



UNIVERSITY OF MORATUWA

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

BSc Engineering
Semester 3 Examination

CS 2062 – OBJECT ORIENTED SOFTWARE DEVELOPMENT

Time allowed: 2 Hours

June 2017

ADDITIONAL MATERIAL: *None*

INSTRUCTIONS TO CANDIDATES:

1. This paper consists of 4 questions in 4 pages.
2. Answer **All** questions.
3. Start answering each of the main questions on a new page.
4. The maximum attainable mark for each question is given in brackets.
5. This examination accounts for 60% of the module assessment.
6. This is a closed book examination.

NB: It is an offence to be in possession of unauthorised material during the examination.

7. If you have any doubt as to the interpretation of the wording of a question, make your own decision, but clearly state it on the script.
8. **You must strictly adhere to standard object-oriented design guidelines and standard UML notation guidelines.** You may make any reasonable assumption but must clearly indicate all assumptions.
9. This paper should be answered only in English.

Question 1 (25 marks)

You have to implement a simple game application. This game application has a set of contestants who try to reach the top of a mountain called 'Mount Doom'. The application should be able to save and keep the previous states of each of the contestants. If needed, the state of the contestant can be restored to a previous state. Game manager is responsible for deciding when the contestant state should be saved, and when it should be restored with a previous state. It also maintains the list of state objects per each contestant.

(a) What is the behavioural design pattern that can be used for managing previous states of contestant objects? Briefly justify your selection. [03]

(b) Contestants are complex objects, meaning that they have many attributes that correspond to their physical structure. However, these attributes of a contestant do not change during the game. Moreover, these attributes of all the contestants are initialized with the same values. Therefore all the contestants can share the same values for these attributes throughout the game. The only attribute that changes is their position (x-y coordinates) in the grid. In addition, each contestant has a unique id.

What is the structural design pattern that can be used to make the contestant objects share the same set of attribute values that do not change, while making sure that each contestant has its own positional information? Briefly justify your selection. [03]

(c) Provide the Java code for this game application. The game manager should save ONLY the position information of a contestant into state objects, whenever needed. Also, a contestant should be able to be moved to a position indicated in a previously saved state object.

You should demonstrate the use of the two design patterns you identified in (a) and (b). It is enough to provide the code corresponding to the use of the two design patterns. E.g. you do not have to write the logic for how a contestant selects his next move. For simplicity, attributes corresponding to the physical structure of a contestant can be modelled as one single object. Logic to render this complex object is not required. [19]

Question 2 (25 marks)

You are required to implement a new word processing application. The underlying structure of a document in the application is shown in Fig Q2.1. As can be seen, a document is a composite data structure, so are the body and section. In this application, paragraph is considered as a non-composite data structure.

```
<document>
  <title>Design Patterns</title>
  <body>
    <section>
      <heading>Structural Design Patterns</heading>
      <paragraph>Structural design patterns are those.....</paragraph>
      <paragraph>There are many structural design patterns.....</paragraph>
    </section>
    <section>
      <heading>Behavioural Design Patterns</heading>
      <paragraph>Behavioural design patterns are those.....</paragraph>
      <paragraph>There are many behavioural design patterns.....</paragraph>
    </section>
  </body>
</document>
```

Fig Q2.1

- (a) Printing content of a document object requires all the elements in the document data structure to be accessed by the printing service in a uniform manner. Which behavioural design pattern can be used for this purpose? Briefly justify your selection. [03]

- (b) Provide the Java code for this word processing application that demonstrates the use of the design pattern you identified in (a), where the printing service gets a uniform way of traversing through the document.

Add a test class that has the logic to print the document shown in Fig Q2.1 to the console output.

Note that some classes share very similar logic. In such cases, it is enough to provide the code for only one class. But you must indicate which other classes share a similar logic. [22]

Question 3 (25 marks)

Max is a newly opened movie theatre. Owner wants to build a website for Max with online ticket reservation facility. You are the system analyst of the proposed system and following are some requirements as explained by the owner of Max.

Max theatre shows a single movie for a period of 30 days and provides three show times (sessions) per day, 10.30 am, 2.30 pm, and 6.30 pm. Customers can buy tickets for a show online or over the counter. System allows customers to buy tickets online up to three days (72 hours) in advance and online reservations will be closed 1 hour before the show starting time. But tickets can be bought over the counter until all seats for a session are sold (even after the movie has started for that session).

When a user wants to do an online reservation, he first needs to provide his email address. Once the system prompts the show time selection interface, the user has to select the date and show time. If all the seats for the selected session are reserved at the time of customer's request, system generates the message 'No seats are available for the selected date and time'. The user can either try out a new session, or exit. If there are available seats, system shows him a graphical representation of the seating arrangement with reserved seats marked in red and available seats marked in green. Customer can then select the preferred seat from the available seats. Final step is the payment. System calculates the payment based on the selected seat type. For simplicity, assume that only one ticket can be booked per reservation. Two payment options are provided. Pay by credit card at the time of reservation, or pay later at the counter, 1 hour before the show starting time. If the customer wants to pay by credit card at the reservation time, he needs to provide other necessary payment information such as name and credit card number, and submit the payment. System verifies the payment information and provides an error message if the verification failed. If the payment is successful, an eTicket is sent to the customer's email. If customer wishes to pay later at the counter, a temporary ticket will be sent to his email and final ticket will be issued after the payment is done. Customer can decide to cancel the reservation any time within the reservation process before he does the actual payment.

System also provides an option to refund a completed (paid) online reservation, if the customer does not want to attend the movie. A reservation can be refunded up to 1 hour before the show starting time. Customer should first request a cancellation from Max theatre. Then Max theatre refunds the amount of the ticket and cancels the reservation.

- (a) Explain the importance of identifying states of objects in Object Oriented System Design. [03]
- (b) Draw the state chart diagram for the 'Reservation' object. Adhere to standard UML notation. [14]
- (c) Identify two other objects that have meaningful states in this system.
Write down all the possible states for the identified objects. You DO NOT have to draw the state chart diagram. [08]

Question 4 (25 marks)

- (a) Draw the Activity Diagram for the online reservation process given in the scenario of Question 3. Assume that the user DOES NOT cancel the reservation. [17]
- (c) As per the requirements specified by owner, 'Max theatre shows a single movie for a period of 30 days and provides three show times (sessions) per day, 10.30 am, 2.30 pm, and 6.30 pm'. This requirement cannot be modelled using Activity Diagram or State Chart Diagram.
 - (i) What is the UML diagram needed to model this requirement? Briefly explain your answer. [03]
 - (ii) Draw the UML diagram that you identified in (i) to model ONLY the specific requirement described in (c). You DO NOT have to draw the full diagram for the whole scenario. [05]

----- END OF THE PAPER -----