

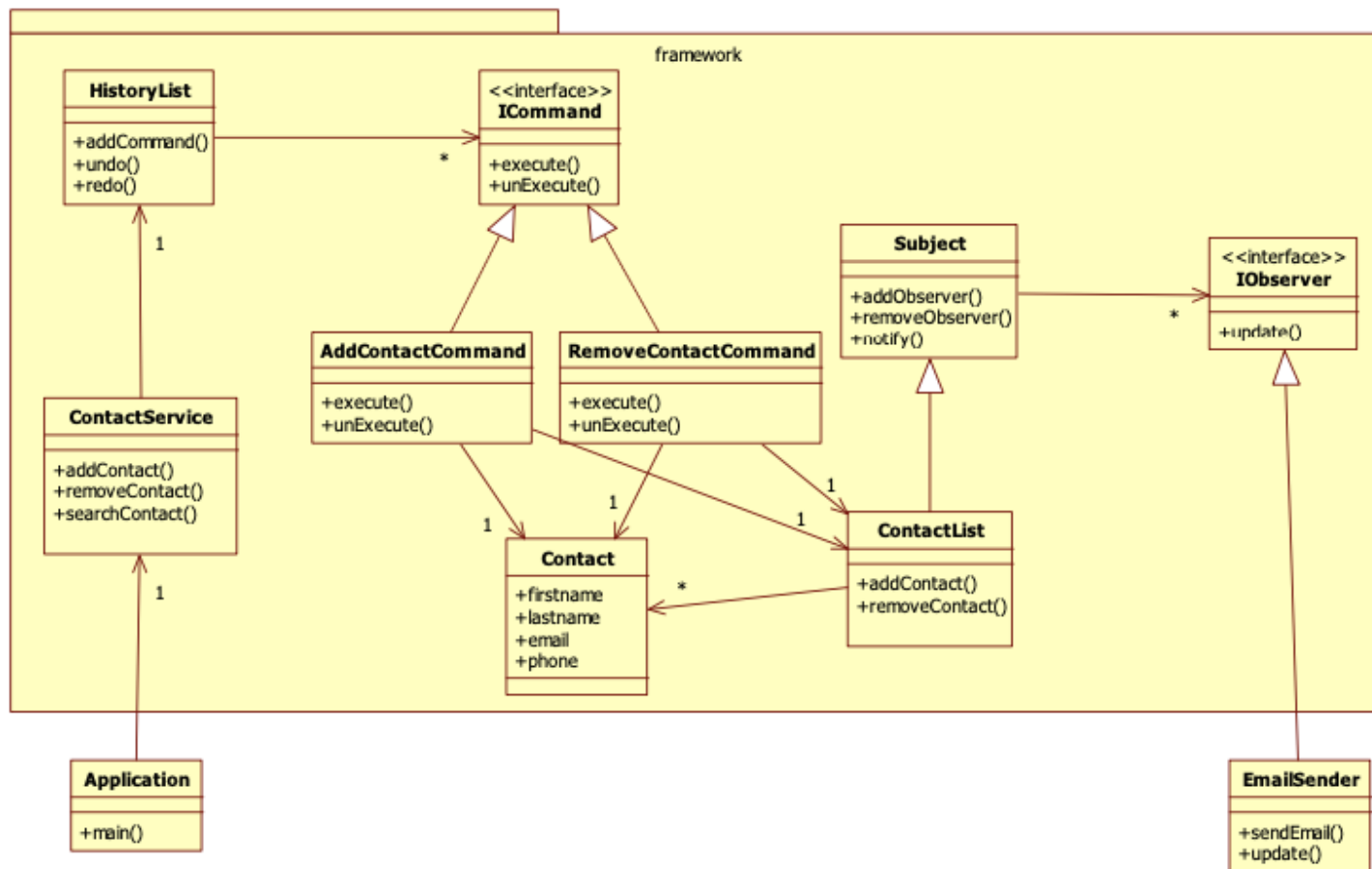
Question 1 [40 points] {50 minutes}

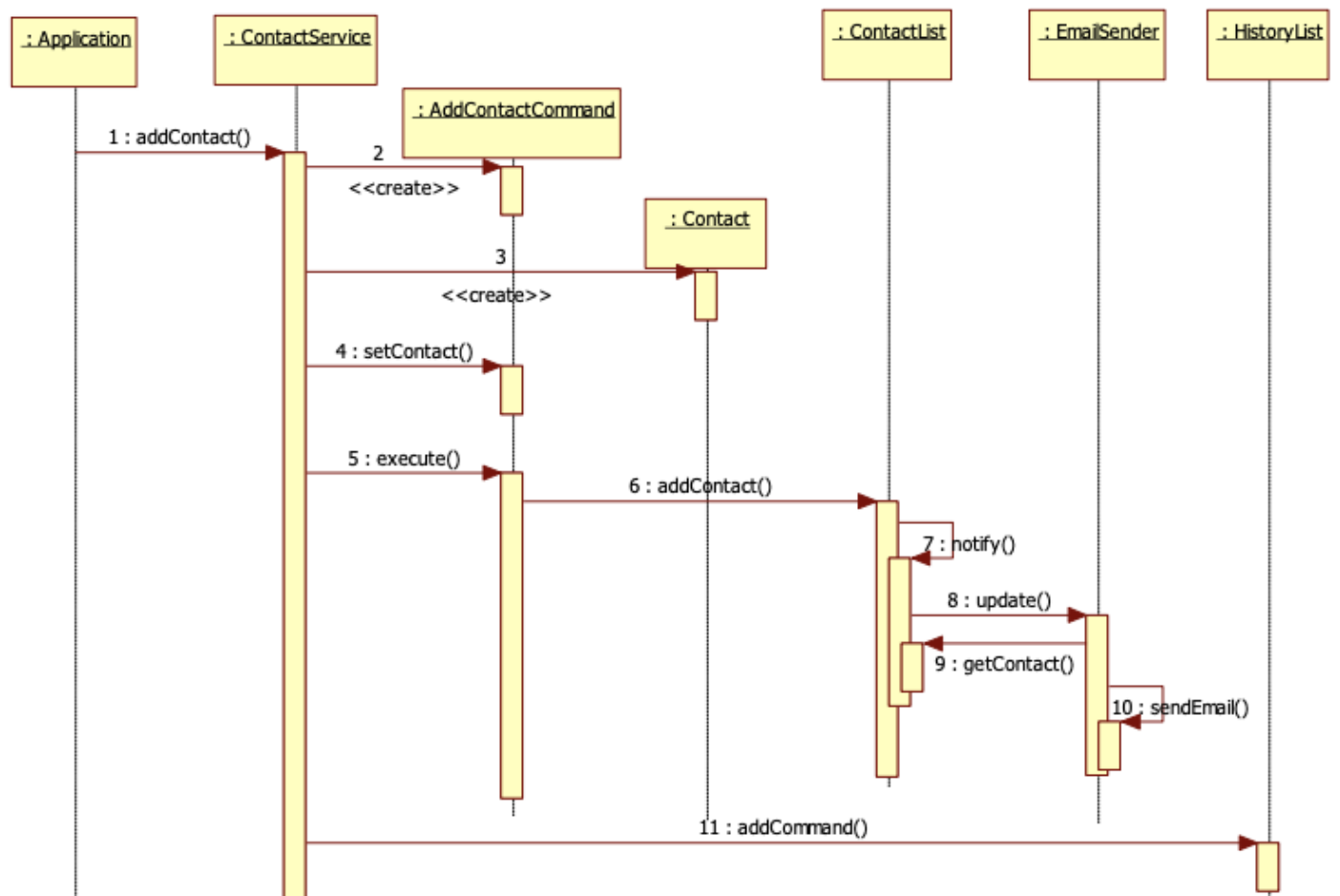
Design a general contact framework. This framework should contain the following functionality

- You should be able to **add** and **remove** contacts
- For every contact, the framework should store the first name, last name, email and phone number
- The frameworks can provide a list of the last 20 add or remove contact actions the user has done. We should be able to undo and/or redo any of these.
- Using the framework, it should be very easy to execute different functionality whenever we add or remove a contact. For example, the application that uses the framework might want to send a welcome SMS for every contact we add, and a goodbye SMS to every contact we remove. Or the application writes to a logfile whenever we add or remove a contact.

Now we want to use this contact framework to implement a contact application. This contact application has the following additional requirements:

- The application that uses the framework sends a welcome email to every contact we add, and a goodbye email to every contact we remove.





Question 2 [50 points] {60 minutes}

We need to design a rental framework which can be used to write rental applications such as a DVD rental application or a car rental application. The framework has the following requirements:

- We should be able to add new rentals, delete rentals and search rentals.
- For every rental we need to store the name, phone, email, street, city and zip code of the customer. We also need to keep track of the start date of the rental, the maximum duration of the rental and the end date of the rental.
- The framework should also support the functionality reserve products that you can rent. For every reservation you make, you need to keep track of the date you reserved it.
- The framework should also allow for categorizing the products that you can rent. So you can have for example a category “new releases” for a DVD rental application, and this category contains sub-categories like “drama” or “romance”
- The framework should also support different algorithms to compute the rental fee.
- The framework should support functionality for handling the events when customers don’t return their products on time. Every rental has a start date and a maximum duration. If the maximum duration has passed, the rental application should be able to handle this by sending an email, sending an SMS, writing to a log file, etc. The framework should have the functionality that an event is generated when the maximum duration has passed, and the application class should handle the desired action for the particular application.
- Rental shops often have more than one copy of the same product. A DVD rental shop might have 4 copies of one DVD title. A car rental might have 4 Ford Mustang cars. The rental framework should support this.

