CS0001

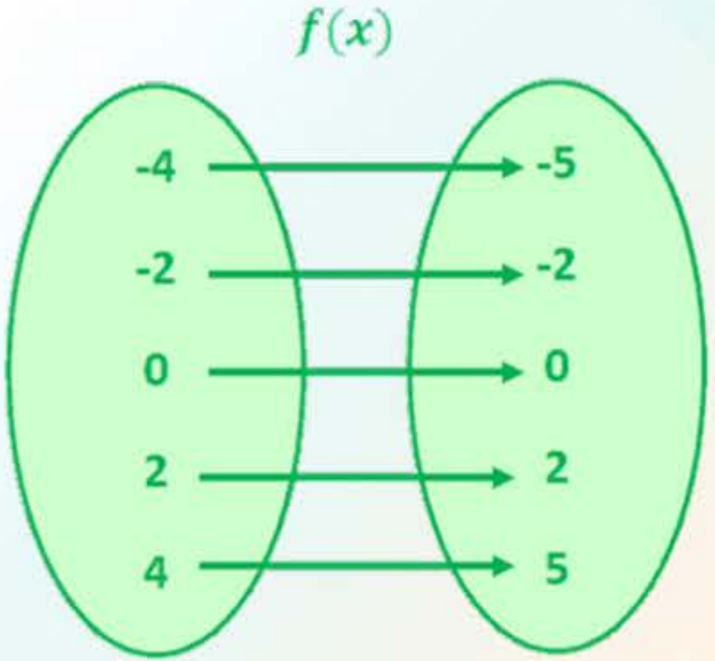
# Discrete Structures 1

## Subtopic 1: Introduction to Functions

# FUNCTIONS

A **Function 'f'** from a **set A** to a **set B** is a **special relation** that follows two specific rules:

1. **Every element** in set A must be paired with an element in set B.
2. Each element in set A can **only be paired with exactly one element** in set B




If *f* is a function from A to B, we write ***f* : A → B**.

# FUNCTIONS

The core components of a function: **Domain** and **Codomain**.

**Domain (The "Input" Set)**

The Domain is the complete set of all possible **input values** that a function can accept.
Think of it as the "from" set, often labeled 'X'.

**Codomain (The "Potential Output" Set)**

The Codomain is the complete set of all potential **output values** the function could produce.

This is the "to" set, often labeled 'Y'.

# FUNCTIONS

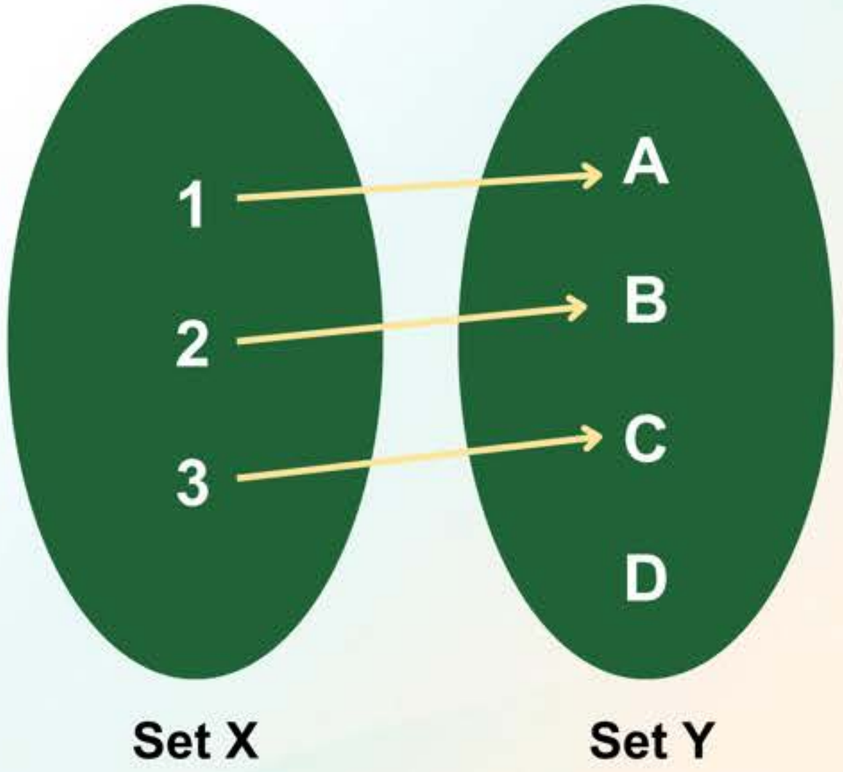
**Given the function notation:**

f: X→Y

Domain (Set X): {1, 2, 3}

Codomain (Set Y): {A, B, C, D}

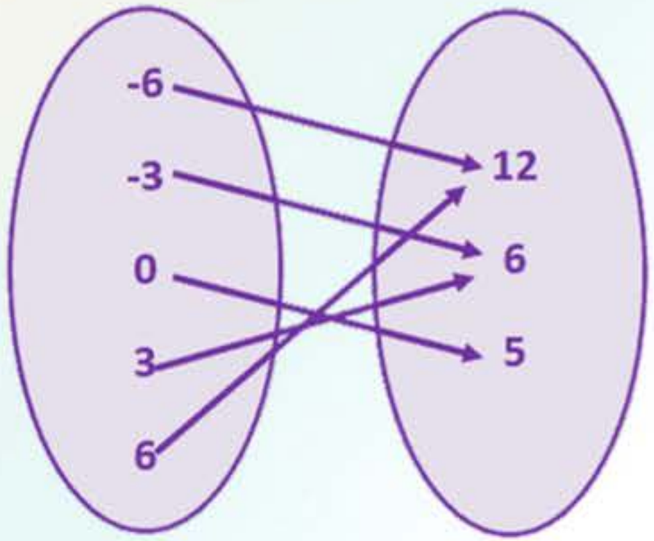
**Key Point:** The Codomain is the **entire** set {A, B, C, D}.
The **Range** (the set of **actual** outputs) is only {A, B, C}.
The element 'D' is in the **Codomain**, but not in the Range.



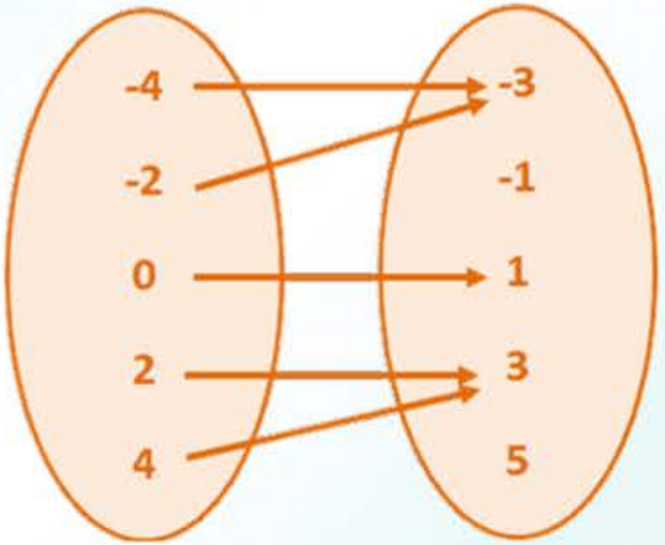
# FUNCTIONS

By definition, which of the following is **not a function**?

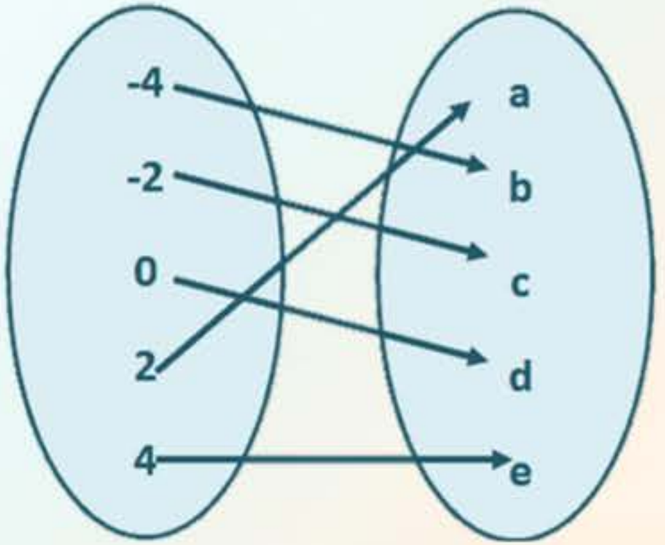
$g(x)$




$m(x)$

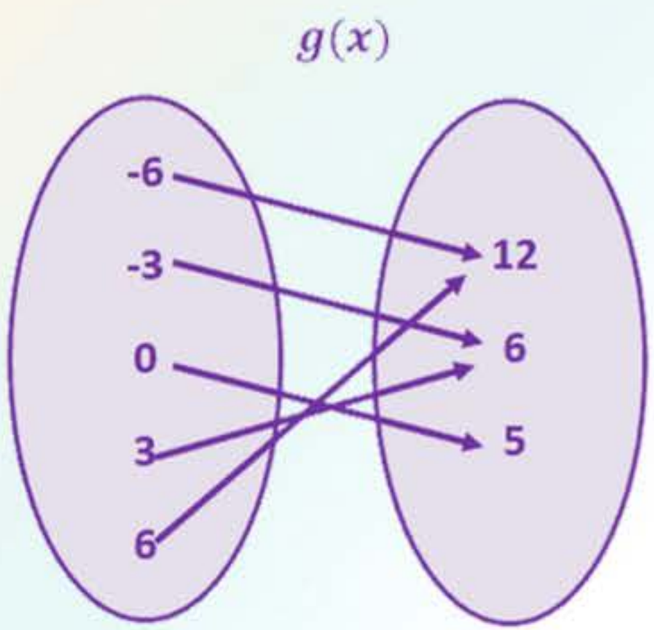


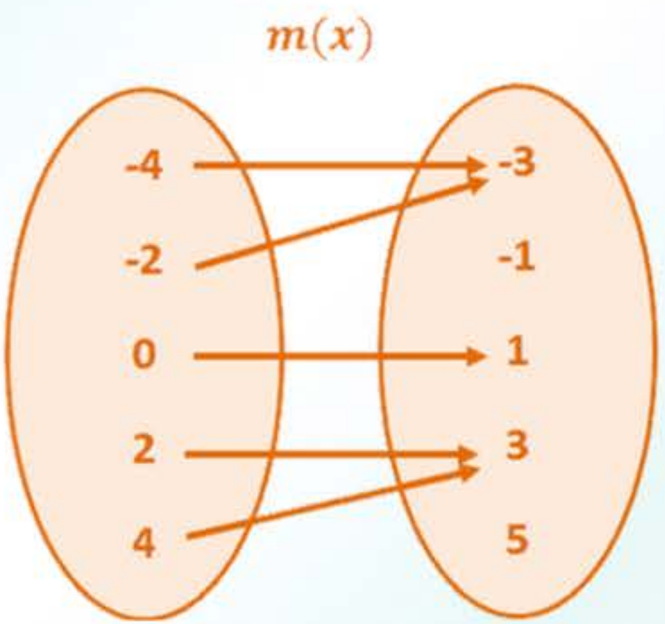

$n(x)$

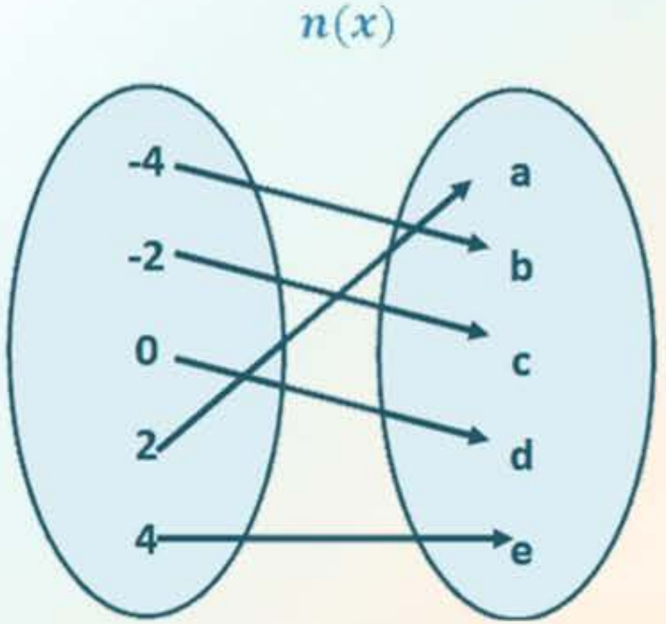


# FUNCTIONS

By definition, which of the following is not a function?




**NONE**. All of them are functions.

# FUNCTIONS

Let us compare the two.

**Figure 1**

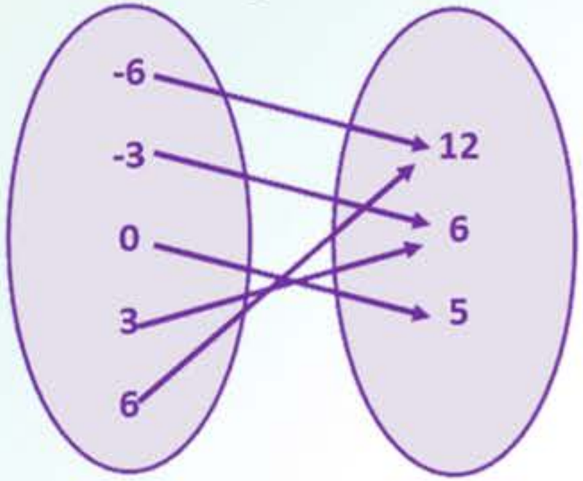
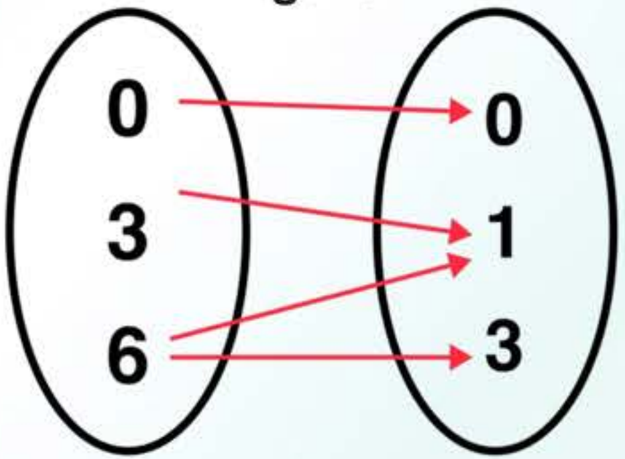



**Figure 2**




**The relation is a not function.**

*Note: It is okay for multiple elements in A to map to the same element in B.*

Figure 1 is a function because every input value has exactly one output value.
Figure 2 **is not a function** because the input value '6' maps to two different output values ('1' and '3').

# FUNCTIONS

Let's use a new **domain (X)** and **codomain (Y)**:
X = {a, b, c, d}
Y = {10, 20, 30, 40, 50}

Identify if it is a **FUNCTION** or **NOT A FUNCTION**.

- $f_1$ = {(a, 20), (b, 30), (c, 10), (d, 40)}
- $f_2$ = {(a, 10), (b, 10), (c, 50), (d, 50)}
- $f_3$ = {(a, 10), (b, 20), (a, 30), (d, 40)}
- $f_4$ = {(a, 40), (c, 10), (d, 20)}

# FUNCTIONS

Let's use a new **domain (X)** and **codomain (Y)**:
X = {a, b, c, d}
Y = {10, 20, 30, 40, 50}

Identify if it is a **FUNCTION** or **NOT A FUNCTION**.

- $f_1$ = {(a, 20), (b, 30), (c, 10), (d, 40)} **FUNCTION**
- $f_2$ = {(a, 10), (b, 10), (c, 50), (d, 50)} **FUNCTION**
- $f_3$ = {(**a**, 10), (b, 20), (**a**, 30), (d, 40)} **NOT A FUNCTION**
- $f_4$ = {(a, 40), (c, 10), (d, 20)} **NOT A FUNCTION**

*The input 'b' from set X is not mapped to any output. A function must use every element in the domain.*