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Question 1

Not yet
answered

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3.00

If in a binary tree a node has two internal children, then its inorder predecessor internal node has

- ☐ a. depth 1
- ☒ b. no internal right child
- ☐ c. two internal children
- ☐ d. no internal left child

[Clear my choice](#)

Question 2

Not yet
answered

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3.00

The running time of RadixSort to sort n integers, each represented by D digits in radix base B is Θ (_____)

- ☒ a. $D(B + n)$
- ☐ b. $B^D n$
- ☐ c. $n(B + D)$
- ☐ d. $B(D + n)$

[Clear my choice](#)

Question 3

Not yet
answered

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4.00

An undirected graph G is BIPARTITE if its vertices can be partitioned into two sets X and Y such that every edge in G has one end vertex in X and the other in Y . Based on this definition we can conclude that an undirected graph G is bipartite if and only if

- ☒ a. G does not have any cycle of length 3 or 5 (length of a cycle is the number of edges on it)
- ☐ b. G does not have any cycle of length 3 or more (length of a cycle is the number of edges on it)
- ☐ c. in BFS(G) there is no edge between two vertices with the same BFS-depth
- ☐ d. in DFS(G) there is no edge between two vertices with the same DFS-depth

[Clear my choice](#)

Question 4

Not yet
answered

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3.00

The expected memory space used in a randomized Skip List of n elements is Θ (_____)

- ☐ a. n^2
- ☐ b. n
- ☒ c. $n \log n$
- ☐ d. $\log n$

[Clear my choice](#)

Question 5

Not yet
answered

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3.00

In hashing with open addressing, if the hash table has size N and contains n elements, then the expected number of collisions for any randomly selected element is

- ☒ a. less than $\frac{N}{N-n}$
- ☐ b. less than $\frac{n}{2}$
- ☐ c. less than $\frac{n}{N-1}$
- ☐ d. less than $\frac{n}{N}$

[Clear my choice](#)

Question 6

Not yet
answered

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2.00

A simple undirected graph G is COMPLETE if every pair of distinct vertices in G are adjacent. Suppose G is such a graph with n vertices. Then

- ☐ a. In BFS(G) height of the BFS-tree is $O(1)$ and there are $O(n)$ non-tree edges
- ☐ b. In DFS(G) there are $(n - 1)(n - 2)/2$ back-edges,, and every node of the DFS-tree has at most one child
- ☒ c. In BFS(G) the root of the BFS-tree has $n - 1$ children, and there are $\Theta(n^2)$ BFS back-edges
- ☐ d. In DFS(G) every node in the DFS-tree has at most $n - 1$ children, there are $\Theta(n)$ DFS back-edges and $\Theta(n^2)$ cross-edges

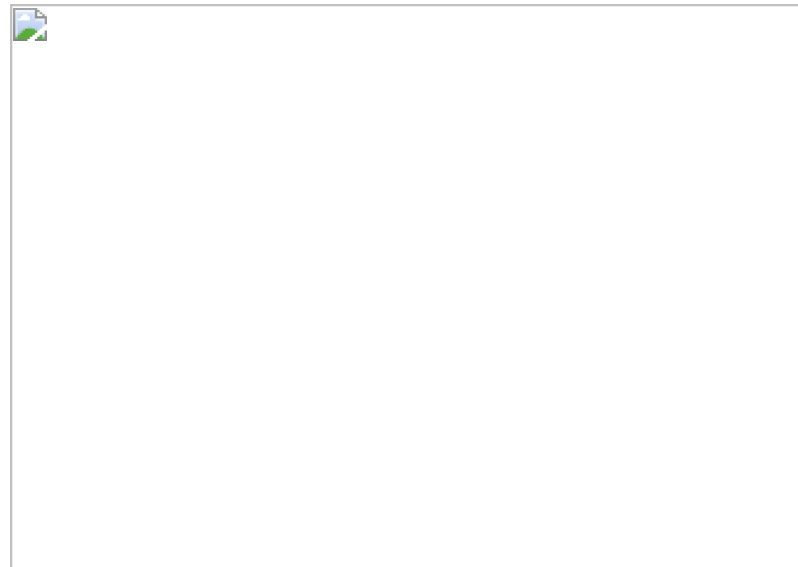
[Clear my choice](#)

Question 7

Not yet
answered

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4.00

Suppose we apply Prim's Minimum Spanning Tree (MST) algorithm to the weighted graph G shown below starting from vertex a . Let T denote the resulting MST.



- ☐ a. There are 2 edges on the unique simple path in T between vertices f and c
- ☐ b. Edge (c, g) is added to T before edge (e, i)
- ☐ c. There are 6 edges on the unique simple path in T between vertices d and j
- ☒ d. Edge (g, h) is the 5th edge added to T

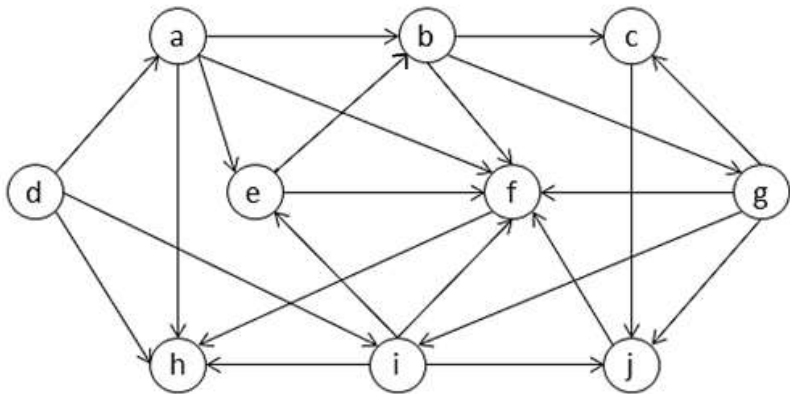
[Clear my choice](#)

Question 8

Not yet
answered

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4.00

Is the following digraph G a DAG? Answer: _____, because _____



- ☐ a. Yes, because G is a simple digraph
- ☒ b. No, because DFS(G) has a back-edge
- ☐ c. No, because DFS(G) has at least one cross-edge or forward-edge
- ☐ d. Yes, because G admits a topological ordering

[Clear my choice](#)

Question 9

Not yet
answered

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5.00

We want to insert the keys 35, 55, 15, 25, in that order, into the Splay Tree T shown below. Which of the following is the resulting Splay Tree?

Which of the following is the resulting Splay Tree?

- ☒ a.
- ☐ b.
- ☐ c.

[Clear my choice](#)

Question 10Not yet
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4.00

Suppose T is an initially empty search tree and we insert the sequence of n keys $1, 2, 3, \dots, n$, in increasing order, into T . Then the height of the resulting search tree T is

- ☐ a. $\Theta(n)$ if T is a Splay tree, but is $\Theta(\log n)$ if T is an AVL tree
- ☒ b. $\Theta(\log n)$ if T is a Splay tree, but is $\Theta(n)$ if T is a BST
- ☐ c. $\Theta(\log n)$, regardless of whether T is a Splay tree or an AVL tree
- ☐ d. $\Theta(n)$, regardless of whether T is a BST or a Splay tree or an AVL tree

[Clear my choice](#)

Question 11Not yet
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4.00

An array $A[0..n-1]$ of n arbitrary and unsorted real numbers is given. We want to determine whether more than a third of the array elements have the same value. Worst-case time complexity of the most efficient algorithm that solves this problem is $\Theta(\text{_____})$.

- ☐ a. $(n + \log n) \log n$
- ☐ b. $n/3 + n \log n$
- ☐ c. $\log n + n + n \log(n/3)$
- ☒ d. $(n\sqrt{n} + \log n) / (\sqrt{n/3} + 3 \log n)$

[Clear my choice](#)

Question 12Not yet
answeredMarked out of
4.00

Let G be a connected weighted graph. Suppose T_1 is a Shortest Path Tree (SPT) of G rooted at some source vertex s , and T_2 is a Minimum Spanning Tree (MST) of G . Now suppose we add a positive constant w to the weight of each edge of G and call the resulting weighted graph G' . Then, as a set of edges in G' ,

- ☐ a. T_1 is an SPT of G' , but T_2 may not be an MST of G'
- ☐ b. T_1 may not be an SPT of G' , and T_2 may not be an MST of G'
- ☐ c. T_1 is an SPT of G' , and T_2 is an MST of G'
- ☒ d. T_1 may not be an SPT of G' , but T_2 is an MST of G'

[Clear my choice](#)

Question 13

Not yet
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3.00

Suppose A is an $n \times n$ matrix of arbitrary positive integers. We want to find the largest integer, if any, that appears at least once in each row of A . For example, the answer would be 4 for the following

matrix: $A = \begin{bmatrix} 4 & 1 & 2 & 8 \\ 2 & 5 & 4 & 1 \\ 3 & 4 & 6 & 3 \\ 4 & 7 & 4 & 2 \end{bmatrix}.$

This problem can be solved most efficiently in Θ (_____) time in the worst-case.

- ☒ a. n^3
- ☐ b. $n \log n$
- ☐ c. n
- ☐ d. $n^2 \log n$

[Clear my choice](#)

Question 14

Not yet
answered

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4.00

Consider the AVL tree T shown below where keys are shown inside the nodes, but the node heights are not shown. Now suppose we delete 51 according to the dictionary delete algorithm on AVL trees described in the course (i.e., lecture slide video recordings)

- ☐ a. Left subtree of the root remains unchanged, depth of 85 remains 3, and 93 becomes right child of 85
- ☒ b. 63 becomes the root, and 81 becomes right child of 79
- ☐ c. Left subtree of the root remains unchanged, and 71 becomes parent of 79
- ☐ d. 63 becomes the root, 71 and 81 become siblings, and 85 remains left child of 93

[Clear my choice](#)

Question 15

Not yet
answered

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4.00

Let T be an AVL tree with n elements. Direct each edge of T from parent to child to form a directed graph G with n vertices and $n-1$ directed edges. Then the transitive closure of G has Θ (_____) edges.

- ☐ a. n^2
- ☒ b. $n \log n$
- ☐ c. n
- ☐ d. $\log n$

[Clear my choice](#)

Question 16

Not yet
answered

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4.00

The time complexity of the following recursive algorithm is Θ (_____)

```
public static double mystery( double x , int n) {  
    if (n <= 0) return 4*x+1 ;  
    for ( int i = 0 , double prod = 1.0 ; i < n ; i++ ) prod *= x + 5*i ;  
    return mystery(prod+x , 3*n/4) + mystery(prod+x+2 , n/4) + x/2 - 3 ;  
}
```

- ☐ a. 2^n
- ☒ b. $n \log n$
- ☐ c. $n \log^2 n$
- ☐ d. n^2

[Clear my choice](#)

Question 17

Not yet
answered

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3.00

Building a min-heap from an array of n items requires _____ worst-case time.

- ☐ a. $\Theta(n \log n)$, since it requires that much time to HeapSort in the worst-case
- ☐ b. $\Omega(n \log n)$, based on the universal lower bound on comparison based sorting
- ☒ c. $\Theta(n)$, using upHeaps in preorder
- ☐ d. $\Theta(n)$, using downHeaps in postorder
- ☐ e. $\Theta(n)$, only if the array is already sorted

[Clear my choice](#)

Question 18

Not yet
answered

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3.00

The algorithm design technique used in Floyd-Warshall's algorithm is

- ☐ a. repeated doubling
- ☐ b. divide and conquer
- ☐ c. greedy method
- ☒ d. dynamic programming

[Clear my choice](#)

Question 19

Not yet
answered

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4.00

The maximum number of edges in any simple directed graph with n vertices that is NOT strongly connected is exactly (not just asymptotically) = _____.

- ☐ a. $(n - 1)^2$
- ☐ b. $n(n - 1)/2$
- ☒ c. $n(n - 1)$
- ☐ d. $(n/2)^2$

[Clear my choice](#)

Question 20

Not yet
answered

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2.00

The maximum degree of any vertex in a simple undirected graph with n vertices is

- ☐ a. $n + 1$
- ☐ b. $2n - 1$
- ☒ c. $n - 1$
- ☐ d. n

[Clear my choice](#)

Question 21

Not yet
answered

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2.00

The auxiliary data structure used in BFS(G) is

- ☒ a. queue
- ☐ b. stack
- ☐ c. none of these
- ☐ d. AVL tree (for efficiency)

[Clear my choice](#)

Question 22

Not yet
answered

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3.00

The time complexity of an efficient algorithm to generate the connected components of an undirected graph G with n vertices and m edges, represented by its adjacency list structure is Θ (_____)

- ☐ a. $n(n + m)$
- ☒ b. $n + m$
- ☐ c. $n * m$
- ☐ d. n^2

[Clear my choice](#)

Question 23

Not yet
answered

Marked out of
4.00

The link structure of a binary tree can be uniquely determined by its

- ☐ a. levelorder and inorder node sequences
- ☐ b. preorder and postorder node sequences
- ☒ c. inorder and preorder node sequences
- ☐ d. postorder and levelorder node sequences

[Clear my choice](#)

Question 24

Not yet
answered

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3.00

We have two divide-&-conquer algorithms, let's call them A and B, where A calls B.

Their time complexities, $T_A(n)$ and $T_B(n)$, are expressed by the following recurrence relations

$$T_A(n) = 4T_A(n/2) + T_B(n) + \Theta(n)$$

$$T_B(n) = 6T_B(n/3) + \Theta(n^2 \log n) .$$

Then

- ☐ a. $T_A(n) = \Theta(n^2 \log^3 n)$
- ☐ b. $T_B(n) = \Theta(n^2 \log^2 n)$
- ☐ c. $T_A(n) = \Theta(n^2 \log^2 n)$
- ☒ d. $T_A(n) = \Theta(n^2 \log n)$

[Clear my choice](#)

Question 25

Not yet
answered

Marked out of
3.00

In an undirected graph with n vertices and m edges, the sum of the degrees of all n vertices is

- ☒ a. $2m$
- ☐ b. $(m^2)/2$
- ☐ c. $2n$
- ☐ d. $(2n - 1)/2$

[Clear my choice](#)

Question 26

Not yet
answered

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3.00

Suppose S is a sequence of n numbers, each equal to 0 or 1. The **worst-case** time complexity to sort S by MergeSort is $\Theta(T_1(n))$, and by randomized QuickSort with (L, E, G) tri-partitioning is $\Theta(T_2(n))$, where

- ☐ a. $T_1(n) = n \log n, T_2(n) = n^2$
- ☒ b. $T_1(n) = n \log n, T_2(n) = n$
- ☐ c. $T_1(n) = n, T_2(n) = n \log n$
- ☐ d. $T_1(n) = n, T_2(n) = n^2$

[Clear my choice](#)

Question 27

Not yet
answered

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4.00

Let $G = (V, E)$ be a simple weighted digraph with n vertices and m edges, and non-negative edge weights. Let $s \in V$ be a selected source. We want to rank the vertices from 1 to n based on how close they are to the source vertex, where closeness of a vertex is measured in terms of its shortest path distance from the source. So, vertex s has rank 1. The problem is to find the rank k vertex for a given integer $k \in [1, n]$. This problem can be solved efficiently by

- ☐ a. doing a BFS and stopping at level k
- ☐ b. doing k Bellman-Ford iterations
- ☒ c. restricting Dijkstra's algorithm to k iterations of its main loop
- ☐ d. doing k iterations of Floyd-Warshall using the weighted adjacency matrix instead

[Clear my choice](#)

Question 28Not yet
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3.00

The fewest possible number of nodes in an AVL tree of height h is Θ (_____)

- ☐ a. $h \log h$
- ☐ b. $2^{h/2}$
- ☒ c. $((1 + \sqrt{5})/2)^h$
- ☐ d. 2^h

[Clear my choice](#)

Question 29Not yet
answeredMarked out of
2.00

Linear probing is equivalent to double hashing with secondary hash function $d(k) =$ _____ .

- ☐ a. $(7 - (k \bmod 7))$
- ☐ b. $(q - (k \bmod q))$ where q is a prime number
- ☐ c. $(k \bmod N)$ where N is the hash table size
- ☒ d. 1

[Clear my choice](#)

Question 30Not yet
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3.00

Consider the set of n distinct positive integers $A = \{1, 2, 3, \dots, n\}$. Give a permuted sequence S of A so that MergeSort(S) and HeapSort(S) would both require $\Theta(n \log n)$ time to sort S in increasing order, but InsertionSort(S) would only need $\Theta(n)$ time to sort S .

- ☐ a. $S = [1, 2, 3, n, n-1, n-2, n-3, \dots, 4]$ (first 3 in increasing order, last $n-3$ in decreasing order)
- ☐ b. $S =$ odd integers in A in increasing order followed by even integers in A in increasing order
- ☒ c. $S = [n, n-1, n-2, 1, 2, 3, \dots, n-3]$ (first 3 in decreasing order, last $n-3$ in increasing order)
- ☐ d. $S =$ even integers in A in increasing order followed by odd integers in A in increasing order

[Clear my choice](#)

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