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1st Lecture
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De Morgan's Law

De Morgan's laws are a pair of transformation rules in boolean algebra and set theory that are used to relate the intersection and union of sets through complements. There are two conditions that are specified under Demorgan's law. These conditions are primarily used to reduce expressions into a simpler form. This increases the ease of performing calculations and solving complex boolean expressions.

According to De Morgan's Laws:

- The complement of the union of two sets is equal to the intersection of their individual complements.
- Additionally, the complement of the intersection of two sets is equal to the union of their individual complements.

These laws can easily be visualised using Venn diagrams. In this article, we will learn about the statements of Demorgan's law, the proof of these statements, their applications, and examples.

What are De Morgan's Laws?

Demorgan's laws are a set of two postulates that are widely used in set theory. They state that: (i) $(A \cup B)' = A' \cap B'$ and (ii) $(A \cap B)' = A' \cup B'$.

- A union B Complement (First De Morgan's Law)
- A Intersection B Complement (Second De Morgan's Law)

When we have a collection of well-defined distinct objects that form a group, this collection is known as set. When we want to simplify set operations such as taking the complement, union, and intersection of sets, we use De Morgan's laws.

De Morgan's Law Statement

Demorgan's law can be used in boolean algebra as well as in set theory to simplify mathematical expressions. Suppose we have two sets A and B that are subsets of the universal set U. A' is the complement of A and B' is the complement of B. '∩' is the symbol for intersection and '∪' is used to denote the union. Then the De Morgan's laws are given below.

De Morgan's Law of Union:

The complement of the union of the two sets A and B will be equal to the intersection of A' (complement of A) and B' (complement of B). This is also known as De Morgan's Law of Union. It can be represented as (A ∪ B)' = A' ∩ B'. We can also generalise this law. Suppose we have n sets given by {A1,A2,...,An} then formula is given by (∪ni=1Ai)′=∩ni=1A′i.