Properties of relations on a set determined by a matrix

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Abstract

This paper introduces a technique of converting a relation set into a matrix of $\mathbb{R}^n$ space using that matrix classifying the properties for the relational set. Using this technique, we can find the properties of a relation set by using some properties of the matrix. In programming, we can use this technique to determine our properties of a relation set by using the matrix. Code snippets are provided to show how this technique can be used in programming.

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Chapter 1

Relations

1.0.1 What is a relation?

A (binary) relation R between sets A and B is a subset of $A \times B$. ($A \times B$ is a Cartesian product.)

Thus, a relation is a set of pairs.

The interpretation of this subset is that it contains all the pairs for which the relation is true. We write aRb if the relation is true for A and B (equivalently B, if $(A, B) \in R$).

A and B can be the same set, in which case the relation is said to be "on" rather than "between":

A binary relation R on a set A is a $\subseteq A \times A$. ($A \times A$ is a Cartesian product.)

Example of a relation using $A = \{0, 1, 2, 3\}$

$R = \{(0, 0), (1, 1), (2, 2), (3, 3)\}$

Relations may also be of other arities. An n-ary relation R between sets X_1, ... , and $X_n \subseteq n$-ary product $X_1...X_n$, in which case R is a set of n-tuples.

Chapter 2

Finding the properties of a relation set