MAT 22B Application 1 (Due 8/10 11:59 PM)

The goal of this assignment is to get familiar with MATLAB and how to plot functions and direction fields. Note that these instructions are specific to MATLAB, but you are welcome to use any programming language you prefer.

1. Create a MATLAB script, and at the top of the script write down the assignment name, date, and group member names. % will comment out a line. %{ $\cdots$ }% will comment out a block.
2. Create a grid of 101 points on $[0, 1]$ using the linspace function[1].
3. Create an anonymous fuction[2] that computes
   (a) $f(x) = \sin(2\pi x)$
   (b) $g(x) = \cos(2\pi x)$
   (c) $h(x) = e^x$
4. Create a vector for each of f, g, and h where the function is evaluted at the grid points created by linspace.
5. Plot $f(x)$, $g(x)$, and $h(x)$ using the plot function in a single figure. Be sure to label your axes, title your plot, and label which graph corresponds to which function. Use MATLAB functions to add labels to your plots[3].
6. Now, create a grid of 101^2 points on $[0, 1] \times [0, 1]$ using the meshgrid function[4].
7. Create an anonymous function that computes
   (a) $q(x, y) = (x - 1)^2 + (y - 1)^2 + 1$
   (b) $r(x, t) = e^{-t} + x$
   (c) $s(x, y) = \sin(2\pi x)\sin(2\pi y)$
8. Create a matrix that evaluates q, r, and s at each point of the 101^2 points of the grid on $[0, 1] \times [0, 1]$. Note that you may need to use .$\wedge$2 and .* instead of the usual $\wedge$2 and *
9. Plot q, r, and s over $[0, 1] \times [0, 1]$ using the surf function[5] in three separate figures. Be sure to label your axes, title your plot, and label which graph corresponds to which function. Use MATLAB functions to add labels to your plots. Note: specifying figure(n) in the line before plot/surf will create a new figure and prevent what you plotted previously from being written over.
10. Create a 21×21 grid of $(t, x) \in [0, 10] \times [-1, 1]$. Evaluate $r(x, t)$ at each point of this grid. Use quiver[6] to plot the direction field for
$$\frac{dx}{dt} = r(x, t) = e^{-t} + x.$$
    Note that we want the horizontal axis to be the t axis and the vertical axis to by the x axis. Finally, use streamline[7] to plot some solution trajectories. Use startx = -1:0.1:1 and startt = zeros(size(startx)). Be sure to label your plots. Note: using the hold on command will allow you to use multiple commands in a single figure. Hint:

[1] `https://www.mathworks.com/help/matlab/ref/linspace.html`
[2] `https://www.mathworks.com/help/matlab/matlab_prog/anonymous-functions.html`
[3] `https://www.mathworks.com/help/matlab/ref/plot.html`
[4] `https://www.mathworks.com/help/matlab/ref/meshgrid.html`
[5] `https://www.mathworks.com/help/matlab/ref/surf.html`
[6] `https://www.mathworks.com/help/matlab/ref/quiver.html`
[7] `https://www.mathworks.com/help/matlab/ref/streamline.html`

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%Example for MAT 22B Group Work 1
%Created by Ben Godkin on 6/21/2021


figure(1)

hold on

quiver(t_grid,x_grid, ones(size(x_grid)), r(x_grid,t_grid))

%This creates a vector of initial conditions of the form (t,x) = (0,x)
startx = -1:0.1:1;
startt = zeros(size(startx));

streamline(t_grid,x_grid,ones(size(x_grid)),r(x_grid,t_grid),startt,startx)

hold off
```