Numerical Methods and `.m` Files

- In order to use MATLAB routines for the Euler, Improved Euler or Runge-Kutta Methods, you will need the files `eul.m`, `rk2.m` or `rk4.m`, respectively. These files are already present on all ITaP machines as standard software. (If using your own copy of MATLAB you may need to download these files from `http://math.rice.edu/~dfield`). You may also access these files from MATLAB via the *Software Remote*:

  `http://goremote.ics.purdue.edu`

- You must first create a function file in the same directory (or folder) as your MATLAB. Here is one way. After MATLAB has been opened, pull down the **File** menu and select **New M-File**. A window will pop up for you to create your function file. For example, to create a function file for the function $f(x, y) = 6x^3 - e^{2y} + \sqrt{x}/y$, type:

```
function W=fcn1(x,y)
W=6*x^3-exp(2*y)+sqrt(x)/y;
```

  (Don't forget the "`;`" at the end.)

- Save this file as a `.m` file with the **same** name as your function. The above example would be saved as `fcn1.m`. You can check if your function has been saved by typing something like the following at a MATLAB prompt: `fcn1(0,3)`

  You should get the value of $f(0, 3)$.

- Your initial value problem should have the form: $\begin{cases} y' = f(x,y) \\ y(x_0) = y_0 \end{cases}$.

  Assuming $f(x, y)$ was saved as the file `fcn1.m`, the syntax for `eul` (as well as `rk2` and `rk4`, just replace `eul`) will be:

```
eul('fcn1',[x0,xf],y0,h)
```

  where `x0` and `xf` denote the initial and final values of x, respectively, `y0` is the initial value of y, and `h` is the step size. (Your version of MATLAB may not utilize brackets. Type `help eul` to find out.) To approximate the actual solution to the IVP at `xf`, with given `h`, using `eul`, just type the following at a MATLAB prompt:

```
[x,y]=eul('fcn1',[x0,xf],y0,h);
```

  The approximations y_0, y_1, y_2, ..., y_n are stored in the matrix **y**

- To print them out, type: `[x,y]`

- To plot them, type: `plot(x,y)`