# ICS 211 Spring 2016 Final Exam, May 9th, 2016

Clearly write your name on both the **back** and **front** of this exam.

This exam is closed-book, closed note, closed computer, closed neighbor. No calculators are allowed. There are a total of 100 points.

Be sure to answer all parts of each question.

**Question 1** (10 points): Implement this method to do an insertion sort.

**public static void insertionSort(E [] data, Comparator<E> c) {**

**Question 2** (10 points): Implement this method to add a value to a max heap (the value is **Comparable**). Assume there is room in the array to add the element.

**public class Heap<E implements Comparable<E>> {**

**protected E[] data;**

**int size; // invariant: size <= data.length**

**…**

**// precondition: size < data.length**

**public void add(E value) {**

**Question 3** (10 points): Implement this method to merge two sorted arrays into a result array. The result array is large enough (so don’t check array sizes).

**public static <T extends Comparable<T>> void merge(T[] left,**

**T[] right,**

**T[] result) {**

**Question 4** (10 points): Discuss the advantages and disadvantages of chained hashing vs. open addressing.

**Question 5** (10 points): Explain how stacks are used by Java to implement recursion.

**Question 6** (5 points): Fill in the blank for both of these sentences.

The node at the top of a tree is called its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Nodes that have the same parent are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Question 7** (5 points): Explain the differences between: **a Binary Tree, a Binary Search Tree,** and **a Binary Search**.

**Question 8** (5 points): Explain the difference between: **x == y** and **x.equals(y)**. Be very clear.

**Question 9** (10 points): Give the worst-case, average case, and best-case runtimes for these sorting algorithms.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Best | Average | Worst |
| Selection  sort |  |  |  |
| Bubble  sort |  |  |  |
| Insertion  sort |  |  |  |
| Heap  sort |  |  |  |
| Merge  sort |  |  |  |
| Quick sort |  |  |  |

**Question 10** (5 points): Write the **List** interface.

**Question 11** (5 points): Write the **Stack** interface.

**Question 12** (5 points): Write the **Queue** interface.

**Question 13** (10 points): Write this recursive method to find the depth of the tree. **Do not use a helper method.**

**private static int depth(BinaryNode<T> node) {**

**if (node == null) {**

**return 0;**

**}**