

Numerical (index.html)

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Python (python-cheatsheet.html)

Statistics (stats-cheatsheet.html)



(https://github.com/QuantEcon/QuantEcon.cheatsheet)

# MATLAB-Python-Julia cheatsheet ¶

**Dependencies and Setup** 

**Creating Vectors** 

**Creating Matrices** 

**Manipulating Vectors and Matrices** 

Accessing Vector/Matrix Elements

**Mathematical Operations** 

Sum / max / min

**Programming** 

# Dependencies and Setup¶

In the Python code we assume that you have already run import numpy as np

In the Julia, we assume you are using **v1.0.2** or later with Compat **v1.3.0** or later and have run using LinearAlgebra, Statistics, Compat

## **Creating Vectors**¶

MATLAB	PYTHON	JULIA

Row vector: size (1, n)

Column vector: size (n, 1)

1d array: size (n, )

Not possible

or

Integers from j to n with step size k

Linearly spaced vector of k points

$$A = linspace(1, 5, k)$$

$$A = np.linspace(1, 5, k)$$

**Creating Matrices**¶

MATLAB

**PYTHON** 

JULIA

Create a matrix

#### 2 x 2 matrix of zeros

$$A = zeros(2, 2)$$

## 2 x 2 matrix of ones

## 2 x 2 identity matrix

$$A = eye(2, 2)$$

#### **Diagonal matrix**

$$A = diag([1 2 3])$$

$$A = np.diag([1, 2, 3])$$

#### **Uniform random numbers**

$$A = rand(2, 2)$$

$$A = rand(2, 2)$$

#### **Normal random numbers**

$$A = randn(2, 2)$$

$$A = randn(2, 2)$$

#### **Sparse Matrices**

```
using SparseArrays
A = spzeros(2, 2)
A[1, 2] = 4
A[2, 2] = 1
```

## **Tridiagonal Matrices**

```
A = [1 2 3 NaN;

4 5 6 7;

NaN 8 9 0]

spdiags(A',[-1 0 1], 4, 4)
```

```
import sp.sparse as sp
diagonals = [[4, 5, 6, 7],
[1, 2, 3], [8, 9, 10]]
sp.diags(diagonals, [0, -1,
2]).toarray()
```

## Manipulating Vectors and Matrices¶

MATLAB

**PYTHON** 

JULIA

#### **Transpose**

Α.'

A.T

transpose(A)

# Complex conjugate transpose (Adjoint)

A'

A.conj()

Α'

MATLAB	PYTHON	JULIA
Concatenate horizontally		
A = [[1 2] [1 2]]  Or	<pre>B = np.array([1, 2]) A = np.hstack((B, B))</pre>	A = [[1 2] [1 2]] or
A = horzcat([1 2], [1 2])		A = hcat([1 2], [1 2])
Concatenate vertically		
A = [[1 2]; [1 2]] or	<pre>B = np.array([1, 2]) A = np.vstack((B, B))</pre>	A = [[1 2]; [1 2]] or
A = vertcat([1 2], [1 2])		A = vcat([1 2], [1 2])
Reshape (to 5 rows, 2 columns)		
A = reshape(1:10, 5, 2)	A = A.reshape(5, 2)	A = reshape(1:10, 5, 2)
Convert matrix to vector		
A(:)	A = A.flatten()	A[:]
Flip left/right		
fliplr(A)	np.fliplr(A)	reverse(A, dims = 2)
Flip up/down		
flipud(A)	np.flipud(A)	reverse(A, dims = 1)
Repeat matrix (3 times in the row din	nension, 4 times in the column dimen	sion)
repmat(A, 3, 4)	np.tile(A, (4, 3))	repeat(A, 3, 4)

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MAILAB	PYTHON	JULIA

#### Preallocating/Similar

```
x = rand(10)
y = zeros(size(x, 1),
size(x, 2))
```

N/A similar type

```
x = np.random.rand(3, 3)
y = np.empty_like(x)
# new dims
y = np.empty((2, 3))
```

```
x = rand(3, 3)
y = similar(x)
# new dims
y = similar(x, 2, 2)
```

#### Broadcast a function over a collection/matrix/vector

```
f = @(x) x.^2

g = @(x, y) x + 2 + y.^2

x = 1:10

y = 2:11

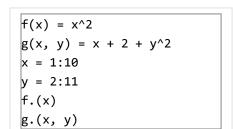
f(x)

g(x, y)
```

Functions broadcast directly

```
def f(x):
    return x**2
def g(x, y):
    return x + 2 + y**2
x = np.arange(1, 10, 1)
y = np.arange(2, 11, 1)
f(x)
g(x, y)
```

Functions broadcast directly



## Accessing Vector/Matrix Elements¶

**MATLAB** 

**PYTHON** 

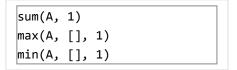
JULIA

MATLAB	PYTHON	JULIA
Access one element		
A(2, 2)	A[1, 1]	A[2, 2]
Access specific rows		
A(1:4, :)	A[0:4, :]	A[1:4, :]
Access specific columns		
A(:, 1:4)	A[:, 0:4]	A[:, 1:4]
Remove a row		
A([1 2 4], :)	A[[0, 1, 3], :]	A[[1, 2, 4], :]
Diagonals of matrix		
diag(A)	np.diag(A)	diag(A)
Get dimensions of matrix		
<pre>[nrow ncol] = size(A)</pre>	nrow, ncol = np.shape(A)	nrow, ncol = size(A)
Mathematical Operations <u>¶</u>		
MATLAB	PYTHON	JULIA
Dot product		
dot(A, B)	np.dot(A, B) or A @ B	<pre>dot(A, B) A · B # \cdot<tab></tab></pre>

MATLAB	PYTHON	JULIA
Matrix multiplication		
A * B	А @ В	A * B
Inplace matrix multiplication		
Not possible	<pre>x = np.array([1, 2]).reshape(2, 1) A = np.array(([1, 2], [3, 4])) y = np.empty_like(x) np.matmul(A, x, y)</pre>	x = [1, 2] A = [1 2; 3 4] y = similar(x) mul!(y, A, x)
Element-wise multiplication		
A .* B	A * B	A .* B
Matrix to a power		
A^2	<pre>np.linalg.matrix_power(A, 2)</pre>	A^2
Matrix to a power, elementwise		
A.^2	A**2	A.^2
Inverse		
inv(A)	np.linalg.inv(A)	inv(A)
or		or
A^(-1)		A^(-1)
Determinant		
det(A)	np.linalg.det(A)	det(A)

MATLAB Eigenvalues and eigenvectors	PYTHON	JULIA
<pre>[vec, val] = eig(A)</pre>	<pre>val, vec = np.linalg.eig(A)</pre>	val, vec = eigen(A)
Euclidean norm		
norm(A)	np.linalg.norm(A)	norm(A)
Solve linear system $Ax=b$ (when $A$ is square)		
A\b	np.linalg.solve(A, b)	A\b
Solve least squares problem $Ax=b$ (when $A$ is rectangular)		
A\b	np.linalg.lstsq(A, b)	A\b
Sum / max / min <u>¶</u>		
MATLAB	PYTHON	JULIA

#### Sum / max / min of each column



```
sum(A, 0)
np.amax(A, 0)
np.amin(A, 0)
```

```
sum(A, dims = 1)
maximum(A, dims = 1)
minimum(A, dims = 1)
```

#### Sum / max / min of each row

```
sum(A, 2)
max(A, [], 2)
min(A, [], 2)
```

#### Sum / max / min of entire matrix

```
sum(A(:))
max(A(:))
min(A(:))
```

```
np.sum(A)
np.amax(A)
np.amin(A)
```

sum(A)
maximum(A)
minimum(A)

## Cumulative sum / max / min by row

```
cumsum(A, 1)
cummax(A, 1)
cummin(A, 1)
```

```
np.cumsum(A, 0)
np.maximum.accumulate(A, 0)
np.minimum.accumulate(A, 0)
```

cumsum(A, dims = 1)
accumulate(max, A, dims =
1)
accumulate(min, A, dims =
1)

# Cumulative sum / max / min by column

```
cumsum(A, 2)
cummax(A, 2)
cummin(A, 2)
```

```
np.cumsum(A, 1)
np.maximum.accumulate(A, 1)
np.minimum.accumulate(A, 1)
```

cumsum(A, dims = 2)
accumulate(max, A, dims =
2)
accumulate(min, A, dims =
2)

# ${\bf Programming} \underline{\P}$

MATLAB

**PYTHON** 

**JULIA** 

PYTHON

JULIA

% This is a comment

# This is a comment

# This is a comment

#### **Comment block**

%{

Comment block

%}

# Block

# comment

# following PEP8

#=

Comment block

=#

#### For loop

for i = 1:N

% do something

end

for i in range(n):

# do something

for i in 1:N
 # do something

end

#### While loop

while i <= N

% do something

end

while i <= N:

# do something

while i <= N

# do something

end

lf

**if** i <= N

% do something

end

**if** i <= N:

# do something

**if** i <= N

# do something

end

#### If / else

**if** i <= N

% do something

else

% do something else

end

**if** i <= N:

# do something

else:

# so something else

**if** i <= N

# do something

else

# do something else

end



#### Print text and variable

#### **Function: anonymous**

$$f = @(x) x^2$$

#### **Function**

```
function f(x)
  return x^2
end

f(x) = x^2 # not anon!
```

#### **Tuples**

Can use cells but watch performance

#### Named Tuples/ Anonymous Structures

```
from collections import
namedtuple

mdef = namedtuple('m', 'x
y')
m = mdef(1, 2)

m.x
```

```
# vanilla
m = (x = 1, y = 2)
m.x

# constructor
using Parameters
mdef = @with_kw (x=1, y=2)
m = mdef() # same as above
m = mdef(x = 3)
```

MATLAB	PYTHON	JULIA

#### **Closures**

$$a = 2.0$$
  
 $f(x) = a + x$   
 $f(1.0)$ 

#### **Inplace Modification**

```
function f(out, x)
    out = x.^2
end
x = rand(10)
y = zeros(length(x), 1)
f(y, x)
```

```
def f(x):
    x **=2
    return

x = np.random.rand(10)
f(x)
```

```
function f!(out, x)
    out .= x.^2
end
x = rand(10)
y = similar(x)
f!(y, x)
```

#### **Credits**

This cheat sheet was created by <u>Victoria Gregory (https://github.com/vgregory757)</u>, <u>Andrij Stachurski (http://drdrij.com/)</u>, <u>Natasha Watkins (https://github.com/natashawatkins)</u> and other collaborators on behalf of <u>QuantEcon (http://quantecon.org/)</u>.

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