EVOLUTIONARY COMPUTING

Course Workload		Assessment form (examination/ graded test/ ungraded test)
ECTS	Hours	
6	216	Oral exam

This course introduces students to the basic principles and schemes of evolutionary algorithms (EA), learns how to design and implement EA for various optimization problems, gains the skills to tune and test EA, and explores parallel EA circuits. The course examines methods to improve the performance of algorithms and circuits for the implementation of high-performance experts based on multiprocessor and distributed systems, as well as using GPUs. During the course, students are involved not only in theoretical aspects but also in the demonstration and analysis of real solved problems using evolutionary computation methods.

Course structure:

1. INTRODUCTION TO EVOLUTIONARY COMPUTING
   - 1.1. The history of the development of evolutionary computing; basic terminology, principles and mechanisms of evolutionary algorithms.
   - 1.2. Classification of optimization problems; demo examples.

2. EVOLUTIONARY ALGORITHM COMPONENTS
   - 2.1. The main components of evolutionary algorithms; presentation of solutions; operators of mutation, crossing; selection methods.

3. CONVERGENCE CONTROL METHODS
   - 3.1. Methods for increasing the efficiency of the evolutionary algorithm; setting and tuning. the parameters of the algorithm; methods to prevent early convergence.

4. VARIETIES OF EVOLUTIONARY ALGORITHMS
   - 4.1. Classification of a variety of evolutionary algorithms; advantages and disadvantages of classes of algorithms.

5. DEVELOPMENT STAGES OF EVOLUTIONARY ALGORITHMS
   - 5.1. The main stages in the development of an evolutionary algorithm: design, development, testing, comparison methods.

6. HYBRID EVOLUTIONARY ALGORITHMS
   - 6.1. Hybrid schemes of evolutionary algorithms; hybridization with heuristics; memetic algorithms.

7. MULTICRITERIA AND LIMITATIONS

7.1. Multi-criteria optimization problems; Pareto front; processing restrictions; uncertainties in assessing fitness function.

8. MULTIPOPULATION AND COEVOLUTIONARY ALGORITHMS

8.1. Multipopulation algorithms; patterns of interaction between populations; homogeneous and heterogeneous populations; co-evolutionary schemes.

9. DISTRIBUTED EVOLUTIONARY ALGORITHM SCHEMES

9.1. Diagrams of distributed evolutionary algorithms; implementation of high-performance evolutionary algorithms based on GPGPU.