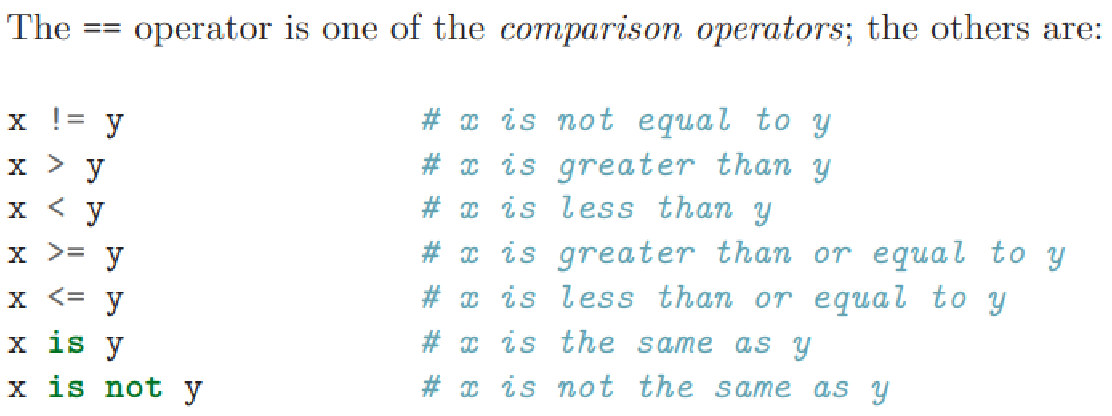
9/3 CSP P4E C3.1-3.2,3.8

Overview

Chapter 3: Boolean expressions

3.1 Boolean expressions

- **Definition of Boolean expressions:** A *boolean expression* is an expression that is either true or false
- True and False are special values that belong to the class bool; they are not strings
- **Example:**
  - The following examples use the operator ==, which compares two operands and produces True if they are equal and False otherwise:
  - 5 == 5 True
  - 5 == 6 False



The == operator is one of the *comparison operators*; the others are:

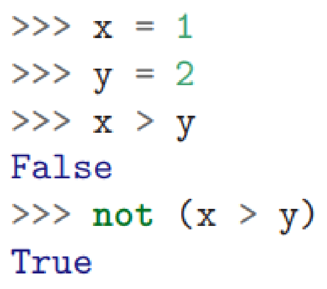
```
x != y               # x is not equal to y
x > y                # x is greater than y
x < y                # x is less than y
x >= y               # x is greater than or equal to y
x <= y               # x is less than or equal to y
x is y               # x is the same as y
x is not y           # x is not the same as y
```

-
- **Common Errors**: use a single equal sign (=) instead of a double equal sign (==). Remember that = is an assignment operator and == is a comparison operator. There is no such thing as =< or =>.
-

3.2: Logical operators

- **3 logical operators:** ***and, or, and not.***
- **Example:**
  - 'x > 0 and x < 10' is true only if x is greater than 0 and less than 10.

    - ‘n%2 == 0 ***or*** n%3 == 0’ is true i***f either of the conditions is true***, that is, if the number is divisible by 2 or 3.
    - Finally, the ***not*** operator negates a boolean expression, so not (x > y) is true if x > y is false



```
>>> x = 1
>>> y = 2
>>> x > y
False
>>> not (x > y)
True
```

- Strictly speaking, the operands of the logical operators should be boolean expressions, but Python is not very strict. Any nonzero number is interpreted as “true.” ‘17 and True’ True

3.8: Short-circuit evaluation of logical expressions

- When Python is processing a logical expression such as x >= 2 and (x/y) > 2, it evaluates the expression from left to right. Because of the definition of and, if x is less than 2, the expression x >= 2 is False and so the whole expression is False
- Short-circuiting: When the evaluation of a logical expression stops because the overall value is already known, it is called short-circuiting the evaluation.
- guardian pattern: We can construct the logical expression to strategically place a guard evaluation just before the evaluation that might cause an error as follows:

```
>>> x = 1
>>> y = 0
>>> x >= 2 and y != 0 and (x/y) > 2
False
>>> x = 6
>>> y = 0
>>> x >= 2 and y != 0 and (x/y) > 2
False
>>> x >= 2 and (x/y) > 2 and y != 0
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ZeroDivisionError: division by zero
>>>
```

In the first logical expression, `x >= 2` is `False` so the evaluation stops at the `and`. In the second logical expression, `x >= 2` is `True` but `y != 0` is `False` so we never reach `(x/y)`.

In the third logical expression, the `y != 0` is *after* the `(x/y)` calculation so the expression fails with an error.

In the second expression, we say that `y != 0` acts as a *guard* to insure that we only execute `(x/y)` if `y` is non-zero.

-
-