

# Matlab Cheat Sheet

## Some nifty commands

clc	Clear command window
clear	Clear system memory
clear x	Clear x from memory
commandwindow	open/select commandwindow
whos	lists data structures
whos x	size, bytes, class and attributes of x
ans	Last result
close all	closes all figures
close(H)	closes figure H
winopen(pwd)	Open current folder
class(obj)	returns objects class
save filename	saves all variables to .mat file
save filename x,y	saves x,y variables to .mat file
save -append filename x	appends x to .mat file
load filename	loads all variables from .mat file
ver	Lists version and toolboxes
beep	Makes the beep sound
doc function	Help/documentation for function
docsearch string	search documentation
web google.com	opens webaddress
inputdlg	Input dialog box
methods(A)	list class methods for A

## Statistical commands

distrnd	random numbers from dist
distpdf	pdf from dist
distcdf	cdf dist
distrnd	random numbers from dist
hist(x)	histogram of x
histfit(x)	histogram and
*Standard distributions (dist): norm, t, f, gam, chi2, bino	
*Standard functions: mean, median, var, cov(x,y), corr(x,y),	
*quantile(x,p) is <u>not</u> textbook version.	
(It uses interpolation for missing quantiles.)	

## Keyboard shortcuts

edit filename	Opens filename in editor
Alt	Displays hotkeys
F1	Help/documentation for <u>highlighted</u> function
F5	Run code
F9	Run <u>highlighted</u> code
F10	Run code line
F11	Run code line, enter functions
Shift+F5	Leave debugger
F12	Insert break point
Ctrl+Page up/down	Moves between tabs
Ctrl+shift	Moves between components
Ctrl+C	Interrupts code
Ctrl+D	Open <u>highlighted</u> codes file
Ctrl+ R/T	Comment/uncomment line
Ctrl+N	New script
Ctrl+W	Close script
Ctrl+shift+d	Docks window
Ctrl+shift+u	Undocks window
Ctrl+shift+m	max window/restore size

## Built in functions/constants

abs(x)	absolute value
pi	3.1415...
inf	$\infty$
eps	floating point accuracy
1e6	$10^6$
sum(x)	sums elements in x
cumsum(x)	Cummulative sum
prod	Product of array elements
cumprod(x)	cummulative product
diff	Difference of elements
round/ceil/fix/floor	Standard functions..
*Standard functions: sqrt, log, exp, max, min, Bessel	
*Factorial(x) is only precise for $x < 21$	

## Cell commands

A cell can contain any variable type.	
x=cell(a,b)	a x <b>x</b> cell array
x{n,m}	access cell n,m
cell2mat(x)	transforms cell to matrix cellfun
cellfun('fname',C)	Applies fname to cells in C

## Strings and regular expressions

strcmp	compare strings (case sensitive)
strcmpi	compare strings (not case sensitive)
strncmp	as strcmp, but only n first letters
strfind	find string within a string , gives start position
regexp	Search for regular expression

## Logical operators

&&	Short-Circuit AND.
&	AND
	Short-Circuit or
	or
~	not
==	Equality comparison
~=	not equal
isa(obj, 'class_name')	is object in class
*Other logical operators: <, >, >=, <=	
*All <u>above</u> operators are <u>elementwise</u>	
*Class indicators: isnan, isequal, ischar, isinf, isvector , isempty, isscalar, iscolumn	
*Short circuits only evaluate second criteria if first criteria is passed, it is therefore faster.	
And useful for avoiding errors occurring in second criteria	
*non-SC are bugged and short circuit anyway	

## Variable generation

j:k	row vector [j,j+1,...,k]
j:i:k	row vector [j,j+i,...,k],
linspace(a,b,n)	n points linearly spaced and including a and b
NaN(a,b)	
ones(a,b)	a <b>x</b> b matrix of NaN values
zeros(a,b)	a <b>x</b> b matrix of 1 values
zeros(a,b)	a <b>x</b> b matrix of 0 values
meshgrid(x,y)	2d grid of x and y vectors
[a,b]=deal(NaN(5,5))	declares a and b
global x	gives x global scope

## Tables

T=table(var1,var2,...,varN)	Makes table*
T(rows,vars)	get sub-table
T{rows,vars}	get data from table
T.var or T.(varindex)	all rows of var
T.var(rows)	get values of var from rows
summary(T)	summary of table
T.var3(T.var3>5)=5	changes some values
T.Properties.Varnames	Variable names
T = array2table(A)	! make table from array
T = innerjoin(T1,T2)	innerjoin
T = outerjoin(T1,T2)	outerjoin !
Rows and vars indicate rows and variables.	
tables are great for large datasets, because they use less memory and allow faster operations.	
*rowfun is great for tables, much faster than eg. looping	

## matrix and vector operations/functions

x=[1, 2, 3]	1x3 (Row) vector
x=[1; 2; 3]	3x1 (Column) vector
x=[1, 2; 3, 4]	2x2 matrix
x(2)=4	change index value nr 2
x(:)	All elements of x (same as x)
x(j:end)	j <sup>th</sup> to last element of x
x(2:5)	2 <sup>nd</sup> to 5 <sup>th</sup> element of x
x(j,:)	all j row elements
x(:,j)	all j column elements
diag(x)	diagonal elements of x
x.*y	Element by element multiplication
x./y	Element by element division
x+y	Element by element addition
x-y	Element by element subtraction
A^n	normal/Matrix power of A
A.^n	Elementwise power of A
A'	Transpose
inv(A)	Inverse of matrix
size(x)	Rows and Columns
eye(n)	Identity matrix
sort(A)	sorts vector from smallest to largest
eig(A)	Eigenvalues and eigenvectors
numel(A)	number of array elements
x(x>5)=0	change elemnts >5 to 0
x(x>5)	list elements >5
find(A>5)	Indices of elements >5
find(isnan(A))	Indices of NaN elements
[A,B]	concatenates horizontally
[A;B]	concatenates vertically
For functions on matrices, see bsxfun,arrayfun or repmat	
*if arrayfun/bsxfun is passed a gpuArray, it runs on GPU.	
*Standard operations: rank,rref,kron,chol	
*Inverse of matrix inv(A) should almost never be used, use RREF through \ instead: inv(A)b = A\b.	

## Plotting commands

```
fig1 = plot(x,y)           2d line plot, handle set to fig1
set(fig1, 'LineWidth', 2)  change line width
set(fig1, 'LineStyle', '-') dot markers (see *)
set(fig1, 'Marker', '.')  marker type (see *)
set(fig1, 'color', 'red') line color (see *)
set(fig1, 'MarkerSize', 10) marker size (see *)
set(fig1, 'FontSize', 14) fonts to size 14
figure                     new figure window
figure(j)                  graphics object j
get(j)                     returns information
                           graphics object j
gcf(j)                     get current figure handle
subplot(a,b,c)             Used for multiple
                           figures in single plot
xlabel('\mu line', 'FontSize', 14) names x/y/z axis
ylim([a b])                Sets y/x axis limits
                           for plot to a-b
title('name', 'fontsize', 22) names plot
grid on/off;               Adds grid to plot
legend('x', 'y', 'Location', 'Best') adds legends
hold on                    retains current figure
                           when adding new stuff
hold off                   restores to default
                           (no hold on)
set(h, 'WindowStyle', 'Docked'); Docked window
                           style for plots
datetick('x', yy)         time series axis
plotyy(x1,y1,x2,y2)       plot on two y axis
refreshdata                refresh data in graph
                           if specified source
drawnow                   do all in event queue
* Some markers: ', +, *, x, o, square
* Some colors: red, blue, green, yellow, black
* color shortcuts: r, b, g, y, k
* Some line styles: -, --, :, -.
* shortcut combination example: plot(x,y, 'b--o')
```

## Output commands

```
format short              Displays 4 digits after 0
format long               Displays 15 digits after 0
disp(x)                  Displays the string x
disp(x)                  Displays the string x
num2str(x)                Converts the number in x to string
num2str(['nA is '       OFTEN USED!
         num2str(a)])    !
mat2str(x)                Converts the matrix in x to string
int2str(x)                Converts the integer in x to string
sprintf(x)                formatted data to a string
```

## System commands

```
addpath(string)          adds path to workspace
genpath(string)           gets strings for subfolders
pwd                       Current directory
mkdir                     Makes new directory
tempdir                   Temporary directory
inmem                     Functions in memory
exit                      Close matlab
dir                       list folder content
ver                       lists toolboxes
```

## Nonlinear numerical methods

```
quad(fun,a,b)            simpson integration of @fun
                           from a to b
fminsearch(fun,x0)       minimum of unconstrained
                           multivariable function
                           using derivative-free method
fmincon                   minimum of constrained function
Example: Constrained log-likelihood maximization, note the -
       Params_est = fmincon(@(Params) -flogL(Params,x1,x2,x3,y)
                           ,InitialGuess, [], [], [], [], LwrBound, UprBound, []);
```

## Debbuging etc.

```
keyboard                 Pauses exeuction
return                   resumes exeuction
tic                       starts timer
toc                       stops timer
profile on               starts profiler
profile viewer           Lets you see profiler output
try/catch                Great for finding where
                           errors occur
dbstop if error          stops at first
                           error inside try/catch block
dbclear                  clears breakpoints
dbcont                   resume execution
lasterr                  Last error message
lastwarn                 Last warning message
break                    Terminates execution of for/while loop
waitbar                  Waiting bar
```

## Data import/export

```
xlsread/xlswrite         Spreadsheets (.xls, .xslm)
readtable/writetable    Spreadsheets (.xls, .xslm)
dlmread/dlmwrite         text files (txt, csv)
load/save -ascii         text files (txt, csv)
load/save                matlab files (.m)
imread/imwrite           Image files
```

## Programming commands

```
return                   Return to invoking function
exist(x)                 checks if x exists
G=gpuArray(x)            Convert variables to GPU array
function [y1,...,yN] = myfun(x1,...,xM)
Anonymous functions not stored in main programme
myfun = @(x1,x2) x1+x2;
or even using
myfun2 = @myfun(x) myfun(x3,2)
```

## Conditionals and loops

```
for i=1:n
    procedure
end                       Iterates over procedure
                           incrementing i from 1 to n by 1
```

```
while(criteria)
    procedure
end                       Iterates over procedure
                           as long as criteria is true(1)
```

```
if(criteria 1)           if criteria 1 is true do procedure 1
    procedure1
elseif(criteria 2)       ,else if criteria 2 is true do procedure 2
    procedure2
else                       , else do procedure 3
    procedure3
end

switch switch_expression if case n holds,
case 1                     run procedure n. If none holds
    procedure 1             run procedure 3
case 2                       (if specified)
    procedure 2
otherwise
    procedure 3
end
```

## General comments

- Monte-Carlo: If sample sizes are increasing generate largest size first in a vector and use increasingly larger portions for calculations. Saves time+memory.
- Trick: Program that (1) takes a long time to run and (2) doesnt use all of the CPU/memory ? - split it into more programs and run using different workers (instances).
- Matlab is a column vector based language, load memory columnwise first always. For faster code also preallocate memory for variables, Matlab requires contiguous memory usage!. Matlab uses copy-on-write, so passing pointers (adresses) to a function will not speed it up. Change variable class to potentially save memory (Ram) using: int8, int16, int32, int64, double, char, logical, single
- You can turn the standard (mostly) Just-In-Time compilation off using: feature accel off. You can use compiled (c,c++,fortran) functions using MEX functions.
- Avoid global variables, they user-error prone and compilers cant optimize them well.
- Functions defined in a .m file is only available there. Preface function names with initials to avoid clashes, eg. MrP\_function1.
- Graphic cards(GPU)'s have many (small) cores. If (1) program is computationally intensive (not spending much time transferring data) and (2) massively parallel, so computations can be independent. Consider using the GPU!
- Using multiple cores (parallel computing) is often easy to implement, just use parfor instead of for loops.
- Warnings: empty matrices are NOT overwritten ([ ] + 1 = []). Rows/columns are added without warning if you write in a nonexistent row/column. Good practise: Use 3i rather than 3\*i for imaginary number calculations, because i might have been overwritten by earlier. 1/0 returns inf, not NaN. Dont use == for comparing doubles, they are floating point precision for example: 0.01 == (1 - 0.99) = 0.