ENGINEERING TRIPOS   PART IIA

Thursday 25 April 2013   2 to 3.30

Module 3F6

SOFTWARE ENGINEERING AND DESIGN

*Answer not more than **three** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

There are no attachments.

STATIONERY REQUIREMENTS
Single-sided script paper

SPECIAL REQUIREMENTS
Engineering Data Book
CUED approved calculator allowed

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator

Version: final

1   A maintenance department has a Maintenance System with a web interface where users can submit and track their maintenance requests. An example of such a maintenance request could be a report of the power failure in one of the buildings on site, a leaking pipe in a room, or a lost key needing a replacement.

(a)   The User can login to their account and submit a Request in the web portal. When a new Request is submitted a Member of the Maintenance Staff on Duty is notified by email. The Request and the Member of Staff on Duty are logged in the Maintenance System, where an Incident is created. The User receives an acknowledgement that the Incident was created.

(i)   Design an object-oriented system that implements this functionality. Illustrate the design with the help of a *Class Diagram*.   [20%]

(ii)   Using a *Sequence Diagram*, show the interactions between objects in the system as a result of a submitted Request.   [30%]

(b)   Once the Incident is assessed by a Member of Staff, its status is updated to "Accepted" or "Rejected". If accepted, the status is updated to "Work in Progress" when the work on resolving the accident begins, and to "Resolved" when the work is completed. The User who originated the Request is notified of any changes of the status of the Incident. Draw a *Sequence Diagram* illustrating an update of an Incident and notification of the User.   [10%]

(c)   It would be useful if the Incident status can be tracked not just by the User who filed the original Request but also by other Users who are interested in its resolution. The Members of the Maintenance Staff would also be interested in tracking the Incidents. Using the *Observer Pattern*, extend the system design to allow the Users and Staff Members to be notified about the Incident status changes. Draw *Class and Sequence Diagrams* to illustrate the design.   [40%]

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2   (a)   Describe the main stages of the *User Experience* for consumer software applications such as Mobile Apps.   [10%]

(b)   A specialised online music company maintains a website for the young musicians at the beginning of their career to promote and sell music. The company would like to create an App that customers can download on their mobile phone and use to discover, listen and buy music. The users should be able to search music by artist name, add tracks or albums to their shopping basket and check out by making the payment and downloading the music to their phone.

(i)   Design the *User Interface* (UI) for a software application for a smartphone with a touchscreen that implements this functionality. Identify all main screens and interaction elements and explain their purpose and design constraints.   [30%]

(ii)   Extend the functionality of the App by allowing the users to mark titles, albums and artists as their Favourites. The users should be able to listen to a random stream of the items added to their Favourites. Identify any additional screens required to support these features.   [10%]

(iii)   Extend the functionality further by allowing the users to rate the tracks and albums, read reviews of other customers and submit their own reviews. Furthermore, add the functionality to display the most popular music based on the ratings and reviews.   [20%]

(iv)   The music company implemented an "intelligent music discovery" service by analysing the tracks that each customer likes and recommending the music that might fit their taste. The user can play recommended tracks and provide feedback on the quality of the recommendation by either skipping the track or adding the track or the artist to their Favourites. Extend the *User Interface* to enable this feature in the App.   [30%]

3   (a)   Explain the purpose of the *Normalisation* process in the database design.   [10%]

(b)   A company that sells from a catalogue of over 5,000 items wants to use a database to store information about the orders it processes. An inexperienced database consultant was hired to design the database to support the business. Fig. 1 shows a design suggested by the consultant. The database stores the order number (OrderNo), the customer name (CustName), and the quantities of each of the items in the order (Cups, Mugs and Plates are shown here, however the full database includes many more items).

OrderNo	CustName	Cups	Mugs	Plates
1	Alice	0	100	100
2	Bob	200	300	100
3	Charlie	0	200	200
4	Alice	400	0	200
5	Charlie	0	400	0

Fig. 1

(i)   Evaluate the database design and identify missing attributes that are required for order processing. Draw an *Entity-Relationship* diagram to illustrate your design enhancements.   [15%]

(ii)   Show the updated design of the tables including any new *Entities* and *Attributes* added in the answer to question (i). Identify the *Primary* and *Foreign keys* used. Construct queries for retrieving the information required to fulfill each order. Explain what relational operators are used in the query.   [30%]

(iii)   The company occasionally inspects some of the items in an order for damage. In such cases a record is made of the employee who performed the tests. Extend the design to allow for such information to be included.   [20%]

(iv)   When a customer reports an order containing damaged items the company needs to check whether the order was inspected and, if so, who was responsible. Construct a query that meets this requirement. Explain what relational operators are used in the query.   [25%]

Version: final

4   (a)   A server is currently processing six transactions (T_1 to T_6) which access six resources (A to F). Transactions either hold a lock for a resource (L), are waiting to acquire a resource (W) or are not interested in a resource (X). Fig. 2 shows the current state of the program, where each column represents a resource and each row represents a transaction.

	A	B	C	D	E	F
T_1	X	L	L	W	X	X
T_2	X	X	X	L	W	X
T_3	L	L	W	X	X	X
T_4	W	X	X	L	X	L
T_5	L	W	X	X	X	X
T_6	X	L	L	L	L	W

Fig. 2

(i)   Two of the locks are write locks. Which transactions hold these write locks and on which resources? Explain your reasoning.   [10%]

(ii)   What is a wait-for graph? Your answer should include a description of what the nodes and edges in the graph represent. Draw the wait-for graph for the scenario above.   [20%]

(iii)   Identify any transaction processing issues in the scenario described in Fig. 2. Explain your reasoning and suggest a resolution.   [30%]

(b)   A large software company is the market leader in the accounting software for individuals. Every year it publishes a new version of the software to reflect the changes in tax rates. Additionally, it needs to publish maintenance releases (to fix bugs) throughout the year. This schedule makes it difficult to develop any new features of the software and the company decided to implement *Continuous Integration* and *Continuous Delivery* principles in an effort to consolidate the development process. Describe how the company can implement *Continuous Integration* and *Continuous Delivery* practices to achieve its goals.   [40%]

END OF PAPER

Version: final