Introduction to Matlab

Logical indexing and plots

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Exercises

1. Using for loops, calculate the volumes of cilinders whose radii are r = {1,1.2,1.3} and whose height is h = 5. That is, calculate three volumes (one for each cilinder). Write these volumes to a vector VolumesCilinder. The volume of a cilinder is given by $V = \pi r^2 h$.

2. Repeat the previous exercise, but now with r = {1, 1.2, 1.3} and h = {5, 10, 12}. Write the results to a 3x3 matrix. Hint: use two nested for loops.

3. Write a function with two inputs, a vector VecX and a number Y. The function should search VecX and find those elements that equal X. The output of the function is a vector Z with those indices. The function must work with any size of vector VecX.

Logical indexing

- Important function: find
- To find the elements of an array that satisfy a condition, we use logical indexing. For example, for a vector VecX = 2:2:20;.
- idx = find(VecX<7) gives the indices of VecX whose values are smaller than 7.
- VecX(idx1) gives you the values of VecX which are smaller than 7.
- For MatX = magic(5); [idxRow, idxCol] = find(MatX<10); gives the two indices of each element of MatX smaller than 10.
- MatX([idxRow,idxCol]) does **NOT** return the values of MatX which are smaller than 10. To do this, we use logical indexing, for example:
  - MatX(MatX<10)
  - MatX(MatX>5)
  - MatX(MatX~=5)

Logical indexing

- You can replace certain values of a matrix:
    - MatX(MatX==5) = -1;
    - MatX(MatX<=3) = MatX(MatX<=3)+1;
    - MatX(MatX>10 && MatX<20) = 15; %More than one condition
- You can find all the elements of a row (or column) that satisfy a condition:
    - MatX(1, MatX(1,:)<20)
    - MatX(MatX(:,3)>5,3) = 200;
- Can you see what this code does?

    MatX = magic(5);
    MatX(MatX>10) = -(1:(numel(MatX(MatX>10))));

Exercises: Create a matrix MatY = ceil(10*rand(10))
1. Change the elements of MatY that are smaller than 3 into -1
2. Change the elements of MatY between 4 and 7 into -2
3. Change the positive elements of the first column of MatY into 0.

Plot command

- plot(x,y), where x and y are vectors of the same size. For example
  - x = 1:0.1:10; y = sin(x); plot(x, y)
  - x1 = -pi:0.1:pi; plot(x1, 2*cos(x1))
  - x2 = 1:10; plot(x2, x2.^2, 'red') %or blue, black, b, r, g, p, m, etc...
  - x3 = 0:0.1:pi/2; plot(x3, arctan(x3), 'b*') % color + marker
  - x4 = -10:10; plot(x4, heaviside(x4), '-.');
- List of markers and colors: help plot
- You can put more than one function in a plot:
  - plot(x, sin(x), 'g', x, cos(x), 'red')

Plot command

- Example: x = 0:0.1:2*pi; plot(x, 2*sin(0.5*x));
- Useful properties

Property	What it does...
title	Sets title for the plot figure
xlabel/ylabel	Gives a label to each axis
legend	Creates a floating legend
axis([x1, x2, y1, y2])	Changes the range of the plot
axis equal/square/tight	Changes the aspect ratio of the plot
grid on/off	Turn the grid on or off
LineWidth	Changes the width of the plot line

- get(gca) gives a list of all the things you can change