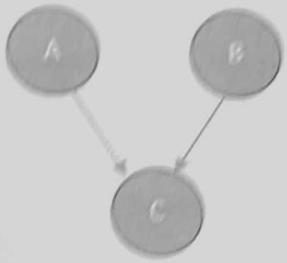
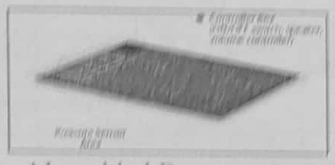
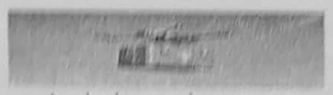
Q: 1, 3, 6, 8

A) Define the followings: [8]

1- Define AI agent.
2- What is back propagation and why do we use it?
3- How supervised and reinforcement learning are related?
4- Define the role of activation function and give the name of popular activation function.
5- Differentiate between Markov decision process and reinforcement learning.
6- Given the figure below, determine the followings:
   a) Whether A and B are conditionally independent given C is observable (NO)
   b) Whether A and B are conditionally independent given C is unobservable (YES)



7- What is the concept of gradient decent in neural network?
8- Explain the difference between impurity and abnormality of a Dataset?

Applications	PEAS	Environment Type	Agent type
 AI-enabled Prayer mat		Full observable Sequential	Reflex
 Ambulance drone		Partial Sequential	Skill-based Goal-based
 AI-enabled smart shoes			
 Autonomous car		Partial Sequential Single	Learning Agent

Q No.2:- Solution: Date:

Circuit	Degree	x	y
A	34	8.29	5.59
B	245	7.07	7.07
C	55	5.735	8.191
D	48	6.691	7.43
E	119	6.56	7.54

$\bar{X} = 6.86$, $\bar{Y} = 7.1642$

x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})^2$	$(x-\bar{x})(y-\bar{y})$
8.29	5.59	1.43	-1.5742	2.0449	-2.2511
7.07	7.07	0.21	-0.0942	0.0441	-0.0197
5.735	8.191	-1.125	1.0268	1.2656	-1.155
6.691	7.43	-0.169	0.2658	0.028561	-0.044
6.56	7.54	-0.3	0.3758	0.09	-0.11274

$\Sigma = 3.473$ $\Sigma = -3.58254$

$$m = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\Sigma(x-\bar{x})^2} = \frac{-3.58254}{3.473}$$

$$\boxed{m = -1.0315}$$

$y = mx + c$

$7.1642 = (-1.0315)(6.86) + c$

$7.1642 = -7.07609 + c$

$7.1642 + 7.07609 = c$

$$\boxed{c = 14.24}$$

Hence

$$\boxed{y = (-1.0315)x + 14.24}$$

No 3, Solution

$\sqrt{(32-8)^2+(10-20)^2}$ $\sqrt{576+100} = 26$

$\sqrt{(32-4)^2+(10-18)^2}$ $\sqrt{784+64} = 29.12$

$\sqrt{(32-5)^2+(10-16)^2}$ $\sqrt{729+36} = 27.65$

$\sqrt{(32-10)^2+(10-15)^2}$ $\sqrt{484+25}$ 22.56

Normal

Min value

Signal 5 is Normally classified

(b) Solution :- K = 3

$P_1 = \sqrt{(64-60)^2+(5.8-6)^2} = \sqrt{4+0.04} = 2.0099$

$P_2 = \sqrt{(64-44)^2+(5.8-6.11)^2} = \sqrt{} = 0.31$

$P_3 = \sqrt{(64-36)^2+(5.8-5.9)^2} = \sqrt{64+0.01} = 8.0006$

$P_4 = \sqrt{(64-37)^2+(5.8-5.8)^2} = \sqrt{49+0} = 7$

$P_5 = \sqrt{(64-39)^2+(5.8-5.3)^2} = \sqrt{25+0.25} = 5.024$

$P_6 = \sqrt{(64-40)^2+(5.8-5.6)^2} = \sqrt{16+0.04} = 4.0049$

$P_7 = \sqrt{(64-42)^2+(5.8-5.9)^2} = \sqrt{4+0.09} = 2.022$

(3)

Date:

$$\frac{P_1 + P_2 + P_7}{3} = \frac{60 + 55 + 80}{3}$$

$$= 65$$

Hence Weight of Mrs. Saleem is 65

Q4 a

The outputs of the hidden layer are

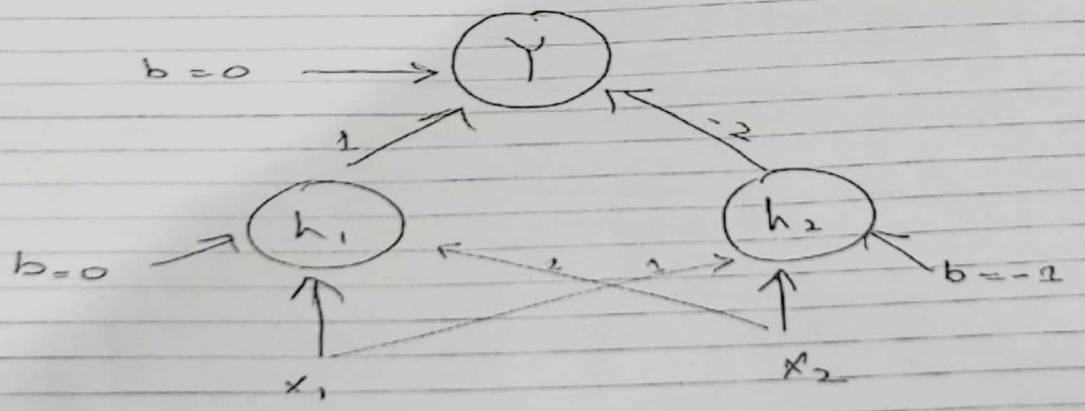
$$H_j = g\left(\sum_k W_{k,j} I_k\right) = c\sum_k W_{k,j} I_k + d$$

The final outputs are

$$O_i = g\left(\sum_j W_{j,i} H_j\right) = c\left(\sum_j W_{j,i}\left(c\sum_k W_{k,j} I_k + d\right)\right) + d$$

PART B:

Date:



Activation function ReLu.

Q No 4:- Solution Date:

PART C :

at h_3:

$3 * (-0.33) - 5 * 0.56 - 0.5 = -4.29$

After Activation function

$= 0.0135$

At h_4:

$3 * (-0.76) - 5 * (-0.1) + 0.3 = 3.08$

and after activation fn

$= 0.956$

At h_5:-

$3 * 0.22 - 5 * 0.38 + 0.6 = -0.64$

After activation

$= 0.35$

at Output node O

$(-0.8) \times 0.0135 + (0.85) * 3.08 - 0.5 * 0.64 + 0.25$

$= 3.18$

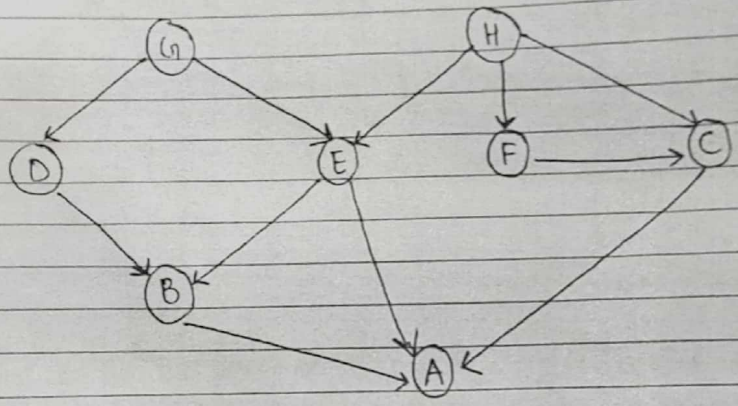
After activation

$= 0.96$

Q5

Q1) $P(A \mid B, C, E)\ P(B \mid D, E)\ P(C \mid F, H)\ P(D \mid G)\ P(E \mid G, H)$

$P(F \mid H)\ P(G)\ P(H)$



Q2) $P(OS = pass \mid ITC = pass) = \dfrac{P(OS = pass \mid ITC = pass)}{P(ITC = pass)}$

$= \dfrac{P(OS = pass \mid DS)\ P(DS \mid ITC = pass, OOP)\ P(OOP)\ \cancel{P(ITC = pass)}}{\cancel{P(ITC = pass)}}$

$= P(OS = pass \mid DS)\ P(DS \mid ITC = pass, OOP)\ P(OOP)$

DS	OOP	$P(OS = pass \mid DS)$	$P(DS \mid ITC = pass, OOP)$	$P(OOP)$	
pass	pass	$1-0.7 = 0.3$	0.2	0.4	0.024
pass	fail	$1-0.7 = 0.3$	0.3	0.6	0.054
fail	pass	$1-0.2 = 0.8$	$1-0.2 = 0.8$	0.4	0.256
fail	fail	$1-0.2 = 0.8$	$1-0.3 = 0.7$	0.6	0.336
					+ 0.67

$P(OS = pass \mid ITC = pass) = \boxed{0.67}$ Answer. M.M

Q 6:

Applications	Supervised LEARNING Methods With one line justification	Unsupervised Learning Methods With one line justification	Reinforcement Learning With one line justification
Hate Speech Detection	Yes		
Self-driving car			Yes
Rescues robots			Yes
Stock Market prediction	yes		
Bank transaction fraud detection	Yes		

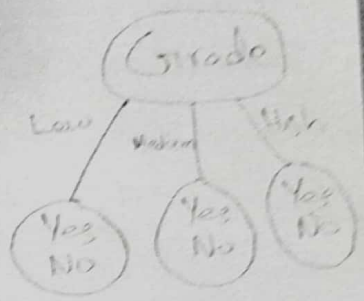
Q8:

Consider the following **Fig.2** giving the concept of AI-enabled IoT based city. Imagine yourself as a Data Scientist leading a team of AI scientist whose task is to develop an AI-enable smart city. To put things in perspective, describe in **10 points / steps** the necessary actions you will take to develop smart city. (For example, how you will collect dataset for different field of the city such as transportation, banking, education etc. Which AI technique you will use for education system, transportation, medical etc.)

1) $H(Pass) = -\frac{3}{6}\log\frac{3}{6} - \frac{3}{6}\log\frac{3}{6}$

$\Rightarrow 1$

2) $H(Pass|Grade) =$



$H(Pass|Grade=Low) = -\frac{1}{2}\log\frac{1}{2} - \frac{1}{2}\log\frac{1}{2} = 1$

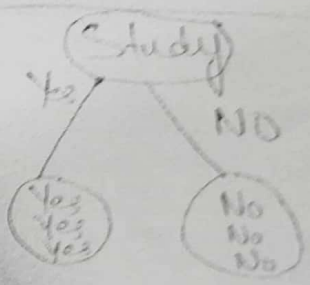
$H(Pass|Grade=Medium) = -\frac{1}{2}\log\frac{1}{2} - \frac{1}{2}\log\frac{1}{2} = 1$

$H(Pass|Grade=High) = -\frac{1}{2}\log\frac{1}{2} - \frac{1}{2}\log\frac{1}{2} = 1$

Weighted Entropy $= (1)(\frac{2}{6}) + 1(\frac{2}{6}) + 1(\frac{2}{6})$

Weighted Entropy $= 1$

3) $H(Pass|Study) =$



$H(Pass|Study='Yes') = -\frac{3}{3}\log\frac{3}{3} - \frac{0}{3}\log\frac{0}{3} = 0$

$H(Pass|Study=No) = -\frac{3}{3}\log\frac{3}{3} - \frac{0}{3}\log\frac{0}{3} = 0$

weighted entropy $= 0$

4) "Study" will be the root node as it has lowest entropy and hence high info gain

Information gain of study = Parent entropy - weighted entropy

$= 1 - 0 = 1$

5) Final decision tree