

# Decisions, Decisions...

## Conditional statements and expressions



### 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')
```

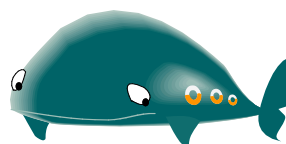
```
hold off
```

Conditionals 4-2

## What lies beneath...

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

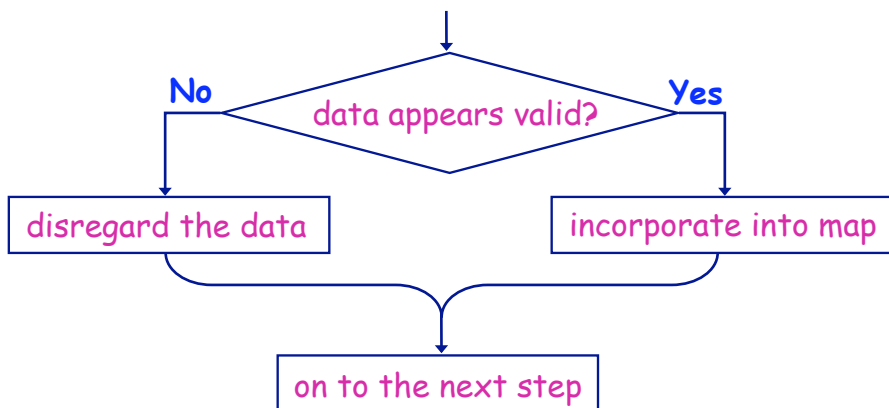
```
if data appears valid
then
  incorporate it into the seafloor map
otherwise
  disregard the data
'nuff said
```



\* 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)`

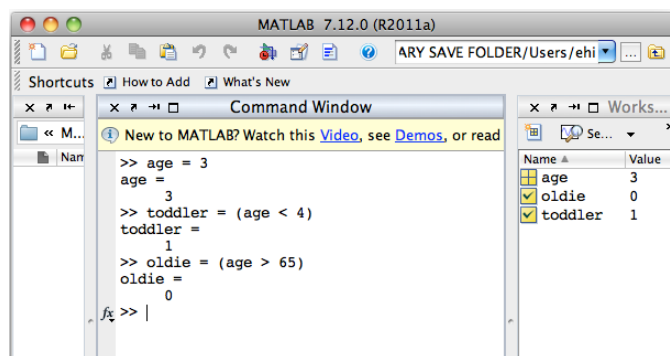
`(2 * num) > (age + 10)`

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

Conditionals 4-7

## Boolean values

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



The screenshot shows the MATLAB Command Window with the following code and output:

```
>> age = 3
age =
     3
>> toddler = (age < 4)
toddler =
     1
>> oldie = (age > 65)
oldie =
     0
fx >> |
```

The Workspace window on the right shows the following variables:

Name	Value
age	3
oldie	0
toddler	1



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

Conditionals 4-8

## Between a rock and a hard place...

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

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

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

Let's evaluate this expression for the following values:

age = 20      age = 15      age = 25



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

Conditionals 4-9

## The whole truth...

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

This question combines two simpler questions:

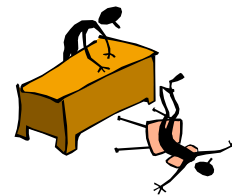
Is your age greater than or equal to 18?

and

Is your age less than or equal to 21?

MATLAB:

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



Conditionals 4-10

## Another question

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

This question combines

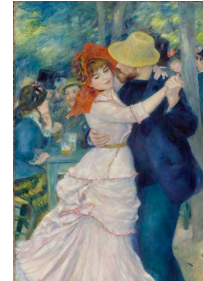
Is your age less than 18?

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?

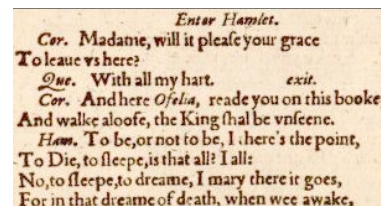
$age \neq 65$

This can be rephrased as:

Is it not true that your age equals 65?

$\sim(age == 65)$

Logical value of expression  
is "flipped" with  $\sim$  ("not")



*Enter Hamlet.*  
*Ger.* Madam, will it please your grace  
To leave vs here?  
*Oph.* With all my hart. *exit.*  
*Ger.* And here *Ophelia*, reade 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