

Ollscoil na hÉireann
The National University of Ireland

Coláiste na hOllscoile, Corcaigh
University College, Cork

Summer Examinations 2007

Fourth Science: Computer Science

CS4000 Software Engineering

Professor Susan Crow
Professor G. Provan
Dr. J. Herbert

Attempt four questions (all questions carry equal marks)

Three hours

1.

- (a) Discuss how a software process can contribute to a successful software development project. (6 marks)
- (b) Discuss why a software project might fail despite a good software process. (6 marks)

A multi-player game for a hand-held gaming console is being developed. You are the software project manager for this project. (In the following questions please ensure your answers are relevant to this particular project.)

- (c) What general software process would you use to develop the software for this particular system? Describe the process and justify its use for this project. (12 marks)
- (d) Describe any limitations of the chosen software process. (4 marks)
- (e) Describe and justify the most important non-functional tests for this system. (6 marks)
- (f) State, with reasons, the single most important method of validation that should be done on this project. (3 marks)
- (g) State, with reasons, the single most important method of verification that should be done on this project. (3 marks)

2.

- (a) What is object-oriented analysis and why is it a useful part of a software development project. (6 marks)

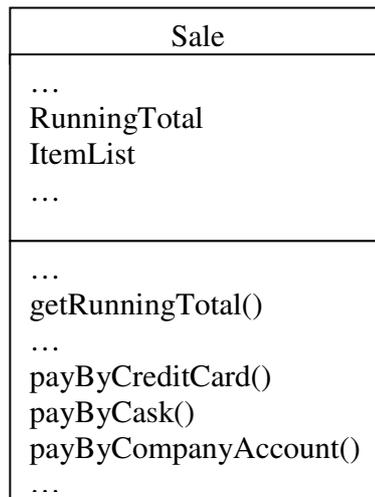
An online sports event booking system is being developed. The system will support various functions including event browsing, ticket booking and purchase. A software process using the UML (for example Larman's lightweight UML process or the Rational Unified Process) will be used in the development of this system.

- (b) Give an overview of the main activities in the software development from requirements through to implementation, describing briefly each activity and describing any relationship between activities and their associated artifacts. (16 marks)
- (c) Give one example of a diagram (or piece of text) that is produced in the UML-based software development of the online sports event booking system, for each of four of the stages of the software development for this application. (12 marks)
- (d) Describe how Larman's Controller software design patterns might be used in this system, and describe the benefits of this pattern for this project. (6 marks)

3.

- (a) An object-oriented application has been implemented by two companies using similar development processes, and each claims to satisfy the functional requirements. Discuss how you would evaluate which is the better system, given only the class diagrams and the executable image for each system. (8 marks)

The following diagram illustrates a design of a class to represent a Sale object in a purchasing system. Attributes of the class include the list of items being purchased and the running total cost of items being purchased. Methods of the class include various get methods and methods for the various ways of paying for the sale.



- (b) Evaluate the above design, stating any limitations it has. (6 marks)
- (c) Improve the above design so that it can be more easily extended for other kinds of payment. Name the software design pattern used and state its advantages. (8 marks)
- (d) Discuss how, if at all, the above design could be improved by the Factory software design pattern. (4 marks)

A program takes two integers and computes an integer result. The following questions relate to this program.

- (e) Theoretically how many tests are needed to completely test the program? (2 marks)
- (f) You do not have the source of the program but you are told that the program takes numbers representing a year and a month and returns the number of days in that month. How would you devise the black-box tests for the program? (8 marks)
- (g) You are now given the source code for the program. What tests would you now add to the testing of the program? (4 marks)

4.

- (a) Component-based software development is often cited as a desirable goal. What in your opinion are the most difficult issues in trying to achieve component-based software development? (6 marks)
- (b) What relationship (if any) is there between different software architectures and non-functional properties? (6 marks)

A travel planning system is being built. The system will access information from a large number of services such as car hire companies, accommodation suppliers, train and airline companies, and from this information will produce an ordered list of choices for a customer with particular travel needs. Different kinds of user interface will be provided to support, for example, hi-bandwidth web or mobile phone access. (Please ensure that your answers for (c) to (e) are relevant to this particular project.)

- (c) Describe in detail an architecture for this application, giving reasons why it is suitable for this application, and stating its benefits and any limitations. (8 marks)
- (d) Describe an alternative architecture that might be suitable, and describe its advantages and disadvantages with respect to the previous architecture. (6 marks)
- (e) What are the three most important non-functional requirements for this system, and describe in detail what you would do when implementing the system to satisfy these requirements. (8 marks)
- (f) Describe in detail three of the difficulties associated with testing the non-functional aspects of a software system? (6 marks)

5.

- (a) Give the meaning of the Hoare triple $\{P\}C\{Q\}$ as used in program verification. (6 marks)
- (b) Contrast the Design by Contract paradigm of Meyer and defensive programming, and give one example of an application where you think Design by Contract would be beneficial and one example of an application where you think defensive programming would be beneficial. (8 marks)
- (c) In a railtrack controller application a class represents a level-crossing barrier. This barrier class has attributes representing the state of the barrier: stopped, goingup, goingdown, isup and isdown. Add two operations (methods) to the class and specify them using a contract expressed in the predicate calculus. Write down a class invariant in standard mathematical logic for this class stating the most important invariant properties. Specify two operations (methods) for the class using contracts expressed in standard mathematical logic. (8 marks)
- (d) Construct a statechart to model accurately a software controller for a DVD player. The object should respond to commands play, stop, load, and pause. Indicate in the statechart at least four features not found in conventional state machines, and indicate these particular features in the statechart. Include in the statechart at least four features not found in conventional state machine (such as hierarchical states or guarded transitions) and indicate these particular features clearly. (18 marks)