# ASSIGNMENT 3


**SCHOOL OF COMPUTING**

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| **SECTION/COURSE CODE** | **: [SECI1013] [01] – [DISCRETE STRUCTURE]** |
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**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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Question 1

a) i) $A - B = \{1, 3, 4, 6, 7, 8\}$

ii) $(A \cap B) \cup C = \{2, 5\} \cup \{a, b\}$
$= \{2, 5, a, b\}$

iii) $A \cap B \cap C = \phi$

iv) $B \times C = \{2, 5, 9\} \times \{a, b\}$
$= \{(2,a), (2,b), (5,a), (5,b), (9,a), (9,b)\}$

v) $P(C) = \{\phi, \{a\}, \{b\}, \{a, b\}\}$

b)
$(P \cap ((P' \cup Q)')) \cup (P \cap Q) = (P \cap ((P'' \cap Q'))) \cup (P \cap Q)$ De Morgan's law
$= (P \cap (P \cap Q')) \cup (P \cap Q)$ Double complement law
$= ((P \cap P) \cap Q') \cup (P \cap Q)$ Associative law
$= (P \cap Q') \cup (P \cap Q)$ Idempotent law
$= P \cap (Q' \cup Q)$ Distributive law
$= P \cap U$ Complement law
$= P$ Identity law

c)

| $p$ | $q$ | $\neg p$ | $\neg p \vee q$ | $q \to p$ | $(\neg p \vee q) \leftrightarrow (q \to p)$ |
|---|---|---|---|---|---|
| F | F | T | T | T | T |
| F | T | T | T | F | F |
| T | F | F | F | T | F |
| T | T | F | T | T | T |

d) Let $n = 2k + 1$,
$(n+2)^2 = (2k+1+2)^2$
$= (2k+3)^2$
$= 4k^2 + 12k + 9$
$= 2(2k^2 + 6k + 4) + 1$
$= 2r + 1$, where $r = 2k^2 + 6k + 4$
$\therefore (n+2)^2$ is odd

e) i) $\exists x \exists y$ such that $y \leq x$, $P(x,y)$ is true, $\exists x \exists y\ P(x,y)$ is true
ii) $\forall x \forall y$ such that $y \geq x$, $P(x,y)$ is false, $\forall x \forall y\ P(x,y)$ is false

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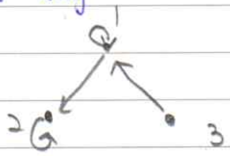
Question 2

a) i) domain = $\{1, 2, 3\}$

range = $\{1, 2\}$

ii) The relation is not irreflexive, since it got 1's on main diagonal.

The relation is antisymmetric since all vertices have at least one directed edge and one way.




b) i) $S = \{(4,5), (5,4), (5,5)\}$

ii) S is not reflexive since

$2 \in X$, $(2,2) \notin S$

$3 \in X$, $(3,3) \notin S$

$4 \in X$, $(4,4) \notin S$

S is symmetric since $(4,5) \in S$, $(5,4) \in S$

S is not transitive since $(4,5) \in S$, $(5,4) \in S$, but $(4,4) \notin S$

S is not equivalence relation because S is not reflexive, symmetric and not transitive

c) i) Define f by $f(x) = x$, all domain have it own range, so it is one to one function but it is not onto because 4 has no arrow pointing to it.

ii) Define g by $g(x) = x$, 1, 2 have their own range but 3 has no arrow pointing to range, hence it is not one to one function. Since all value in Z have arrow pointing to it, hence it is onto.

iii) Define h by $h(x) = x+1$. $h = \{(1,2), (2,3)\}$. $h(x)$ is not one to one function since 1 has no arrow pointing to range. $h(x)$ is not onto since 1 has no arrow pointing to it.

d) i) let $y = 4x+3$

$4x = y-3$

$x = \frac{y-3}{4}$

$m^{-1}(x) = \frac{x-3}{4}$

ii) $n \circ m = n(m(x))$

$= 2(4x+3)-4$

$= 8x+6-4$

$= 8x+2$

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Question 3

a) i) $a_1 = 1$

$a_2 = 1 + 2(2)$

$= 5$

$a_3 = 5 + 2(3)$

$= 11$

$\therefore$ first 3 term $= 1, 5, 11$

ii)

```
a(k)
{
  if (k=1)
     return 1
  return a(k-1) + 2k
}
```

b) let $r_k$ = the number of executes with an input size $k$

$r_1 = 7$,

$r_k = 2r_{(k-1)}$ , $k \geq 2$

$r_2 = 2(7)$

$= 14$

$r_3 = 2(2)(7)$

$r_k = 2^{k-1}(r_{(k-1)})$

$\therefore r_k = 7(2^{k-1})$ , $k \geq 2$

c)

| | |
|---|---|
| $S(4)$ , $n = 4$, | $S(4) = 625$ |
| $n \neq 1$, | |
| return $5S(3)$ | return $= 625$ |
| $S(3)$ , $n = 3$, | $S(3) = 125$ |
| $n \neq 1$, | |
| return $5S(2)$ | return $125$ |
| $S(2)$ , $n = 2$, | $S(2) = 25$ |
| $n \neq 1$, | |
| return $5S(1)$ | return $= 25$ |
| $S(1)$ , $n = 1$, | $S(1) = 5$ |
| return $5$ | return $5$ |

Question 4

a) 1st place, {3, 4, 5, 6, 7, 8, 9, A, B}

$\therefore$ 9 ways

4th place, {5, 6, 7, 8, 9, A, B, C, D, E, F}

$\therefore$ 11 ways

$\underline{9}$ $\underline{16}$ $\underline{16}$ $\underline{11}$

ways $= 9 \times 16 \times 16 \times 11$

$= 25344$

b) first letter = 1

2nd letter = 26

3rd letter = 26

4th letter = 26

first digit = 10

2nd digit = 10

3rd digit = ~~8~~ 1

ways $= 1 \times 26 \times 26 \times 26 \times 10 \times 10 \times 1$

$= 1757600$

c) one word = 8

two word $= {}^8P_2$

$= 56$

3 word $= {}^8P_3$

$= 336$

ways $= 8 + 56 + 336$

$= 400$

d) women $= {}^7C_4$

$= 35$

men $= {}^6C_3$

$= 20$

ways $= 35 \times 20$

$= 700$

e) ways $= \frac{11!}{2! \times 2!}$

$= 9979200$

f) $n = 6$, $r = 10$

ways $= C(6+10-1, 10)$

$= \frac{15!}{10!\,(6-1)!}$

$= 3003$

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Question 5

a) first and last name combination = 3×2

= 6

pigeons = 18

pigeonholes = 6

$\frac{18}{6} = 3$

∴ at least 3 persons have the same first and last name.

b) numbers = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

odd numbers = 1, 3, 5, 7, 9, 11, 13, 15, 17, 19

since get 10 odd number, hence even number = 10

pigeonholes = 10

pigeon, n > 10

∴ 11 integers must pick to be sure getting at least one is odd.

c) divisible by 5 = 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

= 20

not divisible by 5 = 80

pigeonholes = 80

pigeon, n > 80

∴ 81 integers must pick in order to get one that is divisible by 5