Algorithm Design & Analysis

Assignment – 1 (Fundamentals of Algorithm)

1. Horner's rule is a means for evaluating a polynomial at a point x_0 usng a minimum number of multiplications. If the polynomial is $A(x) = a_n x^n + a_{n-1}x^{n-1} + \cdots + a_1 x + a_0$, Horner's rule is $A(x_0) = (\ldots(a_n x_0 + a_{n-1})x_0 + \cdots + a_1)x_0 + a_0$

   a) Write a program to solve this problem. The outcome will be the number of multiplications used to solve the given polynomial and its corresponding evaluated result.

   b) Use this rule to evaluate $3x^4 + 2x^3 + 8x^2 + 9x + 1$ at $x = 2$.

2. Given $n(> 0)$, determine whether n is the sum of all of its divisors, that is, whether n is the sum of all t such that $1 \leq t < n$, and t divides n. Write a program to solve this problem.

3. Write a program to determine whether a point in a 2-D plane is in the interior or exterior of a simple polygon.

4. Write a program to find the number of possible outcomes in a two-team playoff when the winner is the first team to win 5 out of 9, 6 out of 11, 7 out of 13, and 8 out of 15.

5. We design a new representation of queue. A queue will be a pair of two stacks, *St_in* and *St_out*. We always add elements to *St_in* and always remove them from *St_out*. When necessary, we can reverse the *St_in* queue to obtain *St_out* by calling a user defined *Reverse* function. Write a program to performe a sequence of *n* operations, each of which could be *ENQUEUE* (insertion) or *DEQUEUE* (deletion) in this data sturucture.

6. Let R and S are two relations on a given set of positive integers A with set cardinality N. Define a proper data structure to represent R and S. Now, perform the following operations as given below.
   i. $R \cup S$
   ii. $R \cap S$
   iii. R-S
   iv. Determine whether the relation R or S is (a) reflexive and/or irreflexive, (b) symmetric and /or antisymmetric, and (c) transitive.