MATH 151

Properties of Relations

Lecture 5

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- **Relation** R **on a set** A **is called *reflexive* if** $\forall a \in A$; $a R a$
- **Relation** R **on a set** A **is called *symmetric* if** $a R b \Rightarrow b R a$
- **Relation** R **on a set** A **is called *antisymmetric* if** $a R b$ **and** $b R a \Rightarrow a = b$
- **Relation** R **on a set** A **is called *transitive* if** $a R b$ **and** $b R c \Rightarrow a R c$
- **Relation** R **on a set** A **is called *transitive* if** $R^2 \subseteq R$

Exercise 1: Let $\begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$ be the matrix of the relation R . Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 2: Let $\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{pmatrix}$ be the matrix of the relation R . Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 3: Let $\begin{pmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{pmatrix}$ be the matrix of the relation R . Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 4: Let $R = \{(x,x),(y,x),(y,y),(y,z),(z,y)\}$ be a relation on $A = \{x, y, z\}$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 5: Let $R=\{(a,a),(a,b),(a,c),(b,a),(c,c)\}$ be a relation on $A=\{a,b,c\}$.
Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 6: Let $R=\{(2,1),(2,2),(3,1),(3,2),(3,3)\}$ be a relation on $A=\{1,2,3\}$.
Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 7: Let R be a relation defined on the set $\mathbb{Z}$ as follows: $x \; R \; y \Leftrightarrow (x + y)$ is odd. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 8: Let R be a relation defined on the set $\mathbb{Z}$ as follows: $x\ R\ y \Leftrightarrow x + y \geq 12$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

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Exercise 9: Let R be a relation defined on the set $\mathbb{Z}^+$ as follows: $m\ R\ n \Leftrightarrow m.n$ is even. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 10: Let R be a relation defined on the set $\mathbb{Z}$ as follows: $x \; R \; y \Leftrightarrow x = 2y$.
Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 11: Let R be a relation defined on the set $\mathbb{Q}$ as follows: $x\ R\ y \Leftrightarrow (x-y) \in z$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 12: Let R be a relation defined on the set $\mathbb{Z}^+$ as follows: $x \; R \; y \Leftrightarrow \left(\frac{x}{y} \right)$.

Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 13: Let R be a relation defined on the set $\mathbb{N}$ as follows: $m\ R\ n \Leftrightarrow m - n > 1$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 14: Let R be a relation defined on the set $\mathbb{N}$ as follows: $m\,R\,n \Leftrightarrow 3/(m.n)$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 15: Let R be a relation defined on the set $\mathbb{Z}^+$ as follows: $m\,R\,n \Leftrightarrow m+n=20$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.

Exercise 16: Let R be a relation defined on the set $\mathbb{N}$ as follows: $m\,R\,n \Leftrightarrow 6/(m.n)$. Determine whether the relation is reflexive, symmetric, antisymmetric, transitive.