

MATLAB Lecture 1 _ Matrices and Arrays

矩阵和数组

MATLAB → Getting Started → Matrices and Arrays

MATLAB → Getting Started → Expressions

MATLAB → Mathematics → Matrices and Linear Algebra → Matrices in MATLAB

- **Vocabulary:**

addition 加法

multiplication 乘法

left division 左除

complex conjugate transpose 复共轭转置

list 序列, 列表

enter / input 输入

array 数组

variable 变量

expression 表达式

row 行

dimension 维数

subtraction 减法

division 除法

power 乘幂

explicit 显的

element 元素

matrix (pl. matrices) 矩阵

vector 向量

assignment statement 赋值语句

data 数据

column 列

- **Using MATLAB as a Scratchpad**

Operators (运算符)

Expressions use familiar arithmetic operators and precedence rules.

+	Addition
-	Subtraction
*	Multiplication
/	Division
\	Left division (described in "Matrices and Linear Algebra" in the MATLAB documentation)
^	Power
'	Complex conjugate transpose
()	Specify evaluation order

```
>> pi*0.1^2
ans =
    0.0314
>> area = pi*0.1^2 % the area of a circle with radius 0.1
area =
```

```

0.0314
>> volume = area*0.5 % the volume of a cylinder with radius 0.1 and ...
length 0.5
volume =
0.0157
>> (12+2*(7-4))/3^2
ans =
2
>> s = 1 - 1/2 + 1/3 -1/4 + 1/5 - 1/6 ...
+ 1/7 - 1/8
S =
0.6345
>> z1 = 3 + 4i
z1 =
3.0000 + 4.0000i
>> z2 = 1 + 2 * i
>> z3 = 2*exp(i*pi/6)
>> z = z1*z2/z3

```

MATLAB → Getting Started → Matrices and Arrays → Expressions → Operators

● **Enter matrices in MATLAB (矩阵)**

➤ **Enter an explicit list of elements.**

You only have to follow a few basic conventions:

- ✧ Separate the elements of a row with blanks or commas.
- ✧ Use a semicolon ';' to indicate the end of each row.
- ✧ Surround the entire list of elements with square brackets, [].

- Load matrices from external data files.
- Generate matrices using built-in functions.
- Create matrices with your own functions in M-files.

Array: a collection of data values organized into rows and columns

Vector: an array with only one dimension

Matrix: an array with two or more dimensions

Size: specified by the number of rows and the number of columns in the array, with the number of rows mentioned first.

```

>> [1 2 3 4 5 6 7 8 9]; % create an arrays with 9 elements
>> [1,2,3;4,5,6;7,8,9] % create a 3×3 matrix
ans =
1     2     3
4     5     6
7     8     9
>> [1 2 3
4 5 6
7 8 9]

```

```
ans =
     1     2     3
     4     5     6
     7     8     9
```

**MATLAB → Getting Started → Matrices and Arrays → Matrices and Magic Square
→ Entering Matrices**

1. Initializing Variables in MATLAB (变量)

Var = expression

- **Assign data to the variable in an assignment statement (赋值语句).**
- Input data into the variable from the keyboard.
- Read data from a file.

Some rules on variable:

- ✧ Begin with a letter
- ✧ Followed by any combination of letters, numbers and the underscore (_) character
- ✧ Only the first 31 characters are significant
- ✧ Case sensitive

Good programming practice

Easy-to-remember (e.g. name, NAME, Name are different)

Use only lowercase letter (e.g. name is the best)

```
>> aa = [1 2 3 4 5 6 7 8 9]; % create an arrays with 9 elements
>> a = [1 2 3; 4 5 6; 7 8 9] % create a 3×3 matrix
a =
     1     2     3
     4     5     6
     7     8     9
```

```
>> b = [1,2,3; 4,5,6; 7,8,9];
>> c = [1 2; -3 -4];
>> d = [a(1,2), 7+3]
```

MATLAB → Getting Started → Matrices and Arrays → Expressions → Variables

2. Initializing with Shortcut Expressions - by Colon Operator (冒号运算)

First : incr : last

```
>> a1 = 1:9; % obtain a row vector containing the integers from 1 ...
           to 9
>> a2 = 1:2:10;
>> a3 = 10:-3:0;
>> a4 = -pi:0.3:pi;
>> suba1 = a(1:2,3); %obtain a matrix subA1, which is a partition ...
                    of matrix A with the first 2 elements of the 3rd column of A
>> suba2 = a(1:2,:);
>> suba3 = a(:,2);
>> C = a(:, [2,3,1]); %for each of the rows of matrix A, reorder ...
```

the elements in the order 2, 3, 1

```
>> D = a(:,end);
```

**MATLAB → Getting Started → Matrices and Arrays → Matrices and Magic Square
→ The Colon Operator**

3. Array and Matrix Operations

Operation	MATLAB Form	Comments
Array Addition	$a + b$	Array addition and matrix addition are identical.
Array Subtraction	$a - b$	Array subtraction and matrix subtraction are identical.
Array Multiplication	$a .* b$	Element-by-element multiplication of a and b . Both array must be the same shape, or one of them must be a scalar.
Matrix Multiplication	$a * b$	Matrix multiplication of a and b . The number of columns in a must equal to the number of rows in b , or one of them must be a scalar.
Array Right Division	$a ./ b$	Element-by-element division of a and b : $a(i,j)/b(i,j)$. Both arrays must be the same shape, or one of them must be a scalar.
Array Left Division	$a .\ b$	Element-by-element division of a and b : $b(i,j)/a(i,j)$. Both arrays must be the same shape, or one of them must be a scalar.
Matrix Right Division	a / b	Matrix division defined by ab^{-1} .
Matrix Left Division	$a \backslash b$	Matrix division defined by $a^{-1}b$.
Array Exponentiation	$a.^a$	Element-by-element exponentiation of a and b : $a(i,j)^{b(i,j)}$. Both arrays must be the same shape, or one of them must be a scalar.

```
>> a1 = eye[2,2] % obtain an identity matrix
A1 =
    1    0
    0    1
>> a2 = [2, 2; 1, 3];
>> a1*a2 % Matrix multiplication
ans =
    2    2
    1    3
>> a1.*a2 % Element-by-element multiplication
ans =
    2    0
    0    3
>> b1=[1 2 3]; b2=[2 3 1];
```

```
>> b1*b2
??? Error using ==> mtimes
Inner matrix dimensions must agree.
>> b1.*b2
ans =
     2     6     3

>> a1/a2    % a1(a2)-1
ans =
     0.7500    -0.5000
    -0.2500     0.5000

>> a1\a2    % (a1)-1a2
ans =
     2     2
     1     3
```

4. *Initializing with Built-in Functions

MATLAB provides four functions that generate basic matrices.

<u>zeros</u>	All zeros
<u>ones</u>	All ones
<u>rand</u>	Uniformly distributed random elements
<u>randn</u>	Normally distributed random elements

```
clock, date;
sin, cos, tan, cot, sec, csc, asin, acos;
x.^a, sqrt, exp, log, log10, log2;
abs, sign, round, fix, floor, ceil, sum, prod, max, min, mean;
sort, rand, randn;
eye, diag, triu, tril.
```

Several special functions provide values of useful constants.

<u>pi</u>	3.14159265...
<u>i</u>	Imaginary unit, $\sqrt{-1}$
<u>j</u>	Same as i
<u>eps</u>	Floating-point relative precision, $\epsilon = 2^{-52}$
<u>realmin</u>	Smallest floating-point number, 2^{-1022}
<u>realmax</u>	Largest floating-point number, $(2 - \epsilon)2^{1023}$
<u>Inf</u>	Infinity
<u>NaN</u>	Not-a-number

MATLAB → Mathematics → Matrices and Linear Algebra → Matrices in MATLAB

5. *Initializing Variables with Keyboard Input

```

my_val = input ( 'Enter an input value:');
>> age = input ( 'Please enter your age: ');
Please enter your age: 20
>> profession = input ( 'Please enter your profession: ', 's');
Please enter your profession: teacher

```

● Clearing

```

>> clc % Clearing the Command Window. This does not clear the
        workspace, but only clears the view. Afterwards, you still
        can use the up arrow key to recall previous functions.
>> clear % Remove items from workspace, freeing up system memory.

```