### **Declaration of Original Work for CE/CZ2002 Assignment**

We hereby declare that the attached group assignment has been researched, undertaken, completed, and submitted as a collective effort by the group members listed below.

We have honored the principles of academic integrity and have upheld Student Code of Academic Conduct in the completion of this work.

We understand that if plagiarism is found in the assignment, then lower marks or no marks will be awarded for the assessed work. In addition, disciplinary actions may be taken.

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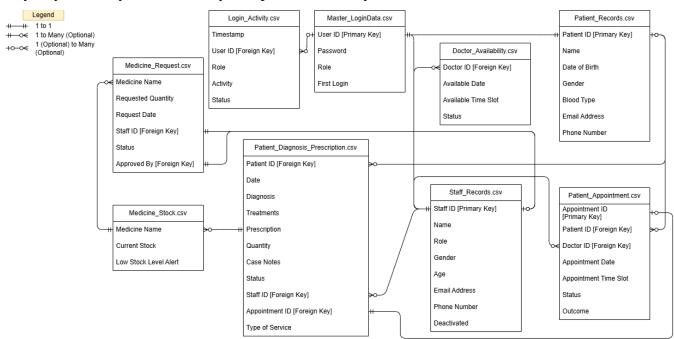
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## 1. Design Considerations

## 1.1. Approach Taken

### 1.1.1. <u>Database Design and Relationship Mapping</u>

A relational database is used to store information about users (Patients, Doctors, Pharmacists, Administrators), appointments, medical records, prescriptions, and medicine stock. Entities are represented as tables, and relationships (such as appointments between patients and doctors) are mapped using AppointmentID as the Primary Key for the system to identify the specific data entry.



#### 1.1.2. 4 Stages of Computational Thinking

- **Decomposition:** Break down the use cases into its individual functions (e.g. Required functions for Patient Schedule Appointment retrieve doctor availability, view available appointments, book appointment)
- Pattern Recognition: Identify repeated functions across all use cases (e.g. log in, view appointments)
- **Abstraction**: Simplified functions that are overlapping with each other (e.g. doctors can view appointment without another scheduling function)
- **Algorithm:** Design algorithms to handle the task efficiently (e.g. appointment scheduling algorithm to check the doctor's availability to ensure that there is no overlap in booking and confirming that the appointment fits within the time slots given.)

#### 1.1.3. Unit Testing

We implemented the project in phases and ensured each section is fully working before proceeding:

- 1) User Authentication: Ensure all 4 user types can log in with the correct roles
- 2) **Diagnosis & Treatment Entry:** Ensure doctors can enter diagnosis and treatments with and without an active appointmentID

- 3) **Prescription Management:** Verify that prescriptions are assigned correctly and Pharmacist can mark it as "Dispensed" in the system
- 4) **Medicine Stock Management:** Test that medicine stock is immediately updated after approval by Administrator and ensure stock is decremented after dispensing medication to Patient
- 5) **Appointment Scheduling:** Ensure available appointments are based on Doctor's availability and ensure Doctors cannot be double-booked on the same timeslot

## 1.2. Assumptions

- a) No csv files are opened while the HMS is up and running (E.g. Patient\_Records.csv)
- b) There is at least one Patient, Doctor, Pharmacist and Administrator in the HMS at all times
- c) Each Patient's appointment with a Doctor is 1 hour long (E.g. 0900 to 1000 hrs.)
- d) Each Patient will only book maximum 1 appointment per day with each Doctor
- e) Doctors do not take last-minute MC or leave
- f) Patients receive prescription on same day of appointment
- g) Low medicine stock is approved on same day of request
- h) Any Doctor removed by Administrator do not have any upcoming appointments with any Patient

## 1.3. Design Principles Applied

### 1.3.1. 4 Main Concepts of Object-Oriented Programming

- **Abstraction:** The system hides complex internal logic, presenting only essential features (e.g., doctors can see appointments, but not the internal working of scheduling).
- Encapsulation and Information Hiding: Critical data such as user credentials (passwords) are protected within the user class, and are not directly accessible from other objects.
- Inheritance: A generic User class is created, and specialized classes such as Doctor, Patient, and Administrator inherit from this class, reducing code duplication.
- **Polymorphism:** Methods like ViewAppointments() are implemented in the base User class but behave differently for doctors and patients, providing specialized views.

#### 1.3.2. SOLID Design Principles

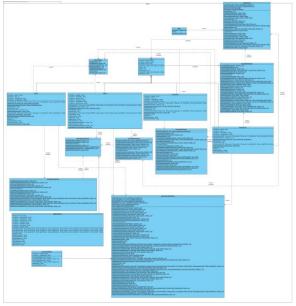
- **Single Responsibility Principle (SRP):** Each class (e.g., Doctor, Appointment, Prescription) has a well-defined responsibility.
- Open/Closed Principle (OCP): The system is open for extension (e.g., adding new roles like Nurse), but closed for modification (core functionality remains untouched).
  - New medication can be directly added into Medicine\_Stock.csv with the Warning Threshold set for each specific medicine

- **Liskov Substitution Principle (LSP):** Derived classes like Doctor and Patient can replace the base User class without breaking the system.
- Interface Segregation Principle (ISP): Interfaces are designed to be minimal, ensuring that classes only implement what they need (e.g., the Doctor class focuses on appointment and prescription-related interfaces).
- **Dependency Inversion Principle (DIP):** High-level modules, like the Administrator class, do not depend on low-level modules like StockManagement directly but through abstractions.

## 2. <u>Unified Modeling Language</u>

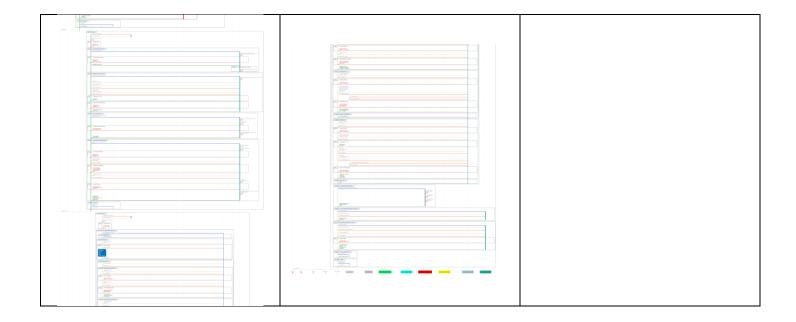
### 2.1. UML Class Diagram

Due to the large scale of the UML Class Diagram, kindly view it through this hyperlink: [GitHub]



## 2.2. UML Sequence Diagram

Due to the large scale of the UML Sequence Diagram, kindly view it through these hyperlinks: [GitHub] [Patient] [Doctor] [Pharmacist] [Administrator]

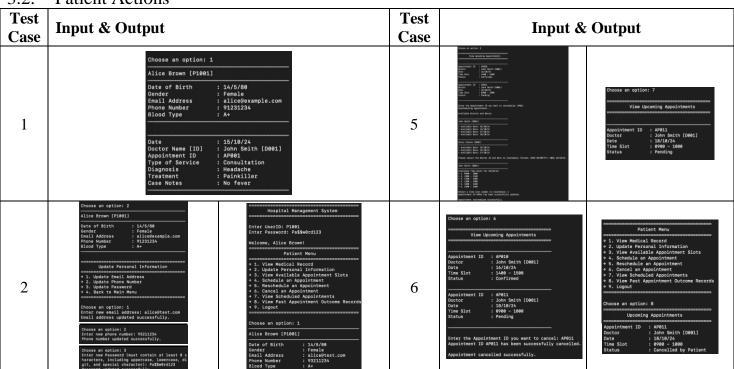


# 3. <u>Testing Results</u>

## 3.1. Main Menu

Patient Menu	<b>Doctor Menu</b>	Pharmacist Menu	Administrator Menu
Welcome, Alice Brown!  Patient Menu  1. View Medical Record 2. Update Personal Information 3. View Available Appointment Slots 4. Schedule an Appointment 5. Reschedule an Appointment 6. Cancel an Appointment 7. View Scheduled Appointments 8. View Past Appointment Outcome Records 9. Logout	Welcome, Dr. John Smith!  Doctor Menu  1. View Patient Medical Records 2. Update Patient Medical Records 3. View Personal Schedule 4. Set Availability for Appointments 5. Accept or Decline Appointment Requests 6. View Upcoming Appointment 7. Record Appointment Outcome 9. Logout	Welcome, Mark Lee!  [1] WARNING: Low Stock Medications: [1] Melatonin is currently running low, please refill  ***Pharmacist Menu  ***Pharmacist Menu  ***1. View Appointment Outcome Record  ***2. View Redication Inventory  **4. Submit Replenishment Request  **5. Logout	Welcome, Sarah Lee! [1] MARNING: Low Stock Medications: [1] Melatomin is currently running low, please refill:  Administrator Manu  *1. Yiew and Manage Hospital Staff *2. Yiew Appointments details *3. Yiew and Manage Medication Inventory *4. Approve Replanishment Requests *5. Yiew Login Logs File *6. Logout

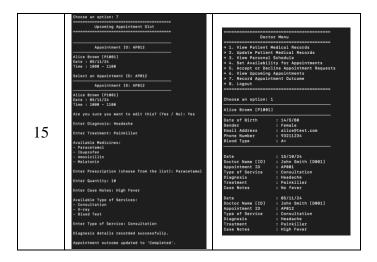
# 3.2. Patient Actions



3	Choose an Option 3  View Available Appointment Sints  John Seith (1982)  - Available Date: 15/12/24  - Available D	7	Choose an option: 7  View Upcoming Appointments
4	Patient Menu  1. View Medical Record  1. View Medical Record  2. View Available Appointment Slots  4. Schedule an Appointment  5. Reschedule an Appointment  6. Gancel an Appointment  7. View Scheduled Appointment  7. View Scheduled Appointment  8. View Part Notice  8. View Part Notice  7. View Scheduled Appointment  7. View Scheduled Appointment  7. View Scheduled Appointment  7. View Appointment Outcome Records  8. View Part Notice  7. View Scheduled Appointment  7. View Upcoming Appointment  8. View Part Notice  7. View Upcoming Appointment  7. View Upcoming Appointment  8. View Part Notice  8. View Part Notice  7. View Upcoming Appointments  7. View Upcoming Appointments  8. View Part Notice  8. View Part Notice  9. View Upcoming Appointments  7. View Upcoming Appointments  9. View Upcoming Appointments  9. View Upcoming Appointments  1. View Upcoming A	8	Choose an option: 8

# 3.3. Doctor Actions

Test		Togt	
	Input & Output	Test	Input & Output
Case 9	Choose an option: 1  Alice Brown [P1001]  Date of Birth : 14/5/80 Gender : Female Email Address : alice@test.com Phone Number : 93211234  Date   15/18/24 Doctor Name [ID] : John Smith [D001] Appointment ID : Ap081 Type of Service : Consultation Dlagnosis : Headache Treatment : Painkiller Case Notes : No fever  Charlie White [P1003]  Date of Birth : 8/7/90 Gender : Male Email Address : charlie.white@example.com Phone Number : 99242467 Blood Type : O-  Date : 15/18/24 Doctor Name [ID] : John Smith [D001] Appointment ID : AP003 Type of Service : X-ray Dlagnosis : Lung Infection Treatment : Antibiotics Case Notes : To monitor	Case 10	The state of the s
11	Choose an option: 3	12	Doctor Mem  * 1. View Patient Medical Records  * 2. Life Patient Medical Records  * 3. Life Patient Medical Records  * 4. Life Patient Medical Records  * 5. Life Patient Medical Records  * 5. Life Patient Medical Records  * 6. Life Medical Records  * 7. Life Patient Medical Records  * 8. Life Patient Medical Records  * 9. Life Patient Medical Records  * 1. Life Patient Medical Records  * 2. Life Patient Medical Records  * 3. Life Patient Medical Records  * 4. Life Medical Records  * 5. Life Patient Medical Records  * 6. Life Medical Records  * 7. Medical Rec
13	Choose an option: 5  Pending Appointment Slots  Patient ID : P1001  Appointment ID : AP012  Date : 86/11/24  Time Slot : 1000 - 1100  Select Appointment ID to approve/decline: AP012  Do you sent to approve this spoolntment? (y/n): Appointment confirmed successfully.  Alies Removed  Alies Re	14	Choose an option: 6  Upcoming Appointment Slot  Appointment ID: AP812  Alice Brown [P1001] Date : 65/11/24 Time : 1000 - 1100



# 3.4. Pharmacist Actions

Test Case	Input & Output	Test Case	Input & Output
16	Choose an option: 1  Completed Appointments  Appointment ID : APMEL  Patient : Alice Brown (F12MEL)  Date : 347,187(-10MEL)  Type of Service : Consultation  Diagnosis : Headsche  Trestownt : Pain-Aliler  Presidint (I) : Blooprefen  Case Notes : No Fever  Status : Diapnosed	17	Comment on polation 2  Penning Prescriptions  Penning Prescriptions  1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
18	Choose an option: 3  [!] WARNING: Low Stock Medications: [!] Melatonin is currently running low, please refill!	19	Choose an option: 4  [[] MARING: Los Stock Medications: [[] Melatomin is currently running low, please refill!  Medicine Stock  Medicine Current Stock  Persectamol 90 Inuprofen 56 Amoxicillin 75 Melatomin 30  Avsilable Medicines: - Paracetamol - Duppofen - Amoxicillin - Helatomin Enter the Medicine Name: Melatomin Enter the Medicine Name: Melatomin Enter the Quantity to request: 200 Replanishment request for Melatomin has been recorded successfully.

# 3.5. Administrator Actions

Test Case	Input	Output
20	Cheese an upstion 1  Minorge monitor litter  a V. Vere monitor litter  a Vere monitor litter  cheese vere monitor  cheese vere vere vere vere vere vere vere	

	Manage Mospital Staff  # 1. View Mospital Staff  # 3. Update Mospital Staff  # 3. Update Mospital Staff  # 4. Delate Mospital Staff  # 5. Return to Main Menu  Choose an option: 2  Add New Mospital Staff  Full Nume: Jounn Choon Rule (Aministrator, Phanameist, Doctor): Administrator Gender Male/Female): Male  # 78: 23  # 20		Enter UserID: AMOZ  Enter Passencri passon  Inter Description AMOZ  Enter Passencri passon  Inter am Passencri passon  Enter mae Passencri Enter Contain at Jeant & c  Enter mae Passencri Contain supercase, a  git, and special Chracter: Passence  Pass SHIR to continue  Welcome, Jorah Choon!  [1] MacDinolis Is currently running low, pleas  c refill:  Administrator Menu  * 1. Use and Manage Negotial Staff  2. User Acquire Manage Negotial Townstory  4. Approve Repolarisment Requests  5. User Legin Logs File  6. Lingoid  Choose an option:     Administrator  Sarah Les (AMOS)  Gendor: Formula  Age: 48  Besti: sarahencample.com  Contact: Filialia  Journal Choon (AMOZ)  Gendor: Wale  Manage Acquired  Immedia Management System  income, passen  1 Management Stafferciam  1 Management System  **Choose an option:     Mospital Management System  **Choose an option:     Mospital Management System  **Choose an option:     **Mospital Management System  **Choose an option:     **Mospital Management System  **Mospital Manage
	Enter your administrator ID for confirmation: A001 Enter your administrator password for confirmation: Pa\$\$#0rd Staff ID A002 has been deactivated successfully.		Enter UserID: A002 Enter Password: Password:23 Account is deactivated. Please contact the administrator.
Test Case	Input & Output	Test Case	Input & Output
21	Choose on option: 2  Wooding Appointments Appointment ID : A Appoint Process of the Control of t	22	Obcose an option: 3  [1] MANNING: com Stock Modications:   [1] Manning: com Stock  Modication Stock  Modication Stock  Modication  Persontamel 98  Industrial 98  Industrial 98  Modication 38  Paracetamel 98  Modication 98  Mod
	Type of Service : Consultation		Approved By : -

3.6. Login System and Password Management

Test Case	Input & Output	Test Case	Input & Output
25	The control of the co	26	Enter UserID: P1001 Enter Password: asd Login failed. Invalid UserID or Password.

# 3.7. Additional Functions

S/N	Function
1	<ul> <li>Regex on Update Personal Information</li> <li>Updated email address must be in the following format "XXX@XXX.XXX"</li> <li>Updated phone number must have 8 digits and must start with "8" or "9"</li> <li>Ability to update password, new password must fulfil the following password policy of: <ul> <li>1 Uppercase letter</li> <li>1 Lowercase letter</li> <li>1 Digit</li> <li>1 Special character</li> <li>At least 8 characters long</li> </ul> </li> </ul>
2	<ul> <li>Regex on Update Patient Medical Records</li> <li>In the update of diagnosis and treatment plan, no digit input is allowed</li> <li>Type of Service must be chosen from the list</li> </ul>
3	Error Handling in Submit Replenishment Request  • Implemented Error Handling, User can only input positive integer
4	<ul> <li>Extra Security Step in View and Manage Hospital Staff</li> <li>When deleting a hospital staff, Administrator must enter ID and Password again for confirmation to avoid accidental deletion</li> </ul>
5	<ul> <li>Warning System in View and Manage Medication Inventory</li> <li>Implemented a warning when medicine stock is low.</li> <li>The warning value is saved directly in "column C" of Medicine_Stock.csv (E.g. Melatonin alert value is 30)</li> </ul>
6	<ul> <li>Logging System in View and Manage Medication Inventory</li> <li>Implemented logging to keep track of Request Date, Medicine, Quantity, Staff ID (Requestor &amp; Approver) and Status</li> </ul>
7	Login User Password Storing  • For security, passwords are not stored in plain-text, they are hashed with MD5 in Master_LoginData.csv
8	Regex on New Password Login  New password must fulfil the following password policy of:  1 Uppercase letter  1 Lowercase letter  1 Digit  1 Special character  At least 8 characters long
9	Administrator View Login Logs  • Allow Administrator to review successful and failed user login attempts on HMS  • Types of Status  • Success  • Failure (User Not Found)  • Failure (Incorrect Password)  • Failure (Account Deactivated)

# 3.8. Additional Function Test Case

Test Case	Input & Output	Test Case	Input & Output
1	Manus de certiero de l'accidente de	2	Enter Appointment ID to update: AP805  1. Update Type of Service 2. Update Diagnosis 3. Update Treatment 4. Update Case Notes  Choose an option: 1 Available Type of Services: - Consultation - X-ray - Blood Test Enter Type of Service: a Invalid Type of Service: a Invalid Type of Service. Please choose from the available options.  Choose an option: 2 Enter new Diagnosis: 1 Invalid input for Diagnosis. Only letters and spaces are allowed.  Choose an option: 3 Enter new Treatment: 1 Invalid input for Treatment. Only letters and spaces are allowed.
3	Choose an option: 4 No medications are running low at the moment.	4	Enter the Staff ID to deactivate: A002 Are you sure you want to deactivate Staff ID A002? (Y/N): Y Enter your administrator ID for confirmation: a Enter your administrator password for confirmation: a Login failed. Invalid UserID or Password. Incorrect password. Deactivation aborted.
5	[!] WARNING: Low Stock Medications: [!] Melatonin is currently running low, please refill!  Administrator Menu	6	Onces on section: 3 to medications are maintag low at the moment.  Medicine Stock  Nection Stock  Nection Stock  Nection Stock  Parastanni ne Stock  Parastanni ne Stock  Americalili 79 Malatonin 128  Parastanni  Necest Date 12/2/A  Necest Date 12
7	Dec.	8	Integrital Management System  Sinter UserID: PIANS State Seasoner: password This is your first login. You are required to change your password. There are Messword into contain at least 8 characters, including uppercase, lowercase, digit, and special character): and The real Password innet contain at least 8 characters, including uppercase, lowercase, digit, and special character):    There new Password innet contain at least 8 characters, including uppercase, lowercase, digit, and special character):
9	Administrator None  1. Vise and Recage Receptal Starff 2. Vise and Recage Recale Starff 2. Vise and Recage Recage Starff 2. Vise and Recage Recage Starff 2. Vise and Recage Recage Starff 2. Vise and Recage S		

## 4. Reflection

### **Database Design**

Since only the basic database structure was provided, we had to brainstorm on how to expand the existing database for our HMS implementation. The database had to effectively store the information in a clear and organized manner so that we can avoid re-designing the database during the code implementation phase. Hence, we drew the UML and ER diagram to help visualize the class, attributes, methods and relationships for all use cases.

#### **UML Diagram**

Multiple classes were used, creating a complex system of dependencies. Scrutiny of each class was required to accurately establish their relationships with one another. With more relationships learnt in the 2<sup>nd</sup> half of the course (dependency, association, etc.), it provides the UML class diagram with a clearer and more comprehensive picture of how each class plays a role in the outcome of the design. Abstraction, encapsulation, polymorphism and inheritance, critical concepts of object-oriented design and programming are evident through the display of the UML class diagram in a visual, easy to understand diagram.

For the UML sequence diagram, it was challenging to ensure that every function that each role was able to perform was covered, complete with every error handling functions.

#### **Code Implementation**

Although the tutorial and lab examples have sufficiently prepared us for this project, we have not implemented on a system of this scale before. Instead of looking the project as one big system, we applied the 4 stages of computational thinking to break up the project into smaller individual deliverables

## 5. GitHub Repository Link

https://github.com/JonahChoon/SC2002-OOP-Assignment