

Curriculum Guide for the Bachelor's Program

COMPUTER SCIENCE

valid from winter semester 2013/2014

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1. Qualification profile

The Bachelor's program in Computer Science at the Johannes Kepler University (JKU) Linz is based on principles, methods and practice and offers a broad basic competence in computer science. It lays the foundations for the Master's program but also offers a professional education by enabling students to apply scientific methods to practical problems and to acquire new knowledge in a process of life-long learning. Graduates of this program are general-purpose IT professionals.

An important characteristic of this degree program is that theory and practice are tightly coupled. Computer science has its roots in mathematics, electrical engineering, and in a number of other areas. At JKU it is considered an engineering discipline, and is therefore neither a branch of pure formal science nor a mere application of ready-made ideas. Being application-oriented, it emphasises the development of methods and tools and uses synergies from industry cooperation.

The degree program aims at problem solving skills. Students are empowered to solve non-trivial tasks systematically using state-of-the-art computer science techniques. They learn to specify and to develop useful and reliable solutions as well as to validate, to maintain and to further develop them.

In addition to technical skills students also acquire social skills. They learn to develop concepts, processes and results in a team and to communicate them to others. They are trained to understand and to use the terminology of clients and partners and to cooperate across multiple disciplines. International student exchange programs as well as courses in English language prepare students for collaboration with international partners. Students acquire basic skills in business, law and project management and are prepared to assess the impact of computer science to social, psychological and ethical aspects of society.

Further links

- Web page of the JKU CS department <http://cs.jku.at>
- Announcements of the curriculum committee <http://cs.jku.at/teaching/stuko/news/>
- Study handbook with lecture descriptions <http://www.jku.at/studienhandbuch/>
- Web page of the student union <http://cs.jku.at/students/>
- Official curriculum <http://cs.jku.at/teaching/>

This Curriculum guide serves as a source of information for students. The full legal regulations of this Bachelor's program are described in the official curriculum.

2. Overview

2.1 General structure

The Bachelor's program in Computer Science is a three years full-time program comprising 180 ECTS points. It is mainly delivered in German. Table 1 shows its overall structure.

Table 1: Structure of the Bachelor's program Computer Science

	hours/week	ECTS
<i>Mandatory subjects</i>		
Propaedeutic	1	1.5
Theory	24	36.0
Hardware	15	22.5
Software	21	31.5
Systems	16	24.0
Applications	15	22.5
Complementary skills	10	15.0
<i>Computer Science electives</i>	7	10.5
<i>Free electives</i>	6	9.0
<i>Bachelor's thesis</i>	5	7.5
Total	120	180.0

2.2 Academic degree

Graduates of the Bachelor's program Computer Science are awarded the academic degree "Bachelor of Science" (BSc).

2.3 Contents of the mandatory subjects

Propaedeutic: General overview of the topics in computer science and of the Bachelor's program. The propaedeutic also serves as special orientation for first-year students.

Theory: Formal foundations of computer science in mathematics (analysis, algebra, number theory, graph theory, combinatorics, statistics), logic (predicate logic, formal specification, reasoning and proofs) as well as in formal systems and models (automata theory, Turing machines, Petri nets, computability, decidability, algorithmic complexity).

Hardware: Digital circuits at gate level, electronics as far as relevant for computer science, architecture of sequential and parallel computers, memory and bus systems, cache hierarchies, superscalar architectures, VLIW architectures, assembler programming, and programming of parallel computers.

Software: Solid programming skills in an imperative programming language, object-oriented software development (class libraries, frameworks, design patterns), modern programming techniques (threading, RMI, reflection, JDBC, applets, servlets, web services), algorithms and data structures (searching, sorting, random numbers, exhaustion, lists, trees, graphs, sets, distributed, parallel and heuristic algorithms), as well as software engineering (software processes, requirements engineering, design, testing).

Systems: Applications of computer science at the systems level, e.g. foundations and case studies of operating systems (memory management, parallel processes and synchronisation, file systems, event processing), networks and distributed systems (ISO/OSI reference model, ethernet, TCP/IP, switching, routing), embedded and mobile architectures (ASICs, microcontrollers, Smartcards, wireless communication, sensors, actuators), multimedia systems (media formats, data compression techniques, animation, interactive television), as well as compiler construction methods.

Applications: Major application areas of computer science with respect to the strengths and focuses of computer science in Linz, e.g. databases, information systems, computer graphics, artificial intelligence, and bioinformatics.

Complementary skills: A special goal of this curriculum and its qualification profile is to develop the students' personality as scientists and engineers. This includes topics such as ethics, gender awareness, social and cultural competence, scientific working techniques, presentation skills, and project management skills. Furthermore, students are exposed to fundamental principles of economy and law.

2.4 ECTS points

According to the *European Credit Transfer System* the effort of courses is specified in ECTS points, where 1 ECTS points corresponds to 25 full hours of work. This includes the attendance in courses as well as the time for preparation, exercises and practical work at home. The total effort of this degree program is 180 ECTS points (approximately 30 ECTS points per semester). In this curriculum 1 unit generally corresponds to 1.5 ECTS points.

Lecturers have to adjust the effort of every course in such a way that it matches the ECTS points of the course. Table 2 shows the expected work load (in full hours) for different amounts of units and ECTS points.

Table 2: Correspondence between hours/week, ECTS points and full hours

hours/week	ECTS	full hours
1	1.5	37.5
2	3.0	75.0
3	4.5	112.5
4	6.0	150.0
5	7.5	187.5

2.5 Study entrance and orientation phase

The study entrance and orientation phase (StEOP) consists of freely selected courses with a total of 16 ECTS points from the first two semesters according to Table 3 (with the exception of "Ethik und Gender Studies"). StEOP courses that were acknowledged via credit transfer are considered to be passed.

Other courses can only be selected once the StEOP is completed (with the exception of courses listed under <http://cs.jku.at/teaching/curricula/2013/steop.html>, which can be studied in parallel to the StEOP).

2.6 Number of students per course

35 students are admitted to labs and to the lab part of combined courses, 15 students are admitted to practicals, and 20 students to seminars. If these numbers are exceeded, parallel courses have to be offered.

3. Mandatory subjects

Students have to pass all courses listed in Table 3. The column "Sem" denotes the semester in which the course should be taken.

Table 3: Mandatory subjects and courses

Subject/courses	Kind	Lecturer	ECTS	Lang.	Sem
Propädeutikum Propädeutikum	1KV	Diverse	1,5	D	1
Theorie Logic	2VO+1UE	Biere, Schreiner	4,5	E	1
Diskrete Strukturen	2VO+1UE	Vetterlein	4,5	D	1
Algebra	2VO+2UE	Aichinger	6,0	D	2
Analysis	2VO+2UE	Kauers	6,0	D	3
Berechenbarkeit und Komplexität	2VO+1UE	Schreiner	4,5	D	3
Formal Models	2VO+1UE	Biere	4,5	E	4
Statistik	2VO+2UE	Forstner	6,0	D	4
Hardware Digitale Schaltungen	2VO+1UE	Wille	4,5	D	1
Elektronik	2VO+1UE	Ostermann	4,5	D	2
Rechnerarchitektur	3VO+1UE	Wille	6,0	D	4
Digitale Signalverarbeitung	2VO+1UE	Huemer	4,5	D	5
Praktikum: Digitale Schaltungstechnik	2PR	RIIC	3,0	D	4
Software Softwareentwicklung 1	2VO+2UE	Ferscha	6,0	D	1
Softwareentwicklung 2	2VO+2UE	Mössenböck	6,0	D	2
Praktikum aus Softwareentwicklung 2	2PR	Prähofer et al.	3,0	D	4
Algorithmen und Datenstrukturen 1	2VO+1UE	Blaschek	4,5	D	2
Algorithmen und Datenstrukturen 2	2VO+1UE	Ferscha	4,5	D	3
Systems Programming	2PR	INS	3,0	E	3
Software Engineering	2VO+1UE	Egyed, Grünb.	4,5	E	5
Systeme Betriebssysteme	2VO+1PR	Mayrhofer	4,5	D	2
Netzwerke und verteilte Systeme	2VO+1UE	Hörmanseder	4,5	D	3
Multimediasysteme	2VO+1UE	Kotsis	4,5	D	2
Übersetzerbau	2VO+2UE	Mössenböck	6,0	D	5
Embedded and Pervasive Systems	2VO+1UE	Ferscha	4,5	D	6
Anwendungen Informationssysteme 1	2VO+2UE	Küng, Wöß	6,0	D	1
Informationssysteme 2	2VO+1UE	Retschitz., Kaps.	4,5	D	3
Computer Graphics	2VO+1UE	Bimber	4,5	E	4
Artificial Intelligence	2VO+1UE	Widmer	4,5	E	5
Bioinformatics	2VO	Bodenhofer	3,0	E	5
Begleitende Inhalte Ethik und Gender Studies ¹	2KV	Renöckl	3,0	D	1
Präsentations- und Arbeitstechnik	2KV	Grünbacher et al.	3,0	D	4
Wirtschaftsgrundlagen für Informatiker	2VO	Retschitzegger	3,0	D	6
Rechtsgrundlagen für Informatiker	2VO	Sonntag	3,0	D	3
Projektorganisation	2KV	Kapsammer	3,0	D	5

¹ Alternatively, the following courses can be selected: "Gender Studies und Soziale Kompetenz" (2KV), "Gender Studies TNF - Einführung" (2KV), "Einführung in IKT, Gesellschaft, Gender und Diversity" (2KS).

4. Computer Science electives

These courses allow students to deepen and broaden their knowledge according to individual preferences. Students have to select courses with a total of 7 hours (10.5 ECTS points) from Sections 4.1 to 4.3. These courses must contain at least one seminar from Section 4.3. CS electives should be attended during the last two semesters of the program and cannot be re-selected in a subsequent Master's program.

4.1 General electives

The general electives comprise the courses listed in Table 4. They are regularly offered every year or at least every two years.

Table 4: General electives (* = offered every 2 years)

Inst.	Courses		Lecturer	ECTS	WS/SS
BIO	Introduction to R	2KV	Bodenhofer	3.0	SS
	Machine Learning: Unsupervised Techniques	2VO+1UE	Hochreiter	4.5	SS
	Sequence Analysis and Phylogenetics	2VO+2UE	Hochreiter	6.0	WS
	Theoretical Concepts of Machine Learning	2VO+1UE	Bodenhofer	4.5	SS
CG	Information Displays	2VO	Bimber	3.0	SS*
	Information Visualization	3KV	Streit	4.5	SS
	Visual Analytics	2VO	Streit	3.0	WS
CP	Biometrische Identifikation	2VO	Scharinger	3.0	WS
	Digitale Bildverarbeitung	2KV	Scharinger	3.0	SS
FAW	Application Oriented Knowledge Processing	2KV	Küng	3.0	SS
	Conceptual Data Modeling	2KV	Wöß	3.0	SS
	Semantic Data Modeling and Applications	2KV	Wöß	3.0	SS
	Web Search and Mining	2KV	Pröll	3.0	SS
	Web Engineering	2KV	Pröll	3.0	WS
FMV	Advanced Model Checking	2KV	Biere	3.0	SS*
	Debugging	2KV	Seidl	3.0	SS*
ICA	Statistics 2	2KV	Forstner	3.0	WS/SS
IFG	Ethics and Gender Studies	2VO		3.0	WS/SS
	Gender Studies Managing Equality TN	2KV		3.0	WS/SS
	Soziale und geschlechterspez. Aspekte der IT	2KS		3.0	SS
IIS	Assistive Technologies and Accessibility	2KV	Miesenberger	3.0	WS
	Web Usability	1KV	Miesenberger	1.5	WS
INS	Cloud Security	2KV	Mayrhofer	3.0	WS
	Hardwareorientiertes Arbeiten an PCs	2PR	Bauer	3.0	WS*
	Sicherheit in Applikationsprotokollen	1KV	Dietmüller	1.5	WS
	Web Security	2KV	Sonntag	3.0	SS
	Wireless LANs	1KV	Schmitzberger	1.5	SS
ISSE	Engineering of Software-intensive Systems	2KV	Egyed	3.0	SS
	Product Line Engineering	2KV	Grünbacher	3.0	SS
RIIC	Design of Integrated Circuits	2PR	Ehrenstorfer	3.0	WS
	Emerging Computer Technologies	3KV	Wille	4.5	WS
	Hardware Design with Programmable Logic	2KV	Möstl	3.0	WS
	VLSI Design	2KV	Rauchenecker	3.0	WS
AG RISC	Computational Geometry	2VO+1UE	Jüttler	4.5	SS
	Computer Algebra	2VO+1UE	Winkler	4.5	WS
	Formal Semantics of Programming Languages	2VO	Schreiner	3.0	SS*
	Rewriting in Computer Science and Logic	2VO	Kutsia	3.0	SS

SSW	Advanced Compiler Construction	2KV	Mössenböck	3.0	SS*
	Human/Computer Interaction	2VO	Blaschek	3.0	WS
	Modeling and Computer Simulation	2KV	Prähofer	3.0	WS*
TK	Capacity Planning	2KV	Kotsis	3.0	SS
	Mobile Computing	2KV	Khalil	3.0	WS/SS
TK	Advanced Model Engineering	2KV	Retschitz., Kaps.	3.0	WS
CIS	Cooperative Information Systems	2KV	Retschitz., Kaps.	3.0	SS
	Modeling Internet Applications	2KV	Schwinger	3.0	SS

4.2 Special topics

Special topics allow institutes to take up current trends in their fields and to use the teaching offer of guest lecturers. Courses from this category can be announced without being listed in the curriculum, and there is no obligation to hold them regularly.

The name of special topics courses consists of a main title ("Special Topics:") and a subtitle denoting the actual contents of the course. The type of such courses (VO, UE, KV, SE) as well as their length in hours can be freely chosen by the lecturers. The ECTS points are calculated as hours \times 1.5.

4.3 Seminars

Seminars are courses in which scientific methods are taught and practiced. Students have to write a seminar thesis about a research-related topic and present it in a seminar talk. The name of a seminar consists of a main title as shown in Table 5 and a subtitle denoting the topic of the seminar. At least 1 seminar has to be selected in the CS electives.

Table 5: *Seminars*

Seminars		ECTS	WS/SS
Seminar in Computational Engineering: ...	2SE	3.0	WS/SS
Seminar in Intelligent Information Systems: ...	2SE	3.0	WS/SS
Seminar in Networks and Security: ...	2SE	3.0	WS/SS
Seminar in Pervasive Computing: ...	2SE	3.0	WS/SS
Seminar in Software Engineering: ...	2SE	3.0	WS/SS

5. Free electives

Students have to take free elective courses with a total of 6 hours (9 ECTS). These courses can be selected from any study at any university and can be taken throughout the whole Master's program. Their goal is to provide students with additional skills beyond the area of Computer Science. Courses in social skills, foreign languages and gender studies are particularly recommended.

For the free electives, students can also select additional courses from the Computer Science electives. These courses, however, cannot be reselected in the Master's program.

6. Bachelor's thesis

As a final work students have to write a Bachelor's thesis, which has to be done in the course "Projektpraktikum" (5PR, 7.5 ECTS). The thesis should have the structure of a scientific publication, i.e.:

- It should be put in its computer science context (specification, definition of terms, related work, etc.).
- Students should demonstrate their knowledge of common methods and notations of computer science.
- The results should be critically evaluated and compared with existing solutions.

7. Organisational

7.1 Course Types

Lectures ("Vorlesungen", VO) are courses that introduce students to certain areas and methods of their study.

Labs ("Übungen", UE) are courses which reinforce topics from the corresponding lecture by carrying out practical and concrete exercises. Marking is based on continuous assessment of the students' work.

Combined courses ("Kombinierte Veranstaltungen", KV) are courses consisting of lectures and labs, which are intertwined according to didactic aspects.

Practicals (PR) have similar goals as labs and are continuously assessed. In contrast to labs they can be independent from lectures and usually promote project-oriented work in a team. The project practical that has to be done as a bachelor thesis is a final project with a written part in which students should apply the knowledge that they acquired during their study.

Seminars (SE) are courses involving collaboration between students. Marking of seminars is based on continuous assessment of the students' work, on their preparation of talks (including seminar papers) and on their participation in discussions.

7.2 Examinations

Every course is marked individually. The examination mode (written or oral) of lectures (VO) and combined courses (KV) is defined by the lecturer. Labs (UE) and practicals (PR) are assessed by continuous and final evaluations. Seminars (SE) are assessed on the basis of the seminar thesis, the seminar presentation and the cooperation of the student in the seminar.

The examination marks of the mandatory subjects (Section 3) and the Computer Science electives (Section 4) are computed as the average marks of the individual course examinations.

The Bachelor's examination certificate summarizes the subject examinations of the mandatory subjects (Section 3), the Computer Science electives (Section 4), the free electives (Section 5) and the Bachelor's thesis (Section 6).

7.3 Recommended course of study

In order to satisfy all dependencies between courses the following course of study is recommended:

1. Semester	20					2. Semester	20				
	VO	UE	KV	PR			VO	UE	KV	PR	
Propädeutikum			1			Algebra	2	2			
Diskrete Strukturen	2	1				Elektronik	2	1			
Logic	2	1				Softwareentwicklung 2	2	2			
Softwareentwicklung 1	2	2				Algorithmen u. Datenstrukt. 1	2	1			
Informationssysteme 1	2	2				Betriebssysteme	2			1	
Digitale Schaltungen	2	1				Multimediasysteme	2	1			
Ethik u. Gender Studies			2								
	10	7	3	0			12	7	0	1	
3. Semester	20					4. Semester	20				
	VO	UE	KV	PR			VO	UE	KV	PR	
Analysis	2	2				Formal Models	2	1			
Berechenb. & Komplexität	2	1				Statistik	2	2			
Systems Programming				2		Rechnerarchitektur	3	1			
Algorithmen u. Datenstrukt. 2	2	1				Computer Graphics	2	1			
Netzwerke u. vert. Systeme	2	1				PR Digitale Schaltungstechnik				2	
Informationssysteme 2	2	1				PR Softwareentwicklung 2				2	
Rechtsgrundlagen f. Inf.	2					Präsentations- u. Arbeitstech.				2	
	12	6	0	2			9	5	2	4	
5. Semester	20					6. Semester	20				
	VO	UE	KV	PR			VO	UE	KV	PR	
Software Engineering	2	1				Embedded/Pervasive Syst.	2	1			
Übersetzerbau	2	2				Wirtschaftsgrundlagen f. Inf.	2				
Digitale Signalverarbeitung	2	1				Projektpraktikum				5	
Artificial Intelligence	2	1				Vertiefung				4	
Bioinformatics	2					Freifach				6	
Projektorganisation			2								
Vertiefung			3								
	10	5	5	0			4	1	10	5	

7.4 Course dependencies

