ASSIGNMENT 1

SCHOOL OF COMPUTING
Faculty of Engineering

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FACULTY OF ENGINEERING

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SECTION/COURSE CODE	**: [SECI1013] [01] – [DISCRETE STRUCTURE]**
LECTURER	**: [DR. RAZANA ALWEE]**
SESSION/SEMESTER	**: [2020/2021] - [01]**

Case Study Report submitted to School of Computing, Univerisiti Teknologi Malaysia in partial fulfilment to complete the SECI1013 Assignment for Semester 1 session 2020/2021

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

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

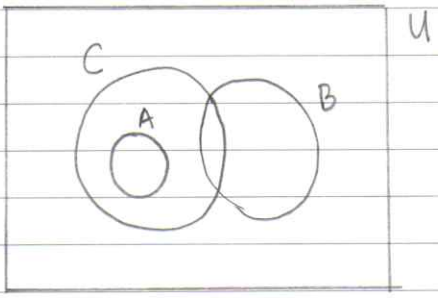
$C = \{x \in \mathbb{R} \mid 3 \leq x < 9\}$

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

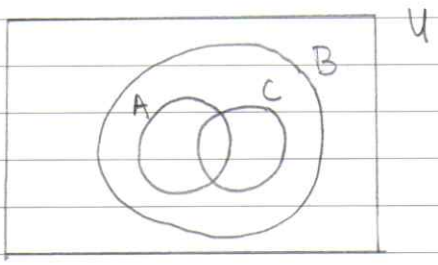
b) $(A \cup B)' = (\{x \in \mathbb{R} \mid 0 < x < 4\})'$
$= \{x \in \mathbb{R} \mid x \leq 0 \text{ or } x \geq 4\}$

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

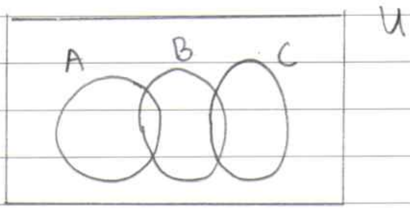
2. a)



b)



c)



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3) For all $(x,y) \in A \times B$, $xSy \longleftrightarrow |x| = |y|$

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

For all $(x,y) \in A\times B$, $xTy \longleftrightarrow x-y$ is even

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

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

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

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

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

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

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

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

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

$\equiv ((p \vee \neg q) \wedge (p \vee q)) \vee (p \wedge q)$ Double negation law

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

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

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

$\equiv p$ Absorption law

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

$$A_1 = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

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

$$A_2 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{bmatrix}$$

c) R_1 is not reflexive because A_1 has 0's on main diagonal.
R_1 is symmetric because $(x,y) \in R$, and $(y,x) \in R$.
R_1 is transitive because $(x,y) \in R$, $(y,z) \in R$, $(x,z) \in R$
R_1 is not equivalence relation because R_1 is not reflexive.

d) R_2 is not reflexive because A_2 has no 1's on main diagonal.
R_2 is antisymmetric because $(x,y) \in R$, $x \neq y$, $(y,x) \notin R$
R_2 is not transitive because $(x,y) \in R$, $(y,z) \in R$, $(x,z) \notin R$
R_2 is not partial order relation because R_1 is not reflexive and not transitive.

6) a)

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

b)

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

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

Consider $f: R \to R$, $f(x) = x$, $\forall x \in R$

$g: R \to R$, $g(x) = -x$, $\forall x \in R$

if $f(x_1) = f(x_2)$ then $x_1 = x_2$

if $g(x_1) = g(x_2)$ then $-x_1 = -x_2$, $x_1 = x_2$

$f+g$ is not one to one function because

$$(f+g)(x) = f(x) + g(x) = x - x = 0, \quad \forall x \in R$$

but $(f+g)(1) = (f+g)(2)$

$1 \neq 2$

8. n = number of stairs

C_n = total number of ways to climb

when $n=1$, $C_1 = 1$

$n=2$, $C_2 = 2$

The last step taken is either single stair or two

* the number of ways to climb the staircase and have the final step be a single stair is $C_{(n-1)}$.
* the final step be a two stairs is $C_{(n-2)}$

$$\therefore C_n = C_{(n-1)} + C_{(n-2)}, \quad n \geq 3$$

providing $C_1 = 1$, $C_2 = 2$

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4) a) $t_3 = t_2 + t_1 + t_0$

$= 1 + 1 + 0$

$= 2$

$t_4 = t_3 + t_2 + t_1$

$= 2 + 1 + 1$

$= 4$

$t_5 = t_4 + t_3 + t_2$

$= 4 + 2 + 1$

$= 7$

$t_6 = t_5 + t_4 + t_3$

$= 7 + 4 + 2$

$= 13$

$t_7 = t_6 + t_5 + t_4$

$= 13 + 7 + 4$

$= 24$

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)
}
```