Lab 3

Contents

1 Plotting

1.1 Plotting a 2D line

```matlab
clear; close all;

x = 1:10;
y = x.^2;

plot(x,y)
```

```matlab
7
8  xlabel('X')
9
10 ylabel('Y')
11
12 title('Plot of the function y=x^2')
```

1.2   Plotting a 3D line

```matlab
1  clear; close all;
2
3  t=0:0.001:10*pi;
4
5  x = t.^2;
6
7  y = cos(t);
8
9  plot3(x,y,t,'k','LineWidth',2);
```

1.3   Plotting a surface

```matlab
1  clear; close all;
2
3  x = -pi:0.1:pi;
4  y = -pi:0.1:pi;
5  [X,Y] = meshgrid (x,y);
6
7  Z = sin(X) + cos(Y);
8  surf(X,Y,Z)
```

1.4   Plotting a bar graph

A bar graph is a graph that presents categorical data with rectangular bars
with heights or lengths proportional to the values that they represent.

```matlab
1  clear; close all;
2
3  x = [1 2 3];
```

```
4  values = [2 3 6; 11 23 26];
5  b = bar(x,values);
```

1.5 Plotting a histogram

A histogram is an approximate representation of the distribution of numerical data.

The histogram function automatically chooses an appropriate number of bins to cover the range of values and show the shape of the underlying distribution.

```
1  clear; close all;
2
3  %Generate 10,000 random numbers and create a
     histogram.
4  x = randn(10000,1);
5  h = histogram(x)
```

2 File Operations

2.1 Read from the file

You can extract data from the file and assign its content to the array. The data in the file should be in matrix format (same number of elements in each row) and of the numeric type.

```
1  % my_data.txt :
2  % 1 2
3  % 3 4
4  my_array = load('my_data.txt')
```

2.2 Write to the file

You can write data to the file starting from the beginning of the file.

```
1  % add the row to the array
2  my_array = [my_array; [5 6]]
3
4  %save the array to another file
5  save 'my_data2.txt' my_array -ascii
```

2.3 Append to the file

You can write data to the file adding information to the end of the file.

```
1  new_row = [7 8];
2  save 'my_data2.txt' new_row -ascii -append
```

2.4 Display content of the file

You can show file content without assigning its content to the array.

```
1  type 'my_data2.txt'
```

3 Advanced File Operations

3.1 Table Arrays

Table arrays store column-oriented data, such as columns from a text file or spreadsheet. Tables store each piece of column-oriented data in a variable. Table variables can have different data types and sizes as long as all variables have the same number of rows. You can load data to table array from the file using function `readtable`.

```
1  % my_data3.txt :
2  %Surname Age
3  %Johnson 30
4  %Brown 45
5
6  table_array = readtable('my_data3.txt')
7
8  disp(table_array.Surname)
```

You can save table array data to a file using function `writetable`.

```
1  Surname = {'Johnson';'Brown'};
2  Age = [30;45];
3  Gender = {'Male'; 'Female'};
4
5  table_array = table(Surname, Age, Gender)
6
7  writetable(table_array, 'my_data4.txt')
```

3.2 Cell Arrays

A cell array is a data type with indexed data containers called cells, where each cell can contain any type of data. Cell arrays commonly contain either combinations of text and numbers, or numeric arrays of different sizes.

An element (cell) in cell array can itself be a sell array.

```
% Creating a cell array
cell_array = {'text', rand(5,8), {11; 22; 33}};

% Display the second element (cell) of the cell array
    (it's a matrix)
disp(cell_array{2})

% Display the second element (cell) of the cell array
    (it's a cell array)
disp(cell_array{3})
```

If cell array does not contain nested cell arrays it can be saved to a file and loaded from it.

```
cell_array = {'text', 5.5, 100500};
writecell(cell_array, 'my_data5.txt');

new_cell_array = readcell('my_data5.txt');
```

4 Homework 3

Task 1

Plot `sin(x)` for `x` values ranging from 0 to π (in separate Figure Windows):

- using 10 points in this range,

- using 100 points in this range.

Task 2

Suppose matrix W has the dimension `n x 2` (where `n` is some positive integer) and represents the waypoints of the trajectory: its first column contains latitudes, the second column contains longitudes. Plot the trajectory for the given W.

Example of matrix W:

```
1   W = [58.620900,  17.918000;
2        58.667600,  17.932200;
3        58.713900,  17.946200;
4        58.761800,  17.961000;
5        58.809300,  17.975600;
6        58.873400,  17.995200;
7        58.940300,  18.015900;
8        59.006700,  18.036700;
9        59.075800,  18.058200;
10       59.125500,  18.074300 ];
```

Task 3

Make a vector of 5 random values and plot them on a bar graph using red bars, something like in Figure 1.
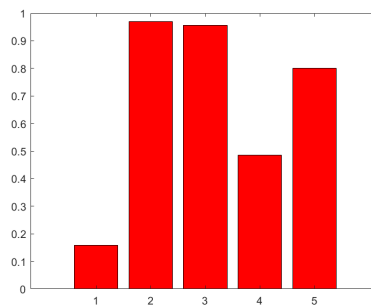

Figure 1: Bar Graph of 5 Random Values

Task 4

Atmospheric properties, such as temperature, air density, and air pressure, are important in aviation. Create a file that stores temperatures in degrees Kelvin at various altitudes. The altitudes are in the first column and the temperatures in the second.

For example, it may look like this:

1000 288
2000 281
3000 269

Using this format create a text file and fill it up with the values for height and temperature (10-15 lines are enough). Write a script that will load this data into a matrix, separate it into vectors, and then plot the data with appropriate axis labels and a title.

Task 5

Plot a histogram for temperature distribution using the file from Task 4.