CSC 2302-01, Data Structures – Summer 2019

Midterm Review

1. Using the definition of Big-Oh, prove that $f(n) = 3n^2+5n+4*2^n = O(2^n)$

2. Using the definition of Big-Oh, prove that $f(n) = (3n^2+5n+7)^5 = O(n^{10})$

3. Algorithms A and B spend exactly $T_A(n) = c_A\ n \log_2 n$ and $T_B(n) = c_B\ n^2$ microseconds, respectively, for a problem of size n. Find the best algorithm for processing $n = 2^{20}$ data items if the algorithm A spends 10 microseconds to process 1024 items and the algorithm B spends only 1 microsecond to process 1024 items.

4. Declare a structure that contains: An integer called ID. Character arrays called first and last, each of 10 characters. A pointer to the structure called next.

5. What will be the output of the c code below?

```
void main()
{
struct india{
char c;
float d;
};
struct world{
int a[3];
char b;
struct india orissa;
};
struct world st ={{1,2,3},'p','q',1.4};
clrscr();
printf("%d\t%c\t%c\t%f",st.a[1],st.b,st.orissa.c,st.orissa.d);
getch();
}
```

6. Write a fragment code of a function, **power(x, n) = $(x+1)^n$**, which raises a non-zero real number to a power using recursive approach (n is a positive integer)

7. Consider the following function implemented in C. **(6pts)**

```
int someFunction (int n)
{
        if (n == 0 || n = = 1 || n == 2))
                return n;
        else
                return someFunction (n-1) + someFunction (n-3);
}
```

What does the function, **someFunction**, return when n = 7?

Answer: ----------

8. Write a fragment code of a recursive function that computes and returns the sum of all elements in an array, where the array and its size are given as parameters.

9. Give the best Big-Oh characterization for each of the following running estimates (where n is the size of the input problem)

(a) $\log(n) + 10000$

(b) $n\log(n) + 15n + 0.002n^2$

(c) $37\,n + n\log(n^2) + 5000\log(n)$

(d) $1000n^2 + 16n + 2^n$

(e) $n + (n-1) + (n-2) + \cdots + 3 + 2 + 1$

(f) $2^{10} + 3^5$

10. For each the following algorithm, give its time complexity in Big-Oh notation

```
Algorithm Algo1(A)
  Input: An array A storing n ≥ 1 integers
  Output: The sum of the elements in A
  s ← A[0]
  for i ← 1 to n − 1 do
     s ← s + A[i]
  return s
```

```
Algorithm Algo2(A)
  Input: An array A storing n ≥ 1 integers
  Output: The sum of the prefix sums in A
  s ← 0
  for i ← 1 to n − 1 do
     s ← s + A[0]
     for j ← 1 to i do
        s ← s + A[j]
  return s
```

11. Write a C program to read name and marks of n number of students from user and store them in a file. If the file previously exits, add the information of n students.

12. Write a C program to add two distances (feet-inch system) entered by user. To solve this program, make a structure. Pass two structure variable (containing distance in feet and inch) to add function by reference and display the result in main function without returning it.