



# Announcement

**Academic year 2021/2022 – issued on 24 June 2022 – number 232**

Any designations of functions are neutral in gender.

## Curricula

### **232 Curriculum for the master's programme in Computer Science (2022 version)**

At its meeting on 23 June 2022, the Senate approved the Curriculum for the master's programme in Computer Science (2022 version) specified below, which was resolved on 13 June 2022 by the Curriculum Committee, a body holding decision-making power, and established in accordance with section 25, para. 8, no. 3 and para. 1, no. 10a of the 2002 Universities Act.

The legal basis is the 2002 Universities Act and the section of the Statutes of the University of Vienna governing university studies as amended from time to time.

#### **§ 1 Objectives and qualification profile**

(1) The master's programme in Computer Science at the University of Vienna provides students with an academic education that emphasises theory, subject-specific knowledge and practical skills in computer science. Students can specialise in several of nine different specialisations: Algorithms, Computer Graphics, Data Analysis, Digital Media Technologies, Information Management and Systems Engineering, Internet Computing and Software Technologies, Networks, Parallel Computing as well as Security. Being able to select from this broad range of topics allows students to position themselves flexibly on the labour market, with the aim of working in leadership positions. A targeted focus on certain topics allows students to graduate in a specialisation subject, including Computer Science, Data Science or Scientific Computing.

(2) Beyond a bachelor's qualification, graduates of the master's programme in Computer Science at the University of Vienna are qualified to participate actively in the research and development of methods in computer science, procedural models, tools and systems in computer science, thus meeting international standards. During the degree programme, students receive a sound education in computer science, which is oriented towards current international standards in research and development. In the courses of the degree programme, students address contents and methods meeting the current state of research in the relevant discipline. The focus is on academically sound reflection guided by the current state of research. The master's programme serves the further consolidation of the knowledge/competences acquired in the bachelor's programme and the acquisition of new (also basic) knowledge/competences if not already acquired in the bachelor's programme.

In addition to professional qualifications, the degree programme emphasises general and ethical competences, such as:

- Problem-solving competences
- Teamwork
- Ability to learn and adapt for the lifelong learning process
- Responsible use of data and information

### (3) Innovative teaching concepts

Students are also supervised by experienced lecturers who are familiar with the relevant teaching/learning concept and offer advice on specific courses, both on site and online, for the purpose of intensifying/improving supervision/interaction.

The degree programme places special attention on project-based learning, which includes self-directed and mainly self-organised learning after a period of instruction. Projects are mainly targeted at teamwork and interaction, both through personal or computer-mediated contact. Collaboration in project teams on which students reflect should introduce them to professional and academic practice.

The degree programme's orientation towards specialisation subjects prepares students for work in interdisciplinary, heterogeneous teams. The courses offered include courses that enhance meta subject competences, especially communication and team competence as well as their transfer to professional practice.

The individual courses intend to provide an effective mixture of on-site and online elements depending on the teaching/learning objectives and the participants' needs.

## § 2 Duration and scope

(1) The workload for the master's programme in Computer Science comprises 120 ECTS credits. This is equivalent to a degree programme duration of four semesters.

(2) The programme is deemed completed if 36 ECTS credits as defined in the provisions on compulsory modules, 54 ECTS credits as defined in the provisions on alternative compulsory modules, 27 ECTS credits as defined in the provisions on the master's thesis and 3 ECTS credits as defined in the provisions on the master's examination have been obtained.

## § 3 Entry requirements

(1) To be admitted to the master's programme in Computer Science students must have completed an eligible bachelor's programme or an eligible degree programme at the same level of university education at a recognised Austrian or foreign post-secondary educational institution.

(2) The bachelor's programme in Computer Science and the bachelor's programme in Business Informatics at the University of Vienna are certainly eligible.

(3) Degree programmes according to para. 1, which impart core competences of computer science to the extent of at least 90 ECTS credits, are also eligible.

Applicants from degree programmes other than those mentioned in para. 2 must present a qualification description prior to admission to explain which achievements of the previous degree programme cover the core competences of computer science, including the relevant number of ECTS credits. Detailed regulations on the qualification description are provided on the website of the competent body for study matters.

(4) To compensate for significant disciplinary differences, supplementary examinations can be stipulated, which have to be completed until the end of the second semester of the master's programme. The Rectorate may specify which supplementary examinations are a prerequisite for taking examinations specified in the Curriculum of the master's programme.

(5) If the significant disciplinary differences according to para. 4 exceed the extent of 30 ECTS credits, this is not considered an eligible degree programme and the student is not admitted to the master's programme.

(6) The language of instruction of the master's programme in Computer Science is English only. Therefore, students must have English language proficiency corresponding to level B2 (Common European Framework of Reference for Languages). Regarding the proof of language proficiency, the regulations of the University of Vienna apply.

### **§ 3a Selection of the specialisation subject**

(1) The selection of a specialisation subject and its related clusters (Computer Science) requires prior approval from the directorate of studies. The rule of no double recognition and no dual use (see section 11, para. 4 of this Curriculum) must be considered.

(2) Students have to obtain prior approval from the directorate of studies and announce the selection of the specialisation subject to the directorate of studies prior to registration for a course in an alternative group of compulsory modules at the latest. Following this declaration, the selection of the specialisation subject is generally binding. Students may change to another specialisation subject once following prior approval from the directorate of studies.

### **§ 4 Academic degree**

Graduates of the master's programme in Computer Science are awarded the degree "*Master of Science*", abbreviated as MSc.

Where the academic degree is stated this must be after the name.

### **§ 5 Structure – Modules with allocated ECTS credits**

#### **(1) Overview**

## 1. (1) Overview

- (1) Group of compulsory modules: Foundations (12 ECTS credits)
  - a. PAP, Parallel Architectures and Programming Models, 6 ECTS credits
  - b. ASE, Advanced Software Engineering, 6 ECTS credits
- (2) Group of compulsory modules: Practical Courses (18 ECTS credits)
  - a. P1, Practical Course: Computer Science 1, 6 ECTS credits
  - b. P2, Practical Course: Computer Science 2, 12 ECTS credits
- (3) Compulsory module: Academic Research and Writing (6 ECTS credits)
  - a. MSE, Academic Research and Writing, 6 ECTS credits
- (4) Alternative group of compulsory modules: Specialisation Subjects (54 ECTS credits each)
  - a. Specialisation subject: Scientific Computing
    - i. Compulsory module: SC1a (6 ECTS credits)
    - ii. Compulsory module: SC1b (18 ECTS credits)
    - iii. Compulsory module: SC2 (18 ECTS credits)
    - iv. Compulsory module: SC3 (6 ECTS credits)
    - v. Compulsory module: SC4 (6 ECTS credits)
  - b. Specialisation subject: Data Science
    - i. Compulsory module: DS1a (6 ECTS credits)
    - ii. Compulsory module: DS1b (18 ECTS credits)
    - iii. Compulsory module: DS2 (12 ECTS credits)
    - iv. Compulsory module: DS3 (6 ECTS credits)
    - v. Compulsory module: DS4 Application Subject (12 ECTS credits)
  - c. Specialisation subject: Computer Science
    - i. Compulsory module: CS1 (36 ECTS credits)
    - ii. Compulsory module: CS2 (18 ECTS credits)
- (5) Master's thesis comprising 30 ECTS credits
  - a. Written master's thesis, 27 ECTS credits
  - b. Master's examination, including public defence, 3 ECTS credits

## (2) Module descriptions

### (2.1) Group of compulsory modules: Foundations (12 ECTS credits)

PAP	<i>Parallel Architectures and Programming Models (compulsory module)</i>	6 ECTS credits
Prerequisites	none	

<b>Module outcomes</b>	Upon completion of this module, students know advanced concepts of parallel computing architectures as well as parallel programming models and languages. They know the major mechanisms and newest developments for hardware-based and software-based performance optimisation of parallel processors and systems. Students are able to apply these concepts to practical exercises and independently develop efficient parallel applications on modern parallel computers.
<b>Module structure</b>	VU Parallel Architectures and Programming Models, 6 ECTS credits, 4 SSt (pi)
<b>Proof of performance</b>	Passing of the continuous assessment course (pi) specified in the module (6 ECTS credits)

<b>ASE</b>	<i>Advanced Software Engineering (compulsory module)</i>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	Upon completion of this module, students understand the central role of software engineering in modern software development. They know current, advanced methods and tools in software engineering, such as methods and tools of software architecture and advanced modelling. They are able to apply these advanced methods and tools in software engineering to a programming exercise, a given software system or a software engineering project.	
<b>Module structure</b>	VU Advanced Software Engineering, 6 ECTS credits, 4 SSt (pi)	
<b>Proof of performance</b>	Passing of the continuous assessment course (pi) specified in the module (6 ECTS credits)	

(2.2) Group of compulsory modules: Practical Courses (18 ECTS credits)

<b>P1</b>	<i>Practical Course 1 (compulsory module)</i>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	12 ECTS credits from the modules of the selected specialisation subject from the alternative group of compulsory module Specialisation Subjects.	
<b>Module outcomes</b>	During a project, students acquire the ability to solve application problems in computer science using modern IT infrastructure.	
<b>Module structure</b>	LP Practical Course: Computer Science 1, 6 ECTS credits, 2 SSt (pi)	
<b>Proof of performance</b>	Passing of the continuous assessment course (pi) specified in the module (6 ECTS credits)	

<b>P2</b>	<i>Practical Course 2 (compulsory module)</i>	<b>12 ECTS credits</b>
<b>Prerequisites</b>	12 ECTS credits from the modules of the selected specialisation subject from the alternative group of compulsory module Specialisation Subjects.	

<b>Recommended prerequisite</b>	P1
<b>Module outcomes</b>	During a project, students acquire the ability to solve application problems in computer science using modern IT infrastructure.
<b>Module structure</b>	LP Practical Course: Computer Science 2, 12 ECTS credits, 4 SSt (pi)
<b>Proof of performance</b>	Passing of the continuous assessment course (pi) specified in the module (12 ECTS credits)

**(2.3) Compulsory module: *Academic Research and Writing* (6 ECTS credits)**

<b>MSE</b>	<b><i>Academic Research and Writing (compulsory module)</i></b>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	ASE, P1	
<b>Recommended prerequisite</b>	12 ECTS credits from a specialisation subject	
<b>Module outcomes</b>	Students acquire the ability to research, analyse and prepare relevant academic questions in the field of computer science and to conduct academic research required for the master's thesis.	
<b>Module structure</b>	VU Academic Research and Writing, 3 ECTS credits, 2 SSt (pi) SE Master's Thesis Seminar, 3 ECTS credits, 2 SSt (pi)	
<b>Proof of performance</b>	Passing of the continuous assessment course (pi) specified in the module (6 ECTS credits)	

**(2.4) Alternative group of compulsory modules: *Specialisation Subjects* (54 ECTS credits)**

Subject to availability and following prior approval from the directorate of studies, students select one of the following alternative groups of compulsory modules (specialisation subjects):

2.4.1 Scientific Computing
2.4.2 Data Science
2.4.3 Computer Science

**(2.4.1) Specialisation Subject: *Scientific Computing* (alternative group of compulsory modules) (54 ECTS credits)**

<b>SC1a</b>	<b><i>Parallel Computing (compulsory module)</i></b>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	Competences from the cluster Parallel Computing (see section 5, para. 2.4.4, no. 8)	

<b>Module structure</b>	<p>Subject to availability, students select courses comprising 6 ECTS credits from the cluster Parallel Computing. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper course VU Parallel Computing, 6 ECTS credits, 4 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete the course in this module.</p>
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (6 ECTS credits in total)

<b>SC1b</b>	<i>Advanced Parallel Computing (compulsory module)</i>	<b>18 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Recommended prerequisite</b>	SC1a	
<b>Module outcomes</b>	Competences from the cluster Parallel Computing (see section 5, para. 2.4.4, no. 8)	
<b>Module structure</b>	Subject to availability, students select advanced courses comprising 18 ECTS credits from the Parallel Computing cluster (gatekeeper course cannot be selected). The courses that can be selected for this discipline will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation of the competences acquired in previous bachelor's programmes, students must not select courses they have already completed in the underlying bachelor's programme.	
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (18 ECTS credits in total)	

<b>SC2</b>	<i>Algorithms (compulsory module)</i>	<b>18 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	Competences from the cluster Algorithms (see section 5, para. 2.4.4, no. 1)	

<b>Module structure</b>	<p>Subject to availability, students choose courses comprising 18 ECTS credits from the Algorithms cluster. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper courses VU Algorithms and Data Structures 2, 3 ECTS credits, 2 SSt (pi) and VU Numerical Algorithms, 3 ECTS credits, 2 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete these courses in this module, which are a mandatory prerequisite for other courses in this module.</p>
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (18 ECTS credits in total)

<b>SC3</b>	<b><i>Data Analysis (compulsory module)</i></b>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	Competences from the cluster Data Analysis (see section 5, para. 2.4.4, no. 3)	
<b>Module structure</b>	<p>Subject to availability, students select courses comprising 6 ECTS credits from the Data Analysis cluster. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper course VU Foundations of Data Analysis, 6 ECTS credits, 4 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete the course in this module.</p>	
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (6 ECTS credits in total)	

<b>SC4</b>	<b><i>Networks (compulsory module)</i></b>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	none	



<b>Module outcomes</b>	Competences from the cluster Networks (see section 5, para. 2.4.4, no. 7)
<b>Module structure</b>	<p>Subject to availability, students choose courses comprising 6 ECTS credits from the Networks cluster. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper course VU Foundations of Networked Systems, 6 ECTS credits, 4 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete the course in this module.</p>
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (6 ECTS credits in total)

(2.4.2) Specialisation Subject: Data Science (alternative group of compulsory modules) (54 ECTS credits)

<b>DS1a</b>	<i>Data Analysis (compulsory module)</i>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	Competences from the cluster Data Analysis (see section 5, para. 2.4.4, no. 3)	
<b>Module structure</b>	<p>Subject to availability, students select courses comprising 6 ECTS credits from the Data Analysis cluster. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper course VU Foundations of Data Analysis, 6 ECTS credits, 4 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete the course in this module.</p>	
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (6 ECTS credits in total)	

<b>DS1b</b>	<i>Advanced Data Analysis (compulsory module)</i>	<b>18 ECTS credits</b>
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<b>Prerequisites</b>	none
<b>Recommended prerequisite</b>	DS1a
<b>Module outcomes</b>	Competences from the cluster Data Analysis (see section 5, para. 2.4.4, no. 3)
<b>Module structure</b>	Subject to availability, students select advanced courses comprising 18 ECTS credits from the Data Analysis cluster (gatekeeper course cannot be selected). The courses that can be selected for this discipline will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation of the competences acquired in previous bachelor's programmes, students must not select courses they have already completed in the underlying bachelor's programme.
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (18 ECTS credits in total)

<b>DS2</b>	<b><i>Algorithms (compulsory module)</i></b>	<b>12 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	Competences from the cluster Algorithms (see section 5, para. 2.4.4, no. 1)	
<b>Module structure</b>	<p>Subject to availability, students choose courses comprising 12 ECTS credits from the Algorithms cluster. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper courses VU Algorithms and Data Structures 2, 3 ECTS credits, 2 SSt (pi) and VU Numerical Algorithms, 3 ECTS credits, 2 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete these courses in this module, which are a mandatory prerequisite for other courses in this module.</p>	
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (12 ECTS credits in total)	

<b>DS3</b>	<b><i>Parallel Computing (compulsory module)</i></b>	<b>6 ECTS credits</b>
<b>Prerequisites</b>	none	

<b>Module outcomes</b>	Competences from the cluster Parallel Computing (see section 5, para. 2.4.4, no. 8)
<b>Module structure</b>	<p>Subject to availability, students select courses comprising 6 ECTS credits from the cluster Parallel Computing. The courses that can be selected for this module will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p> <p>If students have not already completed this cluster's gatekeeper course VU Parallel Computing, 6 ECTS credits, 4 SSt (pi) or if they have not provided proof for relevant prior knowledge, they have to complete the course in this module.</p>
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (6 ECTS credits in total)

<b>DS4</b>	<i>Application Subject: Data Science (compulsory module)</i>	<b>12 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	This module allows students pursuing the specialisation subject Data Science, to apply methods of data analysis in a field of application.	
<b>Module structure</b>	Subject to availability, students choose courses comprising 12 ECTS credits in total. The directorate of studies announces a list of courses allocated to the module in the course directory of the University of Vienna.	
<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (12 ECTS credits in total)	

**(2.4.3) Specialisation Subject: Computer Science (alternative group of compulsory modules) (54 ECTS credits):**

<b>CS1</b>	<i>Computer Science: The Broad Perspective (compulsory module)</i>	<b>36 ECTS credits</b>
<b>Prerequisites</b>	none	

<b>Module outcomes</b>	According to their choice of courses, students acquire competences in the following clusters: <ol style="list-style-type: none"><li>1. Algorithms (see section 5, para. 2.4.4, no. 1)</li><li>2. Computer Graphics (see section 5, para. 2.4.4, no. 2)</li><li>3. Data Analysis (see section 5, para. 2.4.4, no. 3)</li><li>4. Digital Media Technologies (see section 5, para. 2.4.4, no. 4)</li><li>5. Information Management and Systems Engineering (see section 5, para. 2.4.4, no. 5)</li><li>6. Internet Computing and Software Technologies (see section 5, para. 2.4.4, no. 6)</li><li>7. Networks (see section 5, para. 2.4.4, no. 7)</li><li>8. Parallel Computing (see section 5, para. 2.4.4, no. 8)</li><li>9. Security (see section 5, para. 2.4.4, no. 9)</li></ol>
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<b>Module structure</b>	<p>Subject to availability, students select courses comprising 36 ECTS credits in total from the clusters, whereby exactly 6 clusters comprising 6 ECTS credits each must be covered and students must not complete more than 4 gatekeeper courses.</p> <p>Each cluster has (a) gatekeeper course(s) comprising 6 ECTS credits, 4 SSt, each. Students have to complete this/these gatekeeper course(s) or provide proof of relevant prior knowledge as a mandatory prerequisite for attending further courses in the same cluster.</p> <p>List of clusters including the related gatekeeper courses:</p> <ol style="list-style-type: none"><li>1. Algorithms: VU Algorithms and Data Structures 2, 3 ECTS credits, 2 SSt (pi) and VU Numerical Algorithms, 3 ECTS credits, 2 SSt (pi)</li><li>2. Computer Graphics VU Foundations of Computer Graphics, 6 ECTS credits, 4 SSt (pi)</li><li>3. Data Analysis VU Foundations of Data Analysis, 6 ECTS credits, 4 SSt (pi)</li><li>4. Digital Media Technologies VU Signal and Image Processing, 6 ECTS credits, 4 SSt (pi)</li><li>5. Information Management and Systems Engineering VU Information Management and Systems Engineering, 6 ECTS credits, 4 SSt (pi)</li><li>6. Internet Computing and Software Technologies VU Distributed Systems Engineering, 6 ECTS credits, 4 SSt (pi)</li><li>7. Networks VU Foundations of Networked Systems, 6 ECTS credits, 4 SSt (pi)</li><li>8. Parallel Computing VU Parallel Computing, 6 ECTS credits, 4 SSt (pi)</li><li>9. Security VU Information Security Management, 6 ECTS credits, 4 SSt (pi)</li></ol> <p>The courses that can be selected for the clusters will be announced in the course directory. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p>
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<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (36 ECTS credits in total)
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<b>CS2</b>	<i>Advanced Computer Science (compulsory module)</i>	<b>18 ECTS credits</b>
<b>Prerequisites</b>	none	
<b>Module outcomes</b>	<p>According to their choice of courses, students acquire further competences in the 6 already selected clusters from CS1:</p> <ol style="list-style-type: none"> <li>1. Algorithms (see section 5, para. 2.4.4, no. 1)</li> <li>2. Computer Graphics (see section 5, para. 2.4.4, no. 2)</li> <li>3. Data Analysis (see section 5, para. 2.4.4, no. 3)</li> <li>4. Digital Media Technologies (see section 5, para. 2.4.4, no. 4)</li> <li>5. Information Management and Systems Engineering (see section 5, para. 2.4.4, no. 5)</li> <li>6. Internet Computing and Software Technologies (see section 5, para. 2.4.4, no. 6)</li> <li>7. Networks (see section 5, para. 2.4.4, no. 7)</li> <li>8. Parallel Computing (see section 5, para. 2.4.4, no. 8)</li> <li>9. Security (see section 5, para. 2.4.4, no. 9)</li> </ol>	
<b>Module structure</b>	<p>Subject to availability, students select advanced courses comprising 18 ECTS credits in total from the 6 clusters from CS1 they already selected (thus, they cannot select gatekeeper courses in this module).</p> <p>List of clusters:</p> <ol style="list-style-type: none"> <li>1. Algorithms:</li> <li>2. Computer Graphics</li> <li>3. Data Analysis</li> <li>4. Digital Media Technologies</li> <li>5. Information Management and Systems Engineering</li> <li>6. Internet Computing and Software Technologies</li> <li>7. Networks</li> <li>8. Parallel Computing</li> <li>9. Security</li> </ol> <p>The courses that can be selected for the clusters will be announced in the course directory. In addition to these courses, students can also select courses comprising up to 12 ECTS credits from an alternative list of specialisations published by the directorate of studies. To achieve the main objective of the module, namely the further consolidation and expansion of the competences acquired in previous studies, students must not select courses they have already completed in the underlying bachelor's programme.</p>	

<b>Proof of performance</b>	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (18 ECTS credits in total)
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#### (2.4.4) List and description of clusters

##### 1. Algorithms

Students know and can explain algorithms for classical random access models, for parallel computers, for different models of distributed computing and numerical high performance algorithms. They develop and analyse combinatorial and numerical algorithms, such as approximation algorithms for optimisation problems and algorithmic problems (in the analysis) of large data volumes. They are able to apply and analyse these especially in the context of scientific computing and computational science.

Passing both gatekeeper courses

VU Algorithms and Data Structures 2, 3 ECTS credits, 2 SSt

(pi) and VU Numerical Algorithms, 3 ECTS credits, 2 SSt (pi)

is a prerequisite for participation in further courses in this cluster.

##### 2. Computer Graphics

Computer graphics deals with generating images based on models. It covers questions of real-time image generation (for applications, such as video games and virtual/augmented reality) and photorealistic synthesis of images (for applications, such as visual effects in films or computer-aided design). Students are able to apply the foundations of rendering, modelling, geometry processing, GPU techniques, animation, AR/VR and immersive techniques in self-developed programs. They know the basics of user interfaces and are able to apply these, in particular, for the interaction with data and models in a visual analysis environment.

Passing the gatekeeper course

VU Foundations of Computer Graphics, 6 ECTS credits, 4 SSt (pi)

is a prerequisite for participation in further courses in this cluster.

##### 3. Data Analysis

Data analysis deals with the generation of knowledge from data. In all areas of life, such as in the economy, biology, medicine or on social media, more and more data are generated. Students know the process of data collection and how complex and large data volumes of different modalities can be efficiently represented and visualised. They know algorithms to extract knowledge from complex data volumes and are able to efficiently implement these algorithms. They know which methods of data analysis are suitable for which questions and data types and are able to interpret the results of analyses in an application context and to communicate these to persons outside the discipline.

Passing the gatekeeper course

VU Foundations of Data Analysis, 6 ECTS credits, 4 SSt (pi)

is a prerequisite for participating in further courses in this cluster.

#### 4. Digital Media Technologies

Digital media contents consisting of audio (e.g. speech or music), video, text, graphics or images, animations, interactive media elements and other sensory data form the basis for a broad range of fields of application. Students know basic procedures and techniques used for preparing, compiling, producing, displaying, searching, distributing, modifying and saving digital media contents and are able to implement and use these methods by means of common software tools and established standards. The basic procedures and technologies presented comprise the analysis and processing of signals, the representation, encoding, compression and visualisation of digital media types, image analysis methods for computer-vision applications, the administration and organisation of large collections of digital media contents, retrieval procedures and content-based search procedures, procedures for the semantic representation of multimedia contents on the web and on social media systems, as well as protocols and technologies that are closely related to broadcasting and streaming media contents.

Passing the gatekeeper course

VU Groundwater and Pollutants, 6 ECTS credits, 4 SSt. (pi)

is a prerequisite for participation in further courses in this cluster.

#### 5. Information Management and Systems Engineering

Information management deals with the effective and efficient management of information as factor of production in organisations. Students know the formal and technical basics of the description, knowledge-based analysis, processing and interpretation of information as well as the development, realisation and use of information systems. They have subject-specific competences in all central areas of operational information processing, are able to analyse corporate structures and grasp formalised models, formulate questions of analysis, prepare data in an appropriate way, conduct analyses and interpret results. This requires theoretical and practical abilities to apply concepts of knowledge representation and knowledge engineering. Students know current methods to gather, manage and analyse very large data volumes that are generated today in complex business processes, academic experiments, simulations and other activities in modern research. Moreover, they can apply concepts and techniques for the organisation, modelling and administration of multimedia contents.

Passing the gatekeeper course

VU Information Management and Systems Engineering, 6 ECTS credits, 4 SSt (pi)

is a prerequisite for participating in further courses in this cluster.

#### 6. Internet Computing and Software Technologies

This cluster deals with the design, architecture and software engineering of modern distributed systems and the software technologies that play a role in this context. This includes the planning, development, provision, management and quality assurance of software to support internet-based systems. In addition to design methods, architectures and technologies, students also learn about the principles and design patterns of these systems.

Moreover, quality attributes, such as performance, elasticity, scalability, security, reliability, availability, changeability and usability play an important role. Students know different design methods, architectures and technologies as well as the principles and design patterns of these systems and are

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able to apply the acquired methods.

Passing the gatekeeper course

VU Distributed Systems Engineering, 6 ECTS credits, 4 SSt (pi)

is a prerequisite for participating in further courses in this cluster.

## **7. Networks**

Students acquire profound knowledge in the area of networked, distributed and cooperative systems. In addition to technical aspects, students understand the socio-economic and user-centred perspective of networked systems and are able to discuss these in detail. Students are aware of the increasing importance of network security, and know and are able to apply strategies and procedures for increasing and assessing it.

Passing the gatekeeper course

VU Foundations of Networked Systems, 6 ECTS credits, 4 SSt (pi)

is a prerequisite for participating in further courses in this cluster.

## **8. Parallel Computing**

Parallel processors are ubiquitous nowadays and cover the entire computing spectrum, ranging from mobile computing, desktops and servers to extremely powerful super computers and cloud computing centres. Parallel computing is also a key technology to enable future developments in the area of complex academic and industrial simulations, artificial intelligence and machine learning. Students know all essential aspects of parallel computing, such as parallel architectures and programming models, software infrastructures and tools for applications that require a lot of computing and data, high-performance computing, optimisation techniques and runtime systems, such as cloud computing and are able to apply the related techniques and methods.

Passing the gatekeeper course

VU Parallel Computing, 6 ECTS credits, 4 SSt (pi)

is a prerequisite for participation in further courses in this cluster.

## **9. Security**

Students know current technical and organisational aspects in the areas of software security and network security. They understand security topics, such as software security, privacy, incident handling and security management. In the topic area of software security, students know software weaknesses at different stages of the software life cycle: during software development, during pentests and the analysis of weaknesses and exploits during operation (SecOps). Students understand security management and addressing organisational aspects of IT security as an essential part of IT management. They are able to explain and analyse related models, measures and procedures.

Passing the gatekeeper course

VU Information Security Management, 6 ECTS credits, 4 SSt (pi)  
is a prerequisite for participation in further courses in this cluster.

### **(2.5) Master's Thesis comprising 30 ECTS credits**

1. Written master's thesis comprising 27 ECTS credits
2. Master's examination, including public defence comprising 3 ECTS credits

### **§ 6 Master's thesis**

(1) The master's thesis serves to demonstrate the student's ability to achieve adequate standards of content and methodology when independently addressing academic topics. The assignment for the master's thesis must be chosen in a way that the student can reasonably be expected to complete it within six months.

(2) The topic of the master's thesis must be taken from one of the modules from the selected specialisation subject. If a different topic is selected or if there is uncertainty regarding allocation of the selected topic, the competent body responsible for study matters should decide on whether or not it is admissible. The prerequisite for approval of the topic is the completion of the modules ASE and P1, in any case.

(3) The master's thesis comprises 27 ECTS credits.

### **§ 7 Master's examination**

(1) To be admitted to a master's examination the student must have successfully passed all required modules and examinations and the master's thesis must have been positively assessed.

(2) The master's examination is a public defence. This form of examination consists of a defence and an examination on the academic disciplines related to the master's thesis. Grading will be conducted as stipulated in the Statutes of the University of Vienna.

(3) The master's examination comprises 3 ECTS credits.

### **§ 8 Mobility during the master's programme**

The competent body responsible for study matters is responsible for the recognition of academic achievements completed abroad.

### **§ 9 Course classification**

(1) All courses with non-continuous assessment (npi) have to be offered as one of the following types of courses:

Lecture (*Vorlesung, VO*): Lectures are courses that serve the purpose of imparting knowledge through lectures by teachers. Exams take place as a single exam, either as oral or written exam.

(2) All courses with continuous assessment (pi) have to be offered as one of the following types of courses:

Exercise (*Übung, UE*): Exercises are guided by the related lectures and aim at imparting application competences for the concepts taught.

Lecture with exercises (*Vorlesung mit integrierter Übung, VU*): A lecture with exercises combines the objectives of a lecture (VO) and exercise (UE) with a special emphasis on the application of concepts taught.

Seminars (*Seminare, SE*): In seminars, continuous assessment is applied. Seminars serve as a setting for academic discussions. Participants are expected to independently work on a topic and present the insights gained in the form of independent oral or written contributions as presentations. Particular attention is paid to independent literature search and the development of an appealing lecture style.

Practical laboratory course (*Laborpraktikum, LP*): Practical laboratory courses should meet the practical and professional objectives of the degree programme and complement the professional prior education or academic education. These courses do not have to be tied to lectures. The students are assessed based on a project.

## **§ 10 Courses with a limited number of participants and registration procedures**

(1) The following general limits on the number of students apply in the following courses: UE: 25 participants

LP: 25 participants

VU: 25 participants

SE: 25 participants

(2) Modalities concerning the registration for courses and examinations as well as the allocation of places in courses are governed by the stipulations of the Statutes of the University of Vienna.

## **§ 11 Examination regulations**

(1) Proof of performance in courses

The lecturer of a course is responsible for making the necessary announcements according to the stipulations in the Statutes.

(2) Examination content

The examination content relevant to preparing and holding examinations must be in line with the required number of ECTS credits. This also applies to module examinations.

(3) Examination procedure

The examination procedure is subject to the stipulations of the Statutes of the University of Vienna.

(4) No double recognition and no dual use

Courses taken and examinations passed in the degree programme, which constitute entry requirements for the master's programme, can only be recognised in the master's programme if there is no significant difference between the learning outcomes of the master's programme and the learning outcomes of the bachelor's programme. Courses taken and examinations passed that are used, in particular, for qualitative entry requirements and on which the master's programme is based, cannot be recognised due to significant differences in the acquired competences. Courses taken and examinations passed from another compulsory or elective module of the degree programme cannot be recognised within another module within the same degree programme. This also applies to recognition procedures.

(5) Examination results must be allocated to the relevant module by the stated ECTS figure and must not be allocated to different proofs of performance.

## **§ 12 Entry into force**

This Curriculum will enter into force upon announcement in the University Gazette of the University of Vienna as of 1 October 2022.

## **§ 13 Transitional provisions**

(1) This Curriculum applies to all students who commence their degree programme as of the winter semester of 2022/2023.

(2) If, at a later stage of the degree programme, courses are no longer offered which were compulsory under the original curricula, the competent body responsible for study matters decides ex officio (equivalence regulation) or at the request of the students which courses and examinations have to be completed instead.

(3) Students who have started the master's programme in Computer Science before this date may voluntarily accept the provisions of this Curriculum by simple confirmation.

(4) Students who started the master's programme in Computer Science which entered into force prior to this Curriculum (University Gazette of 28 June 2016, 42nd edition, no. 271 as amended) are entitled to complete their degree programme by 31 October 2024.

(5) The competent body responsible for study matters specified in the organisational regulations is entitled to determine in general or on a case-by-case basis which of the courses taken and examinations passed will be recognised for this Curriculum.

## Appendix

Recommended path through the master's programme:

### Semesterplan Master Informatik Ausprägungsfach Allgemeine Informatik

	Modul 1	Modul 2	Modul 3	Modul 4	Modul 5
1. Semester	Parallel Architectures (6 ECTS)	CS1 (6 ECTS)	CS1 (6 ECTS)	CS1 (6 ECTS)	CS1 (6 ECTS)
2. Semester	Advanced Software Engineering (6 ECTS)	CS1 (6 ECTS)	CS1 (6 ECTS)	CS2 (6 ECTS)	Praktikum Informatik 1 (6 ECTS)
3. Semester	Wissenschaftl. Arbeiten (3 ECTS)	Masterarbeit	CS2 (6 ECTS)	CS2 (6 ECTS)	Praktikum Informatik 2 (12 ECTS)
4. Semester	Master Seminar (3 ECTS)		Masterarbeit (30 ECTS)		

### Semesterplan Master Informatik Ausprägungsfach Data Science

	Modul 1	Modul 2	Modul 3	Modul 4	Modul 5
1. Semester	Parallel Architectures (6 ECTS)	DS4 Anwendungsfach (6 ECTS)	DS1a Data Analysis (6 ECTS)	DS2 Algorithms (6 ECTS)	DS3 Parallel Computing (6 ECTS)
2. Semester	Advanced Software Engineering (6 ECTS)	DS4 Anwendungsfach (6 ECTS)	DS1b Data Analysis (6 ECTS)	DS2 Algorithms (6 ECTS)	Praktikum Informatik 1 (6 ECTS)
3. Semester	Wissenschaftl. Arbeiten (3 ECTS)	Masterarbeit	DS1b Data Analysis (6 ECTS)	DS1b Data Analysis (6 ECTS)	Praktikum Informatik 2 (12 ECTS)
4. Semester	Master Seminar (3 ECTS)		Masterarbeit (30 ECTS)		

### Semesterplan Master Informatik Ausprägungsfach Scientific Computing

	Modul 1	Modul 2	Modul 3	Modul 4	Modul 5
1. Semester	Parallel Architectures (6 ECTS)	SC1a Parallel Computing (6 ECTS)	SC2 Algorithms (6 ECTS)	SC3 Data Analysis (6 ECTS)	SC4 Networks (6 ECTS)
2. Semester	Advanced Software Engineering (6 ECTS)	SC1b Parallel Computing (6 ECTS)	SC2 Algorithms (6 ECTS)	SC2 Algorithms (6 ECTS)	Praktikum Informatik 1 (6 ECTS)
3. Semester	Wissenschaftl. Arbeiten (3 ECTS)	Masterarbeit	SC1b Parallel Computing (6 ECTS)	SC1b Parallel Computing (6 ECTS)	Praktikum Informatik 2 (12 ECTS)
4. Semester	Master Seminar (3 ECTS)		Masterarbeit (30 ECTS)		

Module titles and module groups:

German	English
Alternative Pflichtmodulgruppe Ausprägungsfach Data Science	Alternative group of compulsory modules: Specialisation Subject: Data Science
Alternative Pflichtmodulgruppe Ausprägungsfach Informatik Allgemein	Alternative group of compulsory modules: Specialisation Subject: Computer Science
Alternative Pflichtmodulgruppe Ausprägungsfach Scientific Computing	Alternative group of compulsory modules: Specialisation Subject: Scientific Computing
Pflichtmodul Anwendungsfach Data Science	Compulsory module: Application Subject: Data Science
Pflichtmodul Advanced Software Engineering	Compulsory module: Advanced Software Engineering
Pflichtmodul Parallele Architectures and Programming Models	Compulsory module: Parallel Architectures and Programming Models
Pflichtmodul Praktikum 1	Compulsory module: Practical Course: 1
Pflichtmodul Praktikum 2	Compulsory module: Practical Course: 2
Pflichtmodul Wissenschaftliches Arbeiten	Compulsory module: Academic Research and Writing
Pflichtmodulgruppe Grundlagen	Group of compulsory modules: Foundations
Pflichtmodulgruppe Praktika	Group of compulsory modules: Practical Courses
Pflichtmodul Informatik Breite	Compulsory module: Computer Science: The Broad Perspective
Pflichtmodul Informatik Vertiefung	Compulsory module: Computer Science: The In-Depth Perspective
Pflichtmodul Algorithms	Compulsory module: Algorithms
Pflichtmodul Data Analysis	Compulsory module: Data Analysis
Pflichtmodul Data Analysis Vertiefung	Compulsory module: Advanced Data Analysis
Pflichtmodul Networks	Compulsory module: Networks
Pflichtmodul Parallel Computing	Compulsory module: Parallel Computing
Pflichtmodul Parallel Computing Vertiefung	Compulsory module: Advanced Parallel Computing

On behalf of the Senate:  
The Chair of the Curriculum Committee  
K r a m m e r