UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF COMPUTING

SEMSTER 1 2025/2026

SECI 1013 DISCRETE STRUCTURE

SECTION 02

ASSIGNMENT 2

LECTURER:DR.NOORFA HASZLINNA BINTI MUSTAFFA

STUDENT NAME	MATRIC NO
LIM LI JING	A25CS0248
NUR HANANI SAZWANI BINTI MUHAMMAD HELMI WAN	A25CS0313
NUR FARIZA ADLINA BINTI MOHAMMAD FAIZAL	A25CS0310

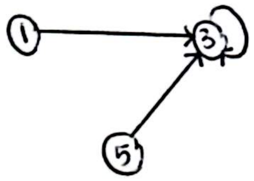
Question 1

$D = \{1,3,5\}$
xRy
$x = \{1,3,5\}$, $y = \{1,3,5\}$

i) $R = \{(1,3), (3,3), (5,3)\}$

ii) Domain of R is $\{1,3,5\}$.
Range of R is $\{3\}$.

iii)



iv) Antisymmetric as (1,3) belongs to R but (3,1) not belongs to R.
Not irreflexive as (3,3) is in R and inverse of (3,3) also in R.
$\therefore$ R is not assymmetric as it is not fulfilled antisymmetric and irreflexive.

Question 2

$R = \{(x,x), (y,y), (z,z), (x,y), (y,x), (x,z),$
$(z,x), (y,z), (z,y)\}$

reflexive, $(x,x), (y,y), (z,z) \in R$.

symmetric, $(x,y) \in R$, $(y,x) \in R$.

not antisymmetric, $\cancel{(x,y)}$ $(y,z) \in R$, $(z,y) \in R$.

transitive, $M_R \otimes M_R = M_R$.

$$M_R = \begin{array}{c|c} & \begin{array}{ccc} x & y & z \end{array} \\ \begin{array}{c} x \\ y \\ z \end{array} & \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \end{array} \otimes \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

$M_R \quad \otimes \quad M_R \qquad\qquad M_R$

equivalence relation because reflexive, symmetric and transitive.

Question 3

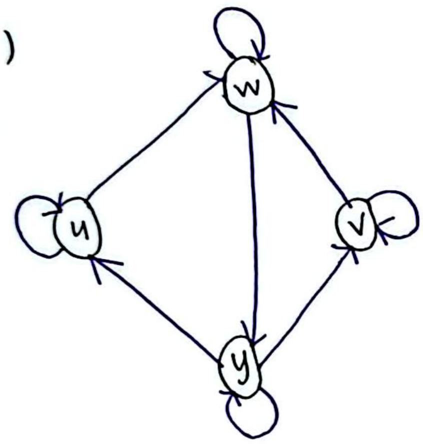
$B = \{u, v, w, y\}$

$R = \{(u,u), (u,w), (v,v), (v,w), (w,w), (w,y), (y,u), (y,v), (y,y)\}$

i) $M_R =$

$$\begin{array}{c} \\ u \\ v \\ w \\ y \end{array} \begin{array}{c} \begin{array}{cccc} u & v & w & y \end{array} \\ \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \end{bmatrix} \end{array}$$

ii)



	u	v	w	y
in-degree	2	2	3	2
out-degree	2	2	2	3

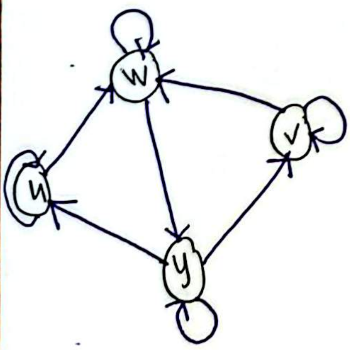
iii)

$$\begin{array}{c} \\ u \\ v \\ w \\ y \end{array} \begin{array}{c} \begin{array}{cccc} u & v & w & y \end{array} \\ \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \end{bmatrix} \end{array}$$

R is reflexive because $(x,x) \in R$ for every $x \in B$

R ~~is~~ have the value 1 on its main diagonal

$\forall x \in B, (x,x) \in R$



R is antisymmetric relation because all $x, y \in B$ is $(x,y) \in R$ but $x \neq y$, then $(y,x) \in R$

$\forall x, y \in B \; (x,y) \in R \wedge (y,x) \in R \rightarrow x = y$

the product boolean,

$$
\begin{array}{c} \\ u \\ v \\ w \\ y \end{array}
\begin{array}{c} \begin{array}{cccc} u & v & w & y \end{array} \\ \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \end{bmatrix} \end{array}
\otimes
\begin{array}{c} \\ u \\ v \\ w \\ y \end{array}
\begin{array}{c} \begin{array}{cccc} u & v & w & y \end{array} \\ \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \end{bmatrix} \end{array}
=
\begin{array}{c} \\ u \\ v \\ w \\ y \end{array}
\begin{array}{c} \begin{array}{cccc} u & v & w & y \end{array} \\ \begin{bmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix} \end{array}
$$

$\forall i \forall j$, if $(n_{ij} = 1)$ then $(m_{ij} = 1)$

$(n_{14} = 1) \land (m_{14} = 0)$

(u, w) and $(v, w) \in R$, $(u, v) \notin R$

so, it is not transitive

∴ Therefore, R is not a partial order.

Question 4

$f : [1, \infty) \longrightarrow [0, \infty)$, $f(x) = (x-1)^2$

Let $f(x_1) = f(x_2)$

$(x_1 - 1)^2 = (x_2 - 1)^2 \quad (\sqrt{})$

$x_1 - 1 = x_2 - 1 \quad (+1)$

$x_1 = x_2$

taking square root of both sides gives $x_1 - 1 = x_2 - 1$ since $x \geq 1$
make both expression non-negative
adding 1 both sides gives $x_1 = x_2$

$\therefore$ f is one-to-one

$f(x) = y$

$(x-1)^2 = y$

$x - 1 = \pm\sqrt{y}$

$x = 1 \pm \sqrt{y}$

only $x = 1 + \sqrt{y} \geq 1$ lies in the domain
so, each $y \geq 0$ exists $x = 1 + \sqrt{y} \in [1, \infty)$ with $f(x) = y$

Thus, f is onto $[0, \infty)$.

$\therefore$ so, f is bijection since f is both one-to-one and onto.

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Question 5

$f(x) = 9x+4$
$g(x) = \frac{3}{2}x-1$

a) $g^{-1}(y) = x$
$y = \frac{3}{2}x-1$
$y+1 = \frac{3}{2}x$
$2(y+1) = 3x$
$x = \frac{2(y+1)}{3}$
$g^{-1}(y) = \frac{2(y+1)}{3}$ //

b) $g(f(x)) = g(9x+4)$
$= \frac{3}{2}(9x+4)-1$
$= \frac{27x+12}{2} - 1$
$= \frac{27x}{2} + \frac{12}{2} - 1$
$= \frac{27x}{2} + 5$ //

c) $f(g(x)) = f(\frac{3}{2}x-1)$
$= 9(\frac{3}{2}x-1)+4$
$= \frac{27}{2}x - 9 + 4$
$= \frac{27}{2}x - 5$ //

CS CamScanner

d) $g(g(x)) = g\left(\frac{3}{2}x - 1\right)$

$$= \frac{3}{2}\left(\frac{3}{2}x - 1\right) - 1$$

$$= \frac{9}{4}x - \frac{3}{2} - 1$$

$$= \frac{9}{4}x - \frac{5}{2}$$

$$f(g(g(x))) = f\left(\frac{9}{4}x - \frac{5}{2}\right)$$

$$= 9\left(\frac{9}{4}x - \frac{5}{2}\right) + 4$$

$$= \frac{81}{4}x - \frac{45}{2} + 4$$

$$= \frac{81}{4}x - \frac{37}{2}$$

Question 6

(a) $P_0 = 4.0$

$P_1 = 5.0$

$\vdots$

$P_t = P_{t-1} + \frac{1}{4} P_{t-2} \quad , t \geq 2$

(b) $P_0 = 4.0$

$P_1 = 5.0$

$P_2 = P_1 + \frac{1}{4} P_0$

$= 5.0 + \frac{1}{4}(4)$

$= 6.0$

$P_3 = P_2 + \frac{1}{4} P_1$

$= 6.0 + \frac{1}{4}(5.0)$

$= 7.25$

$P_4 = P_3 + \frac{1}{4} P_2$

$= 7.25 + \frac{1}{4}(6.0)$

$= 8.75$

$P_5 = P_4 + \frac{1}{4} P_3$

$= 8.75 + \frac{1}{4}(7.25)$

~~$= 10.2$~~

$= 10.5625$

$\therefore 4.0, 5.0, 6.0, 7.25, 8.75, 10.5625$

Question 7

(a) input - n
output - s(n)

```
S(n)
{
  if(n= 1 )
    return 2
  return s(n-1)*s(n-1) - 1
}
```

(b) S(4)
n=4
because $n \neq 1$,
return $s(3)*s(3)-1$

S(4) = 63
return $8*8-1$

$\therefore S(4)=63$

S(3)
n=3
because $n \neq 1$,
return $s(2)*s(2)-1$

S(3) = 8
return $3*3-1$

S(2)
n=2
because $n \neq 1$,
return $s(1)*s(1)-1$

S(2) = 3
return $2*2-1$

S(1)
n=1
because n=1
return 2

S(1)= 2
return 2