

Individual Assignment 1

1. ①. no: 13/25

yes: 12/25

$$\text{Entropy: } -\frac{13}{25} \log_2\left(\frac{13}{25}\right) - \frac{12}{25} \log_2\left(\frac{12}{25}\right) = 0.9988$$

②.

day		weather		time	
weekday	Weekend	Sunny	rainy	1pm	8am
no 12/20	no 1/5	no 12/17	no 1/8	no 8/14	no 5/11
yes 8/20	yes 4/5	yes 5/17	yes 7/8	yes 6/14	yes 6/11

$$\begin{aligned} \text{Entropy} & -\frac{12}{20} \log_2\left(\frac{12}{20}\right) - \frac{8}{20} \log_2\left(\frac{8}{20}\right) = 0.97 & -\frac{12}{17} \log_2\left(\frac{12}{17}\right) - \frac{5}{17} \log_2\left(\frac{5}{17}\right) = 0.87 & -\frac{8}{14} \log_2\left(\frac{8}{14}\right) - \frac{6}{14} \log_2\left(\frac{6}{14}\right) = 0.98 \\ & -\frac{1}{5} \log_2\left(\frac{1}{5}\right) - \frac{4}{5} \log_2\left(\frac{4}{5}\right) = 0.72 & -\frac{1}{8} \log_2\left(\frac{1}{8}\right) - \frac{7}{8} \log_2\left(\frac{7}{8}\right) = 0.54 & -\frac{5}{11} \log_2\left(\frac{5}{11}\right) - \frac{6}{11} \log_2\left(\frac{6}{11}\right) = 0.99 \end{aligned}$$

Information

$$\begin{aligned} 0.9988 - \frac{20}{25} \times 0.97 - \frac{5}{25} \times 0.72 & \quad 0.9988 - \frac{17}{25} \times 0.87 - \frac{8}{25} \times 0.54 & \quad 0.9988 - \frac{14}{25} \times 0.98 - \frac{11}{25} \times 0.99 \\ = 0.0788 & \quad = 0.2344 & \quad = 0.0144 \end{aligned}$$

Highest Information Gain

③

weather				weather			
Sunny		rainy		Sunny		rainy	
no 12/17		no 1/8		no 12/17		no 1/8	
yes 5/17		yes 7/8		yes 5/17		yes 7/8	
weekday		Weekend		1pm		8am	
no 12/15		no 0/2		no 8/10		no 0/7	
yes 3/15		yes 2/2		yes 2/10		yes 3/7	
no 0/5		no 0/3		no 0/4		no 1/4	
yes 4/5		yes 2/3		yes 4/4		yes 3/4	

$$\begin{aligned} \text{Entropy} & -\frac{12}{15} \log_2\left(\frac{12}{15}\right) - \frac{3}{15} \log_2\left(\frac{3}{15}\right) = 0.72 & -\frac{8}{10} \log_2\left(\frac{8}{10}\right) - \frac{2}{10} \log_2\left(\frac{2}{10}\right) = 0.72 \\ & -0 \log_2(0) - 1 \log_2(1) = 0 & -\frac{4}{7} \log_2\left(\frac{4}{7}\right) - \frac{3}{7} \log_2\left(\frac{3}{7}\right) = 0.99 \\ & -0 \log_2(0) - 1 \log_2(1) = 0 & -0 \log_2(0) - 1 \log_2(1) = 0 \end{aligned}$$

$$-\frac{1}{3} \log_2\left(\frac{1}{3}\right) - \frac{2}{3} \log_2\left(\frac{2}{3}\right) = 0.92$$

Information Gain:

$$0.9988 - \frac{15}{25} \times 0.72 - \frac{2}{25} \times 0$$

$$- \frac{5}{25} \times 0 - \frac{3}{25} \times 0.92$$

$$= 0.4564$$

Highest Information Gain

$$-\frac{1}{4} \log_2\left(\frac{1}{4}\right) - \frac{3}{4} \log_2\left(\frac{3}{4}\right) = 0.81$$

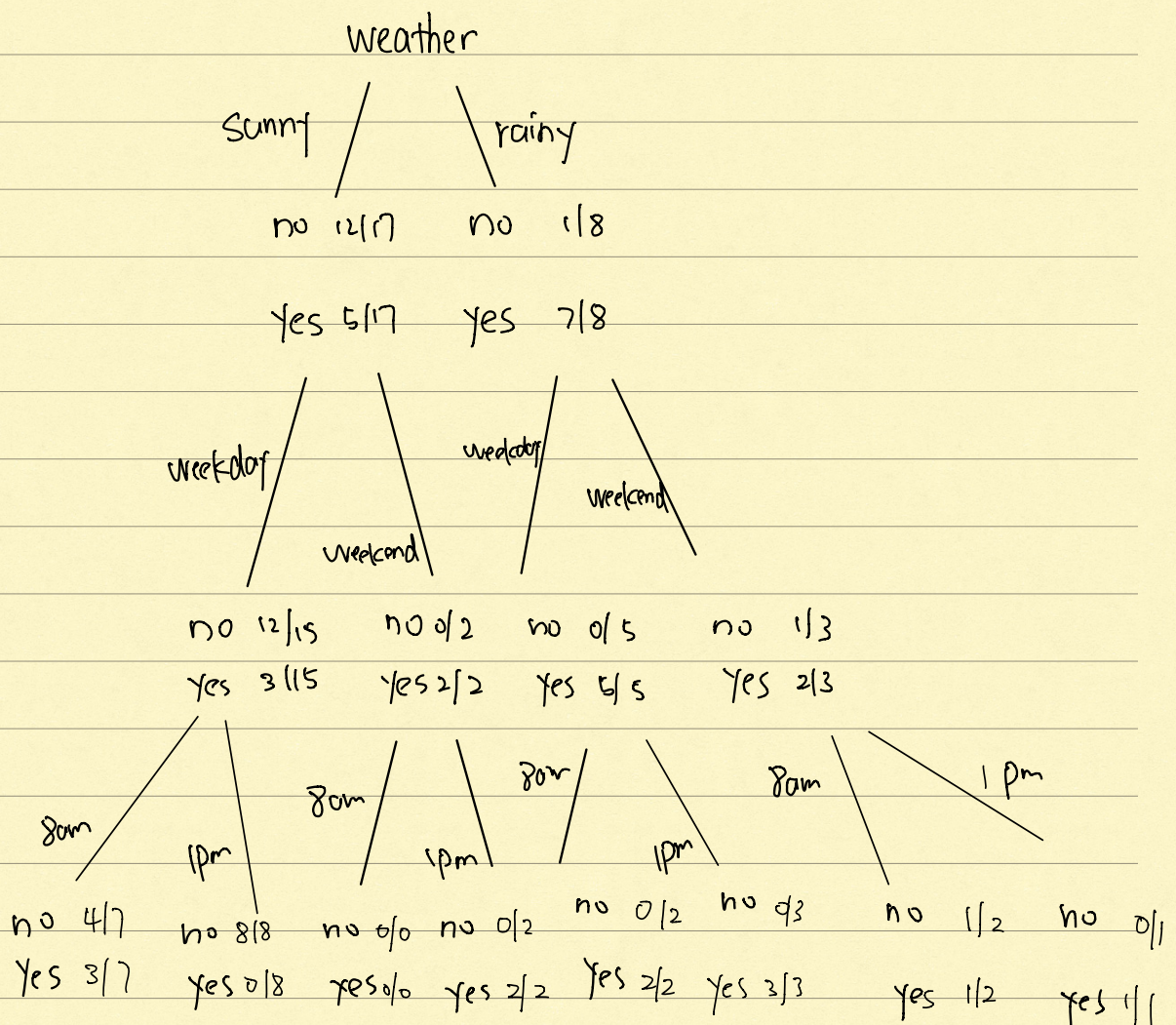
Information Gain:

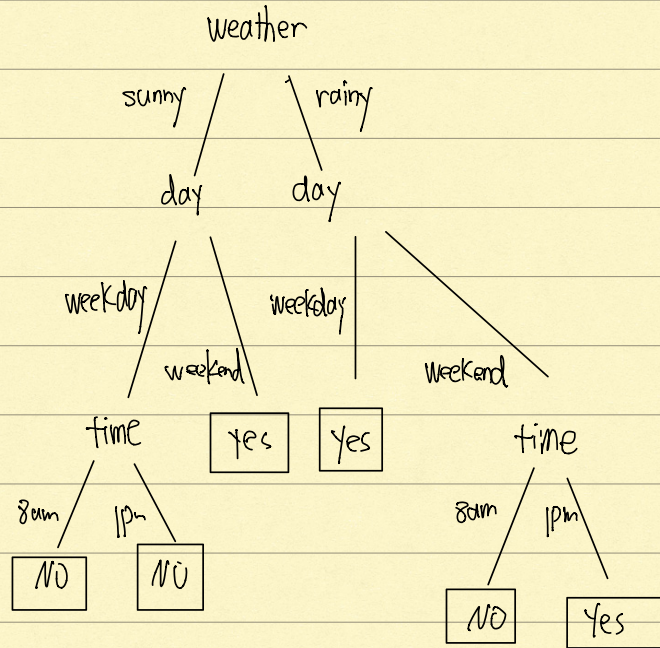
$$0.9988 - \frac{10}{25} \times 0.72 - \frac{7}{25} \times 0.99$$

$$- \frac{4}{25} \times 0 - \frac{4}{25} \times 0.81$$

$$= 0.304$$

④





2.

day	weather	time	traffic
weekday	sunny	1pm	no
weekday	rainy	1pm	yes
weekday	sunny	8am	no
weekday	sunny	1pm	no
weekday	rainy	1pm	yes
weekday	sunny	8am	no
weekend	rainy	8am	yes
weekend	sunny	1pm	yes
weekday	sunny	8am	yes
weekday	sunny	1pm	no
weekday	sunny	1pm	no
weekend	rainy	1pm	yes
weekday	rainy	1pm	yes
weekday	sunny	8am	no
weekday	sunny	1pm	no
weekend	sunny	1pm	yes
weekday	rainy	8am	yes
weekday	sunny	1pm	no
weekday	sunny	8am	no
weekday	sunny	1pm	no
weekday	sunny	8am	yes
weekend	rainy	8am	no
weekday	sunny	1pm	no
weekday	rainy	8am	yes
weekday	sunny	8am	yes

Prediction

		True Class	
		P	N
no	Predicted Y	8 (TP)	0 (FP)
yes			8
no	Predicted N	4 (FN)	13 (TN)
yes			17
no		12	13
no			
yes			
yes			
no			
no			
yes			
yes			
no			
no			
no			
no			
yes			
yes			
no			

Missclassification: $\frac{4}{25} = 0.16$

Sensitivity: $\frac{8}{8+4} = 0.67$

specificity: $\frac{13}{0+13} = 1$

3.

day	weather	time	traffic
weekend	rainy	8am	no
weekday	sunny	8am	yes
weekend	sunny	1pm	yes
weekday	sunny	8am	no
weekend	sunny	1pm	yes
weekday	rainy	8am	no
weekday	sunny	8am	yes
weekday	sunny	1pm	yes
weekday	sunny	1pm	no
weekday	sunny	1pm	no
weekend	rainy	8am	yes
weekday	sunny	8am	yes
weekday	sunny	1pm	no
weekday	rainy	1pm	yes
weekday	sunny	1pm	no

Prediction	True Class	
	P	N
no		
no	Predicted Y	3 (TP)
yes		1 (FP)
no	Class N	5 (FN)
yes		6 (TN)
yes		
no		
no	Misclassification: $\frac{6}{13} = 0.4$	
no		
no	Sensitivity: $\frac{3}{3+5} = 0.375$	
no		
no	Specificity: $\frac{6}{1+6} = 0.857$	
no		
yes		
no		