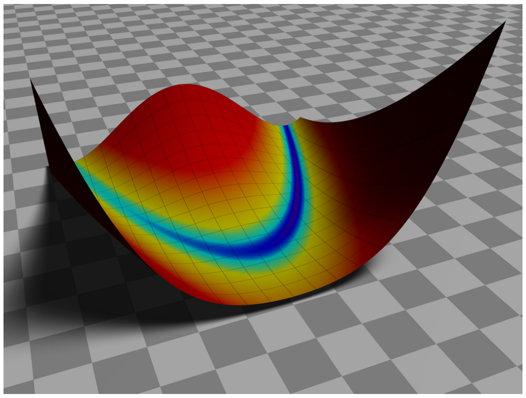
Interior Point Methods

Lecture 20



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Outline

Interior Point Methods

Scaling

Interior Point Methods

Recall some of the challenges with the previous methods:

- quadratic penalty: solution is always infeasible, ill-conditioning.
- SQP: need to keep track of active set (for equality constraints)

Motivation (partly): Let's keep the constraints feasible.

Again assuming constraint of the form:

$$c(x) \leq 0$$

Simple (but poor) version:

$$\pi(x, \mu) = f(x) - \mu \sum_{j=1}^{m} \log\left(-c_j(x)\right),$$

Solve a sequence of problems where $\mu \to 0$.

Forces feasibility and avoids the combinatorial problem.

See notebook example.

Modern implementations use slack variables and do not force constraint feasibility at each iteration (but force feasibility of $s \geq 0$ and $\lambda \geq 0$).

$$
\begin{aligned}
\text{minimize} \quad & f(x) - \mu \sum_{j=1}^{m} \log\left(s_j\right) \\
\text{subject to} \quad & c_j(x) + s_j = 0 \\
& (s \geq 0) \quad \text{naturally enforced}
\end{aligned}
$$

Interior Point Methods and Sequential Quadratic Programming Methods are both considered state-of-the-art.

Generally, IP is faster on large problems and SQP on medium-small problem, but not always.

Scaling

Engine efficiency example.