Tuples in Python

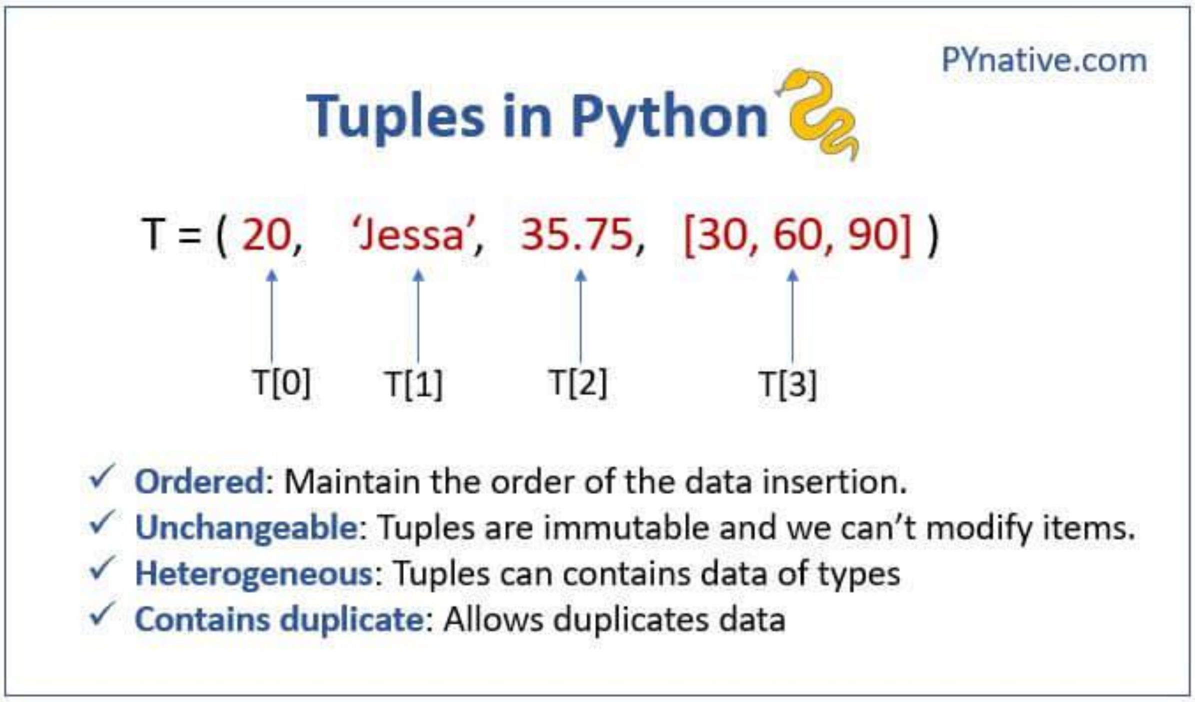
n this article, you will learn how to use a tuple data structure in Python. Also, learn how to create, access, and modify a tuple in Python and all other operations we can perform on a tuple.

What is a Tuple

Tuples are ordered collections of heterogeneous data that are unchangeable. Heterogeneous means tuple can store variables of all types.

Tuple has the following characteristics

- **Ordered**: Tuples are part of sequence data types, which means they hold the order of the data insertion. It maintains the index value for each item.
- **Unchangeable**: Tuples are unchangeable, which means that we cannot add or delete items to the tuple after creation.
- **Heterogeneous**: Tuples are a sequence of data of different data types (like integer, float, list, string, etc;) and can be accessed through indexing and slicing.
- **Contains Duplicates**: Tuples can contain duplicates, which means they can have items with the same value.


PYnative.com
Tuples in Python
T = (20, 'Jessa', 35.75, [30, 60, 90])
T[0]
T[1]
T[2]
T[3]
✓ Ordered: Maintain the order of the data insertion.
✓ Unchangeable: Tuples are immutable and we can't modify items.
✓ Heterogeneous: Tuples can contains data of types
✓ Contains duplicate: Allows duplicates data

Creating a Tuple

We can create a tuple using the two ways

1. **Using parenthesis ():** A tuple is created by enclosing comma-separated items inside rounded brackets.
2. Using a `tuple()` constructor: Create a tuple by passing the comma-separated items inside the `tuple()`.

Example

A tuple can have items of different data type integer, float, list, string, etc;

```
# create a tuple using ()
# number tuple
number_tuple = (10, 20, 25.75)
print(number_tuple)
# Output (10, 20, 25.75)

# string tuple
string_tuple = ('Jessa', 'Emma', 'Kelly')
print(string_tuple)
# Output ('Jessa', 'Emma', 'Kelly')

# mixed type tuple
sample_tuple = ('Jessa', 30, 45.75, [25, 78])
print(sample_tuple)
```

```
# Output ('Jessa', 30, 45.75, [25, 78])

# create a tuple using tuple() constructor
sample_tuple2 = tuple(('Jessa', 30, 45.75, [23, 78]))
print(sample_tuple2)
# Output ('Jessa', 30, 45.75, [23, 78])
```

As we can see in the above output, the different items are added in the tuple like integer, string, and list.

Create a tuple with a single item

A single item tuple is created by enclosing one item inside parentheses followed by a comma. If the tuple time is a string enclosed within parentheses and not followed by a comma, Python treats it as a `str` type. Let us see this with an example.

```
# without comma
single_tuple = ('Hello')
print(type(single_tuple))
# Output class 'str'
print(single_tuple)
# Output Hello

# with comma
single_tuple1 = ('Hello',)
# output class 'tuple'
print(type(single_tuple1))
# Output ('Hello',)
print(single_tuple1)
```

As we can see in the above output the first time, we did not add a comma after the “Hello”. So the variable type was class `str`, and the second time it was a class `tuple`.

Packing and Unpacking

A tuple can also be created without using a `tuple()` constructor or enclosing the items inside the parentheses. It is called the variable “Packing.”

In Python, we can create a tuple by packing a group of variables. Packing can be used when we want to collect multiple values in a single variable. Generally, this operation is referred to as tuple packing.

Similarly, we can unpack the items by just assigning the tuple items to the same number of variables. This process is called "Unpacking."

Let us see this with an example.

```
# packing variables into tuple
tuple1 = 1, 2, "Hello"
# display tuple
print(tuple1)
# Output (1, 2, 'Hello')

print(type(tuple1))
# Output class 'tuple'

# unpacking tuple into variable
i, j, k = tuple1
# printing the variables
print(i, j, k)
# Output 1 2 Hello
```

As we can see in the above output, three tuple items are assigned to individual variables i, j, k, respectively.

In case we assign fewer variables than the number of items in the tuple, we will get the value error with the message too many values to unpack

Length of a Tuple

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We can find the length of the tuple using the `len()` function. This will return the number of items in the tuple.

```
tuple1 = ('P', 'Y', 'T', 'H', 'O', 'N')
# length of a tuple
print(len(tuple1))
# Output 6
```

Iterating a Tuple

We can iterate a tuple using a for loop Let us see this with an example.

```
# create a tuple
sample_tuple = tuple((1, 2, 3, "Hello", [4, 8, 16]))
# iterate a tuple
for item in sample_tuple:
    print(item)
```

Output

```
1

2

3

Hello

[4, 8, 16]
```

As we can see in the above output we are printing each and every item in the tuple using a loop.

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Accessing items of a Tuple

Tuple can be accessed through indexing and slicing. This section will guide you by accessing tuple using the following two ways

- **Using indexing**, we can access any item from a tuple using its index number
- **Using slicing**, we can access a range of items from a tuple

Indexing

A tuple is an ordered sequence of items, which means they hold the order of the data insertion. It maintains the index value for each item.

We can access an item of a tuple by using its index number inside the index operator `[]` and this process is called **“Indexing”**.

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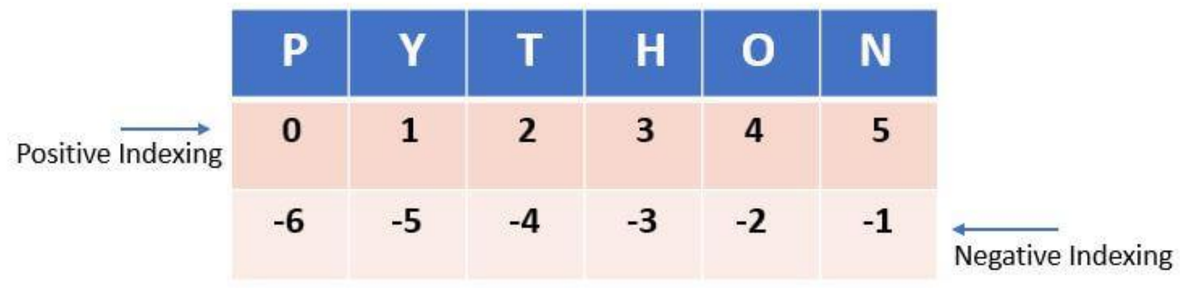
Note:

- As tuples are ordered sequences of items, the index values start from 0 to the tuple’s length.
- Whenever we try to access an item with an index more than the tuple’s length, it will throw the `'Index Error'`.
- Similarly, the index values are always integer. If we give any other type, then it will throw `Type Error`.



P	Y	T	H	O	N
0	1	2	3	4	5
-6	-5	-4	-3	-2	-1

In the above image, we can see that the index values start from zero and it goes till the last item whose index value will be `len(tuple) - 1` .

```
tuple1 = ('P', 'Y', 'T', 'H', 'O', 'N')
for i in range(4):
    print(tuple1[i])
```

Output

```
P

Y
```

```
T

H
```

As seen in the above example, we print the tuple’s first four items with the indexing.

Note: If we mention the index value greater than the length of a tuple then it will throw an index error.

```
tuple1 = ('P', 'Y', 'T', 'H', 'O', 'N')

# IndexError: tuple index out of range
print(tuple1[7])
```

Also, if you mention any index value other than integer then it will throw Type Error.

```
tuple1 = ('P', 'Y', 'T', 'H', 'O', 'N')

# TypeError: tuple indices must be integers or slices, not float
print(tuple1[2.0])
```

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Negative Indexing

The index values can also be negative, with the last but the first items having the index value as -1 and second last -2 and so on.

For example, We can access the last item of a tuple using `tuple_name[-1]`.

Let’s do two things here

- Access tuple items using the negative index value
- Iterate tuple using negative indexing

Example

```
tuple1 = ('P', 'Y', 'T', 'H', 'O', 'N')
```

```
# Negative indexing
# print last item of a tuple
print(tuple1[-1])  # N
# print second last
print(tuple1[-2])  # O

# iterate a tuple using negative indexing
for i in range(-6, 0):
    print(tuple1[i], end=", ")
# Output P, Y, T, H, O, N,
```

Slicing a tuple

We can even specify a range of items to be accessed from a tuple using the technique called ‘Slicing.’ The operator used is `':'`.

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We can specify the start and end values for the **range of items to be accessed from the tuple**. The output will be a tuple, and it includes the range of items with the index values from the start till the end of the range. The end value item will be excluded.

We should keep in mind that the index value always starts with a 0.

For easy understanding, we will be using an integer tuple with values from 0 to 9 similar to how an index value is assigned.

```
tuple1 = (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

# slice a tuple with start and end index number
print(tuple1[1:5])
# Output (1, 2, 3, 4)
```

As seen in the above output the values starting from 1 to 4 are printed. Here the last value in the range 5 is excluded.

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Note:

- If the start value is not mentioned while slicing a tuple, then the values in the tuples start from the first item until the end item in the range. Again the end item in the range will be excluded.

- Similarly, we can mention a slicing range without the end value. In that case, the item with the index mentioned in the start value of the range till the end of the tuple will be returned.

Example

```
tuple1 = (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

# slice a tuple without start index
print(tuple1[:5])
# Output (0, 1, 2, 3, 4)

# slice a tuple without end index
print(tuple1[6:])
# Output (6, 7, 8, 9, 10)
```

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Similarly, we can slice tuple using negative indexing as well. The last but first item will have the index -1.

```
tuple1 = (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

# slice a tuple using negative indexing
print(tuple1[-5:-1])
# Output (6, 7, 8, 9)
```

Here we can see that the items with the negative indexes starting from -1 till -4 are printed excluding -5.

Finding an item in a Tuple

We can search for a certain item in a tuple using the `index()` method and it will return the position of that particular item in the tuple.

The `index()` method accepts the following three arguments

1. **item** – The item which needs to be searched
2. **start** – (Optional) The starting value of the index from which the search will start
3. **end** – (Optional) The end value of the index search

Example

```
tuple1 = (10, 20, 30, 40, 50)

# get index of item 30
position = tuple1.index(30)
print(position)
# Output 2
```

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As seen in the above output the index value of item 30 is printed.

Find within a range

We can mention the start and end values for the `index()` method so that our search will be limited to those values.

Example

```
tuple1 = (10, 20, 30, 40, 50, 60, 70, 80)
# Limit the search locations using start and end
# search only from location 4 to 6
# start = 4 and end = 6
# get index of item 60
position = tuple1.index(60, 4, 6)
print(position)
# Output 5
```

As seen in the above output we have limited the search from the index position 4 to 6 as the number 60 is present in this range only. In case we mention any item that is not present then it will throw a value error.

```
tuple1 = (10, 20, 30, 40, 50, 60, 70, 80)
#index out of range
position= tuple1 .index(10)
print(postion)
# Output ValueError: tuple.index(x): x not in tuple
```

Checking if an item exists

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We can check whether an item exists in a tuple by using the `in` operator. This will return a boolean `True` if the item exists and `False` if it doesn't.

```
tuple1 = (10, 20, 30, 40, 50, 60, 70, 80)
# checking whether item 50 exists in tuple
print(50 in tuple1)
# Output True
print(500 in tuple1)
# Output False
```

As seen in the above output we can see that the item '50' exists in the tuple so we got `True` and '500' doesn't and so we got `False`.

Adding and changing items in a Tuple

A list is a mutable type, which means we can add or modify values in it, but tuples are immutable, so they cannot be changed.

Also, because a tuple is immutable there are no built-in methods to add items to the tuple.

If you try to modify the value you will get an error.

Example

```
tuple1 = (0, 1, 2, 3, 4, 5)
tuple1[1] = 10
# Output TypeError: 'tuple' object does not support item assignment
```

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As a workaround solution, we can convert the tuple to a list, add items, and then convert it back to a tuple. As tuples are ordered collection like lists the items always get added in the end.

```
tuple1 = (0, 1, 2, 3, 4, 5)

# converting tuple into a list
sample_list = list(tuple1)
# add item to list
sample_list.append(6)
```

```
# converting list back into a tuple
tuple1 = tuple(sample_list)
print(tuple1)
# Output (0, 1, 2, 3, 4, 5, 6)
```

As we can see in the above output the item is added to the tuple in the end.

Modify nested items of a tuple

One thing to remember here, If one of the items is itself a mutable data type as a list, then we can change its values in the case of a nested tuple.

For example, let's assume you have the following tuple which has a list as its last item and you wanted to modify the list items.

```
tuple1 = (10, 20, [25, 75, 85])
```

Let's see how to modify the set item if it contains mutable types.

Example

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```
tuple1 = (10, 20, [25, 75, 85])
# before update
print(tuple1)
# Output (10, 20, [25, 75, 85])

# modify last item's first value
tuple1[2][0] = 250
# after update
print(tuple1)
# Output (10, 20, [250, 75, 85])
```

As tuples are immutable we cannot change the values of items in the tuple. Again with the same workaround we can convert it into a list, make changes and convert it back into a tuple.

```
tuple1 = (0, 1, 2, 3, 4, 5)

# converting tuple into a list
```

```
sample_list = list(tuple1)
# modify 2nd item
sample_list[1] = 10

# converting list back into a tuple
tuple1 = tuple(sample_list)
print(tuple1)
# Output (0, 10, 2, 3, 4, 5)
```

As we can see in the above output the last item has been updated from 3 to 11.

Removing items from a tuple

Tuples are immutable so there are no `pop()` or `remove()` methods for the tuple. We can remove the items from a tuple using the following two ways.

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1. Using del keyword
2. By converting it into a list

Using del keyword

The `del` keyword will delete the entire tuple.

```
sampletup1 =(0,1,2,3,4,5,6,7,8,9,10)
del sampletup1

print(sampletup1)
```

Output

```
      3

----> 4 print(sampletup1)



NameError: name 'sampletup1' is not defined
```

AD

As seen in the above output we are getting error when we try to access a deleted tuple.

By converting it into a List

We can convert a tuple into a list and then remove any one item using the `remove()` method. Then again we will convert it back into a tuple using the `tuple()` constructor.

```
tuple1 = (0, 1, 2, 3, 4, 5)

# converting tuple into a list
sample_list = list(tuple1)
# reomve 2nd item
sample_list.remove(2)

# converting list back into a tuple
tuple1 = tuple(sample_list)
print(tuple1)
# Output (0, 1, 3, 4, 5)
```

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As seen in the above output item 3 has been removed from the tuple.

Count the occurrence of an item in a tuple

As we learned, a tuple can contain duplicate items. To determine how many times a specific item occurred in a tuple, we can use the `count()` method of a tuple object.

The `count()` method accepts any value as a parameter and returns the number of times a particular value appears in a tuple.

Example

```
tuple1 = (10, 20, 60, 30, 60, 40, 60)
# Count all occurrences of item 60
count = tuple1.count(60)
print(count)
# Output 3

count = tuple1.count(600)
```

```python
print(count)
# Output 0
```

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Copying a tuple

We can create a copy of a tuple using the assignment operator `'='` . This operation will create only a reference copy and not a deep copy because tuples are immutable.

```python
tuple1 = (0, 1, 2, 3, 4, 5)

# copy tuple
tuple2 = tuple1
print(tuple2)
# Output (0, 1, 2, 3, 4, 5)

# changing tuple2
# converting it into a list
sample_list = list(tuple2)
sample_list.append(6)

# converting list back into a tuple2
tuple2 = tuple(sample_list)

# printing the two tuples
print(tuple1)
# Output (0, 1, 2, 3, 4, 5)
print(tuple2)
# Output (0, 1, 2, 3, 4, 5, 6)
```

AD

As we can see in the above output the tuple1 is not affected by the changes made in tuple2.

Concatenating two Tuples

We can concatenate two or more tuples in different ways. One thing to note here is that tuples allow duplicates, so if two tuples have the same item, it will be repeated twice in the resultant tuple. Let us see each one of them with a small example.

Using the `+` operator

We can add two tuples using the + operator. This is a very and straightforward method and the resultant tuple will have items from both the tuples.

```
tuple1 = (1, 2, 3, 4, 5)
tuple2 = (3, 4, 5, 6, 7)

# concatenate tuples using + operator
tuple3 = tuple1 + tuple2
print(tuple3)
# Output (1, 2, 3, 4, 5, 3, 4, 5, 6, 7)
```

As seen in the above output the resultant tuple has items from both the tuples and the item 3, 4, 5 are repeated twice.

Using the sum() function

We can also use the Python built-in function `sum` to concatenate two tuples. But the sum function of two iterables like tuples always needs to start with Empty Tuple. Let us see this with an example.

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```
tuple1 = (1, 2, 3, 4, 5)
tuple2 = (3, 4, 5, 6, 7)

# using sum function
tuple3 = sum((tuple1, tuple2), ())
print(tuple3)
# Output (1, 2, 3, 4, 5, 3, 4, 5, 6, 7)
```

As we can see in the above output the sum function takes an Empty tuple as an argument and it returns the items from both the tuples.

Using the chain() function

The `chain()` function is part of the itertools module in python. It makes an iterator, which will return all the first iterable items (a tuple in our case), which will be followed by the second iterable. We can pass any number of tuples to the chain() function.

```
import itertools

tuple1 = (1, 2, 3, 4, 5)
tuple2 = (3, 4, 5, 6, 7)

# using itertools
tuple3 = tuple(item for item in itertools.chain(tuple1, tuple2))
print(tuple3)
# Output (1, 2, 3, 4, 5, 3, 4, 5, 6, 7)
```

As seen in the above output we can concatenate any number of tuples using the above method and it is more time-efficient than other methods.

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Nested tuples

Nested tuples are tuples within a tuple i.e., when a tuple contains another tuple as its member then it is called a nested tuple.

In order to retrieve the items of the inner tuple we need a nested for loop

```
nested_tuple = ((20, 40, 60), (10, 30, 50), "Python")

# access the first item of the third tuple
print(nested_tuple[2][0])  # P

# iterate a nested tuple
for i in nested_tuple:
    print("tuple", i, "elements")
    for j in i:
        print(j, end=", ")
    print("\n")
```

Output

```
P

tuple (20, 40, 60) items
```

```
20, 40, 60,



tuple (10, 30, 50) items

10, 30, 50,



tuple Python items

P, y, t, h, o, n,
```

Use built-in functions with tuple

min() and max()

As the name suggests the `max()` function returns the maximum item in a tuple and `min()` returns the minimum value in a tuple.

```
tuple1 = ('xyz', 'zara', 'abc')
# The Maximum value in a string tuple
print(max(tuple1))
# Output zara

# The minimum value in a string tuple
print(min(tuple1))
# Output abc

tuple2 = (11, 22, 10, 4)
# The Maximum value in a integer tuple
print(max(tuple2))
# Output 22
# The minimum value in a integer tuple
print(min(tuple2))
# Output 4
```

Note: We can't find the `max()` and `min()` for a heterogeneous tuple (mixed types of items). It will throw `Type Error`

```
tuple3 = ('a', 'e', 11, 22, 15)
# max item
```

```
print(max(tuple3))
```

AD

all()

In the case of `all()` function, the return value will be true only when all the values inside are true. Let us see the different item values and the return values.

Item values in a tuple	Return value
All values are True	True
One or more False values	False
All False values	False
Empty tuple	True

```
# all() with All True values
tuple1 = (1, 1, True)
print(all(tuple1))  # True

# all() All True values
tuple1 = (1, 1, True)
print(all(tuple1))  # True

# all() with One false value
tuple2 = (0, 1, True, 1)
print(all(tuple2))  # False

# all() with all false values
tuple3 = (0, 0, False)
print(all(tuple3))  # False

# all() Empty tuple
tuple4 = ()
print(all(tuple4))  # True
```

any()

The any() method will return true if there is at least one true value. In the case of the empty tuple, it will return false. Let us see the same possible combination of values for `any()` function in a tuple and its return values.

Item values in a tuple	Return value
All values are True	True
One or more False values	True
All False values	False
Empty tuple	False

Similarly, let's see each one of the above scenarios with a small example.

```python
# any() with All True values
tuple1 = (1, 1, True)
print(any(tuple1))  # True

# any() with One false value
tuple2 = (0, 1, True, 1)
print(any(tuple2))  # True

# any() with all false values
tuple3 = (0, 0, False)
print(any(tuple3))  # False

# any() with Empty tuple
tuple4 = ()
print(any(tuple4))  # False
```

When to use Tuple?

As tuples and lists are similar data structures, and they both allow sequential data storage, tuples are often referred to as immutable lists. So the tuples are used for the following requirements instead of lists.

- There are no `append()` or `extend()` to add items and similarly no `remove()` or `pop()` methods to remove items. This ensures that the data is write-protected. As the tuples are Unchangeable, they can be used to represent read-only or fixed data that does not change.
- As they are immutable, they can be used as a key for the dictionaries, while lists cannot be used for this purpose.
- As they are immutable, the search operation is much faster than the lists. This is because the id of the items remains constant.
- Tuples contain heterogeneous (all types) data that offers huge flexibility in data that contains combinations of data types like alphanumeric characters.

Summary of tuples operations

For the following examples, we assume that `t1` and `t2` are tuples, `x`, `i`, `j`, `k`, `n` are integers.

`t1 = (10, 20, 30, 40, 50)` and `t2 = (60, 70, 80, 60)`

Operation	**Description**
`x in t1`	Check if the tuple `t1` contains the item `x`.
`x not in t2`	Check if the tuple `t1` does not contain the item `x`.
`t1 + t2`	Concatenate the tuples `t1` and `t2`. Creates a new tuple containing the items from `t1` and `t2`

Operation	Description
`t1 * 5`	Repeat the tuple `t1` 5 times.
`t1[i]`	Get the item at the index `i`. Example, `t1[2]` is 30
`t1[i:j]`	Tuple slicing. Get the items from index `i` up to index `j` (excluding j) as a tuple. An example `t1` (10, 20)
`t1[i:j:k]`	Tuple slicing with step. Return a tuple with the items from index `i` up to index j taking every An example `t1[0:4:2]` is (10, 30)
`len(t1)`	Returns a count of total items in a tuple
`t2.count(60)`	Returns the number of times a particular item (60) appears in a tuple. Answer is 2
`t1.index(30)`	Returns the index number of a particular item(30) in a tuple. Answer is 2
`t1.index(40, 2, 5)`	Returns the index number of a particular item(30) in a tuple. But search only from index nun
`min(t1)`	Returns the item with a minimum value from a tuple
`max`(t1)	Returns the item with maximum value from a tuple