

UCS405 (Discrete Mathematical Structures)

Tutorial Sheet-6 (Relations)

1. List the triples in the relation $\{(a, b, c) \mid a, b, \text{ and } c \text{ are integers with } 0 < a < b < c < 5\}$.
2. Represent each of these relations on $\{1, 2, 3\}$ with a matrix and graph (with the elements of this set listed in increasing order).
 - a) $\{(1, 1), (1, 2), (1, 3)\}$
 - b) $\{(1, 2), (2, 1), (2, 2), (3, 3)\}$
 - c) $\{(1, 1), (1, 2), (1, 3), (2, 2), (2, 3), (3, 3)\}$
 - d) $\{(1, 3), (3, 1)\}$

3. Let R be the relation represented by the matrix

$$\mathbf{M}_R = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}.$$

Find the matrix representing

- a) R^{-1} .
 - b) $\text{comp}(R)$
 - c) R^2 .
4. Let R be the relation on the set $\{0, 1, 2, 3\}$ containing the ordered pairs $(0, 1)$, $(1, 1)$, $(1, 2)$, $(2, 0)$, $(2, 2)$, and $(3, 0)$. Find the
 - a) reflexive closure of R .
 - b) symmetric closure of R .
 5. Find the transitive closures of these relations on $\{1, 2, 3, 4\}$.
 - a) $\{(1, 2), (2, 1), (2, 3), (3, 4), (4, 1)\}$
 - b) $\{(2, 1), (2, 3), (3, 1), (3, 4), (4, 1), (4, 3)\}$
 - c) $\{(1, 2), (1, 3), (1, 4), (2, 3), (2, 4), (3, 4)\}$
 - d) $\{(1, 1), (1, 4), (2, 1), (2, 3), (3, 1), (3, 2), (3, 4), (4, 2)\}$
 6. Use Warshall's algorithm to find the transitive closures of above relations.
 7. Find the smallest relation containing the relation $\{(1, 2), (1, 4), (3, 3), (4, 1)\}$ that is
 - a) reflexive and transitive.
 - b) symmetric and transitive.
 - c) reflexive, symmetric, and transitive.