

Exercises Unit 2. MATLAB Graphics

Working period: Third and fourth weeks
Due date: 17 March 2013

Submit only one file **my_name_E2.pdf** with the MATLAB code that solves the following exercises. Also include the results and comments. For the format, use the **exercises_templated.pdf** file available in Unit 1 as a reference.

1. LINE objects

Exercise 1. Graphic equation solving

The aim of this exercise is to solve the equation $\frac{\phi - \sin \phi}{2} = \frac{A}{r^2}$ with $A = 0.0472$ and $r = 2$. To do so, plot the two curves $y_1 = \frac{\phi - \sin \phi}{2}$ and $y_2 = \frac{A}{r^2}$ depending on ϕ and obtain their intersection point graphically. In particular:

- 1) Plot y_1, y_2 as functions of ϕ (functions **ones**, **plot**).
- 2) Enhance the graph by inserting a grid and a title (functions **grid**, **title**).
- 3) Label the x and y axes with **xlabel**, **ylabel**.
- 4) Insert a text to identify each curve using **gtext**.
- 5) Focus the intersection region with **axis**.
- 6) Compute the intersection values $\phi_0, y_1(\phi_0), y_2(\phi_0)$ with **ginput**. □

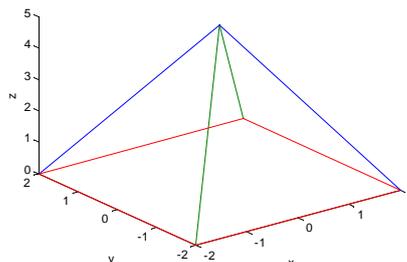
Exercise 2. Filling in areas with LINE objects

Repeat Example 1 in Unit 2 but now fill in the area between the two curves with

- 1) a series of equally horizontal lines (hint: generate the lines for two separate regions, first for $y > 0$ and then for $y < 0$) and
- 2) a hatched effect (that is, intersect the vertical lines with the horizontal lines to obtain a grid) (functions **linspace**, **plot**, **hold on/off**, **cos**, **cosh**, **acos**, **acosh**, **fliplr**). □

Exercise 3. 3D line graphics

- 1) Use the function **plot3** to plot the pyramid of the figure ($b = 4, H = 5$). Label the x, y, z axes. (Functions **xlabel**, **ylabel**, **zlabel**).



2) Generate the following vectors corresponding to a 3D plot:

p : from 0 to 8π equally spaced by $\pi/60$, $A = 2$,

$x = A \cos(p/2)$, $y = A \sin(p/2)$, $z = [1 + 0.2 \cos(2\pi/5)]p$

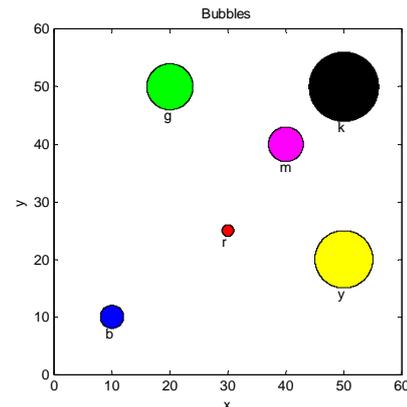
Plot x, y, z using the function `comet3`. Browse the MATLAB help for information about the `EraseMode` property. Which `EraseMode` has function `comet3`?

2. PATCH objects

Exercise 4. Bubbles

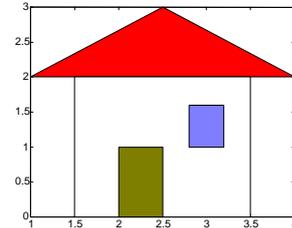
Generate the plot shown in the figure. It consists of several circles centred at $(x,y) = (10,10)$, $(20,50)$, $(30,25)$, $(40,40)$, $(50,50)$ and $(50,20)$. The radii of the circles are respectively 2, 4, 1, 3, 6 and 5. The filling colours are respectively blue, green, red, magenta, black and yellow. Also label each circle with a character. (Functions `fill`, `text`, `axis`).

Hint: To generate and plot the circles you can use functions `linspace`, `exp`, `imag`, `real`, `plot`.



Exercise 5. Polygons and colours

Use the function `fill` to create a simple object based on polygons, like the house in the figure (do not plot the same house; plot another object and be original).



3. SURFACE objects

Exercise 6. Torus

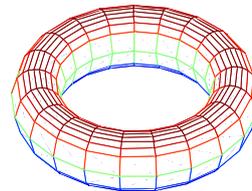
(Magrab,05) The coordinates of a torus are given by:

$$x = r \cos \theta$$

$$y = r \sin \theta$$

$$z = \pm \sqrt{a^2 - (\sqrt{x^2 + y^2} - b)^2}$$

where $b - a \leq r \leq b + a$, $0 \leq \theta \leq 2\pi$ and $b > a$.



Plot the torus for $a=0.2$, $b=0.8$ (`linspace`, `cos`, `sin`, `sqrt`, `[real]`, `mesh`). Take a viewpoint specification of azimuth=46° and elevation=72° (`view`). Eliminate the axes (`axis`).

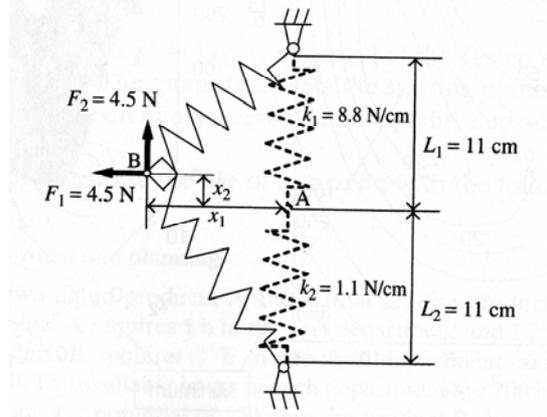
Exercise 7. Two-spring system

(Magrab,05)

Consider the two-spring system shown in the next figure. The springs depicted in dashed lines show the unloaded and undeformed case.

After a load is applied at joint A, the system is deformed until it is in equilibrium at point B, with springs shown using solid lines.

We are interested in finding the equilibrium coordinates (x_1, x_2) of location B.



The equilibrium state of the system is obtained by computing the potential energy for the system and then minimizing it with respect to (x_1, x_2) . The potential energy is:

$$U(x_1, x_2) = 0.5k_1 \left(\sqrt{x_1^2 + (L_1 - x_2)^2} - L_1 \right)^2 + 0.5k_2 \left(\sqrt{x_1^2 + (L_2 + x_2)^2} - L_2 \right)^2 - F_1 x_1 - F_2 x_2$$

- 1) Plot $U(x_1, x_2)$ in 3D with `meshgrid` and `surf`. Label the axes.
- 2) Obtain the contour plot with `contour` and label the contours with their numerical values so that the approximate location of the minimum/maximum point can be visually located (`clabel`).
- 3) Find the coordinates of the minimum with `ginput`. □

4. Specific plots**Exercise 8. Histogram**

Consider a sample of 30 observations of an unknown parameter,

{0.5, 0.6, 0.4, 0.5, 0.4, 0.4, 0.6, 0.8, 0.2, 0.5, 0.4, 0.6, 0.5, 0.6, 0.4, 0.3, 0.5, 0.7, 0.3, 0.5, 0.5, 0.4, 0.5, 0.4, 0.6, 0.5, 0.4, 0.3, 0.7, 0.6}

- 1) Plot the histogram of the sample. Use as many bars (bins) as there are observations. Centre each bar in the observed value (0.2, 0.3, ..., 0.8). (Functions `hist`, `bar`)
- 2) Write a text over each bar indicating the relative percentage (number of observations/total number of observations). (Functions `text`, `num2str`) □

Exercise 9. Probability plots

We want to know if a given sample is Gaussian distributed.

- 1) Load a file containing samples (you can use the files `sample1.mat` or `sample2.mat` available in Moodle).
- 2) Obtain the normal probability plot with `normplot` and indicate if the sample is normally distributed.
- 3) Check the result by applying the Kolmogorov-Smirnov test (function `kstest`). □

5. Movies

Exercise 10. Vector rotation

The following code aims to create an animation effect based on the movement of $e^{j2\pi 50t}$. Explain what each statement does:

```
tmax=1/50;  
figure(1)  
for t=0:tmax/36:tmax;  
    z=exp(j*2*pi*50*t);  
    compass(z),  
    pause(0.01)  
end
```

Optional: Enhance the movement effect (**movie**).

Optional: Create another different animation. □