OPTIMIZATION
MAT/09 - 6 CFU - 1° semestre

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FABIO RACITI

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OBIETTIVI FORMATIVI
This graduated-level course introduces analytic tools and optimization methods that are suitable for large-scale problems arising in data science applications. The course presents both basic and advanced concepts of optimization and explores several algorithms that are efficient for network problems.

The student will acquire the ability to formulate, in mathematical terms, problems related to profit maximization and cost minimization, optimization of resources, and traffic network equilibria.

The goals of the course are:

Knowledge and understanding: the aim of the course is to acquire advanced knowledge that allows students to study optimization problems and model techniques of large-scale decision-making problems. The students will be able to use algorithms for both linear and nonlinear programming problems.

Applying knowledge and understanding: students will acquire knowledge useful to identify and model real-life decision-making problems. In addition, through real examples, the student will be able to implement correct solutions for complex problems.

Making judgments: students will be able to choose and solve autonomously complex decision-making problems and to interpret the solutions.

Communication skills: students will acquire base communication and reading skills using technical language.

Learning skills: the course provides students with theoretical and practical methodologies and skills to deal with large-scale optimization problems.

MODALITÀ DI SVOLGIMENTO DELL’INSEGNAMENTO
There will be both classroom lessons and laboratory lessons. For each topic, exercises will be solved by the teacher or proposed to students.

Should teaching be carried out in mixed mode or remotely, it may be necessary to introduce changes with respect to previous statements, in line with the programme planned and outlined in the syllabus.
**PREREQUISITI RICHIESTI**

Basic elements of vectors and matrices, vector spaces, linear equations, inequalities.

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**FREQUENZA LEZIONI**

Attendance is strongly recommended

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**CONTENUTI DEL CORSO**

**Linear Programming (LP)** (about 13 h)

- LP models; Graphical method; Simplex method; Duality; Sensitivity analysis

**Integer Linear Programming (ILP)** (about 9 h)

- Branch & Bound method; 0-1 programming; Knapsack problem

**Software** (about 5 hours)

- Matlab, Mathematica,

**Network problems** (about 13 h)

- Graphs (Kruskal, Dijkstra, Bellman-Kalaba algorithms)

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**TESTI DI RIFERIMENTO**


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**ALTRO MATERIALE DIDATTICO**

4. S. Boyd, L. Vandenberghe, *Convex optimization*,

Further notes will be given on Studium
**PROGRAMMAZIONE DEL CORSO**

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**VERIFICA DELL'APPRENDIMENTO**

**MODALITÀ DI VERIFICA DELL'APPRENDIMENTO**

The final exam consists of an oral test during which candidates shows that they have assimilated the topics covered in the course.

Learning assessment may also be carried out on line, should the conditions require it.

**ESEMPI DI DOMANDE E/O ESERCIZI FREQUENTI**

The symplex method.

The strong duality theorem.

The Branch & Bound algorithm.

The knapsack problem.

The shortest path algorithm.