Gradient Boosting Algorithm [Boosting Algorithm]

Regression

O/P of DT

$75 + 0.1(-23) =$

Exp (x_1)	Degree (x_2)	Salary (y, O/P)	$\hat{y}$	R_1 $(y-\hat{y})$	R_2	$\hat{y}$	R_3	R_4	$\hat{y}$	R_4	R_5	$\hat{y}$
2	B.E	50K	75	-25	-23	72.7	-22.7	—				
3	Masters	70K	75	-5	-3	74.7	-4.7	—				
5	Master	80K	75	5	3	75.3	4.7	—				
6	PhD	100K	75	25	20	77	23	—				
		75K										

Lets Assume

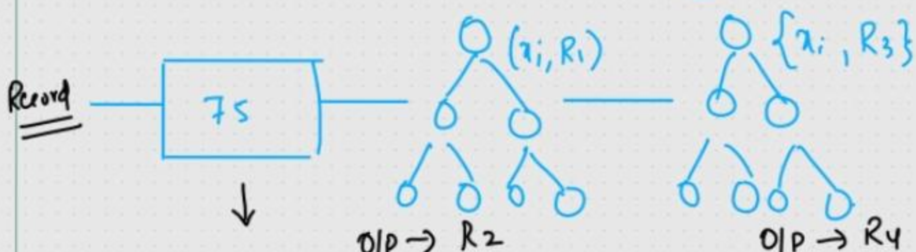
Step 1: Create a Base Model

$\boxed{75K}$

$$\text{Average} = \frac{50+70+80+100}{4} = 75K$$

Step 2: Compute Residuals or Error

Step 3: We construct next sequential Decision Tree with i/p x_i and O/P Residuals $[R_1]$.



$75 + (-23) = 75 - 23 = 52. \Rightarrow$ Overfitting

$$\text{Predicted} = 75 + \alpha(-23)$$

$$= 75 + 0.1\,(-23)$$

$$= 72.7$$

α = Learning Rate. 0 to 1

$\alpha = 0.1$

Final function

Base Learner

M_1

$$F(x) = \alpha_0 h_0(x) + \alpha_1 (h_1(x)) + \alpha_2(h_2(x) + \alpha_3 (h_3(x)) + \dots + \alpha_n(h_n(x))$$

$$\boxed{F(x) = \sum_{i=0}^{n} \alpha_i h_i(x)} \Rightarrow \text{Gradient Boost}$$

(4) **Xgboost classifier** = Extreme Gradient Boost

$\sigma(0 + 0.1(0.33)) = 0.58$

Dataset

0.52

Salary	Credit	Approval (y)	R1	$\hat{y}$	R2
<=50K	B	0	-0.5	0.52	-0.52
<=50K	G	1	0.5	0.58	0.42
<=50K	G	1	0.5	–	–
>50K	B	0	-0.5	–	–
>50K	G	1	0.5	–	–
>50K	N	1	0.5	–	–
<=50K	N	0	-0.5	–	–

(1) Step 1 : Base Model

log(odds) $\boxed{0.5}$ $= \log\left(\frac{P}{1-P}\right)$ 0

SW: 0.142

[-0.5, 0.5, 0.5, -0.5, -0.5, 0.5, 0.5]

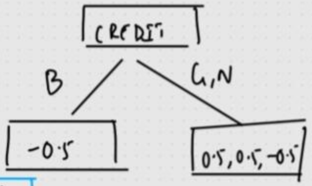
Salary

≤50K → SW=0 → [-0.5, 0.5, 0.5, -0.5]

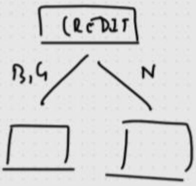
>50K → SW: 0.33 → [-0.5, 0.5, 0.5]

Step 3: We calculate Similarity weight

$$= \frac{(\sum \text{Residual})^2}{\sum Pr(1-Pr)}$$



$\boxed{SW = 1}$ SW = 0.33



71

$\downarrow$

$\boxed{0 \text{ to } 1}$

$\boxed{\alpha = 0.1}$

Model O/P $= \sigma\left[0 + \underbrace{\alpha(1)}_{0.1}\right] = \boxed{\dfrac{1}{1+e^{-0.1}}} = \underline{\underline{0.52}}$

$\sigma = \dfrac{1}{1+e^{-z}}$

$S.W(\leq 10k) = \dfrac{(-0.5+0.5\cancel{+0.5-0.5})^2}{1} \Rightarrow 0$

$1 \Leftarrow 0.5(1-0.5)+0.5(1-0.5)+0.5(1-0.5)+0.5(1-0.5)$

$SW(>10k) = \dfrac{0.25}{0.75}$

$= 0.33$

$\boxed{\underline{\underline{\text{Gain}}} = 0 + 0.33 - 0.142 = \underline{\underline{0.19}}}$

Final O/P

Binary classification $\longrightarrow$ Logistic Regression $\Rightarrow$ Log loss

Test Data $\rightarrow$ $\boxed{0.5}$ —

$\Downarrow$

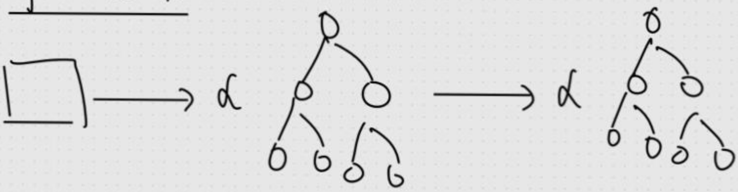
$\text{Log(odds)} = \log\left(\dfrac{p}{1-p}\right)$

$= \log\left(\dfrac{0.5}{0.5}\right)$

$= \log 1$

$= 0$

Xgboost classifier



$\text{O/p} = \sigma\left[\left(\text{Base Learner} + \alpha_1(DT_1) + \alpha_2(DT_2) + \dots \alpha_n(DT_n)\right)\right]$

$\downarrow$ logloss