K 033/521

CURRICULUM GUIDE
BACHELOR IN
COMPUTER SCIENCE.

valid as of WS 2022/23

JOHANNES KEPLER
UNIVERSITY LINZ

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.

Note that the Bachelor's program in Computer Science is mainly taught in German. Courses of Table 2 that are marked with "E" as well as most elective courses (Section 4) are taught in English.

The program is primarily aimed at full-time students, but can also be studied—with certain restrictions—by working students with flexible working hours (up to 20 hours per week). Some lectures and combined courses are also offered in digital form (streaming or download); attendance is usually not compulsory, although it is recommended. In labs, attendance is usually compulsory; however, if possible, at least one of the labs groups is offered in digital form in the late afternoon. For exams, it cannot be guaranteed that they will be offered in digital form or at the end of the day. Working students must expect an extended period of study.

Further links

- Web page of the JKU CS department — cs.jku.at
- Announcements of the curriculum committee — cs.jku.at/teaching/stuko/news/
- Study handbook with lecture descriptions — studienhandbuch.jku.at/
- Web page of the student union — cs.jku.at/students/
- Official curriculum — 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
Mandatory subjects		
Propaedeutic	1	1.5
Theory	24	36.0
Hardware	13	19.5
Software	21	31.5
Systems	16	24.0
Applications	15	22.5
Complementary skills	10	15.0
Computer Science electives	9	13.5
Free electives	6	9.0
Bachelor's thesis	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 machine learning.

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, whereby lectures and the corresponding labs are regarded as a unit.

2.5 Study entrance and orientation phase

The study entrance and orientation phase (STEOP) consists of courses that should provide the students with an overview of the field of Computer Science. In order to complete the STEOP, students have to pass at least 9 ECTS from the following table:

STEOP courses	Kind	ECTS	Semester
Digitale Schaltungen	2VO	3.0	WS
Datenbanken und Informationssysteme 1	2VO	3.0	WS
Logic	2VO	3.0	WS
Softwareentwicklung 1	2VO	3.0	WS
Algebra	2VO	3.0	SS
Algorithmen und Datenstrukturen 1	2VO	3.0	SS
Elektronik	2VO	3.0	SS
Multimediasysteme	2VO	3.0	SS

Further courses can only be selected once the STEOP has been completed, with the exception of the courses in the following table:

Selectable in parallel to the STEOP	Kind	ECTS	Semester
Digitale Schaltungen	1UE	1.5	WS
Diskrete Strukturen	2VO+1UE	4.5	WS
Ethik und Gender Studies	2KV	3.0	WS
Datenbanken und Informationssysteme 1	2UE	3.0	WS
Logic	1UE	1.5	WS
Propädeutikum	1KV	1.5	WS
Softwareentwicklung 1	2UE	3.0	WS
Rechtsgrundlagen der Informatik	2VO	3.0	WS
Algebra	2UE	3.0	SS
Algorithmen und Datenstrukturen 1	1UE	1.5	SS
Betriebssysteme	2VO+1UE	3.0	SS
Elektronik	1UE	1.5	SS
Multimediasysteme	1UE	1.5	SS
Softwareentwicklung 2	2VO+2UE	6.0	SS

3. Mandatory subjects

Students have to pass all courses listed in Table 2. The column "Sem" denotes the semester in which the course should be taken.

Table 2: *Mandatory subjects and courses*

Subject/courses	Kind	Lecturer	ECTS	Lang.	Sem
Propädeutikum					
Propädeutikum	1KV	Diverse	1.5	D	1
Theorie					
Logic	2VO+1UE	Seidl et al.	4.5	E	1
Diskrete Strukturen	2VO+1UE	Rass	4.5	D	1
Algebra	2VO+2UE	Koutschan	6.0	D	2
Analysis	2VO+2UE	Schneider	6.0	D	3
Berechenbarkeit und Komplexität	2VO+1UE	R.Küng	4.5	D	3
Formal Models	2VO+1UE	Seidl	4.5	E	4
Statistik	2VO+2UE	Forstner	6.0	D	4
Hardware					
Digitale Schaltungen	2VO+1UE	Große	4.5	D	1
Elektronik	2VO+1UE	Pretl	4.5	D	2
Rechnerarchitektur	3VO+1UE	Große et al.	6.0	D	4
Digitale Signalverarbeitung	2VO+1UE	ISP	4.5	D	5
Software					
Softwareentwicklung 1	2VO+2UE	Mössenböck	6.0	D	1
Softwareentwicklung 2	2VO+2UE	Prähofer	6.0	D	2
Praktikum aus Softwareentwicklung 2	2PR	Prähofer et al.	3.0	D	4
Algorithmen und Datenstrukturen 1	2VO+1UE	Ferscha	4.5	D	2
Algorithmen und Datenstrukturen 2	2VO+1UE	Ferscha	4.5	E	3
Systems Programming	2PR	Rass et al.	3.0	E	3
Software Engineering	2VO+1UE	Egyed, Grünb.	4.5	E	5
Systeme					
Betriebssysteme	2VO+1UE	Mayrhofer	4.5	D	2
Computernetzwerke	2VO+1UE	Hörmanseder	4.5	D	3
Multimediasysteme	2VO+1UE	Kotsis	4.5	D	2
Compilerbau	2VO+2UE	Mössenböck	6.0	D	5
Embedded and Pervasive Systems	2VO+1UE	Ferscha	4.5	D	6
Anwendungen					
Datenbanken und Informationssysteme 1	2VO+2UE	J.Küng, Wöß	6.0	D	1
Datenbanken und 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
Introduction to Machine Learning	2VO	Klamb., Schedl	3.0	E	5
Begleitende Inhalte					
Ethik und Gender Studies[1]	2KV	Sabitzer, Mara	3.0	D	1
Präsentations- und Arbeitstechnik	2KV	Grünbacher et al.	3.0	D	4
Wirtschaftsgrundlagen der Informatik	2VO	Retschitzegger	3.0	D	6
Rechtsgrundlagen der Informatik	2VO	Sonntag	3.0	D	3
Projektorganisation	2KV	Kaps., Grünb.	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 9 hours (13.5 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 3. They are regularly offered every year or at least every two years.

Table 3: *General electives (* = offered every 2 years)*

Inst.	Courses		Lecturer	ECTS	WS/SS
CG	Information Displays	2VO	Bimber	3.0	SS*
	Information Visualization	3KV	Streit	4.5	SS*
CP	Biometrische Identifikation	2VO	Scharinger	3.0	WS
	Digitale Bildverarbeitung	2KV	Scharinger	3.0	SS
FAW	Application Oriented Knowledge Processing	2KV	J.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
ICS	Statistik 2	2KV	Forstner	3.0	WS/SS
IFG	Ethics and Gender Studies	2VO	IFG	3.0	WS/SS
	Gender Studies Managing Equality TN	2KV	IFG	3.0	WS/SS
	Soziale und geschlechterspez. Aspekte der IT	2KS	IFG	3.0	SS
IIC	Quantum Computing	2VO	R.Küng	3.0	WS
	VLSI Design	2KV	IIC	3.0	WS
	Praktikum: Digitale Schaltungstechnik	2PR	IIC	3.0	WS
IIS	Assistive Technologies and Accessability	2KV	Miesenberger	3.0	WS
	Web Usability	1KV	Miesenberger	1.5	WS
INS	Advanced Operating Systems	2KV	Mayrh., Sonntag	3.0	WS
	Cloud Security	2KV	Mayrhofer	3.0	?
	Introduction to Linux	1KV	INS	1.5	SS
	Web Security	2KV	Sonntag	3.0	SS
ISSE	Engineering of AI-intensive Systems	2KV	Mashkoor	3.0	SS
	Product Line Engineering	2KV	Rabiser	3.0	SS
MAT	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*
ML	Machine Learning: Unsupervised Techniques	2VO+1UE	Hochreiter	4.5	SS
	Sequence Analysis and Phylogenetics	2VO+2UE	Regl et al.	6.0	WS
	Theoretical Concepts of Machine Learning	2VO+1UE	Nessler	4.5	SS
SAI	Debugging	2KV	Seidl	3.0	SS
	SAT Solving	2KV	Seidl	3.0	SS
SSW	Advanced Compiler Construction	2KV	Mössenböck	3.0	SS*
	Modeling and Computer Simulation	2KV	Prähofer	3.0	WS*

STAT	Advanced Regression Analysis	2SE	Waldl	4.0	WS
	Multivariate Verfahren	2KV	Waldl	4.0	WS
	Verallgemeinerte Lineare Modelle	2KV	Wagner	4.0	SS
TK	Human/Computer Interaction	2KV	Kotsis et al.	3.0	WS
	Mobile Computing	2KV	Hummel	3.0	WS
	Mobile Web Development	2KV	Khalil	3.0	SS
	Web Performance	2KV	Kotsis	3.0	WS
TK	Advanced Model Engineering	2KV	Retschitz., Kaps.	3.0	WS
CIS	Big Data Engineering	2KV	Kaps., Retschitz.	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 × 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 4 and a subtitle denoting the topic of the seminar. At least 1 seminar has to be selected in the CS electives.

Table 4: *Seminars*

Seminars		ECTS	WS/SS
Seminar in Computational Engineering: ...	2SE	3.0	WS/SS
Seminar in Data Science: ...	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**			
	VO	UE	KV	PR
Propädeutikum			1	
Diskrete Strukturen	2	1		
Logic	2	1		
Softwareentwicklung 1	2	2		
Datenbanken u. Informationssyst. 1	2	2		
Digitale Schaltungen	2	1		
Ethik u. Gender Studies			2	
	10	7	3	0

2. Semester	**20**			
	VO	UE	KV	PR
Algebra	2	2		
Elektronik	2	1		
Softwareentwicklung 2	2	2		
Algorithmen u. Datenstrukturen 1	2	1		
Betriebssysteme	2	1		
Multimediasysteme	2	1		
	12	8	0	0

3. Semester	**20**			
	VO	UE	KV	PR
Analysis	2	2		
Berechenbarkeit u. Komplexität	2	1		
Systems Programming				2
Algorithmen u. Datenstrukturen 2	2	1		
Computernetzwerke	2	1		
Datenbanken u. Informationssyst. 2	2	1		
Rechtsgrundlagen der Informatik	2			
	12	6	0	2

4. Semester	**20**			
	VO	UE	KV	PR
Formal Models	2	1		
Statistik	2	2		
Rechnerarchitektur	3	1		
Computer Graphics	2	1		
PR Softwareentwicklung 2				2
Präsentations- u. Arbeitstechnik			2	
Vertiefung			2	
	9	5	4	2

5. Semester	**20**			
	VO	UE	KV	PR
Software Engineering	2	1		
Compilerbau	2	2		
Digitale Signalverarbeitung	2	1		
Artificial Intelligence	2	1		
Introduction to Machine Learning	2			
Projektorganisation			2	
Vertiefung			3	
	10	5	5	0

6. Semester	**20**			
	VO	UE	KV	PR
Embedded/Pervasive Systems	2	1		
Wirtschaftsgrundlagen d. Informatik	2			
Projektpraktikum				5
Vertiefung			4	
Freifach			6	
	4	1	10	5

7.4 Course dependencies