**Lab Assignment - 01**

***Submission Link:* https://forms.gle/7m6MyispeTV2AT3M9**

***Submission Guidelines:***

1. You should implement the given codes in python for this first assignment. Other codes can be done in any language.

2. For **problem 1 and 4**, write and download separate python files named **problem1.py** and **problem4.py** respectively.

3. For **problem 2 and 5**, write down the explanations in your copy, create a pdf file with the images of your hand written answers and name it **explanations.pdf**.

4. For **problem 3**, you need to download the image(.png) of the graph with a value of n good enough to differentiate between the two implementations. Name it **problem3.png**.

5. Finally, put all the generated files in a folder. The folder **must** be named following the format **sec\_ID\_labNo.** Zip this folder. This will result in a zip format of **sec\_ID\_labNo.zip**. (Example: 2\_20101234\_1.zip). Submit this zip in the above mentioned link.

6. You **MUST** follow all the guidelines, naming/file/zipping convention stated above. ***Failure to do so will result in straight 50% mark deduction.***

**1) File I/O: [10 marks]**

**Parity:** A number has even parity if it’s an even number, and odd parity if it’s an odd number.

**Palindrome:** A palindrome is a sequence of characters which reads the same backward as forward, such as “madam”, “racecar” or “bob”.

Given pairs of a number and a string, check the *parity* of the number and whether the string is a *palindrome* or not. In case of float/ decimal, indicate that it cannot have parity. In a text file, some pairs will be given in separate lines. Read the words from a text (input.txt) file, do the above mentioned operations, and save the outputs in another text (output.txt) file using File I/O operations. Finally, in a text file named “**records.txt**”, write the percentage of odd, even and no parity, and percentage of palindromes and non-palindromes. Ideally you should store the inputs from the text file into a data structure (e.g. array, list etc. ). You can either:

● pass the array as an argument to the **isPalindrome** function and return the output array, OR,

● you can check the words one by one using a loop and return true/false

Sample input (inside **input.txt** file): **[Download input.txt]**

1 madam

2 apple

3.6 racecar

89 parrot

45.2 discord

Sample output (inside output.txt file):

1 has odd parity and madam is a palindrome

2 has even parity and apple is not a palindrome

3.6 cannot have parity and racecar is a palindrome

89 has odd parity and parrot is not a palindrome

45.2 cannot have parity and discord is not a palindrome

Sample output (inside **record.txt** file):

Percentage of odd parity: 40%

Percentage of even parity: 20%

Percentage of no parity: 40%

Percentage of palindrome: 40%

Percentage of non-palindrome: 60%

**Pseudocode for isPalindrome function:**

**Word <- input**

**IF word=null/empty THEN**

**Return not palindrome**

**N<- length of word**

**For i<N/2**

**If word[i] != word[N-1-i]**

**Return not palindrome**

**i++**

**Return palindrome**

**2) N-th Fibonacci Number: [3 marks]**

You are given two different codes for finding the n-th fibonacci number. Find the time complexity of both the implementations and compare the two.

See Fibonacci sequence to understand if this is new to you.

**Implementation - 1**

**def fibonacci\_1(n):**

**if n <= 0:**

**print("Invalid input!")**

**elif n <= 2:**

**return n-1**

**else:**

**return fibonacci\_1(n-1)+fibonacci\_1(n-2)**

**n = int(input("Enter a number: "))**

**nth\_fib = fibonacci\_1(n)**

**print("The %d-th fibonacci number is %d" % (n, nth\_fib))**

**Implementation - 2**

**def fibonacci\_2(n):**

**fibonacci\_array = [0,1]**

**if n < 0:**

**print("Invalid input!")**

**elif n <= 2:**

**return fibonacci\_array[n-1]**

**else:**

**for i in range(2,n):**

**fibonacci\_array.append(fibonacci\_array[i-1] + fibonacci\_array[i-2])**

**return fibonacci\_array[-1]**

**n = int(input("Enter a number: "))**

**nth\_fib = fibonacci\_2(n)**

**print("The %d-th fibonacci number is %d" % (n, nth\_fib))**

**3) Graph Plot: [2 marks]**

Append the following code segment after the implementations given in the previous problem. [Yes, The code is given. Just Copy-Paste it]. This will generate a graph with the value of **n** along the x-axis and **time required** along the y-axis. You can see both the curves in the same graph for better comparison. Generate graphs for different values of n and see how the performances change drastically for larger values of n.

**Code for plotting graph:**

**import time**

**import math**

**import matplotlib.pyplot as plt**

**import numpy as np**

**#change the value of n for your own experimentation**

**n = 30**

**x = [i for i in range(n)]**

**y = [0 for i in range(n)]**

**z = [0 for i in range(n)]**

**for i in range(n-1):**

**start = time.time()**

**fibonacci\_1(x[i+1])**

**y[i+1]= time.time()-start**

**start = time.time()**

**fibonacci\_2(x[i+1])**

**z[i+1]= time.time()-start**

**x\_interval = math.ceil(n/10)**

**plt.plot(x, y, 'r')**

**plt.plot(x, z, 'b')**

**plt.xticks(np.arange(min(x), max(x)+1, x\_interval))**

**plt.xlabel('n-th position')**

**plt.ylabel('time')**

**plt.title('Comparing Time Complexity!')**

**plt.show()**

**4) Matrix Multiplication: [5 marks]**

Write a program that will take two **n x n** matrices as input and give their product as output. Follow the **following pseudocode** to implement the program. **Analyse the time complexity** of the program after implementation.

**Pseudocode:**

**Procedure Multiply\_matrix(A,B)**

**Input A,B nxn matrix**

**Output C nxn matrix**

**begin**

**Initialize C as a nxn zero matrix**

**for i = 0 to n-1**

**for j = 0 to n-1**

**for k = 0 to n-1**

**C[i,j] += A[i,k]\*B[k,j]**

**end for**

**end for**

**end for**

**end Multply\_matrix**

**Problem 5 :Recursion Tree Time Complexity (5 marks)**

**Find the Worst case time Complexity of the following recursive functions**

**1. T(n) = T(n/2)+n-1, T(1) = 0**

**2. T(n) = T(n-1)+n -1, T(1) = 0**

**3. T(n)=T(n/3)+2T(n/3)+n**

**4. Proof that for T(n)=2T(n/2) + n^2, the worst case complexity will be n^2.**