Names: December 5th, 2018

Computer Science 241

In-Class Exercise: Greatest Hits

1. Here's an implementation of Merge sort:

```
/** Sorts a[start..end] using mergesort. Pre: 0 <= start <= end < a.length  */
public void mergeSort(int[] a, int start, int end) {
  if (end-start <= 1) {
    return;
  }
  int mid = (start+end)/2;
  mergeSort(a, start, mid);
  mergeSort(a, mid, end);
  merge(a, start, mid, end);
}
```

It makes use of the helper method `merge` that implements the following spec and runs in O(`end-start`) time.

```
 /** Merges the two sorted subarrays a[start..mid] and a[mid..end] into a
  * sorted array a[start..end] Pre: 0 <= start <= mid <= end < a.length  */
public void merge(int[] a, start, mid, end);
```

   (a) Let $n = \texttt{end} - \texttt{start}$. Give the recurrence relation that describes the runtime of the mergeSort method:

$$T(0) =$$
$$T(n) =$$

   (b) What is the asymptotic runtime of mergeSort?

2. Circle T or F to indicate whether the statement is true or false.

   (a) T / F The partition step of QuickSort is the "divide" phase of divide-and-conquer, whereas the merge step of MergeSort is the "conquer" phase.

   (b) T / F Finding an element in a binary tree is worst-case O(n).

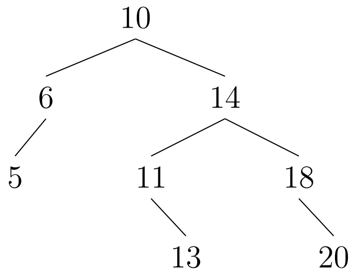
   (c) T / F Implementing the Set ADT with a linked list would make insertion more efficient than using an array.

(d) T / F A hash table with a large load factor is more time-efficient but less space-efficient than one with a small load factor.

3. (1 pt) Which of the following **could** be the **result** of a call of the `partition` method in QuickSort?

   (a) `[ 2, 5, 2, 4, 1 ]`
   (b) `[ 6, 2, 7, 8, 9 ]`
   (c) `[ 6, 7, 2, 3, 4 ]`
   (d) `[ 7, 9, 3, 4, 5 ]`

4. Consider the following Binary Search Tree:



   (a) Insert 19 using standard BST insert and draw it into the tree above.
   (b) Write the sequence of necessary rotations to rebalance the tree, using "direction(value)" to denote a rotation on a node with that value. For example, left(10) indicates a left rotation on the node with value 10.

5. Consider the following three algorithms.

```
Alg1(n):
  for a = 0..n:
    for b = 0..n:
      print a + b
```

```
Alg2(n):
  for a = 0..600:
    for b = 0..(n/2):
      print a + b
```

```
Alg3(n):
  for a = 0..n:
    for b = a..n:
      print a + b
```

For each algorithm, fill the table below to indicate the number of times the algorithm prints a value and the Big-O runtime class, both in terms of n.

	Alg1	Alg2	Alg3
Items Printed			
Big-O Runtime Class			