



SECI1013: DISCRETE STRUCTURE
SESSION 2022/2023 – SEMESTER 1
ASSIGNMENT 1 (PART 1) – CHAPTER 1

INSTRUCTIONS:

1. This assignment must be conducted in a group (**3 or 4 students**).
Please clearly write the **group members name and matric number** in the front-page of the submission.
2. Solutions for each question must be readable and neatly written on plain A4 paper.
Every step or calculation should be properly shown.
Failure to do so will result in rejection of the submission of assignment.
3. For submission, scan and combine all answer/solution sheets as one PDF file.
Then only ONE group member needs to submit on behalf of the group via e-learning
(Due date : 28 October 2024. Submit a hardcopy to my office)

QUESTIONS

1. Let the universe be the set $U = \{x \in \mathbb{Z}, 0 \leq x \leq 20\}$,
 A, B , and C denote the subsets of U ,
$$A = \{p | p \in \text{prime numbers}, 0 \leq p \leq 20\},$$
$$B = \{e | e \in \text{even numbers}, 10 \leq e \leq 20\},$$
$$C = \{o | o \in \text{odd numbers}, 0 \leq o \leq 10\}$$

Write down all possible outcomes with the following set operations:

- a. $A \cap C \cup B$
- b. $P(A \cap B \cup C)$
- c. $A - C$

Determine the cardinality of the following set:

- d. $|A|, |B|, |C|$
- e. $|P(A \cap C)|$

Answer the following set operations with True or False:

- f. $B \subset C'$
- g. $(A \cup B \cup C) \subseteq U$

2. Let A, B , and C denote the subsets of U ,
then show the following set operations and statements are equal or not using properties of set/set identities or Venn diagram:
 - a. $(A - C') \cup (B - C) = A \cup B$
 - b. $(A \cap B) \cup (A - B) = A$

3. Books in the university library are categorized into Social Science (S), Science & Technology (T) and Engineering (E). Alphabets a-g is used to catalogue books in category S, alphabets h-q for category T and the p-z for category E. However, alphabets o, u, x and i are excluded. Some alphabets are used more than once in different categories.

Determine the following sets.

- a) S, T, E
 - b) $S \times (T \cap E)$
4. Let $A = \{a, \{a\}, b, \{a, b\}\}$. State whether the following statement is TRUE or FALSE
- a) $\{a\} \subseteq A$
 - b) $\{a, b\} \in A$

5. State whether $Q \equiv R$ or not.

Show the truth table as the proof of your work for each of the following statements:

- a. $Q = (p \wedge r) \vee (q \vee \neg r), R = (p \vee q) \vee \neg r$
- b. $Q = (p \wedge r) \vee \neg(p \wedge \neg q), R = (p \wedge r) \rightarrow (q \vee r)$

6. Let $D = \{1, 3, 5, 7, 8, 9\}$. Decide whether each of the following statements is true for all elements of D . For each that are not, give a counterexample. That is, provide an element in D for which the statement is not true.

- a) x is even and $x > 7$
- b) x is not odd and $x \leq 7$

7. Let $P(x)$ be the statement " x can speak Arabic" and let $Q(x)$ be the statement " x knows computer language C++". Express the following sentence in term of $P(x)$, $Q(x)$, quantifiers, and logical connectives. The domain for quantifiers consists of all students at your faculty.

There is a student at your faculty who can speak Arabic and who knows C++.

8. Prove the following theorem using direct proof method.

For all integers, if a is odd then $a^2 - 3a$ is even

9. n^2 is an odd integer then n is odd. Proof using contradiction proof method.

SCSI1013: Discrete Structure (2015/2016- Semester 1)

Assignment 1.2 (Due 21/11/2024)

1. R defined by $a R b$ if and only if $a - b$ is an even integer from $A = \{3, 6, 9, 12\}$ to $B = \{2, 3, 4, 5, 6\}$
 - i) Write the ordered pair of the relation.
 - ii) Draw the digraph of the relation.
 - iii) List the domain and range of R
2. Determine whether the relation on set $D = \{1, 3, 8, 10, 15\}$ is equivalent relations where $x, y \in D, x R y$ if and only if $y - x$ is a multiple of 7(Including negative).
3. Given the digraph of relation R as in Figure 1.

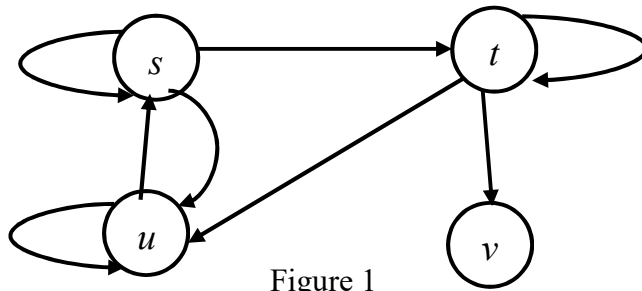


Figure 1

- i) What is matrix of the relation, M_R that represent diagram in Figure 1.
 - ii) List in-degrees and out-degrees of all vertices.
 - iii) Is it the relation of R is an partial order? Check all variance Justify for answer
4. Let $X = \{-2, 0, 2\}$ and $Y = \{-4, 0, 4\}$. For each $x \in X$, define functions $v: X \rightarrow Y$ and $w: X \rightarrow Y$ by:
$$v(x) = 4 - x^2$$
$$w(x) = 2x$$

Determine if v and w are one-to-one, onto Y , and/or bijection.

5. Let f and g be functions from the positive integers to the positive integers defined by the equations,

$$f(x) = 7x - 2, \quad g(x) = \frac{2}{3}x$$

- i) Find the inverse of $g(x)$.
 - ii) Find the compositions $(g \circ f)(x)$
6. As a lead computer scientist in a chemical industry plant, you are assigned to design and develop algorithms that simulate chemical reaction processes. Two chemicals A and B are combined to produce a third chemical C . The initial temperature F_0 , of chemical A , is 5.0 Fahrenheit and the initial temperature F_1 for chemical B is 4.5. When chemicals A and B are combined to produce chemical C , the increment in each minute $t = 0, 1, 2, 3 \dots$, which chemical C warms up to room temperature is a recurrence sequence, with F_0 and F_1 as initial conditions. For $t \geq 2$, this recurrence sequence is found by summing the previous element of the sequence $(t-1)$, with one-fifth of the previous two elements of the sequence $(t-2)$. From the above given information,
- i) Find the recurrence relation of chemical C that models the warming to room temperature.
 - ii) Using the recurrence relation obtained in (a), list down the sequence from $F_0, F_1, F_2, \dots F_5$.
7. Write a recursive algorithm to find the n term of the sequence defined by $w_0 = 5, w_1 = 7$ and $w_n = 2w_{n-1} + w_{n-2}$ for $n \geq 2$. Trace the algorithm for $n = 4$.