Python LEP Tutorial

The purpose of this tutorial is to show how to download and run Python LEP codes. For demonstration, we will use example LEP-T12-2.

Step 1: LEP File Download
a) Open chapter 12 LEP section and click on LEP-T12-2.py under Python Code section.
b) You should see that the file is downloaded at the bottom of the browser (if you are using Google Chrome). However, with Chrome browser, you will see a warning message "***This type of file can harm your computer…***" as shown below in blue box. We assure you that these files are safe and you may keep them on your computer by selecting "Keep" button as shown below by red circle.

This file will be stored at the location you have specified in your Chrome settings which can be Desktop, Downloads etc. If you don't know the stored location, follow **Step 2, else go to Step 3.**

Step 2: Knowing File Location

Right click on the downloaded file LEP-T12-2.py and choose "Show in Folder "as shown in above image. This will show the folder location where your file is stored.
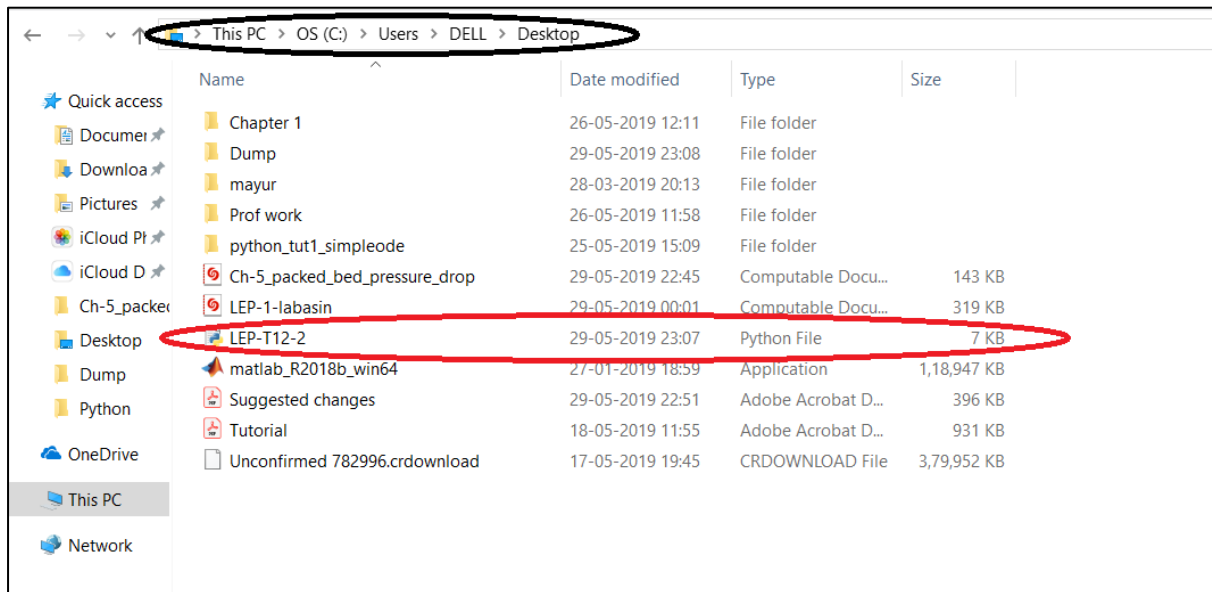
The following location page will appear. You can see here your downloaded file (shown below by red circle) and location (refer black circle). Remember your file location as it will be used later in **Step 6**. In this case the file is stored at Desktop.

Step 3: Open Spyder Software

Make sure you have Spyder3 (Python 3.7) installed on your computer so that you can run the downloaded file. If you don't have Spyder 3 installed, then you can refer to Python Installation tutorial on CRE website (http://umich.edu/~elements/5e/tutorials/python_installation_tutorial.pdf).

To open Spyder, first locate the search box which is present at the bottom of your screen as shown below

Now type "spyder" to search for Spyder software and click on the circled icon shown below. This will open up Spyder.
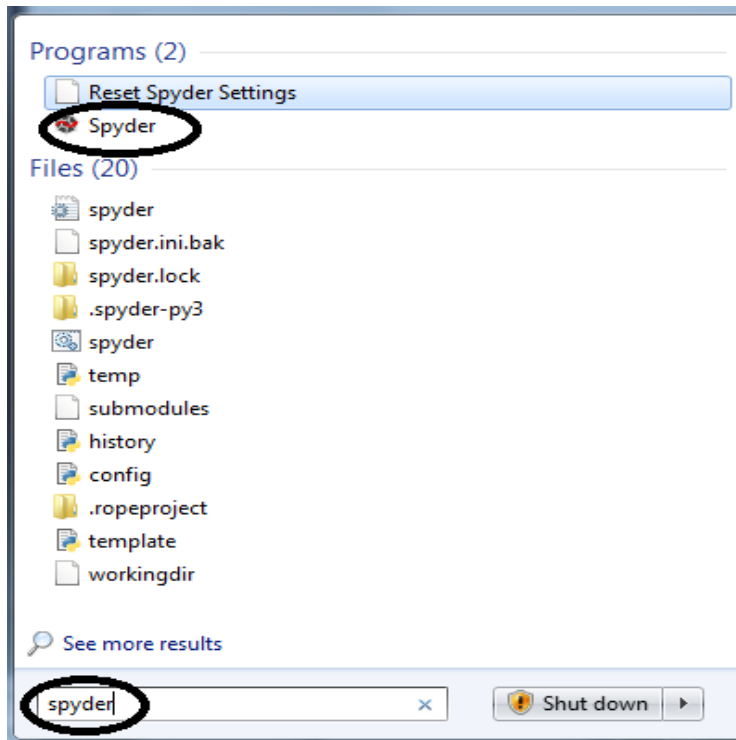
You will see that the Python is loaded and following command windows will appear.

Step 4: Check Python Settings

To create a new window for graphs, you need to have your python "Backend" setting as "Automatic".
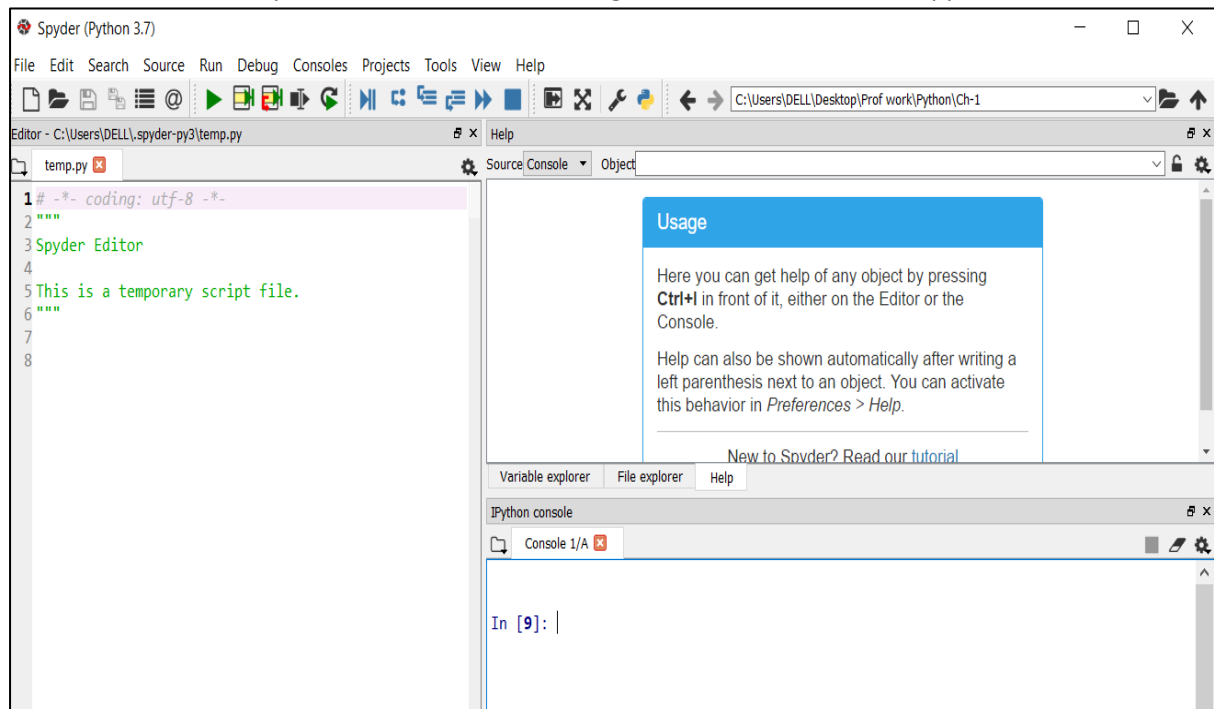If you already have this setting, you can go to **Step 6,** else follow below steps:

Go to Tools option present on the top menu bar and then select Preferences
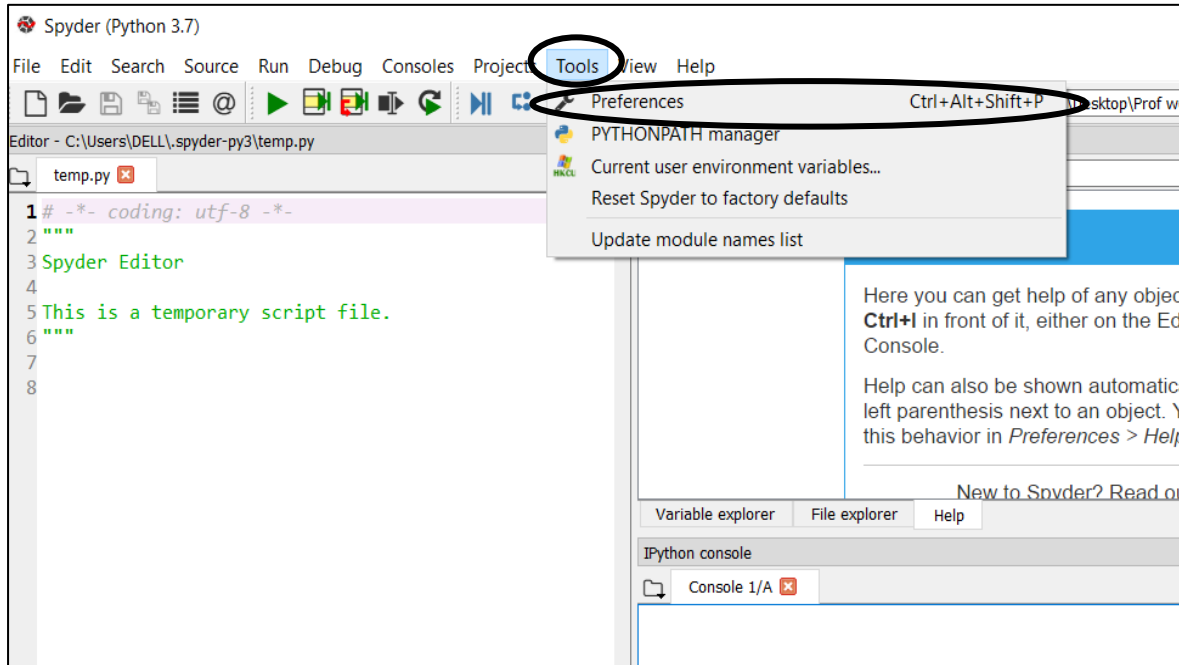
This will open up following pop-up window. Click on "IPython console" option and then select Graphics tab present on top menu bar

Under Graphics, click on drop-down menu for Backend option and select Automatic. When you are done, Click Ok
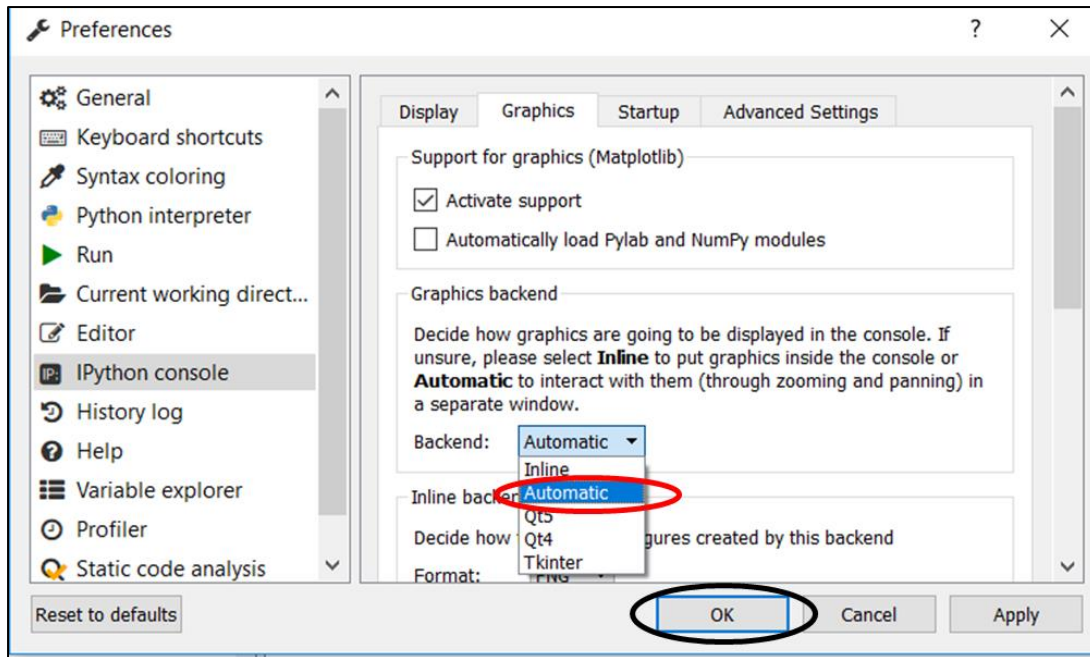
Step 5: Restart Python

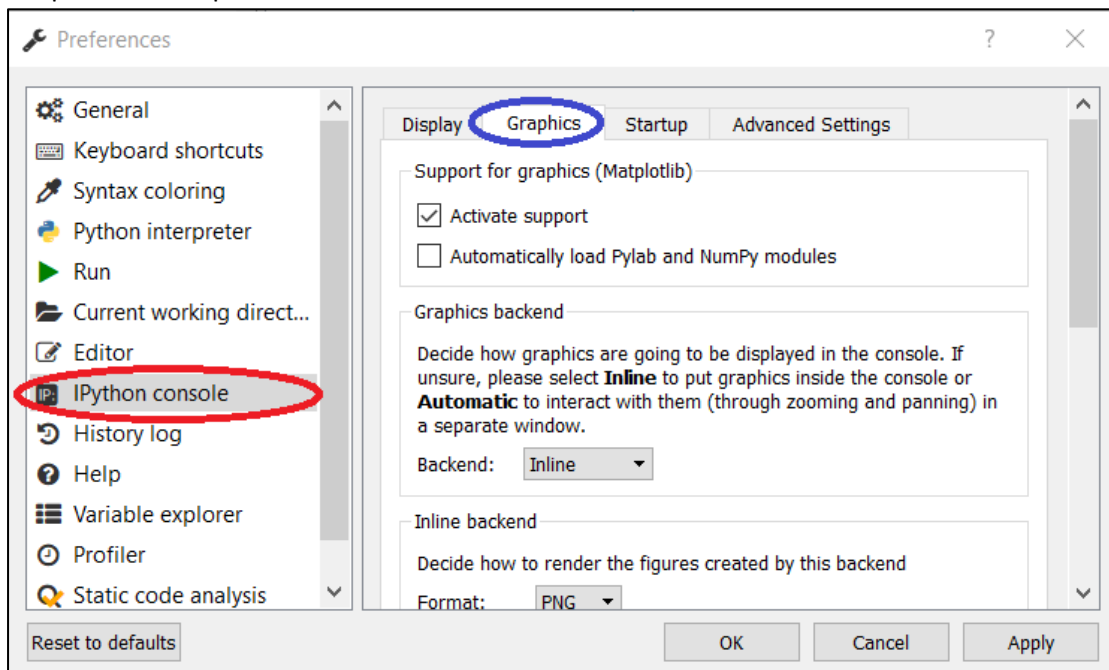Once you have made changes to Python settings, you need to restart kernel. A 'kernel' is a program that runs and introspects the user's code. To restart kernel, you can close the Python software and then re- open it.

As an easy step, follow below option:

Click on Settings icon present under Console 1/A and the click on "Restart kernel"

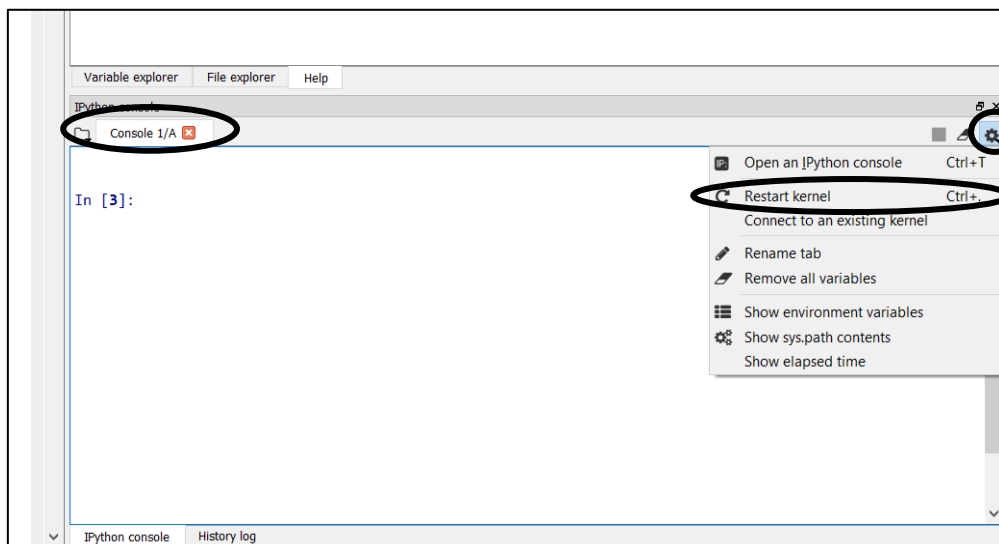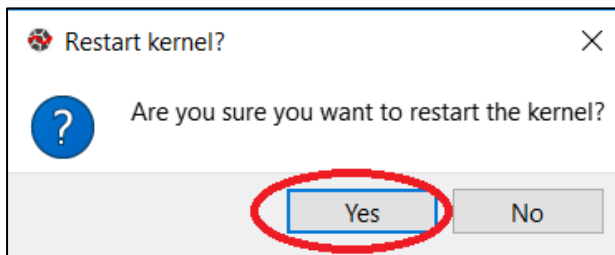You will then be prompted to confirm your action. Click on Yes button.

Now, your settings has been applied successfully.

Step 6: Opening LEP File

Go to the file Menu and Click on Open. As a shortcut, you can also use keyboard button ' Ctrl+O ' .
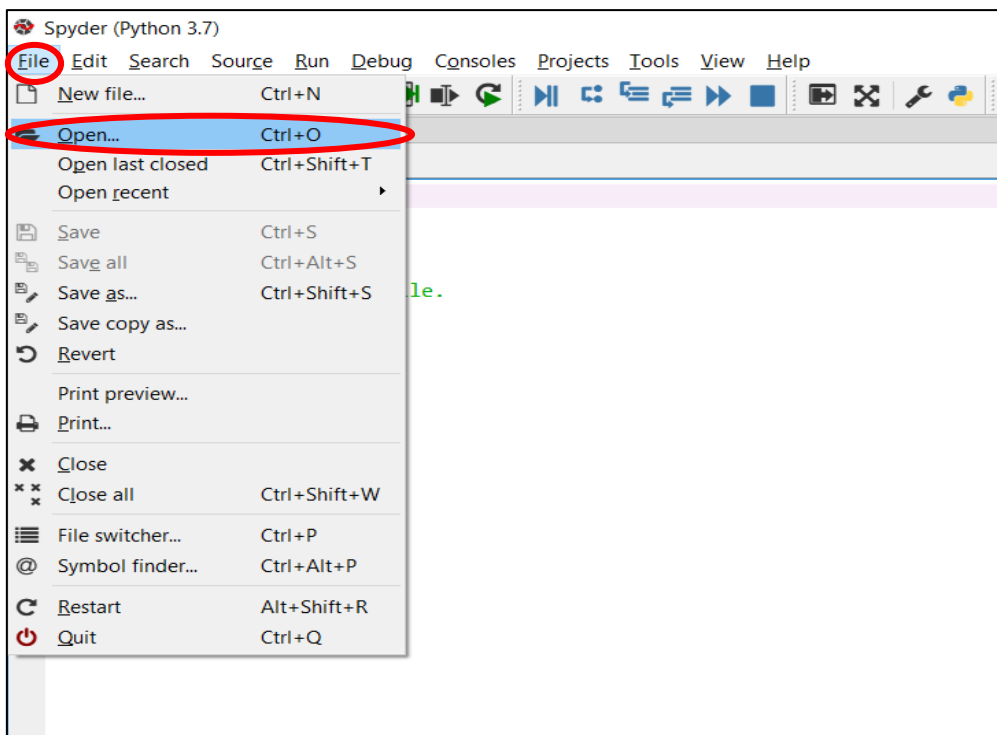
Go to the place where your file (LEP-T12-2) is stored. In this case, file was stored at desktop as was identified in **Step 2**. If your file was saved at different location, then you should go to that location. After you have found the file, double click on "LEP-T12-2" to open it. This will open the codes for this LEP.
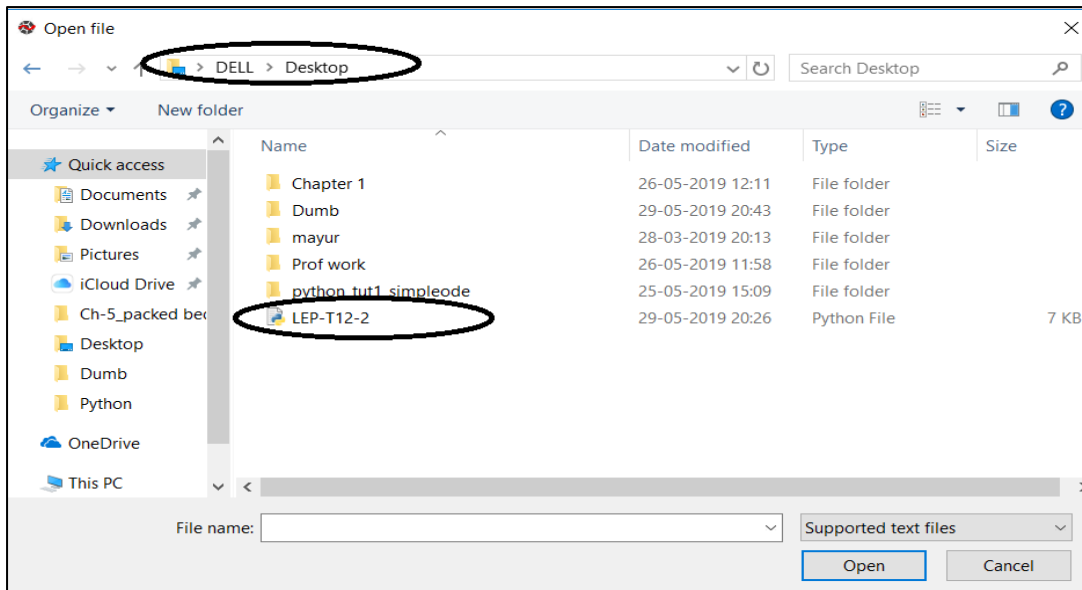
Step 7: Executing the File

You will see that LEP-T12-2 is opened. Click on the run icon (▶) as indicated in the image below to run the code.


```python
#%%
#Libraries
import numpy as np
from scipy.integrate import odeint
import matplotlib.pyplot as plt
import matplotlib as mpl
mpl.rcParams.update({'font.size': 18})
from matplotlib.widgets import Slider, Button

#%%
#Explicit equations
alpha = .0002
To = 330
Uarho = 0.5
Mc = 1000
Cpmc = 18
Hr = -20000
Fao = 5
thetaI = 1
CpI = 40
CpA = 20
thetaB = 1
CpB = 20
Cto = 0.3
Ea = 25000
def ODEfun(Yfuncvec, W, alpha,To, Uarho,Mc,Cpmc,Hr,
           Fao, thetaI, CpI, CpA, thetaB, CpB, Cto,Ea):
```
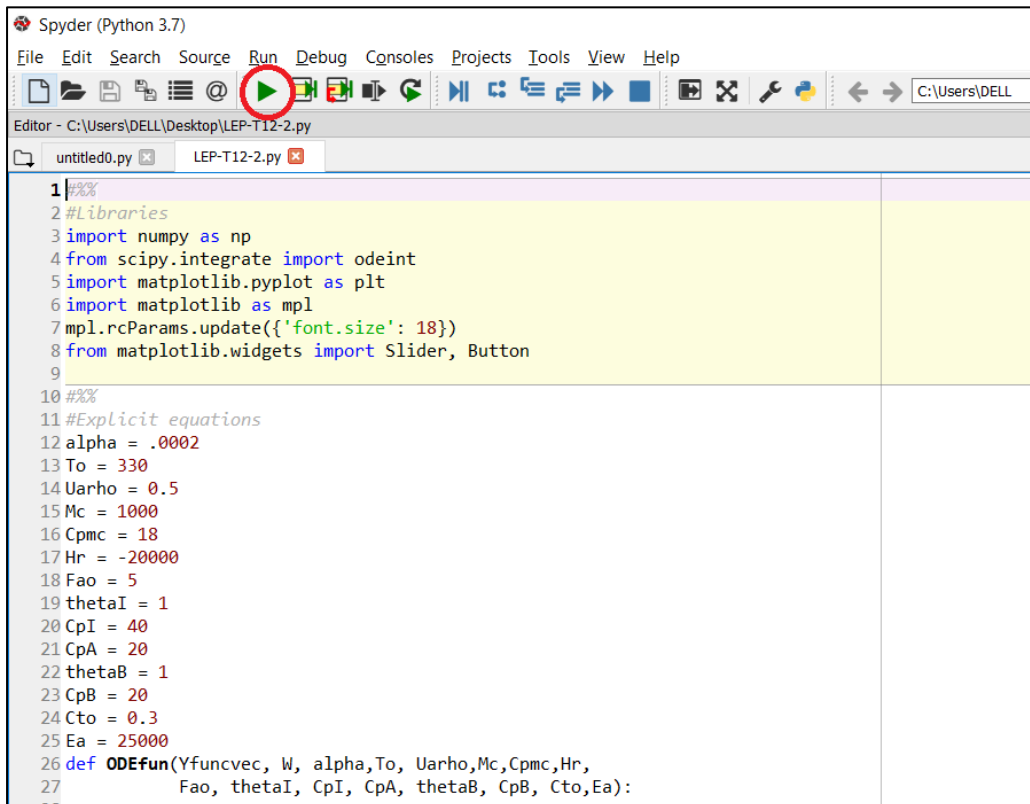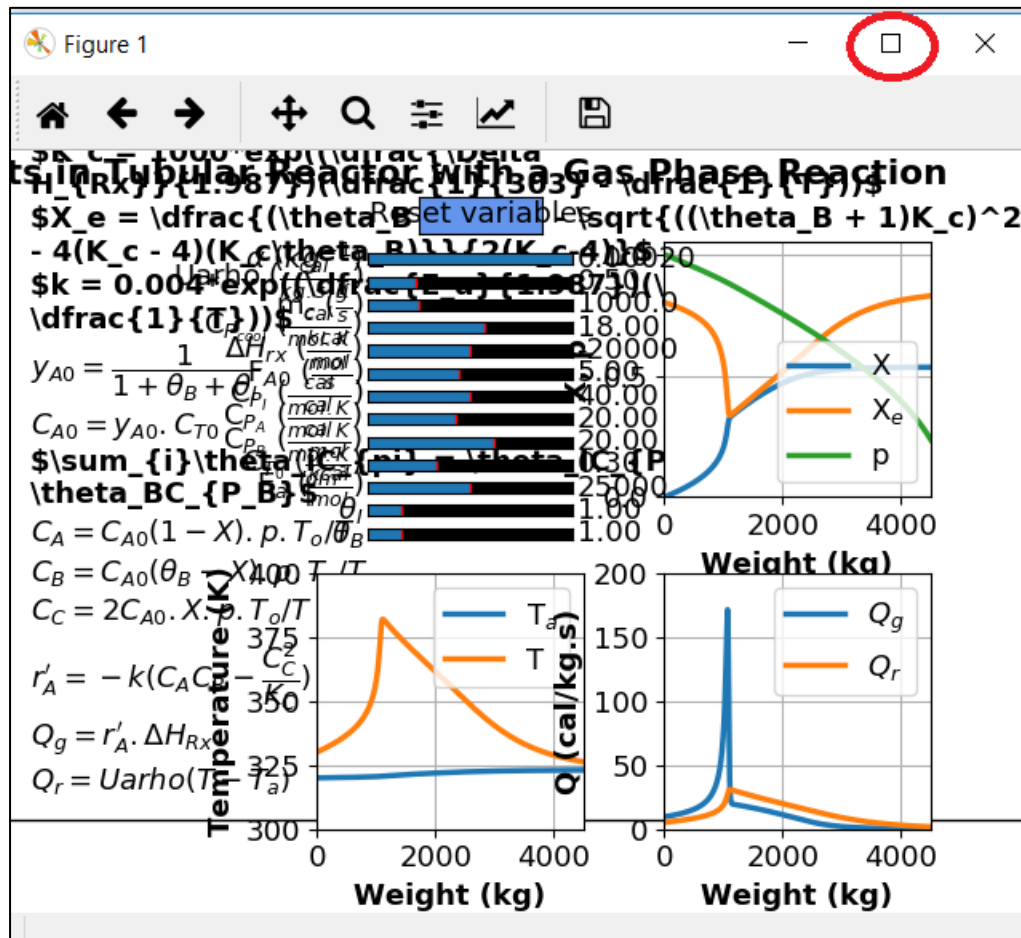
Now look for a new spyder window in the taskbar (shown below by red circle). Click on it to open this file which contains graph.


You will see a window (as shown below) displaying interactive Conversion, Temperature, & Heat profiles.
Click on Maximize button to generate the full graph size.

You will see following window. On the top left zone, you can see all the variables that you can play with and see the simultaneous effects on various graphs. You can also see a "Reset variables" button which initializes the variable values.
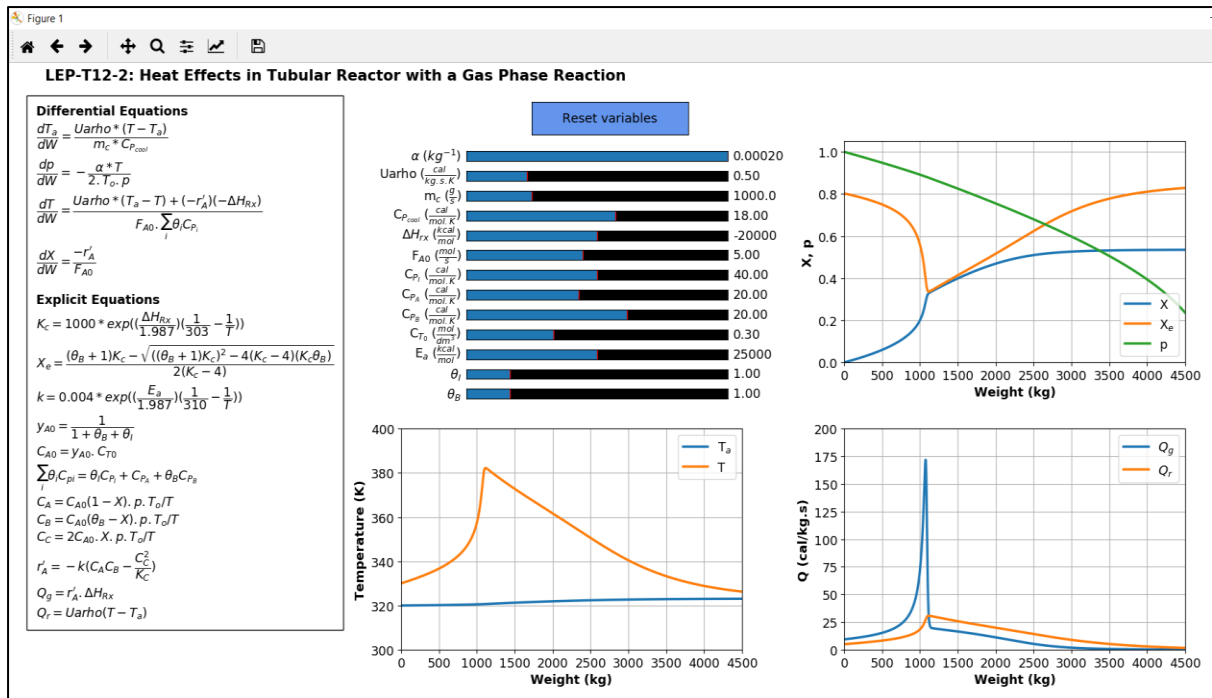

Step 8: Playing with Variables

Change the variable values by shifting slider on slider bar (with your mouse or touchpad). Observe the changes on the different plots. As you change the variable values, you can view the current value of variables by looking at the corresponding values displayed at the end of each slider (shown below by red rectangle)
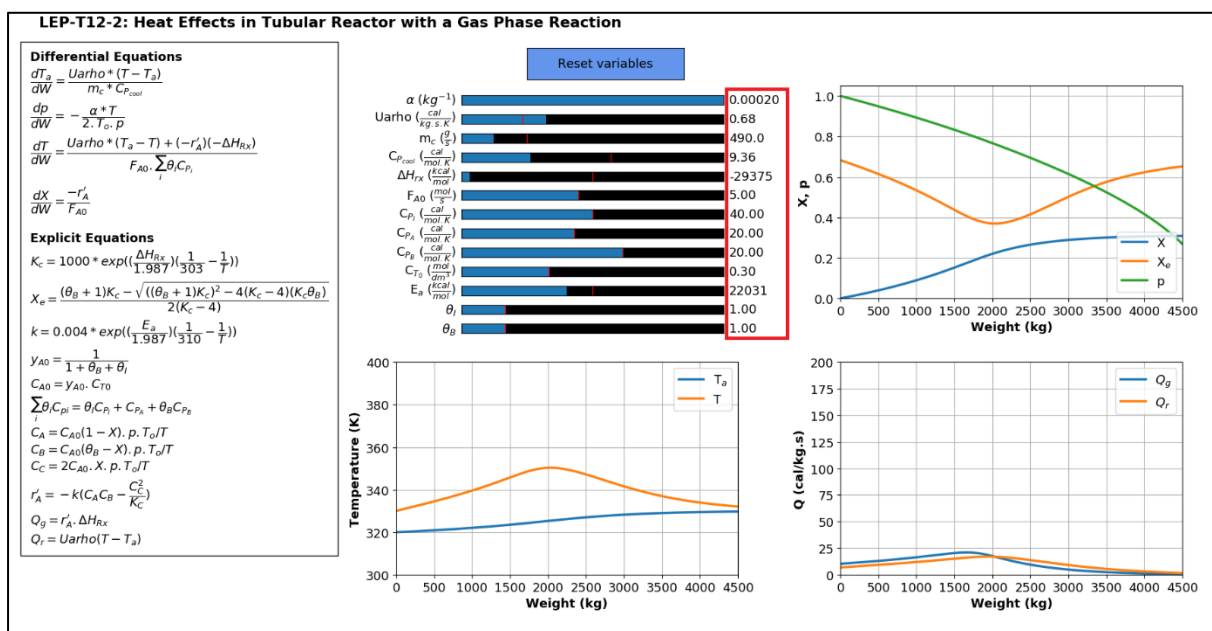
Step 9: Reset Variables

If you wish to go back to the initial values of the variables, you can click on "Reset variables" button to initialize all the variables. This would change the values of all the variables to their initial values as shown below. You can see that after clicking "Reset variables" button, the graph becomes same as that of Step 7.
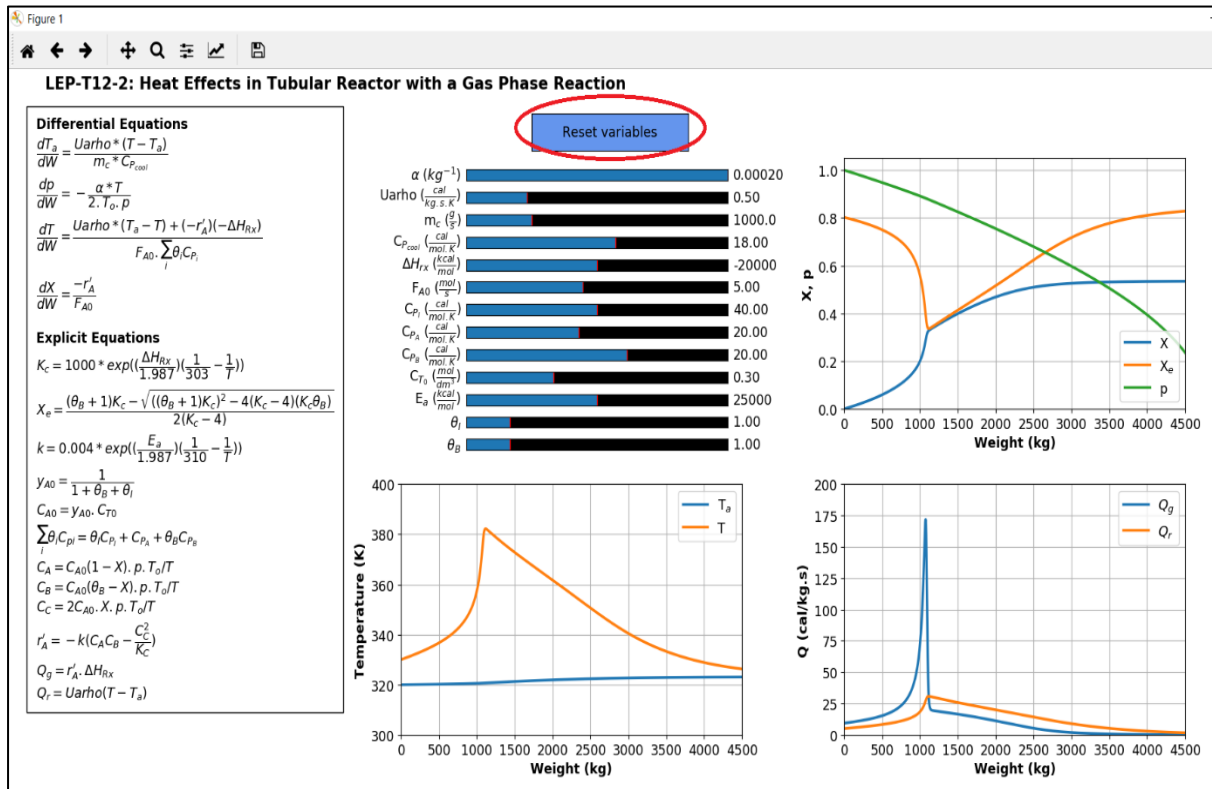
Step 10: Play

Change different variables and observe the change in various graphs. Draw your conclusions.