Using Matlab with Euler's Method: ODE, Spr 04

"Matlab" is a numerical mathematics package that is available in the mathematics computer lab. We will use it to examine numerical solutions to differential equations.

- To start: Go to the math lab and login. At the bottom left of your screen, you'll see a "shell"- press it. In the shell window, type: `matlab`
- In the Matlab opening screen, there are several windows. There is a record of the commands you type (the history window), and some others. The most important one is the command window.

  I will give you Matlab files to download and run. In order to view and edit these, you'll type `edit` in the command window, and this will bring up an editor.

  Always save these files as `filename.m` For example, our first code will be `euler.m` We'll talk about how to run this function in class.

- A first example: Solve $y' = 1 - t - 4y, \;\; y(0) = 1$ for $0 \leq t \leq 2$ using step size $h = 0.05$.
  - Download (right-click and "Save link target as...") `euler.m` from the class website.
  - In the command window, type `edit euler.m`
  - Scroll down until you see the line after `function dy=f(t,y)`. This is where you define the differential equation. Type:

    ```
    dy=1-t+4*y;
    ```

  - Save the file
  - In the command window, type:

    ```
    [t,y]=euler(0,2,0.05,1);
    ```

  - You'll see that arrays t and y were created. Let's plot them: `plot(t,y)`
  - Now suppose we want to compare this with the solution using $h = 0.001$. We'll re-run the `euler`:

    ```
    [tt,yy]=euler(0,2,0.001,1);
    ```

  - Plot the two results together:

    ```
    plot(t,y,tt,yy)
    ```

- It is useful to be able to get a printout of the values produced by this method. Use `eulerprint.m` which will output a text file, `output.txt` which will contain three columns: time, y, and y'. Run this on our previous example:

  ```
  [t,y]=eulerprint(0,2,0.05,1);
  ```

Now you can use the editor to view `output.txt`.

HOMEWORK:

1. Compute Euler's method by hand 4 times with:

$$y' = 2y - 3t, \;\; y(0) = 1 \;\; h = 0.1$$

2. Use `eulerprint` to do problems 5, 6 on page 427. If you're not sure how to enter the differential equation, please ask!

   Plot the solution you get using the smallest stepsize.