

**OLLSCOIL NA hÉIREANN**  
**NATIONAL UNIVERSITY OF IRELAND, GALWAY**

**SEMESTER II, SUMMER 2004 EXAMINATION**

The B.Sc. (Honours) Degree in Computing Studies

***Advanced Programming (CT406)***

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 Professor G. Lyons  
 Dr. J. Duggan

**Time Allowed: 2 hours**  
 Answer any three questions

1. Analyse the following routine, and:
  - (a) Draw a flow graph (40% marks)
  - (b) Calculate  $V(G)$  using three methods (20% marks)
  - (c) Derive a set of tests to ensure code coverage (40% marks)

<b>routine</b>	sort routine
<b>uses</b>	Array, N (array size), sort_flag
<b>updates</b>	array
<b>description</b>	<i>selection sort algorithm</i>

```

Begin
  SET I = 0; J = 0; MIN = 0; T = 0;

  DO WHILE (I < N)
    MIN = I
    J = I + 1
    DO WHILE (J <= N)
      IF Array[J] < Array [Min] Then
        MIN = J
      END IF
      J = J + 1
    END DO
    T = Array[MIN]
    Array[MIN] = Array[I]
    Array[I] = T
    I = I + 1
  END DO
End
  
```

2. Based on the following Use Case description, draw:

- (a) A class diagram, showing clearly those classes that are boundary, entity, and control. (60% marks)
- (b) A sequence diagram. (40% marks)

**Use Case:** Pay A Bill

**Actor:** Customer, External Utility Agency

**Description:** Allows a customer to pay a bill for an external utility agency such as mobile phone, electricity, etc.

**Flow of Events:**

- The customer inserts their card. They are prompted for and enter their PIN. If the PIN is entered incorrectly three times, the card is confiscated.
- An options menu is presented to the Customer, from which they select the bill they wish to pay.
- They are prompted for the amount to be paid. This is checked against their account balance to ensure that sufficient funds are present. (Bills may be paid from current, deposit and mortgage accounts). If there are sufficient funds, the user is asked to confirm the transaction.
- When the transaction is confirmed, the user's account is debited and a transaction is created to record the details of the payment. Also, the External Utility Agency is contacted with details of the transaction.
- A receipt is printed.
- The card is returned to the Customer.

3. (a) Describe how the following metrics are calculated: *class size*, *depth of inheritance* and *Weighted Methods/Class*. (40% marks)
- (b) Determine the LCOM (Lack of Cohesion of Methods) for the following class (60% marks)

```
public class Stack
{
    int[10] data;
    int counter=0;

    void push (int x)
    {
        data[counter]=x;
        counter = counter +1;
    }

    int pop()
    {
        int top = Stack[counter];
        counter = counter -1;
        return top;
    }

    int getSize()
    {
        return (counter + 1);
    }
} // end of class definition
```

4. (a) Describe, using an example, the difference between implementation and specification inheritance. (25% marks)
- (b) State the *Liskov Substitution Principle*, and comment on its importance in object oriented design. (25% marks)
- (c) Describe the Proxy Design pattern and show how it can be used as a "firewall" to control access from a client to a target object. Make use of a class diagram and a sequence diagram to illustrate its structure and behaviour. (50% marks)