Python 3

Introduction

- Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

- The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python Web site, https://www.python.org/, and may be freely distributed. The same site also contains distributions of and pointers to many free third party Python modules, programs and tools, and additional documentation

Introduction

- Python is simpler to use, available on Windows, Mac OS X, and Unix operating systems, and will help you get the job done more quickly.

- Python is simple to use, but it is a real programming language, offering much more structure and support for large programs than shell scripts or batch files can offer. On the other hand, Python also offers much more error checking than C, and, being a very-high-level language, it has high-level data types built in, such as flexible arrays and dictionaries. Because of its more general data types Python is applicable to a much larger problem domain than Awk or even Perl, yet many things are at least as easy in Python as in those languages.

Introduction

- Python allows you to split your program into modules that can be reused in other Python programs. It comes with a large collection of standard modules that you can use as the basis of your programs — or as examples to start learning to program in Python. Some of these modules provide things like file I/O, system calls, sockets, and even interfaces to graphical user interface toolkits like Tk.

- Python is an interpreted language, which can save you considerable time during program development because no compilation and linking is necessary. The interpreter can be used interactively, which makes it easy to experiment with features of the language, to write throw-away programs, or to test functions during bottom-up program development. It is also a handy desk calculator.

Introduction

- Python enables programs to be written compactly and readably. Programs written in Python are typically much shorter than equivalent C, C++, or Java programs, for several reasons:
  - the high-level data types allow you to express complex operations in a single statement;
  - statement grouping is done by indentation instead of beginning and ending brackets;
  - no variable or argument declarations are necessary.

Introduction

- Python is extensible: if you know how to program in C it is easy to add a new built-in function or module to the interpreter, either to perform critical operations at maximum speed, or to link Python programs to libraries that may only be available in binary form (such as a vendor-specific graphics library). Once you are really hooked, you can link the Python interpreter into an application written in C and use it as an extension or command language for that application.

Using the Python Interpreter

- The Python interpreter is usually installed as /usr/local/bin/python3.8 on those machines where it is available; putting /usr/local/bin in your Unix shell's search path makes it possible to start it by typing the command:
    - python3.8
- to the shell.
- On Windows machines where you have installed Python from the Microsoft Store, the python3.8 command will be available. If you have the py.exe launcher installed, you can use the py command.

Using the Python Interpreter

- Typing an end-of-file character (Control-D on Unix, Control-Z on Windows) at the primary prompt causes the interpreter to exit with a zero exit status. If that doesn't work, you can exit the interpreter by typing the following command: quit().

- The interpreter operates somewhat like the Unix shell: when called with standard input connected to a tty device, it reads and executes commands interactively; when called with a file name argument or with a file as standard input, it reads and executes a script from that file.

Using the Python Interpreter

- A second way of starting the interpreter is python -c command [arg] ..., which executes the statement(s) in command, analogous to the shell's -c option. Since Python statements often contain spaces or other characters that are special to the shell, it is usually advised to quote command in its entirety with single quotes.

Using the Python Interpreter

- Some Python modules are also useful as scripts. These can be invoked using python -m module [arg] ..., which executes the source file for module as if you had spelled out its full name on the command line.

- When a script file is used, it is sometimes useful to be able to run the script and enter interactive mode afterwards. This can be done by passing -i before the script.

Argument Passing

- When known to the interpreter, the script name and additional arguments thereafter are turned into a list of strings and assigned to the argv variable in the sys module. You can access this list by executing import sys. The length of the list is at least one; when no script and no arguments are given, sys.argv[0] is an empty string. When the script name is given as '-' (meaning standard input), sys.argv[0] is set to '-'. When -c command is used, sys.argv[0] is set to '-c'. When -m module is used, sys.argv[0] is set to the full name of the located module. Options found after -c command or -m module are not consumed by the Python interpreter’s option processing but left in sys.argv for the command or module to handle.

Interactive Mode

- When commands are read from a tty, the interpreter is said to be in interactive mode. In this mode it prompts for the next command with the primary prompt, usually three greater-than signs (>>>); for continuation lines it prompts with the secondary prompt, by default three dots (...). The interpreter prints a welcome message stating its version number and a copyright notice before printing the first

```
$ python3.8
Python 3.8 (default, Sep 16 2015, 09:25:04)
[GCC 4.8.2] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Interactive Mode

- Continuation lines are needed when entering a multi-line construct. As an example, take a look at this if

```
>>> the_world_is_flat = True
>>> if the_world_is_flat:
...     print("Be careful not to fall off!")
...
Be careful not to fall off!
```

  - >>>

The Interpreter and Its Environment

- By default, Python source files are treated as encoded in UTF-8. In that encoding, characters of most languages in the world can be used simultaneously in string literals, identifiers and comments — although the standard library only uses ASCII characters for identifiers, a convention that any portable code should follow. To display all these characters properly, your editor must recognize that the file is UTF-8, and it must use a font that supports all the characters in the file.

- To declare an encoding other than the default one, a special comment line should be added as the first line of the file. The syntax is as follows:

```
# -*- coding: encoding -*-
```

- where encoding is one of the valid codecs supported by Python.

Source Code Encoding

- For example, to declare that Windows-1252 encoding is to be used, the first line of your source code file should be:

```
# -*- coding: cp1252 -*-
```

- One exception to the first line rule is when the source code starts with a UNIX “shebang” line. In this case, the encoding declaration should be added as the second line of the file. For example:

```
#!/usr/bin/env python3
# -*- coding: cp1252 -*-
```

An Informal Introduction to Python

- In the following examples, input and output are distinguished by the presence or absence of prompts (>>> and ...): to repeat the example, you must type everything after the prompt, when the prompt appears; lines that do not begin with a prompt are output from the interpreter. Note that a secondary prompt on a line by itself in an example means you must type a blank line; this is used to end a multi-line command.

An Informal Introduction to Python

- Many of the examples in this manual, even those entered at the interactive prompt, include comments. Comments in Python start with the hash character, #, and extend to the end of the physical line. A comment may appear at the start of a line or following whitespace or code, but not within a string literal. A hash character within a string literal is just a hash character. Since comments are to clarify code and are not interpreted by Python, they may be omitted when typing

```
# this is the first comment
spam = 1  # and this is the second comment
          # ... and now a third!
text = "# This is not a comment because it's inside quotes."
```

Numbers

- The interpreter acts as a simple calculator: you can type an expression at it and it will write the value. Expression syntax is straightforward: the operators +, -, * and / work just like in most other languages (for example, Pascal or C); parentheses (()) can be used

```
>>> 2 + 2
4
>>> 50 - 5*6
20
>>> (50 - 5*6) / 4
5.0
>>> 8 / 5  # division always returns a floating point number
1.6
```

Numbers

- The integer numbers (e.g. 2, 4, 20) have type int, the ones with a fractional part (e.g. 5.0, 1.6) have type float. We will see more about numeric types later in the tutorial.

- Division (/) always returns a float. To do floor division and get an integer result (discarding any fractional result) you can use the //

```
>>> 17 / 3  # classic division returns a float
5.666666666666667
>>>
>>> 17 // 3  # floor division discards the fractional part
5
>>> 17 % 3  # the % operator returns the remainder of the division
2
>>> 5 * 3 + 2  # result * divisor + remainder
17
```

Numbers

- With Python, it is possible to use the ** operator to calculate powers 1:

```
>>> 5 ** 2   # 5 squared
25
>>> 2 ** 7   # 2 to the power of 7
128
```

Numbers

- The equal sign (=) is used to assign a value to a variable. Afterwards, no result is displayed before the next interactive prompt:

```
>>> width = 20
>>> height = 5 * 9
>>> width * height
900
```

Numbers

- If a variable is not “defined” (assigned a value), trying to use it

```
>>> n  # try to access an undefined variable
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'n' is not defined
```

- There is full support for floating point; operators with mixed to floating point:

```
>>> 4 * 3.75 - 1
14.0
```

Numbers

- In interactive mode, the last printed expression is assigned to the variable _. This means that when you are using Python as a desk calculator, it is somewhat easier to continue calculations, for example:

```
>>> tax = 12.5 / 100
>>> price = 100.50
>>> price * tax
12.5625
>>> price + _
113.0625
>>> round(_, 2)
113.06
```

Numbers

- This variable should be treated as read-only by the user. Don’t explicitly assign a value to it — you would create an independent local variable with the same name masking the built-in variable with its magic behavior.

- In addition to int and float, Python supports other types of numbers, such as Decimal and Fraction. Python also has built-in support for complex numbers, and uses the j or J suffix to indicate the imaginary part (e.g. 3+5j).

Strings

- Python can also manipulate strings, which can be expressed in several ways. They can be enclosed in single quotes ('...') or double quotes ("...") with the sa

```
>>> 'spam eggs'  # single quotes
'spam eggs'
>>> 'doesn\'t'  # use \' to escape the single quote...
"doesn't"
>>> "doesn't"  # ...or use double quotes instead
"doesn't"
>>> '"Yes," they said.'
'"Yes," they said.'
>>> "\"Yes,\" they said."
'"Yes," they said.'
>>> '"Isn\'t," they said.'
'"Isn\'t," they said.'
```

Strings

- In the interactive interpreter, the output string is enclosed in quotes and special characters are escaped with backslashes. While this might sometimes look different from the input (the enclosing quotes could change), the two strings are equivalent. The string is enclosed in double quotes if the string contains a single quote and no double quotes, otherwise it is enclosed in single quotes. The print() function produces a more readable output, by omitting the enclosing quotes ar

```
>>> '"Isn\'t," they said.'
'"Isn\'t," they said.'
>>> print('"Isn\'t," they said.')
"Isn't," they said.
>>> s = 'First line.\nSecond line.'  # \n means newline
>>> s  # without print(), \n is included in the output
'First line.\nSecond line.'
>>> print(s)  # with print(), \n produces a new line
First line.
Second line.
```

Strings

- If you don’t want characters prefaced by \ to be interpreted as special characters, you can use raw

```
>>> print('C:\some\name')  # here \n means newline!
C:\some
ame
>>> print(r'C:\some\name')  # note the r before the quote
C:\some\name
```

Strings

- String literals can span multiple lines. One way is using triple-quotes: """..."""" or '''...'''. End of lines are automatically included in the string, but it's possible to prevent this by adding a \ at the end of the line. The

```
print("""\
Usage: thingy [OPTIONS]
     -h                        Display this usage message
     -H hostname               Hostname to connect to
""")
```

Strings

- produces the following output (note that the initial newline is not included):

```
Usage: thingy [OPTIONS]
     -h                          Display this usage message
     -H hostname                 Hostname to connect to
```

- Strings can be concatenated (glued together) with the + operator, and repeated with *:

```
>>> # 3 times 'un', followed by 'ium'
>>> 3 * 'un' + 'ium'
'unununium'
```

Strings

- Two or more string literals (i.e. the ones enclosed between quotes) next to each other are automatically concatenated.

```
>>> 'Py' 'thon'
'Python'
```

- This feature is particularly useful when you want to break long strings:

```
>>> text = ('Put several strings within parentheses '
...         'to have them joined together.')
>>> text
'Put several strings within parentheses to have them joined together.'
```

Strings

- This only works with two literals though, not with

```
>>> prefix = 'Py'
>>> prefix 'thon'  # can't concatenate a variable and a string literal
  File "<stdin>", line 1
    prefix 'thon'
           ^
SyntaxError: invalid syntax
>>> ('un' * 3) 'ium'
  File "<stdin>", line 1
    ('un' * 3) 'ium'
               ^
SyntaxError: invalid syntax
```

Strings

- If you want to concatenate variables or a variable and a literal, use +:

```
>>> prefix + 'thon'
'Python'
```

Strings

- Strings can be indexed (subscripted), with the first character having index 0. There is no separate character type; a character is simply a string of size one:

```
>>> word = 'Python'
>>> word[0]  # character in position 0
'P'
>>> word[5]  # character in position 5
'n'
```

Strings

- Indices may also be negative numbers, to start counting from the right:

```
>>> word[-1]  # last character
'n'
>>> word[-2]  # second-last character
'o'
>>> word[-6]
'P'
```

Strings

- Note that since -0 is the same as 0, negative indices start from -1.

- In addition to indexing, slicing is also supported. While indexing is used to obtain individual characters, slicing allows you to obtain substring:

```
>>> word[0:2]  # characters from position 0 (included) to 2 (excluded)
'Py'
>>> word[2:5]  # characters from position 2 (included) to 5 (excluded)
'tho'
```

Strings

- Note how the start is always included, and the end always excluded. This makes sure that s[:i] + s[i:] is always equal to s:

```
>>> word[:2] + word[2:]
'Python'
>>> word[:4] + word[4:]
'Python'
```

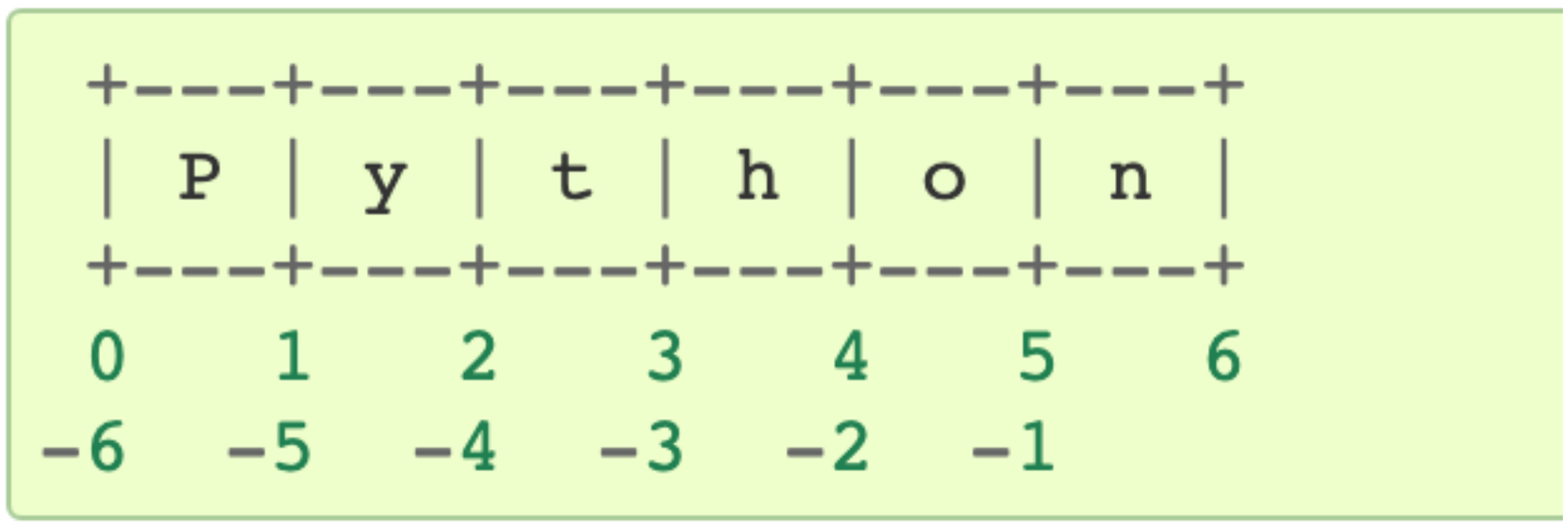
Strings

- Slice indices have useful defaults; an omitted first index defaults to zero, an omitted second index defaults to the size of the string being sliced.

```
>>> word[:2]   # character from the beginning to position 2 (excluded)
'Py'
>>> word[4:]   # characters from position 4 (included) to the end
'on'
>>> word[-2:]  # characters from the second-last (included) to the end
'on'
```

Strings

- One way to remember how slices work is to think of the indices as pointing between characters, with the left edge of the first character numbered 0. Then the right edge of the last character of a string of n chara



Strings

- The first row of numbers gives the position of the indices 0…6 in the string; the second row gives the corresponding negative indices. The slice from i to j consists of all characters between the edges labeled i and j, respectively.

- For non-negative indices, the length of a slice is the difference of the indices, if both are within bounds. For example, the length of word[1:3] is 2.

Strings

- Attempting to use an index that is too large will result in an error:

```
>>> word[42]  # the word only has 6 characters
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
IndexError: string index out of range
```

Strings

- However, out of range slice indexes are handled gracefully when used for slicing:

```
>>> word[4:42]
'on'
>>> word[42:]
''
```

Strings

- Python strings cannot be changed — they are immutable. Therefore, assigning to an indexed

```
>>> word[0] = 'J'
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: 'str' object does not support item assignment
>>> word[2:] = 'py'
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: 'str' object does not support item assignment
```

Strings

- If you neec

```
>>> 'J' + word[1:]
'Jython'
>>> word[:2] + 'py'
'Pypy'
```

create a new one:

- The built-in function len() returns the length of a

```
>>> s = 'supercalifragilisticexpialidocious'
>>> len(s)
34
```

String Methods

- **str.capitalize**()
  - Return a copy of the string with its first character capitalized and the rest lowercased.
  - Changed in version 3.8: The first character is now put into titlecase rather than uppercase. This means that characters like digraphs will only have their first letter capitalized, instead of the full character.

String Methods

- **str.casefold**()
  - Return a casefolded copy of the string. Casefolded strings may be used for caseless matching.
  - Casefolding is similar to lowercasing but more aggressive because it is intended to remove all case distinctions in a string. For example, the German lowercase letter 'ß' is equivalent to "ss". Since it is already lowercase, lower() would do nothing to 'ß'; casefold() converts it to "ss".
  - The casefolding algorithm is described in section 3.13 of the Unicode Standard.
  - New in version 3.3.

String Methods

- **str.center**(width[, fillchar])
  - Return centered in a string of length width. Padding is done using the specified fillchar (default is an ASCII space). The original string is returned if width is less than or equal to len(s).

- **str.count**(sub[, start[, end]])
  - Return the number of non-overlapping occurrences of substring sub in the range [start, end]. Optional arguments start and end are interpreted as in slice notation.

String Methods

- **str.encode**(encoding="utf-8", errors="strict")
  - Return an encoded version of the string as a bytes object. Default encoding is 'utf-8'. errors may be given to set a different error handling scheme. The default for errors is 'strict', meaning that encoding errors raise a UnicodeError.
- **str.endswith**(suffix[, start[, end]])
  - Return True if the string ends with the specified suffix, otherwise return False. suffix can also be a tuple of suffixes to look for. With optional start, test beginning at that position. With optional end, stop comparing at that position.

String Methods

- **str.expandtabs**(tabsize=8)
  - Return a copy of the string where all tab characters are replaced by one or more spaces, depending on the current column and the given tab size. Tab positions occur every tabsize characters (default is 8, giving tab positions at columns 0, 8, 16 and so on). To expand the string, the current column is set to zero and the string is examined character by character. If the character is a tab (\t), one or more space characters are inserted in the result until the current column is equal to the next tab position. (The tab character itself is not copied.) If the character is a newline (\n) or return (\r), it is copied and the current column is reset to zero. Any other character is copied unchanged and the current column is incremented by one regardless of how the character is represented when printed.

String Methods

- Example:

```
>>> '01\t012\t0123\t01234'.expandtabs()
'01      012     0123    01234'
>>> '01\t012\t0123\t01234'.expandtabs(4)
'01  012 0123    01234'
```

- **str.find**(sub[, start[, end]])
  - Return the lowest index in the string where substring sub is found within the slice s[start:end]. Optional arguments start and end are interpreted as in slice notation. Return -1 if sub is not found.

String Methods

- **str.format**(*args, **kwargs)

```
>>> "The sum of 1 + 2 is {0}".format(1+2)
'The sum of 1 + 2 is 3'
```

  - Perform a string formatting operation. The string on which this method is called can contain literal text or replacement fields delimited by braces {}. Each replacement field contains either the numeric index of a positional argument, or the name of a keyword argument. Returns a copy of the string where each replacement field is replaced with the string value of the corresponding argument.

String Methods

- **str.index**(sub[, start[, end]])
  - Like find(), but raise ValueError when the substring is not found.
- **str.isalnum**()
  - Return True if all characters in the string are alphanumeric and there is at least one character, False otherwise. A character c is alphanumeric if one of the following returns True: c.isalpha(), c.isdecimal(), c.isdigit(), or c.isnumeric().

String Methods

- **str.isalpha**()
  - Return True if all characters in the string are alphabetic and there is at least one character, False otherwise. Alphabetic characters are those characters defined in the Unicode character database as “Letter”, i.e., those with general category property being one of “Lm”, “Lt”, “Lu”, “Ll”, or “Lo”. Note that this is different from the “Alphabetic” property defined in the Unicode Standard.
- **str.isascii**()
  - Return True if the string is empty or all characters in the string are ASCII, False otherwise. ASCII characters have code points in the range U+0000-U+007F.
  - New in version 3.7.

String Methods

- **str.isdecimal**()
  - Return True if all characters in the string are decimal characters and there is at least one character, False otherwise. Decimal characters are those that can be used to form numbers in base 10, e.g. U+0660, ARABIC-INDIC DIGIT ZERO. Formally a decimal character is a character in the Unicode General Category “Nd”.
- **str.isdigit**()
  - Return True if all characters in the string are digits and there is at least one character, False otherwise. Digits include decimal characters and digits that need special handling, such as the compatibility superscript digits. This covers digits which cannot be used to form numbers in base 10, like the Kharosthi numbers. Formally, a digit is a character that has the property value Numeric_Type=Digit or Numeric_Type=Decimal.

String Methods

- **str.isidentifier**()
  - Return True if the string is a valid identifier

```
>>> from keyword import iskeyword

>>> 'hello'.isidentifier(), iskeyword('hello')
True, False
>>> 'def'.isidentifier(), iskeyword('def')
True, True
```

String Methods

- **str.islower**()
  - Return True if all cased characters 4 in the string are lowercase and there is at least one cased character, False otherwise.
- **str.isnumeric**()
  - Return True if all characters in the string are numeric characters, and there is at least one character, False otherwise. Numeric characters include digit characters, and all characters that have the Unicode numeric value property, e.g. U+2155, VULGAR FRACTION ONE FIFTH. Formally, numeric characters are those with the property value Numeric_Type=Digit, Numeric_Type=Decimal or Numeric_Type=Numeric.

String Methods

- **str.isprintable**()
  - Return True if all characters in the string are printable or the string is empty, False otherwise. Nonprintable characters are those characters defined in the Unicode character database as “Other” or “Separator”, excepting the ASCII space (0x20) which is considered printable. (Note that printable characters in this context are those which should not be escaped when repr() is invoked on a string. It has no bearing on the handling of strings written to sys.stdout or sys.stderr.)
- **str.isspace**()
  - Return True if there are only whitespace characters in the string and there is at least one character, False otherwise.
  - A character is whitespace if in the Unicode character database (see unicodedata), either its general category is Zs (“Separator, space”), or its bidirectional class is one of WS, B, or S.

String Methods

- **str.istitle**()
  - Return True if the string is a titlecased string and there is at least one character, for example uppercase characters may only follow uncased characters and lowercase characters only cased ones. Return False otherwise.
- **str.isupper**()
  - Return True if all cased characters 4 in the string are uppercase and there is at least one cased character, False otherwise.

String Methods

- **str.join**(iterable)
  - Return a string which is the concatenation of the strings in iterable. A TypeError will be raised if there are any non-string values in iterable, including bytes objects. The separator between elements is the string providing this method.
- **str.ljust**(width[, fillchar])
  - Return the string left justified in a string of length width. Padding is done using the specified fillchar (default is an ASCII space). The original string is returned if width is less than or equal to len(s).

String Methods

- **str.lower**()
  - Return a copy of the string with all the cased characters 4 converted to lowercase.
- **str.lstrip**([chars])
  - Return a copy of the string with leading characters removed. The chars argument is a string specifying the set of characters to be removed. If omitted or None, the chars argument defaults to removing whitespace.

String Methods

- *static* **str.maketrans**(x[, y[, z]])

  - This static method returns a translation table usable for str.translate().

  - If there is only one argument, it must be a dictionary mapping Unicode ordinals (integers) or characters (strings of length 1) to Unicode ordinals, strings (of arbitrary lengths) or None. Character keys will then be converted to ordinals.

  - If there are two arguments, they must be strings of equal length, and in the resulting dictionary, each character in x will be mapped to the character at the same position in y. If there is a third argument, it must be a string, whose characters will be mapped to None in the result.

String Methods

- **str.partition**(sep)
  - Split the string at the first occurrence of sep, and return a 3-tuple containing the part before the separator, the separator itself, and the part after the separator. If the separator is not found, return a 3-tuple containing the string itself, followed by two empty strings.
- **str.replace**(old, new[, count])
  - Return a copy of the string with all occurrences of substring old replaced by new. If the optional argument count is given, only the first count occurrences are replaced.

String Methods

- **str.rfind**(sub[, start[, end]])
  - Return the highest index in the string where substring sub is found, such that sub is contained within s[start:end]. Optional arguments start and end are interpreted as in slice notation. Return -1 on failure.
- **str.rindex**(sub[, start[, end]])
  - Like rfind() but raises ValueError when the substring sub is not found.

String Methods

- **str.rjust**(width[, fillchar])
  - Return the string right justified in a string of length width. Padding is done using the specified fillchar (default is an ASCII space). The original string is returned if width is less than or equal to len(s).
- **str.rpartition**(sep)
  - Split the string at the last occurrence of sep, and return a 3-tuple containing the part before the separator, the separator itself, and the part after the separator. If the separator is not found, return a 3-tuple containing two empty strings, followed by the string itself.

String Methods

- **str.rsplit**(sep=None, maxsplit=-1)
  - Return a list of the words in the string, using sep as the delimiter string. If maxsplit is given, at most maxsplit splits are done, the rightmost ones. If sep is not specified or None, any whitespace string is a separator. Except for splitting from the right, rsplit() behaves like split() which is described in detail below.
- **str.rstrip**([chars])
  - Return a copy of the string with trailing characters removed. The chars argument is a string specifying the set of characters to be removed. If omitted or None, the chars argument defaults to removing whitespace.

String Methods

- **str.split**(sep=None, maxsplit=-1)
  - Return a list of the words in the string, using sep as the delimiter string. If maxsplit is given, at most maxsplit splits are done (thus, the list will have at most maxsplit+1 elements). If maxsplit is not specified or -1, then there is no limit on the number of splits (all possible splits are made).
  - If sep is given, consecutive delimiters are not grouped together and are deemed to delimit empty strings (for example, '1,,2'.split(',') returns ['1', '', '2']). The sep argument may consist of multiple characters (for example, '1<>2<>3'.split('<>') returns ['1', '2', '3']). Splitting an empty string with a specified separator returns [''].

String Methods

- If sep is not specified or is None, a different splitting algorithm is applied: runs of consecutive whitespace are regarded as a single separator, and the result will contain no empty strings at the start or end if the string has leading or trailing whitespace. Consequently, splitting an empty string or a string consisting of just whitespace with a No

```
>>> '1 2 3'.split()
['1', '2', '3']
>>> '1 2 3'.split(maxsplit=1)
['1', '2 3']
>>> '   1   2   3   '.split()
['1', '2', '3']
```

String Methods

- **str.splitlines**([keepends])
  - Return a list of the lines in the string, breaking at line boundaries. Line breaks are not included in the resulting list unless keepends is given and true.

```
>>> 'ab c\n\nde fg\rkl\r\n'.splitlines()
['ab c', '', 'de fg', 'kl']
>>> 'ab c\n\nde fg\rkl\r\n'.splitlines(keepends=True)
['ab c\n', '\n', 'de fg\r', 'kl\r\n']
```

Representation	Description
`\n`	Line Feed
`\r`	Carriage Return
`\r\n`	Carriage Return + Line Feed
`\v` or `\x0b`	Line Tabulation
`\f` or `\x0c`	Form Feed
`\x1c`	File Separator
`\x1d`	Group Separator
`\x1e`	Record Separator
`\x85`	Next Line (C1 Control Code)
`\u2028`	Line Separator
`\u2029`	Paragraph Separator

String Methods

- **str.startswith**(prefix[, start[, end]])
  - Return True if string starts with the prefix, otherwise return False. prefix can also be a tuple of prefixes to look for. With optional start, test string beginning at that position. With optional end, stop comparing string at that position.

- **str.strip**([chars])
  - Return a copy of the string with the leading and trailing characters removed. The chars argument is a string specifying the set of characters to be removed. If omitted or None, the chars argument defaults to removing whitespace.

String Methods

- **str.swapcase**()
  - Return a copy of the string with uppercase characters converted to lowercase and vice versa. Note that it is not necessarily true that s.swapcase().swapcase() == s.
- **str.title**()
  - Return a titlecased version of the string where words start with an uppercase character and the remaining characters are lowercase.

String Methods

- **str.upper**()
  - Return a copy of the string with all the cased characters 4 converted to uppercase. Note that s.upper().isupper() might be False if s contains uncased characters or if the Unicode category of the resulting character(s) is not “Lu” (Letter, uppercase), but e.g. “Lt” (Letter, titlecase).
- **str.zfill**(width)
  - Return a copy of the string left filled with ASCII '0' digits to make a string of length width. A leading sign prefix ('+'/'-') is handled by inserting the padding after the sign character rather than before. The original string is returned if width is less than or equal to len(s).