UTM
UNIVERSITI TEKNOLOGI MALAYSIA
SCHOOL OF COMPUTING
Faculty of Engineering

ASSIGNMENT 1

DISCRETE STRUCTURE-07

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Q1

a. $A \cup C = \{x \in R \mid 0 < x < 9\}$

b. $A \cup B = \{x \in R \mid 0 < x < 4\}$

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

c. $A' = \{x \in R \mid x \leq 0, x > 2\}$

$B' = \{x \in R \mid x < 1, x \geq 4\}$

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

Q4

$\neg((\neg p \wedge q) \vee (\neg p \wedge \neg q)) \vee (p \wedge q) \equiv p$ De Morgan's law

$(\neg(\neg p \wedge q) \wedge \neg(\neg p \wedge \neg q)) \vee (p \wedge q)$ De Morgan's law

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

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

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

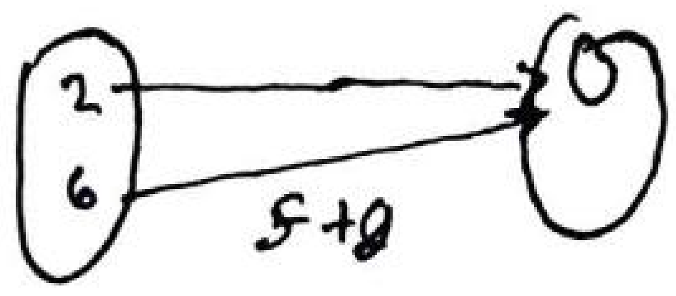
Q1

let $f(x) = x \quad \forall x \in \mathbb{R}$

let $g(x) = -x \quad \forall x \in \mathbb{R}$

ex: $(f+g)(2) = f(2) + g(2)$
$= 2 + (-2)$
$= 0$

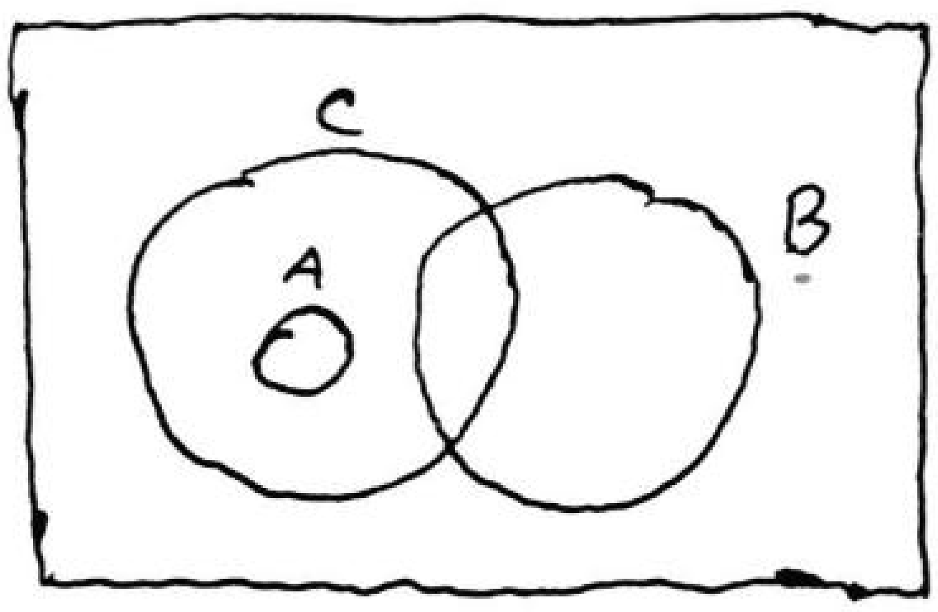
$(f+g)(6) = f(6) + g(6)$
$= 6 + (-6)$
$= 0$



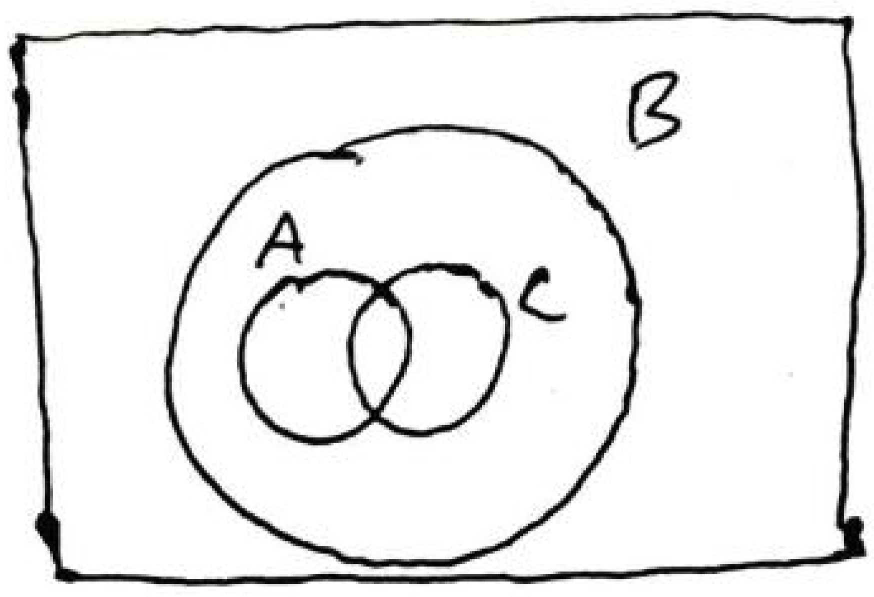
we can see that 0 is a range for both 2 and 6, hence $f+g$ is not one to one

Q2

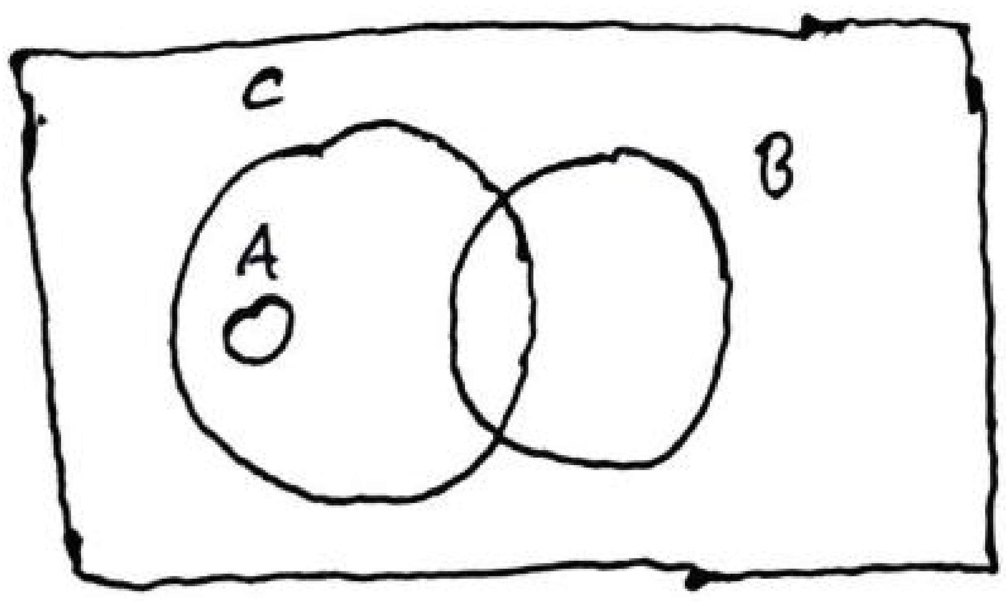
a)



b)



c)



5. $R_1 = \{(x,y) \mid x+y \le 6\}$ $\qquad$ $R_2 = \{(y,z) \mid y > z\}$

Ordering : 1, 2, 3, 4, 5.

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

$$A_1 = \begin{array}{cc} & \begin{matrix} 1 & 2 & 3 & 4 & 5 & (y) \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ (x) \end{matrix} & \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

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

$$A_2 = \begin{array}{cc} & \begin{matrix} 1 & 2 & 3 & 4 & 5 & (z) \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ (y) \end{matrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

c) - R_1 is not reflexive since only ~~(1,1), (2,2),~~ (1,1), (2,2) and (3,3) in the R_1 but not (4,4) and (5,5).

$$\begin{array}{cc} & \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ A_1^T \; \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} & \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Since $A_1 = A_1^T$, R_1 is ~~ref~~ Symmetric.

- R_1 is transitive since $A_1 \otimes A_1 = A_1$

- R_1 is not equivalence since it is not reflexive, symmetric and transitive.

d) - R_2 is irreflexive since (1,1), (2,2), (3,3), (4,4), (5,5) ~~is~~ are not element of R_2.

- R_2 is antisymmetric since:
  $(2,1) \in R_2$
  $(1,2) \notin R_2$

- R_2 is transitive since $A_2 \otimes A_2 = A_2$

- R_2 is ~~partial order since~~ not a partial order relation since it is irreflexive, antisymmetric and transitive.

PAGE
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Question 3:

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

→ $S = \{(-1,1),(1,1),(2,2)\}$

→ $T = \{(-1,1),(1,1),(2,2),(4,2)\}$

→ $S \cap T = \{(-1,1),(1,1),(2,2)\}$

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

Question 6:

→ $R_1 = \{(\cancel{\ }1,1),(2,2),(2,3),(3,1),(3,3)\}$
$R_2 = \{(1,2),(2,2),(3,1),(3,3)\}$

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

Matrix relation:
$$\begin{vmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{vmatrix}$$

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

Matrix relation:
$$\begin{vmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{vmatrix}$$

8. $c_1 = 1$

$c_2 = 2$

$c_n = c_{n-1} + c_{n-2}$ where $n \geq 3$

Question 9:

→ a) $t_1 = t_2 = t_3 = 1,\ t_n = t_{n-1} + t_{n-2} + t_{n-3}\ \forall\ n \geq 4$

$\because\ t_1 = 1,\ t_2 = 1,\ t_3 = 1\ \&\ t_n = t_{n-1} + t_{n-2} + t_{n-3}$

$\therefore\ t_4 = t_{4-1} + t_{4-2} + t_{4-3} = t_3 + t_2 + t_1 = 1+1+1 = \underline{\underline{3}} \rightarrow t_4$

$\therefore\ t_5 = t_{5-1} + t_{5-2} + t_{5-3} = t_4 + t_3 + t_2 = 3+1+1 = \underline{\underline{5}} \rightarrow t_5$

$\therefore\ t_6 = t_{6-1} + t_{6-2} + t_{6-3} = t_5 + t_4 + t_3 = 5+3+1 = \underline{\underline{9}} \rightarrow t_6$

$\therefore\ t_7 = t_{7-1} + t_{7-2} + t_{7-3} = t_6 + t_5 + t_4 = 9+5+3 = \underline{\underline{17}} \rightarrow t_7$

↳ # $\boxed{t_7 = 17}$

→ b) INPUT = n
OUTPUT = tribonacci(n)

```
tribonacci(n) {
        If (n=1)
        Return 1
    Else, If(n=2)
        Return 1
    Else, If (n=3)
        Return 1
    Else,
        Return tribonacci(n-1) + tribonacci(n-2)
        + tribonacci (n-3)
        }
```