Computer Science & IT

Discrete Mathematics

Set Theory & Algebra

Lecture No. 01

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Topics to be Covered

- Topic: Sets and representation of sets
- Topic: Types of sets
- Topic: Venn diagram
- Topic: Set operations and properties of set operations
- Topic: Multiset

Slide

Topic : Syllabus

Discrete Mathematics

{ Expected Marks in GATE 8 - 10 Marks }

(1) Set theory & Algebra
- Sets & Relations
- Functions
- Group Theory

(2) Graph Theory

(3) Mathematical Logic
- Propositional Logic
- Predicate Logic

(4) Combinatorics ← { Basics of Counting }
- Recurrence Relation
- Generating Functions
- Pigeonhole principle

Slide

$${}^{n}P_{r} = \frac{n!}{(n-r)!} = \frac{n(n-1)(n-2)\ldots(n-r+1)(n-r)(n-r-1)\ldots 3\times 2\times 1}{(n-r)(n-r-1)\ldots 3\times 2\times 1}$$

different · different · arrangement

{order in which the object appears is important}

6 Person at 3 chairs (Numbered)

and

$$6 * 5 * 4$$

C_1 C_2 C_3 C_4

$$6*5*4 = 120$$

$$\frac{6!}{3!} = \frac{n!}{(n-r)!} = \frac{6*5*4*3\times 2\times 1}{(6-3)^{3\times 2\times 1}}$$

$$= 6*5*4*3 \times \frac{2\times 1}{(6-4)^{2\times 1}}$$

$$6*5*4*3 = 360$$

Q: How many even numbers of 4 digits are possible ?

=

Case (1) When all digits are distinct

either using Case (1) + when last digit is '0'

9	8	7	1

(0)

= ?

or using Case (2) + When last digit is not '0'

8	8	7	4

2/4/6/8

= ?

Case (2) When digits can be repeated

9	10	10	5

1 to 9

0/2/4/6/8

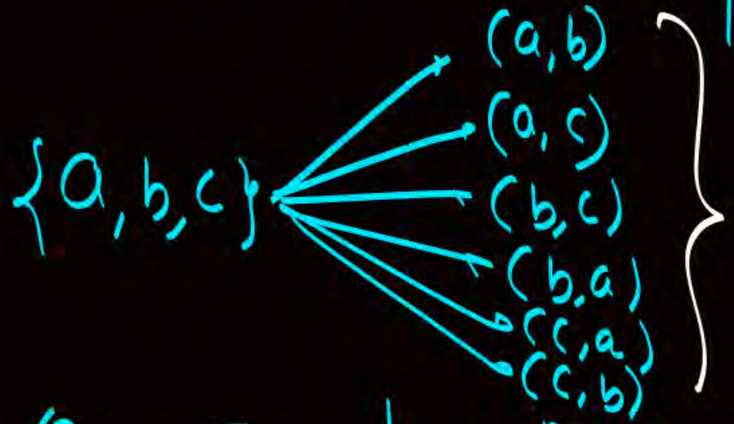
= 4500

$$ {}^{n}C_{r} = \frac{n!}{(n-r)!\, r!} $$

Combination
(Selection)

Order is
not important

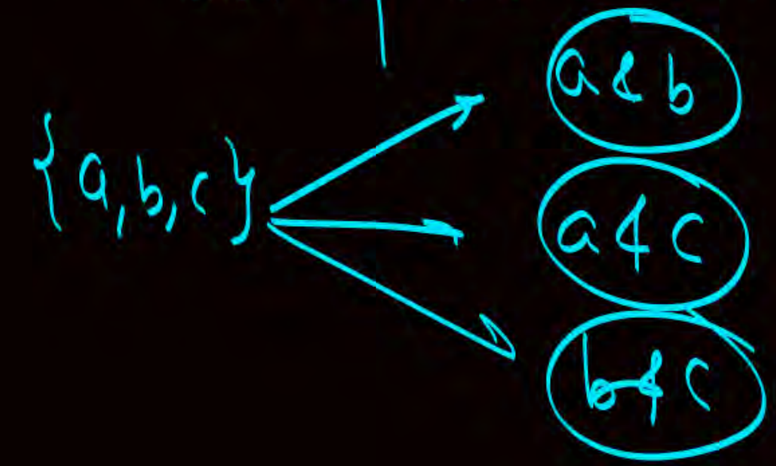
Q. In how many ways we can arrange two elements out of three distinct elements $\{a, b, c\}$ {Permutation} {order is important}



$3 * 2 = 6$

$${}^3P_2 = \frac{3!}{(3-2)!} = \frac{6}{1} = 6$$

Q. In how many ways we can select two elements out of three distinct elements $\{a, b, c\}$ Combinations



$$\frac{3*2}{2!}$$

$${}^3C_2 = \frac{3!}{(3-2)!\,2!} = \frac{6}{1*2} = 3$$

Topic : Set

A well-defined unordered collection of distinct elements is called as set.

eg: $A = \{1, 2, 3, 4, 5, 6\}$

$B = \{1, 2, a, b, c\} = \{a, 1, 2, b, c\}$

order is not important

$C = \{a, 1, \text{Jan}, \text{Feb}, \text{Sat}, \text{Sun}\}$

$D = \{1, 1, 2, 3, a, a, b\} \Rightarrow$ Corresponding set will be $\{1, 2, 3, a, b\}$

Not a set

Slide

Topic : Representation of sets

There are three different ways in which set may be represented.

1. Roaster form or Tabular form:
2. Set-builder form:
3. Statement form:

Topic : Roaster form or Tabular form

We list all the elements of the set within " { } "

eg: $A = \{1, 2, 3, 4, 5\}$

$B = \{1, 2, 3, Jan, Feb\}$

$D = \{0, 0.15, 0.47, 0.98, 1.3, 1.79, 2.56, 3.33\}$

Slide

Topic : Set-builder form

- We define a property, and all the elements which satisfy that property will be members of the set.

eg: $A = \{ x \mid x \in N \text{ and } x \leq 5 \}$

- A is a set
- x that contains element 'x'
- $\mid$ such that "..."
- $x \in N$ and $x \leq 5$: Property that must be satisfied by the elements of the set

Slide

Topic : Set-builder form

it is a set containing all real numbers b/w 0 & 1

there are infinite real numbers b/w 0 & 1

eg: $C = \{ x \mid x \in R \text{ and } 0 \leq x \leq 1 \}$

Can not be represented in roaster form.

Slide

Topic : Statement form

A = Set of all natural numbers less than 6

C = Set of all real numbers b/w 0 & 1.

Slide

Topic : Cardinality of a set

Also known as "size of set"

Cardinality of a set A is defined as number of elements in set A.

It is denoted by $|A|$.

eg: $A = \{1, 2, 3, a, b\}$

$|A| = 5$

Slide

Topic : Types of sets

Empty Set: A set with no elements in it is called an Empty set.

$\Rightarrow$ If set A is an Empty set, $|A| = 0$

$\Rightarrow$ Empty set can be denoted by $\{\}$ or ϕ

$\therefore |\{\}| = 0$

&

$|\phi| = 0$

$\because |\{\phi\}| = ?$

$\{\phi\} = \{\{\}\}$

Slide

$\{\ \}$: it is an Empty set

$\{\emptyset\}$ or $\{\{\}\}$: It is a set containing one element

element of the set is an empty set.

$\therefore |\{\emptyset\}| = |\{\{\}\}| = 1$

$$|\{\{1, 2\}\}| = ?$$

$$= 1$$

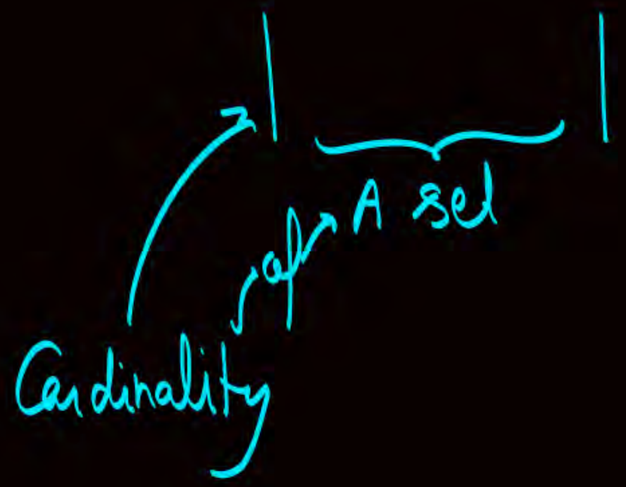
Set

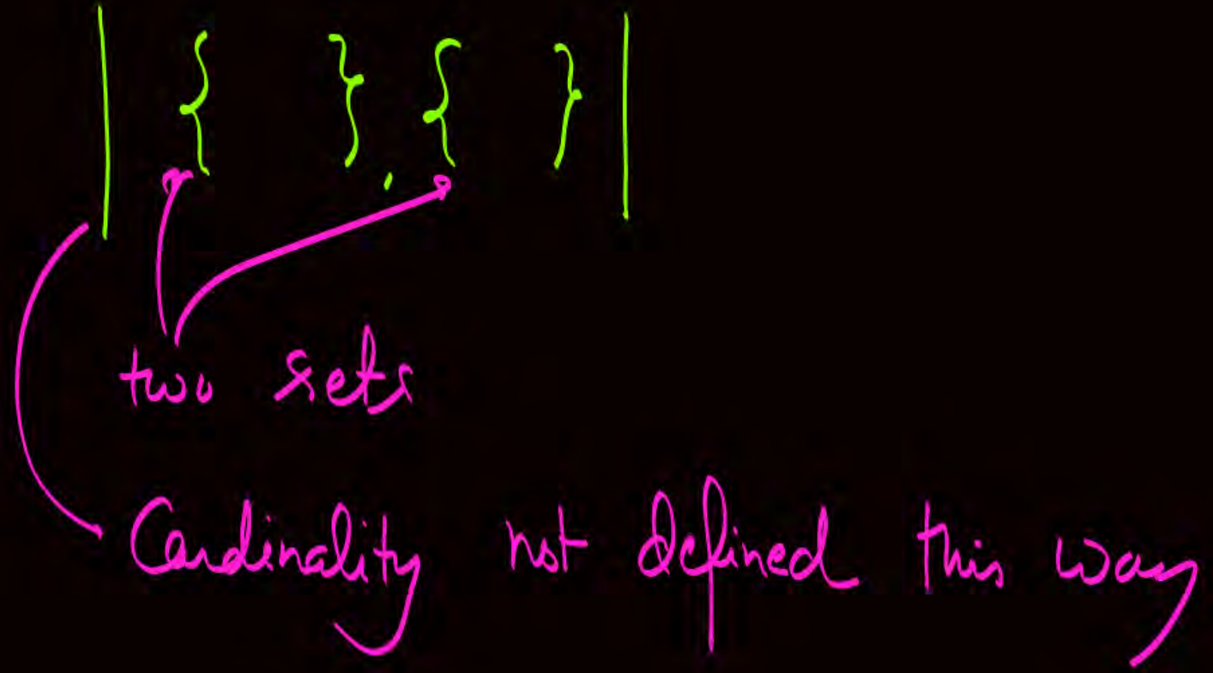
element of set

$|\{\{\{1, 2\}\}\}|$

Set

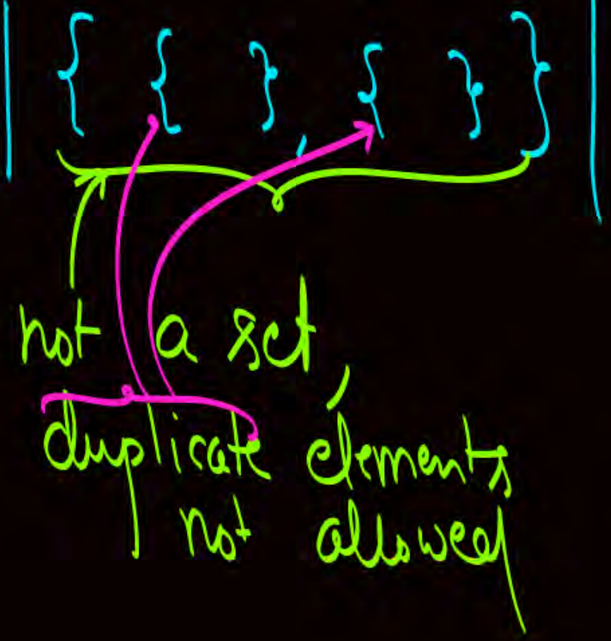
single element within the


|A|
Cardinality refers to a set


{ } { }
two sets
Cardinality not defined this way

eg: $|\{\{1\}, \{2\}\}| = 2$

eg: $|\{\{\}, \{\}\}| = ?$



$|\{1, 2, \{a,b,c\}, \{a,b\}, \{\{1,\{2,3\}\}\}\}| = 5$

① ② ③ ④ ⑤

$3\{\}$

2 mins Summary

Topic Sets and representation of sets

Topic Types of set

Topic Venn Diagram

Topic Set operations and Properties of set operations

Topic Multiset

THANK - YOU

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