Set Theory

Set Theory is very useful for data science and understanding other aspects of math. The basics of set theory involve thinking in terms of sets and doing operations on sets.

A set is a container for a collection of unique or distinct **elements**, without order.

Order doesn't matter in a set; it is all about being a **member** or not.

Elements of a set do not have to be of the same type from a data science perspective. {cat, 1, blue}

Set Theory: In math, curly brackets are used for a set.

{1, 2, 3} or {Aury, Simba, Doc}

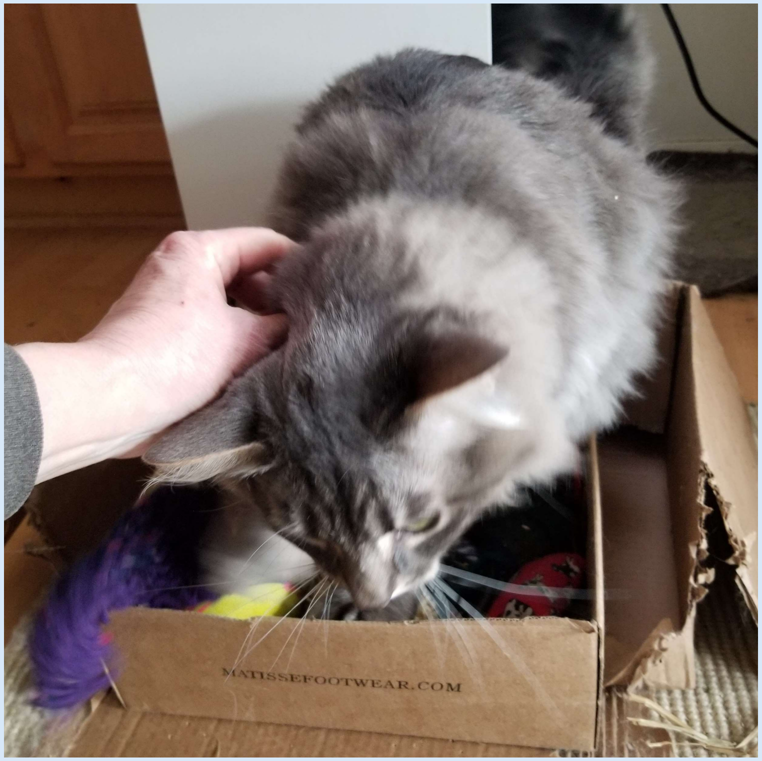
I can't say {cat, bunny, cat} but I can say {cat1, bunny, cat2} or use their names as I did above because the **elements must be unique or distinct**.

A set represents a container for the elements or members of the set that you can tell apart, and the order doesn't matter. {Doc, Simba, Aury}

A set containing one element is not the same as the element or member C={cat}

A box containing a cat is not a cat.

One or more sets can be contained in other sets, like a cat in a box in a box.



Different ways of representing sets:

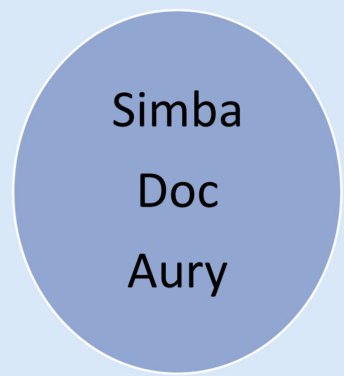
Picture: 

Written description or formula: The set of Jae’s indoor pets.

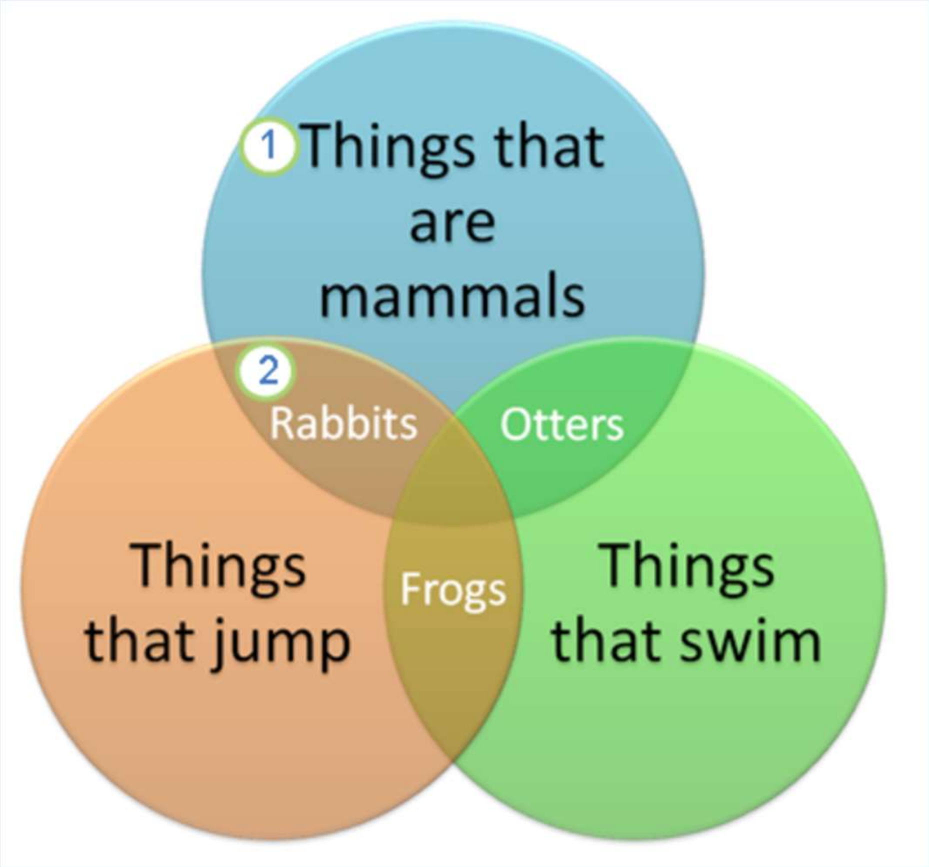
Roster or list: {Aury, Simba, Doc} or {Doc, Aury, Simba}

Set-builder notation: {x: x is Jae’s indoor pet}

Use a Venn Diagram:



Venn Diagram You can make your own in PowerPoint, but I copied this from Create a Venn diagram - Office Support (microsoft.com)



Dolphins and Orcas could be at the intersection of all three sets, as they swim, are mammals, and can jump out of the water. Can you think of others?

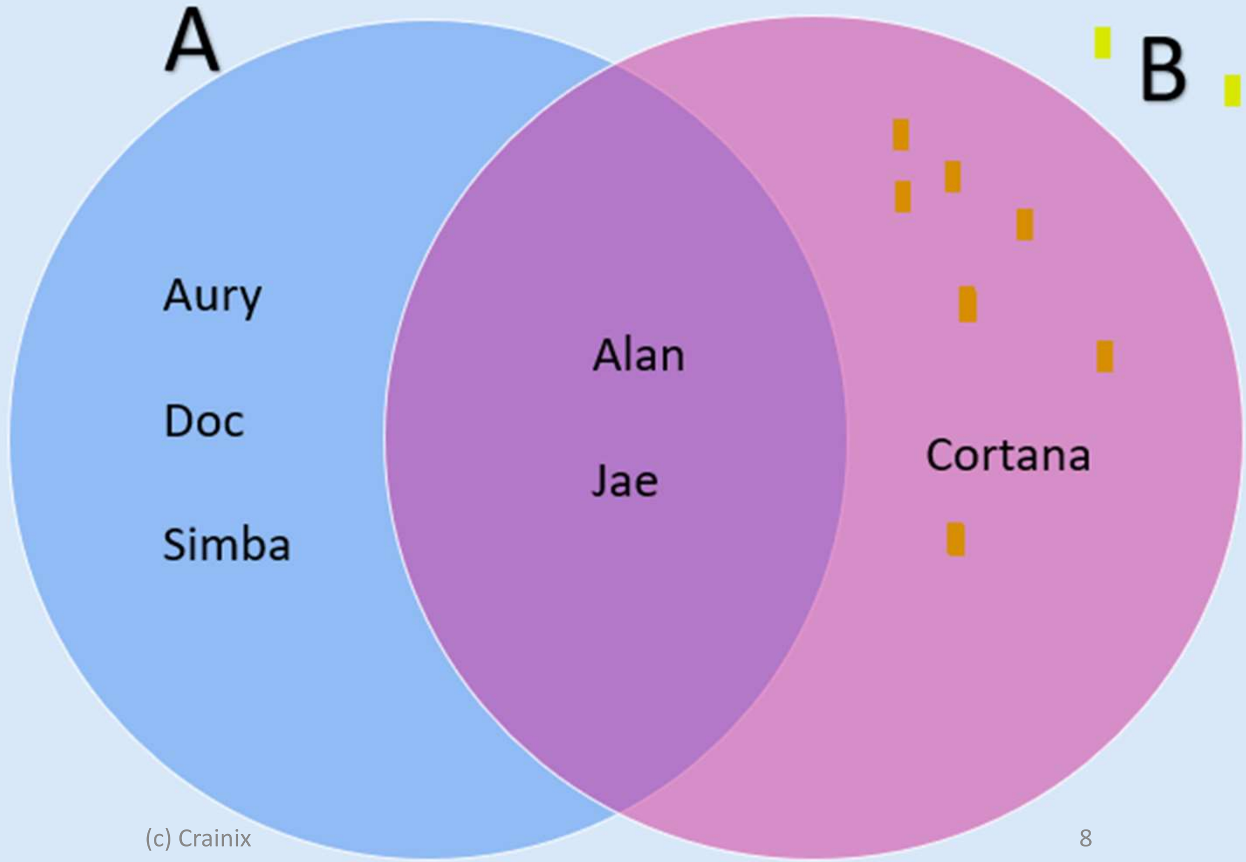
Set symbols of set theory (Ø,U,{},∈,...) (rapidtables.com)

Symbol	Symbol Name	Meaning / definition	Example
$\{ \}$	set	a collection of elements	$A = \{3,7,9,14\}$, $B = \{9,14,28\}$
$\vert$	such that	so that	$A = \{x \mid x \in \mathbb{R}, x<0\}$
$A \cap B$	intersection	objects that belong to set A and set B	$A \cap B = \{9,14\}$
$A \cup B$	union	objects that belong to set A or set B	$A \cup B = \{3,7,9,14,28\}$

Set A is the mammals in our household.

Set B is the English speakers in our house.

Cortana was our Microsoft smart speaker, like Siri or Alexa.



Set A is the mammals in our household.

Set B is the English speakers in our house.

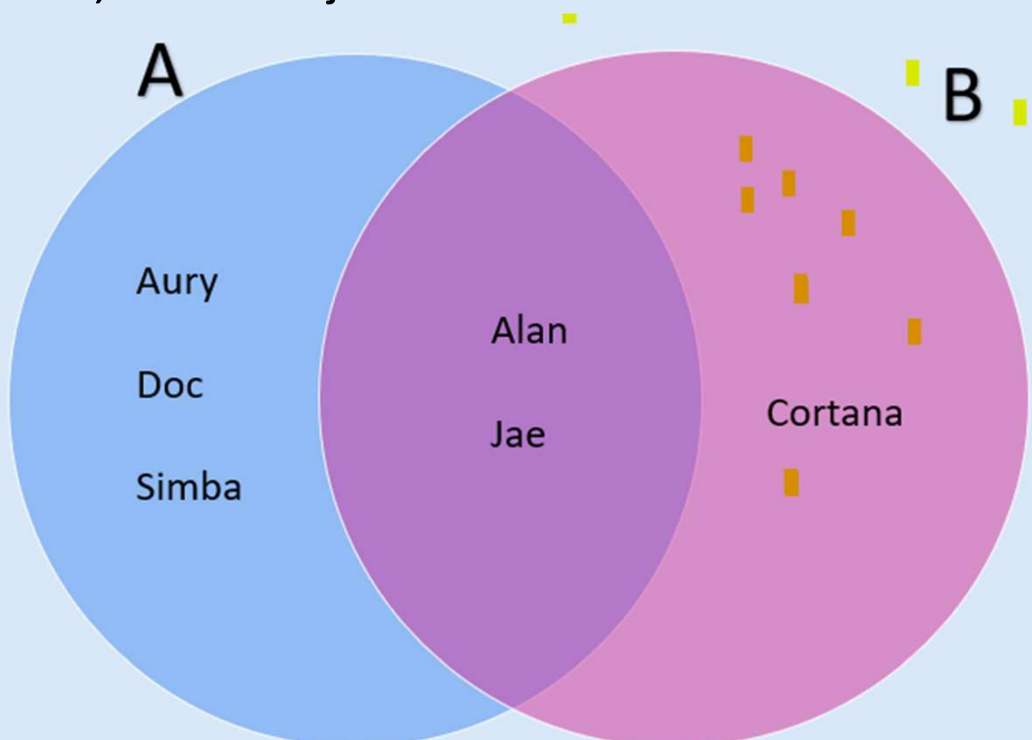
The Union of A and B or A union B

$A \cup B$={Aury, Doc, Simba, Alan, Jae, Cortana}

All the members of both sets, only written once.

Notice that the order doesn't matter.

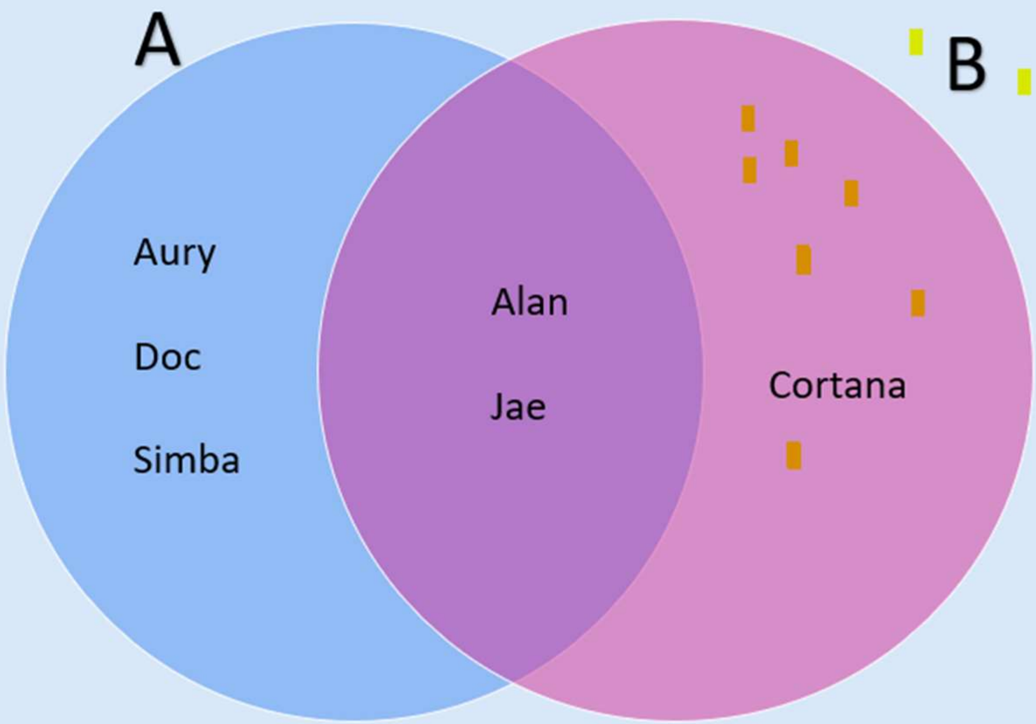
$A \cup B = B \cup A$



Set A is the mammals in our household.
Set B is the English speakers in our house.
Intersection of A and B
or A intersect B
$A \cap B$={Alan, Jae}

The elements that
both sets share.
The Overlap of the sets.

The order
doesn't matter



[Set Theory | Introduction to College Mathematics (lumenlearning.com)]

- The symbol ∈ means “is an element of”.
- A set that contains no elements, { }, is called the **empty set** and is notated Ø or null set.
- A **subset** of a set *A* is another set that contains only elements from the set *A.*

If *B* is a subset of *A*, we write $B \subseteq A$

- A **proper subset** is a subset that is not identical to the original set—it contains fewer elements.

If *B* is a proper subset of *A*, we write $B \subset A$

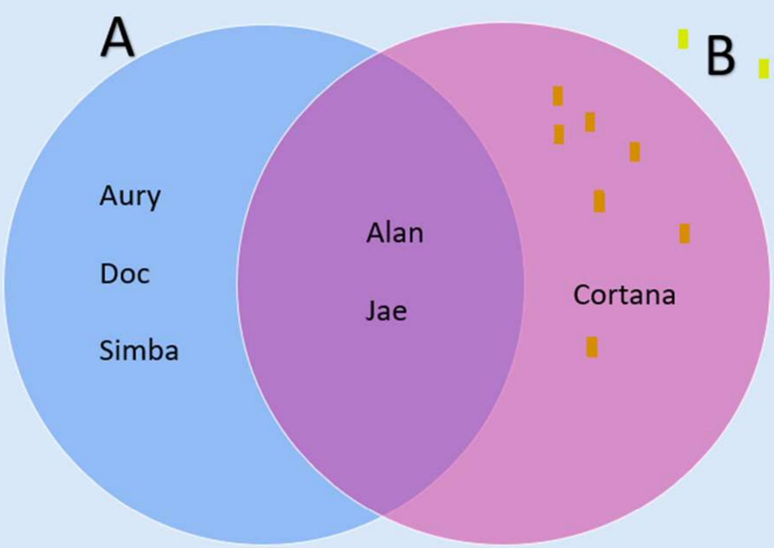
Set A is the set of all mammals in our household.
Set C is the set of animals in our household.
Set D is the set of all mammals in our town.

$A \subseteq C$

A is the same set as C

A is a proper subset of D

$A \subset D$



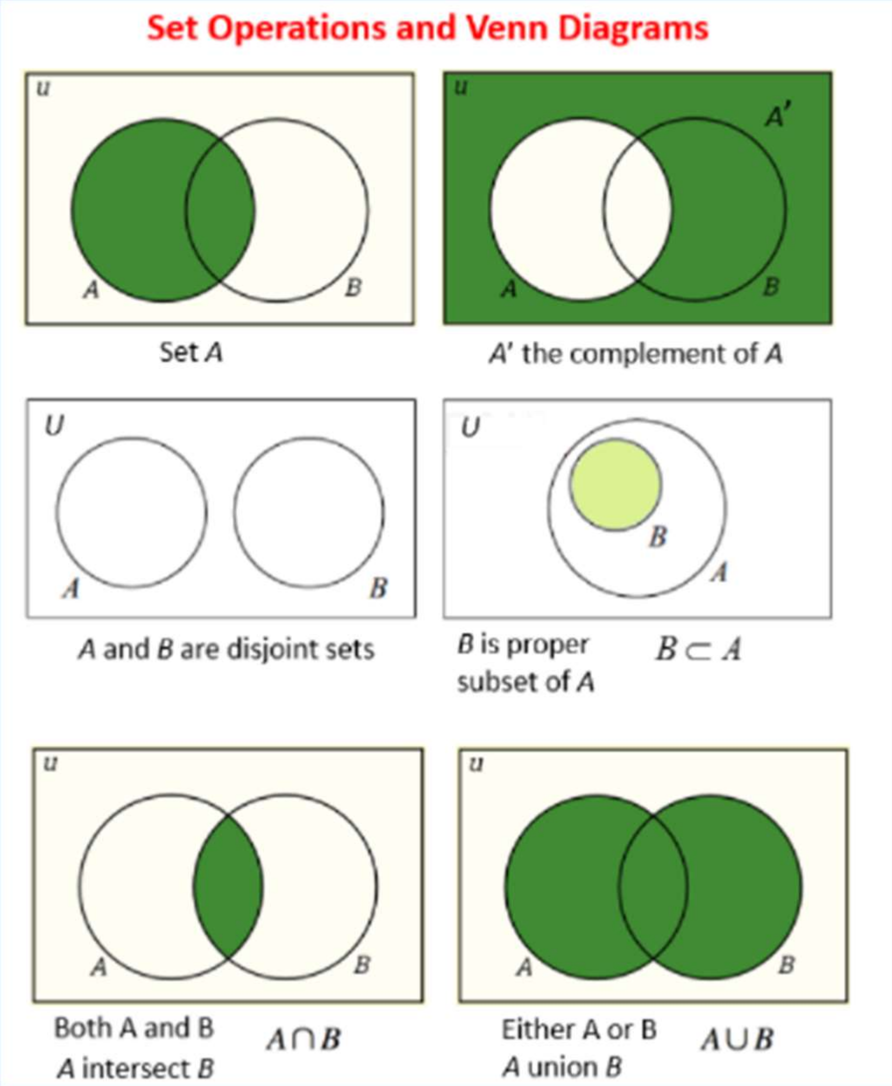
Union, Intersection, and Complement are the basic set operations

- The **union** of two sets contains all the elements contained in either set (or both sets). The union is notated $A \cup B$. More formally, $x \in A \cup B$ if $x \in A$ or $x \in B$ (or both)
- The **intersection** of two sets contains only the elements that are in both sets. The intersection is notated $A \cap B$. More formally, $x \in A \cap B$ if $x \in A$ and $x \in B$.
- The **complement** of a set A contains everything that is *not* in the set A. The complement is notated A', or A^c, *or sometimes* $\sim A$.

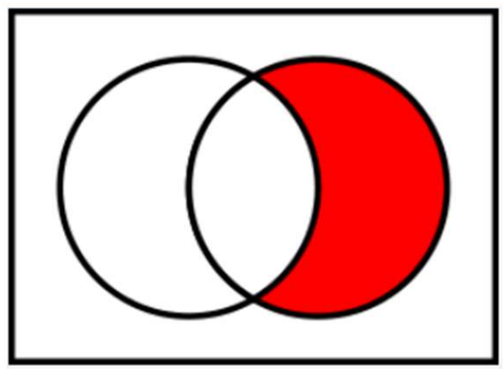
Set Theory | Introduction to College Mathematics (lumenlearning.com)

Set operations with Venn Diagrams

[Venn Diagrams And Subsets (video lessons, examples and solutions) (onlinemathlearning.com)](onlinemathlearning.com)



Relative Complement or difference of sets is the x that is in one set but not another. Here it is the elements of B that are not in A.



Relative complement of A (left) in B (right) $A^c \cap B = B \setminus A$

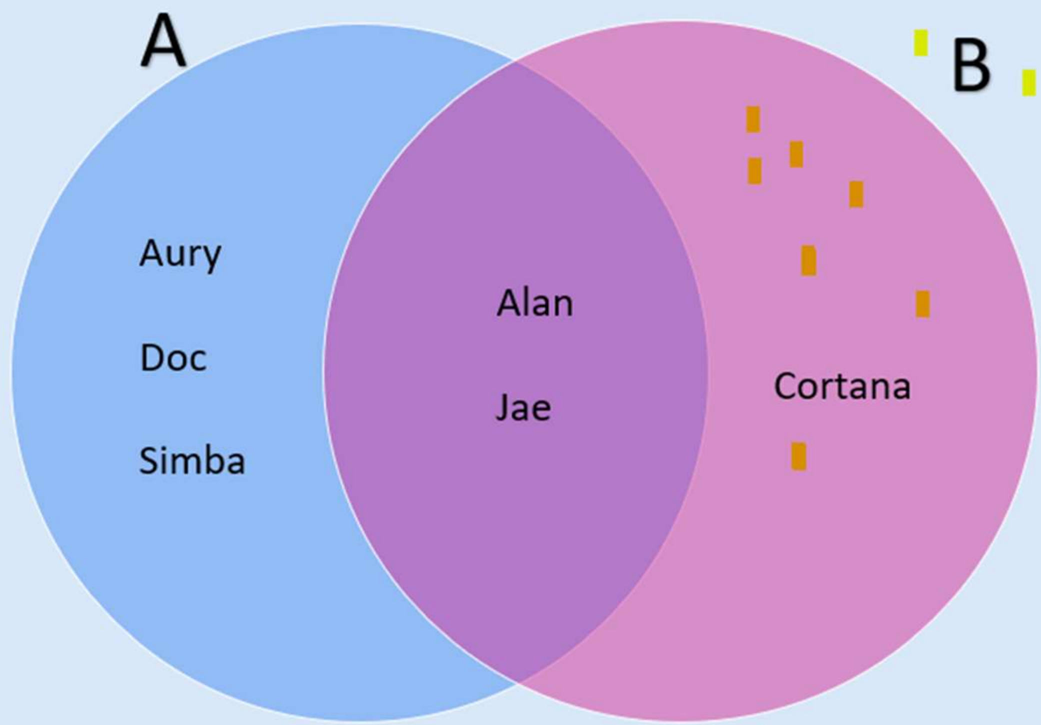
$$B \setminus A = \{x \in B \mid x \notin A\}$$

B-A is another way of writing the elements of B that are not in A. The elements of B minus the ones that are in A.

A-B is {Aury, Doc, Simba}

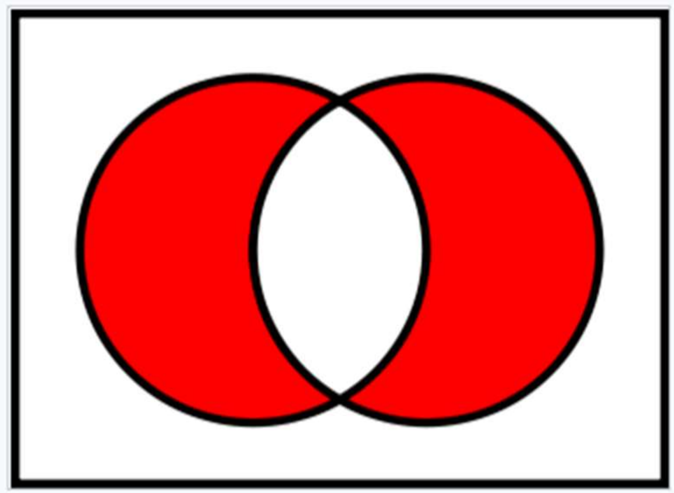
B-A is {Cortana}

Relative complement is
 in the first and not in the second
Here the order matters as you
write it but not within the set.

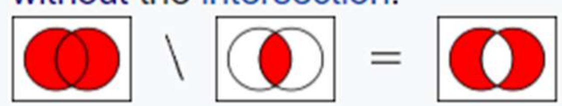


Symmetric difference of sets *A* and *B*, denoted $A \triangle B$ or $A \ominus B$,[7] is the set of all objects that are a member of exactly one of *A* and *B* (elements which are in one of the sets, but not in both).

{x:x∈A, x∈B, x not ∈ A∩B}



Venn diagram of $A \triangle B$. The symmetric difference is the union without the intersection:



Symmetric difference is in one or the other but not both.

AΔB={Aury, Doc, Simba, Cortana}

BΔA={Aury, Doc, Simba, Cortana}

With two sets, the order doesn't matter but with more than two sets, the order does matter. [Algebra 5 - Symmetric Difference – YouTube]

Here is another video about operations with three sets. [Venn Diagrams with 3 sets - Lesson - YouTube]