Data structures and Algorithms LAB – BSEF19
(Morning and Afternoon)

Lab 03 – 11-03-2021

Task 01 (10 marks each)

Implement the following functions recursively and also write their tester main logic.

1. Function to return the sum of first N positive integers, N being its only parameter.
2. Function called ***sumover2*** that has one argument **n** which is an unsigned integer. The function returns a double value which is described as, ***sumover2***(1) returns 1.0 and ***sumover2***(2) returns 0.5 as it is 1/2, ***sumover2***(3) returns 0.166667 as it is 1/2/3, and ….
3. Function to print octal number equivalent to the parameter of ***void printOctal(int n)***
4. Function to return the ***greatest common divisor GCD*** of its two parameters.
5. Function to return the **n**th Fibonacci string. The Fibonacci strings are a series of recursively defined strings. F_0 is the string **a**, F_1 is the string **bc**, and F_{n+2} is the concatenation of F_n and F_{n+1}. For example, F_2 is **abc**, F_3 is **bcabc**, F_4 is **abcbcabc**, etc.

Task 02 (20 & 30 marks)

1. Implement and test the function to recursively compute $\mathbf{e^x}$ (defined in picture below). Note: you may use your own power and factorial functions.
2. Again, implement and test the function to recursively compute $\mathbf{e^x}$ without using any extra computational function, i.e., you may use wrapper and auxiliary functions.

The Maclaurin Expansions of Elementary Functions

$$e^x = \sum_{k=0}^{\infty} \frac{x^k}{k!} = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots$$

$$\sin(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1)!} x^{2k+1} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$$

$$\cos(x) = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k}}{(2k)!} = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$$

$$\sinh(x) = \sum_{k=0}^{\infty} \frac{x^{2k+1}}{(2k+1)!} = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \dots$$

$$\cosh(x) = \sum_{k=0}^{\infty} \frac{x^{2k}}{(2k)!} = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \dots$$