Faculty of engineering (School of computing)
Discrete structure (SECI1013-10)

Topic: Assignment 1

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Question 1

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

$U = \{x | x \in R\}$

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

(b) $A \cup B = \{1, 2, 3\}$

$(A \cup B)' = \{x \in R | x < 1 \text{ OR } x > 3\}$

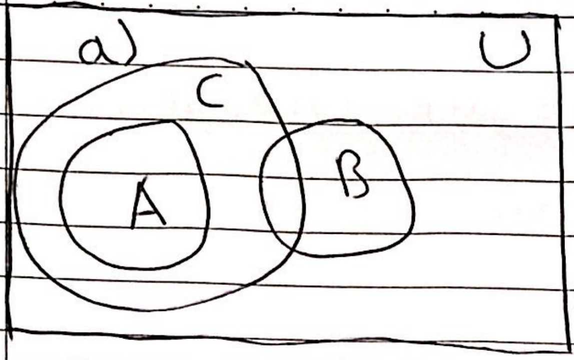
(c) $A' = \{x \in R | x < 1 \text{ OR } x > 2\}$

$B' = \{x \in R | x < 1 \text{ OR } x > 3\}$

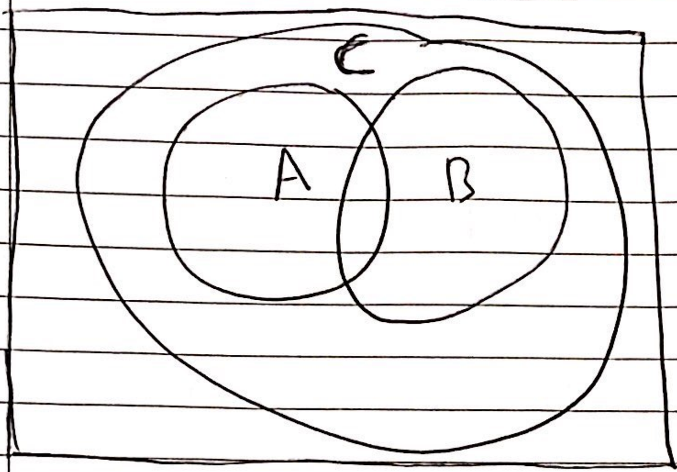
$\therefore A' \cup B' = \{x \in R | x < 1 \text{ OR } x > 2\}$

Q2

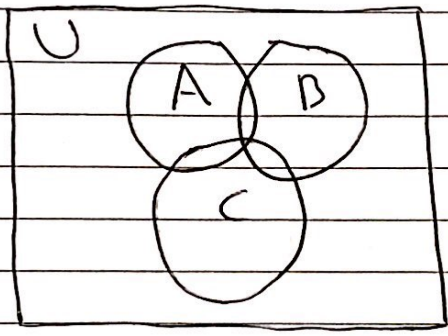
a)



b)



c)



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

b) $S = \{(1,1),(2,2)\}$

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

d) $S \cap T = \{1,2\}$

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

Answer to question: 4

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

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

[$\because$ De Morgan's law]

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

[$\because$ De Morgan's law]

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

$$= p$$ [$\because$ Absorption law] [Showed]

Q5

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

$$\begin{array}{cc} & \begin{matrix} 1 & 2 & 3 & 4 & 5 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{matrix} & \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

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

$$\begin{array}{cc} & \begin{matrix} 1 & 2 & 3 & 4 & 5 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{matrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

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Q 5

c) ~~Same~~ the ~~main~~ Some of the main diagonal matrix element are not 1 and the matrix is ~~not~~ not reflexive

$$M_{R_1} = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \qquad M^T_{R_1} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$M^T_{R_1}$ is equal to M_{R_1}, So R_1 is symmetric.

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

The product of Boolean show that the matris is not transitive.

We cas say $\left.\begin{array}{l} \text{reflexive} \\ \text{symmetric} \\ \text{transitive} \end{array}\right\}$ are not equivalence relation

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Q5

d) Some of the main diagonal matrix element are not 1 and the matrix is ~~not~~ ~~reflexive~~ irreflexive.

$(X, Z) \in R_2$ is an antisymmetric ~~re~~ because for all $(X, Z) \in R_2$ and $Y \neq Z$, then $(Z, Y) \notin R_2$.

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

The product of boolean show that the matrix is no transitive.

We can say $\left.\begin{array}{l} \text{reflexive} \\ \text{antisymmetric} \\ \text{transitive} \end{array}\right\}$ are not a partail order.

(6)

a) $R_1 \cup R_2 = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$

b) $R_1 \cap R_2 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$

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Q7 Given that $f: R \to R$, $g: R \to R$ are two one ~~to~~ one functions.

Suppose $f(x) = x + 2$ and $g(x) = -x + 1$

then $(f+g)(x) = f(x) + g(x)$

$= (x+2) + (-x+1) = 3$, which is a contant function.

There $f+g$ is not one to one function.

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Q8

C_n = Number of different ways to climb a staircase with n stairs.

When n=1, the staircase only contains 1 stair and thus we can only take the staircase by using 1 stair at time once, which is exactly 1 way.

$$C_1 = 1$$

When n = 2, the staircase only contains 2 stairs. We can then take the 2 stairs at one or take the stairs one by one, which thus results in 2 different ways.

$$C_2 = 2$$

When $n \geq 3$, the staircase contains more than 2 stairs and thus we will need to use a combination of 1 stair and 2 stair steps.

If the last will be a 1-stair step, then there were a_{n-1} ways to arrive at the ~~...~~ previous stair(

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(which was a staircase with $n-1$ stairs)

If the last move will be a 2-stair step, then there were a_{n-2} ways to arrive at the pervious stair (which was a staircase with $n-2$ stairs)

The total number of ways is then the sum of the number of ways in which the last move is a 1-stair step and the number of ways in which the last move is a 2-stair step.

$$C_n = C_{n-1} + C_{n-2}$$

$C_1 = 1$ $\quad C_2 = 2$ $\quad C_n = C_{n-1} + C_{n-2}$ when $n \geq 3$.

⑨

a) $t_1 = t_2 = t_3 = 1$

$t_4 = 1 + 1 + 1 = 3$

$t_5 = 1 + 1 + 3 = 5$

$t_6 = 1 + 3 + 5 = 9$

$t_7 = 3 + 5 + 9 = 17$

b) • Input : n

• Output : f(n)

```
f(n) {
    if (n=1 or n=2 or n=3)
        return 1
    return f(n-1) + f(n-2) + f(n-3)
}
```

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