Course Code: CSI 415, Course Title: Pattern Recognition, Sec: SA
Total Marks: 20   Duration: 20 Minutes

Answer all questions. Figures are in the right-hand margin indicates full marks.

Question 1:   5

Draw the basic diagram to design a classification system.

Question 2:   15

Find the Prior and Conditional Probabilities from the Balloons dataset. Then classify the following unknown vector:

$P(c_l \mid x)$, where x = YELLOW, LARGE, STRETCH, CHILD

Balloons Dataset

No.	Color	Size	Act	Age	Child Inflated
1	YELLOW	SMALL	STRETCH	ADULT	T
2	YELLOW	SMALL	STRETCH	CHILD	T
3	YELLOW	SMALL	DIP	ADULT	T
4	YELLOW	SMALL	DIP	CHILD	T
5	YELLOW	LARGE	STRETCH	ADULT	T
6	YELLOW	LARGE	STRETCH	CHILD	F
7	YELLOW	LARGE	DIP	ADULT	F
8	YELLOW	LARGE	DIP	CHILD	F
9	PURPLE	SMALL	STRETCH	ADULT	T
10	PURPLE	SMALL	STRETCH	CHILD	F
11	PURPLE	SMALL	DIP	ADULT	F
12	PURPLE	SMALL	DIP	CHILD	F
13	PURPLE	LARGE	STRETCH	ADULT	T
14	PURPLE	LARGE	STRETCH	CHILD	F
15	PURPLE	LARGE	DIP	ADULT	F
16	PURPLE	LARGE	DIP	CHILD	F

Attributes Information of Balloons dataset:
(Classes Inflated T or F)
Color: yellow, purpl
Size: large, small
Act: stretch, dip
Age: adult,
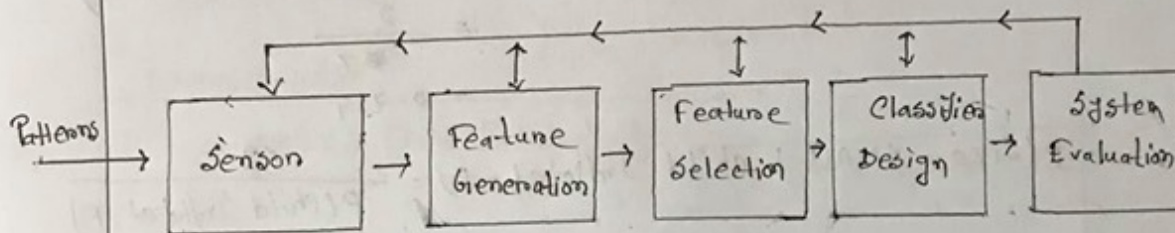Child inflated: T, F

Ans To The Q. No →1

Fig: Classifier Design Diagram.

Ans To The Q. No →2

Prior Probability

$$P(\text{Child Inflated} = T) = \frac{7}{16} = 0.4375$$

$$P(\text{Child Inflated} = F) = \frac{9}{16} = 0.5625$$

Parameter → Color

$$P(\text{Color} = \text{YELLOW} \mid \text{Child Inflated} = T) = \frac{5}{P(\text{Child Inflated}=T)}$$

$$= \frac{5}{7}$$

$$= 0.714$$

$$P(\text{Color} = \text{YELLOW} \mid \text{Child Inflated} = F) = \frac{3}{P(\text{Child Inflated}=F)}$$

$$= \frac{3}{9}$$

$$= 0.33$$

$$P(\text{Color} = \text{PURPLE} \mid \text{Child Inflated} = T) = \frac{2}{P(\text{Child Inflated}=T)}$$

$$= \frac{2}{7}$$

$$= 0.285$$

$$P(\text{Color} = \text{PURPLE} \mid \text{Child Inflated} = F) = \frac{6}{P(\text{Child Inflated}=F)}$$

$$= \frac{6}{9} = 0.66.$$

Panameters ⇒ Size

$$P(Size = SMALL \mid Child \; Inflated = T) = \frac{5}{P(child \; Inflated = T)}$$

$$= \frac{5}{7}$$

$$= 0.714$$

$$P(Size = SMALL \mid child \; Inflated = F) = \frac{3}{P(child \; Inflated = F)}$$

$$= \frac{3}{9}$$

$$= 0.333$$

$$P(Size = LARGE \mid child \; Inflated = T) = \frac{2}{P(child \; Inflated = T)}$$

$$= \frac{2}{7}$$

$$= 0.285$$

$$P(Size = LARGE \mid child \; Inflated = F) = \frac{6}{P(child \; Inflated = F)}$$

$$= \frac{6}{9}$$

$$= 0.666$$

Panameters ⇒ Act.

$$P(Act = STRETCH \mid child \; Inflated = T) = \frac{5}{P(child \; Inflated = T)}$$

$$= \frac{5}{7}$$

$$= 0.714$$

$$P(Act = STRETCH \mid child \; Inflated = F) = \frac{3}{P(child \; Inflated = F)}$$

$$= \frac{3}{9}$$

$$= 0.333$$

$$P(Act = DIP \mid child \; Inflated = T) = \frac{2}{P(child \; Inflated = T)}$$

$$= 2/7$$

$$= 0.285$$

$$P(Act = DIP \mid child\ Inflated = F) = \frac{6}{P(child\ Inflated = F)}$$

$$= \frac{6}{9}$$

$$= 0.666$$

Parameter → Age

$$P(Age = ADULT \mid Child\ Inflated = T) = \frac{5}{P(child\ Inflated = T)}$$

$$= \frac{5}{7}$$

$$= 0.714$$

$$P(Age = ADULT \mid Child\ Inflated = F) = \frac{3}{P(child\ Inflated = F)}$$

$$= \frac{3}{9}$$

$$= 0.33$$

$$P(Age = CHILD \mid Child\ Inflated = T) = \frac{2}{P(child\ Inflated = T)}$$

$$= \frac{2}{7}$$

$$= 0.285$$

$$P(Age = CHILD \mid child\ Inflated = F) = \frac{6}{P(child\ Inflated = F)}$$

$$= \frac{6}{9}$$

$$= 0.666.$$

Given,

$$X = YELLOW, LARGE, STRETCH, CHILD$$

$$P(X \mid T) = 0.714 \times 0.285 \times 0.714 \times 0.285$$

$$= 0.091$$

$$P(X \mid F) = 0.33 \times 0.666 \times 0.33 \times 0.666$$

$$= 0.048$$

$$P(T \mid X) = P(X \mid T) * P(child\ Inflated = T)$$

$$= 0.091 \times 0.9375$$

$$= 0.0179$$

$P(F|X) = P(X|F) * P(child\ Inflated = F)$

$= 0.098 * 0.5625$

$= 0.027$

So,

$P(F|X) > P(T|X)$

So,

$X = YELLOW, LARGE, STRETCH, CHILD = F.$

Ay.