

Semester V (B.Tech.)

Er. No.....221B145

Academic Year: 2024-25

Jaypee University of Engineering & Technology, Guna**T-1(Odd Semester 2024)****18B11CI918 – Machine Learning**

Maximum Duration: 1 Hour

Maximum Marks: 15

Notes:

1. This question paper has 03 questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).

		Marks	CO No.
Q1.	Compare machine learning approach with traditional learning approach with the help of suitable diagrams.	[05]	CO1
Q2.	Explain the usefulness of semi-supervised type of machine learning with the help of suitable examples.	[05]	CO1
Q3.	In order to train a machine learning model to predict house prices, you have to work with the following housing dataset.	[05]	CO2

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   longitude        20640 non-null   float64
 1   latitude         20640 non-null   float64
 2   housing_median_age 20640 non-null   object 
 3   total_rooms      20640 non-null   float64
 4   total_bedrooms   20433 non-null   float64
 5   population       20640 non-null   float64
 6   households       20640 non-null   float64
 7   median_income    20640 non-null   float64
 8   median_house_value 20640 non-null   float64
 9   ocean_proximity  20600 non-null   object 

```

- (a) Which function/command can produce the output shown above?
- (b) Do you see any issue in the dataset? If yes mention it.
- (c) How will you address the issues, if any, in the dataset?

Jaypee University of Engineering & Technology, Guna

T-1(Odd Semester 2024)

21B14HS547 – Concept of Economics

Maximum Duration: 1 Hour

Maximum Marks: 15

Notes:

1. This question paper has 4 questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).
4. Calculators are allowed.

	Marks	CO No.
Q1.	[04]	CO2
Describe the interdependencies between macroeconomic policies (such as fiscal and monetary policies) and microeconomic decision-making by firms and households. How do changes in macroeconomic policies impact the decisions made at the microeconomic level?		
Q2.	[03]	CO2
Explain how monetary policy tools, such as interest rates and open market operations, influence inflation and economic growth in an economy.		
Q3.	[04]	CO3
An Indian entrepreneur quits a job that pays Rs 5 lakh per year and invests Rs 10 lakh in a startup, which could alternatively be invested in government bonds yielding a 7% annual return. Calculate the opportunity cost of choosing the startup. If the startup generates a revenue of Rs 15 lakh with explicit costs of Rs 9 lakh, compute the economic profit and assess the entrepreneur's decision.		
Q4.	[04]	CO3
Rajesh wants to create an education fund for his child and plans to make annual contributions to an account that offers 10% interest compounded annually. If the goal is to accumulate Rs 20 lakh in 15 years, calculate the required annual contribution. Compute the contribution needed if the investment period is extended to 20 years.		

Jaypee University of Engineering & Technology, Guna

T-2(Odd Semester 2024)

18B11MA511 – Probability Theory and Random Processes

Maximum Duration: 1 Hour 30 minutes

Maximum Marks: 25

Notes:

1. This question paper has five questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).

	Marks	CO No
Q1. (a) ✓ The service time at a drive-through window of a fast food restaurant is assumed to be exponentially distributed with a mean of 2 minutes. Find the percentage of customers end up waiting more than 5 minutes.	[2]	CO3
(b) If the probability that an applicant for a driver's licence will pass the road test on any given trial is 0.8, Find the probability that he will finally pass the test (i) on the fourth trial and (ii) in fewer than 4 trials.	[3]	CO3
Q2. Fit a binomial distribution for the following data and hence find the theoretical frequencies:	[5]	CO4
x: 0 1 2 3 4		
f: 5 29 36 25 5		
Q3. A random variable X follows the Poisson distribution. Determine the mean and variance of Poisson distribution.	[5]	CO3

Q4. Consider an experiment of tossing two coins three times. Coin A is fair, but coin B is not fair, with $P(H) = \frac{1}{4}$ and $P(T) = \frac{3}{4}$. Consider a bivariate random variable (X, Y) , where X denotes the number of heads resulting from coin A and Y denotes the number of heads resulting from coin B .

[5] CO3

- (i) Find the range of (X, Y) .
- (ii) Find the joint probability mass functions of (X, Y) .
- (iii) Find $P(X = Y)$, $P(X > Y)$, and $P(X + Y \leq 4)$.

Q5. The joint pdf of a bivariate random variable (X, Y) is given by

[5] CO5

$$f(x, y) = \begin{cases} \frac{1}{y} e^{-x/y} e^{-y} & x > 0, y > 0 \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

- (i) Show that $f(x, y)$ is a valid joint density function.
- (ii) Find $P(X > 1 | Y = y)$.

(18)

Number of printed page 01

Semester V (B.Tech)

Er. No. 2218145

Academic Year: 2024-25

Jaypee University of Engineering & Technology, Guna

T-2(Odd Semester 2024)

18B11CI511 – Theory of Computation

Maximum Duration: 1 Hour 30 minutes

Maximum Marks: 25

Notes:

1. This question paper has *five* questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).
4. Marks are given in the square bracket.

		Marks	CO No.
Q1.	Show that grammar $G_1 = (\{S\}, \{a, b\}, P_1, S)$, where $P_1 = \{S \rightarrow aSb \mid ab\}$ is equivalent to grammar $G_2 = (\{S, A, B, C\}, \{a, b\}, P_2, S)$. Here P_2 consists of $S \rightarrow AC, C \rightarrow SB, S \rightarrow AB, A \rightarrow a, B \rightarrow b$.	[05]	CO3
Q2.	Formulate a regular expression for the language that accepts all strings over the alphabet {0, 1} that ends with either "010" or "0010". Then, construct a non-deterministic finite automaton (NFA) corresponding to this regular expression. Finally, convert the NFA into an equivalent deterministic finite automaton (DFA).	[05]	CO2
Q3.	Find the regular grammar of the given language below on $\{a, b\}$, $L = \{w : n_a(w) \text{ and } n_b(w) \text{ are both even}\}$	[05]	CO3
Q4.	Remove all unit-production, all useless production and all λ -productions from the grammar and find the language generated by grammar in regular expression form.	[05]	CO4
$S \rightarrow aA \mid aBB$ $A \rightarrow aaA \mid \lambda$ $B \rightarrow bB \mid bbC$ $C \rightarrow B$			
Q5.	Convert the grammar given below into Chomsky normal form.	[05]	CO3
$S \rightarrow AB \mid aB$ $A \rightarrow bAB \mid \lambda$ $B \rightarrow bbA$		(5)	

Jaypee University of Engineering & Technology, Guna**T-2(Odd Semester 2024)**

18B11CI918 – Machine Learning

Maximum Duration: 1 Hour 30 minutes

Maximum Marks: 25

Notes:

1. This question paper has 4 questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).

		Marks	CO No.												
Q1.	A machine learning model designed to classify digit 5 with Not 5, gives its performance in the form of following confusion matrix.	[07]	CO4												
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">-ve.</td> <td style="text-align: center;">+ve</td> <td></td> </tr> <tr> <td style="text-align: center;">Not 5</td> <td style="text-align: center;">TN <u>53057</u></td> <td style="text-align: center;">FP <u>1522</u></td> <td></td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">FN <u>1325</u></td> <td style="text-align: center;">TP <u>4096</u></td> <td></td> </tr> </table>		-ve.	+ve		Not 5	TN <u>53057</u>	FP <u>1522</u>		5	FN <u>1325</u>	TP <u>4096</u>			
	-ve.	+ve													
Not 5	TN <u>53057</u>	FP <u>1522</u>													
5	FN <u>1325</u>	TP <u>4096</u>													
	Compute the F1 score of the model.														
Q2.	Write a python script to train a binary classifier to classify the digit 0 or not. Use MNIST dataset for training.	[06]	CO3												
Q3.	Draw a plot to show the effect of learning rate on gradient descent.	[06]	CO4												
Q4.	<p>A hospital, in a country which reports the most <u>snakebite</u> deaths, receives many cases of snake bites <u>every day</u>. The challenge before doctors is to identify if the bite is from <u>non-venomous or venomous</u> snake. If a person bitten by non-venomous snake is given anti-venom injection then the person suffers with vomiting, diarrhea, and fever for a week or more. This hospital was offered two machine learning models (Model-A and Model-B) to identify venomous or non-venomous snake bites and minimize deaths. Model-A offers 100% precision and Model-B offers 100% recall. Which model will you select in this case? <u>Justification must be within 20 words only.</u></p>	[06]	CO5												

Jaypee University of Engineering & Technology, Guna

T-2 (Odd Semester 2024)

18B14MA544- Fuzzy systems and Applications

Maximum duration: 1 Hour 30 minutes

Maximum Marks: 25

Notes:

1. This question paper has five questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).

		Marks [05]	CO.NO CO4
Q1	In data analysis, Principal Component Analysis (PCA) is used to reduce the dimensionality of a dataset. The data is represented by the following covariance matrix C :		
	$C = \begin{bmatrix} 2.5 & 0.8 & 0.6 \\ 0.8 & 1.2 & 0.7 \\ 0.6 & 0.7 & 1.5 \end{bmatrix}$	3.5	
(a)	Find the highest eigen-value of the covariance matrix C .		
(b)	Explain the significance of the highest eigen-value in terms of data compression and variance.		
(c)	Using the eigen-value and its corresponding eigenvector, determine the principal component and explain how this information can be used to reduce the dimensionality of the dataset while preserving the most important features.		
Q2	A university wants to group courses based on their content overlap. The fuzzy equivalence relation R is used to measure the degree of similarity between the courses (C_1, C_2, C_3, C_4, C_5). The fuzzy relations are as follows:	[05]	CO3
	$\mu(C_1, C_2) = 0.7; \mu(C_1, C_3) = 0.5; \mu(C_1, C_4) = 0.8; \mu(C_1, C_5) = 0.4;$ $\mu(C_2, C_3) = 0.6; \mu(C_2, C_4) = 0.7; \mu(C_2, C_5) = 0.5; \mu(C_3, C_4) = 0.6;$ $\mu(C_3, C_5) = 0.7; \mu(C_4, C_5) = 0.8; \mu(C_i, C_i) = 1$ for all i .	2	
(a)	Determine whether this relation qualifies as fuzzy equivalence relation by checking for reflexivity, symmetry, and transitivity.		
(b)	Calculate the transitive closure of this fuzzy relation using the max-min composition.		
(c)	Based on the transitive closure, identify the equivalence classes of courses considering only the relations with a degree greater than or equal to 0.7. Explain which courses are similar and could be grouped together for curriculum planning.		
Q3	Define fuzzy information measure. Show that $H(A)$ defined below is a valid measure of fuzzy information:	[05]	CO4

$$H(A) = \frac{1}{1-\alpha} \sum_{i=1}^n \log[\mu_A^\alpha(x_i) + (1 - \mu_A(x_i))^\alpha], \alpha \neq 1 \text{ and } \alpha > 0$$

3 3.5 3.5 3.5 5

Q4

A company conducts a survey to determine customer preferences for four products (P_1, P_2, P_3, P_4). The preferences are expressed using fuzzy partial order relations, where the degree indicates how much more preferable one product is compared to another. The fuzzy relations are given as:

- $\mu(P_1, P_2) = 0.7$ (P_1 is more preferred than P_2 with a degree of 0.7),
- $\mu(P_2, P_3) = 0.8$ (P_2 is more preferred than P_3 with a degree of 0.8),
- $\mu(P_1, P_3) = 0.6$ (P_1 is more preferred than P_3 with a degree of 0.6),
- $\mu(P_3, P_4) = 0.9$ (P_3 is more preferred than P_4 with a degree of 0.9),
- $\mu(P_1, P_4) = 0.5$ (P_1 is more preferred than P_4 with a degree of 0.5),
- $\mu(P_2, P_4) = 0.7$ (P_2 is more preferred than P_4 with a degree of 0.7),
- $\mu(P_i, P_i) = 1$ for all i .

[05] CO3

(3.5)

- Determine whether this fuzzy relation forms a fuzzy partial order.
- Draw the Hasse diagram for the fuzzy partial order, considering only the relations with a degree greater than or equal to 0.6.
- Given the degrees of preference, rank the product from most important to least important, incorporating the fuzzy values in your ranking.

Suppose a new product P_5 is introduced, with the following fuzzy relations:

- $\mu(P_5, P_1) = 0.6$ (P_5 is more preferred than P_1),
- $\mu(P_5, P_3) = 0.7$ (P_5 is more preferred than P_3),
- $\mu(P_4, P_5) = 0.8$ (P_4 is more preferred than P_5).

- Update the Hasse diagram to include the new product P_5 , and describe how the product ranking changes.

Q5

In a fuzzy transportation problem, consider the following fuzzy cost matrices for transportation between three sources $S = \{s_1, s_2, s_3\}$ and two destinations

$D = \{d_1, d_2\}$:

$$\text{Fuzzy supply matrix} = \begin{bmatrix} 0.5 & 0.9 \\ 0.4 & 0.6 \\ 0.8 & 0.2 \end{bmatrix}, \text{fuzzy demand matrix } B = \begin{bmatrix} 0.7 & 0.5 \\ 0.6 & 0.3 \end{bmatrix}.$$

(5)

Determine the fuzzy transportation cost using the max-min composition for each source-destination pair.

(x+y)(x+z)

Semester V (B.Tech)

Er. No.221B145.....

Academic Year: 2024-25

Jaypee University of Engineering & Technology, Guna

T-3(Odd Semester 2024)

18B11MA511 – Probability Theory and Random Processes

Maximum Duration: 2 Hours

Maximum Marks: 35

Notes:

1. This question paper has seven questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).

Marks CO No

Q1.

The time (in hours) required to repair a machine is exponentially distributed with [05] CO3 parameter $\lambda = 1/2$.

- a) What is the probability that the repair time exceeds 2 hours?
- b) Find the conditional probability that a repair takes at least 10 hours given that its duration exceeds 9 hours.

Q2.

The joint probability density function of a two-dimensional random variables (X, Y) is [05] CO2 given by

$$f(x, y) = xy^2 + \frac{x^2}{8}, \quad 0 \leq x \leq 2, \quad 0 \leq y \leq 1.$$

Compute $P(X > 1)$, $P(X > 1 / Y < \frac{1}{2})$, $P(X + Y < 1)$.

Q3.

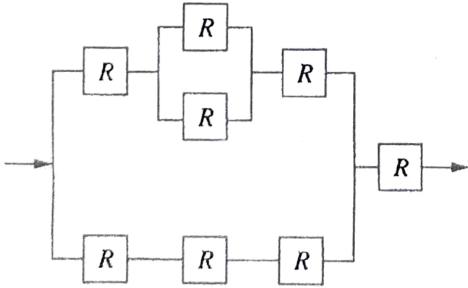
A new fuel injection system is experiencing high failure rates. The reliability function [05] CO5 has found to be

$$R(t) = (t + 1)^{-3/2}, \quad t \geq 0$$

where t is measured in years. The reliability over its intended life of 2 years is 0.19 which is unacceptable. Will a burn-in period of 6 months significantly improve upon this reliability? If so, by how much?

Q4.

For the following network, derive an expression for the system reliability in terms of the [05] CO5 component reliabilities. Assume that each component has a reliability of R.



Also compute the system reliability if $R = 0.9$.

- Q5.** The failure distribution is defined by $f(t) = \frac{3t^2}{10^6}$, $0 \leq t \leq 1000$ hours. [05] COS
a) Compute the probability of failure within a 100 hours warranty period.
b) Determine the design life for a reliability of 0.99.
- Q6.** Show that the random process $X(t) = A \cos(\omega_0 t + \theta)$ is wide-sense stationary process, where A and ω_0 are constants and θ is a uniformly distributed random variable in $(0, 2\pi)$. [05] CO4
- Q7.** A machine goes out of order, whenever a component fails. The failure of this part follows a Poisson process with a mean rate of 1 per week. Find the probability that 2 weeks have elapsed since last failure. If there are 5 spare parts of this component in an inventory and that the next supply is not due in 10 weeks, find the probability that the machine will not be out of order in the next 10 weeks. [05] CO4

Jaypee University of Engineering & Technology, Guna

T-3 (Odd Semester 2024)

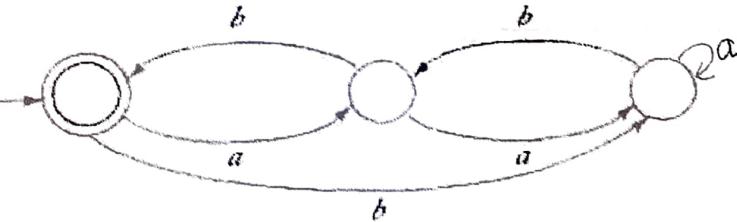
18B11CI511 – Theory of Computation

Maximum Duration: 2 Hours

Maximum Marks: 35

Notes:

1. This question paper has *five* questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).
4. Marks are indicated in the square bracket

		Marks	CO No.
Q1.	(i) Find regular expression R for accepting all the strings over a and b , which ends with aa . (ii) Convert R into NFA with null moves resulting $M1$. (iii) Find NFA without null moves equivalent to $M1$ resulting $M2$. (iv) Find DFA equivalent to $M2$ resulting $M3$ (v) Minimize $M3$	[01] [01] [01] [02] [02]	CO3
Q2.	Find the regular expression for the language accepted by automata given below.	[07]	CO3
			
Q3.	Consider the grammar $S \rightarrow aA, A \rightarrow aABC \mid bB \mid a, B \rightarrow b, C \rightarrow c$ (a) Construct an equivalent PDA for the above grammar (b) Find the sequence of move made by above PDA in processing input string aaabc.		CO4 [05] [02]
Q4.	(a) Construct a pda accepting $L_1 = \{a^n b^m a^n \mid m, n \geq 1\}$ by null store. (b) Construct the corresponding context-free grammar accepting L_1 .	[05] [02]	CO4
Q5.	(a) Design Turing machine that accepts language $\{x^n y^n z^n \mid n \geq 1\}$. (b) Check the acceptability of the string xxxyyzz for the above machine of question 5(a) by showing the instantaneous description for the input string.	[05] [02]	CO5

Number of printed pages 2

Semester V (/B.Tech/)

Er. No. 221B145
Academic

Year: 2024-25

Jaypee University of Engineering & Technology, Guna

T-3 (Odd Semester 2024)

18B11CI918 – MACHINE LEARNING

Maximum Duration: 2 Hours

Maximum Marks: 35

Notes:

1. This question paper has 5 questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).

(1)

Q1. A logistic model was trained to classify infected and Not-infected patients by a disease. Positive class means the patient is infected and negative class means Not-infected. After training when a patient's data was given for prediction, the model predicted negative class with the predicted probability 0.1, but in reality the patient was actually infected. Compute the loss of the model in this case.

Marks CO Nc
[07] CO4

(2)

Q2. Write mathematical form of generalized logistic regression model to support multiple classes directly without having needed to train and combine multiple binary classifiers. Explain each component of the model.

[07] CO5

(3)

Q3. Create stumps for humidity and wind and compute Gini Impurity for both the stumps from the data given in Table 1:

[07] CO3

Day	Humidity	Wind	Decision
1	High	Weak	No
2	High	Strong	No
3	High	Weak	Yes
4	High	Weak	Yes
5	Normal	Weak	Yes
6	Normal	Strong	No
7	Normal	Strong	Yes
8	High	Weak	No
9	Normal	Weak	Yes
10	Normal	Weak	Yes
11	Normal	Strong	Yes
12	High	Strong	Yes
13	Normal	Weak	Yes
14	High	Strong	No

Table 1: Dataset

- Q4. Write a python code to train Support Vector Classifier of Iris flower [07] CO2 dataset based on petal length and petal width.

- Q5. What is a decision tree? Draw a decision tree for the dataset shown in [07] CO1 Table 1.

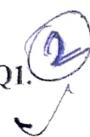
Jaypee University of Engineering & Technology, Guna**T-3 (Odd Semester 2024)****21B14HS547 – Concept of Economics**

Maximum Duration: 2 Hours

Maximum Marks: 35

Notes:

1. This question paper has 6 questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).
4. Calculators are allowed.

Q1. 

Explain the differences between short-run production and long-run production in terms of the three stages of production, isoquants, isocosts, and the optimal input usage condition. How do these concepts shape production decisions in each time frame? Use relevant examples and diagrams to illustrate your understanding.

Marks [06] **CO No.** CO2

Q2.

FlashTech Company operates in an oligopolistic market and faces a kinked demand curve for its product, characterized by the following equations:

$$Q_1 = 90 - 10P$$

$$Q_2 = 50 - 5P$$

The firm's total cost function is given as:

$$TC = 20 + Q + 0.1 Q^2$$

[05] CO5

- a. Analyze and determine the price and output level for FlashTech's product assuming the kinked demand curve.

- b. Based on your answer in part (a), compute the firm's profit.

- c. Evaluate the range of marginal cost values within which the price and output remain stable and diagram your answers.

Q3. The demand equation for a product sold by a monopolistically competitive firm is

$$Q = 30 - 0.5P$$

[06] CO4

The total cost equation of the firm is

$$TC = 200 + 6Q + 0.3Q^2$$

- a. Calculate the profit-maximizing price and quantity.

- b. Analyze whether the firm is earning an economic profit and evaluate whether it operates in long-run or short-run equilibrium at the profit-maximizing price and quantity.

- c. Diagram your answers to parts a and b.

Q4. A cloth merchant, who supplies cotton cloth in both Andhra Pradesh and Tamil Nadu, has the following demand functions:

$$\text{Andhra Pradesh: } P_A = 600 - Q_A$$

$$\text{Tamil Nadu: } P_T = 400 - Q_T$$

The average cost function of the merchant is estimated to be $AC = \frac{15000}{Q} + 100$.

- If price discrimination is not practiced, determine the profit maximizing price and quantity of the merchant?
- If price discrimination is practiced, compute the maximum possible profit the monopolist can earn?

Q5. In a perfectly competitive market, the market-determined price is $P=15$. An individual firm in the industry has the total cost equation:

$$TC = 150 + 4Q + 0.04Q^2$$

- What is the firm's profit-maximizing output level?
- Calculate the firm's total profit at the profit-maximizing output level.
- Diagram your answers to parts a and b.
- What would be the long-run equilibrium price and output level for the firm?

Q6. Given the table below with some missing cost values, use your understanding of cost relationships to calculate the missing entries. Apply the relevant formulas for Total Cost (TC), Total Fixed Cost (TFC), Total Variable Cost (TVC), Average Fixed Cost (AFC), Average Variable Cost (AVC), Average Total Cost (ATC), and Marginal Cost (MC).

Output	TC	TFC	TVC	AFC	AVC	ATC	MC
100	260		60				
200							0.3
300					0.5		
400						1.05	
500			360				
600							3.0

- Complete the table by calculating the missing values.
- Explain the step-by-step process used to derive the missing values.
