Sets

A set is an unordered collection of items. Every element is unique (no duplicates) and must be immutable (which cannot be changed). However, the set itself is mutable. We can add or remove items from it. Sets can be used to perform mathematical set operations like union, intersection, symmetric difference etc.

How to create a set?

A set is created by placing all the items (elements) inside curly braces {}, separated by comma or by using the built-in function set(). It can have any number of items and they may be of different types (integer, float, tuple, string etc.). But a set cannot have a mutable element, like list, set or dictionary, as its element.

```
# set of integers
my_set = {1, 2, 3}
print(my_set)

# set of mixed data types
my_set = {1.0, "Hello", (1, 2, 3)}
print(my_set)

# set do not have duplicates
# Output: {1, 2, 3, 4}
my_set = {1,2,3,4,3,2}
print(my_set)

# set cannot have mutable items here [3, 4] is a mutable list If you uncomment line #12,
# this will cause an error.
# TypeError: unhashable type: 'list'

#my_set = {1, 2, [3, 4]}

# we can make set from a list
# Output: {1, 2, 3}
my_set = set([1,2,3,2])
print(my_set)
```

Creating an empty set is a bit tricky.

Empty curly braces {} will make an empty dictionary in Python. To make a set without any elements we use the set() function without any argument.

```
# initialize a with {}
a = {}
# check data type of a
# Output: <class 'dict'>
print(type(a))

# initialize a with set()
a = set()

# check data type of a
# Output: <class 'set'>
print(type(a))
```

How to change a set in Python?

Sets are mutable. But since they are unordered, indexing have no meaning.
We cannot access or change an element of set using indexing or slicing. Set does not support it. We can add single element using the add() method and multiple elements using the update() method. The update() method can take tuples, lists, strings or other sets as its argument. In all cases, duplicates are avoided.

```
# initialize my_set
my_set = {1,3}
print(my_set)
# if you uncomment line 9,
# you will get an error
# TypeError: 'set' object does not support indexing
#my_set[0]
# add an element
# Output: {1, 2, 3}
my_set.add(2)
print(my_set)


# add multiple elements
# Output: {1, 2, 3, 4}
```

```
my_set.update([2,3,4])
print(my_set)

# add list and set
# Output: {1, 2, 3, 4, 5, 6, 8}
my_set.update([4,5], {1,6,8})
print(my_set)
```

output will be:

```
{1, 3}
{1, 2, 3}
{1, 2, 3, 4}
{1, 2, 3, 4, 5, 6, 8}
```

A particular item can be removed from set using methods, discard() and remove(). The only difference between the two is that, while using discard() if the item does not exist in the set, it remains unchanged. But remove() will raise an error in such condition.
The following example will illustrate this.

```
# initialize my_set
my_set = {1, 3, 4, 5, 6}
print(my_set)
# discard an element
# Output: {1, 3, 5, 6}
my_set.discard(4)
print(my_set)

# remove an element
# Output: {1, 3, 5}
my_set.remove(6)
print(my_set)

# discard an element
# not present in my_set
# Output: {1, 3, 5}
my_set.discard(2)
print(my_set)
```

```
# remove an element
# not present in my_set
# If you uncomment line 27,
# you will get an error.
# Output: KeyError: 2

#my_set.remove(2)
```

Similarly, we can remove and return an item using the pop() method.
Set being unordered, there is no way of determining which item will be popped. It is completely arbitrary.
We can also remove all items from a set using clear().

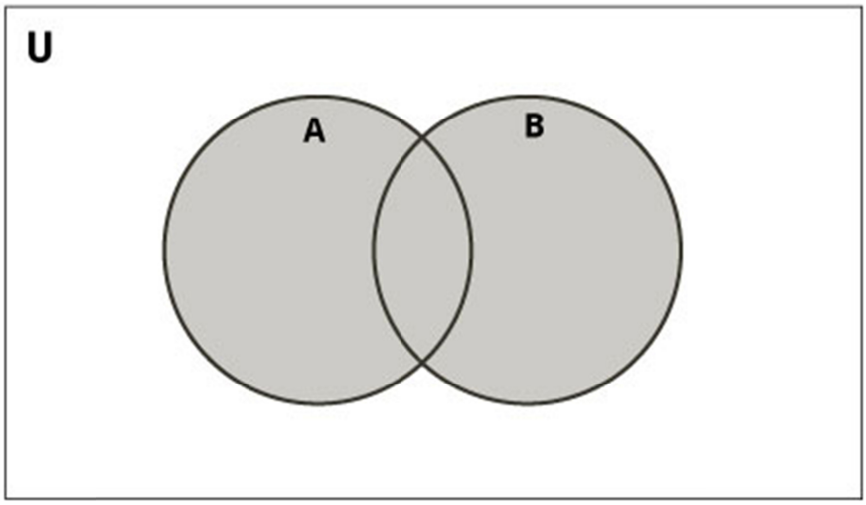
```
# initialize my_set
# Output: set of unique elements
my_set = set("HelloWorld")
print(my_set)

# pop an element
# Output: random element
print(my_set.pop())

# pop another element
# Output: random element
my_set.pop()
print(my_set)

# clear my_set
#Output: set()
my_set.clear()
print(my_set)
```

Python Set Operations

Sets can be used to carry out mathematical set operations like union, intersection, difference and symmetric difference. We can do this with operators or methods.
Let us consider the following two sets for the following operations.

```
>>> A = {1, 2, 3, 4, 5}
>>> B = {4, 5, 6, 7, 8}
```

Set Union

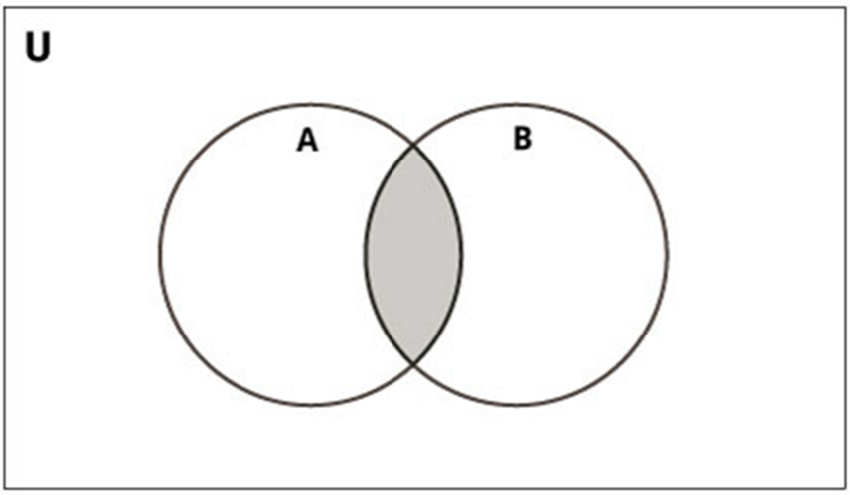


Union of A and B is a set of all elements from both sets.

Union is performed using | operator. Same can be accomplished using the method union().

```
# initialize A and B
A = {1, 2, 3, 4, 5}
B = {4, 5, 6, 7, 8}

# use | operator
# Output: {1, 2, 3, 4, 5, 6, 7, 8}
print(A | B)
# use union function
>>> A.union(B)
{1, 2, 3, 4, 5, 6, 7, 8}

# use union function on B
>>> B.union(A)
{1, 2, 3, 4, 5, 6, 7, 8}
```

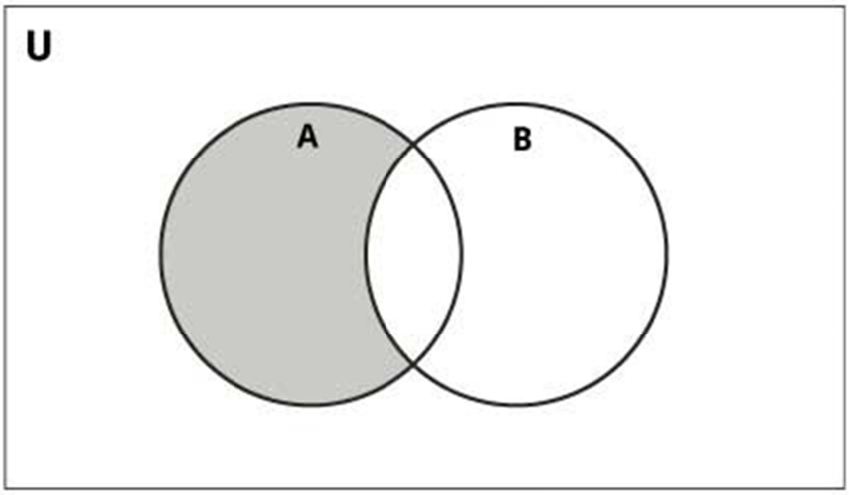
Set Intersection



Intersection of A and B is a set of elements that are common in both sets. Intersection is performed using & operator. Same can be accomplished using the method intersection().

```
# initialize A and B
A = {1, 2, 3, 4, 5}
B = {4, 5, 6, 7, 8}

# use & operator
# Output: {4, 5}
print(A & B)
# use intersection function on A
>>> A.intersection(B)
{4, 5}

# use intersection function on B
>>> B.intersection(A)
{4, 5}
```

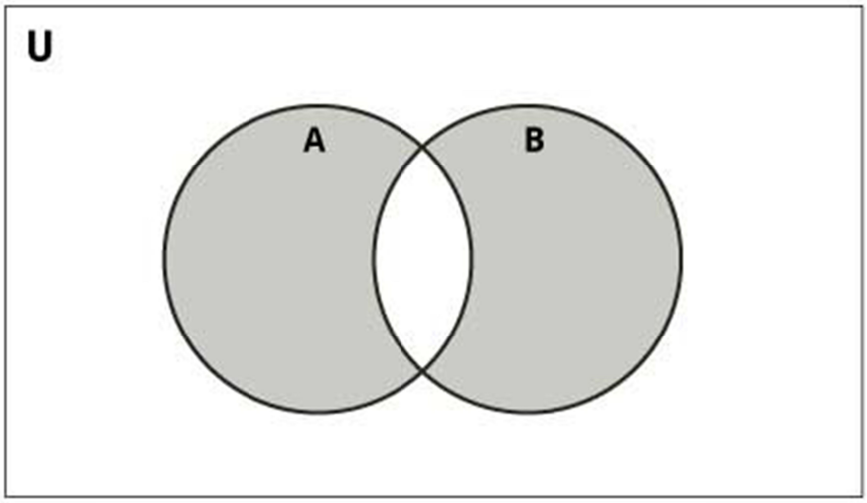
Set Difference



Difference of A and B (A - B) is a set of elements that are only in A but not in B. Similarly, B - A is a set of element in B but not in A.
Difference is performed using - operator. Same can be accomplished using the method difference().

```
# initialize A and B
A = {1, 2, 3, 4, 5}
B = {4, 5, 6, 7, 8}

# use - operator on A
# Output: {1, 2, 3}
print(A - B)

# use difference function on A
>>> A.difference(B)
{1, 2, 3}

# use - operator on B
>>> B - A
{8, 6, 7}

# use difference function on B
>>> B.difference(A)
{8, 6, 7}
```

Set Symmetric Difference



Symmetric Difference of A and B is a set of elements in both A and B except those that are common in both.

Symmetric difference is performed using ^ operator. Same can be accomplished using the method symmetric_difference().

```
# initialize A and B
A = {1, 2, 3, 4, 5}
B = {4, 5, 6, 7, 8}

# use ^ operator
# Output: {1, 2, 3, 6, 7, 8}
print(A ^ B)
# use symmetric_difference function on A
>>> A.symmetric_difference(B)
{1, 2, 3, 6, 7, 8}

# use symmetric_difference function on B
>>> B.symmetric_difference(A)
{1, 2, 3, 6, 7, 8}
```

Different Python Set Methods

There are many set methods, some of which we have already used above. Here is a list of all the methods that are available with set objects.

Method	Description
add()	Adds an element to the set

clear()	Removes all elements from the set
copy()	Returns a copy of the set
difference()	Returns the difference of two or more sets as a new set
difference_update()	Removes all elements of another set from this set
discard()	Removes an element from the set if it is a member. (Do nothing if the element is not in set)
intersection()	Returns the intersection of two sets as a new set
intersection_update()	Updates the set with the intersection of itself and another
isdisjoint()	Returns True if two sets have a null intersection
issubset()	Returns True if another set contains this set
issuperset()	Returns True if this set contains another set
pop()	Removes and returns an arbitary set element. Raise KeyError if the set is empty
remove()	Removes an element from the set. If the element is not a member,raise a KeyError
symmetric_difference()	Returns the symmetric difference of two sets as a new set
symmetric_difference_update()	Updates a set with the symmetric difference of itself and another
union()	Returns the union of sets in a new set
update()	Updates the set with the union of itself and others

Other Set Operations

Set Membership Test

We can test if an item exists in a set or not, using the keyword in.

```
# initialize my_set
my_set = set("apple")

# check if 'a' is present
# Output: True
print('a' in my_set)

# check if 'p' is present
# Output: False
print('p' not in my_set)
```

Iterating Through a Set

Using a for loop, we can iterate though each item in a set.

```
>>> for letter in set("apple"):
...     print(letter)
...
a
p
e
l
```

Built-in Functions with Set

Built-in Functions with Set

Function	Description
all()	Return True if all elements of the set are true (or if the set is empty).
any()	Return True if any element of the set is true. If the set is empty, return False.
enumerate()	Return an enumerate object. It contains the index and value

	of all the items of set as a pair.
len()	Return the length (the number of items) in the set.
max()	Return the largest item in the set.
min()	Return the smallest item in the set.
sorted()	Return a new sorted list from elements in the set (does not sort the set itself).
sum()	Retrun the sum of all elements in the set.

Examples:

1) Write a Python program to create a set.

```
#Create a new empty set
x = set()
print(x)
#Create a non empty set
n = set([0, 1, 2, 3, 4])
print(n)
```

2) Write a Python program to add member(s) in a set.

```
#A new empty set
color_set = set()
color_set.add("Red")
print(color_set)
#Add multiple items
color_set.update(["Blue", "Green"])
print(color_set)
```

Practice Questions on Sets

1) Write a Python program to add member(s) in a set.
2) Write a Python program to remove item(s) from set
3) Write a Python program to remove an item from a set if it is present in the set.

4) Write a Python program to create an intersection of sets
5) Write a Python program to create a union of sets.
6) Write a Python program to create set difference.
7) Write a Python program to create a symmetric difference.
8) Write a Python program to clear a set.
9) Write a Python program to find the length of a set