Assingment1

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Question

Find the max-product and max-min composition of relations R1 and
R2 given as follows: $R1 = \begin{vmatrix} 1.0 & 0.3 & 0.9 & 0.0 \\ 0.3 & 1.0 & 0.8 & 1.0 \\ 0.9 & 0.8 & 1.0 & 0.8 \\ 0.0 & 1.0 & 0.8 & 1.0 \end{vmatrix}$ and $R2 = \begin{vmatrix} 1.0 & 1.0 & 0.9 \\ 1.0 & 0.0 & 0.5 \\ 0.3 & 0.1 & 0.0 \\ 0.2 & 0.3 & 0.1 \end{vmatrix}$

Solution

Given $R1 = \begin{vmatrix} 1.0 & 0.3 & 0.9 & 0.0 \\ 0.3 & 1.0 & 0.8 & 1.0 \\ 0.9 & 0.8 & 1.0 & 0.8 \\ 0.0 & 1.0 & 0.8 & 1.0 \end{vmatrix}$ and $R2 = \begin{vmatrix} 1.0 & 1.0 & 0.9 \\ 1.0 & 0.0 & 0.5 \\ 0.3 & 0.1 & 0.0 \\ 0.2 & 0.3 & 0.1 \end{vmatrix}$

1 Max-Product

$\mu T(x1, z1) = max(min(1.0 * 1.0), min(0.3 * 1.0), min(0.9 * 0.3), min(0.0 * 0.2))$
$\mu T(x1, z1) = max(1.0, 0.3, 0.27, 0.0)$
$\mu T(x1, z1) = 1.0$

$\mu T(x1, z2) = max(min(1.0 * 1.0), min(0.3 * 0.0), min(0.9 * 0.1), min(0.0 * 0.3))$
$\mu T(x1, z2) = max(1.0, 0.0, 0.09, 0.0)$
$\mu T(x1, z2) = 1.0$

$\mu T(x1, z3) = max(min(1.0 * 0.9), min(0.3 * 0.5), min(0.9 * 0.0), min(0.0 * 0.1))$
$\mu T(x1, z3) = max(0.9, 0.15, 0.0, 0.0)$
$\mu T(x1, z3) = 0.15$

$\mu T(x2, z1) = max(min(0.3 * 1.0), min(1.0 * 1.0), min(0.8 * 0.3), min(1.0 * 0.2))$
$\mu T(x2, z1) = max(0.3, 1.0, 0.24, 0.2)$
$\mu T(x2, z1) = 1.0$

$\mu T(x2, z2) = max(min(0.3 * 1.0), min(1.0 * 0.0), min(0.8 * 0.1), min(1.0 * 0.3))$
$\mu T(x2, z2) = max(0.3, 0.0, 0.08, 0.3)$
$\mu T(x2, z2) = 0.3$

$\mu T(x2, z3) = max(min(0.3 * 0.9), min(1.0 * 0.5), min(0.8 * 0.0), min(1.080.1))$
$\mu T(x2, z3) = max(0.27, 0.5, 0.0, 0.1)$
$\mu T(x2, z3) = 0.27$

$\mu T(x3, z1) = max(min(0.9 * 1.0), min(0.8 * 1.0), min(1.0 * 0.3), min(0.8 * 0.2))$
$\mu T(x3, z1) = max(0.9, 0.8, 0.3, 0.16)$
$\mu T(x3, z1) = 0.16$

$\mu T(x3, z2) = max(min(0.9 * 1.0), min(0.8 * 0.0), min(1.0 * 0.1), min(0.8 * 0.3))$
$\mu T(x3, z2) = max(0.9, 0.0, 0.1, 0.24)$
$\mu T(x3, z2) = 0.24$

$\mu T(x3, z3) = max(min(0.9 * 0.9), min(0.8 * 0.5), min(1.0 * 0.0), min(0.8 * 0.1))$
$\mu T(x3, z3) = max(0.81, 0.40, 0.0, 0.08)$
$\mu T(x3, z3) = 0.81$

$\mu T(x4, z1) = max(min(0.0 * 1.0), min(1.0 * 1.0), min(0.8 * 0.3), min(1.0 * 0.2))$
$\mu T(x4, z1) = max(0.0, 1.0, 0.24, 0.2)$
$\mu T(x4, z1) = 1.0$

$\mu T(x4, z2) = max(min(0.0 * 1.0), min(1.0 * 0.0), min(0.8 * 0.1), min(1.0 * 0.3))$
$\mu T(x4, z2) = max(0.0, 0.0, 0.08, 0.3)$
$\mu T(x4, z2) = 0.3$

$\mu T(x4, z3) = max(min(0.0 * 0.9), min(1.0 * 0.5), min(0.8 * 0.0), min(1.0 * 0.1))$
$\mu T(x4, z3) = max(0.0, 0.5, 0.0, 0.1)$
$\mu T(x4, z3) = 0.5$

Hence

Max Product , T = R1 . R2 = $\begin{vmatrix} 1.0 & 1.0 & 0.15 \\ 1.0 & 0.3 & 0.27 \\ 0.16 & 0.24 & 0.81 \\ 1.0 & 0.3 & 0.5 \end{vmatrix}$

2 Max-Min Composition

Now,

$\mu T(x1, z1) = max(min(1.0, 1.0), min(0.3, 1.0), min(0.9, 0.3), min(0.0, 0.2))$
$\mu T(x1, z1) = max(1.0, 0.3, 0.3, 0.0)$
$\mu T(x1, z1) = 1.0$

$\mu T(x1, z2) = max(min(1.0, 1.0), min(0.3, 0.0), min(0.9, 0.1), min(0.0, 0.3))$
$\mu T(x1, z2) = max(1.0, 0.0, 0.1, 0.0)$
$\mu T(x1, z2) = 1.0$

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$$\mu T(x1, z3) = max(min(1.0, 0.9), min(0.3, 0.5), min(0.9, 0.0), min(0.0, 0.1))$$
$$\mu T(x1, z3) = max(0.9, 0.3, 0.0, 0.0)$$
$$\mu T(x1, z3) = 0.9$$

$$\mu T(x2, z1) = max(min(0.3, 1.0), min(1.0, 1.0), min(0.8, 0.3), min(1.0, 0.2))$$
$$\mu T(x2, z1) = max(0.3, 1.0, 0.3, 0.2)$$
$$\mu T(x2, z1) = 1.0$$

$$\mu T(x2, z2) = max(min(0.3, 1.0), min(1.0, 0.0), min(0.8, 0.1), min(1.0, 0.3))$$
$$\mu T(x2, z2) = max(0.3, 0.0, 0.1, 0.3)$$
$$\mu T(x2, z2) = 0.3$$

$$\mu T(x2, z3) = max(min(0.3, 0.9), min(1.0, 0.5), min(0.8, 0.0), min(1.0, 0.1))$$
$$\mu T(x2, z3) = max(0.3, 0.5, 0.0, 0.1)$$
$$\mu T(x2, z3) = 0.5$$

$$\mu T(x3, z1) = max(min(0.9, 1.0), min(0.8, 1.0), min(1.0, 0.3), min(0.8, 0.2))$$
$$\mu T(x3, z1) = max(0.9, 0.8, 0.3, 0.2)$$
$$\mu T(x3, z1) = 0.9$$

$$\mu T(x3, z2) = max(min(0.9, 1.0), min(0.8, 0.0), min(1.0, 0.1), min(0.8, 0.3))$$
$$\mu T(x3, z2) = max(0.9, 0.0, 0.1, 0.3)$$
$$\mu T(x3, z2) = 0.9$$

$$\mu T(x3, z3) = max(min(0.9, 0.9), min(0.8, 0.5), min(1.0, 0.0), min(0.8, 0.1))$$
$$\mu T(x3, z3) = max(0.9, 0.5, 0.0, 0.1)$$
$$\mu T(x3, z3) = 0.9$$

$\mu T(x4, z1) = max(min(0.0, 1.0), min(1.0, 1.0), min(0.8, 0.3), min(1.0, 0.2))$
$\mu T(x4, z1) = max(0.0, 1.0, 0.3, 0.2)$
$\mu T(x4, z1) = 1.0$

$\mu T(x4, z2) = max(min(0.0, 1.0), min(1.0, 0.0), min(0.8, 0.1), min(1.0, 0.3))$
$\mu T(x4, z2) = max(0.0, 0.0, 0.1, 0.3)$
$\mu T(x4, z2) = 0.3$

$\mu T(x4, z3) = max(min(0.0, 0.9), min(1.0, 0.5), min(0.8, 0.0), min(1.0, 0.1))$
$\mu T(x4, z3) = max(0.0, 0.5, 0.0, 0.1)$
$\mu T(x4, z3) = 0.5$

Hence

$$\text{Max Min Composition , T = R1 . R2} = \begin{vmatrix} 1.0 & 1.0 & 0.9 \\ 1.0 & 0.3 & 0.5 \\ 0.9 & 0.9 & 0.9 \\ 1.0 & 0.3 & 0.5 \end{vmatrix}$$