

SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University of Cluj-Napoca
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Mathematics and Computer Science of the Hungarian Line
1.4 Field of study	Computer Science
1.5 Study cycle	Master
1.6 Study programme / Qualification	Data Analysis and Modeling

2. Information regarding the discipline

2.1 Name of the discipline		Evolutionary Algorithms					
2.2 Course coordinator		Lect. dr. Gaskó Noémi					
2.3 Seminar coordinator		Lect. dr. Gaskó Noémi					
2.4. Year of study	2	2.5 Semester	3	2.6. Type of evaluation	E	2.7 Type of discipline	Optional

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1 sem
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					20
Additional documentation (in libraries, on electronic platforms, field documentation)					10
Preparation for seminars/labs, homework, papers, portfolios and essays					23
Tutorship					7
Evaluations					20
Other activities:					-
3.7 Total individual study hours			80		
3.8 Total hours per semester			150		
3.9 Number of ECTS credits			7		

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	

5. Conditions (if necessary) -

5.1. for the course	
5.2. for the seminar /lab	

activities	<ul style="list-style-type: none"> Room with computers as needed; high level programming language environment
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6. Specific competencies acquired

Professional competencies	<ul style="list-style-type: none"> Knowledge, understanding and use of basic concepts of GAs
Transversal competencies	<ul style="list-style-type: none"> Ability to apply GAs to different real life problems Ability to model phenomena using GAs

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	<ul style="list-style-type: none"> an introduction to the field studied. the basic notion, techniques and algorithms. the background for advanced courses
7.2 Specific objective of the discipline	<ul style="list-style-type: none"> application of GAs

8. Content

8.1 Course	Teaching methods	Remarks
<ul style="list-style-type: none"> Week 1: Principles of evolutionary computation. Basic and related models. Structure of an evolutionary algorithm 	<ul style="list-style-type: none"> Interactive exposure Explanation Conversation 	
<ul style="list-style-type: none"> Week 2: Genetic algorithms. Problem representation and fitness function. Canonical genetic algorithm. 	<ul style="list-style-type: none"> Interactive exposure Explanation Conversation 	
<ul style="list-style-type: none"> Week 3: Selection – selection pressure; takeover time; standard schemes. 	<ul style="list-style-type: none"> Interactive exposure Explanation Conversation Didactical demonstration 	
<ul style="list-style-type: none"> Week 4: Selection – proportional selection; premature convergence; scaling mechanisms; rank-based selection 	<ul style="list-style-type: none"> Interactive exposure Explanation 	

	<ul style="list-style-type: none"> • Conversation • Didactical demonstration 	
<ul style="list-style-type: none"> • Week 5: Selection – binary tournament; q-tournament; elitism; steady state EAs; Michalewicz selection; Boltzmann selection 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 6: Variation operators for binary encoding; Variation operators for real-valued encoding 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 7: Hybridisation – specific representation; hybridisation 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 8: Parameter setting and adaptive GAs; adaptive fitness of a search operator 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 9: Adaptive representation –messy genetic algorithms, delta coding; diploidy representation 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 10: Population models and parallel implementations - niching methods; fitness sharing; island and stepping stone models; 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 11: Differential evolution – introduction, parameter settings, variants 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation • Case studies 	
<ul style="list-style-type: none"> • Week 12: Evolution strategies – introduction. (1+1) strategy; standard mutation; Cauchy perturbations 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
<ul style="list-style-type: none"> • Week 13: Evolutionary programming – sequential machine model; function optimization; Cauchy perturbation. 	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	

<ul style="list-style-type: none"> • Week 14: Search and optimization using genetic algorithms 	<ul style="list-style-type: none"> • Interactive exposure • Conversation 	
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Bibliography
Eiben A & Smith JE, Introduction to Evolutionary Computing. Springer-Verlag 2010.
David E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning. Addison-Wesley; 1989.
David E. Goldberg, The Design of Innovation: Lessons from the competent genetic algorithms. Springer-Verlag; 2002.
Sean Luke, Essentials of Metaheuristics. Freely available for download at <http://cs.gmu.edu/~sean/book/metaheuristics/>
Michalewicz, Z., Genetic Algorithms + Data Structures = Evolution Programs, Springer, Berlin, 1992.
Dumitrescu, D., B Lazzarini, Evolutionary Computation, CRC Press, New York, Boca Raton, 2000
Dumitrescu, D., Principiile Inteligentei artificiale, Editura Albastra, Cluj,2000.
Dumitrescu, D., Algoritmi genetici si strategii evolutive. Aplicatii in Inteligenta Artificiala, Editura Albastra, Cluj,2000.
Deb, K., Multiobjective optimization using Evolutionary Algorithms, Wiley, 2001.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Implementation of some genetic operators and the analysis of their performance	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	The laboratory is structured as 2 hours, classes every second week -2 laboratories for this activity
2. Each student chooses a different type of problem (e.g. the traveling salesman problem), and implements three appropriate evolutionary techniques for the selected problem	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	-3 laboratories
3. Parameter setting, analysis of the implemented algorithms	<ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation 	
4. Project presentation, documentation	<ul style="list-style-type: none"> • Interactive exposure • Conversation 	

Bibliography
Eibern A & Smith JE, Introduction to Evolutionary Computing. Springer-Verlag 2010.
David E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning. Addison-Wesley; 1989.
David E. Goldberg, The Design of Innovation: Lessons from the competent genetic algorithms. Springer-

Verlag; 2002.

Sean Luke, Essentials of Metaheuristics. Freely available for download at <http://cs.gmu.edu/~sean/book/metaheuristics/>

Michalewicz, Z., Genetic Algorithms + Data Structures = Evolution Programs, Springer, Berlin, 1992.

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Deb, K., Multiobjective optimization using Evolutionary Algorithms, Wiley, 2001.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course exists in the studying program of all major universities in Romania and abroad;
- The content of the course is considered important in the introduction to Genetic Algorithms

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- know the basic principle of the domain; - apply the course concepts - problem solving	Written exam	50.00%
10.5 Lab activities	-be able to implement course concepts and algorithms -be able to make a practical project during the semester	Practical project	50.00%
10.6 Minimum performance standards			
• At least grade 5 (from a scale of 1 to 10) at both written exam and laboratory work.			

Date

Signature of course coordinator

Lect. dr. Gaskó Noémi

Signature of seminar coordinator

Lect. dr. Gaskó Noémi

Date of approval

Signature of the head of department

Conf. dr. András Szilárd