Assignment: 01

Course Code: CSE427

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Section: 04

1.a

For "Student":

$$Gini(Junior) = \frac{5}{10}\left\{1-\left(\frac{2}{5}\right)^2-\left(\frac{1}{5}\right)^2-\left(\frac{2}{5}\right)^2\right\}$$

$$= 0.64 \times \frac{5}{10} = 0.32$$

$$Gini(senior) = \frac{5}{10}\left\{1-\left(\frac{4}{5}\right)^2-\left(\frac{1}{5}\right)^2\right\}$$

$$= 0.32 \times \frac{5}{10} = 0.16$$

$\therefore$ Gini (Student) $= 0.32 + 0.16$

$= 0.48$

For "Department":

$$Gini(cse) = \frac{5}{10}\left\{1-\left(\frac{3}{5}\right)^2-\left(\frac{1}{5}\right)^2-\left(\frac{1}{5}\right)^2\right\}$$

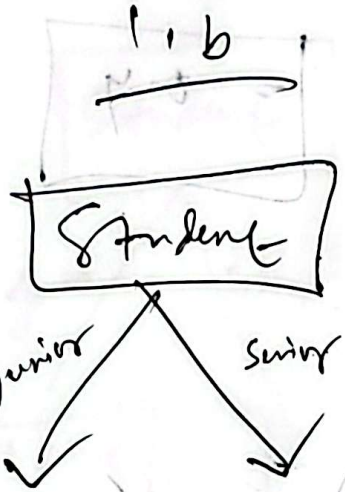
$$= 0.28$$

$$Gini(ece) = \frac{5}{10}\left\{1-\left(\frac{2}{5}\right)^2-\left(\frac{1}{5}\right)^2-\left(\frac{2}{5}\right)^2\right\}$$

$$= 0.32$$

Gini (Department) = 0.32 + 0.28 = 0.60

∴ Best root = Student



For "Junior"

Gini (Department) = $\frac{2}{5}\left(1-1^2-1\right) + \frac{3}{5}\left(1-\left(\frac{2}{3}\right)^2-1\right)$

Gini (SH < 2.75) = $\frac{1}{5}\left(1-1^2\right) + \frac{4}{5}\left(1-\left(\frac{2}{4}\right)^2-2\left(\frac{1}{4}\right)^2\right)$

Gini (SH < 3.5) = $\frac{2}{5}\left\{1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right\} + \frac{3}{5}\left\{1-3\left(\frac{1}{3}\right)^2\right\}$

Gini (SH < 4) = 0.6

Gini (SH < 4.5) = $\frac{4}{5}\left\{1-\left(\frac{2}{4}\right)^2-\left(\frac{2}{4}\right)^2\right\}+\frac{1}{5}(1-1)$

= 0.4

For "Swim":

Gini (Department) = $\frac{3}{5}\left\{1-\left(\frac{1}{3}\right)^2-\left(\frac{2}{3}\right)^2\right\}+\frac{2}{5}\{1-1\}$

= 0.27

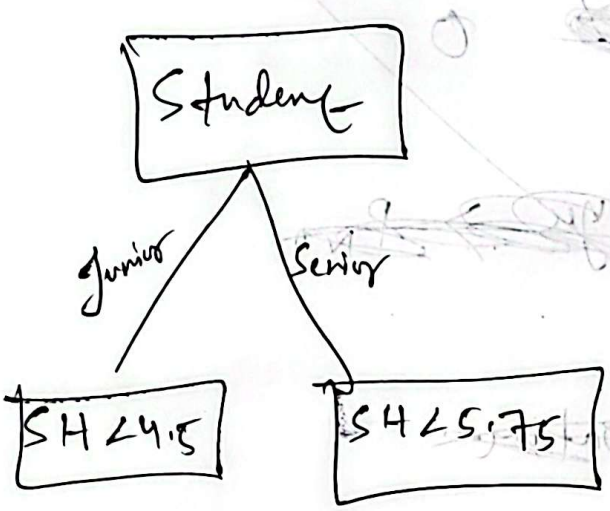
SH < 4.5 = $\frac{1}{5}\{1-1\}+\frac{4}{5}\left\{1-\left(\frac{3}{4}\right)^2-\left(\frac{1}{4}\right)^2\right\}$

SH < 5.75 = $\frac{2}{5}\left\{1-2\left(\frac{1}{2}\right)^2\right\}+\frac{3}{5}\{1-1\}$

= 0.2

SH < 6.75 = $\frac{3}{5}\left\{1-\left(\frac{2}{3}\right)^2-\left(\frac{1}{3}\right)^2\right\}+\frac{2}{5}(1-1)$ = 0.27

$$SH < 7.5 = \frac{4}{5}\left\{1-\left(\frac{3}{4}\right)^2-\left(\frac{1}{4}\right)^2\right\} + \frac{1}{5}\left\{1-1\right)$$



$$\frac{3}{}$$

$P(\text{yes} / 99^\circ F, \text{cough}, \text{Antibiotic}, \text{Female})$

$= P(99^\circ F / \text{yes}) \times P(\text{cough} / \text{yes}) \times P(\text{Antibiotic} / \text{yes}) \times P(\text{Female} / \text{yes})$

$= \frac{2}{5} \times \frac{1}{5} \times \frac{1}{5} \times \frac{4}{5} \times \frac{5}{10} = \frac{4}{625}$

$= 6.4 \times 10^{-3}$

Here,

As $P(99/No) = 0$.

For "no" : values $= (103, 102, 100, 104, 101)$

$\therefore$ Avg. $\mu = 102$

$\therefore$ Variance, $\sigma^2 = \dfrac{(103-102)^2 + (102-102)^2 + (100-102)^2 + (104-102)^2 + (101-102)^2}{5}$

$\Rightarrow \sigma^2 = 2$

$\Rightarrow \sigma = \sqrt{2} = 1.41$

$$P(99/No) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\left(\frac{(99-102)^2}{2\times 2}\right)}$$

$$= \frac{1}{1.41 \times \sqrt{2\pi}} e^{-\left(\frac{(99-102)^2}{4}\right)}$$

$$= 0.0298$$

$\therefore P(No/99, Cough, Antibiotic, Fundo)$

$= P(99/No) \times P(Cough/No) \times P(Antib/No) \times P(Fm/No)$

$= 0.0298 \times \frac{2}{5} \times \frac{2}{5} \times \frac{1}{5} \times \frac{5}{10} = 7.15 \times 10^{-4}$

$= 0.72 \times 10^{-3}$

$P(yes) > P(No)$

$\therefore$ The patient will recover.

4.a

Initial Guess;

Ex5 : Cough = Yes (as at another "Yes" at the same target variable, target variable, it's "Yes")

Percentage = $\frac{94+92}{2} = 93$ [at "Yes" target variable]

Age = $\frac{30+45}{2} = 37.5$

4.b

for "Cough":

∴ for Yes = $\frac{3}{4} \times \frac{0.35+0.4+0.1}{0.15+0.35+0.4+0.1}$

= 0.293

∴ No = $\frac{1}{4} \times \frac{0.15}{0.15+0.35+0.4+0.1}$

= 0.038

revised "Cough" = Yes

For percentage $= \left(98 \times \frac{0.15}{0.15+0.35+0.4+0.1}\right) +$

$\left(94 \times \frac{0.35}{0.15+0.35+0.4+0.1}\right) + \left(92 \times \frac{0.4}{0.15+0.35+0.4+0.1}\right) +$

$\left(96 \times \frac{0.1}{0.15+0.35+0.4+0.1}\right)$

$= \frac{147}{10} + \frac{329}{10} + \frac{184}{5} + \frac{48}{5}$

$= \boxed{94}$

revised value "percentage" $= \boxed{94}$

For Age $= (22 \times 0.15) + 30 \times 0.35 +$

$45 \times 0.4 + 26 \times 0.1 = 34.6$

revised "age" $= \boxed{34.6}$

5.a

Initial weight = $\frac{1}{10}$

5.b

$$\text{Gini (color)} = \frac{4}{10}\left\{1-\left(\frac{3}{4}\right)^2-\left(\frac{1}{4}\right)^2\right\}+\frac{3}{10}\left\{1-\left(\frac{2}{3}\right)^2-\left(\frac{1}{3}\right)^2\right\}+\frac{3}{10}(1-1)$$

$$= 0.28$$

$$\text{Gini (Device)} = \frac{5}{10}\left\{1-\left(\frac{2}{5}\right)^2-\left(\frac{2}{5}\right)^2\right\}+\frac{5}{10}\left\{1-\left(\frac{3}{5}\right)^2-\left(\frac{2}{5}\right)^2\right\}$$

$$= 0.48$$

$$\text{Gini (Sc} < 28) = 0$$

$$\text{Gini (sc} < 29) = \frac{2}{10}\{1-1\}+\frac{8}{10}\left\{1-\left(\frac{5}{8}\right)^2-\left(\frac{3}{8}\right)^2\right\}$$

$$= 0.38$$

Gini (sc < 30) = 0.38

Gini (sc < 32.5) = $\frac{4}{10}\left\{1-\left(\frac{1}{4}\right)^2-\left(\frac{3}{4}\right)^2\right\} + \frac{6}{10}\left\{1-\left(\frac{4}{6}\right)^2-\left(\frac{2}{6}\right)^2\right\}$

= 0.42

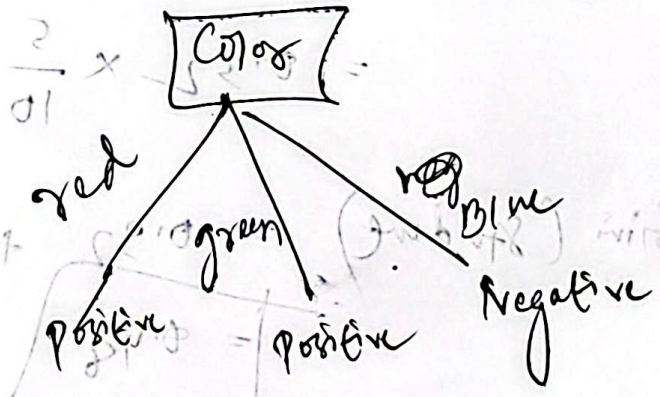
Gini (sc < 35) = 0.42

Gini (sc < 38.5) = $\frac{7}{10}\left\{1-\left(\frac{3}{7}\right)^2-\left(\frac{4}{7}\right)^2\right\} + \frac{3}{10}\left\{1-\left(\frac{2}{3}\right)^2-\left(\frac{1}{3}\right)^2\right\}$

= 0.48

Gini (sc < 42) = 0.48

∴ Stump:



SIC

Amount of say = $\frac{1}{2}\ln\left(\frac{1-TE}{TE}\right)$

$= \frac{1}{2}\ln\left(\frac{1-0.2}{0.2}\right)$

= 0.69

Total error, TE =

$1 \times \frac{1}{10} + 1 \times \frac{1}{10}$

= 0.2

5, d

⇒ updated:

∴ weights for correctly classified $= \frac{1}{10} \times e^{-\ln 2}$

$= 0.05$

⇒ for incorrectly classified $= \frac{1}{10} \times e^{\ln 2}$

$= 0.2$

6

Cross Entropy loss function:

$$= -\frac{1}{n} \sum_{i=1}^{n} \left(y \log \hat{y} + (1-y) \log (1-\hat{y}) \right)$$

$$z = w_1 x_1 + w_2 x_2 + b$$

$$\hat{y} = \sigma(z) = \frac{1}{1+e^{-z}}$$

$$\frac{dL}{dw_1} = \frac{dL}{d\hat{y}} \times \frac{d\hat{y}}{dz} \times \frac{dz}{dw_1} \quad \text{---(1)}$$

$$\frac{dL}{d\hat{y}} = -\frac{y}{\hat{y}} - \frac{1-y}{1-\hat{y}} \times \frac{d}{d\hat{y}}(1-\hat{y})$$

$$= \frac{-y}{\hat{y}} + \frac{1-y}{1+\hat{y}}$$

$$= \frac{\hat{y}-y}{\hat{y}(1-\hat{y})}$$

$$\frac{d\hat{y}}{dz} = \frac{d}{dz}(1+e^{-z})^{-1}$$

$$= (-1) \times (1+e^{-z})^{-2} \times \frac{d}{dz}(1+e^{-z})$$

$$= e^{-z} \times \frac{1}{(1+e^{-z})^2}$$

$$= e^{-z} \times (\hat{y})^2$$

$$= \frac{1-\hat{y}}{\hat{y}} \times (\hat{y})^2$$

$$= \hat{y}(1-\hat{y})$$

$$\hat{y} = \frac{1}{1+e^{-z}}$$

$$\Rightarrow \hat{y} e^{-z} = 1-\hat{y}$$

$$\Rightarrow e^{-z} = \frac{1-\hat{y}}{\hat{y}}$$

$$\frac{dz}{dw_1} = x_1$$

① $\Rightarrow$

$$\frac{dL}{dw_1} = \frac{\hat{y}-y}{\hat{y}(1-\hat{y})} \times \hat{y}(1-\hat{y}) \times x_1$$

$$= (\hat{y}-y)\, x_1$$

$$\frac{dL}{db} = \frac{dL}{d\hat{y}} \times \frac{d\hat{y}}{dz} \times \frac{dz}{db} \quad \text{— (11)}$$

$$= (\hat{y}-y) \times \frac{dz}{db}$$

$$= (\hat{y} - y) \times 1$$

$$\boxed{= \hat{y} - y}$$

$$\frac{dL}{dw_2} = \frac{dL}{d\hat{y}} \times \frac{d\hat{y}}{dz} \times \frac{dz}{dw_2}$$

$$= (\hat{y} - y) \times x_2$$

$$\boxed{= x_2 (\hat{y} - y)}$$