Two hours

Question ONE is COMPULSORY

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Software Engineering Overview

Date:  Wednesday 16th January 2013
Time:  14:00 - 16:00

Please answer Question 1 and two other Questions

This is a CLOSED book examination
The use of electronic calculators is NOT permitted
Question 1
This question is COMPULSORY

a) Briefly explain the relationship between the Unified Process and Agile development.  

(2 marks)

b) One of the things which went wrong with the Waterfall method of development was that it doesn’t cope well with requirements change. State 2 others.  

(2 marks)

c) In almost any system the following is a possible use case:

Authenticate user
1. The user types their username into the box marked “username”
2. The user navigates to the box marked “password” by hitting the Tab key
3. The user types their password into that box
4. The user hits the Enter key to confirm
5. The system allows access if the username and password are correct, otherwise it displays an error message and presents the boxes again.

Briefly state two reasons why this is unlikely to be an appropriate use case.  

(2 marks)

d) What are the two main reasons for doing Domain Modelling?  

(2 marks)

e) Give two examples of Pure Fabrications (other than UI classes) which would probably be required in a timetabling application.  

(2 marks)

f) There are many factors which influence the bug density of an application. The amount of testing done is obviously one; the nature of the application itself is another. State two other factors which are likely to decrease bug density.  

(2 marks)

g) Briefly explain what a statechart is, and how one could be used in the MELT application.  

(2 marks)

h) State two properties which the partitions within a layer should have in a well-designed application.  

(2 marks)
Question 1 (continued)

i) How is Design by Contract related to Java exception handling?  
(2 marks)

j) Apart from Aspects themselves, what are the two key features of the AspectJ programming language? You do not need to show any AspectJ syntax.  
(2 marks)
Question 2

a) In what ways was the process you followed in the team project similar to the Agile UP?  
(4 marks)

b) In what ways was the process you followed in the team project different from the Agile UP?  
(2 marks)

c) State two important rules to follow when eliciting requirements from stakeholders with only basic IT skills. NB: your answer should be specific to that kind of stakeholder, not one that could apply to any stakeholders.  
(2 marks)

d) You have been hired by the Highwayman Bus Company to develop a Second Generation Bus Tracking and Management System. Currently, the Company tracks all its buses by GPS, but the existing system does little more than tell managers where their buses are at any one time, using a crude visual display.

The new system will make many improvements, including making real-time information available to passengers, greatly improving the managers' interface, and comparing the performance of individual drivers. The long-term aim is to maximize revenue by optimizing the usage of buses and drivers. The system will be operated by Controllers, who are responsible for ensuring that services run reliably on a day-to-day basis.

For the following groups of stakeholders in the system, suggest one short-term, and one long-term, concern they will have about it. Hint: think about the consequences of the sentence "The long term aim.." in the preceding description.

   i) Passengers  
   ii) Drivers  
   iii) Company management.  
(2 marks)

(2 marks)

(2 marks)

e) Discuss whether it would be sensible to have a single stakeholder representative work with the project development team.  
(4 marks)

f) As the project progresses, you find that the controllers' user interface which is of course complex, continually causes problems. - each iteration produces some improvements but also reveals further issues. What would you do to try to get a grip on the situation?  
(2 marks)
Question 3

You have been hired to implement software for a Safety and Security system for a large building. Currently the building has many safety and security devices, but very primitive facilities for monitoring them - essentially one large panel of lights for security and another, in a completely different place, for fire safety.

a) You are interviewing the Head of Safety and Security for the building to find out more about what's required. Suggest five questions it would be sensible to ask to start off.

(5 marks)

b) He gives you the following information:

"We have 30 floors with around 30 devices on each so around 1000 total. The majority of these are smoke detectors but there are door alarms and a number of other kinds, maybe 10 in total. The fire safety devices are of high standard - they have to be - but we would like to improve security, in particular we would like to make more use of CCTV.

We do want to monitor both fire safety and security together, but we want that monitoring to be distributed over the building in a flexible way. What we want is a monitoring station on every third floor, but only to have them all manned at busy periods. So at other times (e.g. overnight or at weekends or if we're just short of security staff) we would use fewer monitoring stations. There are also times when we may want more than one monitoring station to monitor a particular group of devices - if we're making a decision about whether to evacuate the building, for instance. Hence the challenge for you guys is to enable the monitoring stations to "see" different groups of devices at particular times."

i) List the important domain classes implied by this description.

(4 marks)

ii) Draw a domain class diagram which shows the relationships between these classes.

(5 marks)
Question 3 (continued)

c) You identify that the project has three main aspects: the user interface for the monitoring stations; the protocol which implements the relationship between devices and monitoring stations, and management functions which summarise the activity which takes place over a given time period. In what (if any) order would you tackle these aspects, and why?  

(3 marks)

d) A device being triggered can be considered as an event, just like a button being pressed in a Java UI. This suggests a way of providing the flexibility required in associating devices with monitoring stations - can you see what it is?  

(3 marks)
Question 4

a) Explain with an example the relationship between the GRASP principles of High Cohesion and Low Coupling, and the practice of Refactoring. (4 marks)

b) Briefly explain what the two types of coupling are, and for each give a specific example of how you kept it low in your MELT implementation. (4 marks)

c) One function of MELT is to output results. Initially, you have a ResultGenerator class which generates results in the format required by the English Language Centre. Later, you discover a requirement to provide results to the University central administration, but in a different format, so you add code to the ResultGenerator class to do this. Then, you discover that different schools within the University also require results, and also have different formats. The ResultGenerator class is becoming large and uncohesive.

Draw a skeleton design class diagram which shows how polymorphism can be used to improve cohesion in this situation. You should assume that the results are always in the form of a spreadsheet, and that only the details of the information on the spreadsheet differ. (3 marks)

d) What is the effect of this use of polymorphism on coupling? You should consider both kinds of coupling mentioned in part b. (2 marks)

e) How does your design support the principle of Protected Variations? (2 marks)

f) Briefly explain what a factory is and how it could be used in the design given in your answer to part c. (3 marks).

g) Now suppose that the assumption stated above, that the results are always in the form of a spreadsheet, does not hold true; results can be in many different forms, such as XML or relational database tables. Draw a skeleton design class diagram which shows how your design in part c can be enhanced to deal with this situation. (2 marks)

[PTO]
Question 5

a) What is the difference between black box testing and white box testing? Give an example of how each could be use in MELT. (3 marks)

b) What is the difference between integration testing and system testing? Give an example of how each could be use in MELT. (3 marks)

c) Estimate how many bugs there are likely to be in your MELT implementation. Explain your reasoning, take into account the estimates of bug density given in the lectures and the factors relating to bug density relevant to your project. (5 marks)

d) Explain, using an example not given in the lectures, the key aspects of JUnit testing. (4 marks)

e) State three ways in which JUnit testing is beneficial. (3 marks)

f) State two disadvantages, or limitations, of JUnit testing. (2 marks)

[END OF EXAMINATION]