CMPT125, Fall 2018

Homework Assignment 1
Due date: October 9, 2018

Submit homework, printed or written in readable handwriting,
to the assignment boxes in CSIL ASB9838.

1) [20 points] Explain in your own words:

   a) What is a pointer in C?
   b) What is the difference between local variables and global variables?
   c) What is the difference static variables and global variables?
   d) What is the execution stack?
   e) We use scanf ("%d", &n) in order to read an integer input. Why are we using the & symbol?

2) [20 points] For each of the following functions write pseudocode. No need to write in C. Explain your answers.

   a) Write a function with the same functionality as sum(int N), but runs in O(1) time.

```
int sum(int N) {
   int i, j, sum = 0;
   for (i=0; i < N; i =i+2)      {
            for (j=0; j < 10; j = j+5)
                  sum = sum+j;
   }
   return sum;
}
```

   b) Write a function that has the same functionality as arr_sqr(int* arr, int N), without using multiplication. You can use the addition/subtraction operation only. The running time of the function should be O(N).

```
// we assume that the array has at least N elements allocated
void arr_sqr(int* arr, int N) {
   int i;
   for (i=0; i < N; i++) {
      arr[i] = i*i;
   }
}
```

3) [20 points] For each of the following algorithms compute its time complexity as a function of N using the Big-O notation. <u>Explain your answers.</u>

a)
```
foo1(int N) {
    for (int i=0; i < N; i++)
        for (int j=0; j < N; j++)
            printf("hello\n");
}
```

b)
```
foo2(int N) {
    int i, j, s = 0;
        for (i=0; i < N; i =i+2)
            for (j=0; j < 10; j = j+5)
                s = s+j;
}
```

c)
```
foo3(int N) {
    int i, s = 0;
    for (i=1; i < N; i = i*2)
        s = s+i;
    return s;
}
```

d)
```
foo4(int N) {
    int i, j, s = 0;
    for (i=1; i < N; i = i*2)
        for (j=0; j < i; j = j+1)
            s = s+j;
}
```

e)
```
foo5(int N) {
    if (N <= 1)
        print("stop\n");
    else {
        foo5(N-1);
        foo5(N-1);
    }
}
```

f)
```
foo5(int N) {
    if (N > 1) {
        foo5(N/2);
        foo5(N/2);
    }
}
```

4) [20 points] For each of the following expressions write their growth rate using Big-O notation. Try to find the best growth rate possible. Explain you answers.

a) $f(n) = n + 10*n^2 + 400 \log(n)$

b) $g(n) = 2 + 4 + 6 + 8 + \ldots + n$ (assume n is even)

c) $h(n) = 1 + 2 + 4 + 8 + 16 + \ldots + n$ (assume n is a power of 2)

d) $p(n) = n*1 + (n-1)*2 + (n-2)*3 + \ldots + 2*(n-1) + 1*n$

e) $q(n) = 2^1 + 2^2 + 2^3 + \ldots + 2^{n-1} + 2^n$

5) [20 points] Write a function (as pseudocode) that gets a matrix of colors, and a starting point, and colors the white area connected to the starting point with RED.
See examples below:
　　　The *green point* on the left represents the starting point.
　　　The *red points* are the area containing the starting point.

For the pseudocode you may use colors by writing, e.g., BLACK, WHITE, RED. For example:
if A[i][j] == WHITE
　　　A[i][j] = RED

Hint: use recursion.