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※ 3.5 Matrices of Relation

- Matrix of Relation
  - Def : Set the entry in row x and column y to 1 if $x R y$ and to 0 otherwise.
    - Label the rows with the element of X. the columns with the element of Y (Relative to the orderings of X, Y)

- Features
  - Always a square matrix
  - Convenient way to represent a relation.

- Determine Property
  - Reflexive : If and only if matrix has 1's on the main diagonal
    - Main diagonal consists of the entries on a line from the upper left to lower right

ex)
$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$
→ main diagonal

  - Symmetric : If and only if A is symmetric about the main diagonal

ex)
$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$
→ Symmetric

  - Transitive : If and only if whenever entry i,j in A^2 is non-zero, entry i,j in A is also non-zero

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

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \rightarrow A^2 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 2 & 2 & 0 \\ 0 & 2 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

non-zero non-zero