



IT 1002 – Mathematics for Computing



Relations



Ordered Pair

- an **ordered pair** (a, b) is a pair of mathematical objects.
- The order in which the objects appear in the pair is significant
- $(a,b)=(c,d)$ if and only if $a=c$, $b=d$



Cartesian Product

- The cartesian product of two sets A and B, denoted $A \times B$, is the set of all ordered pairs (a,b) where $a \in A$ and $b \in B$.
- $A \times B = \{ (a,b) \mid a \in A, b \in B \}$
- Eg: Let $A=\{1,2\}$ and $B=\{a,b,c\}$
- $A \times B = \{(1,a),(1,b),(1,c),(2,a),(2,b),(2,c)\}$
- Note :

$$A \times B \neq B \times A$$

$$n(A \times B) = n(A) \times n(B)$$



Relation

- Let A , B be two sets. A relation from A to B is a subset of $A \times B$.
- Suppose R is a relation on A and B. then R is a set of ordered pairs where each first element comes from A and each second element comes from B
- $(a,b) \in R$ “a is related to b” written aRb
- $(a,b) \notin R$ “a is not related to b” written $a\not Rb$



Domain

- Domain of a relation R from A to B is the set of all first elements of the ordered pairs which belongs to R. it is a subset of A
- Eg: Let $A=\{1,2\}$ and $B=\{a,b,c\}$
 $R= \{(1,a),(1,b),(2,b)\}$
Domain of R = {1,2}



Range

- Range is the set of all second elements and it is a subset of B
- Eg: Let $A=\{1,2\}$ and $B=\{a,b,c\}$
 $R= \{(1,a),(1,b),(2,b)\}$
Range of R = {a,b}



Inverse Relation

- Let R be any relation from set A to set B . The inverse of R denoted by R^{-1} is the set of all ordered pairs (y,x) such that (x,y) is an element of R
- $R^{-1} = \{ (b,a) \mid (a,b) \in R \}$
- Note: Domain & Range of R^{-1} are respectively range & domain of R



Universal Relation

- Let A be any set. Then $A \times A$ is called the universal relation of A
- Eg: Let $A = \{1, 2, 3\}$
Then universal relation set is $R = \{(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)\}$



Empty Relation

- ϕ is called the empty relation or void relation
- $A \times \phi = \phi$



Equality Relation / Identity Relation / Diagonal Relation

- In an identity relation R every element of the set A is related to itself only.
- $R=\{(x,x) : \text{for all } x \in A\}$
- Eg: Let $A = \{1,2,3\}$
Then the identity relation set is $R=\{(1,1),(2,2),(3,3)\}$