Examples of opt problems:

- Network flow
- Max grade s.t. effort $\leq t$
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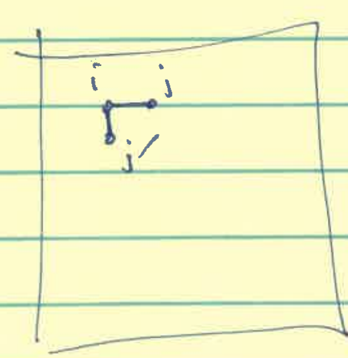
  Physics opt-problems involving Lagrangians
- ~~Ma~~ optimal power flow.
- Max likelihood. } least squares regression, logistic regression
- Motion planning.
- compressive sensing
- SVMs
- Regularized likelihood
  - smoothing spline
  - RKHS estimator

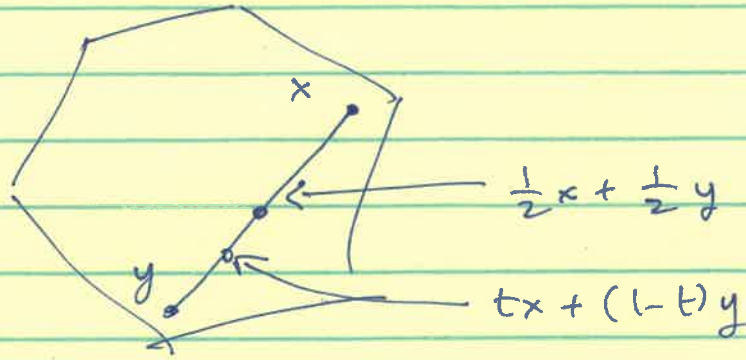
Neural nets

Examples of the contrary

- Bootstrap
- MCMC
- Random forests
- Kernel smoothing

ROF (1992)





$$\mathrm{dom}(f) = \{x : f(x) \text{ is defined and finite}\}$$

$$f(x) = \log(x), \quad \mathrm{dom}(f) = \mathbb{R}_{++} = \{x : x > 0\}$$

Proof of key property:

By contradiction. Suppose there is some feasible z s.t.

$$f(z) < f(x).$$

consider $tx + (1-t)z = y$.

- $y \in D$. Fact 1.
- $g_i(y) \leq 0$ Fact 2

why? $g_i(tx + (1-t)z)$

$\leq t g_i(x) + (1-t) g(z)$

≤ 0

- $h_j(y) = 0$ Fact 3

hence y is feasible.

$$\|y - x\|_2 = \|tx + (1-t)z - x\|_2$$

$$= (1-t)\|z - x\|_2$$

therefore can choose t close to 1 s.t. $\|y-x\|_2 \leq \rho$

$$f(y) = f(tx + (1-t)z) \leq t f(x) + (1-t) f(z) < t f(x) + (1-t) f(x)$$

$$= f(x)$$

CONTRADICTION.