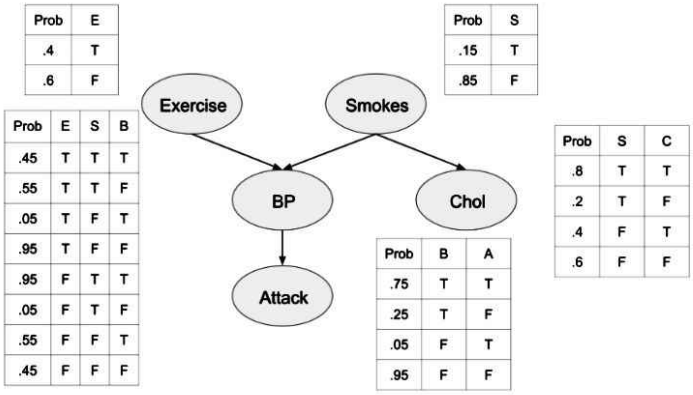
Assignment 2

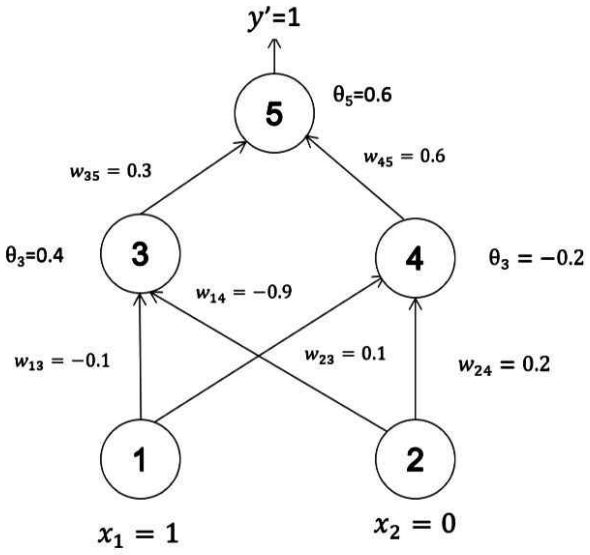
1. Using Naïve Bayes Classifier on the above dataset, classify these 3 examples. Following 3 examples are to be classified using Naïve Bayes Classifier:
   i. P(Color="Red", Type="SUV",Doors=2,Tires="Whitewall")
   ii. P(Color="Green", Type="Car",Doors=4,Tires="Whitewall")
   iii. P(Color="Blue", Type="Minivan",Doors=4,Tires="Blackwall")

Color	Type	Doors	Tires	Class
Red	SUV	2	Whitewall	+
Blue	Minivan	4	Whitewall	-
Green	Car	4	Whitewall	-
Red	Minivan	4	Blackwall	-
Green	Car	2	Blackwall	+
Green	SUV	4	Blackwall	-
Blue	SUV	2	Blackwall	-
Blue	Car	2	Whitewall	+
Red	SUV	2	Blackwall	-
Blue	Car	4	Blackwall	-

2. Answer the following questions given the below Bayesian Belief Network:
   i). What is the probability of the patient exercising regularly, not smoking, not having high cholesterol, not having high BP, and
      a) Not getting a heart attack?
      b) Getting a heart attack?
   ii). A person exercises regularly and smokes. He does not have high cholesterol but he got a heart attack. Does he have a high BP or not?



3. Given below is a feedforward neural network, using the backpropagation algorithm, train the network. Assume a learning rate of 0.8 with an input tuple X=[0 1 1].



4. For any Analytics project to be successful, which are the different key roles to be considered?
5. Write a note on Data Analytics Lifecycle.

ASSIGNMENT 2

Q1. $P(class='+') = \frac{3}{10}$ $\quad P(class='-') = \frac{7}{10}$

(i) Let x1 be an example where color='Red', type='SUV', doors=2, and tires='Whitewall'.

$P(color='Red'/class='+') = 1/3$
$P(type='SUV'/class='+') = 1/3$
$P(doors=2/class='+') = 3/3$
$P(tires='Whitewall'/class='+') = 2/3$

$P(x1/class='+') = \frac{1}{3}\times\frac{1}{3}\times\frac{3}{3}\times\frac{2}{3} = \frac{6}{81} = \frac{2}{27}$

$P(class='+'/x1) = \frac{2}{27}\times\frac{3}{10} = \frac{1}{45} = 0.02$

$P(color='Red'/class='-') = 2/7$
$P(type='SUV'/class='-') = 3/7$
$P(doors=2/class='-') = 2/7$
$P(tires='Whitewall'/class='-') = 2/7$

$P(x1/class='-') = \frac{2}{7}\times\frac{3}{7}\times\frac{2}{7}\times\frac{2}{7} = \frac{24}{2401}$

$P(class='-'/x1) = \frac{24}{2401}\times\frac{1}{10} = 0.00699$

$\therefore P(class='+'/x1) > P(class='-'/x1)$, we assign class '+' to x1.

(ii) Let x2 be an example with color='green', type='car', doors=4, and tires='Whitewall'

$P(color='green'/class='+') = 1/3$
$P(type='car'/class='+') = 2/3$
$P(doors=4/class='+') = 0$
$P(tires='whitewall'/class='+') = 2/3$
$P(x2/class='+') = \frac{1}{3}\times\frac{2}{3}\times 0\times\frac{2}{3} = 0$
$P(class='+'/x2) = 0\times 0.3 = 0$

$P(color='green'/class='-') = 2/7$
$P(type='car'/class='-') = 2/7$
$P(doors=4/class='-') = 5/7$
$P(tires='whitewall'/class='-') = 2/7$
$P(x2/class='-') = \frac{2}{7}\times\frac{2}{7}\times\frac{5}{7}\times\frac{2}{7} = \frac{40}{2401}$

$P(class='-'/x2) = \frac{40}{2401}\times\frac{1}{10} = \frac{4}{347}$

$\therefore P(class='-'/x2) > P(class='+'/x2)$, we assign '-' to x2.

(iii) Let x3 be an example with color='blue', type='minivan', doors=4, and tires='Blackwall'.

$P(color='blue'/class='+') = 1/3$
$P(type='minivan'/class='+') = 0$
$P(doors=4/class='+') = 0$
$P(tires='Blackwall'/class='+') = 1/3$
$P(x3/class='+') = \frac{1}{3}\times 0\times 0\times\frac{1}{3} = 0$
$P(class='+'/x3) = 0\times 0.3 = 0$

$P(color='blue'/class='-') = 3/7$
$P(type='minivan'/class='-') = 2/7$
$P(doors=4/class='-') = 5/7$
$P(tires='Blackwall'/class='-') = 5/7$
$P(x3/class='-') = \frac{3}{7}\times\frac{2}{7}\times\frac{5}{7}\times\frac{5}{7} = \frac{150}{2401}$
$P(class='-'/x3) = \frac{150}{2401}\times\frac{1}{10} = \frac{15}{347}$

$\therefore P(class='-'/x3) > P(class='+'/x3)$, we assign class '-' to x3

~~2 i) a) P(Exercise=T, Smokes=F, Cholestrol=F, BP=F~~

2

2 i) a) $P(A=F/E=T,S=F,C=F,BP=F) = P(E=T) \times P(S=F) \times P(C=F/S=F) \times P(B=F/E=T,S=F) \times P(A=F/B=F) = 0.4 \times 0.85 \times 0.6 \times 0.95 \times 0.95 = 0.18411$

b) $P(A=T/E=T,S=F,C=F,BP=F) = P(E=T) \times P(S=F) \times P(C=F/S=F) \times P(B=F/E=T,S=F) \times P(A=F/B=F) = 0.4 \times 0.85 \times 0.6 \times 0.95 \times 0.05 = 0.01615$

Note: The Prior Intimation Letter (under this Annexure) shall be accepted by the Passport Authority for processing the passport application if the same bears the signature and seal of the employer of the applicant acknowledging its receipt.

(3)

2 ii) Let The person be X

$P(B=T, E=T, S=T, C=F, A=T) = P(E=T) \times P(S=T) \times P(C=F/S=T) \times P(B=T/E=T, S=T) \times P(A=T/B=T) = 0.4 \times 0.15 \times 0.45 \times 0.75 = 0.00405$

$P(B=F, E=T, S=T, C=F, A=T) = P(E=T) \times P(S=T) \times P(C=F/S=T) \times P(B=F/E=T, S=T) \times P(A=T/B=F) = 0.4 \times 0.15 \times 0.2 \times 0.55 \times 0.05$

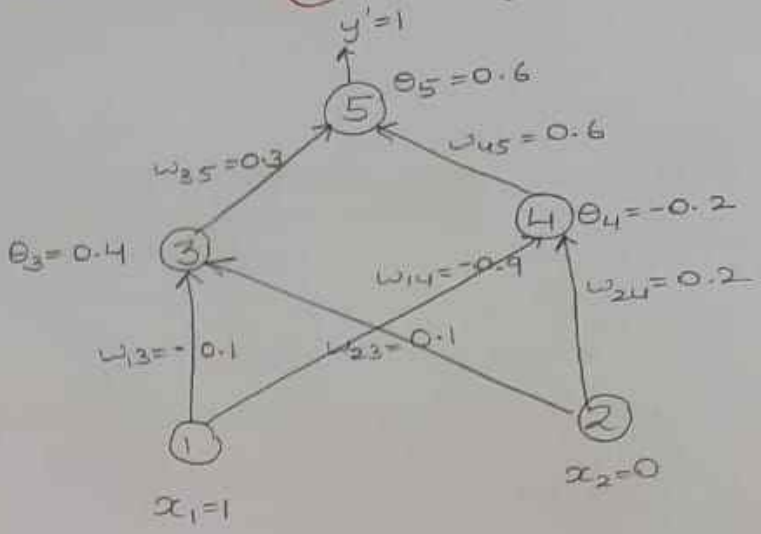
$= 0.00033$

$\because P(B=T, E=T, S=T, C=F, A=T) > P(B=F, E=T, S=T, C=F, A=T)$

$\therefore$ he has high BP

ASSIGNMENT 2 (4)

$\eta = 0.8$



Q3.

	a	o/p O	error E
3	0.3	0.5744	0.00425
4	-1.1	0.2497	0.00651
5	0.92214	0.7155	0.0579

$$a_j = \sum x_i w_{ij} + \theta_j$$

$a_3 = 1 \times -0.1 + 0 \times 0.1 + 0.4$
$= -0.1 + 0 + 0.4 = 0.3$

$O_3 = 0.5744$

$a_4 = 1 \times -0.9 + 0 \times 0.2 - 0.2$
$= -0.9 - 0.2 = -1.1$

$O_4 = 0.2497$

$a_5 = O_3 w_{35} + O_4 w_{45} + \theta_5$
$= 0.5744 \times 0.3 + 0.2497 \times 0.6 + 0.6$
$= 0.92214$

$$O_5 = \frac{1}{1+e^{-a_5}} = \frac{1}{1+e^{-0.92214}} = 0.7155$$

$E_5 = O_5(1-O_5)(y'-O_5)$
$= 0.7155(1-0.7155)(1-0.7155)$
$= 0.0579$

$E_3 = O_3(1-O_3) w_{35} E_5$
$= 0.5744(1-0.5744) 0.3 \times 0.0579$
$= 0.004248$

$E_4 = O_4(1-O_4) w_{45} E_5$
$= 0.2497(1-0.2497) 0.6 \times 0.0579$
$= 0.00651$

$$\Delta\theta_j = \eta E_j \qquad \theta_j = \Delta\theta_j + \theta_j$$

$\Delta\theta_3 = 0.8 \times E_3 = 0.8 \times 0.00425 = 0.0034$
$\Delta\theta_4 = 0.8 \times E_4 = 0.8 \times 0.00651 = 0.0052$
$\Delta\theta_5 = 0.8 \times E_5 = 0.8 \times 0.0579 = 0.04632$

$$\Delta w_{ij} = \eta E_j O_i \qquad w_{ij} = w_{ij} + \Delta w_{ij}$$

$\Delta w_{13} = \eta E_3 O_1 = 0.8 \times 0.00425 \times 1 = 0.0034$
$\Delta w_{23} = \eta E_3 O_2 = 0$

$\Delta_{14} = \eta E_4 O_1 = 0.8 \times 0.00651 \times 1 = 0.0052$
$\Delta_{24} = \eta E_4 O_2 = 0$

wt/bias	original	Δ	new
θ_3	0.4	0.0034	0.4034
θ_4	-0.2	0.0052	-0.1948
θ_5	0.6	0.04632	0.64632
w_{13}	-0.1	0.0034	-0.0966
w_{23}	0.1	0	0.1
w_{14}	-0.9	0.0052	-0.8948
w_{24}	0.2	0	0.2
w_{35}	0.3	0.0266	0.3266
w_{45}	0.6	0.0116	0.6116

$\Delta w_{35} = \eta E_5 O_3$
$= 0.8 \times 0.0579 \times 0.5744$
$= 0.0266$

$\Delta w_{45} = \eta E_5 O_4$
$= 0.8 \times 0.0579 \times 0.2497$
$= 0.0116$