

# Mathematics-1 Sets and Functions

Topics : [Computer engineering](#)

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"Sets and Functions" is a fundamental topic in mathematics that serves as the building block for many other mathematical concepts. Here's an overview of what this chapter typically covers:

## 1. Introduction to Sets:

- Definition of a set: A collection of distinct objects.
- Representation of sets: Roster notation, set-builder notation.
- Cardinality of sets: Number of elements in a set.
- Subsets and supersets: Relationship between sets where every element of one set is also an element of another set (subset) or vice versa (superset).
- Universal set: Set containing all the objects under consideration.

## 2. Types of Sets:

- Finite set: A set with a countable number of elements.
- Infinite set: A set with an uncountable number of elements.
- Empty set (null set): A set with no elements.
- Singleton set: A set with exactly one element.
- Equal sets: Sets having exactly the same elements.
- Power set: Set of all subsets of a given set.

## 3. Operations on Sets:

- Union of sets: Combination of all elements from two or more sets.
- Intersection of sets: Elements common to all sets.
- Difference of sets: Elements present in one set but not in another.
- Complement of a set: Elements not belonging to the set within a universal set.
- Cartesian product: Set of all ordered pairs from two sets.

## 4. Venn Diagrams:

- Graphical representation of sets using circles or rectangles.
- Illustration of set operations (union, intersection, difference, complement) using Venn diagrams.

## 5. Functions:

- Definition of a function: A relation between two sets where each input has exactly one output.

- Domain and range: Set of all possible inputs and outputs of a function, respectively.
- Types of functions: One-to-one (injective), onto (surjective), and bijective functions.
- Composite functions: Combination of two or more functions.
- Inverse functions: Function that "undoes" the original function.

## 6. Special Functions:

- Identity function: Function where the output is equal to the input.
- Constant function: Function where the output is the same constant value for all inputs.
- Polynomial function: Function defined by a polynomial expression.

Sure, let's illustrate "Sets and Functions" with examples:

### Sets:

#### ◦ Finite Set Example:

- Let's consider a set  $A = \{1, 2, 3, 4\}$ . This is a finite set because it has a countable number of elements.
- Another example of a finite set could be the set of weekdays:  $B = \{\text{Monday, Tuesday, Wednesday, Thursday, Friday}\}$ .

#### ◦ Infinite Set Example:

- The set of natural numbers:  $N = \{1, 2, 3, \dots\}$  is an infinite set because it continues indefinitely.
- Similarly, the set of real numbers is also infinite.

#### ◦ Empty Set Example:

- Let's denote the empty set as  $\emptyset$  or  $\{\}$ . It is a set with no elements.
- For example, the set of even numbers that are odd:  $C = \{x \mid x \text{ is an even number and } x \text{ is odd}\} = \emptyset$ .

#### ◦ Union and Intersection Example:

- Let  $A = \{1, 2, 3\}$  and  $B = \{3, 4, 5\}$ . The union of A and B is  $A \cup B = \{1, 2, 3, 4, 5\}$ .
- The intersection of A and B is  $A \cap B = \{3\}$ .

#### ◦ Complement Example:

- Let's consider a universal set  $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ . If  $A = \{2, 4, 6, 8\}$ , then the complement of A is  $A' = \{1, 3, 5, 7, 9, 10\}$ .

#### ◦ Functions:

#### ◦ One-to-One (Injective) Function Example:

- Let's define a function  $f: A \rightarrow B$  where  $A = \{1, 2, 3\}$  and  $B = \{a, b, c\}$  such that  $f(1) = a$ ,  $f(2) = b$ , and  $f(3) = c$ .
- This function is one-to-one because each element in A maps to a unique element in B.

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◦ **Onto (Surjective) Function Example:**

- Consider a function  $g: A \rightarrow B$  where  $A = \{1, 2, 3\}$  and  $B = \{a, b\}$ . Let  $g(1) = a$ ,  $g(2) = b$ , and  $g(3) = b$ .
- This function is onto because every element in  $B$  is mapped to by at least one element in  $A$ .

◦ **Composite Function Example:**

- Suppose we have two functions  $f: X \rightarrow Y$  and  $g: Y \rightarrow Z$ . Let  $f(x) = x^2$  and  $g(y) = 2y$ .
- The composite function  $h(x) = g(f(x)) = 2(x^2)$ .

◦ **Inverse Function Example:**

- Let's define a function  $f: A \rightarrow A$  where  $A = \{1, 2, 3, 4\}$  such that  $f(1) = 2$ ,  $f(2) = 3$ ,  $f(3) = 4$ , and  $f(4) = 1$ .
- The inverse function of  $f$ , denoted as  $f^{-1}$ , would be such that  $f^{-1}(2) = 1$ ,  $f^{-1}(3) = 2$ ,  $f^{-1}(4) = 3$ , and  $f^{-1}(1) = 4$ .

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