MATLAB - Lecture # 8

Topics Covered:
1. Relational and Logical Operators
2. Conditional statements.

```matlab
if-end
if-else-end
if-elseif-else-end
```
In a simple program the commands are executed in the order they are typed.

Many situations may require that:

* Commands will not be executed in order.
* Different commands are executed in different runs.
* The execution of a group of commands is repeated many times.
INTRODUCTION TO PROGRAMMING

- MATLAB provide tools (commands) that can be used to control the flow of a program.

- Read Chapter 7 in the MATLAB book.

- In the class we will only cover `if-end` conditional statements (this lecture) and `for-end` loops (next lecture).

- Students can learn other tools from the book by themselves.
RELATIONAL OPERATORS

<table>
<thead>
<tr>
<th>Relational operator</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>Less than.</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to.</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than.</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal to.</td>
</tr>
<tr>
<td>==</td>
<td>Equal to.</td>
</tr>
<tr>
<td>~=</td>
<td>Not equal to.</td>
</tr>
</tbody>
</table>

- Relational operators compare two numbers in a comparison statement.
- If the statement is true, it is assigned a value of 1.
- If the statement is false, it is assigned a value of 0.
RELATIONAL OPERATORS, EXAMPLES

```
>> 5>8
ans =
   0
>> a=5<10
a =
   1
>> y=(6<10) + (7>8) + (5*3= =60/4)
y =
   1  =0  =1
   2
```

Since 5 is not larger than 8 the answer is 0.

Checks if 5 is smaller than 10, and assigns the answer to `a`.

Since 5 is smaller than 10 the number 1 is assigned to `a`. 
Logical operators have numbers as operands.

- A nonzero number is true.
- A zero number is false.

<table>
<thead>
<tr>
<th>Logical Operator</th>
<th>Name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp; (A &amp; B)</td>
<td>AND</td>
<td>True if both operands ((A \text{ and } B)) are true.</td>
</tr>
<tr>
<td>(A \mid B)</td>
<td>OR</td>
<td>True if either or both operands ((A \text{ and } B)) are true.</td>
</tr>
<tr>
<td>(~A)</td>
<td>NOT</td>
<td>True if the operand ((A)) is false. False if the operand ((A)) is true.</td>
</tr>
</tbody>
</table>
>> 3\&7
ans =
 1
3 \text{ AND 7.} 3 \text{ and } 7 \text{ are both true (nonzero), so the outcome is } 1.

>> a=5\mid0
a =
 1
5 \text{ OR 0 (assign to variable } a). 1 \text{ is assigned to } a \text{ since at least one number is true (nonzero).}

>> x=-2; y=5;

>> -5<x<-1
ans =
 0
-5<x \text{ is true (1) and then } 1<1 \text{ is false (0).}

Mathematically correct. The answer is false since MATLAB executes from left to right. -5<x is true (=1) and then 1<1 is false (0).

>> -5<x \& x<-1
ans =
 1
The mathematically correct statement is obtained by using the logical operator \&. The inequalities are executed first. Since both are true (1), the answer is 1.
Conditional statements enable MATLAB to make decisions.

The process is similar to the way we (humans) make decisions.

A condition stated. If the condition is met, one set of actions is taken. If the condition is not met, either nothing is done, or a second set of actions is taken.

Example:
If I win the Lottery,
I will quit college, buy a new car, and go fishing.
If I do not win the Lottery,
I will study harder so that I can get a better job.
THE FORM OF A CONDITIONAL STATEMENT

If Conditional expression

Examples:

\[
\begin{align*}
\text{if} & \quad a < b \\
\text{if} & \quad c \geq 5 \\
\text{if} & \quad a == b \\
\text{if} & \quad a \sim= 0 \\
\text{if} & \quad (d<h) \& (x>7) \\
\text{if} & \quad (x\sim=13) \mid (y<0)
\end{align*}
\]

consisting of relational and/or logical operators

All variables must have assigned values.
THREE FORMS OF THE `if` STATEMENT

1. If conditional statement
   commands
   end

2. `if` conditional statement
   command group 1
   `elseif` conditional statement 2
   command group 2
   `else`
   command group 3
   end

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THE *if-end* STATEMENT

*if* conditional expression

A group of MATLAB commands.

MATLAB program.

MATLAB program.
EXAMPLE OF USING THE \texttt{if-end} STATEMENT

% A script file that demonstrates the use of the if-end statement.
% The user is asked to enter three grades.
% The program calculates the average of the grades.
% If the average is less than 60, a massage:
% The student did not pass the course. is printed.

score = input('Enter (as a vector) the scores of the three tests   ');
ave_grade = (score(1) + score(2) + score(3))/3;
disp('The average grade is:')
disp(ave_grade)
if ave_grade < 60
    disp('The student did not pass the course.')</nend
EXAMPLE OF USING THE `if-end` STATEMENT

Executing the script file of the previous slide in the Command Window:

```matlab
>> Lecture8Example1
Enter (as a vector) the scores of the three tests   [78 61 85]
The average grade is:
   74.6667

>> Lecture8Example1
Enter (as a vector) the scores of the three tests   [60 38 55]
The average grade is:
   51
The student did not pass the course.
```
THE *if-else-end* STATEMENT

```
... MATLAB program.

if conditional expression

... Group 1 of MATLAB commands.

else

... Group 2 of MATLAB commands.

end

... MATLAB program.
```

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EXAMPLE OF USING THE \textbf{if-else-end} STATEMENT

% A script file that demonstrates the use of the if-else-end statement. 
% The user is asked to enter three grades. The program calculates 
% the average of the grades. If the average is less than 60, a 
% massage: The student did not pass the course. is printed. 
% Otherwise, a massage: The student passed the course. is printed.

score = input('Enter (as a vector) the scores of the three tests ');
ave_grade = (score(1) + score(2) + score(3))/3;
disp('The average grade is:')
disp(ave_grade)
if ave_grade < 60
    disp('The student did not pass the course.')
else
    disp('The student passed the course.')
end
EXAMPLE OF USING THE `if–else–end` STATEMENT

Executing the script file of the previous slide in the Command Window:

```plaintext
>> Lecture8Example2
Enter (as a vector) the scores of the three tests [65 80 83]
The average grade is:
    76
The student passed the course.
>> Lecture8Example2
Enter (as a vector) the scores of the three tests [60 40 55]
The average grade is:
    51.6667
The student did not pass the course.
```
THE `if–elseif–else–end` STATEMENT

```
if conditional expression
    Group 1 of MATLAB commands.
elseif conditional expression
    Group 2 of MATLAB commands.
else
    Group 2 of MATLAB commands.
end
```

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EXAMPLE OF USING THE
\texttt{if-elseif-else-end} STATEMENT

% A script file that demonstrates the use of the if-elseif-else-end % statement.
% The program calculates the tip in a restaurant according to the % amount of the bill.
% If the bill is less than 10$ the tip is $1.80. 
% Between $10 and $60 the tip is 18\% of the bill. 
% Above $60 the tip is 20\% of the bill. 

format bank 
clear tip
bill = input('Enter the amount of the bill (in dollars): ');
if bill <= 10)
    tip = 1.8;
elseif (bill > 10) & (bill <= 60)
    tip = bill*0.18;
else
    tip = bill*0.2;
end
disp('The tip is (in dollars):')
disp(tip)
EXECUTING THE SCRIPT FILE OF THE RESTAURANT TIP CALCULATION

>> Lecture8Example3
Enter the amount of the bill (in dollars): 15
The tip is (in dollars):
   2.70

>> Lecture8Example3
Enter the amount of the bill (in dollars): 6
The tip is (in dollars):
   1.80

>> Lecture8Example3
Enter the amount of the bill (in dollars): 100
The tip is (in dollars):
   20.00
COMMENTS ABOUT \textbf{if–end} STATEMENTS

- For every \textbf{if} command a computer program must have an \textbf{end} command.

- A program can have many \textbf{if ..... end} statements following each other.

- A computer program can perform the same task using different combinations of \textbf{if - end}, \textbf{if – else – end}, and \textbf{if – elseif – else – end} statements.
MATLAB ASSIGNMENT 8:

1. MATLAB book, Chapter 7, Problem 1.

2. MATLAB book, Chapter 7, Problem 8.

3. MATLAB book, Chapter 7, Problem 16.

In problem 1 submit a printout of the Command Window.
In problems 2 and 3 submit a printout of the script file, and a printout of the Command Window showing how the script file was used.
The first line in the script file, and in the Command Window should be a comment with your name.