

UTM
Exercise 1

Write the relation R as $(x,y) \in R$

(a) The relation R on $\{1, 2, 3, 4\}$ defined by $(x,y) \in R$ if $x^2 \geq y$.

(b) The relation R on $\{1, 2, 3, 4, 5\}$ defined by $(x,y) \in R$ if 3 divides $x-y$.

INSPIRING CREATIVE AND INNOVATIVE MINDS

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

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

UTM
Exercise 12

The relation R on the set $\{1, 2, 3, 4, 5\}$ defined by the rule $(x,y) \in R$ if $x \geq y$

(i) List the elements of R
(ii) Find the domain of R
(iii) Find the range of R
(iv) Is the relation R reflexive, symmetric, asymmetric, antisymmetric, transitive, and/or equivalence relation or partial order?

INSPIRING CREATIVE AND INNOVATIVE MINDS

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

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

(iii) Range = $\{1, 2, 3, 4, 5\}$

(iv) The relation R is not reflexive because $(5,5) \notin R$

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

$M_R = M_R^T$

\therefore It is symmetric

$(1,2) \in R, (2,1) \in R$

\therefore Its not antisymmetric

Its not irreflexive and antisymmetric

\therefore Its not asymmetric

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

$(m_{25} = 0) \neq (n_{25} = 1)$

$(2,1), (1,5) \in R$, but $(2,5) \notin R$

\therefore Its not transitive

For equivalence relation,

• It is symmetric but its not transitive and reflexive.

\therefore Its not equivalence relation

For partial order,

• Its not antisymmetric, transitive and reflexive

\therefore Its not partial order

The relation R on the set $\{1,2,3,4,5\}$ defined by the rule $(x,y) \in R$ if 3 divides $x-y$

- List the elements of R
- Find the domain of R
- Find the range of R
- Is the relation of R reflexive, symmetric, asymmetric, antisymmetric, transitive, and/or equivalence relation or partial order?

INSPIRING CREATIVE AND INNOVATIVE MINDS

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

$$(ii) \text{Domain} = \{1, 2, 3, 4, 5\}$$

$$(iii) \text{Range} = \{1, 2, 3, 4, 5\}$$

(iv) It is reflexive because $(x,y) \in R$

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

$$M_R = M_R^T$$

\therefore It is Symmetry

$$(1,4) \in R, (4,1) \in R$$

\therefore It is not antisymmetric

It is not irreflexive and antisymmetric

\therefore It is not asymmetric

$$M_R = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

$$(M_{11}=1), (M_{44}=1)$$

\therefore It is transitive because $(1,4), (4,1) \in R, (1,1) \in R$

For equivalence relation,

It is reflexive, symmetry and transitive.

\therefore It is equivalence relation

For partial order,

It is reflexive, transitive but not antisymmetric.

\therefore It is not partial order