Bharathidasan University

Centre for Differently Abled Persons

Tiruchirappalli - 620024.

- Programme Name : Bachelor of Computer Applications
- Course Code : Discrete Mathematics
- Course Title : 20UCA1AC1
- Unit : Unit I
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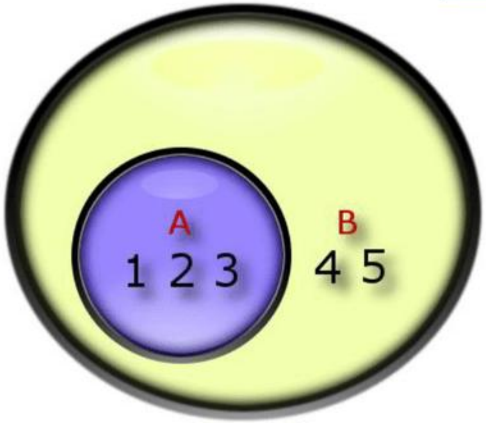
Set Theory



SET

- Set is a collection of objects.
- Set is represented by → {}

Example:

{1,2,3,4,5,6,7,8,9,10}

Here,

A= {1,2,3,4,5} can be written as → $1 \in A$

A= {2,3,4,5} → $1 \notin A$

REPRESENATION OF SETS

1. Statement Form

The set is defined in statement form

Example:

The set of all odd number less than 10.

2. Roaster Form

The elements are listed within the pair of brackets {} and are separated by commas.

Example:

Let N is the set of odd numbers less than 10.

N = {1, 3, 5, 7, 9}.

3. Set Builder Form

Define a set by its property

Example:

{x : x is odd number less than 10}.

EMPTY SET

- The set has no element inside.
- Count of element is 0

Example:

{ }

FINITE SET

- The set has starting and ending point
- The set is countable

Example:

P= {0, 2, 4, 6, …, 98}

INFINITE SET

- The set has no starting and ending point

Example:

A set of all whole numbers.

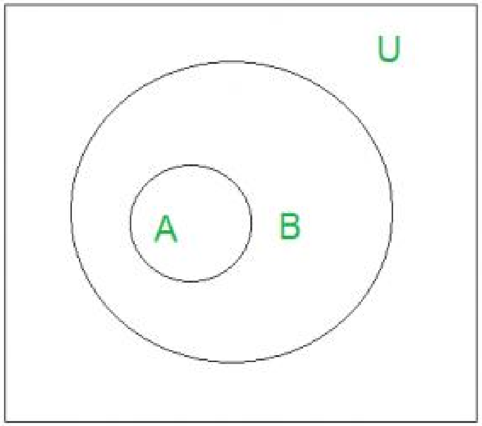
W= {0, 1, 2, 3, 4,…}

SUBSETS

- If all element of set A is a part of set B, then A is subset of B.

  Subset → ⊆

  ‘A ⊆ B ‘denotes A is a subset of B.



POWER SETS

- All possible subset of a set S.

Example:

What is the power set of $\{0,1,2\}$?

Solution: All possible subsets

$\{\varnothing\}, \{0\}, \{1\}, \{2\}, \{0,1\}, \{0,2\}, \{1,2\}, \{0,1,2\}.$

UNIVERSAL SETS

Universal set contain all elements of other set including its own set

Universal Set → U

Here, there are three sets named as A, B and C.

A={1,3,6,8}

B={2,3,4,5}

C={5,8,9}

Therefore, universal set of A, B, C is

U={1,2,3,4,5,6,8,9}

If Universal set contains Sets A, B and C, then these sets are also called subsets of Universal set.

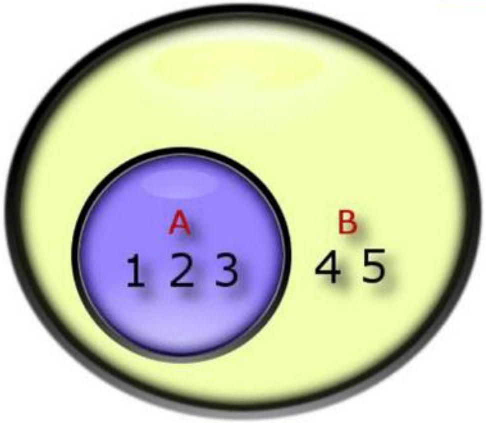
Denoted by;

$A \subset U$ (A subset of U)

$B \subset U$ (B subset of U)

$C \subset U$ (C subset of U)

Set Theory



OPERATION ON SETS

Two or more set combine together to form a single set

There are four types

1. UNION ON SETS

- Union of two set contains all elements of both set.

  Union →U

- Repetition of elements is not allowed

Example:

A = {1,2,3,4,5}

B = {5,6,7,8,9}

AUB = {1,2,3,4,5,6,7,8,9}

EXERCISE 1:

A = {4,6,8,0,1}

B = {2,4,1,5,6,8}, Find A U B?

Answer:

A U B = {1,2,4,5,6,8}

2. INTERSECTION OF SETS

Common elements of two or more set are selected

Intersection → ∩

Example:

A = {1,2,3,4,5}

B = {1,3,6,9}

A ∩B = {1,3}

EXERCISE 1

A= {2,4,6,8,0}

B= {1,2,3,4,5,6}

Find A ∩B ?

Answer:

A ∩B = {2,4,6}

3.DIFFERENCE OF SETS

- If A and B are two sets, then their difference is A - B or B - A.

If A = {1, 2, 4} and B = {4, 5, 6}

A - B means elements of A which are not the elements of B.

A - B = {1,2}

EXERCISE 1

Let A = {a, b, c, d, e, f} and B = {b, d, f, g}.

Find the difference between the two sets:

(i) A and B

(ii) B and A

Solution:

(i) A - B = {a, c, e}→ belongs to Set A but not to B

(ii) B - A = {g) → belongs to Set B but not to A

4. COMPLEMENTS OF SETS

The complement of set A is the set of all elements in the universal set that are not in A.

It is denoted by A’

Example:

If A = {1, 2, 3, 4} and U = {1, 2, 3, 4, 5, 6, 7, 8} then find A complement (A’).

Solution:

A = {1, 2, 3, 4} and Universal set = U = {1, 2, 3, 4, 5, 6, 7, 8}

∴ A complement = A’ = {5, 6, 7, 8}.

PROPERTIES OF SET OPERATIONS

1. Commutative Laws:

- For any two finite sets A and B;

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

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

2. Associative Laws:

- For any three finite sets A, B and C;

  (i) $(A \cup B) \cup C = A \cup (B \cup C)$

  (ii) $(A \cap B) \cap C = A \cap (B \cap C)$

Thus, union and intersection are associative.

3. Distributive Laws:

- For any three finite sets A, B and C;

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

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

  Thus, union and intersection are distributive over intersection and union respectively.

4. De Morgan's Laws:

For any two finite sets A and B;

(i) $A - (B \cup C) = (A - B) \cap (A - C)$

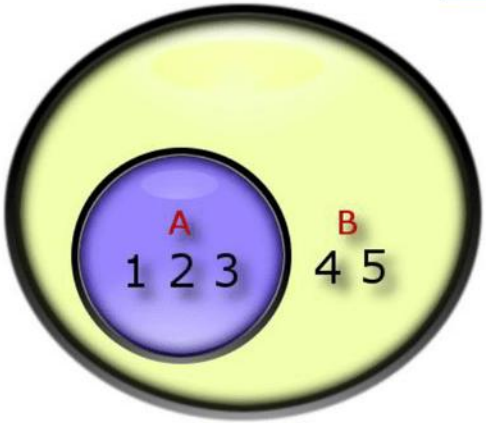
(ii) $A - (B \cap C) = (A - B) \cup (A - C)$

De Morgan's Laws can also we written as:

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

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

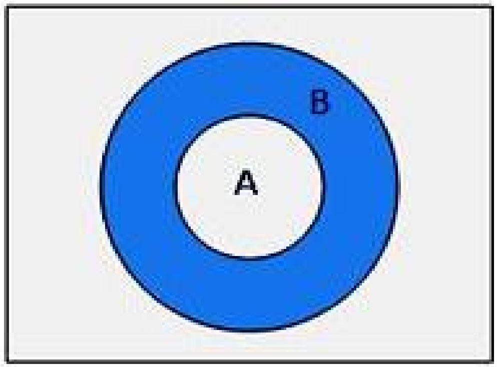
Set Theory



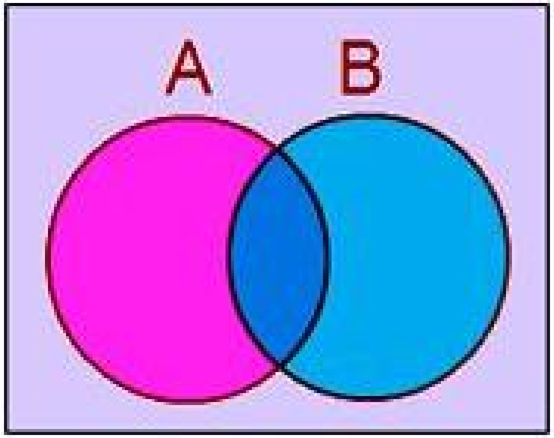
VENN DIAGRAM

- It is pictorial representation of relation between two concepts
- Rectangle represents universal set.
- Circles or ovals represents other subsets of the universal set.

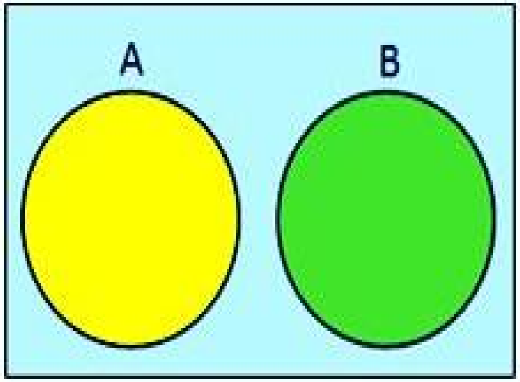
1. If A is a subset of B



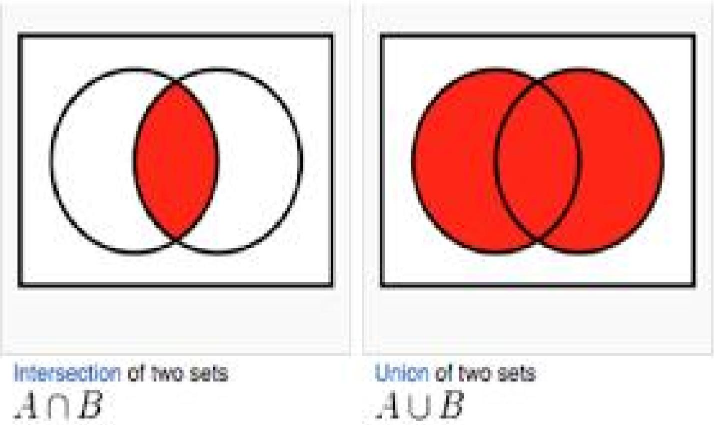
2. If set A and set B have some elements in common



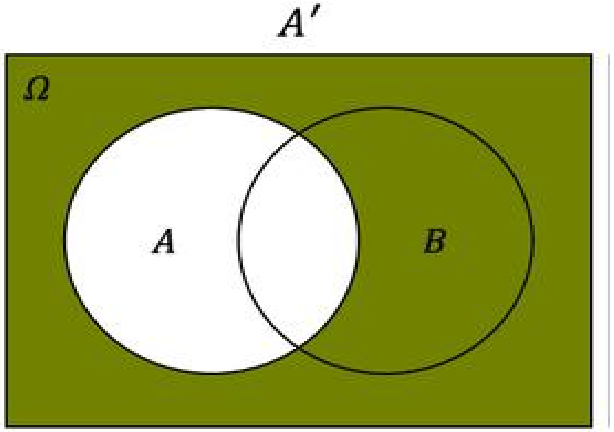
3. If set A and set B are disjoint



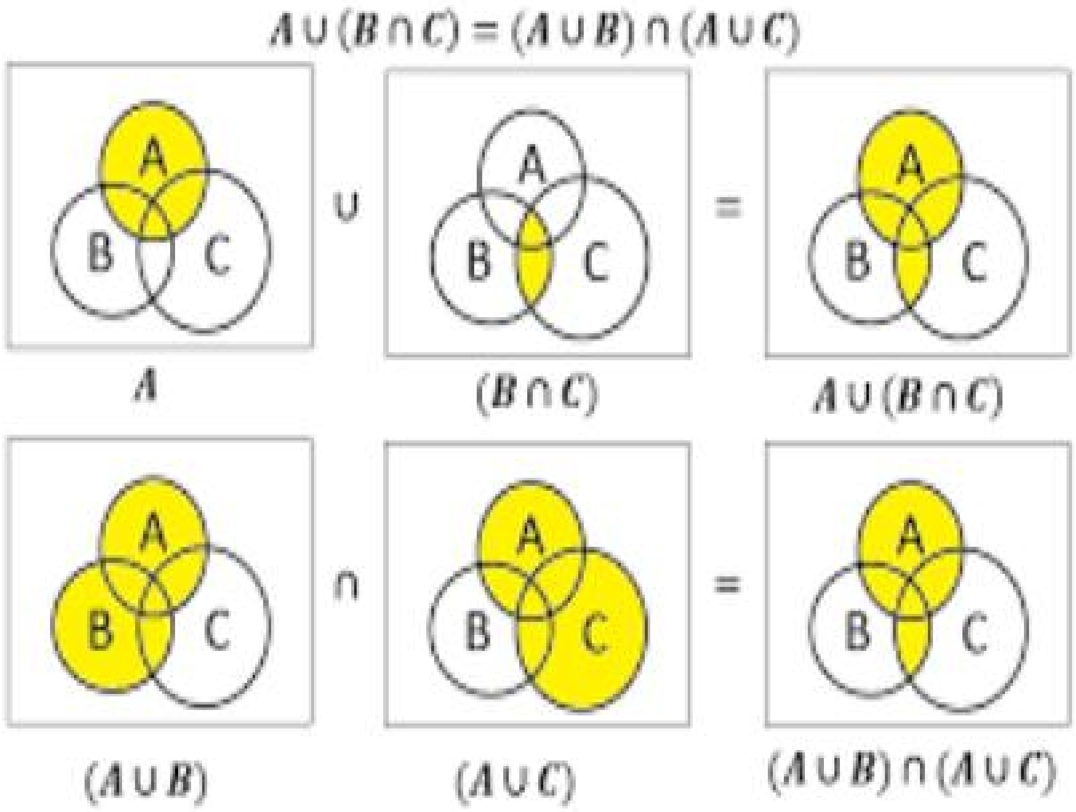
4. AUB and A∩B



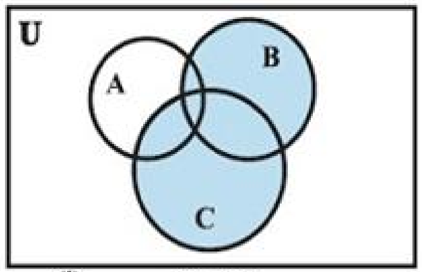
5. A'



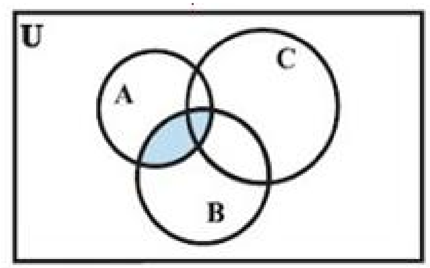
6. A U (B ∩ C) = (A U B) ∩ (A U C)



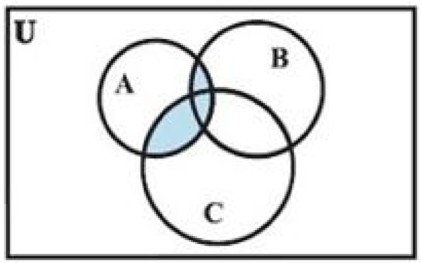
7. A ∩ (B U C) = (A ∩ B) U (A ∩ C)



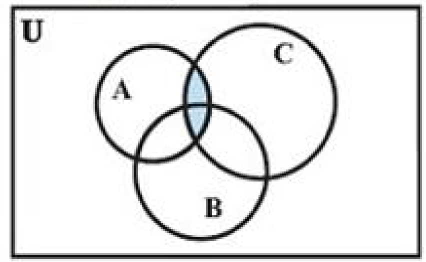
(i) (B∪C)



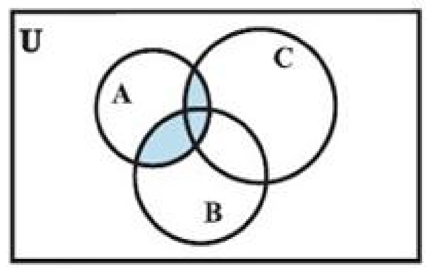
(iii) (A∩B)



(ii) A∩(B∪C)

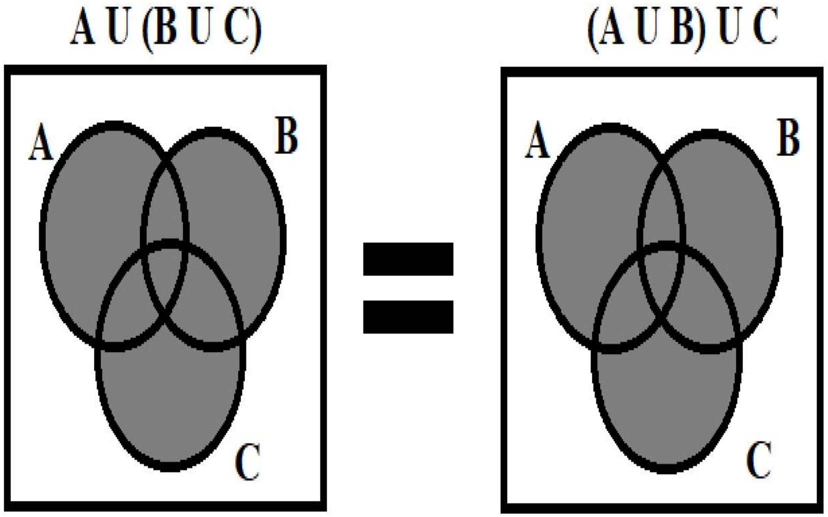


(iv) (A∩C)



(v) (A∩B) ∪ (A∩C)

8. (A U B) U C = A U (B U C)



SAMPLE SUM

1. If A = {a, b, c, d}, B = {c, d, e, f} and C = {b, d, f, g}; then $(A \cap B) \cup (A \cap C) = A \cap (B \cup C)$?

SOLUTION:

LHS:

(i) $(A \cap B) = \{c, d\}$

(ii) $(A \cap C) = \{b, d\}$

(iii) $(A \cap B) \cup (A \cap C) = \{c, d\}\ U\ \{b, d\}$

$= \{b, c, d\}$

RHS:

(i) $(B \cup C) = \{b, c, d, e, f, g\}$

(ii) $A \cap (B \cup C) = \{a, b, c, d\} \cap \{b, c, d, e, f, g\}$

$= \{b, c, d\}$

Thus LHS = RHS