

Version RET/3

EGT2
ENGINEERING TRIPOS PART IIA

Wednesday 23 April 2014 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.*

*Write your candidate number **not** your name on the cover sheet.*

There are no attachments.

STATIONERY REQUIREMENTS

Single-sided script paper

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed

Engineering Data Book

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

1 A media management online service allows its users to store and view photos and videos. Users can mark their items as Favourites, add Tags (short keywords) and Notes to each image or video. Users can also display all media items by Date, Location or Keywords (appearing in Notes or Tags).

(a) Identify the principal *Classes* and their *Relationships* for the object-oriented system that implements this functionality. Illustrate the design with the help of a *Class Diagram*.

[20%]

(b) Following some feedback from the users, the online service has been extended to allow users to create simple photo collages to share with their friends and family. Users can choose one of the pre-defined collage templates that specifies a certain layout and frame style around the images, select a number of photos to include in the collage and add a text title.

(i) Extend your design to implement such functionality. Provide an illustration of the design with the help of a *Class Diagram*.

[30%]

(ii) Extend the design to allow a collage to include videos and other existing collages as well photos. Draw a *Class Diagram* to illustrate the design.

[30%]

(iii) Draw a *Sequence Diagram* to demonstrate a scenario for displaying a collage view. Assume that the collage contains 1 photo, 1 video and 1 other collage.

[20%]

2 A large manufacturer of medical imaging equipment successfully launches advanced image processing software that allows users to automate medical image analysis to aid in the diagnostics of certain medical conditions.

In an attempt to diversify their business, the company decides to set up a community website connecting and supporting the patients suffering from these medical conditions. The website will allow its users to connect to each other, have discussions on various topics and interact.

The project is assigned to the same software engineering team that developed the medical diagnostics image processing software.

(a) Specify the software development model that most likely was employed for the development of the medical diagnostics image processing software. Describe this software development model and explain the advantages of the approach for this type of software. [30%]

(b) Suggest if it would be appropriate for the team to follow the same software development methodology for the development of the community website. Explain your answer. [20%]

(c) Suggest an alternative software development methodology that might be more suitable for the development of the community website. Describe the software development process in this case and provide at least two advantages and two disadvantages of the proposed model. [25%]

(d) Design a testing strategy for the community website. Identify the key test areas that would allow the company to address the main risks in the project and specify the appropriate tests to mitigate these risks. [25%]

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

(b) A construction company uses a database to store information associated with a building project. A small version of the database is shown in Fig. 1. The database stores the task name (TaskName), the name of the manager of that task (ManagerName) and the tasks which must be completed before the task is started (Prerequisites). The full database contains thousands of tasks and each task may have tens of dependencies.

TaskName	ManagerName	Prerequisites
erect fencing	Alice	none
worker facilities	Chris	none
connect services	Bob	erect fencing, worker facilities
clear and level site	Alice	erect fencing, worker facilities
check plans	Chris	none
excavate foundations	Chris	connect services, clear and level site, check plans

Fig. 1

(i) Evaluate the database design and suggest how to improve it. Draw an *Entity-Relationship Diagram* to illustrate your answer. [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. [10%]

(iii) Design a query that returns the managers who manage tasks which are prerequisites of tasks managed by *Chris*. Express your answer using relational algebra and SQL code. [20%]

(iv) Express your answer to question (iii) as an expression tree. Optimise the query by pushing selections and projections down the tree. [15%]

(v) Design a query that returns the tasks which are the prerequisites of the prerequisites of task *excavate foundations*. Express your answer using relational algebra and SQL code. [30%]

4 (a) State the four *ACID properties* of transactions and explain why each is important. [25%]

(b) Fig. 2 shows a sequence of fourteen actions scheduled for execution by four transactions T1, T2, T3 and T4 operating on four database accounts A, B, C and D. Each operation Q.read must acquire a read lock Q.R on account Q and each operation Q.write must acquire a write lock Q.W on account Q. Once acquired, all locks are held until the transaction commits or aborts. Draw a *resource allocation graph* for this sequence of transactions and hence determine the first point where deadlock occurs. [30%]

time	transaction	action	time	transaction	action
1	T1	A.read	8	T2	D.write
2	T2	B.read	9	T4	D.read
3	T1	A.write	10	T4	A.read
4	T3	C.read	11	T1	commit
5	T3	D.read	12	T3	D.read
6	T1	C.write	13	T3	commit
7	T2	C.read	14	T2	commit

Fig. 2

(c) Draw the corresponding *wait-for-graph* at the point of deadlock. [20%]

(d) Explain how a system can recover from deadlock and discuss the criteria for choosing a *victim*. What would be the choice of victim in this case and in what order would the remaining transactions then complete? [25%]

END OF PAPER

Version RET/3

THIS PAGE IS BLANK