Support vector machines unit:

- Linear programming (**today**)
- SVM concepts (Friday)
- Lab: SVM applications (next week Monday)
- The math of SVMs (next week Wednesday)
- SVM algorithms (next week Friday)
- (Midterm on Friday, Mar 21, after spring break)

Today:

- Linear programs in the context of optimization problems
- How to solve a linear program
- Lagrangian duality
- Quadratic programming

Example constrained optimization problem (from Deisenroth, pg 215):

Maximize

$$5x_0 + 3x_1 \qquad \text{objective}$$

Subject to

$$\left.\begin{array}{rcl} 2x_1 & \leq & 33 - 2x_0 \\ 4x_1 & \geq & 2x_0 - 8 \\ x_1 & \leq & 1 \\ x_1 & \leq & 8 \end{array}\right\} \text{constraints}$$

Same example, in standard form:

Maximize

$$5x_0 + 3x_1 \qquad \text{objective}$$

Subject to

$$\left.\begin{array}{rrcr} 2x_0 & +2x_1 & \leq & 33 \\ 2x_0 & -4x_1 & \leq & 8 \\ -x_0 & +x_1 & \leq & 5 \\ 0x_0 & -x_1 & \leq & -1 \\ 0x_0 & +x_1 & \leq & 8 \end{array}\right\} \text{constraints}$$

Same example, in "linear algebra" form:

Let $\boldsymbol{x} = \begin{bmatrix} x_0 \\ x_1 \end{bmatrix}$, $\boldsymbol{c} = \begin{bmatrix} 5 \\ 3 \end{bmatrix}$, $\boldsymbol{b} = \begin{bmatrix} 33 \\ 8 \\ 5 \\ -1 \\ 8 \end{bmatrix}$, and $\mathbf{A} = \begin{bmatrix} 2 & 2 \\ 2 & -4 \\ -1 & 1 \\ 0 & -1 \\ 0 & 1 \end{bmatrix}$

Maximize

$$\boldsymbol{c}^T\boldsymbol{x} \qquad \text{objective}$$

Subject to

$$\mathbf{A}\boldsymbol{x} \leq \boldsymbol{b} \qquad \text{constraints}$$

Coming up:

Due Fri, Feb 21:
Submit "Dataset" checkpoint for term project

Recommended sometime:
Read or skim chapter on GMM/EM from Deisenroth et al.
(See Canvas)

Due Tues, Feb 25:
Take GMM quiz

Due Fri, Feb 28:
Do GMM/EM programming assignment

Due Wed, Mar 5:
Read and respond to Urbina et al, "Dual use of AI-powered drug discovery"
(See Canvas)

Also coming sometime...
Textbook and supplemental reading about SVMs