



IT 1107 – Mathematics for IT



Sets & Basic Set Operations



Definition of set

A set is an unordered collection of zero or more distinct well defined objects

Eg:

$$A = \{1, 2, 3\}$$

$$B = \{\text{Numbers less than 10}\}$$

$$C = \{\text{All the positive numbers}\}$$

Set Theory Notations

Symbol	Meaning	Example
Upper case	Designates set name	$A = \{1, 2, 3\}$
Lower case	Designates set elements	$A = \{a, b, c\}$
$\{ \}$	a collection of elements	$A = \{3, 7, 9, 14\}$, $B = \{9, 14, 28\}$
\in or \notin	Is / is not an element of	$A = \{1, 2, 3\}$ $5 \notin A$ $1 \in A$
\subseteq	Is a subset of (includes equal sets)	$\{9, 14, 28\} \subseteq \{9, 14, 28\}$
\subset	Is a proper subset of	$\{9, 14\} \subset \{9, 14, 28\}$
$\not\subset$	left set not a subset of right set	$\{9, 66\} \not\subset \{9, 14, 28\}$



Properties of Sets

- Sets are inherently **unordered**

The order in which the elements are presented in a set is not important

$A = \{a, e, i, o, u\}$ and

$B = \{i, o, a, u, e\}$ both define the same set

- All elements are **distinct** (unequal)

One member does not appear more than once

$F = \{a, e, i, o, u, a\}$ is not a set since the element 'a' repeats



Elements

- The items contained in a set are called **elements** or **members** of the set
- Notation
 - \in means “is an element of”
 - \notin means “not an element of”
- Eg: $S = \{ x, y, z \}$
 - $x \in S$
 - $p \notin S$



Specifying set

- There are 2 ways to specify a set
 - Listing notation
 - List all the members of the set
 - Eg: $A = \{a, e, i, o, u\}$
 - Set builder notation
 - State those properties which characterized the members in the set
 - Eg: $B = \{x : x \text{ is an even integer}, x > 0\}$



Some common sets

- \mathbb{Z}
 - \mathbb{Z} is the set of all integers
 - $\mathbb{Z} = \{ \dots, -2, -1, 0, 1, 2, \dots \}$
 - \mathbb{Z}^+ - the set of positive integers
 - \mathbb{Z}^- - the set of negative integers
- \mathbb{N}
 - Set of non negative integers
 - $\mathbb{N} = \{0, 1, 2, 3, \dots\}$



- P
 - Set of prime numbers
 - $P = \{2, 3, 5, 7, 11, 13, \dots\}$
- Q
 - Set of rational numbers
 - $Q = \left\{ \frac{a}{b} : a, b \text{ integers}, b \neq 0 \right\}$
 - Q^+ - Set of positive rational numbers
 - Q^* - Set of non zero rational numbers



- \mathbb{R}
 - Set of all real numbers consisting of integers , rational numbers like $-\frac{3}{4}$, $\frac{22}{7}$ and irrational numbers like $\sqrt{2}$, π
 - \mathbb{R}^+ - Set of positive real numbers
 - \mathbb{R}^* - Set of non zero real numbers
- \mathbb{C}
 - Set of complex numbers



Equality of two sets

- A set “A” is equal to a set “B” if and only if both sets have same elements
- If set “A” and “B” are equal we write $A=B$
- Eg: $A = \{1,2,3,4,5\}$

$$B = \{x : x < 6, x \in \mathbb{Z}^+\}$$

$$C = \{1,2,3,4\}$$

Then $A=B$ and $A \neq C$



Cardinality of sets

- **Cardinality** refers to number of elements in a set
- Let “A” be any set. Then cardinality of “A” is denoted by $|A|$
- Eg: $A = \{a, e, i, o, u\}$
then $|A| = 5$



Finite Sets

- a finite set is a set that has a finite number of elements.
- It is countable
- Eg: $A = \{1, 3, 5, 7, 9\}$



Infinite Sets

- An infinite set is a set that is not a finite set.
- Infinite sets may be countable or uncountable.
- Eg: $A = \{ \text{all the negative numbers} \}$
 $B = \{ \text{all real numbers} \}$



Complement of a set

- The complement of a set “A” is the set of elements which belongs to the universal set but which does not belong to “A”
- This is denoted by A^c / \bar{A} / A'
- Eg: let $Y = \{ x: x \geq 0 \}$
then $Y' = \{x: x < 0 \}$