



Important Python Concepts – in Detail

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Data Types, Data Structures

Help for Python

More Information about Python

<https://docs.python.org/3/>

More information about data types

<https://docs.python.org/3/library/datatypes.html>

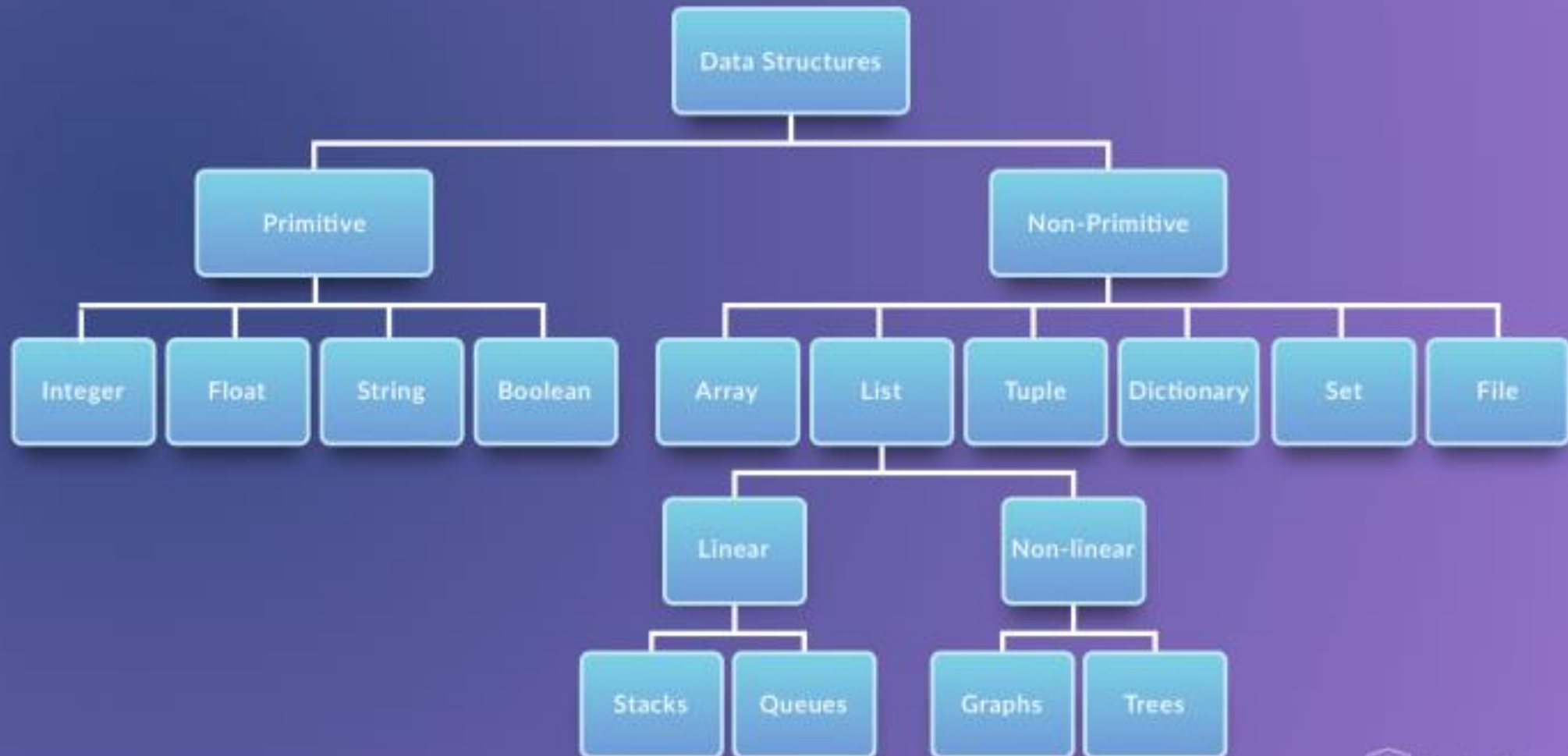
Immutable:

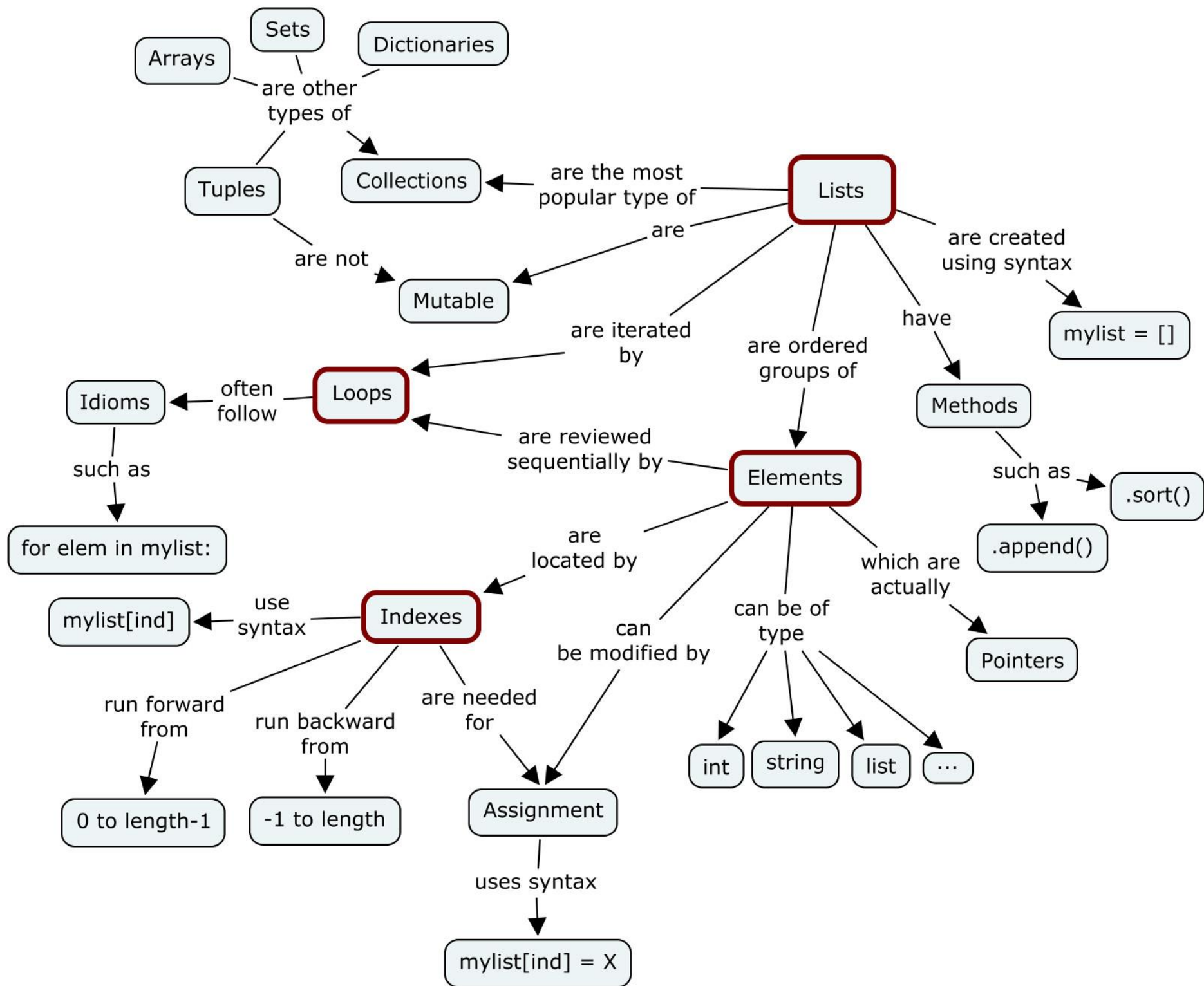
In primitive type, it copies the actual value and therefore changing one value won't change a different variable even if they were used the same root var..

In Python : Tuple is Immutable

Mutable

Non primitive however, only use references and therefore changing one value will change in all the vars that store the same reference...





Tuples are Immutable ?

Python tuples have a surprising trait: they are immutable, but their values may change.

This may happen when a tuple holds a reference to any mutable object, such as a list.

Variables are NOT like boxes where you store data.

<http://radar.oreilly.com/2014/10/python-tuples-immutable-but-potentially-changing.html>

Tuples are Immutable?

What is immutable is the physical content of a tuple, consisting of the object references only. The value of the list referenced by `dum[1]` changed, but the referenced object id is still the same. A tuple has no way of preventing changes to the values of its items, which are independent objects and may be reached through references outside of the tuple, like the skills name we used earlier. Lists and other mutable objects inside tuples may change, but their ids will always be the same.



Types of Data Structures

- String
- Data Structures
 - List
 - Tuple
 - Set
 - Dictionary



String

- Its a sequence of characters
- Single Quotes & Double Quotes are treated similar
- Triple Quotes : doc-string, multiline comments
- Strings are immutable
- Representation & Slicing



String

- Methods :-
 - count
 - index
 - find
 - join
 - isalnum, isalpha, isdigit, islower, isspace, isupper
 - lstrip, rstrip, replace, partition, split, rsplit
 - endswith, startswith



List

- Ordered collections of heterogeneous objects
- Representation is similar to String
- Mutable, can grow and shrink whenever required



List

- Methods :-

- count
- append
- extend
- index
- insert, pop, remove, reverse, sort
- `__add__`, `__contains__`, `__eq__`, `__ge__`,
`__sizeof__`



Tuple

- Ordered collections of heterogenous objects
- Representation is similar to String, List
- Immutable
- Methods :-
 - count
 - index
 - `__mul__`, `__add__`, `__contains__`, `__eq__`,
`__ge__`, `__sizeof__`



Set

- Ordered collections of heterogeneous unique objects
- Representation is similar to String, List but cannot be sliced or accessed using index
- Mutable



Set

- Methods :-
 - add
 - pop
 - clear
 - copy
 - discard v/s remove (raise KeyError)
 - difference, intersection, union



Dictionary

- Unordered collection of key-value pairs
- Representation is similar to String, List but cannot be sliced or accessed using index.
- Mutable



Dictionary

- Methods :-
 - copy
 - fromkeys
 - has_key
 - items
 - keys, values
 - iteritems, iterkeys, itervalues
 - pop, popitem
 - viewitems, viewkeys, viewvalues



Slicing

Slicing : extracting specific set of data from the container.

Lists, Strings & Tuple support Slicing

Reverse Indexing

Formatting for Printing



Format

Basic Formatting-Simple positional formatting is probably the most common use-case

<https://docs.python.org/3.4/library/string.html>

Old

```
'%s %s' % ('one', 'two')
```

New

```
'{} {}'.format('one', 'two')
```

Output

```
o n e   t w o
```

Old

```
'%d %d' % (1, 2)
```

New

```
'{} {}'.format(1, 2)
```




Format

How % string modulo operator works

https://www.python-course.eu/python3_formatted_output.php

(Below is the old style)

```
print("Art: %5d, Price per Unit: %8.2f" % (453, 59.058))
```

A diagram with arrows showing the mapping of format specifiers to arguments. An arrow points from "%5d" to "453". Another arrow points from "%8.2f" to "59.058". A third arrow points from the "%" operator to the opening parenthesis of the tuple.

output

String Modulo Operator

```
Art: 453, Price per Unit: 59.06
```



Format

How % string modulo operator works

https://www.python-course.eu/python3_formatted_output.php

(Below is the old style)

```
print("Art: %5d, Price per Unit: %8.2f" % (453, 59.058))
```

Diagram illustrating the components of the old-style Python string formatting:

- Format String:** The string `"Art: %5d, Price per Unit: %8.2f"` is identified as the format string.
- String Modulo Operator:** The `%` operator is identified as the string modulo operator.
- Tuple with values:** The tuple `(453, 59.058)` is identified as the tuple with values.



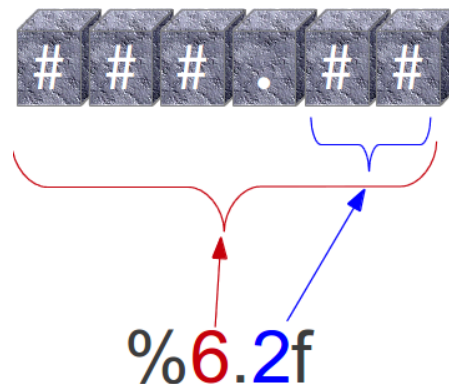
Format

How % string modulo operator works

https://www.python-course.eu/python3_formatted_output.php

(Below is the old style)

The second one "%8.2f" is a format description for a float number. Like other placeholders, it is introduced with the "%" character. This is followed by the total number of digits the string should contain. This number includes the decimal point and all the digits, i.e. before and after the decimal point. Our float number 59.058 has to be formatted with 8 characters. The decimal part of the number or the precision is set to 2, i.e. the number following the "." in our placeholder. Finally, the last character "f" of our placeholder stands for "float".





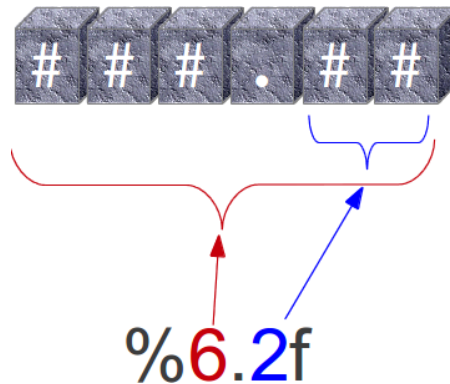
Format

How % string modulo operator works

https://www.python-course.eu/python3_formatted_output.php

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Format

NEW STYLE of Positional Parameter of the format {}

https://www.python-course.eu/python3_formatted_output.php

A positional parameter of the format method can be accessed by placing the index of the parameter after the opening brace, e.g. {0} accesses the first parameter, {1} the second one and so on. The index inside of the curly braces can be followed by a colon and a format string, which is similar to the notation of the string modulo, which we had discussed in the beginning of the chapter of our tutorial, e.g. {0:5d}

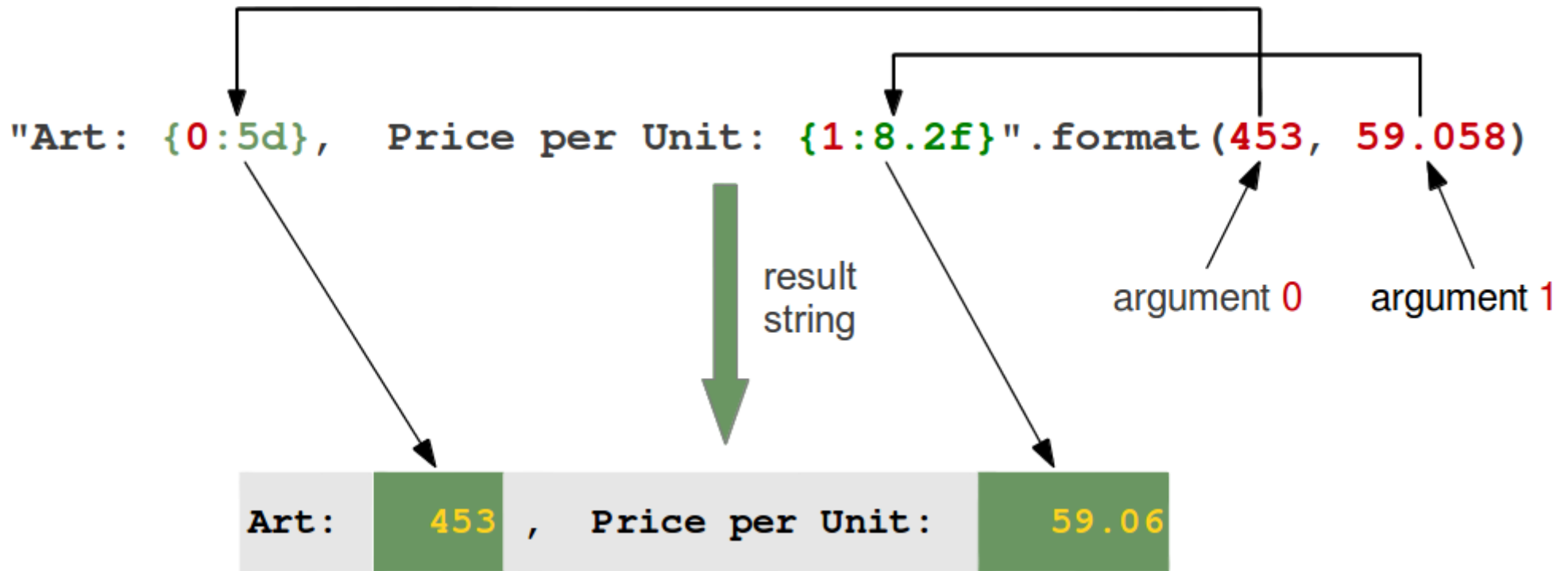
If the positional parameters are used in the order in which they are written, the positional argument specifiers inside of the braces can be omitted, so '{} {} {}' corresponds to '{0} {1} {2}'. But they are needed, if you want to access them in different orders: '{2} {1} {0}'



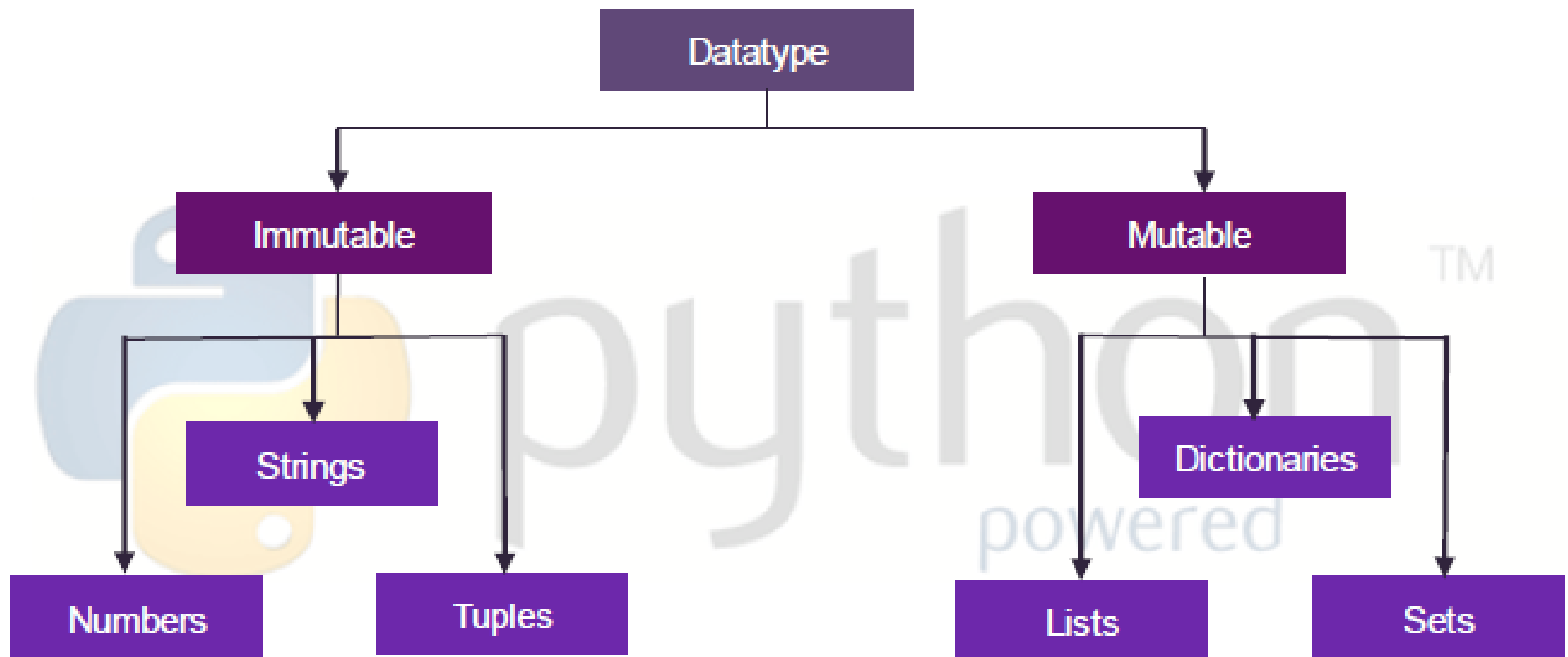
Format

NEW STYLE of Positional Parameter of the format {}

https://www.python-course.eu/python3_formatted_output.php



Immutable Vs Mutable



Mutable vs Immutable Example

Mutable instances is passed by reference.

Immutable instances is passed by value.

Abstract example. Suppose that exist a file named *txtfile* in my HDD. Now, when you ask *txtfile* from me, I can return it in two modes:

1. **Create a shortcut to *txtfile* and pas shortcut to you** (Mutable)
2. **Take a copy for *txtfile* and pas copy to you.**(Immutable)

Mutable vs Immutable Example

1. **Create a shortcut to *txtfile* and pas shortcut to you** (Mutable)

In first mode, returned *txtfile* is a mutable file, because when you do changes in shortcut file, you do changes in original file too. Advantage of this mode is that each returned shortcut required less memory (on RAM or in HDD) and disadvantage is that everyone (not only me, owner) have permissions to modify file content.

Mutable vs Immutable Example

2. Take a copy for *txtfile* and pas copy to you.(Immutable)

In second mode, returned *txtfile* is an immutable file, because all changes in received file does not refer to the original file. Advantage of this mode is that only me (owner) can modify original file and disadvantage is that each returned copy required memory (in RAM or in HDD).

By Val, By Ref

Different way in which ByVal and ByRef
are implemented in Python

(Python has no ByVal and ByRef
Implementation, there is a work around)

Object references are passed by value

Amongst programming languages are pass-by-reference and pass-by-value. Unfortunately, Python is “pass-by-object-reference”, of which it is often said:

“Object references are passed by value.”

Pass by Ref and Pass by Value

pass by reference



fillCup()

pass by value



fillCup()

By Reference

A also changes

It maintains a Reference
to the location

By Value

A doesn't change

Because it maintains a copy

Pass by Ref and Pass by Value

pass by reference



`fillCup()`

pass by value

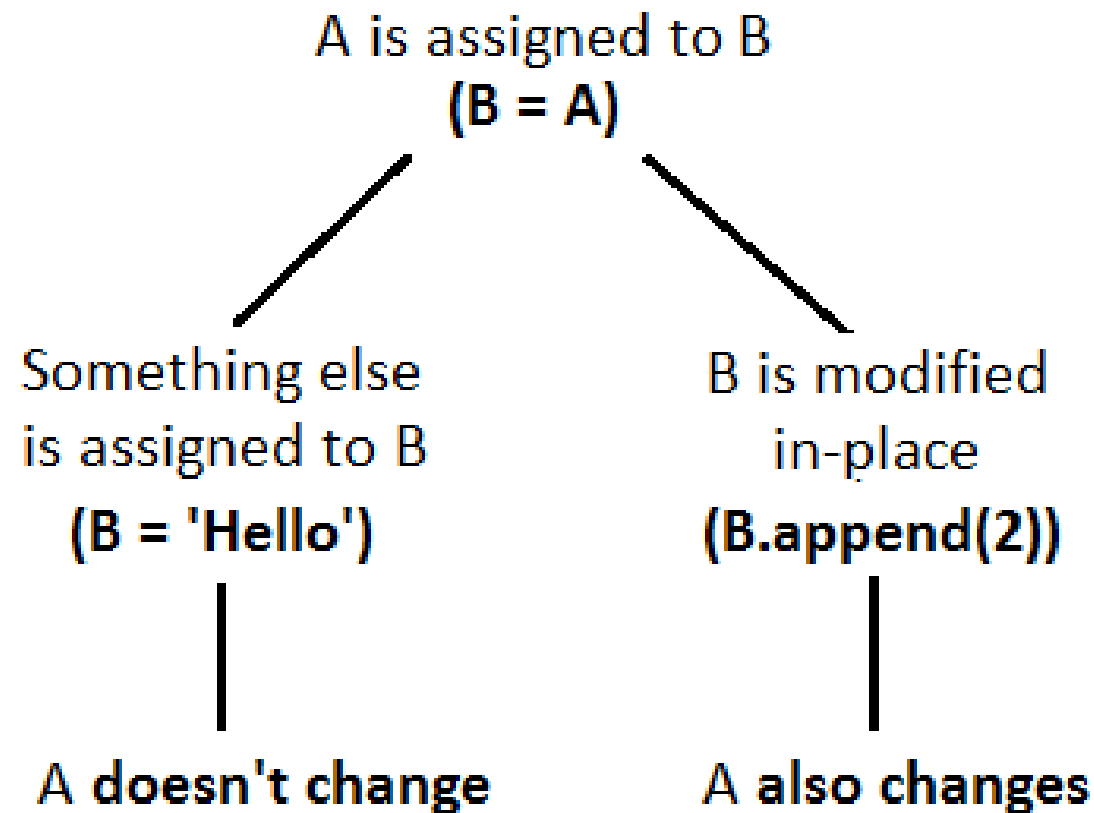


`fillCup()`

Pass by reference means that a number (called a memory address) is passed on, this address defines where the value is stored.

pass by value means the actual value is passed on.

ByVal vs ByRef



By Value

A doesn't change

Because it maintains a copy

By Reference

A also changes

It maintains a Reference to the location

Mutable object : By Reference

If you pass a *mutable* object into a method, the method gets a reference to that same object and you can mutate it to your heart's delight, but if you rebind the reference in the method, the outer scope will know nothing about it, and after you're done, the outer reference will still point at the original object.

Immutable object : By Value

If you pass an *immutable* object to a method, you still can't rebind the outer reference, and you can't even mutate the object.

There are techniques to change the values of Immutable by using the RETURN VALUE

Passing Immutable Objects-7.a

```
def increment(n):
```

```
    n += 1
```

```
    #though we are increment n+1 there is no  
    change in the data
```

```
a = 3
```

```
increment(a)
```

```
print(a)
```

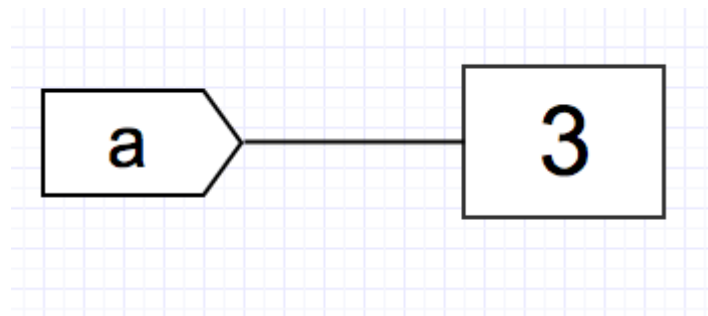
```
#Output
```

```
#a = 3  # a is still referring to the same object
```

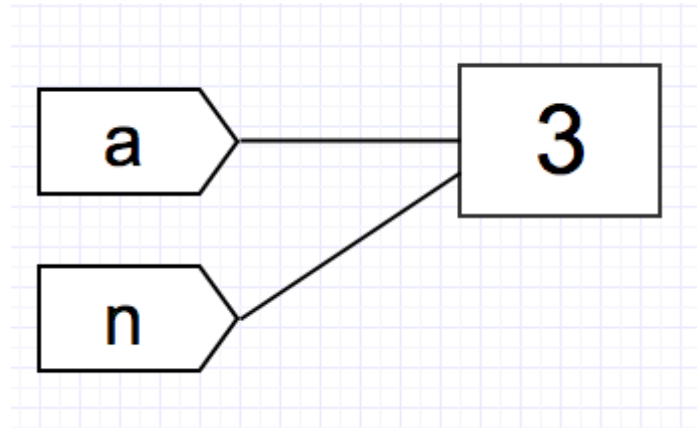
Immutable Int-7.a

You may be wondering: if functions in Python can modify the value in place, then why is it that the value of `a` remains unchanged? Let's parse this out:

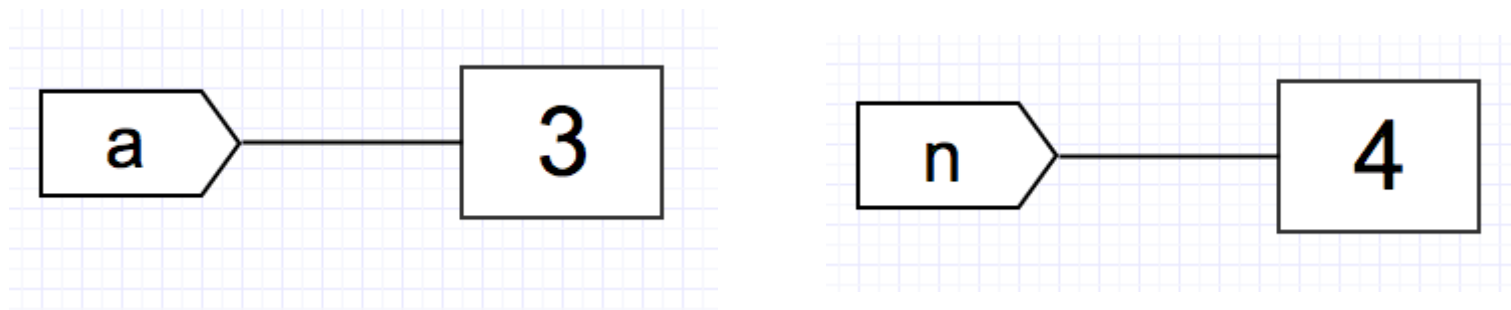
With `a = 3`, we have the variable `a` referring to the object with value 3:



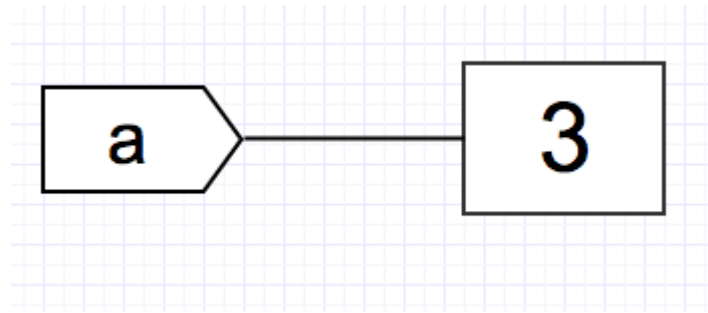
When we pass `a` to `increment(n)`, the function has the local variable `n` referred to the same object:



Now comes the interesting part: `n += 1`. Since integer is **immutable, by definition** we are not able to modify the object's value to 4 in place: we must *create a new object* with the value 4. We may visualize it like below:



All this time, the variable *a* continues to refer to the object with the value 3, since we did not change the reference:



...which explains why the value of *a* does not change after calling `increment()`.

Change the values of Immutable by using the RETURN VALUE(by Ref) -7.b

Does that mean we will never be able to manipulate immutable objects by passing it to functions? Turns out, we can still “modify” immutable objects by ***capturing the return of the function. (thus making it MUTABLE NOW)***

#7.b)Immutable-ByRef-Value is changed by using the return value

```
def increment2(n):
```

```
    n += 1
```

```
    return n
```

```
a = 3
```

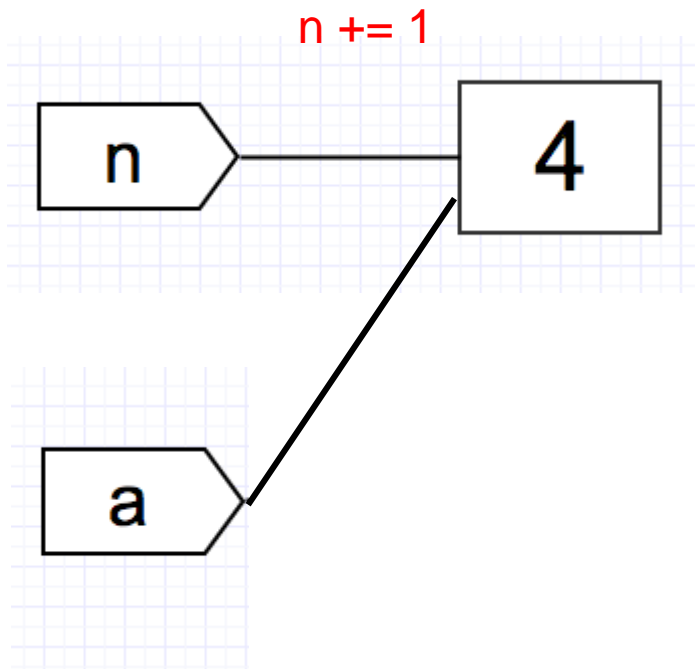
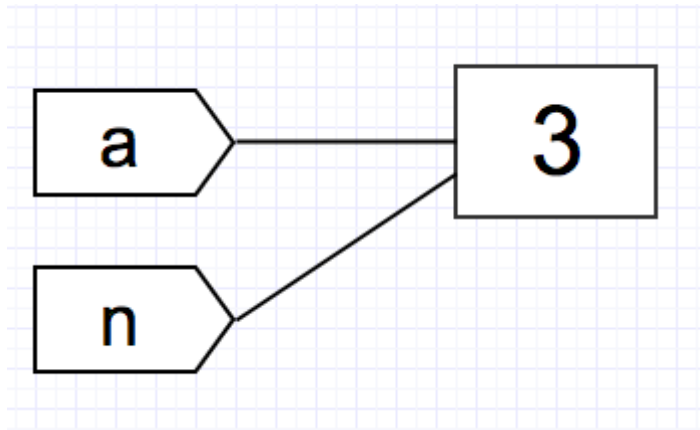
```
a = increment2(a)
```

```
# the return value of increment2() is captured!
```

```
print(a)
```

```
#Output#a = 4  # a now refers to the new object  
                created by the function
```

Return: reassigns a



“a” now points to the new object that is created by n

7.b

By assigning the return value of the function to **a**, we have reassigned **a** to refer to the new object with the value 4 created in the function.

Note the object **a** initially referred to never change—it is still 3—but by having a point to a new object created by the function, we are able to “modify” the value of **a**.

Lists are Mutable

Using Mutable and Immutable
concepts using Lists

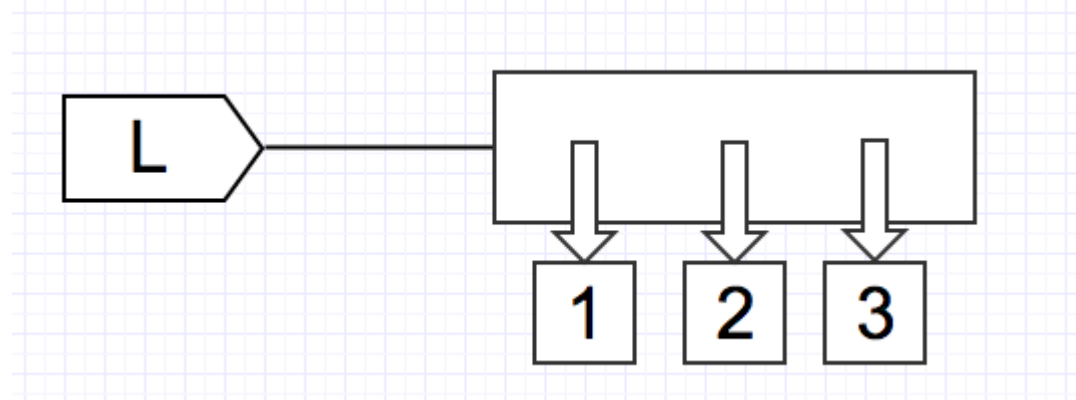
7.C -Passing Mutable Objects- By Ref-Change

The same increment() function generates a different result when we passing a mutable object: The value is changed by using **append**

```
>>> def increment(n):  
...   n.append([4])  
  
>>> L = [1, 2, 3]  
>>> increment(L)  
>>> print(L)  
L = [1, 2, 3, 4] # a changed!
```

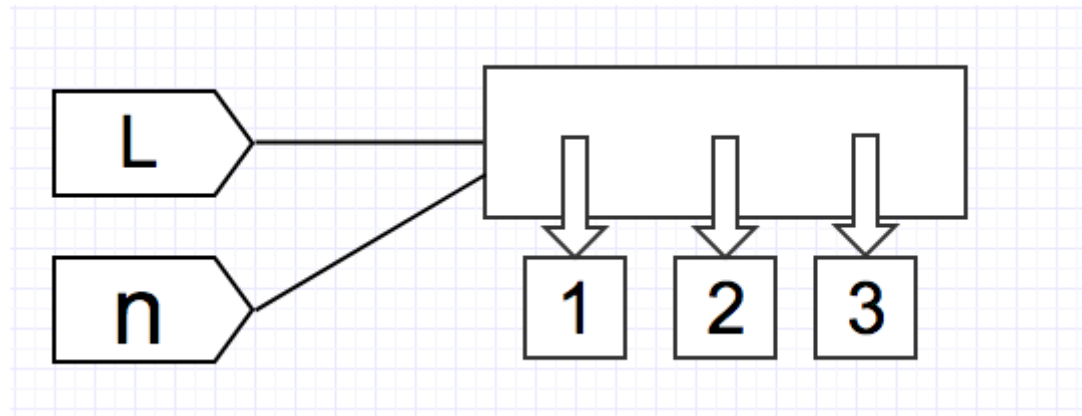
7.C -Passing Mutable Objects- By Ref-Change

The code `L = [1, 2, 3]` has the variable `L` refer to the list object containing references to three immutable objects: integer 1, 2, and 3.



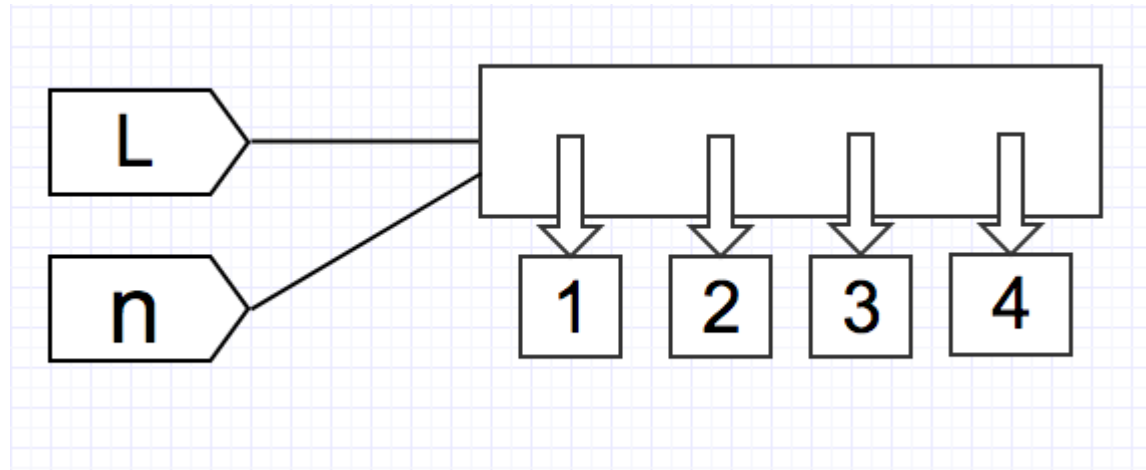
7.C -Passing Mutable Objects- By Ref-Change

As usual, when we pass L to increment(), the function has the local variable n refer to the same object as L:



7.C -Passing Mutable Objects- By Ref-Change

The `.append()` method modifies the list in place, since list is mutable:



Since no new object is created and the change occurred in place of the object, when we print `L`, we get the modified list.

7.d -Passing Mutable Objects- By Value-No Change

```
>>> def assign_value(n, v):  
... n = v
```

```
>>> L1 = [1, 2, 3]
```

```
>>> L2 = [4, 5, 6]
```

```
>>> assign_value(L1, L2)
```

```
>>> print(L1)
```

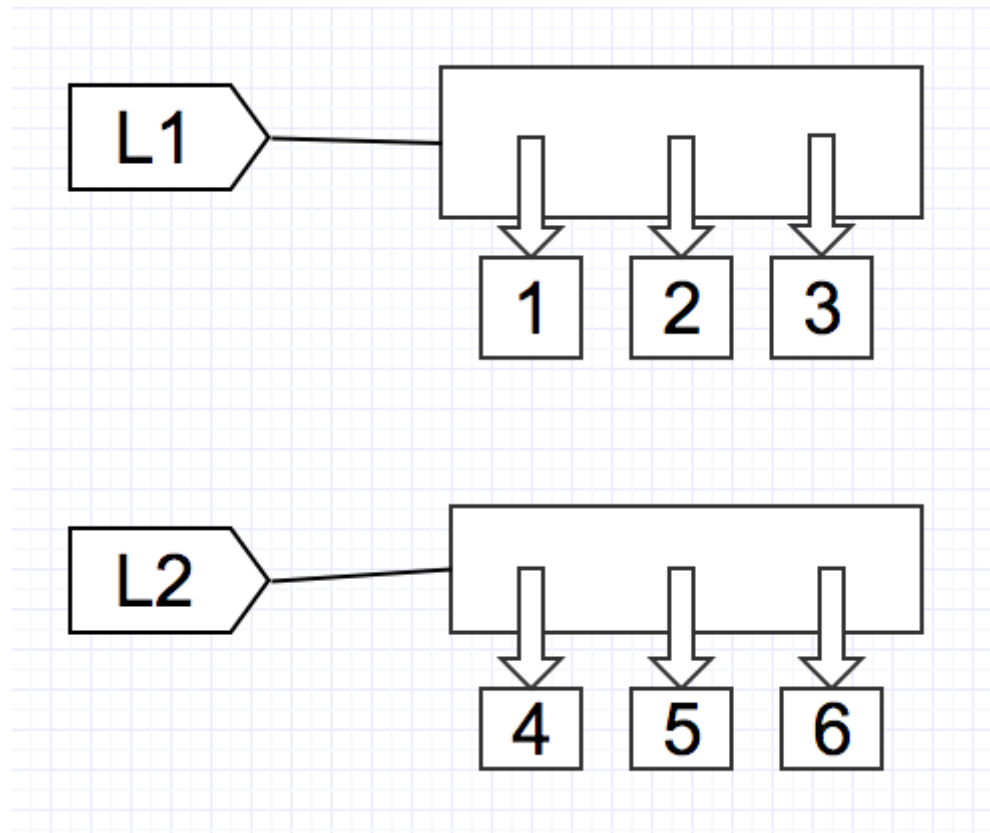
```
>>> print(L2)
```

```
L1 = [1, 2, 3]
```

```
L2 = [4, 5, 6]
```

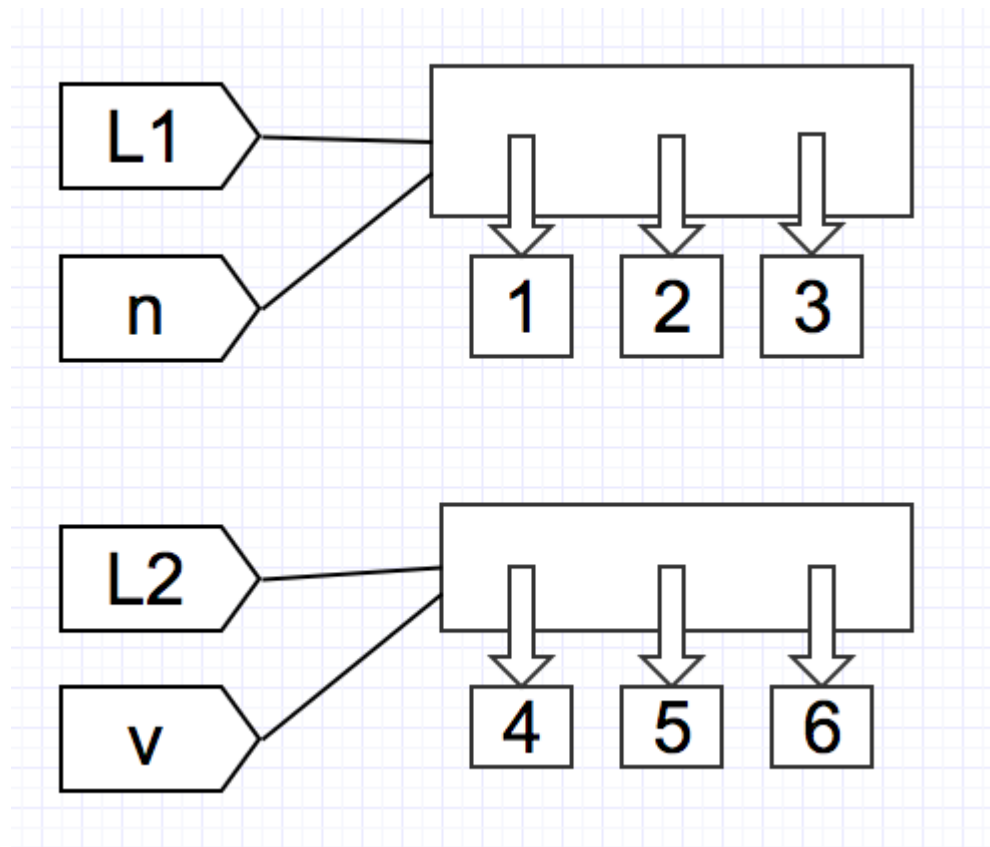
7.d -Passing Mutable Objects- By Value-No Change

the lists look like this:



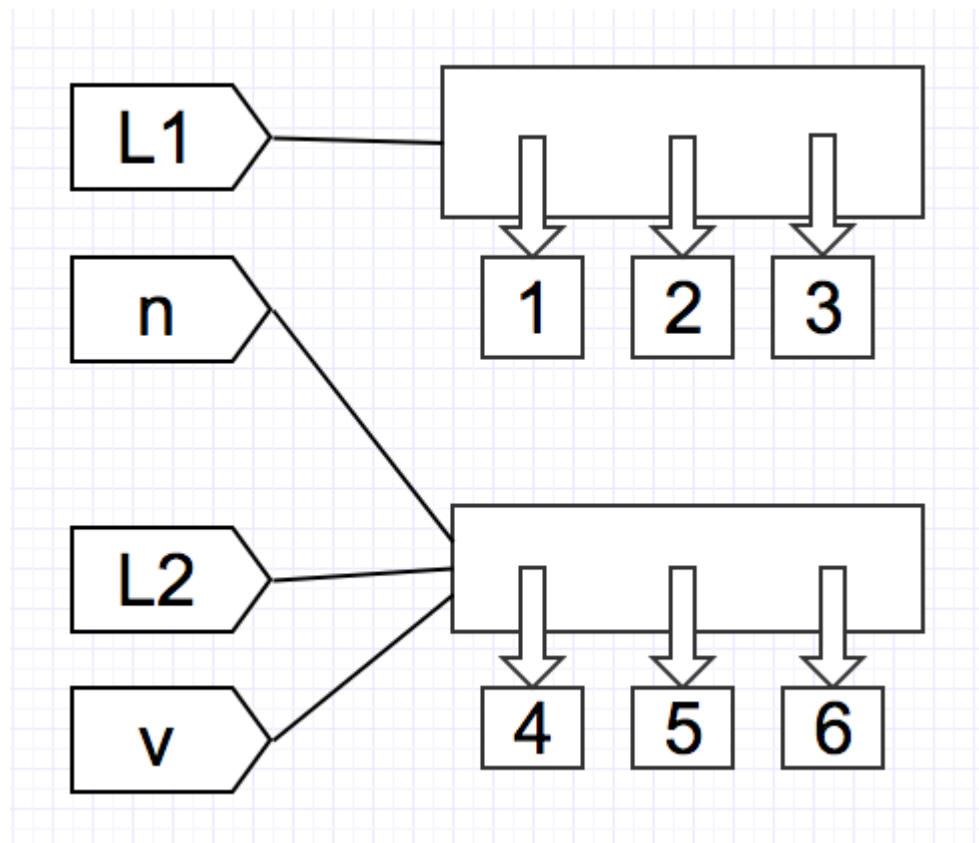
7.d -Passing Mutable Objects- By Value-No Change

When we pass them to `assign_value(n, v)`, the function has `n`, `v`, refer to `L1`, `L2` respectively:



7.d -Passing Mutable Objects- By Value-No Change

However, since the function body has $n = v$, this reassigns n to refer to what v refers to (which is L2):



7.d -Passing Mutable Objects- By Value-No Change

At the end, both n , L2, and v refer to the list [4, 5, 6], while L1 refers to [1, 2, 3].

End

03 July 2020