- Previous class:
  - Intro to computer programming
  - Variables & assignment
  - Input & output
  - Script
  - Calling functions for graphics

- Now:
  - Branching
  - Nested statements

1

A script (program) is a file with a sequence of commands

Comment begins with %

Variable holds a value

```
% Quadratic equation solver
a= input('Enter a: ');
b= input('Enter b: ');
c= input('Enter c: ');
d= b^2 -4*a*c;
r1= (-b-sqrt(d))/(2*a);
r2= (-b+sqrt(d))/(2*a);
```

Semi-colon suppresses "echo"

Assignment operator: value on RHS is assigned to variable named on LHS

A file with the extension .m

2

```
% Quadratic equation solver
a= input('Enter a: ');
b= input('Enter b: ');
c= input('Enter c: ');
d= b^2 -4*a*c;
if d >= 0
    r1= (-b-sqrt(d))/(2*a);
    r2= (-b+sqrt(d))/(2*a);
else
    fprintf('Complex roots\n')
end
```

File: qSolver.m

The if-else construct

```
if  <condition>
    statements to execute if condition is true
else
    statements to execute if condition is false
end
```

Only one block of statements will be executed!

5

Relational operators

<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to
==	Equal to
~=	Not equal to

6

Suppose I don't care about the values of the roots—I just want to know if the roots are comlex.

```
% Quadratic equation solver
a= input('Enter a: ');
b= input('Enter b: ');
c= input('Enter c: ');
d= b^2 -4*a*c;
if d < 0
    fprintf('Complex roots\n')
end
```

The `if` construct

`if` *<condition>*

statements to execute if condition is true

`end`

9

Logical AND

Q. When is a real number x in the interval [L,R]?

A. If x is greater than or equal to L and less than or equal to R.

```
if (x>=L && x<=R)
   fprintf('x is in [L,R]')
else
   fprintf('x is not in [L,R]')
end
```

10

Always use logical operators for multiple conditions

Why is it wrong to use the expression
$$L <= x <= R$$
for checking if x is in $[L,R]$?

Example: Suppose `L` is 5, `R` is 8, and `xc` is 10. We know that 10 is not in [5,8], but the expression `L <= xc <= R` gives...

11

Logical OR

Q. When is a real number x <u>not</u> in the interval [L,R]?

A. If x is less than L or less greater than R.

```
if (x<L || x>R)
   fprintf('x is not in [L,R]')
else
   fprintf('x is in [L,R]')
end
```

12

Boolean expressions

- They involve comparisons.
- They have a value that can be thought of as either true or false.

Example:
1. Variables a, b, and c have positive real values. Can we make a triangle with sides that have those values? Yes if the following is true:

14

2. Variable x has a positive integer value. Is it divisible by 3 and 5? Yes if the following is true:

15

3. Variable y has a positive integer value. Does it name a non-leap year? Yes if the following is true:

Hint: Y is an "ordinary" year if it is not divisible by 4 or if it is a century year not divisible by 400.

17

"false" is 0, "true" is non-zero

X, Y represent boolean expressions.
E.g.,   d>3.14

X	Y	X && Y "and"	X || Y "or"	~X "not"
1	1			
1	0			
0	1			
0	0			

23

Logical operators "short-circuit"

a > b && c > d
true   Go on

a > b && c > d
false   Stop

Entire expression is false since the first part is false

A **&&** condition short-circuits to false if the left operand evaluates to *false.*

A || condition short-circuits to _____ if _____ _____

24

```
% Find number of days in month m
m= input('Which month? ');




fprintf("Month %d has %d days\n",...
        m, days);
```

```
% Find number of days in month m
m= input('Which month? ');

        Fill in the necessary code.

    There are 3 possibilities: 30, 31, or 28 days.
    So we need to choose 1 among 3 options.

fprintf("Month %d has %d days\n",...
        m, days);
```

27

```
% Find number of days in month m
m= input('Which month? ');
if m==2
   days= 28;
else
   if rem(m,2)==1 && m<=7 ||...
      rem(m,2)==0 && m>=8
      days= 31;
   else
      days= 30;
   end
end
fprintf("Month %d has %d days\n",...
        m, days);
```

Nested if statements

The `if-elseif-else` construct

if   *<condition 1>*

   statements to execute if condition 1 is true

elseif *<condition 2>*

   statements to execute if condition 2 is true

elseif *<condition 3>*

   statements to execute if condition 3 is true

else

   statements to execute if condition 3 is false

end

Use this construct when there are many alternatives. Only one block of statements will be executed.

32

Things to know about the if construct

- _____ branch of statements is executed
- There can be _____ **elseif** clauses
- There can be _____ **else** clause
- The **else** clause _____ in the construct
- The **else** clause _____ (boolean expression)

33

Does this program work?

```
score= input('Enter score: ');
if score>55
     disp('D')
elseif score>65
     disp('C')
elseif score>80
     disp('B')
elseif score>93
     disp('A')
else
     disp('Not good…')
end
```

A: yes

B: no

35