University of Glasgow

Saturday, 28th April 2012
2.00pm – 4.00pm
(2 hours)

DEGREES OF MSci, MEng, BEng, BSc, MA and MA (Social Sciences)

CS3X: PROFESSIONAL SOFTWARE DEVELOPMENT 3

Answer all 3 questions

This examination paper is worth a total of 60 marks.

For examinations of at least 2 hours duration, no candidate shall be allowed to leave the examination room within the first hour or the last half-hour of the examination.

INSTRUCTIONS TO INVIGILATORS: Please collect all exam question papers and exam answer scripts and retain for school to collect. Candidates must not remove exam question papers.

1. Project management

(a) Sketch a waterfall project model as a Gantt chart, where each phase of the waterfall project is represented as a distinct task in the Gantt chart.

[4]

(b) Sketch a waterfall project model as a PERT chart, where each phase of the waterfall project is represented as a distinct task on the PERT chart.

[4]

(c) With reference to these two diagrams, outline three disadvantages of the waterfall approach to project management.

[6]

(d) Describe three fundamental principles of the agile software engineering philosopy.

[6]

2. Requirements analysis

The following scenario is used for this question.

> WheelsOfDreams is a luxury and specialist car rental company that has developed in-house software system for managing bookings. The company maintains a range of vehicle models, including vintage cars, classic sports cars, and limousines.
>
> The system is web-based, so that customers can make car bookings for themselves. A customer must first register with the system. Then, a user can search for the type of car they would like to hire, check its availability for the dates they want and then confirm a booking. To complete a booking, a customer must give a name for the driver of the car and a UK driving licence number.
>
> A booking can be made for one day, a weekend or a week. Booking a car for a weekend or a week is typically cheaper (on a per-day basis) than booking for a single day. The customer must also pay a deposit to cover any potential damage to the car, although insurance is provided by the WheelsOfDreams company.
>
> Limousines are provided with a chauffeur for the duration of the booking (and so do not need the customer to provide a driver). When a booking is made for a limousine a manager is notified, who then assigns an available chauffeur. Other cars have the option of booking a chauffeur for an extra fee. This is useful, if the car is to be used for a wedding, for example.
>
> As the range of cars owned by the company changes, managers are able to add and remove cars from the system. A car can't be removed from the system if it is subject to a booking by a customer. A senior manager is able to alter a customer's booking, so that they receive a comparable or superior car, if their booked vehicle is no longer available.
>
> WheelsOfDreams has decided to begin marketing the software to other car hire companies and so need to improve the documentation associated with the system.

(a) Draw a use case diagram describing the main functions of the system described above. Give a short description (one sentence, maximum) of each use case you have identified. State any assumptions you have made.

[9]

(b) Draw a class diagram, outlining the key classes, their attributes and relationships that would be needed to support the activities identified in your use case diagram. You do not need to show the operations of your classes or the types of the attributes that you identify.

[7]

(c) In the existing system, customers must go to the WheelsOfDreams depot to collect their car. The company has decided to offer a drop-off service at an address specified by the customer during the booking process. The car will also be collected from this location.

Explain how you would adapt your use case and class diagrams to accommodate these changes. You do not need to show the changes on the diagrams.

[4]

3. Software architecture

(a) What are the main features of a *software component*?

[2]

Questions b through e concern the design and implementation of a software system, which has the following high-level specification.

The system is a graphics processor, which applies a sequence of different transformations to an image, using different *image filters*. The filters are:

- SCALE: image is scaled to a standard size
- COLOUR: image colourmap is adjusted
- WATERMARK: a copyright notice is added to the image
- EXPORT: image is encoded as JPEG and saved to a file

The input image is supplied by the user. The final output image is saved as a JPEG file in a location selected by the user.

(b) Identify a high-level architectural pattern that would be appropriate for this software system and explain why it is a suitable solution for the image processing design problem.

[2]

(c) Suppose each transformation is implemented as a separate component that implements the interface shown below:

```
public interface ImageFilter {
  public Image getOutput();
}
```

Sketch a UML component diagram for the overall software system.

[6]

(d) Your manager decides to implement the system in Java, using the OSGi component model. Outline three benefits of the OSGi component model.

[6]

(e) Your manager decides to outsource implementation of one of the components to a third-party developer. Identify two features of component-based software engineering that facilitate this approach.

[4]

END OF QUESTION PAPER