Fundamentos de Programação

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Summary

- Boolean expressions
  - The bool type
  - Relational operators
  - Logical operators
  - Properties
- Conditional execution
  - If statement
  - If-else
  - If-elif-else

Boolean expressions

- A **boolean expression** is an expression that is either true or false.

```
>>> n = 5      # this IS NOT a boolean expression!
>>> n == 5     # this IS a boolean expression!
True
>>> 6 == n     # this is another boolean expression.
False
```

- `True` and `False` are special values that belong to the type `bool`.
- Boolean values may be stored in variables.

```
>>> isEven = n%2==0
```

- May be converted to string.

```
>>> str(isEven)
'False'
```

- Or to integer.

```
>>> int(False)   # 0
>>> int(True)    # 1
```

Zero and empty values convert to `False`:

```
>>> bool(0)         # False
>>> bool(0.0)       # False
>>> bool('')        # False
```

Other values convert to `True`:

```
>>> bool(1)         # True
>>> bool('False')   # True (surprise!)
```

Relational and logical operators

- **Relational operators** produce boolean results:

```
x == y       # x is equal to y
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 < y < z    # x is less than y and y is less than z (cool!)
```

- There are three **logical operators**: `and`, `or`, `not`.

```
x>=0 and x<10     # x is between 0 and 10 (exclusive)
0<=x and x<10     # same thing
x==0 or not isEven and y/x>1
```

Properties

- Remember these properties:

```
x == y    <=>   not x != y    <=>    y == x
x != y    <=>   not x == y    <=>    y != x
x > y     <=>   not x <= y    <=>    y < x
x <= y    <=>   not x > y     <=>    y >= x
not (not A)      <=>   A
not (A and B)    <=>   (not A) or (not B)
not (A or B)     <=>   (not A) and (not B)
```

- And these (but beware of *short-circuit evaluation**):

```
A or B     <=>   B or A
A and B    <=>   B and A
A or (B and C)    <=>    (A or B) and (A or C)
A and (B or C)    <=>    (A and B) or (A and C)
```

Precedence rules

- Arithmetic > relational > `not` > `and` > `or`.

```
          x<=1+2*y**3 or n!=0 and not 1/n<=y
       (x<=1+2*y**3) or (n!=0 and not 1/n<=y)
    (x<=(1+2*y**3)) or ((n!=0) and (not 1/n<=y))
  (x<=(1+(2*y**3))) or ((n!=0) and (not (1/n<=y)))
(x<=(1+(2*(y**3)))) or ((n!=0) and (not ((1/n)<=y)))
```

Short-circuit evaluation

- Operators `and` and `or` only evaluate the second operand if needed!

```
X and Y    # if X is false then X, otherwise Y
X or Y     # if X is true then X, otherwise Y
```

- This is called **short-circuit evaluation**.
- It can be very useful:

```
1/n>2 and n!=0    # ZeroDivisionError if n==0
n!=0 and 1/n>2    # False if n==0, 1/n not evaluated
n==0 or 3/n<4     # True if n==0, 3/n not evaluated
```

- But remember:
  - Commutative and distributive properties may not be valid!

Conditional execution (1)

- The ability to check conditions and change the behavior of the program accordingly is almost always used. **Conditional statements** give us this ability.
- The simplest form is the `if` statement:

```
if x > 0:
  print('x is positive')
```

- The boolean expression after `if` is called the condition.
- The indented statement(s) gets executed if the condition is true. If not, nothing happens.
- There is no limit on the number of statements that can appear in the body, but there has to be at least one.

Conditional execution (2)

- A second form of the `if` statement is alternative execution, in which there are two possibilities and the condition determines which one gets executed.

```
if x%2 == 0:
  print('x is even')
else:
  print('x is odd')
```

- Sometimes there are more than two possibilities and we need more than two branches (chained conditional).

```
if x < y:
  print('x is less than y')
elif x > y:
  print('x is greater than y')
else:
  print('x and y are equal')
```

Conditional execution (3)

- One conditional can also be nested within another.

```
if x == y:
  print('x and y are equal')
else:
  if x < y:
    print('x is less than y')
  else:
    print('x is greater than y')
```

- Although the indentation of the statements makes the structure apparent, nested conditionals become difficult to read very quickly.
- Logical operators often provide a way to simplify nested conditional statements.

Code transformations

- Transformations may simplify the code.

```
if Cond1:
  if Cond2:
    Suite1
  else:
    Suite2
else:
  Suite3
```

```
if not Cond1:
  Suite3
else:
  if Cond2:
    Suite1
  else:
    Suite2
```

```
if not Cond1:
  Suite3
elif Cond2:
  Suite1
else:
  Suite2
```