Background:

Imagine you have been hired as a database designer to support the operations of an organization. The first task is to define and select the type of organization you will be working with. You may choose an organization you are familiar with, one you've encountered in real life, or one you aspire to work for after graduation (e.g., a university, a sports association, a retail business, or a manufacturing company). Based on your selection, make reasonable and realistic assumptions regarding the organization's operations, as well as its underlying entities, attributes, and relationships. Be sure to clearly state and justify these assumptions.

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Project Requirements:

Your project must satisfy the following requirements. To illustrate each requirement, we provide a simple example using a student dormitory management system. For your specific implementation, you are free to choose different scenarios and have more complex functions:

1. Analyze the organization's requirements. You must define at least *2 distinct roles* within your system and implement a minimum of *10 different functions.*

   For example, in a student dormitory management system, there could be roles such as "Student" and "Administrator."

   Student Functions**:** Students should be able to log in, submit maintenance requests, and provide feedback.

   Administrator Functions**:** Administrators should be able to manage dormitory information, update student details, and more.

2. Design the database schema. Identify the relevant entities, attributes, relationships, and any constraints. Clearly label primary keys, foreign keys. You should list the schema for each table in your report.

   For example, in the student dormitory management system, there are several data tables such as `Dormitory_Information`, `Student_Information` and so on:

   `Dormitory_Information`:

Dormitory Number	Building number	Floor number	Dormitory door number	Total number of beds	Number of vacant beds

   `Students_Information`:

Student_ID	Password	Name	Gender	Telephone number	Major	Dormitory Number

   Note: *Red indicates the primary key, and* `Dormitory Number` *is the foreign in*

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`Students_Information` *referencing the primary key in* `Dormitory_Information`.

3. Populate the Database with Realistic Data: Populate the schema with a reasonable amount of realistic data to make sure that each function works properly. You are responsible for acquiring, crawling, or generating appropriate data for your project.

   For example, in a student dormitory management system, the `Student_Information` table should contain reasonable data:

Student_ID	Password	Name	Gender	Telephone number	Major	Dormitory Number
21383	123456	Xiaoming	male	11111	Physics	M101
21384	987654	Xiaohong	female	22222	Math	F201
21385	234567	Lihua	male	33333	Chemistry	M101

4. Develop SQL Queries for the Designed Functions: Write SQL queries that implement the functions you have designed based on the table schemas. Ensure the queries align with the operations required by the system.

   For example, in a student dormitory management system, when a student attempts to log in, the system should use an SQL query to check whether the `Student_ID` and `Password` from the `Student_Information` table match the information provided by the user:

   User Input:

   ```
   Student_ID: 21383
   Password: 123456
   ```

   SQL Query:

   ```
   SELECT Student_ID
   FROM Student_Information
   WHERE Student_ID = 21383 and Password = 123456;
   ```

   Note: This is a simple query for demonstration purposes. In a real-world scenario, you can ***hash and salt passwords*** *to avoid storing them in plain text and prevent direct*

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password comparisons. Instead, the system should compare hashed values to enhance security. A more secure approach would involve:

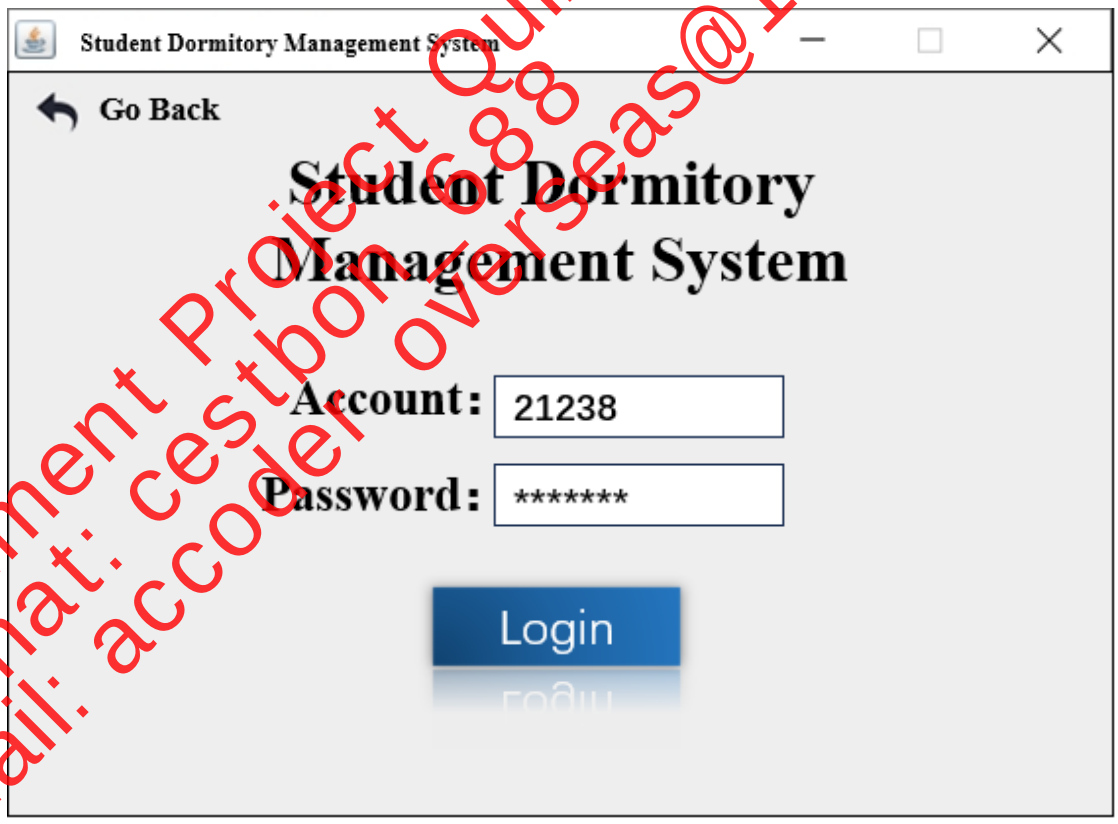
a) *Storing a hashed version of the password.*

b) *Using a hashing function (such as bcrypt, SHA-256, or Argon2) when users enter their password.*

c) *Comparing the stored hash with the hash of the input password.*

5. Reasonable front-end and back-end design: The back-end system should be designed to meet all project requirements effectively and efficiently. The front-end should offer a smooth user experience, with an intuitive and easy-to-use interface. You may choose to implement the front-end using a Command Line Interface (CLI) or develop a Web or Mobile App interface.

For example, in a student dormitory management system, a basic implementation of a student login screen might look like the following:



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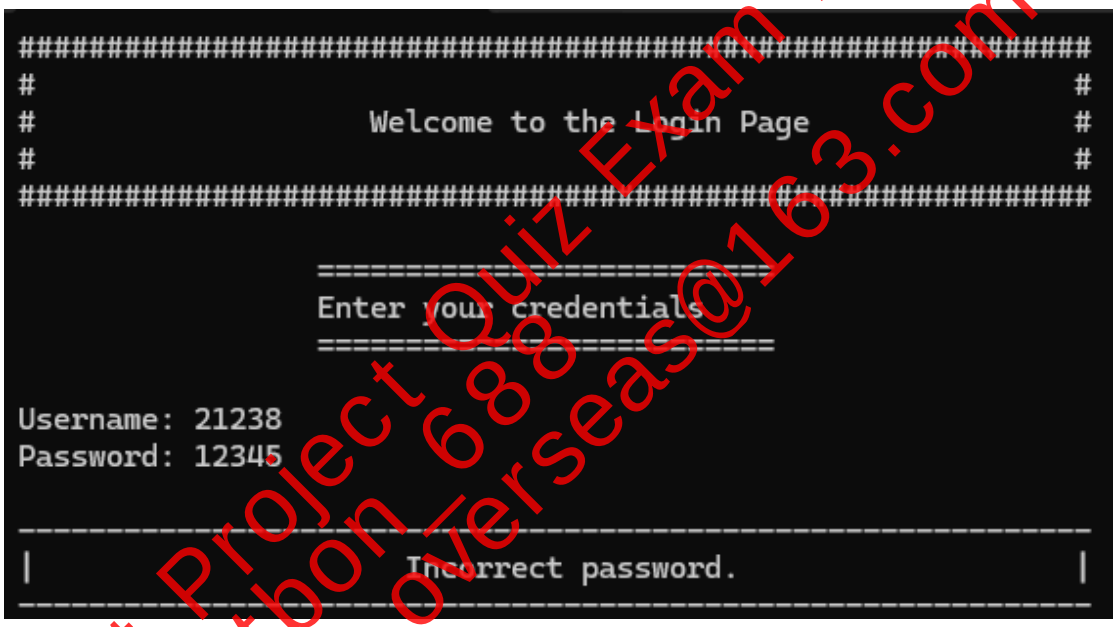
The following can be a CLI implementation of a student login screen:

```
Welcome to the Student Dormitory Management System
Please enter your Student ID:
> 21383
Please enter your password:
> ********
Login Successful. Welcome, Xiaoming!
```

Or a more elegant one:



Note: You can use CLI to implement the front-end, while the web design and APP design will have extra points, *up to 10% of the total project score*, but will **not** *exceed the maximum total project score*, that is to say, without a graphical interface, you can still get full marks, but a good graphical interface could help you to get a high score!

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Project Scenarios:

We offer you two project options below, or you may design your own project based on your area of interest. The choice of project will not affect your score, as long as you meet the listed requirements and adhere to the scoring criteria.

1. CUHK(SZ) Library Management System

With the rise of digital resources and technology-driven tools, libraries have evolved into hybrid environments that manage not only physical books but also a vast array of digital media, databases, and online resources. Traditional manual management methods can no longer keep up with the growing demands for efficiency, accessibility, and data-driven decision-making.

A modern Library Management System (LMS) integrates both physical and digital resources, offering advantages such as:

Seamless Search and Access: Users can search across physical collections, digital archives, and online databases simultaneously.

Data Analytics: Library administrators can gain insights from usage data, helping them manage inventory better, track popular resources, and optimize budgets.

...

Hint: Roles you may consider in this project include librarians, patrons (students or general readers), and IT administrators. Functions could include book borrowing and returning, inventory tracking, catalog updates, analytics reports, and more. You may simplify some scenarios as needed, as long as you include at least 2 roles and 10 functions in your system.

2. CUHK (SZ) food ordering system

The food service industry is rapidly evolving due to technological advancements. Traditional methods of ordering food are being replaced by modernized, online ordering systems. This shift not only offers convenience to customers but also provides restaurant operators with a more efficient service and management model.

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Online food ordering systems connect customers and restaurants via the internet, allowing users to browse menus, place orders, and pay from anywhere using web or mobile applications.

Hint: Roles to consider for this project include customers, delivery personnel, restaurants, and other relevant participants. You may simplify some scenarios as needed, as long as you include at least 2 roles and 10 functions in your system.

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Project Scoring Rules:

1. Requirements analysis (10%)

- Whether the project's functions are fully described and understood.
- Whether the project objectives, user groups (roles), and their corresponding needs (functions) are clearly defined.
- Ensure the system includes **at least 2 roles** and **at least 10 functions** (combined across different roles).

2. Design Accuracy (10%)

- Whether the database design accurately reflects the roles and functions defined in the requirements analysis.
- Whether best practices in database design are followed, such as proper indexing, appropriate data type selection, and the use of foreign keys.

3. Reasonable Data Population and Query Implementation (10%)

- Whether sufficient data has been populated to cover all defined entities and relationships.
- Whether the data diversity supports testing of various queries (i.e., testing different system functions).
- Whether the SQL queries are well-designed to ensure the correct and efficient execution of the system's functions.

4. Reasonable front-end and back-end design, program usability (35%)

- Whether the back-end API design is clear and whether it adequately supports the functional requirements of the front-end.
- Whether the front-end provides an intuitive and user-friendly experience.
- Even if you use a Command Line Interface (CLI), ensure the program is easy to use and provides a good user experience.

5. Report and demo video (35%)

- The report should include a comprehensive requirement analysis, schema design, implementation details, and instructions on how to use the system.
- The demo video should clearly demonstrate the main functions of the

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system, with smooth transitions between features. The presenter should be familiar with the project and guide viewers through the key functions effectively.

6. Additional Bonus Points (up to 10%)

- You can earn up to an additional 10% bonus if you implement a web or mobile app front-end interface. Points will be awarded based on the aesthetics, functions, and usability of the design.
- Note: Bonus points will not exceed the overall maximum score of 100%.

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Documentation Requirements:

The report should contain the following sections.

1). the overall project description

2). the requirements analysis

3). the database and SQL design

4). front and back-end design and implementation

5). How to use the system

The implementation details should contain a table describing which requirement is implemented by which function/procedure in your code.

For example,

In the above student dormitory management system, to realize the student login behavior, the front-end needs to call the user login function to encapsulate the user input, the back-end needs to listen to the data and select the corresponding operation according to the unpacking result, and call the user login function to determine whether the user input matches the database content. The table is shown below:

Requirements	The function that implements it	Function Introduction
Student Login	StudentsLogin (Frontend)	Read user input data, encapsulate and pass to backend
	OperationDetection (Backend)	Accepting packets sent from the front-end, unpacking and analyzing the operations to be implemented
	StudentsLogin	Query the database according to the information in the

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	(Backend)	packet and determine whether the user input matches the database content.
Feedback	……	…..
……	…….	……

Demo Requirements:

1). Demonstrate that each function works properly.

2). Show that each table contain a reasonable amount of data.

3). Ensure that the demo is well organized and easy to follow, and is controlled to be within **5 minutes in length**.

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