



Freie Universität Bozen
Libera Università di Bolzano
Università Lìedia de Bulsan

Faculty of Computer Science

PhD programme in COMPUTER SCIENCE

Duration: 4 years

Academic year: 2020/2021

Start date: 01/11/2020

Official programme language: English

Website: <https://www.unibz.it/en/faculties/computer-science/phd-computer-science/>

Programme contents:

The aim of the PhD programme is to allow students to acquire the abilities and skills to carry out independent research in the area of computer science. This also involves the ability to communicate ideas clearly and efficiently orally and in writing and the ability to work in groups.

In order to conclude the programme successfully, the PhD student has to elaborate a research topic independently and this research must contribute significantly to current knowledge in the area of computer science. Due to the time limits of the programme, PhD students will focus on their research work. To achieve this, they are supported by a structured PhD programme.

In the following, this structure is described in detail together with the procedures for the nomination of the supervisor, the definition of the research and study plan, and the examinations:

- The programme is divided into five phases, which end at months 6, 12, 24, 36, and 48 respectively.
- For each PhD student, the PhD Course Committee nominates a supervisor, who is preferably chosen among its members. It can also nominate a co-supervisor who can provide additional support.
- Together with their supervisor, each student sets up a *Research and Study Plan*, which defines the research goal and the steps to achieve it. The latter include subjects where the student needs to deepen their expertise. The Research and Study Plan is updated continuously, taking into account both the progress that has been made and new developments that arise in the area of research during the course of the PhD work.
- There are five milestones at the end of the five phases at which students report on their work and at which the PhD Committee assesses their progress. The updated Research and Study Plan is one of the deliverables for each milestone.

In the following, we provide a more detailed description of the five phases:

Phase 1 covers the first six months. During this period, the student identifies with the support of his or her supervisor the area of research, a specific topic within the area, and one or more possible approaches to the topic. The student acquires the necessary foundations for carrying out the research, for instance, by way of attending courses or through supervised literature studies. The supervisor will introduce the student to the relevant research activities at the faculty.

Phase 2 comprises the second half of the first year. The student spends time both on the acquisition of skills and on first research steps.

Phase 3 comprises the second year, and is to be spent on an in-depth exploration of the research topic.

Phase 4 comprises the third year, and is to be spent on continued exploration of the research topic.

Phase 5 comprises the fourth year, and the aim is to complete the research and to present it in a thesis.

Research areas

Research at the Faculty of Computer Science spans three main research areas, which are being developed by research groups on a long-term basis. Within these three research areas, the group members investigate the following specific topics:

Information and database systems engineering:

1. DATABASE TECHNOLOGIES FOR SPATIAL AND TEMPORAL DATA
2. TIME SERIES ANALYTICS FOR INDUSTRY 4.0
3. APPROXIMATION TECHNIQUES IN DATABASES
4. QUERY OPTIMIZATION IN DATABASES
5. DATA MINING AND MACHINE LEARNING FOR PERSONALIZATION
6. INFORMATION ACCESS, DECISION SUPPORT AND RECOMMENDER SYSTEMS
7. HUMAN-COMPUTER INTERACTION
8. INTERACTION DESIGN
9. EDGE COMPUTING ARCHITECTURES AND PLATFORMS
10. COMPUTATIONAL MATHEMATICAL AND HIGH-PERFORMANCE SCIENTIFIC COMPUTING
11. IoT AND SENSOR DATA MANAGEMENT AND ANALYTICS

Knowledge representation and databases:

1. LOGIC-BASED LANGUAGES FOR KNOWLEDGE REPRESENTATION
2. INTELLIGENT DATA ACCESS AND INTEGRATION
3. SEMANTIC TECHNOLOGIES
4. CONCEPTUAL AND COGNITIVE MODELLING
5. DATA-AWARE PROCESS MODELLING, VERIFICATION, AND SYNTHESIS
6. BUSINESS PROCESS MONITORING, MINING, AND CONFORMANCE
7. TEMPORAL ASPECTS OF DATA AND KNOWLEDGE
8. EXTENDING DATABASE TECHNOLOGIES
9. VISUAL AND VERBAL PARADIGMS FOR INFORMATION EXPLORATION
10. REASONING WITH UNCERTAIN AND IMPRECISE KNOWLEDGE

Software and systems engineering:

1. EMPIRICAL SOFTWARE ENGINEERING
2. MINING SOFTWARE REPOSITORIES
3. SOFTWARE RELIABILITY AND TESTING
4. AUTOMATIC IMPROVEMENT AND EMPIRICAL INVESTIGATION OF SOFTWARE QUALITY ATTRIBUTES
5. RECOMMENDATION SYSTEMS IN SOFTWARE ENGINEERING
6. SOFTWARE SYSTEM BEHAVIOR
7. SOFTWARE EVOLUTION AND MAINTENANCE
8. SOFTWARE ENGINEERING EDUCATION
9. AGILE AND LEAN PROCESSES
10. LEAN STARTUP AND SOFTWARE STARTUPS
11. DEPENDABLE IoT, EDGE AND CLOUD COMPUTING
12. SOFTWARE ARCHITECTURE

Among these topics, the following research projects are being proposed:

Possible research projects and respective supervisors	
Title	Supervisor
Virtual Knowledge Graphs	Diego Calvanese

High quality open data publishing	Diego Calvanese
Semantic technologies for data and process management	Diego Calvanese
The Mathematics of Machine Learning and Artificial Intelligence	Bruno Carpentieri
High-Performance Scientific Computing and Parallel Algorithms for Data Science and Graph Analytics.	Bruno Carpentieri
Controllability Analysis of Complex Biological Networks	Bruno Carpentieri
Closing the digital divide: computer-mediated communication in older age	Antonella De Angeli
Closing the digital divide: towards an inclusive education in the virtual classroom	Antonella De Angeli
Closing the digital divide: gender, age and race in Computer Science	Antonella De Angeli
Database technologies for temporal data	Johann Gamper
Techniques for advanced time series analytics	Johann Gamper
Efficient join algorithms in databases	Johann Gamper
Enterprise architecture and business modeling	Giancarlo Guizzardi
Ontology-driven conceptual modeling	Giancarlo Guizzardi
Foundational Ontology and Commonsense Reasoning	Giancarlo Guizzardi
Question answering from news article archives	Adam Jatowt
Extracting action-related knowledge from text	Adam Jatowt
Novel information retrieval and access methods for news collections	Adam Jatowt
Business rule mining	Fabrizio Maggi
Process-oriented predictions and recommendations	Fabrizio Maggi
Robotic Process Automation	Fabrizio Maggi
Artificial Intelligence for Process Management	Marco Montali
Modelling, Verification, and Mining of data-aware processes	Marco Montali
Process mining	Marco Montali
Generation of Fine-Grained Knowledge Graphs from Natural Language	Werner Nutt
Data Profiling for Knowledge Graphs	Werner Nutt
Learning to Schedule Business Processes	Werner Nutt
Software architecture and performance engineering	Claus Pahl
Cloud and IoT systems and technologies	Claus Pahl

Software engineering education and educational technology	Claus Pahl
Group conversations mining and supporting	Francesco Ricci
Integrated models of on-line and off-line customer behaviour	Francesco Ricci
Choice modelling and support with recommender systems	Francesco Ricci
Software maintenance and evolution	Romain Pierre Robbes
Machine learning and transfer learning on software repositories	Romain Pierre Robbes
Tools to increase software developer productivity	Romain Pierre Robbes
Explanations and transparency in recommender systems	Markus Zanker
Persuasive information systems	Markus Zanker
Online decision support systems	Markus Zanker
Internet of Things Design	Rosella Gennari
Child Computer Interaction	Rosella Gennari
Design, Computing and Making in Education	Rosella Gennari
Logic and cognition	Oliver Kutz
Computational creativity / Conceptual blending	Oliver Kutz
Cognitive robotics and common sense	Oliver Kutz
Matrix and tensor factorization in social media	Panagiotis Symeonidis
Link prediction in heterogeneous information networks	Panagiotis Symeonidis
Session-based recommendations	Panagiotis Symeonidis
Software startups and lean startup methodology	Xiaofeng Wang
Agile and lean software development methods and practices	Xiaofeng Wang
Innovation in software business	Xiaofeng Wang

Admission requirements

Italian degrees

Degree from the old Italian system: all

Master (*laurea specialistica/magistrale*): all

Foreign degrees

Applicants who have obtained their degrees abroad must have a university education of at least five years duration and fulfil the prerequisites listed below.

Other requirements:

In order to apply for the PhD programme in **COMPUTER SCIENCE** applicants must have sufficient knowledge of English.

The prerequisites for admission to doctoral programmes include having acquired an appropriate educational degree, and/or have worked in the PhD course fields, in particular being able to demonstrate a deep knowledge of the fundamental techniques and methods used in computer science. Qualifications in Computer Science, Computer Engineering, Information or Electronic Engineering are preferable.

Admission to the program is based on the assessment of applicants through:

- CV and academic qualifications;
- English language level (at least B2);
- their research exposé;
- Interview.

A. DOCUMENTATION REQUIRED

To apply to the PhD programme, applicants must include the following documentation, otherwise excluded:

- Diploma supplement or certificate with exams list of Master degree: see art. 3 of the "Call General Part" for the **admitted documents**;
- Curriculum vitae (CV) (in English and possibly following the EU format that can be downloaded here <https://europass.cedefop.europa.eu/en/documents/curriculum-vitae>). If available, please indicate your ranking within your graduating cohort. ATTENTION: include in the contact information also your skype id;
- Research exposé ** (=in English as a PDF file, no **longer than two pages** in total, digital format);

** *The **Research exposé** (RE) is a document that should convince the selection committee that you are -supplementing the more formal certificates and achievements - a promising candidate, who has clear ideas about why to pursue your research as well as about your envisioned career after successfully passing the PhD. One aspect of this is the description of a research activity (this should be no more than one page in length), which can be either a current or recent research activity (e.g. your master thesis), or a research activity that you envision carrying out during your Ph.D. You should also explicitly indicate in the RE which of the research topics proposed by faculty members you are interested in, and whether you are also interested in the research topics proposed by our external parties. Last but not least you may mention why you think unibz and our faculty is the right place for all of the aforementioned.*

Other documents to be included in the application if available:

- list of publications with related links, if applicable (up to a maximum of 3 publications from the past 5 years);
- up to a maximum of 3 reference letters provided by the applicant's work or research supervisors, describing the work carried out and the quality of the same (*the letters MUST be signed in original and scanned!*).

B. LANGUAGE REQUIREMENT

The official teaching language is English. Therefore, the following language requirements apply, otherwise you will be excluded from the admission procedure:

Entry level (to gain admission)

English: B2

The levels of the Common European Framework of Reference apply.

You can demonstrate your language proficiency in the application portal (in the section "upload language certificates" and/or "enrol for language exams") after you have created an application in the section "create/manage applications".

- In case your final certificate has been awarded by an **Italian** public institution, you need to submit a self-declaration.
- In case your final certificate has been awarded by a **foreign** public institution, you need to upload diploma scanned copy of the original.

You can demonstrate language proficiency through:

1. **the main teaching language in your final high school year** if English (recognised as C1)
2. **a bachelor or master degree** in English (recognised as C1). unibz graduates must upload the language certificates obtained and/or declare that they have passed language exams at the unibz Language Centre (B2, B2+ or C1)
3. **a recognised language certificate** (see the list of [recognised certificates](#)) If you cannot upload the certificates, you can send them by e-mail as PDF files or deliver them in person to the Language Centre by the application deadline (see "Deadlines" section).
4. **language exams organised by the unibz Language Centre**. You can register for these exams online through the application portal (in the section "enrol for language exams") after you have filled out your application in the section "create/manage applications". The registration periods are indicated in the "Deadlines" section. If you start your application outside a language exams registration period, you must return to the portal during one of the periods indicated above in order to register for an exam.

Information regarding the structure of the language proficiency exams, their duration, their administration, and typical processing time for the publication of the results can be found on the following webpage: <https://www.unibz.it/en/services/language-centre/language-exams/>

C. EVALUATION CRITERIA for examinations and/or qualifications:

The selection is based on:

- the evaluation of each applicant's profile as specified in the curriculum, the study titles and the research exposé;
- the coherence between the curriculum and the research areas in the call;
- the evaluation of the reference letters and the publications, and
- an interview.

The following points will be awarded:

- up to a maximum of 50 points for the curriculum, qualifications and publications:
 - *Educational and working curriculum (up to 35 points)*
 - *Experience abroad, participation at summer schools and conferences, contribution to research projects, scholarships (up to 10 points)*
 - *Publications (up to 5 points)*
- up to a maximum of 5 points for the reference letters;
- up to a maximum of 10 points for the research exposé and for the coherence between the curriculum and the research areas in the call.

The Evaluation Committee will select the best applicants on the basis of a comparative assessment. For those applicants that satisfy the pre-requisites (reported in the general call document), the Evaluation Committee will first evaluate the applicant's application documents, which include the curriculum vitae, their qualifications, including publications and reference letters (if any), the research exposé and the coherence between the curriculum and the proposed research areas.

Candidates that have obtained at **least 45 points** in the evaluation of their application documents will be admitted to the next stage of the selection process. This will consist of an interview in which also the knowledge of English of the applicant will be assessed. The interviews will take place in video-call (Skype, MS Teams, etc.). Up to a maximum of 35 points will be awarded for the interview.

INTERVIEW dates

Description	Date	Place
Personal Interview	On 24 July 2020 (if needed also on 23 July)	ONLINE interviews

The precise date and time of the interview will be communicated per email **by July 21, 2020**.

The *final score* is the sum of the score for the evaluation of the application documents, and of the score for the interview. The maximum score is 100.

Applicants that have obtained a final score of **at least 70/100** are considered *eligible*. Eligible applicants will be ranked according to their final score. The top eligible applicants will be admitted according to the number of available places with and without grant, according to their order in the ranking list. The remaining eligible applicants will be put on a waiting list. Applicants in the waiting list will be admitted to the program in case an already admitted applicant is not available or withdraws their application.

The ranking list will be published on the website of unibz by August 07, 2020.

Grants funded by external parties

For grants funded by external parties, the candidate, if interested in, **must indicate this in the research exposé**, by mentioning the specific topics and motivating why they are interested in the topic associated to the grant.

The candidate interested in topics funded by external parties must clearly indicate such topics in the research exposé (see the above description of the research exposé). For these grants, a separate ranking lists will be established containing candidates who are also eligible according to the general ranking and who in addition have a scientific profile that is particularly suited to the specific topics associated to these grants.

D. PHD POSITIONS AND GRANTS

Total PhD positions: 21 places

PhD positions with grants from University: 12 places

A specific group of topics is associated to **3 unibz grants**

<i>Group of Topics related to the grants</i>	<i>Positions</i>	<i>Funding body</i>
<ul style="list-style-type: none"> • Virtual Knowledge Graphs over Graph Structured Data • Virtual Knowledge Graphs over Nested Data • Virtual Knowledge Graphs over Streaming and Temporal Data • Virtual Knowledge Graphs for Data Analytics • Annotations for Data Management in Virtual Knowledge Graphs • Cost-based Optimization for Query Processing in Virtual Knowledge Graphs 	3	UNIBZ Referent: Prof. Diego Calvanese

PhD positions with grants funded by external parties: 6 places

PhD positions with grants of partner in agreement (FBK): **3 places**

<i>Topic related to the grants</i>	<i>Positions</i>	<i>Funding body</i>
Multi-perspective process mining	1	FBK - Fondazione Bruno Kessler (TN) Referent: Dr. Chiara Di Francescomarino
Computational models of human behaviors	1	FBK - Fondazione Bruno Kessler (TN) Referent: Dr. Bruno Lepri
Data-driven Conversational Agents	1	FBK - Fondazione Bruno Kessler (TN) Referent: Dr. Bernardo Magnini

PhD position with other grant of partner in agreement (CNR and NOI AG): **1 place**

<i>Topic related to the grants</i>	<i>Positions</i>	<i>Funding body</i>
<ul style="list-style-type: none">Design and implementation of a system based on "Virtual Knowledge Graphs" for the use of open data related to cultural heritage*	1	CNR – Consiglio Nazionale delle Ricerche and NOI AG Referent: Dott. Claudio Masolo

*Study place and scholarship available after activation of the agreement between unibz and CNR

PhD position with other grant of partner in agreement (COVISION LAB): **1 place**

<i>Topic related to the grants</i>	<i>Positions</i>	<i>Funding body</i>
<ul style="list-style-type: none">Computer Vision and Deep Learning	1	Covision Lab SCARL (Bressanone - BZ) Referent: Dott. Franz Tschimben

PhD position with other grant of partner in agreement (SIAG): **1 place**

<i>Topic related to the grants</i>	<i>Positions</i>	<i>Funding body</i>
<ul style="list-style-type: none">Data science and Data ManagementSecuritySoftware and Process ModernisationIntelligent Decision Support	1	SIAG – Informatica Alto Adige S.p.A. Referent: Dott. Stefan Gasslitter

PhD positions without grant: 3 places