Sample Problem 1: School Results Application

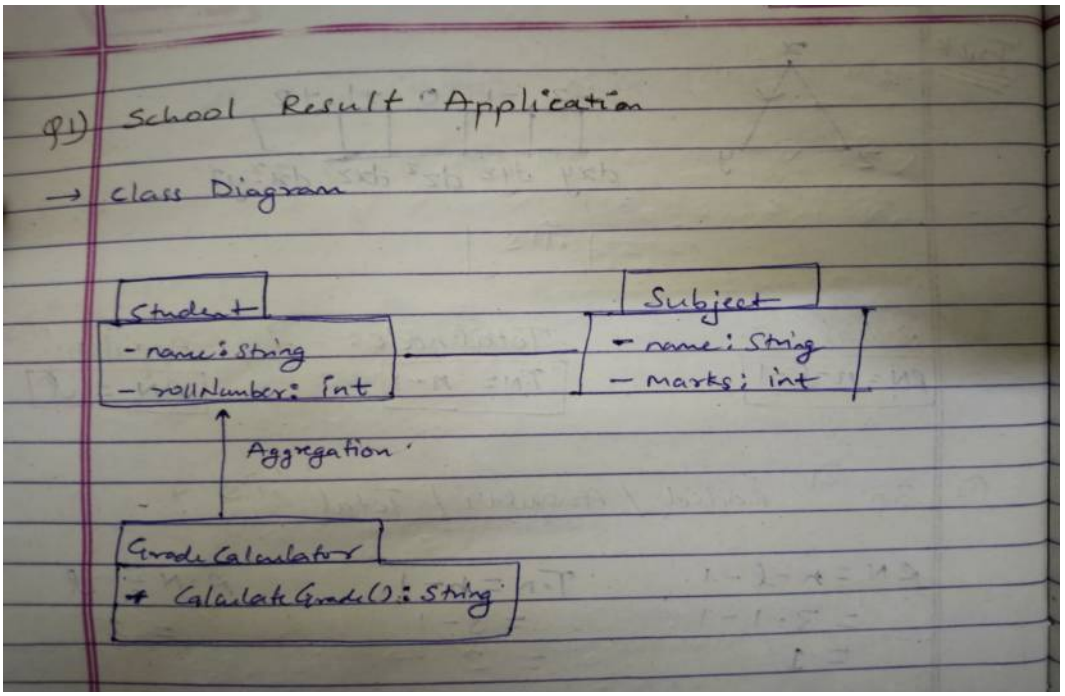
Class Diagram

The class diagram represents the structure of a school results application where students have subjects, and their scores are calculated for grades.

Diagram Description:

- **Classes**: `Student`, `Subject`, `GradeCalculator`
- **Relationships**:
    - A `Student` has multiple `Subject` entries (Aggregation).
    - `GradeCalculator` computes the results for a `Student`.

→ Draw the Class Diagram



Object Diagram

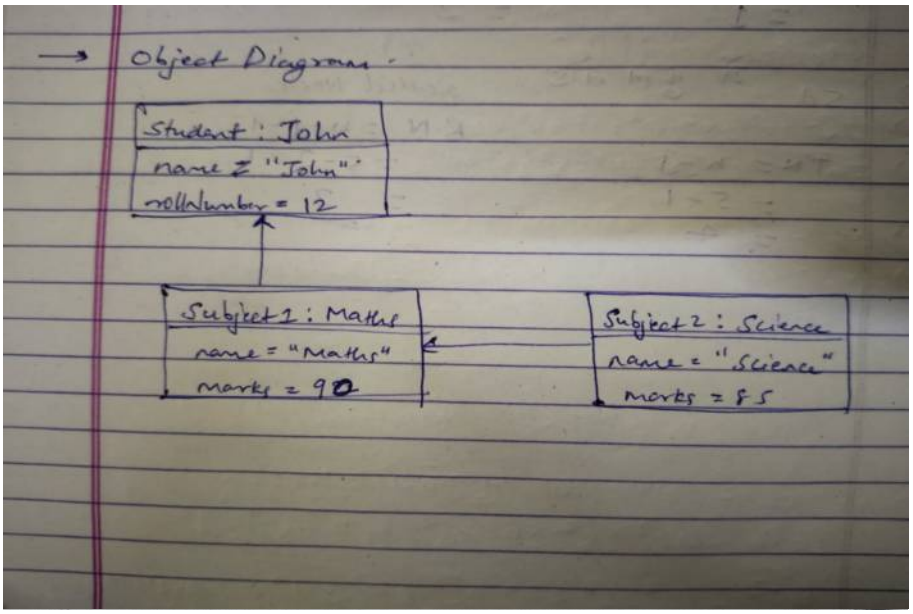
An object diagram provides a snapshot of the `Student` and their `Subject` objects at a particular point.

Example:

- **Student**: John

- **Subjects**: `Maths`, `Science`
- **Marks**: `90`, `85`

→ Draw the Object Diagram



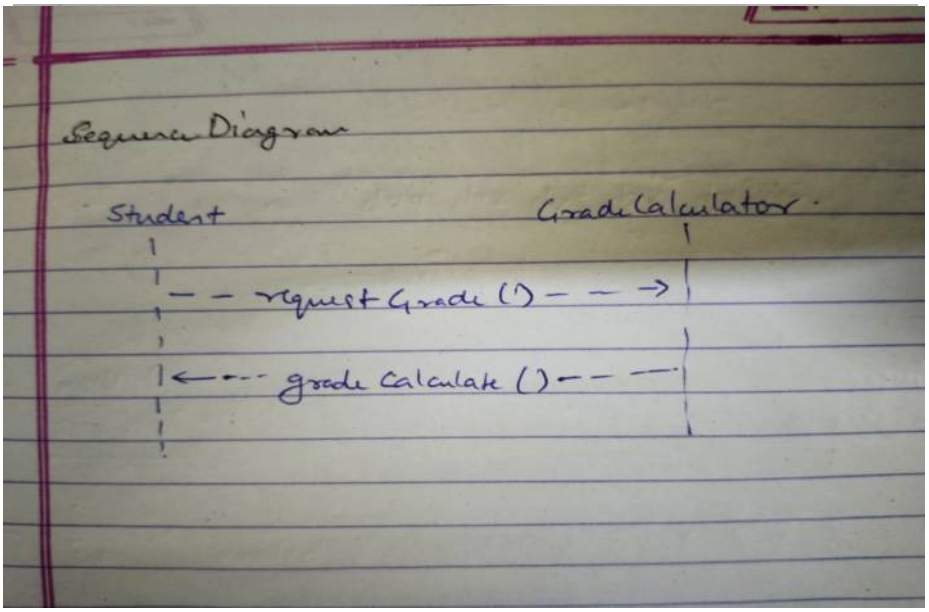
Sequence Diagram

The sequence diagram shows how objects interact to calculate grades.

Scenario: A student requests their grade based on marks in subjects.

Actors:

1. `Student`
2. `GradeCalculator`



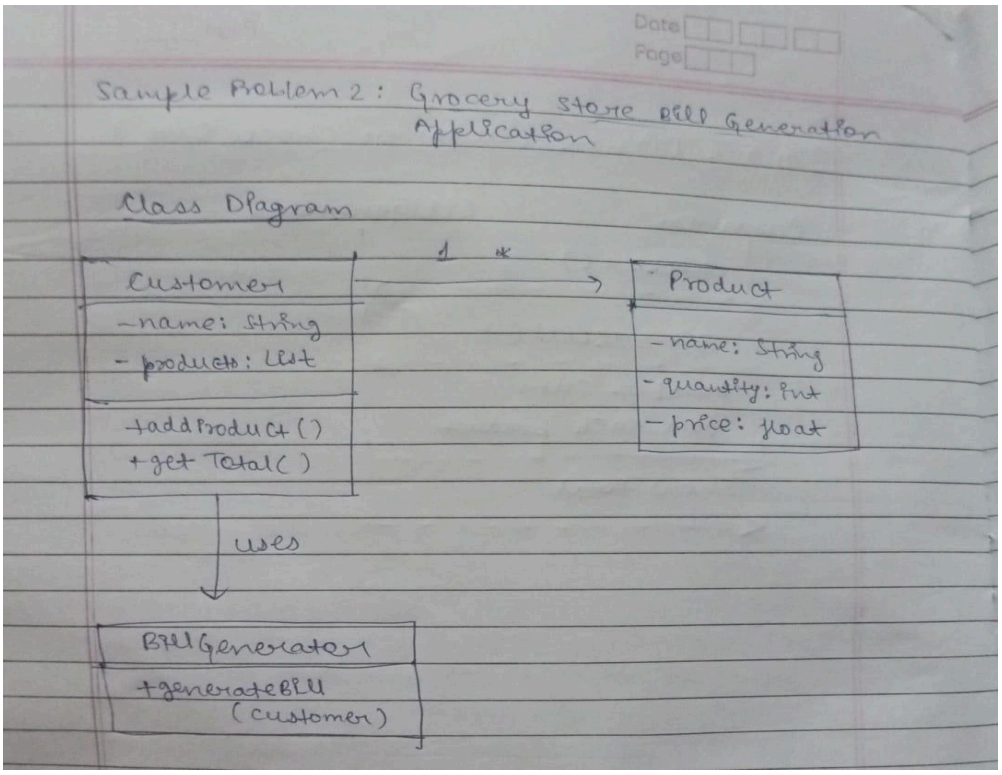
Sample Problem 2: Grocery Store Bill Generation Application

Class Diagram

The class diagram models the system where a customer buys products, and the bill is generated.

Diagram Description:

- **Classes**: `Customer`, `Product`, `BillGenerator`
- **Relationships**:
  - A `Customer` can purchase multiple `Product` items (Composition).
  - `BillGenerator` computes the total for the `Customer`.

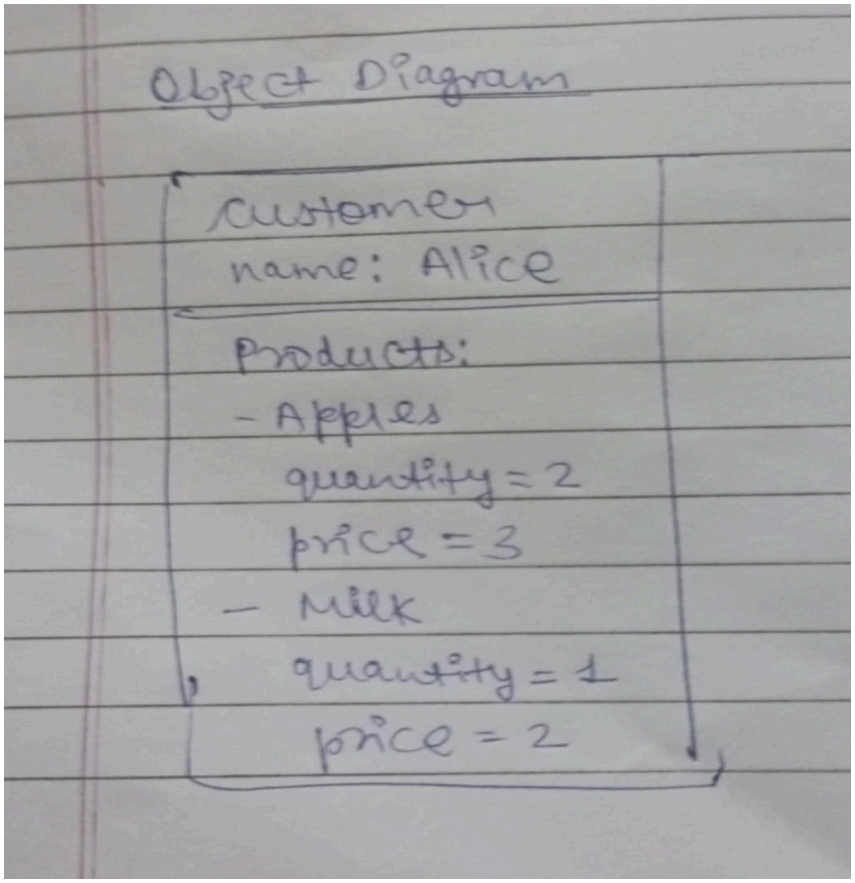


Object Diagram

An object diagram shows the details of a `Customer` and the `Product` objects they have purchased.

Example:

- **Customer**: `Alice`
- **Products**:
    - `Apples` (2 kg at $3 per kg)
    - `Milk` (1 liter at $2 per liter)



Sequence Diagram

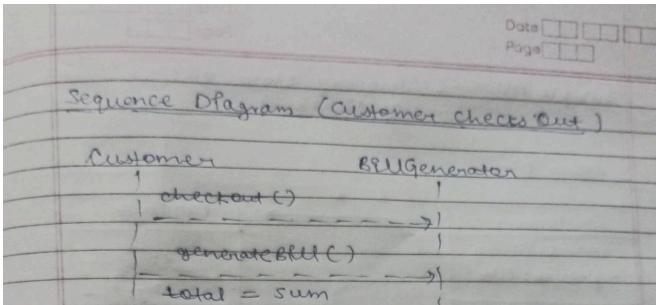
The sequence diagram shows the process of bill generation for a customer.

Scenario: A customer checks out at the grocery store, and the total bill is generated.

Actors:

1. `Customer`
2. `BillGenerator`

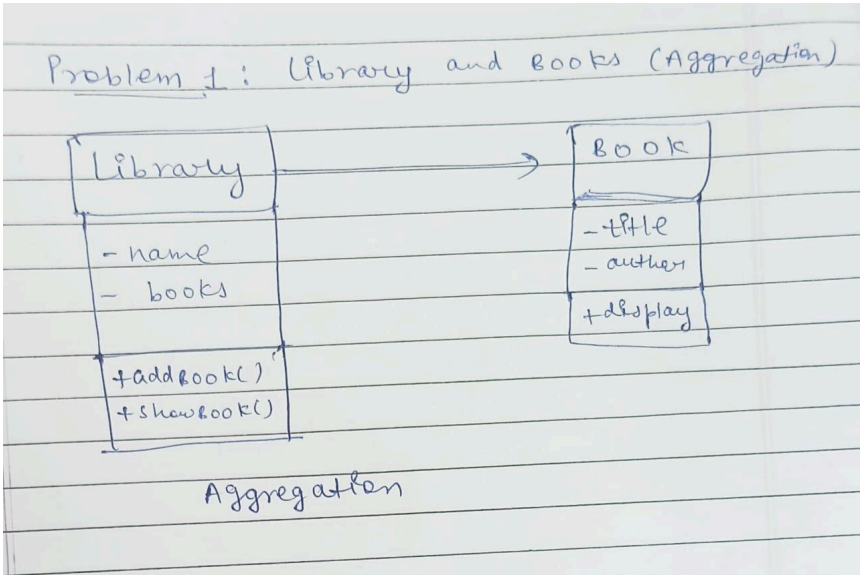
→ Draw the Sequence Diagram



Assisted Problems

Problem 1: Library and Books (Aggregation)

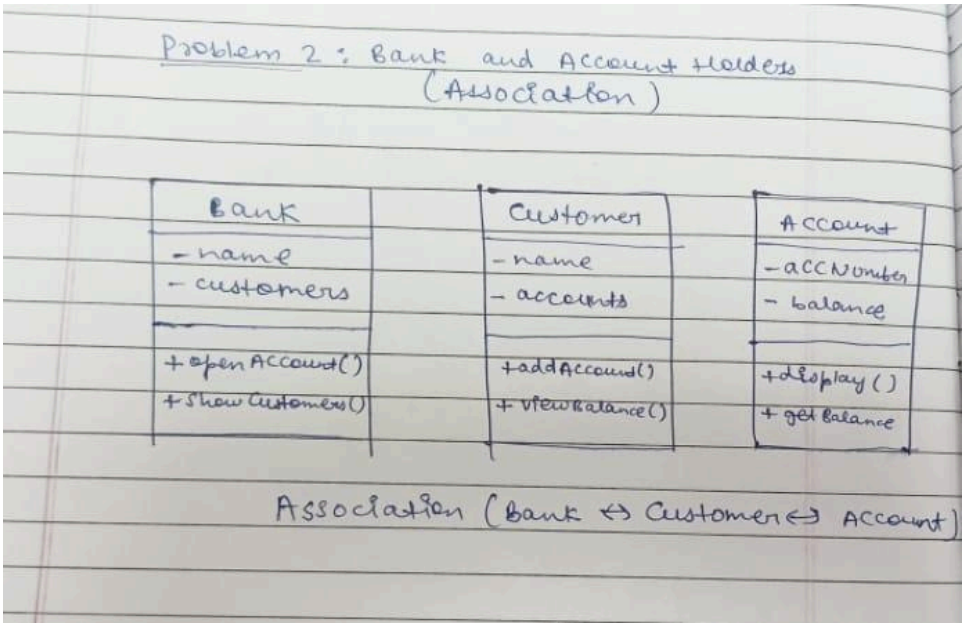
- **Description**: Create a `Library` class that contains multiple `Book` objects. Model the relationship such that a library can have many books, but a book can exist independently (outside of a specific library).
- **Tasks**:
    - Define a `Library` class with an `ArrayList` of `Book` objects.
    - Define a `Book` class with attributes such as `title` and `author`.
    - Demonstrate the aggregation relationship by creating books and adding them to different libraries.
- **Goal**: Understand aggregation by modeling a real-world relationship where the `Library` aggregates `Book` objects.



Problem 2: Bank and Account Holders (Association)

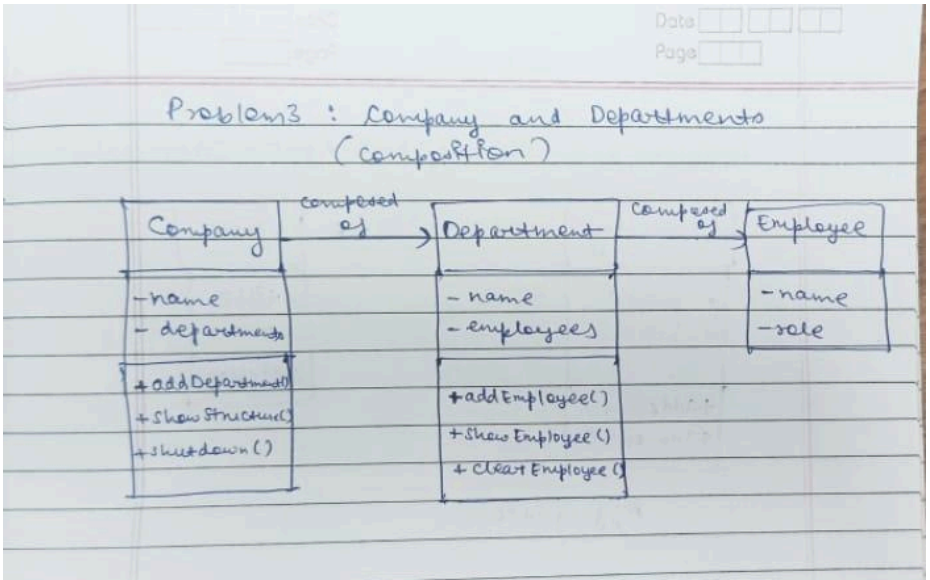
- **Description**: Model a relationship where a `Bank` has `Customer` objects associated with it. A `Customer` can have multiple bank accounts, and each account is linked to a `Bank`.
- **Tasks**:
    - Define a `Bank` class and a `Customer` class.
    - Use an association relationship to show that each customer has an account in a bank.
    - Implement methods that enable communication, such as `openAccount()` in the `Bank` class and `viewBalance()` in the `Customer` class.

- **Goal**: Illustrate association by setting up a relationship between customers and the bank.



Problem 3: Company and Departments (Composition)

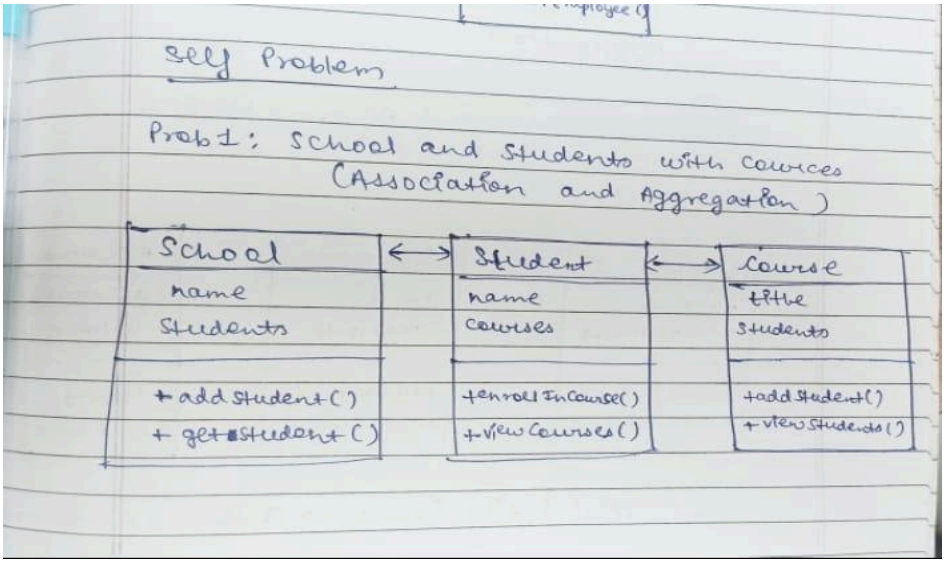
- **Description**: A `Company` has several `Department` objects, and each department contains `Employee` objects. Model this using composition, where deleting a company should also delete all departments and employees.
- **Tasks**:
  - Define a `Company` class that contains multiple `Department` objects.
  - Define an `Employee` class within each `Department`.
  - Show the composition relationship by ensuring that when a `Company` object is deleted, all associated `Department` and `Employee` objects are also removed.
- **Goal**: Understand composition by implementing a relationship where `Department` and `Employee` objects cannot exist without a `Company`.



Self Problems

Problem 1: School and Students with Courses (Association and Aggregation)

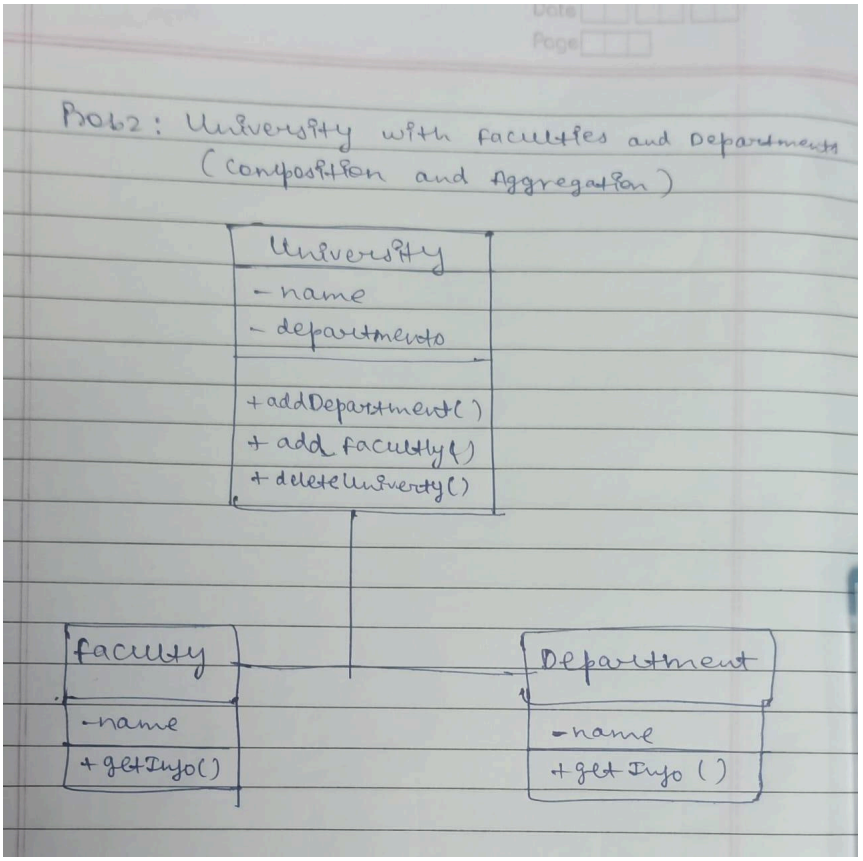
- **Description**: Model a `School` with multiple `Student` objects, where each student can enroll in multiple courses, and each course can have multiple students.
- **Tasks**:
    - Define `School`, `Student`, and `Course` classes.
    - Model an association between `Student` and `Course` to show that students can enroll in multiple courses.
    - Model an aggregation relationship between `School` and `Student`.
    - Demonstrate how a student can view the courses they are enrolled in and how a course can show its enrolled students.
- **Goal**: Practice association by modeling many-to-many relationships between students and courses.



Problem 2: University with Faculties and Departments (Composition and Aggregation)

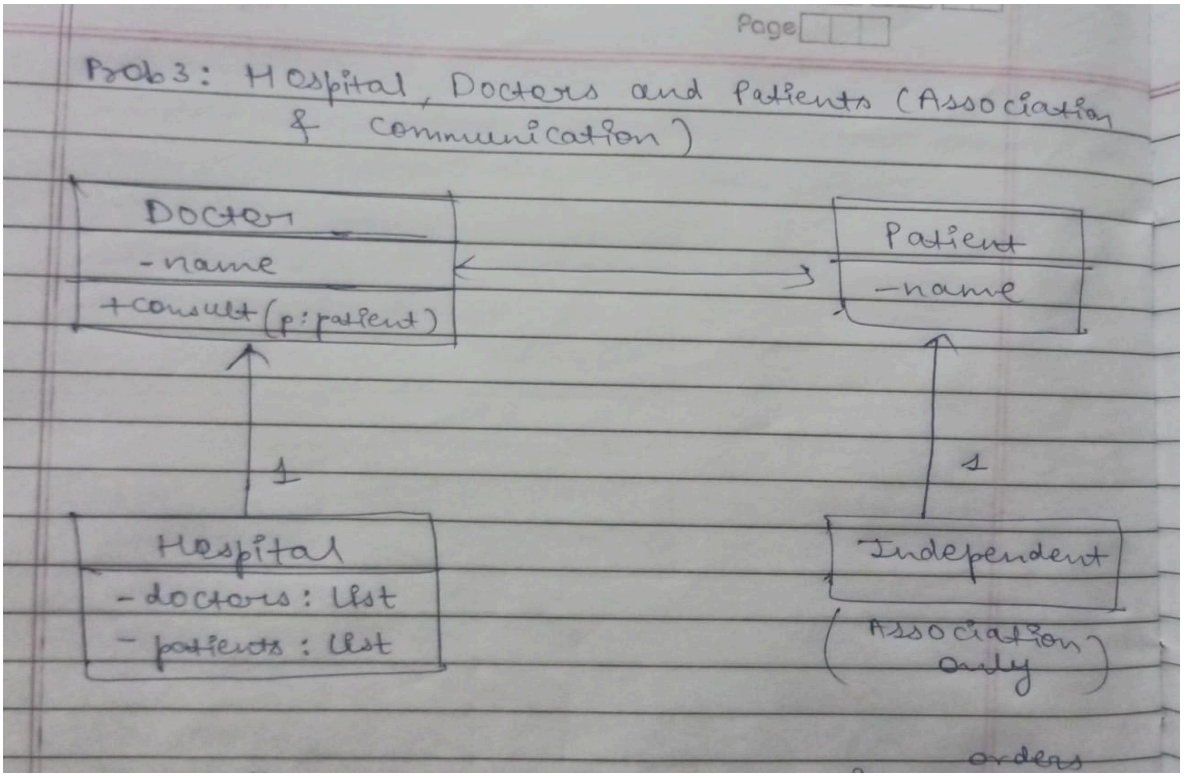
- **Description**: Create a `University` with multiple `Faculty` members and `Department` objects. Model it so that the `University` and its `Departments` are in a composition relationship (deleting a university deletes all departments), and the `Faculty` members are in an aggregation relationship (faculty can exist outside of any specific department).
- **Tasks**:
    - Define a `University` class with `Department` and `Faculty` classes.

    - Demonstrate how deleting a `University` also deletes its `Departments`.
    - Show that `Faculty` members can exist independently of a `Department`.
- **Goal**: Understand the differences between composition and aggregation in modeling complex hierarchical relationships.



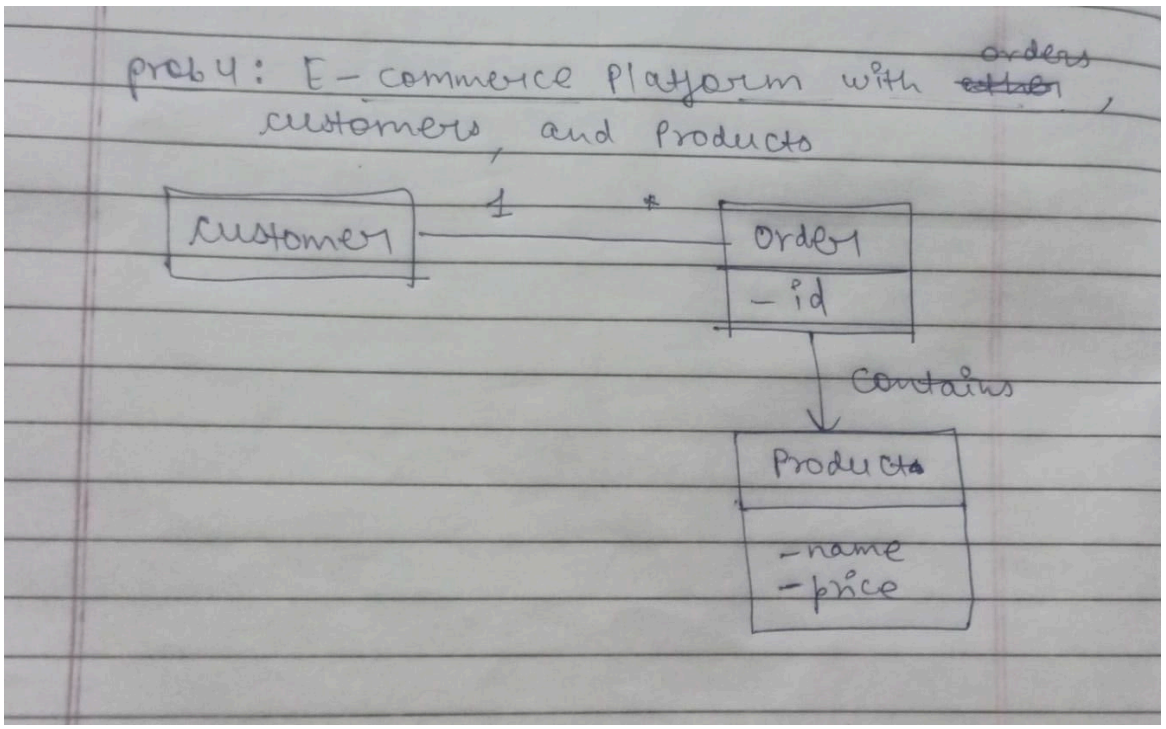
Problem 3: Hospital, Doctors, and Patients (Association and Communication)

- **Description**: Model a `Hospital` where `Doctor` and `Patient` objects interact through consultations. A doctor can see multiple patients, and each patient can consult multiple doctors.
- **Tasks**:
    - Define a `Hospital` class containing `Doctor` and `Patient` classes.
    - Create a method `consult()` in the `Doctor` class to show communication, which would display the consultation between a doctor and a patient.
    - Model an association between doctors and patients to show that doctors and patients can have multiple relationships.
- **Goal**: Practice creating an association with communication between objects by modeling doctor-patient consultations.



Problem 4: E-commerce Platform with Orders, Customers, and Products

- **Description**: Design an e-commerce platform with `Order`, `Customer`, and `Product` classes. Model relationships where a `Customer` places an `Order`, and each `Order` contains multiple `Product` objects.
- **Goal**: Show communication and object relationships by designing a system where customers communicate through orders, and orders aggregate products.



Problem 5: University Management System

- **Description**: Model a university system with `Student`, `Professor`, and `Course` classes. Students enroll in courses, and professors teach courses. Ensure students and professors can communicate through methods like `enrollCourse()` and `assignProfessor()`.
- **Goal**: Use association and aggregation to create a university system that emphasizes relationships and interactions among students, professors, and courses.