QUESTION 2

Design and draw a UML class diagram for the Townhall system. Include the main classes and their relationships for modelling the system. Maximum 6 classes. Only display the classes, associations and their multiplicities. (Include your answer in a PDF file).

QUESTION 3

Draw a UML sequence diagram for the online process of ordering a sandwich. (Include your answer in a PDF file).

QUESTION 4

A first step of system design is to clarify the requirements, and then break down the solution domain into subsystems. A subsystem is a collection of classes, associations, operations, events and constraints that are interrelated.

Identify a list of subsystems for the Townhall system. Keep your subsystem decomposition simple and abstract at this stage. Make a list describing a maximum of 5 subsystems.

What is the coupling between your subsystems? Is the level of coupling and cohesion in your system high or low? Explain your answer.

A. List of Subsystems

* User Management Subsystem: Handles user accounts, authentication, and authorization. This includes managing user profiles, login/logout, and security aspects such as password management.
* Library Management Subsystem: Manages all library operations, including book cataloguing, borrow management(checkouts and returns), and notifications about availability and due dates.
* Cafeteria Management Subsystem: Responsible for handling cafeteria operations, including menu management, order processing, and inventory tracking system.
* Marriage Register Subsystem: Manages the records of marriages, including registration of new marriage records, quoting and ensuring access to sensitive information.
* Financial Transactions Subsystem: Responsible for all financial aspects related to the other subsystems, including payment processing for cafeteria orders and marriage registration services.

B. Coupling and Cohesion

* The coupling between these subsystems is kept moderate to low. Although each subsystem is designed to operate independently, it interacts with other subsystems through well-defined interfaces when necessary. For example, the user management subsystem is central, which interfaces with all other subsystems to ensure authenticated and authorized access. The financial transactions Subsystem needs to interface with the cafeteria management subsystem and the marriage register subsystem to process payments, but does not need to interact directly with the library management subsystem.
* Each subsystem is tight because it includes only the classes and functions for one specific feature. For example, library management subsystems deal only with library-related tasks, like managing books from borrow to inventory, without mixing with functions such as order processing in the cafeteria.
* A low-coupling system means that a change in one part does not force a change in another part of the system. This makes the system easier to manage and scale and helps to better isolate errors. Each part of the system is also highly cohesive, meaning it focuses on a set of tasks, making it easier to maintain and improve. Low coupling and high cohesion systems are more adaptable and easier to manage.

QUESTION 5

Select one of your chosen subsystems and identify 2 contrasting designs for implementing that subsystem. Use design rationale to document the best design decision considering these 2 options. Your answer should clearly identify: Issue, Proposals (your two design ideas), Criteria, Arguments and Resolution. Also mention any unresolved questions or assumptions you identify.

## User Management Subsystem

### Issue

The main problem of the user management subsystem is to determine the most efficient way to handle user authentication and authorization, while maintaining user convenience and system efficiency while ensuring security.

### Proposals

#### Traditional Username and Password System

This approach uses the traditional username and password combination for user authentication. It requires criteria such as specific password strength requirements, regular password updates, and integration of security questions for password recovery.

Arguments:

* Pros: Familiar to most users, relatively straightforward to implement and maintain.
* Cons: More vulnerable to common security threats such as password theft and system attacks.

#### Multi-Factor Authentication (MFA) System

This approach requires users to authenticate with two or more authentication methods, adding an extra layer of protection. In addition to a username and password, it can include a code sent to the user's phone, biometric face-scan verification, or security tokens.

Arguments:

* Pros: Significantly enhances security by adding layers that are harder to breach.
* Cons: It adds complexity to the system and may reduce user convenience due to the additional steps required during the login process. And elderly people may not know how to use the function, which may also increase implementation and operating costs.

### Criteria

* Security: The ability to protect user data and prevent unauthorized access.
* User Convenience: Ease of use for the user, impacting their satisfaction and the speed of system interactions.
* System Complexity and Maintenance: The complexity of implementing and maintaining the system over time.
* Scalability: The ability to handle increased load as the number of users grows.

### Resolution

Considering these criteria and arguments, a multi-factor certification system is a better design decision. Despite its added complexity and potential impact on user convenience, these shortcomings are outweighed by improvements in security as a public system or even a government system in the town. The primary goal of the system must be to protect user data and prevent data leak. Implementing MFA also prepares the system for scalability, as a secure system is critical as the user base expands.

### Unresolved Questions

* For user: How will users, especially older people who may be less tech-savvy, adjust to the additional steps and complexities introduced by the MFA? Will they find the system too cumbersome, which could lead to lower usage or satisfaction?
* For integration: Does the existing technical framework within townhall facilitate or hinder this integration?
* For capability and cost: Are the technical resources and budget available to implement an MFA system? Can the town hall afford the initial setup and maintenance costs without compromising other services?

### Assumptions

* Technical Proficiency: The assumption is that users include seniors, have a basic level of digital literacy, or will be provided with training to help them use the MFA system.
* Resource Availability: It is assumed that City Hall has the technical and financial resources to implement and maintain an MFA system without affecting other essential services.
* System Compatibility: It is assumed that City Hall's current technical infrastructure can be integrated with the MFA system and that any necessary upgrades or modifications can be made.
* User cooperation: The assumption is that users will cooperate and be willing to adopt new security measures and recognise the benefits of the MFA's enhanced security in protecting their personal data.