Evolutionary Algorithms

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Course code:	BMETE90AX46
No. of credits:	3
Classes:	Fridays 8-10

Short description: The goal of the course is to present a broadly applicable and quite efficient tool for optimization and constraint satisfaction problems. These methods are called evolutionary or genetic algorithms since their basic concepts mimic the evolution of species.

Prerequisites: Introductory calculus, basic probability theory and linear algebra.

Detailed course description:

Introduction: optimization problems, negative examples for brute-force type algorithms, the basic concept of genetic algorithms: biological ground (gene, inheritance, evolution, fitness).

The general scheme of genetic algorithms, the realization in the most simple case. Representation in evolutionary algorithms, operators (crossover and mutation) for bit representation, roulette wheel and tournament selection, elitism.

Traveling agent problem. Permutation representation and its operators (pmx, cyclic, edge, order, inversion, swap, insert, shuffle). Choosing suitable fitness function, its influence on selection pressure, the problem of constraint handling.

Theory of simple genetic algorithms, theory of building blocks and its criticism (Gray coding). Scheme theorem, No Free Lunch Theorem.

Evolutionary strategies: simulated annealing as progenitor, genetic version: Rechenberg's algorithm, crossover operators (the problem of correlation). Mutation operators, multidimensional normal distribution, $(\mu + \lambda)$ vs (μ, λ) selection. Parameter control: tuning - control - self adaptation. 1/5 rule, adaptation for discrete representation. Measuring the efficiency of genetic algorithms, MBF, SR, AES.

Evolutionary programming: representation with finite state machines, realization of operators. Genetic programming: tree representation, crossover and mutation operators.

Course requirements: Final mark is based on homework assignments. At least 70% attendance of the contact lessons is required as a condition for obtaining the credits for the subject. A total of 120 points can be obtained from the problem sets issued each week. The homework assignments cover three main topics (simple algorithms, permutation representations, real representations). Students have to reach a total of 12 points in each topic to pass. Marks based on the total score are as follows:

0-39:	1
40-49:	2
50-59:	3
60-69:	4
70+ :	5