Decisions: Boolean Logic

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Review

- What kinds of statements have we seen so far?
  - Assignment statements
  - Input statements
  - Output statements

- These are generally necessary, but not sufficient, to solve “interesting” problems

Decision making

- Decisions are questions with answers that are either **true** or **false** (**Boolean**)
  - e.g., Is it true that the variable ‘num’ is positive?
- A program can *branch* one way or another depending upon the answer to the question (the result of the Boolean expression).

```
x = True
y = False
```


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Relational Operators

Relational operators

- Allow us to compare other data types to produce booleans

Operator	Meaning	Math. Equivalent	Example
<	<	Less than	3 < 5
>	>	Greater than	5 > 3
==	=	Equal to	3 == 3
<=	≤	Less than or equal to	5 <= 5
>=	≥	Greater than or equal to	5 >= 4
!=	≠	Not equal to	5 != 3

Boolean expression

(operand) ***relational operator*** *(operand)*

- The result of the relational operator (comparison) is of type **bool** (short for boolean)
- *Boolean*: a binary variable, having two possible values: "**True**" and "**False**"
- True → 1 or T and False → 0 or F

```
x = 1.0
y = 2.0
c = (x <= y)
print (type(c))
```

<class 'bool'>

Boolean Operators

Logical (Boolean) operators

- For bool variables **a** and **b**
  - **a and b** (True only when **a** and **b** are both True)
  - **a or b** (False only when **a** and **b** are both False)
  - **not a** (True only when **a** is False and vice versa)

Precendence

With relational and boolean operators

Update on precedence

Order	Operations	Precedence
1	()	Highest
2	x ** y	
3	-x, +x	
4	x * y, x / y, x % y, x // y	
5	x + y, x - y	
6	<, <=, >, >=	
7	!=, ==	
8	not	
9	and	
10	or	
11	=	Lowest

Truth Tables

Truth Table for OR

A	B	A or B

Truth Table for OR

A	B	A or B
T	T	T

Truth Table for OR

A	B	A or B
T	T	T
T	**F**	**T**

Truth Table for OR

A	B	A or B
T	T	T
T	F	T
F	**T**	**T**

Truth Table for OR

A	B	A or B
T	T	T
T	F	T
F	T	T
F	**F**	**F**

Logical expression

(boolean expression) ***logical operator*** *(boolean expression)*

- Logical operators → and, or, and not (more later)

A	B	A or B
T	T	T
T	F	T
F	T	T
F	F	F

A	B	A and B
T	T	T
T	F	F
F	T	F
F	F	F

B	not B
T	F
F	T

Truth Tables

Example

Boolean Logic

- Example:
  - Construct a truth table for A and (B or not C):

Boolean Logic

- Example:
  - Construct a truth table for **A and (B or not C)**:

A	B	C
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

Boolean Logic

- Example:
  - Construct a truth table for **A and (B or not C)**:

A	B	C	not C
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Boolean Logic

- Example:
  - Construct a truth table for **A and (B or not C)**:

A	B	C	not C	B or not C
0	0	0	1	1
0	0	1	0	0
0	1	0	1	1
0	1	1	0	1
1	0	0	1	1
1	0	1	0	0
1	1	0	1	1
1	1	1	0	1

Boolean Logic

- Example:
  - Construct a truth table for **A and (B or not C)**

A	B	C	not C	B or not C	A and (B or not C)
0	0	0	1	1	0
0	0	1	0	0	0
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	1	1	1
1	0	1	0	0	0
1	1	0	1	1	1
1	1	1	0	1	1

Onward to … if else statements.

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