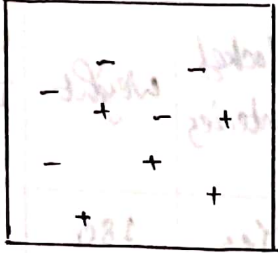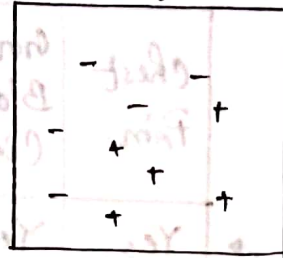# Adaboost

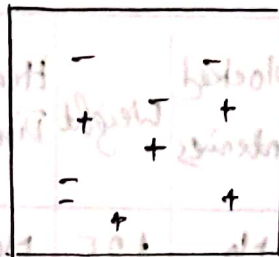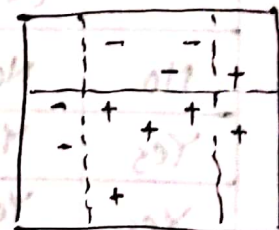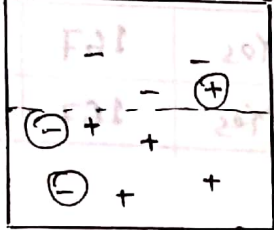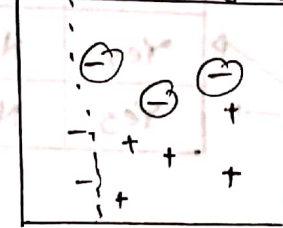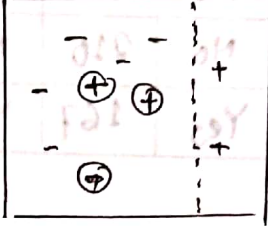| original dataset, D_1	Update Weights, D_2	Update weights, D_3	combined Classifi...

Weak Learner (Decision Stump) (DS $=$ DT with only one split)

$$x < threshold$$

Class -1 Class $+1$
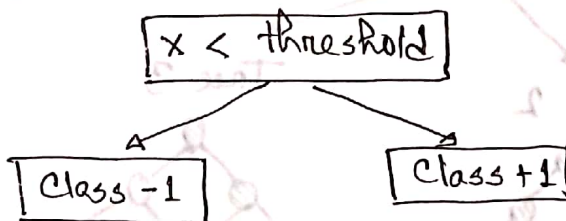
Error:

$$\epsilon_t = \frac{miss\ classifications}{samples} = \frac{miss\ classifications}{N} \quad (in\ the\ first\ iteration)$$

$$\epsilon_t = \sum_{miss} weights$$

If error > 0.5, just flip the decision and the error $= 1 - error$

Weights:

$$w_0 = \frac{1}{N} \text{ for each sample}$$

$$w = \frac{w.\ exp(-\alpha.y.h(x))}{sum(w)}, \text{ where } h(x) = \text{prediction of } t$$

Performance:

$$\alpha = 0.5 \cdot \log\left(\frac{1-\epsilon_t}{\epsilon_t}\right)$$

Note: with low error we will have a high positive value and high error we will have high negative value.

Prediction:

$$y = sign\left(\sum_{t}^{T} \alpha_t \cdot h(x)\right)$$

Training:

* Initialize weights for each sample - $1/N$

for t in T:
* Train weak classifier (greedy search to find best feature and thresh)
* Calculate error $\epsilon_t = \sum_{miss} weights$
   * flip error and decision if error > 0.5
* calculate $\alpha = 0.5 \cdot \log\left(\frac{1-\epsilon_t}{\epsilon_t}\right)$
* update weights: $w = \frac{w \cdot \exp(-\alpha \cdot h(x))}{Z}$