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* Initial entropy:-

→ The Data has 5 positive Samples and 5⁻ negative Samples

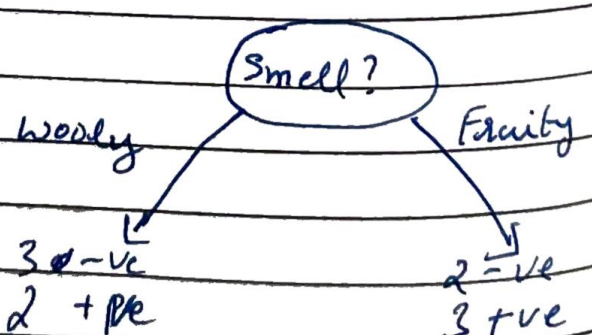
→ P(Positive) = P(Negative) = $\frac{1}{2}$

→ Initial entropy:- $-\frac{1}{2}\log$

$$-\frac{1}{2}\log_2\left(\frac{1}{2}\right) + \left(\frac{1}{2}\log_2\left(\frac{1}{2}\right)\right) = 1$$

* First Split:-

a) If 1st spit is performed using feature: Smell



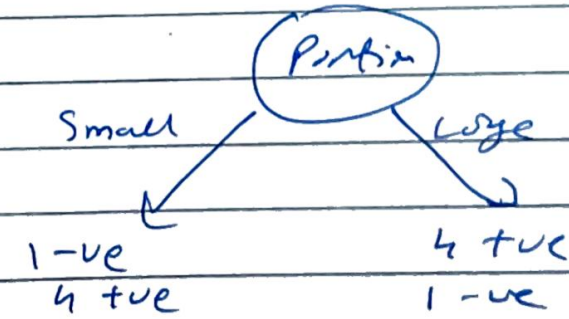
Entropy after split

$$= \frac{1}{2}\left(\frac{-3}{5}\log_2\left(\frac{3}{5}\right) - \frac{2}{5}\log_2\left(\frac{2}{5}\right)\right)$$

$$+ \frac{1}{2}\left(\frac{-2}{5}\log_2\left(\frac{2}{5}\right) - \frac{3}{5}\log_2\left(\frac{3}{5}\right)\right)$$

$$= 0.4854 + 0.4854 = \underline{0.9708}$$

b) If 1st split is performed using feature Portion

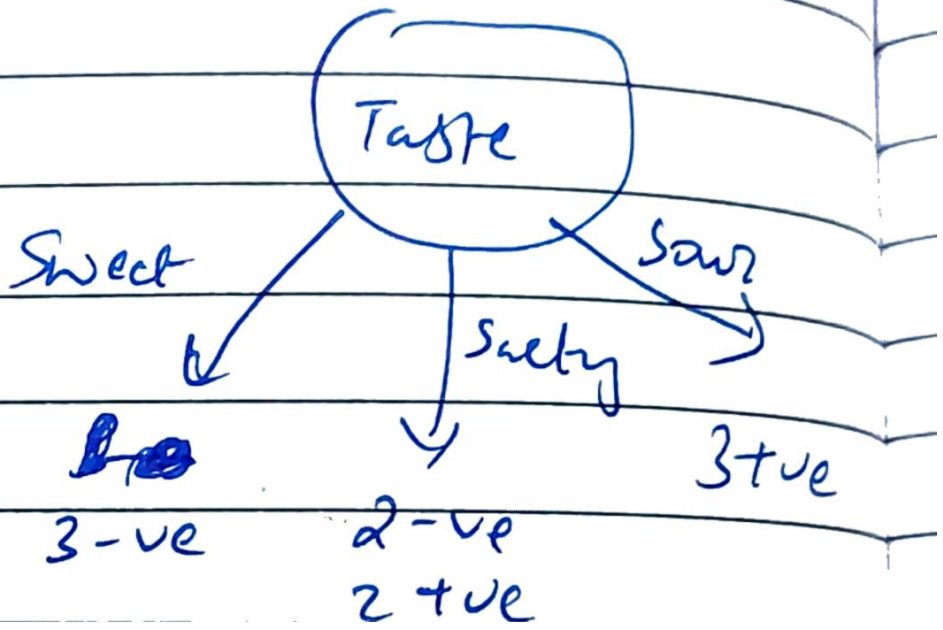


$$= \frac{1}{2}\left(\frac{-1}{5}\log_2\left(\frac{1}{5}\right) - \frac{4}{5}\log_2\left(\frac{4}{5}\right)\right)$$

$$+ \frac{1}{2}\left(\frac{-4}{5}\log_2\left(\frac{4}{5}\right) - \frac{1}{5}\log_2\left(\frac{1}{5}\right)\right)$$

$$= 0.3609 + 0.3609 = \underline{0.7218}$$

c) If the 1st split is performed using feature Taste



$$\frac{3}{10}\left(\frac{-3}{3}\log 1\right) + \left(\frac{2+2}{10}\right)\log\left(\frac{-1}{2}\log_2\frac{1}{2} - \frac{1}{2}\log_2\frac{1}{2}\right)$$

[Sweet] $\hookrightarrow = 0$ [Salty]

$$+ \frac{3}{10}\left(\frac{3}{3}\log\left(\frac{3}{3}\right)\right)$$

$= 0$

[Sour]

$$= \frac{4}{10} = \underline{\underline{0.4}}$$

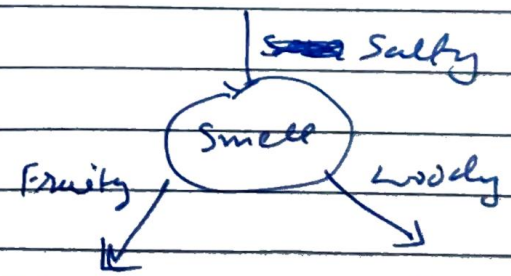
→ Maximum information gain or maximum impurity decrease is used as criteria to determine split

IG = (initial impurity) − (impurity after split)

Smell → = 1 − 0.9708 = 0.0292
Portion → 1 − 0.7218 = 0.2782
Taste → 1 − 0.4 = 0.6

II split:- [This node is reached when ~~Soft~~ taste is salty]

a) If No split is decided using Smell:-



Entropy

2 +ve
2 -ve

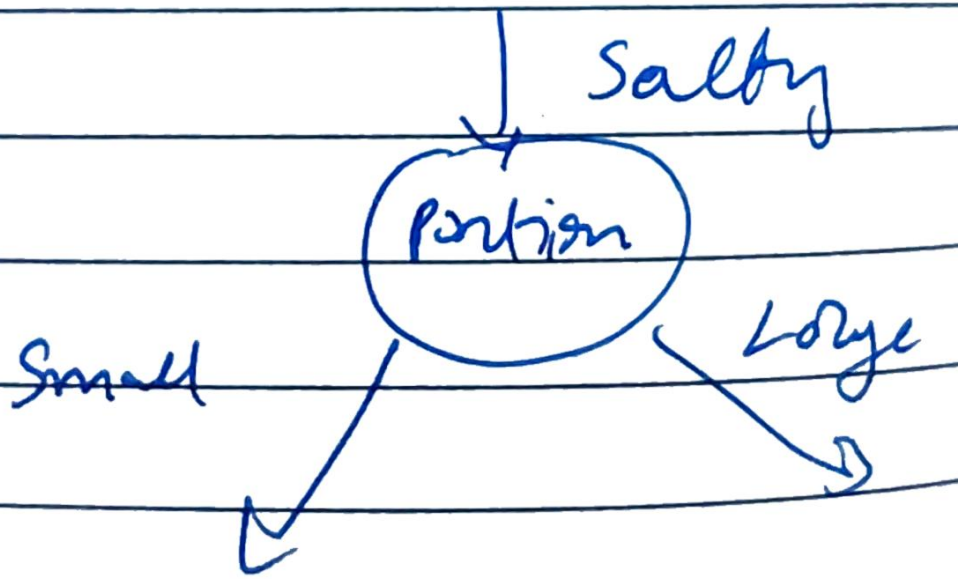
0

$= \frac{1}{2}\log_2\left(\frac{1}{2}\right) + \frac{1}{2}\log_2\left(\frac{1}{2}\right)$

$= 1$

[Bad Split]

b) If Split is decided using portion



Entropy = 0

[Good Split]

-> Therefore complete tree ~~architecture~~ architecture can be