NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

AY 2024/25 SEMESTER 1

SC2002 OBJECT ORIENTED DESIGN & PROGRAMMING

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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Hospital Management System (HMS)

1. Design Considerations

1.1 Design Approach

The Hospital Management System (HMS) is a Java Console Application designed with a focus on reducing complexity, advanced reporting or analytics, and maintainability, ensuring each class has minimal dependency on other system parts and is assigned a specific, well-defined task. To achieve this, the system is structured into several distinct packages, each addressing a specific domain.

1.2 Assumptions

1. The system assumes a single-user environment, meaning no two users will interact with the system simultaneously.
2. Doctors will predefine their availability, and patients can only book from available slots.
3. Patients can only book 1 slot from a specific day.

1.3. Design Principles

1.3.1 SOLID design principles

Single Responsibility Principle (SRP)

The Single Responsibility Principle (SRP) states that there should never be more than ONE reason for a class to change. To adhere to SRP, we structured the system into distinct classes, each dedicated to handling specific functionalities targeted at system requirements.

In our system, the `Appointment.java` class also focuses solely on managing operations related to appointments, such as scheduling and retrieving appointment details. It encapsulates appointment-specific data like the date, time, and doctor-patient associations, ensuring that responsibilities do not overlap with other system functionalities. Similarly, the `Inventory.java` class is dedicated to managing the hospital's medication inventory, handling operations such as tracking stock level and updating inventory. Each of these classes is

focused on a single aspect of the user's interaction with the system, ensuring the clarity of responsibility of each class and minimising the risk of unwanted coupling between different functionalities.

Open/Closed Principle (OCP)

Open/Closed Principle (OCP) states that a module should be open for extension but closed for modification, where new functionality is allowed to be added without the existing source code being modified. We made use of inheritance concepts in order to fulfil this principle in our system design.

For instance, the User class is designed to provide common methods like `changePassword` which can be applied to all user types. This class is open to extension through subclasses (e.g., Admin, Patient) such as `showMenu()` to incorporate role-specific behaviours without altering the original code via the use of abstraction. It also enables extensibility by allowing the creation of additional subclasses without altering existing code, for instance a new Nurse subclass. This design displays OCP, ensuring the User class remains reusable and unmodified as the system evolves, supporting extensibility and maintainability.

Liskov Substitution Principle (LSP)

The Liskov Substitution Principle (LSP) asserts that subclasses must maintain the expected behaviour of their superclass, ensuring that the application continues to function correctly when instances of the superclass are substituted with instances of its subclasses.

The `UserController` and other role-specific controllers leverage on polymorphism by ensuring that all controllers extend a common abstract base class or implement a shared interface. This design allows the system to use a generalised reference to interact with various controllers while maintaining their specific functionalities. For instance, the `UserController` may provide general user operations, while specialised controllers like `PatientController` override or extend these methods to implement role-specific actions, such as scheduling appointments or managing prescriptions.

Interface Segregation Principle (ISP)

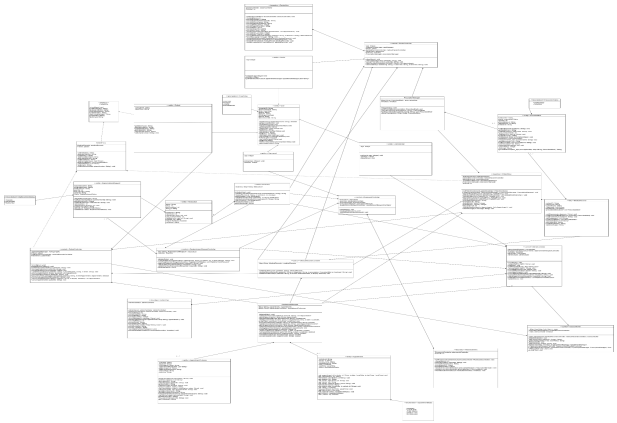
ISP states that "Many client specific interfaces are better than one general purpose interface", and that classes should not depend on interfaces that they do not use. The `IPatientInfo` interface focuses solely on the retrieval of patient-specific data, ensuring that implementing classes are not forced to define irrelevant methods. It offers a concise set of methods such as `getBloodType, getDateOfBirth, getPatientName` that are directly relevant to patient information, separating patient-specific behaviours into its own interface, thus promoting modularity, maintainability, and clarity.

Dependency Inversion Principle (DIP)

Meanwhile, DIP states that high level modules should not depend on low level modules, and instead both should depend on abstractions. Meanwhile, abstractions should also not depend on details.

2. UML Class Diagram

2.1 Overview: (Note: The diagram is attached in a separate should the image be too unclear)



2.2 Creation of Classes in UML Diagram:

The Patient class represents an individual receiving care and includes attributes like patientID, name, dateOfBirth, gender, contactDetails, and medicalHistory. It stores personal and medical details and provides methods such as `viewMedicalRecords()` to access history,

`updateContactInformation()` to modify personal details, and appointment management methods like `scheduleAppointment()` and `cancelAppointment()`.

The Appointment class manages scheduling between doctors and patients, with attributes like appointmentID, date, time, patientID, doctorID, and status to track details. Methods such as `createAppointment()`, `cancelAppointment()`, and `rescheduleAppointment()` handle appointment operations.

The Pharmacist class manages medication inventory and dispensing, with attributes like pharmacistID, name, and contactDetails. Methods include `dispenseMedicine()` for providing medicines, `checkMedicineStock()` for verifying availability, and `updateMedicineInventory()` for adjusting stock levels.

2.3 Types of Relations Used in UML Diagram:

Association: As stated below, the UML diagram involves a lot of compositional relations, which are by definition unidirectional association classes.

Inheritance: All the User classes, that being Pharmacist, Doctor, Administrator and Patient all inherit several common attributes and methods from the User Superclass, such as name, HospitalID, password, functions that check and change the password, etc.

Realisation: The PatientProxy class and the Patient class both realise the interface IPatientinfo, for both classes, share the same abstract functions involving the display of the Patient's non-medical information.

Composition: The vast majority of the class relations in our UML diagram will be compositions, with all of the entity classes being an integral part (created with the class and destroyed with the class, not created independently elsewhere) of either other entity classes or in one of the control or boundary classes. The control and boundary classes are all of a bi-directional composition relation with each other that is of the same type (Patientview with Patientocontroller and so forth for the other types of users), for the construction and functionality of one requires the construction of the other.

Dependency: PatientProxy is used by the Patient control and boundary classes as a means to temporarily store and display Patient information.

3. Test Case Demonstration

PATIENT ACTIONS

TEST CASE	RESULT

1: View Medical Record	`--- 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`
	`Select an option (1-9): 1`
	
	`Patient ID : PT001`
	`Patient Name: Ryan Tan`
	`Date of Birth: 08/09/1999`
	`Gender: Male`
	`Email Address: ryan.tan@example.com`
	`Phone Number: 91234567`
	`Blood Type: A+`
	`No past prescriptions available.`
	`Past Diagnoses:`
	`- Diabetes`
	`Treatments:`
	`- Insulin Treatment`

2: Update Personal Information	`--- Update Personal Information ---`
	`1. Update Phone Number`
	`2. Update Email`
	`3. Return to Main Menu`
	`Select an option (1-3): 1`
	`Enter new Phone Number (blank if no edits): 99999999`
	`Patient information updated successfully for ID: PT001`
	
	`--- Update Personal Information ---`
	`1. Update Phone Number`
	`2. Update Email`
	`3. Return to Main Menu`
	`Select an option (1-3): 2`
	`Enter new Email (blank if no edits): ryan123@gmail.com`
	`Patient information updated successfully for ID: PT001`
	
	Newly updated record:
	
	`Patient ID : PT001`
	`Patient Name: Ryan`
	`Date of Birth: 8/9/1999`
	`Gender: Male`
	`Email Address: ryan123@gmail.com`
	`Phone Number: 99999999`
	`Blood Type: A+`
	`No past prescriptions available.`
	`Past Diagnoses:`
	`- Diabetes`
	`Treatments:`
	`- Insulin Treatment`

3: View Available Appointment Slots	`--- View Available Slots ---`
	`Index: 1`
	`Appointment ID: D001-2024-10-19-12:30`
	`Doctor ID: D001`
	`Doctor Name: John Tan`
	`Date: 2024-10-19`
	`Time: 12:30`
	`----------`
	`Index: 2`
	`Appointment ID: D003-2024-10-23-16:00`
	`Doctor ID: D003`
	`Doctor Name: Yi Sheng`
	`Date: 2024-10-23`
	`Time: 16:00`
	`----------`

4: Schedule an Appointment
 	
Displays the list of available appointments, which is booked by the patient.
Addition:
Patients cannot book overlapping same-day appointments.
	`1. Book an Appointment`
	`2. Return to Main Menu`
	
	`Select an option (1-2): 1`
	`Enter Index of the slot you want to book: 2`
	`Appointment successfully booked`
	
	Addition:
	
	`Enter Index of the slot you want to book: 1`
	`Patient already has an appointment on this date.`
	`Booking failed: Patient has reached the appointment limit or already has an appointment on this date.`
	`Failed to book appointment`

5: Reschedule an Appointment Shows list of current upcoming appointments. Rescheduled appointment from 2024-10-19 11:00 to 2024-10-19 12:30.	--- Displaying Your Appointments --- Index: 1 Appointment ID: D002-2024-10-19-11:00 Doctor ID: D002 Doctor Name: Winnie Poh Date: 2024-10-19 Time: 11:00 --- Enter Index of the slot you want to cancel: 1 Appointment ID: D001-2024-10-19-12:30 Doctor ID: D001 Doctor Name: John Tan Date: 2024-10-19 Time: 12:30 --- Index: 2 Appointment ID: D003-2024-10-23-16:00 Doctor ID: D003 Doctor Name: Yi Sheng Date: 2024-10-23 Time: 16:00 --- Enter Index of the slot you want to book: 1 Appointment has been successfully rescheduled from D002-2024-10-19-11:00 to D001-2024-10-19-12:30
6: Cancel an Appointment	--- Displaying Your Appointments --- Index: 1 Appointment ID: D001-2024-10-19-12:30 Doctor ID: D001 Doctor Name: John Tan Date: 2024-10-19 Time: 12:30 --- Enter Index of the slot you want to cancel: 1 Appointment successfully cancelled
7: View Scheduled Appointments	--- Displaying Your Appointments --- Index: 1 Appointment ID: D001-2024-10-19-12:30 Doctor ID: D001 Doctor Name: John Tan Date: 2024-10-19 Time: 12:30
8: View Past Appointment Outcome Records	--- Displaying Appointment Outcomes --- Appointment ID: D001-2024-10-18-11:00 Doctor Name : John Tan Service : Cardiology Consultation Medications : None Press Enter to return to the main menu...

DOCTOR ACTIONS	
TEST CASE	**RESULT**
9: View Patient Medical Records Viewing medical records of patients under their care. Unable to view if the patient is not under the doctor.	Enter Patient ID: PT002 --- Patient Medical Record --- Patient ID: PT002 Name: Alice Blood Type: B+ Past Diagnoses: - Asthma No past prescriptions available. Treatments: - Inhaler Treatment Enter Patient ID: PT003 Patient ID PT003 is not under your care.

10: Update Patient Medical Records Updated new medical records of patient PT001. Under the medical record of PT001, new information is updated.	Enter Patient ID: PT001 Updating Medical Record for Patient ID: PT001 Enter new diagnoses: cancer Enter new treatments: chemotherapy Medical record updated for patient ID: PT001 Medical record updated for patient ID: PT001 Medical record updated successfully for Patient ID: PT001 **Updated records:** Patient ID : PT001 Patient Name: Ryan Tan Date of Birth: 08/09/1999 Gender: Male Email Address: ryan.tan@example.com Phone Number: 91234567 Blood Type: A+ No past prescriptions available. Past Diagnoses: - Diabetes Treatments: - Insulin Treatment
11: View Personal Schedule	--- Upcoming Appointments --- Index: 1 Appointment ID: D001-2024-10-22-15:00 Patient ID: PT001 Date: 2024-10-22 Time: 15:00 Status: CONFIRMED ---------- Index: 2 Appointment ID: D001-2024-10-18-12:00 Patient ID: PT002 Date: 2024-10-18 Time: 12:00 Status: SCHEDULED ----------
12: Set Availability for Appointments Set available appointment for 29/10/2024 from 12:00-13:00. New available slot is reflected in the list of available appointments in the Patient menu.	Enter the date (DD/MM/YYYY): 29/10/2024 Enter start time (24 hour clock HH:mm, only 00 & 30 minutes are accepted): 12:00 Enter end time (24 hour clock HH:mm, only 00 & 30 minutes are accepted): 13:00 Appointment with ID D001-2024-10-29-12:00 has been added. Appointment with ID D001-2024-10-29-12:30 has been added. Availability slots have been set for 2024-10-29 from 12:00 to 13:00 **Updated patient menu:** ---------- Index: 3 Appointment ID: D001-2024-10-29-12:00 Doctor ID: D001 Doctor Name: John Arknights Date: 2024-10-29 Time: 12:00 ----------
13: Accept or Decline Appointment Requests List of upcoming CONFIRMED and SCHEDULED appointments are displayed. Doctors can choose to	--- Upcoming Appointments --- Index: 1 Appointment ID: D001-2024-10-22-15:00 Patient ID: PT001 Date: 2024-10-22 Time: 15:00 Status: CONFIRMED ---------- Index: 2 Appointment ID: D001-2024-10-29-12:00 Patient ID: PT001 Date: 2024-10-29 Time: 12:00 Status: SCHEDULED ---------- ---------- Index: 3 Appointment ID: D001-2024-10-18-12:00 Patient ID: PT002 Date: 2024-10-18 Time: 12:00 Status: SCHEDULED

accept/decline SCHEDULED appointments from patients.	**Appointment index 2 is accepted:**
	`Enter Index of the slot you want to accept: 2`
	`Appointment with ID D001-2024-10-29-12:00 has been accepted.`
	Appointment index 3 is declined:
	`Enter Index of the slot you want to cancel: 3`
	`Appointment with ID D001-2024-10-18-12:00 has been declined.`

14: View Upcoming Appointments
 	
From test case 13, the newly updated personal schedule after accepting appt 2 and declining appt 3.
	`--- Upcoming Appointments ---`
	`Index: 1`
	`Appointment ID: D001-2024-10-22-15:00`
	`Patient ID: PT001`
	`Date: 2024-10-22`
	`Time: 15:00`
	`Status: CONFIRMED`
	`----------`
	`Index: 2`
	`Appointment ID: D001-2024-10-29-12:00`
	`Patient ID: PT001`
	`Date: 2024-10-29`
	`Time: 12:00`
	`Status: CONFIRMED`
	`----------`

15: Record Appointment Outcome	`--- Record Appointment Outcome ---`
	`Enter Appointment Outcome: diabetes`
	`Enter Medication needed for Appointment: insulin`
	`Enter Medication Quantity: 5`
	`Enter Appointment Service Type: consultation`
	`Prescription added with ID: PP003`
	`Recorded outcome for Appointment ID D001-2024-10-22-15:00: diabetes`

PHARMACIST ACTIONS	
TEST CASE	**RESULT**

16: View Appointment Outcome Record	`--- Prescription Records ---`
	`Prescription ID: PP001`
	`Name: INSULIN`
	`Quantity: 1`
	`Status: PENDING`
	`----------`
	`Prescription ID: PP002`
	`Name: IBUPROFEN`
	`Quantity: 15`
	`Status: DISPENSED`
	`----------`

17: Update Prescription Status	`Dispensing medication...`
	`Enter Prescription ID: PP001`
	
	`--- Prescription Record ---`
	`Prescription ID: PP001`
	`Name: INSULIN`
	`Quantity: 1`
	`Status: PENDING`
	`----------`
	`Fulfill this prescription? (Y/N): Y`
	`Prescription PP001 has been fulfilled.`
	`Updated Stock level for INSULIN: 19`

18: View Medication Inventory	--- Inventory --- Medication ID: M004 Name: ANTIHISTAMINES Stock Count: 75 Low Stock level: 20 ---------- Medication ID: M003 Name: AMOXICILLIN Stock Count: 300 Low Stock level: 15 ---------- ---------- Medication ID: M002 Name: IBUPROFEN Stock Count: 510 Low Stock level: 20 ---------- Medication ID: M001 Name: PARACETAMOL Stock Count: 100 Low Stock level: 10 ----------
19: Submit Replenishment Request	Submitting replenishment request... Enter Medication ID: M001 Enter Quantity to replenish: 50 Replenishment request submitted successfully for Medication ID: M001 with quantity: 50. **Reflected in Admin's menu:** --- View Replenishment Requests --- Request ID: R004 Med ID: M001 Quantity: 50 Status: PENDING ----------

ADMINISTRATOR ACTIONS	
TEST CASE	**RESULT**
20: View and Manage Hospital Staff Administrators can view the list of hospital staff and add, update or remove staff members. Can filter view staff by role/gender/all. Staff filtered by Pharmacist role. **Add staff:** Added new Doctor Tan Xiao Ming. **Update staff info:** Phone number of Tan	**View staff:** --- View Staff --- 1. Filter by Role 2. Filter by Gender 3. All Your Choice: 1 --- View Staff by Role --- Enter role: Pharmacist --- Displaying Staff --- Staff ID: P001 Name: Marcus Goh Role: PHARMACIST Gender: Male Age: 64 Phone Number: +65 93456789 Email: marcus.goh@hospital.com ---------- Staff ID: P003 Name: Milly Wong Role: PHARMACIST Gender: Female Age: 72 Phone Number: +65 90123456 Email: milly.wong@hospital.com ---------- **Add staff:** Enter new staff member details... Enter role (Admin/Doctor/Pharmacist): Doctor DOCTOR Enter name: Tan Xiao Ming Enter gender: male Enter age: 30 Enter email address: txm@gmail.com Enter phone number: 90909090 Doctor added successfully. **Update staff info:** Enter ID of the Staff you want to update StaffID: D007 Enter new name (current: Tan Xiao Ming) (leave blank if not changing): Enter new age (leave blank if not changing): Enter new email (leave blank if not changing): Enter new Contact Number (leave blank if not changing): 88888888

Xiao Ming changed as reflected in the new staff records. **Remove staff:** Tan Xiao Ming removed.	**Reflected new info (changed phone number):** --- Staff ID: D007 Name: Tan Xiao Ming Role: DOCTOR Gender: male Age: 30 Phone Number: 88888888 Email: txm@gmail.com --- **Remove staff:** --- Remove Staff --- Enter ID of the Staff you want to remove StaffID: D007 Staff with ID D007 removed.
21: View Appointments Details	Index: 1 Appointment ID: D001-2024-10-22-15:00 Doctor ID: D001 Doctor Name: John Tan Date: 2024-10-22 Time: 15:00 --- Index: 2 Appointment ID: D001-2024-10-19-12:30 Doctor ID: D001 Doctor Name: John Tan Date: 2024-10-19 Time: 12:30 --- Index: 3 Appointment ID: D002-2024-10-19-10:00 Doctor ID: D002 Doctor Name: Winnie Poh Date: 2024-10-19 Time: 10:00 ---
22: View and Manage Medication Inventory	Enter Medicine ID: M002 Current Stock of IBUPROFEN: 510 Enter Quantity you want to add: 40 Updated stock for IBUPROFEN to 550
23: Approve Replenishment Requests Approved stock replenishment request R004 from pharmacist.	**Old stock count:** Medication ID: M001 Name: PARACETAMOL Stock Count: 100 Low Stock level: 10 --- **Updated stock count:** --- Approve Replenishment Request --- Enter request ID: R004 Request R004 approved...Updating inventory. Inventory updated for medication: PARACETAMOL with added quantity: 50 New Quantity: 150

LOGIN SYSTEM AND PASSWORD MANAGEMENT	
TEST CASE	**RESULT**

25: First-Time Login and Password Change Patient logs in for the first time, changing the password from "password" to "password1". After additional confirmation, logs in successfully and the Patient Menu is displayed.	Welcome to the Hospital Management System Enter your hospital ID (or type 'exit' to quit): PT001 Enter your password: password You are logging in for the first time. Please change your password. Enter new password (must be more than 6 characters and cannot be 'password'): password1 Confirm new password: password1 Updated password hash: password1 Password updated successfully. Login successful... --- 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 Select an option (1-9):
26: Login with Incorrect Credentials	Welcome to the Hospital Management System Enter your hospital ID (or type 'exit' to quit): PT001 Enter your password: password2 Invalid password. Please try again. Invalid login credentials. Please try again.

4. Reflection

Through our project, we recognised the importance of UML diagram in assisting in the process of creating a well-functioning system, as well as the significance of how SOLID design principles play a role in allowing our system to be highly maintainable and extensible, emphasising the importance of high cohesion and loose coupling. Initially, we created the base UML diagram with the general role classes, however, as we started to code, we quickly realised the complications with new classes being added and the complexities of the relationships between classes. With the integration of the different role-related classes being a key challenge that we faced throughout the project, we realised the importance of having low dependencies, and all in all, we have gained insight on how the SOLID principles are applied in creating a system.