

= 1 cannot form part of the conditional expression of a conditional statement . This has the advantage of avoiding a classic C error of mistaking an assignment operator = for an equality operator
== in conditions : if (c = 1) { ... } is valid C code but if c = 1 : ... causes a syntax error in Python .

== Methods ==

Methods on objects are functions attached to the object 's class ; the syntax instance.method (argument) is , for normal methods and functions , syntactic sugar for Class.method (instance , argument) . Python methods have an explicit self parameter to access instance data , in contrast to the implicit self (or this) in some other object @-@ oriented programming languages (e.g. , C + + , Java , Objective @-@ C , or Ruby) .

== Typing ==

Python uses duck typing and has typed objects but untyped variable names . Type constraints are not checked at compile time ; rather , operations on an object may fail , signifying that the given object is not of a suitable type . Despite being dynamically typed , Python is strongly typed , forbidding operations that are not well @-@ defined (for example , adding a number to a string) rather than silently attempting to make sense of them .

Python allows programmers to define their own types using classes , which are most often used for object @-@ oriented programming . New instances of classes are constructed by calling the class (for example , SpamClass () or EggsClass ()) , and the classes are instances of the metaclass type (itself an instance of itself) , allowing metaprogramming and reflection .

Before version 3 @. @ 0 , Python had two kinds of classes : old @-@ style and new @-@ style . Old @-@ style classes were eliminated in Python 3 @. @ 0 , making all classes new @-@ style . In versions between 2 @. @ 2 and 3 @. @ 0 , both kinds of classes could be used . The syntax of both styles is the same , the difference being whether the class object is inherited from , directly or indirectly (all new @-@ style classes inherit from object and are instances of type) .

== Mathematics ==

Python has the usual C arithmetic operators (+ , - , * , / , %) . It also has * * for exponentiation , e.g. 5 * * 3

= 125 and 9 * * 0 @. @ 5 =

3 @. @ 0 , and a new matrix multiply @ operator is included in version 3 @. @ 5 .

The behavior of division has changed significantly over time :

Python 2 @. @ 1 and earlier use the C division behavior . The / operator is integer division if both operands are integers , and floating @-@ point division otherwise . Integer division rounds towards 0 , e.g. 7 / 3

= 2 and -7 / 3 =

-2 .

Python 2 @. @ 2 changes integer division to round towards negative infinity , e.g. 7 / 3

= 2 and -7 / 3 =

-3 . The floor division // operator is introduced . So 7 // 3

= 2 , -7 // 3 =

-3 , 7 @. @ 5 // 3

= 2 @. @ 0 and -7.5 // 3 =

-3.0 . Adding from __ future __ import division causes a module to use Python 3 @. @ 0 rules for division (see next) .

Python 3 @. @ 0 changes / to be always floating @-@ point division . In Python terms , the pre @-@ 3 @. @ 0 / is classic division , the version @-@ 3 @. @ 0 / is real division , and // is floor

division .

Rounding towards negative infinity , though different from most languages , adds consistency . For instance , it means that the equation $(a + b) // b$

$= a // b + 1$ is always true . It also means that the equation $b * (a // b) + a \% b =$

a is valid for both positive and negative values of a . However , maintaining the validity of this equation means that while the result of $a \% b$ is , as expected , in the half $[-b, 0)$ open interval $[0, b)$, where b is a positive integer , it has to lie in the interval $(b, 0]$ when b is negative .

Python provides a round function for rounding a float to the nearest integer . For tie breaking , versions before 3 use round away from zero : round (0.5) is 1 , round (-0.5) is -1 . Python 3 uses round to even : round (1.5) is 2 , round (2.5) is 2 .

Python allows boolean expressions with multiple equality relations in a manner that is consistent with general use in mathematics . For example , the expression $a < b < c$ tests whether a is less than b and b is less than c . C-derived languages interpret this expression differently : in C , the expression would first evaluate $a < b$, resulting in 0 or 1 , and that result would then be compared with c .

Python has extensive built-in support for arbitrary precision arithmetic . Integers are transparently switched from the machine-supported maximum fixed-precision (usually 32 or 64 bits) , belonging to the python type int , to arbitrary precision , belonging to the python type long , where needed . The latter have an " L " suffix in their textual representation . The Decimal type / class in module decimal (since version 2.4) provides decimal floating point numbers to arbitrary precision and several rounding modes . The Fraction type in module fractions (since version 2.6) provides arbitrary precision for rational numbers .

Due to Python 's extensive mathematics library , it is frequently used as a scientific scripting language to aid in problems such as numerical data processing and manipulation .

== Libraries ==

Python has a large standard library , commonly cited as one of Python 's greatest strengths , providing tools suited to many tasks . This is deliberate and has been described as a " batteries included " Python philosophy . For Internet-facing applications , many standard formats and protocols (such as MIME and HTTP) are supported . Modules for creating graphical user interfaces , connecting to relational databases , pseudorandom number generators , arithmetic with arbitrary precision decimals , manipulating regular expressions , and doing unit testing are also included .

Some parts of the standard library are covered by specifications (for example , the Web Server Gateway Interface (WSGI) implementation wsgiref follows PEP 333) , but most modules are not . They are specified by their code , internal documentation , and test suite (if supplied) . However , because most of the standard library is cross-platform Python code , only a few modules need altering or rewriting for variant implementations .

The standard library is not needed to run Python or embed it in an application . For example , Blender 2.49 omits most of the standard library .

As of January 2016 , the Python Package Index , the official repository of third-party software for Python , contains more than 72,000 packages offering a wide range of functionality , including :

graphical user interfaces , web frameworks , multimedia , databases , networking and communications

test frameworks , automation and web scraping , documentation tools , system administration

scientific computing , text processing , image processing

== Development environments ==

Most Python implementations (including CPython) can function as a command line interpreter , for which the user enters statements sequentially and receives the results immediately (read ? eval ?

print loop (REPL)) . In short , Python acts as a command @-@ line interface or shell .

Other shells add abilities beyond those in the basic interpreter , including IDLE and IPython . While generally following the visual style of the Python shell , they implement features like auto @-@ completion , session state retention , and syntax highlighting .

In addition to standard desktop integrated development environments (Python IDEs) , there are also web browser @-@ based IDEs , Sage (intended for developing science and math @-@ related Python programs) , and a browser @-@ based IDE and hosting environment , PythonAnywhere .

= = Implementations = =

The main Python implementation , named CPython , is written in C meeting the C89 standard . It compiles Python programs into intermediate bytecode , which is executed by the virtual machine . CPython is distributed with a large standard library written in a mixture of C and Python . It is available in versions for many platforms , including Windows and most modern Unix @-@ like systems . CPython was intended from almost its very conception to be cross @-@ platform .

PyPy is a fast , compliant interpreter of Python 2 @.@ 7 and 3 @.@ 2 . Its just @-@ in @-@ time compiler brings a significant speed improvement over CPython . A version taking advantage of multi @-@ core processors using software transactional memory is being created .

Stackless Python is a significant fork of CPython that implements microthreads ; it does not use the C memory stack , thus allowing massively concurrent programs . PyPy also has a stackless version .

MicroPython is a lean , fast Python 3 variant that is optimised to run on microcontrollers .

Other just @-@ in @-@ time compilers have been developed in the past , but are now unsupported :

Google began a project named Unladen Swallow in 2009 with the aims of speeding up the Python interpreter by 5 times , by using the LLVM , and of improving its multithreading ability to scale to thousands of cores .

Psyco is a just @-@ in @-@ time specialising compiler that integrates with CPython and transforms bytecode to machine code at runtime . The emitted code is specialised for certain data types and is faster than standard Python code .

In 2005 , Nokia released a Python interpreter for the Series 60 mobile phones named PyS60 . It includes many of the modules from the CPython implementations and some added modules to integrate with the Symbian operating system . This project has been kept up to date to run on all variants of the S60 platform and there are several third party modules available . The Nokia N900 also supports Python with GTK widget libraries , with the feature that programs can be both written and run on the target device .

There are several compilers to high @-@ level object languages , with either unrestricted Python , a restricted subset of Python , or a language similar to Python as the source language :

Jython compiles into Java byte code , which can then be executed by every Java virtual machine implementation . This also enables the use of Java class library functions from the Python program .

IronPython follows a similar approach in order to run Python programs on the .NET Common Language Runtime .

The RPython language can be compiled to C , Java bytecode , or Common Intermediate Language , and is used to build the PyPy interpreter of Python .

Pyjamas compiles Python to JavaScript .

Shed Skin compiles Python to C + + .

Cython and Pyrex compile to C.

A performance comparison of various Python implementations on a non @-@ numerical (combinatorial) workload was presented at EuroSciPy ' 13 .

= = Development = =

Python 's development is conducted largely through the Python Enhancement Proposal (PEP) process . The PEP process is the primary mechanism for proposing major new features , for collecting community input on an issue , and for documenting the design decisions that have gone into Python . Outstanding PEPs are reviewed and commented upon by the Python community and by Van Rossum , the Python project 's benevolent dictator for life .

Enhancement of the language goes along with development of the CPython reference implementation . The mailing list python @-@ dev is the primary forum for discussion about the language 's development ; specific issues are discussed in the Roundup bug tracker maintained at python.org. Development takes place on a self @-@ hosted source code repository running Mercurial .

CPython 's public releases come in three types , distinguished by which part of the version number is incremented :

Backwards @-@ incompatible versions , where code is expected to break and must be manually ported . The first part of the version number is incremented . These releases happen infrequently ? for example , version 3 @.@ 0 was released 8 years after 2 @.@ 0 .

Major or " feature " releases , which are largely compatible but introduce new features . The second part of the version number is incremented . These releases are scheduled to occur roughly every 18 months , and each major version is supported by bugfixes for several years after its release .

Bugfix releases , which introduce no new features but fix bugs . The third and final part of the version number is incremented . These releases are made whenever a sufficient number of bugs have been fixed upstream since the last release , or roughly every 3 months . Security vulnerabilities are also patched in bugfix releases .

Many alpha , beta , and release @-@ candidates are also released as previews , and for testing before final releases . Although there is a rough schedule for each release , this is often pushed back if the code is not ready . The development team monitors the state of the code by running the large unit test suite during development , and using the BuildBot continuous integration system .

The community of Python developers has also contributed over 72 @,@ 000 software modules (as of January 2016) to the Python Package Index (PyPI) , the official repository of third @-@ party libraries for Python .

The major academic conference on Python is named PyCon . There are special mentoring programmes like the Pyladies .

= = Naming = =

Python 's name is derived from the television series Monty Python 's Flying Circus , and it is common to use Monty Python references in example code . For example , the metasyntactic variables often used in Python literature are spam and eggs , instead of the traditional foo and bar . Also , the official Python documentation often contains various obscure Monty Python references .

The prefix Py- is used to show that something is related to Python . Examples of the use of this prefix in names of Python applications or libraries include Pygame , a binding of SDL to Python (commonly used to create games) ; PyS60 , an implementation for the Symbian S60 operating system ; PyQt and PyGTK , which bind Qt and GTK , respectively , to Python ; and PyPy , a Python implementation originally written in Python .

= = Uses = =

Since 2003 , Python has consistently ranked in the top ten most popular programming languages as measured by the TIOBE Programming Community Index . As of June 2016 , it is the fourth most popular language . It was ranked as Programming Language of the Year for the year 2007 and 2010 . It is the third most popular language whose grammatical syntax is not predominantly based on C , e.g. C + + , Objective @-@ C (note , C # and Java only have partial syntactic similarity to C , such as the use of curly braces , and are closer in similarity to each other than C) .

An empirical study found scripting languages (such as Python) more productive than conventional languages (such as C and Java) for a programming problem involving string manipulation and search in a dictionary . Memory consumption was often " better than Java and not much worse than C or C + + " .

Large organizations that make use of Python include Google , Yahoo ! , CERN , NASA , and some smaller ones like ILM , and ITA . The social news networking site , Reddit , is written entirely in Python .

Python can serve as a scripting language for web applications , e.g. , via `mod _ wsgi` for the Apache web server . With Web Server Gateway Interface , a standard API has evolved to facilitate these applications . Web frameworks like Django , Pylons , Pyramid , TurboGears , web2py , Tornado , Flask , Bottle and Zope support developers in the design and maintenance of complex applications . Pyjamas and IronPython can be used to develop the client @-@ side of Ajax @-@ based applications . SQLAlchemy can be used as data mapper to a relational database . Twisted is a framework to program communications between computers , and is used (for example) by Dropbox .

Libraries like NumPy , SciPy and Matplotlib allow the effective use of Python in scientific computing , with specialized libraries such as BioPython and Astropy providing domain @-@ specific functionality . Sage is a mathematical software with a " notebook " programmable in Python : its library covers many aspects of mathematics , including algebra , combinatorics , numerical mathematics , number theory , and calculus .

Python has been successfully embedded in many software products as a scripting language , including in finite element method software such as Abaqus , 3D parametric modeler like FreeCAD , 3D animation packages such as 3ds Max , Blender , Cinema 4D , Lightwave , Houdini , Maya , modo , MotionBuilder , Softimage , the visual effects compositor Nuke , 2D imaging programs like GIMP , Inkscape , Scribus and Paint Shop Pro , and musical notation program or scorewriter capella . GNU Debugger uses Python as a pretty printer to show complex structures such as C + + containers . Esri promotes Python as the best choice for writing scripts in ArcGIS . It has also been used in several video games , and has been adopted as first of the three available programming languages in Google App Engine , the other two being Java and Go .

Python has been used in artificial intelligence tasks . As a scripting language with module architecture , simple syntax and rich text processing tools , Python is often used for natural language processing tasks .

Many operating systems include Python as a standard component ; the language ships with most Linux distributions , AmigaOS 4 , FreeBSD , NetBSD , OpenBSD and OS X , and can be used from the terminal . Many Linux distributions use installers written in Python : Ubuntu uses the Ubiquity installer , while Red Hat Linux and Fedora use the Anaconda installer . Gentoo Linux uses Python in its package management system , Portage .

Python has also seen extensive use in the information security industry , including in exploit development .

Most of the Sugar software for the One Laptop per Child XO , now developed at Sugar Labs , is written in Python .

The Raspberry Pi single @-@ board computer project has adopted Python as its main user @-@ programming language .

LibreOffice includes Python and intends to replace Java with Python . Python Scripting Provider is a core feature since Version 4 @.@ 0 from 7 February 2013 .

= = Languages influenced by Python = =

Python 's design and philosophy have influenced several programming languages , including :

Boo uses indentation , a similar syntax , and a similar object model . However , Boo uses static typing (and optional duck typing) and is closely integrated with the .NET Framework .

Cobra uses indentation and a similar syntax . Cobra 's " Acknowledgements " document lists Python first among languages that influenced it . However , Cobra directly supports design @-@ by

@-@ contract , unit tests , and optional static typing .

ECMAScript borrowed iterators , generators , and list comprehensions from Python .

Go is described as incorporating the " development speed of working in a dynamic language like Python " .

Groovy was motivated by the desire to bring the Python design philosophy to Java .

Julia was designed " with true macros [.. and to be] as usable for general programming as Python [and] should be as fast as C " . Calling to or from Julia is possible ; to with PyCall.jl and a Python package pyjulia allows calling , in the other direction , from Python .

OCaml has an optional syntax , named twt (The Whitespace Thing) , inspired by Python and Haskell .

Ruby 's creator , Yukihiro Matsumoto , has said : " I wanted a scripting language that was more powerful than Perl , and more object @-@ oriented than Python . That 's why I decided to design my own language . "

CoffeeScript is a programming language that cross @-@ compiles to JavaScript ; it has Python @-@ inspired syntax .

Swift is a programming language invented by Apple ; it has some Python @-@ inspired syntax .

Python 's development practices have also been emulated by other languages . The practice of requiring a document describing the rationale for , and issues surrounding , a change to the language (in Python 's case , a PEP) is also used in Tcl and Erlang because of Python 's influence .

Python has been awarded a TIOBE Programming Language of the Year award twice (in 2007 and 2010) , which is given to the language with the greatest growth in popularity over the course of a year , as measured by the TIOBE index .