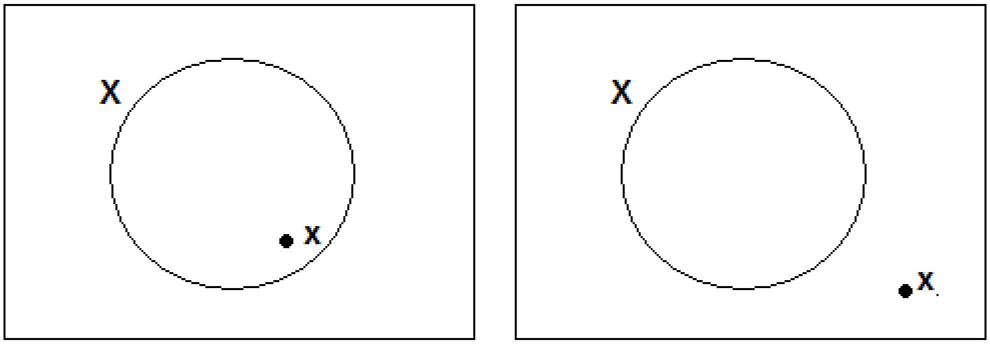
2.1 Basic Set Theory

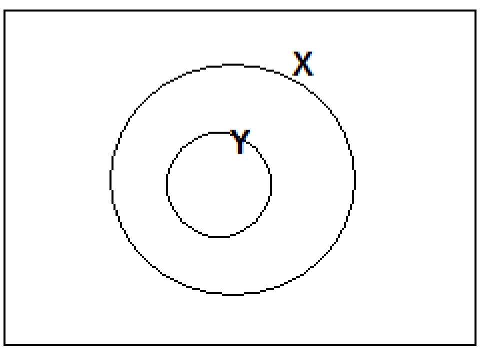
A **set** is a collection of elements where you can always tell whether an element is in the set or not.



In the pictures above X is the set and x is an element. In the picture on the right it is clear that x is not in the set X. In the picture on the left, x is inside the circle so it is clearly in the set.

When an element is in a set it can be written as $\mathbf{x \in X}$.

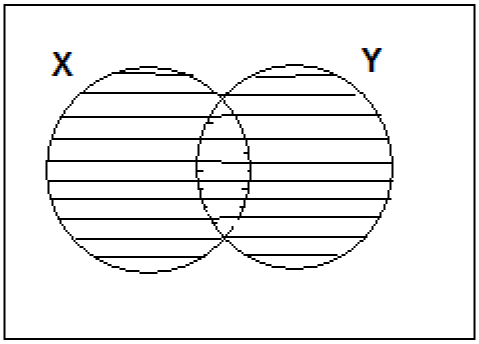
A set is a **subset** of another if all of its elements are also in that other set.



In the picture above, all of the elements that are in set Y are also in set X. This makes Y a subset of X. This can be written as $\mathbf{Y \subseteq X}$.

2.1.1 Union

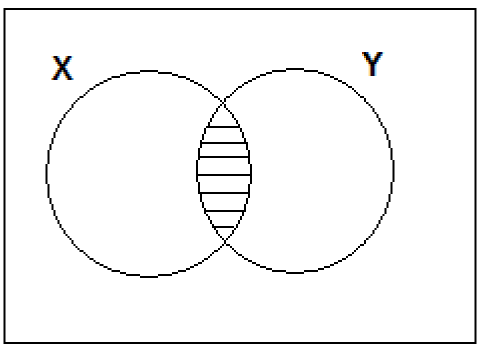
The **union** is the set including all the elements in one set and all the elements in another set.



The shaded region in the picture above includes all the elements in set X and all the elements in set Y so it represents the union.
This can be written as **X** ∪ **Y**.

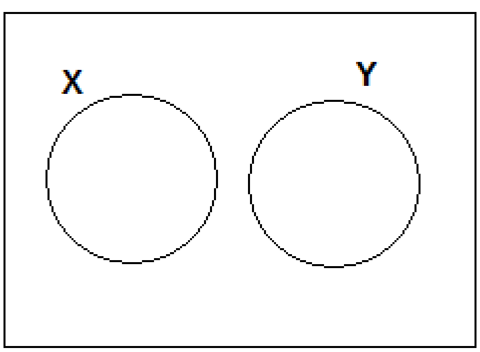
2.1.2 Intersection

The **intersection** is the set of elements that are in all of the given sets at the same time.



The shaded region in the picture above includes only the elements that are in both set X and set Y, the intersection.
This can be written as **X ∩ Y.**

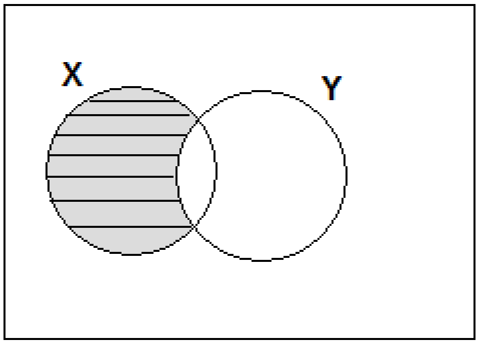
An **empty set** is a set that contains no elements



Neither set X nor set Y have any elements in them. Both are empty sets.
An empty can be written as **Ø.**

2.1.3 Complement

When given two sets, the **compliment** is the set that contains all the elements that are in one set, but not the other.



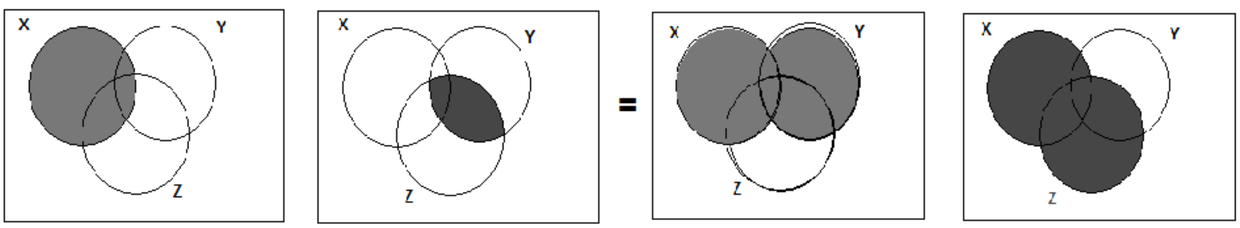
In the above picture the shaded region represents X complement Y. It contains all the elements that are X and not in Y.
This can be written as **X-Y.**

2.1.4 Putting Things Together

These sets can be combined to make more complex equations. They can easily be solved by breaking the equation down into smaller parts

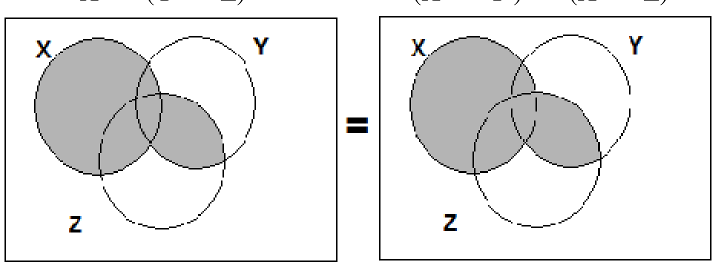
$X \cup (Y \cap Z) = (X \cup Y) \cap (X \cup Z)$

X U Y ∩ Z X U Y ∩ X U Z



X union Y intersect Z X union Y intersects X union Z

$X \cup (Y \cap Z)$ $(X \cup Y) \cap (X \cup Z)$



X union (Y intersect Z) (X union Y) intersects (X union Z)