Software Evolution

Date: Monday 28th May 2012
Time: 09:45 - 11:15

Please answer any TWO questions from the FOUR questions provided

For full marks your answers should be concise as well as accurate.
Marks will be awarded for reasoning and method as well as being correct.

This is a CLOSED book examination
The use of electronic calculators is NOT permitted
1. 
   a) Summarise the four types of change that may occur during the evolution of a software system. For each type, you should identify the driver for the change and those aspects of the requirements, code, and business and technological environments that will be affected. (4 marks)

   b) You have just been appointed as the information services (IS) team of a small company that sells designer kitchen accessories on-line. As this is a small company, all of the staff are based together in an industrial unit that is close to a motorway junction. The company have an in-house system that you are now responsible for maintaining, that supports both web-based sales and telephone enquiries. The system designer has long departed, as has the previous person responsible for its maintenance. Although you have the source code of the system, there appears to be no design documentation.

   Evaluate, with reasons, two distinct approaches that you could take to ensuring that you understand the system after your initial appointment. For each approach, identify the sources of information that you would use. (4 marks)

   c) Which of the idioms mentioned in the lectures is present in the code fragment below? For each idiom that you discover, give the language-independent form of the idiom and state clearly (e.g. using line numbers) which parts of the code correspond to which components of the idiom. Clearly state any assumptions that you make about the rest of the code. (4 marks)

   ```java
   <T> x(Collection<T> c, T y) {
   for (T e : c) {
       if (e.equals(y)) {
           return e;
       }
   }
   return null;
   }
   Question continues on next page
1) (Continued from previous page)

d) Draw the control flow graph of the following fragment of code. (8 marks)

```java
final Collection<EClassifier> allClassifiers = new ArrayList<EClassifier>();
allClassifiers.addAll(emfModel.getEmfClassifiers());
Iterable<IEObjectDescription> classifiers = getEmfClassifiers(emfModel);

boolean explicitEcoreImport = false;
for (Import emfImport : emfModel.getImports()) {
    if (emfImport.getEPackage() != null) {
        if (emfImport.getEPackage().getNSURI().equals(EcorePackage.eNS_URI)) {
            explicitEcoreImport = true;
        }
        if (emfImport.getAlias() == null) {
            classifiers = Iterables.concat(classifiers, getEClassifiers(emfImport.getEPackage()));
        }
    }
}
if (!explicitEcoreImport) {
    classifiers = Iterables.concat(classifiers, getEClassifiers(EcorePackage.eINSTANCE));
}
```
2. A company A that sells on-line designer bathroom fittings has just been taken over by company B that offers a basic on-line do-it-yourself bathroom design service along with a telephone support hotline.

The architecture of company A’s computer system is shown in Appendix A, it is a reasonably modern system implemented in C on top of a relational database, with web-based clients. The architecture of company B’s system is shown in Appendix B, although the web application for designing bathrooms (implemented in Java) is fairly new, the core database and telephone support system are implemented in COBOL and have been around for many years.

To support the operation of the enlarged company B, the two computer systems will be re-engineered into a single system that supports the current functionalities, the selection of the fittings as part of the design service and management statistics on the use of the design service. An evaluation of possible architectures for the re-engineered system has already been performed and the decision is that the system will use the architecture shown in Appendix C.

a) You are the manager responsible for the re-engineering project. By referring to the two architectures, characterise, with reasons, each of the architectures in terms of its decomposability. (3 marks)

b) Based on the requirements for the re-engineered system, evaluate each of the three migration strategies (forward, reverse and general) that could be used during the re-engineering project. From your analysis, clearly state which of the possible strategies you would adopt for this task. (7 marks)

c) Design a migration path for the re-engineering project based on the migration strategy that you selected in part b). This path should aim to allow mission-critical functions to operate reliably while bringing important functionality on-line as soon as possible. For each migration step:

i) Describe what changes occur during the step. Complete or partial architecture diagrams may assist with this. However, be careful to distinguish target and legacy components and show the exact placement and type (forward/reverse) of gateways.

ii) Justify the changes made in the step in terms of benefits, costs and risks.

iii) State assumptions that you have made that are not otherwise clear. (10 marks)
3.

a) The following elements describe issues related to data. Assuming that these issues occur because of data quality problems, for each issue state the kind of data quality problem and its most likely root cause.

i) A travel company sends customers on the New Year Alpine Experience holiday their final invoice two months before departure. Only those who booked direct with the company pay the invoice, those who booked through an agent do not. (2 marks)

ii) A British manufacturing company requires some special parts for a product that they will produce in March next year. They have identified a Far East supplier of the parts and placed an electronic order for delivery at the beginning of March. Unexpectedly, the parts are delivered at the start of January. (2 marks)

b) You have been employed as a consultant for a travel company. They have one system with a dedicated database that handles customer bookings. They also have a management system, separate from the bookings system, that analyses the bookings data and helps in the company’s strategic planning. Currently bookings data is transferred to the management system about once every two months using a manual process based on creating files that are copied between the systems. The company now find that they want the data transferred weekly, but the current process is too time consuming to be used.

Your job is to evaluate the four update options (triggers, timestamps/versions, log analysis, snapshot comparison) that they have identified, or suggest a better one. Outline the report that you will give the company evaluating the options and identifying, with reasons, your recommendation. Note, the company understand what the options are, the report must not describe them, it must evaluate them. (10 marks)

c) You are leading the IT services team for a small UK charity. They use an on-line system for clients to book appointments with advisors and for advisors to maintain information about clients. A national web hosting company have kindly donated space on their database and server farm to the charity to allow them to run these services. The charity now needs to analyse their data so that they can more actively manage their operations and report how money is spent to their sponsors. As the charity is subject to the same limited functionality constraints as other customers of the web hosting company, this analysis must be performed on the small server in the charity’s office that runs the standard office IT functions.

Before implementing the analysis, you need to evaluate how (push, pull or hybrid) and when data for analysis will be retrieved from the web hosting company. State clearly what your evaluation would be and, with reasons, what approach you will implement. (6 marks)
4. 

a) Compare and contrast the evolution of software systems that contain black-box elements with those that do not. 

(3 marks)

b) You are head of a team that is developing a new computer system for a geothermal analysis company. The core of the system is an algorithm that takes data collected from a range of sensors and predicts where drill holes should be bored to access underground sources of heat. Your system needs to take the results of this algorithm and further process them before providing information to the users.

The core algorithm is highly complex, and poorly understood and documented. There is an existing implementation of the algorithm that you could buy; experience within the geothermal industry suggests that this implementation is reliable. The implementation comes in two flavours, both read the input data from a file, one displays the results of the analysis to standard output whereas the other shows the analysis results as part of a webpage. You have also identified that if you had your own implementation of the algorithm, the analysis results could be passed to the subsequent processing code via internal data structures.

Evaluate the three options in terms of the relative effort from your team that they require, the quality of the solution that they would provide and their long-term maintenance costs. With reasons, identify which of these options you would recommend. 

(10 marks)

c) You have heard that an open source version of the core analysis algorithm mentioned in part c) is being developed. Apparently, rather than being a solid block, this will have an application programming interface (API) that allows integrators control over how they combine the algorithm into a complete system. The open source developers are predicting a major release every year and minor update releases every two or three months. They are promising that the API will remain stable during the period of each major release, but that as the software is new, the API may evolve with each major release.

Evaluate the use of this open-source solution using the same criteria (effort from your team, the quality of the solution and long-term maintenance costs) as you used in part c). Recommend, with reasons, whether or not your recommendation of part c) should be altered to the adoption of this open-source software solution. 

(7 marks)
Appendix A – Company A’s System Architecture

Customers

Ordering System

Warehouse Staff

Dispatch System

Finance Staff

Finance System

Product/Order Information
Appendix B – Company B’s System Architecture

Diagram:
- Customers
- Design System
- Access Layer
- Design Data
- Support Staff
- Telephone Support