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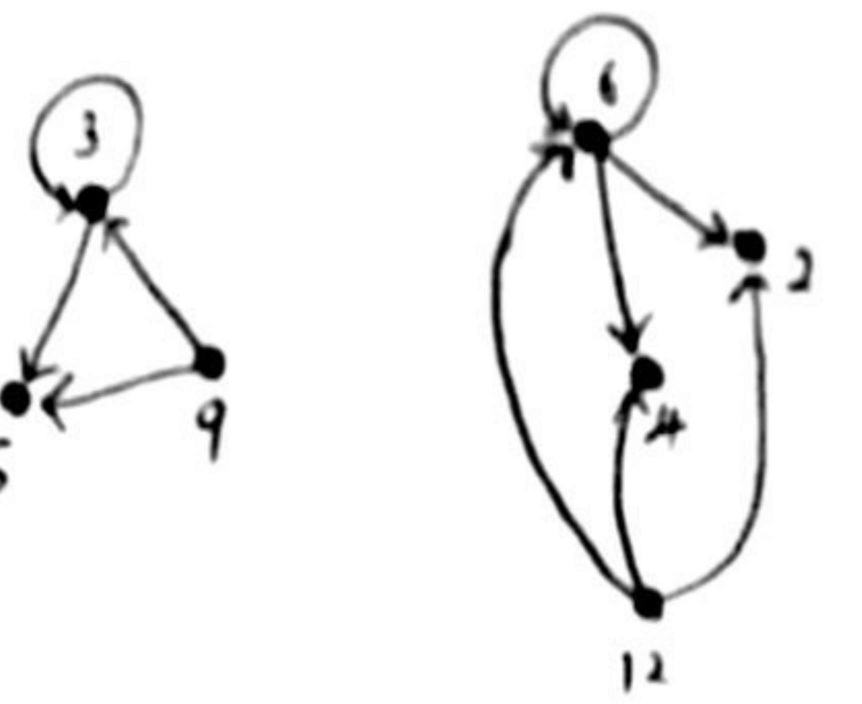
1. (i) $R = \{(3,3), (3,5), (6,2), (6,4), (6,6), (9,3), (9,5), (12,2), (12,4), (12,6)\}$

(ii)



(iii) domain: $\{3, 6, 9, 12\}$

range: $\{2, 3, 4, 5, 6\}$

2. $D = \{(1,1), (1,8), (1,15), (3,3), (3,10), (8,1), (8,8), (8,15), (10,3), (10,10), (15,1), (15,8), (15,15)\}$

- D is reflexive because all element related to itself, which are (1,1), (3,3), (8,8), (10,10), (15,15)

- $$M_R = \begin{array}{c|c} & \begin{array}{ccccc} 1 & 3 & 8 & 10 & 15 \end{array} \\ \begin{array}{c} 1 \\ 3 \\ 8 \\ 10 \\ 15 \end{array} & \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix} \end{array} = M_R^T$$

D is symmetric.

- $$\begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix}$$

D is transitive.

$\therefore$ Since D is reflexive, symmetric and transitive, it is equivalent relation.

3. (i)

$$\begin{array}{c|c} & \begin{array}{cccc} s & t & u & v \end{array} \\ \begin{array}{c} s \\ t \\ u \\ v \end{array} & \begin{pmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \end{array}$$

(ii)

	s	t	u	v
in-degree	2	2	3	1
out-degree	3	3	2	0

(iii) - The relation of R is not reflexive because not all element is related
(v,v) $\notin$ R.

- The relation of R is not antisymmetric because there is $(s,u) \in R$ and $(u,s) \in R$.

- $$\begin{pmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \otimes \begin{pmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

The relation of R is not transitive.

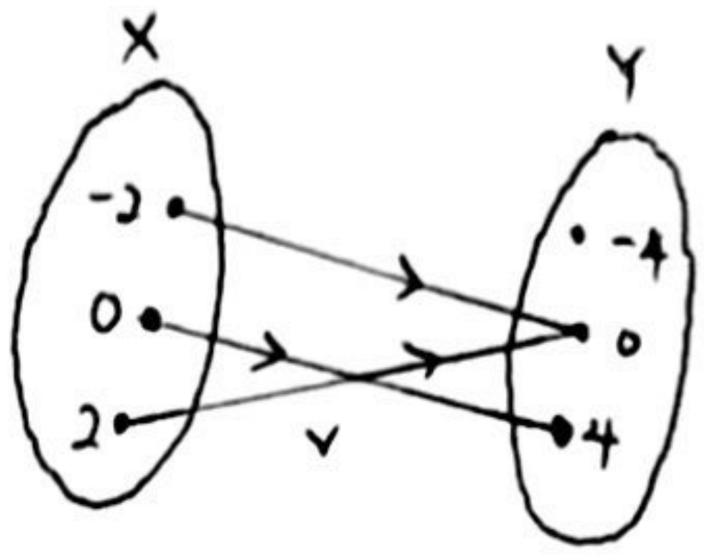
$\therefore$ A partial order must be reflexive, antisymmetric and transitive. Since R is reflexive, not antisymmetric and not transitive, the relation of R is not a partial order.

4. $V(x) = 4 - x^2$

$V(-2) = 4 - (-2)^2 = 0$

$V(0) = 4 - (0)^2 = 4$

$V(2) = 4 - (2)^2 = 0$



$V(x) = \{(-2,0), (0,4), (2,0)\}$

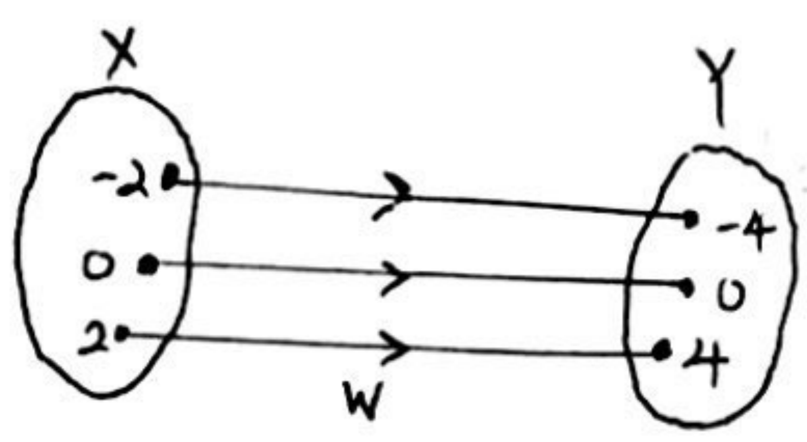
V(x) is not one-to-one because both of -2 and 2 on X are pointing to 0 on Y.
V(x) is not onto because there is no element pointing to -4 on Y.
$\therefore$ V(x) is not bijection because it is not one-to-one and not onto.

$W(x) = 2x$

$W(-2) = 2(-2) = -4$

$W(0) = 2(0) = 0$

$W(2) = 2(2) = 4$



$W(x) = \{(-2,-4), (0,0), (2,4)\}$

W(x) is one-to-one because each element in Y has at most one arrow.
W(x) is onto because each element in Y has at least one arrow pointing to it.
$\therefore$ W(x) is bijection because it is one-to-one and onto.

5. (i) $g(x) = \frac{2}{3}x$

$y = \frac{2}{3}x$

$3y = 2x$

$x = \frac{3}{2}y$

$g^{-1}(y) = \frac{3}{2}y$

$\therefore$ Inverse function of $g(x)$ is $g^{-1}(y) = \frac{3}{2}y$

(ii) $(g \circ g \circ f)(x) = ggf(x)$

$= gg[f(x)]$

$= gg(7x-2)$

$= g[g(7x-2)]$

$= g[\frac{2}{3}(7x-2)]$

$= \frac{2}{3}[\frac{2}{3}(7x-2)]$

$= \frac{2}{3}(\frac{14}{3}x - \frac{4}{3})$

$(g \circ g \circ f)(x) = \frac{28}{9}x - \frac{8}{9}$

$\therefore$ Compositions $(g \circ g \circ f)(x) = \frac{28}{9}x - \frac{8}{9}$.

(i) $F_0 = 5.0$

$F_1 = 4.5$

$F_t = F_{t-1} + \frac{1}{5} F_{t-2} \quad , t \geq 2$

(ii) $F_0 = 5.0$

$F_1 = 4.5$

$F_2 = F_{(2-1)} + \frac{1}{5} F_{(2-2)}$

$= F_1 + \frac{1}{5} F_0$

$= 4.5 + \frac{1}{5}(5.0)$

$F_2 = 5.5$

$F_3 = F_{(3-1)} + \frac{1}{5} F_{(3-2)}$

$= F_2 + \frac{1}{5} F_1$

$= 5.5 + \frac{1}{5}(4.5)$

$F_3 = 6.4$

$F_4 = F_{(4-1)} + \frac{1}{5} F_{(4-2)}$

$= F_3 + \frac{1}{5} F_2$

$= 6.4 + \frac{1}{5}(5.5)$

$F_4 = 7.5$

$F_5 = F_{(5-1)} + \frac{1}{5} F_{(5-2)}$

$= F_4 + \frac{1}{5} F_3$

$= 7.5 + \frac{1}{5}(6.4)$

$F_5 = 8.78$

7. $W_0 = 5$

$W_1 = 7$

input : n

output : w(n)

```
w(n)
{
  if (n=0)
     return 5
  else if (n=1)
     return 7
  else
     return (2* w(n-1))+ w(n-2)
}
```

when $n \geq 2$,

$w(n) = 2w(n-1) + w(n-2)$

$w(2) = 2w(2-1) + w(2-2)$

$= 2w(1) + w(0)$

$= 2(7) + 5$

$w(2) = 19$

$w(3) = 2w(3-1) + w(3-2)$

$= 2w(2) + w(1)$

$= 2(19) + 7$

$w(3) = 45$

$w(4) = 2w(4-1) + w(4-2)$

$= 2w(3) + w(2)$

$= 2(45) + 19$

$w(4) = 109$