Version EP/2

EGT3
ENGINEERING TRIPOS PART IIB

Friday 9 May 2025 2 to 3.40

Module 4M21

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.*

STATIONERY REQUIREMENTS
Single-sided script paper

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM
CUED approved calculator allowed
Engineering Data Book

10 minutes reading time is allowed for this paper at the start of the exam.

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

You may not remove any stationery from the Examination Room.

1 A company is designing an app for helping users to lose weight through a 12-week weight loss programme. The app is designed to run on the user's smart watch. The app first asks the user to input their data and their goals of weight loss. Thereafter, it provides daily and weekly updates on progress made. Progress can be shared with family and friends.

(a) Explain how the app addresses the needs set out by self-determination theory. [30%]

(b) The company decides to engage in user research to better understand how a user might want to use their app. They decide to use contextual inquiry as the method.

(i) Briefly explain what is meant by contextual inquiry. [10%]

(ii) Describe how the principles of contextual inquiry could be applied when engaging in user research about this design problem. [20%]

(iii) Explain why, or why not, contextual inquiry would be a useful user research method for this design problem. [20%]

(c) The company attempts to further improve the design of the app by using *research through design*. Explain what is meant by research through design and give an example of how this method could be used for this design problem. [20%]

2 Workers at a factory are tasked with manual assembly of control panels. Since the design is complex and frequently changes, the control panels tend to contain manufacturing faults. To improve the quality of the product, the factory is investigating equipping workers with augmented reality glasses to provide real-time manual guided assembly support. The glasses will provide guidance on each step and check that every step has been successfully completed.

(a) Derive a solution-neutral problem statement for the system. [10%]

(b) Describe the aspects of the system that can be related to the framework of reality-based interaction. [20%]

(c) Explain how this system can be evaluated against the user-centric and system-centric evaluation criteria in the types and levels of automation framework. [30%]

(d) The design firm creating the glasses have no easy access to the factory where the glasses will be used. As a consequence, the design firm evaluates the glasses by recruiting first-year university students and asks them to use the glasses in a guided assembly task that involves building a Lego model. Explain the threats to validity of any findings using this approach to user research. [20%]

(e) Explain why appropriation of this system is likely, and discuss two possible solutions to support appropriation of the system. [20%]

3 (a) Explain what is meant by encapsulation, and why this is an important concept in the context of object oriented design. [10%]

(b) Consider an object oriented system that has a very basic class *EmailNotifier* that is used by application to alert the users about important events. The *EmailNotifier* class has a single method `send`, which accepts a pre-configured message argument, and sends the message to a predefined list of emails.

For critical issues, some users expected to receive an email alert, accompanied by either an SMS (short message service) notification, a push notification or both. The *EmailNotifier* class was therefore extended, and the additional notification methods were added to new subclasses *SMSNotifier*, *PushNotifier* and *SMSPushNotifier*.

(i) Draw a class diagram to illustrate a software design for the system described above. [15%]

(ii) Consider the scenario of sending one critical alert through push notification, SMS and email. Describe the interactions between the objects within the system, paying attention to the order in which these interactions occur. Define the objects within the system and the series of method calls that take place, specifying the type of each method. [15%]

(iii) Discuss the advantages and disadvantages of this approach. [10%]

(c) Propose an enhanced design to implement functionality described in part (b), which addresses some of the limitations identified in part (b)(iii) and extends easily to support notifications by multiple communication channels.

(i) Draw a class diagram to illustrate your proposed enhanced software design. [25%]

(ii) Draw a sequence diagram for the scenario of notifying users by email, SMS and using push notification. [10%]

(iii) Discuss the advantages and limitations of this approach. [15%]

4 A major airline company decides to set up a community website for their customers. The customers can connect, share their experience and advice, and interact with each other. The project is assigned to the same software development team that developed an application that calculates the amount of fuel to load onto a commercial airplane.

(a) Describe the team that is likely to be working on the project and clearly define their roles and responsibilities. [15%]

(b) Specify the software development model that was likely to be employed for the development of the application that calculates how much fuel to load onto an aircraft. Justify your answer. List the main stages in the development process and explain advantages of this approach for this type of software. [25%]

(c) Suggest if it would be appropriate for the team to follow the same software development methodology for the development of the community website. If appropriate, propose an alternative approach. Justify your answer. [25%]

(d) Propose 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 suggest the specific types of tests to mitigate these risks. [35%]

END OF PAPER

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