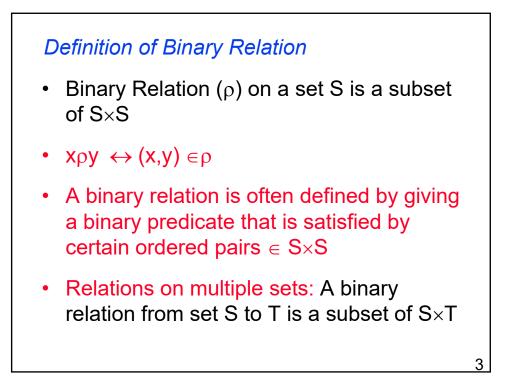
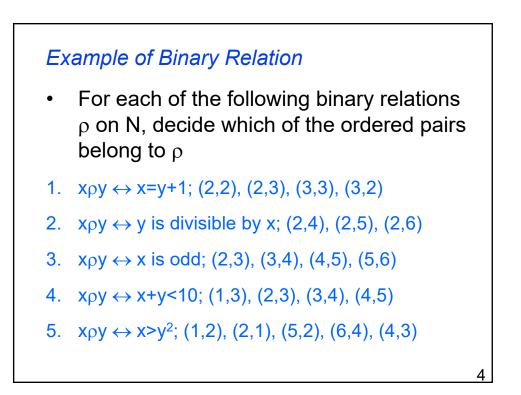


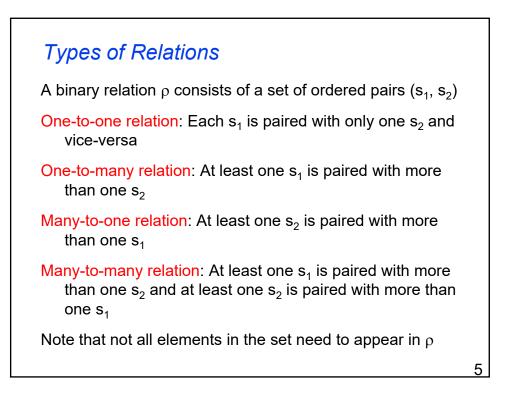
- Binary Relations
- Different kinds of relations (one-to-one, etc.)
- Properties of relations (transitive, etc.)
- Closures of relations
- Partial Orderings
- Equivalence Relations
- Section 4.1 of text

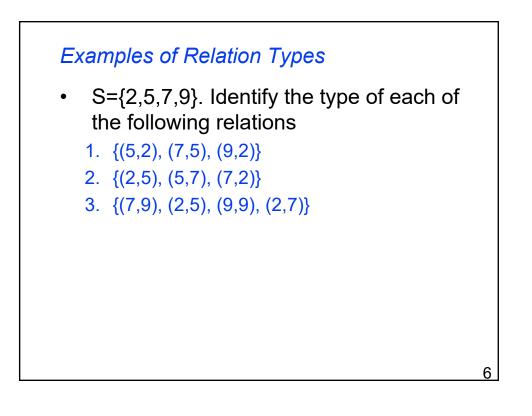
Binary Relation

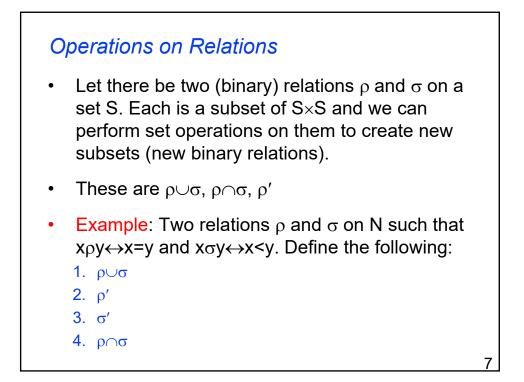
- Cartesian product of a set S with itself, $S{\times}S$
- S={1,2,3}
- $S \times S = \{(1,1), (1,2), (1,3), (2,1), (2,2), (2,3), (3,1), (3,2), (3,3)\}$
- A (binary) relation is a subset of S×S
- Example: Equality relation
- Example: Less than relation

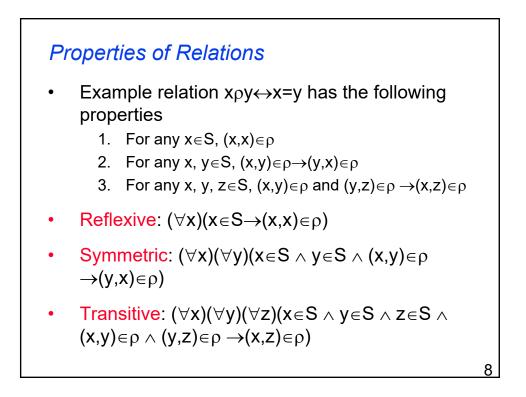


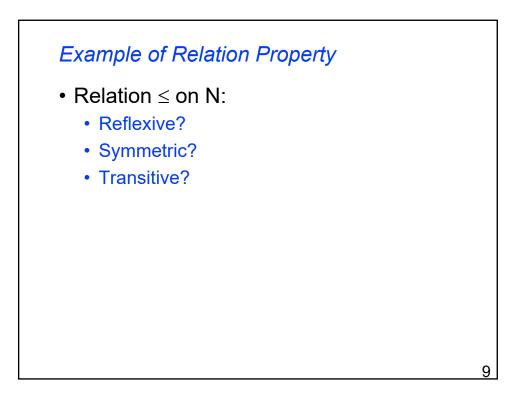


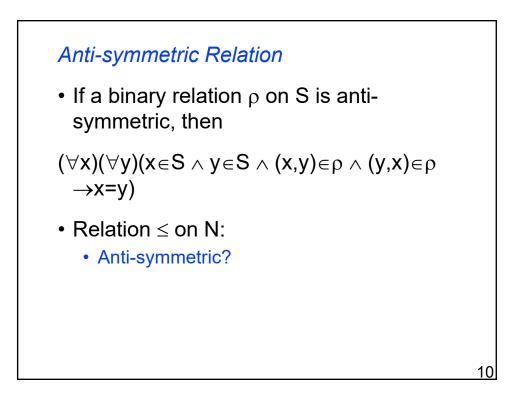


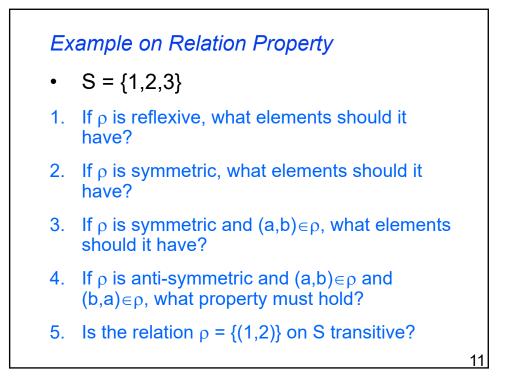


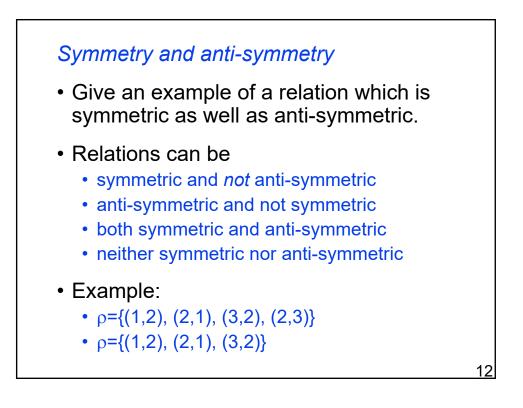


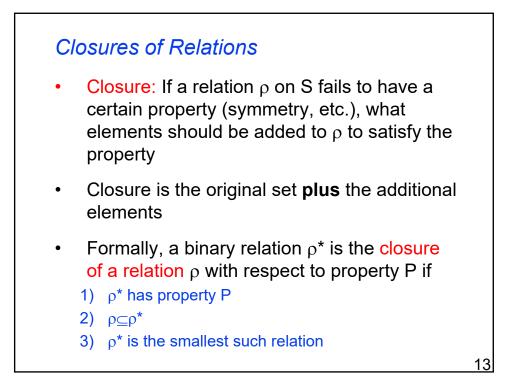


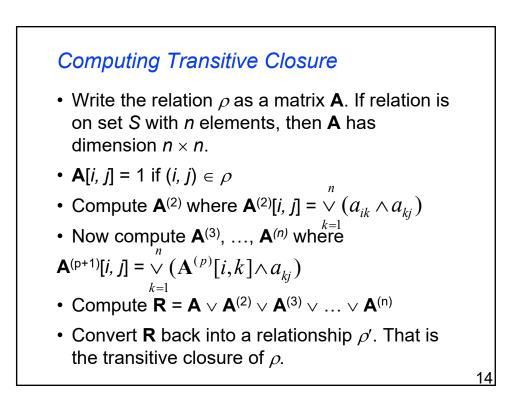








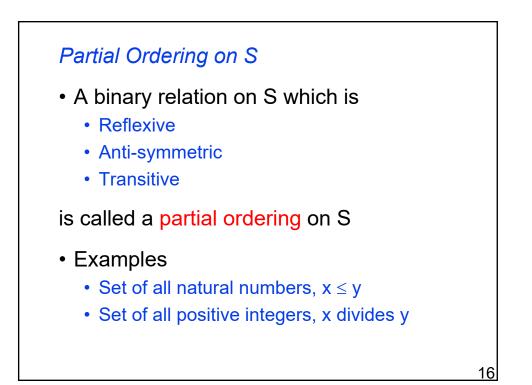


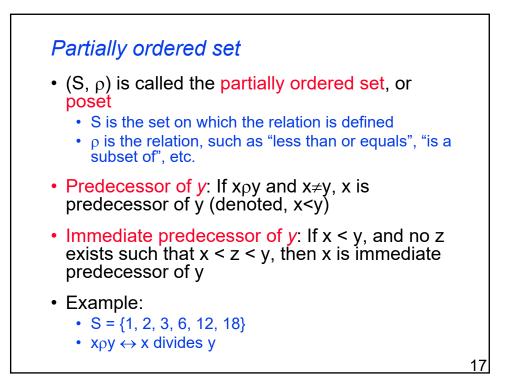


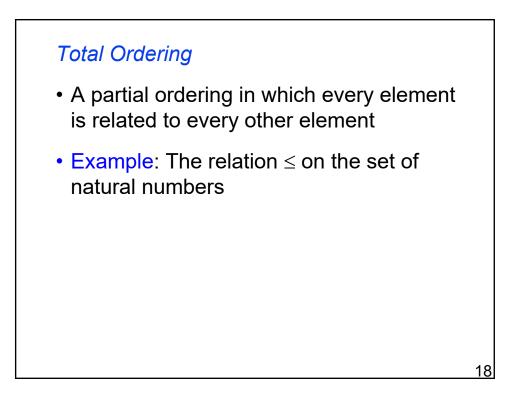
Example of Closure

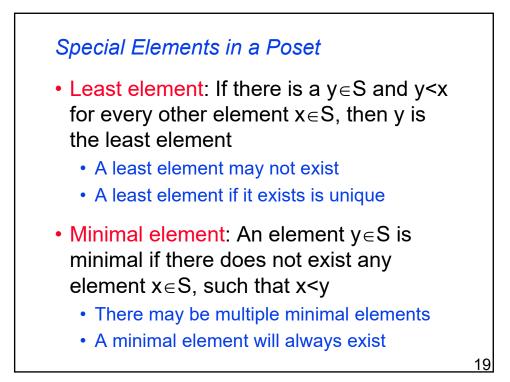
- S={1,2,3}
- $\rho = \{(1,1), (1,2), (1,3), (3,1), (2,3)\}$
- 1. What is the reflexive closure of ρ ?
- 2. What is the symmetric closure of ρ ?
- 3. What is the transitive closure of ρ ?
- 4. What is the anti-symmetric closure of ρ ?

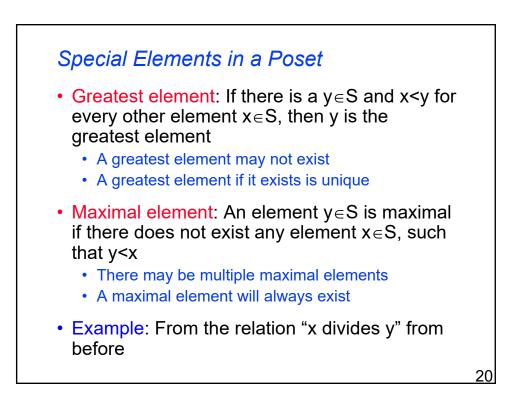
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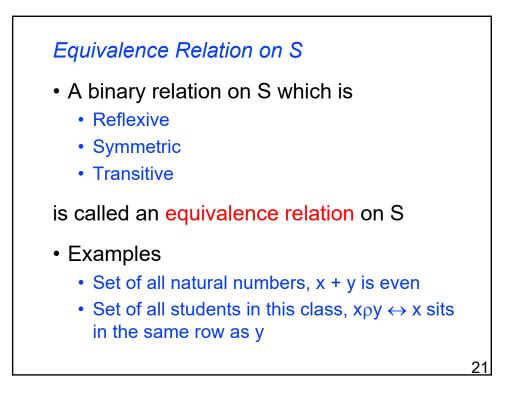


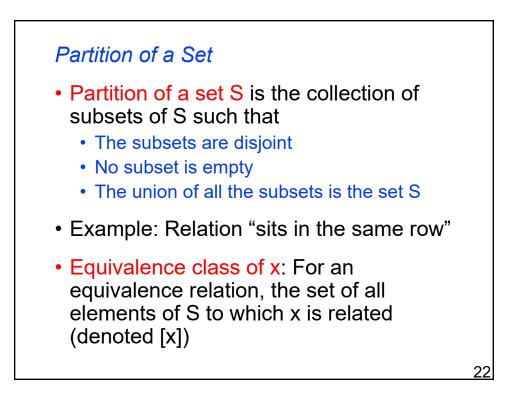


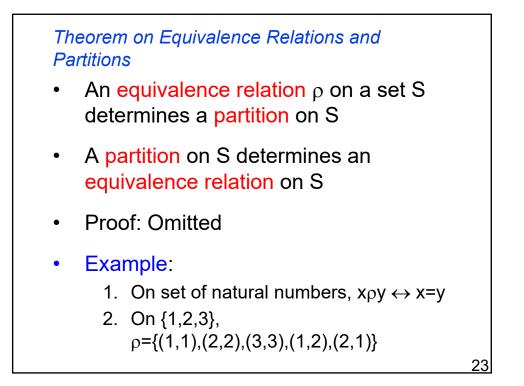


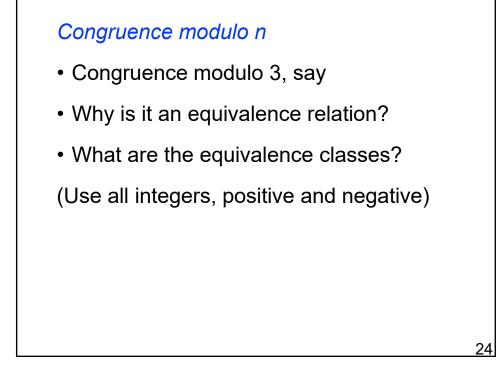


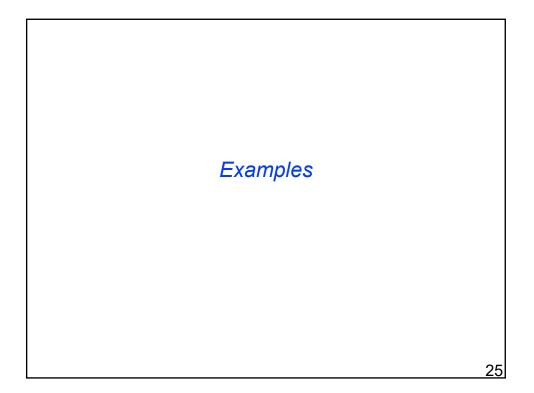


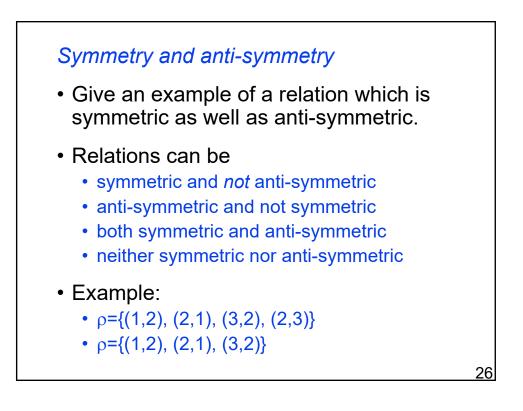












Examples

• Identify the 4 kinds of elements

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

$$\rho = \{(a,a), (b,b), (c,c), (d,d), (a,b), (a,c)\}$$

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