

## RELATIONS

$$A = \{a, b, c\}$$

$$B = \{\text{antman}, \text{batman}, \text{catwoman}, \text{captainamerica}, \text{ironman}\}$$

$$A \times B = \{(a, \text{antman}), (a, \text{batman}), \dots, (c, \text{ironman})\}$$

$(x, y)$   
 $\checkmark$        $\times$

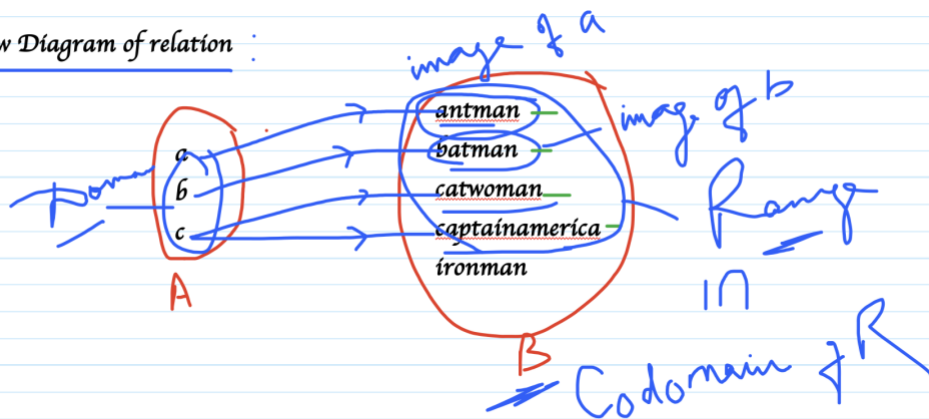
①  $R = \{(x, y) : x \text{ is the first letter of } y, x \in A, y \in B\}$  ✓ Set builder

②  $R = \{(a, \text{antman}), (b, \text{batman}), (c, \text{catwoman}), (c, \text{captainamerica})\}$  → Roster  
 $R \subseteq B$

Ways to represent Relation

1. Set-builder form
2. Roster method
3. Diagrammatic/Arrow Diagram

3. Arrow Diagram of relation :



- A relation  $R$  from a non-empty set  $A$  to a non-empty set  $B$  is a subset of the  $A \times B$ .
- The subset  $R$  is derived by describing a relationship b/w 1st element & 2nd element of ordered pairs of  $A \times B$
- The second element is called the image of the first element
- The set of all first elements of the ordered pairs of  $R$  → Domain of  $R$

$$D = \{a, b, c\}$$

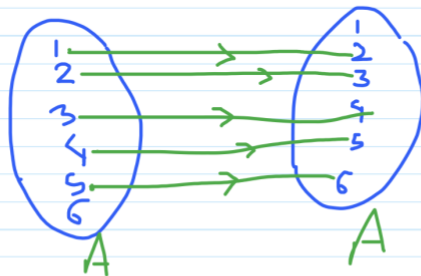
The set of all 2nd elements of  $R$  is called Range of  $R$

Range of  $R = \{\text{antman, batman, catwoman, captainamerica}\}$

ex -  $A = \{1, 2, 3, 4, 5, 6\}$

$R$  from  $A \rightarrow A$  by  $R = \{(x, y) \mid y = x+1\}$

1. Represent the relation using arrow diagram ✓
2. Write down Domain, Range, & codomain of  $R$



$R = \{(1,2), (2,3), (3,4), (4,5), (5,6)\}$

Domain =  $\{1, 2, 3, 4, 5\}$

Range =  $\{2, 3, 4, 5, 6\}$

Codomain =  $A = \{1, 2, 3, 4, 5, 6\}$

ex -  $A = \{1, 2, 3\}$ ,  $B = \{3, 4\}$ . Find the number of relations from  $A$  to  $B$

$R$  is subset of  $A \times B$ .  $n(A \times B) = 3 \times 2 = 6$

$R$  is a set of cardinality 6.  $R$  is a set of 6 ordered pairs (elements)

Number of subsets of  $R = 2^6 = 64$

ex - Write the relation  $R = \{(x, x^3) : x \text{ is a prime number} < 10\}$  in Roster form.

$A = \{x : x \text{ is prime, } x < 10\}$

$A = \{2, 3, 5, 7\}$

$R = \{(x, x^3) : x \in A\}$

$R = \{(2, 8), (3, 27), (5, 125), (7, 343)\}$

ex-  $A = \{1, 2, 3, 5\}$ ,  $B = \{4, 6, 9\}$ . Define a relation  $R$  from  $A$  to  $B$  by  
 $R = \{(x, y) : \text{the difference of } x \text{ \& } y \text{ is odd; } x \in A, y \in B\}$   
 Write  $R$  in roster form.

$$A \times B = 12$$

$$R = \{(\underline{1}, \underline{4}), (\underline{1}, \underline{6}), (2, 9), (\underline{3}, \underline{4}), (\underline{3}, \underline{6}), (\underline{5}, \underline{4}), (\underline{5}, \underline{6})\}$$

