Course No.:CSE450

Full Marks: 60

Course Title: Artificial Intelligence

Time: 03 hours

N.B.

i) Answer **SIX** questions out of **EIGHT**.
ii) All questions are of equal values.

1. a) "System that think and act like humans, are called AI" – justify this. 2
    b) Write a PEAS description of the "AI Book Shopping" agent. Characterize the task 8 environments as being accessible, deterministic, episodic, static, and continuous or not. What agent architecture is best for this domain and why?

2. a) Give the initial state, actions, transition model, goal test and path cost for the following 3 problem:

    "You are lost in the Amazon jungle, and have to reach the sea. There is a stream nearby".

    b) i. which node will be expended next by a uniformed cost search? 4

    ii. Which leaf will be expended next by a A* search?
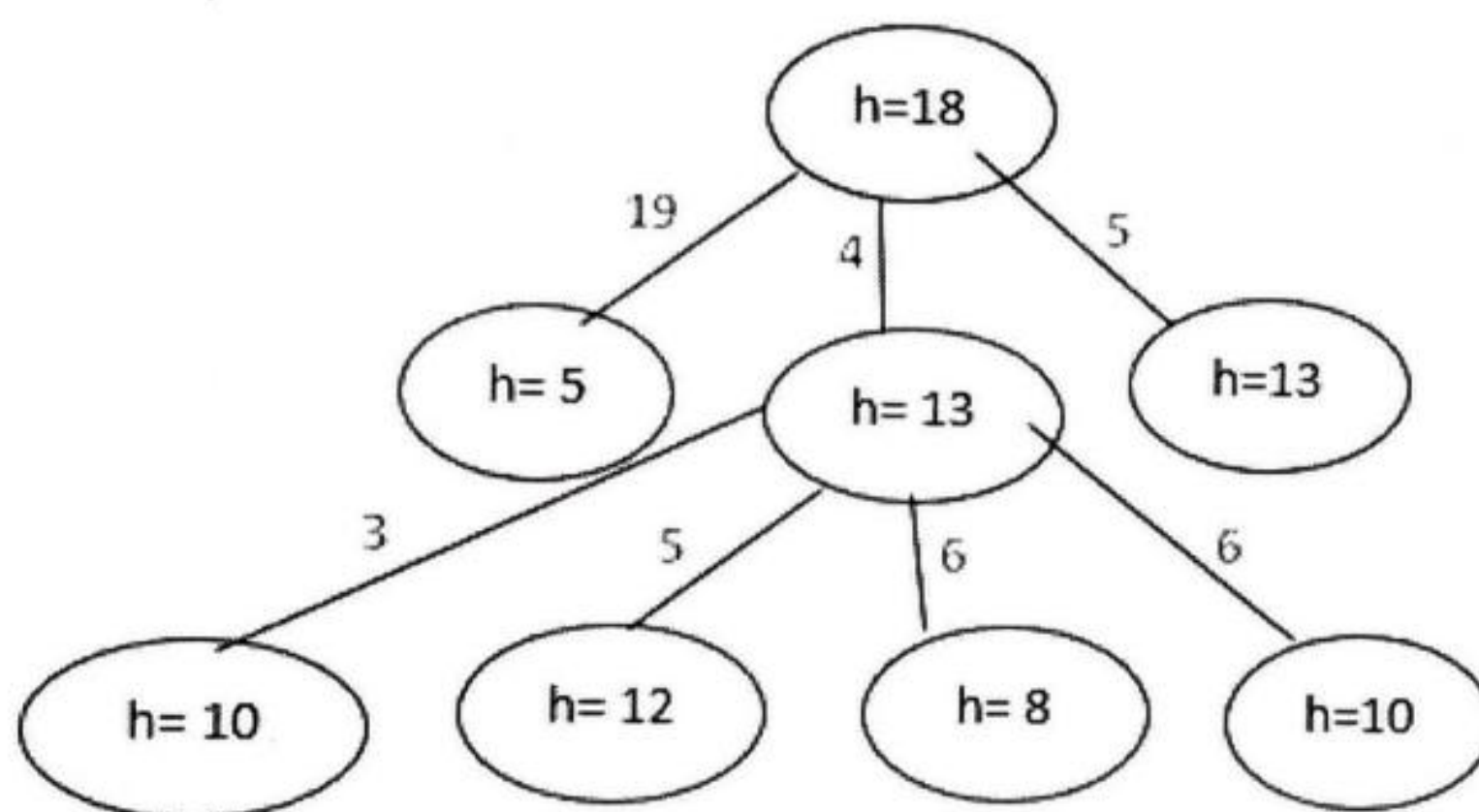
    c) Iterative-deepening (ID) is a type of search algorithm which is said to combine the 3 benefits of breadth-first and depth-first

3. a) Briefly describe about the structure of an intelligent agent. 3
    b) Write a prolog program that tokenizes an input string and reverse the token using 2 dynamic database.

    Sample goal: reverse_token ("CSE BSMRSTU")

    Sample output: BSMRSTU CSE
    c) Does any relation between knowledge and intelligence exists-explain it? Briefly 3 describe about AI knowledge cycle.
    d) Define propositional logic. What are the limitations of it? 2

4. a) What are the differences between propositional logic and predicate logic in two points? 2
    b) Consider the following facts represented in predicate logic: 5

    i.   man(Marcus)
    ii.   Pompeian(Marcus)
    iii. $\forall x$: Pompeian(x) => Roman(x)
    iv.   Ruler(Caesar)
    v. $\forall x$: Roman(x) => loyalto(x, Caesar) $\vee$ hate(x, Caesar)
    vi. $\forall x \exists y$: loyalto(x,y)
    vii. $\forall x \forall y$: person(x) $\wedge$ ruler(y) $\wedge$ tryassassinate(x,y) => $\neg$loyalto(x,y)
    viii. tryassassinate(Marcus, Caesar)

Now, using the resolution, prove that Marcus hate Caesar.

c) Compare between backward chaining and forward chaining.   3

5. a) How Fuzzy Logic overcome the problem of Boolean Logic?   2

   b) In a simplified diagnosis problem where fever might occur due to the four reasons like   6
      – Allergy (All), Flu, Cold and Pneumonia (Pneu) i.e. the frame of discernment, θ
      might consist of the set {All, Flu, Cold, Pneu}. Suppose, the probability that following
      an observation of fever that Flu, Cold or Pneumonia cause it is 0.6and the probability
      of fever caused by Allergy, Flu or Cold is 0.8.

      i. Use the Dempster-Shafer combination rule to compute beliefs for further subsets
         derived from the above.
      ii. We now discover that probability of allergy is 0.8. Combine this information to
          compute the beliefs for all possible outcome of set intersections.

   c) Compare between inductive and abductive reasoning with example.   2

6. a) What is planning in AI context? Write the components of a planning system with   4
      explanation.

   b) Consider the following block world problem: 6

Initial state   Goal state
Fig-Q6(b): A simple blocks world problem.
Now, show how STRIPS solves this problem.

7. a) Write down the back propagation algorithm by explicitly mentioning the input, output   6
      and hidden layers computations.

   b) Give the formal description of the Bayesian Network.   4

8. a) Define expert systems in AI. Briefly describe the step by step iterative procedure to   4
      develop an expert system.

   b) What is local minima problem in Artificial Neural Network? How can we get rid of   2
      this problem?

   c) What is inference engine? To recommend any solution elaborate the forward changing   4
      and backward changing strategies of an inference engine.

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Department of computer Science & Engineering
4th year 2nd Semester B.Sc. Engg. Examination-2019

Course No.:CSE452
Full Marks: 60
N.B.

Course Name: **Digital Image Processing**
Times: 3 Hours

i) Answer any **SIX (6)** from the following **EIGHT (8)** questions.
ii) All questions are of equal values.

1.	a)	What is digital image processing?	1
	b)	Briefly describe the key stages of Digital image processing with diagram.	6
	c)	Discuss the applications of digital image processing.	3
2.	a)	Define 4-adjacency, 8-adjacency and m-adjacency with example.	3
	b)	Explain the representation of digital images.	3
	c)	Discuss the image digitization process with figure.	4
3.	a)	What is image enhancement?	2
	b)	Explain spatial filtering method with general equation. Write down the effects of mask size.	5
	c)	Differentiate between log transform and power law transformation.	3
4.	a)	Explain how Fourier transforms are useful in digital image processing?	6
	b)	Write about image smoothing in frequency domain.	2
	c)	What is negative transformation of an image? Give example.	2
5.	a)	What do you mean by compression of an image? Why do we require image compression?	2
	b)	Considering the following table calculate the code by using Huffman coding.	4

Symbol	Probability
A_2	0.4
A_6	0.3
A_1	0.1
A_4	0.1
A_3	0.06
A_5	0.04

c) Explain the JPEG compression technique. What level of compression can be achieved using JPEG? 4

6. a) What is Morphological Image processing? Why is it used? 2

b) What happens in Dilation and Erosion? Consider the following input image. Show the Dilated Image using the structuring element.   5

		1	1			
		1		1		
		1			1	
	1				1	
		1	1	1	1	

Input Image

	1	
1	1	1
	1	

Structuring Element

c) Discuss opening and closing morphological operations.   3

7. a) Give the schematic sketch of R G B color cube? Indicate the primary color vertices on the cube.   4

b) Describe how the gray levels vary in the R, G and B primary images that make up the front face of the color cube.   3

c) Explain about the CMY color model in details.   3

8. a) What is Image Segmentation? List some applications of image Segmentation.   1+2

b) What kind of operations are performed by using the following mask?   4

-1	-1	-1
2	2	2
-1	-1	-1

-1	-1	2
-1	2	-1
2	-1	-1

-1	2	-1
-1	2	-1
-1	2	-1

2	-1	-1
-1	2	-1
-1	-1	2

c) Illustrate the basic adaptive thresholding algorithm for image segmentation.   3

Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science & Engineering
4th Year 1st Semester B.Sc. Engineering Examination-2019
Course Title: Pattern Recognition
Full Marks: 60   Course Code: CSE462
N.B.   Time: 3(Three) Hours

i) Answer any SIX questions
ii) All questions are of equal values.

Q1. a) What is pattern recognition? Give the examples of human perceptron that's why we would like to give similar capabilities to machine.   4
      b) Differentiate supervised learning and unsupervised learning   3
      c) Explain how pattern recognition is used in the field of remote sensing, bioinformatics and geoinformatics.   3

Q2. a) Explain the single Nearest neighbor technique.   4
      b) Calculate the distances between the following samples given below using Euclidean and Minkowski distance (r=1 & 3) measurement techniques.   6

A	12	4	6	5	19	17	9	33	2
B	10	3	9	2	17	22	10	29	4

Q3. a) What do you understand by overfitting and tree pruning?   2
      b) Explain how a ROC curve works.   2
      c) You will use the dataset below to learn a decision tree which predicts if people pass pattern recognition course(Yes or No), based on their previous GPA (High, Medium, or Low) and whether or not they studied   6

GPA	Studied	Passed
L	F	F
L	T	T
M	F	F
M	T	T
H	F	T
H	T	T

For this problem, you can write your answers using log2, but it may be helpful to note that $\log_2 3 \approx 1.6$.

    I.   What is the entropy H (Passed)?
    II.   What is the entropy H (Passed | GPA)?
    III. What is the entropy H (Passed | Studied)?

Q4. a) Why K nearest neighbor classifier is called as lazy learner? Differentiate between eager learner and lazy learner.   3

      b) For the following data set apply K-NN(using k=3) to predict test data-→Acid Durability=3 and strength=7 class= ?   4

Name	Acid Durability	Strength	Class
Type-1	7	7	Bad
Type-2	7	4	Bad
Type-3	3	4	Good
Type-4	1	4	Good

      c) Write down some disadvantages of k-NN classifiers and Explain how to improve K-NN efficiency.   3

Q5   a)   What are the pros and cons of naïve Bayes classifier?   2
      b)   For the following data set apply Nave-Bayes for New patient: P34=M, P61=M, BMI =   4
            H . What is the best guess at cancer field?

P34 level	P61 level	BMI	Prostate cancer
High	Low	Medium	Y
Medium	Low	Medium	Y
Low	Low	High	Y
Low	High	Low	N
Low	Low	Low	N
Medium	Medium	Low	N
High	Low	Medium	Y
High	Medium	Low	N
Low	Low	High	N
Medium	High	High	Y

      c)   Extend Baye's theorem for multiple features and classes.   4

Q6.   a)   Write a short note on Hidden Markov model(HMM)   3
      b)   What do you mean by dimension reduction? Discuss principal component   4
            analysis(PCA) algorithm for dimension reduction
      c)   Explain the parzen window approaches for density estimation   3

Q7.   a)   What is the differences between Simple Markov Model and Hidden Markov Model?   2

      b)   Consider the market basket transactions given in the following table. Let min_sup=50%   8
            and min_conf=50%

ID	Items bought
01	A,C,D
02	B,C,E
03	A,B,C,E
04	B,E

      I.   Find all the frequent item sets using Apriori algorithm
      II.   Obtain significant decision rules
      III.   Derive the FP-Tree for the above transaction table.

Q8.   a)   What is SVM? Why is SVM effective on high dimensional data?   3
      b)   4

	x	y	z
1	4	4	4
2	8	4	6
3	15	8	12
4	24	4	20
5	24	12	16

Table-1

            Perform clustering of data given in table-1 by k-means Algorithm.
      c)   What the confusion matrix is and why you need it? How to calculate confusion matrix   3
            for a 2-class classification problem?
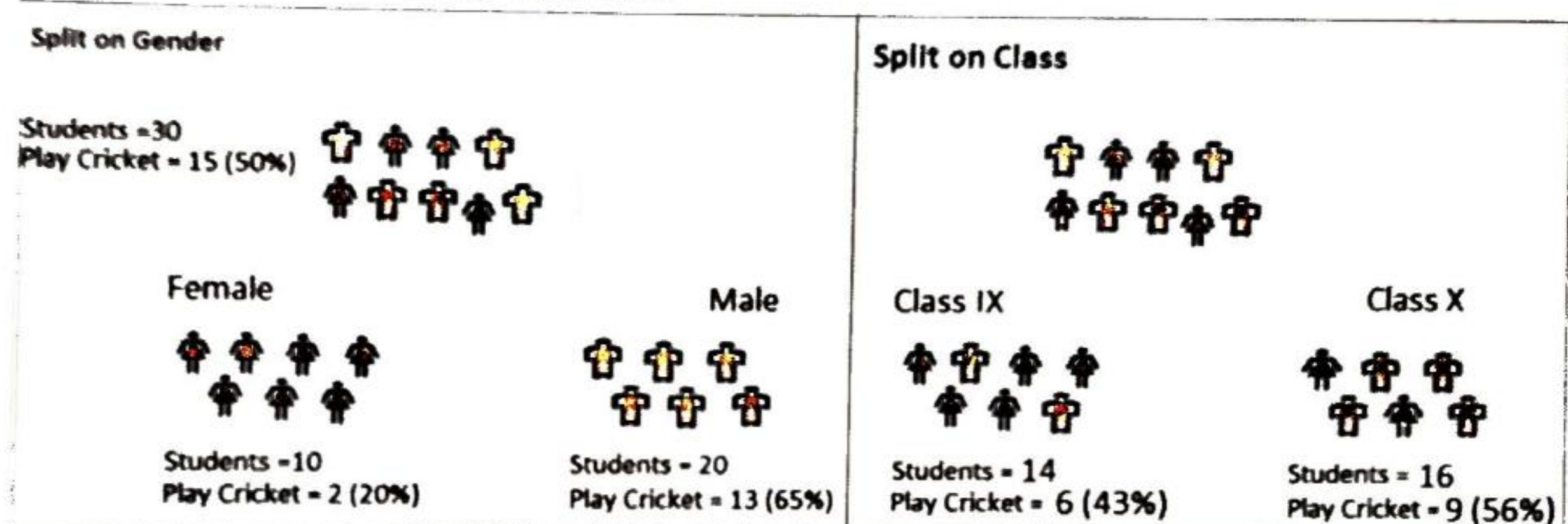
Course No: **CSE490**
Full Marks: **60**

Course Title: **Machine Learning**
Time: **03 hours**

N.B.
i) Answer any **SIX (6)** from the following **EIGHT (8)** questions.
ii) All questions are of equal values.

Q.1 (a) What is Machine Learning? Show the workflow of Machine Learning with a diagram?   1+3
   (b) Classify different types of Machine Learning.   3
   (c) Distinguish between clustering and classification with an example.   3

Q.2 (a) Decision tree splits the nodes on all available variables and then selects the split which results in most homogeneous sub-nodes. Referring to example in the snapshot below, where we want to segregate the students based on target variable (playing cricket or not). In the snapshot, we split the population using two input variables Gender and Class. Now, you need to identify which split is producing more homogeneous sub-nodes using Gini Index.   4

Split on Gender

Students =30
Play Cricket = 15 (50%)

Female
Students =10
Play Cricket = 2 (20%)

Male
Students = 20
Play Cricket = 13 (65%)

Split on Class

Class IX
Students = 14
Play Cricket = 6 (43%)

Class X
Students = 16
Play Cricket = 9 (56%)

   (b) What is the core idea of k Nearest Neighbors (kNN) learning? How to decide the class label in kNN?   2+2
   (c) How do you choose the number of neighbors in kNN?   2

Q.3 (a) Let us consider the following weather data. You need to calculate the probability of playing cricket when the weather is overcast using Naïve Bayes Classifier.   4

Weather	Play	Weather	Play	Weather	Play	Weather	Play
Sunny	Yes	Overcast	Yes	Sunny	Yes	Overcast	No
Sunny	Yes	Rainy	No	Overcast	Yes	Rainy	Yes
Overcast	Yes	Rainy	No	Sunny	Yes		
Rainy	No	Sunny	Yes	Rainy	No		

   (b) When classification accuracy is not enough to evaluate a model?   2
   (c) Consider the following confusion matrix for a binary classification model. Find accuracy, precision, recall and F1 score of it.   4

Actual Values

		Positive (1)	Negative (0)
Predicted Values	Positive (1)	55	2
	Negative (0)	5	38

Q.4 (a) Write the Random Forests algorithm. What are the differences between Random Forests and Decision Trees?   4
   (b) How does Support Vector Machines (SVMs) work? How to identify the right hyper-plane in SVM?   4
   (c) How can SVM classify non-linearly separable data?   2

Q.5 (a) What is regression analysis? Why do you need to use regression analysis? 1+2

(b) Explain simple linear regression and multiple linear regression. 4

(c) Suppose you are given two list of values for a regression model (as follow): 3

Original values:	-2	1	-3	2	3	5	4	6	5	6	7
Predicted values:	-1	1	-2	2	3	4	4	5	5	7	7

Find MAE, MSE, and RMSE to evaluate the model.

Q.6 (a) Write down the properties of maximum likelihood estimators. 2

(b) Consider the data in the following table: 6

ID	Height	Age	Weight
1	5	45	77
2	5.11	26	47
3	5.6	30	55
4	5.9	34	59
5	4.8	40	72
6	5.8	36	60
7	5.3	19	40
8	5.8	28	60
9	5.5	23	45
10	5.6	32	58
11	5.5	38	??

Predict the weight of ID 11 based on their height and age using KNN.

(c) What do you mean by feed forward network? 2

Q.7 (a) What is the criteria for good clustering? 1

(b) Write the k-Means clustering algorithm. What are the strength and weakness of k-Means clustering? 3+2

(c) Consider the following proximity matrix. Find the clusters by applying single link and complete link 4
hierarchical clustering. Also show your results by drawing a dendrogram.

Point	P1	P2	P3	P4	P5
P1	0	0.10	0.41	0.55	0.35
P2	0.10	0	0.64	0.47	0.98
P3	0.41	0.64	0	0.44	0.85
P4	0.55	0.47	0.44	0	0.76
P5	0.35	0.98	0.85	0.76	0

Q.8 (a) Differentiate learning and generalization. Which one is more desirable and why? 3

(b) 5

A=0.35
0.1
0.3
Output
0.8
0.4
0.9
Output
Node
B=0.9
0.6

Input Node   Hidden Node
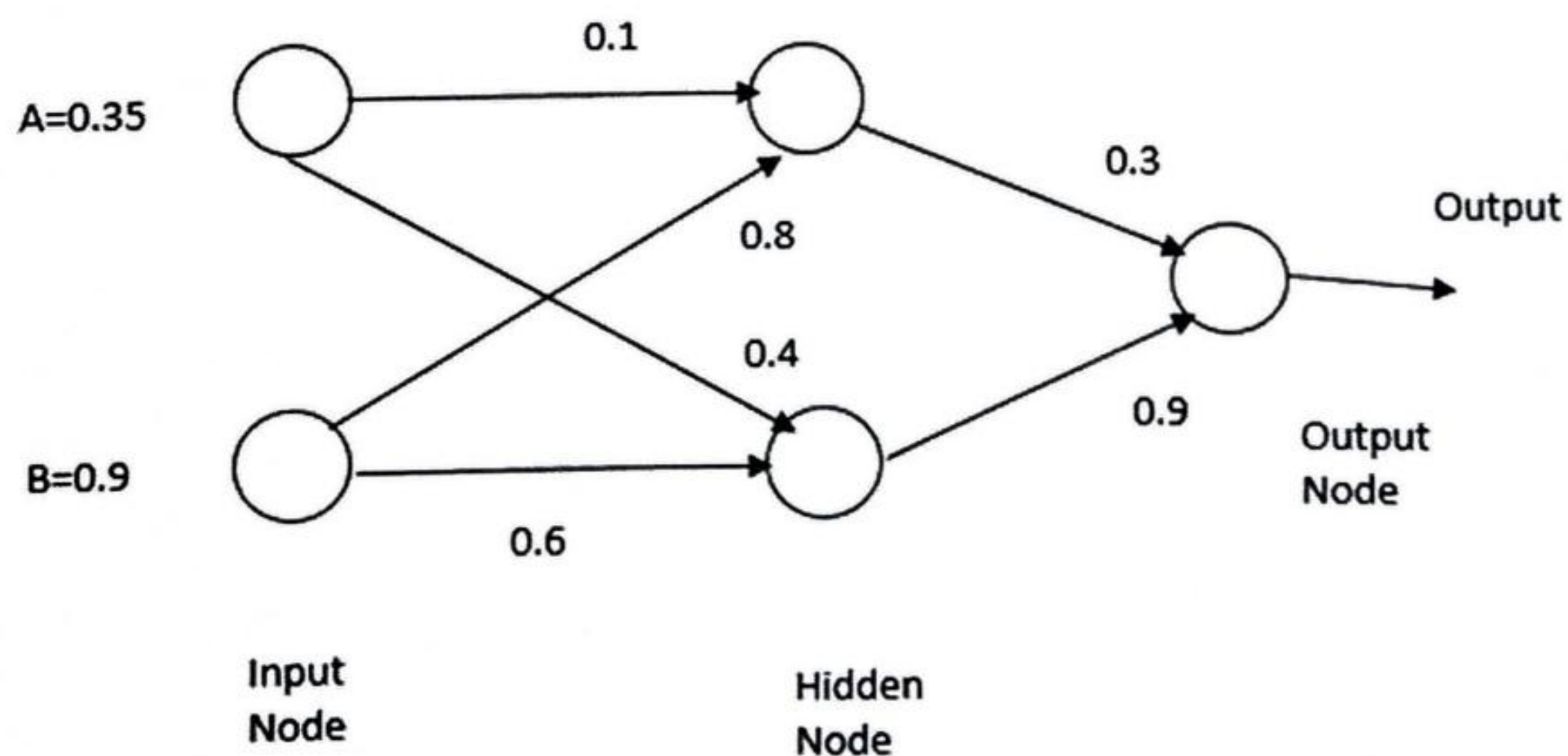
i. Perform a forward pass on the network.
ii. Perform a backward pass on the network.
iii. Perform a further forward pass and comment on the result.
Use sigmoid function as activation function.

(c) How do you differentiate regression and classification problems in Machine Learning? Give one 2
practical example.