

OLLSCOIL NA hÉIREANN
NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II, SUMMER 1999 EXAMINATION

Second B.Sc. in Information Technology

Software Engineering I (CT216)

Professor D. Bell

Dr. G. Lyons

Dr. J. Duggan

Dr. S. Flynn

Time Allowed: 3 hours

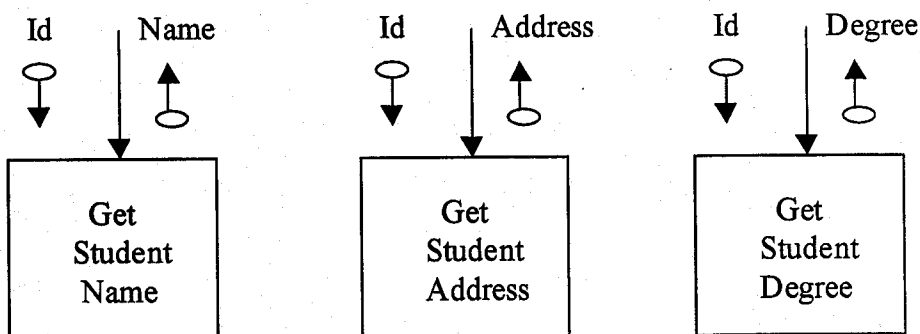
Answer any five questions

Use a separate answer book for each section

Section A: Structured Techniques

1. (a) Explain the terms *Factoring*, *Fan In*, and *Fan Out*.

(b) The routines *Get Student Name*, *Get Student Address* and *Get Student Degree* are used as part of a student information system. Each routine must access a persistent data source to retrieve information. However, accessing the persistent data source (three times) has presented a performance problem. Show how an information cluster can be used to improve performance. Comment on the coupling and cohesion levels of the new design.



2. Examine the routine *Selection Sort* and:

- Construct a Flow Graph;
- Calculate $V(G)$;
- Design a driver routine that ensures that all software paths in the routine are executed.

Routine: Selection Sort
Uses: N (size of the array)
Updates: List (the array containing elements to be sorted)

Begin

Integer i, j, min, temp;

for(i=0; i < n - 1; i++)

{

min = i;

for (j = i+1; j < n; j++)

{

if(List[j] < List[i])

min = j;

}

tmp = List[i];

List[i] = List[min];

List[min] = tmp;

}

End

3. (a) Explain the terms: Functional Dependency; Second Normal Form; Third Normal Form.

(b) Identify functional dependencies in the following relation. Convert the relation to Third Normal Form (3NF).

Student ID	Name	Degree	Result	Subject	Title
98765433	J. Murphy	BA	56	CT111	Programming
98765433	J. Murphy	BA	78	IT118	Italian
98744411	M. Ruane	BSC	65	CT111	Programming
98744411	M. Ruane	BSC	71	IT118	Italian

4. (a) Describe:

- Stamp Coupling
- Sequential Cohesion
- Communicational Cohesion

(b) Using appropriate measures, determine the quality of the routine *Process Array*. If appropriate, redesign the routine so that it conforms to best design practice.

Routine: Process Array
Uses: Flag, List, N
Returns: Min, Max

Begin

```
Integer j;  
  
If(Flag == 1){  
    Min = List[0];  
    For(j=1; j < N; j++)  
        If(Min > List[j])  
            Min = List[j];  
    Return Min;  
}  
else if (Flag == 2){  
    Max = List[0];  
    For(j=1; j < N; j++)  
        If(Max < List[j])  
            Max = List[j];  
    Return Max;  
}
```

End

5. (a) For each of the following entities and relationships, show the entity sets (with sample entity instances), and draw E-R models with cardinalities.

- A Student can study more than one subject. A subject is taken by one or more students.
- A person can manage one or more people. Each person can only have one manager.

(b) Study the problem description (Fantasy Football) and construct and E-R model.

An Owner can have one or more Teams. Owners are uniquely identified by an Owner Id, and have attributes Name and E-Mail Address. Each Team has a unique Team Id, Team Name and Total Value. Teams consist of many players, and each player can belong to more than one team. Players are uniquely identified by a Player ID, and have further attribute information, namely: Name, Club and Value. For each player, their points value for every week of competition must be stored.

6. For the following problem description, construct:

- An Event List
- A Preliminary Behavioural Model
- A leveled DFD
- Process Specifications

In a banking system, customers want to withdraw funds. To do so, they provide their account number and personal identification number. This is matched against the CUSTOMER data store. If the number is valid, the user is prompted for the amount they wish to withdraw. If the number is invalid, an “Invalid PIN” message is displayed, and the user must re-enter their number (3 attempts maximum).

A check is made against the balance held in ACCOUNTS to see if sufficient funds are available. If there is not enough funds, an “Invalid Amount” message is displayed, and the transaction terminates. If there are enough funds, the balance in ACCOUNTS is modified, and an “Account Debited Successfully” message is displayed.

Section B: Formal Methods

7. Model the booking system for a particular flight. The aeroplane has a limited capacity and the flight should not be overbooked. The operations should include: a passenger booking onto the flight; a passenger cancelling his booking; a query of how many seats are still available; the production of a passenger list. (Hint: Use the given set [PERSON]).
8. The IT Centre management would like to keep track of their staff and which subjects they teach. Develop a Z specification that keeps track of this information. Operations should include: add a new staff member; given a staff member, find out which subjects he/she teaches; given a subject, find out which staff teach it; and remove a staff member. (Hint: use the given types [PERSON], [SUBJECT]).