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CSED261: Discrete Mathematics for Computer Science
Homework 6: Relations

Question 1. Determine whether the relation R on the set of all real numbers is reflexive, symmetric, antisymmetric, and/or transitive, where $(x, y) \in R$ if and only if

1. $x + y = 0$.
2. $x = \pm y$.
3. $x - y$ is a rational number.

Solutions

Question 2. Represent each of these relations on $\{1, 2, 3, 4\}$ with a matrix (with the elements of this set listed in increasing order).

1. $\{(1, 2), (1, 3), (1, 4), (2, 3), (2, 4), (3, 4)\}$
 2. $\{(1, 1), (1, 4), (2, 2), (3, 3), (4, 1)\}$
 3. $\{(1, 2), (1, 3), (1, 4), (2, 1), (2, 3), (2, 4), (3, 1), (3, 2), (3, 4), (4, 1), (4, 2), (4, 3)\}$
 4. $\{(2, 4), (3, 1), (3, 2), (3, 4)\}$
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Solutions

Question 3. Suppose that the relation R is reflexive. Show that R^* is reflexive.

Solutions

Question 4. Suppose that the relation R is irreflexive. Is the relation R^2 necessarily irreflexive?

Solutions

Question 5. Which of these relations on the set of all people are equivalence relations? Determine the properties of an equivalence relation that the others lack.

1. $\{(a, b) \mid a \text{ and } b \text{ are the same age}\}$
2. $\{(a, b) \mid a \text{ and } b \text{ have the same parents}\}$
3. $\{(a, b) \mid a \text{ and } b \text{ share a common parent}\}$
4. $\{(a, b) \mid a \text{ and } b \text{ have met}\}$
5. $\{(a, b) \mid a \text{ and } b \text{ speak a common language}\}$

Solutions

Question 6. Let R be the relation on the set of ordered pairs of positive integers such that $((a, b), (c, d)) \in R$ if and only if $ad = bc$. Show that R is an equivalence relation.

Solutions