 **הטכניון - מכון טכנולוגי לישראל הפקולטה למדעי הנתונים וההחלטות**

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**Linear and Combinatorial Programming - 098331**

# Fall Semester 2023-2024

Instructor: Prof. Asaf Levin, Bloomfield Bld. Room number 316, phone number 4507.   
e-mail: [levinas@technion.ac.il](mailto:levinas@technion.ac.il).

Office Hour: Sundays 1530-1630. Please send an email so I will reserve the time for you – the office hours will be carried out as zoom meetings.

Lecture: Thursday 1630-1930.

Teaching Assistant: Dr. Elena Kleiman

Office hour by appointment via email [elena.kleiman@gmail.com](mailto:elena.kleiman@gmail.com).

Recitation: Thursday 1930-2030.

The course is a core master course in operations research. We focus on combinatorial optimization problems as well as on efficient methods for solving these problems with their linear programming based analysis. Specifically, the outline of the course is as follows:

1. Introduction: Formulation of problems as integer programs, a short introduction to linear programming (simplex and duality), introduction to data structues and algorithms, basic concepts in graph theory.
2. Matroids and intersection of matroids.
3. Solving typical optimization problems on graphs: shortest path, minimimum spanning tree, maximum flow, min-cost flow, matchings in bipartite and non-bipartite graphs.
4. Introduction to NP-completeness and approximation algorithms.
5. Additional topics like parametric search methods, totally unimodular matrices.

There will be a weekly exercise that will be posted on the moodle website of the course. The exercise is due to the next Friday at noon and will be submitted as a moodle task (approximately 8 days after the corresponding class). Each student submits his/her own solutions to the homework assignments by scanning his/her solutions or writing down the solutions by using a word processor or using a tablet etc.. An exercise that will be submitted late (or not submitted at all) will have a score of 0. If you have technical problems to submit via the moodle website you should send your solution file by email to the teaching assistant.

Attending classes and recitations is recommended (for getting a passing grade). We also have video recordings accessible to students of classes+recitations of the 2020-2021 class (English).

At the end of the semester there will be an oral exam whose date will be coordinated between the lecturer and the students. The oral exam (apx. one hour taking place as a zoom meeting) will be on the homework assignments as well as the material studied during the course.

The final grade will be based on the average score of the exercises and the oral exam based on the following formula:

Final grade = 0.6\*oral exam + 0.4\*average score of the homework assignment.

**References:**

1. *Network flows, theory, algorithms and applications*, R. K. Ahuja, T. L. Magnanti and J. B. Orlin, Prentice-Hall, 1993.

2. *A first course in combinatorial optimization*, J. Lee, Cambridge University Press, 2004.

*3. Combinatorial Optimization*, W. Cook, W.H. Cunningham, W.R. Pulleyblank and A. Schrijver, Wiley, 1998.

4. *Combinatorial Optimization; Polyhedra and Efficiency*, A. Schrijver, Springer, 2000.

5*. Theory of Linear and Integer Programming*, A. Schrijver, Wiley, 1987.