Assignment 4: Function, Recursion, Strings, and Pointers: C Programming

Demo Assignments

(1) A 5-digit positive integer is entered through the keyboard, write a function to calculate sum of digits of the 5-digit number:
   a. Without using recursion
   b. Using recursion

(2) Compute Fibonacci(n) given N using recursion. Print how many calls are required for obtaining this Nth number in the series?

(3) Write a program to measure the length of a string, which is read from the keyboard and display back the string and its length.

(4) Write a demo example for a pointer passed to and a pointer return by a function.

(5) Write a demo example for pointer to an array.

Exercise Assignments:

B.1.4.1 Write a program that takes 10 words (strings) from user and sorts elements in lexicographical (dictionary) order. The program will contain a function for sorting (function name sorting).

B.1.4.2 Solve the tower of Hanoi problem with N disks (N<7) and 3 towers (T1, T2, T3) using recursion from tower 1 (T1) to tower 3 (T3) as shown in the below figure. Display each and every move. Print how many moves do you have to make to solve a problem of N disks and 3 towers? It will have two function movement and display.

Remember:
1. Only one disk can be moved at a time.
2. Each move consists of taking the upper disk from one of the towers and placing it on top of another tower i.e. a disk can only be moved if it is the uppermost disk on a stack.
3. No disk may be placed on top of a smaller disk.

Extra Point: Attempt an iterative version of the Problem 2.
B.2.4.1 A positive integer is entered through the keyboard, write a function (function name: `binary`) to find the binary equivalent of this number using recursion. For example, if input is 156, then binary value is 10011100.

\[
\begin{array}{c|c|c|c|c|c}
2) & 156 & & & & \\
2) & 78 & & & & \\
2) & 39 & & & & \\
2) & 19 & & & & \\
2) & 9 & & & & \\
2) & 4 & & & & \\
2) & 2 & & & & \\
2) & 1 & & & & \\
\end{array}
\]

**Remainder:**

\[
\begin{array}{c|c|c|c|c|c|c|c}
2) & 156 & & 1 & & & & \\
2) & 78 & & 0 & & & & \\
2) & 39 & & 0 & & & & \\
2) & 19 & & 0 & & & & \\
2) & 9 & & 0 & & & & \\
2) & 4 & & 0 & & & & \\
2) & 2 & & 0 & & & & \\
2) & 1 & & 1 & & & & \\
\end{array}
\]

\[156_{10} = 10011100_2\]

B.2.4.2 Write a function (function name: `gcd`) to compute the greatest common divisor (GCD) given by Euclid’s algorithm, exemplified for \(J = 1980, K = 1617\) as follows:

\[
\begin{align*}
1980 & \div 1617 = 1 & 1980 - 1 \times 1617 & = 363 \\
1617 & \div 363 = 4 & 1617 - 4 \times 363 & = 165 \\
363 & \div 165 = 2 & 363 - 2 \times 165 & = 33 \\
5 & \div 33 = 5 & 165 - 5 \times 33 & = 0 \\
\end{align*}
\]

Thus, the greatest common divisor is 33. It will be a recursive solution.

**Extra Point:** Attempt an iterative version of the Problem 2.

B.3.4.1 \(N\) positive integers are entered through the keyboard. Write a function (function name: `prime`) to obtain the prime factors of this number. Also display the distinct prime factors of this number. For example, prime factors of 24 are 2, 2, 2 and 3, whereas prime factors of 35 are 5 and 7. The distinct prime factors of 24 are 2 and 3, whereas 35 are 5 and 7.

B.3.4.2 Write a function (function name: `distance`) to compute the distance between two points and use it to develop another function (function name: `area`) that will compute the area of the triangle whose vertices are \(A(x_1, y_1), B(x_2, y_2), \) and \(C(x_3, y_3)\). Use these to develop a function functions (function name: `tritest`) which returns a value 1 if the point \((x, y)\) is inside the triangle ABC, otherwise a value 0 for \(N\) points, where \(N\) points are entered through the keyboard.

**Extra Problem 1:** Recursive function (function name: `binomial`) to find the value of Binomial Coefficient \(\binom{n}{r}\) where the boundary conditions are \(\binom{n}{0} = 1\) if \(r=0\) and \(\binom{n}{n} = 1\) if \(r=n\)

**Extra Problem 2:** Write a program to compute the area of a triangle. If the lengths of the sides of a triangle are denoted by \(a, b, \) and \(c,\) then area of triangle is given by:

\[
area = \sqrt{S(S-a)(S-b)(S-c)} \quad \text{where} \quad S = \left( a + b + c \right) / 2.
\]

Write a function to compute \(S\) (function name: `funcS`).