Relation Part II

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Relation Matrix

Relation Matrix

- Let **A** and **B** are two non-empty sets with **|A| =** $\boldsymbol{m}$ and **|B| =** $\boldsymbol{n}$. Let **R** be a relation **A** to **B**.
- Then the relation **R** can be represented by a $\boldsymbol{m}$ $\boldsymbol{x}$ $\boldsymbol{n}$ matrix denoted by a $\boldsymbol{M_R}$ and this matrix is called **adjacency matrix**.

Relation Matrix

$$\boldsymbol{M_R} = [M_{ij}]_{mXn}$$

Where,

$$M_{ij} = \begin{cases} 1, if\ elements\ belongs\ \boldsymbol{R} \\ 0, if\ elements\ are\ not\ belongs\ to\ \boldsymbol{R} \end{cases}$$

Relation Matrix

- **Example:**

A = {1, 2, 3, 4}

B = {x, y, z}

R = {(1,x), (1,y), (2,y), (3,z), (4,x,), (4,y),(4,z)}

$$M_{ij} = \begin{cases} 1, if\ elements\ belongs\ \boldsymbol{R} \\ 0, if\ elements\ are\ not\ belongs\ to\ \boldsymbol{R} \end{cases}$$

$$\boldsymbol{M_R} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{ccc} x & y & z \end{array} \\ \begin{bmatrix} \mathbf{1} & \mathbf{1} & 0 \\ 0 & \mathbf{1} & 0 \\ 0 & 0 & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} \end{bmatrix} \end{array}$$

Question

Q1. What is the relation matrix of following relation **R**?

A = {a, b, c, d}

B = {1, 2, 3, 4}

R = {a,1),(a,3),(b,2),(b,4),(c,1),(c,4),(d,2),(d,4)}

Diagraph of Relation On Sets

Diagraph

- A **directed graph** also called **diagraph**, is a graph in which the edges have a **direction**.
- When a **relation** is defined on a **set A** then we can represent the relation by a diagraph.

Diagraph

- First the element of **A** are written down.
- Then **arrows** are drawn from each element $\boldsymbol{x}$ to each element $\boldsymbol{y}$ whenever

$$\boldsymbol{(x, y) \epsilon R}$$

Diagraph

- **Example**:

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

$$R = \{(a,a),(a,b),(a,c),(b,b),(b,a),(b,c),(c,a),(c,b)\}$$

- Here **A** is the set and **R** is the relation on set **A**.
- Represent the relation **R** by its **digraph**.

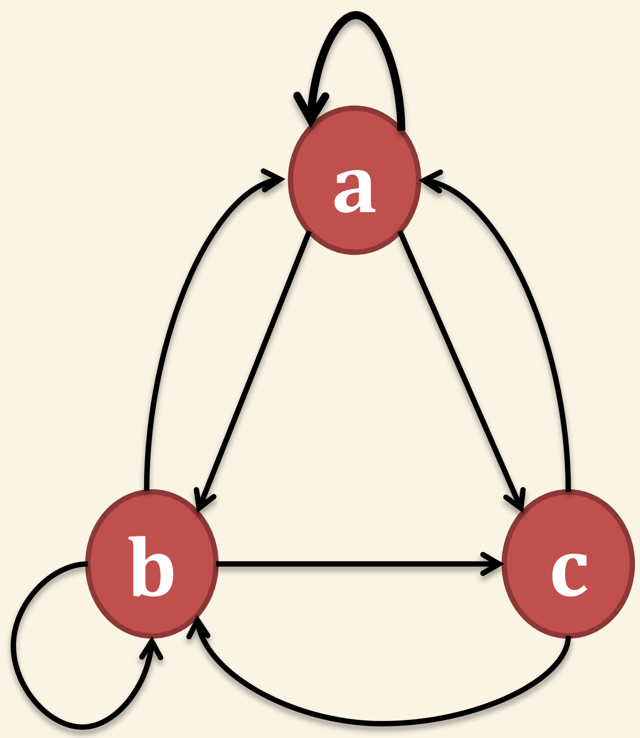
Diagraph

- **Solution**:

A = {a, b, c}

R = {(a,a),(a,b),(a,c),(b,b),(b,a),(b,c),(c,a),(c,b)}

- First of all, we represent all the element of A by small circles.
- Then we will show the relation.

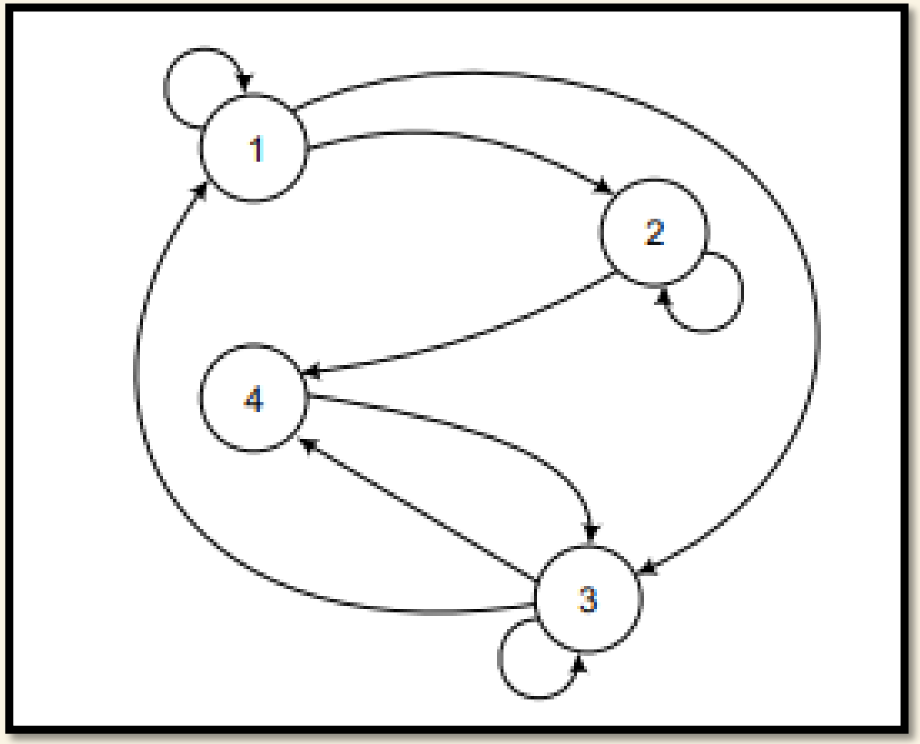


Question

Q1. Represent the relation R by its diagraph?

A = {1, 2, 3, 4}

R = {(1,1),(1,2),(1,3),(2,2),(2,4),(3,1),(3,3),(3,4),(4,3)}



Operations on Relations

Operations on Relations

- **Union** and **Intersection** of two relation **R** and **S.**
- If **R** and **S** are two relations from set **A** to set **B**, then

$$R \cup S = All\ elements\ of\ set\ \boldsymbol{A}\ and\ \boldsymbol{B}$$

$$R \cap S = Common\ element\ of\ set\ \boldsymbol{A}\ and\ \boldsymbol{B}$$

Operations on Relations

- **Example:**

A = {a, b, c}

R = {(**a,a**),(a,b),(**a,c**),(b,c),(b,b),(**c,c**)}

S = {(**a,a**),(b,a),(**a,c**),(c,b),(**c,c**)}

$R \cup S =$ {(a,a),(a,b),(a,c),(b,c),(b,b),(c,c),(b,a),(c,b)}

Operations on Relations

- **Example:**

A = {a, b, c}

R = {(**a,a**),(a,b),(**a,c**),(b,c),(b,b),(**c,c**)}

S = {(**a,a**),(b,a),(**a,c**),(c,b),(**c,c**)}

$R \cap S = \{(a,a),(a,c),(c,c)\}$

Question

Q1. Perform the **Union** and **Intersection** operation on **R** and **S** relation.

$$A = \{1, 2, 3, 4\}$$

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

$$S = \{(1,1),(1,3),(2,3),(3,4),(4,4)\}$$

Covering and Partition

Covering

- For a set **S**, and **A** is a **subset** of set **S** and **Union** of **A = S**, then set **A** is called **covering**.

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

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

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

$A \cup A = S$

Partition

- For a set **S**, and **A** is a **subset** of set **S** and **Intersection** of **A** is **empty** then **A** is called **partition**.

S = {a, b, c}

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

$A \cap A = \emptyset$

Thank You