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

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 only apply for the current research topics. 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 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.

2. The Process of Doctoral Studies

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 which can be found at the library of the Institute.

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 Council 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 8 courses. Appendix 1 contains the list of courses compiled by the lecturers of the School. This list can be broadened; 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 higher level regulations (Government Decree 51/2001, Regulations Governing the Doctoral Training Programmes and the Awarding of the Doctoral Degree, 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 (each module can be completed only once):

Research	*Credit*
Literature review I.-VI.	15
Participation in research seminars (2 classes weekly)	3
Holding a lecture at a research seminar	5
Making a research plan I.-III.	5
Holding a lecture at a Hungarian conference	3
Holding a (foreign language) lecture at an international conference	5
Study writing I.-III.	10
Accepted, full length publication, with no points awarded	10
Accepted publication with point(s) awarded	30
Other accepted publication, with no points awarded	5
Making a research report I.-II.	5

Courses: visiting the courses of the given semester
Each course is worth 5 credits
Requirement: terminal exam

Education:	C*redit*
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*

Credit requirements for obtaining a pre-degree certificate: During the six semesters students have to collect a minimum of 180 credits, as follows:

- minimum 100 credits from the Research module,
- minimum 40 credits from the Courses module,
- maximum 40 credits from the Education module.

At the beginning of each semester students have to discuss with theirs supervisors which PhD courses to take up, so that by the end of the sixth semester they will have completed at least 8 courses.

5. Research Programme of the Doctoral School

Research topics have three main categories. You can find the description of each topic below.

Theoretical Computer Science

Supervisors and lecturers working in this field of research:
Professor Erzsébet Csuhaj-Varjú, Doctor of the Hungarian Academy of Sciences, scientific advisor,
Professor Zoltán Ésik, Doctor of the Hungarian Academy of Sciences
Professor Zoltán Fülöp, Doctor of the Hungarian Academy of Sciences
Péter Hajnal, PhD, associate professor,
Szabolcs Iván, PhD, assistant professor,
György Turán, PhD, senior research fellow,
Sándor Vágvölgyi, PhD, associate professor,
Professor Heiko Vogler.

Under the supervision of the participating lecturers students can choose from the following research topics:
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

Supervisors and lecturers working in this field of research:
Professor Tibor Csendes, Doctor of the Hungarian Academy of Sciences,
Professor János Csirik, Doctor of the Hungarian Academy of Sciences,
Professor József Dombi, Doctor of the Hungarian Academy of Sciences,
Professor, Habil. Gábor Galambos
Csanád Imreh, PhD, associate professor,
Kovács Zoltán, PhD, assistant professor,
Miklós Krész, PhD, college associate professor,
Maróti Miklós, PhD, associate professor,
Professor Emeritus Ferenc Móricz, Doctor of the Hungarian Academy of Sciences,
András Pluhár, PhD, associate professor,
Péter Gábor Szabó, PhD, assistant professor,
Tamás Vinkó, PhD, assistant professor.

Under the supervision of the participating lecturers students can choose from the following research topics:
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

Applications of Computer Science

Supervisors and lecturers working in this field of research:
Zoltán Alexin, PhD, assistant professor,
Péter Balázs, PhD, associate professor,
Balázs Bánhelyi, PhD, assistant professor,

Árpád Beszédes, PhD, assistant professor,
Professor János Csirik, Doctor of the Hungarian Academy of Sciences,
Miklós Csűrös, PhD,
Professor Péter Csermely, Corresponding Member of the Hungarian Academy of Sciences,
Professor József Dombi, Doctor of the Hungarian Academy of Sciences,
Richárd Farkas, PhD, assistant professor,
Rudolf Ferenc, PhD, assistant professor,
Professor Zoltán Gingl, Doctor of the Hungarian Academy of Sciences,
Professor Tibor Gyimóthy, Doctor of the Hungarian Academy of Sciences,
Professor Zoltán Hantos, Doctor of the Hungarian Academy of Sciences,
Professor László Hatvani, Full Member of the Hungarian Academy of Sciences,
Péter Horváth, PhD,
Márk Jelasity, Doctor of the Hungarian Academy of Sciences, senior research fellow,
Professor Péter Kacsuk, Doctor of the Hungarian Academy of Sciences,
Zoltán Kató, Doctor of the Hungarian Academy of Sciences, associate proessor,
Attila Kertész, PhD,
Professor László Kérchy, Doctor of the Hungarian Academy of Sciences,
Zoltán Kincses, PhD, assistant professor,
István Matijevics, PhD, college professor,
Róbert Mingesz, PhD, assistant professor,
Antal Nagy, PhD, assistant professor,
László Nyúl, PhD, associate professor,
Kálmán Palágyi, PhD, associate professor,
Szilveszter Pletl, PhD, college professor,
András Pluhár, PhD, associate professor,
László Tóth, PhD, research fellow,
Professor Vilmos Totik, Full Member of the Hungarian Academy of Sciences,
György Turán, PhD, senior research fellow.

Under the supervision of the participating lecturers students can choose from the following research topics:
Advanced programming paradigms. Theory of compilers. Cross compilers. Effective compilation of embedded mobile systems. Legacy system analysis. Software maintenance. Program slicing and its applications. Software reengineering. Component based software development. 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. Examining self-adaptive protocols with self-adaptive software principles. Frame and rule based knowledge representation and their hybrid versions for characterising protocols and test sets.
Machine learning algorithms (decision trees, learning logic programmes, genetic programming, neuron networks). Complexity of learning algorithms. Speech recognition. Natural language processing. Complementing formal markup languages applied in protocol technology (SDL, MSC, TTCN, ASN.1) with elements of artificial intelligence.
Image processing in nuclear medicine. Image reconstruction from projections. Discrete tomography. Medical image archiving and communication systems. Segmentation of medical images. Image registration. Skeletonization, thinning and their applications. Geographic information systems.

Appendix 1. Subjects taught at the Doctoral School

The appendix lists the courses compiled by the members of the Doctoral School. The list can be expanded with new courses, topics are permanently updated. The courses are divided into five groups, according to the main subjects of the School. Students taking a comprehensive exam of a main subject have to prepare from the subject-matter of three courses belonging to it.

Algorithms and Artificial Intelligence

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

Theoretical Computer Science

Algebraic specification
Algebraic semantics of concurrent processes
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
Iteration theories
Categories in computer science
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
Algebras of synchronised systems
Term rewriting systems

Image Processing

Digital topology and mathematical morphology
Markov fields is image processing
Medical image processing
Variational methods in image processing

Skeletonization in image processing

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