Assignment7

October 2, 2016

EE1103 Numerical Methods
Assignment 7
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We first import numpy and matplotlib using pylab, and increase the size of the plots.

In [1]:
```
# Importing matplotlib and numpy directly
# Python 2.7
%pylab inline
rcParams['figure.figsize'] = 12, 9 # Increase size of plots
rcParams['font.size'] = 20 # Increase font size in plots
```

```
Populating the interactive namespace from numpy and matplotlib
```

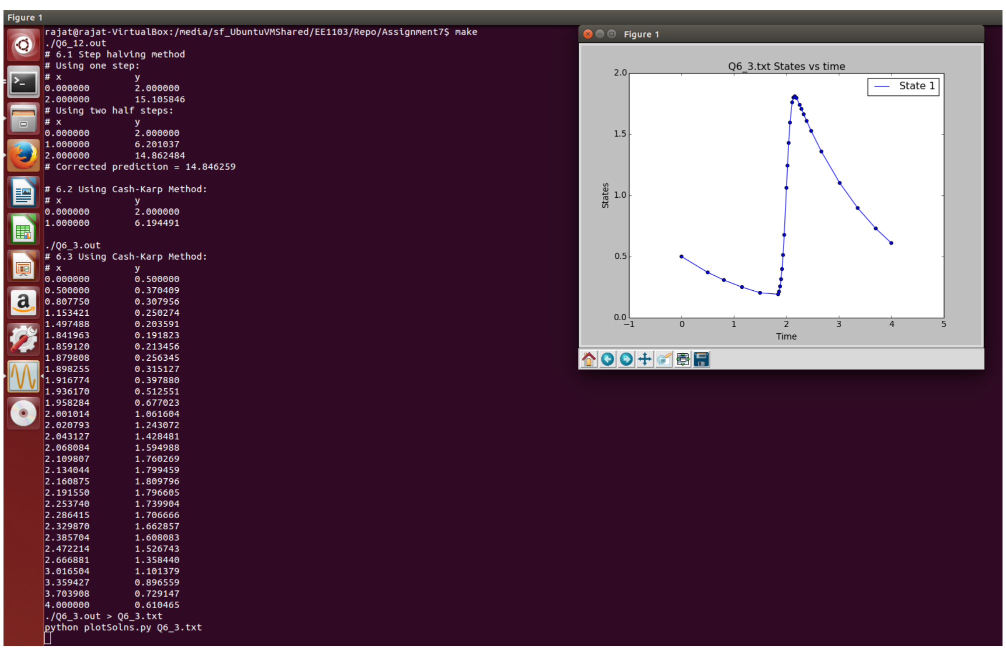
In [2]:
```
def plotData(s):
    plt = matplotlib.pyplot
    # Open the file
    fo = open(s, 'r')

    # Read lines ignoring those that begin with '#'
    lines = fo.read().split("\n")
    lines = [x.strip() for x in lines if len(x) != 0 and x[0] != '#']

    # Close the file
    fo.close()

    # List of time instants
    t = []

    # List of state vectors
    states = []

    for i in lines:

        # Separate the columns
```

```
        values = i.split("\t")

        # First column contains time instants
        t.append(float(values[0]))

        # Add each successive column as a new state in the state vector
        states.append([float(i) for i in values[1:]])

    # Plot the data
    plt.plot(t,states)
    plt.scatter(t,states)
    plt.xlabel("Time")
    plt.ylabel("States")
    plt.title(s+" States vs time")
    plt.legend(["State "+str(i) for i in range(1,len(states[0])+1,1)])
    plt.show()
```

0.0.1 Answers to the questions

Please run make before running this notebook as the graphs cannot be plotted without the text files generated by make.

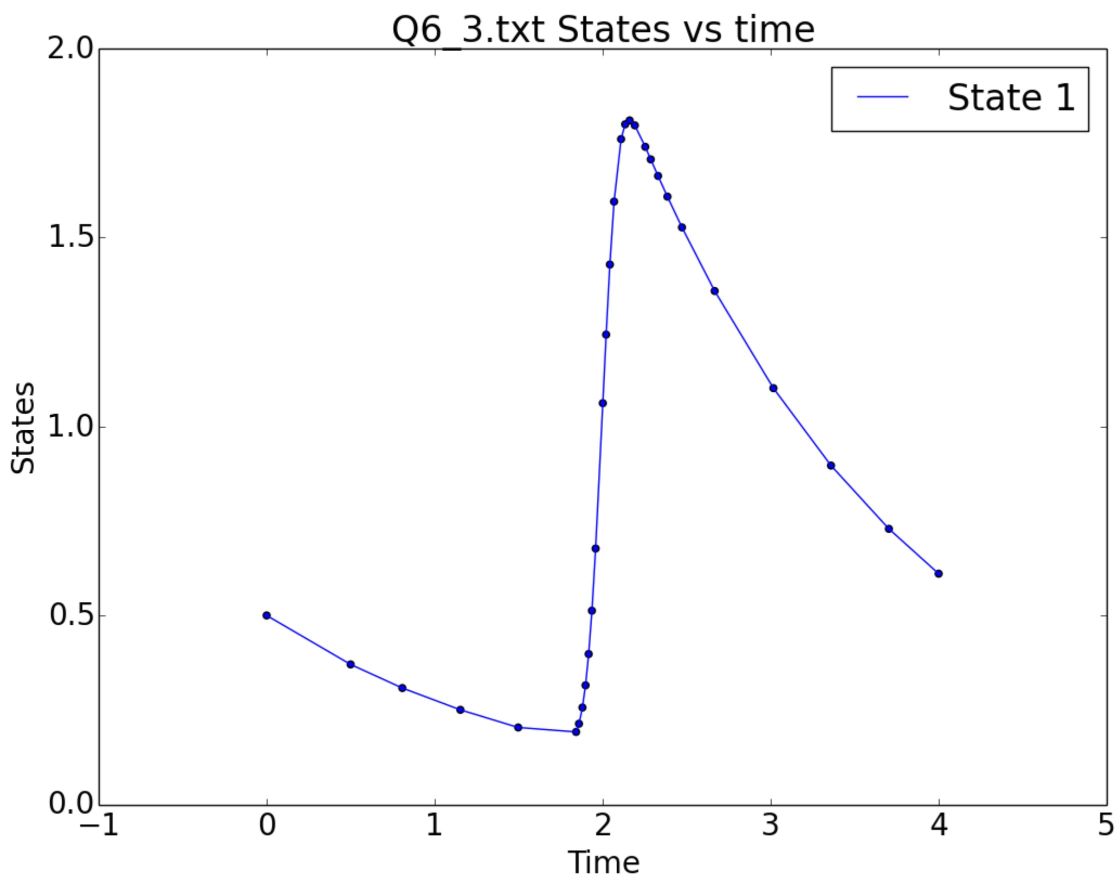
6.1 and 6.2 The tabulation of the results obtained from solving the differential equations is shown in the image below. It also contains the tabulation and plot for question **6.3**.



Output

6.3 The Cash-Karp variant of the adaptive Runge-Kutta 4-5 method was used to solve the differential equation with a relative tolerance of $\epsilon = 10^{-7}$. The plot of the resulting solution is given below:

```
In [3]: plotData("Q6_3.txt")
```



It is clear from this plot that the stepsize is small in regions of high curvature (around $t = 2$) and relatively large in regions of low curvature(around $t = 1$ and $t = 3$), which verifies that the stepsize adjustment is in order.

```
In [ ]:
```