Syllabus of the course MATH 482

LINEAR PROGRAMMING AND COMBINATORIAL OPTIMIZATION

This is a course on mathematical aspects of problems in linear and integral optimization that are relevant in computer science and operation research. It is based on the book *Combinatorial optimization. Algorithms and complexity* by C. Papadimitriou and K. Steiglitz. It replaces (and is more thorough than) Math 383, which does not exist anymore.

The course start by describing and analyzing the simplex algorithm for linear programming. Next the geometric concepts underlying the algorithm are discussed and the main theme of the course— duality—-starts. Using this idea, some modifications of the simplex method are given and their computational aspects are analyzed. This is mostly Chapters 2-4 of the book.

The primal–dual algorithm is introduced and it is shown what its variations can do for basic problems of combinatorial optimization: the shortest path problem, the max-flow problem, the min-cost flow problem. Then some applications of the above material to matrix games and combinatorial min-max theorems are discussed. This is mostly Chapters 5 and 6 of the book. For applications of duality such as game theory, instructor's supplements are used.

After that, it is described what can be done for integer linear programs (such as Traveling Salesman Problem or scheduling problems). This is Chapters 13 and 14 and instructor's supplement.

Then the important in combinatorial optimization notion of *matroids* is duscussed. This is Chapter 12 and instructor's supplement. Also some ideas of dynamic programming and branch-and-bound are introduced and discussed. This is a part of Chapter 18.

Prerequisite: Math 415 or equivalent