Mathematics Foundations (CBCA104)

Lecture-2

29/09/2022

Course Details

Course Code: CBCA104
Course Name: Mathematics Foundations
Credits: 3-1-0 (4)

Outline

- Sets: Definition and Examples
- Set Properties
- Types of Sets

What is a set?

A *set* is a well- defined collection (group) *distinct* objects.

Examples:

- People in a class: { Alice, Bob, Chris }
- Classes offered by a department: { CSE101, CSE202, … }
- Colours of a rainbow:{ Red, Orange, Yellow, Green, Blue}
- States of matter { Solid, Liquid, Gas, Plasma }
- States in the India: { Delhi, Haryana, Uttar Pradesh, … }

Although a set can contain (almost) anything, we will most often use sets of numbers.

- All positive numbers less than or equal to 5: {1, 2, 3, 4, 5}

- A few selected real numbers: { 2.1, π, 0, -6.32, e }

Points to Remember

- Objects, elements or members of a set are synonymous terms.
- Sets are usually denoted by capital letters like A, B, C, X, Y, Z, etc.
- The elements of a set are usually denoted by small letters like a, b, c, x, y, z, etc.

Points to Remember

- If a is an element of a set A, we say that "a belongs to A".

- The Greek symbol " $\in$ " is used to denote the phrase "belongs to". Thus we write $a \in A$.

- If b is not an element of a set A, we write $b \notin A$ and read that "b does not belong to A".

Points to Remember

- V= the set of vowels in English alphabets.
- V={a, e, i, o, u}.
- Then, $a \in V$ but $b \notin V$.

Set Properties

- **Order does not matter.**

1. We often write them in order because it is easier for humans to understand it that way {1, 2, 3, 4, 5} is equivalent to {3, 5, 2, 4, 1}.

1. No matter what objects a, b, and c denote,
   {a, b, c} = {a, c, b} = {b, a, c} =
   {b, c, a} = {c, a, b} = {c, b, a}.

- **Sets are notated with curly brackets, {}.**

Set Properties

- **Sets do not have duplicate elements.**

Consider the set of vowels in the alphabet.
It makes no sense to list them as {a, a, a, e, i, o, o, o, o, o, u}.
What we really want is just {a, e, i, o, u}.

Example

- X is the set of letters in “ALLOY”. Then X is {A, L, O, Y}.
- B is the set of letters in “LOYAL”. Then B is {L, O, Y, A}.

Sets X and B are same.

Few Important Sets

- Set of Natural Numbers: **N** = { 1, 2, …}.
- Set of Integers: **Z** = {…, -2, -1, 0, 1, 2, …}.
- Set of Rational Numbers:

Q={p/q, q and q are integers and q is not zero}.

- Set of all Positive Integers: Z^+={1, 2, 3, 4,…}.

Set Equality

- Two sets are declared to be equal *if and only if* they contain **exactly the same** elements.

- In particular, it does not matter *how the set is defined or denoted.*

- For example: The set {1, 2, 3, 4} =

  {x | x is an integer where $x>0$ and $x<5$ } =

  {x | x is a positive integer whose square is >0 and <25}.

Empty Set

- A set which does not contain any element is called the empty set or null set or void set.
- The empty set is denoted by the symbol ϕ or {}.
- Example: Let X= {x: 1<x<2 and x is a natural number}.

Set X is empty set because there is no natural number between 1 and 2.

Finite and Infinite Sets

- A set which is empty or consists of a definite number of elements is called finite set otherwise the set is called infinite set.

- If the set is denoted by **S** then number of elements in the set is denoted by **n(S).**

Finite and Infinite Sets

- Let W be the set of the days of the week.

Then the set W is finite set.

- Let S be set of solutions of the equations $x^2 - 1 = 0$.

$Then\ the\ set\ S\ is\ finite.$

- Let L be the set of points on a line.

Then the set L is infinite.

Infinite Sets

- Symbols for some special infinite sets:
  N = {1, 2, …} **The natural numbers.**
  Z = {…, -2, -1, 0, 1, 2, …} **The integers.**
  R = The “real” numbers

- Infinite sets come in different sizes!