Numerical Methods for Optimization

Henry Wolkowicz *

May 6, 2002

University of Waterloo
Department of Combinatorics & Optimization
Waterloo, Ontario N2L 3G1, Canada

Abstract

Contents

1 Introduction

The theory and methods of optimization are in constant use in branches of e.g. mathematics and engineering. The aim of this course is to assist the student, researcher, and teacher to obtain an understanding of the basic theory and the current state of the art in numerical methods for optimization. The modern era of Optimization (within Operations Research) can be said to have begun with Dantzig's simplex method in 1949. Since then the field has advanced tremendously. In particular, the introduction of interior point methods has dramatically increased the size of problems that can be solved.

This course will begin with an introduction of a general nonlinear program (NLP). We then develop the theory and methods for unconstrained optimization and for solving nonlinear equations. This leads to methods for solving general NLPs and also to special models such as semidefinite programming, SDPs.

No text will be used. However, an excellent reference is the book: Numerical Optimization, by Jorge Nocedal, and Stephen Wright, 1999, Springer Verlag.

2 Background

1. introduce the general NLP model and its properties

2. outline several applications

3 Uncontrained Minimization

1. optimality conditions

2. Algorithms

    (a) line search methods: least change secant methods
    (b) trust region methods

4 Contrained Minimization Theory

1. optimality conditions

2. duality

3. algorithms

    (a) interior point methods
    (b) Sequential Quadratic Programming (SQP) methods

5 Special Models

1. Semidefinite Programming and applications

References