Worksheet 5

General Instructions: Do not copy-paste from this file to terminal. If you have doubts, contact the instructors or TAs. And **do not panic**!

- The first two tasks in this worksheet require you to use Python3 shell. You need to copy paste your work (commands and outputs) to a file using gedit or nano.
- The last few problems in this worksheet will require you to write a program.
- You should keep all your files in `CS1101/ws06` folder.
- Use `gedit` or `nano` to type your programs.
- The name of the programs should be `prob-n.py` for n^{th} problem.
- Save the output of your program in a text file `prob-n-output.txt`.
- After you finish, create an archive of the folder `ws06` with name `ws06-idnumber.tgz` and upload in `WeLearn`.

Examples of programs using functions are available on the course page. Download and run the programs. Your programs (from now on) should follow the format of prog-55.py. We expect that all programs to have *comments*, particularly the functions.

1. The following series yields the value of $\tan^{-1}(x)$:

   $$\tan^{-1}(x) = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \ldots$$

   Define a function $f(x, n)$ which calculates the above series upto n^{th} term for a given x. Write a program which findsthe number of terms required to compute the value of π (using the above series) correct upto an absolute difference of 10^{-2}. The program should print the number of terms required (value of n), the exact value of π, the computed value of π and their absolute difference.

2. The value of natural logarithm of $1 + x$ can be estimated using the following series:

   $$ln(1 + x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \ldots \quad |x| < 1$$

   Define a function $f(x, n)$ which calculates the above series upto n^{th} term for a given x. Write a program which finds the number of terms required to compute $ln(0.75)$ (using the above series) correct upto an absolute difference of 10^{-4}.

3. Plot the function $\sin x$ with x range of 0 to 6π. Set the scale of y axis such that all relevant data points are visible. Set the title of the plot as "Plot of powers of sine function". The x axis label should be "theta (in radian)" and the y axis label should be "Value of sine functions".

   Generate a similar plot containing three curves $\sin x, \sin^2 x, \sin^3 x$.

4. Write a python code giving a two column output: x and $sin(x)$. Take 100 datapoints for $x \in [0, 2\pi]$. In gnuplot plot the output file, and compare with gnuplot sin(x).

5. Write a python to calculate π correct upto a numerical value of 0.05 using the above series in problem 1. Your program should print iteration number, calculated value of π, and the actual value of π. Save this data to a data file. Using gnuplot, plot the second versus the first column of data and the third versus the first column using the commands shown in slides.