MATEMATIKA DISKRIT
Pertemuan 4

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Sets : an Introduction

Definition

A **set** is a collection of objects. The objects in a set are called its **elements** or **members**. The elements in a set can be any types of objects, including sets! The members of a set do not even have to be of the same type. For example, although it may not have any meaningful application, a set can consist of numbers and names.

We usually use capital letters such as A, B, C, S and T to represent sets, and denote their generic elements by their corresponding lowercase letters a, b, c, s and t, respectively.

Sets : an Introduction

To indicate that b is an element of the set B, we adopt the notation $b \in B$, which means "b belongs to B" or "b is an element of B". Consequently, saying $x \in \mathbb{R}$ is another way of saying x is a real number.

Definition (Subset)

Set A is a **subset** of Set B if and only if every element in Set A is also in Set B.
In symbols:

$$A \subset B \iff x \in A \to x \in B. \tag{1}$$

Notations

We designate these notations for some special sets of numbers:

$$\mathbb{N} = \text{the set of natural numbers}$$
$$\mathbb{Z} = \text{the set of integers}$$
$$\mathbb{Q} = \text{the set of rational numbers}$$
$$\mathbb{R} = \text{the set of real numbers}$$

Real Numbers and some Subsets of Real Numbers

All these are infinite sets, because they all contain infinitely many elements. In contrast, finite sets contain finitely many elements.

We list the natural numbers and integers while defining the rational, real and irrational numbers.

$$\mathbb{N} = \{1, 2, 3, ...\}$$
$$\mathbb{Z} = \{..., -3, -2, -1, 0, 1, 2, 3, ...\}$$

Definition (Rational Numbers)

A **rational number** is a number that can be expressed as a ratio of two integers (with the second integer not equal to zero). Hence, a rational number can be written as $\frac{m}{n}$ for some integers m and n, where $n \neq 0$

Definition (Real Numbers)

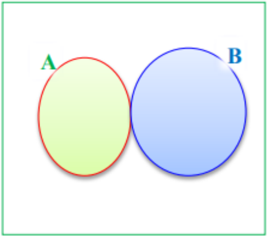
The **real numbers** are the numbers corresponding to all the points on the number line.

Definition (Irrational Numbers)

An **irrational number** is a real number that can not be expressed as a ratio of two integers; i.e., is not rational.

Pictorial Representation of a Set: Venn Diagrams

Pictorially, a non-empty set is represented by a **circle-like closed figure** inside a bigger rectangle. This is called a **Venn diagram**. See fig below



Pictorial Representation of a Set: Venn Diagrams

Some properties of subset:

1. Empty set is a subset of any set, that is $\{\} \subseteq A$ for any set A, thus $\{\} \subseteq \{\}$.
2. Any set is a subset of itself, that is for any set A, $A \subseteq A$.
3. $A = B$, if and only if $A \subseteq B$ and $B \subseteq A$

Operation on Sets

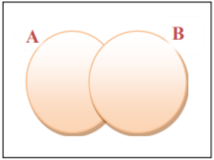
There are three types of set operations, Intersection denoted by $\cap$, Union denoted by $\cup$, and Complementation.

1. The **union** of A and B is denoted by $A \cup B$ and is defined as the set of all elements that are **A or B**. Thaut is : $\cup B = \{x : x \in A \ \text{ or } \ x \in B\}$
2. The **intersection** of A and B is denoted by $A \cap B$ and is defined as the set of all elements that are **A and B**. That is : $\cap B = \{x : x \in A \ \text{ and } \ x \in B\}$
3. The **Complement** of **B in A** is denoted by $A - B$ and is defined as the set of all elements that are **in A** but **not in B**. That is $A - B = \{x : x \in A \ \text{ and } \ x \notin B\}$
4. The **absolute complement** of set A denoted by A^c is defined by $A^c = \{x : x \in S \ \text{ and } \ x \notin A\}$, here S is the universal set.

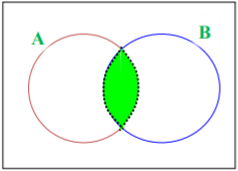
Venn Diagram : Example

The Universal Set is represented by a rectangle. The shaded regions represent, respectively, the union, intersection and complement of the sets A and B.

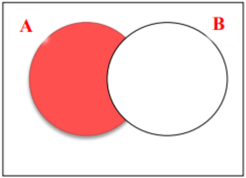
a) $A \cup B$



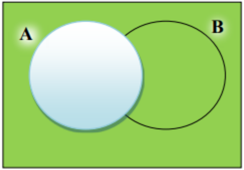
b) $A \cap B$



c) $A - B$



d) A'



Venn Diagram : Example

Let $S=\{1,2,3,4,5,6,7,8,9\}$, $A=\{1,2,3,4,5\}$, $B=\{4,5,6,7,8\}$ then

1. $A \cup B$
2. $A \cap B$
3. $A - B$
4. $B - A$
5. $\bar{A}$
6. $\overline{(A \cup B)}$