Differential Equations, Spring 2017
Computer Project 1, Due Friday, February 10

The goal of this assignment is to graph a slopefield. The following files should be uploaded to Computer Project 1 in Canvas:

slopefield.m

graphslopefield.m

Make sure the files have exactly these names, otherwise you might not get credit for them.

1. Consider the differential equation

$$\frac{dy}{dx} = f(x, y).$$

with

$$f(x, y) = \begin{cases} y(y - 2) & y \geq 0 \\ .5y^2 \cos x - y & y < 0. \end{cases}$$

Create the function $f(x, y)$ in a Matlab file called slopefield.m. (This means Matlab will refer to the function f as slopefield.) Since the function is defined piecewise, you will need to use an if statement to program it. Here is some code to get you started (you need to fill in the ...).

```
function val=slopefield(x,y)
    if y >=0
        val=...
    elseif y<0
        val=...
    end
end
```

2. Your next task is to create a script to graph a slope field for the function $f(x, y)$. The region for the slopefield should be $-4 < x < 4, -4 < y < 4$. The script should be called graphslopefield.m. Remember that a script is simply a bunch of Matlab commands, and it can be executed from the command window by typing in the name of the script.

Here is the basic idea of how to graph a slopefield: Generate a list of (x, y) points. Evaluate the function at each of the points to find the corresponding slopes, and draw a little line segment of the correct slope at each of the points. Here is some code to get you started. You need to fill in the .... Some of the commands are explained below.

```
xvals=linspace(-4,4,41);
yvals=linspace(-4,4,41);
```

```
hold on;
for x=xvals
    for y=yvals
        slope=slopefield(x,y);
        ...
        x1=...
        y1=...
        x2=...
        y2=...
        plot([x1 x2],[y1 y2],'b');
    end
end
```

The first two lines create the (x, y) values to use. The command `linspace(a,b,n)` returns a list of n evenly spaced numbers starting at a and ending at b. The command `hold on` tells Matlab to plot everything on the same graph. Then we have two `for ... end` loops, the first one loops over all entries in `xvals`, and the next one loops over all entries in `yvals`. In the interior of the for loops is a plot command which will plot a line segment from the point `(x1,y1)` to `(x2,y2)`. The `'b'` argument to `plot` tells Matlab to make all the line segments blue (otherwise they will be different colors). It is up to you to determine exactly how you want to calculate the points. The only requirement is that your final graph looks nice and is correct. (Part of looking nice is that the line segments should all be of the same length.) Now run your program by calling it from the command prompt:

> `graphslopefield`

This should cause a graph of the slope field to pop up (it might take a little while). You might want to adjust the size of the graph so that the x and y axes have the same scale (just drag the corner of the window to adjust the size). You can draw in some solution curves on a printout of the slope field if you want to.