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ASSIGNMENT 1.2
DISCRETE STRUCTURE
SECTION 02

48.75 / 50

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1) R is defined by a R b if and only if a-b is an even integer.

A = {3, 6, 9, 12} to B = {2, 3, 4, 5, 6}

i) R = { (3,3), (3,5), (6,2), (6,4), (6,6), (9,3), (9,5), (12,2), (12,4), (12,6) }

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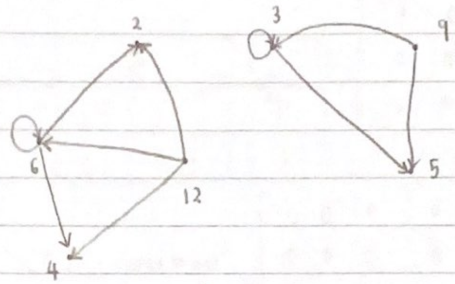
ii)



iii) domain = {3, 6, 9, 12} 1

range = {2, 3, 4, 5, 6} 1

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2) $D = \{1, 3, 8, 10, 15\}$, $x, y \in D$, $x R y$ only if $y - x$ is multiple of 7

$R = \{(1,1), (1,8), (1,15), (3,3), (3,10), (8,1), (8,8), (8,15), (10,3), (10,10), (15,1), (15,8), (15,15)\}$

$$\begin{array}{c|c} & \begin{matrix} 1 & 3 & 8 & 10 & 15 \end{matrix} \\ \begin{matrix} 1 \\ 3 \\ 8 \\ 10 \\ 15 \end{matrix} & \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix} \end{array} \Rightarrow \text{reflexive}$$

$$M_{RT} = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \end{bmatrix}$$

$M_R = M_{RT}$

symmetric

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

Transitive

$M_R \otimes M_R = M_R$

$\therefore$ Hence, it is an equivalent relation

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3) i)

$$M_R = \begin{array}{c} \\ s \\ t \\ u \\ v \end{array} \begin{array}{c} \begin{array}{cccc} s & t & u & v \end{array} \\ \begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

2

ii)

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

2

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iii) ⇒ Not reflexive because does not have all 1 on its main diagonal which is $(v,v) \notin R$ 2

⇒ Not antisymmetric because $(u,s) \in R$ and $(s,u) \in R$ 2

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

⇒ Not transitive 2

∴ Hence, it is not a partial order function.

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

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

1/2

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

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

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

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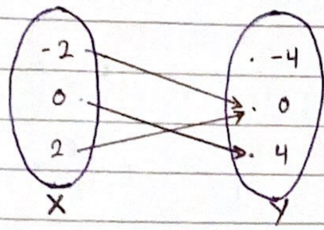


$(-2,0) \in f$, $(2,0) \in f$ but $-2 \neq 2$

=> Not one-to-one because there is two arrow pointing to $Y = \{0\}$

=> Not onto Y because there is no arrow pointing to $Y = \{-4\}$

=> Not bijection because it's not one-to-one and not onto Y

2

$w(x) = 2x$

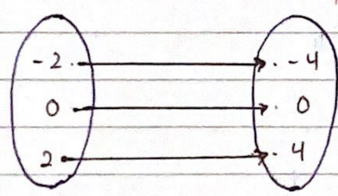
$R = \{(-2,-4), (0,0), (2,4)\}$

1

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

$w(0) = 2(0) = 0$

$w(2) = 2(2) = 4$



=> one-to-one

=> onto Y

=> bijection

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

$g^{-1}(y) = x$

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

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

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

2

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

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

$= g\left(\frac{14}{3}x - \frac{4}{3}\right)$

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

$= \frac{28}{9}x - \frac{8}{9}$

3

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6) $A + B = C$

$A, F_0 = 5.0$ $B, F_1 = 4.5$ $t = 0, 1, 2, 3, \ldots$

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

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ii) $F_0 = 5.0$

$F_1 = 4.5$

$F_2 = F_1 + \frac{1}{5} F_0$

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

$= 5.5$

$= 6.4$ $\frac{1}{4}$ F_3 ?

$F_3 = 5.5 + \frac{1}{5}(4.5)$

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$F_4 = F_3 + \frac{1}{5} F_2$

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

$= 7.5$

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$F_5 = F_4 + \frac{1}{5} F_3$

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

$= 8.78$

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7) $w_0 = 5$, $w_1 = 7$ $w_n = 2w_{n-1} + w_{n-2}$, $n \geq 2$

recursive algorithm

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)))
}

w(4), n=4, n≠1, n≠0
  return (2*w(3) + w(2))

w(4) = 109

w(3) = 45

∴ when n=4
w(4) = 109

w(3), n=3, n≠1, n≠0
  return (2*w(2) + w(1))

w(2), n=2, n≠1, n≠0
  return (2*w(1) + w(0))

w(2) = 19

w(1), n≠0, n=1
  return 7

w(1) = 7

w(0), n=0
  return 5

$w_0 = 5$

1 1 1 1 3 5 8