Lesson 2: Introduction to MATLAB

Topics:

- Relational Expressions / Relational Operators
- Logical Operators
- Operator precedence rules
- Type casting
- Built-in numerical functions
- Common Pitfalls and Programming Tips

Learning Outcomes:

1. Become familiar with relational and logical operators
2. Cast variables
3. Use built-in functions

Book Sections: 1.6 - 1.8

1. Relational Expressions

Defintion: Relational expressions (logical expression, Boolean expression) evaluate to either TRUE or FALSE.

1.1 Relational Operators

```
% >  greater than
% <  less than
% >= greater than or equal
% <= less than or equal
% == equal
% ~= not equal

% Examples
x=7;
y=9;

x<y
```

```
x<y
```

```
ans = logical
   1
```

```
x>y
```

```
ans = logical
   0
```

```
x<=y
```

```
ans = logical
   1
```

```
x~=y
```

```
ans = logical
   1
```

```
x==y
```

```
ans = logical
   0
```

```
% Notice the output as 1 (True) or 0 (False).
```

1.2 (Short-circuit) Logical Operators

```
% ||    OR
% &&    AND
% ~     NOT

x=5, y=7, z=7
```

```
x =
     5
y =
     7
z =
```

```
     7
```

```
(x<10) || (x==z)   % x less than 10 OR x=z
```

```
ans = logical
   1
```

```
(z<=5) && (y==z)   % z less than or equal 5 AND y=z
```

```
ans = logical
   0
```

```
~(x>8) && (z==y)   % x NOT greater than 8 AND z=y
```

```
ans = logical
   1
```

```
% Note: Only the first expression is evaluated in
% %     first two expressions


% XOR function: True if and only if one argument is true
xor(3<5,1<7)
```

```
ans = logical
   0
```

```
xor(3>5,7<1)
```

```
ans = logical
   1
```

```
xor(3>5,1<7)
```

```
ans = logical
   1
```

1.3 Operator Precedence Rule

```
% Higest to lowest
```

```
% ()
% ^
% -, ~
% *, /,\
% +, -
% Relational: <,<=, >,>=,==,~=
% &&
% & ||
```

```
% Note
x=4; % x=7 both evaluate true since order is left to right
3<x<5 % is a logical error

% 3<x && x<5
```

2 Type Casting and ranges

Variables have a "**type**", default number is double.

Variable Types

MATLAB has the following basic data types:

- Integers (int8, int16, ...)
- Single precision
- Double precision (**default**)
- Logical
- Charcter (chr) or string

The **range** of a variable is the smallest and largest value it can take. For example, uint8 ranges from 0 to 255 since $2^8 = 256$.

Variables of one type can be **cast** as another, for example, double as an integer.

```
whos % display variables, size, and type


% 1.7 Type casting
x=pi;               % double precision
x=single(pi);       % single precision
x=int8(-45)         % 8-bit signed integer
```

```
x=uint32(2341)      % 32-bit unsigned (positive) integer
x=logical(1)        % Logical variable


% For more information about these and other data types
help datatypes


% Characters ('x') and Strings ("x")
Achar='hello world'      % Use single quotes
Astring="hello world"    % Use Double quotes


x='5';                   % Different than x=5;
X=5;

whos
```

3. Built-in Numerical Functions

MATLAB has hundreds of built-in functions. Here are some basic numerical functions (See also L1.mlx).

```
rem(14,3)       % difference rem(3,14)?
```

```
ans =
     2
```

```
mod(14,3)       % difference mod(3,14)?
```

```
ans =
     2
```

```
floor(5.8205)
```

```
ans =
     5
```

```
ceil(5.8205)
```

```
ans =
     6
```

```
fix(5.8205)
```

```
ans =
     5
```

```
fix(-5.8205)
```

```
ans =
    -5
```

```
round(5.8205)
```

```
ans =
     6
```

```
round(pi,5)     % round to 5 places
sign(-pi)
```

```
ans =
    -1
```

```
x=73;
n=3;
nthroot(x,n)    % Nth root function
```

Common Pitfalls

1. Using = for relational operator
2. Compound relations 3<x<5 vs. 3<x && x<5
3. Confusing || and &&
4. Confusing the order of arguments when passing to a function, for example rem(3,10) and rem(10,3)
5. Confusing / and \ left and right division
6. Adding a space in <= (2-character operator)
7. Confusing **xor** and ||

Exercises

1. cos(pi/2)==0
2. 3 == 5+2
3. (10>5)+2
4. 10>5>2
5. Find the numerical equivalent of 'x'
6. Which character is 107?
7. round(pi,3)
8. fix(pi)

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