

Basic operations in Matlab

EE 201

Scalar Arithmetic Operations

Name of operation	Operation in Calculus	Operation in MATLAB	Symbol
Multiplication	ab ($a \times b$)	$a*b$	*
Right division	$\frac{a}{b}$ ($a \div b$)	a/b	/
Addition	$a+b$	$a+b$	+
Subtraction	$a-b$	$a-b$	-
exponentiation	a^b	a^b	^
Power of 10	10^x	$1e^x$	e

Examples:

- 1) Write MATLAB expressions for the following algebraic expression

$$y = 2x + 5\sqrt{z} - 400$$

Solution:

$$y=2*x+5*z^0.5-400$$

OR

$$y=2*x+5*z^0.5-4e2$$

OR

$$y=2*x+5*z^0.5-4*10^2$$

Example :

Number	Exponent form	MATLAB form
789.34	7.8934×10^2	7.8934e2
0.0001	1×10^{-4}	1e-4
4	4×10^0	4e0
4000000000000	4×10^{11}	4e11

Order of precedence

Order of precedence	Operation
First	Parentheses (), evaluated starting with the innermost pair.
Second	Exponentiation (<i>power</i>) ^ , evaluated from left to right.
Third	Multiplication * and division / with equal precedence, evaluated from left to right.
Fourth	Addition + and subtraction - with equal precedence, evaluated from left to right.

Example

- State the order of evaluation of the operators in each of the following MATLAB statement and show the value of **x** after statement is performed

$$x = (3 * 9 * (3 + (9 * 3 / (4 - 1)))) ?$$

□ Solution:

$$1) x = (3 * 9 * (3 + (9 * 3 / (4 - 1))))$$

$$2) x = (3 * 9 * (3 + (9 * 3 / 3)))$$

$$3) x = (3 * 9 * (3 + (27 / 3)))$$

$$4) x = (3 * 9 * (3 + 9))$$

$$5) x = (3 * 9 * 12)$$

$$6) x = (27 * 12)$$

$$7) x = 324$$

The Assignment Operator (Replacement)=

- ❑ When you type `x=3` in MATLAB, you tell MATLAB to assign the value 3 to the variable `x`.
- ❑ We can then type `x = x + 2` in MATLAB . This assigns the value $3 + 2 = 5$ to `x`. But in algebra this implies that $0 = 2$?!!!!.
- ❑ In **algebra** we can write $x + 2 = 20$, but in **MATLAB** we **cannot** ?!!!!.
- ❑ In **MATLAB** the left side of the `=` operator **must** be a single variable.
- ❑ The **right side** must be a *computable* value.

`z+5=y` \longrightarrow wrong

`y=3;`
`z=5+y` \longrightarrow correct

Variable Names

- ❑ Variables are symbolic names that represent locations in the computer's random access memory (RAM)
- ❑ To use a variables must declare it by telling the compiler its name and value. This is called a variable declaration.
- ❑ Variable declaration tells the compiler to allocate appropriate memory space for the variables.

Variable Names

□ Rules for declaring a variables in MATLAB:

a-Variable names must begin with a letter

b-The rest of name can contain letters, digits and underscore characters

c-MATLAB is case-sensitive

□ Thus the following names represent 4 different variables:

speed

Speed

SPEED

Speed_1

d-Variables names must contain less than 63 characters

Note:

Avoid Using Function Names for Variables

- ❑ When naming a variable, make sure you are not using a name that is already used as a function name, either one of your own M-file functions or one of the functions (Command) in the MATLAB language. If you define a variable with a function name, you will not be able to call that function until you remove the variable from memory with the [clear](#) function,
- ❑ For example, if you enter the following command, you will not be able to use the MATLAB **help** command until you clear the variable with `clear help`
- ❑ `help = 50;`

```
>> help=50;
>> help sin
??? Error: "help" was previously used as a variable,
conflicting with its use here as the name of a function or command.
See MATLAB Programming, "How MATLAB Recognizes Function Calls That Use
Command Syntax" for details.

>> clear help
>> help sin
SIN    Sine of argument in radians.
       SIN(X) is the sine of the elements of X.

       See also asin, sind.

       Overloaded methods:
           codistributed/sin
           sym/sin

       Reference page in Help browser
           doc sin
```

Example

□ which of the following are legitimate (valid) variable names in MATLAB?
Explain why invalid?

a Global

b My_var

c _input

d X+Y

e Example1-1

□ Answer:

a-legitimate (valid)

b-legitimate (valid)

c-invalid because begins with a
underscore

d-invalid because contains symbol +

e-invalid because contains symbol -

Special Variables and Constants

Command	Description
ans	Temporary variable containing the most recent answer .
pi	The number $\pi=3.141592653589793....$
Inf	Infinity (∞) (example: 7/0).
NaN	Indicates an undefined numerical result (Not a Number), (example: 0/0).

Some Commonly Used Mathematical Functions

Function in calculus	MATLAB Syntax
e^x	exp(x)
\sqrt{x}	sqrt(x)
ln x	log(x)
$\log_{10} x$	log10(x)
$ x $	abs(x)
cos x	cos(x)
sin x	sin(x)
tan x	tan(x)
$\cos^{-1} x$	acos(x)
$\sin^{-1} x$	asin(x)
$\tan^{-1} x$	atan(x)

Note: The MATLAB trigonometric functions use radian measure

To convert from Degree → Radian use :
 $180^\circ \rightarrow \pi$

Or use sind()

$$x^y = x^{\wedge} y$$

Examples

Write MATLAB expressions to calculate the following algebraic expressions:

a- $x = e^{(-2.1)^3} + 3.47 \log_{10} 14 + \sqrt[4]{287}$

b- $y = \cos\left(\frac{4.12\pi}{6}\right)^2 + 100 \sin(90^\circ)$

Solution:

$$\text{a- } x = \exp((-2.1)^3) + 3.47 * \log_{10}(14) + (287)^{(1/4)}$$

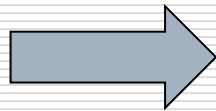
$$\text{b- } y = \cos((4.12 * \pi / 6)^2) + 100 * \sin(\pi / 2)$$

Expressing Function Arguments

We can write $\sin 2$ in text, but MATLAB requires parentheses surrounding the 2 (which is called the function argument or parameter) Thus to evaluate $\sin 2$ in MATLAB, we type $\sin(2)$. The MATLAB function name must be followed by a pair of parentheses that surround the argument.

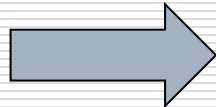
Example :

$$y = \sin x^2$$



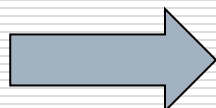
$$y = \sin(x^2)$$

$$w = \sin^2 x$$



$$w = (\sin(x))^2 \text{ or } w = \sin(x)^2$$

$$z = \sin(\sqrt{x} + 1)$$



$$z = \sin(\text{sqrt}(x) + 1)$$

Some common mathematical functions

`ceil(x)` Round to nearest integer toward ∞ .

`fix(x)` Round to nearest integer toward zero.

`floor(x)` Round to nearest integer toward $-\infty$.

`round(x)` Round toward nearest integer.

`sign(x)` $+1$ if $x > 0$; 0 if $x = 0$; -1 if $x < 0$

a	ceil(a)	fix(a)	floor(a)
- 2.5	-2	-2	-3
-1.75	-1	-1	-2
-1.25	-1	-1	-2
-0.5	0	0	-1
0.5	1	0	0
1.25	2	1	1
1.75	2	1	1
2.5	3	2	2

Example:

```
>> y=2.2361;  
>> z=3.8730;  
>> m=ceil(y)
```

```
m =
```

```
3
```

```
>> c=ceil(z)
```

```
c =
```

```
4
```

```
>> r=round(y)
```

```
r =
```

```
2
```

```
>> n=round(z)
```

```
n =
```

```
4
```

```
>> f=fix(y)
```

```
f =
```

```
2
```

```
>> i=fix(z)
```

```
i =
```

```
3
```

```
>> a=floor(y)
```

```
a =
```

```
2
```

```
>> b=floor(z)
```

```
b =
```

```
3
```

Complex numbers

1. $(3+6i)(-7-9i)$

2. $\frac{5+4i}{5-4i}$

3. $\frac{3}{2}i$ or $\frac{3i}{2}$

4. $\frac{3}{2i}$ The solution

1. $(3+6i)*(-7-9i)$ or $(3+6*i)*(-7-9*i)$

2. $(5+4i)/(5-4i)$ or $(5+4*i)/(5-4*i)$

3. $3/2*i$ or $3i/2$

4. $3/(2*i)$ or $3/2i$

note that i should not be defined as a variable, if so then don't give $*$ before i .

for example if you define $i=5$ then $3+6i$ will be written as $3+6i$ (not $3+6*i$).

More commands

□ Clear command

Clear variable1 variable2

a= 10

b=10

Clear a (clear the value of variable a)

Clear a b(clear the of value of a and b)

Random Real Numbers

- ❑ `rand` – generate one real number between 0 to 1.
- ❑ `rand*10` –Generate one real number between 0 to 10
- ❑ `rand*100` –Generate one real number between 0 to 100
- ❑ `rand(3,3)`-generate 3 by 3 matrix of real numbers between 0 to 1.
- ❑ `rand(3,3)*10`-generate 3 by 3 matrix of real numbers between 0 to 10.

-
- `rand *(10-5)+5-` Generate the one number between 5 to 10.
 - `rand (3,3)*(10-5)+5-` Generate the 3 by 3 matrix between 5 to 10.
 - `randn-` Generate the normally distributed random real Numbers

Random Integer

- ❑ randi- Generate the random integer based on input arguments.
- ❑ randi(a,b)-Generate b by b matrix with random integer between 1 to a
- ❑ randi(3,b)-generate b by b matrix with random integer between 1 to 3
- ❑ randi([-5,5],3,4)- Generate 3 by 4 matrix between -5 to 5.