Python Memoire

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# [builtins](https://docs.python.org/3/library/functions.html)

range(*stop*) *or* range(*start, stop*[*, step=1*])

The arguments to the range constructor must be integers

zip(*\*iterables*)

Make an iterator that aggregates elements from each of the iterables.

len(*s*)

Return length (number of items) of an object.

abs(*x*)

Return the absolute value of a number.

sum(*iterable, /, start=0*)

Sums *start* and the items of an iterable from left to right, and returns total.

max(*iterable \**[*, key, default*]) *or* max(*arg1, arg2, \*args*[*, key*])

min(*iterable \**[*, key, default*]) *or* min(*arg1, arg2, \*args*[*, key*])

Return the smallest/largest item in an iterable or the smallest of two or more arguments

isinstance(*object, classinfo*)

Return True if the *object* argument is an instance of the *classinfo* argument.

issubclass(*class, classinfo*)

Return True if *class* is a subclass of *classinfo*. A class is considered a subclass of itself.

dir([*object*])

Without an argument, return the list of names in the current local scope. With an argument, return a list of valid attributes for that object.

all(*iterable*)

Return True if all elements of the iterable are True (or the iterable is empty).

any(*iterable*)

Return True if any of the elements in iterable is True. If the iterable is empty, return False.

ord(*c*)

Return integer representing Unicode of chararacter *c*.

chr(*i*)

Return the string representing character whose Unicode is integer *i*.

id(*object*)

Return identity of *object*; integer which is unique and constant for the lifetime of the object.

type(*object*) *or* type(*name, bases, dict*)

With one argument, return the type of *object*. With three arguments, return a new type object.

bin(*x*)

Convert an integer to a binary string prefixed with “*0b”*.

hex(*x*)

Convert an integer to a hex string prefixed with *“0x”*.

enumerate(*iterable, start=0*)

Return a enumerate object. Yields a tuple containing a count, and the next value of the iterable.

eval(*expression*[*, globals*[*, locals*]])

The expression argument is parsed and evaluated as a Python expression (technically speaking, a condition list) using the globals and locals dictionaries as global and local namespace.

sorted(*iterable, \*, key=None, reverse=False*)

Return a new sorted list from the items in *iterable*. *key* specifies a function of one argument that extracts the comparison key for each element.

del

Deletion of a name removes the binding of that name from the local or global namespace.

next(*iterator*[*, default*])

Retrieve the next item from the iterator by calling its *\_\_next\_\_()* method. If *default* is given, it is returned if the iterator is exhausted, otherwise StopIteration is raised.

map(*function, iterable, ...*)

Return an iterator that applies function to every item of iterable, yielding the results. If additional iterable arguments are passed, function must take that many arguments and is applied to the items from all iterables in parallel. With multiple iterables, the iterator stops when the shortest iterable is exhausted.

iter(*object*[*, sentinel*])

Returns an iterator object. Without the second argument, *object* must be a collection object which supports iteration. If the *sentinel* argument is given, the object must be callable; the created iterator will call object with no arguments until value returned is equal to *sentinel*.

setattr(*object, name, value*)

Assign *value* to the attribute *name*, provided the object allows it. setattr(x, 'foobar', 123) is equivalent to x.foobar = 123

getattr(*object, name*[*, default*])

Return the value of the named attribute of the object. getattr(x, 'foobar') is equivalent to x.foobar

hasattr(*object, name*)

True if *name* is the string of the name of one of the objects attributes, False if not.

delattr(*object, name*)

del attr(x, 'foobar') is equivalent to del x.foobar

reversed(*seq*)

Return a reverse iterator.

round(*number*[*, ndigits*])

Return number rounded to ndigits precision after the decimal point. If ndigits is omitted or is None, it returns the nearest integer to its input.

callable(*object*)

Return True if the *object* appears callable, False if not.

complex([*real*[, *imag*]])

Returns a complex number with the value *real* + *imag* \* j, or convert a string or number to a complex number.

breakpoint(*\*args, \*\*kws*)

This function drops you into the debugger at the call site.

filter(*function, iterable*)

Construct an iterator from those elements of *iterable* for which *function* returns True.

slice(*stop*) or slice(*start, stop*[*, step*])

Return a slice object representing the set of indices specified by *range(start, stop, step)*.

property(*fget=None, fset=None, fdel=None, doc=None*)

Return a property attribute. *fget* is a function for getting an attribute value, *fset* is a function for setting an attribute value. *fdel* is a function for deleting an attribute value.

classmethod()

staticmethod()

super()

# [os](https://docs.python.org/3/library/os.html)

name

environ

system(*command*)

Execute string *command* in a subshell. Implemented by calling C function system(). On Unix, returns the exit status of the process in the format for wait(). On Windows, return the value returned by system shell.

replace(*src, dst, \*, src\_dir\_fd=None, dst\_dir\_fd=None*)

Rename the file or directory *src* to *dst*. Raises error if *dst* is a directory, if it is a file, said file is replaced.

scandir(*path=’.’*)

Returns an iterator corresponding to the entries in the directory given by *path*. In arbitrary order, and does not include *‘.’* or *‘..’*.

listdir(*path=’.’*)

Returns a list containing the names of the entries in the directory given by *path*. List is in arbitrary order, and does not include *‘.’ or ‘..’*.

walk(*top, topdown=True, onerror=None, followlinks=False*)

Generate the file names in a directory tree by wakling the tree, either top-down or bottom-up. For each directory in the tree rooted at directory *top*, yields a 3-tuple, (dirpath, dirnames, filenames).

stat(*path, \*, dir\_fd=None, follow\_symlinks=True*)

Get the status of a file or file descriptor – performs equivalent of a stat() system call on given *path*.

remove(*path, \*, dir\_fd=None*)

Remove (delete) the file *path*. Raises *IsADirectoryError* if *path* is a directory.

rmdir(*path, \*, dir\_fd=None*)

Remove (delete) the directory *path*.

readlink(*path, \*, dir\_fd=None*)

Return a string representing the path to which the symbolic link points.

link(*src, dst, \*, src\_dir\_fd=None, dst\_dir\_fd=None, follow\_symlinks=True*)

Create a hard link pointing to *src* named *dst*.

symlink(*src, dst, target\_is\_directory=False, \*, dir\_fd=None*)

Create a symbolic link pointing to *src* named *dst*.

chown(*path, uid, gid, \*, dir\_fd=None, follow\_symlinks=True*)

Change the owner and group id of path to the numeric *uid* and *gid.* Leave unchanged for -1.

chmod(*path, mode, \*, dir\_fd=None, follow\_symlinks=True*)

Change the mode of *path* to the numeric *mode*.

chroot(*path*)

Change the root directory of the current process to *path*.

sync()

Force write of everything to disk.

getlogin()

getpid()

getpgrp()

getppid()

getuid()

# [os.path](https://docs.python.org/3/library/os.path.html)

realpath(*path*)

Return the canonical path of the specified filename, eliminating any symbolic links in the path.

abspath(*path*)

Return a normalized absolutized version of the pathname path.

isfile(*path*)

Return True if path is an existing regular file. This follows symbolic links, so both islink() and isfile() can be true for the same path.

isdir(*path*)

Return True if path is an existing directory. This follows symbolic links, so both islink() and isdir() can be true for the same path.

spitext(*path*)

Split the pathname path into a pair (root, ext) such that root + ext == path, and ext is empty or begins with a period and contains at most one period.

getmtime(*path*)

Return the time of last modification of path. The return value is a floating point number giving the number of seconds since the epoch (see the time module). Raise OSError if the file does not exist or is inaccessible.

getctime(*path*)

Return the system’s ctime which, on some systems (like Unix) is the time of the last metadata change, and, on others (like Windows), is the creation time for path. The return value is a number giving the number of seconds since the epoch

dirname(*path*)

Return the directory name of pathname path.

basename(*path*)

Return the base name of pathname path.

getsize(*path*)

Return the size, in bytes, of path.

expanduser(*path*)

On Unix and Windows, return the argument with an initial component of ~ or ~user replaced by that user’s home directory.

# [sys](https://docs.python.org/3/library/sys.html)

argv

The list of arguments passed to a python script. *argv[0]* is the script name.

getsizeof(*object*[*, default*])

Return the size of an object in bytes. The object can be any type of object. All built-in objects will return correct results, but this does not have to hold true for third-party extensions as it is implementation specific.

getrecursionlimit()

Return the current value of the recursion limit, the maximum depth of the Python interpreter stack.

setrecursionlimit(*limit*)

Set the maximum depth of the Python interpreter stack to *limit*.

float\_info

A named tuple holding information about the float type.

path

A list of strings that specifies the search path for modules. Initialized from the environment variable PYTHONPATH, plus an installation-dependent default.

# [re](https://docs.python.org/3/library/re.html)

findall(*pattern, string, flags=0*)

Return all non-overlapping matches of pattern in string, as a list of strings. The string is scanned left-to-right, and matches are returned in the order found. If one or more groups are present in the pattern, return a list of groups; this will be a list of tuples if the pattern has more than one group. Empty matches are included in the result.

finditer(*pattern, string, flags=0*)

Return an iterator yielding match objects over all non-overlapping matches for the RE pattern in string. The string is scanned left-to-right, and matches are returned in the order found. Empty matches are included in the result.

match(*pattern, string, flags=0*)

If zero or more characters at the beginning of string match the regular expression pattern, return a corresponding match object. Return None if the string does not match the pattern; note that this is different from a zero-length match.

search(*pattern, string, flags=0*)

Scan through string looking for the first location where the regular expression pattern produces a match, and return a corresponding match object. Return None if no position in the string matches the pattern; note that this is different from finding a zero-length match at some point in the string.

sub(*pattern, repl, string, count=0, flags=0*)

Return the string obtained by replacing the leftmost non-overlapping occurrences of pattern in string by the replacement *repl*. If the pattern isn’t found, string is returned unchanged. *repl* can be a string or a function; if it is a string, any backslash escapes in it are processed. Backreferences, such as *\6*, are replaced with the substring matched by group 6 in the pattern.

split(*pattern, string, maxsplit=0, flags=0*)

Split string by the occurrences of pattern. If capturing parentheses are used in pattern, then the text of all groups in the pattern are also returned as part of the resulting list. If maxsplit is nonzero, at most maxsplit splits occur, and the remainder of the string is returned as the final element of the list.

**Match Object**

group(*[group1, ...]*)

Returns one or more subgroups of the match. If there is a single argument, the result is a single string; if there are multiple arguments, the result is a tuple with one item per argument. Without arguments, group1 defaults to zero (the whole match is returned). If a groupN argument is zero, the corresponding return value is the entire matching string; if it is in the inclusive range [1..99], it is the string matching the corresponding parenthesized group.

groups(*default=None*)

Return a tuple containing all the subgroups of the match, from 1 up to however many groups are in the pattern. The default argument is used for groups that did not participate in the match; it defaults to None.

groupdict(*default=None*)

Return a dictionary containing all the named subgroups of the match, keyed by the subgroup name. The default argument is used for groups that did not participate in the match; it defaults to None.

start([*group*])

end([*group*])

Return the indices of the start and end of the substring matched by group; group defaults to zero (meaning the whole matched substring). Return -1 if group exists but did not contribute to the match.

re

The regex objects whose match() or search() method produced this instance

string

The string passed to match() or search()

# [datetime](https://docs.python.org/3/library/datetime.html)

datetime(*year, month, day, hour=0, minute=0, second=0, microsecond=0, tzinfo=None, \*, fold=0*)

The year, month and day arguments are required. tzinfo may be None, or an instance of a tzinfo subclass.

timedelta(*days=0, seconds=0, microseconds=0, milliseconds=0, minutes=0, hours=0, weeks=0*)

All arguments are optional and default to 0. Arguments may be integers or floats, and may be positive or negative.

strftime(*format*)

Return a string representing the date, controlled by an explicit format string.

strptime(*date\_string, format*)

Return a datetime corresponding to date\_string, parsed according to format.

fromtimestamp()

fromisoformat()

combine()

# [math](https://docs.python.org/3/library/math.html)

pi

exp()

expm1()

log()

log1p()

log2()

log10()

pow()

sqrt()

acos()

asin()

atan()

atan2()

sin()

cos()

tan()

degrees()

radians()

acosh()

asinh()

atanh()

cosh()

sinh()

tanh()

dist()

ceil()

floor()

comb()

copysign()

fabs()

factorial()

fmod()

fsum()

frexp()

gcd()

lcm()

isqrt()

modf()

nextafter()

perm()

prod()

remainder()

trunc()

ulp()

isclose()

isfinite()

isinf()

isnan()

erf()

# [random](https://docs.python.org/3/library/random.html)

seed(*a=None, version=2*)

Initialise rng. If *a* is *None*, seed is provided by OS, or if unavailable, the current time is used.

random()

Return a random float in the range *[0, 1)*.

uniform(*a, b*)

Return a randomly selected float in the range *[a, b)*.

randrange(*stop*) *or* randrange(*start, stop*[*, step*])

Randomly selected element from *range(start, stop, step)*.

randint(*a, b*)

Random integer between *[a, b]*.

randbytes(*n*)

Get *n* random bytes.

sample(*population, k, \*, counts=None*)

Return a *k* sized list of elements chosen from *population* without replacement.

choice(*seq*)

Return a random element from the non-empty sequence *seq*.

choices(*population, weights=None, \*, cum\_weights=None, k=1*)

Return a *k* sized list of elements chosen from *population* with replacement.

shuffle(*x*[*, random*])

Shuffle sequence *x* in-place.

getstate()

Return object capturing internal rng state.

setstate(*state*)

Restore rng state to that obtained from *getstate()*.

# [statistics](https://docs.python.org/3/library/statistics.html)

mean()

fmean()

geometric\_mean()

harmonic\_mean()

median()

mode()

multimode()

quantiles()

pstdev()

pvariance()

stdev()

variance()

# [itertools](https://docs.python.org/3/library/itertools.html)

repeat(*object*[*, times*])

Make an iterator that returns object over and over again. Runs indefinitely unless the times argument is specified.

cycle(*iterable*)

Make an iterator returning elements from the iterable and saving a copy of each. When the iterable is exhausted, return elements from the saved copy. Repeats indefinitely.

count(*start=0, step=1*)

Make an iterator that returns evenly spaced values starting with number start.

zip\_longest(*iterables, fillvalue=None*)

Make an iterator that aggregates elements from each of the iterables. If the iterables are of uneven length, missing values are filled-in with fillvalue. Iteration continues until the longest iterable is exhausted.

permutations(*iterable, r=None*)

Return successive r-length permutations of elements in iterable. If r is not specified or is None, then r defaults to the length of the iterable. The permutation tuples are emitted in lexicographic ordering according to the order of the input iterable.

product(*\*iterables, repeat=1*)

Cartesian product of input iterables. Roughly equivalent to nested for-loops in a generator expression. For example, product(A, B) returns the same as ((x,y) for x in A for y in B). The nested loops cycle like an odometer with the rightmost element advancing on every iteration.

combinations(*iterable, r*) *or* combinations\_with\_replacement*(iterable, r*)

Return r length subsequences of elements from the input iterable. The combination tuples are emitted in lexicographic ordering according to the order of the input iterable. Elements are treated as unique based on their position, not on their value. With replacement: return r length subsequences of elements from the input iterable allowing individual elements to be repeated more than once.

tee(*iterable, n=2*)

Return n independent iterators from a single iterable.

islice(*iterable, stop*) *or*islice(*iterable, start, stop*[*, step*])

Make an iterator that returns selected elements from the iterable.

starmap(*function, iterable*)

Make an iterator that computes the function using arguments obtained from the iterable. The difference between map() and starmap() parallels the distinction between function(a,b) and function(\*c)

filterfalse(*predicate, iterable*)

Make an iterator that filters elements from iterable returning only those for which the predicate is False. If predicate is None, return the items that are false.

groupby(*iterable, key=None*)

Make an iterator that returns consecutive keys and groups from the iterable. The key is a function computing a key value for each element.

chain(*\*iterables*)

Make an iterator that returns elements from the first iterable until it is exhausted, then proceeds to the next iterable, until all of the iterables are exhausted. Used for treating consecutive sequences as a single sequence.

accumulate(*iterable*[*, func, \*, initial=None*])

Make an iterator that returns accumulated sums, or accumulated results of other binary functions (specified via the optional func argument). If func is supplied, it should be a function of two arguments.

# [time](https://docs.python.org/3/library/time.html)

time()

asctime()

ctime()

gmtime()

localtime()

mktime()

get\_clock\_info()

sleep()

strftime()

strptime()

thread\_time()

# [subprocess](https://docs.python.org/3/library/subprocess.html)

run()

check\_output()

poll()

wait()

communicate()

send\_signal()

terminate()

kill()

# [functools](https://docs.python.org/3/library/functools.html)

reduce(*function, iterable*[*, initializer*])

Apply *function* of two arguments cumulatively to the items of *iterable*, LR, so as to reduce the iterable to a single value.

partial(*func, /, \*args, \*\*kw*)

Return a new partial object, which when called will behave like *func* called with the positional arguments *args* and keyword arguments *kw*.

partialmethod(*func, /, \*args, \*\*kw*)

Return a partialmethod descriptior, which behaves like *partial*(), except it is to be used as a method definition rather than directly called.

@cache(*user\_function*)

Lightweight unbounded function cache.

@cached\_property(*func*)

Transform a method of a class into a property whose value is computed once and then cached as a normal attribute for the life of the insance. Like *property()*, wit the addition of caching.

@lru\_cache(*user\_function*) or @lru\_cache(*maxsize=128, typed=False*)

Decorator to wrap a function with a memorizing callable that saves up to *maxsize* most recent calls.

@total\_ordering()

Given a class defining one or more rich comparison ordering methods, this class decorator supplies the rest. The class must define one of: *\_\_lt\_\_(), \_\_le\_\_(), \_\_gt\_\_(), or \_\_ge\_\_()*, in addition to *\_\_eq\_\_()*.

# [collections](https://docs.python.org/3/library/collections.html)

Counter([*iterable-or-mapping*])

A counter is a dict subclass for counting hashable objects. It is a collection where elements are stored as dict keys, and counts are stored as dict values.

Counter.elements()

Return an iterator over elements, repeating each as many times as its count. Elements are returned in the order first encountered.

Counter.most\_common([*n*])

Return a list of the *n* most common elements and their counts from the most common to least. If *n* is omitted or None, all elements are returned.

Counter.subtract([*iterable-or-mapping*])

Elements are subtracted from an iterable or another mapping, but subtracts counts instead of replacing them.

Counter.update([*iterable-or-mapping*])

Elements are counted from an iterable or added-in from another mapping or counter. Like *dict.update()*, but adds counts instead of replacing them. *Iterable* is expected to be a sequence of elements (not *k-v* pairs)

defaultdict(*default\_factor*[*, ...*])

Return a dict like object (subclass of dict). If *default\_factor* is not None, it is called without arguments to provide a default value for the given *key*.

deque([*iterable*[*, maxlen*]])

Returns deque object, initialized LR with data from *iterable*. Deques are a generalization of stacks and queues.

deque.append(*x*)

Add *x* to RHS of deque

deque.appendleft(*x*)

Add *x* to LHS of deque

deque.clear()

Remove all elements from deque

deque.copy()

Create shallow copy of deque

deque.count(*x*)

Count number of deque elements equal to *x*

deque.extend(*iterable*)

Append elements from *iterable* to RHS of deque

deque.extendleft(*iterable*)

Append elements from *iterable* to LHS of deque in reversing order

deque.index(*x*[*, start*[*, stop*]])

Return the position of first *x* in the deque (between indexes *start* and *stop*)

deque.insert(*i, x*)

Insert *x* into the deque at position *i*

deque.pop()

Remove and return element from RHS, raise *IndexError* if empty

deque.popleft()

Remove and return element from LHS, raise *IndexError* if empty

deque.remove(*value*)

Remove first occurrence of *value*. If not found, raise *ValueError*

deque.reverse()

Reverse elements in-place

deque.rotate(*n=1*)

Rotate the deque *n* steps right. Rotate left for negative value.

namedtuple()

OrderedDict([*items*])

Return instance of dict subclass with methods for rearranging order.

popitem(*last=True*)

Removes and returns a *k-v* pair. Order is LIFO if *last* is True, or FIFO if it is False.

move\_to\_end(*key, last=True*)

Move an existing *key* to either end of ordered dict, right (end) if *last* is True, left (start) if it is False. Raises *KeyError* if *key* does not exist.

ChainMap(*\*maps*)

Group multiple dicts or other mappings together to create a single, updateable view. Order is that of a series of *dict.update()* calls, starting at the last mapping.

ChainMap.new\_child(*m=None*)

Return a new ChainMap containing a new map, followed by all of the maps in the current instance. If *m* is specified, it becomes the new map at the front of the list of mappings (an empty dict is used if None).

# [heapq](https://docs.python.org/3/library/heapq.html)

Note: heapsort is not a stable sort.

heappush(*heap, item*)

Push the value item onto the *heap*, maintaining the heap invariant

heappop(*heap*)

Pop and return the smallest item from the *heap*, maintaining the heap invariant. Raise *IndexError* if empty. Use *heap[0]* to access smallest element without removing it.

heappushpop(*heap, item*)

Push *item* on the heap, then pop and return the smallest item from *heap*.

heapify(*x*)

Transform list *x* into a heap.

heapreplace(*heap, item*)

Pop and return the smallest item from *heap*, and also push the new *item*. Raise *IndexError* if empty.

merge(*\*iterables, key=None, reverse=False*)

Merge multiple sorted inputs into a single sorted output, returning iterator over sorted values.

nlargest(*n, iterable, key=None*)

Return a list with the *n* largest elements from *iterable*.

nsmallest(*n, iterable, key=None*)

Return a list with the *n* smallest elements from *iterable*.

# [bisect](https://docs.python.org/3/library/bisect.html)

bisect\_left(*a, x, lo=0, hi=len(a)*)

Locate the insertion point for *x* in *a* to maintain sorted order. Parameters *lo* and *hi* may specify a subset of the list to be considered. The returned insertion point *i* partitions the array *a* into two halves so that   
*all(val < x for val in a[lo:i])* and *all(val >= x for val in a[i:hi])*

bisect\_right(*a, x, lo=0, hi=len(a)*)

bisect(*a, x, lo=0, hi=len(a)*)

As per *bisect\_left()*, but returns an insertion point which comes after any existing entries of *x* in *a*. The returned insertion *i* point partitions the array *a* so that:  
*all(val <= x for val in a[lo:i])* and *all(val > x for val in a[i:hi])*

insort\_left(*a, x, lo=0, hi=len(a)*)

Insert *x* in *a* in sorted order. Assuming *a* is sorted, equivalent to: *a.insert(bisect.bisect\_left(a, x, lo, hi), x)*

insort\_right(*a, x, lo=0, hi=len(a)*)

insort(*a, x, lo=0, hi=len(a)*)

As per *insort\_left()*, but insert *x* in *a* after any existing entries of *x*.

# [queue](https://docs.python.org/3/library/queue.html)

Queue(*maxsize=0*)

FIFO queue. Infinite for *maxsize=0*

LifoQueue(*maxsize=0*)

LIFO queue. Infinite for *maxsize=0*

PriorityQueue(*maxsize=0*)

Priority queue. Infinite for *maxsize=0*

*Queue elements are accessible through attribute*

queue.queue

*Queue Methods:*

qsize()

Approximate size of queue

empty()

True if queue is empty, False otherwise

full()

True if queue is full, False otherwise

put(*item, block=True, timeout=None*)

Put *item* into queue. If *block* is True and *timeout* is None, block until free spot is available. If *timeout* is given, block the given value of seconds before raising *Full* exception.

put\_nowait(*item*)

Equivalent to *put(item, False)*

get(*block=True, timeout=None*)

Remove and return an item from queue. If *block* is True and *timeout* is None, block until an item is available. If *timeout* is given, block the given number of seconds before raising *Empty* exception.

get\_nowait()

Equivalent to *get(False)*

task\_done()

Indicate that a formerly enqueued task is complete. Used by consumer threads. For each *get()*, a subsequent *task\_done()* tells queue processing is complete. If *join()* is blocking, resume when all items have been processed.

join()

Block until all items in the queue have been gotten and processed.

# [inspect](https://docs.python.org/3/library/inspect.html)

getmembers()

getmodule()

signature()

getclasstree()

ismodule()

isclass()

ismethod()

isfunction()

isgenerator()

isawaitable()

isbuiltin()

Get all classes present in a module

inspect.getmembers(sample, inspect.isclass)

Get all methods in function

inspect.getmembers(sample.X, inspect.isfunction)

# [textwrap](https://docs.python.org/3/library/textwrap.html)

wrap(*text, width=70, \*\*kwargs*)

Wraps the single paragraph in *text* so every line is at most *width* characters long. Returns a list of lines, without final newlines.

fill(*text, width=70, \*\*kwargs*)

Wraps the single paragraph in *text*, and returns a single string containing the wrapped paragraph. Equivalent to *“\n”.join(wrap(text, ...))*

shorten(*text, width, \*\*kwargs*)

Collapse and truncate the given *text* to fit the given *width*. kwargs are those of TextWrapper (*placeholder, …*).

dedent(*text*)

Remove any common leading whitespace from every line in *text*.

indent(*text, prefix, predicate=None*)

Add *prefix* to the beginning of the selected lines in *text*.

# [requests](https://requests.readthedocs.io/en/master/api/)

get()

post()

put()

delete()

head()

options()

# [operator](https://docs.python.org/3/library/operator.html)

add(*a, b*)

concat(*seq1, seq2*)

contains(*seq, obj*)

truediv(*a, b*)

floordiv(*a, b*)

and\_(*a, b*)

xor(*a, b*)

invert(*a*)

or\_(*a, b*)

pow(*a, b*)

is\_(*a, b*)

is\_not(*a, b*)

setitem(*obj, k, v*)

delitem(*obj, k*)

getitem(*obj, k*)

lshift(*a, b*)

mod(*a, b*)

mul(*a, b*)

matmul(*a, b*)

pos(*a*)

neg(*a*)

not\_(*a*)

rshift(*a, b*)

setitem(*seq, slice(i,j), values*)

delitem(*seq, slice(i,j)*)

getitem(*seq, slice(i,j))*

mod(*s, obj*)

sub(*a, b*)

truth(*obj*)

lt(*a, b*)

le(*a, b*)

eq(*a, b*)

ne(*a, b*)

ge(*a, b*)

gt(*a, b*)

attrgetter(*attr*) *or* attrgetter(*\*attrs*)

Return a callable object that fetches *attr* from its operand. If more than one attribute requested, returns tuple.

itemgetter(*item*) *or* itemgetter(*\*items*)

Return a callable object that fetches *item* from its operand, using *\_\_getitem\_\_()* method. Returns a tuple if multiple items given.

methodcaller(*name, /, \*args, \*\*kwargs*)

Return a callable object that calls the method *name* on its operand. If additional arguments / keywords are given, they are passed to method.

# [json](https://docs.python.org/3/library/json.html)

dumps(*obj*, *\**, *skipkeys=False*, *ensure\_ascii=True*, *check\_circular=True*, *allow\_nan=True*, *cls=None*, *indent=None*, *separators=None*, *default=None*, *sort\_keys=False*, *\*\*kw*)

Serialize *obj* to a JSON formatted str. Arguments as per *dump()*.

loads(*s*, *\**, *cls=None*, *object\_hook=None*, *parse\_float=None*, *parse\_int=None*, *parse\_constant=None*, *object\_pairs\_hook=None*, *\*\*kw*)

Deserialize *s* (str, bytes, or bytearray) containing JSON document to a python object. Arguments as per *load()*.

load(*fp*, *\**, *cls=None*, *object\_hook=None*, *parse\_float=None*, *parse\_int=None*, *parse\_constant=None*, *object\_pairs\_hook=None*, *\*\*kw*)

Deserialize file-like *fp* containing JSON document to python object.

dump(*obj*, *fp*, *\**, *skipkeys=False*, *ensure\_ascii=True*, *check\_circular=True*, *allow\_nan=True*, *cls=None*, *indent=None*, *separators=None*, *default=None*, *sort\_keys=False*, *\*\*kw*)

Serialize *obj* as JSON formatted stream to file-like object *fp*. Produces str (not bytes), *fp* must support str input.

Translation: JSON Python

object dict

array list

string str

number (int) int

number (real) float

true True

false False

null None

# [pickle](https://docs.python.org/3/library/pickle.html)

# [tempfile](https://docs.python.org/3/library/tempfile.html)

TemporaryFile()

TemporaryDirectory()

gettempdir()

mkstemp()

mkdtemp()

# [difflib](https://docs.python.org/3/library/difflib.html)

SequenceMatcher(*isjunk=None, a=’’, b=’’, autojunk=True*)

SequenceMatcher.find\_longest\_match(*alo=0, ahi=None, blo=0, bhi=None*)

SequenceMatcher.get\_opcodes()

SequenceMatcher.get\_grouped\_opcodes(*n=3*)

SequenceMatcher.ratio()

# [glob](https://docs.python.org/3/library/glob.html)

glob()

iglob()

escape()

# [site](https://docs.python.org/3/library/site.html)

getsitepackages()

getuserbase()

# [multiprocessing](https://docs.python.org/3/library/multiprocessing.html)

cpu\_count()

# [cProfile](https://docs.python.org/3/library/profile.html)

run()

# socket

# hashlib

sha256()

# traceback

print\_stack()

# http.client

HTTPConnection()

# [array](https://docs.python.org/3/tutorial/datastructures.html)

array(*typecode*[*, initalizer*])

A new array whose items are restricted by typecode, and initalised from *initalizer*, which must be a list, bytes-like object, or iterable.

append(*x*)

Append a new item with value *x* to the end of the array

buffer\_info()

Return a tuple (*address, base*) giving memory address and length of the array buffer

byteswap()

Byteswap all items of the array

count(*x*)

Return the number of occurrences of *x* in the array

extend(*iterable*)

Append items from *iterable* to end of the array. If *iterable* is an array, it must have the same typecode.

frombytes(*s*)

Append items from the string, interpreting the string as an array of machine values.

fromfile(*f, n*)

Read n items from file object *f* and append them to the end of the array

fromlist(*list*)

Append items from *list*.

fromunicode(*s*)

Extend this array with data from the given Unicode string. Array must be type *‘u’*

index(*x*)

Return the smallest *i* such that *i* is the index of the first occurrence of *x* in array.

insert(*i, x*)

Insert a new item with value *x* in the array before position *i*

pop([*i*])

Remove the item with the index *i* from the array and returns it. *i* defaults to *-1*.

remove(*x*)

Remove the first occurrence of *x* from the array

reverse()

tobytes()

tofile(*f*)

tolist()

tounicode()

*typecodes:*

b signed char l signed long

B unsigned char L unsigned long

u wchar\_t q signed long long

h signed short Q unsigned long long

H unsigned short f float

i signed int d double

I unsigned int

# [set](https://docs.python.org/3/library/stdtypes.html#set)

set([*iterable*])

frozenset([*iterable*])

add(*elem*)

Add element *elem* to set.

update(*\*others*) *or* set |= other ...

Add elements from all *others* to set.

remove(*elem*)

Remove element *elem* from set. Raises *KeyError* if not found.

discard(*elem*)

Remove element *elem* from set if it is present.

pop()

Remove and return an arbitrary element from the set. Raises KeyError if the set is empty.

clear()

Remove all elements from the set.

copy()

Return a shallow copy of the set.

isdisjoint(*other*)

Return True if the set has no elements in common with other.

issubset(*other*) *or* set <= other

Test whether every element in the set is in other.

issuperset(*other*) *or* set >= other

Test whether every element in other is in the set.

union(*\*others*) *or* set | other ...

Return a new set with elements from the set and all others.

intersection(*\*others*) *or* set & other ...

Return a new set with elements common to the set and all others.

difference(*\*others*) *or* set – other ...

Return a new set with elements in the set that are not in the others.

symmetric\_difference(*other*) *or* set ^ other

Return a new set with elements in either the set or other but not both.

intersection\_update(\*others) *or* set &= other ...

difference\_update(\*others) *or* set -= other ...

symmetric\_difference\_update(\*others) *or* set -= other ...

# [dictionary](https://docs.python.org/3/library/stdtypes.html#dict)

dict(*\*\*kwarg*) *or* dict(*mapping, \*\*kwarg*) *or* dict(*iterable, \*\*kwarg*)

clear()

Remove all items from dict.

copy()

Return shallow copy of the dict.

get(*key*[*, default=None*])

Return value for *key* if key is in the dict, else *default*.

pop(*key*[*, default*])

Return and remove value for key from dict. Raises exception if key not in dict and default not given.

popitem()

Remove and return a (*key, value*) pair. Pairs are returned in LIFO order.

items()

Return view of the dictionaries items (*key, value*) pairs.

keys()

Return view of the dictionaries keys.

values()

Return view of the dictionaries values.

setdefault(*key*[*, default=None*])

If *key* is in the dict, return its value. If not, insert *key* with value of *default.*

update([*other*])

Update the dictionary with the key/value pairs from *other*, (overwrites existing keys).

d | other

Create new dict with merged keys and value of *d* and *other*. The values of *other* take priority if there are conflicts.

d |= other

Update the dict *d* with keys and values from *other*. Values from *other* take priority if there are conflicts.

# [string](https://docs.python.org/3/library/stdtypes.html#string-methods)

str(*object=’’*) *or* str(*object=b’’, encoding=’utf-8’, errors=’strict’*)

Return a string version of object. If neither *encoding*, nor *errors* is given, str(*object*) returns *object.\_\_str\_\_()*. If *encoding* or *errors* is given, *object* should be a bytes-like object.

join(*iterable*)

Return a string which is the concatenation of the strings in iterable, using string providing join as separator.

count(*sub*[*, start*[*, end*]])

Return the number of non-overlapping occurrences of substring *sub*, in the range [*start, end*] (if given).

replace(*old, new*[*, count*])

Return a copy of the string with all occurrence of substring *old* replaced by *new*. If *count* is given, only the first *count* occurrences are replaced.

Simulating rreplace()

*new*.join(\_*str*.rsplit(*old, count*))

strip([*chars*])

Return a copy of the string with leading and trailing characters removed. The *chars* argument is a string specifying the set of characters to be removed. If None is given, defaults to removing whitespace. The chars argument is not a prefix or suffix; rather, all combinations of its values are stripped.

find(*sub*[*, start*[*, end*]])

Return the lowest index in the string where substring *sub* is found within range [*start, end*] (if given). If not found, return *-1*.

rfind(*sub*[*, start*[*, end*]])

Return the highest index in the string where substring *sub* is found within range [*start, end*] (if given). If not found, return *-1*.

index(*sub*[*, start*[*, end*]])

Like *find()*, but raise *ValueError* if substring not found.

rindex()

Like *rfind()*, but raise *ValueError* if substring not found.

split(*sep=None, maxsplit=-1*)

Return a list of words in the string, using *sep* as the delimiter string. If *maxsplit* is given, at most *maxsplit* splits are done (resulting in at most maxsplit+1 elements). If *sep* is given, consecutive delimiters are deemed to delimit empty strings. If *sep* is None, runs of consecutive whitespace are regarded as seperator.

format(*\*args, \*\*kwargs*)

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.

capitalize()

Return a copy of the string with its first character capitalized and the rest lowercased.

center(*width*[*, fillchar*])

Return centred in a string of length *width*. Padding is done using *fillchar* (default is space). Origional string is returned if *width* *<= len(s)*.

ljust(*width*[*, fillchar*])

Return the string left-justified in a string of length *width*. Padding is done using *fillchar* (default is space). Original string is returned if *width <= len(s)*.

rjust(*width*[*, fillchar*])

As per *ljust()*, except right-justified.

encode(*encoding=’utf8’, errors=’strict’*)

Return an encoded version of the string as bytes object.

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.

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.

rstrip([*chars*])

*strip()* on RHS of string.

lstrip([*chars*])

*strip()* on LHS of string.

lower()

Return a copy of the string with all the cased characters converted to lowercase.

upper()

Return a copy of the string with all cased characters converted to uppercase.

islower()

Return True if all cased characters are lower case (and there is at least one cased character).

isupper()

Return True if all cased characters are upper case (and there is at least one cased character).

swapcase()

Return a copy of the string with uppercase characters converted to lowercase, and vice-versa.

title()

Return a titlecased version of the string where words start with an uppercase character and the remaining characters are lowercase

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.

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.

zfill(*width*)

Return a copy of the string left-filled with *‘0’* digits to make a string of length *width*. A leading sign is handled by inserting the padding after the sign character. The origional string is returned if *width <= len(s)*.

partition(*sep*)

Split the string at the first occurrence of *sep*, and return a 3-tuple containing the string before, at, and after the separator. If the separator is not found, return a 3-tuple containing the string, followed by two empty strings.

rpartition(*sep*)

As per *partition()*, but split at the last occurrence of *sep*.

removeprefix(*prefix, /*)

If the string starts with the *prefix* string, return string with prefix removed, otherwise remove original string.

removesuffix(*suffix, /*)

If the string ends with the *suffix* string, return string with suffix removed, otherwise remove original string.

isprintable()

Return True if all characters in the string are printable, or the string is empty, otherwise False.

isnumeric()

Return True if all characters in the string are numeric characters, and there is at least one character, False otherwise.

isalpha()

Return True if all characters in the string are alphabetic and there is at least one character, False otherwise.

isalnum()

Return True if all characters in the string are alphanumeric and there is at least one character, False otherwise.

isascii()

Return True if the string is empty or all characters in the string are ASCII, False otherwise.

translate(*table*)

Return a copy of the string in which each character has been mapped through the given translation table.

maketrans(*x*[, *y*[*, z*]])

(static) returns a translation table usable for *translate()*.

# [list](https://docs.python.org/3/library/stdtypes.html#list)

list(*[iterable]*)

The constructor builds a list whose items are the same and in the same order as iterable’s items. iterable may be either a sequence, a container that supports iteration, or an iterator object. If iterable is already a list, a copy is made and returned.

append(*x*)

Appends *x* to the end of the sequence. Equivalent to *s[len(s):len(s)] = [x]*.

pop([*i*])

Retrieves the item at *i*, and also removes it (Defaults to *-1*).

sort(*\*, key=None, reverse=False*)

This method sorts the list in place, using only < comparisons between items. Exceptions are not suppressed, if any comparison operations fail, the entire sort operation will fail (and the list will likely be left in a partially modified state). This method sorts the sequence in place. It is a stable sort.

clear()

Remove all items from list. Equivalent to *del s[:]*

copy()

Create a shallow copy of the list. Equivalent to *s[:]*

extend(*t*)

Extends the list with the contents of *t*. Equivalent to *s[len(s):len(s)] = t*

insert(*i, x*)

Inserts *x* into list at index given by *i*. Equivalent to *s[i:i] = [x]*

remove(*x*)

Remove the first item from list where *s[i]* is equal to *x*.

reverse()

Reverses list in-place.

index(*x*[*, i*[*, j*]])

Index of the first occurrence of *x* in list (at or after index *I* and before index *j*).

count(*x*)

Total number of occurrences of *x* in list.

[i for i, c in enumerate(\_vals) if c == n]

List of indexes of all occurrences of *n* in list *\_vals*.

# bytes

# bytearray

count()

removeprefix()

removesuffix()

decode()

find()

index()

join()

replace()

startswith()

endswith()

strip()

split()

# memoryview

# [numpy](https://numpy.org/doc/stable/reference/index.html)

sum(*a, axis=None, dtype=None, out=None, keepdims=<no value>, initial=<no value>, where=<no value>*)

Sum of array elements over a given axis

ndarray(*shape, dtype=float, buffer=None, offset=0, strides=None, order=None*)

A multidimensional array of homogenous, fixed-size items. Should be constructed using *array, zeros,* or *empty*.

zeros(*shape, dtype=float, order=’C’, like=None*)

Return new array of given shape and type, fill with 0.

ones(*shape, dtype=None, order=’C’, \*, like=None*)

Return new array of given shape and type, fill with 1.

empty(*shape, dtype=float, order=’C’, like=None*)

Return a new array of given shape and type, without initializing entries.

full(*shape, fill\_value, dtype=None, order=’C’, like=None*)

Return a new array of given shape and type, filled with *fill\_value*

save(*file, arr, allow\_pickle=True, fix\_imports=True*)

Save an array to a binary file in Numpy *.npy* format.

savez(*file, \*args, \*\*kwds*)

Save several arrays into a single binary file in *.npz* format.

load(*file, mmap\_mode=None, allow\_pickle=False, fix\_imports=True, encoding='ASCII*)

Load arrays or pickled objects from *.npy*, *.npz*, or pickled files. Note: use False for *allow\_pickle* for any untrusted data sources.

diag(*v, k=0*)

If *v* is a 2d array, return a copy of its *k*-th diagonal. If *v* is a 1d array, return a 2d array with *v* on the *k-*th diagonal.

diagonal(*a, offset=0, axis1=0, axis2=1*)

Return specified diagonals.

diagflat(*v, k=0*)

Create a 2d array with the flattened input as diagonal

identity(*n, dtype=None, \*, like=None*)

Return the identity array.

eye(*N, M=None, k=0, dtype=<class 'float'>, order='C', \*, like=None*)

Return a 2d array with ones on the diagonal and zeros elsewhere.

arange([*start,*] *stop,* [*step,*] *dtype=None, \*, like=None*)

Return evenly spaced values within a given interval. Equivalent to *range()* for integer arguments. For non-integer arguments, use *linspace()*

linspace(*start, stop, num=50, endpoint=True, retstep=False, dtype=None, axis=0*)

Returns *num* evenly spaced numbers over a specified interval. If *endpoint* is True, *stop* is the last sample, otherwise it is excluded. If *retstep* is True, return *(samples, step)*, where *step* is the spacing between samples.

logspace(*start, stop, num=50, endpoint=True, base=10.0, dtype=None, axis=0*)

Return array of values spaced evenly on a log scale

nditer(***op*, *flags=None*, *op\_flags=None*, *op\_dtypes=None*, *order='K'*, *casting='safe'*, *op\_axes=None*, *itershape=None*, *buffersize=0***)

Iterator object to iterate over arrays. See: [Iterating over arrays](https://numpy.org/doc/stable/reference/arrays.nditer.html#arrays-nditer). Note that iteration order is that of the memory layout of the array.

dot(*a, b, out=None*)

Dot product of two arrays.

vdot(*a, b*)

Dot product of two vectors. Flattens matrices. Uses complex conjugate of first argument.

tensordot(*a, b, axes=2*)

Tensor dot product along specified axes.

einsum(*subscripts, \*operands, out=None, dtype=None, order=’K’, casting=’safe’, optimize=False*)

Evaluate Einstein summation convention on the operands

inner(*a, b*)

Compute the inner product of two arrays

outer(*a, b, out=None*)

Compute the outer product of two vectors

cross(*a, b, axisa=-1, axisb=-1, axisc=-1, axis=None*)

Return the cross product of two (arrays of) vectors. If the dimension of *a* or *b* is 2, the third component is assumed to be zero. If the dimension of both is 2, only the z-component (only non-zero component) of the result is returned.

cumsum(*a, axis=None, dtype=None, out=None*)

Return the cumulative sum of the elements along a given axis

set\_printoptions(*precision=None, threshold=None, edgeitems=None, linewidth=None, suppress=None, nanstr=None, infstr=None, formatter=None, sign=None, floatmode=None, \*, legacy=None*)

Set options determining how floats, arrays, and other Numpy objects are displayed.

sort(*a, axis=-1, kind=None, order=None*)

Return a sorted copy of an array

where(*condition*[*, x, y*])

Return elements chosen from x or y depending on condition. If *x* and *y* are omitted, indexes are returned.

full\_like(*a, fill\_value, dtype=None, order=’K’, subok=True, shape=None*)

Return a full array with the same shape and type as a given array

ones\_like(*a, dtype=None, order=’K’, subok=True, shape=None*)

Return an array of ones with the same shape and type as a given array

empty\_like(*prototype, dtype=None, order=’K’, subok=True, shape=None*)

Return a new array with the same shape and type as a given array

zeros\_like(*a, dtype=None, order=’K’, subok=True, shape=None*)

Return an array of zeros with the same shape and type as a given array

asfarray(*a, dtype=<class ‘numpy.double’>*)

Return an array converted to float type

asarray(*a, dtype=None, order=None, \*, like=None*)

Convert the input to an array

multiply(*x1, x2, /, out=None, \*, where=True, casting=’same\_kind’, …*)

Multiply arguments elementwise

add(*x1, x2, /*[*, out, where, casting, order, …*])

Add arguments elementwise

subtract(*x1, x2, /*[*, out, where, casting, …*])

Subtract arguments elementwise

divide(*x1, x2, /*[*,out, where, casting, …*])

Divide arguments elementwise

power(*x1, x2, /*[*, out, where, casting*)

First array elements raised to powers from second array, elementwise

in1d(*ar1, ar2, assume\_unique=False, invert=False*)

Test whether each element of a 1d array is also present in a second array

isin(*element, test\_elements, assume\_unique=False, invert=False*)

Calculates *element* in *test\_elements*, broadcasting over *element* only. Returns Boolean array of the shape of *element* that is True when an element of *element* is in *test\_elements* and False otherwise.

intersect1d(*ar1, ar2, assume\_unique=False, return\_indicies=False*)

Find the intersection of two arrays. Return the sorted, unique values that are in both input arrays.

unique(*ar, return\_index=False, return\_inverse=False, return\_counts=False, axis=None*)

Find the unique elements of an array (that is, each element once, elements with multiple occurrences will be included once). Return the sorted unique elements of an array.

setdiff1d(*ar1, ar2, assume\_unique=False*)

Find the set difference of two arrays. Return the unique values in *ar1* that are not in *ar2*.

setxor1d(*ar1, ar2, assume\_unique=False*)

Find the set exclusive-or of two arrays. Return the sorted, unique values that are in only one of the input arrays.

union1d(*ar1, ar2*)

Find the union of two arrays. Return the unique, sorted array of values that are in either of the two input arrays.

all(*a, axis=None, out=None, keepdims=<no value>, \*, where=<no value>*)

Test whether all array elements along a given axis evaluate to True

any(*a, axis=None, out=None, keepdims=<no value>, \*, where=<no value>*)

Test whether any array element along a given axis evaluates to True

tile(*A, reps*)

Construct an array by repeating *A* the number of times given by *reps*

repeat(*a, repeats, axis=None*)

Repeat elements of an array

argmax(*a, axis=None, out=None*)

Return the indicies of the maximum values along an axis

argmin(*a, axis=None, out=None*)

Returns the indicies of the minimum values along an axis

greater(*x1, x2, /[, out, where, casting, …])*

greater\_equal(*x1, x2, /[, out, where, …]*)

less(*x1, x2, /[, out, where, casting,* …])

less\_equal(*x1, x2, /[, out, where, casting, …]*)

equal(*x1, x2, /[, out, where, casting, …])*

not\_equal(*x1, x2, /[, out, where, casting, …]*)

Elementwise comparisons

allclose(*a, b[, rtol, atol, equal\_nan]*)

True if two arrays are equal elementwise within a tolerance.

lexsort(*keys, axis=-1*)

Perform an indirect stable sort using a sequence of *keys*. Returns an array of integer indices that describe the sort order by multiple columns. Sort is done using *keys* in reverse order as columns.

nonzero(*a*)

Return the indices of the elements that are non-zero. Returns a tuple of arrays, one of each dimension of *a*.

argwhere(*a*)

Find the indices of array elements that are non-zero, grouped by element.

count\_nonzero(*a, axis=None, \*, keepdims=False*)

Counts the number of non-zero values in the array *a*.

extract(*condition, arr*)

Return the elements of an array that satisfy some condition.   
Equivalent to: *compress(ravel(condition), ravel(arr)).*

ravel(*a, order=’C’*)

Return a contiguous flattened array.

tri(*N, M=None, k=0, dtype=<class ‘float’>, \*, like=None*)

Return an array with ones at and below the given diagonal *k*, and zeros elsewhere.

tril(*m, k=0*)

Return an array with elements above the *k*-th diagonal zeroed.

triu(*m, k=0*)

Return an array with elements below the *k*-th diagonal zeroed.

swapaxes(*a, axis1, axis2*)

Interchange two axes of an array

moveaxis(*a, source, destination*)

Move axes of an array to new positions. Other axes remain in their original order.

atleast\_1d(*\*arys*)

atleast\_2d(*\*arys*)

atleast\_3d(*\*arys*)

Convert inputs to arrays with at least 1/2/3 dimensions.

require(*a, dtype=None, requirements=None, \*, like=None*)

Return an ndarray of the provided type that satisfies requirements.

expand\_dims(*a, axis*)

Expand the shape of an array

squeeze(*a, axis=None*)

Remove axes of length one from *a*

reshape(*a, newshape, order=’C’*)

Gives a new shape to an array without changing its data

concatenate(*(a1, a2, …), axis=0, out=None, dtype=None, castring=’same\_kind’*)

Join a sequence of arrays along an existing axis

block(*arrays*)

Assemble an n-d array from nested list of blocks. Blocks in the innermost lists are concatenated along the last dimension (-1), then these are concatenated along second last dimension, and so on until outermost list.

split(*ary, indicies\_or\_sections, axis=0*)

Split an array into multiple sub-arrays as views into *ary*. Raises *ValueError* if *indicies\_or\_sections* is an integer, but split does not result in equal division. If *indicies\_or\_sections* is a 1d sorted list, use values as indexes of locations to split at.

array\_split(*ary, indicies\_or\_sections, axis=0*)

Split an array into multiple sub-arrays.

vsplit(*ary, indices\_or\_sections*)

Split an array into multiple sub-arrays vertically (row-wise). Equivalent to *split()* with *axis=0*

hsplit(*ary, indices\_or\_sections*)

Split array into subarrays horizontally (column-wise). Equivalent to *split()* with *axis=1*.

dsplit(*ary, indices\_or\_sections*)

Split array into multiple sub-arrays along 3rd axis (depth). Equivalent to *split()* with *axis=2*

stack(*arrays, axis=0, out=None*)

Join a sequence of arrays along a new axis. *axis* specifies the index of the new axis in the dimension of result

hstack(*tup*)

Stack arrays in sequence horizontally (column-wise). Equivalent to concatenation along *axis=1*

vstack(*tup*)

Stack arrays in sequence vertically (row-wise). Equivalent to concatenation along *axis=0* after 1d arrays have been reshaped to (1,N).

dstack(*tup*)

Stack arrays in sequence depth wise. Equivalent to concatenation along <third-axis> <*axis=2*> after 2d arrays have been reshaped to (M,N,1), and 1d arrays have been reshaped to (1,N,1).

column\_stack(*tup*)

Stack 1d arrays as columns into a 2d array

row\_stack(*tup*)

Stack arrays in sequence vertically (row-wise)

take(*a, indices, axis=None, out=None, mode=’raise’*)

Take elements from an array along an axis.

put(*a, ind, v, mode=’raise’*)

Replaces specified elements of an array with given values. Indexing works on flattened array. Roughly equivalent to: *a.flat[ind] = v*

copyto(*dst, src, casting=’same\_kind’, where=True*)

Copies values from one array to another, broadcasting as necessary.

compress(*condition, a, axis=None, out=None*)

Return selected slices of an array along a given axis. When working on 1d array, equivalent to *extract()*.

place(*arr, mask, vals*)

Change elements of an array based on conditional and input values.

meshgrid(*\*xi, copy=True, sparse=False, indexing=’xy’*)

Return N-d coordinate array, given 1-d coordinate arrays *x1, x2, …, xn*.

delete(*arr, obj, axis=None*)

Return an array, with sub-arrays along an axis deleted. For a 1d array, return elements not returned by *arr[obj]*

insert(*arr, obj, values, axis=None*)

Inset *values* along the given *axis* before the given indices *obj*.

append(*arr, values, axis=None*)

Append values to the end of an array

frombuffer(*buffer, dtype=float, count=-1, offset=0, \*, like=None*)

Interpret a buffer as a 1-d array

percentile(*a, q, axis=None, out=None, overwrite\_input=False, interpolation=’linear’, keepdims=False*)

Compute the *q-*th percentile(s) of the data along the specified axis.

genfromtxt()

logical\_not()

logical\_and()

logical\_xor()

unravel\_index(*indices, shape, order=’C’*)

Converts a flat index, or array of flat indices, into a tuple of coordinate arrays

ravel\_multi\_index(*multi\_index, dims, mode=’raise’, order=’C’*)

Converts a tuple of index arrays into an array of flat indices, applying boundary modes to the multi-index

triu\_indicies(*n, k=0, m=None*)

Return the indices for the upper-triangle of an *(n, m)* array

tril\_indicies(*n, k=0, m=None*)

Return the indices for the lower-triangle of an *(n, m)* array

mask\_indicies(*n, mask\_func, k=0*)

Return the indicies to access *(n, n)* arrays, given a masking function

ascontiguousarray(*a, dtype=None, \*, like=None*)

Return a contiguous array *(ndim >= 1)* in memory (C order)

broadcast(*in1, in2, …*)

Produce an object that mimics broadcasting

broadcast\_arrays(*\*args, subok=False*)

Broadcast any number of arrays against each other

broadcast\_to(*array, shape, subok=False*)

Broadcast an array to a new shape

broadcast\_shapes(*\*args*)

Broadcast the input shapes into a single shape

fromiter(*iterable, dtype, count=-1, like=None*)

Create a new 1d array from an iterable object

isnan(*x, /, out=None, \*, where=True, casting=’same\_kind’, order=’K’, dtype=None, subok=True[, signature, extobj]*)

Test elementwise for NaNs and return result as boolean array.

mean(*a, axis=None, dtype=None, out=None, keepdims=<no value>, \*, where=<no value>*)

Compute the arithmetic mean along the specified axis

nanmean(*a, axis=None, dtype=None, out=None, keepdims=<no value>*)

Compute arithmetic mean along specified axis, ignoring NaNs

round(*a, decimals=0, out=None*)

Round an array to the given number of decimals

shares\_memory(*a, b, max\_work=None*)

Determine if two arrays share memory

ndenumerate(*arr*)

Multidimensional index iterator, yields pairs of array coordinates and values

ndindex(\**shape*)

An n-dimensional iterator object to index arrays.

nditer(*op, flags=None, op\_flags=None, op\_dtypes=None, order=’K’, casting=’safe’, op\_axes=None, itershape=None, buffersize=0*)

Efficient multi-dimensional iterator to iterate ober arrays.

select(*condlist, choicelist, default=0*)

Return array drawn from elements in *choicelist*, depending on *condlist*.

partition(*a, kth, axis=-1, kind=’introselect’, order=None*)

Return a copy of the array, with elements rearranged such that the value of the element in *k*-th position is in the position it would be in in a sorted array. Elements larger/smaller are moved behind/before. *k-*th may be an array.

argpartition(*a, kth, axis=-1, kind=’introselect’, order=None*)

Perform an indirect partition along the given axis. Returns an array of indices of the same shape as *a* that index data along the given axis in partitioned order. *k*-th may be an array.

take\_along\_axis(*arr, indices, axis*)

Take values from the input array by matching 1d index and data slices. *argsort()* and *argpartition()* produce suitable indices for this function.

put\_along\_axis(*arr, indices, values, axis*)

Put values into destination array by matching 1d index and data slices. *argsort()* and *argpartition()* produce suitable indices for this function.

bincount(*x, weights=None, minlength=0*)

Count number of occurrences of each value in array of non-negative integers

amax(*a, axis=None, out=None, keepdims=<no value>, initial=<no value>, where=<no value>*)

Return the maximum of an array, or maximum along an axis

amin(*a, axis=None, out=None, keepdims=<no value>, initial=<no value>, where=<no value>*)

Return the minimum of an array, or minimum along an axis

average(*a, axis=None, weights=None, returned=False*)

Compute the weighted average along the specified axis

cov(*m, y=None, rowvar=True, bias=False, ddof=None, fweights=one, aweights=None, \*, dtype=None*)

Estimate a covariance matrix, given data and weights

corrcoef(*x, y=None, rowvar=True, bias=<no value>, ddof=<no value>, \*, dtype=None*)

Return Pearson product-moment correlation coefficents

lib.stride\_tricks.sliding\_window\_view(*x, window\_shape, axis=None, \*, subok=False, writeable=False*)

Create a sliding window view into the array with the given window shape. Window slides across all dimensions of the array, and extracts subsets of the array at all window positions.

lib.stride\_tricks.as\_strided(*x, shape=None, strides=None, subok=False, writable=True*)

Create a view into the array with the given shape and strides. This function manipulates internal data structure of ndarray, and can result in corruption/crashes if used incorrectly.

core.records.fromarrays(*arrayList, dtype=None, shape=None, formats=None, names=None, titles=None, aligned=False, byteorder=None*)

Create a record array from a (flat) list of arrays

array\_equiv(*a1, a2*)

Returns True if input arrays are shape consistent, and all elements are equal. Shape consistent meaning one array can be broadcast into the shape of the other.

sort\_complex(*a*)

Sort a complex array using the real part first, then the imaginary part

around(*a, decimals=0, out=None*)

Evenly round to the given number of decimals

diff(*a, n=1, axis=-1, prepend=<no value>, append=<no value>*)

Calculate the n-th discrete difference along the given axis

ediff1d(*ary, to\_end=None, to\_begin=None*)

Differences between consecutive elements of an array

gradient(*f, \*varargs, axis=None, edge\_order=1*)

Gradient of an n-dimensional array

log(*x*, */*, *out=None*, *\**, *where=True*, *casting='same\_kind'*, *order='K'*, *dtype=None*, *subok=True*[, *signature*, *extobj*])

Natural logarithm, element-wise

logaddexp(*x1, x2, /, out=None, \*, where=True, casting='same\_kind', order='K', dtype=None, subok=True[, signature, extobj])*

Natural logarithm of the sum of exponentials of the inputs

logaddexp2(*x1, x2, /, out=None, \*, where=True, casting='same\_kind', order='K', dtype=None, subok=True[, signature, extobj])*

Base-2 Logarithm of the sum of exponentials of the input

mgrid

ogrid

r\_

Translates slice objects to concatenation along the first axis. If the index expression contains comma-seperated-arrays, stack them along their first axis. Or, if the index expression contains slice notation or scalars, then create a 1d array with a range indicated by slice notation.

c\_

Translate slice objects to concatenation along the second axis

s\_

A nicer way to build up index tuples for arrays

ix\_

Construct an open mesh from multiple sequences

# [numpy.char](https://numpy.org/doc/stable/reference/routines.char.html)

|  |  |
| --- | --- |
| [**add**](https://numpy.org/doc/stable/reference/generated/numpy.char.add.html#numpy.char.add)(x1, x2) | Return element-wise string concatenation for two arrays of str or unicode. |
| [**multiply**](https://numpy.org/doc/stable/reference/generated/numpy.char.multiply.html#numpy.char.multiply)(a, i) | Return (a \* i), that is string multiple concatenation, element-wise. |
| [**mod**](https://numpy.org/doc/stable/reference/generated/numpy.char.mod.html#numpy.char.mod)(a, values) | Return (a % i), that is pre-Python 2.6 string formatting (interpolation), element-wise for a pair of array\_likes of str or unicode. |
| [**capitalize**](https://numpy.org/doc/stable/reference/generated/numpy.char.capitalize.html#numpy.char.capitalize)(a) | Return a copy of *a* with only the first character of each element capitalized. |
| [**center**](https://numpy.org/doc/stable/reference/generated/numpy.char.center.html#numpy.char.center)(a, width[, fillchar]) | Return a copy of *a* with its elements centered in a string of length *width*. |
| [**decode**](https://numpy.org/doc/stable/reference/generated/numpy.char.decode.html#numpy.char.decode)(a[, encoding, errors]) | Calls *str.decode* element-wise. |
| [**encode**](https://numpy.org/doc/stable/reference/generated/numpy.char.encode.html#numpy.char.encode)(a[, encoding, errors]) | Calls *str.encode* element-wise. |
| [**expandtabs**](https://numpy.org/doc/stable/reference/generated/numpy.char.expandtabs.html#numpy.char.expandtabs)(a[, tabsize]) | Return a copy of each string element where all tab characters are replaced by one or more spaces. |
| [**join**](https://numpy.org/doc/stable/reference/generated/numpy.char.join.html#numpy.char.join)(sep, seq) | Return a string which is the concatenation of the strings in the sequence *seq*. |
| [**ljust**](https://numpy.org/doc/stable/reference/generated/numpy.char.ljust.html#numpy.char.ljust)(a, width[, fillchar]) | Return an array with the elements of *a* left-justified in a string of length *width*. |
| [**lower**](https://numpy.org/doc/stable/reference/generated/numpy.char.lower.html#numpy.char.lower)(a) | Return an array with the elements converted to lowercase. |
| [**lstrip**](https://numpy.org/doc/stable/reference/generated/numpy.char.lstrip.html#numpy.char.lstrip)(a[, chars]) | For each element in *a*, return a copy with the leading characters removed. |
| [**partition**](https://numpy.org/doc/stable/reference/generated/numpy.char.partition.html#numpy.char.partition)(a, sep) | Partition each element in *a* around *sep*. |
| [**replace**](https://numpy.org/doc/stable/reference/generated/numpy.char.replace.html#numpy.char.replace)(a, old, new[, count]) | For each element in *a*, return a copy of the string with all occurrences of substring *old* replaced by *new*. |
| [**rjust**](https://numpy.org/doc/stable/reference/generated/numpy.char.rjust.html#numpy.char.rjust)(a, width[, fillchar]) | Return an array with the elements of *a* right-justified in a string of length *width*. |
| [**rpartition**](https://numpy.org/doc/stable/reference/generated/numpy.char.rpartition.html#numpy.char.rpartition)(a, sep) | Partition (split) each element around the right-most separator. |
| [**rsplit**](https://numpy.org/doc/stable/reference/generated/numpy.char.rsplit.html#numpy.char.rsplit)(a[, sep, maxsplit]) | For each element in *a*, return a list of the words in the string, using *sep* as the delimiter string. |
| [**rstrip**](https://numpy.org/doc/stable/reference/generated/numpy.char.rstrip.html#numpy.char.rstrip)(a[, chars]) | For each element in *a*, return a copy with the trailing characters removed. |
| [**split**](https://numpy.org/doc/stable/reference/generated/numpy.char.split.html#numpy.char.split)(a[, sep, maxsplit]) | For each element in *a*, return a list of the words in the string, using *sep* as the delimiter string. |
| [**splitlines**](https://numpy.org/doc/stable/reference/generated/numpy.char.splitlines.html#numpy.char.splitlines)(a[, keepends]) | For each element in *a*, return a list of the lines in the element, breaking at line boundaries. |
| [**strip**](https://numpy.org/doc/stable/reference/generated/numpy.char.strip.html#numpy.char.strip)(a[, chars]) | For each element in *a*, return a copy with the leading and trailing characters removed. |
| [**swapcase**](https://numpy.org/doc/stable/reference/generated/numpy.char.swapcase.html#numpy.char.swapcase)(a) | Return element-wise a copy of the string with uppercase characters converted to lowercase and vice versa. |
| [**title**](https://numpy.org/doc/stable/reference/generated/numpy.char.title.html#numpy.char.title)(a) | Return element-wise title cased version of string or unicode. |
| [**translate**](https://numpy.org/doc/stable/reference/generated/numpy.char.translate.html#numpy.char.translate)(a, table[, deletechars]) | For each element in *a*, return a copy of the string where all characters occurring in the optional argument *deletechars* are removed, and the remaining characters have been mapped through the given translation table. |
| [**upper**](https://numpy.org/doc/stable/reference/generated/numpy.char.upper.html#numpy.char.upper)(a) | Return an array with the elements converted to uppercase. |
| [**zfill**](https://numpy.org/doc/stable/reference/generated/numpy.char.zfill.html#numpy.char.zfill)(a, width) | Return the numeric string left-filled with zeros |
| [**equal**](https://numpy.org/doc/stable/reference/generated/numpy.char.equal.html#numpy.char.equal)(x1, x2) | Return (x1 == x2) element-wise. |
| [**not\_equal**](https://numpy.org/doc/stable/reference/generated/numpy.char.not_equal.html#numpy.char.not_equal)(x1, x2) | Return (x1 != x2) element-wise. |
| [**greater\_equal**](https://numpy.org/doc/stable/reference/generated/numpy.char.greater_equal.html#numpy.char.greater_equal)(x1, x2) | Return (x1 >= x2) element-wise. |
| [**less\_equal**](https://numpy.org/doc/stable/reference/generated/numpy.char.less_equal.html#numpy.char.less_equal)(x1, x2) | Return (x1 <= x2) element-wise. |
| [**greater**](https://numpy.org/doc/stable/reference/generated/numpy.char.greater.html#numpy.char.greater)(x1, x2) | Return (x1 > x2) element-wise. |
| [**less**](https://numpy.org/doc/stable/reference/generated/numpy.char.less.html#numpy.char.less)(x1, x2) | Return (x1 < x2) element-wise. |
| [**compare\_chararrays**](https://numpy.org/doc/stable/reference/generated/numpy.char.compare_chararrays.html#numpy.char.compare_chararrays)(a, b, cmp\_op, rstrip) | Performs element-wise comparison of two string arrays using the comparison operator specified by *cmp\_op*. |
| [**count**](https://numpy.org/doc/stable/reference/generated/numpy.char.count.html#numpy.char.count)(a, sub[, start, end]) | Returns an array with the number of non-overlapping occurrences of substring *sub* in the range [*start*, *end*]. |
| [**endswith**](https://numpy.org/doc/stable/reference/generated/numpy.char.endswith.html#numpy.char.endswith)(a, suffix[, start, end]) | Returns a boolean array which is *True* where the string element in *a* ends with *suffix*, otherwise *False*. |
| [**find**](https://numpy.org/doc/stable/reference/generated/numpy.char.find.html#numpy.char.find)(a, sub[, start, end]) | For each element, return the lowest index in the string where substring *sub* is found. |
| [**index**](https://numpy.org/doc/stable/reference/generated/numpy.char.index.html#numpy.char.index)(a, sub[, start, end]) | Like [**find**](https://numpy.org/doc/stable/reference/generated/numpy.char.find.html#numpy.char.find), but raises *ValueError* when the substring is not found. |
| [**isalpha**](https://numpy.org/doc/stable/reference/generated/numpy.char.isalpha.html#numpy.char.isalpha)(a) | Returns true for each element if all characters in the string are alphabetic and there is at least one character, false otherwise. |
| [**isalnum**](https://numpy.org/doc/stable/reference/generated/numpy.char.isalnum.html#numpy.char.isalnum)(a) | Returns true for each element if all characters in the string are alphanumeric and there is at least one character, false otherwise. |
| [**isdecimal**](https://numpy.org/doc/stable/reference/generated/numpy.char.isdecimal.html#numpy.char.isdecimal)(a) | For each element, return True if there are only decimal characters in the element. |
| [**isdigit**](https://numpy.org/doc/stable/reference/generated/numpy.char.isdigit.html#numpy.char.isdigit)(a) | Returns true for each element if all characters in the string are digits and there is at least one character, false otherwise. |
| [**islower**](https://numpy.org/doc/stable/reference/generated/numpy.char.islower.html#numpy.char.islower)(a) | Returns true for each element if all cased characters in the string are lowercase and there is at least one cased character, false otherwise. |
| [**isnumeric**](https://numpy.org/doc/stable/reference/generated/numpy.char.isnumeric.html#numpy.char.isnumeric)(a) | For each element, return True if there are only numeric characters in the element. |
| [**isspace**](https://numpy.org/doc/stable/reference/generated/numpy.char.isspace.html#numpy.char.isspace)(a) | Returns true for each element if there are only whitespace characters in the string and there is at least one character, false otherwise. |
| [**istitle**](https://numpy.org/doc/stable/reference/generated/numpy.char.istitle.html#numpy.char.istitle)(a) | Returns true for each element if the element is a titlecased string and there is at least one character, false otherwise. |
| [**isupper**](https://numpy.org/doc/stable/reference/generated/numpy.char.isupper.html#numpy.char.isupper)(a) | Returns true for each element if all cased characters in the string are uppercase and there is at least one character, false otherwise. |
| [**rfind**](https://numpy.org/doc/stable/reference/generated/numpy.char.rfind.html#numpy.char.rfind)(a, sub[, start, end]) | For each element in *a*, return the highest index in the string where substring *sub* is found, such that *sub* is contained within [*start*, *end*]. |
| [**rindex**](https://numpy.org/doc/stable/reference/generated/numpy.char.rindex.html#numpy.char.rindex)(a, sub[, start, end]) | Like **[rfind](https://numpy.org/doc/stable/reference/generated/numpy.char.rfind.html" \l "numpy.char.rfind" \o "numpy.char.rfind)**, but raises *ValueError* when the substring *sub* is not found. |
| [**startswith**](https://numpy.org/doc/stable/reference/generated/numpy.char.startswith.html#numpy.char.startswith)(a, prefix[, start, end]) | Returns a boolean array which is *True* where the string element in *a* starts with *prefix*, otherwise *False*. |
| [**str\_len**](https://numpy.org/doc/stable/reference/generated/numpy.char.str_len.html#numpy.char.str_len)(a) | Return len(a) element-wise. |

|  |  |
| --- | --- |
| [**array**](https://numpy.org/doc/stable/reference/generated/numpy.char.array.html#numpy.char.array)(obj[, itemsize, copy, unicode, order]) | Create a **[chararray](https://numpy.org/doc/stable/reference/generated/numpy.char.chararray.html" \l "numpy.char.chararray" \o "numpy.char.chararray)**. |
| [**asarray**](https://numpy.org/doc/stable/reference/generated/numpy.char.asarray.html#numpy.char.asarray)(obj[, itemsize, unicode, order]) | Convert the input to a **[chararray](https://numpy.org/doc/stable/reference/generated/numpy.char.chararray.html" \l "numpy.char.chararray" \o "numpy.char.chararray)**, copying the data only if necessary. |
| [**chararray**](https://numpy.org/doc/stable/reference/generated/numpy.char.chararray.html#numpy.char.chararray)(shape[, itemsize, unicode, …]) | Provides a convenient view on arrays of string and unicode values. |

# numpy topics:

broadcasting

Extends <>

Rules of broadcasting:

1. All input arrays with ndim smaller than the input array of largest ndim, have 1’s prepended to their shapes.
2. The size in each dimension of the output shape is the maximum of all the input sizes in that dimension.
3. An input can be used in the calculation if its size in a particular dimension either matches the output size in that dimension, or has value exactly 1.
4. If an input has a dimension size of 1 in its shape, the first data entry in that dimension will be used for all calculations along that dimension. In other words, the stepping machinery of the ufunc will simply not step along that dimension (the stride will be 0 for that dimension).

That is, arrays are broadcastable to the same shape if one of the following is true:

1. The arrays all have exactly the same shape.
2. The arrays all have the same number of dimensions and the length of each dimensions is either a common length or 1.
3. The arrays that have too few dimensions can have their shapes prepended with a dimension of length 1 to satisfy property 2.

b[:, None] *or* b[:, np.newaxis]

Expand dimensions of resulting selection by one dimension.

...

As many ‘:’ as needed

# [numpy.ufunc](https://numpy.org/doc/stable/reference/ufuncs.html)

(Universal Functions)

Function that operates on *ndarray* in an element-by-element fashion. Performs standard broadcasting on input arrays. These are vectorized wrappers. In numpy, ufuncs are instances of *numpy.ufunc*.

Attributes

ufunc.nin Number of inputs

ufunc.nout Number of outputs

ufunc.nargs Number of arguments

ufunc.ntypes Number of types

ufunc.types List of types grouped *input->output*

ufunc.identity

ufunc.signature How the dimensions of each input/output are split into core/loop dims

Methods

ufuncs which take two input arguments and return one output argument have the five methods (see below)

ufunc.reduce(*array[, axis, dtype, out, …]*)

Reduce arrays dimensions by one, by applying *ufunc* along one axis

ufunc.accumulate(*array[, axis, dtype, out]*)

Accumulate the results of applying the operator to all elements

ufunc.reduceat(*array, indices[, axis, …]*)

Perform a (local) reduce with specified slices over a single axis

ufunc.outer(*A, B, /, \*\*kwargs*)

Apply the *ufunc* to all pairs *(a, b)* with *a* in *A* and *b* in *B*

ufunc.at(*a, indices[, b]*)

Performs unbuffered in-place operation on operand *a* for elements specified by *indices*

List of ufuncs

|  |  |
| --- | --- |
| [**add**](https://numpy.org/doc/stable/reference/generated/numpy.add.html#numpy.add)(x1, x2, /[, out, where, casting, order, …]) | Add arguments element-wise. |
| [**subtract**](https://numpy.org/doc/stable/reference/generated/numpy.subtract.html#numpy.subtract)(x1, x2, /[, out, where, casting, …]) | Subtract arguments, element-wise. |
| [**multiply**](https://numpy.org/doc/stable/reference/generated/numpy.multiply.html#numpy.multiply)(x1, x2, /[, out, where, casting, …]) | Multiply arguments element-wise. |
| [**matmul**](https://numpy.org/doc/stable/reference/generated/numpy.matmul.html#numpy.matmul)(x1, x2, /[, out, casting, order, …]) | Matrix product of two arrays. |
| [**divide**](https://numpy.org/doc/stable/reference/generated/numpy.divide.html#numpy.divide)(x1, x2, /[, out, where, casting, …]) | Returns a true division of the inputs, element-wise. |
| [**logaddexp**](https://numpy.org/doc/stable/reference/generated/numpy.logaddexp.html#numpy.logaddexp)(x1, x2, /[, out, where, casting, …]) | Logarithm of the sum of exponentiations of the inputs. |
| [**logaddexp2**](https://numpy.org/doc/stable/reference/generated/numpy.logaddexp2.html#numpy.logaddexp2)(x1, x2, /[, out, where, casting, …]) | Logarithm of the sum of exponentiations of the inputs in base-2. |
| [**true\_divide**](https://numpy.org/doc/stable/reference/generated/numpy.true_divide.html#numpy.true_divide)(x1, x2, /[, out, where, …]) | Returns a true division of the inputs, element-wise. |
| [**floor\_divide**](https://numpy.org/doc/stable/reference/generated/numpy.floor_divide.html#numpy.floor_divide)(x1, x2, /[, out, where, …]) | Return the largest integer smaller or equal to the division of the inputs. |
| [**negative**](https://numpy.org/doc/stable/reference/generated/numpy.negative.html#numpy.negative)(x, /[, out, where, casting, order, …]) | Numerical negative, element-wise. |
| [**positive**](https://numpy.org/doc/stable/reference/generated/numpy.positive.html#numpy.positive)(x, /[, out, where, casting, order, …]) | Numerical positive, element-wise. |
| [**power**](https://numpy.org/doc/stable/reference/generated/numpy.power.html#numpy.power)(x1, x2, /[, out, where, casting, …]) | First array elements raised to powers from second array, element-wise. |
| [**float\_power**](https://numpy.org/doc/stable/reference/generated/numpy.float_power.html#numpy.float_power)(x1, x2, /[, out, where, …]) | First array elements raised to powers from second array, element-wise. |
| [**remainder**](https://numpy.org/doc/stable/reference/generated/numpy.remainder.html#numpy.remainder)(x1, x2, /[, out, where, casting, …]) | Return element-wise remainder of division. |
| [**mod**](https://numpy.org/doc/stable/reference/generated/numpy.mod.html#numpy.mod)(x1, x2, /[, out, where, casting, order, …]) | Return element-wise remainder of division. |
| [**fmod**](https://numpy.org/doc/stable/reference/generated/numpy.fmod.html#numpy.fmod)(x1, x2, /[, out, where, casting, …]) | Return the element-wise remainder of division. |
| [**divmod**](https://numpy.org/doc/stable/reference/generated/numpy.divmod.html#numpy.divmod)(x1, x2[, out1, out2], / [[, out, …]) | Return element-wise quotient and remainder simultaneously. |
| [**absolute**](https://numpy.org/doc/stable/reference/generated/numpy.absolute.html#numpy.absolute)(x, /[, out, where, casting, order, …]) | Calculate the absolute value element-wise. |
| [**fabs**](https://numpy.org/doc/stable/reference/generated/numpy.fabs.html#numpy.fabs)(x, /[, out, where, casting, order, …]) | Compute the absolute values element-wise. |
| [**rint**](https://numpy.org/doc/stable/reference/generated/numpy.rint.html#numpy.rint)(x, /[, out, where, casting, order, …]) | Round elements of the array to the nearest integer. |
| [**sign**](https://numpy.org/doc/stable/reference/generated/numpy.sign.html#numpy.sign)(x, /[, out, where, casting, order, …]) | Returns an element-wise indication of the sign of a number. |
| [**heaviside**](https://numpy.org/doc/stable/reference/generated/numpy.heaviside.html#numpy.heaviside)(x1, x2, /[, out, where, casting, …]) | Compute the Heaviside step function. |
| [**conj**](https://numpy.org/doc/stable/reference/generated/numpy.conj.html#numpy.conj)(x, /[, out, where, casting, order, …]) | Return the complex conjugate, element-wise. |
| [**conjugate**](https://numpy.org/doc/stable/reference/generated/numpy.conjugate.html#numpy.conjugate)(x, /[, out, where, casting, …]) | Return the complex conjugate, element-wise. |
| [**exp**](https://numpy.org/doc/stable/reference/generated/numpy.exp.html#numpy.exp)(x, /[, out, where, casting, order, …]) | Calculate the exponential of all elements in the input array. |
| [**exp2**](https://numpy.org/doc/stable/reference/generated/numpy.exp2.html#numpy.exp2)(x, /[, out, where, casting, order, …]) | Calculate *2\*\*p* for all *p* in the input array. |
| [**log**](https://numpy.org/doc/stable/reference/generated/numpy.log.html#numpy.log)(x, /[, out, where, casting, order, …]) | Natural logarithm, element-wise. |
| [**log2**](https://numpy.org/doc/stable/reference/generated/numpy.log2.html#numpy.log2)(x, /[, out, where, casting, order, …]) | Base-2 logarithm of *x*. |
| [**log10**](https://numpy.org/doc/stable/reference/generated/numpy.log10.html#numpy.log10)(x, /[, out, where, casting, order, …]) | Return the base 10 logarithm of the input array, element-wise. |
| [**expm1**](https://numpy.org/doc/stable/reference/generated/numpy.expm1.html#numpy.expm1)(x, /[, out, where, casting, order, …]) | Calculate exp(x) - 1 for all elements in the array. |
| [**log1p**](https://numpy.org/doc/stable/reference/generated/numpy.log1p.html#numpy.log1p)(x, /[, out, where, casting, order, …]) | Return the natural logarithm of one plus the input array, element-wise. |
| [**sqrt**](https://numpy.org/doc/stable/reference/generated/numpy.sqrt.html#numpy.sqrt)(x, /[, out, where, casting, order, …]) | Return the non-negative square-root of an array, element-wise. |
| [**square**](https://numpy.org/doc/stable/reference/generated/numpy.square.html#numpy.square)(x, /[, out, where, casting, order, …]) | Return the element-wise square of the input. |
| [**cbrt**](https://numpy.org/doc/stable/reference/generated/numpy.cbrt.html#numpy.cbrt)(x, /[, out, where, casting, order, …]) | Return the cube-root of an array, element-wise. |
| [**reciprocal**](https://numpy.org/doc/stable/reference/generated/numpy.reciprocal.html#numpy.reciprocal)(x, /[, out, where, casting, …]) | Return the reciprocal of the argument, element-wise. |
| [**gcd**](https://numpy.org/doc/stable/reference/generated/numpy.gcd.html#numpy.gcd)(x1, x2, /[, out, where, casting, order, …]) | Returns the greatest common divisor of |x1| and |x2| |
| [**lcm**](https://numpy.org/doc/stable/reference/generated/numpy.lcm.html#numpy.lcm)(x1, x2, /[, out, where, casting, order, …]) | Returns the lowest common multiple of |x1| and |x2| |

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| [**sin**](https://numpy.org/doc/stable/reference/generated/numpy.sin.html#numpy.sin)(x, /[, out, where, casting, order, …]) | Trigonometric sine, element-wise. |
| [**cos**](https://numpy.org/doc/stable/reference/generated/numpy.cos.html#numpy.cos)(x, /[, out, where, casting, order, …]) | Cosine element-wise. |
| [**tan**](https://numpy.org/doc/stable/reference/generated/numpy.tan.html#numpy.tan)(x, /[, out, where, casting, order, …]) | Compute tangent element-wise. |
| [**arcsin**](https://numpy.org/doc/stable/reference/generated/numpy.arcsin.html#numpy.arcsin)(x, /[, out, where, casting, order, …]) | Inverse sine, element-wise. |
| [**arccos**](https://numpy.org/doc/stable/reference/generated/numpy.arccos.html#numpy.arccos)(x, /[, out, where, casting, order, …]) | Trigonometric inverse cosine, element-wise. |
| [**arctan**](https://numpy.org/doc/stable/reference/generated/numpy.arctan.html#numpy.arctan)(x, /[, out, where, casting, order, …]) | Trigonometric inverse tangent, element-wise. |
| [**arctan2**](https://numpy.org/doc/stable/reference/generated/numpy.arctan2.html#numpy.arctan2)(x1, x2, /[, out, where, casting, …]) | Element-wise arc tangent of x1/x2 choosing the quadrant correctly. |
| [**hypot**](https://numpy.org/doc/stable/reference/generated/numpy.hypot.html#numpy.hypot)(x1, x2, /[, out, where, casting, …]) | Given the “legs” of a right triangle, return its hypotenuse. |
| [**sinh**](https://numpy.org/doc/stable/reference/generated/numpy.sinh.html#numpy.sinh)(x, /[, out, where, casting, order, …]) | Hyperbolic sine, element-wise. |
| [**cosh**](https://numpy.org/doc/stable/reference/generated/numpy.cosh.html#numpy.cosh)(x, /[, out, where, casting, order, …]) | Hyperbolic cosine, element-wise. |
| [**tanh**](https://numpy.org/doc/stable/reference/generated/numpy.tanh.html#numpy.tanh)(x, /[, out, where, casting, order, …]) | Compute hyperbolic tangent element-wise. |
| [**arcsinh**](https://numpy.org/doc/stable/reference/generated/numpy.arcsinh.html#numpy.arcsinh)(x, /[, out, where, casting, order, …]) | Inverse hyperbolic sine element-wise. |
| [**arccosh**](https://numpy.org/doc/stable/reference/generated/numpy.arccosh.html#numpy.arccosh)(x, /[, out, where, casting, order, …]) | Inverse hyperbolic cosine, element-wise. |
| [**arctanh**](https://numpy.org/doc/stable/reference/generated/numpy.arctanh.html#numpy.arctanh)(x, /[, out, where, casting, order, …]) | Inverse hyperbolic tangent element-wise. |
| [**degrees**](https://numpy.org/doc/stable/reference/generated/numpy.degrees.html#numpy.degrees)(x, /[, out, where, casting, order, …]) | Convert angles from radians to degrees. |
| [**radians**](https://numpy.org/doc/stable/reference/generated/numpy.radians.html#numpy.radians)(x, /[, out, where, casting, order, …]) | Convert angles from degrees to radians. |
| [**deg2rad**](https://numpy.org/doc/stable/reference/generated/numpy.deg2rad.html#numpy.deg2rad)(x, /[, out, where, casting, order, …]) | Convert angles from degrees to radians. |
| [**rad2deg**](https://numpy.org/doc/stable/reference/generated/numpy.rad2deg.html#numpy.rad2deg)(x, /[, out, where, casting, order, …]) | Convert angles from radians to degrees. |

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| [**bitwise\_and**](https://numpy.org/doc/stable/reference/generated/numpy.bitwise_and.html#numpy.bitwise_and)(x1, x2, /[, out, where, …]) | Compute the bit-wise AND of two arrays element-wise. |
| [**bitwise\_or**](https://numpy.org/doc/stable/reference/generated/numpy.bitwise_or.html#numpy.bitwise_or)(x1, x2, /[, out, where, casting, …]) | Compute the bit-wise OR of two arrays element-wise. |
| [**bitwise\_xor**](https://numpy.org/doc/stable/reference/generated/numpy.bitwise_xor.html#numpy.bitwise_xor)(x1, x2, /[, out, where, …]) | Compute the bit-wise XOR of two arrays element-wise. |
| [**invert**](https://numpy.org/doc/stable/reference/generated/numpy.invert.html#numpy.invert)(x, /[, out, where, casting, order, …]) | Compute bit-wise inversion, or bit-wise NOT, element-wise. |
| [**left\_shift**](https://numpy.org/doc/stable/reference/generated/numpy.left_shift.html#numpy.left_shift)(x1, x2, /[, out, where, casting, …]) | Shift the bits of an integer to the left. |
| [**right\_shift**](https://numpy.org/doc/stable/reference/generated/numpy.right_shift.html#numpy.right_shift)(x1, x2, /[, out, where, …]) | Shift the bits of an integer to the right. |

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| [**greater**](https://numpy.org/doc/stable/reference/generated/numpy.greater.html#numpy.greater)(x1, x2, /[, out, where, casting, …]) | Return the truth value of (x1 > x2) element-wise. |
| [**greater\_equal**](https://numpy.org/doc/stable/reference/generated/numpy.greater_equal.html#numpy.greater_equal)(x1, x2, /[, out, where, …]) | Return the truth value of (x1 >= x2) element-wise. |
| [**less**](https://numpy.org/doc/stable/reference/generated/numpy.less.html#numpy.less)(x1, x2, /[, out, where, casting, …]) | Return the truth value of (x1 < x2) element-wise. |
| [**less\_equal**](https://numpy.org/doc/stable/reference/generated/numpy.less_equal.html#numpy.less_equal)(x1, x2, /[, out, where, casting, …]) | Return the truth value of (x1 <= x2) element-wise. |
| [**not\_equal**](https://numpy.org/doc/stable/reference/generated/numpy.not_equal.html#numpy.not_equal)(x1, x2, /[, out, where, casting, …]) | Return (x1 != x2) element-wise. |
| [**equal**](https://numpy.org/doc/stable/reference/generated/numpy.equal.html#numpy.equal)(x1, x2, /[, out, where, casting, …]) | Return (x1 == x2) element-wise. |
| [**logical\_and**](https://numpy.org/doc/stable/reference/generated/numpy.logical_and.html#numpy.logical_and)(x1, x2, /[, out, where, …]) | Compute the truth value of x1 AND x2 element-wise. |
| [**logical\_or**](https://numpy.org/doc/stable/reference/generated/numpy.logical_or.html#numpy.logical_or)(x1, x2, /[, out, where, casting, …]) | Compute the truth value of x1 OR x2 element-wise. |
| [**logical\_xor**](https://numpy.org/doc/stable/reference/generated/numpy.logical_xor.html#numpy.logical_xor)(x1, x2, /[, out, where, …]) | Compute the truth value of x1 XOR x2, element-wise. |
| [**logical\_not**](https://numpy.org/doc/stable/reference/generated/numpy.logical_not.html#numpy.logical_not)(x, /[, out, where, casting, …]) | Compute the truth value of NOT x element-wise. |
| [**maximum**](https://numpy.org/doc/stable/reference/generated/numpy.maximum.html#numpy.maximum)(x1, x2, /[, out, where, casting, …]) | Element-wise maximum of array elements. |
| [**minimum**](https://numpy.org/doc/stable/reference/generated/numpy.minimum.html#numpy.minimum)(x1, x2, /[, out, where, casting, …]) | Element-wise minimum of array elements. |
| [**fmax**](https://numpy.org/doc/stable/reference/generated/numpy.fmax.html#numpy.fmax)(x1, x2, /[, out, where, casting, …]) | Element-wise maximum of array elements. |
| [**fmin**](https://numpy.org/doc/stable/reference/generated/numpy.fmin.html#numpy.fmin)(x1, x2, /[, out, where, casting, …]) | Element-wise minimum of array elements. |

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| [**isfinite**](https://numpy.org/doc/stable/reference/generated/numpy.isfinite.html#numpy.isfinite)(x, /[, out, where, casting, order, …]) | Test element-wise for finiteness (not infinity or not Not a Number). |
| [**isinf**](https://numpy.org/doc/stable/reference/generated/numpy.isinf.html#numpy.isinf)(x, /[, out, where, casting, order, …]) | Test element-wise for positive or negative infinity. |
| [**isnan**](https://numpy.org/doc/stable/reference/generated/numpy.isnan.html#numpy.isnan)(x, /[, out, where, casting, order, …]) | Test element-wise for NaN and return result as a boolean array. |
| [**isnat**](https://numpy.org/doc/stable/reference/generated/numpy.isnat.html#numpy.isnat)(x, /[, out, where, casting, order, …]) | Test element-wise for NaT (not a time) and return result as a boolean array. |
| [**fabs**](https://numpy.org/doc/stable/reference/generated/numpy.fabs.html#numpy.fabs)(x, /[, out, where, casting, order, …]) | Compute the absolute values element-wise. |
| [**signbit**](https://numpy.org/doc/stable/reference/generated/numpy.signbit.html#numpy.signbit)(x, /[, out, where, casting, order, …]) | Returns element-wise True where signbit is set (less than zero). |
| [**copysign**](https://numpy.org/doc/stable/reference/generated/numpy.copysign.html#numpy.copysign)(x1, x2, /[, out, where, casting, …]) | Change the sign of x1 to that of x2, element-wise. |
| [**nextafter**](https://numpy.org/doc/stable/reference/generated/numpy.nextafter.html#numpy.nextafter)(x1, x2, /[, out, where, casting, …]) | Return the next floating-point value after x1 towards x2, element-wise. |
| [**spacing**](https://numpy.org/doc/stable/reference/generated/numpy.spacing.html#numpy.spacing)(x, /[, out, where, casting, order, …]) | Return the distance between x and the nearest adjacent number. |
| [**modf**](https://numpy.org/doc/stable/reference/generated/numpy.modf.html#numpy.modf)(x[, out1, out2], / [[, out, where, …]) | Return the fractional and integral parts of an array, element-wise. |
| [**ldexp**](https://numpy.org/doc/stable/reference/generated/numpy.ldexp.html#numpy.ldexp)(x1, x2, /[, out, where, casting, …]) | Returns x1 \* 2\*\*x2, element-wise. |
| [**frexp**](https://numpy.org/doc/stable/reference/generated/numpy.frexp.html#numpy.frexp)(x[, out1, out2], / [[, out, where, …]) | Decompose the elements of x into mantissa and twos exponent. |
| [**fmod**](https://numpy.org/doc/stable/reference/generated/numpy.fmod.html#numpy.fmod)(x1, x2, /[, out, where, casting, …]) | Return the element-wise remainder of division. |
| [**floor**](https://numpy.org/doc/stable/reference/generated/numpy.floor.html#numpy.floor)(x, /[, out, where, casting, order, …]) | Return the floor of the input, element-wise. |
| [**ceil**](https://numpy.org/doc/stable/reference/generated/numpy.ceil.html#numpy.ceil)(x, /[, out, where, casting, order, …]) | Return the ceiling of the input, element-wise. |
| [**trunc**](https://numpy.org/doc/stable/reference/generated/numpy.trunc.html#numpy.trunc)(x, /[, out, where, casting, order, …]) | Return the truncated value of the input, element-wise. |

# einsum() Examples

Let A and B be two 1D arrays of compatible shapes (meaning the lengths of the axes we pair together either equal, or one of them has length 1):

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| **Call signature** | **NumPy equivalent** | **Description** |
| ('i', A) | A | returns a view of A |
| ('i->', A) | sum(A) | sums the values of A |
| ('i,i->i', A, B) | A \* B | element-wise multiplication of A and B |
| ('i,i', A, B) | inner(A, B) | inner product of A and B |
| ('i,j->ij', A, B) | outer(A, B) | outer product of A and B |

Now let A and B be two 2D arrays with compatible shapes:

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| **Call signature** | **NumPy equivalent** | **Description** |
| ('ij', A) | A | returns a view of A |
| ('ji', A) | A.T | view transpose of A |
| ('ii->i', A) | diag(A) | view main diagonal of A |
| ('ii', A) | trace(A) | sums main diagonal of A |
| ('ij->', A) | sum(A) | sums the values of A |
| ('ij->j', A) | sum(A, axis=0) | sum down the columns of A (across rows) |
| ('ij->i', A) | sum(A, axis=1) | sum horizontally along the rows of A |
| ('ij,ij->ij', A, B) | A \* B | element-wise multiplication of A and B |
| ('ij,ji->ij', A, B) | A \* B.T | element-wise multiplication of A and B.T |
| ('ij,jk', A, B) | dot(A, B) | matrix multiplication of A and B |
| ('ij,kj->ik', A, B) | inner(A, B) | inner product of A and B |
| ('ij,kj->ikj', A, B) | A[:, None] \* B | each row of A multiplied by B |
| ('ij,kl->ijkl', A, B) | A[:, :, None, None] \* B | each value of A multiplied by B |

# numpy.random

rand(*d0, d1, …, dn*)

Random value(s) in a given shape.

randn(*d0, d1, …, dn*)

Value(s) from the standard normal distribution in a given shape.

randint(*low*[*, high, size*])

Random integers in range *[low, high)*

random([*size*])

Random floats in the interval *[0, 1)*

choice(*a*[*, size=None, replace=True, p=None*])

Random sample from a given 1d array

bytes(*length*)

Random bytes

shuffle(*x*)

Shuffle contents of sequence in-place. (Use from instance of *default\_rng*)

permutations(*x*)

Randomly permute a sequence, or return a permuted range. If *x* is multi-dimensional, only the first index is shuffled. (Use from instance of *default\_rng*)

normal([*loc, scale, size*])

Random samples from a normal (Gaussian) distribution. Mean = *loc*, standard deviation = *scale*.

seed()

get\_state()

set\_state()

# [numpy.random.default\_rng](https://numpy.org/doc/stable/reference/random/generator.html#numpy.random.default_rng)

default\_rng()

Use methods provided by *default\_rng* in preference to those of *numpy.random*

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| [**integers**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.integers.html#numpy.random.Generator.integers)(low[, high, size, dtype, endpoint]) | Return random integers from low (inclusive) to high (exclusive), or if endpoint=True, low (inclusive) to high (inclusive). |
| [**random**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.random.html#numpy.random.Generator.random)([size, dtype, out]) | Return random floats in the half-open interval [0.0, 1.0). |
| [**choice**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.choice.html#numpy.random.Generator.choice)(a[, size, replace, p, axis, shuffle]) | Generates a random sample from a given 1-D array |
| [**bytes**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.bytes.html#numpy.random.Generator.bytes)(length) | Return random bytes |

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| [**shuffle**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.shuffle.html#numpy.random.Generator.shuffle)(x[, axis]) | Modify an array or sequence in-place by shuffling its contents. |
| [**permutation**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.permutation.html#numpy.random.Generator.permutation)(x[, axis]) | Randomly permute a sequence, or return a permuted range. |
| [**permuted**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.permuted.html#numpy.random.Generator.permuted)(x[, axis, out]) | Randomly permute x along axis axis. |

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| --- | --- |
| [**beta**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.beta.html#numpy.random.Generator.beta)(a, b[, size]) | Draw samples from a Beta distribution. |
| [**binomial**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.binomial.html#numpy.random.Generator.binomial)(n, p[, size]) | Draw samples from a binomial distribution. |
| [**chisquare**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.chisquare.html#numpy.random.Generator.chisquare)(df[, size]) | Draw samples from a chi-square distribution. |
| [**dirichlet**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.dirichlet.html#numpy.random.Generator.dirichlet)(alpha[, size]) | Draw samples from the Dirichlet distribution. |
| [**exponential**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.exponential.html#numpy.random.Generator.exponential)([scale, size]) | Draw samples from an exponential distribution. |
| [**f**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.f.html#numpy.random.Generator.f)(dfnum, dfden[, size]) | Draw samples from an F distribution. |
| [**gamma**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.gamma.html#numpy.random.Generator.gamma)(shape[, scale, size]) | Draw samples from a Gamma distribution. |
| [**geometric**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.geometric.html#numpy.random.Generator.geometric)(p[, size]) | Draw samples from the geometric distribution. |
| [**gumbel**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.gumbel.html#numpy.random.Generator.gumbel)([loc, scale, size]) | Draw samples from a Gumbel distribution. |
| [**hypergeometric**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.hypergeometric.html#numpy.random.Generator.hypergeometric)(ngood, nbad, nsample[, size]) | Draw samples from a Hypergeometric distribution. |
| [**laplace**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.laplace.html#numpy.random.Generator.laplace)([loc, scale, size]) | Draw samples from the Laplace or double exponential distribution with specified location (or mean) and scale (decay). |
| [**logistic**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.logistic.html#numpy.random.Generator.logistic)([loc, scale, size]) | Draw samples from a logistic distribution. |
| [**lognormal**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.lognormal.html#numpy.random.Generator.lognormal)([mean, sigma, size]) | Draw samples from a log-normal distribution. |
| [**logseries**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.logseries.html#numpy.random.Generator.logseries)(p[, size]) | Draw samples from a logarithmic series distribution. |
| [**multinomial**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.multinomial.html#numpy.random.Generator.multinomial)(n, pvals[, size]) | Draw samples from a multinomial distribution. |
| [**multivariate\_hypergeometric**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.multivariate_hypergeometric.html#numpy.random.Generator.multivariate_hypergeometric)(colors, nsample) | Generate variates from a multivariate hypergeometric distribution. |
| [**multivariate\_normal**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.multivariate_normal.html#numpy.random.Generator.multivariate_normal)(mean, cov[, size, …]) | Draw random samples from a multivariate normal distribution. |
| [**negative\_binomial**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.negative_binomial.html#numpy.random.Generator.negative_binomial)(n, p[, size]) | Draw samples from a negative binomial distribution. |
| [**noncentral\_chisquare**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.noncentral_chisquare.html#numpy.random.Generator.noncentral_chisquare)(df, nonc[, size]) | Draw samples from a noncentral chi-square distribution. |
| [**noncentral\_f**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.noncentral_f.html#numpy.random.Generator.noncentral_f)(dfnum, dfden, nonc[, size]) | Draw samples from the noncentral F distribution. |
| [**normal**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.normal.html#numpy.random.Generator.normal)([loc, scale, size]) | Draw random samples from a normal (Gaussian) distribution. |
| [**pareto**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.pareto.html#numpy.random.Generator.pareto)(a[, size]) | Draw samples from a Pareto II or Lomax distribution with specified shape. |
| [**poisson**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.poisson.html#numpy.random.Generator.poisson)([lam, size]) | Draw samples from a Poisson distribution. |
| [**power**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.power.html#numpy.random.Generator.power)(a[, size]) | Draws samples in [0, 1] from a power distribution with positive exponent a - 1. |
| [**rayleigh**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.rayleigh.html#numpy.random.Generator.rayleigh)([scale, size]) | Draw samples from a Rayleigh distribution. |
| [**standard\_cauchy**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.standard_cauchy.html#numpy.random.Generator.standard_cauchy)([size]) | Draw samples from a standard Cauchy distribution with mode = 0. |
| [**standard\_exponential**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.standard_exponential.html#numpy.random.Generator.standard_exponential)([size, dtype, method, out]) | Draw samples from the standard exponential distribution. |
| [**standard\_gamma**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.standard_gamma.html#numpy.random.Generator.standard_gamma)(shape[, size, dtype, out]) | Draw samples from a standard Gamma distribution. |
| [**standard\_normal**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.standard_normal.html#numpy.random.Generator.standard_normal)([size, dtype, out]) | Draw samples from a standard Normal distribution (mean=0, stdev=1). |
| [**standard\_t**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.standard_t.html#numpy.random.Generator.standard_t)(df[, size]) | Draw samples from a standard Student’s t distribution with df degrees of freedom. |
| [**triangular**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.triangular.html#numpy.random.Generator.triangular)(left, mode, right[, size]) | Draw samples from the triangular distribution over the interval [left, right]. |
| [**uniform**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.uniform.html#numpy.random.Generator.uniform)([low, high, size]) | Draw samples from a uniform distribution. |
| [**vonmises**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.vonmises.html#numpy.random.Generator.vonmises)(mu, kappa[, size]) | Draw samples from a von Mises distribution. |
| [**wald**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.wald.html#numpy.random.Generator.wald)(mean, scale[, size]) | Draw samples from a Wald, or inverse Gaussian, distribution. |
| [**weibull**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.weibull.html#numpy.random.Generator.weibull)(a[, size]) | Draw samples from a Weibull distribution. |
| [**zipf**](https://numpy.org/doc/stable/reference/random/generated/numpy.random.Generator.zipf.html#numpy.random.Generator.zipf)(a[, size]) | Draw samples from a Zipf distribution. |

# [numpy.ndarray](https://numpy.org/doc/stable/reference/arrays.ndarray.html)

*attributes*

flags

*dict*, Information about memory layout of array

shape

*tuple* of array dimensions

strides

*tuple* of bytes to step in each direction when traversing array

ndim

*int*, number of array dimensions

data

*buffer* object, pointing to start of array data

size

*int*, number of elements in array

itemsize

*int*, length of one element in bytes

nbytes

*int*, total bytes consumed by array

base

*ndarray*, base object if memory is from some other object

T

*ndarray*, transposed array

real

*ndarray*, real part of the array

imag

*ndarray,* imaginary part of the array

flat

*numpy.flatiter* object, 1d iterator over array

ctypes

*ctypes* object, for interaction with ctypes module

*conversion:*

item(*\*args*)

Copy an element of an array to a python scalar and return it

tolist()

Return the array as an *a.ndim* levels deep nested list of python scalars

itemset(*\*args*)

Insert scalar into array. If last item of *args* is *item*, then equivalent to *a[args]=item*. *args* may only be size 1 if array is size one.

tostring([*order*])

deprecated.

tobytes(*order=’C’*)

Construct python bytes containing the raw data bytes in the array.

tofile(*fid[, sep=””, format=”%s”]*)

Write array to file. Binary format if *sep* is empty. Result can be read with *fromfile()*.

dump(*file*)

Dump a pickle of the array to a file.

dumps()

Return the pickle of the array as string.

astype(*dtype, order=’K’, casting=’unsafe’, subok=True, copy=True*)

Copy of the array, cast to a specific type.

byteswrap(*inplace=False*)

Swap the bytes of the array elements. Toggle between little/big-endian. re/im components swapped separately.

copy(*order=’C’*)

Return a copy of the array

view(*[dtype][, type]*)

New view of array with same data

getfield(*dtype, offset=0*)

Returns the field of the given array as a certain type.

setflags(*write=None, align=None, uic=None*)

Set array flags.

fill(*value*)

Fill the array with a scalar value

*manipulation:*

reshape(*shape, order=’C’*)

Return an array containing the same data with a new shape. One shape dimension can be *-1*, it will be inferred from the other dimensions.

resize(*new\_shape, refcheck=True*)

Change shape and size of array in-place

transpose(*\*axes*)

Returns a view of the array with axes transposed

swapaxes(*axis1, axis2*)

Return a view of the array with *axis1* and *axis2* interchanged

flatten(*order=’C’*)

Return a copy of the array collapsed into one dimension.

ravel(*order=’C’*)

Return a flattened array

squeeze(*axis=None*)

Remove axes of length one from *a*

*selection and manipulation:*

take(*indices, axis=None, out=None, mode=’raise’*)

Return an array formed from the elements of *a* at the given indices.

put(*indices, values, mode=’raise’*)

Set *a.flat[n] = values[n]* for all *n* in *indices*

repeat(*repeats, axis=None*)

Repeat elements of an array

choose(*choices, out=None, mode=’raise’*)

Use an index array to construct a new array from a set of choices.

sort(*axis=-1, kind=None, order=None*)

Sort array in-place

argsort(*axis=-1, kind=None, order=None*)

Return the indices that would sort this array

partition(*kth, axis=-1, kind=’introselect’, order=None*)

Rearranges the elements in the array such that the value of the element in *kth* position is in the position it would be in a sorted array. All elements smaller are moved before, and all greater or equal are moved after it. Order of partitioned elements is undefined.

argpartition(*kth, axis=-1, kind=’introselect’, order=None*)

Return the indices that would partition this array

searchsorted(*v, side=’left’, sorter=None*)

Find indices where elements of *v* should be inserted in *a* to maintain order

nonzero()

Return the indices of the elements that are non-zero

compress(*condition, axis=None, out=None*)

Return selected slices of this array along a given axis, for each index where *condition* evaluates to True

diagonal(*offset=0, axis1=0, axis2=1*)

Return specified diagonals

*calculation:*

max(*axis=None, out=None, keepdims=False, initial=<no value>, where=True*)

Return the maximum along a given axis

argmax(*axis=None, out=None*)

Return indices of the maximum values along the given axis

min(*axis=None, out=None, keepdims=False, initial=<no value>, where=True*)

Return the minimum along a given axis

ptp(*axis=None, out=None, keepdims=False*)

Peak to peak (max-min) value along a given axis.

clip(*min=None, max=None, out=None, \*\*kwargs*)

Return an array whose values are limited to *[min, max]*. One of *max, min* must be given.

conj()

Complex conjugate of all elements

round(*decimals=0, out=None*)

Return *a* with each element rounded to the given number of decimals

trace(*offset=0, axis1=0, axis2=1, dtype=None, out=None*)

Return the sum along diagonals of the array

sum(*axis=None, dtype=None, out=None, keepdims=False, initial=0, where=True*)

Return the sum of the array elements over the given axis

cumsum(*axis=None, dtype=None, out=None*)

Return the cumulative sum of the elements along the given axis

mean(*axis=None, dtype=None, out=None, keepdims=False, \*, where=True*)

Returns the average of the array elements along a given axis

var(*axis=None, dtype=None, out=None, ddof=0, keepdims=False, \*, where=True*)

Returns the variance of the array elements, along given axis

std(*axis=None, dtype=None, out=None, ddof=0, keepdims=False, \*, where=True*)

Returns the standard deviation of the array elements along given axis

prod(*axis=None, dtype=None, out=None, keepdims=False, initial=1, where=True*)

Return the product of the array elements over the given axis

cumprod(*axis=None, dtype=None, out=None*)

Return the cumulative product of the elements along the given axis

all(*axis=None, out=None, keepdims=False, \*, where=True*)

Returns True if all elements evaluate to True

any(*axis=None, out=None, keepdims=False, \*, where=True*)

Returns True if any of the elements evaluate to True

*arithmetic, matrix multiplication, comparison*

\_\_lt\_\_()

\_\_le\_\_()

<...>

# [numpy.linalg](https://numpy.org/doc/stable/reference/routines.linalg.html)

*matrix and vector products*

dot(*a, b*[*, out*])

Dot product of two arrays

multi\_dot(*arrays, \**[*, out*])

Dot product of multiple arrays in single function call

vdot(*a, b*)

Dot product of two vectors

inner(*a, b*)

Inner product of two arrays

outer(*a, b*[*, out*])

Outer product of two vectors

matmul(*x1, x2, /*[*, out, casting, order, …*])

Matrix product of two arrays

tensordot(*a, b*[*, axes*])

Tensor dot product along specified axis.

einsum(*subscripts, \*operands*[*, out, dtype, …*])

Evaluates the Einstein summation convention on the operands.

einsum\_path(*subscripts, \*operands*[*, optimize*])

Evaluates the lowest cost contraction order for an einsum expression.

matrix\_power(*a, n*)

Raise a square matrix to the (integer) power *n*

kron(*a, b*)

Kronecker product of two arrays

*decompositions*

cholseky(*a*)

Cholseky decomposition

qr(*a*[*, mode*])

qr factorization of a matrix

svd(*a*[*, full\_matricies, compute\_uv, …*])

Single value decomposition

*eigenvalues*

eig(*a*)

Compute the eigenvalues and right eigenvectors of a square array

eigh(*x*[*, p*])

Return the eigenvalues and eigenvectors of a complex Hermitian or real symmetric matrix

eigvals(*a*)

Compute the eigenvalues of a general matrix

eigvalsh(*a*[*, UPLO*])

Compute the eigenvalues of a complex Hermitian or real symmetric matrix

*norms and other numbers*

norm(*x*[*, ord, axis, keepdims*])

Matrix or vector norm

cond(*x*[*, p*])

Compute the conditional number of a matrix

det(*a*)

Compute the determinant of an array

matrix\_rank(*M*[*, tol, hermitian*])

Return the matrix rand of an array uing SVD method

slogdet(*a*)

Compute the sign and (natural) logarithm of the determinant of an array

trace(*a*[*, offset, axis1, axis2, dtype, out*])

Return the sum along diagonals of the array

*solving, inverting*

solve(*a, b*)

Solve a linear matrix equation, or system of linear scalar equations

tensorsolve(*a, b*[*, axes*])

Solve the tensor equation *ax = b* for *x*

lstsq(*a, b*[*, rcond*])

Return the least-squares solution to a linear matrix equation

inv(*a*)

Compute the (multiplicative) inverse of a matrix

pinv(*a*[*, rcond, hermitian*])

Compute the (Moore-Penrose) pseudo-inverse of a matrix

tensorinv(*a*[*, ind*])

Compute the inverse of an N-dimensional array

# [numpy.polynomial](https://numpy.org/doc/stable/reference/routines.polynomials.package.html" \l "module-numpy.polynomial)

This package provides *convenience classes* for each of six different kinds of polynomials:

| **Name** | **Provides** |
| --- | --- |
| Polynomial | Power series |
| Chebyshev | Chebyshev series |
| Legendre | Legendre series |
| Laguerre | Laguerre series |
| Hermite | Hermite series |
| HermiteE | HermiteE series |

The following lists the various constants and methods common to all of the classes representing the various kinds of polynomials. In the following, the term Poly represents any one of the convenience classes (e.g. Polynomial, Chebyshev, Hermite, etc.) while the lowercase p represents an **instance** of a polynomial class.

Constants

* Poly.domain – Default domain
* Poly.window – Default window
* Poly.basis\_name – String used to represent the basis
* Poly.maxpower – Maximum value n such that p\*\*n is allowed
* Poly.nickname – String used in printing

Creation - Methods for creating polynomial instances.

* Poly.basis(degree) – Basis polynomial of given degree
* Poly.identity() – p where p(x) = x for all x
* Poly.fit(x, y, deg) – p of degree deg with coefficients determined by the least-squares fit to the data x, y
* Poly.fromroots(roots) – p with specified roots
* p.copy() – Create a copy of p

Conversion - Methods for converting a polynomial instance of one kind to another.

* p.cast(Poly) – Convert p to instance of kind Poly
* p.convert(Poly) – Convert p to instance of kind Poly or map between domain and window

Calculus

* p.deriv() – Take the derivative of p
* p.integ() – Integrate p

Validation

* Poly.has\_samecoef(p1, p2) – Check if coefficients match
* Poly.has\_samedomain(p1, p2) – Check if domains match
* Poly.has\_sametype(p1, p2) – Check if types match
* Poly.has\_samewindow(p1, p2) – Check if windows match

Misc

* p.linspace() – Return x, p(x) at equally-spaced points in domain
* p.mapparms() – Return the parameters for the linear mapping between domain and window.
* p.roots() – Return the roots of p.
* p.trim() – Remove trailing coefficients.
* p.cutdeg(degree) – Truncate p to given degree
* p.truncate(size) – Truncate p to given size

Creation of Polynomial instance:

b = [1, -12, 10, 7, -10]

# Note: Polynomial() takes cooefficents in reverse order to np.roots(), hence reversed a

p = np.polynomial.Polynomial(a[::-1])

# [numpy datetime functions](https://numpy.org/doc/stable/reference/routines.datetime.html)

|  |  |
| --- | --- |
| [**datetime\_as\_string**](https://numpy.org/doc/stable/reference/generated/numpy.datetime_as_string.html#numpy.datetime_as_string)(arr[, unit, timezone, …]) | Convert an array of datetimes into an array of strings. |
| [**datetime\_data**](https://numpy.org/doc/stable/reference/generated/numpy.datetime_data.html#numpy.datetime_data)(dtype, /) | Get information about the step size of a date or time type. |

|  |  |
| --- | --- |
| [**busdaycalendar**](https://numpy.org/doc/stable/reference/generated/numpy.busdaycalendar.html#numpy.busdaycalendar)([weekmask, holidays]) | A business day calendar object that efficiently stores information defining valid days for the busday family of functions. |
| [**is\_busday**](https://numpy.org/doc/stable/reference/generated/numpy.is_busday.html#numpy.is_busday)(dates[, weekmask, holidays, …]) | Calculates which of the given dates are valid days, and which are not. |
| [**busday\_offset**](https://numpy.org/doc/stable/reference/generated/numpy.busday_offset.html#numpy.busday_offset)(dates, offsets[, roll, …]) | First adjusts the date to fall on a valid day according to the roll rule, then applies offsets to the given dates counted in valid days. |
| [**busday\_count**](https://numpy.org/doc/stable/reference/generated/numpy.busday_count.html#numpy.busday_count)(begindates, enddates[, …]) | Counts the number of valid days between *begindates* and *enddates*, not including the day of *enddates*. |

# [numpy.ma](https://numpy.org/doc/stable/reference/maskedarray.generic.html)

(Masked array)

# sympy

Symbol()

# sympy.solvers.solveset

nonlinsolve()

# pandas