

$$\text{Entropy}(S_{\text{overcast}}) = -\frac{4}{4} \log_2 \frac{4}{4} - \frac{0}{4} \log_2 \frac{0}{4} = 0$$

$$\text{Entropy}(S_{\text{rain}}) = -\frac{3}{5} \log_2 \frac{3}{5} - \frac{2}{5} \log_2 \frac{2}{5} = 0.971$$

$$G_{\text{air}}(S, \text{outlook}) = \text{Entropy}(S) - \sum_{v \in \{\text{Sunny, overcast, Rain}\}} \frac{|S_v|}{|S|} \text{Entropy}(S_v)$$

$$G_{\text{air}}(S, \text{outlook})$$

$$= \text{Entropy}(S) - \frac{5}{14} \text{Entropy}(S_{\text{Sunny}}) - \frac{4}{14} \text{Entropy}(S_{\text{overcast}}) - \frac{5}{14} \text{Entropy}(S_{\text{rain}})$$

$$G_{\text{air}}(S, \text{outlook}) = 0.94 - \frac{5}{14} \times 0.971 - \frac{4}{14} \times 0 - \frac{5}{14} \times 0.971$$

$$= 0.2464$$

A Attribute: Temp

values(Temp) = Hot, Mild, cool

| | Yes | No |
|---------------------------|-----|----|
| Hot | 2 | 2 |
| Mild | 4 | 2 |
| Normal Cool | 3 | 1 |

$$S = [9+, 05-]$$

$$\text{Entropy}(S) = -\frac{9}{14} \log_2 \frac{9}{14} - \frac{5}{14} \log_2 \frac{5}{14} = 0.94$$

$$S_{\text{Hot}} = [2+, 2-]$$

$$\text{Entropy}(S_{\text{Hot}}) = -\frac{2}{4} \log_2 \frac{2}{4} - \frac{2}{4} \log_2 \frac{2}{4} = 1.0$$

$$S_{\text{Mild}} = [4+, 2-]$$

$$\text{Entropy}(S_{\text{Mild}}) = -\frac{4}{6} \log_2 \frac{4}{6} - \frac{2}{6} \log_2 \frac{2}{6} = 0.9183$$

$$S_{\text{Cool}} = [3+, 1-]$$

$$\text{Entropy}(S_{\text{Cool}}) = -\frac{3}{4} \log_2 \frac{3}{4} - \frac{1}{4} \log_2 \frac{1}{4} = 0.8113$$

$$\text{Gain}(S, \text{Temp}) = \text{Entropy}(S) - \sum_{v \in \{\text{Hot, Mild, Cool}\}} \frac{|S_v|}{|S|} \text{Entropy}(S_v)$$

$$\text{Gain}(S, \text{Temp}) = \text{Entropy}(S) - \frac{4}{14} \text{Entropy}(S_{\text{Hot}}) - \frac{6}{14} \text{Entropy}(S_{\text{Mild}}) - \frac{4}{14} \text{Entropy}(S_{\text{Cool}})$$

$$= 0.94 - \frac{4}{14} \times 1.0 - \frac{6}{14} \times 0.9183 - \frac{4}{14} \times 0.8113$$

$$= 0.0289$$

Teacher's Signature :

Attribute: Humidity
value (Humidity) = High, normal

$$S = [9+, 5-]$$

$$\text{Entropy}(S) = -\frac{9}{14} \log_2 \frac{9}{14} - \frac{5}{14} \log_2 \frac{5}{14} = 0.94$$

$$S_{\text{High}} \leftarrow [3+, 4-] \quad \text{Entropy}(S_{\text{High}}) = -\frac{3}{7} \log_2 \frac{3}{7} - \frac{4}{7} \log_2 \frac{4}{7} = 0.9852$$

$$S_{\text{Normal}} \leftarrow [6+, 1-]$$

$$\text{Entropy}(S_{\text{Normal}}) = -\frac{6}{7} \log_2 \frac{6}{7} - \frac{1}{7} \log_2 \frac{1}{7} = 0.5916$$

$$\text{gain}(S, \text{Humidity}) = \text{Entropy}(S) - \sum_{v \in (\text{High}, \text{Normal})} \frac{|S_v|}{|S|} \text{Entropy}(S_v)$$

$$\text{gain}(S, \text{Humidity})$$

$$= \text{Entropy}(S) - \frac{7}{14} \text{Entropy}(S_{\text{High}}) - \frac{7}{14} \text{Entropy}(S_{\text{Normal}})$$

$$= 0.94 - \frac{7}{14} 0.9852 - \frac{7}{14} 0.5916$$

$$= 0.1516$$

Attribute : wind values (wind) = strong, weak

$$S = [9+, 5-]$$

$$\text{Entropy}(S) = -\frac{9}{14} \log_2 \frac{9}{14} - \frac{5}{14} \log_2 \frac{5}{14} = 0.94$$

$$S_{\text{strong}} \leftarrow [3+, 3-] \quad \text{Entropy}(S_{\text{strong}}) = 1.0$$

$$S_{\text{weak}} \leftarrow [6+, 2-] \quad \text{Entropy}(S_{\text{weak}}) = -\frac{6}{8} \log_2 \frac{6}{8} - \frac{2}{8} \log_2 \frac{2}{8} = 0.8113$$

$$\text{gain}(S, \text{wind}) = \text{Entropy}(S) - \sum_{v \in \{\text{strong}, \text{weak}\}} \frac{|S_v|}{|S|} \text{Entropy}(S_v)$$

$$\text{gain}(S, \text{wind}) = \text{Entropy}(S) - \frac{6}{14} \text{Entropy}(S_{\text{strong}}) - \frac{8}{14} \text{Entropy}(S_{\text{weak}})$$

$$\text{gain}(S, \text{wind}) = 0.94 - \frac{6}{14} \times 1.0 - \frac{8}{14} \times 0.8113$$

$$= 0.0478$$

Teacher's Signature :

gain (S, outlook) = 0.2464 max gain so root node

gain (S, Temp) = 0.0289

gain (S, humidity) = 0.1516

gain (S, wind) = 0.0478

when it comes to ~~outlook~~ sunny only consider $D_1, D_2, D_8, D_9, D_{11}$
 overcast — D_3, D_7, D_{12}, D_{13}
 Rain — $D_4, D_5, D_6, D_{10}, D_{14}$
 ↓ ↓ ↓ ↓ ↓
 Yes Yes No No No

