Admin

- Exam #1 due (03/01/2021 @ noon) [i.e., 2 hours from now]
- Homework # 3 is due 03/08/2021 [1130 Pm]

  ~2 homework assignments left   "papers with code"

- Final project Pitch due 03/10/2021
  - What do you want to do?   [1 (maybe 2) paragraphs]
    o Is there a link to your project? (eg kaggle)
  - Where are you going to get your data?
    o You can also do a theory-based project but this is rare
  - Do you have a partner? If so, who are they and both of you should submit your pitch
  - If you hear nothing about your final project after a week then you're all set!

Adaboost (Adaptive Boosting)

You may have seen that building a "strong" or accurate classifier can be difficult to achieve; however, building a "weak" or poorly performing classifier is easy!

- Eg, getting a 51% on a physics 1 exam as a freshman is easy, but getting a 99% is hard

Adaptive Boosting (Adaboost) is an algorithm to convert a collection of weak "rules of thumb" to a strong (accurate) decision
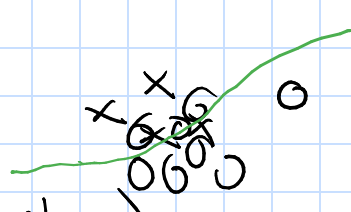
Notation

$h \in \mathcal{H}$ [h is a classifier in the hypothesis class $\mathcal{H}$]

$S := \{(x_i, y_i)\}_{i=1}^{n}$ [$y_i \in \{\pm 1\}$]

$h(x) \in \{\pm 1\}$

Adaptive Boosting Pseudo Code

Input: $S = \{(x_i, y_i)\}_{i=1}^{n}$, $\mathcal{H}$ (hypothesis class)

T (rounds)

* Initialize: $D_1(i) = \frac{1}{n}$

$$\star \quad \sum_{i=1}^{n} D_t(i) = 1$$

D is a distribution

a weight is assigned to each sample to quantify how difficult the sample is to classify

→ small weight → easy
→ large weight → difficult

for $t = 1, \ldots, T$ do

[error]

① $h_t = \text{Weak Learn}(S, D_t, \mathcal{H})$

② $\varepsilon_t = \sum_{i=1}^{n} D_t(i) [\![h_t(x_i) \neq y_i]\!]$

$$[\![\cdot]\!] = \begin{cases} 1, & \text{true} \\ 0, & \text{false} \end{cases}$$

③ $\alpha_t = \frac{1}{2} \log \frac{1 - \varepsilon_t}{\varepsilon_t}$

Z_t → normalization

④ $D_{t+1}(i) = \frac{D_t(i)}{Z_t} \exp\left(-\alpha_t \, h_t(x_i) \, y_i \right)$

Output: $H(x) = \text{sign}\left(\sum_{t=1}^{T} \alpha_t \, h_t(x) \right)$