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(Lecture 21,22) Relations to Matrices.

Ques- $A = \{1,2,3\}$, $B = \{1,2\}$

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

Cross product $(A \times B)$

$(1,1),(1,2)$
$(2,1),(2,2)$
$(3,1),(3,2)$

Cross product will tell us about the rows and columns of matrix and pairs in relation will be 1 in matrix and other will be 0.

$$m = \begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$$

Ques- $A = \{1,2,3\}$

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

Cross product $(A \times A)$

$(1,1),(1,2),(1,3)$
$(2,1),(2,2),(2,3)$
$(3,1),(3,2),(3,3)$

$$m = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

Now find out Relation type in above matrix.

For Reflexive:-

If diagonal elements in a Matrix are same than it is Reflexive.

$$\begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

For Symmetric:-

Write Transpose of matrix, if it is same as original then it is Symmetric.

$$T = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

Anti-Symmetric:-

If Transpose is not same than it is Anti-Symmetric.

To Add up Two Matrices (OR)

$$M_{r1} = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}, \quad M_{r2} \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix} \quad M_{r1} \cup M_{r2} = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

(It is like OR operation)

Intersection of Matrices (It is like And operation)

$$M_{r1} = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}, \quad M_{r2} = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix} \quad M_{r1} \cap M_{r2} = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

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Composite Relations

In, composite relations, we actually multiply the matrices.

Question:-

$$M_r = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad M_s = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$

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

$$S = \{(1,1), (1,3), (2,3), (3,1), (3,3)\}$$

$$RoS = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

multiply like this with every one.

$$RoS = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

$$RoS = \{(1,1), (1,3), (3,1), (3,3)\}$$

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Chapter 8

Graphs

A graph $G = (V, E)$, consists of V, a non-empty set of vertices and E, a set of edges.

Graph Terminology

Types	Edges	multiple edges allowed	Loops allowed
Simple graph	Undirected	No	No
Multigraph	Undirected	Yes	No
Pseudograph	Undirected	Yes	Yes
Simple directed graph	Directed	No	No
Directed multigraph	Directed	Yes	Yes
Mixed graph	both	Yes	Yes

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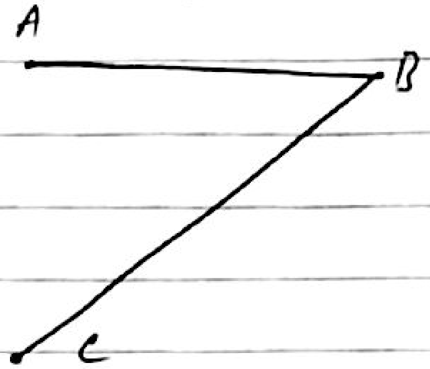
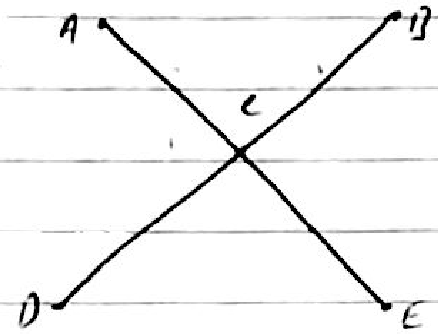
Some Examples of Graphs:-

i)



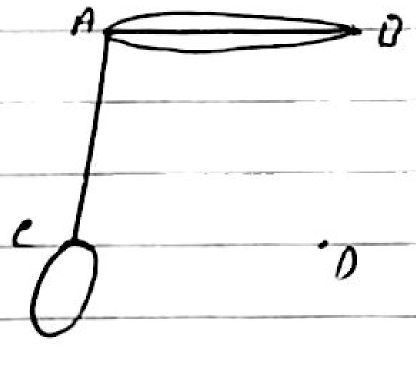
Multigraph

ii)



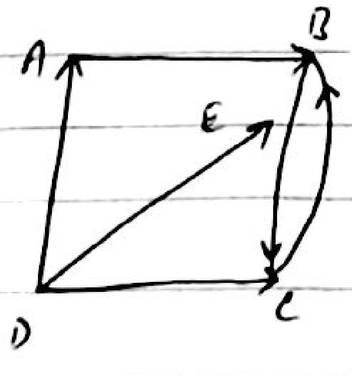
Simple graph or Multigraph

iii)



Pseudograph

iv)



Directed Multigraph