

SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babe Bolyai University
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Computer Science
1.4 Field of study	Computer Science
1.5 Study cycle	Bachelor
1.6 Study programme / Qualification	Computer Science

2. Information regarding the discipline

2.1 Name of the discipline	Optimization Techniques						
2.2 Course coordinator	Assoc. Prof. Nicolae Popovici, Ph.D.						
2.3 Seminar coordinator	Assoc. Prof. Nicolae Popovici, Ph.D.						
2.4. Year of study	2	2.5 Semester	4	2.6. Type of evaluation	Exam	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	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar	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					10
Tutorship					10
Evaluations					8
Other activities:					
3.7 Total individual study hours	58				
3.8 Total hours per semester	100				
3.9 Number of ECTS credits	4				

4. Prerequisites (if necessary)

4.1. curriculum	<ul style="list-style-type: none"> • Algebra 1 (Linear Algebra) • Mathematical Analysis 2 (Differential Calculus on \mathbb{R}^n)
4.2. competencies	Basic notions of linear algebra, analytical geometry and differential calculus in the n-dimensional Euclidean space

5. Conditions (if necessary)

5.1. for the course	<ul style="list-style-type: none"> • Videoprojector
5.2. for the seminar /lab activities	<ul style="list-style-type: none"> • Standard infrastructure

6. Specific competencies acquired

Professional competencies	<ul style="list-style-type: none"> Knowledge of basic notions and fundamental results from linear optimization, game theory and convex analysis
Transversal competencies	<ul style="list-style-type: none"> Ability to model practical problems as optimization problems and to solve them by implementable numerical methods

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

7.1 General objective of the discipline	The study of the mathematical foundations of several optimization techniques currently used in Operations Research.
7.2 Specific objective of the discipline	Students should acquire knowledge about: <ul style="list-style-type: none"> Convex analysis; Linear optimization; Matrix game theory; Convex optimization.

8. Content

8.1 Course	Teaching methods	Remarks
1. Optimization problems in general setting; Classical models	Direct instruction, mathematical proof, exemplification	
2. Level sets; Existence and unicity of optimal solutions	Direct instruction, mathematical proof, exemplification	
3. Convex sets; Extremal points	Direct instruction, mathematical proof, exemplification	
4. Convex functions; Properties of their extrema	Direct instruction, mathematical proof, exemplification	
5. Theorems of the alternatives and separation theorems	Direct instruction, mathematical proof, exemplification	
6. Probleme de Linear optimization problems; interpretation from mathematical economics and geometrical points of view	Direct instruction, mathematical proof, exemplification	
7. Duality in linear optimization; Weak and strong duality theorems	Direct instruction, mathematical proof, exemplification	
8. The Simplex algorithm in primal form	Direct instruction, mathematical proof, exemplification	

9. The Simplex algorithm in dual form	Direct instruction, mathematical proof, exemplification	
10. Matrix games	Direct instruction, mathematical proof, exemplification	
11. The relationship between the matrix games and the linear optimization problems	Direct instruction, mathematical proof, exemplification	
12. Convex optimization problems	Direct instruction, mathematical proof, exemplification	
13. Analytical solution methods for convex optimization problems	Direct instruction, mathematical proof, exemplification	
14. Numerical solution methods for convex optimization problems	Direct instruction, mathematical proof, exemplification	
Bibliography 1. BOYD, S., VANDENBERGHE, L.: Convex Optimization, Cambridge University Press, 2004. 2. BRECKNER, B.E., POPOVICI, N., Convexity and Optimization. An Introduction, EFES, Cluj-Napoca, 2006. 3. BRECKNER, W.W., Cercetare opera ional , Universitatea Babe -Bolyai, Cluj-Napoca, 1981. 4. POPOVICI, N., Optimizare vectoriala, Casa Cartii de Stiinta, Cluj-Napoca, 2005. 5. VANDERBEI, R.: Linear Programming. Foundations and Extensions, Springer, New York, 2008.		
8.2 Seminar	Teaching methods	Remarks
1. Special classes of convex sets	Problem-based instruction, debate, mathematical proofs	2 hours
2. Convex functions; Generalized convexity	Problem-based instruction, debate, mathematical proofs	2 hours
3. Optimization problems solved by the Simplex algorithm in primal form	Problem-based instruction, debate, mathematical proofs	2 hours
4. Optimization problems solved by the Simplex algorithm in dual form	Problem-based instruction, debate, mathematical proofs	2 hours
5. Matrix games	Problem-based instruction, debate, mathematical proofs	2 hours
6. Convex optimization problems	Problem-based instruction, debate, mathematical proofs	2 hours
7. Numerical solution of certain convex optimization problems	Problem-based instruction, debate, mathematical proofs	2 hours
Bibliography 1. BRECKNER, B.E., POPOVICI, N., Probleme de analiza convexa in R^n . Casa Cartii de Stiinta, Cluj-Napoca, 2003. 2. BRECKNER, B.E., POPOVICI, N., Probleme de cercetare operationala, EFES, Cluj-Napoca, 2006. 3. BRECKNER, W.W., DUCA, D., Culegere de probleme de cercetare operationala, Universitatea Babe-Bolyai, Facultatea de Matematica, Cluj-Napoca, 1983.		

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 ensures a solid theoretical background, according to national and international standards, within bachelor programmes, on optimization theory, operations research, management, etc.
- The optimization techniques are currently applied in industry, medicine, insurance, etc.

10. Evaluare

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- intelegerea notiunilor, a rezultatelor teoretice si a metodelor de rezolvare a problemelor de optimizare prezentate la curs; - capacitatea de a demonstra principalele rezultate teoretice stabilite la curs.	Written and viva-voce exam	75%
10.5 Seminar/lab activities	rezolvarea unor exercitii si probleme cu ajutorul rezultatelor teoretice si a metodelor numerice studiate la curs	Continuous evaluation	25%
10.6 Minimum performance standards			
The final grade should be greater than or equal to 5.			

Date

Signature of course coordinator

Signature of seminar coordinator

30.04.13

Assoc. Prof. Nicolae Popovici, Ph.D.

Assoc. Prof. Nicolae Popovici, Ph.D.

Date of approval

Signature of the head of department

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Prof. Bazil Pârș, Ph.D.