Mathematical Foundations for Computer Applications

Unit-1 Set Theory and Matrix Theory

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Sets and Types

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Set-Definition

- A set is an unordered collection of **objects**, called **elements or members** of the set. A set is said to contain its elements.

  Examples -- V = {a, e, i, o, u}.

- The set A of odd positive integers less than 10 can be expressed by A = {1, 3, 5, 7, 9}.

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Set-Definition

- Eg- $a \in A$ to denote that a is an element of the set A.
- Eg- $a \notin A$ denotes that a is not an element of the set A.

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Introduction to Set Theory

A set is a well defined group of objects .

A set can be **finite or infinite**.

Example :1) B = { 3 , 7 , 9 , 14 } **Finite Set**

$7 \in \mathbf{B}$, $20 \notin \mathbf{B}$

2) A = { 1 , 3 , 6 , 10 , …….} **Infinite Set**

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ROSTER FORM AND SET BUILDER FORM

Roster Form:

- Listing the elements of a set inside a pair of braces { } is called the **roster form**.

Examples--(i) Let A be the set of even natural numbers less than 11.

$A = \{2, 4, 6, 8, 10\}$

(ii) $A = \{x : x \text{ is an integer and } -1 \leq x < 5\}$

$A = \{-1, 0, 1, 2, 3, 4\}$

(iii) The set of positive integers less than 100

$A = \{1, 2, 3, \ldots, 99\}$.

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ROSTER FORM AND SET BUILDER FORM

Set Builder Form :

- Set-builder notation is a notation for **describing a set** by indicating the properties that its members must satisfy.

Examples

(i) A = { x : x is a letter in the word dictionary }

(ii) P = { x | x is a prime number less than 100 }

Note-To express the set in Set-builder form actual elements of the set are not listed.

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Problems

1. Write the following sets in Set-Builder Form :

(i) A = {1, 3 ,5, 7, 9}
(ii) B = {16, 25, 36, 49, 64}
(iii) C = {5,10,15,20,25}
(iv) D = {violet, indigo, blue, green, yellow, orange, red}
(v) E = {January, March, May, July, August, October, December}

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Answers

(i) A = {x | x is an odd number less than 10}.

(ii) B = {x | x is a perfect square natural number between 15 and 65}

(iii) C = {x | x is a multiple of 5 between 5 and 25 }.

(iv) D = {x | x is a colour in rainbow}.

(v) E = {x | x is a month having 31 days}.

Problems

2. Write the following sets in Roster Form :

(i) The first four odd natural numbers each divisible by 3.
(ii) The first four odd natural numbers each divisible by 5.
(iii) The counting numbers between 15 and 35, each of which is divisible by 6.
(iv) The names of the last three days of a week.
(v) The names of the last four months of a year.

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Answers

(i) A = {3, 9, 15, 21}

(ii)B= {5, 15, 25, 35}

(iii)C= {18, 24, 30}

(iv)D= {Friday, Saturday, Sunday}

(v)E= {September, October, November, December}

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Standard Sets

N = {0, 1, 2, 3, . . .}, the set of **natural numbers**
Z = {. . . ,−2,−1, 0, 1, 2, . . .}, the set of **integers**
Z+ = {1, 2, 3, . . .}, the set of **positive integers**
Q = {p/q | $p \in$ **Z**, $q \in$ **Z**, and $q \neq 0$}, the set of **rational numbers**
R, the set of **real numbers**
R+, the set of **positive real numbers**
C, the set of **complex numbers**.

The Size of a Set

- Let *S* be a set. If there are exactly ***n* distinct elements** in *S* where *n* is a non negative integer
- *S* is a *finite set* and that *n* is the *cardinality* of *S*. The cardinality of *S* is denoted by $|S|$.

Eg—i) A = { 1 ,2,3} , |A| =3.

ii)Let *S* be the set of letters in the English alphabet.

Then $|S| = 26$.

Equal Sets

- Two sets are equal if and only if they have the s**ame elements.** Therefore, if A and B are sets,

then A and B are equal if and only if $\forall x(x \in A \leftrightarrow x \in B)$.
We write **A = B** if A and B are equal sets.

Eg--The sets {1, 3, 5} and {3, 5, 1} are equal

Note-It does not matter if an element of a set is listed more than once, so {1, 3, 3, 3, 5, 5, 5, 5} is the same as the set {1, 3, 5} because they have the same elements.

Empty Set

- The empty set (or null set) is a set that has **no members.** The symbol **Ø , { }.**

  Examples:

i) Ø = { } (roster)

ii) Ø = {x : x is a person attending fest who is 200 years old.} (set-builder)

Empty Set

Note: {∅} **not** empty set;
Cardinality =1.

- A set with one element is called a **singleton set**.

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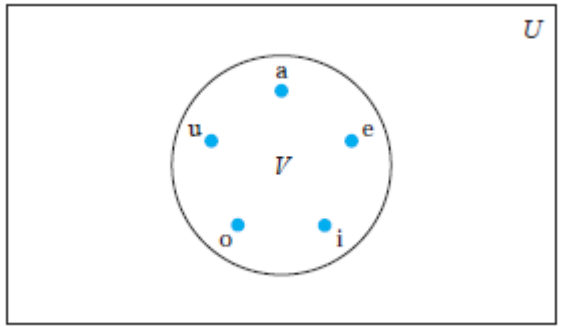
Venn Diagrams

- Sets can be represented graphically using Venn diagrams

Eg-- Draw a Venn diagram that represents *V,* the set of vowels in the English alphabet.

Universal set *U*, which is the set of the 26 letters



THANK YOU

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