



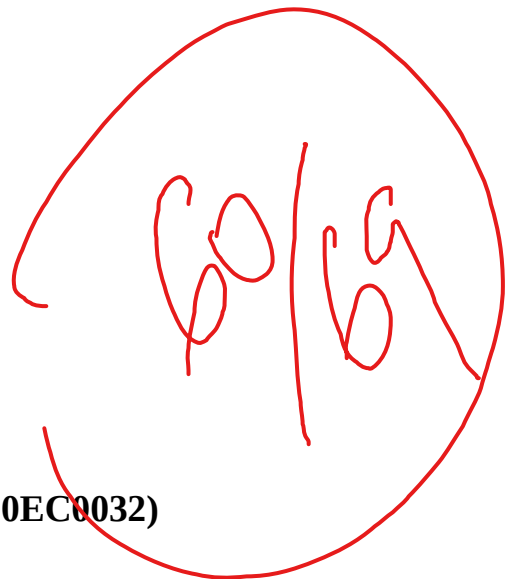
SECI 1013
DISCRETE STRUCTURE

SEMESTER 1 2020/2021

TUTORIAL 1:

LECTURER:
DR RAZANA ALWEE

SUBMITTED BY:
ERICA DESIRAE MAURITIUS (A20EC0032)
INDRADEVI A/P VIKNESHWARAN (A20EC0050)
LEE JIA YEE (A20EC0063)



No:

Date:

$$0 < x \leq 2 \text{ or } 3 \leq x < 9$$

$$1. A = \{x \in \mathbb{R} \mid 0 < x \leq 2\}$$

$$B = \{x \in \mathbb{R} \mid 1 \leq x < 4\}$$

$$C = \{x \in \mathbb{R} \mid 3 \leq x < 9\}$$

$$a) A \cup C = \{x \in \mathbb{R} \mid 0 < x \leq 2\} \cup \{x \in \mathbb{R} \mid 3 \leq x < 9\}$$

$$= \{x \in \mathbb{R} \mid 0 < x < 9\}$$

$$A \cup C = \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$b) (A \cup B)' = (\{x \in \mathbb{R} \mid 0 < x \leq 2\} \cup \{x \in \mathbb{R} \mid 1 \leq x < 4\})'$$

$$= \{x \in \mathbb{R} \mid 0 < x < 4\}'$$

$$(A \cup B)' = \{x \in \mathbb{R} \mid x \leq 0, x \geq 4\}$$

$$(A \cup B)' = \{4, 5, 6, 7, 8\}$$

$$c) A' \cup B' = (\{x \in \mathbb{R} \mid 0 < x \leq 2\})' \cup (\{x \in \mathbb{R} \mid 1 \leq x < 4\})'$$

$$= \{x \in \mathbb{R} \mid x \leq 0, x > 2\} \cup \{x \in \mathbb{R} \mid x < 1, x \geq 4\}$$

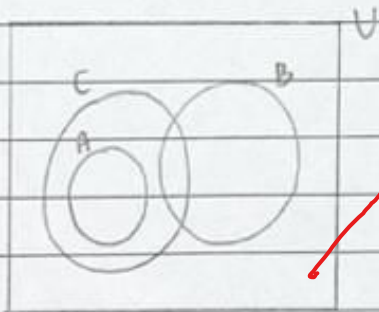
$$A' \cup B' = \{x \in \mathbb{R} \mid x < 1, x > 2\}$$

$$A' \cup B' = \{3, 4, 5, 6, 7, 8\}$$

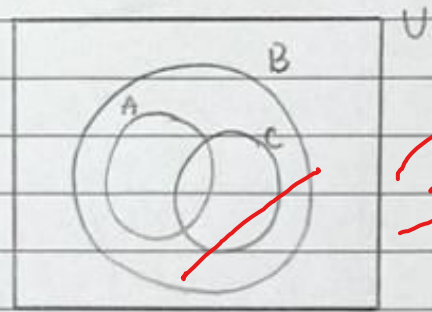
real numbers

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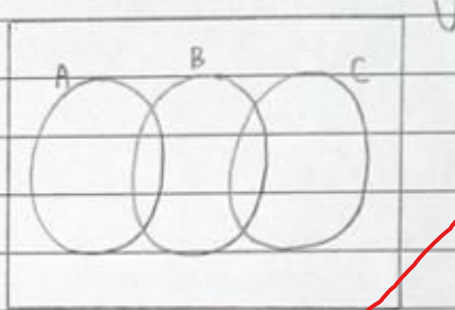
2. a)



b)



c)



No:

Date:

$$3. A = \{-1, 1, 2, 4\}$$

$$B = \{1, 2\}$$

$$A \times B = \{(-1, 1), (-1, 2), (1, 1), (1, 2), (2, 1), (2, 2), (4, 1), (4, 2)\} \#$$

$$xSy \iff |x| = |y|$$

$$S = \{(-1, 1), (1, 1), (2, 2)\} \#$$

$$xTy \iff x - y \text{ is even}$$

$$T = \{(-1, 1), (1, 1), (2, 2), (4, 2)\} \#$$

$$S \cap T = \{(-1, 1), (1, 1), (2, 2)\} \#$$

$$S \cup T = \{(-1, 1), (1, 1), (2, 2), (4, 2)\} \#$$

$$4. \neg((\neg p \wedge q) \vee (\neg q \wedge p)) \vee (p \wedge q) \equiv$$

$$\equiv (\neg(\neg p \wedge q) \wedge \neg(\neg q \wedge p)) \vee (p \wedge q)$$

- De Morgan's Law

$$\equiv ((\neg\neg p \vee \neg q) \wedge (\neg\neg q \vee \neg p)) \vee (p \wedge q)$$

- De Morgan's Law

$$\equiv (p \vee \neg q) \wedge (q \vee \neg p) \vee (p \wedge q)$$

- Double Negation Law

$$\equiv (p \vee (\neg q \wedge q)) \vee (p \wedge q)$$

- Distributive Law

$$\equiv (p \vee (q \wedge \neg q)) \vee (p \wedge q)$$

- Commutative Law

$$\equiv (p \vee \emptyset) \vee (p \wedge q)$$

- Negation Law

$$\equiv p \vee (p \wedge q)$$

- Identity Law

$$\equiv p \quad \therefore \text{shown}$$

- Absorption Law

$$5. R_1 = \{(1,1), (1,2), (1,3), (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (4,1), (4,2), (5,1)\}$$

$$R_2 = \{(2,1), (3,1), (3,2), (4,1), (4,2), (4,3), (5,1), (5,2), (5,3), (5,4)\}$$

a)

	1	2	3	4	5
1	1	1	1	1	1
2	1	1	1	1	0
$A_1 = 3$	1	1	1	0	0
4	1	1	0	0	0
5	1	0	0	0	0

b)

	1	2	3	4	5
1	0	0	0	0	0
2	1	0	0	0	0
$A_2 = 3$	1	1	0	0	0
4	1	1	1	0	0
5	1	1	1	1	0

c) R_1 is not reflexive because $(4,4), (5,5) \notin R_1$.

	1	2	3	4	5
1	1	1	1	1	1
2	1	1	1	1	0
$A_1^T = 3$	1	1	1	0	0
4	1	1	0	0	0
5	1	0	0	0	0

$\therefore R_1$ is symmetric because $A_1 = A_1^T$

$\therefore R_1$ is not transitive because $(2,1), (1,5) \in R_1$, but $(2,5) \notin R_1$.

$(3,1), (1,4) \in R_1$, but $(3,4) \notin R_1$.

$(3,1), (1,5) \in R_1$, but $(3,5) \notin R_1$.

$(3,2), (2,4) \in R_1$, but $(3,4) \notin R_1$.

$(4,1), (1,3) \in R_1$, but $(4,3) \notin R_1$.

$(4,1), (1,4) \in R_1$, but $(4,4) \notin R_1$.

$(4,1), (1,5) \in R_1$, but $(4,5) \notin R_1$.

$(4,2), (2,3) \in R_1$, but $(4,3) \notin R_1$.

$(4,2), (2,4) \in R_1$, but $(4,4) \notin R_1$.

$(5,1), (1,2) \in R_1$, but $(5,2) \notin R_1$.

$(5,1), (1,3) \in R_1$, but $(5,3) \notin R_1$.

$(5,1), (1,4) \in R_1$, but $(5,4) \notin R_1$.

$(5,1), (1,5) \in R_1$, but $(5,5) \notin R_1$.

$\therefore R_1$ is not equivalence relation because R_1 is symmetric but R_1 is not reflexive and not transitive.

d) $\therefore R_2$ is irreflexive because A_2 has 0's on the main diagonal.

$$A_2^T = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 0 & 1 & 1 & 1 & 1 \\ 2 & 0 & 0 & 1 & 1 & 1 \\ 3 & 0 & 0 & 0 & 1 & 1 \\ 4 & 0 & 0 & 0 & 0 & 1 \\ 5 & 0 & 0 & 0 & 0 & 0 \end{array}$$

anti-symmetric ??
not symmetric

$\therefore R_2$ is not symmetric because $A_2 \neq A_2^T$

$\therefore R_2$ is transitive because $(3,2), (2,1) \in R_2, (3,1) \in R_2$

$(4,2), (2,1) \in R_2, (4,1) \in R_2$

$(4,3), (3,1) \in R_2, (4,1) \in R_2$

$(4,3), (3,2) \in R_2, (4,2) \in R_2$

$(5,2), (2,1) \in R_2, (5,1) \in R_2$

$(5,3), (3,1) \in R_2, (5,1) \in R_2$

$(5,3), (3,2) \in R_2, (5,2) \in R_2$

$(5,4), (4,1) \in R_2, (5,1) \in R_2$

$(5,4), (4,2) \in R_2, (5,2) \in R_2$

$(5,4), (4,3) \in R_2, (5,3) \in R_2$

$\therefore R_2$ is not partial order relation because R_2 is antisymmetric and transitive, but R_2 is irreflexive.

$$6. R_1 = \{(1,1), (2,2), (2,3), (3,1), (3,3)\}$$

$$R_2 = \{(1,2), (2,2), (3,1), (3,3)\}$$

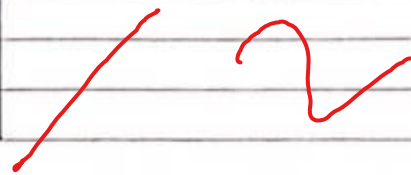
a) $R_1 \cup R_2 = \{(1,1), (1,2), (2,2), (2,3), (3,1), (3,3)\}$

$$M_{R_1 \cup R_2} = \begin{array}{c|ccc} & 1 & 2 & 3 \\ \hline 1 & 1 & 1 & 0 \\ 2 & 0 & 1 & 1 \\ 3 & 1 & 0 & 1 \end{array}$$

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$$b) R_1 \cap R_2 = \{(2,2), (3,1), (3,3)\}$$

$$M_{R_1 \cap R_2} = \begin{matrix} & \begin{matrix} 1 & 2 & 3 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \end{matrix}$$



$$7. \quad f: \mathbb{R} \rightarrow \mathbb{R} \quad g: \mathbb{R} \rightarrow \mathbb{R} \quad \mathbb{R} = \text{set of real numbers}$$

$$\text{let } f(x) = x, \quad g(x) = -x$$

$$\begin{aligned} f+g &= (f+g)(x) \\ &= f(x) + g(x) \\ &= x + (-x) \\ &= 0 \Rightarrow \text{for all real numbers } x \end{aligned}$$

Since $f: \mathbb{R} \rightarrow \mathbb{R}$ and $g: \mathbb{R} \rightarrow \mathbb{R}$ are both one-to-one function, but when $f+g$, it is not one-to-one function because there exist only one answer for all real numbers

8. $C(n)$ = ways to climb the stairs.

$$n=1, C(n)=1$$

$$n=2, C(n)=2$$

when $n \geq 3$ there are two possible ways:

i. last step is a single stair : $C(n-1)$

ii. last step are two stairs : $C(n-2)$

$$\text{Thus, } C(n) = C(n-1) + C(n-2) \text{ for } n \geq 3$$

$$9. \quad t_0 = t_1 = t_2 = 1, \quad t_n = t_{n-1} + t_{n-2} + t_{n-3} \text{ for all } n \geq 3$$

$$a. \quad t_7 = t_6 + t_5 + t_4$$

$$= 19 + 9 + 5$$

$$= 31$$

$$t_3 = t_2 + t_1 + t_0$$

$$= 1 + 1 + 1$$

$$= 3$$

$$t_4 = t_3 + t_2 + t_1$$

$$= 3 + 1 + 1$$

$$= 5$$

$$t_6 = t_5 + t_4 + t_3$$

$$= 9 + 5 + 3$$

$$= 17$$

$$t_5 = t_4 + t_3 + t_2$$

$$= 5 + 3 + 1$$

$$= 9$$

9

b.

 $t(n)$ { if ($n = 0$)

return 0

else if ($n = 1$ or $n = 2$)

return 1

else

return $t(n-1) + t(n-2) + t(n-3)$

}