. This is not possible for interim examinations in the fourth period.
6. In this statement of the result of an interim examination, the student is also informed of their right to inspection, referred to in Article 4.5 as well as the right to appeal to the Examination Appeals Board.
7. Students may submit an appeal of a decision by the Examination Board to the Examination Appeals Board within six weeks.

#### **Article 4.5 Right of inspection and explanation**

1. Students may request access to review and inspect all graded work within at least 30 working days following publication of a written interim examination result. For the results of interim examinations with 'open' questions, at their request, the student shall be granted a copy of their graded work at cost.
2. During the period referred to in paragraph 1 of this Article, any student who has taken an interim examination may review the questions and assignments of the interim examination in question, as well as the standards on which the result was based.
3. Students must be offered at least one opportunity to inspect or have their examinations explained, as referred to in paragraphs 1 and 2. If the student demonstrates that they are or were unable to attend an inspection, they may request the Examination Board to allow them another opportunity to inspect the examination, within the period referred to in the first paragraph if possible. In all cases, the inspection must take place at least five working days before the resit of an interim examination. For examinations in the fourth period, students may view their work until one working day before the resit.
4. The examiner shall retain all written interim examinations and related papers (assignments or otherwise) that count towards the final result for a period of two years following the date when the examination was administered. Master's programme reports and theses must remain available for visitations, accreditations and inspections, and shall be kept for seven years.

#### **Article 4.6 Confirmation of examination results**

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1. Students are given the opportunity to take the final examination after they have provided sufficient proof of passing the components leading up to the final examination.
2. Examinations are scheduled each month.
3. The Examining Board will determine the result of the final examination, as well as the rules in relation to the manner in which the result of the examination is determined. The result of the examination is determined by the Examining Board within five weeks following the student's request. If the examination takes place in July, the results will be determined no later than 31 August. Where needed in relation to entry requirements for a subsequent programme or the acceptance of a job, a statement can be released indicating that the student has met the requirements of the examination within five days. This is only possible if the student has met the criteria specified in clause 1.
4. Prior to determining the result of the final examination, the Examination Board may evaluate and assess the student's knowledge with respect to one or more components or aspects of the programme, if and to the degree to which the results of the related interim examinations justify this.

#### **Article 4.7 Awarding distinctions**

The guidelines concerning distinctions can be found in the Appendix of the Guideline for Distinction Regulations.

## **Section 5. Study performance, guidance and evaluation of education**

#### **Article 5.1 Study performance and support**

1. The faculty dean is responsible for recording student results in such a way that, upon request, the Examination Board can respond by providing the student with an overview of the progress of the study programme within a reasonable time frame.
2. The dean is responsible for providing adequate student counselling.

#### **Article 5.2 Method of evaluation of education**

In compliance with the quality assurance system of the university as described in the Handboek Kwaliteitszorg Onderwijs Radboud Universiteit (Radboud University Quality Assurance Manual), the dean shall ensure that the education of the degree programmes is evaluated systematically.

## **PART III PROGRAMME-SPECIFIC PART**

## **Section 6 Admission to the degree programme and education**

#### **Article 6.1 Admission requirements**

Admission requirements for the programme:

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1. Students must have successfully completed the final examination of the Bachelor's programme in Computing Science at Radboud University.
2. Students must have successfully completed the final examination of the Bachelor's programme in Computing Science Radboud University or Technical Computing Science at another Dutch university.
3. Students must be in possession of a degree certificate that is at least equal to the degree referred to in Article 6.1 clause a.
4. For the Data Science specialisation, students must have successfully completed the final examination of the Bachelor's programme in Artificial Intelligence at Radboud University or another Dutch university or have passed the final examination of the Bachelor's programme in Knowledge Engineering at Maastricht University.
5. For the Mathematical Foundations of Computer Science specialisation, students must also have successfully completed the Bachelor's programme in Mathematics Radboud University or an equivalent programme at another Dutch university.
6. Students must have demonstrated suitability for participation in the degree programme, in the opinion of the Examination Board.
7. Students must also provide proof of sufficient proficiency in English, as described in Article 2.2.

## **Article 6.2 Pre-Master's programme**

Those who have earned a Computing Science degree or a degree in a related field from a university of applied sciences (HBO) and have completed the corresponding pre-Master's programme of 30 EC are also eligible for admission to the degree programme.

## **Section 7 Structure and design**

### **Article 7.1 Programme-specific learning outcomes**

1. In addition to the general learning outcomes described in the general part of these regulations, the Computing Science degree programme aims to enable students to work and think at an academic level and to ensure that graduates of the programme:
  - a. Have thorough academic knowledge and insight in the area of their specialisation (discussed in more detail below per specialisation in points e to h), are experts in a sub-area within their specialisation and can contribute to the further academic development within this sub-area, and are able to acquire knowledge, insight and skills in other sub-areas of Computing Science;
  - b. Can apply their knowledge and skills to research and system development issues, both independently and in small teams. Depending on the chosen specialisation and expertise, the emphasis here may be on research or system development;
  - c. Understand the social aspects of ICT;

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- d. Are able to communicate at a professional level and providing a clear oral and written presentation of completed work.
  - e. For the Software Science specialisation, graduates possess broad knowledge of state-of-the-art techniques for the development and analysis of software (including software technology, domain-specific languages, computer-aided analysis, and the use of mathematic models and modelling techniques) and are able to apply these techniques.
  - f. For the Data Science specialisation, graduates have a broad overview of the data science discipline (incl. algorithmic, organisational, software, hardware and ethical aspects), are able to use appropriate data science techniques to extract insights from data, are experienced with specifying, designing and creating applications in which data science plays an important role, and can contribute to discussions about the role of data science in society.
  - g. For the Cyber Security specialisation, graduates possess broad knowledge of information and computer security (including organisational, software, hardware, network, cryptographic, legal and privacy aspects), can evaluate the security aspects of existing systems and systems yet to be developed and to this end are able to formulate and prioritise safety requirements, are experienced in specifying, designing or developing applications in which safety plays an important role, and can contribute to discussions on the role of cyber security and privacy in society.
  - h. For the Mathematical Foundations of Computer Science (MFoCS) specialisation, graduates have a broad knowledge of theoretical computing science and the mathematics that serve as its foundation and can apply mathematical techniques (such as logic and algebra) in modelling and analysing computing science concepts.
2. Students who choose the Science, Management and Innovation specialisation as described in Article 7.2e, will also achieve the following learning outcomes upon graduation:
- a. Able to bridge the gap between their own discipline and other disciplines, based on a profound understanding of the chosen core theme and how this relates to societal, political, economic, and environmental requirements of the world today;
  - b. Familiar with and able to analyse specific problems within their theme, and able to apply a range of approaches to address these, argue for, select and implement feasible options, taking into account the full breadth of technological, societal, political and economic perspectives.
  - c. Proficient in using research methods and techniques, including basic finance and economics, to verify, justify and substantiate strategies and plans and are capable of effectively using a wide variety of information and communication channels;
  - d. Able to balance perspectives and interests in specific contexts within a company or (non)governmental organisation in order to formulate appropriate strategies and plans towards implementation of the Sustainable Development Goals (SDGs).
  - e. Able to communicate insights, views and analyses of complex issues to others in a clear, concise and understandable manner, both in written and spoken form.

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- f. Able to work in multidisciplinary and multicultural high-performance teams based on sound division of tasks, knowledge, competencies, and responsibilities, whilst respecting diverging views and opinions.
3. Students who choose the Science in Society specialisation as described in Article 7.2f, will also achieve the following learning outcomes:
    - a. Able to analyse the role of scientific expertise in societal and political decision-making with regard to socio-scientific issues.
    - b. Able to design and conduct independent and methodologically sound social research at the interface of science and society and are capable of contributing to academic research.
    - c. Able to understand and design public and stakeholder participation processes in research and innovation;
    - d. Able to analyse, improve and evaluate interdisciplinary collaborations with multiple stakeholders and integrating different perceptions, interests and types of knowledge
    - e. (experiential, professional and scientific);
    - f. Able to substantiate and communicate the relevance of their scientific discipline in society.

## Article 7.2 Composition of the programme

1. Subject to the provisions in Part II of these regulations, the student chooses one of the following specialisations of the degree programme:
  - a. Software Science
  - b. Data Science
  - c. Cyber Security (TRU/e), offered in collaboration with TU/e
  - d. Mathematical Foundations of Computer Science (MFoCS)
  - e. Science, Management and Innovation
  - f. Science in Society
2. Contrary to the provisions in Article 3.3 paragraph 3, the Computing Science programme does not have a separate portfolio component. Career orientation is incorporated into a number of courses.

## Article 7.2a Master's specialisation in Software Science

The Master's specialisation in Software Science consists of the following components:

### 1. Compulsory courses (27 EC)

Course code	Course name	EC
NWI-I00032	Advanced Programming	6



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NWI-I00155	Design of Embedded Systems	6
NWI-I00110	Testing Techniques	6
NWI-IMI003	Philosophy and Ethics for Computing and Information Science	3
NWI-IMC045	Research Seminar Software Science	6

## 2. Choice of sub-specialisation (24 EC)

Free selection from the following courses:

Course code	Course name	EC
NWI-IMC004	Compiler Construction	6
NWI-IMC059	Software Product Lines	6
NWI-IMI004	Software Development Entrepreneurship	6
NWI-ISOFSE	Software Security	6
NWI-I00139	Proof Assistants (not offered in 2021–2022)	6
NWI-IMC046	Model Checking	6
NWI-IMC009	Automated Reasoning	6
NWI-IMC010	Type Theory and Coq	6
NWI-IMC011	Semantics and Domain Theory	6
NWI-IMC036	Category Theory and Coalgebra	6
NWI-IMC060	Program Verification with Types and Logic	6
NWI-WM072B or: NWI-WM072C	Complexity Theory <sup>1</sup> Complexity Theory (Mastermath version)	6 8

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<sup>1</sup>The 6 EC version of this course will not be offered in years when the 8 EC Mastermath version is offered.

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NWI-WM120C or: NWI-WM223	Computability Theory <sup>2</sup> Computability Theory (Mastermath version)	6 8
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### **3. Electives (18 EC)**

Master's components of the Computing Science degree programme. If a student wishes to take Master's components of another programme, this must be submitted to the Examination Board for approval. The Examination Board can also approve the inclusion of Bachelor's courses in the elective space, if the student is able to motivate this choice and the Bachelor's courses have a thematic coherency with the other courses in the elective space.

### **4. Free electives (6 EC)**

### **5. Research internship (15 EC)**

Course code	Course name	EC
NWI-IMC047	Research Internship	15

To be decided in consultation with the coordinator of the Software Science specialisation. All ICIS divisions are automatically approved as internship departments.

### **6. Graduation thesis (30 EC)**

A graduation thesis of 30 EC, to be decided in consultation with one of the ICIS staff members as supervisor.

## **Article 7.2b Master's specialisation in Data Science**

The Master's specialisation in Data Science consists of the following components:

### **1. Compulsory courses (27 EC)**

Course code	Course name	EC
NWI-I00041	Information Retrieval	6

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<sup>2</sup>The 6 EC version of this course will not be offered in years when the 8 EC Mastermath version is offered.

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NWI-IMC030	Machine Learning in Practice	6
NWI-IMC012	Bayesian Networks and Causal Inference	6
NWI-IMI003	Philosophy and Ethics for Computing and Information Science	3
NWI-IMC044	Research Seminar Data Science	6

## 2. Choice of sub-specialisation (24 EC)

Free selection from the following courses:

Course code	Course name	EC
NWI-IMC056	Statistical Machine Learning	6
NWI-IMC042	Natural Computing	6
NWI-IMC058	Deep Learning	3
NWI-NM048B	Advanced Machine Learning	6
NWI-NM048D	CDS: Machine Learning	3
NWI-IMC037	Intelligent Systems in Medical Imaging	6
SOW-MKI49	Neural Information Processing Systems (formerly: Computational Neurocognitive Modeling)	6
NWI-SM299	Pattern Recognition for the Natural Sciences	3
LET-REMA-LCEX06	Text and Multimedia Mining	6
NWI-IMC006	Law in Cyberspace	6
NWI-I00035	Foundations of Information Systems	6
SOW-MKI52	New Media Lab	6
LET-REMA-LCEX10	(Automatic) Speech Recognition	6
NWI-NM116B	Machine Learning in Particle Physics and Astronomy	6

## 3. Electives (18 EC)

Master's components of the Computing Science of Artificial Intelligence degree programme. If students wish to take Master's components from another programme, they must request approval

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from the Examination Board. The Examination Board can also approve the inclusion of Bachelor's courses in the elective space, if the student is able to motivate this choice and the Bachelor's courses have a thematic coherency with the other courses in the elective space.

#### **4. Free electives (6 EC)**

#### **5. Research internship (15 EC)**

Course code	Course name	EC
NWI-IMC047	Research Internship	15

To be decided in consultation with the coordinator of the Data Science specialisation. All ICIS divisions are automatically approved as internship departments.

#### **6. Graduation thesis (30 EC)**

A graduation thesis of 30 EC, to be decided in consultation with one of the ICIS staff members as supervisor.

### **Article 7.2c Master's specialisation in Cyber Security**

The Master's specialisation in Cyber Security consists of the following components:

#### **1. Compulsory courses (33 EC)**

Course code	Course name	EC
NWI-ISOFSE	Software Security	6
NWI-I00153	Security in Organisations	6
NWI-IMC062	Advanced Network Security	6
NWI-IMC061	Applied Cryptography	6
NWI-IMI003	Philosophy and Ethics for Computing and Information Science	3
NWI-I00136	Privacy Seminar	6

#### **2. Choice of sub-specialisation (24 EC)**

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At least four courses must be selected from the following list.

Course code	Course name	EC
NWI-IMC066	Security Protocol Project	3
NWI-IMC068	Physical Attacks on Secure Systems	6
NWI-IMC006	Law in Cyberspace	6
NWI-IMC064	Engineering Cryptographic Software	3
NWI-IMC065	Selected Topics on Hardware for Security	3
NWI-IMC030	Machine Learning in Practice	6
NWI-IMC056	Statistical Machine Learning	6
NWI-IMC058	Deep Learning	3
NWI-IMC060	Program Verification with Types and Logic	6
NWI-IMC063	Cryptology	6
NWI-IMC067	Capita Selecta in Cyber Security	6

### **3. Electives (12 EC)**

Master's components of the Computing Science degree programme. If students wish to take Master's components from another programme, they must request approval from the Examination Board. The Examination Board can also approve the inclusion of Bachelor's courses in the elective space, if the student is able to motivate this choice and the Bachelor's courses have a thematic coherency with the other courses in the elective space.

### **4. Free electives (6 EC)**

### **5. Research internship (15 EC)**

Course code	Course name	EC
NWI-IMC047	Research Internship	15

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To be decided in consultation with the coordinator of the Cyber Security specialisation. All ICIS divisions and EIPSI at TU/e are automatically approved as internship departments.

### **6. Graduation thesis (30 EC)**

A graduation thesis of 30 EC, to be decided in consultation with one of the ICIS staff members as supervisor.

### **Article 7.2d Master's specialisation in Mathematical Foundations of Computer Science (MFoCS)**

The Master's specialisation in Mathematical Foundations of Computer Science consists of the following components:

#### **1. Compulsory courses (27 EC)**

Course code	Course name	EC
NWI-IMC010	Type Theory and Coq	6
NWI-WM069B	Computer Algebra	6
NWI-IMC036	Category Theory and Coalgebra	6
NWI-IMI003	Philosophy and Ethics for Computing and Information Science	3
NWI-IMC057	MFoCS Seminar	6

#### **2. Choice of sub-specialisation (18 EC)**

Free selection from the following courses:

Course code	Course name	EC
NWI-IMC009	Automated Reasoning	6
NWI-I00139	Proof Assistants	6
NWI-IMC011	Semantics and Domain Theory	6
NWI-IMC046	Model Checking	6
NWI-IMC060	Program Verification with Types and Logic	6

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NWI-WM072B or: NWI-WM072C	Complexity Theory <sup>3</sup> Complexity Theory (Mastermath version)	6 8
NWI-WM120C or: NWI-WM223	Computability Theory <sup>4</sup> Computability Theory (Mastermath version)	6 8

### **3. Electives (24 EC)**

Master's components of the Computing Science, Mathematics, or the national Mastermath programme. If students wish to take Master's components from another programme, they must request approval from the Examination Board.

### **4. Free electives (6 EC)**

### **5. Research internship (15 EC)**

Course code	Course name	EC
NWI-IMC047	Research Internship	15

To be decided in consultation with the coordinator of the MFoCS specialisation. All ICIS divisions and the Mathematics division of IMAPP are automatically approved as internship departments.

### **6. Graduation thesis (30 EC)**

A graduation thesis of 30 EC, to be decided in consultation with one of the ICIS staff members as supervisor.

## **Article 7.2e Master's specialisation in Science, Management and Innovation (SMI)**

The Master's specialisation in Science, Management and Innovation consists of the following components:

### **1. Compulsory courses (15 EC)**

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<sup>3</sup>The 6 EC version of this course will not be offered in years when the 8 EC Mastermath version is offered.

<sup>4</sup>The 6 EC version of this course will not be offered in years when the 8 EC Mastermath version is offered.

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Course code	Course name	EC
NWI-FMT003E	Sustainable Innovation Management	6
NWI-FMT030	Reaching the Sustainable Development Goals	6
NWI-FMT019	Methods in Societal Research: Science, Management & Innovation	3

## **2. Theme courses (15 EC)**

Choice of one of the themes:

### Climate and Energy

Course code	Course name	EC
NWI-FMT022	Energy and Climate	6
NWI-FMT026	Energy Modelling	3
NWI-FMT032	Environmental Life Cycle Assessment	6

### Health

Course code	Course name	EC
NWI-FMT023	The Future of Health	6
NWI-FMT029	How Health Systems Work	6
	Free elective	3

### Green Industries & IT

Course code	Course name	EC
NWI-FMT022	Energy and Climate	6
NWI-SM299	Pattern Recognition in the Natural Science	3
NWI-FMT032	Environmental Life Cycle Assessment	6

### Biodiversity



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Course code	Course name	EC
NWI-BM038A	Environmental and Ecological Concepts	3
NWI-BM075	Biodiversity Assessment	3
NWI-BM033F	Nature in a Crowded Country	3
NWI-FMT032	Environmental Life Cycle Assessment	6

### **3. Disciplinary courses (51 EC)**

Students can choose one of the Data Science or Software Science course packages, as described in Article 7.2a paragraphs 1 and 2 and Article 7.2b paragraphs 1 and 2.

### **4. Free choice electives (12 EC)**

The student can use the free elective space to expand the Science, Management and Innovation final research project by 3 EC.

### **5. Science, Management and Innovation final research project (27 EC)**

The SMI research project may, in consultation with the coordinator or a lecturer from the SMI specialisation, be completed both internally (at the Faculty of Science) or externally (government, businesses, consulting firms, NGOs, etc.), at home or abroad. In the first month, the student will write a research plan which must be approved by both the external and first supervisor as well as the second reader. The assessment of the thesis is based on the criteria described in the manual '*Doing a research project: A guide for students of the Science, Management & Innovation Master's specialisation*'.

## **Article 7.2f Master's specialisation in Science in Society (SiS)**

The Master's specialisation in Science in Society consists of the following components:

### **1. Compulsory courses (24 EC)**

Course code	Course name	EC
NWI-FC002B	Science and Societal Interaction	3
NWI-FC003B	Research, Responsibility and Uncertainty	3
NWI-FC0010D	Framing Knowledge	6

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NWI-FC0013C	Science and Media	3
NWI-FC0043B	Science and Public Policy	3
NWI-FC0044C	Methods of Societal Research: Science in Society	6

## **2. Disciplinary courses (51 EC)**

Students can choose one of the Data Science or Software Science course packages, as described in Article 7.2a paragraph 1 and 2 and Article 7.2b paragraph 1 and 2.

## **3. Limited choice electives (3 EC)**

To be filled with components related to the topic of the thesis. These components must be submitted to the SiS coordinator for approval.

## **4. Free choice electives (12 EC)**

## **5. Science in Society Research Project (30 EC)**

In consultation with a SiS lecturer, the SiS graduation project can be completed both internally (at the ISIS department) or externally (government, consulting firms, NGOs, etc.). In the first month, the student will write a research plan which must be approved by both the first supervisor, a second reader and the science advisor. The assessment of the thesis is based on the criteria described in the 'Graduation project guidelines SiS'.

## **Article 7.3 Deviating programme**

If a student does not choose a specialisation, they must submit a motivated request for permission to the Examination Board for an alternative course selection for the Master's programme. The submitted course selection must include at least 60 EC of the total 120 EC. Compulsory components of the deviating programme include the course NWI-IMI003 Philosophy and Ethics for Computing and Information Science (3 EC) and the Graduation thesis (30 EC).

## **Section 8. Transitional provisions**

For students of Software Science who started during or before 2016–2017 academic year, the following applies:

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- NWI-I00155 Design of Embedded Systems (6 EC) may be replaced by NWI-IMCO46 Model Checking (6 EC).

For students of Software Science who started during or before academic year 2018/2019, the following applies:

- As electives in the specialisation, the following courses can also be chosen in addition to the courses specified in Article 7.2a: NWI-IMC035 Software Analysis.

For students of Mathematical Foundations of Computing Science who started in or before the 2017–2018 academic year, the following applies:

- As electives in the specialisation, the following courses can also be chosen in addition to the courses specified in Article 7.2b: WI-I00032 Advanced Programming (6 EC), NWI-IMC004 Compiler Construction (6 EC), NWI-NB054E or NWI-IMC056 Statistical Machine Learning (6 EC), NWI-IMC035 Software Analysis (6 EC), NWI-WB070B Intuitionistic Mathematics (6 EC), NWI-WM040B Philosophy of Mathematics (6 EC), NWI-WM038B Axiomatic Set Theory (6 EC), or NWI-WM135 Independence Proofs in Set Theory (6 EC).

For students of Mathematical Foundations of Computing Science who started in or before the 2018–2019 academic year, the following applies:

- The old NWI-IMC049 MFoCS seminar (6 EC) may be replaced with NWI-IMC049 MFoCS seminar (3 EC), but only if the minimum number of study points of the Master's programme has been obtained;
- A 40 EC graduation thesis may replace the 30 EC graduation thesis and
- NWI-IMC047 Research Internship (15 EC)
- The course NWI-IMC036 Category Theory and Coalgebra is not compulsory.
- The course NWI-IMC055 Quantum Processes and Computation may be used as a specialisation elective

For Data Science students who started in or before the 2020–2021 academic year, NWI-NM116 Machine Learning in Particle Physics and Astronomy (3 EC) may be included as a specialisation option, provided that the minimum number of credits required for the Master's programme is met.

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For students of Data Science who started in or before the 2018–2019 academic year, the following courses may be used as a specialisation elective:

- NWI-I00054 Cognition and Representation
- NWI-NM048C Machine Learning (instead of WI-NM048B Advanced Machine Learning and NWINM048D CDS Machine Learning)

For students of Cyber Security who started in or before the 2020–2021 academic year, the following applies:

- instead of taking the course NWI-ISOFSE Software Security (6 EC), you may also take the course NWI-IMC051 Software Security (5 EC);
- instead of taking the course NWI-I00153 Security in Organisations (6 EC), you may also take the course NWI-IMC053 Security in Organisations (5 EC);
- instead of taking the course NWI-IMC062 Advanced Network Security (6 EC), you may also take the course NWI-IMC050 Advanced Network Security (5 EC);
- instead of taking the course NWI-IMC061 Applied Cryptography (6 EC) you may also take the course NWI-TRUE02 Cryptology (5 EC);
- instead of taking the course NWI-I00136 Privacy Seminar (6 EC), you may also take the course NWI-TRUE08 Seminar Information Security Technology (at TU/e; 5 EC);
- as a Specialisation option, in addition to the courses listed in Article 7.2c, the courses NWI-IMC001 Hardware Security (6 EC), NWI-IMC039 Cryptographic Engineering (6 EC), NWI-TRUE01 Principles of Data Protection (at TU/e; 5 EC), NWI-TRUE03 Physical Aspects of Digital Security (at TU/e; 5 EC), NWI-TRUE04 Applied Cryptography (at TU/e; 5 EC), NWI-TRUE06 Cryptographic Protocols (at TU/e; 5 EC), NWI-TRUE07 Verification of Security Protocols (at TU/e; 5 EC), and NWI-TRUE09 Cyberattacks, Crime and Defenses (at TU/e; 5 EC) may also be included, provided these courses do not have substantial content overlap with other courses included in the specialisation;
- provided that a total of at least 53 EC of compulsory courses and courses from the specialisation choice are included.
- For students of Cyber Security who started in or before the 2017-2018 academic year, the following applies:
- NWI-TRUE05 Hacker's Hut (5 EC, taught at TU/e) may be used as a specialisation elective.

For students of Science, Management and Innovation, the following applies:

- NWI-FMT021 Neuroscience (3 EC) may be used to fill the 6 EC of free elective space for Health elective courses.

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- NWI-FMT020 Bio-economy may be used instead of one of the 3 EC courses in the Climate and Energy theme.
- NWI-FMT025B From Lab to Clinic may be used instead of NWI-FMT029 How Health Systems Work.
- For students of the specialisation in Science, Management and Innovation the following applies:
- Students who have successfully completed NWI-FMT020 Bio-Economy may use it instead of one of the 3 EC courses in the Climate and Energy theme.
- Students who have successfully completed NWI-FMT025B From Lab to Clinic may use it instead of NWI-FMT029 How Health Systems Work.
- Students who have successfully completed NWI-FMT024 Policy and Economics *and* NWI-FMT006A Entrepreneurship Clinic may use it instead of NWI-FMT030 Reaching the SDGs.
- Students who have successfully completed NWI-FMT006A Entrepreneurship but *not* NWI-FMT024 Policy and Economics can place it in the free elective space *or* follow NWI-FC0043B Science and Public Policy with which they may use NWI-FMT006A Entrepreneurship and NWI-FC0043B Science and Public Policy together instead of NWI-FMT030 Reaching the SDGs.
- Students who have successfully completed NWI-FMT024 Policy and Economics but *not* NWI-FMT006A Entrepreneurship can place this in the free elective space.
- Students who have successfully completed NWI-MM020A Environmental Life Cycle Assessment and a 3 EC free elective may use it instead of NWI-FMT032 Environmental Life Cycle Assessment.
- Students who in the 2020–2021 academic year or earlier have already started on the theme of Managing ICT Innovations by following NWI-IMI004 Software Development Entrepreneurship or NWI-IMC021 System Development Management, may complete the theme Managing ICT Innovations as described in Article 7.2e of the EER Master Computing Science 2020-2021 (i.e. with themed courses NWI-IMI004 Software Development Entrepreneurship, NWI-IMC021 System Development and 3 EC of free electives).

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## **PART IV FINAL PROVISIONS**

### Paragraph 9. Final provisions

#### **Article 9.1 Safety net scheme and hardship clause**

1. In all cases not covered fully or clearly by these regulations, the decision lies with the dean.
2. In all cases in which these regulations may result in an unreasonable or unfair situation for individual students, the Examining Board or the dean is authorised to make an exception to the provisions in these Education and Examination Regulations.

#### **Article 9.2 Establishment and amendments**

1. Notwithstanding the provisions in Article 7 of the Structure Regulations, these regulations are drawn up or amended by the dean after receiving advice from the programme committees and after having obtained the approval of the Joint Assembly of the faculty.
2. An amendment to these regulations has no impact on the current academic year, unless this would disproportionately damage to student interests.
3. In derogation from clause 1, the dean is authorised to drop elective components of the curriculum should the circumstances be deemed impossible to offer the course.

#### **Article 9.3 Entry into force**

These regulations enter into force on 1 September 2021.

#### **Article 9.4 Publication**

1. The dean is responsible for publishing these regulations and any amendments thereto.
2. Interested parties may consult these regulations via the prospectus.

As established by the dean on 30-06-2021.