Al-Mustaqbal University College
Department of Medical Instrumentation Techniques Engineering
Class: Third
Subject: Variables and assignment statement, logical operator.
Lecturer: Dr. Ali Kareem Abbas
Lecture: (4)

Variables and assignment statement

Variable names can be assigned to represent numerical values in Matlab. The rules for these variable names are:

Must start with a letter

• May consist only of the letters a-z, digits 0-9, and the underscore character (_)

• May be as long as you would like, but Matlab only recognizes the first 31 characters

• Is case sensitive: items, Items, itEms, and ITEMS are all different variable names.

Assignment statement: Matlab command of the form:

• variable = number

• variable = expression

Example: *Expressions with variables*

```
>> screws = 32;
>> bolts = 18;
>> rivets = 40;
>> items = screws + bolts + rivets
items =
          90
>> cost = screws * 0.12 + bolts * 0.18 + rivets * 0.08
cost =
         10.2800
>> average_cost = cost/items
average_cost =
                    0.1142
```

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Basic Mathematical Functions

MATLAB supports many mathematical functions, most of which are used in the same way you write them mathematically.

Command	Description
abs(x)	Absolute value $\|x\|$ (magnitude of complex number)
sign(x)	Sign, returns -1 if $x < 0$, 0 if $x = 0$, 1 if $x > 0$
ceil(x)	Round towards plus infinity.
conj(x)	Complex conjugate.
fix(x)	Round towards zero.
floor(x)	Round towards minus infinity.
rem(x,y)	Remainder of x/y. For example, rem(100,21) is 16. Also called the modulus function. { r = x- y.*fix(x./y)}
mod(x)	Modulus after division.
imag(x)	Complex imaginary part.
real(x)	Complex real part.
round(x)	Round towards nearest integer.

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Writing arithmetic expressions

EX1: Consider the equation to convert from temperature in Fahrenheit (T_F) to temperature in Celsius (T_C):

$$T_C = \frac{5}{9}(T_F - 32)$$

EX2: Use multiple statements
Consider the equation:

$$H(s) = \frac{s^2 + 4s + 13}{s^3 - 2s^2 + 4s + 5}$$

Matlab commands:
>> H = numerator/denominator;

H.W2: Solving for quadratic roots
Solve for s: $2s^2 + 10s + 12 = 0$
Analysis: Derive and apply the quadratic equation by first expressing the quadratic polynomial in parametric form

$$as^2 + bs + c = 0$$

Logical operator

A logical operation is a special symbol or word that connects two or more phrases of information. It is often used to test whether a certain relationship between the phrases is true or false.

In computing, logical operations are necessary because they model the way that information flows through electrical circuits, such as those inside a CPU. These types of operations are called Boolean operations.

The question or condition is defined using relational and logical operators.

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Relational Operators

Relational operators perform element-by-element comparisons between two arrays. They return a logical array of the same size, with elements set to logical 1 (true) where the relation is true, and elements set to logical 0 (false) where it is not.

Relational Operator	Description
<	less than
<=	less than or equal
>	greater than
>=	greater than or equal
==	equal
~=	not equal

EX1:

```
>> A=1:9
A =
     1   2   3   4   5   6   7   8   9
>>B=8-A
B =
     7   6   5   4   3   2   1   0  -1
>> tf1 = A <=4
tf1 =
     1   1   1   1   0   0   0   0   0
```

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```
>> tf2 = A > B
tf2 =
     0   0   0   0   1   1   1   1   1
>> tf3 = (A==B)
tf3 =
     0   0   0   1   0   0   0   0   0
>> tf4 = B-(A>2)
tf4 =
     7   6   4   3   2   1   0  -1  -2
```

EX2: If one of the operands is a scalar and the other a matrix, the scalar expands to the size of the matrix. For example, the two pairs of statements:

```
>> X = 5;  or X = 5*ones(3,3);
>>X >= [1 2 3; 4 5 6; 7 8 10]
```

produce the same result:

```
ans =
   1   1   1
   1   1   0
   0   0   0
```

Logical Operations

Logical, or Boolean, operators: a logical operand that produces a logical result. Logical operators provide a way to combine or reject relational expressions.

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Inputs		and	or	not	xor
A	B	A & B	A | B	~A	xor(A,B)
0	0	0	0	1	0
0	1	0	1	1	1
1	0	0	1	0	1
1	1	1	1	0	0

EX1:

```
>> A=1:9
A =
    1   2   3   4   5   6   7   8   9
>> tf1 = A>4
tf1 =
    0   0   0   0   1   1   1   1   1
>> tf2 = ~(A>4)
tf2 =
    1   1   1   1   0   0   0   0   0
>> tf3 = (A>2)&(A<6)
tf3 =
     0   0   1   1   1   0   0   0   0
>> tf4 = xor((A>2),(A<6))
tf4 =
    1   1   0   0   0   1   1   1   1
```

EX2: This example shows the logical OR of the elements in the vector u with the corresponding elements in the vector v:

```
>> u = [0 0 1 1 0 1];
```

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```
>> v = [0 1 1 0 0 1];

>> u | v

ans =

     0   1   1   1   0   1
```

Relational and Logical Functions

Function	Description
any(x)	Returns a scalar that is 1 (true) if *any* element in the vector x is nonzero; otherwise, the scalar is 0 (false). Returns a row vector containing a 1 (true) in each element for which any element of the corresponding column of matrix x is nonzero, and a 0 (false) otherwise.
all(x)	Returns a scalar that is 1 (true) if *all* elements in the vector x are nonzero; otherwise, the scalar is 0 (false). Returns a row vector containing a 1 (true) in each element for which all elements of the corresponding column of matrix x are nonzero, and a 0 (false) otherwise.
find(x)	Returns a vector containing the indices of the nonzero elements of a vector x. Returns a vector containing the indices of the nonzero.
isnan(x)	Returns an array with ones where the elements of x are NaN and zeroswhere they are not.
isfinite(x)	Returns an array with ones where the elements of x are finite and zeros where they are not. For example, isfinite([pi NaN Inf -Inf]) is [1 0 0 0].
isinf(x)	Returns an array with ones where the elements of x are +Inf or –Inf and zeros where they are not.
isempty(x)	Returns 1 if x is an empty array and 0 otherwise.