

**ΟΙΚΟΝΟΜΙΚΟ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΑΘΗΝΩΝ**



ATHENS UNIVERSITY
OF ECONOMICS
AND BUSINESS

M.Sc. Program in Data Science
Department of Informatics
Optimization Techniques

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Content – Topics to be covered

- Continuous Optimization
 - Linear Programming
 - Models and Formulation
 - Simplex, variants and other algorithms
 - LP Duality Theory and applications
 - Convex Non-Linear Optimization
 - Convex sets and convex functions
 - Unconstrained convex optimization, descent methods
 - Constrained optimization
 - Applications to Machine Learning
 - Linear Regression
 - Support Vector Machines

Content – Topics to be covered

- Discrete Optimization
 - Integer Programming and Combinatorial Optimization
 - Integer Programming formulations
 - Branch and bound techniques
 - Integrated optimisation methods
 - Benders Decomposition
 - Constraint Programming
 - Greedy Heuristics & Metaheuristics
 - Design of approximation algorithms
 - Local Search Algorithms, Tabu search, Simulated Annealing, Genetic Algorithms

Main focus & prerequisites

- Basic algorithmic ideas behind commercial optimization tools
- Theoretical foundations

Required background:

- There are no formal requirements to take the course
- It helps if you have taken undergrad courses on calculus, discrete math or algorithms
- Generally, it suffices if you have developed an elementary math background via courses in your undergrad program

Timeline

- **Continuous Optimization (5-6 lectures)**
 - Linear Programming: Lectures 1-3
 - Models and formulations
 - Simplex, variants and other algorithms
 - LP Duality Theory
 - Convex Optimization: Lectures 4-5
 - Unconstrained optimization, descent methods
 - Constrained optimization
 - Applications to Machine Learning: Lecture 5-6
 - Regression
 - Support Vector Machines

Timeline

- **Discrete Optimization (4-5 lectures)**
 - Combinatorial Optimization: Lectures 7-8
 - Integer Programming
 - Branch and bound
 - Integrated optimisation methods: Lect. 8-9
 - Benders Decomposition
 - Constraint Programming
 - Greedy Heuristics & Metaheuristics: Lect. 9-10
 - Design of Approximation Algorithms
 - Local Search: Basic version, Tabu Search, Simulated Annealing, Genetic Algorithms

Bibliography

- [HL] F. Hillier, G. Lieberman, “Introduction to Operations Research”, 10th edition, [Chapters 2-4, 6, 12]
 - For Linear Programming, Integer Programming, Branch and Bound
- [BV] S. Boyd, L. Vandenberghe, “Convex Optimization”, [Chapters 1-4, 9-10]
 - For Convex optimization
- [KT] J. Kleinberg, E. Tardos, “Algorithm Design” [Chapters 11-12]
 - For local search and for approximation algorithms
- More material will also be provided throughout the lectures
- **and many many resources on the WWW**

Grading Scheme

Full Course

- **1 Programming project** **30%**
 - You can work in groups of 2 people
 - It will be announced by Lecture 6
- **Final exam** **50%**
- **2 Problem set** **20%**
 - Individual
 - The 1st will be announced by Lecture 3 and the 2nd by Lecture 7.

Half Course:

- **1 Problem Set** **15%**
- **Final Exam** **85%**

Communication

- Office hours (Lefkados 33 & Evelpidwn 47A, 8th floor, office 801):
 - Tuesdays: 11:00 – 14:00
 - Or by appointment
- You can always email me regarding questions
- Eclass: Optimization Techniques 2024
 - Please check for announcements in a weekly basis