

BOĞAZIÇI UNIVERSITY
DEPARTMENT OF INDUSTRIAL ENGINEERING
Spring 2016 – 2017

IE 611 INTEGER PROGRAMMING

Day and Time	: M 9:00 – 11:00, W 9:00 – 11:00
Classroom	: M 2180, M 1181
Instructor	: İ. Kuban Altınel
Office / Phone	: Old Engineering Building, M 4060 / x6407
Office Hours	: M 11:00 – 13:00, W 11:00 – 13:00
Grading	: 5 problem sets 30 % Midterm exam 25 % (This will be a closed book inclass exam) Final exam 40 % (This will be a closed book inclass exam) Attendance 5 %
Prerequisite	: IE 501 or equivalent.
Textbook	: Integer and Combinatorial Optimization by Nemhauser and Wolsey
References	: 1. Integer and Combinatorial Optimization, Nemhauser G. and L. Wolsey. 2. Linear Optimization and Extensions, Padberg M. 3. Introduction to the theory of computing, M. Sipser. 4. Arc Routing: Theory, Solutions and Applications, Dror M. editor. 5. The Travelling Salesman Problem, Lawler E. et. al. editors. 6. The Travelling Salesman Problem, Punnen A. et. al. editors. 7. Column generation, G. Desaulniers, J. Desrosiers, M. M. Solomon

They are available **ON RESERVE** at the library.

COURSE OUTLINE

1. **MODELLING WITH BINARY VARIABLES:** Knapsack, assignment, matching, packing, covering, partitioning, facility location, fixed charge network flows, travelling salesman problem, non-linear functions, disjunctive constraints, scheduling, lot sizing, and resource allocation.
2. **POLYHEDRAL THEORY:** Describing the polyhedra by facets, describing the polyhedra by extreme points and extreme rays, polyhedral ties between linear and integer programming, Minkowski's theorem, projection and linear transformation of the polyhedra.
3. **THEORY OF VALID INEQUALITIES:** Chvatal-Gomory procedure, disjunctive constraints, generation of valid inequalities, superadditive functions and valid inequalities, valid inequalities for mixed integer sets, reformulation linearization technique.
4. **GENERAL ALGORITHMS:** General relaxation algorithm (fractional cutting plane algorithm), general branch and bound algorithm, branch and bound using LP relaxations, general cutting plane algorithms (Gomory's fractional cutting plane algorithm), extension to mixed integer linear programming, lift and project algorithm.
5. **LAGRANGEAN DUALITY:** Lagrangean relaxation and duality, Benders' formulation, constraint generation algorithm for the mixed integer programming, subgradient algorithm of Held and Crowder.
6. **COLUMN GENERATION:** Dantzig-Wolfe reformulation of an IP, Mixed-integer column generation, solving very large integer programs, column generation for symmetric TSP.
7. **REFORMULATION AND LINEARIZATION:** RLT for binary mixed integer linear programs, generating convex hulls using RLT.

8. **STRONG VALID INEQUALITIES AND FACETS FOR STRUCTURED IP's:** Vertex packing polytope, valid inequalities for the 0-1 knapsack problem, valid inequalities for the travelling salesman polytope.

IE 611 TENTATIVE PROGRAM

<u>WEEK</u>	<u>MONTH</u>	<u>DAY</u>	<u>TENTATIVE DAILY OUTLINE</u>
1	February	06M 08W	Modelling Modelling
2		13M 15W	Polyhedral theory Polyhedral theory
3		20M 22W	Polyhedral theory Polyhedral theory
4	March	27M 01W	Polyhedral theory Polyhedral theory
5		06M 08W	Polyhedral theory Polyhedral theory
6		13M 15W	Theory of valid inequalities Theory of valid inequalities
7		20M 22W	Theory of valid inequalities Theory of valid inequalities
8		27M 29W	General algorithms General algorithms
9	April	03M 05W	General algorithms Lagrangean duality
10		10M 12W	Lagrangean duality Column generation
11		17M 19W	SPRING BREAK SPRING BREAK
12		24M 26W	Column generation Reformulation-linearization
13	May	01M 03W	LABOR DAY Lift-and-project
14		08M 10W	Lift-and-project Strong valid inequalities

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15M

Strong valid inequalities