AdaBoost

Given: $(x_1, y_1), \ldots, (x_m, y_m)$ $x_i \in \mathcal{X}, y_i \in \{-1, +1\}$
Initialize: $D_1(i) = 1/m$ (uniform distribution)

For $t = 1, \ldots, T$

1. <u>train weak learner</u> using distribution D_t, obtaining
$$h_t : \mathcal{X} \to \{-1, +1\}$$

2. <u>assess error rate</u> of h_t w.r.t. D_t,
$$\epsilon_t = \Pr_{D_t}[h_t(x) \neq y]$$

3. <u>assign confidence</u> to h_t,
$$\alpha_t = \frac{1}{2} \ln \frac{1 - \epsilon_t}{\epsilon_t}$$

4. <u>update distribution</u>, increasing weight were incorrect and vice versa
$$D_{t+1}(i) = \frac{D_t(i) e^{-\alpha_t y_i h_t(x_i)}}{Z_t}$$
where $Z_t = \sum_i D_t(i) e^{-\alpha_t y_i h_t(x_i)}$ is a normalization factor. Note that
$$e^{-\alpha_t y_i h_t(x_i)} = \begin{cases} \sqrt{\frac{\epsilon_t}{1-\epsilon_t}} & h_t(x_i) = y_i \\ \sqrt{\frac{1-\epsilon_t}{\epsilon_t}} & h_t(x_i) \neq y_i \end{cases}$$

Output final hypothesis:

$$\begin{aligned} f(x) &= \sum_{t=1}^{T} \alpha_t h_t(x) \\ H(x) &= \operatorname{sign}(f(x)) \\ &= \operatorname{sign}\left(\sum_{t=1}^{T} \alpha_t h_t(x) \right) \end{aligned}$$