

University of Swaziland
Department of Computer Science
Final Examination
May 2008

Title of paper : Software Engineering

Course number : CS452

Time Allowed : Three(3) hours

Instructions :

- *Each question is worth 25 marks.*
- *Answer question 1*
- *Answer any three (3) questions from questions 2 to 6*

This paper may not be opened until permission has been granted by the invigilator

Questions 1 is based on the following case study.

Manzini hospital x-ray management system.

Patients present X-ray request forms, obtained from their doctors, to the receptionist. The receptionist receives each form and produces an appointment card which is given to the patient. This card contains information such as patient particulars and the time and date on which the patient may come for the X-ray. The X-ray request forms are filed for later reference. The receptionist also keeps a diary of all the appointments.

When patients arrive for X-rays on the appointed date and time, they produce their appointment cards. A nurse checks the validity of the card and passes the appointment card to the clerk. The clerk generates an x-ray film-and-report request form for the filing section. The X-ray request form is retrieved from its file and given to the radiographer. The X-ray film-and-report requests are placed in a temporary file for collection by the filing section.

On receipt of the X-ray request form, the radiographer takes the appropriate photographs (called films) and places them on a temporary file for collection by the filing section. Each appointment results in a set of films.

The filing clerks collect the X-ray film-and-report requests. A patient may have many X-ray films and reports, the new films are attached and placed on a temporary file for the attention of the radiologist who will make out a report for the appointment.

The radiologist examines all the X-ray films and reports which the patient has and produces a final report which is sent to the patients doctor. A copy of this report is also sent to the filing section. When the filing section receives this report all corresponding films and reports are returned to the permanent files.

Question 1 – 25 marks
(Compulsory)

(a) Using UML notation, draw a USE CASE diagram for X-ray management system.

10 marks

(b) Draw a sequence diagram for the scenario described in paragraph 2 of the description of the X-ray management system.

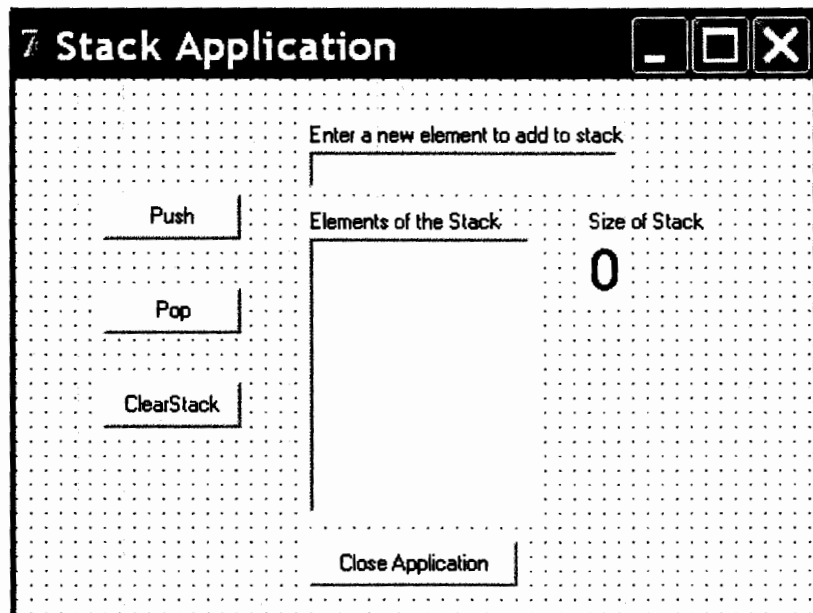
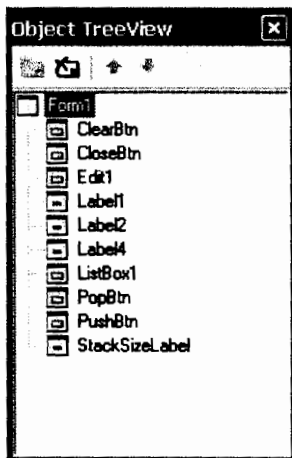
15 marks

Question 2 – 25 Marks

(Instructions: Read the whole question before attempting to answer. Preferable, both part (a) and (b) should be answered on the same page or directly opposite pages to allow linking of diagrams.)

(a) Consider the following Delphi user interface. The Object TreeView for the project is as shown on the left. Using UML notation draw a Human Interaction Component (HIC) class diagram for this user interface.

15 Marks



- (b) The Problem Domain Component (PDC) for the Stack Application project contains the following TStack class definition.

```
const MaxSize = 15;
Type DataType = string;
Tstack = class(Tobject)

private
  Size : 0..MaxSize;
  Item  : Array[1..MaxSize] of Datatype;
  function IsEmpty : Boolean;
  function IsFull  : Boolean;

public
  procedure Push (NewElement : DataType);
  procedure Pop;
  function Top :DataType;

end;
```

- (i) Draw a PDC class diagram for the Stack Application. 7 Marks
(ii) Show (if any) processing dependencies between the HIC obtained in (a) above and the PDC. 3 Marks

Question 3 - 25 Marks

- a) *Software Design is a wicked problem.* Discuss? 5 marks
- b) Distinguish between the following terms
- (i) Size-based and structure-based complexity metrics. 2 marks
 - (ii) Procedural abstraction and control abstraction. 2 marks
 - (iii) System test and Acceptance Test. 2 marks
- c) Give an outline of Halstead's software science. 4 marks
- d) Define and explain at least four different levels of *Cohesion* of increasing strengths. 5 marks
- e) Define and explain at least four different types of *Coupling* from tightest to loosest. 5 marks

Question 4 - 25 Marks

- a) What is the user interface? *3 marks*
- b) Explain how a good user interface contributes to the quality of the software system. *4 marks*
- c) Explain how enforcing the principles of good design contribute towards achieving the following desirable design features
- (i) Modifiability *3 marks*
 - (ii) Reusability *3 marks*
 - (iii) Structural simplicity *3 marks*
- d) Consider the following program code.
1. **Procedure** SelectSort (var r:array[1..n] of integer)
 2. **Var** j, k, small : integer;
 3. **Begin**
 4. If (n > 1)
 5. For k:= 1 to n-1 do
 6. **begin**
 7. Small := k;
 8. For j := k+1 to n do
 9. **begin**
 10. If r[j] < r[small] then
 11. small := j;
 12. **End;**
 13. Swap (r[k], r[small])
 14. **End;**
 15. **End;**
- (i) Determine the cyclomatic complexity of the code. *3 marks*
 - (ii) List all the linearly-independent paths. *4 marks*
 - (iii) Explain how the information obtained in (i) and (ii) above may be used as a basis for testing. *2 marks*

Question 5 - 25 Marks

- (a) What is a test objective? What kind of uses does it have? *2 marks*
- (b) What is a test adequacy criteria? *2 marks*
- (c) Distinguish between a error, fault and failure *3 marks*
- (d) Distinguish between fault detection and fault prevention. *3 marks*
- (e) Briefly describe the following test techniques. For each technique outline the basic procedure and state its test objective. Also indicate whether it's a static or dynamic technique and the phase(s) of the software development process where the test technique may be used.
- (i) Correctness proof *5 Marks*
 - (ii) Control-flow coverage *5 Marks*
 - (iii) Mutation testing *5 Marks*

Question 6 – 25 Marks

- a) Briefly explain some of the required properties of a good user interface. *6 marks*
- b) Briefly explain/describe the role of the following in improving user interface design.
- (i) Usage profile *3 marks*
 - (ii) Task Profile *3 marks*
- c) Briefly explain the advantages and disadvantages of the following human-computer interaction style
- (i) Direct manipulation *3 marks*
 - (ii) Natural Language *3 marks*
- d) Explain the major contribution of Object-Oriented modeling in improving the design of the User Interface. *7 marks*