Date / /

Step 1:-

Entropy of whole data set :-

$$-\frac{C(P)}{C(T)} \times \log_2 \frac{C(P)}{C(T)} - \frac{C(N)}{C(T)} \times \log_2 \frac{C(N)}{C(T)}$$

$$-\frac{9}{14} \times \log_2 \frac{9}{14} - \frac{5}{14} \times \log_2 \frac{5}{14}$$

$$\left(-\frac{9}{14} \times (-0.637)\right) - \left(\frac{5}{14} \times (-1.485)\right)$$

$$= 0.4095 + 0.530$$

$$\text{Entropy}_{all} = 0.9395.$$

Step 2:- (1) Entropy of each attribute in each column.

a) Outlook :- (Sunny, Overcast, Rain)

$$\text{Entropy}_{Sunny} = -\frac{2}{5} \times \log_2 \frac{2}{5} - \frac{3}{5} \log_2 \frac{3}{5}$$

$$= 0.97.$$

$$\text{Entropy}_{Overcast} = \left(-\frac{4}{4} \times \log_2 \frac{4}{4}\right) - \left(\frac{0}{4} \times \log_2 \frac{0}{4}\right)$$

$$= 0$$

$$\text{Entropy}_{Rain} = -\frac{3}{5} \times \log_2 3/5 - \frac{2}{5} \times \log_2 (2/5)$$

$$= 0.970$$

$$\text{Gain}_{Outlook} = 0.9395 - \frac{5}{14}(0.97) - \frac{4}{14}(0) - \frac{5}{14}(0.97)$$

$$= 0.2466.$$

Date / /

b) -- Temprature :- (Hot, mild, cold)

$$\text{Entropy}_{hot} = -\frac{2}{4}\log_2\frac{2}{4} - \frac{2}{4}\log_2\frac{2}{4}$$

$$= 1$$

$$\text{Entropy}_{mild} = -\frac{4}{6}\log_2\frac{4}{6} - \frac{2}{6}\log_2\frac{2}{6}$$

$$= 0.9182$$

$$\text{Entropy}_{cold} = -\frac{3}{4}\log_2\frac{3}{4} - \frac{1}{4}\log_2\frac{1}{4}$$

$$= 0.811$$

$$\text{Gain}_{Temp} = 0.9395 - \left(\frac{4}{14} \times 1\right) - \left(\frac{6}{14} \times 0.9182\right) - \left(\frac{4}{14} \times 0.811\right)$$

$$= 0.02855.$$

c) -- Humidity :- (High, Normal)

$$\text{Entropy}_{high} = -\frac{3}{7}\log_2\frac{3}{7} - \frac{4}{7}\log_2\frac{4}{7}$$

$$= 0.985$$

$$\text{Entropy}_{normal} = -\frac{6}{7}\log_2\frac{6}{7} - \frac{1}{7}\log_2\frac{1}{7}$$

$$= 0.591.$$

$$\text{Gain}_{humidity} = 0.9395 - \left(\frac{7}{14} \times 0.985\right) - \left(\frac{7}{14} \times 0.591\right)$$

$$= 0.1515.$$

Date / /

d) - Wind :- (Weak, Strong)

$$\text{Entropy}_{\text{Weak}} = -\frac{7}{8}\log_2\frac{7}{8} - \frac{1}{8}\log_2\frac{1}{8}$$

$$= 0.81$$

$$\text{Entropy}_{\text{Strong}} = -\frac{3}{6}\log_2\frac{3}{6} - \frac{3}{6}\log_2\frac{3}{6}$$

$$= 1$$

$$\text{Gain} = 0.9395 - \left(\frac{8}{14} \times 0.543\right) - \left(\frac{6}{14} \times 1\right)$$

$$= 0.2006$$

$\text{Gain}_{\text{OUTLOOK}} = 0.2466$

$\text{Gain}_{\text{temperature}} = 0.028$

$\text{Gain}_{\text{Humidity}} = 0.1515$

$\text{Gain}_{\text{wind}} = 0.0478$