National University of Singapore

School of Computing

IS2103 – Enterprise Systems Server-side Design and Development

Assignment 2: Group Project

Total Marks: 40 marks

BACKGROUND

The National Library of Singapore (NLS) recently conducted a publicity drive to promote the reading habit among the general public. This has led to an increase in the number of library members (those who take books on loan from the library) and library usage. As a result, the library is planning to streamline the lending process of books to avoid wait times of the members and to reduce the workload of the staff. The library management has decided to incorporate a new Integrated Library System (ILS).

Your team has recently been recruited by NLS to design and develop an enterprise-scale software system for implementing the business model of their future library services.

NLS INTEGRATED LIBRARY SYSTEM (ILS)

The **Integrated Library System ("ILS")** allows the library staff to operate library services. It provides a comprehensive suite of applications and web services for the library to operate with minimal maintenance efforts.

The library staff are responsible for counter operations at the loans desk and all administrative operations. They can use the **admin terminal** located at the loans desk to perform their daily operations.

Members must register for an account with their identity number (e.g., NRIC or Passport Number) and a security code. They can borrow books from the library through the loans desk staff or self-service kiosk. In addition, the members can return books and carry out various additional tasks at the loans desk, self-service kiosks and book-drop machines located around the city. The tasks will be confirmed in a real-time mechanism.

HIGH-LEVEL SYSTEM ARCHITECTURE

All software elements constituting the ILS are to be developed in Java using the Java Platform, Enterprise Edition (Java EE). In particular, Enterprise JavaBeans (EJB) and Java Persistence API (JPA) technologies are to be used in conjunction with a suitable Relational Database Management System (RDBMS) such as MySQL. Only Command-line Interface (CLI) client applications are required. The ILS will consist of:

i) A core backend to be developed with a component-based architecture
ii) A Library Admin Terminal to support the library staff
iii) A Self-Service Kiosk Terminal for members
iv) Web services for interfacing with external systems
v) A Book Drop Machine (BDM) Client running on the book drop machines

The high-level architecture of the ILS is depicted in a block diagrams as shown in Figure 1 below. Library Admin Terminal is a client application used by library staff and Self-Service Kiosk client is used by members. In addition, the advanced book drop machines located outside of the library at various public venues can be used the members using the BDM client running on them.

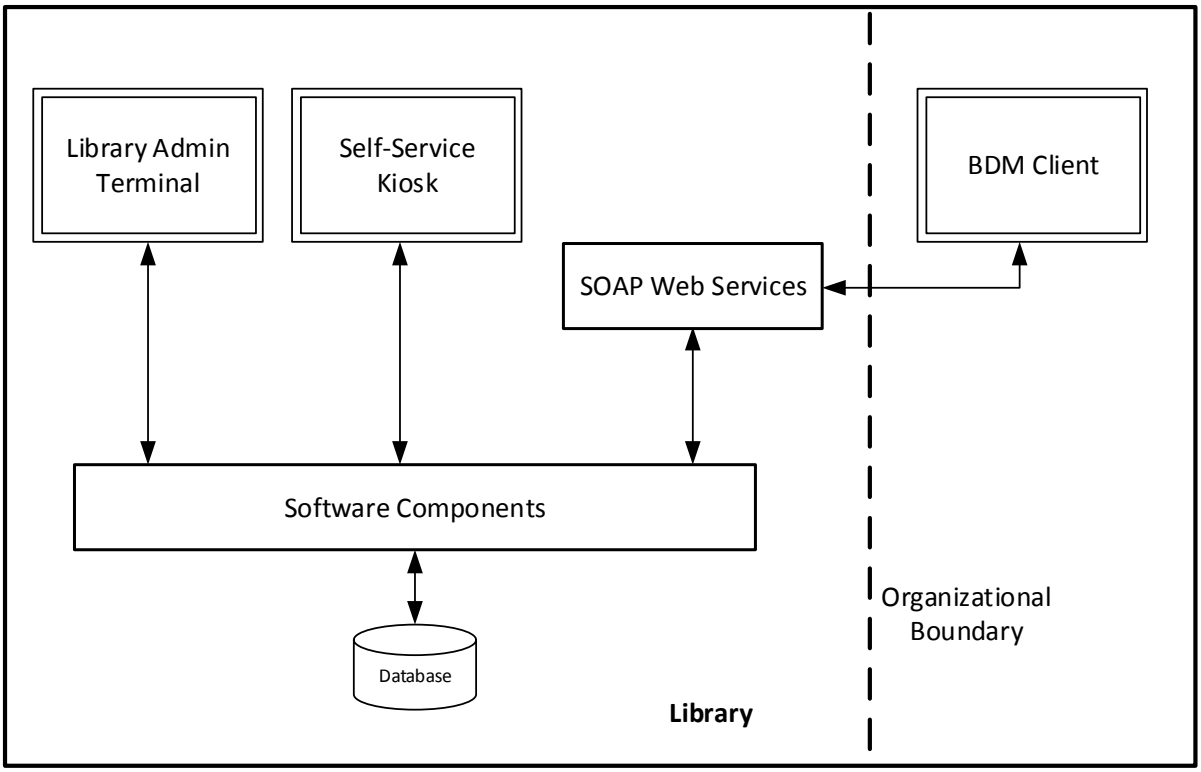

Figure 1 High-level architecture of the Integrated Library System (ILS)

PROJECT TASKS

Your team has been tasked to implement a pilot version of **Integrated Library System ("ILS")**. Your solution will be deployed at NLS upon successful testing.

There are several points to note for your development:

1. You are **NOT** required to draw a UML class diagram.
2. You are **NOT** required to draw any formal software engineering diagram.
3. The date format is yyyy-MM-dd (e.g. 2018-02-01) and the time format is HH:mm (e.g. 16:30).
4. The library is open from Monday to Friday, from 09:00 to 17:00. The library loans desk will only operate during these times. However, self-service kiosks and book drop machines operate around the clock, 24/7.
5. A book is only loaned for a 2 weeks period. A member can loan up to a maximum of 3 books at any given time.
6. Books that are already loaned can be reserved (put on hold) by other members.
7. If a book is not under any reservations, the library member can extend the loan term by another 2 weeks.
8. If a book is under reservations (on hold), the book can only be loaned by the member who created the first reservation (first in first out priority)
9. Overdue books are charged a fine of $1 per day per book.
10. Member cannot loan any further books until all overdue fines are paid.

There are several employees at the library as shown in Table 1.

staffId	firstName	lastName	userName	password
1	Linda	Chua	manager	password
2	Barbara	Durham	assistant	password

Table 1 Staff Entities

A sample of the books available at the library is given in Table 2.

bookId	title	isbn	year
1	The Lord of the Rings	S18018	1954
2	Le Petit Prince	S64921	1943
3	Harry Potter and the Philosopher's Stone	S38101	1997
4	The Hobbit	S19527	1937
5	And Then There Were None	S63288	1939
6	Dream of the Red Chamber	S32187	1791
7	The Lion, the Witch and the Wardrobe	S74569	1950

Table 2 Book Entities

In addition, the library has also provided you with sample data of their member database as shown in Table 3 (The security code column has been removed for security purposes).

memberId	identityNumber	firstName	lastName	gender	age	phone	address
1	S7483027A	Tony	Teo	Male	44	87297373	11 Tampines Ave 3
2	S8381028X	Wendy	Tan	Female	35	97502837	15 Computing Dr

Table 3 Member Entities

ARCHITECTURE AND DESIGN

Design a suitable **logical data model** consisting of a set of entity classes, their attributes, and the relationships among the entity classes to support the entire ILS software system. You are **NOT** required to draw a UML class diagram. You are only required to create the entity classes using JPA and then apply the **forward engineering** technique to generate the physical data model (i.e. the underlying relational database tables).

Java annotations from JPA must be used appropriately to decorate the entity classes in order to enforce the strictest possible integrity constraints on the logical data model. More explicitly, you are to ensure the correctness and integrity of the data that are eventually stored in the underlying relational database according to some well-defined business rules or assumptions.

For examples:

```
@Column(length = 32, nullable = false)
private String firstName;
@Column(length = 9, nullable = false, unique = true)
private String identificationNumber;
```

are preferred over:

```
private String firstName;
private String identificationNumber;
```

And:

```
@ManyToOne(optional = false)
@JoinColumn(nullable = false)
private MemberEntity memberEntity;
```

are preferred over:

```
@ManyToOne
private MemberEntity memberEntity;
```

Using Java EE, design a suitable **physical architecture** for the ILS software system taking reference from the high-level architecture shown in Figure 1. Your architecture should state clearly the various Java EE software elements that you are developing and their accompanying rationales.

LIBRARY ADMIN TERMINAL

The UML use case diagram for the Library Admin Terminal is shown in Figure 2 below. A brief description of selected business use cases together with the associated business rules are given in Table 4.

If use case A includes use case B, it means that when performing the basic course of actions for use case A, the behaviour of use case B will be invoked at a point specified by the base use case, i.e., use case A. In Figure 2, "Return Book" and "Extend Book" both include "View Lent Books".

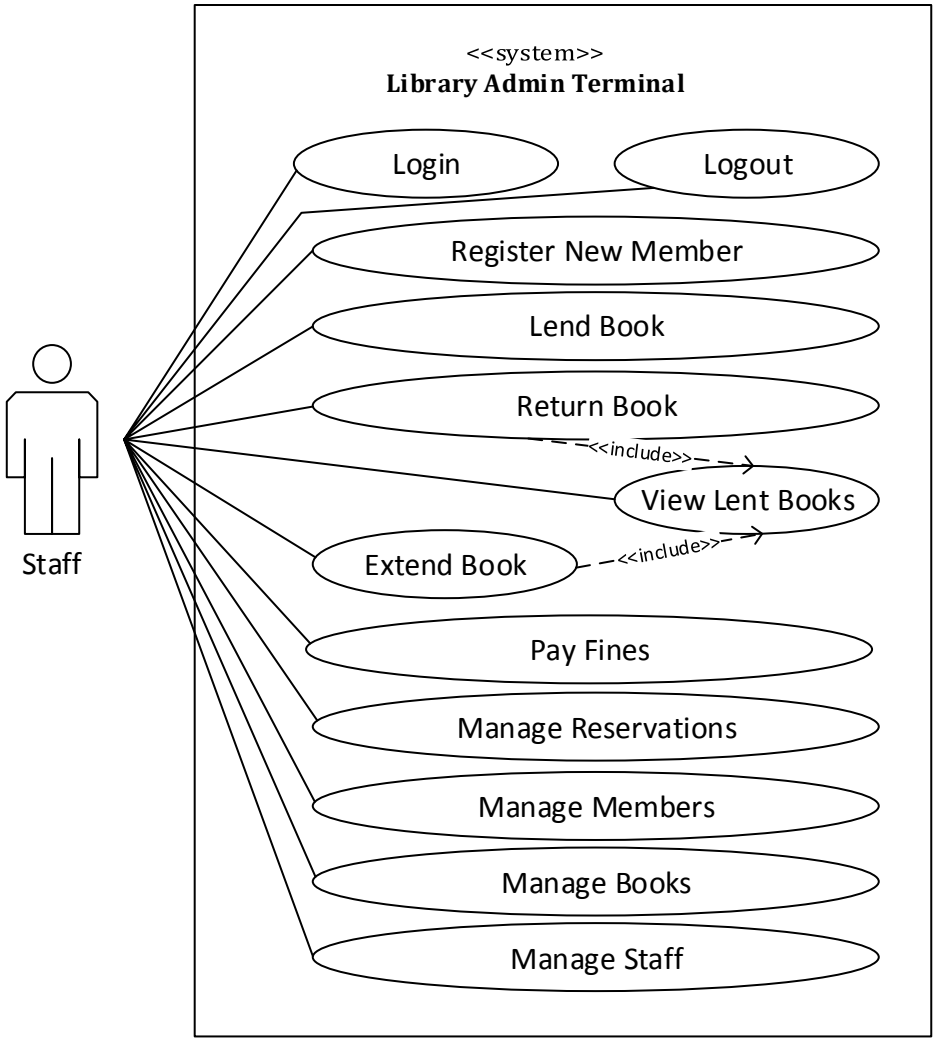

Figure 2 UML use case diagram for Library Admin Terminal

S/N	Use Case	Description/Business Rules
1	Login	• May only be performed if staff is not currently logged into the system. • Staff must be currently logged into the system to perform all other use cases.
2	Register New Member	• If a member is not registered, admin staff registers a new member record in the system. Admin staff needs to ask and enter member information: o Identity Number (NRIC or Passport) o Security Code o First Name o Last Name o Gender o Age o Phone o Address
3	Lend Book	• Admin staff lends a book to the member (given his/her member identity number.) for a 2 weeks period. • The system rejects lending if, o Member has unpaid fines o Member has already borrowed 3 books o The book is reserved by another member with higher priority
4	View Lent Books	• The system shows a list of books borrowed by the member, given his/her member identity number.
5	Return Book	• The system shows a list of books borrowed by the member, given his/her member identity number. • Admin staff updates system for the returned book. • The system will automatically generate fines if the book was overdue.
6	Extend Book	• The system shows a list of books borrowed by the member, given his/her member identity number. • Admin staff updates system for the book extension. • The system rejects extension if, o If the book is already overdue o Member has unpaid fines o The book is reserved by another member
7	Pay Fines	• The system lists unpaid fines for the member, given his/her member identity number. • Admin staff receives fine payment (cash or card) and updates the system. • Each fine should be paid in full.
8	Manage Reservations	• The system provides functionalities for admin staff to perform given the book ID. o View Reservations for Book o Delete Reservation
9	Manage Members	• The system provides functionalities for admin staff to perform: o Add Member o View Member Details o Update Member o Delete Member o View All Members
9	Manage Books	• The system provides functionalities for admin staff to perform: o Add Book o View Book Details o Update Book o Delete Book o View All Books

10	Manage Staff	• The system provides functionalities for admin staff to perform: o Add Staff o View Staff Details o Update Staff o Delete Staff o View All Staff
11	Logout	• Logout if staff is currently logged in the system.

Table 4 Use case descriptions and business rules of Library Admin Terminal

You are expected to create a simple console interface for the library staff to perform the necessary business use cases. At the bare minimum, the system shall produce the following outputs of key business use cases, but not limited to:

Login

```
*** Welcome to Library Admin Terminal ***

1: Login
2: Exit

>
```

```
*** ILS :: Login ***

Enter username> manager
Enter password> password
Login successful!
```

Main Menu

```
*** ILS :: Main ***

You are login as Linda Chua

1: Registration Operation
2: Library Operation
3: Administration Operation
4: Logout

>
```

Registration Operations

```
*** ILS :: Registration Operation ***

1: Register New Member
2: Back

>
```

```
*** ILS :: Registration Operation :: Register New Member ***

Enter Identity Number> S81859483A
Enter Security Code> 123456
Enter First Name> Harry
Enter Last Name> Tan
Enter Gender> Male
Enter Age> 37
Enter Phone> 84927473
Enter Address> 1 Upper Kent Ridge Road
Member has been registered successfully!
```

Library Operations

```
*** ILS :: Library Operation ***

1: Lend Book
2: View Lent Books
3: Return Book
4: Extend Book
5: Pay Fines
6: Manage Reservations
7: Back

>
```

```
*** ILS :: Library Operation :: Lend Book ***

Enter Member Identity Number> S81859483A
Enter Book ID: 2

Successfully lent book to member. Due Date: 2019-03-25.
```

```
*** ILS :: Library Operation :: View Lent Books ***

Enter Member Identity Number> S81859483A

Currently Lent Books:
Id |Title                   | Due Date
1  |The Lord of the Rings   | 2019-03-14
2  |Le Petit Prince         | 2019-03-25
```

```
*** ILS :: Library Operation :: Return Book ***

Enter Member Identity Number> S81859483A

Currently Lent Books:
Id |Title                   | Due Date
1  |The Lord of the Rings   | 2019-03-14
2  |Le Petit Prince         | 2019-03-25

Enter Book to Return> 1
Book successfully returned.
```

```
*** ILS :: Library Operation :: Extend Book ***

Enter Member Identity Number> S89859412R

Currently Lent Books:
Id |Title                   | Due Date
4  |The Hobbit              | 2019-03-12

Enter Book to Extend> 4
Book successfully extended. New due date: 2019-03-25
```

```
*** ILS :: Library Operation :: Pay Fines ***

Enter Member Identity Number> S85874412N

Unpaid Fines for Member:
Id |Amount
4  | $12.00
16 | $5.00

Enter Fine to Settle> 4
Select Payment Method (1: Cash, 2: Card)> 1
Fine successfully paid.
```

```
*** ILS :: Library Operation :: Manage Reservations ***
1: View Reservations for Book
2: Delete Reservation
3: Back

>
```

The outputs for manage reservations are omitted for brevity.

Administration Operations

```
*** ILS :: Administration Operation ***

1: Member Management
2: Book Management
3: Staff Management
4: Back

>
```

```
*** ILS :: Administration Operation :: Member Management ***

1: Add Member
2: View Member Details
3: Update Member
4: Delete Member
5: View All Members
6: Back
```

```
*** ILS :: Administration Operation :: Book Management ***

1: Add Book
2: View Book Details
3: Update Book
4: Delete Book
5: View All Books
6: Back
```

```
*** ILS :: Administration Operation :: Staff Management ***

1: Add Staff
2: View Staff Details
3: Update Staff
4: Delete Staff
5: View All Staff
6: Back
```

The outputs for administration operations are omitted for brevity.

SELF-SERVICE KIOSK

The UML use case diagram for the Self-Service Kiosk is shown in Figure 3. A brief description of selected business use cases together with the associated business rules are given in Table 5.

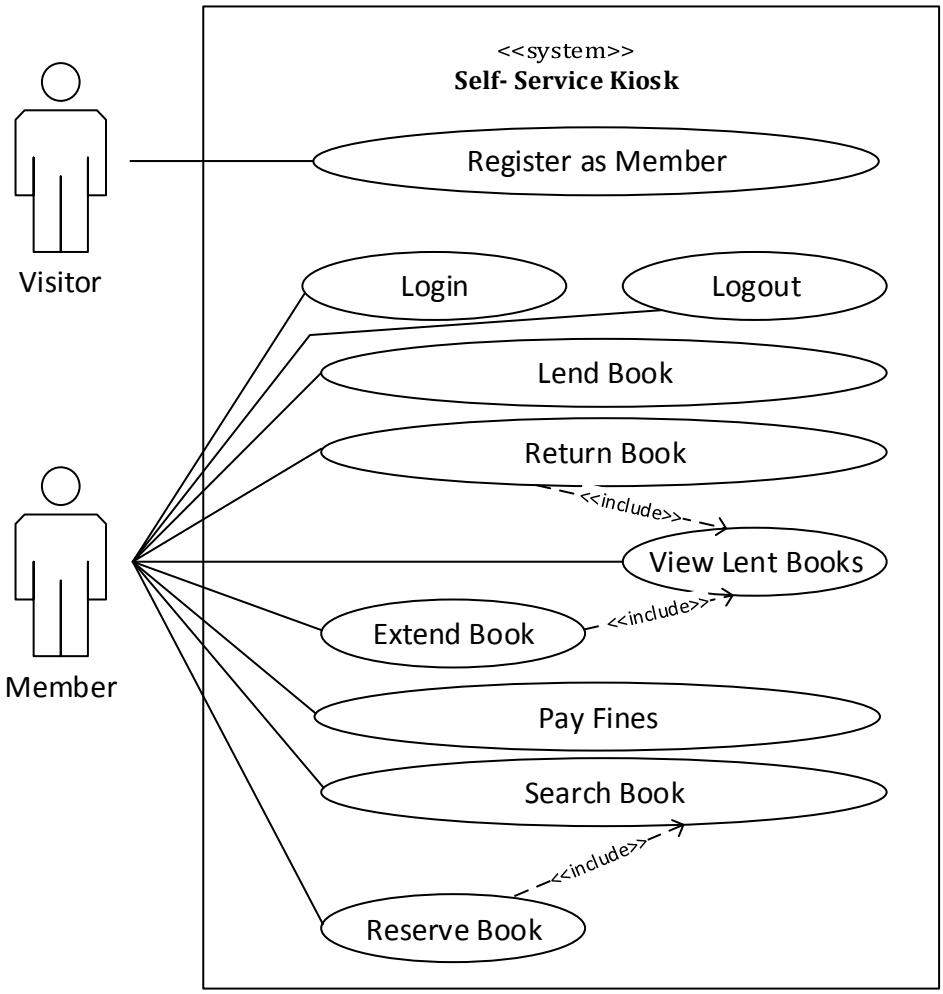

Figure 3 UML use case diagram for Self-Service Kiosk

S/N	Use Case	Description/Business Rules
1	Register	• If a member is not registered, the system will prompt for the following information: o Identity Number (NRIC or Passport) o Security Code o First Name o Last Name o Gender o Age o Phone o Address
2	Login	• If a member is registered, the member will login into the system using: o Identity Number o Security Code
3	Lend Book	• The system allows the member to borrow books • The system rejects lending if, o Member has unpaid fines o Member has already lent 3 books o The book is reserved by another member with higher priority

4	View Lent Books	• The system shows a list of books borrowed by the member, given his/her member identity number.
5	Return Book	• The system shows a list of books borrowed by the member, given his/her member identity number. • Member enters the book to be returned. • The system will automatically generate fines if the book was overdue.
6	Extend Book	• The system shows a list of books borrowed by the member, given his/her member identity number. • The member updates system for the book extension. • The system rejects extension if, o If the book is already overdue o Member has unpaid fines o The book is reserved by another member
7	Pay Fines	• The system lists unpaid fines for the member, given his/her member identity number. • Member pays fine by entering card details. • Each fine should be paid in full.
8	Search Book	• The system provides functionalities for members to search book by the title. • All books with search string having partial or full match are listed. • Details of whether the book is currently available, is on hold with reservation or if applicable a due date is shown.
9	Reserve Book	• The system provides functionalities for members to search book by the title name. Books will be listed as in above use case 8. • Member can reserve books that are already lent or on with other reservations using his/her member identity number. • Member cannot reserve books that are currently available in the library without any reservations. • Member cannot make multiple reservations on the same book. • Member cannot reserve books currently loaned by him/her. • Members with unpaid fines cannot reserve books.
10	Logout	• Logout if member is currently logged in the system.

Table 5 Use case descriptions and business rules of Self-Service Kiosk

At the bare minimum, the system shall produce the following outputs of key business use cases, but not limited to:

Main Menu

```
*** Welcome to Self-Service Kiosk ***

1: Register
2: Login
3: Exit

>
```

```
*** Self-Service Kiosk :: Register ***

Enter Identity Number> S81859483A
Enter Security Code> 123456
Enter First Name> Harry
Enter Last Name> Tan
Enter Gender> Male
Enter Age> 37
Enter Phone> 84927473
Enter Address> 1 Upper Kent Ridge Road
You have been registered successfully!
```

```
*** Self-Service Kiosk :: Login ***

Enter Identity Number> S81859483A
Enter Security Code> 123456
Login successful!
```

Member Menu

```
*** Self-Service Kiosk :: Main ***

You are login as Harry Tan

1: Borrow Book
2: View Lent Books
3: Return Book
4: Extend Book
5: Pay Fines
6: Search Book
7: Reserve Book
8: Logout

>
```

```
*** Self-Service Kiosk :: Borrow Book ***

Enter Book ID: 2

Successfully lent book. Due Date: 2019-03-25.
```

```
*** Self-Service Kiosk :: View Lent Books ***

Currently Lent Books:
Id |Title                   | Due Date
1  |The Lord of the Rings   | 2019-03-14
2  |Le Petit Prince         | 2019-03-25
```

```
*** Self-Service Kiosk :: Return Book ***

Currently Lent Books:
Id |Title                   | Due Date
1  |The Lord of the Rings   | 2019-03-14
2  |Le Petit Prince         | 2019-03-25

Enter Book to Return> 1
Book successfully returned.
```

```
*** Self-Service Kiosk :: Extend Book ***

Currently Lent Books:
Id |Title                   | Due Date
4  |The Hobbit              | 2019-03-12

Enter Book to Extend> 4
Book successfully extended. New due date: 2019-03-25
```

```
*** Self-Service Kiosk :: Pay Fines ***

Unpaid Fines for Member:
Id |Amount
16 | $5.00

Enter Fine ID to Settle> 16
Enter Name of Card> Harry Tan
Enter Card Number> 4568111122223333
Enter Card Expiry (MMYYYY)> 102022
Enter Pin> 123
Fine successfully paid.
```

```
*** Self-Service Kiosk :: Search Book ***

Enter Title to Search> Red Chamber

Search Results:
Id |Title                        | Availability
6  | Dream of the Red Chamber    | Due on 2019-03-22
```

```
*** Self-Service Kiosk :: Reserve Book ***

Enter Title to Search> Red Chamber

Search Results:
Id |Title                        | Availability
6  | Dream of the Red Chamber    | Due on 2019-03-22

Enter Book ID to Reserve: 6
Book successfully reserved.
```

BOOK DROP MACHINE CLIENT

The UML use case diagram for the Book Drop Machine (BDM) Client is shown in Figure 4 below. A brief description of selected business use cases together with the associated business rules are given in Table 6.

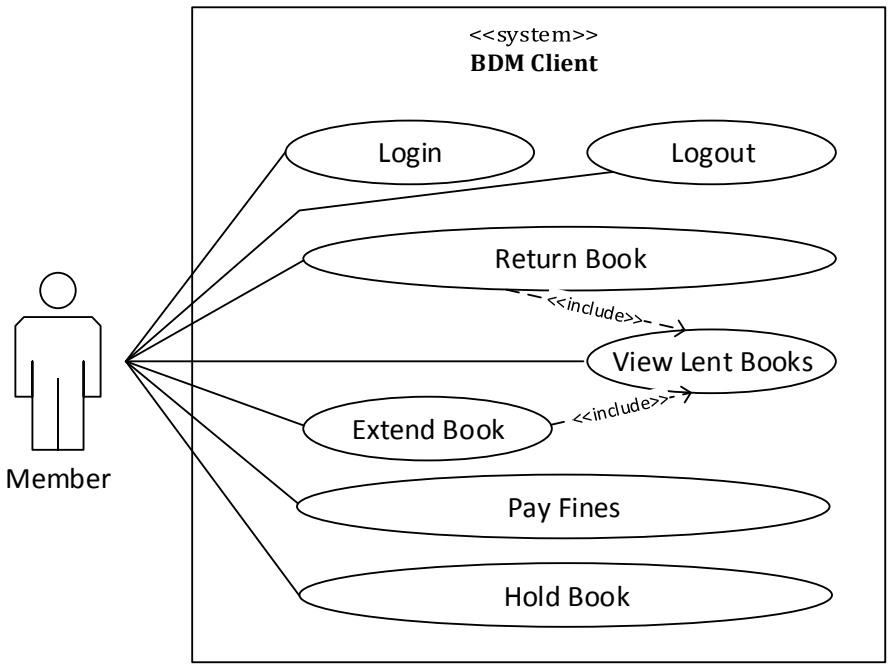

Figure 4 UML use case diagram for BDM Client

S/N	Use Case	Description/Business Rules
1	Login	• If a member is registered, the member will login into the system using: o Identity Number o Security Code
2	View Lent Books	• The system shows a list of books borrowed by the member, given his/her member identity number.
3	Return Book	• The system shows a list of books borrowed by the member, given his/her member identity number. • Member enters the book ID to be returned and drops the book into machine. • The system will automatically generate fines if the book was overdue.
4	Extend Book	• The system shows a list of books borrowed by the member, given his/her member identity number. • The member updates system for the book extension. • The system rejects extension if, o If the book is already overdue o Member has unpaid fines o The book is reserved by another member
5	Pay Fines	• The system lists unpaid fines for the member, given his/her member identity number. • Member pays fine by entering card details. • Each fine should be paid in full.
6	Reserve Book	• The system provides functionalities for members to search book by the title name. • Member can reserve books that are already lent or on with other reservations using his/her member identity number. • Member cannot reserve books that are currently available in the library without any reservations. • Member cannot make multiple reservations on the same book. • Member cannot reserve books currently loaned by him/her. • Members with unpaid fines cannot reserve books.
7	Logout	• Logout if member is currently logged in the system.

Table 6 Use case descriptions and business rules of BDM Client

At the bare minimum, the system shall produce the following outputs of key business use cases, but not limited to:

Main Menu

```
*** Welcome to BDM Client ***

1: Login
2: Exit

>
```

```
*** BDM Client :: Login ***

Enter Identity Number> S81859483A
Enter Security Code> 123456
Login successful!
```

Member Menu

```
*** BDM Client :: Main ***

You are login as Harry Tan

1: View Lent Books
2: Return Book
3: Extend Book
4: Pay Fines
5: Reserve Book
6: Logout

>
```

```
*** BDM Client :: View Lent Books ***

Currently Lent Books:
Id |Title                   | Due Date
1  |The Lord of the Rings   | 2019-03-14
2  |Le Petit Prince         | 2019-03-25
```

```
*** BDM Client :: Return Book ***

Currently Lent Books:
Id |Title                   | Due Date
1  |The Lord of the Rings   | 2019-03-14
2  |Le Petit Prince         | 2019-03-25

Enter Book to Return> 1
Please drop to machine complete return.
Book successfully returned.
```

```
*** BDM Client :: Extend Book ***

Currently Lent Books:
Id |Title                   | Due Date
4  |The Hobbit              | 2019-03-12

Enter Book to Extend> 4
Book successfully extended. New due date: 2019-03-25
```

```
*** BDM Client :: Pay Fines ***

Unpaid Fines for Member:
Id |Amount
16 | $5.00

Enter Fine ID to Settle> 16
Enter Name of Card> Harry Tan
Enter Card Number> 4568111122223333
Enter Card Expiry (MMYYYY)> 102022
Enter Pin> 123
Fine successfully paid.
```

```
*** BDM Client :: Reserve Book ***

Enter Title to Search> Red Chamber

Search Results:
Id |Title                       | Availability
6  | Dream of the Red Chamber    | Due on 2019-03-22

Enter Book ID to Reserve: 6
Book successfully reserved.
```

USER INTERFACE

For each client application, implement a suitable CLI (Command Line Interface) interface consisting of menus, prompts, cues and feedback messages (both informative and error messages). Users should be able to interact with the CLI interface with relative ease.

SYSTEM QUALITY

All client applications should demonstrate **some degree of input data validation** and all server-side business processing should demonstrate some degree of business rules validation. Error handling should be done properly using Java checked exceptions. Error handling for each use case should reflect alternative and/or exceptional course(s) of action that deviate from the basic course of action as appropriate.

The quality of the coding will be assessed via criteria such as appropriate and correct use of the JPA EntityManager API methods, EJB component types, number of remote session bean business method invocation, etc.

ASSESSMENT CRITERIA

This group project is worth 40 marks out of the overall assessment for the whole module. In general, all members in the group will get the same score if there is no negative peer review.

The assessment criteria are listed in Table 7 below:

Component	**Marks**
Architecture and Design • Appropriateness and correctness of logical data model, physical data model and physical system architecture. • Also includes the implementation of the entity classes and the forward engineering of the underlying relational database table.	5
System Functionalities – Library Admin Terminal • Implementation of use cases with respect to the logical data model as well as complexity of the use cases that are implemented as measured by the fulfilment of the business rules.	10
System Functionalities – Self-Service Kiosk • Implementation of use cases with respect to the logical data model as well as complexity of the use cases that are implemented as measured by the fulfilment of the business rules.	10
System Functionalities – BDM Client • Implementation of use cases with respect to the logical data model as well as complexity of the use cases that are implemented as measured by the fulfilment of the business rules. • Also include web services exposed on the server-side of ILS.	10
System Quality • The quality of the user interface (Command Line Interface) including cues and input data validation. • The quality of the coding including general aspects such as proper exception handling and Java EE specific aspects such as correct use of annotations and the entity manager.	5
Total	**40**

Table 7 Assessment Criteria

GENERAL ASSIGNMENT SCHEDULE

The general assignment schedule is shown in Table 8. Late submission will not be graded.

S/N	Week	Date	Activity	Remark
1	7	8 Mar	Release of group project specification	
2	12	10 Apr	Submission of Project Deliverables Submission of Project Peer Review	Upload to IVLE Workbin by 23:59hr (Grace period of 15 minutes)

Table 8 General Assignment Schedule

PROJECT SUBMISSION INSTRUCTIONS

Place all the deliverables into a **single zip archive file** with the following folder structure:

- **src folder:**
  - Place all your NetBeans project folder(s) in here.
  - You should "clean" the projects beforehand, the file size will be much smaller.
  - Test data, if any, such as the default system administrator account should be loaded using a singleton session bean decorated with the @Startup annotation. **Do not use a SQL script to load the test data.**
  - Ensure that your main enterprise application's EJB module contains a glassfish-resources.xml file and a persistence unit persistence.xml.
- **readme.txt:**
  - A text file containing the personal details of all group members, including full name, matriculation number and email addresses.

Name the zip archive file with your project group name in the format "**GPXX.zip**" where "XX" is your group number. So, if your group number is 01, then the zip file will be named "**GP01.zip**". Please check your IVLE Project Group for your correct group number. Upload the zip archive file to the IVLE Workbin folder: Assignment 2 Submission. Each group should only need to upload one zip file. Should you upload more than 1 zip files, please delete those that are not required for evaluation, otherwise, the latest uploaded zip file will be used for evaluation.

The submission deadline is **Wednesday, 10 April 2019, 23:59 hrs** (Grace period of 15 minutes). A penalty of 10 marks will be deducted for late submission after **00:15hrs on 11 April 2019**.