# ICS 211 Spring 2014 Exam 2, April 14th, 2014

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

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

Be sure to answer all parts of each question.

**Question 1** (10 points): Write a **recursive** method **even** that takes as a parameter a **LinkedNode<E>** and returns a **boolean**. If the parameter is null or refers to a linked list of even length, the method should return **true**. Otherwise the method should return **false**.

**Question 2** (20 points): Implement a **recursive** method to add a value to a binary search tree (correctly handling the case where the value is already in the tree). The method is originally called by this public **add** method (the declaration of **root** is also shown, and **T extends java.lang.Comparable<T>**).

**protected BinaryNode<T> root;**

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

**root = add(value, root);**

**}**

**Question 3** (10 points): Implement the following method.

**public class ArrayStack<E> implements StackInterface<E> {**

**private int top;**

**private E[] array;**

**public E peek() throws EmptyStackException {**

**Question 4** (20 points): Implement this method to perform a binary search. If the value is found, the method returns the index of the value, otherwise the method returns -1. The array **data** is sorted in ascending order.

**static int binarySearch(java.lang.Comparable value, Object[] data) {**

**Question 5** (10 points): Create a max heap (stored in an array) by inserting, in sequence, the values 5, 2, 4, 7, 6, 8, 1, 3. Show the resulting array.

**Question 6** (5 points): Which of the following is a preorder traversal of a binary tree?

1. Visit root node, traverse TR, traverse TL
2. Traverse TL, traverse TR, visit root node
3. Visit root node, traverse TL, traverse TR
4. Traverse TL, visit root node, traverse TR

**Question 7** (5 points): What is the worst-case runtime of binary search on a sorted array of *n* items.

**Question 8** (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 9** (5 points): A double-linked list requires the same amount of storage as that of a single-linked list.

True or False (circle one)

**Question 10** (5 points): What is the worst-case runtime to add a value to a heap that has *n* values?

**Question 11** (5 points): What is the worst-case runtime to add a value to a binary search tree with *n* values?