

Complement of a Set

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What is a Complement of a Set?

Let set 'A' represents even numbers from 1 to 10. So, $A = \{2, 4, 6, 8, 10\}$

Now, the [universal set](#) $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

As elements 1, 3, 5, 7, 9 are not a part of set 'A', so we call them as the [Complement](#) of 'A'.

From the above example, we can define the complement of the set as follows:

Let 'U' be the universal set and 'A' a subset of 'U'. Then the complement of 'A' is the set of all elements of 'U' which are not the elements of 'A'.

We write complement of 'A' as A' or A^c .

Thus, $A' = \{x: x \in U \text{ and } x \notin A\}$

Also, $A' = U - A$

We will explore more about the complement of the set by using following example:

Example: Let $U = \{1, 2, 3, 4, 5, 6\}$, $A = \{2, 3\}$ and $B = \{3, 4, 5\}$.

Find A' , B' , $A' \cap B'$, $A \cup B$ and hence show that $(A \cup B)' = A' \cap B'$.

Solution: We first find A' and B'

$A' = \{1, 4, 5, 6\}$

$B' = \{1, 2, 6\}$

So, $A' \cap B' = \{1, 6\}$

Also, $A \cup B = \{2, 3, 4, 5\}$ so that $(A \cup B)' = \{1, 6\}$

$(A \cup B)' = \{1, 6\} = A' \cap B'$

From this example, we conclude that if A and B are any two [subsets](#) of the universal set U, then

$(A \cup B)' = A' \cap B'$

Similarly, $(A \cap B)' = A' \cup B'$

$U \setminus B'$

From the above discussion, we can state that the complement of [union of two sets](#) is the intersection of their complements and the complement of the [intersection of two sets](#) is the union of their complements.

In general,

$$1) (A \cup B)' = A' \cap B'$$

$$2) (A \cap B)' = A' \cup B'$$

These are called De Morgan's laws.

Properties of Complement Sets

1) Complement Laws:

$$(i) A \cup A' = U$$

$$(ii) A \cap A' = \emptyset$$

2) [De Morgan's Law](#):

$$(i) (A \cup B)' = A' \cap B'$$

$$(ii) (A \cap B)' = A' \cup B'$$

3) Law of double complementation:

$$(A')' = A$$

4) Laws of empty set and universal set $\emptyset' = U$ and $U' = \emptyset$

Try this:

If $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $A = \{2, 4, 6, 8\}$ and $B = \{2, 3, 5, 7\}$. Verify:

$$(i) (A \cup B)' = A' \cap B'$$

$$(ii) (A \cap B)' = A' \cup B'$$

Now try it yourself! Should you still need any help, [click here](#) to schedule live online session with e Tutor!

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Reference Links:

- http://en.wikipedia.org/wiki/Universal_set

- [http://en.wikipedia.org/wiki/Complement_\(set_theory\)](http://en.wikipedia.org/wiki/Complement_(set_theory))
- <http://en.wikipedia.org/wiki/Subset>
- [http://en.wikipedia.org/wiki/Union_\(set_theory\)](http://en.wikipedia.org/wiki/Union_(set_theory))
- [http://en.wikipedia.org/wiki/Intersection_\(set_theory\)](http://en.wikipedia.org/wiki/Intersection_(set_theory))
- http://en.wikipedia.org/wiki/De_Morgan's_laws

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