

Tutorial - Matlab and pplane

This homework aims to help you install Matlab on your personal computer, as well as experiment with the numerical tool *pplane8* to create phase portraits. You do not need to turn anything in, but you are encouraged to explore the tool as it may be useful later in the course.

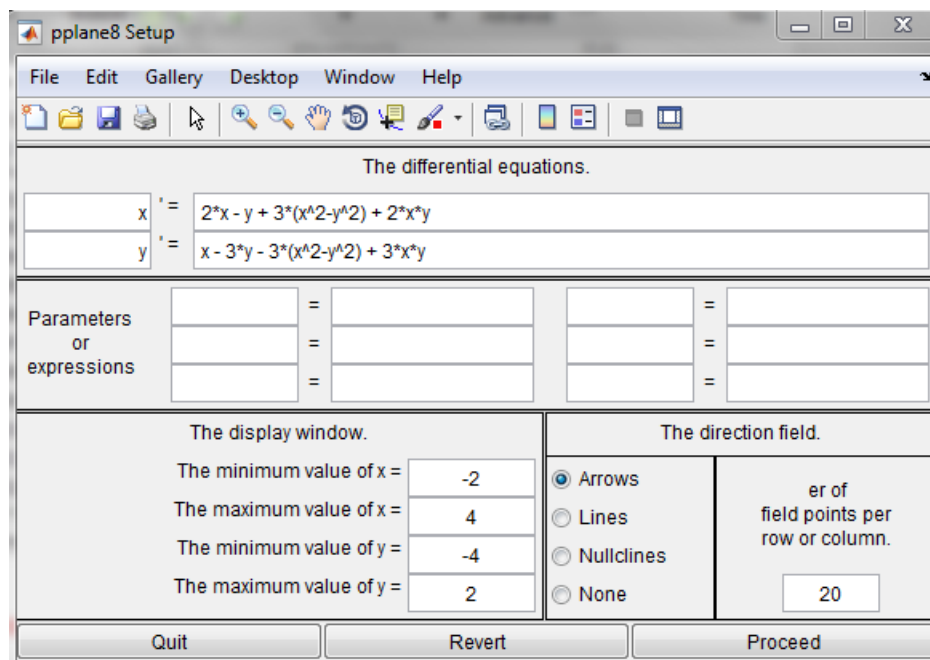
Matlab tutorial

Follow along the *matlab_tutorial.pdf* file that you can find under *Files/Resources* on Canvas. This explains how you can install Matlab from the Brown software catalog.

It also provides a few sections on how to use Matlab if you are new to it. Go through all of it if you can, and in particular, you may find the sections on Numbers, Linear Algebra and Plotting (in 2 dimensions) useful in getting some familiarity with Matlab.

Phase portraits with pplane8

Download the script *pplane8.m*, which has been developed by John C Polking at Rice University, from the Canvas page (*Files/Resources*) and save it on your computer. Start Matlab and change your working folder to the folder in which you saved *pplane8.m*. Next, type “pplane8” in Matlab: the Setup window will pop up in which you can enter differential equations in the plane and any parameters that appear in these equations.



Now suppose we want to look at the phase portrait for Example 7 considered in class:

$$\mathbf{x}' = \begin{pmatrix} 7 & 1 \\ -4 & 3 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 7x_1 + x_2 \\ -4x_1 + 3x_2 \end{pmatrix}. \quad (1)$$

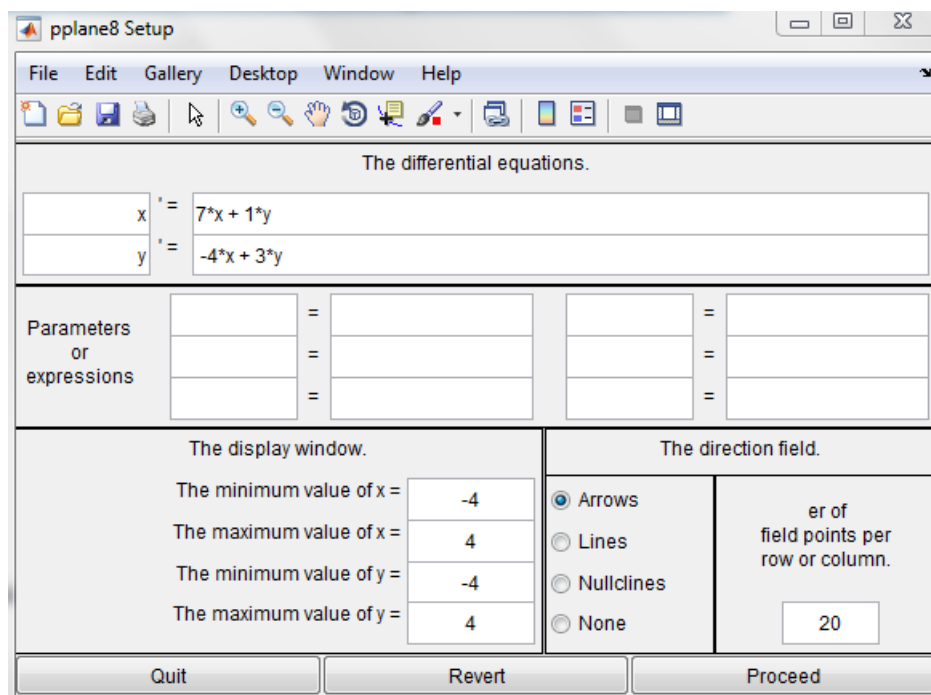
In *pplane*, the variables have the different names

$$x = x_1,$$

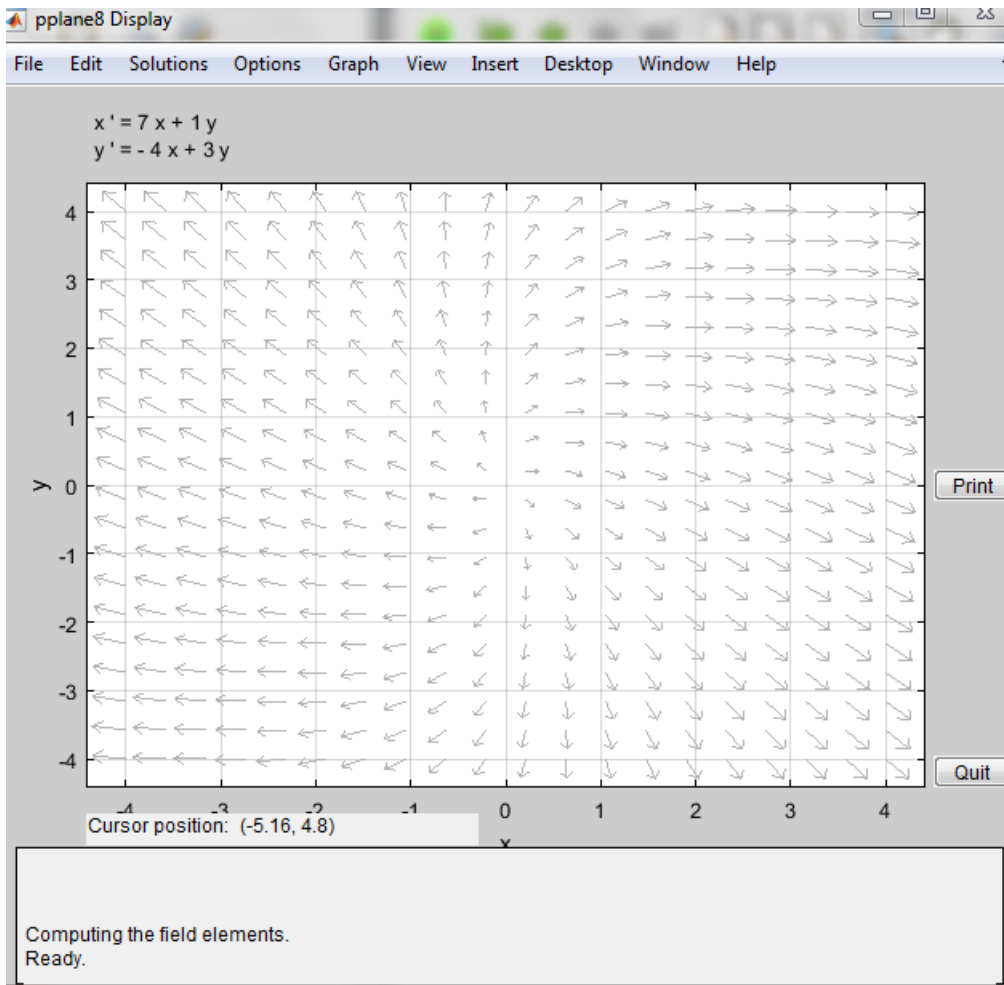
$$y = x_2.$$

Type the equation for x'_1 in the x' field, and the one for x'_2 in the y' field. You can also set the minimum and maximum values for x and y , which correspond to how long the x and y axes will be when displayed. You can set a parameter, such as α instead of 7 in the first differential equation, and vary the value of α in the parameters box.

To save the differential equations into your working folder, choose “File → Save the current system” from the menubar, which allows you to reuse your equations later by selecting “File → Load a system...”.



Clicking on “Proceed” will take you to a window with the phase portrait of our differential equation:



From the menubar, select “Options → Solution direction → Forward” so that pplane solves only in forward time. Then click anywhere in the window to compute the trajectory with the chosen initial condition.

Recall that one of the limitations of *pplane* is that it can solve only planar systems.