

Short manual for dfield

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This document describes how to use the matlab program *dfield8.m* to compute the direction field and solutions for first-order differential equations.

Where do I find this program ? First determine the version of matlab you have by starting matlab and clicking on *HELP*→*About Matlab*.

- Those students using the latest version of matlab7 (v. 7.7) must download *dfield8.m* and *pplane8.m* (which will be used later in the course) from the web address <http://math.rice.edu/~dfield/#8.0>.
- Those students using earlier versions of matlab7 must download *dfield7.m* and *pplane7.m* (which will be used later in the course) from the web address <http://math.rice.edu/~dfield/#7.0>.

Start matlab and set the working directory to be the folder into which you downloaded the program. To start dfield simply type *dfield8* (or *dfield7*), in the matlab command window.

How do I use this program ? This manual shows how to use dfield on problem 12 of the textbook's Section 1.1 written in the form

$$y' = -y(A - y), \quad A = 5$$

When dfield starts it displays the default Setup window with one of the examples (available under *Gallery*) already loaded. Edit the entries in this Setup window to look like Figure 1 and press Proceed.

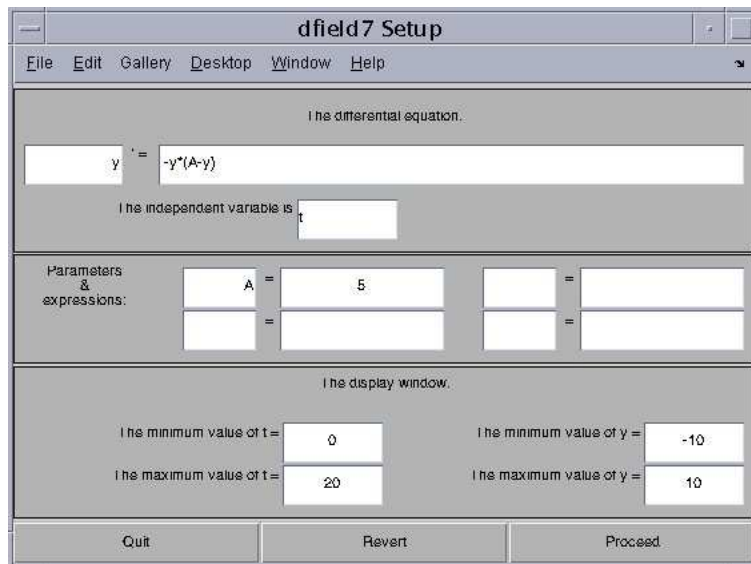


Figure 1: Setup window

The Display window, Figure 2, will appear. The line segments represent the slope of the straight line tangent to the integral curves (solutions) of the differential equation. The collection of these line segments is the direction field of the differential equation for the range of y and t values chosen in the Setup window. To fill up the Display window with more line segments (to better see the

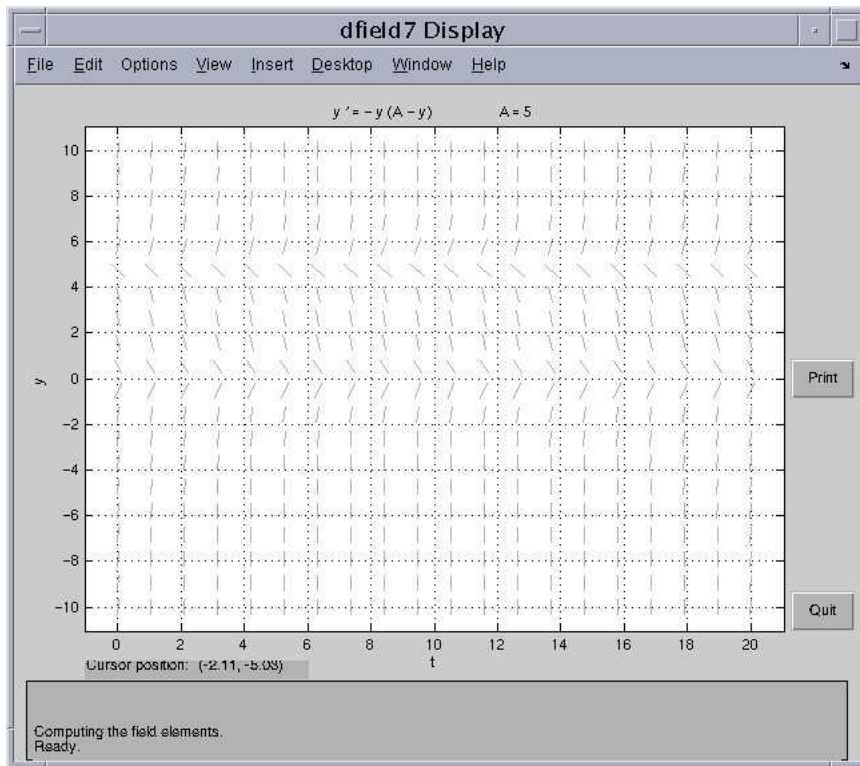


Figure 2: Display window

direction field) in the form of arrows (which indicate the orientation of the solution curves) go to *Options*→*Window Settings* and edit the pop-up window, Figure 3 in this document, to look like the one shown in the Figure. Press Change Settings and observe the changes in the Display window (Figure 4).

Before you compute a solution that will satisfy a given initial condition go to *Options*→*Solution Direction* and choose *Forward*. Then, go to *Options*→*Keyboard Input* and set the initial condition as shown in Figure 5. Press Compute. The Display window will now show the solution (Figure 6). You can repeat this with various initial conditions to see what happens.

Dfield can also compute, and display in its Display window, level curves of the right-hand side of the differential equation, $-y(A - y)$ in our example. These are curves on the solution plane (the $t - y$ plane here) on which the slope of the solution, $\frac{dy}{dt}$, is equal to a constant. To do this go to *Options*→*Plot Level Curves* and edit the pop-up window so that it looks like Figure 7. Press Proceed and see what happens in the Display Window (Figure 8). Note that what you will see is different than what's shown on Figure 8 here because I removed the solution curve before plotting

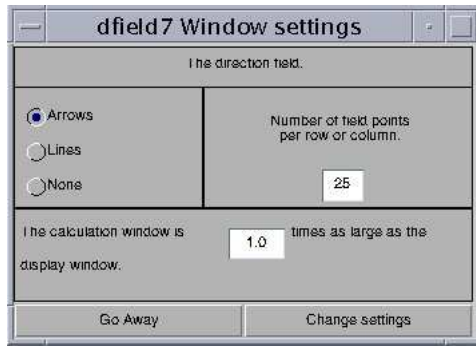


Figure 3: Window Settings window

the level curves. This removal was done through the *Edit* button via which you can remove solution curves, level curves, etc., should the graph become too crowded.

It will be useful to you to save what you entered in the Setup window so that it can be re-loaded later if the need arises. To do this go to *File*→*Save the Current Equation* in the Setup window. When you restart matlab and dfield you can re-load the differential equation into the Setup window by doing *File*→*Load an Equation*.

CAUTION: if you quit dfield and then restart it in the same matlab session you will likely encounter errors/etc. So, if you quit dfield and want to restart it, issue a *close all* and then a *clear all* in the command window. Then restart dfield.

What do I do with the graphs ? Print them out and include them in your computational assignment write-up. However, the graphs must be presentable and this is accomplished by editing the graph displayed in the Display window using the graph editing capability of matlab which is available on the Display window through its *View* menu.

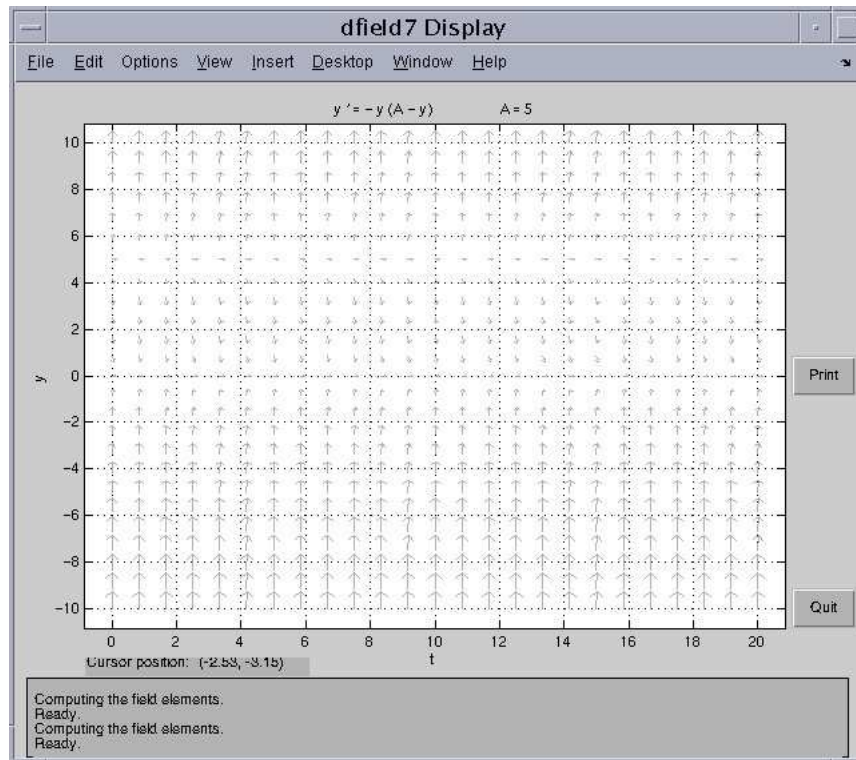


Figure 4: Display window



Figure 5: Keyboard Input window

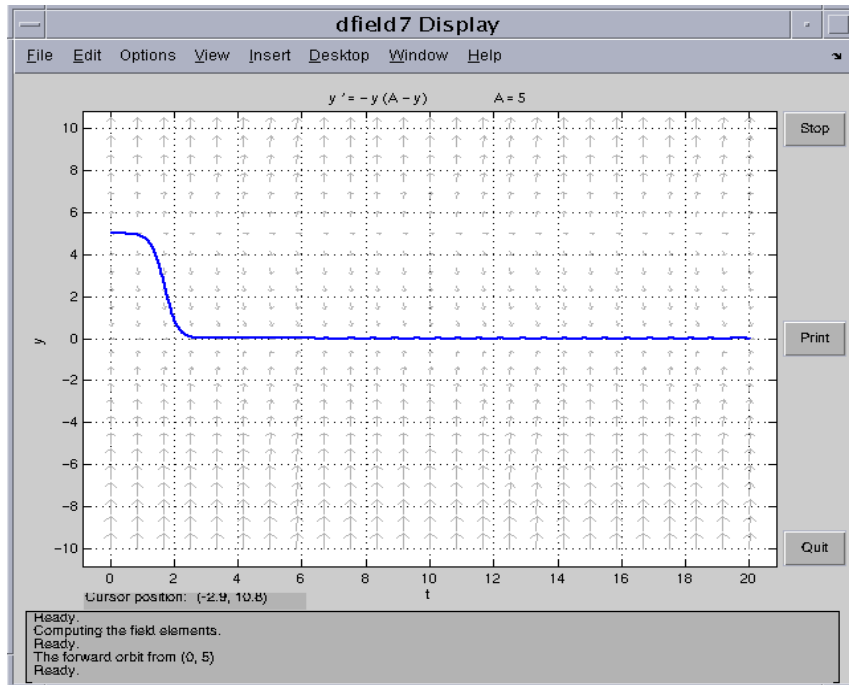


Figure 6: Display window

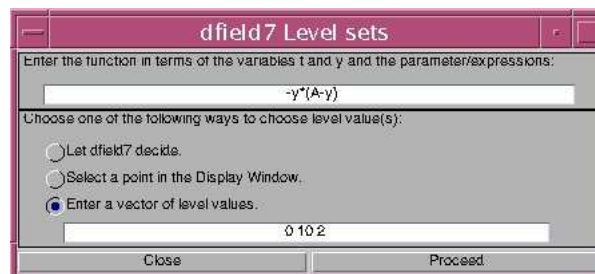


Figure 7: Level Sets window

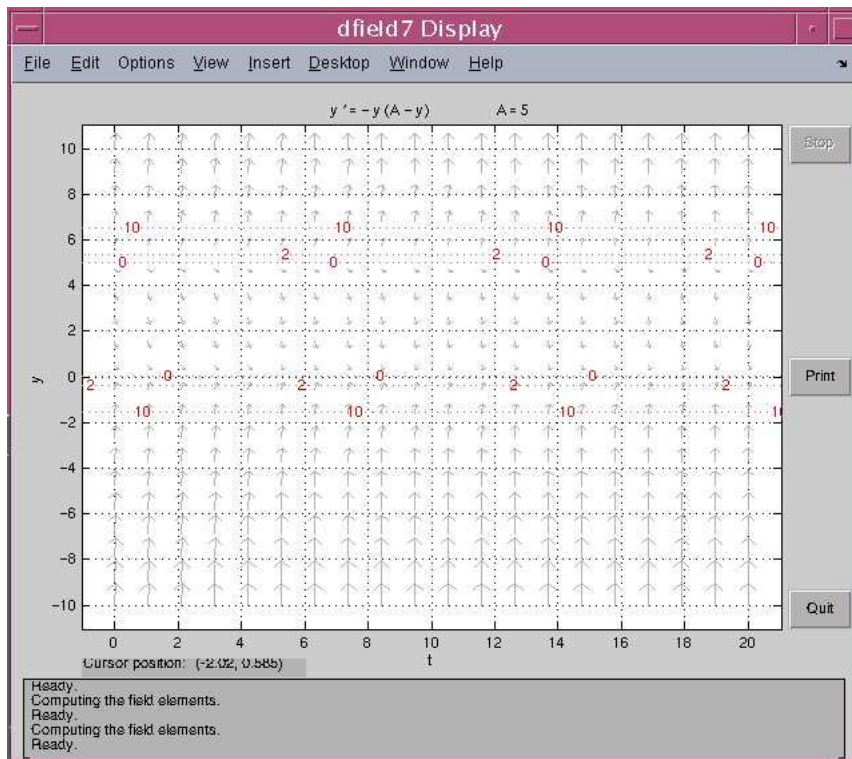


Figure 8: Display window