

## IC 152 Assignment 6

### Nested and Recursive functions

All other submission instructions are the same as previous assignments. Submit two files: pdf for algorithms, explanations, proofs, and python files for code.

1. Run the following code:

```
def sumab(a):  
    def sumb(b):  
        return a + b  
    return sumb
```

```
f = sumab(20)  
print(f(10))
```

- a) Write an algorithm of above code with a clear step by step understanding of what it is doing.
  - b) Also comment about the scope of variable a in the function sumb().
2. Using math.sin() function from math library and modifying nested function in question 1, implement your own version of cos() function via nested call:
    - If you call the outer function with value of math.pi/2 as the argument/input, you should be able to find cos(x) for any x in radians by calling the nested function.
    - If you call the outer function with value of math.pi, you should be able to find sin(x) for any x in radians by calling the nested function.
  3. Write a recursive function to find the factorial of n, where n is the input or argument to the function.  
Hint: First, using pen and paper, write n! as the (recursive) equation of the form  $f(n) = g(n, f(n-1))$  with g suited as per the problem. Next, in python code call function within itself to apply the recursive equation. Think of stopping criterion to return the final value using the if condition.

E.g. code to find sum of first n natural numbers using recursive function:

```
def fsum_n(n):  
    if n==1:  
        return 1  
    return n + fsum_n(n-1)
```

```
# calling fsum_n(10):-  
print(fsum_n(10))
```

4. Write the algorithm and python code for following **using a single recursive function**:  
prefRevCapStr( ), which prefixes a string with its capitalized reversal separated by an arrow (with a blank before and after the arrow):

For example, prefRevCapStr("Diwali-to-come") should return the string

"EMOC-OT-ILAWID -> Diwali-to-come"

Hint: Try thinking of a function of the string at nth instance as the recursive sum (concatenation) of the strings at  $\leq (n-1)$ th instances.

Your Code must follow following in addition to using a single recursive function:

you cannot append input string and "->" outside the function call.

you cannot use nested function.

you cannot use global variable.

They keyword "def" should be used only once in your code for entire question 4 solution.

5. a. Write a recursive function to implement the equation  $f(n) = f(n-1) + f(n-2)$ , for any integers value of  $n \geq 0$ . Given  $f(0) = 1$ , and  $f(1) = 3$ .
- b. Re implement Q) 5a using a list starting from  $f(0)$  and  $f(1)$  as the first two elements of the list. You cannot use a recursive function in this part.
- c. Which implementation out of Q) 5a and Q) 5b is faster, and why?
6. Open Ended Bonus Question (not for bonus marks but for bonus learning): Use your innovation to combine nested and recursive functions and solve a real life problem.