Training Programme of the Doctoral School of Computer Science of the University of Szeged

This information pertains to doctoral students starting their studies in the 1st semester of the academic year 2016/2017 or later.

1. The admission procedure (looking for excellence)

The webpage of the Doctoral School gives an introduction of its members, describes the structure of education and research, and lists the current research topics of the given semester. Students can apply for the current research topics as part of the structured programme, or as individual students. As the first step of the admission procedure, the University of Szeged and its Faculty of Science and Informatics informs the public via different media and institutions of higher education that its Doctoral programme is open for admission. The supervisors of the topics at the Doctoral School also personally contact their talented students about the possibilities of continuing their education at the Doctoral School.

The exam syllabus describing the topics of the oral entrance exam can be found on the homepage of the School. This syllabus is based on the core subjects taught at the computer science programs of universities. Students applying for admission have to mark their field of interest and enter their former achievements on the data sheet, after which the admission committee assigns each student two subjects for the entrance exam. Students have to take an oral examination in those subjects; the Council of the School appoints an Admission Board of at least three members to evaluate these exams. The primary goal of the entrance exam is to find out whether applicants are able to meet educational requirements and to acquire a Doctoral degree.

The Admission Board ranks applicants based on the evaluation system described in the Doctoral Regulations of the Faculty of Science and Informatics of the University of Szeged. The Council of the Doctoral School defines which applicants get admitted to the state-funded scholarship program, based on the ranking and the number of students the state fully supports. In case of self-funded applicants and applicants funded by some other authority or institute only suitability for the programme has to be considered.

The details of the admission of individual students is described in the Operational Regulations.

2. The Process of Doctoral Studies

The structured doctoral programme of the University of Szeged can be accomplished as a full-time training or as a correspondence course. This latter provides a possibility for those already working to obtain a doctoral degree

After the common enrolment procedure of the Faculty, the head of the Doctoral School welcomes first year students. He delineates the structure of the School and the educational and research programmes, the requirements, and the regulations governing the doctoral training programme and the awarding of the doctoral degree. He also presents the documents describing these issues in detail – these are available on the webpage of the Doctoral School.

Before the start of the semester, after consulting with their supervisors and the lecturers of the PhD courses, students have to choose a number of courses for the given semester. The Council of the Doctoral School is responsible for the availability of these courses.

Students make a written report about their work at the end of each semester. These are evaluated by supervisors and also reviewed by the Head of the Doctoral School.

3. Regulations governing the Doctoral Training Programme and the examinations

Each semester, the lecturers of the School, or if necessary, Hungarian or foreign cooperative partners hold PhD courses. These courses are planned taking the research area of students into consideration. During the organised training each student has to complete at least 5 courses. Appendix 1 contains the list of courses compiled by the lecturers of the School. This list can be broadened, upon approval of the Council of the Doctoral School; keeping the syllabus up to date is a permanent task of the School.

4. The Credit System

The credit system of the Doctoral School, compliant with the Doctoral Regulations of the University of Szeged, assures the principle of uniform assessment, and the transparency and consistency of the system of requirements. The following credit points can be obtained by students.

COMPULSORY MODULES TO CHOOSE FROM:

Research module: – Credit

Participation in research seminars (2 classes weekly)	3
Holding a lecture at a research seminar*	5
Holding a lecture at a Hungarian conference*	5
Holding a (foreign language) lecture at an international conference*	10
Accepted publication*	10
Research work	20
Professional practice abroad	15

The Accepted publication course can be accomplished by verifying the acceptance of the publication. The supervisor declares, whether the student's contribution is worth 10 credits of work. The Research work and the Professional experience abroad courses are evaluated by the supervisor, based on the written report of the student.

Courses marked with an * can be completed more times within a semester. Those without a * can be completed only once per semester.

Training module: visiting the courses of the given semester

Each course is worth 5 credits. Requirement: terminal exam

Education module: – Credit

Holding practical classes/labs (1 class weekly)	2
Holding practical classes/labs (2 classes weekly)	4
Holding practical classes/labs (3 classes weekly)	6
Holding practical classes/labs (4 classes weekly)	8

Educational credits can only be obtained by teaching at the Institute of Informatics of the University of Szeged.

Credit requirements for obtaining a pre-degree certificate: During the eight semesters students have to collect a minimum of 240 credits, as follows:

- a minimum of 20 and a maximum of 45 credit points must be obtained each semester

- minimum 140 credits from the Research module,
- minimum 25 credits from the Training module, at least 15 of which must come from theoretical courses
- by the end of the fourth semester, at least 5 courses must be completed from the Training module
- maximum 48 credits from the Education module.

At the beginning of each semester students have to consult their supervisors, and take up courses offered by the Council in a way, so that by the end of the fourth semester they will have completed at least 5 courses.

5. The comprehensive exam

At the end of the fourth semester the student takes an open, comprehensive exam before the committee. The students must have at least 90 credits and must have completed all training credits to register for the comprehensive exam. Individual students are an exception, as their registration for the comprehensive exam~~,~~ and the acceptance of that registration mean their enrolment for the programme.

The comprehensive exam has two main parts: during the first part the theoretical knowledge of the student is assessed ("theoretical part"), while in the second part the student gives account of his/her scientific progress ("dissertation part"). During the theoretical part, the student takes exams in one major subject/topic and in one minor subject/topic. The subjects/topics are listed in Appendix 1. The theoretical exam may also have written part. In the second part of the comprehensive exam the student holds a lecture, giving account of his/her knowledge about relevant scientific literature and his/her research results, and describing his/her research plan for the second part of the doctoral training, and the schedule for writing the dissertation and publishing the results.

The examination committee evaluates the theoretical and dissertation part of the exam separately. A report, containing a literal assessment, is made of the comprehensive exam. The result of the examination must be announced on the day of the oral exam. The comprehensive examination is successful, if the majority of the committee members consider both parts of the exam successful. If the theoretical part is unsuccessful, the student can repeat the exam in the unaccomplished subject(s) once in the given examination period. In case of failure of the dissertation part, the exam cannot be repeated.

6. Research Programme of the Doctoral School

The research programmes of the Doctoral School can be divided into the six main categories below. Within each category the regularly available research topics are listed.

Theoretical Computer Science

Structural theory of automata, composition and decomposition of automata. Tree automata and tree languages, tree transducers. Algebra of languages and tree languages. Term rewriting systems. Multidimensional languages. Automata and semirings, formal power series. Automata and formal logic. Formal semantics. Algebra of concurrent processes. Fixed points in computer science. Iteration theories. Categories in computer science. Grammar systems, formal language models of distributed and cooperative systems. DNA computing, molecular computer science.

Operations Research and Combinatorial Optimization

Theory of economic decision making (multifactor decision making, group decision making). Fuzzy theories. Learning algorithms. Global optimization. Reliable numerical procedures. Optimization in chemical phase-balance tasks. Interval inclusion functions. Process network synthesis. Bin packing algorithms. On-line algorithms. Scheduling problems. Set partitioning. Logistics / Supply planning tasks

Software development

Advanced programming paradigms. Theory of Compilers. Effective compilation of embedded mobile systems. Legacy system analysis. Software maintenance. Program slicing and its applications. Software reengineering. Object-oriented design and development (C++, JAVA). Web programming (XML). Databases, data mining. Network protocols. Testing of protocols. Formal specification of protocols. Common memory parallel programming. Shared memory parallel programming. Software development.

Artificial intelligence

Machine learning algorithms (decision trees, genetic algorithms, neuron networks). Complexity of learning algorithms. Speech recognition. Natural language processing. Frame and rule based knowledge representations. Peer-to-peer networks.

Image processing

Image reconstruction from projections. Discrete tomography. Medical image analysis. Image segmentation. Image registration and fusion. Computer vision. Skeletonization, thinning and their applications. Discrete geometry and topology.

Technical informatics

FPGA based emulated-digital CNN-UM implementation, FPGA based image and signal processing. Sensors, sensor networks, embedded systems, sensor based signal processing. Robotics, trajectory tracking, pneumatic artificial muscles, fuzzy control. Noise and fluctuations in different systems, applications of secure communication. Software instrumentation.

Appendix 1. Subjects taught at the Doctoral School

The School teaches the following six subjects/topics. Each subject is made up of courses. The list of courses can be expanded with the consent of the Council of the Doctoral School. If a subject qualifies as a major subject of the comprehensive exam, then two courses belonging to the subject will make up the exam; if it is a minor subject, the exam will focus on one course.

Algorithms and Artificial Intelligence

Algorithmic geometry
Machine learning methods
Combinatorial geometry
Analysing bin packing algorithms
Artificial neuron networks
Self-organizing systems
Parallel algorithms
Peer-to-peer and self-organizing algorithms
Computational learning theory
Selected topics of artificial intelligence
Randomised algorithms

Theoretical Computer Science

Algebraic examination of programming semantics
Attribute grammars
Automata and formal logic
Composition of automata
Introduction to the theory of automata and formal languages
Introduction to universal algebra with computer science applications
Theory of complexity
Tree automata
Combinatorial methods in theory of complexity
Context-free languages and their syntactic analysis
Logics in computer science
L systems
Quantum computing
Model checking
Molecular computer science and formal language aspects of genetic development
Multi-agent systems and their formal language paradigms
Semantics of programming languages
Varieties of regular languages
Recursive functions
Term rewriting systems

Image Processing

Image reconstruction
Digital topology and mathematical morphology
Markov fields in image processing
Medical image processing
Variational methods in image processing
Skeletonization in image processing

Technical informatics

Adaptive signal processing
FPGA based digital control
System identification
Control theory
Real time measurements and control
Noise and fluctuations in physical systems

Operations Research

Numerical methods of differential equations
Evolutionary algorithms
Fuzzy theory
Global optimization
Game theory
Combinatorial game theory
Combinatorial optimization
Reliable numerical procedures
Numerical analysis
Theory of multifactor and group decision making

Software development

Databases, large-scale information systems and Enterprise applications
Embedded systems
Compiler programs and their optimisation
Functional programming
Architectures of networks and distributed systems
Object oriented paradigm and its co-areas
Parallel programming
Paradigms of programming languages
Static and dynamic programme analysis
Software project management
Software validation and quality assurance
Software maintenance and re-engineering

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