Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Pattern-based Software Development

Date:        Wednesday 21st May 2014
Time:        14:00 - 16:00

Answer ALL Questions in Section A
AND
Answer ALL Questions in Section B
Also answer ONE Question in Section C

Please use a separate answer book for each Section.

This is a CLOSED book examination

The use of electronic calculators is NOT permitted
Section A

Answer All Questions

a) Explain the five fundamental concepts of a REA business model. (5 marks)

b) Explain the fundamental idea of a REA business model and two fundamental processes linked to this idea. (5 marks)

c) State two different situations in which design patterns are a tool for communication. Your answer should state who is doing the communicating and include a specific example of each situation. (4 marks)

d) Explain how the Template Method design pattern works, stating clearly what is implemented where, and what is visible to classes outside the pattern. (4 marks)

e) Under what circumstances is it appropriate to use the Visitor pattern? (2 marks)
Section B

Answer ALL Questions

Question B1

a) Explain the idea behind the **REA Exchange Process** pattern and the central relationship in this pattern. (5 marks)

b) Explain the idea behind the **REA Conversion Process** pattern and the central relationship in this pattern. (5 marks)
Question B2

You are designing an e-commerce system for a bookstore. You want to apply some of the REA structural patterns you have learned from this course in your design. Your first step is to use the REA Exchange Process pattern to design the “purchase” relationship. Answer the following questions:

a) Show your design of the “purchase” relationship in a UML class diagram. Your diagram should show (1) all the entities and their interactions involved in this relationship; (2) the roles played by these entities in their interactions.  

b) Explain which economic event is an increment event and which one is a decrement event and why.
Section C

Answer ONE Question in this Section

The questions in this section relate to the design of an online assessment system such ABC or MELT.

Question C1

a) “The exam server returns copies of the question paper created by a Factory which is a Singleton”. Explain this statement and how it relates to the use of design patterns for communication. (4 marks)

b) Show the important elements of this class in Java syntax. (4 marks)

c) Suppose the application is being extended so that it will accept question papers written in a variety of different formats and convert those to the format used by the exam software. Draw a UML class diagrams showing how the Adapter pattern can be used to organise this part of the application. (4 marks)

d) Give an example (not one given in the course) of another application in which the adapter pattern could play a useful role. (4 marks)

e) Explain how the Factory and Adapter patterns are related to GRASP principles. For full marks you should include four different GRASP principles in your answer. (4 marks)
Question C2

When an ABC exam is taking place, student activity is monitored by a tool, which shows a dynamically updated table of the students taking the exam, with information such as when the most recent backup occurred for each student, and whether any students have attempted to cheat by accessing applications or web pages other than the exam. The monitoring tool works by sending HTTP messages to the server, receiving data in response, so to a firewall it looks just like a web browser. In other words, the tool is polling the server at intervals for batches of information, rather than the server providing each piece of information as soon as it is available.

a) In the first version of the monitoring tool, there was a 1-1 mapping between exams and invigilator tool instances. It was not possible for one exam to be monitored by many tools, or many exams to be monitored by one tool. Also, we expect in the future to have different types of tools for different users, e.g. invigilators in a room vs. managers overseeing the whole exam process. We might even have different types of servers, e.g. local vs. remote. Explain how the Observer design pattern can be used to remove these restrictions and provide the basis of future developments. (4 marks)

b) Draw a UML diagram to illustrate the Observer pattern as applied to this situation. (6 marks)

c) In what way does the method of communication between the tool and the server described above require changes to the standard Observer pattern? (2 marks)

d) Suggest another way in which the Observer pattern could be used in the monitoring tool. (2 marks)

e) Briefly suggest how two other design patterns might be used in the monitoring process. (2 marks)

f) Explain how the Observer pattern is related to GRASP principles. For full marks you should include four different GRASP principles in your answer. (4 marks)

END OF EXAMINATION

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