university of groningen

Appendices for the Master's degree programme(s) in Computing Science 2026-2027

Appendix I. Learning outcomes of the Master's degree programme (Art. 3.1)

The Master graduate in Computing Science:

- Is fully acquainted with the advanced 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 their own responsibilities therein;
- Has specialized knowledge of theories, methods and techniques in one of the following subfields of Computing Science:
    - Software Engineering and Distributed Systems
    - Machine Learning and Visual Computing
    - AI Engineering
    - 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.
- Has the ability to design and implement software, integrating and reusing existing components where necessary, into a solution or system that meets quality criteria agreed upon with interested parties.

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 their 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 their 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 their own project;
- Is able to provide practical solutions in matters concerning the ethical and professional codes of their own field of expertise and of the professional organisation

Appendix II. Tracks/specializations (Art. 3.6)

The Master Computing Science (RIO 60364) has four tracks:

- Software Engineering and Distributed Systems (SEDS)- variant 5547
- Machine Learning and Visual Computing (MLVC)- variant 5549
- AI Engineering- variant 5548
- Science, Business & Policy (SBP)- variant 5546

Appendix III. Content of the degree programme (Art. 3.78.1)

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

The programme for **SBP** is:

Course unit	**Course code**	**ECTS**
Student Colloquium (CS)	WMCS019-05	5
In-company or Research Internship *	WMCS021-05	15
SBP mandatory courses Introduction Science and Business Introduction Science and Policy Work placement Business and Policy	 WMSE001-10 WMSE002-10 WMSE902-40	**60** 10 10 40
20 ECTS out of a course package from one of the tracks		20
10 ECTS out of any course package of the track chosen above		10
10 ECTS from any track		10
Total		**120**

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

For MLVC, SEDS and AI Engineering, **course packages** for a specific topic are available within each track.

The **mandatory programme** for SEDS, MLVC and AI Engineering is:

Course unit	**Course code**	**ECTS**
Student Colloquium (CS)	WMCS019-05	5
In-company or Research Internship	WMCS021-05	15
Master Thesis	WMCS901-30	30
Total		**50**

Furthermore, the remaining ECTS have to fulfill the requirements for **at least one** of the course packages in the chosen track as defined below.

The track **Software Engineering and Distributed Systems** offers the following course packages:

- Theoretical Computing Science
- Software Engineering
- Large-Scale Software Systems
- Cybersecurity
- Advanced Computer Architecture

The programme for **SEDS - Theoretical Computing Science** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Modal Logic and Proof Theory Logical Aspects of Multi-Agent Systems Models and Semantics of Computation Programs and Interactive Proofs Algorithms for Computationally Challenging Problems	 WMCS027-05 WMAI020-05 WMCS026-05 WMCS033-05 WMCS049-05	**20** 5 5 5 5 5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **SEDS - Software Engineering** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Cloud Computing and Cloud-based Applications Software Architecture Software Maintenance and Evolution Evidence-Based Software Engineering Software Analytics	 WMCS032-05 WMCS004-05 WMCS013-05 WMCS024-05 WMCS031-05	**20** 5 5 5 5 5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **SEDS - Large-Scale Software Systems** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Cloud Computing and Cloud-based Applications Enterprise Application Integration Information Systems Scalable Computing Performance Engineering	 WMCS032-05 WMCS007-05 WMCS009-05 WMCS017-05 WMCS045-05	**20** 5 5 5 5 5
10 ECTS out of any course package in same track		10

10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **SEDS - Cybersecurity** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Data Privacy Ethical Hacking Software and System Security Network Security Analytics Hardware Security Kernel Engineering	 WMCS052-05 WMCS030-05 WMCS034-05 WMCS036-05 WMCS043-05 WMCS051-05	**20** 5 5 5 5 5 5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **SEDS - Advanced Computer Architecture** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Embedded Systems Performance Engineering Emerging Computer Architectures Hardware Security Kernel Engineering	 WMCS050-05 WMCS045-05 WMCS046-05 WMCS043-05 WMCS051-05	**20** 5 5 5 5 5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The track **Machine Learning and Visual Computing** offers the following course packages:

- Visual Computing
- Applied Data Science
- Machine Learning Theory

The programme for **MLVC- Visual Computing** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Scientific Visualization Advanced Computer Graphics Computer Vision Multi-Scale and Advanced Image Analysis	 WMCS018-05 WMCS006-05 WMCS015-05 WMCS047-05	**20** 5 5 5 5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **MLVC - Applied Data Science** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Introduction to Data Science Social Network Analysis Modelling and Simulation Scientific Visualization Pattern Recognition for CS	 WMCS002-05 WMCS028-05 WMCS003-05 WMCS018-05 WMCS011-05	**20** 5 5 5 5 5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **MLVC- Machine Learning Theory** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of: Introduction to Data Science Neural Networks and Computational Intelligence Advanced Machine Learning Theory of Machine Learning Robotic State Estimation Multimodal Mobile Sensing Intelligent Mobile Perception in Practice	 WMCS002-05 WMCS010-05 WMAI030-05 WMCS038-05 WMCS040-05 WMCS041-05 WMCS042-05	**20** 5 5 5 5 5 5 5
10 ECTS out of any course package in same track		10

10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The track **AI Engineering** offers the following course packages:

- Engineering of AI Systems
- Robotics

The programme for **AI Engineering - Engineering of AI Systems** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of:		**20**
Introduction to Data Science	WMCS002-05	5
Cloud Computing and Cloud-based Applications	WMCS032-05	5
Scientific Visualization	WMCS018-05	5
Data Privacy	WMCS052-05	5
Advanced Machine Learning	WMAI030-05	5
Scalable Computing	WMCS017-05	5
Machine Learning Systems Deployment and Operations	WMCS039-05	5
Data Challenges in AI Systems	WMCS048-05	5
Human- Centered Artificial Intelligence	WMCC023-05	5
Deep Learning	WMAI017-05	5
Trustworthy and Explainable AI	WMAI032-05	5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

The programme for **AI Engineering - Robotics** is:

Course unit	**Course code**	**ECTS**
20 ECTS out of:		**20**
Introduction to Data Science	WMCS002-05	5
Robotic State Estimation	WMCS040-05	5
Robotics for AI	WMAI011-05	5
Intelligent Mobile Perception in Practice	WMCS042-05	5
Cognitive Robotics	WMAI003-05	5
Multimodal Mobile Sensing	WMCS041-05	5
Control Methods for Robotics	WMAI037-05	5
Human-Robot Interaction for Social Robots	WMAI027-05	5
10 ECTS out of any course package in same track		10
10 ECTS out of any track		10
30 ECTS electives (see App. IV)		30
Total		**70**

Appendix IV. Electives (Art. 3.89.1)

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

Optional modules in the programme **SEDS, MLVC and AI Engineering** are:

30 ECTS are chosen from Master level courses. For courses not mentioned in the course packages nor the pre-approved electives of the MSc CS, the student needs to request the formal approval of the Board of Examiners. Based on a motivated request by a student, the Board of Examiners may grant permission to choose electives other than those offered in the MSc Computing Science. These courses can be from the University of Groningen or another university in the Netherlands or abroad and must be Master level courses (at the discretion of the Board of Examiners).

Electives pre-approved by the Board of Examiners

Course code	**Course name**
WMPH007-05	Computational Physics
WMMA015-05	Contemporary Statistics with Applications
LIX016M05	Learning from Data
WMIE005-05	Robotics for IEM
LIX021M05	Computational Semantics
WMIE007-05	Fitting Dynamical Models to Data
WMAS011-05	Statistical Signal Processing
WMIE021-05	Systems Engineering

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, 2.1A.2 and 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 (Dutch: Informatica), RIO 56978
- BSc Computer Science, RIO 50426
- BSc Technische Informatica, RIO 56964
- BSc Computing Science, RIO 59326

Appendix VII. Pre-Master's programmes and Fast-Track programmes (Art. 2.3)

A. Pre-Master's programmes

FSE offers Pre-Master's programmes with a maximum of 60 ECTS for access to the MSc Computing Science, and individually determined Pre-Master's programmes. The overview below shows:

- which NVAO-accredited HBO diploma grants access to the MSc Computing Science upon completion of the Pre-Master's programme;
- the content and student workload for these fixed programmes.

Below listed are the standard Pre-Master's programmes for HBO Bachelor ICT/ Computer Science/ Information Technology graduates per Computing Science Master track offered at the University of Groningen.

- Bachelor 30020- HBO ICT
- Bachelor 34475- HBO Computer Science/ Technische Informatica
- Bachelor 34479- HBO Information Technology/ Informatica

Track MSc Computing Science: Software Engineering and Distributed Systems

Semester	Course Unit	Course Code	ECTS
1a	Introduction to Logic	WBCS030-05	5
1a	Advanced Algorithms	WBCS052-05	5
1b	Computer Architecture	WBCS010-05	5
1b	Statistics and Probability	WBCS049-05	5
2a	Operating Systems	WBCS023-05	5
2b	Languages and Machines	WBCS027-05	5
Total			30

Track MSc Machine Learning and Visual Computing

Semester	Course Unit	Course Code	ECTS
1a	Calculus 1 (for IEM)	WBIE003-05	5
1b	Linear Algebra (for IEM)	WBIE009-05	5
1b	Statistics and Probability	WBCS049-05	5
2a	Calculus 2 (for IEM)	WBIE017-05	5
2a	Introduction to Machine Learning	WBCS032-05	5
2b	Introduction to Computer Graphics and Visualization	WBCS056-05	5
Total			30

Track MSc Computing Science: AI Engineering

Semester	Course Unit	Course Code	ECTS
1a	Calculus 1 (for IEM)	WBIE003-05	5
1b	Linear Algebra (for IEM)	WBIE009-05	5
1b	Statistics and Probability	WBCS049-05	5
2a	Calculus 2 (for IEM)	WBIE017-05	5
2a	Introduction to Machine Learning	WBCS032-05	5
2b	Fundamentals of Distributed Systems	WBCS057-05	5
Total			30

Starting date 1 September
Please note that the above mentioned course packages are tailored to one of the MSc Computing Science tracks and that successful completion of any of the three Pre-Master packages grants access to the Master Computing Science (regardless of which track).

For holders of a HBO diploma not listed above, or for holders of a Dutch or foreign degree not listed in Appendix VI, the Board of Admissions decides:

a. The content and student workload of a tailor-made Pre-Master's programme.
   or
b. Admission is not granted.

B. Fast-Track programmes

The MSc degree programme does not offer Fast-Track programmes.

Appendix VIII. Transitional provisions (Art. 7.1)

Students who have already completed a discontinued course are excluded from taking the respective replacement course. Any cases not listed in the Teaching and Examination Regulations, through either the current curriculum or the transitional provisions, are to be treated by the Board of Examiners of the degree programme.

Current curriculum		**Previous courses/ replacements**	
Course Name	**Course Code**	**Course Name**	**Course code**
Advanced Topics in Security and Privacy	WMCS001-05	Data Privacy	WMCS052-05

Students who have already successfully finished [WBCS016-05] Software Language Engineering are not allowed to take [WMCS037-05] Software Language Engineering.

Appendix IX. Additional requirements Open Degree programmes (Art. 3.9~~10~~.2)

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.

Appendix X. Double Degree 28Digital Data Science

Students who enter the Master's degree programme in Computing Science at the University of Groningen as part of the 28Digital Master School - Data Science Double Degree complete a predefined second-year curriculum of 60 ECTS within the existing Computing Science tracks **Machine Learning and Visual Computing** or **AI Engineering**. This curriculum replaces the standard second-year composition of the programme for these students.

Curriculum components at the University of Groningen (60 ECTS)

Component	**Course unit**	**Course code**	**ECTS**
Track-aligned coursework	Selected CS MSc course units (see list below)	various	10
Research Internship	In-company or Research Internship (CS)	WMCS-TBD	14
Master Thesis	Master Thesis	WMCS901-30	30
Innovation & Entrepreneurship	I&E Minor Thesis	EIT/I&E course	6
Total			60

Track-aligned coursework (10 ECTS)
Students select 10 ECTS from the following Master-level Computing Science course units, depending on courses completed at the Entry university in Year-1 of the 28Digital programme.

The final selection is subject to prior approval by the Board of Examiners.

Eligible course units include:

- Introduction to Data Science - WMCS002-05 (5 ECTS)
- Data Challenges in AI Systems - WMCS048-05 (5 ECTS)
- Machine Learning Systems Deployment and Operations - WMCS039-05 (5 ECTS)

Other Master-level Computing Science course units from the **Machine Learning and Visual Computing** or **AI Engineering** tracks may be approved by the Board of Examiners on a motivated request, provided coherence with the chosen track and graduation requirements is maintained.

Research Internship (14 ECTS)
The Research Internship (WMCS-TBD, 14 ECTS) is fully supervised and examined at the University of Groningen. The internship must be (applied) research-oriented and aligned with the academic profile of the Computing Science programme and the 28Digital Data Science domain. Assessment follows the applicable internship regulations of the Computing Science programme.

Master Thesis (30 ECTS)
The Master Thesis (WMCS901-30, 30 ECTS) is supervised and examined at the University of Groningen in accordance with the Computing Science thesis regulations. The thesis must satisfy the academic learning outcomes of the MSc Computing Science programme and may be embedded in an industrial or applied research context consistent with the 28Digital programme.

Innovation & Entrepreneurship component (6 ECTS)
The I&E Minor Thesis (6 ECTS) is part of the 28Digital Innovation & Entrepreneurship curriculum and is offered in collaboration with Hanze University of Applied Sciences. The course unit is partially co-supervised, but fully examined by University of Groningen staff, in accordance with the examination regulations of the Computing Science programme.

Recognition of prior learning
Coursework and Innovation & Entrepreneurship components completed at the Entry university in Year-1 of the 28Digital programme are recognised upon approval by the Board of Examiners, in line with the applicable TER provisions on exemptions and recognition of prior learning.