1. T F  A programmer must know in advance how many nodes are in a linked-list.
2. T F  A linked-list is empty when the head node's value is null.
3. T F  A doubly-linked-list is always kept in ascending sequence.
4. T F  Every node in a binary tree points to at least one other node.
5. T F  The size of a linked-list is not usually known in advance.
6. T F  A linked-list can be stored in an array.

Stacks and queues

1. Which element is returned when a stack is popped?
   A. The element which has been on the stack the longest amount of time.
   B. The element which has been on the stack for the shortest amount of time.
   C. The element at the front.
   D. The element at the top.

2. Name the two major functions of a queue.  __________  __________

3. Given the following stack components and the function call for a push operation, write the push function in perfect C++ code. Variable top indicates the top of the stack and 25 is the value to push to the stack.

   ```
   int arr[MAX];
   int top = -1;
   top = push(arr, top, 25);
   ```

Recursion

1. What do you call a recursive function's solvable problem?

2. Convert the following function to one that uses recursion.
   Make the sign function recursive, but still work the same way.

   ```
   void sign(int n) {
       while (n > 0)
           cout << "No Parking\n";
       --n;
   }
   ```
Binary search trees

1. Insert the following values into an initially-empty binary search tree, in this order: 
   11, 9, 13, 15, 7, 8, 4, 10
   
   a. What is the height of the tree? ______
   b. How many levels does the tree have? ______
   c. How many nodes are in the root-node's left subtree? ______
   d. How many leaf nodes are there? ______

2. The post-order traversal of a BST is useful for which of the following?
   A. inserting nodes
   B. removing/deleting all nodes
   C. checking for duplicate nodes
   D. displaying the nodes in reverse order

Hash tables

1. An empty hash table is below with size 10 and hash function hash(x) = x mod 10. Linear probing is 
   used to resolve collisions. Insert the following keys into the table, in this order. 32, 55, 14, 24, 19, 82, 9

      0     1     2     3     4     5     6     7     8     9
     +------+------+------+------+------+------+------+------+------+
     |      |      |      |      |      |      |      |      |      |
     +------+------+------+------+------+------+------+------+------+

2. An empty hash table is below with size 7 and hash function hash(x) = (3x + 4) mod 7. 
   Linear probing is used to resolve collisions. 
   Insert the following keys into the table, in this order. 3, 4, 7, 25

      0     1     2     3     4     5     6
     +------+------+------+------+------+------+------+
     |      |      |      |      |      |      |      |
     +------+------+------+------+------+------+------+
Algorithm efficiency

1. What is the expected number of comparisons to find a key value in each of the following data structures. Assume each has a size of \( n \). Give your answer in terms of \( n \). (You may use Big-O notation)
   
   - a. Linked list
   - b. Binary search tree
   - c. Hash table
   - d. Unordered array
   - e. Ordered array