MATLAB assignment 3

Introduction to Linear Algebra (Week 3) **Fall, 2020**

1. (*3D Graphics in* MATLAB)

   (a) Referring to the followings, draw a graph of helix curve given by the vector equation

   $$\alpha(t) = (t\cos(10\pi t),\, t\sin(10\pi t),\, \tanh t)\,,$$

   where the parameter t varies from -1 to 1.

   i. Construct a vector **t** which consist of equally-spaced points in $[-1,\, 1]$. Use more than 100 points.
   [If you do not know what to do, go back to 'week2'.]

   ii. Use the MATLAB built-in command `plot3` to plot the curve in 3D space.

   (b) Referring to the followings, plot the surface(or mesh graph) of the graph given by

   $$z = xye^{-x^2-y^2},$$

   over the region in the xy-plane defined by $\mathcal{D} = \{(x, y) : -2 \le x \le 2, -2 \le y \le 2\}$.

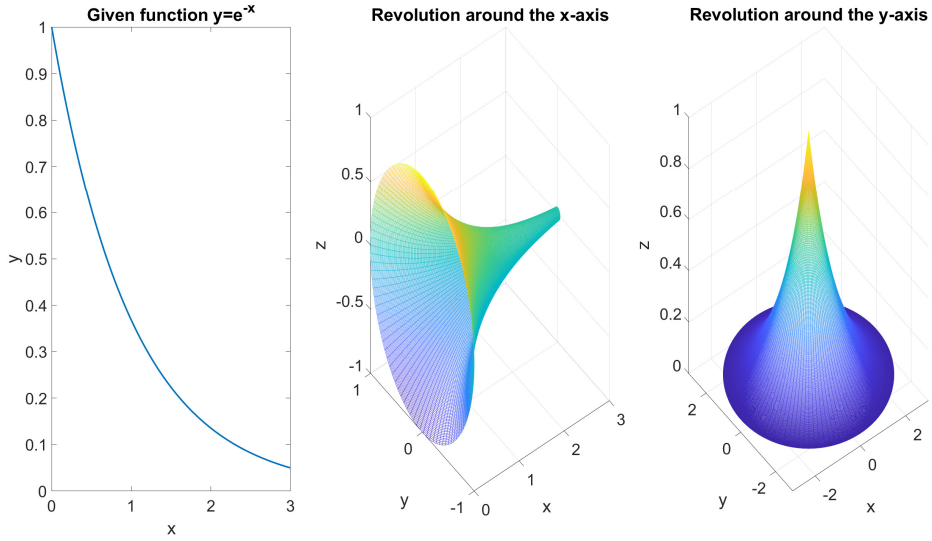
   i. Using the MATLAB built-in command `meshgrid`, construct two matrices, each of which consist of the x coordinates and y coordinates of the $\mathcal{D}$, respectively.

   ii. Using the MATLAB built-in commands `surf` or `mesh`, create a 3D surface plot.

2. (Surface of Revolution)

   (a) For a given function $y = f(x)$, plot the function $y = f(x)$ on axis1, plot the surface of revolution around the x-axis on axis2 and plot the surface of revolution around the y-axis on axis3 in same figure. Use MATLAB command `subplot(1,3)`.

   (ex) $y = e^{-x}$ on $0 \leq x \leq 3$.



   i $y = xe^{-x}$ on $-1 \leq x \leq 3$.

   ii $y = cos(x)$ on $0 \leq x \leq 2\pi$.

3. (contour and quiver)

(a) In this problem, we plot the **contour lines(level curves)** of a surface which is represented by the equation

$$z = y \sin x - x \cos y,$$

over a region $\mathcal{D} = \{(x, y) : -3 \leq x \leq 3, -3 \leq y \leq 3\}$.

i. Plot contour lines of the given surface, and label the height value of each contour line. One may use the MATLAB command `contour` and `clabel`.

ii. Using the MATLAB command `meshc` or `surfc`, plot the contour lines together with its 3D surface **in the same figure**.
[You may use the `hold on` command]

(b) Considering the items below, plot the contours of the surface and the gradient vector field of the two variable function given by

$$z = x^2 + y^3 - 5 \sin(xy),$$

over the region $\mathcal{D} = \{(x, y) : -3 \leq x \leq 3, -3 \leq y \leq 3\}$.

i. In order to compute the gradient vector of the function at each point, use the command `gradient`.

ii. In order to plot the contour lines of the function, use the command `contour`.

iii. In order to plot the distribution of a vector field at each point, use the command `quiver`.

iv. In order to plot contours together with the vector field in the same figure, use the command `hold on`.

4. *Symbolic Computation in* MATLAB

In addition to basic built-in functions of MATLAB, there are many supplementary toolboxes to be used in a variety of numerical computations. In order to use a specific MATLAB toolbox, you are required to install it separately. We use the **Symbolic Math Toolbox** which enables us to do symbolic computation in MATLAB.

(a) In this problem, we find the roots of the following polynomial:

$$f(x) = x^6 - 11x^5 + 7x^4 + 163x^3 - 164x^2 - 476x + 480.$$

i. Using the MATLAB command *syms*, declare a variable x as a symbolic object.

ii. Using the MATLAB command *factor*, find the factors of the given polynomial.

iii. Using the MATLAB command *solve*, find the roots of the given polynomial.

iv. Using the MATLAB command *subs*, check that all the roots obtained from (iii) solve the equation $f(x) = 0$.

There is **nothing** to submit in this assignment.
Study and practice by yourself, and please try to make a lot of questions.