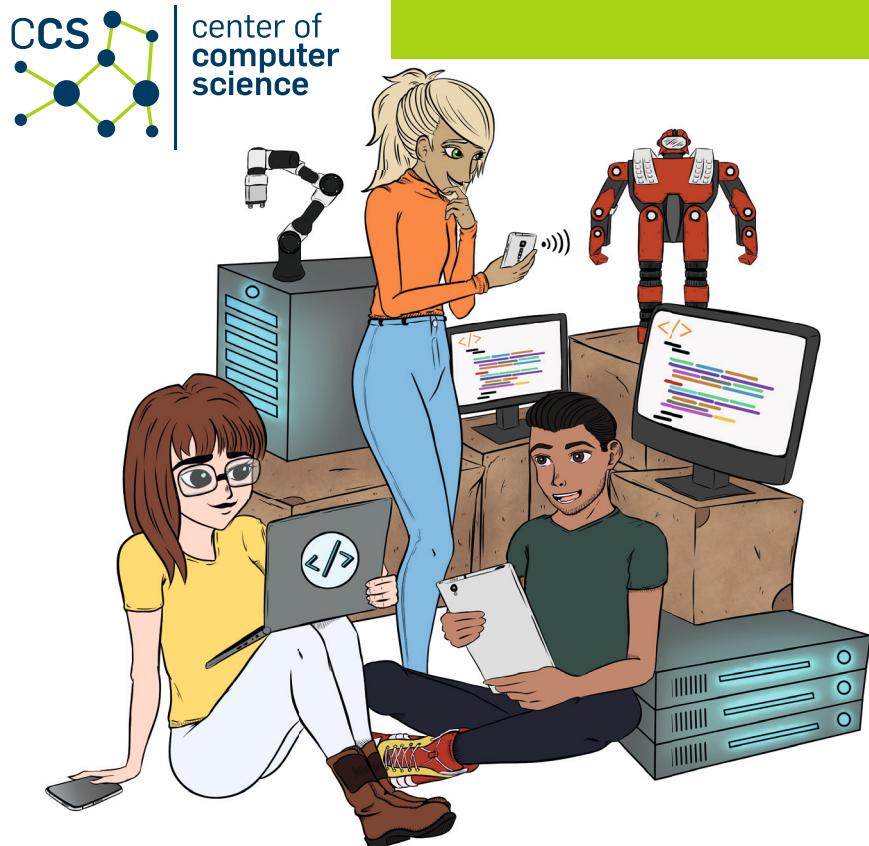


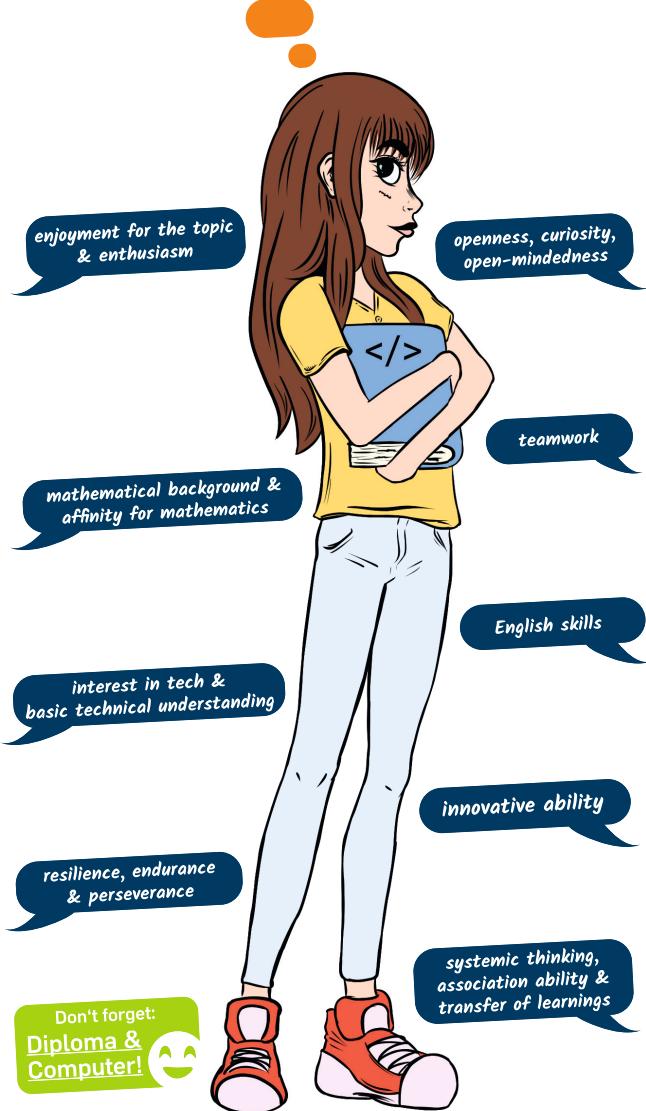
BACHELOR OF SCIENCE (B.Sc.) COMPUTER SCIENCE

CUTTING-EDGE, FUTURE-ORIENTED,
INTERNATIONAL AND BILINGUAL

www.informatik.rub.de/bsc



What skills do I need to study computer science?



LIST OF CONTENTS

- 3 WELCOME
- 4 COMPUTER SCIENCE IS ALL AROUND
- 6 INSIGHTS FOR BEGINNERS
- 7 IN HIGH DEMAND
- 8 OUR DEGREE PROGRAM
- 9 GOOD REASONS
- 10 STRUCTURE OF THE CURRICULUM
- 12 MASTER'S DEGREE: DEEPEN YOUR INTERESTS
- 13 BRIEF INTRODUCTIONS
- 16 YOUR PATH TO OUR STUDY PROGRAM: APPLICATION AND ENROLLMENT
- 18 SERVICE
- 19 CONTACT

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June 2021

WELCOME

Dear prospective students,

You are facing one of the most important and exciting decisions of your life – the choice of your subject. This decision will have a huge impact on your life because it will set the course for your professional path and for an interesting and successful career. Like hardly any other scientific discipline, computer science offers you the best chances for an exciting, creative and lucrative career, in which you can actively shape our future as well as your way of working. Computer Science has developed rapidly in the last decades and increasingly influences our everyday life. This development is the breeding ground for new business fields, enables flexible working models and facilitates an excellent work-life balance.

At the Ruhr-University, we have designed a modern degree program "Computer Science" for you, which optimally prepares you for the challenges of the coming decades. You can expect a young, highly motivated team of professors, which conducts international cutting-edge research in fields of the future.

This booklet will give you a comprehensive overview of our modern computer science program, its main teaching areas and its research personalities. You will learn, what computer science is capable of and in which variety of industries the field



Professor Alexander May is the Chairholder of the Chair for Cryptography and IT Security and the founding director of the Center of Computer Science at the Ruhr-University Bochum.

is already present today and which impact it will have in the future. We do not only describe how our study program is designed and structured but also which occupational perspectives open up to you after you completed your studies with us.

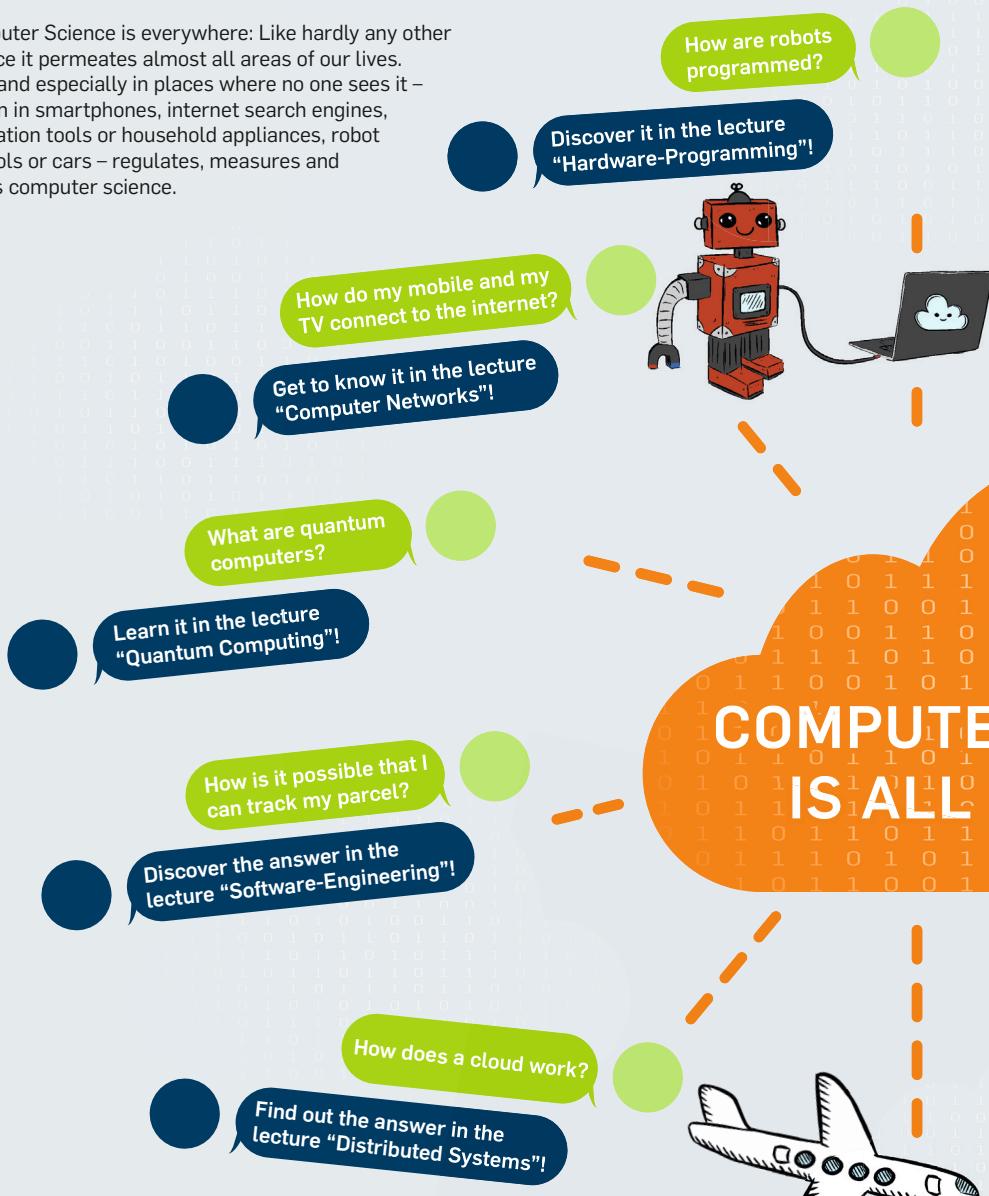
If you have any further questions, please contact the student advisory service or me. We, the staff of the Center of Computer Science, would be very pleased to welcome you as one of our students. We will accompany and support you throughout your whole educational path.

With kind regards,

Prof. Dr. Alexander May

COMPUTER SCIENCE IS ALL AROUND

Computer Science is everywhere: Like hardly any other science it permeates almost all areas of our lives. Even and especially in places where no one sees it – hidden in smartphones, internet search engines, navigation tools or household appliances, robot controls or cars – regulates, measures and warns computer science.



A STUDY PROGRAM IS THE RIGHT WAY

The problems concerning information technology of today's world are complex and increasing. It requires special knowledge to solve them. Knowledge, which can only be gained in a scientific degree program. This knowledge enables you to quickly grasp new types of problems and to find new solutions. The more dynamic an area is, the more important the knowledge foundations are.

THE POWER OF INFORMATION

Computer science is rapidly developing, supporting and influencing other disciplines. Information as the basis for new business models has become "the gold" of the 21st century. Pieces of information are collected, processed and sold. New knowledge is generated from information. Information is power, it will increasingly influence and "rule" the world.



How does my navigation system find the quickest route?

Discover it in the lecture
"Computer Science 2 – Data Structures and Algorithms"!

How does an online shop know which products might be interesting for me?

Learn it in the lecture
"Machine Learning"!

How does an ATM know if I have enough money in my account?

Get to know it in the lecture
"Database Systems"!

What can be done with ones and zeros?

Discover it in the lecture
"Technical Computer Science 2 – Digital Technology"!



How does my smartphone recognize my face?

Find out the answer in the lecture "Artificial Intelligence"!

How do digital signatures work?

Learn it in the lecture
"Introduction into Cryptography 1"!

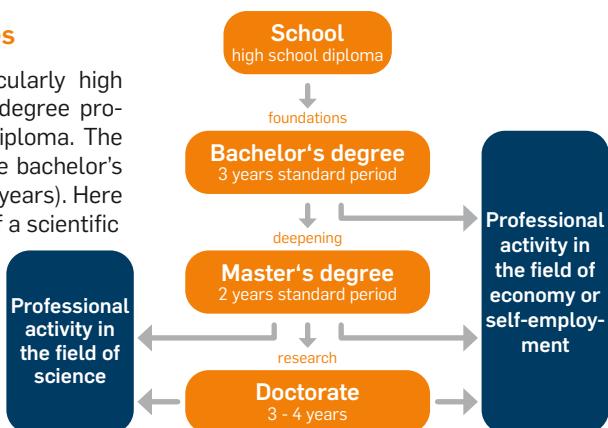
COMPUTER SCIENCES FORMS THE FUTURE

After your studies you will be able to work on new developments and to independently develop systems, to create new technologies, to become a driver of innovation, to take responsibility for future developments and thus to shape the future of society. You will have a fulfilling, dynamic, exciting and lucrative professional life.

INSIGHTS FOR BEGINNERS

First A-Levels, then Studies

If you want to achieve particularly high goals, you start a bachelor's degree program after your high school diploma. The standard period of study of the bachelor's degree is six semesters (three years). Here you will be taught the basics of a scientific discipline. The workload of the entire course accounts to 180 credit points (CP) with an average of 30 CP per semester.



One credit point (also called ECTS) is a "measuring unit" that indicates how extensive a course is. One credit point means that you have to invest about 30 hours to complete the material. When you have successfully completed the entire required 180 CP, you will be awarded a bachelor's degree, in our case the "Bachelor of Science". It qualifies you for a profession and you can choose whether you want to continue with a master's degree program, start your career as a computer scientist in the industry or public service or take the plunge into self-employment by starting your own business.

You will be optimally prepared for continuing your education with a master's degree program. Here you have the choice from a variety of options to deepen your knowledge in your areas of interest. More expertise strengthens your position in the job market, makes you even more indispensable and opens even more doors in the industry. You will also acquire the necessary prerequisites for a doctorate and thus for an academic career.

Computer Science at RUB

Computer science is represented at the Ruhr-University by several research institutes. In addition to the Center of Computer Science, the RUB is home to the world-renowned Horst-Görtz Institute for IT Security. For over 20 years, more than 150 scientists have turned Bochum into Germany's capital of IT security. The "Institut für Neuroinformatik" focuses on natural and artificial cognitive systems (e.g., those realized by artificial intelligence). We accompany about 2,000 young people on their educational path within the following bachelor's, master's and doctoral degree programs:

- Computer Science
- Applied Computer Science
- IT Security
- Mathematics with the minor Computer Science
- Information Technology (as part of the study program Electrical Engineering and Information Technology)

IN HIGH DEMAND

Potential employers

Most innovations in today's society are driven and supported by computer scientists. There is a very high demand for professional training, which, given the current number of graduates, is far from being met. Computer scientists are "in short supply" and in great and steadily increasing demand in all industries. 30 years ago, software companies were typical employers for these specialists. Today, the situation is quite different:

Computer scientists are key specialists in the financial sector, in the engineering sciences, in all governmental agencies, in many production companies or the automotive industry. There is no sector does not need them! Science also has an enormous need for trained computer scientists: At the universities and research institutes, intensive research is conducted to develop new processes and to shape the future!



Excellent support

We are optimally networked, with both industry and science. You can benefit from all the contacts we maintain and cultivate! With our concept IT.Connect365 we integrate you in our network: We have our own job portal for jobs in the IT industry, we help arranging internships, organize our own company contact fairs ITS.Connect and IT.Connect as well as regularly invite company representatives for lectures and organize workshops.

We will also open the door to the world science for you: We give you the possibility to implement explorative learning in the very early stages of your studies, to discuss scientific contributions or to work on research projects as a paid student assistant. You will get in contact with scientific institutions at home and abroad and we will enable you to participate in national and international workshops and conferences. If your goal is to do doctoral studies, we will show you the right way from the beginning and lead you there!

OUR DEGREE PROGRAM

Computer Science (Bsc) at the RUB

Our bachelor's degree program in computer science is a full-time and attendance study program, which takes six semesters. The examination regulations allow you to study part-time for a longer period and thus to adjust the pace of your studies to your individual life situation and performance ability.

Thematically, the course concentrates on the classic core areas of computer science, such as technical computer science, theoretical computer science, algorithms, software development, verification, distributed and networked systems, databases and information systems, artificial intelligence, machine learning and IT security.

The students acquire a broad and theoretically sound fundamental knowledge in computer science as well as important mathematical skills, which are used to model problems and situations. Besides the ability to think analytically, students will also learn practical skills.

The program is offered by the Center of Computer Science (CCS), which is a joint institution of the Faculty of Mathematics and the Faculty of Electrical Engineering and Information Technology. Through teaching-imports from other faculties and scientific institutions, a broad range of subjects is guaranteed. Thus interfaces with other scientific disciplines are created.

Teaching languages: German and English

Computer science is an international discipline and its "official language" is English. Therefore, a goal of the program is to develop the language skills of students by establishing English as a second, equally used, language in the course of study. While the basics in the first three semesters are mainly taught in German, more modules are offered in English in the second half. For the beginning, your school knowledge in English is sufficient as your language skills will be trained and developed through specially designed courses, like English for Computer Science or Presenting and Writing in English, your language skills will be trained and developed. At the end of your studies, it will be no problem for you to write your thesis in English!



Training goals

- Top professional education in computer science
- English as the technical language
- Methodological competence
- Ability for lifelong learning
- Teamwork and project management
- Soft skills and personality development

GOOD REASONS

There are many good reasons to study at the RUB:

At the RUB, all scientific fields are located on one large campus area with over 20 faculties and over 185 degree programs. Although more than 40,000 people study, teach and conduct research here, you will find many quiet and green places to study and relax. The close cooperation between the various institutes breaks down conventional boundaries between subjects. The equipment is great, the hierarchies flat, the atmosphere colloquial and the doors for students are always open. Various student services offer support for all aspects of studying and beyond. In national and international rankings, the degree programs of the RUB occupy top positions. Our graduates benefit from the academic reputation of their university.

Due to Bochum's location in the heart of the Ruhr area, no distance is really far. Many students from the entire Ruhr area and surrounding cities commute daily to Bochum. It is also affordable to rent an own apartment, as the rents are low compared to other university cities. There are many student halls with a wide range of offers from simple rooms to small apartments. Bochum is a genuine student city with tradition. Lively nightlife, a colourful pub scene, many festivals and world-class cultural events are part of everyday life.

More information:

<https://studium.ruhr-uni-bochum.de/en/10-reasons-choose-rub>

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Tip: Study abroad

Studying abroad for one or two semesters is extremely attractive for many students. Who does not want to improve their foreign language skills, gain insights into new fields of research and meet students from all over the world? Studying abroad expands your horizon, allows you to leave your normal routine behind for a while and provides you with soft skills that will be the icing on the cake for your CV.

We maintain an active exchange with many foreign partner universities and will happily advise and support you on planning a semester abroad and during your studies there. A stay abroad is not compulsory in our program but it is designed in a way so that one or two international semesters can easily be integrated.

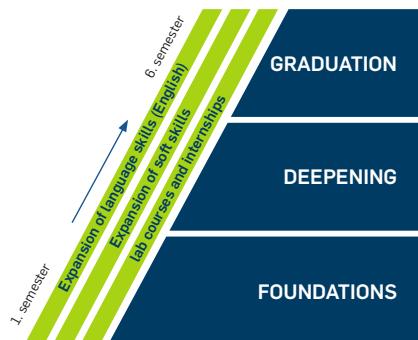
STRUCTURE OF THE CURRICULUM

Basics (mandatory modules in the first three semesters)

At the beginning of the program, the basic modules in the field of computer science, technical computer science and mathematics, as well as distributed systems and software engineering, build the basis of the professional training as a computer scientist. After the first year of study you will have acquired programming as a core competence as well as first basic knowledge in the fields of algorithm development, hardware of IT systems and architectures of distributed systems. In addition, you will gain conceptual mathematical foundations and skills in the use of mathematical software through the mathematical modules of the first semesters.

Specialization (mandatory modules in the fourth and electives in the fifth semester)

The basics of the first three semesters are followed by core areas such as operation systems, database systems, computer networks and artificial intelligence. You can then expand your knowledge in the specialization phase in the areas of formal verification, information systems, machine learning, data mining, web engineering, concurrent programming, system security, cryptography, quantum algorithms or information theory. Here, the theoretical foundations of computer science as well as programming and software developing skills are expanded, basics for practical computer science are laid and connected with the important mathematical building blocks from stochastics. This optimally prepares you for either a scientific master's degree program or the working world.



Final phase (final semester)

The practical training and the bachelor thesis represent the final phase of the study program. In the practical training, e.g. an industrial internship, the knowledge and skills acquired during your course of study will be applied purposefully and practically. Thereby you will have first points of contact with company structures. This phase is an optimal preparation for your professional life. In your thesis, you will independently realize your first scientific project.



1. Semester	2. Semester	3. Semester	4. Semester	5. Semester	6. Semester
Computer Science 3 Programming	Computer Science 2 Algorithms and Data Structures	Computer Science 3 Technical Computer Science	Operating Systems	Specialization Subject	Specialization Subject
		e		e	e
Technical Computer Science 1 Computer Architecture	Technical Computer Science 2 Digital Technology	Technical Computer Science 3 HW-Programming	Computer Networks	Specialization Subject	Specialization Subject
		e		e	e
Mathematics 1 Basics	Mathematics 2 Algorithmic Mathematics	Mathematics 3 Applications	Database Systems	Specialization Internship and seminar	General Studies
		e		e	e
Requirements Engineering	Distributed Systems	Software-Engineering	Programmier-praktika	Industrial Internship	Bachelor thesis
e	e	e	e	e	
English for CS 1	English for CS 2	Presenting in English	Writing in English		
e	e	e	e		

Labelled with e: The lecture is given in English

Labelled with *: The lecture can be chosen from a catalogue

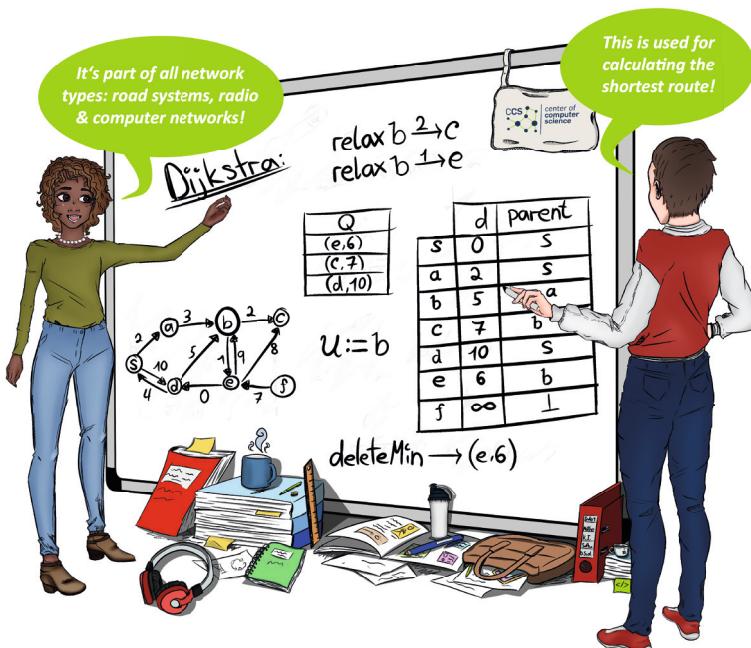
MASTER'S DEGREE: DEEPEN YOUR INTERESTS

Computer science is an extremely dynamic discipline. In order to understand and develop new technologies, firmly anchored knowledge foundations are indispensable. To understand, for example, how navigation systems find the quickest route, you need to be familiar with the underlying graph algorithms, such as Dijkstra's algorithm. You will build these foundations during your bachelor's degree. In its final phase, you will start to choose your area of specialization by choosing advanced courses and the topic of your thesis. However, the in-depth specialization happens in the master's program.

Just as athletes only become professionals in their discipline through intensive training, you will only become a computer science specialist with a further deepening and consolidation of your knowledge. After the bachelor's degree, our international and research-oriented master's degree program "Computer Science" provides you with another four semesters of expertise in various cutting-edge fields. You have the choice and flexibility to create an individual curriculum according to your interests. You can expand your knowledge through a wide range of courses or deepen it in pre-defined areas. In addition, you can prepare yourself for leadership roles through free elective modules in areas such as business, leadership or project management.

- Operating Systems and Networks
- Software Engineering and Programming
- Data and Algorithms
- Artificial Intelligence
- IT Security

Link: <https://informatik.rub.de/master/>



BRIEF INTRODUCTIONS



Software conquers the world: Living without software is hardly imaginable today. In addition to smartphones, computers, (industrial) robots, and cars, more and more everyday appliances, such as refrigerators, are equipped with software. Software companies dominate the markets. Modern software is data-driven, rich in variants and uses technologies such as artificial intelligence. The field of software engineering provides methods and tools that allow software to be developed faster and more automatically. The success of this highly innovative field depends on highly creative developers that we train here at the RUB.

Prof. Dr. Thorsten Berger

Professorship for Software Engineering

We live in a digital age; data about our world is available at the push of a button. This data is a valuable raw material, that, with the right tools, we can use to improve our health, our businesses and our society. Managing data has become a key discipline, that drives my research and involves many unsolved challenges: Data comes in many different forms, meanings and qualities. Often, data lacks structure or contains inconsistencies, so that the insights to be gained from it are impaired. Therefore, the challenge is to develop new data management techniques that combine efficient access with quality enrichment to be able to deliver fast high quality data.



Prof. Dr. Maribel Acosta

Professorship for Databases and Information Technology



Our research also contributes to climate protection: It is often forgotten that IT systems also consume a lot of energy – be it a single search query on the Internet, watching an episode on Netflix or even receiving an e-mail. The rapidly advancing digitalization of our society urgently requires energy-conscious system software for efficient computer systems. Operating systems must evaluate the energy requirements of the respective hardware infrastructure and use this information in the scheduling of software activities and the control of hardware components (e.g. CPUs). It is our task, to investigate and develop energy-aware systems.

Prof. Dr. Timo Höning

Professorship for Operating Systems and System Software

KURZ BERICHTET



From search engines to navigation devices - it is almost impossible to imagine our lives without algorithms, from search engines to navigation devices. Much data has a spatial component and nowadays more and more data of this kind is being generated. Analyzing this is an exciting challenge to which I would like to contribute with my research. In particular, I am concerned with algorithms for geometric problems, for example: How can I reconstruct the road network from a large amount of data of vehicles in the city? Or: How can I measure the quality of such a road network? There are still many exciting questions open here and new ones that are worth investigating are always appearing.

Prof. Dr. Maike Buchin

Professorship for Theoretical Computer Science

What fascinates me? Everything is connected! Networking is the backbone of distributed systems and we rely on its smooth functioning. Without high-performance data communication, many of today's indispensable services, such as video streaming or the financial system would not even exist. In order to drive this development forward, we must be able to understand and control the complex interdependencies in the interaction of networked individual systems. In my research, I strive to master the challenges in distributed and networked systems, which is a very exciting task.



Prof. Dr. Steffen Bondorf

Professorship for Distributed and Networked Systems



My research area is the safety of complex systems, both from an attack and defense perspective. My courses, such as system security, program analysis and operating system security are also in this topic area. Developing secure and trustworthy systems is one of the biggest challenges in modern computer science. I recommend studying computer science to young people because computers, the Internet, machine learning and similar topics will increasingly gain importance in the future. Computer science is a fascinating field of study, you can specialize in the subject area you find most interesting and fulfil yourself.

Prof. Dr. Thorsten Holz

Professorship for System Security



Learning through algorithms, also known as machine learning, is one of the most important methods of artificial intelligence. For future developments, it is crucial to understand the basic computational principles of learning. Today, machine learning is already influencing our lives. Our browser shows us adverts for products we are interested in, our smartphone recognizes our face, technical systems understand our language, interpret the content and even translate it. Much more will be possible in the future: Get involved and shape the new developments!

Prof. Dr. Asja Fischer

Professorship for Machine Learning

How can the correctness of software and hardware be formally verified? How can database queries be answered more quickly? How can knowledge be stored in such a way that it can be used easily? In answering those questions, methods from the field of theoretical computer science, in particular from the field of logic play a major role. I am fascinated by how theory and practice interact to solve important problems. In my courses you will learn how to use means of logic to understand and solve the challenging problems from different areas of computer science.



Prof. Dr. Thomas Zeume

Professorship for Logic and Formal Verification



The human factor is at the center of my research and my courses. I investigate how user requirements have to be taken into account during software development, how people optimally interact and communicate with automated systems or what role the human factor plays in the security of IT systems. We also conduct various field studies at our chair. The interdisciplinary research at the interface between technology, psychology and economics is very important. We need many young people to carry out research in this area, it is very exciting!

Prof. Dr. Martina Angela Sasse

Professorship for Human-Centred Security

YOUR PATH TO OUR STUDY PROGRAM: APPLICATION AND ENROLLMENT

Did you finish school in **Germany**?
Information for national prospective students

1. Requirements

Abitur

or an equal school leaving certificate

+

English

level B2, English in the Abitur is sufficient

2. Application

Our study program is **admission-free**, there is **no numerus clausus (NC)**: Everyone that meets the admission requirements can enroll into the course. There is no tuition fee, only a social contribution of approximately 340 euros is due after enrollment.

You can directly enroll into our study program. No application is necessary.

3. Enrollment (Matriculation)

The enrollment takes place online within the designated deadline, which is usually August and September. You have to enter your data in the portal "Online Immatrikulation" of the Student Office and then upload the required documents.

Online-Immatrikulation (online enrollment): <https://online.uv.ruhr-uni-bochum.de/>

Deadlines: <https://studium.ruhr-uni-bochum.de/de/semesterfristen>

Did you finish school **outside of Germany**?
Information for international prospective students

1. Requirements

University entrance qualification

+

English

at level B2

+

German

at level C2

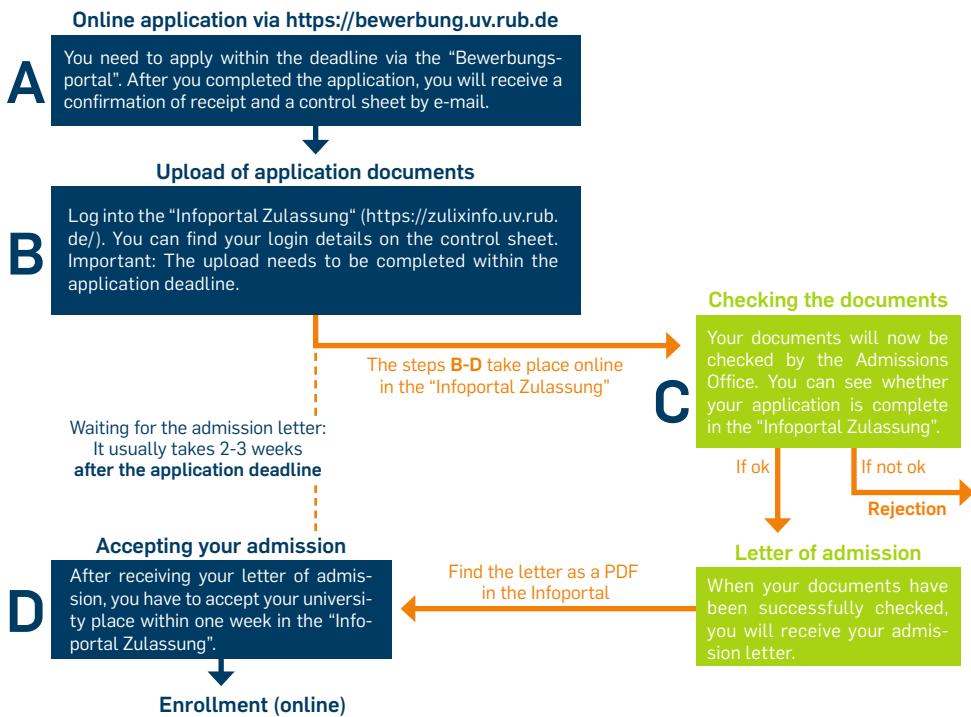
Accepted language certificates:

For English: UNICert II, IELTS academic with grade 6,0 or more, TOEFL IBT with 85 points or more, PTE academic with 55 points or more, FCE (First Certificate in English), CAE (Certificate in Advanced English), CPE (Certificate of Proficiency in English)

For German: TestDaF with at least 16 points within one exam, DSH (level 2 or 3), Deutsches Sprachdiplom - DSD - II, ZOP resp. Goethe-Zertifikat C2 of the Goethe-Institut, KDS or GDS of the Goethe-Institut, ÖSD-Sprachdiplom C1, telc Deutsch C1 Hochschule, Feststellungsprüfung (exam section German)

2. Application for international students

Although the B.Sc. Computer Science is admission-free, international students must apply for the study program within the application periods (normally beginning of June until mid of July) via the online application portal (German: "Bewerbungsportal") of the university: <https://bewerbung.uv.ruhr-uni-bochum.de>. Upon the application, the admission office checks if the requirements are met. The process is sketched in the following page.



3. Enrollment (Matriculation)

The enrollment is done online within the designated deadline given in your admission letter, which is usually August and September. You have to enter your data in the portal "Online Immatrikulation" of the Student Office and then upload the required documents. Follow the instruction given while going through the enrollment process.

Online-Immatrikulation (online enrollment): <https://online.uv.ruhr-uni-bochum.de/>
Deadlines: <https://studium.ruhr-uni-bochum.de/de/semesterfristen>

The Admissions Office of the university supports you with all questions concerning admission. You can reach them via e-mail (admission@uv.rub.de) or via the applicant hotline +49 234 32 26644.

International Office: The ISS (International Student Services) supports all international students in a variety of ways, e.g. with visa matters, with the search for accommodation, with comprehensive information at the orientation days etc.
More information: <http://international.rub.de/rubiss>

More information for prospective international students:
<https://studium.rub.de/de/bewerbung-fuer-internationale-studieninteressierte>



SERVICE

Service throughout the life cycle of the program

We offer tailored support for every phase of your studies:

After your studies
& interface studies-job

During your studies

Tutorials | mentoring programs | student advisory | personal office hours with the lecturers | helpdesk | offers of the student body | company contacts | seminars and coachings | exchange programs and many more

Start of your studies

Pre-courses | welcoming days | information events | tutorials | helpdesk

Company contact fair | application coaching | events and networking possibilities for former students (alumni) | own job exchange

if needed,
you can get
a laptop on loan
from us

→ So that you do not have to jump in at the deep end, the pre-courses offer in three coordinated formats the best preparation for your computer science studies.

Pre-course

Pre-course Computer Science (week 1-2): You haven't had a good opportunity to get into programming yet? We offer you an exciting introduction to programming. At the end of the course, you will have learned a programming language, have understood its underlying logic and have written your own first program.

Pre-course Mathematics (week 3-5): Here we provide you with a refresher for your math skills and prepare you for the university mathematics for computer scientists. This is also a good opportunity to get to know the typical format of lectures and exercises.

Tutorial & helpdesk

Accompanying the start of your studies there is a tutorial where you will be supported by experienced students and get answers to all your organizational questions. In addition, you will find content-related help at the helpdesk which is offered daily. The tutorial accompanies you during the pre-course and your entire first year of study.

<https://informatik.rub.de/bsc/info/vorkurs/>

CONTACT

Student advisory for the subject “Computer Science”

Our Student Advisory Service provides competent, binding and confidential support to prospective and our existing students. Whether you have a short question or you need a detailed consultation tailored to your personal situation – we are here for you! All common communication channels are available to you: In person on site, by telephone, by e-mail or via video conference (e.g. via Skype or Zoom).



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Student body

The term "student body" basically refers to all students of a subject or a department. The students of computer science are organized together with the students of mathematics in the student body "Mathematics and Computer Science". Often, the student representatives (similar to a student council) are meant by the word student body.

The student representatives are there for you if you have questions or problems concerning your studies. They stand up for your opinion and help where they can. If you are interested in studying, you can also contact them and ask questions about your studies. They will be happy to help you!



Website:

<https://www.rub.de/fsr-mathe/>

E-Mail:

fsr-informatik@rub.de

Central student advisory service of the RUB

Website: www.rub.de/zsb

E-Mail: zsb@rub.de

The Central Student Advisory Service ("Zentrale Studienberatung" or "ZSB") advises and supports students on their way to university and accompanies them in all phases of their studies. Whether it is a matter of helping with a potential analysis to find the right study subject, finding your way through the numerous offers on campus, finding the right financing options or finding a place to live in Bochum, the ZSB advisors are there for you.

CENTER OF COMPUTER SCIENCE (CCS)



INTENSIVELY NETWORKED

The CCS connects all working groups at the RUB that are active in the field of informatics and computer science in a unique way. It combines the research strength of excellent basic research and research in cutting-edge application fields. The CCS is jointly run by the Faculty of Mathematics and the Faculty of Electrical Engineering and Information Technology as a scientific institution.

EXCELLENT RESEARCH

The CCS members cover a broad range of modern computer science with their research. Especially core areas such as algorithms, distributed systems, database systems, software engineering, machine learning or IT security are in focus. The worldwide recognized Horst-Görtz Institute for IT Security (HGI) is also part of the center.



FUTURE-ORIENTED TEACHING

Our degree programs always have their finger on the pulse of time. In addition to a solid basic education, they include an extensive range of lectures concerning cutting-edge research topics and interact profitably with other disciplines. With our bilingual (German & English) teaching offer and international exchange programs, we support internationality.

UNIQUE IN STRUCTURE & INTERDISCIPLINARITY

Through international exchange and extensive scientific expertise, more and more synergy effects are created. The success of the resulting direct technology transfer is worldwide visible and recognized. Great emphasis is put on networking with the industry!

