(i) consider a multi-layer perceptron (MLP) model with one hidden layer and one output layer. the hidden layer has 10 neurons and the output layer has 3 neurons. The input to the mlp is a 5-dimension vector. each neuron is connected to every neuron in the previous layer and bias term is included for each neuron. the activation function is used the sigmoid function calculate the total number of trainable parameters in this mlp model

sol

(i) weights for the hidden layer:

each of the 10 neuron is connected to 5 input features therefore the number of weights the hidden layer is 10 times 5 = 50

Biases for the hidden layer

each of the 10 neurons has one bias term therefore, the number of biases in the hidden layer is 10

output layer:-

the output layer has 3 neurons and each neuron in the output layer is connected to all 10 neurons from hidden layer, additionally each neuron has bias term

weight for the output layer:

each of 3 neuron is connected to hidden neurons therefore the number of weights in the output layer is 3 times 10=30

② biases for the output layer:

each of the neurons has one bias term

therefore the number of biases in the output layer is 3

Total no. of trainable parameters

1. Total weights

hidden layer =50

output layer =30

Total weights = 50+30 = 80

② Total bias:

hidden layer =10

output layer = 3

Total biases =10+3=13

②

Day	weather	Temperature	humidity	wind	Play
1	sunny	Hot	high	weak	NO
2	cloudy	Hot	high	weak	Yes
3	sunny	mild	normal	strong	Yes
4	cloudy	mild	high	strong	Yes
5	rainy	mild	high	strong	NO
6	rainy	cool	normal	strong	NO
7	rainy	mild	high	weak	Yes
8	sunny	hot	high	strong	NO
9	cloudy	hot	normal	weak	Yes
10	rainy	mild	high	strong	NO

Entrophy $= -\sum p_i \log p_i$

$= \frac{5}{10} \log_2 \left(\frac{5}{10}\right) - \frac{5}{10} \log_2 (5/10)$

$= 0.5 + 0.5$

$= 1$

sunny $(1,2)_3 = \frac{1}{3} \log_2 \left[\frac{1}{3}\right] - \frac{2}{3} \log_2 \left[\frac{2}{3}\right] = 0.5 + 0.38 = 0.88$

cloudy $[3,0]_3 = \frac{3}{3} \log_2 \left[\frac{3}{3}\right] - 0 = 0$

rainy $[1,3] = -\frac{1}{4} \log_2 - \frac{3}{4} \log_2 \left[\frac{3}{4}\right] = 0.5 + 0.3 = 0.81$

$IG = 1 - \frac{3}{10}(0.88) - \frac{3}{10}(0) - \frac{4}{10}(0.81)$

$= 1 - 0.26 - 0.324$

$\boxed{IG = 0.42}$

Hot $[2,2] = 1$

mild $[3,2] = -\frac{3}{5} \log_2 \left(\frac{3}{5}\right) - \frac{2}{5} \log_2 \left(\frac{2}{5}\right) = 0.44 + 0.52$
$= 0.96$

cool $[0,1] = 0$

$IG = 1 - \frac{4}{10} \times 1 - \frac{5}{10} \times 0.96$

$= 1 - 0.4 - 0.44$

$\boxed{IG = 0.12}$

high $(3,4)_7 = \frac{3}{7} \log_2 \left[\frac{3}{7}\right] - \frac{4}{7} \log_2 \left[\frac{4}{7}\right] = 0.52 + 0.46$
$= 0.98$

normal $[2,1]_3 = \frac{2}{3} \log_2 \left(\frac{2}{3}\right) - \frac{1}{3} \log_2 \left[\frac{1}{3}\right] = 0.88$

$IG = (1) - \frac{7}{10} \times 0.98 - \frac{3}{10} \times 0.88$

$= 1 - 0.68 - 0.26$

$\boxed{IG = 0.06}$

weak $[3,1]_4 = 0.81$

Strong (2,4) 6 $= \frac{2}{6} \log_2 \frac{2}{6} - \frac{4}{6} \log_2 \frac{4}{6} = 0.52 + 0.38$

$= 0.90$

$IG = 1 - \frac{4}{10} \times 0.81 - \frac{6}{10} \times 0.90$

$\boxed{IG = 1 - 0.864 = 0.14}$

weather

sunny (1,4) — [1, 3, 9]

cloudy (3,0) — [2, 4, 9] — yes

raining (1,3) — [5, 6, 7, 10]

day	temp	hum	wind	play
1	hot	high	weak	NO
3	mild	normal	strong	yes
8	hot	high	strong	NO

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

$= 0.91$

Hot (0,2) = 0 high (0,2) = 0 weak (0,1) = 0

Mild (1,0) = 0 normal = 0 strong (1,1) = 0.5

$\boxed{IG = 0.91}$ $\boxed{IG = 0.98}$ $\boxed{IG = 0.67}$

temp

mild E (1,2) 3 $= \frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) = 0.88$

cool [0,1] = 0

$IG = 1 - \frac{3}{10} \times 0.88$

$= 0.264$

hum [high] = 0.88

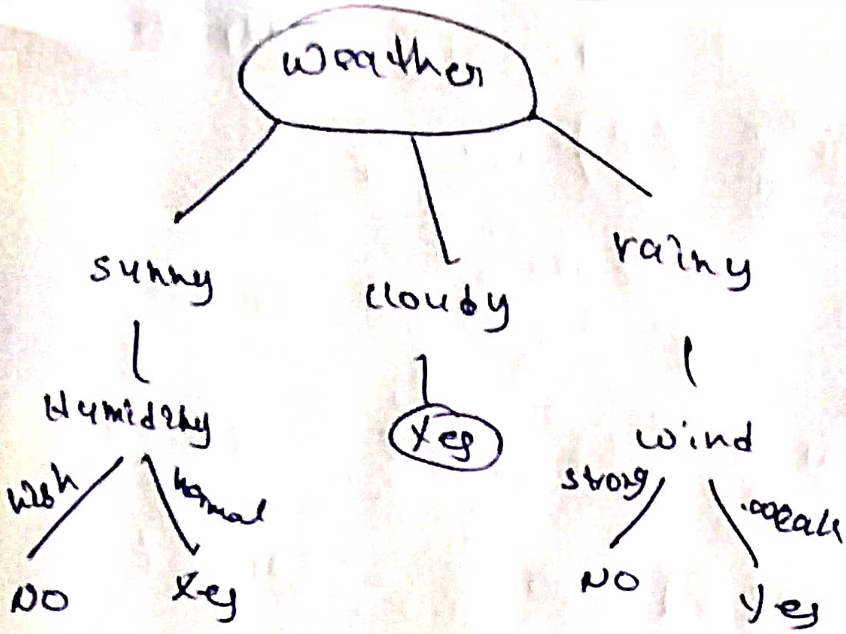
= 0

= 0.264

wind (strong 0,3) = 0

weak = 0

$\boxed{IG = 0.81}$


Weather
sunny
cloudy
rainy
Humidity
Yes
wind
high
normal
NO
Yes
strong
weak
NO
Yes