THE UNIVERSITY OF ZAMBIA

Department of Computer Science

CSC2901 – Discrete Structures

Test

Instructions

Answer all the questions and send a scanned copy to

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1. Consider the algorithm described in the pseudocode below.

```
algorithm mystery(A,n,z)
        input: A, an array of n integers, and z is a given integer
        output:??
        for i <- 0 to n-1 do
                x <- z – a[i]
                for j <- i+1 to n-1 do
                        if x = a[j] then
                                print a[i]
                                print a[j]
                                Stop
                        end if
                next
        next
        Print "Failure"
        Stop
end.
```

   a. Draw the flowchart for this algorithm
   b. Simulate how mystery([2, 4, 1, 6, 7, 3], 6, 7) is executed. [use the table of variables]

2.

   a. Given two subsets A and B of the Universal set U. State the Sum Rule for two sets A and B.
   b. Use the Sum Rule for two sets to show that

      $$|A \cup B \cup C| = |A| + |B| + |C| - |A \cup B| - |A \cup C| - |B \cup C| + |A \cap B \cap C|$$

      [Hint: start with $A \cup B \cup C = A \cup (B \cup C)$]

   c. Let U be the set of 35 students participating in the sports of Football, Basketball or volleyball. 6 of these students participate in all the sports and 7 of them do not participate in any sport. Those who play Football are 16 in total while it is known that 8 play both Basketball and Volleyball. Calculate how many students
      i. Play exactly Basketball and Volleyball and not Football
      ii. Play either Basketball only or Volleyball only.

3.

a. Given a set $A = \{a, b, c\}$ and R defined on A as $R = \{(a, b), (b, a), (b, b), (c, a)\}$. Explain why R is
    i. Not Reflexive
    ii. Not Symmetric
    iii. Not Anti-symmetric
    iv. Not Transitive
b. What is
    i. R^2,
    ii. R^3
    iii. $R \cup R^2 \cup R^3$
c. Hence, show that $R \cup R^2 \cup R^3$ is transitive.

4.

a. Find the inverse $7 (mod\ 11)$ and hence solve for x in $7x \equiv 5 (mod\ 11)$
b. Suppose Alice picks $p = 7$ and $q = 11$ as the two integers for encrypting her messages using the RSA algorithm. What is Alice's
    i. public key
    ii. private key
c. Suppose Bob wants to send a message m = 6 to Alice. What will be the encrypted message?

5. Consider the Boolean expression xy'z + xyz' + xyz
    a. Draw the Logic network for this expression
    b. Simplify this expression using
        i. Analytical methods
        ii. The K-map
    c. Draw the logic network of the simplified expression.