Note:
The following curriculum is a consolidated version. It is legally non-binding and for informational purposes only.
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Curriculum for the
Master's Programme Computer Science
at the Faculty for Mathematics, Computer Science and Physics
at the University of Innsbruck

§ 1 Qualification Profile

Computer science is concerned with foundations, technology and applications of systematic and automated information processing. Computer science delivers methods and tools to manage complex systems in natural sciences, technology and other areas of human life, applying mathematical-formal as well as engineering principles. On the other hand findings from natural science and technology flow into computer science and specific application problems can provide an impetus for further development of the basic principles. Accordingly fields of application and occupational areas of computer scientists are manifold ranging from foundational research to development, adaption and maintenance of specific hardware-, software- and networking solutions in different areas of trade, business and industry.

The diversity as well as the mathematical-formal and engineering components of computer science are clearly reflected in the educational concept of the University of Innsbruck, which increasingly promotes problem-oriented and project-oriented teamwork additional to traditional and established learning approaches.

The Master's Programme Computer Science enhances and widens the skills and knowledge in the field of computer science acquired in the Bachelor Study in Computer Science. The Master Programme enables for the ability to independent scientific working, prepares for the PhD Study and enables for the specialisation in a core area or an application area of computer science.

Within the scope of the Master's Programme the following key competencies will be acquired and enhanced respectively:

- scientific methods, literature search and autonomous study of literature,
- fast and efficient familiarisation with new application areas,
- abstraction, formalisation and critical examination of a given problem,
- autonomous problem analysis, self-dependent and creative problem solving,
- clear presentation and thorough documentation of the developed solutions,
- project management as well as working and handling of new media, information services and communication tools.

The Master‘s Programme provides solid and scientific education in computer science while also deepening the application of the learned to specific problems. The entwined education enables graduates to

- develop and apply new methods for hardware-, software- and network solutions in an autonomous manner,
- work on hardware-, software- or network projects requiring expert knowledge in a chosen core area or application area,
- lead larger hardware-, software- or network development projects respectively (international) teams and departments,
- possess expert knowledge in several areas of computer science and applications thereof respectively being able to fall back on that knowledge.

Overall graduates of the Master‘s Programme are able, after a short introductory period, to actively take part in the development and realization of innovative and complex hardware-, software- or network systems in (international) companies and (international) institutions. Additionally they are able to lead the development or realization and to independently conduct trainings.

§ 2 Classification

The Master‘s Programme Computer Science is part of the studies relating to engineering.

§ 3 Scope and Duration

The Master’s Programme in Computer Science covers 120 ECTS-Credits. Seven compulsory modules covering altogether 50 ECTS-Credits and five elective modules covering altogether 50 ECTS-Credits must be passed. The Master’s Thesis corresponds to 20 ECTS-Credits. Altogether, this corresponds to a duration of the study programme of four semesters.

§3a Language of Instruction:

The Master’s Programme Computer Science is offered in English. In justified exceptional cases, examinations and the Master’s Thesis may be passed and written in German respectively.

§ 4 Admission

(1) Admission to the Master‘s Programme Computer Science requires completion of a relevant bachelor study, or a relevant bachelor study from a college of higher education, or a comparable study at an acknowledged domestic or international post-secondary educational institution. If equality is fundamentally given and only specific additions are missing to establish full equality, the Rectorate is empowered to link the establishment of equality to the condition of taking additional exams which have to be taken during the Master Programme.

(2) The Bachelor‘s Programme Computer Science at the University of Innsbruck in any case fulfils the requirement of being a relevant study as stated in paragraph 1.

§ 5 Types of Courses and Participation Thresholds at which Courses need to be split up

(1) **Lecture (VO)**

Lectures introduce, in a didactically well-designed manner, central concepts, results and methods of the respective field of activity.

Purpose: raise interest and to facilitate well-structured knowledge and basic understanding of a field of activity in a relatively short period of time.

(2) **Introductory Seminar (PS)**

Introductory Seminars are usually linked to a Lecture. The students are assigned tasks and the solutions thereof are discussed in the introductory seminar. If the introductory seminar is linked to a lecture then the content of the lecture is repeated and exercises are carried out.

Purpose: Training to solve problems independently, exercise in working methodically, exercise in presenting professional contents and scientific deepening of learned contents.

Continuous assessment of course work; The number of students in each class is limited to 25.

(3) **Seminar (SE)**

A seminar serves the scientific examination of contents and methods of a subject through presentations, written assignments and discussions. Students learn the written (assignment) and oral (seminar presentation) demonstration of scientific findings.

Purpose: autonomous development of current research topics, presentation and scientific discussion of developed contents, scientific deepening in a selected field of computer science.

Continuous assessment of course work; The number of students in each class is limited to 15.

(4) **Practical Training (PR)**

A practical training serves the acquisition of skills via independent work and fosters the practical examination of scientific contents.

Purpose: training of independent problem solving. Enhancement and independent extension of learning contents via their practical application.

Continuous assessment of course work; The number of students in each class is limited to 25.

§ 6 Compulsory and Elective Modules

(1) **Compulsory Modules**

1.	**Compulsory Module: Compiler Construction**	**h**	**ECTS-Credits**
a.	**VO Compiler Construction** Lexical analysis, syntax analysis (top-down and bottom-up strategies); semantic analysis, attributed grammars and attribute evaluation; translation into intermediate code, runtime environments, target code generation	2	3
b.	**PS Compiler Construction** Practical application and implementation of compiling algorithms; use of compiler construction tools for lexical syntax analysis; development of a compiler for a simple procedural programming language	1	2
	Total	**3**	**5**
	Learning Outcomes: Students who have completed this module can describe the structure and tasks of the different stages of a compiler. They are able to explain and apply the used techniques and algorithms. They can use compiler construction tools and are able to create a complete compiler for a simple programming language.		
	Prerequisites: none		

2.	**Compulsory Module: Formal Language and Automata Theory**	**h**	**ECTS-Credits**
a.	**VO Formal Language and Automata Theory** Finite automata; regular expressions; context-free grammars; pushdown automata; Turing machines; introduction to computability theory	2	3

b.	**PS Formal Language and Automata Theory** Discussion, deepening and practicing the contents of the lecture; practicing of scientific argumentation and the presentation of formal content.	1	2
	Total	**3**	**5**
	Learning Outcomes: Students who have completed this module know different classes of formal languages. Additionally they are familiar with different representations of formal languages. They can further distinguish between decidable and undecidable problems.		
	Prerequisites: none		

3.	**Compulsory Module: Master's Seminar 1**	**h**	**ECTS-Credits**
	SE Master Seminar 1 In-depth study of a specialised research topic in computer science, whose content surpasses the content of other modules; preparation for the Master Thesis; demonstration of the findings in the form of an assignment and a presentation.	2	5
	Total	**2**	**5**
	Learning Outcomes: Students who have completed this module are able to deal with a subdomain of computer science in a creative and methodically correct manner and to comprehensively present the result of this examination orally and in writing.		
	Prerequisites: none		

4.	**Compulsory Module: Master's Seminar 2**	**h**	**ECTS-Credits**
	SE Master Seminar 2 In-depth study of a specialised research topic in computer science, whose content surpasses the content of other modules; preparation for the Master Thesis; demonstration of the findings in the form of an assignment and a presentation.	2	5
	Total	**2**	**5**
	Learning Outcomes: Students who have completed this module are able to deal with a subdomain of computer science in a creative and methodically correct manner and to comprehensively present the result of this examination orally and in writing.		
	Prerequisites: none		

5.	**Compulsory Module: Specialisation Module**	**h**	**ECTS-Credits**
	Courses amounting to a total of 20 ECTS-CP, available at the Faculty for Mathematics, Computer Sciences and Physics at the University of Innsbruck labelled with the addition VMI (Vertiefungsmodul Master Informatik). It is recommended to take classes dealing with gender aspects of mathematics, computer science and physics.	-	20
	Total	**-**	**20**

	Learning Outcomes: Students who have completed this module have in-depth knowledge in one or several sub areas of computer science. They familiarised themselves with current problems of these sub areas and methods for the solution thereof.
	Prerequisites: none

6.	**Compulsory Module: Preparation of the Master's Thesis**	**h**	**ECTS-Credits**
	Agreement on the topic, the scope and the form of the Master's Thesis on the basis of a brief summary of the contents (abstract) as well as agreement on the work processes and the study progress. Planning of an appropriate time frame for the completion of the Master's Thesis.	-	7.5
	Total	**-**	**7.5**
	Learning Outcomes: After successful completion of this module, the students will be able to write a brief summary of the content of the planned Master's Thesis (abstract), to outline an anticipated schedule and to conclude a written Master's Thesis agreement.		
	Prerequisites: none		

7.	**Compulsory Module: Defensio of the Master Thesis**	**h**	**ECTS-Credits**
	Study-concluding defence of the Master Thesis; Prerequisite to registering is the positive completion of all other compulsory and elective modules as well as a positive grade on the Master Thesis.	-	2.5
	Total	**-**	**2.5**
	Learning Outcomes: positive completion of all other compulsory and elective modules as well as a positive grade on the Master Thesis		
	Prerequisites: none		

(2) **Elective Modules**

Five modules out of the Modules 1 to 20 amounting to a total of 50 ECTS-CP have to be selected.

1.	**Elective Module: Automated Reasoning**	**h**	**ECTS-Credits**
a.	**VO Computational Logic** Semantic and proof systems for predicate logic with equality; introduction to modal logic and second-order logic; Herbrand's theorem; introduction to LCF provers	2	4
b.	**VO Automatic Theorem Proving** Introduction to automatic theorem proving methods in systems of predicate logic with equality; resolution and paramodulation calculi; applications of first-order theorem provers	2	4
c.	**PS Automated Reasoning** Discussion, deepening and practicing the contents of the lectures, both in theoretical and in practical exercises	1	2
	Total	**5**	**10**

	Learning Outcomes: Students who have completed this module know different first- and higher-order logics and their advantages and disadvantages. Additionally they are familiar with suitable calculi to implement an automatic theorem prover.
	Prerequisites: none

2.	**Elective Module: Computer Vision**	**h**	**ECTS-Credits**
a.	**VO Visual Geometry** Cameras and their calibration; stereo -geometry; linear filters, finding point correspondences; generalisation to multiple cameras	1	2
b.	**SE Advanced Topics in Computer Vision** Selected topics in image processing and image understanding, e.g. object recognition, -localisation and – segmentation; object tracking in video; gesture recognition; other applications.	2	4
c.	**PR Programming Project Computer Vision** Design and implementation of a match-moving-system for simultaneous determination of scene- and camera geometry using a sequence of images.	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module possess in-depth knowledge and competencies of geometric aspects of image recording, of methods to characterize local image content and further selected sub areas of computer vision. They possess the skills to apply these to related, complex problems in computer vision as well as to further elaborate similar and more specialised contents in an autonomous manner. Furthermore they have accumulated a wide basic knowledge in the most important aspects of computer vision and possess the skill to apply this knowledge to practical problems.		
	Prerequisites: none		

3.	**Elective Module: Data Warehouse Systems**	**h**	**ECTS-Credits**
a.	**VO Data Warehouse Systems** Architecture of data warehouse systems from a computer science perspective; reference architectures; multi-dimensional data model; multi-dimensional index structures; OLAP and data mining	2	4
b.	**PS Data Warehouse Systems** Discussion, deepening and rehearsal of the lecture's content in theoretical as well as in practical exercises.	1	2
c.	**SE Data Warehouse Systems** Working on and presentation of selected topics in the area of data warehouse systems from a business- and scientific perspective	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module possess a wide understanding for the problems, concepts and techniques of data warehouse systems, the implementation thereof in modern database systems and their application and importance in the economy. Specifically they will possess the skills to technically solve the most important problems and to autonomously elaborate more specialised content.		

	Prerequisites: none

4.	Elective Module: Enterprise Architecture	h	ECTS-Credits
a.	**VO Business Processes and Workflows** Core concepts of process-oriented information systems; process modelling languages; techniques for process analysis; methods and techniques for the implementation of process oriented applications; process execution; monitoring and mining	2	4
b.	**PS Business Processes and Workflows** The topics of the lecture for business processes and workflows are further elaborated via practical problems	1	2
c.	**VO IT Governance** Problems and goals of IT Governance: relevant IT Governance standards and frameworks; instruments, methods and processes for the implementation of IT Governance; strategic alignment; added value from IT; risk management; enterprise architecture; current problems/issues	1	2
d.	**PS IT Governance** Working on case studies and problems of IT Governance in teams; use of established standards and frameworks to work on problem solutions; risk analysis; arguing for the added value of IT, deriving of key performance indicators	1	2
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module possess skills in the area of enterprise architecture. In particular, they possess the skill to represent business processes as process models, to analyse, and implement them. They know the frameworks and standards for the implementation of IT Governance. They can identify problems in IT Governance and are able to select instruments, methods and processes to improve them. They have acquired the skill to work in teams.		
	Prerequisites: none		

5.	Elective Module: Decision Procedures	h	ECTS-Credits
a.	**VO Theory of Decision Procedures** Decision procedures for propositional logic (DPLL, conflict graph, heuristics); decision procedures for equality logic with uninterpreted functions (Ackermann's reduction, Bryant's reduction); decision procedures for linear arithmetic (simplex algorithm, Fourier-Motzkin elimination, omega test); decision procedures for bit vectors; pointer logic; Nelson-Oppen combination method	2	4
b.	**VO Practice of Decision Procedures** SAT, PB and SMT encodings; encoding of non-linear arithmetic	1	2
c.	**PS Theory and Practice of Decision Procedures** Practicing of the themes of the lectures by applying the presented concepts	2	4
	Total	**5**	**10**

	Learning Outcomes: Students who have completed this module know decision procedures for propositional logic and for restrictions of predicate logic. They can implement these decision procedures and formulate specifications in these logics and verify them using tools.
	Prerequisites: none

6.	**Elective Module: Vehicular Networks**	**h**	**ECTS-Credits**
a.	**VO Vehicular Networks** In-car networks, network architectures, bus systems, control units, driver assistance functions, inter-car networks, methods for car to car and car-to-infrastructure communication, media access, traffic information systems, safety and security, privacy	2	4
b.	**PS Vehicular Networks** Discussion, deepening and rehearsal of the lecture's content in theoretical as well as practical exercises; training in scientific arguing and presenting	3	6
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module understand the most important concepts of intra-vehicle and inter-vehicle communication, which is characterized by high dynamics and heterogeneity of the used protocols. They are able to use measures like performance and reliability. They understand wireless communication between vehicles with a focus on its distributed nature, scalability and security (incl. privacy).		
	Prerequisites: none		

7.	**Elective Module: Advanced Compiler Construction**	**h**	**ECTS-Credits**
a.	**VO Advanced Compiler Construction** Sequence of optimisation phases; parallelism and latency in single- and many-core processors; data stream analysis; intra- and inter procedural analysis; high-level transformations and formalisation using linear algebra; automated parallelisation of serial code; adaptive just-in-time translation; feedback-controlled translation; iterative translation	2	4
b.	**PS Advanced Compiler Construction** The lecture's content will be deepened an rehearsed using practical exercises and tasks	1	2
c.	**SE Selected Topics in Compiler Construction** Compiler technologies for state-of-the-art-many-core systems; transformations that optimise energy usage of programs; dynamic multi-parameter optimisation; automated parallelisation of serial programs; programming and optimisation of GPUs and FPGAs; semantic program analysis; strategies for exception handling in object- oriented languages; memory usage and garbage collection	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module can specify and explain complex program analysis and optimisation techniques of compilers and implement optimisation strategies.		
	Prerequisites: none		

8.	Elective Module: Advanced Communication Systems	h	ECTS-Credits
a.	**VO Advanced Communication Systems** Circuit switching (ISDN, Sonet/SDH), virtual circuit switching (ATM, MPLS), multimedia communication (streaming, RTP, H.323, SIP, Multicast), quality of service mechanisms (integrated services, differentiated services, active queue management, policing, scheduling), wireless communication, mobile ad-hoc and sensor networks, self-organisation in massively distributed systems	2	4
b.	**PS Advanced Communication Systems** Discussion, deepening and rehearsal of the lecture's content in theoretical as well as practical exercises; training in scientific arguing and presenting	3	6
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module understand the most important concepts of advanced communication systems. Besides understanding the basics of modern circuit- and packet switching networks, they also understand quality of service mechanisms which form the basis for multimedia transmission. They understand the characteristics of wireless and mobile networks.		
	Prerequisites: none		

9.	Elective Module: Advanced Concepts and Techniques in Software Engineering	h	ECTS-Credits
a.	**VO Advanced Concepts and Techniques in Software Engineering** Selected advanced concepts and techniques for planning, analysis, design, implementation and maintenance of software	2	4
b.	**PS Advanced Concepts and Techniques in Software Engineering** Discussion, deepening and rehearsal of the lecture's content using practical tasks; exercises in autonomous problem analysis, creative problem solving, clear presentation and thorough documentation using advanced problems of software engineering	1	2
c.	**VO Advanced Concepts and Techniques in Software Quality** Selected advanced concepts and techniques for quality assurance of software (e.g. testing of software, identification and evaluation of metrics or evaluation of processes)	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module understand the advanced concepts and techniques of software engineering and can apply them to projects. They can apply the learned techniques for quality assurance of IT systems. They possess the skills to autonomously analyse and solve a given problem as well as to manage IT projects.		
	Prerequisites: none		

10.	Elective Module: Advanced Distributed and Parallel Systems	h	ECTS-Credits
a.	**VO Advanced Distributed and Parallel Systems** Advanced service-oriented architectures; Cloud- and Grid computing technologies; Peer-to-Peer architectures; resource and data management; scheduling algorithms, workload distribution and performance analysis	2	4

b.	**PS Advanced Distributed and Parallel Systems** Execution of program optimisations for parallel and distributed systems; application and performance evaluation of parallel and distributed program transformations; usage of tools for parallel and distributed program development; optimized resource management- and scheduling algorithms.	3	6
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module are able to describe and classify more complex distributed and parallel computer architectures (e.g. Cloud architectures). They understand techniques for resource management, scheduling and workload distribution. Performance analysis and optimisation of distributed and parallel applications can be carried out.		
	Prerequisites: none		

11.	**Elective Module: Information Retrieval**	**h**	**ECTS-Credits**
a.	**VO Information Retrieval** Architecture of web information systems; models of information retrieval; content-based search in music, text and images: architecture of search engines; distance- and string metrics; personalisation and filtering techniques	3	6
b.	**PS Information Retrieval** Discussion, deepening and rehearsal of the lecture's content in theoretical as well as practical exercises	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module understand the concepts, techniques and algorithms of information retrieval in modern information systems. They possess detailed knowledge of the mode of operation of current web search engines and multimedia retrieval systems, especially their algorithms for retrieving, processing and evaluation of data. Furthermore they possess the skills to apply this knowledge in a practical manner and to autonomously further expand their knowledge in the area of information retrieval.		
	Prerequisites: none		

12.	**Elective Module: Information Security**	**h**	**ECTS-Credits**
a.	**VO Information Security** Foundations of information- and IT security (e.g. security requirements, basics of cryptography, selected cryptographic protocols, access control models, security engineering, security standards)	2	4
b.	**PS Information Security** Discussion, deepening and rehearsal of the lecture's content in practical exercises; training in autonomous problem analysis, creative problem solving, clear presentation and thorough documentation using problems of information security	2	4
c.	**VO IT Security Architectures** Selected concepts and architectures for security-critical IT systems (e.g. layer models, security services, configuration concepts, security monitoring, security standards)	1	2
	Total	**5**	**10**

	Learning Outcomes: Students who have completed this module understand concepts and methods of information security and can apply them. They can use the acquired techniques for protection of IT systems in regards to confidentiality, integrity and availability of data and services. They have acquired the ability to autonomously analyse problems and creatively solve problems.
	Prerequisites: none

13.	Elective Module: Interactive Theorem Proving	h	ECTS-Credits
a.	**VO Interactive Theorem Proving** Design of an LCF prover; formal proofs; structured proofs and proof scripts; higher-order logic: induction, recursive data structures and recursive functions; automation; termination proofs; correctness of programs	2	4
b.	**PS Interactive Theorem Proving** Deepened understanding of interactive theorem proving through training with established theorem provers; practicing through case studies of programs from different domains; working on a larger verification project	3	6
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module are familiar with the verification of specifications. They know first- and higher-order logics and can carry out structured proofs in those logics and verify them in interactive theorem provers.		
	Prerequisites: none		

14.	Elective Module: Machine Learning	h	ECTS-Credits
a.	**VO Advanced Machine Learning** Classification and regression with kernels; Bayesian and Markov Networks; exact and approximate inference, sequential models	2	4
b.	**PS Advanced Machine Learning** Theoretical and practical exercises in machine learning	1	2
c.	**VO Probabilistic Models and Inference** In-depth study of selected topics of probabilistic modelling; Examples of their application in computer vision and robotics	1	2
d.	**PS Probabilistic Models and Inference** Theoretical and practical exercises in probabilistic modelling	1	2
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module possess in-depth knowledge and competencies regarding modern methods of machine learning and probabilistic modelling. They possess the skills to apply them to complex problems of machine learning and to further expand their knowledge to similar and more complex problems in an autonomous fashion.		
	Prerequisites: none		

15.	Elective Module: Network Security	h	ECTS-Credits
a.	**VO Network Security** Basics of cryptography, cryptographic techniques (modification detection, random numbers), security protocols, security in communication protocols (IEEE 802.1x, WEP, IPec, SSL, TLS), security in mobile networks, attack detection and prevention (denial of service, intrusion detection)	2	4
b.	**PS Network Security** Discussion, deepening and rehearsal of the lecture's content using theoretical and practical tasks; exercises in scientific arguing and presenting	3	6
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module understand the most important concepts of network security, the practical relevance and concept of cryptographic techniques and their application. They are able to apply security protocols and to integrate methods of network security into protocol stacks. They have acquired competencies in the area of attack identification in high-speed networks.		
	Prerequisites: none		

16.	Elective Module: New Database Models	h	ECTS-Credits
a.	**VO New Database Models** Architecture of new database systems; NoSQL-database models and their processing algorithms; document-oriented, graph-based and in- memory database systems; object relational and XML databases; current techniques and approaches	3	6
b.	**PS New Database Models** Discussion, deepening and rehearsal of the lecture's content using theoretical and practical tasks; exercises in scientific arguing and presenting	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module know and understand the foundations of new database concepts and can compare them with and evaluate against the architecture of conventional database systems. They understand the concepts of object-oriented, document-oriented, XML and graph-based systems and possess the skill to apply them in the respective query languages. Furthermore they possess the ability to autonomously acquire further skills regarding the content of the different areas.		
	Prerequisites: none		

17.	Elective Module: Parallel Systems	h	ECTS-Credits
a.	**VO Parallel Systems** Introduction to parallel systems; architecture of parallel computer architectures; programming models and programming of parallel computers; performance metrics and performance analysis; data dependence analysis; optimisation techniques for serial and parallel programs	2	4

b.	**PS Parallel Systems** Application of parallel programming techniques for parallelisation of simple programs on modern parallel architectures; methods for data- and work distribution; data dependence and performance analysis using performance metrics; parallelisation using compilers, program optimisation	3	6
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module are familiar with parallel programming in theory and practice. They have a solid understanding of the possibilities, challenges and limitations of parallel processing and can identify promising parallelisation strategies. Performance analysis can be applied as an interface between parallel computer architectures and programs.		
	Prerequisites: none		

18.	**Elective Module: Semantic Web**	**h**	**ECTS-Credits**
a.	**VO Semantic Web** Web of Data, Web 3.0, semantic web; ontologies und ontology engineering; reasoning; architecture; representation; languages (RDF, RDFS, OWL, RIF); linked data; tools, applications, case studies	3	6
b.	**PS Semantic Web** Discussion, deepening and rehearsal of the lecture's content	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module possess an in-depth knowledge of fundamental methods, tools and applications for combining and automatic retrieval of information in the semantic web or web 3.0. They have command of relevant descriptive languages (RDF, RDFS, OWL, RIF) and methodologies for knowledge representation in the form of ontologies and have an overview of the inference mechanisms and applications which build on that.		
	Prerequisites: none		

19.	**Elective Module: Semantic Web Services**	**h**	**ECTS-Credits**
a.	**VO Semantic Web Services** Principles and foundations of web services; semantic web services frameworks; semantic web services technologies and tools; semantic web services case studies	3	6
b.	**PS Semantic Web Services** Discussion, deepening and rehearsal of the lecture's content	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module understand the fundamental concepts and technologies in conjunction with semantic web services. They are familiar with frameworks for representation, relaying and execution of semantic web services and possess an overview of application with build on them.		
	Prerequisites: none		

20.	Elective Module: Web Engineering	h	ECTS-Credits
a.	**VO Web Engineering** Analysis and design of complex web applications; testing of web applications; operation and maintenance of web applications; methodologies, technologies and tools for web applications; interface design; usability; accessibility; security; project management	3	6
b.	**PS Web Engineering** Discussion, deepening and rehearsal of the lecture's content	2	4
	Total	**5**	**10**
	Learning Outcomes: Students who have completed this module possess an in-depth understanding of the specific requirements of web applications. They master relevant technologies and languages (XHTML, JavaScript, CSS, Java) as well as methods for the development of web applications, especially requirement analysis, test procedures and project management.		
	Prerequisites: none		

§ 7 Master's Thesis

In the Master's Programme in Computer Science a Master's Thesis corresponding 20 ECTS-Credits must be written. The Master's Thesis is a scientific paper that serves as proof of the ability to deal with a scientific topic in a subarea of Computer Science independently and appropriately with regards to content and methodology.

§ 8 Procedure for the assignment of places in courses where the number of participants is limited

For courses with a limit on the number of participants the places are assigned as follows:

1. Students who would face an extension of their study time due to the non-assignment of a place have to be treated preferentially.
2. If criteria § 8.1 does not suffice for the regulation of access to a course then students who would take this course as a compulsory module have to be given priority over those students taking this course as an elective module.
3. If criteria § 8.1 and § 8.2 do not suffice for the regulation of access to a course then the available places have to be assigned via a drawing.

§ 9 Examination Regulations

(1) For each lecture of a module an examination has to be taken. The lecturer announces before the lecture starts if the examination will be oral or in writing.

(2) In seminars, the success of participation, a presentation and a written assignment will be assessed.

(3) For all courses with continuous assessment of the course work, the lecturer will announce the assessment criteria before the course starts.

(4) A module is considered as complete when all its courses have been completed and positively assessed.

(5) The compulsory module "Preparation of the Master's Thesis" is evaluated by the supervisor of the Master's Thesis based on an abstract. Positive evaluation reads "participated with success", negative evaluation "participated without success".

(6) The Master's Programme is completed by means of a committee examination (thesis presentation). This concluding examination is attributed 2,5 ECTS-CP. The examination takes approximately 45 minutes and commences with 15 minute public presentation of the Master Thesis. The examination is concluded by subject-related questions asked by the members of the

examination committee.

§ 10 Academic Degree

Alumni of the Master‘s Programme Computer Science are awarded the academic degree “Master of Science“ abbreviated as “MSc“.

§ 11 Coming into Force

(1) This curriculum comes into force on 1 October 2007.

(2) The amendment of this curriculum in the version of the University of Innsbruck Bulletin from 23 June 2010, issue 42, no. 331 comes into force on 1 October 2010 and has to be applied to all students.

(3) The amendment of this curriculum in the version of the University of Innsbruck Bulletin from 15 May 2012, issue 27, no. 276 comes into force on 1 October 2012 and has to be applied to all students.

(4) The changes of the curriculum in the version of the University of Innsbruck Bulletin of 24 May 2019, Issue 49, No. 477 come into effect as of 1 October 2019 and are to be applied to all students.

(5) The changes of the curriculum acc. to the version of the University of Innsbruck Bulletin of 28 June 2019, Issue 66, No. 587 come into effect on 1 October 2019 and are to be applied to all students.

§ 12 Transitory Provisions

(1) Regular students who have commenced the „Magister“ Programme Computer Science before 1 October 2007 are entitled from this point in time onwards to complete this study within a maximum of five semesters.

(2) If the „Magister“ Programme is not completed within the specified time then the curriculum of the Master Programme will apply.

(3) Students of the „Magister“ Programme Computer Science are entiteled to change to the curricula of the Master Programme at any time on a voluntary basis.

(4) The recognition of exams according to § 78 Para. 1 University Organisation Act 2002 is set out in appendix 1 of this curriculum

(5) The course examinations according to the curriculum for the Master Programme in Computer Science in the version of the University of Innsbruck Bulletin from, 23 April 2007, issue 33, no. 197, correspond to the respective course examinations of the curriculum in the version of the University of Innsbruck Bulletin from 23 June 2010, issue 42, no. 331, as follows:

Curriculum 2007	**Curriculum 2010**
Elective Module 1: Internet Technology VO 3 Internet Technology VO 2 Peer-to-Peer-Systems	Elective Module 2: Advanced Computer Systems VO 3 Internet Technology VO 2 Advanced Computer Architecture
Elective Module 2: Advanced Computer Architecture VO 2 Parallel Systems PS 1 Parallel Systems VO 2 Advanced Computer Architecture	Elective Module 1: Parallel Systems and Advanced Distributed Systems VO 2 Parallel Systems VO 1 Advanced Distributed Systems PS 2 Advanced Programming of Parallel and Distributed Systems
VO 3 Internet Technology	VO 3 Internet Technology
VO 2 Peer-to-Peer-Systems	VO 1 Advanced Distributed Systems
VO 2 Parallel Systems	VO 2 Parallel Systems
PS 1 Parallel Systems	PS 2 Advanced Programming of Parallel and

	Distributed Systems

(6) The course examinations according to the curriculum for the Master Programme in Computer Science in the version of the University of Innsbruck Bulletin rom 23 June 2014, issue 42, no. 331, correspond to the respective course examinations of the curriculum in the version of the University of Innsbruck Bulletin from 15 May 2012, issue 27, no. 276, as follows:

Curriculum 2007 und 2010		ECTS-AP	**Curriculum 2012**		ECTS-AP
Logic (PM1)	VO2	4	Compiler Construction (PM1)	VO2+PS1	3+2
Formal Specification (PM1)	VO2	4	Formal Languages and Automata Theory (PM2)	VO2+PS1	3+2
Introduction to Model Checking (PM1)	VO1	2			
Master Seminar 1 (PM2)	SE2	5	Master Seminar 1 (PM3)	SE2	5
Master Seminar 2 (PM3)	SE2	5	Master Seminar 2 (PM4)	SE2	5
Parallel Systems (WM1)	VO2	4	Parallel Systems (WM17)	VO2	4
Advanced Parallel Systems (WM1)	VO1	2	Advanced Parallel and Distributed Systems (WM10)	VO2	4
Advanced Programming of Parallel and Distributed Systems (WM1)	PS2	4	Advanced Parallel and Distributed Systems (WM10)	PS3	6
Internet Technology (WM2)	VO3	6	Advanced Communication Systems (WM8)	PS3	6
Advanced Computer Architecture (WM2)	VO2	4	Advanced Communication Systems (WM8)	VO2	4
Semantic Web (WM4)	VO3	6	Semantic Web (WM18)	VO3	6
Web Engineering (WM4)	VO2	4	Web Engineering (WM20)	VO3	6
New Database Models (WM5)	VO3	6	New Database Models (WM16)	VO3	6
Information Systems (WM5)	VO2	4	New Database Models (WM16)	PS2	4
Information Security (WM6)	VO2	4	Information Security (WM12)	VO2	4
Information Security (WM6)	PS2	4	Information Security (WM12)	PS2	4
IT Security Architectures (WM6)	VO1	2	IT Security Architectures (WM12)	VO1	2
Model-Checking (WM8)	VO2	4	Theory and Practice of Decision Procedures (WM5)	PS2	4
Automatic Deduction (WM8)	VO2	4	Theory of Decision Procedures (WM5)	VO2	4
Experiments with Verification (WM8)	VO1	2	Practice of Decision Procedures (WM5)	VO1	2

Exams covering all other courses in compulsory or elective modules of the „Magister“ Programme Computer Science (curriculum from 3 September 2001) will be recognised with the same amount of ECTS-CP as exams of courses of the specialisation module.