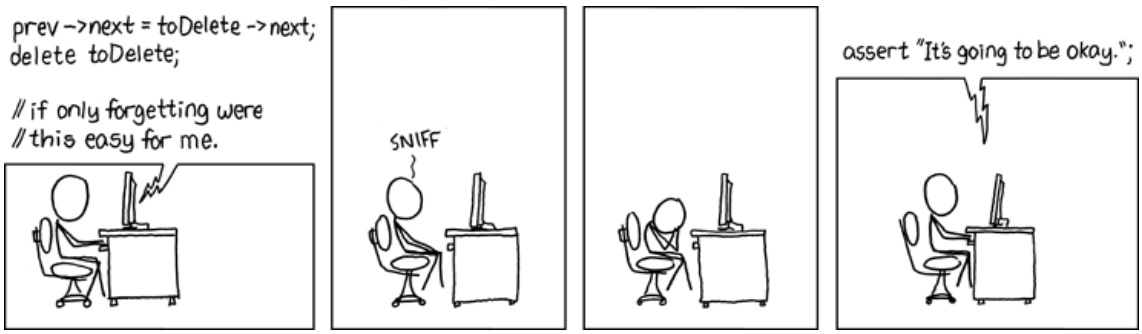
CS 151 Spring 2020
OWLS Midterm Exam
March 4 2020

Name:

T-number:



This test is closed notes, closed book, closed computer (no running anything in Java). No aids are permitted. In total there are a bunch of questions. You have 60 minutes. We will not be scanning these tests to grade them: it doesn't matter if you write your T-number on the top of every page but make sure you write your answers in the space provided for them. Are you actually reading this? We did not provide a few extra blank pages at the end for extra workspace; if you use the extra pages, please note so on the question(s) you use them for. Please also sign the honor code below.

Good luck!

Honor Code:

1. **Short Answer** (5 pts)

   (a) Describe the role of the constructor

   (b) What is the java syntax for inheritance? How about to incorporate interfaces in a class?

   (c) In your own words, describe both an abstract class and an interface.

   (d) Describe how bubble sort works in your own words.

   (e) What is the difference between the public and private modifiers?

   (f) My favorite data structure is _____

2. **ArrayLists** (16 pts) What are the contents of list after these operations?

```
ArrayList<Integer> list = new ArrayList<Integer>();
list.add(1);
list.add(2);
list.add(0, 3);
list.add(2, 4);
list.add(1, 5);
list.get(1);
list.remove(4);
list.add(1, 7);
```

3. **Big O.** Write the Big-O runtime of the following functions.

   (a) (5pts)

```
public void clear(){
   return new int[] ;
}
```

   (b) (5pts) *Note:* "This is my " and "the day eating..." should be in quotes

```
public void Stevie(int n){
   for (int i = 0; i <= n; i++){
      System.out.println( This is my + i + th day eating at Stevie)
   }
```

   (c) (3 pts)

```
public int foo(int[] sortedArray, int key, int low, int high) {
   int index = Integer.MAX_VALUE;

   while (low <= high) {
      int mid = (low + high) / 2;
      if (sortedArray[mid] < key) {
         low = mid + 1;
      } else if (sortedArray[mid] > key) {
         high = mid - 1;
      } else if (sortedArray[mid] == key) {
         index = mid;
         break;
      }
   }
   return index;
}
```

4. **Stacks**

   a. What are the contents of stack after these operations?

   Stack<Integer> stack = new Stack<Integer>();
   stack.push(10);
   stack.push(5);
   stack.push(7);
   stack.push(11);
   stack.pop();
   stack.peek();
   stack.pop();
   stack.push(3);
   stack.push(7);
   stack.peek();
   stack.pop();
   stack.peek();

   b. Suppose you choose to implement your stack with a linkedlist. Write the following methods.

      1. void clear

      2. int peek()

Describe what the following code does (so many points) Think about it on a case-by-case basis:

```
public int OWLS(int input, String output) {
   int newIn;
   boolean outputFlag = false;
   if(output != ""){
      newIn = input += 1;
      outputFlag = true;
   }
   else{
      newIn = input;
   }
   if((newIn % 2) == 0 && outputFlag){
      System.out.println("Gosh, I really appreciate my owls");
      System.out.println("input int: " + input);
   }
   else if ((newIn % 2) == 0 && !outputFlag){
      System.out.println("I miss the Jonas Brothers"};
      System.out.println("input int: " + newIn);
   }
   else{
      System.out.println("Its cool to study computer science"};
      }
}
```

5. **Queues**

   a. Write a method that dequeues from a queue (using a doubly linked list implementation (assume the constructor initiliazes next and prev for each node, and that we have a setNext() and setPrev() function).

   b. Give the BigOh runtime of 2 queue operations (ie peek, enqueue, dequeue. . . .)

7. (30 pts) **Short answer**

   (a) Explain how you would redesign a stack to support a getMin() function which returns the current smallest element in the stack. Give the runtime of this function

   (b) Write about how you could use two stacks/queues and a linked list to implement one of the sorting algorithms we've studied. (Hint: return the *sorted list*)

(c) Consider using a stack as a way of visualizing a recursive call. Implement a recursive fibonacci method to get the nth fibonacci number and draw out the stack after calling a recersive fibonacci function to get Fib(4).

(d) Consider a new data structure: the "Group Stack", which takes in integers and groups them as more repeat integers get added. In words, describe how you would implement a "push" operation.
Example: if our square stack was 0 1 2 3 4 and we pushed 3, 4, and then 5, our group stack would be 0 1 2 (3,3) 4, then 0 1 2 (3,3) (4,4), then 0 1 2 (3,3) (4,4) (5,5). Popping 2, 3, 3 off the stack would yield 0 1 (4,4) (5,5)

Thats it, you're done :)