ASSIGNMENT 1 TUTORIAL

SCHOOL OF COMPUTING, FACULTY OF ENGINEERING

SECI 1013 | DISCRETE STRUCTURE

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SECTION 9

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DISCRETE STRUCTURE
(SECI 1013)
TUTORIAL 1

① $A = \{x \in R \mid 0 < x \leq 2\}$ $\quad A = \{1, 2\}$

$B = \{x \in R \mid 1 \leq x < 4\}$ $\quad B = \{1, 2, 3\}$

$C = \{x \in R \mid 3 \leq x < 9\}$ $\quad C = \{3, 4, 5, 6, 7, 8\}$

a) $A \cup C$

$A = \{1, 2\}$

$C = \{3, 4, 5, 6, 7, 8\}$

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

b) $(A \cup B)'$

$A = \{1, 2\}$ $\quad A' = \{x \leq 0\}$

$B = \{1, 2, 3\}$ $\quad B' = \{x \geq 4\}$

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

$= \{\ldots, -2, -1, 0, 4, 5, 6, 7, 8, \ldots\}$

c) $A' \cup B'$

$A' = \{x \leq 0$ or $x > 2\}$

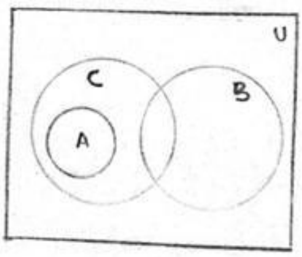
$B' = \{x < 1$ or $x \geq 4\}$

$A' \cup B' = \{x < 1$ or $x > 2\}$

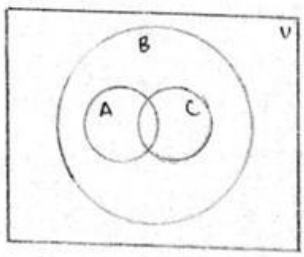
$= \{\ldots, -2, -1, 0, 3, 4, 5, 6, 7, 8, \ldots\}$

② Draw venn diagrams

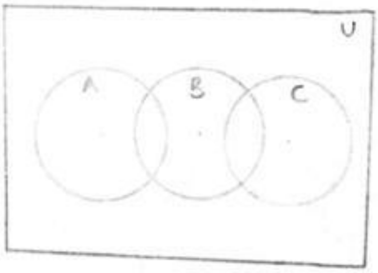
a) $A \cap B = \emptyset$, $A \subseteq C$, $C \cap B \neq \emptyset$



b) $A \subseteq B$, $C \subseteq B$, $A \cap C \neq \emptyset$



c) $A \cap B \neq \emptyset$, $B \cap C \neq \emptyset$, $A \cap C = \emptyset$, $A \not\subset B$, $C \not\subset B$



3) $S \cap T = \{(x,y) \in A \times B \mid (x,y) \in S \text{ and } (x,y) \in T\}$

$S \cup T = \{(x,y) \in A \times B \mid (x,y) \in S \text{ or } (x,y) \in T\}$

$A = \{-1, 1, 2, 4\}$ $\quad B = \{1, 2\}$

For all $(x,y) \in A \times B$, $\quad x S y \leftrightarrow |x| = |y|$

For all $(x,y) \in A \times B$, $\quad x T y \leftrightarrow x-y$ is even

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

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

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

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

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

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

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

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

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

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

$p \equiv p$ — absorption law

shown

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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) $M_{R_1} : \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{pmatrix}$

b) $M_{R_2} : \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{pmatrix}$

c) R_1 → not reflexive → $(4,4) \notin R$, $(5,5) \notin R$

→ Symmetric → $(1,2) \in R$ and $(2,1) \in R$

$(1,3) \in R$ and $(3,1) \in R$

$(1,4) \in R$ and $(4,1) \in R$

$(1,5) \in R$ and $(5,1) \in R$

$(2,3) \in R$ and $(3,2) \in R$

$(2,4) \in R$ and $(4,2) \in R$

$\cancel{(3,5) \notin R}$

→ not transitive → $(3,2) \in R$ and $(2,4) \in R$ but $(3,4) \notin R$

$(4,2) \in R$ and $(2,3) \in R$ but $(4,3) \notin R$

$(4,2) \in R$ and $(2,4) \in R$ but $(4,4) \notin R$

hence it is not equivalence relation.

d) R_2 → not reflexive ⇝ main diagonal are '0'

not antisymetric ⇝ $\forall$ $(y,z) \in R \rightarrow (z,y) \notin R$

transitive ⇝ $(3,2) \in R$ and $(2,1) \in R$, $(3,1) \in R$

$(4,2) \in R$ and $(2,1) \in R$, $(4,1) \in R$

$(4,3) \in R$ and $(3,1) \in R$, $(4,1) \in R$

$(4,3) \in R$ and $(3,2) \in R$, $(4,2) \in R$

$(5,2) \in R$ and $(2,1) \in R$, $(5,1) \in R$

$(5,3) \in R$ and $(3,1) \in R$, $(5,1) \in R$

$(5,3) \in R$ and $(3,2) \in R$, $(5,2) \in R$

$(5,4) \in R$ and $(4,1) \in R$, $(5,1) \in R$

$(5,4) \in R$ and $(4,2) \in R$, $(5,2) \in R$

$(5,4) \in R$ and $(4,3) \in R$, $(5,3) \in R$

hence it is not partial order relation.

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

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

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

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

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

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

Q7) Given that $f: R \to R$ and $g: R \to R$ are both one-to-one
$f+g = ?$

Let $f(x) = x+1$ and $g(x) = -x+1$

$$\therefore (f+g)(x) = f(x) + g(x)$$
$$= x+1 + (-x+1)$$
$$= 2$$ $\Rightarrow$ the result will be 2 for any value of x and thus it is not a one-to-one function

Q8) C_n = number of ways to climb the staircase for $n \geq 1$

when $n=1$ $\Rightarrow$ only one possibility which is 1 stair

when $n=2$ $\Rightarrow$ 2 possibilities
- 2X 1 stair
- 1X 2 stair

when $n \geq 3$ $\Rightarrow$ must have a combination of possibilities

$$\therefore C_n = C_{n-1} + C_{n-2} \qquad n \geq 3$$

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

7) 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)

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t(n) {
    if (n = 0)
        return 0
    if (n = 1 or n = 2)
        return 1
    return t(n-1) + t(n-2) + t(n-3)
}
```

$$\overset{13}{t(6)} + \overset{7}{t(5)} + \overset{4}{t(4)}$$

$t(5) + t(4) + t(3)$

$7 + 4 + 2$

$t(4) + t(3) + t(2)$

$4 + 2 + 1$

$\downarrow$

$t(2) + t(1) + t(0)$

$1 \quad 1 \quad 0$

$t(3) + t(2) + t(1)$

$2 + 1 + 1$