

CS 173 Lecture B, September 24, 2015

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Relations

Binary relations are sets of ordered pairs, expressing relationship (of some sort). Thus, a binary relation R on a set S is a subset of $S \times S$.

A binary relation is finite if the number of elements in the set is finite...

Properties of binary relations

Properties of binary relations R on a set S that are often interesting.

- ▶ Reflexive: $\forall x \in S, (x, x) \in R$
- ▶ Irreflexive: $\forall x \in S, (x, x) \notin R$
- ▶ Symmetric: $\forall x \in S, \forall y \in S, (x, y) \in R \Rightarrow (y, x) \in R$
- ▶ Anti-symmetric: $\forall x \in S$ and $\forall y \in S$, if $(x, y) \in R$ and $(y, x) \in R$, then $x = y$.
- ▶ Transitive: $\forall x \in S, y \in S, z \in S$, if $(x, y) \in R$ and $(y, z) \in R$, then $(x, z) \in R$

Take these definitions literally!

Consider the relation R on $A = \{1, 2, 3\}$ with only one element in it: $(2, 2)$. Thus, $R = \{(2, 2)\}$.

Questions:

1. Is R reflexive?
2. Is R irreflexive?
3. Is R symmetric?
4. Is R anti-symmetric?
5. Is R transitive?

Take these definitions literally!

Consider the relation R on $B = \{2\}$ with only one element in it: $(2, 2)$. Thus, $R = \{(2, 2)\}$.

Questions:

1. Is R reflexive?
2. Is R irreflexive?
3. Is R symmetric?
4. Is R anti-symmetric?
5. Is R transitive?

Take these definitions literally!

Consider the relation R on $B = \{2\}$ where $R = \emptyset$.

Questions:

1. Is R reflexive?
2. Is R irreflexive?
3. Is R symmetric?
4. Is R anti-symmetric?
5. Is R transitive?

Take these definitions literally!

Consider the relation R on $B = \{1, 2\}$ where $R = \{(1, 2), (2, 1)\}$.

Questions:

1. Is R reflexive?
2. Is R irreflexive?
3. Is R symmetric?
4. Is R anti-symmetric?
5. Is R transitive?

Take these definitions literally!

Consider the relation R on $B = \{1, 2\}$ where $R = \{(1, 2), (2, 1), (1, 1), (2, 2)\}$.

Questions:

1. Is R reflexive?
2. Is R irreflexive?
3. Is R symmetric?
4. Is R anti-symmetric?
5. Is R transitive?

Take these definitions literally!

Consider the relation R on $B = \{1, 2\}$ where $R = \{(1, 1), (2, 2)\}$.

Questions:

1. Is R reflexive?
2. Is R irreflexive?
3. Is R symmetric?
4. Is R anti-symmetric?
5. Is R transitive?