

# A Matlab Cheat-sheet (MIT 18.06, Fall 2007)

## Basics:

save 'file.mat'	save variables to <i>file.mat</i>
load 'file.mat'	load variables from <i>file.mat</i>
diary on	record input/output to file <i>diary</i>
diary off	stop recording
whos	list all variables currently defined
clear	delete/undefine all variables
help command	quick help on a given <i>command</i>
doc command	extensive help on a given <i>command</i>

## Defining/changing variables:

$x = 3$  define variable  $x$  to be 3  
 $x = [1 \ 2 \ 3]$  set  $x$  to the  $1 \times 3$  row-vector (1,2,3)  
 $x = [1 \ 2 \ 3];$  same, but don't echo  $x$  to output  
 $x = [1; 2; 3]$  set  $x$  to the  $3 \times 1$  column-vector (1,2,3)  
 $A = [1 \ 2 \ 3 \ 4; 5 \ 6 \ 7 \ 8; 9 \ 10 \ 11 \ 12];$   
set  $A$  to the  $3 \times 4$  matrix with rows 1,2,3,4 etc.  
 $x(2) = 7$  change  $x$  from (1,2,3) to (1,7,3)  
 $A(2,1) = 0$  change  $A_{2,1}$  from 5 to 0

## Arithmetic and functions of numbers:

$3*4$ ,  $7+4$ ,  $2-6$   $8/3$  multiply, add, subtract, and divide numbers  
 $3^7$ ,  $3^{(8+2i)}$  compute 3 to the 7th power, or 3 to the  $8+2i$  power  
 $\text{sqrt}(-5)$  compute the square root of  $-5$   
 $\text{exp}(12)$  compute  $e^{12}$   
 $\text{log}(3)$ ,  $\text{log}_{10}(100)$  compute the natural log (ln) and base-10 log ( $\log_{10}$ )  
 $\text{abs}(-5)$  compute the absolute value  $|-5|$   
 $\text{sin}(5\pi/3)$  compute the sine of  $5\pi/3$   
 $\text{besselj}(2,6)$  compute the Bessel function  $J_2(6)$

## Arithmetic and functions of vectors and matrices:

$x * 3$  multiply every element of  $x$  by 3  
 $x + 2$  add 2 to every element of  $x$   
 $x + y$  element-wise addition of two vectors  $x$  and  $y$   
 $A * y$  product of a matrix  $A$  and a vector  $y$   
 $A * B$  product of two matrices  $A$  and  $B$   
 $x * y$  not allowed if  $x$  and  $y$  are two column vectors!  
 $x .* y$  element-wise product of vectors  $x$  and  $y$   
 $A^3$  the square matrix  $A$  to the 3rd power  
 $x^3$  not allowed if  $x$  is not a square matrix!  
 $x.^3$  every element of  $x$  is taken to the 3rd power  
 $\text{cos}(x)$  the cosine of every element of  $x$   
 $\text{abs}(A)$  the absolute value of every element of  $A$   
 $\text{exp}(A)$   $e$  to the power of every element of  $A$   
 $\text{sqrt}(A)$  the square root of every element of  $A$   
 $\text{expm}(A)$  the matrix exponential  $e^A$   
 $\text{sqrtm}(A)$  the matrix whose square is  $A$

## Constructing a few simple matrices:

$\text{rand}(12,4)$  a  $12 \times 4$  matrix with uniform random numbers in  $[0,1)$   
 $\text{randn}(12,4)$  a  $12 \times 4$  matrix with Gaussian random (center 0, variance 1)  
 $\text{zeros}(12,4)$  a  $12 \times 4$  matrix of zeros  
 $\text{ones}(12,4)$  a  $12 \times 4$  matrix of ones  
 $\text{eye}(5)$  a  $5 \times 5$  identity matrix  $I$  ("eye")  
 $\text{eye}(12,4)$  a  $12 \times 4$  matrix whose first 4 rows are the  $4 \times 4$  identity  
 $\text{linspace}(1.2, 4.7, 100)$   
row vector of 100 equally-spaced numbers from 1.2 to 4.7  
 $7:15$  row vector of 7,8,9,...,14,15  
 $\text{diag}(x)$  matrix whose diagonal is the entries of  $x$  (and other elements = 0)

## Portions of matrices and vectors:

$x(2:12)$  the 2nd to the 12th elements of  $x$   
 $x(2:\text{end})$  the 2nd to the last elements of  $x$   
 $x(1:3:\text{end})$  every third element of  $x$ , from 1st to the last  
 $x(:)$  all the elements of  $x$   
 $A(5,:)$  the row vector of every element in the 5th row of  $A$   
 $A(5,1:3)$  the row vector of the first 3 elements in the 5th row of  $A$   
 $A(:,2)$  the column vector of every element in the 2nd column of  $A$   
 $\text{diag}(A)$  column vector of the diagonal elements of  $A$

## Solving linear equations:

$A \setminus b$  for  $A$  a matrix and  $b$  a column vector, the solution  $x$  to  $Ax=b$   
 $\text{inv}(A)$  the inverse matrix  $A^{-1}$   
 $[L,U,P] = \text{lu}(A)$  the LU factorization  $PA=LU$   
 $\text{eig}(A)$  the eigenvalues of  $A$   
 $[V,D] = \text{eig}(A)$  the columns of  $V$  are the eigenvectors of  $A$ , and the diagonals  $\text{diag}(D)$  are the eigenvalues of  $A$

## Plotting:

$\text{plot}(y)$  plot  $y$  as the  $y$  axis, with 1,2,3,... as the  $x$  axis  
 $\text{plot}(x,y)$  plot  $y$  versus  $x$  (must have same length)  
 $\text{plot}(x,A)$  plot columns of  $A$  versus  $x$  (must have same # rows)  
 $\text{loglog}(x,y)$  plot  $y$  versus  $x$  on a log-log scale  
 $\text{semilogx}(x,y)$  plot  $y$  versus  $x$  with  $x$  on a log scale  
 $\text{semilogy}(x,y)$  plot  $y$  versus  $x$  with  $y$  on a log scale  
 $\text{fplot}(@ (x) \dots \text{expression} \dots, [a,b])$   
plot some expression in  $x$  from  $x=a$  to  $x=b$   
 $\text{axis equal}$  force the  $x$  and  $y$  axes of the current plot to be scaled equally  
 $\text{title}('A \text{ Title}')$  add a title  $A \text{ Title}$  at the top of the plot  
 $\text{xlabel}('blah')$  label the  $x$  axis as *blah*  
 $\text{ylabel}('blah')$  label the  $y$  axis as *blah*  
 $\text{legend}('foo', 'bar')$  label 2 curves in the plot *foo* and *bar*  
 $\text{grid}$  include a grid in the plot  
 $\text{figure}$  open up a new figure window

## Transposes and dot products:

$x.', A.'$	the transposes of $x$ and $A$	
$x', A'$	the complex-conjugate of the transposes of $x$ and $A$	$\text{dot}(x,y)$ , $\text{sum}(x.*y)$ ...two other ways to write the dot product
$x' * y$	the dot (inner) product of two <i>column</i> vectors $x$ and $y$	$x * y'$ the <i>outer</i> product of two <i>column</i> vectors $x$ and $y$