# Python Lists

mylist = ["apple", "banana", "cherry"]

## List

Lists are used to store multiple items in a single variable.

Lists are one of 4 built-in data types in Python used to store collections of data, the other 3 are [Tuple](https://www.w3schools.com/python/python_tuples.asp), [Set](https://www.w3schools.com/python/python_sets.asp), and [Dictionary](https://www.w3schools.com/python/python_dictionaries.asp), all with different qualities and usage.

Lists are created using square brackets:

### Example

Create a List:

thislist = ["apple", "banana", "cherry"]  
print(thislist)

## List Items

List items are ordered, changeable, and allow duplicate values.

List items are indexed, the first item has index [0], the second item has index [1] etc.

## Ordered

When we say that lists are ordered, it means that the items have a defined order, and that order will not change.

If you add new items to a list, the new items will be placed at the end of the list.

Note: There are some [list methods](https://www.w3schools.com/python/python_lists_methods.asp) that will change the order, but in general: the order of the items will not change.

## Changeable

The list is changeable, meaning that we can change, add, and remove items in a list after it has been created.

## Allow Duplicates

Since lists are indexed, lists can have items with the same value:

### Example

Lists allow duplicate values:

thislist = ["apple", "banana", "cherry", "apple", "cherry"]  
print(thislist)

## List Length

To determine how many items a list has, use the len() function:

### Example

Print the number of items in the list:

thislist = ["apple", "banana", "cherry"]  
print(len(thislist))

## List Items - Data Types

List items can be of any data type:

### Example

String, int and boolean data types:

list1 = ["apple", "banana", "cherry"]  
list2 = [1, 5, 7, 9, 3]  
list3 = [True, False, False]

A list can contain different data types:

### Example

A list with strings, integers and boolean values:

list1 = ["abc", 34, True, 40, "male"]

## type()

From Python's perspective, lists are defined as objects with the data type 'list':

<class 'list'>

### Example

What is the data type of a list?

mylist = ["apple", "banana", "cherry"]  
print(type(mylist))

## The list() Constructor

It is also possible to use the list() constructor when creating a new list.

### Example

Using the list() constructor to make a List:

thislist = list(("apple", "banana", "cherry")) # note the double round-brackets  
print(thislist)

## Python Collections (Arrays)

There are four collection data types in the Python programming language:

* List is a collection which is ordered and changeable. Allows duplicate members.
* [**Tuple**](https://www.w3schools.com/python/python_tuples.asp) is a collection which is ordered and unchangeable. Allows duplicate members.
* [**Set**](https://www.w3schools.com/python/python_sets.asp) is a collection which is unordered, unchangeable\*, and unindexed. No duplicate members.
* [**Dictionary**](https://www.w3schools.com/python/python_dictionaries.asp) is a collection which is ordered\*\* and changeable. No duplicate members.

\*Set items are unchangeable, but you can remove and/or add items whenever you like.

\*\*As of Python version 3.7, dictionaries are ordered. In Python 3.6 and earlier, dictionaries are unordered.

When choosing a collection type, it is useful to understand the properties of that type. Choosing the right type for a particular data set could mean retention of meaning, and, it could mean an increase in efficiency or security.

# Python - Access List Items

## Access Items

List items are indexed and you can access them by referring to the index number:

### Example

Print the second item of the list:

thislist = ["apple", "banana", "cherry"]  
print(thislist[1])

Note: The first item has index 0.

### Negative Indexing

Negative indexing means start from the end

-1 refers to the last item, -2 refers to the second last item etc.

### Example

Print the last item of the list:

thislist = ["apple", "banana", "cherry"]  
print(thislist[-1])

### Range of Indexes

You can specify a range of indexes by specifying where to start and where to end the range.

When specifying a range, the return value will be a new list with the specified items.

### Example

Return the third, fourth, and fifth item:

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[2:5])

Note: The search will start at index 2 (included) and end at index 5 (not included).

Remember that the first item has index 0.

By leaving out the start value, the range will start at the first item:

### Example

This example returns the items from the beginning to, but NOT including, "kiwi":

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[:4])

By leaving out the end value, the range will go on to the end of the list:

### Example

This example returns the items from "cherry" to the end:

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[2:])

### Range of Negative Indexes

Specify negative indexes if you want to start the search from the end of the list:

### Example

This example returns the items from "orange" (-4) to, but NOT including "mango" (-1):

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[-4:-1])

## Check if Item Exists

To determine if a specified item is present in a list use the in keyword:

### Example

Check if "apple" is present in the list:

thislist = ["apple", "banana", "cherry"]  
if "apple" in thislist:  
  print("Yes, 'apple' is in the fruits list")

# Python - Change List Items

## Change Item Value

To change the value of a specific item, refer to the index number:

### Example

Change the second item:

thislist = ["apple", "banana", "cherry"]  
thislist[1] = "blackcurrant"  
print(thislist)

## Change a Range of Item Values

To change the value of items within a specific range, define a list with the new values, and refer to the range of index numbers where you want to insert the new values:

### Example

Change the values "banana" and "cherry" with the values "blackcurrant" and "watermelon":

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "mango"]  
thislist[1:3] = ["blackcurrant", "watermelon"]  
print(thislist)

If you insert more items than you replace, the new items will be inserted where you specified, and the remaining items will move accordingly:

### Example

Change the second value by replacing it with two new values:

thislist = ["apple", "banana", "cherry"]  
thislist[1:2] = ["blackcurrant", "watermelon"]  
print(thislist)

Note: The length of the list will change when the number of items inserted does not match the number of items replaced.

If you insert less items than you replace, the new items will be inserted where you specified, and the remaining items will move accordingly:

### Example

Change the second and third value by replacing it with one value:

thislist = ["apple", "banana", "cherry"]  
thislist[1:3] = ["watermelon"]  
print(thislist)

## Insert Items

To insert a new list item, without replacing any of the existing values, we can use the insert() method.

The insert() method inserts an item at the specified index:

### Example

Insert "watermelon" as the third item:

thislist = ["apple", "banana", "cherry"]  
thislist.insert(2, "watermelon")  
print(thislist)

Note: As a result of the example above, the list will now contain 4 items.

# Python - Add List Items

## Append Items

To add an item to the end of the list, use the append() method:

### Example

Using the append() method to append an item:

thislist = ["apple", "banana", "cherry"]  
thislist.append("orange")  
print(thislist)

## Insert Items

To insert a list item at a specified index, use the insert() method.

The insert() method inserts an item at the specified index:

### Example

Insert an item as the second position:

thislist = ["apple", "banana", "cherry"]  
thislist.insert(1, "orange")  
print(thislist)

Note: As a result of the examples above, the lists will now contain 4 items.

## Extend List

To append elements from another list to the current list, use the extend() method.

### Example

Add the elements of tropical to thislist:

thislist = ["apple", "banana", "cherry"]  
tropical = ["mango", "pineapple", "papaya"]  
thislist.extend(tropical)  
print(thislist)

The elements will be added to the end of the list.

## Add Any Iterable

The extend() method does not have to append lists, you can add any iterable object (tuples, sets, dictionaries etc.).

### Example

Add elements of a tuple to a list:

thislist = ["apple", "banana", "cherry"]  
thistuple = ("kiwi", "orange")  
thislist.extend(thistuple)  
print(thislist)

# Python - Remove List Items

## Remove Specified Item

The remove() method removes the specified item.

### Example

Remove "banana":

thislist = ["apple", "banana", "cherry"]  
thislist.remove("banana")  
print(thislist)

## Remove Specified Index

The pop() method removes the specified index.

### Example

Remove the second item:

thislist = ["apple", "banana", "cherry"]  
thislist.pop(1)  
print(thislist)

If you do not specify the index, the pop() method removes the last item.

### Example

Remove the last item:

thislist = ["apple", "banana", "cherry"]  
thislist.pop()  
print(thislist)

The del keyword also removes the specified index:

### Example

Remove the first item:

thislist = ["apple", "banana", "cherry"]  
del thislist[0]  
print(thislist)

The del keyword can also delete the list completely.

### Example

Delete the entire list:

thislist = ["apple", "banana", "cherry"]  
del thislist

## Clear the List

The clear() method empties the list.

The list still remains, but it has no content.

### Example

Clear the list content:

thislist = ["apple", "banana", "cherry"]  
thislist.clear()  
print(thislist)

# Python - Loop Lists

## Loop Through a List

You can loop through the list items by using a for loop:

### Example

Print all items in the list, one by one:

thislist = ["apple", "banana", "cherry"]  
for x in thislist:  
  print(x)

Learn more about for loops in our [Python For Loops](https://www.w3schools.com/python/python_for_loops.asp) Chapter.

## Loop Through the Index Numbers

You can also loop through the list items by referring to their index number.

Use the range() and len() functions to create a suitable iterable.

### Example

Print all items by referring to their index number:

thislist = ["apple", "banana", "cherry"]  
for i in range(len(thislist)):  
  print(thislist[i])

The iterable created in the example above is [0, 1, 2].

## Using a While Loop

You can loop through the list items by using a while loop.

Use the len() function to determine the length of the list, then start at 0 and loop your way through the list items by refering to their indexes.

Remember to increase the index by 1 after each iteration.

### Example

Print all items, using a while loop to go through all the index numbers

thislist = ["apple", "banana", "cherry"]  
i = 0  
while i < len(thislist):  
  print(thislist[i])  
  i = i + 1

Learn more about while loops in our [Python While Loops](https://www.w3schools.com/python/python_while_loops.asp) Chapter.

## Looping Using List Comprehension

List Comprehension offers the shortest syntax for looping through lists:

### Example

A short hand for loop that will print all items in a list:

thislist = ["apple", "banana", "cherry"]  
[print(x) for x in thislist]

Learn more about list comprehension in the next chapter: [List Comprehension](https://www.w3schools.com/python/python_lists_comprehension.asp).

# Python - List Comprehension

## List Comprehension

List comprehension offers a shorter syntax when you want to create a new list based on the values of an existing list.

Example:

Based on a list of fruits, you want a new list, containing only the fruits with the letter "a" in the name.

Without list comprehension you will have to write a for statement with a conditional test inside:

### Example

fruits = ["apple", "banana", "cherry", "kiwi", "mango"]  
newlist = []  
  
for x in fruits:  
  if "a" in x:  
    newlist.append(x)  
  
print(newlist)

With list comprehension you can do all that with only one line of code:

### Example

fruits = ["apple", "banana", "cherry", "kiwi", "mango"]  
  
newlist = [x for x in fruits if "a" in x]  
  
print(newlist)

## The Syntax

newlist = [expression for item in iterable if condition == True]

The return value is a new list, leaving the old list unchanged.

### Condition

The condition is like a filter that only accepts the items that valuate to True.

### Example

Only accept items that are not "apple":

newlist = [x for x in fruits if x != "apple"]

The condition if x != "apple"  will return True for all elements other than "apple", making the new list contain all fruits except "apple".

The condition is optional and can be omitted:

### Example

With no if statement:

newlist = [x for x in fruits]

### Iterable

The iterable can be any iterable object, like a list, tuple, set etc.

### Example

You can use the range() function to create an iterable:

newlist = [x for x in range(10)]

Same example, but with a condition:

### Example

Accept only numbers lower than 5:

newlist = [x for x in range(10) if x < 5]

### Expression

The expression is the current item in the iteration, but it is also the outcome, which you can manipulate before it ends up like a list item in the new list:

### Example

Set the values in the new list to upper case:

newlist = [x.upper() for x in fruits]

You can set the outcome to whatever you like:

### Example

Set all values in the new list to 'hello':

newlist = ['hello' for x in fruits]

The expression can also contain conditions, not like a filter, but as a way to manipulate the outcome:

### Example

Return "orange" instead of "banana":

newlist = [x if x != "banana" else "orange" for x in fruits]

The expression in the example above says:

"Return the item if it is not banana, if it is banana return orange".

# Python - Sort Lists

## Sort List Alphanumerically

List objects have a sort() method that will sort the list alphanumerically, ascending, by default:

### Example

Sort the list alphabetically:

thislist = ["orange", "mango", "kiwi", "pineapple", "banana"]  
thislist.sort()  
print(thislist)

### Example

Sort the list numerically:

thislist = [100, 50, 65, 82, 23]  
thislist.sort()  
print(thislist)

## Sort Descending

To sort descending, use the keyword argument reverse = True:

### Example

Sort the list descending:

thislist = ["orange", "mango", "kiwi", "pineapple", "banana"]  
thislist.sort(reverse = True)  
print(thislist)

### Example

Sort the list descending:

thislist = [100, 50, 65, 82, 23]  
thislist.sort(reverse = True)  
print(thislist)

## Customize Sort Function

You can also customize your own function by using the keyword argument key = function.

The function will return a number that will be used to sort the list (the lowest number first):

### Example

Sort the list based on how close the number is to 50:

def myfunc(n):  
  return abs(n - 50)  
  
thislist = [100, 50, 65, 82, 23]  
thislist.sort(key = myfunc)  
print(thislist)

## Case Insensitive Sort

By default the sort() method is case sensitive, resulting in all capital letters being sorted before lower case letters:

### Example

Case sensitive sorting can give an unexpected result:

thislist = ["banana", "Orange", "Kiwi", "cherry"]  
thislist.sort()  
print(thislist)

Luckily we can use built-in functions as key functions when sorting a list.

So if you want a case-insensitive sort function, use str.lower as a key function:

### Example

Perform a case-insensitive sort of the list:

thislist = ["banana", "Orange", "Kiwi", "cherry"]  
thislist.sort(key = str.lower)  
print(thislist)

## Reverse Order

What if you want to reverse the order of a list, regardless of the alphabet?

The reverse() method reverses the current sorting order of the elements.

### Example

Reverse the order of the list items:

thislist = ["banana", "Orange", "Kiwi", "cherry"]  
thislist.reverse()  
print(thislist)

# Python - Copy Lists

## Copy a List

You cannot copy a list simply by typing list2 = list1, because: list2 will only be a reference to list1, and changes made in list1 will automatically also be made in list2.

There are ways to make a copy, one way is to use the built-in List method copy().

### Example

Make a copy of a list with the copy() method:

thislist = ["apple", "banana", "cherry"]  
mylist = thislist.copy()  
print(mylist)

Another way to make a copy is to use the built-in method list().

### Example

Make a copy of a list with the list() method:

thislist = ["apple", "banana", "cherry"]  
mylist = list(thislist)  
print(mylist)

# Python - Join Lists

## Join Two Lists

There are several ways to join, or concatenate, two or more lists in Python.

One of the easiest ways are by using the + operator.

### Example

Join two list:

list1 = ["a", "b", "c"]  
list2 = [1, 2, 3]  
  
list3 = list1 + list2  
print(list3)

Another way to join two lists is by appending all the items from list2 into list1, one by one:

### Example

Append list2 into list1:

list1 = ["a", "b" , "c"]  
list2 = [1, 2, 3]  
  
for x in list2:  
  list1.append(x)  
  
print(list1)

Or you can use the extend() method, which purpose is to add elements from one list to another list:

### Example

Use the extend() method to add list2 at the end of list1:

list1 = ["a", "b" , "c"]  
list2 = [1, 2, 3]  
  
list1.extend(list2)  
print(list1)

# Python - List Methods

## List Methods

Python has a set of built-in methods that you can use on lists.

|  |  |
| --- | --- |
| Method | Description |
| [append()](https://www.w3schools.com/python/ref_list_append.asp) | Adds an element at the end of the list |
| [clear()](https://www.w3schools.com/python/ref_list_clear.asp) | Removes all the elements from the list |
| [copy()](https://www.w3schools.com/python/ref_list_copy.asp) | Returns a copy of the list |
| [count()](https://www.w3schools.com/python/ref_list_count.asp) | Returns the number of elements with the specified value |
| [extend()](https://www.w3schools.com/python/ref_list_extend.asp) | Add the elements of a list (or any iterable), to the end of the current list |
| [index()](https://www.w3schools.com/python/ref_list_index.asp) | Returns the index of the first element with the specified value |
| [insert()](https://www.w3schools.com/python/ref_list_insert.asp) | Adds an element at the specified position |
| [pop()](https://www.w3schools.com/python/ref_list_pop.asp) | Removes the element at the specified position |
| [remove()](https://www.w3schools.com/python/ref_list_remove.asp) | Removes the item with the specified value |
| [reverse()](https://www.w3schools.com/python/ref_list_reverse.asp) | Reverses the order of the list |
| [sort()](https://www.w3schools.com/python/ref_list_sort.asp) | Sorts the list |

# Python List Exercises

## Test Yourself With Exercises

Now you have learned a lot about lists, and how to use them in Python.

Are you ready for a test?

Try to insert the missing part to make the code work as expected:

## Exercise:

Print the second item in the fruits list.

fruits = ["apple", "banana", "cherry"]

print(fruits[1])