

Part V

Appendices

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Appendix A

Glossary of Matlab Commands

Mathematical Operations

- + Addition. Type `help plus` for information.
- Subtraction. Type `help minus` for information.
- * Scalar or matrix multiplication. Type `help mtimes` for information.
- / Scalar or right matrix division. Type `help slash` for information.
For matrices, the command `A/B` is equivalent to `A*inv(B)`.
- ^ Scalar or matrix powers. Type `help mpower` for information.
- .* Element by element multiplication. Type `help times` for information.
- .^ Element by element exponentiation. Type `help power` for information.
- ./ Element by element division.

Built-in Mathematical Constants

- `eps` Machine epsilon, i.e. approximately the computer's floating point roundoff error.
- `i` $\sqrt{-1}$.
- `Inf` ∞ .
- `NaN` Not a number. Indicates an invalid operation such as `0/0`.
- `pi` $\pi = 3.14159\dots$

Built-in Mathematical Functions

- `abs(x)` Absolute value $|x|$.
- `acos(x)` Inverse cosine $\arccos x$.
- `asin(x)` Inverse sine $\arcsin x$.

`atan(x)` Inverse tangent $\arctan x$.
`cos(x)` Cosine $\cos x$.
`cosh(x)` Hyperbolic cosine $\cosh x$.
`cot(x)` Cotangent $\cot x$.
`exp(x)` Exponential function $e^x = \exp x$.
`log(x)` Natural logarithm $\ln x = \log_e x$.
`sec(x)` Secant $\sec x$.
`sin(x)` Sine $\sin x$.
`sinh(x)` Hyperbolic sine $\sinh x$.
`sqrt(x)` Square root \sqrt{x} .
`tan(x)` Tangent $\tan x$.
`tanh(x)` Hyperbolic tangent $\tanh x$.
`max` Computes maximum of the rows of a matrix.
`mean` Computes the average of the rows of a matrix.
`min` Computes the minimum of the rows of a matrix.

Built-in Numerical Mathematical Operations

`fzero` Tries to find a zero of the specified function near a starting point or on a specified interval.
`inline` Define a function in the command window.
`ode113` Numerical multiple step ODE solver.
`ode45` Runge-Kutta 45 numerical ODE solver.
`quad` Numerical integration using an adaptive Simpson's rule.
`dblquad` Double integration.
`triplequad` Triple integration.

Built-in Symbolic Mathematical Operations

`collect` Collects powers of the specified variable in a given symbolic expression.
`compose` Composition of symbolic functions.
`diff` Symbolic differentiation.
`double` Displays double-precision representation of a symbolic expression.
`dsolve` Symbolic ODE solver.
`expand` Expands an algebraic expression.
`factor` Factor a polynomial.

<code>int</code>	Symbolic integration; either definite or indefinite.
<code>limit</code>	Finds two-sided limit, if it exists.
<code>pretty</code>	Displays a symbolic expression in a nice format.
<code>simple</code>	Simplifies a symbolic expression.
<code>subs</code>	Substitutes for parts a a symbolic expression.
<code>sym</code> or <code>syms</code>	Create symbolic variables.
<code>symsum</code>	Performs a symbolic summation, possibly with infinitely many entries.
<code>taylor</code>	Gives a Taylor polynomial approximation of a given order at a specified point.

Graphics Commands

<code>contour</code>	Plots level curves of a function of two variables.
<code>contourf</code>	Filled contour plot.
<code>ezcontour</code>	Easy contour plot.
<code>loglog</code>	Creates a log-log plot.
<code>mesh</code>	Draws a mesh surface.
<code>meshgrid</code>	Creates arrays that can be used as inputs in graphics commands such as <code>contour</code> , <code>mesh</code> , <code>quiver</code> , and <code>surf</code> .
<code>ezmesh</code>	Easy mesh surface plot.
<code>plot</code>	Plots data vectors.
<code>ezplot</code>	Easy plot for symbolic functions.
<code>plot3</code>	Plots curves in 3-D.
<code>polar</code>	Plots in polar coordinates.
<code>quiver</code>	Plots a vector field.
<code>semilogy</code>	Semilog plot, with logarithmic scale along the vertical direction.
<code>surf</code>	Solid surface plot.
<code>trimesh</code>	Plot based on a triangulation
<code>trisurf</code>	Surface plot based on a triangulation

Special Matlab Commands

<code>:</code>	Range operator, used for defining vectors and in loops. Type <code>help colon</code> for information.
<code>;</code>	Suppresses output. Also separates rows of a matrix.
<code>=</code>	Assigns the variable on the left hand side the value of the right hand side.

ans The value of the most recent unassigned.
cd Change directory.
clear Clears all values and definitions of variables and functions. You may also use to clear only specified variables.
diary Writes a transcript of a MATLAB session to a file.
dir Lists the contents in the current working directory. Same as `ls`.
help
inline Define an inline function.
format Specifies output format, e.g. `> format long`.
load Load variables from a file.
save Saves workspace variables to a file.

Matlab Programming

== Is equal?
~= Is not equal?
< Less than?
> Greater than?
<= Less than or equal?
break Breaks out of a `for` or `while` loop.
end Terminates an `if`, `for` or `while` statement.
else Alternative in an `if` statement.
error Displays an error message and ends execution of a program.
for Repeats a block of commands a specified number of times.
function First word in a function program.
if Checks a condition before executing a block of statements.
return Terminates execution of a program.
warning Displays a warning message.
while Repeats a block of commands as long as a condition is true.

Commands for Matrices and Linear Algebra

Matrix arithmetic:

`A = [1 3 -2 5 ; -1 -1 5 4 ; 0 1 -9 0]` Manually enter a matrix.

`u = [1 2 3 4]'`

`A*u`

`B = [3 2 1; 7 6 5; 4 3 2]`

`B*A`multiply B times A .

`2*A`multiply a matrix by a scalar.

`A + A`add matrices.

`A + 3`add a number to every entry of a matrix.

`B.*B`component-wise multiplication.

`B.^3`component-wise exponentiation.

Special matrices:

`I = eye(3)`identity matrix

`D = ones(5,5)`

`O = zeros(10,10)`

`C = rand(5,5)`random matrix with uniform distribution in $[0,1]$.

`C = randn(5,5)`random matrix with normal distribution.

`hilb(6)`

`pascal(5)`

General matrix commands:

`size(C)`gives the dimensions ($m \times n$) of A .

`norm(C)`gives the norm of the matrix.

`det(C)`the determinant of the matrix.

`max(C)`the maximum of each row.

`min(C)`the minimum in each row.

`sum(C)`sums each row.

`mean(C)`the average of each row.

`diag(C)`just the diagonal elements.

`inv(C)`inverse of the matrix.

Matrix decompositions:

`[L U P] = lu(C)`

`[Q R] = qr(C)`

`[U S V] = svd(C)`singular value decomposition.