

## Homework 2

### 1. Question 1.4.4

Develop a table like the one on page 181 for TwoSum.

```
public class TwoSum {
    public static int count(int[] a) {
        /* BLOCK A */
        int N = a.length;
        int cnt = 0;
        for (int i = 0; i < N; /* BLOCK B */ i++)
            for (int j = i+1; j < N; /* BLOCK C */ j++)
                if (a[i] + a[j] + a[k] == 0)
                    /* BLOCK D */ cnt++;
        /* BLOCK A CONTINUED */
        return cnt;
    }
    ...
}
```

statement block	time in seconds	frequency	total time
D	$t_0$	$x$ (depends on input)	$t_0 x$
C	$t_1$	$N^2/2 + N/2$	$t_1(N^2/2 + N/2)$
B	$t_2$	$N$	$t_2 N$
A	$t_3$	1	$t_3$

### 2. Fall 2010 Midterm Question 1d

Consider the following Java data type definition for a 2-3 tree, where the nested class Node represents either a 2-node or a 3-node.

```
public class TwoThreeTree<Key extends Comparable<Key>, Value> {
    private Node root;
    private class Node {
        private int count; // subtree count
        private Key key1, key2; // the one or two keys
        private Value value1, value2; // the one or two values
        private Node left, middle, right; // the two or three subtrees
    }
    ...
}
```

}

How much memory (in bytes) does each Node object consume?

Node - 16 bytes of overhead + 8 bytes of extra overhead because Node is nested

count - 8 bytes (4 int bytes + 4 bytes of padding)

key1 and key2 - 8 bytes each (references)

value1 and value 2 - 8 bytes each (references)

left, middle, right - 8 bytes each (references)

$$16 + 8 + 8 + 8 * 2 + 8 * 2 + 8 * 3 = 88 \text{ bytes per Node}$$

### 3. Fall 2011 Midterm Question 2

Suppose that you collect the following timing data for a program as a function of the input size  $N$ .

N	time
125	0.03 sec
1,000	1.00 sec
8,000	32.00 sec
64,000	1,024.00 sec
512,000	32,768.00 sec

Estimate the running time of the program (in seconds) as a function of  $N$  and use tilde notation to simplify your answer.

*Hint:* recall that  $\log_b a = \lg a / \lg b$ :

Ratio $8N/N$	Ratio $T(8N)/T(N)$
8	33.33333...
8	32
8	32
8	32
8	32

$$\lg 32 / \lg 8 = \log_8 32 = 5/3$$

$$b = 5/3$$

$$a * 1000^{5/3} = 1.00$$

$$a = 1/100000T(N) = 1/100000N^{5/3} \sim N^{5/3}$$