# NANYANG TECHNOLOGICAL UNIVERSITY

## SEMESTER 1 EXAMINATION 2019-2020

## CE2006/CZ2006 – SOFTWARE ENGINEERING

Nov/Dec 2019 Time Allowed: 2 hours

## INSTRUCTIONS

1. This paper contains 4 questions and comprises 5 pages.
2. Answer **ALL** questions.
3. This is an open-book examination.
4. All questions carry equal marks.
5. Refer to **Appendix A** on page 5 for the project description which is needed to answer all questions.

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1. Based on the project description given in Appendix A,

   (a) Identify the actors and use cases of the project and draw the use case diagram. Use <<include>> and <<extend>> relationships where appropriate.

   (10 marks)

   (b) Write the use case description for the functionality of renting video. Your use case description must include description of the use case, pre-condition, flow of events and any alternative flow if it exists.

   (8 marks)

   (c) From your use case description in Q1(b), identify the main classes and their associations and draw a conceptual class diagram that depicts the classes including their stereotypes and associations between them. You do not need to identify any attribute or operation within the classes.

   (7 marks)

2. (a) From your use case description in Q1(b) and the identified main classes in Q1(c), draw the sequence diagram that realizes the video renting functionality.

(10 marks)

(b) Draw a state machine diagram to show the states of the video renting component of the **VRS** system.

(7 marks)

(c) Suppose the **VRS** project has the following activities: Activity A takes 40 hours and can start after the project starts. Activity B takes 70 hours and should happen after the project starts. Activity C must happen after Activity A and takes 35 hours. Activity D must happen after activities B and C and takes 30 hours. Activity E must take place after activity C and takes 25 hours. Activity F takes place after activities D and E and takes 22 hours. Activity G happens after activity D and takes 15 hours. Activities F and G are the last activities of the project.

(i) Decide the critical path of the project with an activity diagram and the shortest duration of the project.

(5 marks)

(ii) What will be the answers to the Q2(c)(i) if activity B actually takes 80 hours?

(3 marks)

3. (a) Refer to the classes identified in your answer to Q1(c):

(i) Propose an appropriate architecture for the **VRS** system, and draw a detailed Class diagram with key attributes and methods in each class to reflect the architecture design.

(8 marks)

(ii) Propose an alternative architecture design using a different design pattern and discuss the advantages of the alternative architecture.

(6 marks)

Note: Question No. 3 continues on Page 3

(b) Answer the following questions related to software design:

(i) Explain the process of Object Design with respect to the **VRS**?

(4 marks)

(ii) Propose a scenario in **VRS** system where the design strategy "Strategy Design + Factory Design + Dynamic Loading" can be applied.

(2 marks)

(iii) Discuss how the pull and push strategies of observer pattern are used in the Java Swing UI framework.

(5 marks)

4. (a) The **VRS** system allows the clerk to input the following information about the video:

1. Video name: the name of the video, which must be in ASCII format.
2. Type of the video: one of "Movie", "TV", "Documentary", "Cartoon" and "Music".
3. Year of the video: the year is an integer value between 1900 and 2019.

(i) Determine the equivalence classes for the above THREE video inputs.

(3 marks)

(ii) Determine the boundaries of the equivalence classes identified in your answers to Q4(a)(i). For each boundary, identify a value on the boundary, a value just below the boundary, and a value just above the boundary.

(4 marks)

(iii) You intend to perform **defensive testing** of the video input interface. Design a set of test cases to test the THREE video inputs based on the equivalence classes and boundary values identified in your answers to Q4(a)(i) and Q4(a)(ii).

(5 marks)

Note: Question No. 4 continues on Page 4

(b) The **VRS** system automatically calculates the late fee for the customer. The *payLateFee()* method (as shown in the Java code snippets in Figure Q4(b)) implements this interface.

(i) Draw the control flow graph for the *payLateFee()* method. [*Use the line numbers for clarity*]

(5 marks)

(ii) Calculate the Cyclomatic Complexity of the *payLateFee()* method.

(2 marks)

(iii) List the basis set of linearly independent paths for performing basic path testing of the *payLateFee()* method. Design a test case (including the input parameters to the *payLateFee()* method and expected outcome) for each of the basic paths.

(6 marks)

```
1.  int payLateFee(String customer, int amount) {
2.      int lateFee = 0;
3.      Int returnAmount = amount;
4.      // Video class contains three attributes: (String name, int fine, bool isLate)
5.      Video[] videoRecords = findVideoRecords(customer);
6.      for(int i = 0; i < videoRecords.length; i++) {
7.          if(videoRecords [i].isLate)) {
8.              int fine = videoRecords [i].fine;
9.              returnAmount = returnAmount – fine;
10.             if(returnAmount >= 0) {
11.                 System.Out.Print("Late payment for video" + videoRecords [i].name +
    " is successful!")
12.             }
13.             else {
14.                 System.Out.Print("Late payment for video" + videoRecords [i].name +
    " is unsuccessful!")
15.             }
16.         }
17.     }
18.     return returnAmount;
19. }
```

**Figure Q4(b)**

Note: Appendix A is on Page 5

**Appendix A**

## Video Rental System (VRS) Description

The VRS provides both customers and store clerks functionalities for renting videos. The initial requirements are shown below.

Both customers and store clerks need to log in to the system in order to use the system. New customers need to register to the system to get the login information. Customers can search videos, rent videos, return videos through the system. If a customer does not return the video before or on the due date, a late fee will occur. The customer can pay for the late fee through this system. The system supports credit card payment. A customer can rent videos only if the customer has no unpaid late charge in the system. The customer must pay the rentals to complete the renting transaction. Sometimes, customers may get discount for some videos. Store clerks can do administration work on this system, including generating different video rental reports and printing selected reports.

END OF PAPER

**CE2006 SOFTWARE ENGINEERING**
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Please read the following instructions carefully:

1. **Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**

2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.

3. Please write your Matriculation Number on the front of the answer book.

4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.