

# Decisions, Decisions...

## Conditional statements and expressions

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### CS112 Scientific Computation

Department of Computer Science  
Wellesley College

## Straight-line code

`timeSamples = 0:5:200;`

`tempLaw = 24.5+69*exp(-0.0426*timeSamples);`

`hold on`

`plot(timeSamples, tempLaw, 'g--o')`

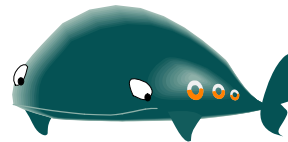
`hold off`

Conditionals 4-2

## What lies beneath...

When mapping the ocean floor with sonar, large marine animals or equipment faults may produce erroneous data\*

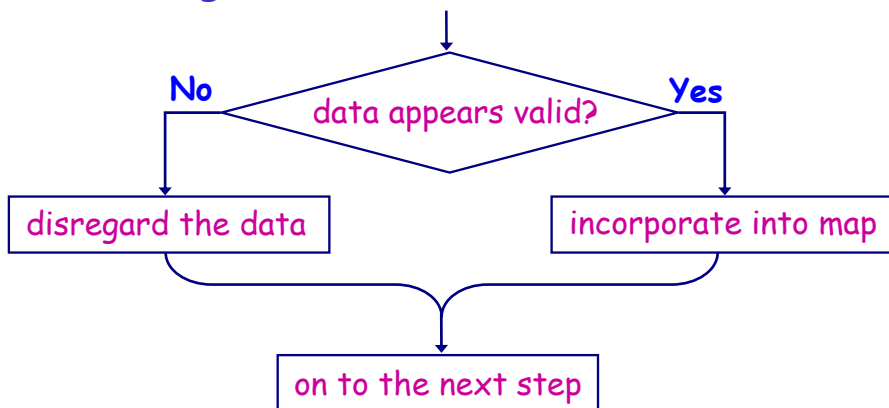
```
if data appears valid
then
    incorporate it into the seafloor map
otherwise
    disregard the data
'nuff said
```



\* We follow the politician's rule: If the data is suspicious, disregard it

Conditionals 4-3

## Branching code



Conditionals 4-4

## MATLAB `if` statement

General format of the MATLAB `if` statement:

```
if conditional expression
    actions to perform if conditional expression is true
else
    actions to perform if conditional expression is false
end
```

```
age = input('Enter your age:');
if (age < 18)
    disp('Like to help you son, but you''re too young to vote')
else
    disp('Glad to meet ya!')
end
```

else clause  
is optional



Conditionals 4-5

## Multiple actions

```
if conditional expression
    actions to perform if conditional expression is true
else
    actions to perform if conditional expression is false
end
```

```
if (a == 0)
    result1 = 0;
    result2 = 1;
else
    result1 = 10/a;
    result2 = a^2 + 1;
end
```



Conditionals 4-6

## Conditional expressions

- **Relational operators** compare two numbers:

`==` `~=` `<` `>` `<=` `>=`

- **Conditional expressions** have the general form:

`expression operator expression`

- For example\*:

`age == 21`

`age ~= 21`

`age < (2 * num + 4)`

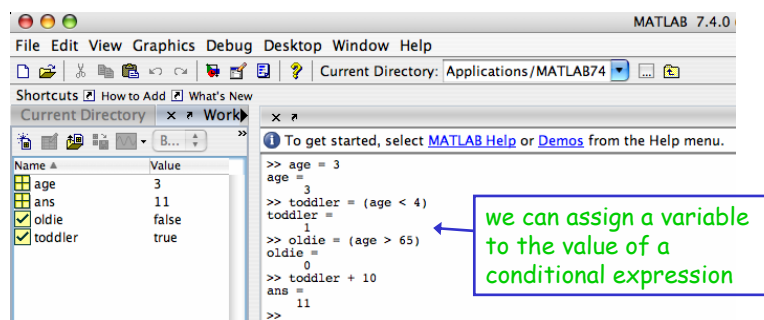
`(2 * num) > (age + 10)`

\* If `age` is 15 and `num` is 10, would these expressions be `true` or `false`?

Conditionals 4-7

## Boolean values

The *value* of a conditional expression is **1 (true)** or **0 (false)**



```
MATLAB 7.4.0
File Edit View Graphics Debug Desktop Window Help
Current Directory: Applications/MATLAB74
Shortcuts How to Add What's New
Current Directory x Work
Name Value
age 3
ans 11
oldie false
toddler true
>> age = 3
age =
    3
>> toddler = (age < 4)
toddler =
     1
>> oldie = (age > 65)
oldie =
     0
>> toddler + 10
ans =
    11
>>
```

we can assign a variable to the value of a conditional expression



`oldie` and `toddler` are type *logical*, but their value can sometimes be treated as a number

Conditionals 4-8

## The whole truth...

Question: *Are you between 18 and 21 years of age?\**

This question combines two simpler questions:

Is your age greater than or equal to 18?

*and*

Is your age less than or equal to 21?

MATLAB:

```
(age >= 18) & (age <= 21)
```



\* Which means in Massachusetts you get a funny looking driver's license

Conditionals 4-9

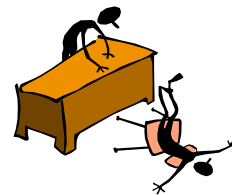
## Wouldn't it be easier to write ...

```
if (18 <= age <= 21)
    disp('You have a Junior Operator''s license!')
end
```

Well, yes, that's a valid MATLAB expression,  
but *the result may not be what you expect...*

Let's evaluate this expression for the following values:

```
age = 20
age = 15
age = 25
```



Conditionals 4-10

## Another question

Question: Are you under 18 or over 65 years of age?\*

This question combines

Is your age less than 18?

or

Is your age greater than 65?

MATLAB:

`(age < 18) | (age > 65)`



\* Which means reduced admission fee at the MFA...

Conditionals 4-11

## Final question: To be, or not to be,...

Question: Is your age not equal to 65?

`age ~= 65`

This can be rephrased as:

Is it not true that your age equals 65?

`~(age == 65)`

Logical value of expression  
is "flipped" with `~` ("not")

A page of text from Shakespeare's Hamlet, showing the famous 'To be, or not to be' soliloquy. The text is in an old script and includes the following lines:  
*Enter Hamlet.*  
*Cor.* Madam, will it please your grace  
To leave vs here?  
*Que.* With all my hart. *exit.*  
*Cor.* And here *Ofelia*, read you on this booke  
And walke aloofe, the King shal be vnscene.  
*Ham.* To be, or not to be, I here's the point,  
To Die, to sleepe, is that all? I all:  
No, to sleepe, to dreame, I mary there it goes,  
For in that dreame of death, when wee awake,

Conditionals 4-12

## More questions\*

Suppose **a** is 5 and **b** is 2

$(a == 5) \& (b == 5)$

$(a == 5) | (b == 5)$

$(a == 5) \& \sim(b == 5)$

$(a == 1) | b$

$(a >= 5) \& (b < 5)$

$(a >= 5) | (b < 5) \& (b > 2)$

$\sim((a \sim= 5) | (b \sim= 5))$

\* I lie like a rug



Conditionals 4-13

## Analyzing health data

What is the average cholesterol level for women in their twenties who exercise at least 30 minutes a day?

cholesterol	189	239	178	185	251	165	...
age	25	35	28	40	28	22	...
sex	'm'	'm'	'f'	'm'	'm'	'f'	...
exercise	30	15	40	25	15	60	...

Conditionals 4-14

## Vector to scalar comparisons

A conditional expression can be applied **element-by-element** to a vector of values:

```
ages = [55 52 20 10 63];  
oldies = (ages >= 50);  
twenties = (ages == 20);
```

ages	55	52	20	10	63
oldies	1	1	0	0	1
twenties	0	0	1	0	0



\* Write a statement that assigns **numOldies** to the number of values in the **ages** vector over 50

Conditionals 4-15

## Vector to vector comparisons

A conditional expression can be applied to two vectors:

```
ages = [55 52 20 10 63];  
newAges = [55 27 20 15 63];  
sameAge = (ages == newAges);  
older = (ages > newAges);
```

ages	55	52	20	10	63
newAges	55	27	20	15	63
sameAge					
older					

Conditionals 4-16

## Vector to vector comparisons

A conditional expression can be applied to two vectors:

```
ages = [55 52 20 10 63];  
newAges = [55 27 20 15 63];  
sameAge = (ages == newAges);  
older = (ages > newAges);
```

ages	55	52	20	10	63
newAges	55	27	20	15	63
sameAge	1	0	1	0	1
older	0	1	0	0	0

Conditionals 4-17

## Luxuries\*

- **any** returns true if *any* of the logical values in a vector are true
- **all** returns true if *all* of the logical values in a vector are true
- Examples:

```
ages = [10 62 18 27]  
anyKids = any(ages < 18)  
anySeniors = any(ages >= 65)  
allAdults = all(ages >= 18)  
noSeniors = all(ages <= 65)
```

\* Why luxuries?

Conditionals 4-18