Name of the course: Theoretical Foundations of Computer Science	Total credits:6

CODE: (Neptun)

Type: Optional

Total hours of per semester: 24

lecture:

practice:

consultation: 24

Other:

Type of testing:

Other: oral exam

Semester: 2,3,4

Description

Computer science –the scientific discipline. Alphabets, words, languages. Algorithmic problems. Kolmogorov complexity.

Finite automata and their variants. Deterministic and non-deterministic finite automata. Regular expressions, regular languages.

Grammars. The Chomsky hierarchy. Context-free grammars and pushdown automata.

Turing machines and their variants (multitape multihead, non-deterministic). Church thesis. Recursive and recursively enumerable languages. Languages decidable and recognizable by Turing Machines. The diagonalization method. Universal Turing machines. Reduction, undecidable languages. The Halting Problem. The Post Correspondence Problem. Kolmogorov-complexity method. Rice's theorem.

Space and time complexity of algorithms and Turing machines. Complexity classes. Classes P and NP. NP completeness. The SAT problem, Cook's theorem. TSP problem and further NP complete problems for graphs and logical formulae. Complexity class PSPACE and PSPACE-complete problems. Complexity classes L and NL. Algorithms for hard problems. Pseudopolynomial algorithms, Approximation algorithms. Randomization. Communication ad cryptography.

Literature

1. J.E. Hopcroft, R. Motwani, J.D. Ullman: Introduction to Automata Theory, Languages, and Computation. Third Edition. Pearson, 2013
2. J. Hromkovic: Theoretical Computer Science. Introduction to Automata, Computability, Complexity, Algorithmics, Randomization, Communication, and Complexity. Springer, 1998.
3. M. Sipser: Introduction to the Theory of Computation. Third Edition, Cengage, 2012.

Competencies

- Ability to formalize complex technical problems, to analyze theoretical and practical background, and to provide adequate solutions.
- Expertise in design, development, operation and management tasks in the domain of complex software systems and database management systems.
- Ability for written and oral communication in English, using the technical terms and expressions of computer science. Ability to argue, to prepare reports, to read, understand and exploit scientific and technical material (e.g. books and papers).
- Expertise in utilizing sources of technical information, their critical interpretation and evaluation, and the extraction of information relevant to the solution of a specific problem.
- Ability to perform supervised scientific research, and skills required for post-graduate studies.

Attitude

- Attends professional, technological development related to their qualification.
- Commitment to critical feedback and self-assessment.
- Commitment to lifelong learning and receptivity to new IT competencies.
- Adopts and coordinates the ethical principles of work, organizational culture and research.
- Shares professional knowledge, mediates professional results.
- Mediates and implements eco-conscious behavior and social responsibility, helping them with IT tools.
- Commitment to quality standards and its IT tools.
- Open to initiate collaboration with IT and other specialists.

Autonomy and responsibility

a) Takes responsibility for his professional decisions taken during his professional activities.
b) Takes responsibility for observing and enforcing deadlines.
c) Takes responsibility for own and fellow workers' work.
d) In the case of operational critical IT systems, he/she can be assigned responsibility for development and operation, according to his/her professional competencies.

Course leader: : Dr. Erzsébet Csuhaj-Varjú Erzsébet, DSs, full professor
Course teachers:
……Dr. Péter Burcsi, habil, associate professor, Dr. Ambrus Kaposi associate professor.