university of groningen

Appendices for the Master's degree programme(s) in Computing Science 2023-2024

I. Learning outcomes
II. Tracks/specializations
III. Content of the degree programme
IV. Electives
V. Entry requirements and compulsory order
VI. Admission to the degree programme
VII. Transitional provisions
VIII. Additional Requirements Open degree Programmes

Appendix I. Learning outcomes of the degree programme (art. 3.1)

The Master graduate in Computing Science:

- Is fully acquainted with the basic terms and techniques used in Computing Science, and is familiar with a number of classical problems and their solutions;
- Is experienced in the effective use of the tools available in solving Computing Science problems, such as compilers, theorem proofs, visualisation software, case-tools and domain specific software and hardware;
- Is familiar with Computing Science applications in several other scientific fields of study;
- Is capable of clear communication (both oral and in writing) on the subject of Computing Science and its applications;
- Is capable of working in a team and in various projects;
- Is sensitive to the social aspects of Computing Science applications and his/her own responsibilities therein;
- Has specialized knowledge of theories, methods and techniques in one of the following subfields of Computing Science:
    - Intelligent Systems and Visual Computing
    - Software Engineering and Distributed Systems
    - Data Science and Systems Complexity
    - Science, Business & Policy
- Is able, by using scientific data and assessments, to analyse problems in Computing Science or a related scientific field of study, to provide specified solutions to the problem, and – if possible – to materialise these solutions (in the shape of an algorithm or program or an implementation in software or hardware);
- Is able to critically read professional literature and to assess its correctness, usability and relevance;
- Is able to contribute to the enhancement of scientific understanding in a subfield of Computing Science;
- Has a proper understanding of the scientific relevance of problem definitions and results, and of the validity of the scientific method used.

The first six learning outcomes are similar to those of the Bachelor programme in Computing Science.

Some subfields in the Computing Science master degree have the following additional learning outcomes:

The Master in Computing Science graduated in the subfield of Software Engineering and Distributed Systems:

- Is capable of systematically designing and implementing software systems in cooperation with interested parties;
- Is capable of integrating existing and new software components into a system that meets the quality criteria that were agreed upon.

The Master in Computing Science graduated in the subfield of Science, Business & Policy (SBP):

- Has a full understanding of the way in which businesses and policy organisations are functioning (governments and nongovernmental organisations, NGO's);
- Understands the connections between natural science research, trade and industry and governmental policies;
- Is able to integrate aspects of natural science, business and management;
- Is able to translate a concrete problem definition in business or management into a natural science problem definition;

- Is able to connect problem aspects of natural sciences to other relevant subject fields;
- Is able to put research data and conclusions into a business or policy context;
- Has developed his/her social and communicative skills**:**
- Is able to write texts that are effective and to the point;
- Is able to draw up an innovation plan or management plan for either a business or a government organisation;
- Is able to give convincing oral presentation;
- Is able to deliver an active contribution to plenary discussions;
- Familiar with techniques used in business meetings and is capable of chairing a meeting;
- Is able to work on a project as part of a team;
- Is able to give and receive feedback concerning his/her way of functioning in a team;
- Can work in a project;
- Is able to fully consider the interests or objectives of the ordering customer;
- Is able to plan a project independently;
- Is able to cooperate with the relevant parties involved in the project;
- Is able to adequately deal with limitations in time, information and means;
- Is able to prepare the implementation of a project result;
- Is capable of taking professional responsibility;
- Is able to take responsibility on behalf of the organisation;
- Is able to recognize the strategic aspects of his/her own project;
- Is able to provide practical solutions in matters concerning the ethical and professional codes of his/her own field of expertise and of the professional organisation.

Appendix II. Tracks/specializations (art. 3.6)

The Master Computing Science has four tracks:

1. Intelligent Systems and Visual Computing (ISVC)
2. Software Engineering and Distributed Systems (SEDS)
3. Data Science and Systems Complexity (DSSC)
4. Science, Business & Policy (SBP)

Appendix III. Content of the degree programme (art. 3.8)

Course details, mode of assessment and examination are described in Ocasys.

1. The compulsory programme for **ISVC** is:

Course unit	**Course code**	**ECTS**
Modelling and Simulation	WMCS003-05	5
Image Processing	WMCS008-05	5
Pattern Recognition (for CS)	WMCS011-05	5
Neural Networks and Computational Intelligence	WMCS010-05	5
Student Colloquium (Computing Science)	WMCS019-05	5
Scientific Visualization	WMCS018-05	5
Computer Vision	WMCS015-05	5
In-company or Research Internship (CS)	WMCS021-15	15
Machine Learning	WMAI010-05	5
Advanced Computer Graphics	WMCS006-05	5
Master Thesis	WMCS901-30	30
Total		**90**

2. The compulsory programme for **SEDS** is:

Course unit	**Course code**	**ECTS**
Cloud Computing and Cloud-based Applications	WMCS032-05	5
Software Architecture	WMCS004-05	5
Software Maintenance and Evolution	WMCS013-05	5
Evidence-based Software Engineering	WMCS024-05	5
Information Systems	WMCS009-05	5
Student Colloquium (Computing Science)	WMCS019-05	5
Scalable Computing	WMCS017-05	5
Models and Semantics of Computation	WMCS026-05	5
In-company or Research Internship (CS)	WMCS021-15	15
Enterprise Application Integration	WMCS007-05	5
Master Thesis	WMCS901-30	30
Total		**90**

3. The compulsory programme for **DSSC** is:

Course unit	Course code	ECTS
Introduction to Data Science	WMCS002-05	5
Modelling and Simulation	WMCS003-05	5
Advanced Topics in Security and Privacy	WMCS001-05	5
Pattern Recognition (for CS)	WMCS011-05	5
Neural Networks and Computational Intelligence	WMCS010-05	5
Information Systems	WMCS009-05	5
Student Colloquium (Computing Science)	WMCS019-05	5
Scientific Visualization	WMCS018-05	5
Scalable Computing	WMCS017-05	5
In-company or Research Internship (CS)	WMCS021-15	15
Master Thesis	WMCS901-30	30
Total		**90**

4. The compulsory programme for **SBP** is:

Course unit	Course code	ECTS
Cloud Computing and Cloud-based Applications	WMCS032-05	5
Introduction to Data Science	WMCS002-05	5
Student Colloquium (Computing Science)	WMCS019-05	5
In-company or Research Internship (CS)*	WMCS021-15	15
Introduction Science and Business	WMSE001-10	10
Introduction Science and Policy	WMSE002-10	10
Work placement Business and Policy	WMSE902-40	40
Total		**90**

*For the SBP-track this internship needs to take place in a CS research group (and not in a company)

Appendix IV. Electives (art. 3.9.1)

Course details, mode of assessment and examination are described in Ocasys.

1. Optional modules in the programme for **ISVC** are:
   15 ECTS are free choice
   15 ECTS are chosen from:

Course unit	Course code	ECTS
Cloud Computing and Cloud-based Applications	WMCS032-05	5
Introduction to Data Science	WMCS002-05	5
Advanced Topics in Security and Privacy	WMCS001-05	5
Scalable Computing	WMCS017-05	5
Models and Semantics of Computation	WMCS026-05	5
Advanced Parallel Programming	WMCS020-05	5
Perception for Visual Computing	WMCS029-05	5
Modal Logic and Proof Theory	WMCS027-05	5
Handwriting Recognition	WMAI019-05	5
Logical Aspects of Multi-Agent Systems	WMAI020-05	5
Statistical Genomics	WMMA008-05	5
Advanced self-organisation of social systems	WMBY017-05	5
Natural Language Processing	LIX001M05	5
Statistical Signal Processing	WMAS011-05	5

Robotics for IEM	WMIE005-05	5
Computational Physics	WMPH007-05	5
Cognitive modelling: basic principles and methods	WMCC006-05	5
Computational Semantics	LIX021M05	5

2. Optional modules in the programme **SEDS** are:
   15 ECTS are free choice
   15 ECTS are chosen from:

Course unit	**Course code**	**ECTS**
Introduction to Data Science	WMCS002-05	5
Advanced Topics in Security and Privacy	WMCS001-05	5
Pattern Recognition	WMCS011-05	5
Process Aware Information Systems	WMCS012-05	5
Scientific Visualisation	WMCS018-05	5
Advanced Parallel Programming	WMCS020-05	5
Ethical Hacking	WMCS030-05	5
Software Analytics	WMCS031-05	5
Modal Logic and Proof Theory	WMCS027-05	5
Machine Learning	WMAI010-05	5
Logical Aspects of Multi-Agent Systems	WMAI020-05	5
Robotics for IEM	WMIE005-05	5
Systems Engineering	WMIE021-05	5

3. Optional modules in the programme **DSSC** are:
   15 ECTS are free choice
   15 ECTS are chosen from:

Course unit	**Course code**	**ECTS**
Cloud Computing and Cloud-based Applications	WMCS032-05	5
Software Maintenance and Evolution	WMCS013-05	5
Image Processing	WMCS008-05	5
Advanced Parallel Programming	WMCS020-05	5
Ethical Hacking	WMCS030-05	5
Process Aware Information Systems	WMCS012-05	5
Software Analytics	WMCS031-05	5
Modal Logic and Proof Theory	WMCS027-05	5
Machine Learning	WMAI010-05	5
Statistical Genomics	WMMA008-05	5
Contemporary Statistics with Applications	WMMA015-05	5
Advanced self-organisation of social systems	WMBY017-05	5
Systems Engineering	WMIE021-05	5
Fitting dynamical models to data	WMIE007-05	5
Robotics for IEM	WMIE005-05	5
Learning from Data	LIX016M05	5
Natural Language Processing	LIX001M05	5
Statistical Signal Processing	WMAS011-05	5

4. Optional modules in the programme **SBP** are:
   30 ECTS are chosen from any of the compulsory or guided choice courses of the other tracks.

Appendix V. Entry requirements and compulsory order (art. 4.4)

The entry requirement for the Master Thesis (WMCS901-30) is successful completion of at least 60 ECTS of the Computing Science master's degree programme, including the In-company or Research Internship (CS) (WMCS021-15) . The supervisor of the Master Thesis reserves the right to require successful completion of specific courses.

The entry requirements for Work placement Business and Policy (WMSE902-40): Research project (of the Master CS), Introduction Science and Policy (WMSE002-10) are Introduction Science and Business (WMSE001-10).

There are no additional entry requirements for computing science courses.

The entry requirements of optional modules are not always met by Computing Science students. Entry requirements are specified on Ocasys and have to be checked by students themselves.

Appendix VI. Admission to the degree programme (art. 2.1A.1 + 2.1B.1)

Holders of the following Bachelor's degrees from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the Master's degree programme in Computing Science on that basis:
- BSc Computing Science

Appendix VII. Transitional provisions (art. 7.1)

Transitional arrangement for the Master's programme in Computing Science:

Web and Cloud Computing (WMCS005-05) has been removed from the programme starting 2023-2024. From 2023-2024 onwards, it has been replaced with Cloud Computing and Cloud-based Applications (WMCS032-05).

Students that have already successfully finished Web and Cloud Computing are not allowed to take Cloud Computing and Cloud-based Applications as an elective course. For students that have not successfully finished Web and Cloud Computing before September 1st 2023, the course Cloud Computing and Cloud-based Applications is mandatory.

Formal Modeling of Communicating Systems (WMCS016-05) has been removed from the programme starting 2022-2023. From 2022-2023 onwards, it has been replaced with Models and Semantics of Computation (WMCS026-05).

Students that have already successfully finished Formal Modeling of Communicating Systems are not allowed to take Models and Semantics of Computation as an elective course. For students that have not successfully finished Formal Modeling of Communicating Systems before September 1st 2022, the course Models and Semantics of Computation is mandatory.

Software Patterns (WMCS014-05) has been removed from the programme starting 2021-2022. From 2021-2022 onwards, it has been replaced with Evidence-based Software Engineering (WMCS024-05).

Students that have already successfully finished Software Patterns are allowed to take Evidence-based Software Engineering as an elective course. For students that have not successfully finished Software Patterns before September 1st 2021, the course Evidence-based Software Engineering is mandatory.

Appendix VIII. Additional Requirements Open degree Programmes (art. 3.10)

In exceptional circumstances students wishing to pursue an open degree programme may file a request with the Board of Examiners. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme and can determine further conditions in their Rules and Regulations.