# Assignment: 04

Que.1 Decision Tree:-

$S(\text{Full table}) = \underset{[-5,+5]}{} \quad -\frac{5}{10}\log\frac{5}{10} - \frac{5}{10}\log\frac{5}{10} \rightarrow$ ~~0.301~~ 1

PHASE I

* $S(\text{Yes, Long-Term Debt}) = -1/5\log 1/5 - 4/5\log 4/5 =$ ~~0.217~~ 0.721
  [+1, -4]

  $S(\text{No, Long-Term Debt}) = -4/5\log 4/5 - 1/5\log 1/5 =$ ~~0.217~~ 0.721
  [+4, -1]

* $S(\text{Yes, Unemployee}) = -\log 1 = 0$
  [+0, -2]

  $S(\text{No, Unemployee}) = -3/8\log 3/8 - 5/8\log 5/8 =$ ~~0.287~~ 0.954
  [-3, +5]

* $S(\text{Good, Credit}) = -1/3\log 1/3 - 2/3\log 2/3 =$ ~~0.276~~ 0.918
  [+2, 1]

  $S(\text{Bad, Credit}) = -3/7\log 3/7 - 4/7\log 4/7 =$ 0.296 0.985
  [+3, -4]

* $S(\text{Yes, Down Paymat}) = -2/5\log 2/5 - 3/5\log 3/5 =$ ~~0.292~~ 0.970
  [+2, -3]

  $S(\text{No, Down P}) = -3/5\log 3/5 - 2/5\log 2/5 =$ ~~0.292~~ 0.970
  [-2, +3]

$\Rightarrow$ Gain = Entropy(S) $- \sum \frac{|S_v|}{S}$ Entropy($S_v$).

* Gain(S, Long Term Debt) =

$$\frac{1-5}{10}(0.721 + 0.721) \Rightarrow 1 - 0.5 \times 1.442$$
$$\Rightarrow 0.279.$$

Gain(S, Unemployee) =

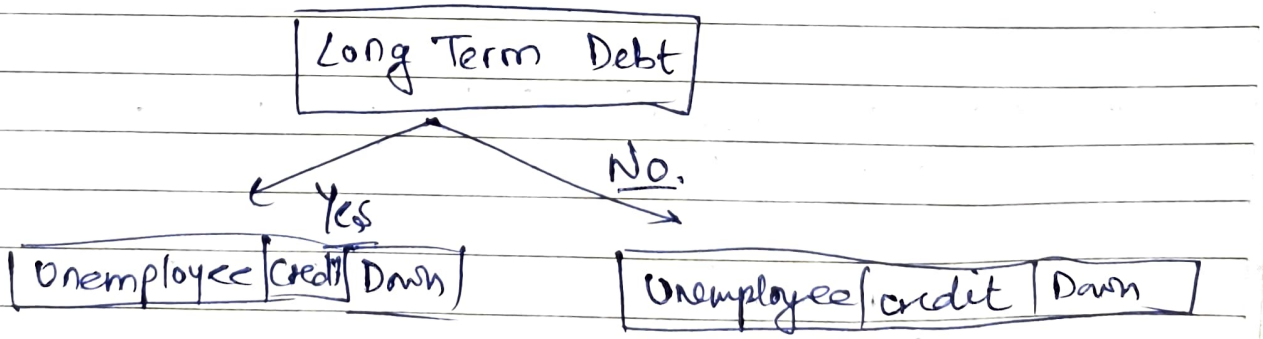
$$1 - \frac{8}{10} \times 0.954 \Rightarrow 0.236$$

Gain(S, Credit R) =

$$1 - \frac{3}{10} \times 0.918 - \frac{7}{10} \times 0.985 = 0.035$$

Gain (S, Down P.) =

$$1 - \frac{5}{10}(0.970 + 0.970) = 0.03$$



PHASE = II

* LTD = Yes → $S(Yes) = -\frac{1}{5}\log\frac{1}{5} - \frac{4}{5}\log\frac{4}{5} = 0.721$

$S(Unemployee, Yes) = -\frac{1}{5}\log\frac{1}{5} - \frac{4}{5}\log\frac{4}{5} = 0.721$

[-4, +1]

$-\log 1 = 0$

* $S(Credit, Good) = -\log 1 = 0$

[+1, -4]

$S(Unemployee, No) = -\frac{1}{4}\log\frac{1}{4} - \frac{3}{4}\log\frac{3}{4} = 0.811$

(+1, -3)

$S(Credit, Bad) = -\log 1 = 0$

[-4]

* $S(Down, Yes) = -\log 1 = 0$

[-2]

$S(Down, No) = -\frac{1}{3}\log\frac{1}{3} - \frac{2}{3}\log\frac{2}{3} = 0.645$

(+1, -2)

Gain (Yes, Unemployee) $= 0.721 - \frac{4}{5} \times 0.811 = 0.072$

Gain (Yes, Credit) $= 0.721$

Gain (Yes, Down) $= 0.721 - \frac{3}{5} \times 0.645 = 0.334$

LTD = No

* $S(\text{No}, \text{Unemployee}, \text{No}) = -\log 1 = 0$
  (+4)

  $S(\text{Unemployee}, \text{Yes}) = -\log 1 = 0$
  (-1)

* $S(\text{credit}, \text{Good}) = -\frac{1}{2}\log\frac{1}{2} - \frac{1}{2}\log\frac{1}{2} = 1$
  (-1, +1)

  (+3)
  $S(\text{credit}, \text{Bad}) = -\log 1 = 0$

* $S(\text{Down P}, \text{Yes}) = -\frac{1}{3}\log\frac{1}{3} - \frac{2}{3}\log\frac{2}{3} = 0.645$
  (+2, -1)

  $S(\text{Down P}, \text{No}) = -\log 1 = 0$
  (+2)

→ Gain (No, Unemployee) = 0.721