



SECI 1013
DISCRETE STRUCTURE

SEMESTER 1 2020/2021

TUTORIAL 1:

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No:

Date:

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

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

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

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

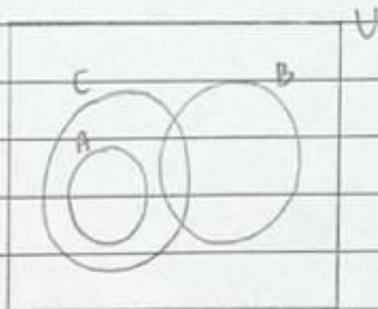
c) $A' \cup B' = (\{x \in \mathbb{R} \mid 0 < x \leq 2\})' \cup (\{x \in \mathbb{R} \mid 1 \leq x < 4\})'$

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

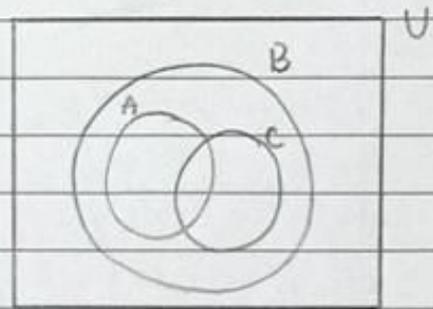
$A' \cup B' = \{x \in \mathbb{R} \mid x < 1, x > 2\}$

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

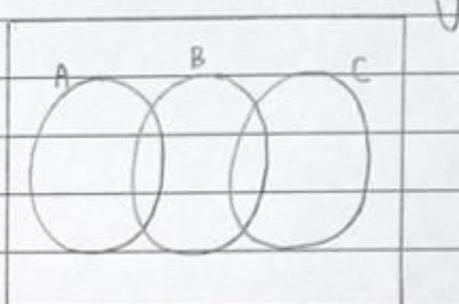
2. a)



b)



c)



No:

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

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

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

$$x \in y \leftrightarrow |x| = |y|$$

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

$$x \in y \leftrightarrow x - y \text{ is even}$$

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

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

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

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

$$\begin{aligned} &\equiv (\neg(\neg p \wedge q) \wedge \neg(\neg q \wedge \neg p)) \vee (p \wedge q) && \text{- De Morgan's Law} \\ &\equiv ((\neg\neg p \vee \neg q) \wedge (\neg\neg q \vee \neg\neg p)) \vee (p \wedge q) && \text{- De Morgan's Law} \\ &\equiv ((p \vee \neg q) \wedge (q \vee p)) \vee (p \wedge q) && \text{- Double Negation Law} \\ &\equiv (p \vee (\neg q \wedge q)) \vee (p \wedge q) && \text{- Distributive Law} \\ &\equiv (p \vee (q \wedge \neg q)) \vee (p \wedge q) && \text{- Commutative Law} \\ &\equiv (p \vee \emptyset) \vee (p \wedge q) && \text{- Negation Law} \\ &\equiv p \vee (p \wedge q) && \text{- Identity Law} \\ &\equiv p && \therefore \text{shown} \quad \text{- Absorption Law} \end{aligned}$$

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

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

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.

	1	2	3	4	5
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

$\therefore R_2$ 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.

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

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

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

	1	2	3
1	1	1	0
2	0	1	1
3	1	0	1

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

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

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

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

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

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 : $C(n-2)$

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

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

$$\begin{aligned} a. \quad t_7 &= t_6 + t_5 + t_4 \\ &= 17 + 9 + 5 \\ &= 31 \end{aligned}$$

$$\begin{aligned} t_3 &= t_2 + t_1 + t_0 \\ &= 1 + 1 + 1 \\ &= 3 \end{aligned}$$

$$\begin{aligned} t_4 &= t_3 + t_2 + t_1 \\ &= 3 + 1 + 1 \\ &= 5 \end{aligned}$$

$$\begin{aligned} t_6 &= t_5 + t_4 + t_3 \\ &= 9 + 5 + 3 \\ &= 17 \end{aligned}$$

$$\begin{aligned} t_5 &= t_4 + t_3 + t_2 \\ &= 5 + 3 + 1 \\ &= 9 \end{aligned}$$

9

b. $t(n)$

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{ if (n = 0)
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    return 0
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    else if (n = 1 or n = 2)
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```
        return 1
```

```
    else
```

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

```
}
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