

# CS 188 SECTION 12

These slides are on Piazza! Search for “Daylen’s slides”

# CORRECTION: LAPLACE SMOOTHING

---

$$P_{LAP,k}(x) = \frac{c(x) + k}{N + k|X|}$$



Number of events that X can take on

# CALCULUS REVIEW SECTIONS

---

- Session 1: **today**; 6-7:30 pm, Soda 405: single variable calculus
- Session 2: **today**; 7:30-9 pm, Soda 405: identical content to session 1
- Session 3: **tomorrow**; 6-7.30 pm, Soda 380; multi variable calculus
- Session 4: **tomorrow**; 7.30-9 pm, Soda 380; identical content to session 3

# UPCOMING DEADLINES

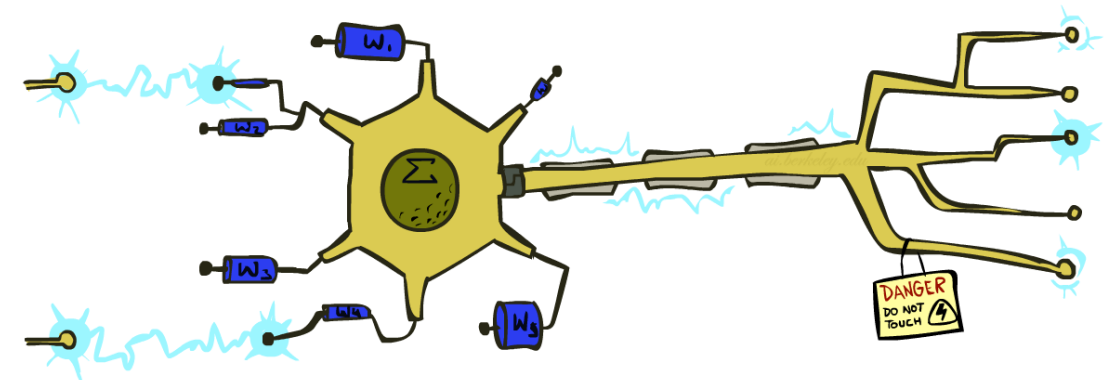
---

- Project 5 due **today** @ 5pm
- HW 6 due **Wednesday** @ 11:59
- Project 6 due **Sunday** @ 5pm
- Final Exam **next Thursday**

# BINARY PERCEPTRONS

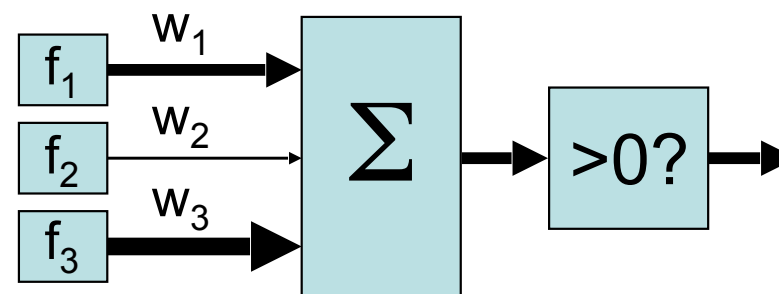
---

- Inputs are **feature values**
- Each feature has a **weight**
- Sum is the **activation**



$$\text{activation}_w(x) = \sum_i w_i \cdot f_i(x) = w \cdot f(x)$$

- If the activation is:
  - Positive, output +1
  - Negative, output -1



# BINARY PERCEPTRONS

---

- Start with weights = 0
- For each training instance:
  - Classify with current weights

$$y = \begin{cases} +1 & \text{if } w \cdot f(x) \geq 0 \\ -1 & \text{if } w \cdot f(x) < 0 \end{cases}$$

- If correct (i.e.,  $y=y^*$ ), no change!
- If wrong: adjust the weight vector by adding or subtracting the feature vector. Subtract if  $y^*$  is -1.

$$w = w + y^* \cdot f$$

# MULTICLASS PERCEPTRONS

---

Prediction highest score wins

$$y = \arg \max_y w_y \cdot f(x)$$

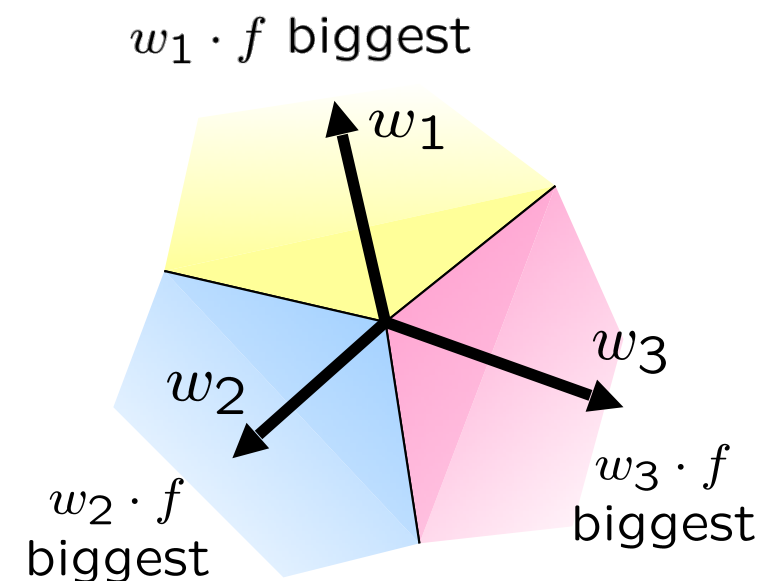
- Start with all weights = 0
- Pick up training examples one by one
- Predict with current weights

$$y = \arg \max_y w_y \cdot f(x)$$

- If correct, no change!
- If wrong: lower score of wrong answer, raise score of right answer

$$w_y = w_y - f(x)$$

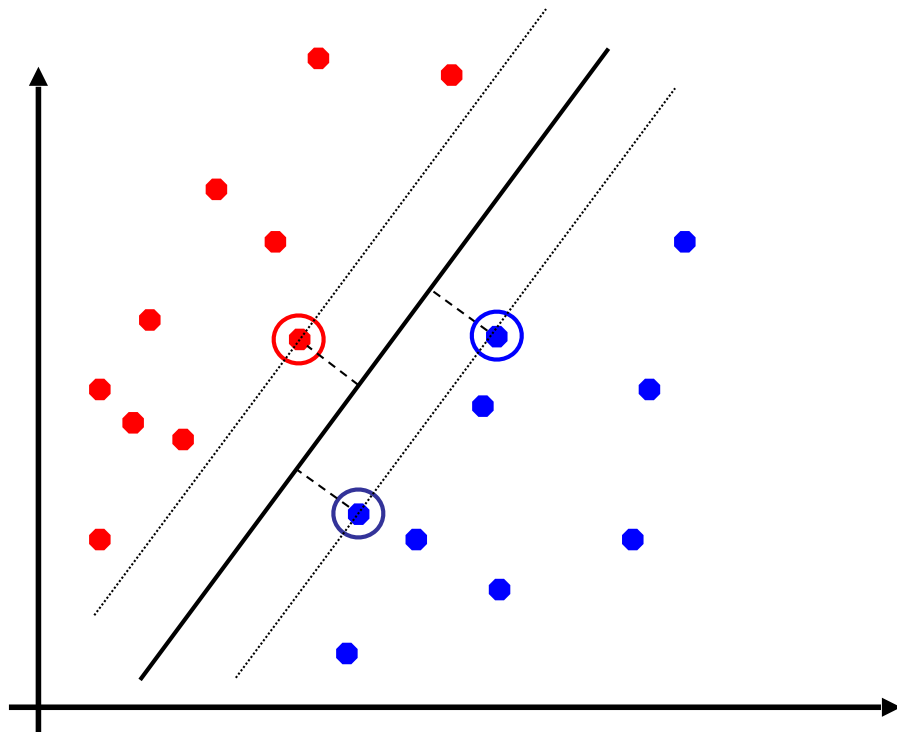
$$w_{y^*} = w_{y^*} + f(x)$$



# OTHER CLASSIFIERS DISCUSSED

---

## ► Support Vector Machines



SVM

$$\min_w \frac{1}{2} ||w||^2$$

$$\forall i, y \quad w_{y^*} \cdot f(x_i) \geq w_y \cdot f(x_i) + 1$$

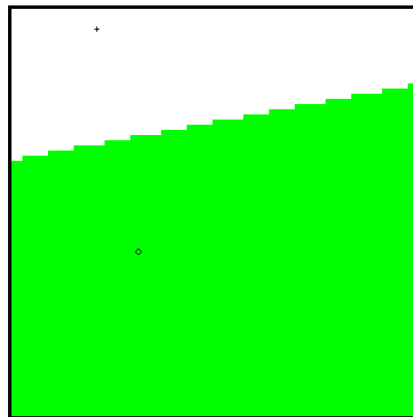


# OTHER CLASSIFIERS DISCUSSED

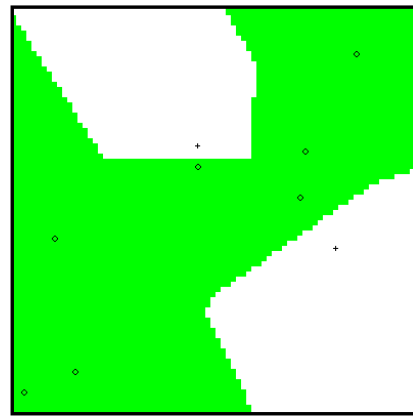
---

## ► Nearest Neighbors

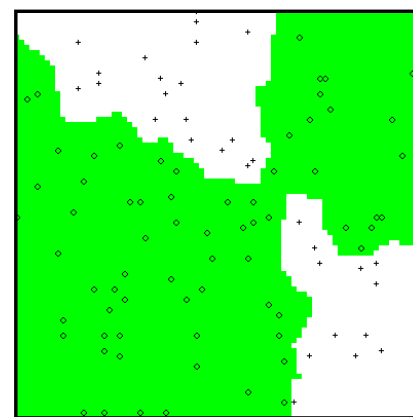
2 Examples



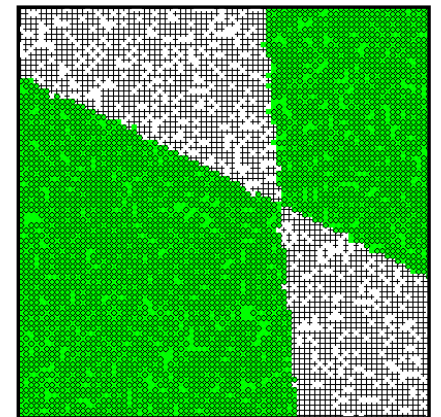
10 Examples



100 Examples



10000 Examples



**WORKSHEET**