Data Structures 1

Which of the following data structures best represents how the Java LinkedList class is implemented?

a. Array  
b. 2D array  
c. Singly linked list  
d. Doubly-linked list  
e. Tree

Data Structures 2

Suppose we have a Stack $S$ and a Queue $Q$. What are the contents of $S$ after the following operations?

```
S.push(7)  
S.push(9)  
S.push(8)  
Q.enq(S.pop())  
Q.enq(S.pop())  
S.push(Q.deq())  
S.push(Q.deq())
```
Data Structures 3

Where in a MaxHeap might the smallest element reside, assuming that all the elements are distinct?

Data Structures 4

Which of the following is least likely to be implemented with an array?

a. Heap
b. Hashtable
c. Queue
d. Stack
e. Vector

Data Structures 5

The Classes and Interfaces of the Java API can be represented as a graph. Suppose there is a vertex for each Class and for each Interface in the Java API. Also, there is a directed edge from vertex x to vertex y either if y extends x or if y implements x. Which of the following best describes the Java API graph?

a. Tree
b. Forest
c. DAG (directed acyclic graph)
d. Weighted, undirected graph
e. Heap

Trees 1

Suppose we have numbers between 1 and 1000 in a binary search tree and we want to search for the number 363. Which of the following sequences could not be the sequence of nodes examined?

b. 924, 220, 911, 244, 898, 258, 362, 363.
d. 2, 399, 387, 219, 266, 382, 381, 278, 363.
e. 935, 278, 347, 621, 299, 392, 358, 363.
Suppose we have a graph of $n$ vertices in which there is exactly one simple path connecting any two vertices. How many edges will such a graph have?

What is the maximum possible height of a binary search tree with $n$ nodes?

In what order will the nodes of the following tree be visited in a postorder traversal of the tree?

A ternary tree is a tree where each node has at most three children. What is the height of a complete ternary tree containing $n$ nodes?
Graphs 1

Give an example of a graph operation which is more efficient when the graph is represented with an adjacency matrix as opposed to an adjacency list.

Graphs 2

Give an example of a weighted graph which has more than one minimum spanning tree.

Graphs 3

Suppose a breadth first search is conducted on the graph below, starting at vertex A. In what order will the vertices of the graph be visited, assuming the neighbors of a vertex are explored in alphabetical order?

Graphs 4

If a course A is a prerequisite for course B, then there is a directed edge from A to B in a graph. How many different valid topological sorts are there for the prerequisite graph shown below?
Graphs 5

A $k$-coloring of an undirected graph colors every vertex one of $k$ colors, such that no two adjacent vertices have the same color. What is the smallest value of $k$ such that all trees are $k$-colorable?

Potpourri 1

What is the name of the highest prize awarded to computer scientists?

Potpourri 2

Suppose a binary search for the number 21 is performed on the sorted array below. How many elements of the array will be inspected in the course of the binary search?

```
 2 3 4 6 9 10 12 15 18 21 28 35 36 40
```

Potpourri 3

What output is displayed by the method below when invoked on the following vector of strings:

```
["a", "b", "c", "d", "e"]
```

```java
public static void removeAndDisplay(Vector<String> v) {
    for (int i=0; i<v.size(); i++) {
        System.out.println(v.remove(i));
    }
}
```
Consider the following method.

```java
public static void mystery(int x) {
    System.out.println("mystery");
    if (x < 5) mystery(3*x - 1);
    if (x > 5) mystery(x - 3);
}
```

How many times will the word `mystery` be printed following the invocation of `mystery(10)`?

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Consider the following hashtable and hash function.

```java
public int hash(int key) {
    return (key*13) % htable.length;
}
```

Assume the hash table employs open addressing with linear probing to resolve collisions. To what index in the hashtable will the integer key 174 map?

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Before Java was named `Java`, it was called by another name. What was the programming language known as before it was known as Java?

- a. Oak
- b. Jasper
- c. Latte
- d. Jakarta
- e. Bling Bling