Systems Development

(Dat3, SW3, IxD5, iDA7)

Written Exam

4 January 2019, 10:00-14:00

Student Name	
Student Number	
Study Programme and Semester	

This exam set consists of 18 pages (including this page) with 4 assignments. Before you start, check that your exam set contains all these pages.

The weight of each assignment is provided in its title and sub-titles.

You have 4 hours to complete the exam.

Use a readable handwriting in your solution.

Write your solution to each assignment in the space provided in this set. Only solutions written in the exam set can be handed in. You may make a draft of your solution before filling it into the exam set. You can obtain paper for making a draft from the exam officials.

You can write your solution in either English or Danish (or a mix).

The following exam aids are permitted:

- The textbook
- Copies of slides and other course material
- Personal notes from the course

Communication devices such as computers and cell phones are ***not permitted*** in the exam room.

You must provide your student id upon request by the officials.

Assignment 1. Street Food App (20%)

S-Food is a company that is running a modern street food business. S-Food owns a large building where they rent small shops to food producers and bars that are selling their products in the building. S-Food wants an object-oriented analysis of a system to support this business.

In the building, there are about 10 food shops, a couple of bars and a large seating area with tables and chairs, where the customers consume food and drinks. When the customers arrive to the building, they go to the seating area and find a table. All tables are numbered, and the number is displayed with a QR code on the table.

To order and pay food and drinks, customers have to download an app to their smartphones. The app is provided for free by S-Food. In the app, there is a page with a menu with all food shops and bars. You can choose one of these, and for each food shop, there is a list of food items they sell with pictures and prices of each, and for each bar, there is a list of drink items with prices. On these pages, customers select the items they want to order. For some items, it is also necessary to order a number of items or a quantity (for example, by weight). If customers want more information about the food, they can walk around and visit the shops.

With the app, a customer composes a meal consisting of a number of orders. An order is either a number of food items from a single food shop or a number of drink items from a single bar. Once customers have selected the food and drink items they want in their meal, they go to a checkout page in the app. Here they first authorise payment of the meal through their credit card, which has to be registered in their app. Then they take a picture of the QR code on their table. As soon as a food shop has produced the food in their order, or a bar has the drinks in their order, they deliver it to the table. This means that the customers do all the ordering from their table.

The system is communicating with the smartphone apps over a wireless internet that connects the apps to S-Food's server that runs the system. The app on the customers' smartphones is the frondend of the system.

Each food shop and bar uses a backend system that for each order produces a list of the food or drink items they need to produce and deliver to the customer who made the order. However, in this assignment, you just ignore that backend of the system and only focus on the frontend that the customers will see.

Assignment 1.1. System Definition (5%)

S-Food has made this system definition for the frontend system:

> A system provided as an app, which is used by customers who want to order food and drinks at the street food market operated by S-Food. The customers come to S-Food on their own initiative, and their only relation to S-Food is that they download and use the app to order and pay for food and drinks. The system is primarily an administrative tool that is responsible for registering all customers and their orders, and facilitating secure payment of these with the customers' credit cards. Secondarily, it is a communication medium that customers use to request delivery of orders from the food shops and bars. The system can register a new customer with credit card information, compose a meal with a number of orders for food shops and bars, select food or drink items in each order of a meal, make payment of a meal, and register the table where a customer wants his/her orders delivered. The app is running on each customer's smartphone. It communicates through a wireless network with a server that registers what the

individual customer has ordered and paid. On the smartphone, there is always a copy of all meals from the current day, so they are available if the wireless network should fail. The app includes a QR code reader. The app will be developed by S-Food's own IT department in cooperation with S-Food's sales department, the food shops and bars, and a few customers that will be selected to represent the whole customer segment. It may be necessary to resolve conflicting requirements between these different groups. The app will be used by users with very different levels of IT skills.

Divide this system definition into the elements of the FACTOR criterion (write your answer in the boxes below).

F	
A	
C	

T	
O	
R	

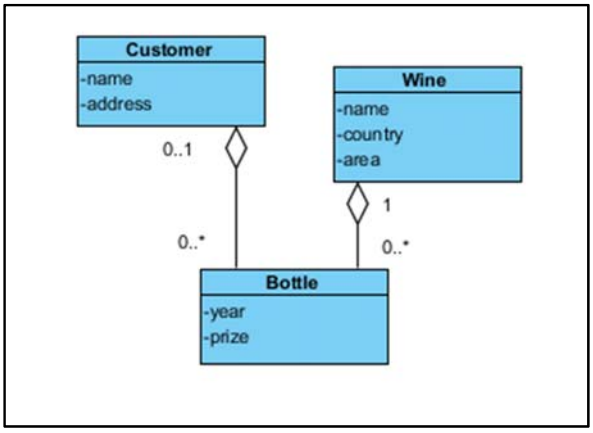
Assignment 1.2. Class Diagram (15%)

Make a class diagram of the problem domain of this system. The classes must have the relevant attributes (write your answer in the box below):

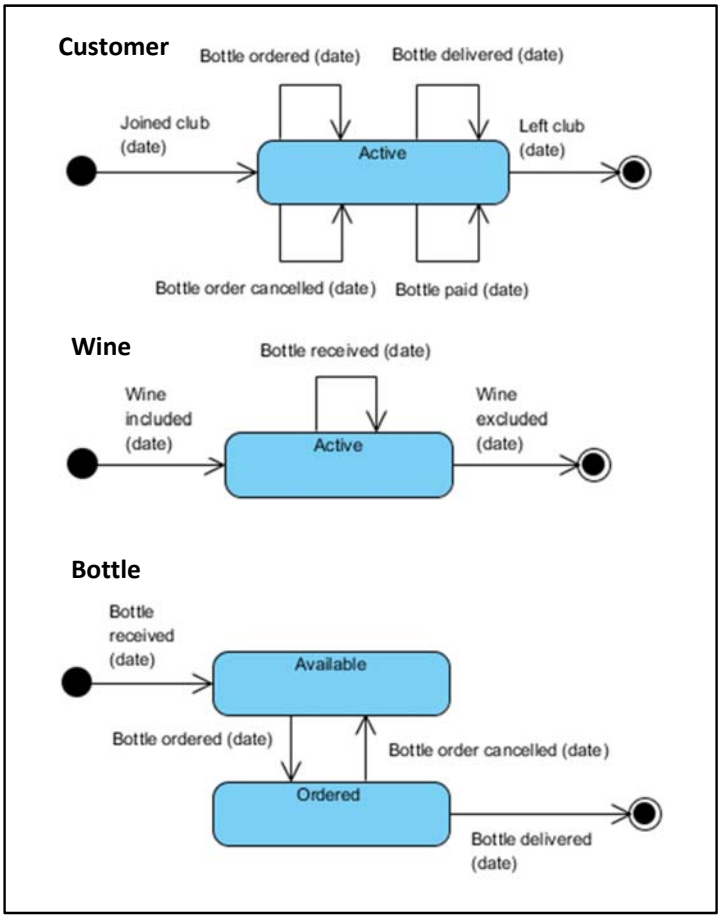
Assignment 2. Wine Club (35%)

A wine club is selling wine through its website shop to a group of customers who are members of the club. A Customer can join the club through its website and thereby become an active member. Eventually, the Customer may leave the club, also trough the website. In the meantime, while the Customer is active, he/she can order wine from the club.

Below is the class diagram for the problem domain.



Below are statechart diagrams for the classes in the problem domain.



Assignment 2.1. Application Domain and Problem Domain (5%)

Give a textual definition of the application domain for this system and give the relevant examples of objects in this application domain (write your answer in the boxes below).

Application Domain (definition)	
Objects (examples)	

Give a textual definition of the problem domain for this system and give the relevant examples of objects in this problem domain (write your answer in the box below).

Problem Domain (definition)	
Objects (examples)	

Assignment 2.2. Actors and Use Cases (10%)

The system supports the following use cases:

- Join as a new member
- Leave as a member
- Include wine in the assortment
- Exclude wine from the assortment
- Register bottle(s) received
- Order bottle(s) of wine
- Cancel bottle order(s)
- Register delivery of bottle(s)

You can assume that payment for orders is handled outside this system.

Define relevant actors for the system and make an actor table (write your answer in the box below – it continues on the next page).

Assignment 2.2 continued

Assignment 2.3. Functions (10%)

Make a complete function list for the system (with complexity and function type for each) (write your answer in the box below – there are more lines than needed).

Function name	Complexity	Function type

Assignment 2.4. Use Case (10%)

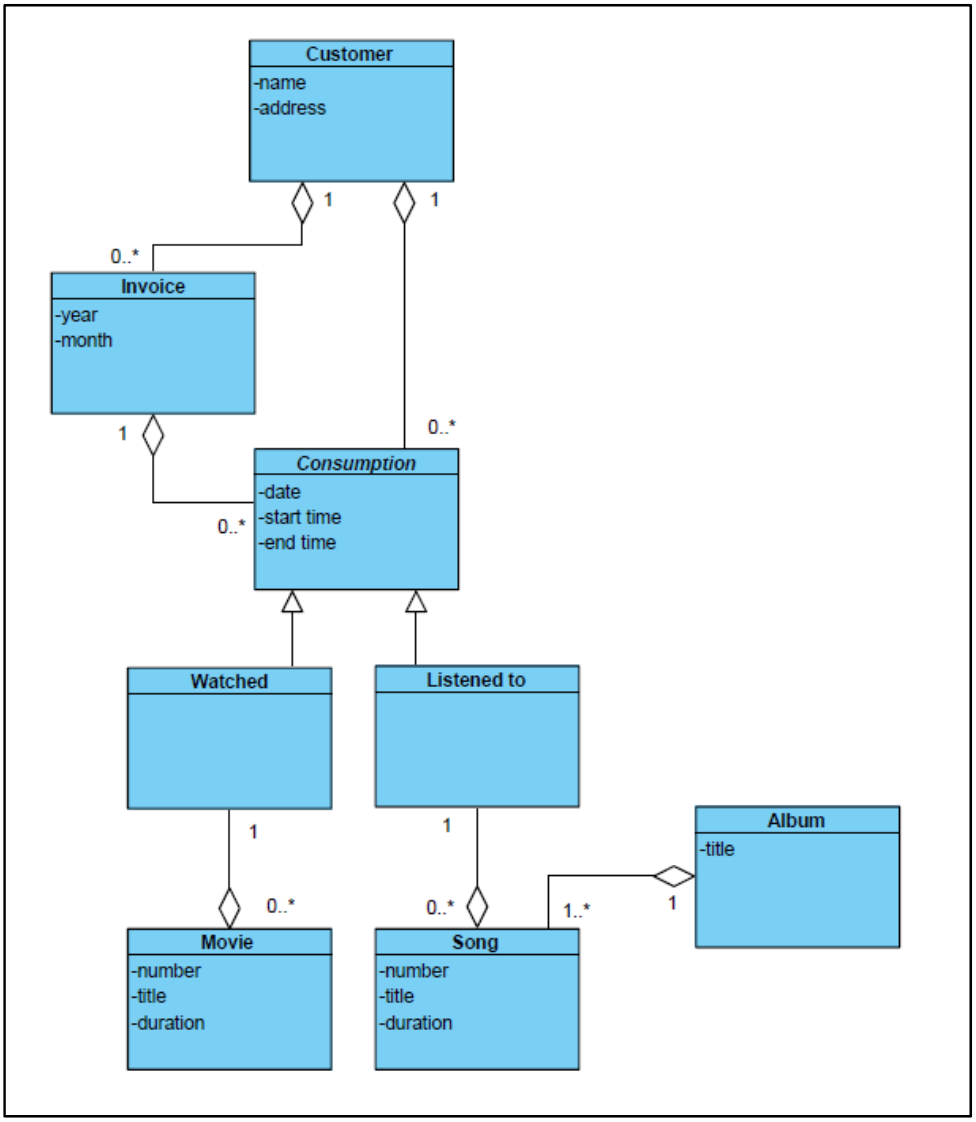
Describe the use case ‘Order bottles of wine’ (with objects and functions) (write your answer in the box below). If necessary, you may introduce new attributes to the classes in the problem domain; if you do that, just make a note about it at the bottom of the box below.

Assignment 3. Streaming Service (35%)

This assignment is about a system for administration of consumption on a streaming service for movies and music. The owner of the service has together with a software development company made the following system definition:

F: Register the movies the customers watch and the songs they listen to, and support payment by customers for their consumption of these movies and songs.
A: Will be used only by the administrative personnel that is employed by the organization that provides the streaming service
C: Developed for and in collaboration with the administrative personnel.
T: PC platform with common tools.
O: Customer, Movie, Song.
R: Registration, administration and payment of the customers' consumption through the streaming service.

They have also made the following class diagram of the problem domain of the system:



Assignment 3.1. Patterns (10%)

Identify object-oriented patterns in the class diagram above, and for each pattern describe which classes it connects and if relevant, the role of each class in the pattern (write your answer in the box below – there are more lines than needed).

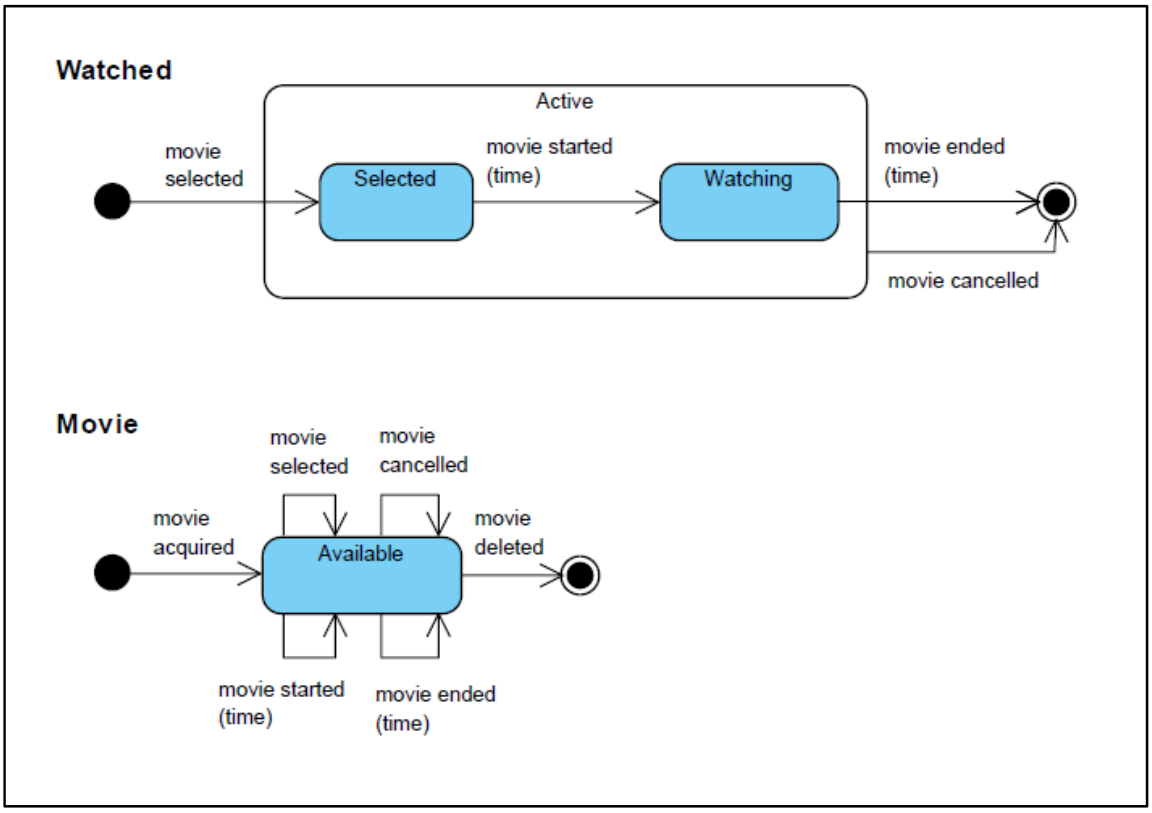
Pattern	Classes connected

Assignment 3.2. Event Table (10%)

The behaviour in the problem domain can be described as follows:

- A customer can join the streaming service and leave it. In between these, he/she is a member of the streaming service.
- A member can select a movie and watch it. It can be cancelled during watching.
- A member can select a song and listen to it. It can be cancelled while listening to it.
- A member select movies and songs, and they pay for the movies and songs they select.
- Movies and songs are acquired by the service and deleted when members no longer select them.
- An invoice is generated each month with the consumption of the customer during that month.
- The customer pays the invoice within a certain time limit defined on the invoice.
- If the customer does not pay within the time limit, he/she is excluded from the club. When a customer is excluded from the club, he/she has to pay before being able to leave the club.
- While being excluded, it is not possible to watch movies and listen to songs.

The system developers have also made the following two statechart diagrams.



Make a complete event table for this problem domain (write your answer in the box below).

Assignment 3.3. Statechart Diagrams (15%)

Make statechart diagrams for the three classes Customer, Invoice and Consumption (write your answer in the box below).

Assignment 4. App Supporting Social Exercising (10%)

A non-profit organization wants to provide an app to support increased exercising by facilitating social contact between users. The aim is to increase the users' exercising by connecting them to other users who want to do the same type of exercises.

The system developers have produced the following system definition:

> An IT-system provided by a non-profit organization to support a community of users in establishing contacts to other users in the community who want to do exercises. A couple of volunteers in the non-profit organization will take care of system administration, but apart from that the users in the community will be the only ones applying the system. A user can set up an event that involves a specific type of exercise, e.g. running, playing football or bicycling. Other users can view the events that are available and sign up for the ones that are interesting for them. Events will have at least a single occurrence, but may also have multiple occurrences that are happening several times with defined time intervals, e.g. weekly. The aim of the system is to increase the amount of exercising for the users. The system allows users to select events, but it will also encourage users to participate in events based on their stated preferences. The system will be based on a server at the non-profit organization and clients on the users' smartphones. It will be developed by a software company in collaboration with volunteers in the non-profit organization and prospective users.

Explain which system architecture you would use for this system and give the reasons why (write your answer in the box below).

Make a diagram of your system architecture (write your answer in the box below).