Chapter 1 Introduction

1. A mathematical optimization problem has the form

where:

* is the optimization variable
* is the objective function
* are the (inequality) constraint functions
* are the limits or bounds for the constraints

1. When the objective function and the constraint functions are convex, the optimization problem is called a convex optimization problem.
2. There is in general no analytical formula for the solution of convex optimization problems, but there are very effective methods for solving them.
3. It can be difficult to recognize a convex optimization problem. Many non-convex problems can be transformed into a convex optimization problem.

Chapter 2 Convex Sets

1. Affine set
   1. Line: Suppose are two points in , points of the form form the line passing through and
   2. Affine set: A set is affine if and , . In other words, an affine set contain the line through any two distinct points in the set.
   3. Affine combination of points : , where .
   4. A set is affine the set contains every affine combination of its points.
   5. Affine hull: the set of all affine combinations of points in some set in called the affine hull of . It is the smallest affine set that contains .
   6. The idea of affine combination can be generalized to infinite sums, integrals and probability distributions.
   7. An affine set is a shifted subspace: , where is a subspace,
   8. The solution set of linear equations is an affine set. Conversely, every affine set can be express as the solution set of a system of linear equations.
2. Convex set
   1. Line segment: Suppose are two points in , points of the form form the line segment between and
   2. Convex set: A set is convex if and , . In other words, a convex set contain the line segment between any two distinct points in the set.
   3. Convex combination of points : , where
   4. A set is convex the set contains every convex combination of its points.
   5. Convex hull: the set of all convex combinations of points in some set in called the convex hull of . It is the smallest convex set that contains .
   6. The idea of convex combination can be generalized to infinite sums, integrals and probability distributions.

Suppose satisfy , and , where is convex. Then if the series converges.

Suppose satisfies for all and , where is convex. Then in the integral exists.

Suppose is convex and is a random vector with with probability one. Then .

1. Convex cone
   1. Cone: A set is called a cone if and ,
   2. Convex cone: A set is a convex cone if it is convex and a cone, i.e., and we have
   3. Conic combination (or nonnegative linear combination) of points : , where
   4. A set is convex cone the set contains every conic combination of its points.
   5. Conic hull: the set of all conic combinations of points in some set in called the conic hull of . It is the smallest convex cone that contains .
   6. The idea of conic combination can be generalized to infinite sums, integrals and probability distributions.
2. Convex cone Affine set Convex set
3. Some examples of convex sets
   1. Hyperplane: , where

Half space: , where