Last Name: _____ **, First Name:** _____

1) (20 pts) A class has n students, s_1 through s_n. Student s_i has taken t_i tests, each scored from 0 to 100. This data is entered via standard input using the following format:

First line stores the number of students, n.

The next n lines store the student data with the ith of these lines storing the test information for student s_i.

Each of these lines starts with the integer, t_i, the number of tests taken by student s_i. This is followed by the t_i test scores for that student, in order.

Here is a small sample file for 3 students who've taken 5, 2 and 9 tests, respectively:

```
3
5 100 90 95 99 100
2 85 86
9 83 88 85 85 89 96 75 83 95
```

Complete the function below so that reads in this information from standard input and returns an array of arrays (the first array has length t_1, the second array has length t_2, etc.). Note since all of the required information is in the input, no parameters are needed for the function.

```
int** getTestData() {
```

```
}
```

2) (6 pts) Using the calloc function, write a single line of code to allocate room for `n` variables of type `struct item`. Assume that n is defined as an integer and stores a reasonable positive value and that the type `struct item` is declared. Name the array `myitems`.

_____

3) (10 pts) A algorithm that sorts n items runs in $O(n\sqrt{n})$. When run on an input of 10,000 items, the algorithm takes 200 milliseconds. How long, in seconds, will the algorithm take when run on an input of 90,000 items?

_____

4) (12 pts) We define a set of strings s_1, s_2, ... as follows: s_1 = "1" and to form s_{i+1} we stick together two copies of s_i next to each other followed by the character i+1. For example, s_2 = 112 and s_3 = 1121123. Write a function that takes in n (guaranteed to be in between 1 and 9, inclusive) and prints out s_n.

```
void printSequence(int n) {




}
```

5) (10 pts) Determine a closed form solution for the following summation, in terms of n:

$$\sum_{i=n}^{2n-1} (4i + 7)$$

6) (10 pts) Determine the run-time, in terms of the formal parameter n, of the following function. Leave your answer in a Big-Oh bound and justify your answer.

```
int f(int array[], int n) {

    int i, total = 0;
    for (i=0; i<n; i++) {
        int low = 0, high = n-1;
        while (low < high) {
            int mid = (low+high)/2;
            if (2*array[i] < array[mid])
                high = mid-1;
            else
                low = mid+1;
        }
        total += low;
    }
    return total;
}
```

_____

7) (15 pts) Consider the following recursive function:

```
int compute(int array[],int low, int high) {

    if (low == high) return array[low]%3 + 1;

    int mid = (low+high)/2;
    int left = compute(array, low, mid);
    int right = compute(array, mid+1, high);
    return left*right;
}
```

Consider the function call compute(array, 0, 6) where array is shown below:

index	0	1	2	3	4	5	6
array	17	4	19	30	47	999	13

Determine the result of this recursive call, as well as each other recursive call that gets made as a result of this original one and its return value. Please fill in the recursive calls in the order that they *start*. (Note: This order is different than the order in which they finish and a significant hint has been given to you below.)

Recursive Call	Return Value
compute(array, 0, 6)	72
compute(array, 0, __3__)	12
compute(array, 0, __1__)	6
compute(array, 0, __0__)	3
compute(array, 1, __1__)	2
compute(array, 2, __3__)	2
compute(array, 2, __2__)	2
compute(array, 3, __3__)	1
compute(array, 4, __6__)	6
compute(array, 4, __5__)	3
compute(array, 4, __4__)	3
compute(array, 5, __5__)	1
compute(array, 6, __6__)	2

8) (15 pts) Complete the program below so that it prints out all the permutations of 0,1,2, ...,SIZE-1 such that the absolute value of the difference between each pair of adjacent numbers in the permutations is 2 or greater. For example, when SIZE = 4, the code would print out:

```
1 3 0 2
2 0 3 1
```

the only 2 permutations such that the absolute value of the difference between each pair of adjacent terms is 2 or greater.

```c
#include <stdio.h>
#include <math.h>

#define SIZE 4

void printPerms(int perm[], int used[], int k, int n);
void print(int perm[], int n) ;

int main() {
    int perm[SIZE], used[SIZE], i;
    for (i=0; i<SIZE; i++) used[i] = 0;
    printPerms(perm, used, 0, SIZE);
    return 0;
}

void printPerms(int perm[], int used[], int k, int n) {

    if ( _____ ) print(perm, n);

    int i;
    for (i=0; i<n; i++) {
        if (!used[i]) {
            if ( _____ || _____ ) {

                used[i] = _____ ;

                perm[k] = _____ ;

                printPerms(_____ , _____ , _____ , _____ );

                used[i] = _____ ;
            }
        }
    }
}
```

9) (2 pts) Nate Silver famously predicted the outcome of every state in the last presidential election. With what precious metal does he share his last name? _____

Scratch Page - Please clearly label any work on this page you would like graded.