consider left node

Day	Temp	humidity	wind	play tennis
D_1	Hot	high	weak	No
D_2	Hot	high	strong	No
D_8	mild	high	weak	No
D_9	cool	normal	weak	Yes
D_{11}	mild	normal	strong	Yes

Attribute temp

value (Temp) = Hold, mild, cool

$$S_{sunny} = [2+, 3-]$$

$$Entropy(S_{sunny}) = \frac{-2}{5} \log_2 \frac{2}{5} - \frac{3}{5} \log_2 \frac{3}{5} = 0.97$$

$S_{hot} \leftarrow [0+, 2-]$ $Entropy(S_{hot}) = 0.0$

$S_{mild} \leftarrow [1+, 1-]$ $Entropy(S_{mild}) = 1.0$

$S_{cool} \leftarrow [1+, 0-]$ $Entropy(S_{cool}) = 0.0$

$$gain(S_{sunny}, Temp) = Entropy(S) - \sum_{v \in (Hot, mild, cool)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$= Entropy(S) - \frac{2}{5} Entropy(S_{Hot}) - \frac{2}{5} Entropy(S_{mild})$$

$$- \frac{1}{5} Entropy(S_{cool})$$

Attribute - Humidity (high, normal)

S_{sunny} = [2+, 3-]

$Entropy(S) = -\frac{2}{5} \log_2 \frac{2}{5} - \frac{3}{5} \log_2 \frac{3}{5} = 0.97$

S_{high} ← [0+, 3-]

$Entropy(S_{high}) = 0.0$

S_{Normal} ← [2+, 0-]

$Entropy(S_{normal}) = 0.0$

gain $(S_{sunny}, humidity)$

$= Entropy(S) - \frac{3}{5} Entropy(S_{high}) - \frac{2}{5} Entropy(S_{normal})$

gain $(S_{sunny}, humidity) = 0.97 - \frac{3}{5} \times 0.0 - \frac{2}{5} \times 0.0$

$= 0.97$

Attribute - wind

value (wind) = strong, weak

$S_{sunny} \rightarrow [2+ 3-]$

Entropy $(s) = \frac{-2}{5} \log_2 \frac{2}{5} - \frac{3}{5} \log_2 \frac{3}{5} = 0.97$

$S_{strong} \leftarrow [1+, 1-]$

Entropy $(S_{strong}) = 1.0$

$S_{weak} \leftarrow [1+, 2-]$

Entropy $(S_{weak}) = -\frac{1}{3} \log_2 \frac{1}{3} - \frac{2}{3} \log_2 \frac{2}{3}$

$= 0.9183$

Gain $\left(S_{sunny}, wind \right) =$

Entropy $(s) - \sum\limits_{w \in (strong, weak)} \frac{|S_v|}{|S|}$ Entropy (Sv)

Gain $\left(S_{sunny}, wind \right) =$ Entropy $(s) - \frac{2}{5}$ Entropy $\left(S_{strong} \right) -$

$\frac{3}{5}$ Entropy $\left(S_{weak} \right)$

gain (S_sunny, Wind)

$$= 0.97 - \frac{2}{5} \times 1.0 - \frac{3}{5} \times 0.918$$

$$= 0.0192$$

⋆ Gain (S_sunny, Temp) = 0.570

Gain (S_sunny, Humidity) = 0.97

gain (S_sunny, Wind) = 0.0192

No.
③
high   normal
Yes ②

outlook

sunny   Overcast   Rain
             { 4, 0-13 }   (D4, D5, D6, D10, D14)
             Yes

humidity

high   normal

{D1, D2, D8}   { D9, D11 }
No   Yes
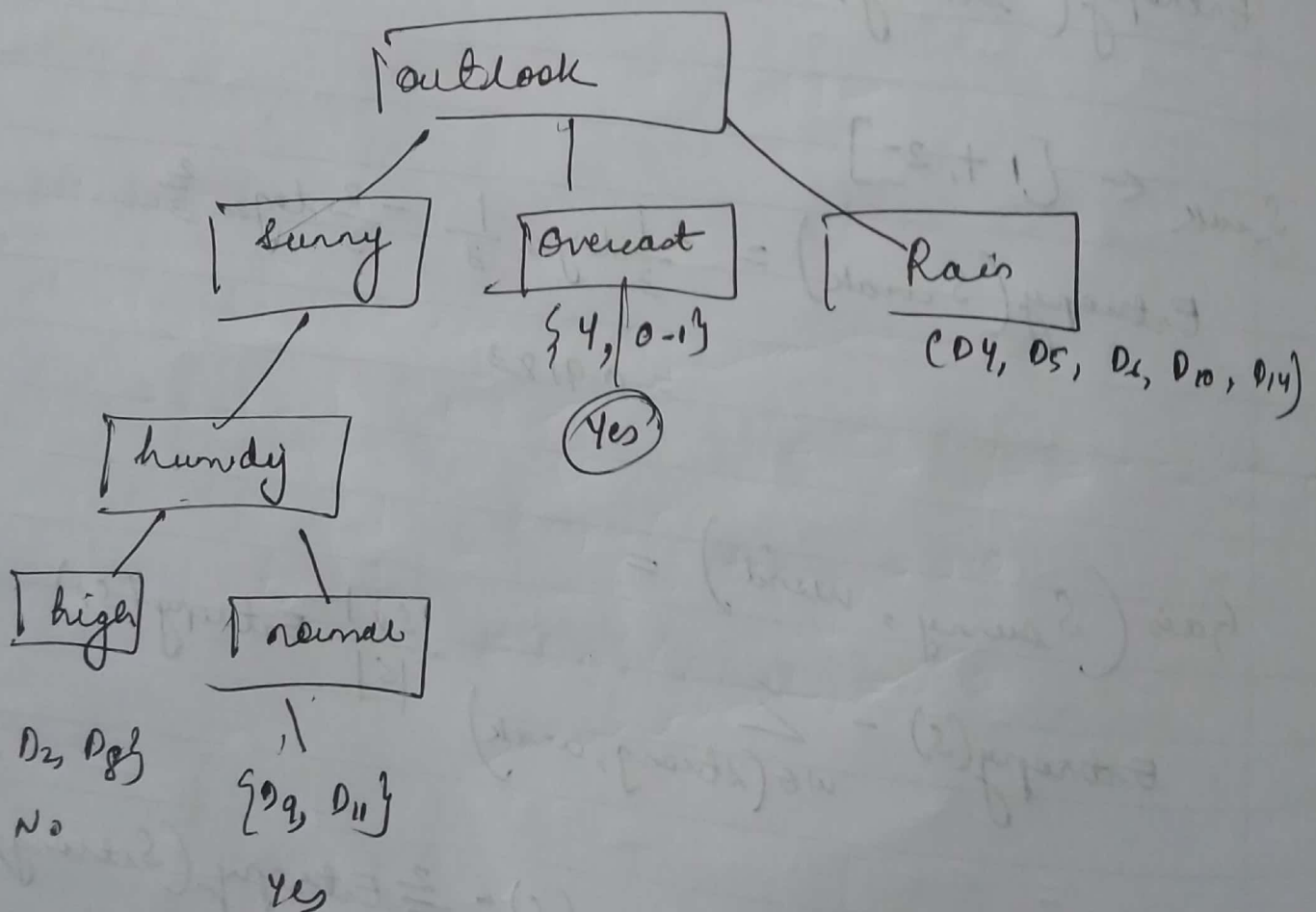
Day	Temp	humidity	wind	play tenn
D4	Mild	high	weak	Yes
D5	cool	normal	weak	Yes
D6	cool	normal	strong	No
D10	Mild	normal	weak	Yes
D14	Mild	high	strong	Yes

Attribute : Temp

Values (Temp) = Hot, Mild, cool

$S_{Rain} = [3+, 2-]$ Entropy $(S_{sunny}) = -\frac{3}{5} \log_2 \frac{3}{5} - \frac{2}{5} \log_2 \frac{2}{5} = 0.97$

$S_{Hot} \leftarrow [0+, 0-]$ Entropy $(S_{Hot}) = 0.0$

$S_{mild} \leftarrow [2+, 1-]$ Entropy $(S_{mild}) = -\frac{2}{3} \log_2 \frac{2}{3} - \frac{1}{3} \log_2 \frac{1}{3}$

$$= 0.9183$$

$$gain (S_{Rain}, Temp) = Entropy (S) - \sum_{v \in (Hot, Mild, cool)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$gain (S_{Rain}, Temp)$

$$= Entropy (S) - \frac{0}{5} Entropy (S_{Hot}) - \frac{3}{5} Entropy (S_{mild})$$

$$- \frac{2}{5} Entropy (S_{cool})$$

$$Gain (S_{Rain}, Temp) = 0.97 - \frac{0}{5} \times 0.0 - \frac{3}{5} \times 0.918 - \frac{2}{5} \times 1.0$$

$$= 0.0192$$

Attribute - humidity

values (humidity) = high, normal

$S_{Rain} = [3+, 2-]$

$S_{high} \leftarrow [1+, 1-]$

$S_{normal} \leftarrow [2+, 1-]$

$Entropy(S_{sunny}) = -\frac{3}{5}\log_2 \frac{3}{5} - \frac{2}{5}\log_2 \frac{2}{5} = 0.9$

$Entropy(S_{high}) = 1.0$

$Entropy(S_{normal}) = -\frac{2}{3}\log_2 \frac{2}{3} - \frac{1}{3}\log_2 \frac{1}{3}$
$$= 0.9183$$

$$gain(S_{Rain}, humidity) = Entropy(S) - \frac{2}{5}Entropy(S_{high})$$
$$- \frac{3}{5}Entropy(S_{normal})$$

$$gain(S_{Rain}, humidy) = 0.97 - \frac{2}{5} \times 1.0 - \frac{3}{5} \times 0.918$$

$$= 0.0192$$

Attribute - wind

values (wind) = Strong, weak

$S_{Rain} = [3+, 2-]$

$S_{strong} \leftarrow [0+, 2-]$

$S_{weak} \leftarrow [3+, 0-]$

$Entropy(S_{sunny}) = -\frac{3}{5}\log_2 \frac{3}{5} - \frac{2}{5}\log_2 \frac{2}{5}$

$Entropy(S_{strong}) = 0.0$

$Entropy(S_{weak}) = 0.0$

Gain $(OS_{Rain}, Wind)$

$$= Entropy (s) - \frac{2}{5} Entropy (S_{strong}) - \frac{3}{5} Entropy (S_{weak})$$

Gain $(OS_{Rain}, Wind)$

$$= 0.97 - \frac{2}{5} 0.0 - \frac{3}{5} 0.0$$

$$= 0.99$$

gain $(S_{Rain}, Temp) = 0.0192$

gain $(S_{Rain}, humidity) = 0.0192$

gain $(S_{Rain}, wind) = 0.97$

Outlook

Rain

wind

Strong   weak

NO   yes

D6, D14   D4 D5 D10