Support vector machines unit:

- Linear programming (last week Wednesday)
- SVM concepts (last week Friday)
- Lab: SVM applications (Monday)
- The math of SVMs (**today**)
- SVM algorithms (Friday)

Today:

- Problem overview
- Constrained optimization, Lagrangian multipliers
- Hard-margin SVMs as constrained optimization
- Begin formulation of soft-margin and kerelized SMVs

The most important source for all of this was Stephen Marsland, *Machine Learning: An Algorithmic Perspective*, 2015, pg 179–183.

Given training data $\mathbf{X}, \boldsymbol{y}$, where $y_n \in \{-1, +1\}$, find $\boldsymbol{w}$, b, and r, so as to

$$\begin{aligned} \text{maximize} \quad & r \\ \text{subject to the constraints} \quad & \forall\, \boldsymbol{x_n}, y_n, \quad y_n(\boldsymbol{w}^T\boldsymbol{x_n} + b) \geq r \\ & ||\boldsymbol{w}|| = 1 \\ & r > 0 \end{aligned}$$

Or, equivalently, find $\boldsymbol{w}$ and b, so as to

$$\begin{aligned} \text{minimize} \quad & \tfrac{1}{2}||\boldsymbol{w}||^2 \\ \text{subject to the constraints} \quad & \forall\, \boldsymbol{x_n}, y_n, \quad y_n(\boldsymbol{w}^T\boldsymbol{x_n} + b) \geq 1 \end{aligned}$$

Coming up:

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

Due Fri, Mar 7:
Take SVM quiz

Due Wed, Mar 19:
Implement SVM classification

(Midterm on Fri, Mar 21)