

MATLAB Quick Reference

Arrays, matrices, plotting, file I/O, control flow

Basics

Command Window

```
x = 5;           % assign (semicolon suppresses output)
x = 5           % assign and display result
disp('Hello')  % print to console
clc           % clear command window
clear        % clear all variables
```

Help & Info

```
help sin      % quick help for function
doc sin      % open documentation
who          % list variables in workspace
whos        % list with details (size, type)
```

Operators

```
+ - * / ^      Arithmetic (matrix operations)
.* ./ .^      Element-wise operations
== ~= < > <= >= Comparison operators
&& || ~       Logical AND, OR, NOT (scalars)
& | ~        Element-wise logical (arrays)
```

Variables & Types

Numeric Types

```
x = 3.14;      % double (default)
n = int32(42); % 32-bit integer
z = 2 + 3i;    % complex number
tf = true;     % logical
```

Type Checking

```
class(x)      Return type name as string
isa(x, 'double') Check if x is specific type
isnumeric(x)  True if numeric type
ischar(x)     True if character array
islogical(x)  True if logical type
```

Special Constants

```
pi           3.14159...
Inf / -Inf   Infinity
NaN         Not a Number
eps         Machine epsilon (~2.2e-16)
i / j       Imaginary unit
```

Arrays & Matrices

Creating Arrays

```
v = [1 2 3 4 5]; % row vector
v = [1; 2; 3];   % column vector
A = [1 2; 3 4];  % 2x2 matrix
r = 1:5;         % [1 2 3 4 5]
r = 0:0.5:2;     % [0 0.5 1 1.5 2]
```

Built-in Constructors

```
zeros(3)      % 3x3 of zeros
ones(2, 4)    % 2x4 of ones
eye(3)        % 3x3 identity
rand(2, 3)    % 2x3 uniform random
linspace(0,1,5) % 5 evenly spaced [0..1]
```

Indexing & Slicing

```
A(2, 3)       % row 2, col 3
A(1, :)       % entire first row
A(:, 2)       % entire second column
A(1:2, 1:2)   % submatrix
A(end, :)     % last row
```

Matrix Operations

```
A'            Transpose (conjugate)
A.'           Transpose (no conjugate)
inv(A)        Matrix inverse
det(A)        Determinant
eig(A)        Eigenvalues and eigenvectors
A \ b         Solve Ax = b
size(A)       Dimensions [rows cols]
numel(A)      Total number of elements
```

Control Flow

if / elseif / else

```
if x > 0
    disp('positive')
elseif x == 0
    disp('zero')
else
    disp('negative')
end
```

for & while

```
for i = 1:10
    fprintf('i = %d\n', i);
end
while x > 0
    x = x - 1;
end
```

switch

```
switch grade
    case 'A'
        disp('Excellent')
    case {'B', 'C'}
        disp('Good')
    otherwise
        disp('Try harder')
end
```

Loop Control

```
break        Exit the innermost loop
continue     Skip to next iteration
return       Exit function immediately
```

Functions

Function File

```
% Save as myfunc.m
function result = myfunc(x, y)
    result = x.^2 + y.^2;
end
```

Multiple Outputs

```
function [mn, mx] = minmax(v)
    mn = min(v);
    mx = max(v);
end
[lo, hi] = minmax([3 1 4 1 5]);
```

Anonymous Functions

```
f = @(x) x.^2 + 1;
f(3) % returns 10
g = @(x,y) x + y;
arrayfun(f, [1 2 3]) % apply to each element
```

Useful Built-ins

```
sum(v)        Sum of elements
mean(v)       Mean value
max(v) / min(v) Maximum / minimum
sort(v)       Sort ascending
find(v > 3)   Indices where condition is true
length(v)     Length of vector
```

Plotting

2D Plots

```
x = 0:0.1:2*pi;
plot(x, sin(x), 'r-', 'LineWidth', 2)
xlabel('x'); ylabel('sin(x)')
title('Sine Wave'); grid on
legend('sin(x)')
```

Multiple Plots

```
hold on
plot(x, sin(x), 'b-')
plot(x, cos(x), 'r--')
hold off
subplot(1,2,1); plot(x, sin(x))
subplot(1,2,2); plot(x, cos(x))
```

Other Plot Types

```
bar(x, y)     Bar chart
histogram(data) Histogram
scatter(x, y) Scatter plot
pie(data)     Pie chart
surf(X, Y, Z) 3D surface plot
imagesc(A)    Display matrix as image
```

Save Figure

```
saveas(gcf, 'plot.png')
exportgraphics(gcf, 'plot.pdf')
```

File I/O

Text Files

```
data = readmatrix('data.csv');
writematrix(A, 'output.csv')
T = readtable('data.csv');
writetable(T, 'output.csv')
```

MAT Files

```
save('workspace.mat') % save all variables
save('data.mat', 'x', 'y') % save specific vars
load('data.mat')       % load into workspace
S = load('data.mat');  % load into struct
```

Low-Level File I/O

```
fid = fopen('log.txt', 'w');
fprintf(fid, 'Value: %f\n', 3.14);
fclose(fid);
lines = readlines('log.txt');
```

String Operations

String vs Char Array

```
s = "Hello"; % string (double quotes)
c = 'Hello'; % char array (single quotes)
s + " World" % "Hello World" (string)
[c, ' World'] % "Hello World" (char concat)
```

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String Functions

strlength(s)	Length of string
upper(s) / lower(s)	Case conversion
contains(s, pat)	True if pattern found
replace(s, old, new)	Replace substring
split(s, delim)	Split into array
join(arr, delim)	Join string array
strip(s)	Remove leading/trailing whitespace

Formatting

```
sprintf('x = %.2f', 3.14159) % "x = 3.14"
fprintf('i = %d\n', 42)    % print to console
num2str(3.14)              % number to string
str2double("3.14")        % string to number
```

Cell & Struct

Cell Arrays

```
C = {1, 'hello', [1 2 3]}; % mixed types
C{2} % access: 'hello'
C{end+1} = true; % append element
cellfun(@length, C) % apply func to each
```

Structs

```
s.name = 'Alice';
s.age = 30;
s.scores = [90 85 92];
fieldnames(s) % {'name', 'age', 'scores'}
rmfield(s, 'age') % remove field
```

Struct Arrays

```
people(1).name = 'Alice'; people(1).age = 30;
people(2).name = 'Bob';   people(2).age = 25;
{people.name} % {'Alice', 'Bob'}
[people.age] % [30, 25]
```

Common Patterns

Vectorized Operations

```
% Avoid loops – use vectorization
v = 1:1000;
result = sum(v.^2); % fast
idx = v(v > 500 & v < 600); % logical indexing
```

Table Operations

```
T = table([25;30], ["A";"B"], 'VariableNames', ...
          {'Age', 'Grade'});
T.Age % access column
T(T.Age > 25, :) % filter rows
```

Error Handling

```
try
    result = riskyFunction(x);
catch ME
    fprintf('Error: %s\n', ME.message);
end
```

Timing Code

```
tic
heavyComputation();
toc % prints elapsed time
```