CS 411: Artificial Intelligence

Convex Programming

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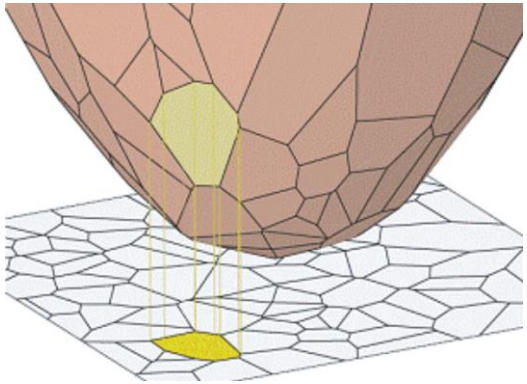

Agenda

- Questions on Written 2 / Grad 2
- Discussion of Optimization and Convex Programming
- Demo and Questions on Programming 2

Questions on Homework 2 / Grad Homework 2?

Mathematical Programming

- Optimization variables: $x_1, x_2, \dots, x_n$ $(\vec{x})$
- Feasible set: $(x_1, x_2, \dots, x_n) \in F$
- Objective function: $f(x_1, x_2, \dots, x_n)$
- Optimal solution: $(x_1^*, x_2^*, \dots, x_n^*) \in F$

$$\min_{x_1, x_2, \dots, x_n} f(x_1, x_2, \dots, x_n)$$

$$\text{s.t. } (x_1, x_2, \dots, x_n) \in F$$

Example: Pacman Search Problem

- Optimization variables: $x_1, x_2, \ldots, x_n$ $(\vec{x})$
  - x_i is the i-th direction to move.
  - 0 for actions after goal is reached
- Feasible set: $(x_1, x_2, \ldots, x_n) \in F$
  - x_i is a valid action at that point, or 0
  - Sequence of actions reaches goal?
- Objective function: $f(x_1, x_2, \ldots, x_n)$
  - Number of non-zero actions

Convex Program (Standard Form)

$$\min_{x_1,\ldots,x_n} f(x_1,\ldots,x_n)$$

$$\forall i.g_i(x_1,\ldots,x_n) \leq 0$$

$$\forall j.h_j(x_1,\ldots,x_n) = 0$$

- f, g_i convex
- h_j affine

Gradient Descent

- Optimize $f(x)$ by finding a local minimum
- Start with x_0
- Update as $x_i = x_{i-1} - \eta f'(x_{i-1})$
- η is the learning rate (e.g. $\eta = 0.05$)

Questions on Programming 2?

- Programming Assignment 2 due Sunday 23:59
  - Covered everything but Problem 3 (Thursday's video)
  - Please install ASAP!
  - Sudoku problems are a bit harder