Software Design Method

Final Group Project

HealthCare Information System

Group:

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1. Motivation(Describe the reason you picked the topic)

Health Care Information Systems can improve hospital's cost control, increase the timeliness and accuracy of patient care and administration information, increase service capacity, reduce personnel costs and improve the quality of patient care. However, experience shows that most of these benefits will not occur automatically following system implementation. Operational problems may exist that diminish information timeliness, accessibility, and accuracy; policies and procedures may not have been sufficiently tailored to reflect the realities and intents of the systems; and personnel tasks may not have been adequately restructured. In order to realize the full potential of information systems, health care organizations must plan for and implement strategies that are designed to maximize such benefits. So we use what we learn in the Software Design Method class to build a more user friendly and more efficient Health Care Information System.

2. Discuss related work (literature survey)

After read the paper <Best Practices in the Design and Development of Health Care Information System>, we acquired two important points for the system:
One of the most important constraints of the medical data is the need to permanently adjust the items of data to be stored in the database. Some data architecture patterns are presented, which enable the information systems to support those adjustments without any change of the data model or software application, providing scalability in design to the systems. Another issue related to medical data is the possible existence of different terms for the same concept. This is usually the case when legacy data are imported, or when medical teams from different specializations are using the same system.

The professor give us a useful website: "http://www.open-emr.org", which is a fully build Health System. OpenEMR is a open source electronic health records and medical practice management software can be downloaded on the Internet for free, contains such as Scheduling, Medical Billing, Clinical Decision Rules functions and so on. This website give us a more straightforward acknowledge of the Health Care System and inspire us the following steps from use cases through coding.

At last, the textbook(Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development) is the most important resource for the final project, by which guiding us the correct format and contents of the Use Case, Domain Model, SSD, DCD.

Use Case

At first we addressed seven use cases and we pick two of the most important use cases then fully addressed them.

1. Appointment System - Schedule /view / update /cancel appointment
2. Patient registration / create patient
3. Medical records - Review / update patient medical records
4. Treatments - Schedule /view / update /cancel treatment / lab
5. Prescribe medication
6. Reorder medication (patient refills / reorders medication)
7. Process medical payment

1.First use case

Use Case Section	Comment
Use Case Name	Register patient
Scope	Hospital medical system
Level	User Level
Primary Actor	Patient, Receptionist
Stakeholders and Interests	- **Patient**: Wants to get registered with minimal effort. Wants the reports with exact details provided. - **Receptionist**: Wants to take details from Patient and provide registration details. Wants accurate, fast entry and no data errors. - **Doctor**: Wants to check patient, prescribe medicines and give treatment. - **Hospital**: Wants to accurately record patient details and appointments and take best care of patients. Wants to ensure Insurance payments receivables are recorded. Wants some fault tolerance to allow sales capture even if server components (e.g., remote credit validation) are unavailable. Wants automatic and fast update of accounting and inventory. - **Insurance Agencies**: Want to evaluate policies taken. Receive and settle claims from patients. - **Government Tax Agencies**: Want to collect tax from every transaction. May be multiple agencies, such as national, state and county. - **Payment Authorization Service**: Wants to receive digital authorization requests in the correct format and protocol. Wants to accurately account for their payables to the hospital.
Preconditions	1. Receptionist is identified and authenticated 2. Receptionist has navigated to the registration screen.
Success Guarantee	Registration is saved. Details are correctly entered. Registration card is generated. Database is updated. Insurance details and Payment authorization approvals are recorded.
Main Success Scenario	1. Patient arrives at the Health Care to get registered. 2. Receptionist requests the type of registration

	required. 3. Patient selects the registration type (In Patient/Out Patient). 4. Receptionist enters the registration type. 5. System records the registration type and presents set of queries to enter the patient details, insurance details and department name for which patient is interested. a. Receptionist repeats step 5 until all details are entered. 6. System records the details of patients in database. 7. System generates the registration card. 8. Receptionist tells Patient the registration number. 9. Receptionist prints registration card to the Patient. 10. System logs insurance policy details and sends details to Insurance Agency for policy verification 11. System sends registration details to Doctor 12. System sends registration details to Hospital management for allocation of bed for In Patient 13. Patient leaves with registration card and makes payment if registration fees is applicable
Extensions	3. a. Invalid identifier: i. System signals error and rejects entry b. There are multiple of same Patient details: i. Receptionist can enter same name and other details 1. Patient asks Receptionist to remove insurance policy information from the registration: a. Receptionist enters policy identifier for removal from registration. b. System displays updated details. 2. Patient asks Receptionist to cancel registration: a. Receptionist cancels registration on System. 3. Receptionist suspends the registration: a. Systems records the details so that it is available for retrieval to continue registration later. 4. The system generated registration fee is not wanted (e.g., Patient complained about registration and is offered a lower price for particular insurance members): a. Receptionist enters membership details.

	b. System presents new registration fee. 5. System detects the department for which patient is looking is not available due to Doctor unavailability a. Receptionist asks Patient whether to proceed with registration 6. System detects failure to communicate with external insurance agency: a. **System restarts** the service on the node, and continues i. System detects that the service does not restart 1. System signals error. 2. Receptionist may manually contact insurance agency over phone and verify insurance details ii. Patient says they **have partially saved registration form submitted online**: 1. Receptionist searches system using details provided. 2. System retrieves the registration file. 3. Receptionist enters remaining details. 4. System completes the registration. **7. Scanning Driver's license:** a. Patient provides Driver's license. b. Receptionist scans the Driver's license. c. System automatically fills the major fields required for registration from the information available from scan. d. Receptionist enters the missing details. e. System records the registration. **8. Paying registration fee by credit:** a. Patient enters their credit account information. b. System send payment authorization request to an external Payment Authorization Service System, and requests payment approval. i. System detects failure to collaborate with external system: 1. System signals error to Receptionist. 2. Receptionist asks Patient for alternate payment. c. System receives payment approval and signals approval to Receptionist. i. System receives payment denial: 1. System signals denial to Receptionist. 2. Receptionist asks Patient for alternate payment. d. System records the credit payment, which includes the payment approval.

	e. System presents credit payment signature input mechanism f. Receptionist asks Patient for a credit payment signature. Patient enters signature. **9. Paying registration fee by debit:** a. Patient enters their debit account information. b. System send payment authorization request to an external Payment Authorization Service System, and requests payment approval. i. System detects failure to collaborate with external system: 1. System signals error to Receptionist. 2. Receptionist asks Patient for alternate payment. c. System receives payment approval and signals approval to Receptionist. i. System receives payment denial: 1. System signals denial to Receptionist. 2. Receptionist asks Patient for alternate payment. d. System records the debit payment, which includes the payment approval. e. System presents debit PIN input mechanism Receptionist asks Patient for a debit PIN. Patient enters debit PIN.
Special Requirements	- Touch screen UI on a large flat panel monitor. Text must be visible from 1 meter. - Credit authorization response within 30 seconds 90% of the time. - Insurance verification within 60 seconds 90% of the time. - Somehow, we want robust recovery when access to remote services such as hospital room management system is failing. Language internationalization on the text displayed.
Technology and Data Variations List	- Details captured from scanning Government issued ID cards. - Credit account information entered by card reader or keyboard. Debit account information entered by card reader or keyboard.
Frequency of Occurrence	Continuous

Register Patient: Domain Model

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Domain Model 2
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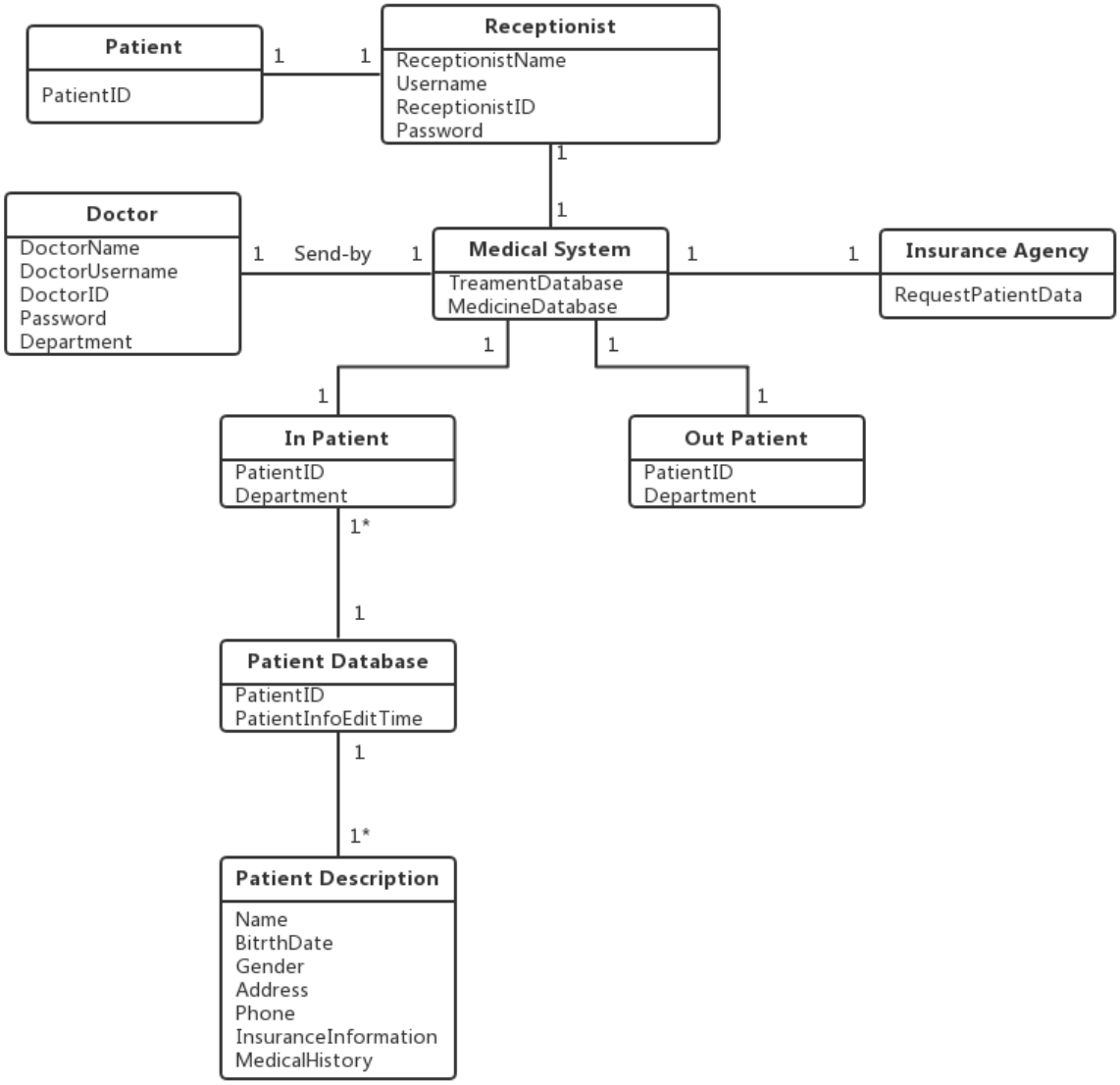
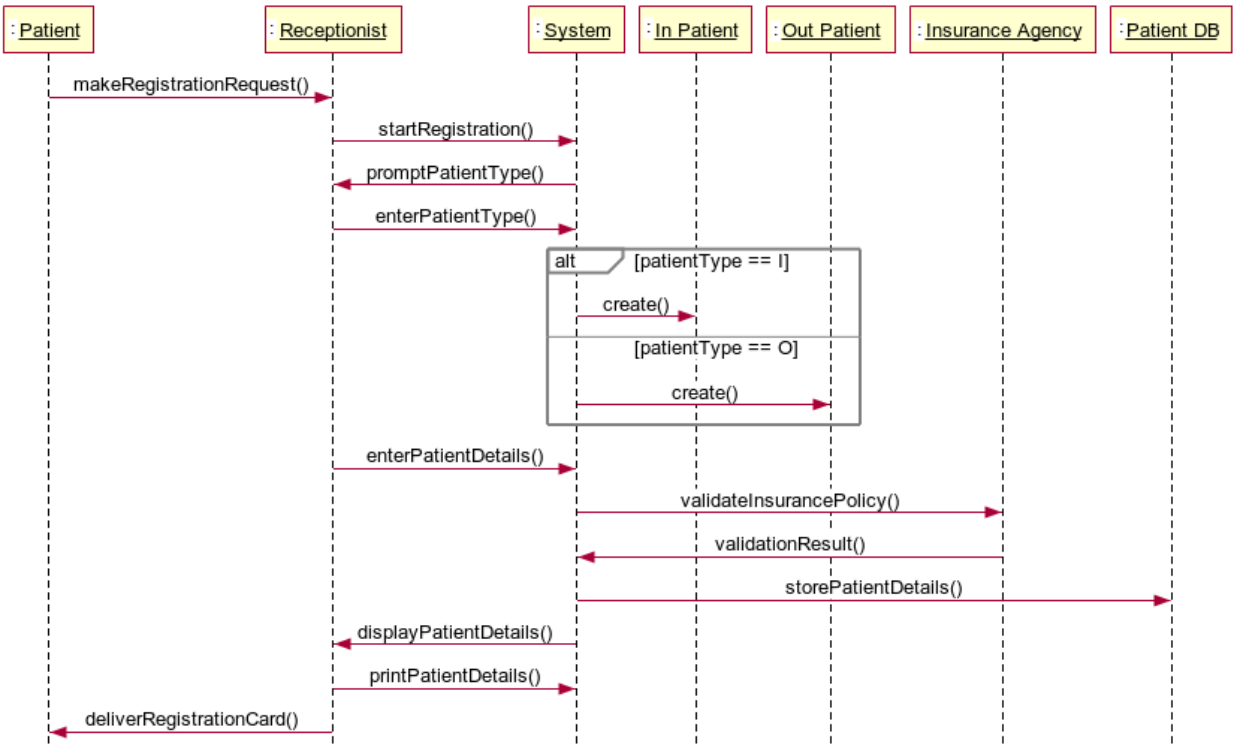
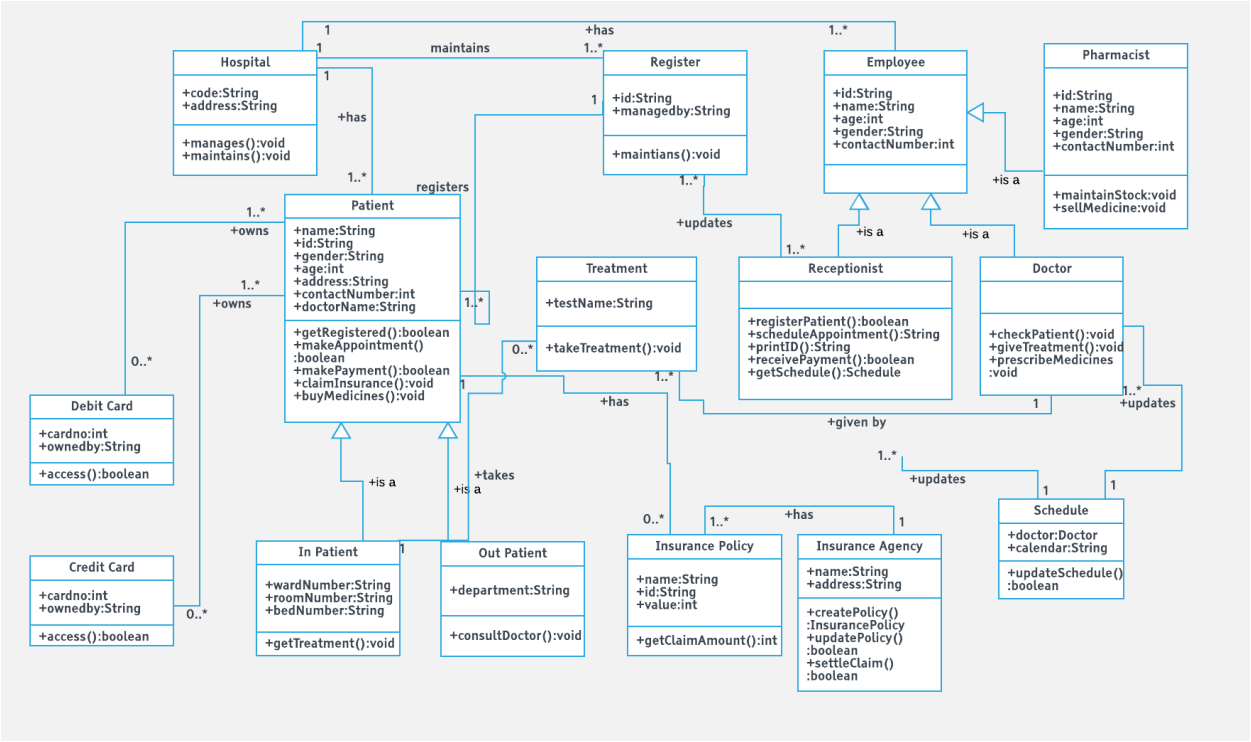


Register Patient: Sequence Diagram



Register Patient: Design Class Diagram



- Map it to Code

2. Second Use Case

Use Case Section	Comment
Use Case Name	Process Medical Payment
Scope	Hospital medical system
Level	User Goal
Primary Actor	Hospital Cashier
Stakeholders and Interests	- Hospital Cashier: Wants accurate, fast entry, and no payment errors, as cash drawer shortages are deducted from his/her salary - Doctor: Wants patients get their medicine quickly, and be healthy as soon as possible - Patient: Wants purchase and fast service with minimal effort. Wants easily visible display of medicine and prices in receipt. - Pharmacist: Wants system to show medicine list (e.g., medicine name and quantity) accurately, and picks up medicines without errors. - Hospital: Wants to accurately record transactions and satisfy patient requirements. Wants to ensure that Payment Authorization Service payment receivables are recorded. Wants some fault tolerance to allow medicine sales capture even if server components (e.g., remote credit validation) are unavailable. Wants automatic and fast update of accounting and inventory. - Manager: Wants to easily debug Cashier problems. - Government Tax Agencies: Want to collect tax from every sale. May be multiple agencies, such as national, state, and county. - Payment Authorization Service: Wants to receive digital

	authorization requests in the correct format and protocol. Wants to accurately account for their payables to the hospital.
Preconditions	Hospital cashier is identified and authenticated. Doctor has already made a prescription for patient in hospital medical system.
Success Guarantee	Medical sale is saved. Tax is correctly calculated. Accounting and Inventory are updated. Commissions recorded. Receipt is generated. Payment authorization approvals are recorded.
Main Success Scenario	1. Patient arrives at hospital front desk and checks out by his patient identify number to purchase. 2. Hospital cashier starts a new sale. 3. Hospital cashier enters patients ID. 4. System displays medicine name and their description, price, and running total. Price calculated from a set of price rules. 5. System presents total with calculated taxes. 5. System prints a list for medicine name and quantity to pharmacist. 6. Pharmacist picks up medicines by following the medicine list to front desk. 7. Hospital cashier scans each medicine. 8. Hospital cashier tells Patient the total, and asks for payment. 9. Patient pays and System handles payment. 10. System logs completed sale and sends sale to Inventory system (to update inventory). 11. System presents receipt. 12. Patient leaves with medicine and receipt.
Extensions	**3a**. Invalid Patient ID(not found in the system): 1. System signals error and reject entry. 2. Hospital cashier responds to the error: 1. Hospital cashier check with the doctor.

	2. Hospital cashier enters the patient ID again. **8a**. Paying by cash: 1. Cashier enters the cash amount tendered. 2. System presents the balance due, and releases the cash drawer. 3. Cashier deposits cash tendered and returns balance in cash to Customer. 4. System records the cash **8b**. Paying by credit: 1. Patient enters their credit account information. 2. System displays their payment for verification. 3. Cashier confirms. ● System sends payment authorization request to an external Payment Authorization Service System, and requests payment approval. 4a. System detects failure to collaborate with external system: 1. System signals error to Cashier. 2. Cashier asks Customer for alternate payment. ● System receives payment approval, signals approval to Cashier, and releases cash drawer (to insert signed credit payment receipt). 5a. System receives payment denial: 1. System signals denial to Cashier. 2. Cashier asks Customer for alternate payment. **8c**. Paying by debit… **11a**. Printer out of paper 1. If System can detect the fault, will signal the problem. 2. Cashier replaces paper. 3. Cashier requests another receipt.
Special Requirements	- Touch screen UI on a large flat panel monitor. Text must be visible from 1 meter. - Credit authorization response within 30 seconds 90% of the time. - Somehow, we want robust recovery when access to remote services such

	the inventory system is failing. - Language internationalization on the text displayed.
Technology and Data Variations List	7a. Medicine scanned by bar code laser scanner (if bar code is present) or keyboard. 8a. Credit account information entered by card reader or keyboard. 8b. Credit payment signature captured on paper receipt. But within two years, we predict many customers will want digital signature capture.
Frequency of Occurrence	Could be nearly continuous
Miscellaneous	Open issues: - Explore the remote service recovery issue. - Can hospital add machines for picking up medicines to replace pharmacist?

Process Medical Payment: Domain Model

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Domain Model 2
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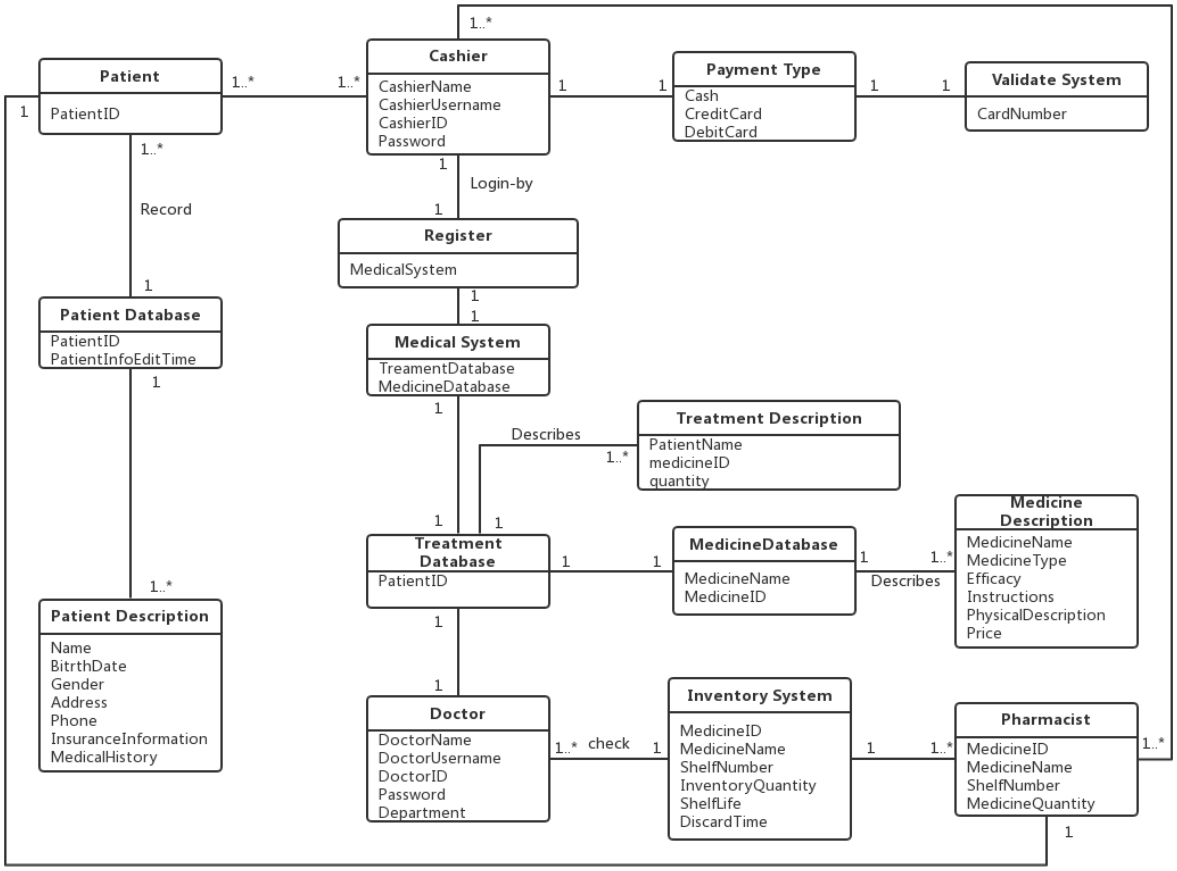
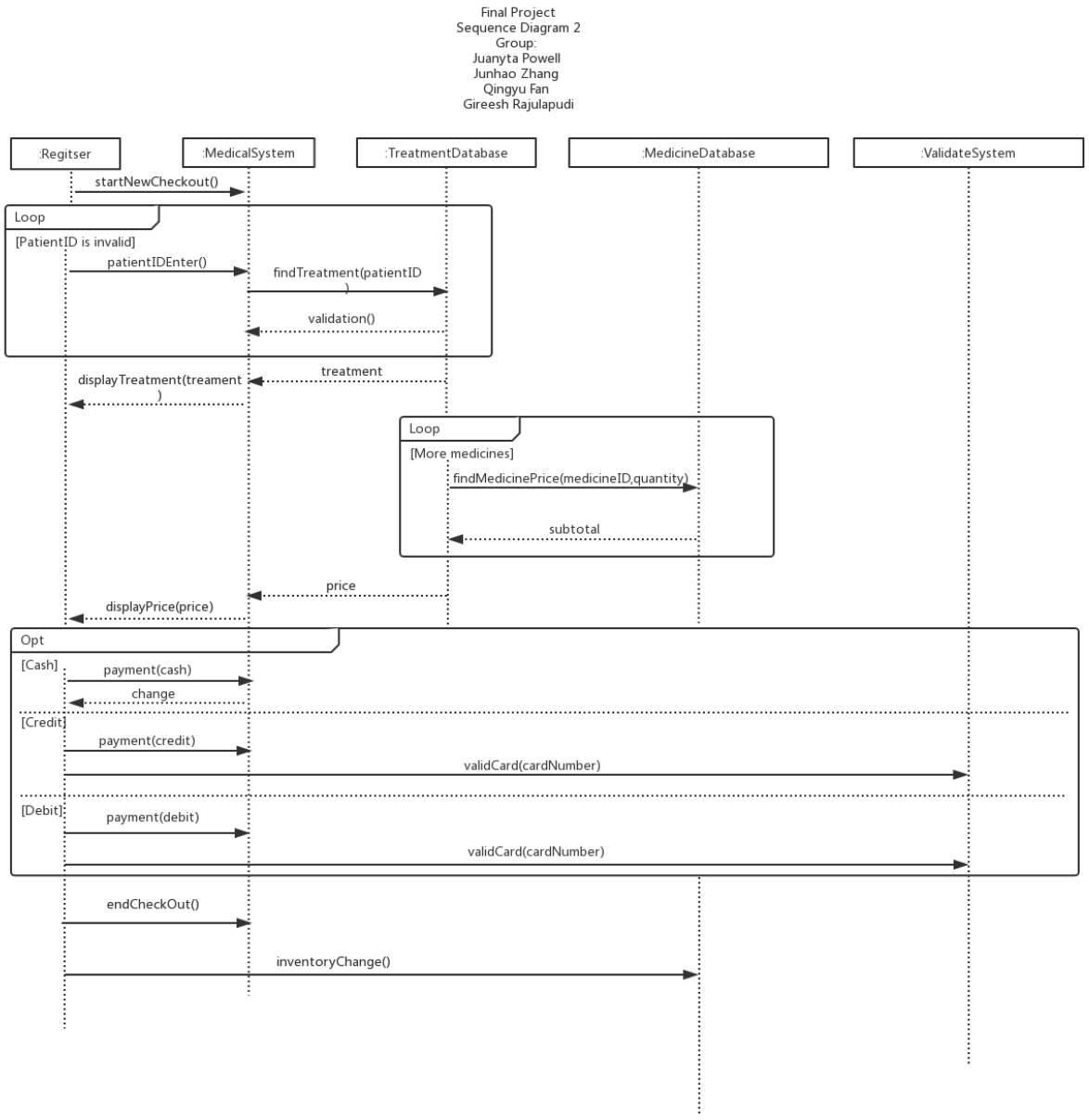


Process Medical Payment: Sequence Diagram



Process Medical Payment: Design Class Diagram

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Design Class Diagram 2
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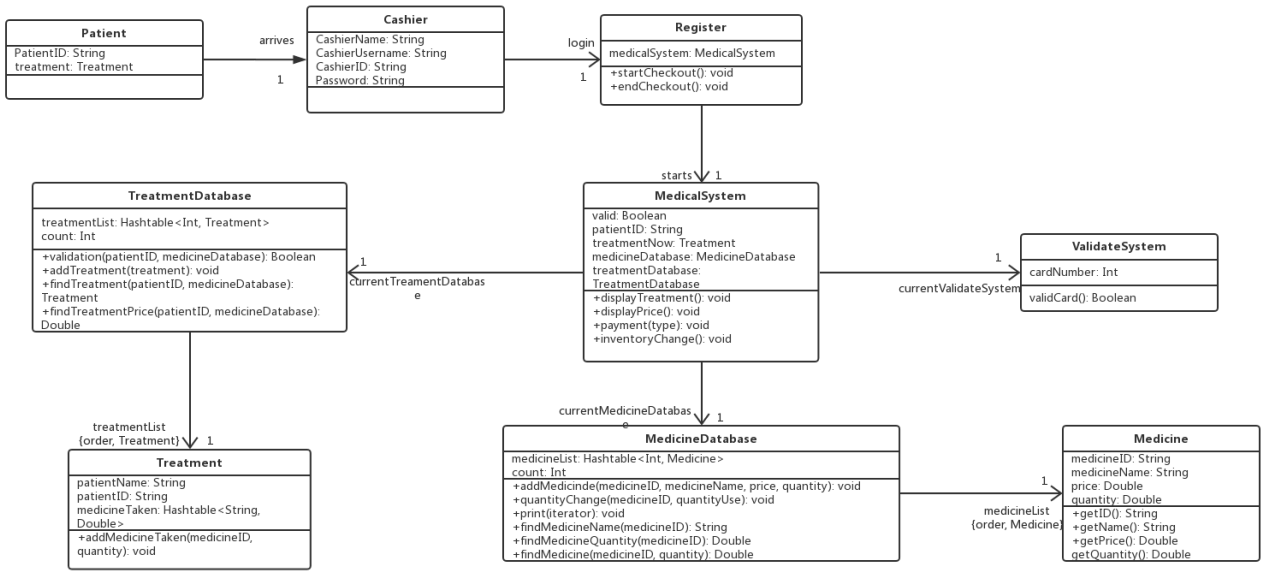

3. Conclusion:

In our project, we implement four different patterns that we have learnt this semester. The first pattern is singleton pattern. For building our Medicine Database and Treatment Database, we use singleton pattern to build them to make sure there are only one database. Then, we use factory pattern when register InPatient and OutPatient. In the add/remove medicine from Medicine Database option, we use command pattern to insert addMedicineCommand and removeMedicineCommand into slot[0]. And also building a function for undoing. Last, in the treatment database, we use the iterator pattern. We first construct hashtable iterator by ourselves. Then implementing it into treatment database, since we have a hashtable for storing each patient's treatment. So we use four patterns in our project.