

Professor Angela Gallegos wrote up this helpful handout for generating slope fields in Fall 2006.

Here are some sample differential equations to try and generate their slope fields:

$$\frac{dy}{dt} = t^2 + t; \quad \frac{dy}{dt} = y + t + 1; \quad \frac{dy}{dt} = 2y(1 - y).$$

Have fun!

Using Matlab...

The school computer labs in Fowler *should* be equipped with Matlab. John Polking at Rice University has created a Matlab code that generates slope fields for differential equations. You can gain access to this code by typing

```
dfield
```

into Google. “ODE Software for MATLAB” should be the first link that pops up. Click on it. (Alternatively, you can directly head to the website: <http://math.rice.edu/~dfield/>.) Click on the link

For use with version 7.0 of MATLAB

and then click on the link

```
dfield7.m
```

and save the file to your computer. Please be aware of the location you saved it to.

Now you can open Matlab on your computer. Look under

Start--> All Programs--> Mathematics --> MATLAB.

Once you have the Matlab window open, you should see a three part GUI window. The right most and largest window is the command window. Above it is a box that describes the current directory. Change **Current Directory** to the same directory where you saved the file dfield7. For example, if you saved the file to your desktop, make sure you have changed the Matlab working directory to the desktop. At the prompt in the command window which looks like

```
>>
```

type

```
dfield7
```

and hit return. A GUI window should open up in which you can type the differential equation you are interested in and set the variable range over which you can see it. When you have entered the expression, click on proceed and your slope field should pop up. You can click on any point in the slope field window and a solution trajectory should be drawn. (You can erase the solutions by going to **Edit --> Erase all solutions.**) Be careful to use Matlab syntax. For example, if you want to see the slope field for the differential equation

$$\frac{dx}{dt} = x^2\sqrt{t},$$

enter the text:

$$x^2 \sqrt{t}$$

Have fun!

Using your text cd...

To use your cd, insert it and follow the installation wizard for the appropriate system you are running on your computer. If you install the cd contents to the default directory and you are running a Windows system, you should be able to start the program by looking under **Start--> All Programs--> BDH Differential Equations--> Differential Equations.**

However, for now, a copy of this file should be stored on the S drive. Go to

Start--> My Computer-->S ('stuserver')--> Math Courses--> Math 341.

Then you can double click on

Differential Equations.exe

Once you open that program, a window should pop up with lots of program names listed. You are interested in the one called **HPGSolver**. Click on it. Again, a window should pop up which allows you to enter the differential equation you are interested in over your variable range of interest. When you are authoring a differential equation expression, a guide will pop up that shows you the syntax for several different mathematical expressions. Again the $\hat{=}$ is used for exponentiation and the $\hat{*}$ is used for multiplication. After you have entered the differential equation, click on **Show Field** and the slope field should appear. The default settings will allow you to generate solutions by clicking on a point in the window. You can click on the button next to **Draw Slopes** in order to draw just the slope at a point instead of the solution. Try drawing slopes when the slope field is not shown (you can hide your slope field by clicking on **Hide Field** while the slope field is on display. How many do you have to click on to get an idea of what the slope field looks like? Aren't you glad you are not drawing it by hand!

Using the online "Slope field calculator"...

Search

slope field calculator

(3 separate words) in Google. The first link at the very top of the page is the one you want. It should link you to

alamos.math.arizona.edu/ODEApplet/JODEApplet.html.

Click on the link. The slope field calculator (via a java applet) should be before you. It is very similar in its setup to the other two windows you have seen. The syntax is the same for entering the differential equation you are interested in (i.e. \sqrt{x} for square root of x ; $x*y$ for the product xy). Click on the button **Submit All** after you have made changes. And if you click on a point in the display window once the slope field you want is generated, the corresponding solution will be drawn. You can click on **Clear All** to erase the solutions you have drawn in the window.

Given the choice of the three technologies, you should use the one that is easiest or most convenient for you when generating slope fields. All will allow printing and will be useful for your homework. Enjoy!