

Software Systems Design Test

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Module: 201700117 Software Systems

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- Different questions will be graded by different people. We ask you kindly to **use a separate sheet for each question** (not the back side of the sheet for another question).
- You are allowed to consult the printed version of the slides. It is not allowed to consult other materials - including your own notes.
- Diagrams can be drawn with pen or pencil, as you like.
- When you are finished, raise your hand. We will collect the test from you.
- Hand in only the answers to the questions. You can take the test with you.
- The test is marked out of 10.0 points

Hint: Model only what is described in the text below. If you are unsure about any aspect, make an assumption and make a note of the assumption in your answer.

Restaurant Administration

The *Eat-Some-More* restaurant is a popular restaurant in the city center of Barchester. Customers can make a reservation beforehand, or can turn up and, if a table is available, be seated straight away, or wait in the waiting area for a table to become available. You are requested to make a design for a software system for the restaurant covering the reservations, assigning customers to tables, serving, and paying for the meal. For simplicity groups of customers seated at the same table will be treated as one “customergroup” by the system.

Each waiter has a hand-held electronic device (ED) to interact with the system. The restaurant has a number of waiters who work shifts. On each shift each waiter is assigned to a certain set of tables to attend to. When a customer phones to make a reservation, though, each waiter can access all the tables in the restaurant for the reservation.

Reservation:

One of the members of a customergroup can call in advance and make a reservation. When the customer calls to reserve a table, a waiter clicks on the reservation link on his/her ED. The waiter will enter the date and time period (begin and end time), and a schematic layout of all the tables in the restaurant will be displayed with the number of customers that can be seated at each table. All the tables will be colour coded according to whether they are

available, reserved or pre-reserved for that time period. A table that has been reserved for a specific time period will have a pre-reserve time of an hour in which it cannot be reserved for, or be assigned to another group. This is to ensure that the table will be available for the reserved time period. The table will have another colour than a reserved table. If the table is available for the date and time period, the waiter can click on the specific table (tables if the group is large and requires more than one table) and reserve it for the specific day and time period. The waiter will record the name and telephone number of the contact person in the customergroup and the amount of people in the group. The system will then reserve the table(s).

A customer can call at any time before the reserved time and change or cancel the reservation. If only the time period changes, the waiter will check on his/her ED to see whether the change can be made to the reservation. If a change can be made the time period is altered. If the change cannot be made, or the date changes, the old reservation is cancelled and the customer can decide whether to make a new reservation or not. When a reservation is cancelled, the table is made available again.

On the day of the reservation the customer can phone to say that they will be late. The waiter can check on his/her ED whether the time period can be changed or, if it cannot be changed, whether another table is available. Otherwise the customer is warned that the table is reserved for another group and the customer can decide whether to continue with the previously arranged time period, make a new reservation, or cancel the reservation.

On the day of the reservation, the system will warn the waiter assigned to the reserved table on his/her ED. The first warning will be an hour before the reserved time. This will allow the waiter to warn any customers sitting at the table that they need to finish within the hour as the table is reserved. This warning will be repeated 15 minutes before the reservation, so that the waiter can make sure that the table will be available at the reserved time.

If a customer does not show up 15 minutes after the reserved start time, the table will be made available, and the waiter is notified. If there is a waiting list of customers the table can be assigned to a new customergroup.

Customers arriving:

Hint: For simplicity, you may assume that all members of a customergroup arrive at the same time.

If a customergroup with a reservation arrives they are taken to the reserved table(s) immediately. If a customergroup arrives who have not made a reservation the waiter checks on his/her ED whether a table that is large enough anywhere in the restaurant is available. If a table is available the customers are taken to the table. If no table is available, the customers are given the option of waiting until a table becomes available. If they are prepared to wait they are put on a waiting list. As soon as a table becomes available the next customergroup on the waiting list that is small enough for the available table is removed from the waiting list and taken to the table.

Serving:

When the customers are seated, the waiter brings the menus to them. The waiter changes the state of the table to occupied and the system will create an empty order linked to the table and note the date, time and waiter. For simplicity it will be assumed that only one bill can be made per customergroup (bills cannot be split). The customers at a table can order several items over the period that they are seated at the table. For each item ordered the waiter selects the item from a list of items on his/her ED. The item can be either a beverage or a dish. The item is added to the table's bill and placed on the beverage or dish waiting lists of the kitchen staff. The ordered item contains the item code, item name, table number, waiter name and a time stamp. For simplicity, the customers can not have special requests, but can only order the items on the menu.

The beverages can be ordered in different sizes - small, medium or large - each with their own price. The dishes are standard, each having one standard price.

At the end of the meal, the waiter prints out the bill for the table and the total amount to pay and gives it to the customergroup. When the customer pays the waiter records the payment on his/her ED. The state of the table is then changed to available or pre-reserved.

Hint: For simplicity you may assume payment is cash only.

Kitchen staff:

Some kitchen staff attend to the beverages and make sure that they are made as soon as possible. Other kitchen staff attend to the dishes. The staff note from the waiting list of ordered dishes which dish to prepare next. As soon as the dish is ready, the kitchen staff make an entry on the system and the waiter is sent a message on his/her ED that the dish can be delivered to the table. For simplicity, do not distinguish between the beverage and kitchen staff actors -- refer to them as restaurant staff.

Manager:

At times the manager wants statistics from the system on the table occupation, and the number of items sold of each type of beverage and dish. The manager will have the option to specify the time period for the statistics.

Questions 1 - (Activity Diagram) [2.5 points]

Draw an activity diagram with all the activities in the restaurant related to a customergroup's (potential) reservation to payment.

Questions 2 - (Use Cases) [3 points]

The actors in the system are the waiters, kitchen staff, system clock and the manager. The manager can do all the functions the waiters can do plus request statistics. The customergroup will not interact directly with the computer system.

2a (Use case Diagram) [2 points]

Draw a use case diagram for the whole system as described.

2b (Use case description) [1 point]

Write a use case description for the waiter making a reservation, starting from the moment where the customer phones to the successful/unsuccessful completion of the reservation.

Questions 3 - (Class Diagram) [2 points]

Create a class diagram for the whole system as described.

Questions 4 - (State Machine) [1 point]

Draw a state machine diagram for the state of a table, eg. unoccupied, pre-reserved, etc.

Questions 5 - (Software Metrics) [1.5 points]

5a (Cyclomatic Complexity) [1 point]

Calculate the cyclomatic complexity of the Java method given below:

```
1. public static int[] selectionSort(int[] nums){
2.     int i = 0;
3.     int j = 0;
4.     int temp = 0;
5.     while (i < nums.length-1) {
6.         j = i + 1;
7.         while (j < nums.length){
8.             if (nums[j] < nums[i]){
9.                 temp = nums[i];
10.                nums[i] = nums[j];
11.                nums[j] = temp;
12.            }
13.            j++;
14.        }
15.        i++;
16.    }
17.    return nums;
18. }
```

5b (Cyclomatic Complexity) [0.5 points]

Is it considered good practice with respect to code maintainability, if a method has a high cyclomatic complexity, or a low cyclomatic complexity?

What needs to be done to a method to improve its code maintainability with respect to cyclomatic complexity?