Think Python

How to Think Like a Computer Scientist

Version 1.1.24+Kart [Python 3.2]

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Green Tea Press

Needham, Massachusetts

Printing history:

April 2002: First edition of *How to Think Like a Computer Scientist*.

August 2007: Major revision, changed title to *How to Think Like a (Python) Programmer*.

June 2008: Major revision, changed title to *Think Python: How to Think Like a Computer Scientist*.

Green Tea Press
9 Washburn Ave
Needham MA 02492

The original form of this book is LaTeX source code. Compiling this LaTeX source has the effect of generating a device-independent representation of a textbook, which can be converted to other formats and printed.

The LaTeX source for this book is available from `http://www.thinkpython.com`

Chapter 1

The Boolean Type

1.1 Modulus operator

The **modulus operator** works on integers and yields the remainder when the first operand is divided by the second. In Python, the modulus operator is a percent sign (`%`). The syntax is the same as for other operators:

```
>>> quotient = 7 / 3
>>> print(quotient)
2.3333333333333335
>>> remainder = 7 % 3
>>> print(remainder)
1
>>> quotient = 7 // 3
print(quotient)
2
```

So 7 divided by 3 is 2 (using integer division), with 1 left over.

The modulus operator turns out to be surprisingly useful. For example, you can check whether one number is divisible by another—if `x % y` is zero, then `x` is divisible by `y`.

Also, you can extract the right-most digit or digits from a number. For example, `x % 10` yields the right-most digit of `x` (in base 10). Similarly `x % 100` yields the last two digits.

1.2 Boolean expressions

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

`True` and `False` are special values that belong to the type `bool`; they are not strings:

```
>>> type(True)
<class 'bool'>
>>> type(False)
<class 'bool'>
```

The == operator is one of the **relational 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
```

Although these operations are probably familiar to you, the Python symbols are different from the mathematical symbols. A common error is to use a single equal sign (=) instead of a double equal sign (==). Remember that = is an assignment operator and == is a relational operator. There is no such thing as =< or =>.

1.3 Logical operators

There are three **logical operators**: `and`, `or`, and `not`. The semantics (meaning) of these operators is similar to their meaning in English. For 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 if *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, that is, if `x` is less than or equal to `y`.

Here are some examples of using these operators:

```
>>> a = False
>>> b = True
>>> not a
True
>>> not b
False
>>> a and b
False
>>> a or b
True
>>>
```

The `and`, `or`, and `not` operators have different precedences. `not` has the highest precedence, followed by `and` and then `or`. This is similar to the arithmetic operators, where `*` has higher precedence than +.

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
```

This flexibility can be useful, but there are some subtleties to it that might be confusing. You might want to avoid it for now until we have had more experience with boolean operators.