Lesson 43 - Slope Fields I

Objectives

- Create a slope field for a given first order differential equation.
- Given an initial condition, approximate a solution to a first order differential equation using a slope field.
- Discuss the long term behavior of a first order differential equation based on what the slope field looks like.
- Use a differential equation to model the temperature of an object with Newton's Law of Cooling.

READ

- Stewart, Chapter 9.2, pages 572-575
- Stewart, Chapter 3.8, pages 237-238

THINK ABOUT

- Why use a graphical solution instead of a computed function?
- Can a graphical solution tell you more than a function can tell you?

MATHEMATICA COMMANDS AND TASKS YOU NEED TO KNOW

We are going to use a package that you will need to install in order to create slope fields. Follow these directions exactly.

1. Go to the MA205 WebSite and download the DETools.zip file. Save it to your desktop.
2. Right Click the icon, then left click on "Extract All", and left click on "Next".
3. When the window pops up left click on "Browse".
4. Left click "c:". Left click "program files".
5. Left click "Wolfram Research" then Left click "Mathematica".
6. Left click "6.0" then Left click "addons"
7. Now, Left click "Applications", Left click "OK", Left click "Next", and Left click "Finish".
8. A window should pop up that shows the applications folder. You should now see a DiffEqs folder listed.

Mathematica 5.2 users may follow the below additional steps.

9. Launch Mathematica 5.2. Left click "Help" (on toolbar), and left click "Rebuild Help Index" at the bottom.
10. Bring up the help browser.
11. Select "Add Ons" tab at the top.
12. Type in "Diff". You should now see the package and its documentation should also be displayed.

MATHEMATICA COMMANDS AND TASKS YOU NEED TO KNOW CONT.

Here is a test example:
Enter in the command:

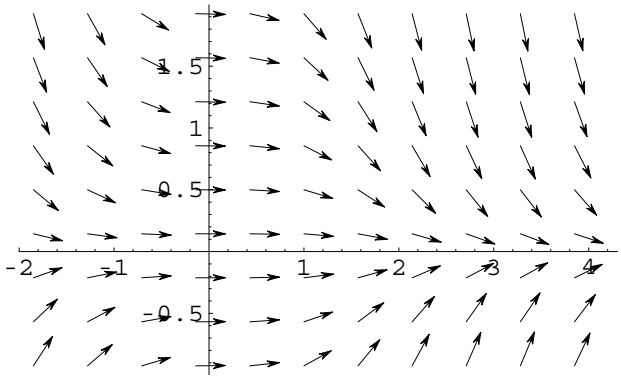
```
<< DiffEqs`DEGraphics`
```

Note: The marks used in the above syntax are not single quotation marks next to the "ENTER" key. These marks are the accents located on the key above the "TAB" key and below the "ESC" key on the left side of the keyboard.

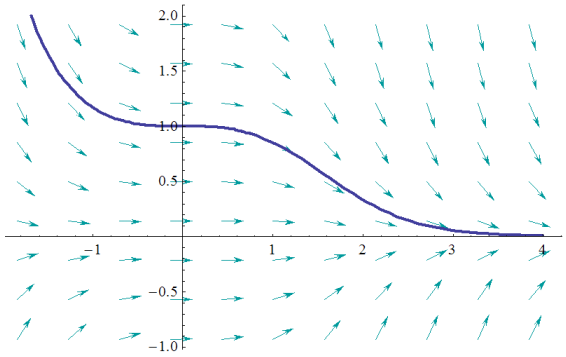
In order to plot the slope field for the differential equation $\frac{dy}{dt} = y\cos t - y$, enter in the following:

```
DEPlot[y Cos[t] - y, {t, -2, 4}, {y, -1, 2}, InitialPoints → None]
```

What you should see is:



This command will also sketch a sample of a few potential solution curves, if the `InitialPoints-->None` is not used. Further, to sketch a particular solution for a specific initial condition, you can input that initial condition here. For example, for the initial condition $x = 0$, $y = 1$, then enter the command:

```
DEPlot[y*Cos[t] - y, {t, -2, 4}, {y, -1, 2}, InitialPoints → {{0, 1}}]
```

which results in the figure: