King’s College
London

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Degree Programmes BSc

Module Code 6CCS3SIA
Module Title Software Engineering of Internet Applications
Examination Period May 2013

Time Allowed Two hours
Rubric ANSWER THREE OF FOUR QUESTIONS.

All questions carry equal marks. If more than three questions are answered, the answers to the first three questions in exam paper order will count.

Calculators Calculators are not permitted
Notes Books, notes or other written material may not be brought into this examination

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1. a. (i) Explain how finite state machines can be used to design the interaction between a web application and its users.

(ii) What do states and transitions in the state machine represent in such design diagrams?

[10 (5 each part) marks]

b. An online shopping system allows customers to register with their name, email and address (there is a form for these details on the home page of the site). Registered users can then login, search for products, select products and then checkout and purchase products, which involves providing credit card details. Users can logout from the system (if they are logged in).

Draw an interaction state machine diagram for this system.

[25 marks]

c. (i) Explain what is meant by the portability of a web application.

(ii) Describe two alternative approaches for improving web application portability, and explain their advantages and disadvantages.

[15 (5 + 10) marks]
2. a. For each of the following components, explain (i) what role does it play within an Enterprise Information System (EIS); (ii) does it have persistent data; (iii) can it be shared between different users/clients:

- Stateless session beans
- Statefull session beans
- Entity beans.

[15 (5 each component) marks]

b. This question part and the next concern the following system:

A book wholesaler system holds data on books, orders and customers (Figure 1, on the next page). There are two different categories of users: (i) customers, who can only view their own orders, and initiate or cancel orders for specific books, and (ii) staff, who can add/remove customers and books, and view and delete the orders of any customer.

Define a business tier architecture for this system, and draw this as an architecture diagram. For each component in your architecture identify its kind (eg., session bean, entity bean), and for each dependency between components, identify if it is a read-only or an update dependency.

[20 marks]

c. Draw an alternative business tier architecture which could also be used for the book wholesaler system of the preceding question part. Explain in what ways your chosen architecture is better than this alternative.

[15 marks]
Figure 1: Class diagram of book wholesaler system
3. **a.** Explain the roles of the integration and resource tiers in an EIS. What components are typically located in these tiers?

[20 (10 each tier) marks]

**b.** (i) Explain the purpose of the Intercepting Filter pattern for EIS design.

(ii) Identify which EIS tier it belongs to, and which other tiers it relates to.

(iii) Draw a diagram of its typical structure.

[30 (10 each) marks]
4. a. (i) Explain what a web service is.
   (ii) What two general properties should a system’s functionality have in order to be suitable to be made available as a web service?

   [10 (5 each part) marks]

b. Explain the purpose and elements of the Router and Broker web service patterns, giving the diagrams of their typical structures.

   [20 (10 each pattern) marks]

c. A service used by an online book retailer to fulfil customer orders operates as follows: the service first requests cost and time estimates for an order of the requested number of copies of a book from a number of different suppliers. If there are suppliers able to supply the order within the customer deadline, then the order is confirmed with the supplier giving the lowest quote. Otherwise, the supplier promising the fastest delivery is chosen.

   Define a web service architecture for this service.

   [20 marks]
SOLUTIONS

1. [Covers web application specification techniques and issues from part 2 of the course]

   a. State machines can describe the possible web pages which may be displayed to the user, as states, and the actions which may be performed on these pages, as transitions. The transitions may correspond to HTML links between pages, or the submission of a form and the return of a response (page) to the browser.

      [10 (5 + 5) marks]

   b. This is shown in Figure 2. (10 marks for states, 10 for transitions, 5 for correct use of nested and initial states).

      [25 marks]
c. (i) Portability means that a web system, and particularly its client side, can be used equivalently on different platforms, with the same effectiveness and functionalities.

(ii) Two techniques are: (1) Use a minimum subset of HTML and scripting which is processed equivalently by different browsers, eg., restricting colours used to the ‘web safe’ subset.

(2) Provide alternative versions of the web pages of the system for different browsers, eg., to encode the different scripting needed for AJAX in IE versus Firefox. (1) has the disadvantage of restricting the capabilities of the system interface, whilst avoiding duplication of web pages, (2) permits more sophisticated interfaces, but leads to higher maintenance costs because different versions of the same pages need to be maintained.

[15 (5 + 10) marks]
2. [Covers topics from part 3 of the course: EIS architecture and design architectures for EIS]

a. • Stateless session beans: these provide a service which requires no data to be stored between invocations of the service, for example, sending an email confirming an operation. They are potentially sharable between users, as they store no user-specific data. They persist for a session.

• Statefull session beans: these provide a service which does require session data to be stored, for example, shopping cart operations and data. They are not sharable between users, as they store user-specific data. They persist for a session.

• Entity beans: these provide data and services for specific entities stored persistently. They provide an object-oriented facade for entities. They may persist for the duration of an application execution.

[15 (5 each) marks]
b. This is shown in Figure 3. (6 marks for correct dependencies, 7 for session beans, 7 for entity beans).

[20 marks]

c. There could be session beans for each entity bean, which would reduce dependencies within the business tier, but this would also mix together operations with different authorisation levels, and different users. Each user would need instances of each session bean.

Another alternative would be a single session bean, but this would not be modular.

(8 marks for alternative design, 7 marks for justification).

[15 marks]
3. [This question covers EIS architectures and design patterns from part 3 of the course]

a. The integration tier provides interfaces to resource tier components, for use by higher tiers. For example, database interfaces and web service interfaces. It helps to insulate business and higher tiers from the implementation details of resources.

The resource tier contains the resources used by the EIS, typically these are relational databases or other persistent data stores. In addition remotely located resources such as web services used by the system can be considered to be in this tier.

[20 (10 each) marks]
b. (i) The pattern aims to encapsulate the details of security and other checks which need to be carried out for access of users to functional components of the system. It provides a flexible and configurable means to add filtering, pre and post processing, to presentation-tier request handling.

When a client request enters a web application, it may need to be checked before being processed, eg:

- Is the client’s IP address from a trusted network?
- Does the client have a valid session?
- Is the client’s browser supported by the application?

and so forth.

It would be possible to code these as nested if tests, but it is more flexible to use separate objects in a chain to carry out successive tests.

(ii) It is a presentation tier pattern, it relates also to the client tier.

(iii) This is shown in Figure 4. The elements of the pattern are:

- **Filter Manager**: sets up filter chain with filters in correct order. Initiates processing.
• **Filter One, Filter Two, etc:** individual filters, which each carry out a single pre/post processing task.

• **Target:** the main application entry point for the resource requested by the client. It is the end of the filter chain.

30 (10 each) marks

4. [This covers web service concepts and patterns from part 4 of the course]

a. (i) Web services are services provided by one application, which can be used by other applications via the internet. Typical examples could be an electronic payment service, such as PayPal, or an electronic data interchange service for e-commerce.

   (ii) Web services should be operations which: do not require fine-grained exchange of data; do not require highly time-critical responses; receive and return data which can be effectively transmitted across the internet.

10 (5 + 5) marks
b. A Router web service selects one of a number of possible services to invoke, based on rules (Figure 5).

![Router pattern diagram]

Figure 5: Router pattern

A Broker web service invokes all of its subordinate services, according to its rules (Figure 6).

![Broker pattern diagram]

Figure 6: Broker pattern

(5 marks for each explanation, 5 marks for each diagram).

[20 (10 each) marks]
c. This could be as shown in Figure 7. The Broker pattern is appropriate for the first step, since all suppliers are polled to find their capabilities to fulfil the order, then Router is used to make a choice of one service according to the business rule.
(10 marks for each correct pattern application).

[20 marks]