Your Roll No...............

Sr. No. of Question Paper : 1143   A

Unique Paper Code   : 32341401

Name of the Paper   : Design and Analysis of Algorithms

Name of the Course   : **B.Sc. (H) Computer Science**

Semester   : IV

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Question No. **1** is compulsory.

3. Attempt any **four** of Questions Nos. **2** to **8**.

1. (a) Consider the recursive version of Insertion sort algorithm as follows :

    In order to sort A[1 : n], we recursively sort A[1 : n-1] and then insert A[n] into the sorted array A[1 : n-1]. Write a recurrence for the running time of this algorithm.   (3)

P.T.O.

(b) What are the minimum and maximum number of elements in a binary heap of height h?. (2)

(c) Which of the following algorithms are stable: Insertion sort, Quicksort? Justify with the help of an example. (3)

(d) What are the two key factors that decide whether Dynamic Programming is applicable for an optimization problem or not? (2)

(e) "The minimum spanning tree in a graph is not always unique." Justify. Give a graph with 5 nodes that has two different minimum spanning trees.

(2)

(f) Would you use BFS to find the shortest path between two nodes in a weighted graph with arbitrary edge weights? Justify your answer with the help of a graph having at least 5 Vertices and at least 7 edges. (3)

(g) "Counting sort is a comparison sort algorithm." Yes or No. Justify your answer using the input $A = < 4, 3, 2, 4, 1, 5, 2, 4, 3 >$ (3)

(h) A priority queue can be implemented in two different ways using min-heap and using singly linked list in which elements are stored in sorted

order (Smaller values indicates higher priority). Compare the time complexity of following operations when performed on two different implementations of priority queue.

    (1) Finding the highest priority element

    (2) Deleting the highest priority element

    (3) Increase the priority of a certain element

                        (6)

(i) Find possible Topological sorts of the given directed acyclic graph. Give any four :   (2)
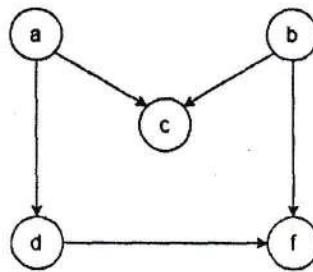
(j) Give the worst case for the merge algorithm to merge two sorted arrays $A[1 \dots k]$, $B[1 \dots m]$ (where $n = k + m$) and give the total number of comparisons in the worst case (in terms of n). Merge the two sorted arrays $A = [3, 7, 9, 12, 14]$ and $B = [2, 5, 6, 10]$ using merge algorithm. How many number of comparisons are done by the algorithm in the above example?   (6)

(k) Consider the Interval Scheduling problem wherein we are given a resource and a set of requests each having a start time and a finish time. The goal is to maximize the number of requests scheduled. Show that the following greedy strategy does not give an optimal solution for the above problem.

Greedy strategy: Select the request with fewest number of incompatible requests.   (3)

2. (a) Professor William claims that the $\Omega(n\ lg\ n)$ lower bound for sorting n numbers does not apply to his machine. The control flow of a program on his machine can split three ways after a single comparison of two elements of the array $a_i : a_j$. The three ways are $a_i < a_j$, $a_i = a_j$, or $a_i > a_j$. Show that the professor is wrong by proving that the number of three-way comparisons required to sort n elements is $\Omega(n\ lg\ n)$.   (5)

(b) Suppose you have an algorithm to find median of n elements of an unsorted array in $O(n)$ time in the worst case. Now consider an implementation of Quicksort where you first find median using the above algorithm, then use median as pivot. What will be the time complexity of this modified

Quicksort? Write down the recurrence relation to justify your time complexity (Median of n elements is the element whose rank is $n/2$ if n is even and it is $(n+1)/2$ if n is odd).   (5)

3. (a) Illustrate the operation of BUILD -MAX -H EAP on the array A $<4, 3, 17, 10, 28, 19, 6, 12, 7>$. Write down the total number of comparisons done by BUILD -MAX -H EAP.   (5)

   (b) Consider the following recursive relation for 0-1 knapsack problem.

   If $w < w_i$, then OPT(i, w) = OPT$(i-1, w)$

   else OPT(i, w) = max(OPT$(i-1, w)$, v_i + OPT$(i-1$, _____$))$

   where OPT(i, w) denote the value of the optimal solution using a subset of items $\{1,2,...i\}$ with maximum allowed weight w.

   v_i is the cost of ith item

   Fill the missing value.

   What is the running time of the recursive implementation of the above recurrence? Justify. Give memoized recursive algorithm for the above problem. Explain how does it improve the running time?   (5)

4. (a) Give an algorithm to sort n integers in the range 0 to $n^3 - 1$ in $O(n)$ time. Justify it's time complexity.   (4)

(b) Suppose we use randomized select to select the minimum element of the array A = < 4, 2, 1, 7, 8, 12, 3, 0, 9, 5, 10 >. Describe a sequence of partitions that result in a worst case performance of randomized select.   (4)

(c) Suppose an input to the bucket sort algorithm is not uniformly distributed. What will be the effect of this condition on the running time of the algorithm? Justify.   (2)

5. (a) A Shopkeeper has n empty boxes and M number of balls. Let $\{K_1, K_2 \ldots\ldots\ldots Kn\}$ denote the number of balls that each box can store.

Given M and $\{K_1, K_2 \ldots\ldots\ldots Kn\}$, describe a greedy algorithm which determines the minimum number of boxes needed to store the balls. Give time complexity of the algorithm.   (4)

(b) Design a $O(|V|+|E|)$ time algorithm to find whether a given undirected graph is bipartite (where V is the set of vertices, E is the set of edges of the graph).   (4)

(c) Give space requirements of adjacency matrix and adjacency list representation having *m* edges and *n* vertices..   (2)

6. (a) "Prim's algorithm only include an edge in the Minimum Spanning tree when it is justified by the Cut property.". State the Cut Property. Justify the above statement on the given graph showing cuts in all the intermediate steps.
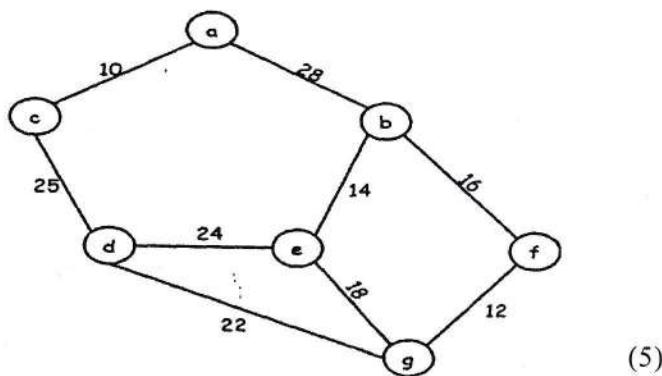
                                                        (5)

(b) Suppose divide and conquer approach is used by an algorithm to solve a problem on the input of size *n*. The algorithm divides the problem into *k* number of smaller instances, each of which is 1/b the size of the original problem. It solves the problem recursively on these smaller instances and combine their solutions to construct the final

solution of the original problem. Let $G(n)$ denotes the cost of dividing the problem into smaller instances and $F(n)$ denotes the cost of combining the solutions.

Write the recurrence relation to find the running time of the algorithm. Give $G(n)$ and $F(n)$ for Both Quicksort and Mergesort algorithm. (3)

(c) Let G be a graph with n vertices and m edges. What is the upper bound on the running time of Depth First Search on G, where G is represented as an adjacency matrix? (2)

7. (a) A boat has a capacity C to carry load. There are n number of items each having certain weight Wi associated with it. The goal is to select the set of items that the boat should carry so that it could carry maximum load(i.e. sum of the weights of selected items should be maximum) within its capacity C.

Design a Polynomial time Dynamic Programming algorithm for the problem. Derive the time complexity of the above algorithm.

Run this algorithm on the sample instance given below to find the optimal solution. (6)

Capacity of the boat = 4kg

Items	Weights
Item1	3 kg
Item2	2 kg
Item3	1 kg

(b) Suppose we perform a sequence of n operations on a data structure in which the ith operation costs i if i is an exact power of 2, and 1 otherwise. Use aggregate analysis to determine the amortized cost per operation.   (4)

8. (a) The following graph represents network of airports that are connected to each other. Each edge represents the distance (in multiples of 1000 miles) covered by the flight to travel from one airport to another and vertices represents the airports. A flight starts from airport s and has to reach destinations c, d and e. Run an efficient algorithm to find the route taken by the flight to each to its destinations in minimum possible time. Show all the intermediate steps taken by the algorithm.

Also derive its time complexity.   (5)

P.T.O.
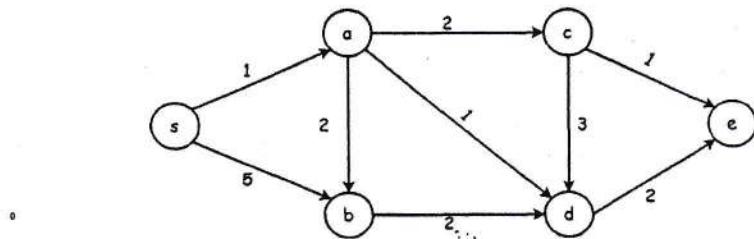
(b) There are *n* Jobs where each job starts at time s_i and finishes at time fi. There is a profit associated with each job. The goal is to find a subset of non-overlapping jobs such that the sum of their profits is maximum.

Given below is the instance of the problem :

Job Number	Start Time (s$_i$)	Finish time (f$_i$)	Profit (p$_i$)
Job1	0	6	60
Job2	1	4	30
Job3	3	5	10
Job4	5	7	30
Job5	5	9	50
Job6	7	8	10

Give a Dynamic programming iterative solution for the above problem. Explain the recurrence relation used in the solution.

Show that the "Optimal solution to the above problem contains within it optimal solution to its subproblems." With reference to the above example. (5)

(1500)

Your Roll No...............

Sr. No. of Question Paper : 1370   A

Unique Paper Code   : 32341402

Name of the Paper   : Software Engineering (DSC)

Name of the Course   : **B.Sc. (H) Computer Science**

Semester   : IV

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. The paper has **Two** Sections.

3. All questions in **'Section A'** are compulsory.

4. Attempt any **Four** questions from **'Section B'**.

5. Parts of a question must be answered together.

SECTION A

1. (i) What is a prototyping model? When is it most appropriate to use prototyping model?   (1+2)

P.T.O.

(ii) What is Gantt chart? How is it used for project scheduling?   (1+2)

(iii) What is an SRS? List any 3 characteristics of SRS.   (1+3)

(iv) State three basic assumptions which an agile process is expected to handle.   (3)

(v) What is risk exposure? How is Risk Exposure determined?   (1+2)

(vi) What do you understand by CMMI? Explain the various levels of CMMI.   (5)

(vii) "Software Engineering is a layered technology". Justify the given statement.   (5)

(viii) Explain any two development activities defined by the process patterns used in Scrum.   (4)

(ix) What is Cohesion? Explain any three different types of cohesion.   (2+3)

SECTION B

2. Explain the following terms :   (10)

(i) Known requirements

(ii) Unknown requirements

(iii) Undreamt requirements

(iv) Functional requirements

(v) Non-functional requirements

3.   The given system computes the salary of the employees and generates the salary slip. Create context level and level 1 DFD (Data Flow Diagram) of the given system.

Also draw the data dictionary of the system.

- The basic input is the weekly timesheet

- The source for the input is a worker

- The basic output is the pay-check

- The sink for the output is also a worker

Procedure :

- In this system, first the employee's record is retrieved, using the employee ID, which is contained in the timesheet.

P.T.O.

- From the employee record, the rate of payment and overtime are obtained.

- These rates, and the regular and overtime hours are used to compute the pay.

- After the total pay is determined, taxes are deducted.

- To compute the tax deduction, information from the tax rate file is used.

- The amount of tax deducted is recorded in the employee and company records.

- Finally, the pay-check is issued for the net pay.

- The amount paid is also recorded in the company records. (10)

4. Compute the **Cyclomatic Complexity** of the given flow graph using three different methods. Identify all the regions and list all the **independent paths** of the flow graph : (10)
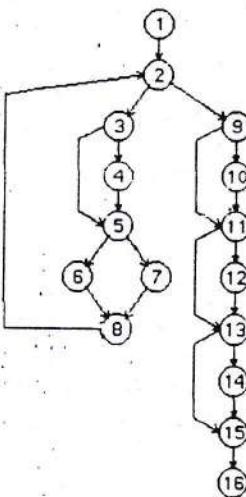
5: (a) How are maintainability and integrity of the software used as a measure of software quality?

(6)

(b) Explain the following metric to determine the specification quality :–

(i) Specificity

(ii) Completeness of the functional requirement

(4)

6. (a) Compute the **Function Point value** for a project with the following information domain characteristics :

Assume the measurement parameters are equally divided among low, average and high complexity. Further, assume that the **complexity adjustment value** is 1.05.

(5)

Measurement Parameters	count	Weighing factors		
		Low	average	high
Number of user inputs	12	3	4	6
Number of user outputs	21	4	5	7
Number of user inquiries	6	3	4	6
Number of files	6	7	10	15
Number of external interfaces	9	5	7	10

(b) At the conclusion of a project, it has been determined that 30 errors were found during the modelling activity and 12 errors were found during the construction activity that were traceable to errors that were not discovered in the modelling activity. What is the DRE for the modelling activity?

(5)

7. (a) Draw a use case diagram for an online shopping portal "ESHOP". The functional requirements are as given below :

- The users will log in and the Admin will authenticate the log in details of the user.

- After successful log in users can select the product to purchase and keep them in cart.

- They can view and edit the cart items.

- To place the order user has to calculate the total amount to be paid which is verified by the admin.

- After verification the payment can be done through credit card.

- The payment receipt is sent on mail to user.

(6)

(b) Consider a program for computing the function f(x,y), where the input boundaries of x and y are given below :

$1 <= x <= 10$

$10 <= y <= 20$.

Design the boundary value test cases for the above program.

(4)

8. (a) What is top down and bottom approach for integration testing? Explain the use of Stubs and Drivers in the context of Integration Testing. Illustrate with an example.

(6)

P.T.O.

(b) Explain any FOUR key quality attributes as identified by ISO 9126 standards.   (4)

Sr. No. of Question Paper : 1108

Unique Paper Code : 32341601

Name of the Paper : BHCS13: Artificial Intelligence

Name of the Course : B.Sc. (II) Computer Science

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Question 1 is compulsory.

3. Attempt any **four** questions from Question 2 to Question 8.

4. Parts of a question must be answered together.

1. (a) Describe the following terms : (4)

    (i) Heuristic Function

    (ii) Software Agent

(b) Write a context free grammar that can accept the sentence: "Ram hit the ball". (3)

P.T.O.

(c) In the following two-ply game tree, the terminal nodes show the utility values computed by the utility function. Use the Minimax algorithm to compute the utility values for other nodes in the given game tree.   (2)
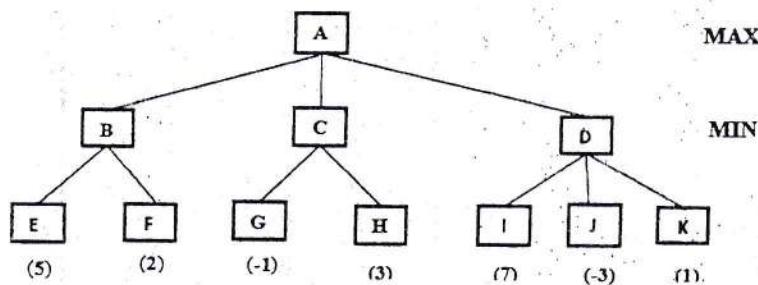
(d) Find whether the following set is unifiable or not. If unifiable, find the most general unifier(m.g.u.).

w = {PARENTS(x, FATHER(x), MOTHER(bill)),
PARENTS(bill, FATHER(bill), y)}   (2)

(e) Express the following sentence as conceptual dependency structure:

"Sohan gave Tina a box of chocolate"   (2)

(f) Write the conceptual graph and FOPL representation for the following sentence:

"Every motorbike has a handle"   (4)

(g) Consider that append(L1,L2,L3) is a function in Prolog, in which list LI is contacted with L2 and the result is stored in L3. What would be the output of the following statement in Prolog?

?- append([2,3,4],L,[2,3,4,a,b]).   (2)

(h) Find the meaning of the statement

$$(\sim P \vee Q) \& R \rightarrow S \vee (\sim R \& Q)$$

for the interpretation: P is true, Q is false, R is true, S is true.   (2)

(j) Transform the following sentence into disjunctive normal form :

$$\sim(P \vee \sim Q) \& (R \rightarrow S)$$ (3)

(k) Determine whether the following sentence is satisfiable, contradictory or valid:

$$S : P \rightarrow Q \rightarrow \sim P$$ (2)

(l) Why should the heuristic function of A* algorithm always underestimate? Give reason, example.

(3)

(m) What is non-monotonic reasoning? Give an example. (3)

(n) Prove that if A and B are independent events, P(A|B) = P(A). (Note that A and B are independent if and only if P(A & B) = P(A)P(B)). (3)

2. (a) Differentiate between partially observable and fully observable task environment of an agent. Give an example of each. (5)

(b) Create a frame network for terrestrial motor vehicles (cars, trucks, motorcycles) and given one complete frame in detail for cars which includes the slots for the main component parts, their attributes, and relations between parts. (5)

3. (a) What is closed world assumption? Give an example. (3)

(b) Define Modus ponens rule. Elaborate using an example. (3)

(c) Given formula S_1 and S_2 below, show that $Q(a)$ is a logical consequence of the two.

S_1: $(\forall x)(P(x) \to Q(x))$ and S_2: $P(a)$ (4)

4. (a) Create a script for shopping in a supermarket.

            (5)

(b) Joint probability $P(x_1, x_2,\dots, x_7)$ by inspection as a product of chain conditional probabilities is :

$$P(x_1, x_2, \dots, x_7) = P(x_7 \mid x_3) . P(x_6 \mid x_5) . P(x_5 \mid x_2 \ x_1) . P(x_4 \mid x_1 \ x_2) . P(x_3) . P(x_2 \mid x_1) . P(x_1)$$

Draw the Bayesian belief network for the same.

            (5)

5. (a) Write a program in Prolog to compute the sum of elements of a list.   (5)

(b) What are alpha and beta cutoffs? How alpha-beta pruning is used to improve the efficiency of Minimax procedure?   (5)

6. (a) Compare and contrast Best-first search and Hill Climbing search. You can use example.   (4)

(b) What is a Recursive Transition Network (RTN)? Give an example.   (4)

(c) Give two limitations of propositional logic.   (2)

7.   (a) Consider the following axioms :

January

Clouds

Cold & Preciptation → Snow

January → Cold

Clouds → Precipitation

Convert them into clausal form and prove the truth of "Snow" using resolution.   (5)

(b) Develop a parse tree for the sentence "The cruel man locked the dog in the house" using the following rules.

S → NP VP

NP → N

NP → DET N

VP → V NP

VP → V PP

VP → V NP PP

PP → PREP NP

DET → ART ADJ

DET → ART

N → man | dog | house

V → locked

ART → the | a

ADJ → cruel

PREP → in   (5)

8. (a) Solve the following crypt arithmetic problem using constraint satisfaction.

ODD

+ ODD

EVEN

-----------   (4)

(b) Describe the limitations of Hill Climbing Methods.

(3)

(c) Define the PEAS for vacuum cleaner agent.

(3)

(1500)
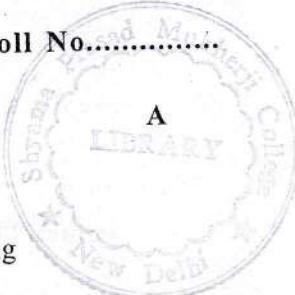
Your Roll No...............

Sr. No. of Question Paper : **1174**   **A**

Unique Paper Code   : 32347611

Name of the Paper   : Data Mining

Name of the Course   : **B.Sc. (Hons.) Computer Science**

Semester   : VI

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Question No. **1 (Section A)** is compulsory.

3. Attempt any **4** Questions from Nos. **2** to **8 (Section B)**.

4. Parts of a question must be answered together.

Section A

1. (a) How are accuracy rate and error calculated for evaluation of a classification model?   (2)

P.T.O.

(b) Briefly describe the aggregation technique in data-preprocessing?   (2)

(c) Normalize the age of four students, given by the values {18, 21, 22, 25}.   (2)

(d) Explain briefly the significance of dimensionality reduction.   (2)

(e) What is an outlier in context of a dataset?   (2)

(f) What kind of Association Rules do you think would be stronger and more interesting – the rules with high support and low confidence or the rules with low support and high confidence? Why?   (3)

(g) Define the use of sampling in data mining? Name two sampling methods.   (3)

(h) What are the three factors that affect the computational complexity of Apriori algorithm?

                                                                          (3)

(i) Distinguish between the following type of clustering schemes :

    (i) Exclusive vs. Fuzzy Clustering

    (ii) Complete vs. Partial Clustering   (4)

(j) What do you understand by the term missing data in data mining? Briefly describe two methods for dealing with missing data. (4)

(k) Define the terms scalability and heterogeneity? What challenges do they pose while mining the data? (4)

(l) Define precision and recall metrics used for classification. (4)

Section B

2. (a) Explain discretization and binarization in context of data pre-processing. (4)

(b) Consider a categorical attribute Customer satisfaction {unsatisfactory, poor, neutral, good, very good}

(i) Convert the above categorical attribute to three binary attributes. (2)

(ii) Convert the same attribute to five asymmetric binary attributes. (2)

(c) State the Apriori Principle. (2)

P.T.O.

3. For the given employee table, identify the type of each attribute (nominal, ordinal, interval- scaled, ratio-scaled), giving justification for your choice. For each attribute that has missing values, briefly state how will you handle missing values therein.   (10)

Emp_id	Gender	Age	Home _pin code	Date_ of_ joining	Desig.	Contact_No	Email_id
1001	M	32	232322	16/4/10	Captain	981828706	b@gma.com
1002	F	31	222321	21/3/11	Captain	981121072	f@gma.com
1003	F	34	243431	23/4/08	Major	992665007	??
1004	M	??	232432	21/5/09	Captain	987654390	r@gma.com
1005	M	35	454656	13/4/07	Colonel	981123456	d@gma.com
1006	??	36	465645	04/5/05	Colonel	786789564	a@gma.com
1007	F	30	234123	09/7/12	Captain	885678909	??
1008	M	32	676878	18/7/10	Major	??	x@gma.com
1009	M	33	565768	24/6/11	Colonel	989967890	e@gma.com
1010	M	30	498976	05/9/12	Major	??	d@gma.com

4. (a) Consider the following dataset where each data object has a class label along with five features associated with it.

Class	Cap Shape	Bruises	Odour	Stalk Shape	Habitat
Edible	Flat	Yes	anise	Tapering	grasses
poisonous	Convex	Yes	pungent	enlargening	grasses
Edible	Convex	Yes	almond	enlargening	grasses
Edible	Convex	Yes	almond	Tapering	meadows
Edible	Flat	Yes	anise	enlargening	woods
Edible	flat	No	none	enlargening	urban
poisonous	conical	Yes	pungent	enlargening	urban
Edible	flat	Yes	anise	enlargening	meadows
poisonous	convex	Yes	pungent	enlargening	urban

Consider the following pair of rules :

- *(Odour = pungent) and (habitat = urban)*
  → *(Class = poisonous)*

- *(Bruises = yes)* → *(Class = edible)*

(i) Are the two rules mutually exclusive? Justify your answer.   (2)

(ii) Calculate coverage and accuracy for each of the rules.   (4)

(b) Consider the one-dimensional labeled data set given below :

X:	0.5	3.0	4.5	4.6	4.9	5.2	5.3	5.5	7.0	9.5
Y:	-	-	+	+	-	-	+	+	-	-

Classify the data point x = 4.0 according to the 5-nearest neighbours, using the majority voting scheme.   (4)

5. (a) What are the three conditions needed to be satisfied by a distance measure, so that it can be established as a distance metric?   (3)

P.T.O.

(b) Show whether Euclidean Distance, used for finding distance between two data objects $o_1(x_1, y_1)$ and $o_2(x_2, y_2)$, can be treated as a distance metric.   (6)

(c) With the help of a diagram, explain the usage of a dendrogram.   (1)

6. Consider a transaction database D, consisting of nine transactions, as shown in the following table. Suppose the minimum support is set at 45% and the minimum confidence is set at 70%, show clearly the steps for finding out frequent itemsets of all sizes using the Apriori algorithm. Also generate the strong association rules from the frequent itemsets of size 3.   (10)

TID	List of Items
T1	A,B,C,F
T2	B,D
T3	B,C
T4	A,B,C
T5	A,C,F
T6	B,C,F
T7	A,D
T8	A,B,C,E,F
T9	A,B,C

7.   Consider a dataset of images of dogs and cats. Suppose there are 500–images of dogs and cats each. The classification model predicts 340 correct images of dogs and 410 correct images of cat. Perform the operations that follow :

(a) Draw the confusion matrix for this problem.

(b) Compute the classifier accuracy, error and sensitivity.   (4+6)

8.   Given the following data points: 4, 9, 18, 13, 11, 2, 6, 25, k = 3 and initial centroids $\mu_1 = 5$, $\mu_2 = 10$ and $\mu_3 = 15$. Show clearly the clusters and new cluster centres obtained after each iteration of K-means algorithm for two iterations of the algorithm.   (10)

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(4)

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(3)

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Your Roll No..............
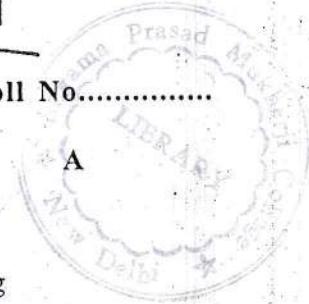
Sr. No. of Question Paper : 1262   A

Unique Paper Code   : 32347607

Name of the Paper   : Machine Learning

Name of the Course   : B.Sc. (Hons.) Computer Science
                           (LOCF)

                           (Admission of 2019)

Semester   : VI

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. **Section A** is compulsory.

3. Attempt any **4 (four)** questions from **Section B**.

4. Use of scientific calculator is allowed.

SECTION A

1. (i) Distinguish between supervised learning and unsupervised learning. Illustrate with an example.

    (5)

   (ii) Define Concept Learning. How the concept learning can be viewed as the task of searching?   (5)

P.T.O.

(iii) Calculate the output y of a single layer neural network with three input neuron and one output neuron. The input feature vector is $(x1, x2, x3) = (0.8, 0.6, 0.4)$ and weight values are $[w1, w2, w3] = [0.2, 0.1, -0.3]$ and bias $= 0.35$. Use binary Sigmoid function as activation function. (5)

(iv) Distinguish between overfitting and underfitting. How it can affect model generalization? (5)

(v) Using an example discuss how new features can be constructed by forming Cartesian production of existing features. What are the implications of this approach? (5)

(vi) Suppose that the probability of five events are P(first) $= 0.5$ and P(second) $=$ P(third) $=$ P(fourth) $=$ P(Fifth) $= 0.125$. Calculate its entropy. (5)

(vii) Use K-means clustering to cluster the following data into two groups :

$\{2, 4, 10, 12, 3, 20, 30, 11, 25\}$

Assume cluster centroid are m1=2 and m2=4. The distance function used is Euclidean distance. (5)

SECTION B

2. (i) Find the least square regression line for the given dataset using the normal equation method. Show computation at each step.

x1	x2	y
1	9	14
2	1	7
3	2	12
4	3	16
5	4	20

(4)

(ii) Consider the dataset given below having two input variables x1, x2 and one output variable y. Update the coefficients θ_0, θ_i and θ_2 using gradient descent for the logistic regression model. Assume the learning rate = 0.3 and the initial values of coefficients as $\theta_0 = -0.5$, $\theta_i = 1$, and $\theta_2 = -1$. Perform one iteration of gradient descent.

(6)

x1	1	3	8	6
x2	2	5	3	2
y	0	0	1	1

3. (i) State Bayes Theorem.   (2)

(ii) Consider the training data in the following table where Play is a class attribute.

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Humidity	Sunny	Wind	Play
L	N	S	N
H	N	W	Y
H	N	W	N
H	Y	S	Y
H	N	W	Y
L	Y	S	N

Build a Naive Bayes Classifier using the above data. Estimate the class label for day (Humidity=L, Sunny=N, Wind=W) using the above classifier. (8)

4. (i) Differentiate between Standard and Stochastic Gradient Descent. (4)

(ii) Identify the first splitting attribute for decision tree with the following dataset using ID3 algorithm :

Field	Experience	Hired
IT	Coding	No
IT	Coding	No
IT	Administration	Yes
IT	Administration	Yes
Business	Coding	Yes
Business	Coding	Yes
Business	Administration	No
Business	Administration	No

(6)

5. Consider the following neural network with initial weights, biases, and training input / outputs as mentioned.
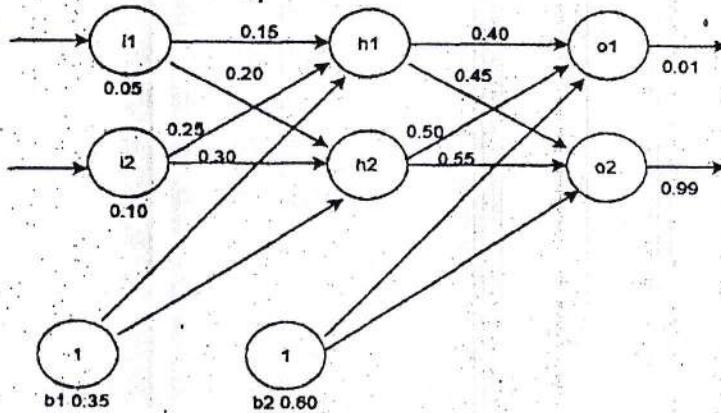
Given the inputs i1 = 0.05, i2 = 0.10, determine the values of output nodes o1 and o2. Also calculate the prediction error E_{total} if the actual output values o1 and o2 are 0.01 and 0.99 respectively. Use Sigmoid as the activation function for the hidden as well as the output layers. (10)

6. (i) What is the difference between K-means clustering and K-Nearest Neighbor classifier? (4)

(ii) Discuss steps used by Principal Component Analysis to extract important features. (6)

7. (i) Given the set of values $X = (3, 9, 11, 5, 2)^T$ and $Y = (1, 8, 11, 4, 3)^T$. Evaluate the regression coefficients using ordinary least square method. (4)

(ii) Assume a total of 1,000 patients are tested for influenza; 900 are found to be healthy, while 100 are found to be sick. A test resulted in 60 being positive and 40 being negative for the sick persons. The same test was positive for 120 and negative for 780 in healthy adults. Construct a confusion matrix for the data and determine precision and recall. (6)

8. (i) What is regularization? What is the effect of the following on the model?

(a) The regularization parameter (λ) is zero

(b) The regularization parameter (λ) is very large. (4)

(ii) State the mathematical formulation of the SVM problem. Give an outline of the method used for solving the classification problem using SVM. (6)

[This question paper contains 6 printed pages.]

Your Roll No.................

Sr. No. of Question Paper : 1353   A

Unique Paper Code   : 32341602

Name of the Paper   : Computer Graphics

Name of the Course   : B.Sc. (H) Computer Sc.

Semester   : VI

Duration : 3 Hours   Maximum Marks : 75
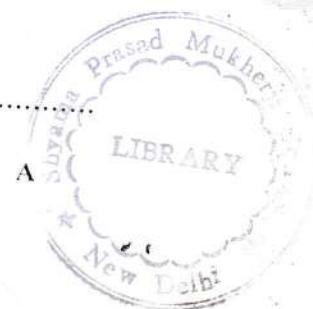
Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. **Section A** is compulsory.

3. Attempt any **four** questions from **Section B**.

4. Parts of a question must be answered together.

SECTION A

1. (a) Show that the composition of two rotations is additive.

$$R(\alpha) \times R(\beta) = R(\alpha+\beta)$$

(2)

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(b) Suppose an RGB raster system is to be designed using an 8 inch x 10 inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 6 bits per pixel in the frame buffer, how much storage in bytes do we need for the frame buffer? Also find the aspect ratio of the raster system.   (3)

2. (a) Construct a translation matrix to translate a Point P from position (h, k) to the origin.   (2)

(b) Discuss briefly the steps involved in design of animation sequence.   (3)

3. (a) Is RGB colour model additive? Justify your answer.   (2)

(b) Define Projection. Give any two differences between parallel and perspective projections.   (3)

4. (a) Write any two properties of Bezier curve.   (2)

(b) Consider a triangle ABC with A(0,0), B(5,0) and C(0,5). Give transformation matrix after shearing triangle ABC by 3 units along Y-axis and 4 units along X-axis. Use homogeneous coordinates.   (3)

5. (a) What is the condition for trivial acceptance of a line segment AB with A(0,4) and B(8,4) in Cohen Sutherland Line Clipping Algorithm using rectangular window coordinates as A(0,0), B(8,0), C(8,8) and D(0,8)? (2)

(b) Using Bresenham's line drawing algorithm find out the list of the rasterized pixels for the line from (20,10) to (25,14). (3)

6. (a) What is Specular reflection? (2)

(b) What are the steps in an Area-Subdivision method for Visible Surface determination? Is it an object-space method or image-space method? (3)

7. (a) What is interlacing? Discuss its significance in raster graphics. (2)

(b) Show that a 2D reflection through the x-axis, followed by a 2D reflection through the line y=x, is equivalent to a pure rotation about the origin. (3)

SECTION B

8. (a) Prove that two scaling transformations are commutative.

P.T.O.

Write 3X3 2-D transformation matrix for each of the following transformations respectively :

    (i) Enlarge the object by three times.

    (ii) Translate the object by 3 units in x direction.   (4)

(b) Using mid-point circle drawing algorithm find out the pixel positions lying in the first quadrant of the circle with centre at (0,0) and radius of 8 units.   (6)

9. (a) Describe Phong interpolation shading method for polygon rendering. Give any two advantages of this method.   (4)

   (b) Using Sutherland Hodgman Polygon Clipping Algorithm, clip the polygon ABC with coordinates A(100,150), B(200,250) and C(300,200) against the clipping window with coordinates P(150,150), Q(150,200), R(200,200) and S(200,150).   (6)

10. (a) A triangle is defined by vertices (2,0), (0,2), (−2,0). It is transformed by 2x2 transformation matrix

$$T = \begin{bmatrix} 6 & 4 \\ 2 & 4 \end{bmatrix}$$

Find the area of transformed triangle.   (4)

(b) Consider a line AB with position vectors of end point as [A] = [1 2] and [B] = [3 4]. The transformation matrix is given as $[T] = \begin{bmatrix} 2 & 4 \\ 6 & 2 \end{bmatrix}$.

Calculate the transformed line A'B'. Also prove that the midpoint of original line AB yield same results for the midpoint of transformed line A'B'.   (6)

11. (a) Consider a square ABCD with coordinates as A(0,0), B(0,4), C(4,4) and D(4,0). Let the centre of the square be at coordinate P(2,2). Apply 2-D transformation to reduce the square ABCD to half of its size, with centre fixed at point P.   (4)

(b) Perform a 3-point perspective projection onto the x=0 plane on a unit cube with centre of projections at $x_c = -10$, $y_c = -10$ and $z_c = -10$. Also, give the vanishing points. Consider the coordinates of the unit cube as follows :

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$$[X] = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

(6)

12. (a) Explain CMY color model in graphics system.

(4)

(b) What do you mean by hidden surfaces? Explain Z-Buffer algorithm for visible surface determination.

(6)

13. (a) What is Morphing? Morph a triangle into a square by equalizing the vertex count. (4)

(b) Consider two Bezier curve segments defined by control points $P_0(20,20)$, $P_1(40,50)$, $P_2(60,20)$ and $P_3(80,20)$. Another curve segment is defined by $Q_0(a,b)$, $Q_1(c,d)$, Q_2 and Q_3. Find the point Q_0 and Q_1 such that two curve join smoothly and 'C¹' continuity exists between them. (6)

14. (a) What is dithering? What are its advantages over halftoning? (4)

(b) Derive the basis matrix for Hermite curve. (6)

(1200)