CS 61B
Spring 2020

Small Group Tutoring
Section 5: Complexity, Number Representation

Worksheet 7

1 List'em all!

List all the asymptotic runtimes from quickest to slowest.
$\theta(n^2), \theta(n^{0.5}), \theta(\log n), \theta(3^n), \theta(c), \theta(n^{n!})\theta(n), \theta(n\log n), \theta(n!), \theta(n^n), \theta(2^n)$

2 What's that runtime?

For each of the methods below, please specify the runtime in BigO, BigΘ or BigΩ Notation. Please give the tightest bound possible.

```
________ private static void f(int n) {
            for(int i = 0; i < n; i++) {
                for(int j = 0; j < n; j++) {
                    linear(n); // runs in linear time with respect to input
                }
            }
        }
```

```
________ private static void g(int n) {
             if (n < 1) return;
             for(int i = 0; i < n; i++) {
                linear(100);
             }
             g(n/2);
             g(n/2);
         }
```

```
________ private static void h(int n) {
             Random generator = new Random();
             for(int i = 0; i < n; i++) {
                if(generator.nextBoolean()) {
                    /* nextBoolean returns true with
                       probability .5. */
                    break;
                }
             }
         }
```

```
__________ private static void i(int n) {
               if (n < 1) return;
               for(int i = 0; i < n; i++) {
                  System.out.println("Yow!");
               }
               i((999 * n) / 1000);
           }
```

3 How fast?

Given an IntList of length N, provide the runtime bound for each operation. Recall that IntList is the naive linked list implementation from class.

Operations	Runtime
size()	
get(int index)	
addFirst(E e)	
addLast(E e)	
addBefore(E e, Node n)	
remove(int index)	
remove(Node n)	
reverse()	

4 Sum 'em Up

1. Define a function, sumTo, that takes a sorted int[] array and an int x and returns true if two numbers in the array sum to x and false otherwise. For example, if given the following input: [1, 2, 4, 7, 8, 10] and $x = 12$, the function should return true.

2. Provide the tightest possible runtime bound on your solution.

5 Number Representation

Convert the following **4**-bit numbers from signed integers to binary, and from binary to signed integers.

Decimal: 7 Binary: ____

Decimal: -5 Binary: ____

Decimal: ___ Binary: 1000

Decimal: 3 + 7 Binary: ____

Now what is the decimal representation of this binary number? ___

Now for the questions below, consider that we are no longer working with 4-bit numbers, but rather 64 bit numbers.

Decimal: 1 << 2 Binary: ____

What is the decimal representation of this? ____

Decimal: 10 >> 2 Binary: ____

What is the decimal representation of this? _______

Given a number x, how do we determine if it's even or odd using bit and boolean operators?

How do we determine whether x is a power of 2?

What is a number that can be represented as a 64 bit signed binary number but its absolute value cannot? (x can be represented but $|x|$ cannot)