This activity will introduce some components of MATLAB that we will use most often in this course. You'll need to navigate to the Handouts folder and download the file called "`introMATLAB_worksheet`" to your local directory.

Consider the following differential equation

$$\frac{dy}{dt} = f(y) = \frac{1}{24} y\,(22 - y)$$

1. Plot $f(y)$ vs y in two ways:
   (a) Define the derivative $f(y)$ as a function handle and plot $f(y)$ vs y for $y \in [-10,\ 40]$ using `plot`. Can you produce a green dashed line of width 3? Make sure to label the axes too.
   (b) Now, we can also make the same plot using the `fplot` function. Use the `help` documentation to figure out how to use this function. Recreate the plot above using `fplot` instead of `plot`.
   (c) Write a couple of sentences describing the difference between `plot` and `fplot`. When would you use one over the other?
2. Now let's plot the direction field. The code to do this is already in the live script, but you will explore the different components.
   (a) Notice that the first line of code calls the `meshgrid` function. Once you run this line of code, you will see two matrices in the workspace. What do T and Y look like? Why? What does `meshgrid` do? Try looking at the `help` documentation and changing the arguments of `meshgrid` to see how T and Y change.
   (b) The next line of code is meant to evaluate the derivative at each entry of T and Y. Make sure that you have previously defined f as a function handle.
   (c) Now, we call the `quiver` function to plot arrows at each point of the ty plane to describe the direction of motion (the evaluation of the derivative at that point). Run this section of code. What do you notice about the size of the arrows? Why?
   (d) We can create unit vectors so that each vector is of length one. To do that, we will define a length as follows `L = sqrt(1 + F.^2)`. Then, to create unit vectors, we divide each component of the vector by its length: `quiver(T,Y,1./L,F./L,0.5)`.
   (e) Write a couple of sentences describing why direction fields are useful and what they can tell us about our differential equation and its solutions.
3. Make a table of United States census data.
   (a) Use the `table` function to make of table of the census data.
   (b) Plot the census population as disconnected points over the time frame 1790 – 2020. On top of those points, plot the logistic function

$$P(t) = \frac{355}{1 + e^{56.5 - .029t}}$$

   . Include a legend and label the axes.
4. Save your live script as a pdf by clicking on the arrow beneath save and choosing "export to pdf." Print out the pdf file and submit it in class. Make sure that you click the button that puts the output **beneath the code**.