24th August 2022
Scribed Notes - Lecture 9

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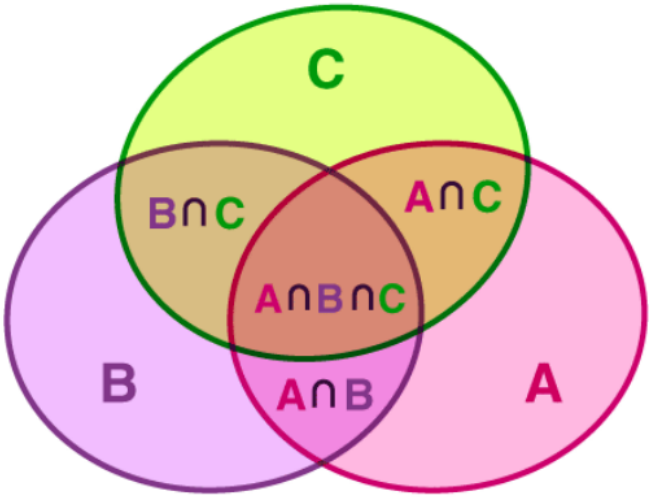
Principle of Inclusion and Exclusion

->The Principle of Inclusion and Exclusion, hereafter called Principle of inclusion and Exclusion, gives a formula for the size of the union of n finite sets.

->It is particularly useful in Combinations and Probability problem solving when it is necessary to devise a counting method that ensures an object is not counted twice.



- $|A \cup B| = |A| + |B| - |A \cap B|$
- $|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$

|

- | A U B U C U D| = |A| + |B| + |C| - | A ∩ B | - | B ∩ C | - | C ∩ D | - | A ∩ D | - | B ∩ D | - | A ∩ C | + | A ∩ B ∩ C | + | A ∩ D ∩ C | + | A ∩ B ∩ D | + | D ∩ B ∩ C | + | A ∩ C ∩ D | - | A ∩ B ∩ C ∩ D |

Note: | | represent cardinality of sets
Cardinality of subsets can't exceed that of a set
It should not be ambiguous.

What do you mean by Cardinality of set?
The cardinality of a set is the number of elements in a set. Let A = {1, 2, 3, 9}. The cardinality of set A = 4.

PRINCIPLE: Finding union of many sets ensure that every element is counted only once

Assume element i is present in exactly Ki sets $1 \leq Ki \leq n$

Example:

Suppose each student is asked to contribute 1 pen per club and he is a part of 5 clubs, the initially, he will contribute 5 pens($5C_1$)

Iteration 1: -> 5C1 (+5)
Iteration 2: <- 5C2 (-10)
Iteration 3: -> 5C3 (+10)
Iteration 4: <- 5C4 (-5)
Iteration 5: -> 5C5 (1)
At the end, he will end up contributing just 1 pen.

Formula For Inclusion and Exclusion Principle: