Set Theory

The set is represented by listing all the elements comprising it. The elements are enclosed within braces and separated by commas.

Example 1 − Set of vowels in English alphabet, B={a,e,i,o,u}

Example 2 − Set of odd numbers less than 20, A={1,3,5,7,9,11,13,15,17,19}

Set Builder Notation

The set is defined by specifying a property that elements of the set have in common. The set is described as P = {x: a (x)}

Example 1 − The set {a, e, i, o, u}

is written as −

P = {y : y is a vowel in English alphabet}

Example 2 − The set {1,3,5,7,9,11,13,15,17,19}

is written as –

A = {y : $1 \le y < 20$ and (y%2) $\neq$ 0}

If an element y is a member of any set A, it is denoted by $y \in A$

and if an element x is not a member of set A, it is denoted by $x \notin A$.

Cardinality of a Set

Cardinality of a set A, denoted by |A|, is the number of elements of the set.

The number is also referred as the cardinal number. If a set has an infinite number of elements, its cardinality is ∞

Example − | {1,2,3, 4}|=4, |{1,2,3,4,…}|=∞.

Types of Sets

Sets can be classified into many types. Some of which are finite, infinite, subset, universal, proper set, etc.

Finite Set

A set which contains a definite number of elements is called a finite set.

Example – $A = \{y | y \in N \text{ and } 50>y>40\}$.

Infinite Set

A set which contains infinite number of elements is called an infinite set.

Example – $A = \{y | y \in N \text{ and } y>20\}$

Subset

A set B is a subset of set C (Written as $B \subseteq C$) if every element of B is an element of set C.

Example 1 − Let, C = {1,2,3,4,5,6}

and B = {1,2}.

Here set B is a subset of set C as all the elements of set B are in set C.

Proper Subset

The term “proper subset” can be defined as “subset of but not equal to”. A Set B is a proper subset of set C (Written as $B \subset C$) if every element of B is an element of set C and $|B|<|C|$.

Universal Set

It is a collection of all elements in a particular context or application. All the sets in that context or application are essentially subsets of this universal set. Universal sets are represented as U.

Example − We may define U as the set of all sport events. In this case, set of all format of cricket is a subset of U

, set of all lawn tennis is a subset of U

, and so on.

Empty Set or Null Set

An empty set contains no elements. It is denoted by ∅.

As the number of elements in an empty set is finite, empty set is a finite set. The cardinality of empty set or null set is zero.

Example − $S=\{ x \mid x \in N$

And $7 < x < 8 \}= \emptyset$.

Venn Diagrams

In the late 1800's, an English logician named John Venn developed a method to represent relationship between sets. He represented these relationships using diagrams, which are now known as Venn diagrams. A Venn diagram represents a set as the interior of a circle. Often two or more circles are enclosed in a rectangle where the rectangle represents the universal set.

Venn Diagram in case of two elements

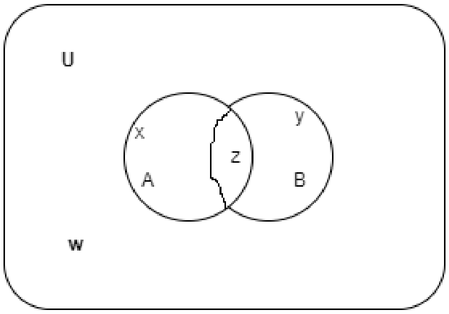
Where;

x = number of elements that belong to set A only

y = number of elements that belong to set B only

z = number of elements that belong to set A and B both (A∩B)

w = number of elements that belong to none of the sets A or B is



From the above figure, it is clear that

n(A) = x + z ;

n (B) = y + z ;

n(A ∩ B) = z;

n (A ∪ B) = x +y+ z.

Total number of elements = x + y + z + w.

Set Operations

Set Operations include Set Union, Set Intersection, Set Difference, Complement of Set, and Cartesian Product.

Set Union

The union of sets A and B (denoted by A∪B) is the set of elements which are in A, in B, or in both A and B. Hence, A∪B={x|x∈A OR x∈B}.

Example − If A={10,11,12,13}

and B = {13,14,15}

, then A∪B={10,11,12,13,14,15}

Set Intersection

The intersection of sets A and B (denoted by A∩B) is the set of elements which are in both A and B. Hence, A∩B={x|x∈A AND x∈B}.

Set Difference/ Relative Complement

The set difference of sets A and B (denoted by A–B) is the set of elements which are only in A but not in B. Hence, $A-B=\{x|x\in A \text{ AND } x\notin B\}$

Example − If $A=\{10,11,12,13\}$

and $B=\{13,14,15\}$,

then $(A-B) = \{10,11,12\}$

and $(B-A) = \{14,15\}$.

Here, we can see $(A-B) \neq (B-A)$

Cartesian Product / Cross Product

The Cartesian product of n number of sets A1, A2,…An

denoted as $A1\times A2\cdots\times An$

can be defined as all possible ordered pairs $(x1,x2,\ldots xn)$

where $x1\in A1$, $x2 \in A2,\ldots xn\in An$

Example − If we take two sets $A=\{a,b\}$

and $B=\{1,2\}$

The Cartesian product of A and B is written as − $A\times B=\{(a,1),(a,2),(b,1),(b,2)\}$

The Cartesian product of B and A is written as − $B\times A=\{(1,a),(1,b),(2,a),(2,b)\}$