

Indian Institute of Technology, Madras - BS in Data Science and Applications

Notations :

- 1.Options shown in green color and with ✓ icon are correct.
- 2.Options shown in red color and with ✗ icon are incorrect.

Question Paper Name :

IIT M FOUNDATION AN4 EXAM QPF4 16
JULY 2023

Subject Name :

2023 July: IIT M FOUNDATION AN4 EXAM
QPF4

Creation Date :

2023-07-10 18:54:05

Duration :

240

Total Marks :

705

Display Marks:

Yes

Share Answer Key With Delivery Engine :

Yes

Actual Answer Key :

Yes

Calculator :

Scientific

Magnifying Glass Required? :

No

Ruler Required? :

No

Eraser Required? :

No

Scratch Pad Required? :

No

Rough Sketch/Notepad Required? :

No

Protractor Required? :

No

Show Watermark on Console? :

Yes

Highlighter :

No

Auto Save on Console?

Yes

Change Font Color :

No

Question Label : Short Answer Question

Consider the E-R diagram in Figure 5.

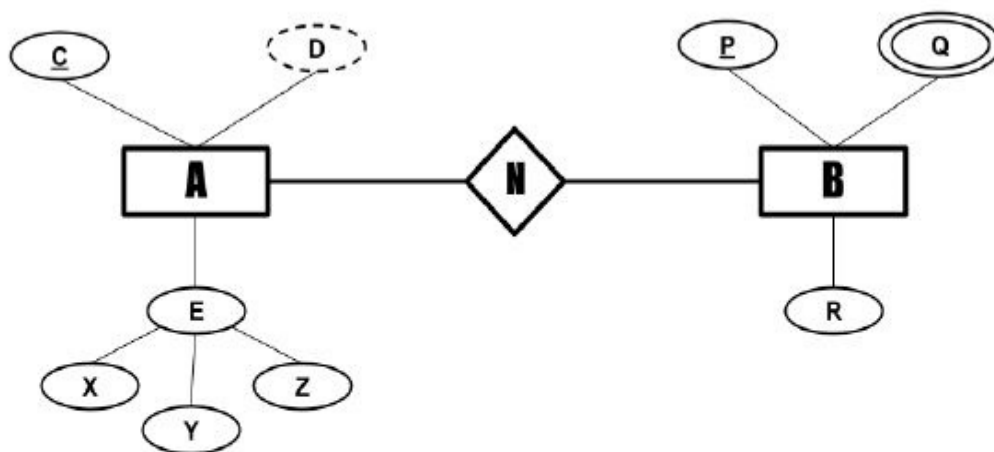


Figure 5: ERD

Consider the following assumptions :

a : denotes the number of attributes in entity set A

b : denotes the minimum number of table(s) required to represent this E-R diagram?

What is the value of $a + b$?

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

8

PDSA

Section Id :	64065339060
Section Number :	10
Section type :	Online
Mandatory or Optional :	Mandatory

Number of Questions :	17
Number of Questions to be attempted :	17
Section Marks :	50
Display Number Panel :	Yes
Group All Questions :	No
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	64065382516
Question Shuffling Allowed :	No
Is Section Default? :	null

Question Number : 199 Question Id : 640653577643 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 0

Question Label : Multiple Choice Question

THIS IS QUESTION PAPER FOR THE SUBJECT "DIPLOMA LEVEL : PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON (COMPUTER BASED EXAM)"

ARE YOU SURE YOU HAVE TO WRITE EXAM FOR THIS SUBJECT?

CROSS CHECK YOUR HALL TICKET TO CONFIRM THE SUBJECTS TO BE WRITTEN.

(IF IT IS NOT THE CORRECT SUBJECT, PLS CHECK THE SECTION AT THE TOP FOR THE SUBJECTS REGISTERED BY YOU)

Options :

6406531928997. ✓ YES

6406531928998. ✗ NO

Sub-Section Number :	2
Sub-Section Id :	64065382517

Question Shuffling Allowed :

Yes

Is Section Default? :

null

Question Number : 200 Question Id : 640653577644 Question Type : MSQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Consider the following functions:

- $f(n) = 102n^4 + 26n^3$
- $g(n) = 103n^3 + 20n^2$
- $h(n) = 110n^3 \log n + 36n^2$

Which of the following is/are true?

Options :

6406531928999. ✖ $f(n) = O(g(n))$

6406531929000. ✔ $g(n) = O(h(n))$

6406531929001. ✖ $f(n) = O(h(n))$

6406531929002. ✖ $h(n) = O(g(n))$

6406531929003. ✔ $h(n) = O(f(n))$

Question Number : 201 Question Id : 640653577649 Question Type : MSQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Unimodal List: A list $L[0 \dots n-1]$ of distinct elements is *unimodal* if it consists of an increasing sequence followed by a decreasing sequence. More precisely, there is an index $m \in 1, 2, \dots, n-2$ such that:

- $L[i] < L[i + 1]$ for all $0 \leq i < m$, and
- $L[i] > L[i + 1]$ for all $m \leq i < n-1$.

Suppose the middle element of a unimodal list is x , and the elements to the left and right of x are p and q , respectively. Which of the following facts must be used to find the maximum element in $O(\log n)$ time?

Options :

6406531929020. ✓ If $p < x > q$, then x is the maximum in the list.

6406531929021. ✗ If $p < x < q$, then the maximum element is in the left half of the list.

6406531929022. ✓ If $p < x < q$, then the maximum element is in the right half of the list.

6406531929023. ✓ If $p > x > q$, then the maximum element is in the left half of the list.

6406531929024. ✗ If $p > x > q$, then the maximum element is in the right half of the list.

Question Number : 202 Question Id : 640653577652 Question Type : MSQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

```
1 class Node:
2     def __init__(self, data):
3         self.data = data
4         self.next = None
```

Consider an implementation of a **singly linked list**, where each node is created using the given class `Node`. Suppose it has only a `head` pointer that points to the first node of the linked list.

Which of the following statement(s) is/are **true**? Assume we are using the most efficient algorithms.

Options :

6406531929029. ✓ Finding an item in a sorted linked list of n items takes $O(n)$ time.

6406531929030. ✗ Finding an item in a sorted linked list of n items takes $O(\log n)$ time

6406531929031. ✓ Adding a new item to the end of the linked list of n items takes $O(n)$ time.

6406531929032. ✗ Removing an item from the end of the linked list of n items takes $O(1)$ time.

6406531929033. ✓ Removing duplicate items from the sorted linked list of n items takes $O(n)$ time.

Question Number : 203 Question Id : 640653577654 Question Type : MSQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Linear probing is an open addressing scheme in computer programming for resolving hash collisions in hash tables. Linear probing takes the original hash index and increments the value by 1 until a free slot is found.

Consider the given hash table with hash function $h(\text{key}) = \text{key} \bmod 5$ which uses linear probing for solving collisions.

Index	Key
0	45
1	51
2	60
3	18
4	34

Which among the following options corresponds to possible orders of insertion of values in the hash table?

Options :

6406531929038. ✓ 51, 18, 45, 60, 34

6406531929039. ✗ 34, 45, 18, 60, 51

6406531929040. ✗ 18, 45, 34, 60, 51

6406531929041. ✓ 34, 45, 18, 51, 60

6406531929042. ✓ 18, 34, 51, 45, 60

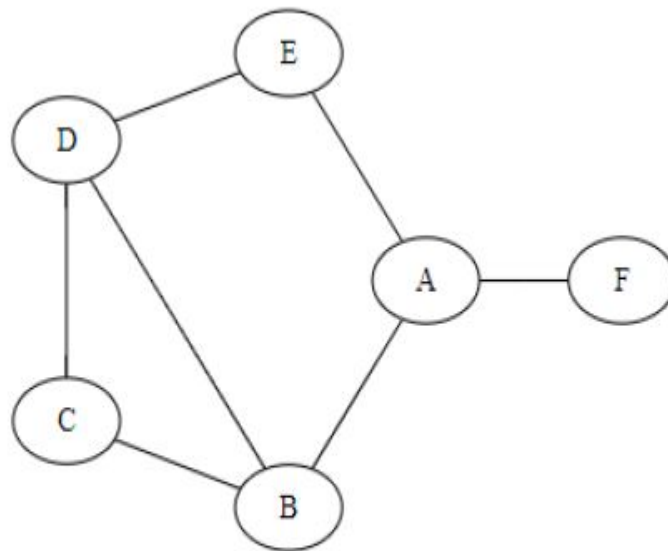
Question Number : 204 Question Id : 640653577657 Question Type : MSQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Consider the following graph:



If we run breadth first search(BFS) on the given graph starting at any vertex, which of the following is/are possible order of visiting the nodes?

Note : When a node has multiple neighbours, BFS would visit alphabetically.

Options :

6406531929049. ✖ A B E C D F

6406531929050. ✔ B A C D E F

6406531929051. ✔ C B D A E F

6406531929052. ✔ D B C E A F

6406531929053. ✖ E A B D F C

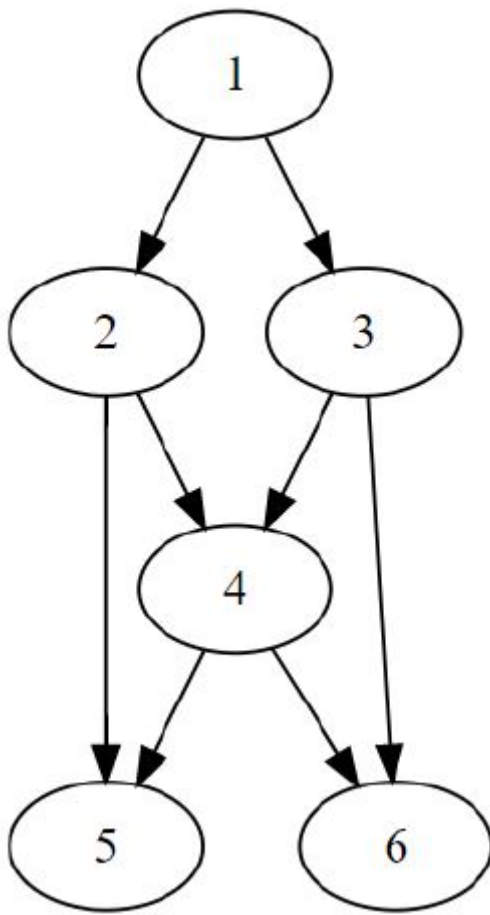
Question Number : 205 Question Id : 640653577659 Question Type : MSQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3 Max. Selectable Options : 0

Question Label : Multiple Select Question

Consider the following DAG



Which of the following is/are **not a valid** topological orderings for the given DAG?

Options :

6406531929058. ✖ 1 2 3 4 5 6

6406531929059. ✔ 1 3 4 2 5 6

6406531929060. ✖ 1 3 2 4 5 6

6406531929061. ✔ 1 3 2 5 4 6

6406531929062. ✔ 1 2 4 3 5 6

Sub-Section Number :

3

Sub-Section Id :

64065382518

Question Shuffling Allowed :

Yes

Is Section Default? :

null

Question Number : 206 Question Id : 640653577645 Question Type : MCQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

```
1 def fun(n):  
2     count = 0  
3     for i in range(n):  
4         j = 1  
5         while j < n:  
6             count += 1  
7             j *= 2  
8     return count
```

What is the time complexity of the function `fun` given above?

Options :

6406531929004. ✖ $O(1)$

6406531929005. ✖ $O(n)$

6406531929006. ✔ $O(n \log n)$

6406531929007. ✖ $O(n^2)$

Question Number : 207 Question Id : 640653577646 Question Type : MCQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

We have an input list of three-dimensional points [(7, 8, 1), (3, 7, 5), (6, 8, 1), (6, 7, 5), (0, 5, 2), (9, 9, 0)]. We sort these in ascending order by the third coordinate. Which of the following corresponds to a stable sort of this input?

Options :

6406531929008. ✖ [(9, 9, 0), (6, 8, 1), (7, 8, 1), (0, 5, 2), (6, 7, 5), (3, 7, 5)]

6406531929009. ✔ [(9, 9, 0), (7, 8, 1), (6, 8, 1), (0, 5, 2), (3, 7, 5), (6, 7, 5)]

6406531929010. ✖ [(9, 9, 0), (6, 8, 1), (7, 8, 1), (0, 5, 2), (3, 7, 5), (6, 7, 5)]

6406531929011. ✖ [(9, 9, 0), (7, 8, 1), (6, 8, 1), (0, 5, 2), (6, 7, 5), (3, 7, 5)]

Question Number : 208 Question Id : 640653577647 Question Type : MCQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Consider the following Implementation for insertion sort

```
1 def insertionsort(L):
2     n = len(L)
3     if n < 1:
4         return(L)
5     for i in range(n):
6         j = i
7         while(j > 0 and L[j] < L[j-1]):
8             (L[j],L[j-1]) = (L[j-1],L[j])
9             j = j-1
10    return(L)
```

Suppose L is a list of distinct integer elements. Let x , y and z be the largest, second largest, and third largest elements in the list L. Suppose z appears before x in the list. Which of the following is true, with respect to the implementation above?

Options :

6406531929012. ✖ x and z are always compared in a run of insertion sort, regardless of the position of y .

6406531929013. ✖ x and z are compared in a run of insertion sort if and only if y appears before z in the list L .

6406531929014. ✔ x and z are compared in a run of insertion sort if and only if y appears after x in the list L .

6406531929015. ✖ x and z are compared in a run of insertion sort if and only if y appears after z but before x in the list L .

Question Number : 209 Question Id : 640653577648 Question Type : MCQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

3-way-Merge Sort: Suppose that instead of dividing the input list L in half at each step of Merge Sort, you divide L into three equal parts, sort each parts, and finally combine all of them using an efficient three-way merge (merge three sorted lists instead of two).

What is the overall asymptotic running time of the **3-way-Merge Sort** algorithm?

Options :

6406531929016. ✖ $O(n^2)$

6406531929017. ✖ $O(n^2 \log n)$

6406531929018. ✖ $O(n(\log n)^2)$

6406531929019. ✔ $O(n \log n)$

Question Number : 210 Question Id : 640653577651 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Which of the following statements is **not true** about Quicksort?

Options :

6406531929026. ✖ For every fixed strategy to choose a pivot for Quicksort, we can construct a worst-case input that requires time $O(n^2)$.

6406531929027. ✖ If we could find the median in time $O(n)$, Quicksort would have worst-case complexity $O(n \log n)$

6406531929028. ✔ If we randomly choose a pivot element each time, Quicksort will always terminate in time $O(n \log n)$.

Question Number : 211 Question Id : 640653577653 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Assume `s` is a stack and `q` is a queue. `Push` and `Pop` operations are usual stack operations, `Enqueue` and `Dequeue` are usual queue operations, and `isEmpty()` is a method that returns true if either the stack or the queue is empty. Assume that stack `s` and Queue `q` are empty initially.

```
1 for i in range(5):
2     s.Push(i)
3     q.Enqueue(i)
4
5 while not q.isEmpty():
6     s.Push(q.Dequeue())
7
8 while not s.isEmpty():
9     q.Enqueue(s.Pop())
10
11 while not q.isEmpty():
12     print (q.Dequeue(),end = " ")
```

What is the output of the given code snippet?

Options :

6406531929034. ✖ 0 1 2 3 4 4 3 2 1 0

6406531929035. ✖ 4 3 2 1 0 0 1 2 3 4

6406531929036. ✔ 4 3 2 1 0 4 3 2 1 0

6406531929037. ✖ 0 1 2 3 4 0 1 2 3 4

Question Number : 212 Question Id : 640653577656 Question Type : MCQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Consider a graph G . Let T be a *BFS* tree of G with root r . Let $d(r, v)$ denote the length of the shortest path between the nodes r and v . If vertex x is visited before vertex y in the breadth first search traversal, which of the following statements is true?

Options :

6406531929044. ✖ $d(r, x) > d(r, y)$

6406531929045. ✖ $d(r, x) = d(r, y)$

6406531929046. ✖ $d(r, x) < d(r, y)$

6406531929047. ✔ $d(r, x) \leq d(r, y)$

6406531929048. ✖ $d(r, x) \geq d(r, y)$

Question Number : 213 Question Id : 640653577658 Question Type : MCQ Is Question

Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 3

Question Label : Multiple Choice Question

Consider the following statements:

1. While creating a DFS tree for a directed graph, among non-tree edges, only back edges correspond to cycles.
2. The depth of any DFS tree rooted at a vertex is at least as much as the depth of any BFS tree rooted at the same vertex.

Choose the correct option.

Options :

6406531929054. ✖ Only statement 1 is true

6406531929055. ✖ Only statement 2 is true

6406531929056. ✔ Both statements 1 and 2 are true

6406531929057. ✖ Both statements 1 and 2 are false

Sub-Section Number : 4
Sub-Section Id : 64065382519
Question Shuffling Allowed : Yes
Is Section Default? : null

Question Number : 214 Question Id : 640653577650 Question Type : SA Calculator : None
Response Time : N.A Think Time : N.A Minimum Instruction Time : 0
Correct Marks : 4

Question Label : Short Answer Question

Consider the given list $L = [9, 14, 17, 37, 57, 62, 82, 92, 97]$. After applying the Quick-sort partition algorithm once, the list is modified to : $[14, 9, 17, 37, 62, 57, 82, 97, 92]$.

The number of elements that could have been chosen as a pivot in the first round is ____ ?

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes

Answers Type : Equal
Text Areas : PlainText

Possible Answers :

3

Question Number : 215 Question Id : 640653577655 Question Type : SA Calculator : None
Response Time : N.A Think Time : N.A Minimum Instruction Time : 0
Correct Marks : 4

Question Label : Short Answer Question

A connected, simple, undirected graph G has 1225 edges. The minimum number of vertices in G is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

50

AppDev1

Section Id :	64065339061
Section Number :	11
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	16
Number of Questions to be attempted :	16
Section Marks :	50
Display Number Panel :	Yes
Group All Questions :	No
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	64065382520
Question Shuffling Allowed :	No
Is Section Default? :	null

Question Number : 216 Question Id : 640653577660 Question Type : MCQ Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0

Correct Marks : 0

Question Label : Multiple Choice Question

THIS IS QUESTION PAPER FOR THE SUBJECT "DIPLOMA LEVEL : MODERN APPLICATION