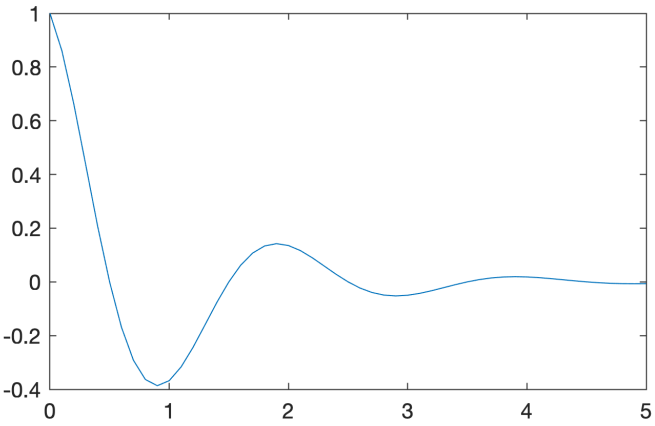
1. Check out MATLAB for UBC Mathematics to learn about plotting functions and creating MATLAB figures. The basic procedure to plot the graph of a function $y = f(x)$ is:

   1. Create a vector `x` of $x$ values using `a:h:b` or `linspace(a,b,N)`
   2. Create a vector `y` of $y$ values using vector operations and functions on `x`
   3. Create the plot with the command `plot(x,y)`
   4. Save the figure with command `savefig`

   For example, the following script plots the function $y = e^{-x}\cos(\pi x)$:

```
x = 0:0.1:5;
y = exp(-x).*cos(pi*x);
plot(x,y)
savefig('example.fig')
```




   Consider the first order differential equation

$$y' = \pi y \sin(\pi x) \ , \quad y(0) = 1$$

   Solve the equation and copy/paste/modify the script above to plot the unique solution $y(x)$ for $0 \le x \le 20$ and save the figure as `hw1figure1.fig`. Make sure to use sufficiently many points to plot the solution smoothly.

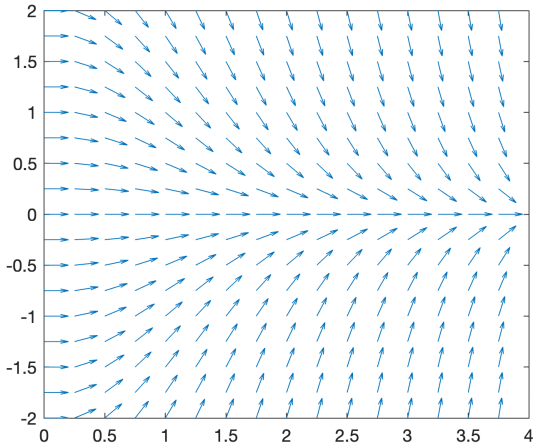
2. Copy/paste/modify the script from the previous question to plot the unique solution of the equation

$$y' + y = e^{-3t} \ , \quad y(0) = 0$$

   over the interval $0 \le t \le 10$ and save the figure as `hw1figure2.fig`.

3. Check out MATLAB for UBC Mathematics to learn about plotting slope fields. The function `slopefield` plots the slope field of a first order differential equation (scroll to bottom of page to find the source code). Create the file `slopefield.m` in your MATLAB development environment, copy-paste the source code into `slopefield.m`, and run the following script:

```
f = @(t,y) -t.*y;
t = 0:0.25:4;
y = -2:0.25:2;
slopefield(f,t,y);
savefig('example.fig')
```




The script above accomplishes the following tasks:

- Define the right hand side of the equation $y' = -ty$ as a function $f(t, y) = -ty$
- Define vector `t` of $t$ values over the interval $0 \leq t \leq 4$ using step size 0.25
- Define vector `y` of $y$ values over the interval $-2 \leq y \leq 2$ using step size 0.25
- Plot the slope field of the equation $y' = -ty$ over the corresponding region
- Save the figure as `example.fig`

Consider the first order differential equation

$$y' = y^2 - 2t$$

The equation is neither linear nor separable therefore we do not have any methods to solve it. But we can always plot the slope field to make qualitative observations about solutions.

(a) Use the function `slopefield` to plot the slope field of the equation above over the intervals $0 \leq t \leq 6$ and $-1 \leq y \leq 3.5$ with grid step size 0.2 in both directions. Save the figure as `hw1figure3.fig`.

(b) Estimate $\alpha$ (accurate to 1 decimal place) such that if $y(t)$ is any solution such that $y(0) > \alpha$ then

$$\lim_{t \to \infty} y(t) = +\infty$$

Save the value as `hw1alpha` in a file called `hw1.mat`. Note that it may be helpful to use trial and error to plot the slope field in a small region near the initial value $\alpha$.