# Examples

**Matlab documentation:**

- *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)

**I.** Check the following operations with vectors:
$a = [1 \ 2 \ 3]$ or $a = [1, 2, 3]$    %line vector
$b = [4; 5; 6]$ or $b = [4 \ 5 \ 6]\prime$    %column vector
$c = a * b$
$d = [4 \ 5 \ 6]$ or $d = b'$    %the transpose vector of $b$
$e = a. * d$
$f = a.\hat{\ }2$
$g = a.\hat{\ }d$
$v = 1 : 6$
$w = 2 : 3 : 10$    %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 $b$
$c = a * b$
$d = a. * b$
$e = a.\hat{\ }2$
$size(a)$
$length(a)$
$m = mean(a)$
$m1 = mean(a, 2)$

$g = geomean(a)$
$s = sum(a)$
$s1 = sum(a, 2)$
$p = prod(a)$
$p1 = prod(a, 2)$
$max(a)$
$min(a)$
$diag(a)$
$m > 2$
$a > b$
$inv(b)$
$det(b)$
$f = abs(b)$
$b = [16\ 15\ 24]'$
$x = a \backslash b$
$triu(a)$
$tril(a)$
$m = [2\ 3\ 5; 7\ 11\ 13; 17\ 19\ 23]$
$m(2, 1)$
$m(:, 1)$ %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 $f : [0, 1] \to \mathbb{R}$, $f(x) = e^{10x(x-1)} \sin 12\pi x$,

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

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: $f_1, f_2, f_3 : [0, 2\pi] \to \mathbb{R}$, $f_1(x) = \cos x$, $f_2(x) = \sin x$, $f_3(x) = \cos 2x$.

4. Plot the graph of the function

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

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

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

6. Compute

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

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