THE UNIVERSITY
of LIVERPOOL

JANUARY 2003 EXAMINATIONS

Bachelor of Science Flexible Degree: Level 2
Bachelor of Arts Flexible Degree: Level 2

Software Engineering

TIME ALLOWED : Two Hours

INSTRUCTIONS TO CANDIDATES

Answer *all* questions in Section A.
Answer *any one* question from Section B.

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).

SECTION A — Answer *all* three questions in this section.

Question 1

a) Briefly identify and explain each of the key steps in the traditional waterfall model of the software life-cycle.

(10 marks)

b) Identify and discuss some of the key problems in arriving at a complete and accurate requirements specification at the beginning of a software development project.

(4 marks)

c) Explain:

    (i) what is meant by a prototype of a software system;

(1 mark)

    (ii) how prototypes can reduce the risks of inaccurate requirements specifications.

(2 marks)

d) Briefly explain some of the problems with using the waterfall model in practice, with particular reference to the linear progression through each stage.

(2 marks)

e) Explain:

    (i) what is meant by an iterative software engineering process;

(2 marks)

    (ii) the advantages of an iterative approach to software engineering, over the waterfall model.

(2 marks)

f) One of the key problems with engineering software is the problem of scaling up human resources on a software project. Explain why adding more software engineers to a project does not always reduce the overall development time, particularly if engineers are added at a late stage in the project.

(2 marks)

Total: 25 marks

Question 2

A simple automated software system is to be developed for a video library. The initial requirements for the system are as follows.

The video library contains films on video cassettes and DVD discs. It may have several copies of any given film. Each film may comprise of several discs or cassettes. There is a master catalogue of films which contains details of each film, including how many copies of a film are in stock and how many discs or cassettes comprise each film. Each film has a nightly rental charge. Members of the library may borrow or return copies of films. When they return a copy, they are charged according to the rental charge and the duration of the loan. If a film is not returned intact, that is with all the discs or cassettes comprising a copy of a film, then the member of the library is charged a replacement fee. The actual discs or cassettes comprising a given film are kept behind the counter in a filing cabinet. When a library member wishes to borrow a copy of a film, they present an empty case to the librarian, and the librarian browses the catalogue and retrieves a reference number which they then use to look up the location of the actual discs or cassettes in the filing cabinet.

The automated system must:

- keep track of when copies of films are borrowed or returned, and calculate the total charge when they are returned;

- keep track of how many DVD discs or video cassettes comprise a given film;

- maintain a reference number for each copy;

- allow the librarian to browse the catalogue and look-up the reference number for a given copy;

- allow the librarian to update the catalogue when new films are acquired, or new copies of films are acquired, or when old copies are sold.

a) Give UML use case diagrams for the system.

(10 marks)

b) Derive a conceptual object model for the system and illustrate it in a UML class diagram showing the main classes in the model and the relationships between them.

(10 marks)

Total: 20 marks

Question 3

The following classes have been identified in an object-model for a military simulation system:

   i) Vehicle

   ii) Jeep

   ii) Car

   iii) Plane

The Vehicle class has the following attributes:

- max passengers,
- max speed.

The Jeep class has the following attributes:

- number of wheels,
- number of gears.

The Car class has the following attributes:

- number of wheels,
- number of gears.

The Plane class has the following attribute

- max altitude.

The Plane, Jeep and Car classes are sub-classes of the Vehicle class.

a) Draw a UML class diagram for this model taking note to illustrate the inheritance relationships between classes.

(2 marks)

b) *Refactor* this design so that it no longer violates the *once and only once* design principle. Draw a UML class diagram for the new object model.

(3 marks)

Total: 5 marks

SECTION B – Answer *one* question from this section

Question 4

a) Explain what you understand by black box testing and white box testing, making the distinctions between them clear.

(4 marks)

b) Explain the roles of the following in software testing:

    i) alpha and beta testing,

(4 marks)

    ii) regression testing,

(4 marks)

    iii) unit testing,

(4 marks)

    iv) coverage analysis

(4 marks)

Total: 20 marks

Question 5

a) Draw a simple graph showing how the cost of making changes to a software system is likely to vary according to how late the change is made into the software's life-cycle, when following a traditional software engineering methodology.

(1 mark)

b) Explain *why* making changes to the design of a software system late into a project can be so expensive.

(2 marks)

c) Kent Beck's "Extreme Programming" methodology attempts to reduce the cost of change associated with engineering software. Draw another graph showing how the cost of making changes to a software system is likely to vary according to how late the change is made, on a successful Extreme Programming project.

(1 mark)

d) Describe the following practices of Extreme Programming (XP), and explain how they can benefit a project:

   i) test-driven development,

(4 marks)

   ii) pair programming,

(4 marks)

   iii) continuous integration,

(4 marks)

   iv) on-site customer.

(4 marks)

Total: 20 marks