

Introduction to Binary Relations

a binary relation is a way of expressing a relationship b/w two sets ("binary" b/c 2 sets)

Mathematical definition:

a binary relation b/w two sets A and B is a subset R of $A \times B$.

$A = B$ or $A \neq B$

Notation: aRb for $(a,b) \in R$ and $a \in A$ and $b \in B$

If two sets, A and B , are finite, then the binary relation R b/w A and B can be represented by:

- a list of ordered pairs
- an arrow diagram w/ A elements on left + B on right and an arrow from $a \in A$ to $b \in B$ if aRb
- a matrix representation
 - a rectangular array w/ $|A|$ rows and $|B|$ columns
 - each row corresponds to an $a \in A$ and each column corresponds to an $b \in B$
 - if aRb , there is a 1 in row a , column b
 - else: there is a zero

Binary relation on a set A is a subset of $A \times A$

i.e. the relation is b/w a set and itself

the set A is called the domain of the binary relation

- the arrow diagram for a relation R on a finite set A requires only one copy of the elements of A
- there is an arrow from $a \in A$ to $b \in A$ if aRb
- a self loop represents an element related to itself (ex: $(a,a), aRa$)