

Introduction to Python

Basic Syntax

Operations and Variables

Topics

- 1) Operations
 - a) Arithmetic
 - b) Comparison
 - c) Boolean
- 2) Variables
- 3) Assignments and Augmented Assignments
- 4) User input

Arithmetic Operations

Operator	Name	Description
$a + b$	Addition	Sum of a and b
$a - b$	Subtraction	Difference of a and b
$a * b$	Multiplication	Product of a and b
a / b	True division	Quotient of a and b
$a // b$	Floor division	Quotient of a and b , removing fractional parts
$a \% b$	Modulus	Remainder after division of a by b
$a ** b$	Exponentiation	a raised to the power of b
$-a$	Negation	The negative of a
$+a$	Unary plus	a unchanged (rarely used)

Mixing Types

Any expression that two floats produce a float.

```
In[1]: 17.0 - 10.0
```

```
Out [1]: 7.0
```

When an expression's operands are an int and a float, Python automatically converts the int to a float.

```
In[2]: 17.0 - 10
```

```
Out [1]: 7.0
```

```
In[3]: 17 - 10.0
```

```
Out [1]: 7.0
```

True Division vs Floor Division

The operator `/` is true division and the operator `//` returns floor division(round down after true divide).

```
In[1]: 23 // 7
```

```
Out [1]: 3
```

```
In[2]: 3 // 9
```

```
Out [2]: 0
```

```
In[2]: -4 // 3
```

```
Out [2]: -2
```

```
In[3]: 6 / 5
```

```
Out [3]: 1.2
```

Modulo Operator

The operator % returns the modulus which is the remainder after floor division.

```
In[1]: 18 % 5
```

```
Out [1]: 3
```

```
In[2]: 3 % 9
```

```
Out [2]: 3
```

```
In[2]: 125 % 10
```

```
Out [2]: 5
```

```
In[3]: -17 % 10
```

```
Out [3]: 3
```

```
In[3]: 17 % -10
```

```
Out [3]: -3
```

Note: This is different than Java, which gives the remainder after integer division. But the two are the same for positive operands.

Why floor division is useful

Sometimes we only want the integer part of division. Consider the question:

How many weeks are there in 25 days?

Answer: 3 weeks plus 4 days.

```
In[1]: 25 // 7
```

```
Out [1]: 3
```

Why the modulo operator is useful

Sometimes we only want the remainder part of the division. Consider the question:

If today is a Tuesday, which day is 43 days from today?

Answer: 43 divided by 7 is 6 with a remainder of 1. Thus it will be Wednesday.

```
In[1]: 43 % 7
```

```
Out [1]: 1
```

Even/odd: A number x is even if $x \% 2 == 0$ and odd if $x \% 2 != 0$

Exponentiation and Negation

```
In[1]: 2 ** 3
```

```
Out[3]: 8
```

Negation is a **unary operator**. It applies to only one operand. Other operations such as $+$, $-$, $*$, $/$, $//$, $\%$ are **binary operators**, they apply to two operands.

```
In[2]: -5
```

```
Out [3]: -5
```

```
In[3]: --5
```

```
Out[3]: 5
```

Operator Precedence

Precedence	Operator	Operation
highest	**	exponentiation
	-	negation
	*, /, //, %	multiplication, division, floor division, modulus
lowest	+, -	adding, subtraction

Operators on the same row are applied left to right. Exponentiation, however, is applied right to left. Expressions in parenthesis are evaluated first(PEMDAS).

Operator Precedence

In[1]: `-2 ** 4`

Out[3]: `-16`

In[2]: `7 - 4 * 5 % (1 + 2)`

Out [3]: `5`

`7 - 4 * 5 % (1 + 2)`

`7 - 4 * 5 % 3`

`7 - 20 % 3`

`7 - 2`

`5`

Comparison Operators

Operation	Description
a == b	a equal to b
a != b	a not equal to b
a < b	a less than b
a > b	a greater than b
a <= b	a less than or equal to b
a >= b	a greater than or equal to b

Note that = is for assignment and == is for equals.

These operators return either True or False.

Comparison Operators

```
In[1]: 10 == 5
```

```
Out[1]: False
```

```
In[2]: 3 <= 7
```

```
Out[2]: True
```

```
In[3]: 3 != 7
```

```
Out[3]: True
```

Boolean Operations

Python provides operators to combine the values using the standard concepts of “**and**”, “**or**”, and “**not**”.

These operators are expressed using the words and, or, and not:

X	Y	X or Y
True	True	True
True	False	True
False	True	True
False	False	False

X	Y	X and Y
True	True	True
True	False	False
False	True	False
False	False	False

X	not X
True	False
False	True

Boolean Operations

```
In[1]: x = 4
```

```
(x < 6) and (x > 2)
```

```
Out[1]: True
```

```
In[2]: (x > 10) or (x % 2 == 0)
```

```
Out[2]: True
```

```
In[3]: not (x < 6)
```

```
Out[3]: False
```

Operator Precedence

Precedence	Operator	Operation
highest	**	exponentiation
	-	negation
	*, /, //, %	multiplication, division, floor division, modulus
	+, -	adding, subtraction
	==, !=, <, >, <=, >=	comparisons
	not	logical not
	and	logical and
	or	logical or
lowest	=	assignment

Boolean Operations

Math operators have the highest precedence. Then comparison operators are followed by logical operators. The assignment operator is evaluated last.

```
In[1]: result = 3 + 2 * 4 < 14 or 3 == 5  
       result
```

```
Out[1]: True
```

Variables

We can use variables to refer to values that can be used later.

You can create a new variable by given it a value.

```
In[1]: x = 4  
      x
```

```
Out[1]: 4
```

Variable names can use letters, digits, and the underscore symbol (but they can't start with a digit).

= is not equality

Unlike in math, = is not equality in Python. It is an assignment: assign the expression on the right side of = to the variable on the left.

```
In[1]: x = 4
        x = x + 1    # in math, this has no solutions!
        x
Out[1]: 5
```

Assignment is not symmetric.

```
In[1]: x = 4    # correct!
        10 = y   # error!
```

Augmented Assignment

An **augmented assignment** combines an assignment statement with an operator to make the statement more concise.

Shorthand

variable += **value**;

variable -= **value**;

variable *= **value**;

variable /= **value**;

variable %= **value**;

Equivalent version

variable = **variable** + **value**;

variable = **variable** - **value**;

variable = **variable** * **value**;

variable = **variable** / **value**;

variable = **variable** % **value**;

```
In[1]: x = 4
```

```
    x += 1    # equivalent to x = x + 1
```

```
    x
```

```
Out[1]: 5
```

Augmented Assignment

```
In[1]: x = 3  
       x *= 2 + 5  
       x
```

```
Out[1]: 21
```

```
In[1]: number = 5  
       number *= number  
       number
```

```
Out[1]: 25
```

Input

Programs may use the input function to obtain information from the user.

```
print('Please enter some text:')
```

```
x = input()
```

```
print('Text entered:', x)
```

```
print('Type:', type(x))
```

Please enter some text:

hello

Text entered: hello

Type: <class 'str'>

Input

Since user input almost always requires a message to the user about the expected input, the input function optionally accepts a string that it prints just before the program stops to wait for the user to respond.

```
x = input('Please enter an integer value: ')
y = input('Please enter another integer value: ')
num1 = int(x)
num2 = int(y)
print(num1, '+', num2, '=', num1 + num2)
```

Please enter an integer value: 4

Please enter another integer value: 5

4 + 5 = 9

Input

Or even more succinctly.

```
num1 = int(input('Please enter an integer value: '))  
num2 = int(input('Please enter another integer value: '))  
print(num1, '+', num2, '=', num1 + num2)
```

Please enter an integer value: 4

Please enter another integer value: 5

4 + 5 = 9

Lab

Write a program that asks the user to enter three test scores: name these variables test1, test2 and test3. Create three variables: average, variance and standard_deviation and compute their values.

The program then prints out the average, variance and standard deviation. Your program should have a output EXACTLY as below:

Enter Test 1 score:78

Enter Test 2 score:80

Enter Test 3 score:77

Average: 78.33333333333333

Variance: 1.5555555555555556

Standard Deviation: 1.247219128924647

The variance = $((\text{test1} - \text{ave})^2 + (\text{test2} - \text{ave})^2 + (\text{test3} - \text{ave})^2)/3$

The standard deviation: square root of variance

References

I) Vanderplas, Jake, A Whirlwind Tour of Python, O'reilly Media.

This book is completely free and can be downloaded online at O'reilly's site.