<u>SETS AND FUNCTIONS</u> jasveena-224001588

- sets are collection of objects : here objects can be anything. For example, in a set of numbers the elements will be numbers, in a set of words the elements can be other related words or even alphabets.
- Functions : it is a way to manipulate or identify objects from sets, functions in sets are related to functions in programming somewhat. Functions help to identify what kind of a relation a particular function represents.

HOW TO DEFINE SETS ?

The objects in a set are called elements.

- A set is denoted using the curly braces {}
- $\in$ **denotes "belongs to"**
- $\notin$ denotes "doesn't belong to"
- the uppercase letters denote the sets and the lowercase letters denote the elements in the sets.

  For Example :

  A= set of numbers <5

  A = { 4,3,2,1}

  B = $\{x \in \mathbb{N} : x < 4\}$

  B= {1,2,3}

There are some commonly used number sets which we denote by specific letters, for example,

- $\mathbb{N}$ The set of natural numbers: **{1, 2, 3, 4, …}**
- $\mathbb{Z}$ The set of integers: **{0, ±1, ±2, …}**
- $\mathbb{Q}$ The set of rational numbers: a/b, for a, b integers, $b \neq 0$
- $\mathbb{R}$ The set of real numbers, which includes $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$, and irrational numbers

- $\mathbb{C}$ The set of complex numbers: $x + iy$, for x, y real, $i^2 = -1$

The universal set is denoted by U, whereas a null set is denoted by { } or ø.

SUBSETS AND PROPER SUBSETS

- A is called a subset of B if all the elements of A are there in B. it is denoted by $A \subset B$
- For Example : A = {1, 2, 3, 4 ,5 }
  B = { 1,2,3,4,5,6,7,8,9} so A is a subset of B.
- We use $A \not\subset B$ to denote that A is not a subset of B.

OPERATIONS ON SETS

UNION OF SETS

A union of set is nothing but combining all the elements of the given sets.

It is denoted by $A \cup B$.

For example A={1,2,3,4,5,6}

B= { 7,8,9}

so A U B = { 1,2,3,4,5,6,7,8,9}

INTERSECTION OF SETS

Intersection means finding the common elements of the two sets and creating a new set.

For example :

A= {1,2,3,4,5,6}

B= {2,3,4,5,6,7,8,9}

$A \cap B$ = { 2,3,4,5,6}

COMPLEMENT OF SETS

Complement of a set is the set of all elements a universal set U, but not in A, and is denoted by $\bar{A}$ or A'

OR

The complement of a set is the set that includes all the elements of the universal set that are not present in the given set.

DIFFERENCE OF SETS

The **set difference** of ***A*** and ***B*** is the set of all elements in ***A*** excluding those in ***B***, and is denoted by $A \backslash B$ or $A - B$.

LAWS IN SETS

$A \cap U = A$ Identity laws.

$A \cap \emptyset = A$

$A \cap U = U$ Domination laws

$A \cap \emptyset = \emptyset$

$A \cap A = A$ Impodent laws

$A \cup A = A$

$\overline{\overline{A}} = A$ Double Complement laws

$A \cap B = B \cap A$ Commutative laws

$A \cup B = B \cup A$

$(A \cap B) \cup C = A \cap (B \cap C)$ Associative laws

$(A \cup B) \cup C = A \cup (B \cup C)$

$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ Distributive laws

$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

$\overline{A \cap B} = \overline{A} \cup \overline{B}$ De morgan's law

$\overline{A \cup B} = \overline{A} \cap \overline{B}$

$A \cup \overline{A} = U$ Complement law

$A \cap \overline{A} = \emptyset$

$A \cap (A \cup B) = A$ Absorption law

$A \cup (A \cap B) = A$

FUNCTIONS

An easy definition of what a function is, could be "functions are the expressions, rules or laws that define a relationship between one variable and the other." Functions are also called **mappings** or **transformations**. For example :

- Let ***X*** and ***Y*** be sets. A **function *f*** from ***X*** to ***Y*** assigns each element of ***X*** to exactly one element in ***Y***.
- In $f : X \rightarrow Y$, (i.e. ***f*** maps ***X*** to ***Y***):

  X is called the **domain** of ***f***.

  Y is called the **co-domain** of ***f***.

- $f(x) = y$:

  y is referred to as the **image** of ***x***.

  x is the **pre-image** of ***y***.

EXAMPLES OF FUNCTIONS :

- $f : \mathbb{R} \rightarrow \mathbb{R} : f(x) = x^2$
- $f : \mathbb{R} \rightarrow \mathbb{R}$: f(x) = y = x (identity function)
- $f : \mathbb{R} \rightarrow \mathbb{R}$: f(x) = y = c (constant function)
- $f : \mathbb{R} \rightarrow \mathbb{R}$: f(x) = |x| (modulus function)
- $f : \mathbb{R} \rightarrow \mathbb{R}$: f(x) = [x] (greatest integer function)

some more examples of functions include;

Floor function

The **floor function** takes an input ***x*** and outputs the greatest integer less than or equal to ***x***.

For example f(5.5)= [5.5]= 5

Ceiling function

The **ceiling function** takes an input ***x*** and outputs the smallest integer greater than or equal to ***x***.

For example f (5.5)= [5.5] = 6

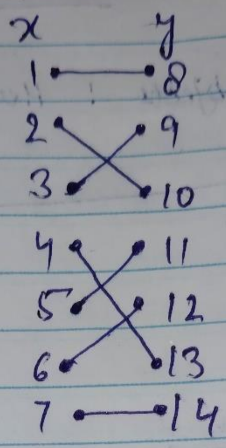
INJECTIVE FUNCTIONS

A function is called an injective function when all the elements in the codomain have at most one pre image in the domain.

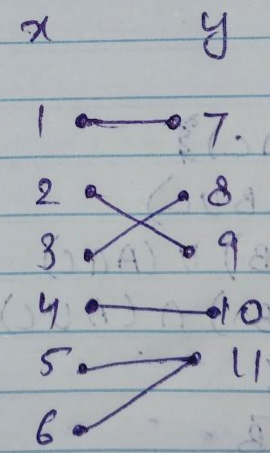
SURJECTIVE FUNCTIONS

A function is called a surjective function when all the elements in the codomain have atleast one pre image in the domain.

INJECTIVE



SURJECTIVE



REFLECTIONS

WHAT IS THE MOST IMPORTANT THING YOU LEARNED FROM THIS MODULE ?

The most important thing I learned from this module was the operation with sets.

HOW IS THIS USEFUL ?

It is useful as it kind of makes segregating the data quite easily.

HOW DOES THIS RELATE TO WHAT YOU ALREADY KNOW ?

This whole task was based on sets and functions and except for one or two new concepts I was already familiar with everything as I studied it in school.

Why do you think your course teams wants you to learn the content of this module ?

I think this module is the basis of discrete mathematics and since this topic works with data. It will be quite useful in future.