

# Lab 1

## Examples

### Matlab documentation:

- [http://www.mathworks.com/help/pdf\\_doc/matlab/getstart.pdf](http://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf)
- `help`
- `help` followed by a command name
- `doc` followed by a command name (*e.g.*, `help plot`, `doc plot`)

**Mathematical Moments** (<http://www.ams.org/publicoutreach/mathmoments/browsemoments?cat=all>)  
a series of posters that promote the role Mathematics plays in science, nature and technology.

**I.** Check the following operations with vectors:

```

a = [1 2 3] or a = [1, 2, 3]    %line vector
b = [4; 5; 6] or b = [4 5 6]'    %column vector
c = a * b
d = [4 5 6] or d = b'           %the transpose vector of b
e = a .* d
f = a.^2
g = a.^d
v = 1 : 6
w = 2 : 3 : 10    %the starting point:step:the final point
y = 10 : -1 : 0
exp(a)
exp(1)    %number e
sqrt(a)
m = max(a)
[m, k] = max(a)
h = [-2 -9 8]
k = abs(h)
mean(a)
geomean(a)
sum(a)
prod(a)

```

**II.** Consider the matrices  $a = \begin{bmatrix} 1 & 2 & 13 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$  and  $b = \begin{bmatrix} 4 & 8 & 12 \\ -1 & 0 & 5 \\ 2 & 3 & 8 \end{bmatrix}$ . Check

the following operations:

```

[m, n] = size(a)
t = b'    %the transpose matrix of b
c = a * b

```

```

d = a.*b
e = a.^2
size(a)
length(a)
m = mean(a)
m1 = mean(a,2)
g = geomean(a)
s = sum(a)
s1 = sum(a,2)
p = prod(a)
p1 = prod(a,2)
max(a)
min(a)
diag(a)
m > 2
a > b
inv(b)
det(b)
f = abs(b)
b = [16 15 24]'
x = a\b
triu(a)
tril(a)
m = [2 3 5; 7 11 13; 17 19 23]
m(2,1)
m(:,1) %all rows of column 1
m(2,:) % all columns of line 2
m(2,1:2) %line 2, all but last column
m(2,2:end) %second row, all but first column
m(2:3,2:3) %a submatrix
Some particular matrices: a) eye(8), eye(5,7), zeros(5,7), ones(7,9)
b) M = magic(4)
sum(M), sum(M,2), sum(diag(M)), sum(diag(fliplr(M)))

```

## II. Polynomials

1. Evaluate the polynomial  $p(x) = 2x^3 - 5x^2 + 8$  in  $x = 2$ . (Use: *polyval*).
2. Find the roots of the polynomial  $p(x) = x^3 - 5x^2 - 17x + 21$ . (Use: *roots*).

## III. Graphs

1. Plot the functions  $f : [0, 1] \rightarrow \mathbb{R}$ ,  $f(x) = e^{10x(x-1)} \sin 12\pi x$ ,  
and  $f : [0, 1] \rightarrow \mathbb{R}$ ,  $f(x) = 3e^{5x^2-1} \cos 12\pi x$ .

2. Plot the epicycloid

$$\begin{cases} x(t) = (a+b)\cos(t) - b\cos((\frac{a}{b}+1)t), \\ y(t) = (a+b)\sin(t) - b\sin((\frac{a}{b}+1)t), \end{cases} \quad t \in [0, 10\pi], \text{ for given } a, b.$$

3. Plot, on a single graph, the functions:  $f_1, f_2, f_3 : [0, 2\pi] \rightarrow \mathbb{R}$ ,  $f_1(x) = \cos x$ ,  $f_2(x) = \sin x$ ,  $f_3(x) = \cos 2x$ .

4. Plot the graph of the function

$$f(x) = \begin{cases} x^3 + \sqrt{1-x}, & -1 \leq x \leq 0 \\ x^3 - \sqrt{1-x}, & 0 < x \leq 1. \end{cases}$$

5. For  $x \in \{0, 1, \dots, 50\}$  plot the function

$$f(x) = \begin{cases} x/2 & \text{if } x = \text{even} \\ 3x + 1 & \text{if } x = \text{odd}. \end{cases}$$

6. Compute

$$g = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + 1}}}}$$

(Consider the general case, for a given number of fractions.)

7. Plot the function  $g : [-2, 2] \times [-4, 4] \rightarrow \mathbb{R}$ ,  $g(x, y) = e^{-((x-\frac{1}{2})^2 + (y-\frac{1}{2})^2)}$ . (Use: *meshgrid*, *mesh*).