



मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
प्रयागराज-211004 भारत

Motilal Nehru National Institute of Technology Allahabad
Prayagraj-211004 [India]

Computer Science and Engineering Department
Mid Semester (Even) Examination 2023-24

Programme Name: MCA

Semester: III

Course Code: CS33104

Course Name: Analysis of Algorithms

Student Reg. No.:

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Duration: 90 Minutes

Max. Marks: 25

Instructions: (Related to Questions)

1. Precise answer with proper justification will be considered to get complete marks.
2. Attempt all questions.

Marks

Q1 a Design an algorithm to rearrange elements of a given array of n real numbers so that all its negative elements precede all its positive elements without making use of an auxiliary array. Analyze the running time of your algorithm.

4

Q2 a Suppose we have a set $S = \{a_1, a_2, \dots, a_n\}$ of n proposed activities that wish to use a resource, such as a lecture hall, which can serve only one activity at a time. Each activity a_i has a start time s_i and a finish time f_i , where $0 \leq s_i \leq f_i \leq \infty$. If selected, activity a_i takes place during the half-open time interval $[s_i, f_i)$. Activities a_i and a_j are compatible if the intervals $[s_i, f_i)$ and $[s_j, f_j)$ do not overlap. That is, a_i and a_j are compatible if $s_i \geq f_j$ or $s_j \geq f_i$. In the activity-selection problem, we wish to select a maximum-size subset of mutually compatible activities.

5

Design an optimal algorithm for the activity selection problem and prove your method and determine its complexity.

Q3 a Given an array A , find the nonempty, contiguous subarray of A whose values have the largest sum and this contiguous subarray the maximum subarray. For example, in

the array of Figure, the maximum subarray of $A[1..16]$ is $A[8 \dots 11]$, with the sum 43.

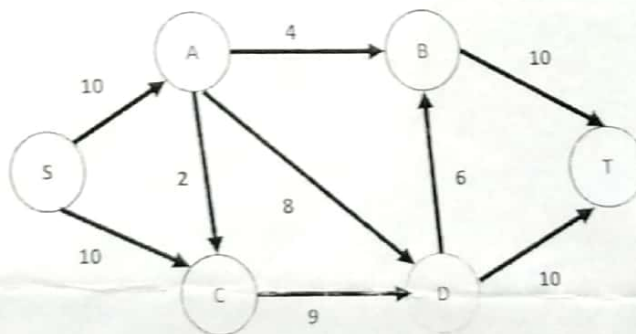
6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	13	-3	-25	20	-3	-16	-23	18	20	-7	12	-5	-22	15	-4	7

maximum subarray

Computing the cost of one subarray might take time proportional to the length of the subarray, when computing all n^2 subarray sums leads to brute-force solution takes $O(n^2)$. Propose a better solution that you can solve this problem in $O(n \log n)$ complexity.

Q4 ✓ Consider the following graph, $G=(V, E)$ such that $V \neq \emptyset$. Assume that 'S' is the source vertex. Determine the shortest path from source vertex to remaining vertices. Further, support your answer with the algorithm pseudo code with its time complexity.



5

Q5 ✓ a Determine the complexity of this recurrence relation $T(n)=T(n-1)+O(n)$ and prove it

2

b Dijkstra's algorithm doesn't work always. Justify the statement given supporting your answer with an example

2

c Justify under which instance when you apply quick sort, the array divides equally every time into half such that your time complexity will be $O(n \log n)$. Support your answer with an example.

1

$$T(n) = T(n-1) + O(n)$$

$$T(n+1) = T(n-2) + O(n) + O(n)$$

$$T(n-k) = T(n-k+1) + (k+1)n$$

$$n-k=0$$

$$n=k$$



Department of Computer Science & Engineering
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Prayagraj- 211004, UP, India

Mid Semester (odd) Examination 2023-2024

Programme Name: MCA	Semester: 3 rd
Course code: CS33102	Course Name: Database Management System
Registration No.	2 0 2 2 C A 0 3 0
Duration: 90 Minutes	Total marks 25

Instructions:

1. Attempt all the questions and mention the question number against each answer.

		Marks
Q.1	What is data? Explain the difference between data and information with the help of an example.	[1+2]
Q.2	a) Explain instance and schema in DBMS. Write four major disadvantages of a file system.	[2+2]
	b) Explain the primary key and the secondary key with the help of an example.	[2]
Q.3	What is deletion anomaly? Explain it with the help of an example. What kind of dependency creates the insertion anomaly?	[5]
Q.4	Suppose, R (P, Q, R, S, T, U, V, W, X, Y) is a relation and a set of its Functional Dependency is FD = {PQ → R, P → ST, Q → U, U → VW, and S → XY}, find the prime and non-prime attributes and determine whether the given R is in 3NF? If not convert it into 3 NF.	[5]
Q.5	Consider the relation R = {A, B, C, D, E} and the functional dependencies on R are as follows. A → BC CD → E B → D E → A Find the closure of A, B and D.	[3]
Q.6	What is E-R model? Write the objectives of the E-R model.	[1+2]

Motilal Nehru National Institute of Technology Allahabad
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Mid Semester Examination (2023-24)

Programme Name: M.C.A

Course Code: CS33101

Branch: N.A

Duration: 90 Minutes

Semester: III

Course Name: Operating Systems

Student Reg. No.:

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Max. Marks: 25

Instructions: (1) *All questions are compulsory.* (2) *Figures to the right indicate the full marks.*

✓ 1. What is an operating system and why do we need it? Describe the three main objectives of operating system. [4]

✓ 2. Consider the Four processes; all arrives at time zero, with total execution time of 10, 50, 45 and 50 units, respectively. Each process spends the first 20% of execution time doing I/O, the next 60% of time doing computation and the last 20% of the time doing I/O again. The operating system uses a shortest remaining time first algorithm (SRTF) and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its burst. Consider that ties are broken by giving priority to the process with the highest process id. Assume that all I/O operations can be overlapped as much as possible. For what percentage of time does the CPU remains idle? [4]

Handwritten calculation:
$$\begin{array}{r} 20 \times 45 \\ 100 \\ \hline 90 \\ 45 \\ \hline 135 \\ 27 \end{array}$$

✓ 3. Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the question, use nonpreemptive scheduling, and base all decisions on the information you have at the time the decision must be made:

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P ₁	0.0	8
P ₂	0.4	4
P ₃	1.0	1

✓ a. What is the average turnaround time for these processes with the FCFS scheduling algorithm?

- ✓ b. What is the average turnaround time for these processes with the SJF scheduling algorithm?
- ✓ c. The SJF algorithm is supposed to improve performance, but notice that we chose to run process P_1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that process P_1 and P_2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future – knowledge scheduling - [6]
- ✓ 4. Define the different states of a process. with diagram. Explain the need of process suspension. [4]
- ✓ 5. What is System Call? why do OS needs system Call? Why do kernel Processes not need to make System Calls? [4]
- ✓ 6. What is a Device Driver and what are its function? [3]



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Motilal Nehru National Institute of Technology Allahabad
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Computer Science and Engineering Department

Mid Semester (Odd) Examination (2023-24)

Programme Name: MCA	Semester: III
Course Code: (CS33105)	Course Name: Object-Based Modeling
Branch: CSED	Student Reg. No.: 2022CA030
Duration: 1 Hours 30 Minutes	Max. Marks: 25
Instructions: Attempt all questions and make suitable assumption whenever required. Draw neat diagrams whenever required.	

Q. No	Question Description	CO
1	(a) Explain briefly why <u>object-oriented modeling</u> is better than <u>procedural modeling</u> with the notion of ADTs and encapsulation. (3M)	CO1
	(b) Define <u>polymorphism</u> . Enlist and explain different types of polymorphisms with suitable examples. (3M)	CO1
2	(a) Our institute has decided to have an <u>online college magazine system</u> . Some suggested classes are <u>Articles</u> , <u>Editors</u> , <u>Writers</u> , <u>Readers</u> , <u>Moderators</u> , <u>Register</u> and <u>Login</u> , etc. You can also add some other classes to this system. Write <u>constructor definitions</u> for each class object. You should also write different <u>attributes</u> for each class with different access levels. (4M)	CO1
	(b) Define <u>Interface</u> along with its importance in object-based modeling. Suggest two interfaces for any class given in Q. 2(a) and write their implementation. (3M)	CO1
3	(a) According to Craig Larman, define the term <u>Unified Process</u> . Explain different phases of a unified process and draw a neat sketch for each. (3M)	CO2
	(b) MNNIT researchers have decided to provide an innovative and automated AI-based system for <u>traffic management</u> in Allahabad City. The inception phase has suggested <u>Driver</u> , <u>RTO Server</u> , and <u>Traffic Police</u> as the main actors for this system. Considering the actors mentioned above, enlist the different classes required for the elaboration phase. Draw the <u>UML class diagram</u> for the classes that you have chosen. (4M)	CO2
	(c) Define <u>swimlane</u> . Enlist different types of swimlanes used in UML activity diagram. Draw the <u>UML activity diagram</u> for the traffic management system discussed in Q. 3(b). Suggest the required hardware and draw the <u>UML deployment diagram</u> for the above-mentioned system. (5M)	CO2

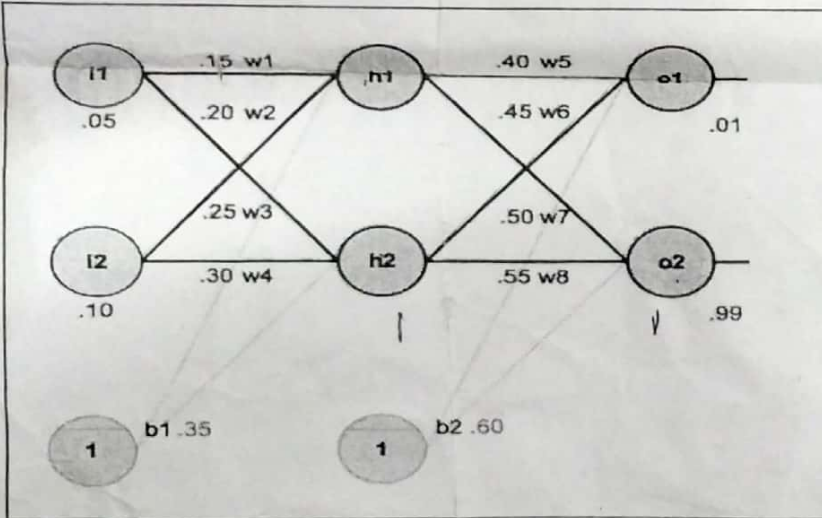


Department of Computer Science & Engineering
Mid Semester Examination, Session 2023-24 (Odd)

Programme:	M.C.A	Branch:	M.C.A	Semester:	3 rd Sem
Course Name:	Soft Computing				
Course Code:	<CS33103>				
Time:	90 Minutes	Max. Marks:	25	Registration No.:	2 0 2 2 C A 0 1 4

Instructions (related to question paper):

1. All questions are compulsory
2. Attempt the questions strictly in sequential order.
3. Calculator is allowed
4. Write assumptions correctly (in case you feel data is missing)

		Marks	Corresponding course outcome with weightage (if any)
Q1	Write the answer of the following question		
a	<p>Take a neural network given below with two inputs, two hidden neurons, two output neurons. Additionally, the hidden and output neurons will include a bias.</p>  <p>For given inputs 0.05 and 0.10, we want the Neural Network to output 0.01 and 0.99. Assume sigmoidal function (logistic function) in hidden layer and output neurons.</p> <p>Calculate the following in forward propagation:</p> <ol style="list-style-type: none"> Calculate the total net input for h_1 and h_2. Calculate the output of h_1 and h_2. Calculate the total predicted output for o_1 Calculate the total predicted output for o_2 <p>Take error function $E = \sum \frac{1}{2} (\text{target} - \text{predicted})^2$</p> <p>Find the updated weights between <u>hidden layer and output layer</u> after backpropagation using gradient descent algorithm with learning rate $\alpha = 0.5$.</p>	(8)	CO-2

Q2	<p>Write the answer of the following question</p>		
	<p>You are training a machine learning model with three weights w_1, w_2, and w_3 parameters using the RMSProp optimization algorithm. The loss function you are minimizing is defined in 3D space as follows:</p> $L(w_1, w_2, w_3) = 2w_1^2 + 3w_2^2 + w_3^2 + 7$ <p>You start with an initial learning rate (α) of 0.1, a decay rate (β) of 0.9, and initial squared gradient values for each weight parameter ($S_{w_i} = 0$). Perform one iteration of the RMSProp algorithm to update the weight parameters w_1, w_2, w_3. The gradients of the loss with respect to w_1, w_2, w_3 at this iteration are 1.5, -2.0 and 3.0, respectively. Calculate the updated values of w_1, w_2, w_3 after this iteration using the RMSProp algorithm.</p>	[6]	CO-1
Q3	<p>Write the answer of the following question</p>		
a	<p>Consider two fuzzy sets, A and B, defined over the universe of discourse X, with their respective membership functions as follows:</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>• Membership function for set A: $\mu_A(x) =$</p> $\begin{cases} 1 & \text{if } x \leq 4 \\ (6-x)/2 & \text{if } 4 < x \leq 6 \\ 0 & \text{if } x > 6 \end{cases}$ <p>• Membership function for set B: $\mu_B(x) =$</p> $\begin{cases} 0 & \text{if } x \leq 3 \\ (x-3)/2 & \text{if } 3 < x \leq 5 \\ 1 & \text{if } x > 5 \end{cases}$ </div> <p>a) Perform the intersection operation between fuzzy sets A and B, and calculate its membership function.</p> <p>b) Perform the union operation between fuzzy sets A and B, and calculate its membership function.</p> <p>c) Determine the complement of set A, and calculate its membership function.</p>	(6)	CO-3
	<p>Write the answer of the following question</p>		
Q4	<p>Explain the role of activation functions in artificial neural networks. Provide an overview of commonly used activation functions and discuss their advantages, disadvantages, and typical use cases.</p>	(5)	CO-2

$w_1 = -2x$

---ALL THE BEST---