Booleans

Remix CS 2019-20

Basic Logical Operators

$a = b$ Checks if **a** and **b** equal to each other

$a < b$ Checks if **a** is less than **b**

$a > b$ Checks if **a** is greater than **b**

$a \leq b$ Checks if **a** less than or equal to **b**

$a \geq b$ Checks if **a** is greater than or equal **b**

What is a Boolean?

In computer science, a boolean is a data type that can have the value of either TRUE or FALSE.

Examples of Booleans

1. $2 < 5$ TRUE

2. $8 = (4 \cdot 2)$ TRUE

3. $4 > 7$ FALSE

4. $3 = 6$ FALSE

Compound Boolean Expressions

Booleans can be combined using logical operators to make compound boolean expressions.

Logical _and_ Operator

The _and_ operator combines 2 boolean expressions. The result is equal to TRUE if both are TRUE and is equal to FALSE otherwise.

Examples:

$2 < 4$ and $3 = 3$

TRUE   TRUE

So the whole expression is TRUE

$4 = 5$ and $8 \geq 7$

FALSE   TRUE

So the whole expression is FALSE

More Examples

1. $1 = 2$ and $4^2 > 17$

2. ($1 = 1$ and $2 \geq 3/2$) and $2 < 7 - 2$

3. $6 < 9$ and ($2 \leq 2$ and $25^{1/2} > 11$)

4. (True and True) and (False and True)

Logical _or_ Operator

The _or_ operator combines 2 booleans and is equal to TRUE if at least 1 of the booleans is TRUE, and is equal to FALSE otherwise.

Examples:

$2 < 4$ or $3 = 3$

TRUE   TRUE

So the whole expression is TRUE

$4 = 5$ or $8 \geq 7$

FALSE   TRUE

So the whole expression is TRUE

More Examples

1. $-3 = 2$ or $2^3 > 8$

2. (True or False) or False

3. $(1 = 1$ or $2 \geq 13)$ and $3 + 4 \leq 14/2$

4. $6 < -4$ or $(2 \leq 2$ and $25^{1/2} > 11)$

Logical *<u>not</u>* Operator

The *<u>not</u>* operator makes a boolean into its opposite value.

Examples:

not TRUE is equivalent to FALSE

not (2 > 1) is equivalent to FALSE

not (5 = 9) is equivalent to TRUE

Is this statement True or False

((True and 2 < 1) or 3 = 6 - 3) and (False or not (17 > 31))

Breakdown:

(True and 2 < 1) Evaluates to False

not (17 > 31) Evaluates to True

(3 = 6 - 3) Evaluates to True

Rewrite the statement as: (False or True) and (False or True)

Which is True

Review

A	B	A AND B	A OR B	NOT A
False	False			
False	True			
True	False			
True	True			

What this looks like in python….

Python Syntax

Mathematical	Python
=	==
<	<
>	>
≤	<=
≥	>=
or	or
and	and
not	not

CodeSkulptor Examples

```
Code                                                          Output
 1  print "1 <= 8", 1 <= 8
 2
 3  print "2 == 2", 2 == 2
 4
 5  print "3 == 4*2", 3 == 4*2
 6
 7  print "4 > 9", 4 > 9
 8
 9  print "2 > 0.2 or -4 < -7", 2 > 0.2 or -4 < -7
10
11  print "1 == 7 or (2 < 3 and 9 >= 9)", 1 == 7 or (2 < 3 and 9 >= 9)
```
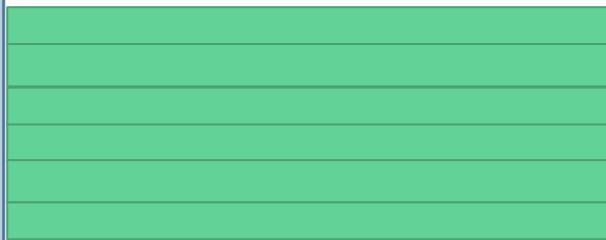
What will the output of this code be?

(Answer on next slide)

Code	Output
| ```
1 a = 9
2
3 b = 12/4
4
5 c = 7//2
6
7 print (b == c) and a - 2 >= 7
8
``` | |

What will the output of this code be?

Code	Output
| ```
1  a = 9
2
3  b = 12/4
4
5  c = 7//2
6
7  print (b == c) and a - 2 >= 7
8
``` | True |

What will the output of this code be?

(Answer on next slide)

Code	Output

<pre>1 a = 9
2
3 b = 12/4
4
5 c = 7//2
6
7 d = True
8
9 e = not (a > 19)
10
11 print not e or ((c > 1 and b == 3) and b > c)
12</pre>	

What will the output of this code be?

Code	Output
1 a = 9 2 3 b = 12/4 4 5 c = 7//2 6 7 d = True 8 9 e = not (a > 19) 10 11 print not e or ((c > 1 and b == 3) and b > c) 12	False

Boolean Exercises

Coding Problems:
https://py3.codeskulptor.org/#user303_92K3NMiKSk_0.py

Kahoot:
https://create.kahoot.it/share/booleans/9064f61c-7def-46ef-ab99-b7b0ae4729c1