04/08/22

AdaBoost problem:-

Index	x	y	Initial weights	$\hat{y}$	correct?	updated weights
1	1.0	1	0.072	1	yes	0.0537
2	2.0	1	0.072	1	yes	0.0537
3	3.0	1	0.072	1	yes	0.0537
4	4.0	-1	0.072	-1	yes	0.0537
5	5.0	-1	0.072	-1	yes	0.0537
6	6.0	-1	0.072	-1	yes	0.0537
7	7.0	1	0.167	1	yes	0.1249
8	8.0	1	0.167	-1	NO	0.2492
9	9.0	1	0.167	-1	NO	0.2492
10	10.0	-1	0.072	-1	yes	0.0537

→ First based on the y & $\hat{y}$ we predict if the class is yes (or) NO. (∵ 'Yes' if y & $\hat{y}$ are same, else 'NO') step 1: we need to find the error rate,

we know that, error rate $\boxed{(\epsilon) = w \cdot (\hat{y} \neq y)}$.

$\therefore$ Error rate $(\epsilon) = (0.072, 0.072, 0.072, 0.072, 0.072, 0.072, 0.167, 0.167, 0.167, 0.072) \cdot \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{pmatrix}$

$\therefore$ Error rate $(\epsilon) = (0.072 \times 0) + (0.072 \times 0) + (0.072 \times 0) + (0.072 \times 0) + (0.072 \times 0) + (0.072 \times 0) + (0.167 \times 0) + (0.167 \times 1) + (0.167 \times 1) + (0.072 \times 0)$

$\therefore$ Error rate $(\epsilon) = 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0.167 + 0.167 + 0.$

$\therefore$ Error rate $(\epsilon) = \underline{0.334}$.

Step 2: we need to find the coefficient,

we know that, coefficient $\boxed{(\alpha_J) = 0.5 \log \frac{1-\epsilon}{\epsilon}}$

$\therefore$ Coefficient $(\alpha_J) = 0.5 \log\left(\frac{1-0.334}{0.334}\right)$

$\therefore$ Coefficient $(\alpha_J) \approx \underline{0.3450}$.

Step 3: Now, we need to update the weights,

we know that, updated weights $(w) \Rightarrow$

$$\boxed{(w) = w \times \exp(-\alpha_J \times \hat{y} \times y)}$$

$w_1 = 0.072 \times \exp(-0.3450 \times 1 \times 1)$

$\therefore w_1 = \underline{0.0509}$.

$w_2 = 0.072 \times \exp(-0.3450 \times 1 \times 1)$

$\therefore w_2 = \underline{0.0509}$.

$w_3 = 0.072 \times \exp(-0.3450 \times 1 \times 1)$

$\therefore w_3 = \underline{0.0509}$.

$w_4 = 0.072 \times \exp(-0.3450 \times -1 \times -1)$

$\therefore w_4 = \underline{0.0509}$.

$w_5 = 0.072 \times exp(-0.3450 \times -1 \times -1)$

$\therefore w_5 = \underline{0.0509}.$

$w_6 = 0.072 \times exp(-0.3450 \times -1 \times -1)$

$\therefore w_6 = \underline{0.0509}.$

$w_7 = 0.167 \times exp(-0.3450 \times 1 \times 1)$

$\therefore w_7 = \underline{0.1182}.$

$w_8 = 0.167 \times exp(-0.3450 \times -1 \times 1)$

$\therefore w_8 = \underline{0.2358}.$

$w_9 = 0.167 \times exp(-0.3450 \times -1 \times 1)$

$\therefore w_9 = \underline{0.2358}.$

$w_{10} = 0.072 \times exp(-0.3450 \times -1 \times -1)$

$\therefore w_{10} = \underline{0.0509}.$

<u>Step 4:-</u> Now we need to normalize the updated weights to sum to 1.

we know that to, normalize $\boxed{(w) = \frac{w}{\Sigma_i w_i}}$

↪ In order to find the Normalized weight, first find the $\varepsilon_i W_i$.

$$\varepsilon_i W_i = 7 \times 0.0509 + 2 \times 0.2358 + 1 \times 0.1182$$

$$\therefore \varepsilon_i W_i = \underline{\underline{0.9461}}.$$

Now, we can find the Normalized weight (w)

$$\therefore W_1 = \frac{0.0509}{0.9461} = \underline{\underline{0.0537}}.$$

$$w_2 = \frac{0.2358}{0.9461} = \underline{\underline{0.2492}}.$$

$$w_3 = \frac{0.1182}{0.9461} = \underline{\underline{0.1249}}.$$

→ Finally, we update the table with the updated weight data accordingly (see the top table)