BS CS

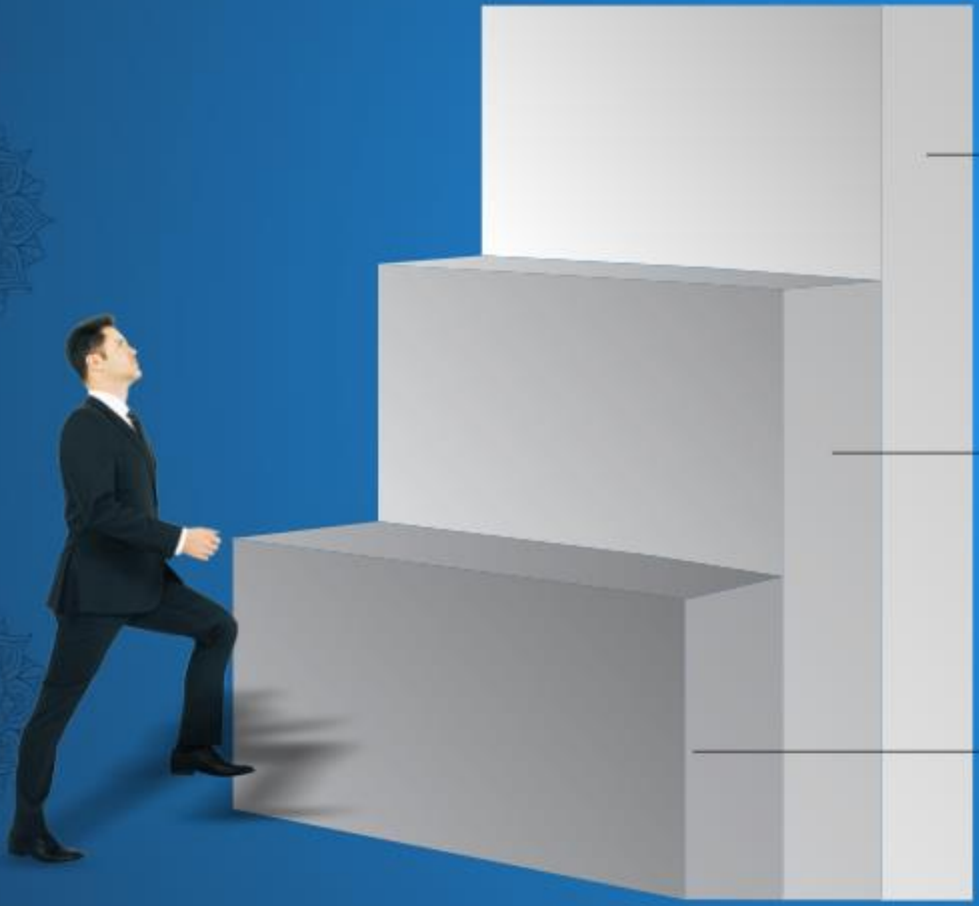
DISCRETE MATHEMATICS

Topic:

FUNCTIONS

Introduction to Functions and Relations

Understanding Functions and Relations in Discrete Mathematics



1. **Definition of Functions and Relations**

   Functions and relations explain how elements from one set interact with elements from another set, forming crucial mathematical relationships.

2. **Significance in Mathematical Modeling**

   These concepts are essential for building models that simulate real-world situations in various fields including engineering and economics.

3. **Applications in Computer Science**

   Functions and relations are widely used in algorithms, data structures, and database management, making them integral to computer science.

Understanding Functions

A relation *f* from a set *X* to *Y*, is called *function*, denoted $f: X \longrightarrow Y$, is a relation from *X*, the *domain*, to *Y*, the *co-domain*.

Have you thought how a relation becomes a function?

- ✓ Domain of Relation R is = X (First Set)
- ✓ There is no repetition in the first elements of Relation.

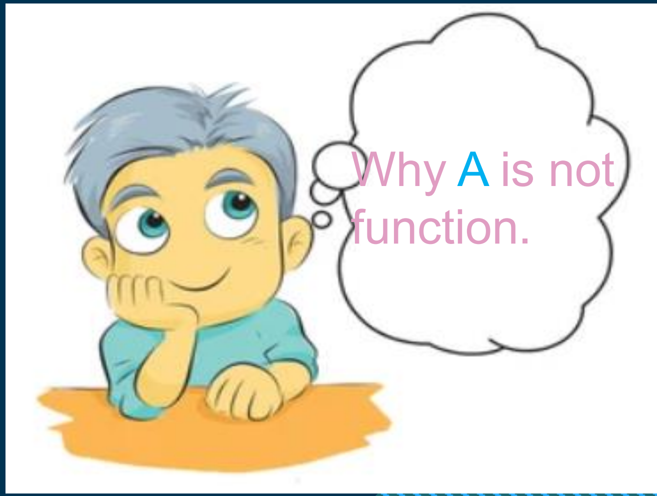
Let's solve an example:

X= { 2,4,6}
Y= {1,3,5,7}
Let's check the following relation is a function:

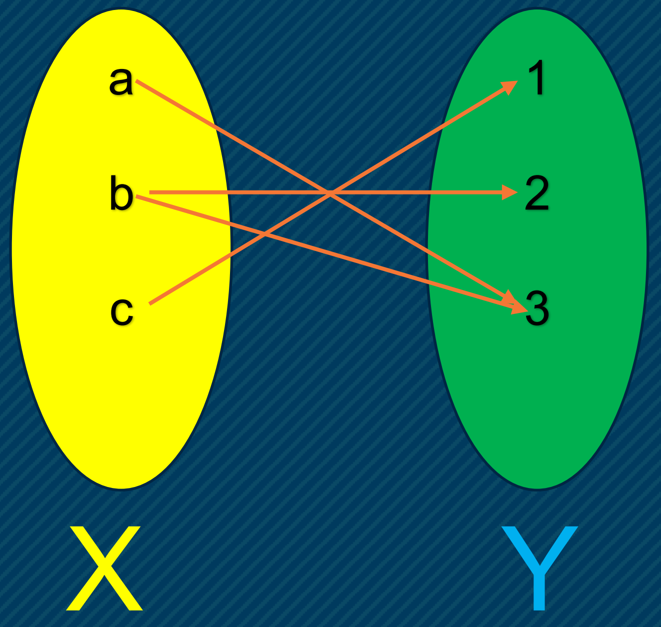
- R1 = { (2,1),(2,3),(2,5),(4,7) }
- R2 = { (4,5),(6,5),(6,7) }
- R3 = { (2,3),4,5),(6,7) }

- *R1 is not a function, because 6∈ X* does not appear as first element in any ordered pair in R1.
- *R2 is not a function, because the ordered pairs (6,5) and (6,7) have the first element and 2 ∈ X* does not appear as the first element in ordered pair in R2.
- *R3 defines a function.*

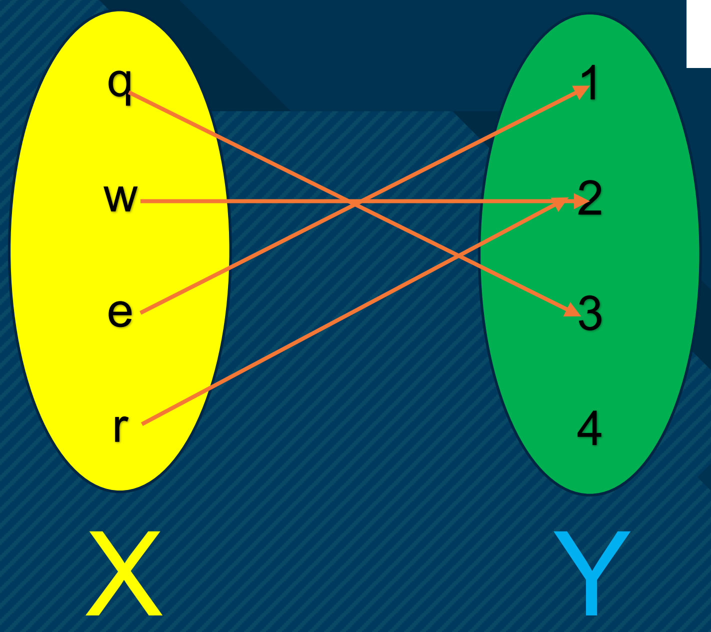
Let's understand this from a diagram:



A.



B.



B is a function

Types of

Injective Function

OR

Into

Surjective

OR

Onto

Bijective Function

AND

One-to-One Function

One-to-One (1-1):

DEFINITION:

f is one-to-one if it takes distinct points of the domain to distinct points of the co-domain.

Example:

X = {2,4,5}

Y = {1,2,4,6}

X x Y =

{(2,1),(2,2),(2,4),(2,6),(4,1),(4,2),(4,4),(4,6),(5,1),5,4),(5,6) }

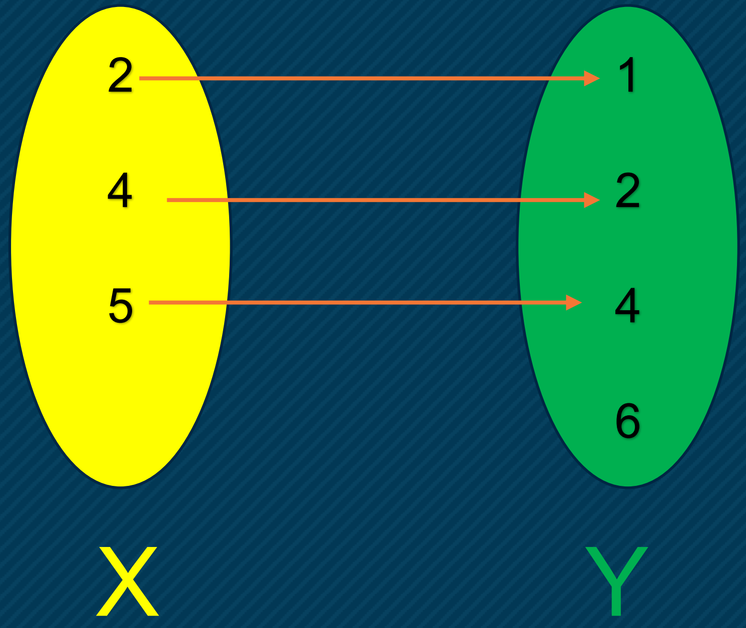
R = { (2,1),(4,2),(5,4) }

Domain of R = {2,4,5}

Range of R = {1,2,4}

As you see Domain of R = X and first elements of R doesn't repeat .

So, R is a function.



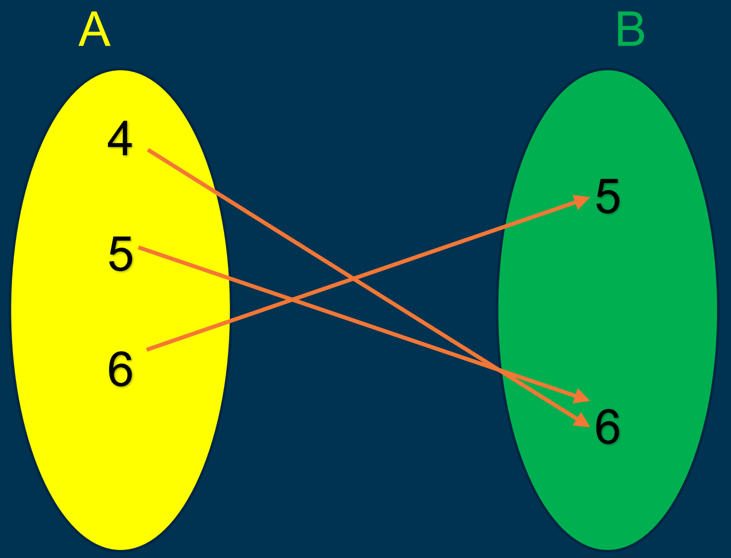
Range of R is a proper subset of Y
Range R $\subset$ Y . So, it is an
Into/injective function.'
It is also one-to-one function.

SURJECTIVE/ONTO:

DEFINITION:

A function $f:A \rightarrow B$ is surjective (onto) if every element in B is the image of at least one element in A. This means the range of f is equal to the codomain of B.

Example:

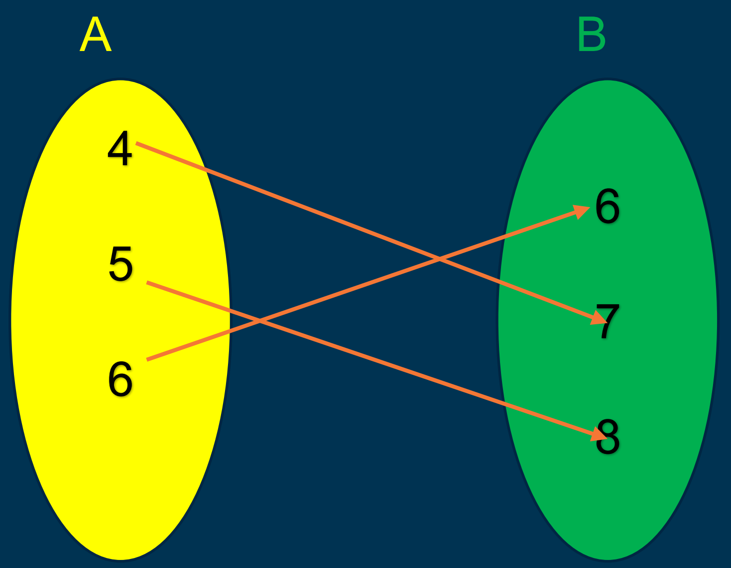


A = {4,5,6}
B = {5,6}
F is a relation from A x B
R = {(4,6),(5,5),(6,6)}
Range of R = A
As you see first elements of R doesn't repeat . So, R is a function.
Range = B
So, it is an onto function.

BIJECTIVE FUNCTION:

A function $f:A \to B$: is bijective if it is both one-to-one and surjective. This means every element in A maps to a unique element in B, and every element in B is covered.

EXAMPLE:



A = {4,5,6}

B = {6,7,8}

R is relation from A x B

R = { (4,6),(5,7),(6,8)}

As you see Domain of R=A and first elements of R doesn’t repeat . So, R is a function.

Range of R = B (onto) and also there is one to one linkage.

So, it’s a Bijective function.

THANKSFOR YOUR TIME.