

CS 191
Homework 7

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Section 4.1, Exercise 1. Write down all of the properties that each of the following binary relations satisfies from among the five properties: reflexive, symmetric, transitive, irreflexive, and antisymmetric.

g. The “is brother of” relation on the set of people.

Answer: Irreflexive, Transitive.

Let R be a binary relation on set A . R is irreflexive if $(x,x) \notin R$ for $x \in A$. A cannot be a brother of itself. So, R is irreflexive. R is transitive if xRy and yRz implies xRz for $x,y,z \in A$. If A is brother of B and B is a brother of C then, A is a brother of C . So, R is transitive. X cannot be a brother to itself. So, X is not reflexive. Similarly, let A be a son and B be a daughter. A is a brother of B does not implies that B is a brother of A . So, R is not symmetric. Finally, if A and B have a same brother then that does not imply that A and B are same. So R is not antisymmetric.

h. The “has a common national language with” relation on countries

Answer: Reflexive, Symmetric

Let R be a binary relation on set A , R is reflexive if xRx for all $x \in A$. A country X will always have the same common language which implies xRx . So, R is Reflexive. R is symmetric if xRy and yRx for $x,y \in A$. We can say that If language of A and B are same then language of B and A are same which implies xRy and yRx . So, R is symmetric. If A and B have same common language then it does not imply that A and C have same common language. So, R is not transitive. It is also not true that a country A can have different common language. So, R is not Irreflexive. Similarly, if A and B have same common language then we cannot say country A and B are the same. So, R is not antisymmetric.

Exercise 2. Write down all of the properties that each of the following relations satisfies from among the properties of reflexive, symmetric, transitive, irreflexive, and antisymmetric.

b. $R = \{(a,b) | a^2 = b^2\}$ over the real numbers.

Answer: Reflexive, Symmetric, Transitive

c. $R = \{(x,y) | x \bmod y = 0 \text{ and } x,y \in \{1, 2, 3, 4\}\}$.

Answer: Reflexive, Antisymmetric, Transitive

Exercise 5 b. Write suitable names for each of the following compositions.

$\text{isSisterOf} \circ \text{isParentOf}$.

Answer: isAuntOf

Exercise 13. Find the transitive closure of each of the following relations over the set $\{a,b,c,d\}$

c. $\{(a,b), (b,a)\}$

Answer: $\{(a, b), (b, a), (a, a), (b, b)\}$

d. $\{(a, b), (b, c), (c, d), (d, a)\}$

Answer: $\{(a, b), (b, c), (c, d), (d, a), (a, a)\}$