BBM 382-Software Engineering
Midterm Exam
SOLUTIONS

April 4, 2017
Duration: 3 hours (Open book & notes)

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Student ID: ……

Student Name: ……

Signature: ……

Section: ☐ #1 (Dr. Vahid Garousi)
☐ #2 (Dr. Ayça Tarhan)

Part	Question	Points	Your mark
A-Software process and requirements	1	15	
	2	15	
	3	10	
	4	20	
	Sum	**60**	
B-Software design	5	15	
	6	20	
	7	5	
	Sum	**40**	
	Total	**100**	

Answer the midterm's questions in accordance to the system specifications provided below.

Web-based email system (HUmail):

Hacettepe University has signed a contract with your company about the following software project. Your task is to develop an email system called *HUmail*. This application should look like the popular Gmail. You should develop BOTH the email server and a web-based email client. You can use standard web and application servers. User accounts are created by an administrator (Users cannot create account themselves). User accounts can be of types: student, or personnel. Users can then login, and do various standard email activities (e.g., read, compose, send, forward, and delete emails, etc.). There should also be support for user preferences (email settings such as email signature) and email folders. The system should also have a spam detector.

PART A- Software process and requirements

Question-1. (15 points) AT

Explain each requirements level given below by a sentence. For each level, provide an example requirement for *HUmail*. *(Note that not every level of requirement is exemplified in the definition of HUmail. You may need to create your own examples for some of them.)*

a. Business requirement (3 pts)

Business requirements of a software system denote what the business entity (behind the software to be developed) expects (requires) the software to do in terms of business aspects.

For HUmail*:* the business entity (behind the software) is Hacettepe University. Hacettepe University would expect (require) this software to operate in a way to meet its business and operational activities. HU would require this software to maintain email accounts and email achieve of its personnel and students as conformant to its business and operational activities.

b. User requirement (4 pts)

User requirements, often referred to as user needs, describe what the user does with the system, such as what activities that users must be able to perform.

1. Users of HUmail need this system to enable them sending emails via their HUmail accounts.

c. System requirement (8 pts)

System requirements are the building blocks developers use to build the system. These are the traditional “shall” statements that describe what the system “shall do.” System requirements are classified as either functional or supplemental requirements.

1.1) HUmail should let user create and edit emails
1.2) HUmail should let users to select recipients
1.3) HUmail should let users to send emails to recipients
1.4) HUmail should enable secure transfer of email contents.

Question-2. (15 points) AT

Explain each of the following requirements by a sentence. For each type, provide a typical example requirement for *HUmail*.

a. Functional requirement (4 pts)

Functional requirements are the necessary functional features of a software.
HUmail should let students and staff read and send emails.

b. Product quality requirement (4 pts)

Product quality requirement are expectations on the quality of a software product.
The MTBF (mean time between failures) of HUmail should be less than one per month.

c. Domain requirement (3 points)

Domain requirement is the Requirement that comes from the application domain of the system that reflects the characteristics of that domain.

HUmail should support various email standards and protocols, e.g. SMTP, IMAP and POP3.
HU should enable timely delivery of email messages.

d. Process requirement (4 points)

Process requirement is the Requirement on the process models used for developing a software.

HUmail should be developed using the Agile Scrum process model.

Question-3. (10 points) VG

Write typical "verifiable" requirements for each of the following product quality attributes of *HUmail*:

a) Usability (3 points)

Users (students and personnel) shall be able to use all the system functions after six hours of training, without any errors.

b) Performance (response time) (3 points)

With up to 1,000 concurrent users (students and personnel), the system performance (as measured by response time of any operation) should not exceed 3 seconds.
With up to 10,000 concurrent users (students and personnel), the response time of any operation in the system should not exceed 5 seconds.
It is unlikely that more than 10,000 users will use the system concurrently. Thus, for more than 10,000 concurrent users, no requirements are set on the response time.

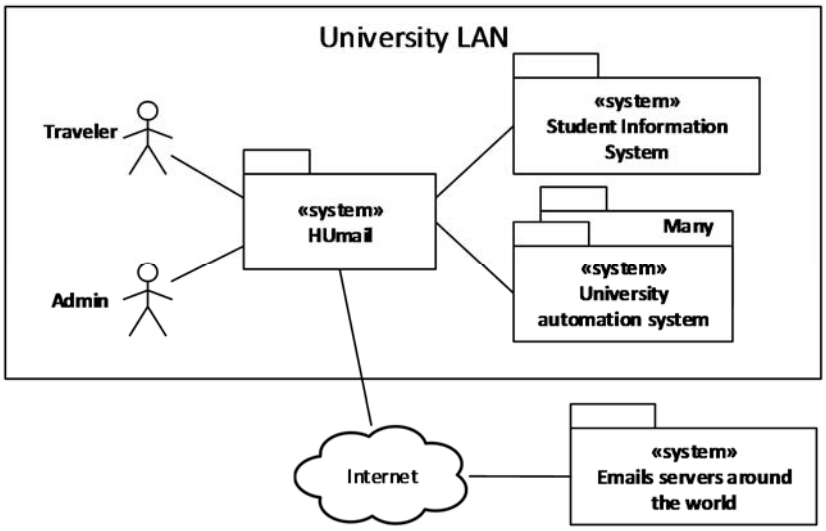
c) Security (4 points)

Number of high-severity vulnerabilities detected on the system by the latest vulnerability scanning process executed each month, using modern tools in this area, should always be 0.

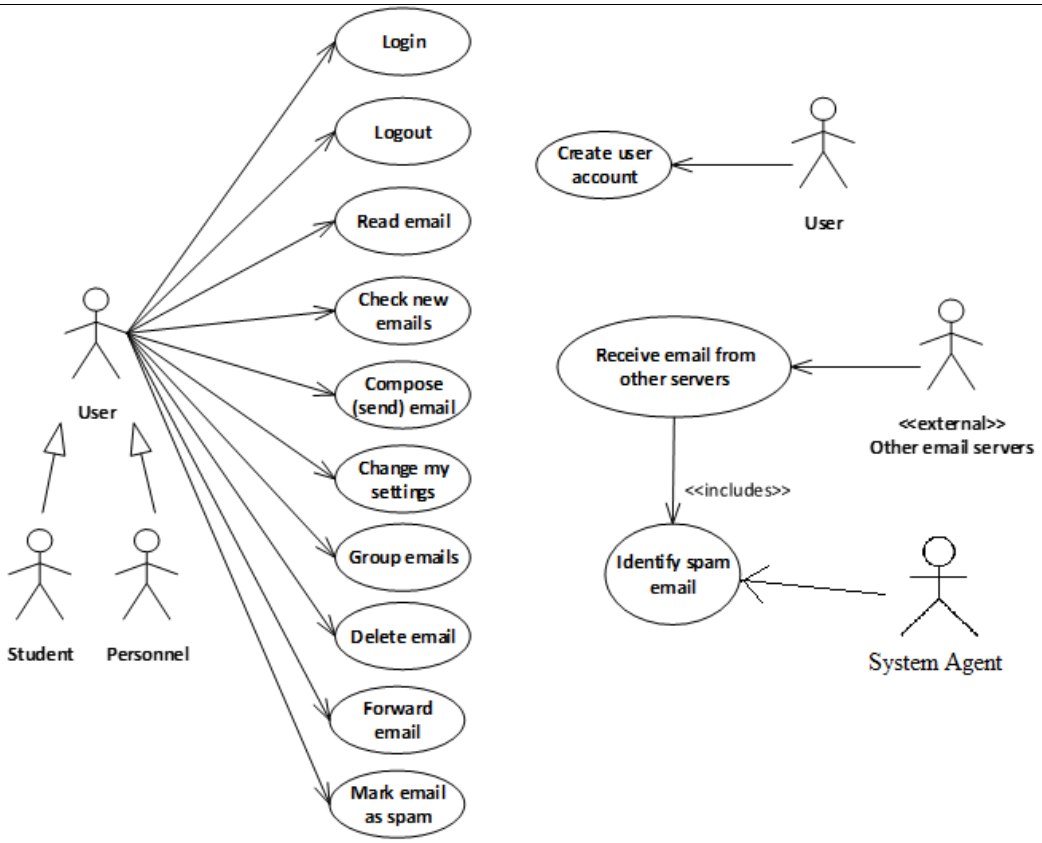
Question-4. (20 points) AT

Identify the scope of and carry out requirements analysis for *HUmail*. Note that the system includes BOTH the email server and a web-based email client.

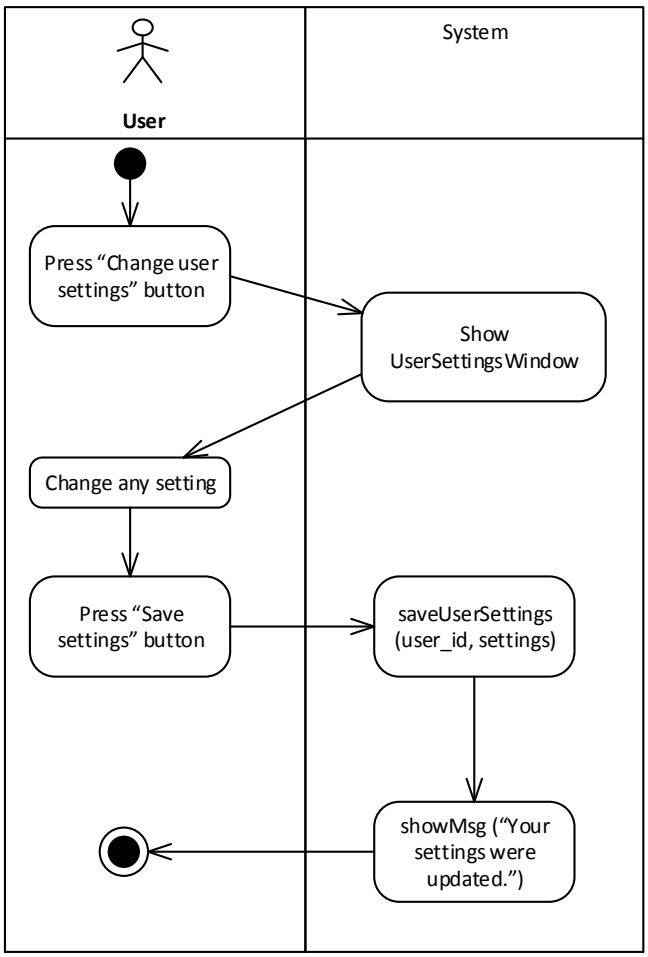
a. Draw the UML Context Diagram for this system. (5 points)



b. Draw the UML Use-case Diagram for this system. (10 points)



c. Draw Activity Diagram for the "Change user settings/preferences" use-case that you identified in the step above. (5 points)



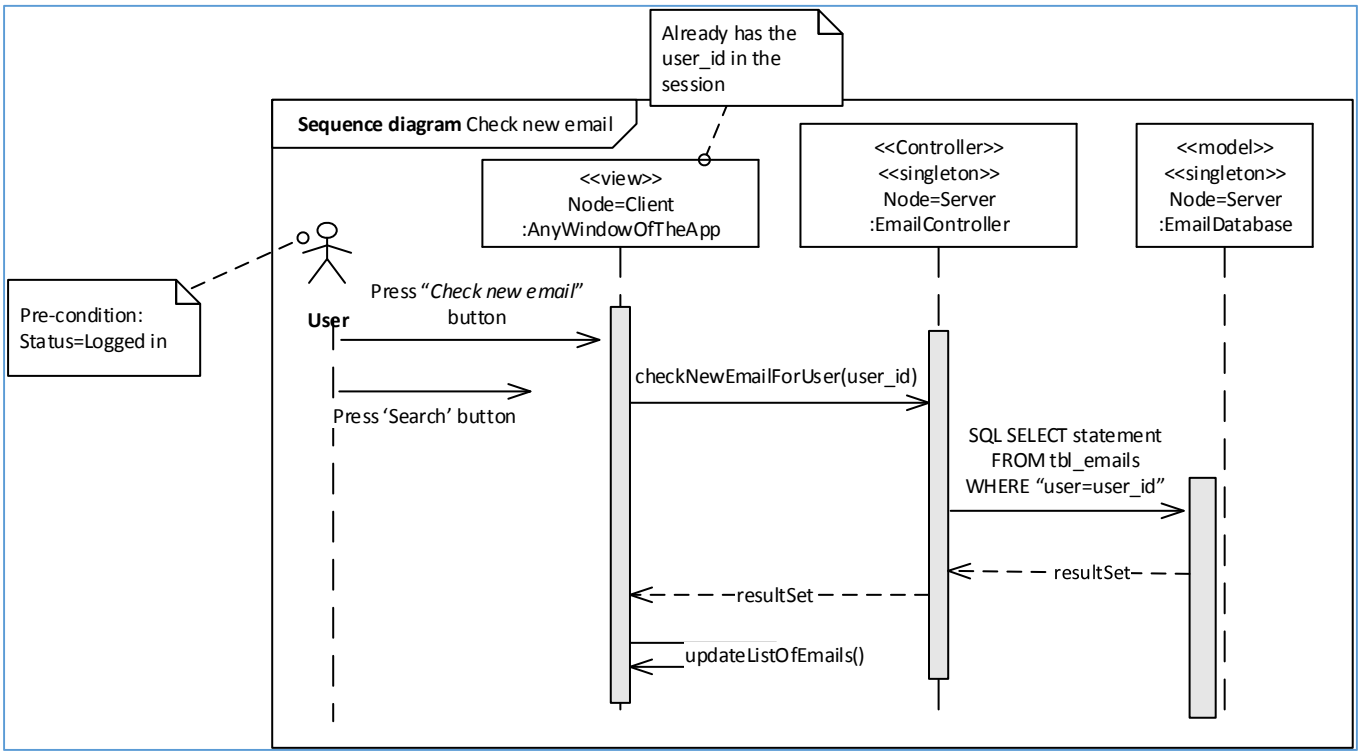
PART B-Software design

In the questions #5 and #6 below, follow the MVC architecture pattern.

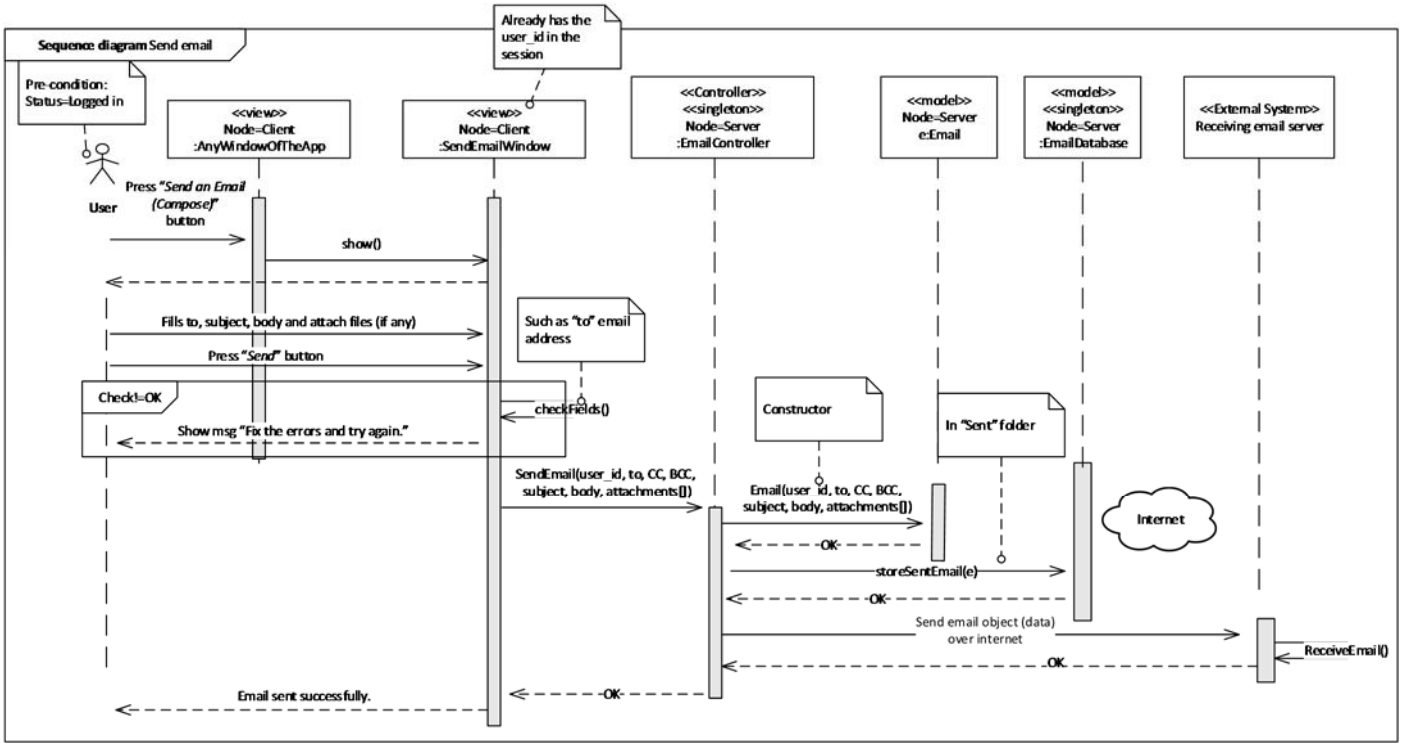
Question-5. (15 points) VG

Draw sequence diagrams for three use-cases, the ones that relate to “check new email”, “change user settings/preferences” and “send email”.

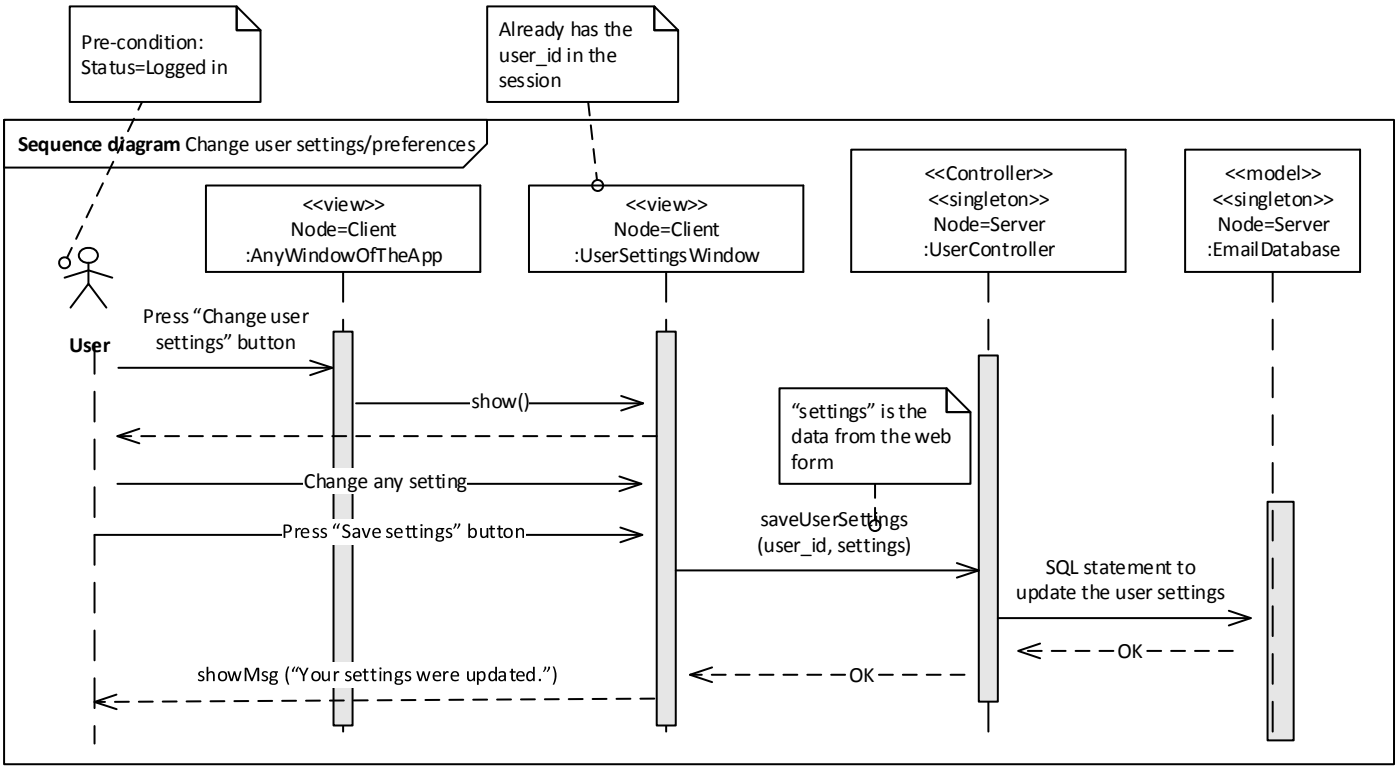
Sequence diagrams for use-case “check new email”:



Sequence diagrams for use-case “Send email”:

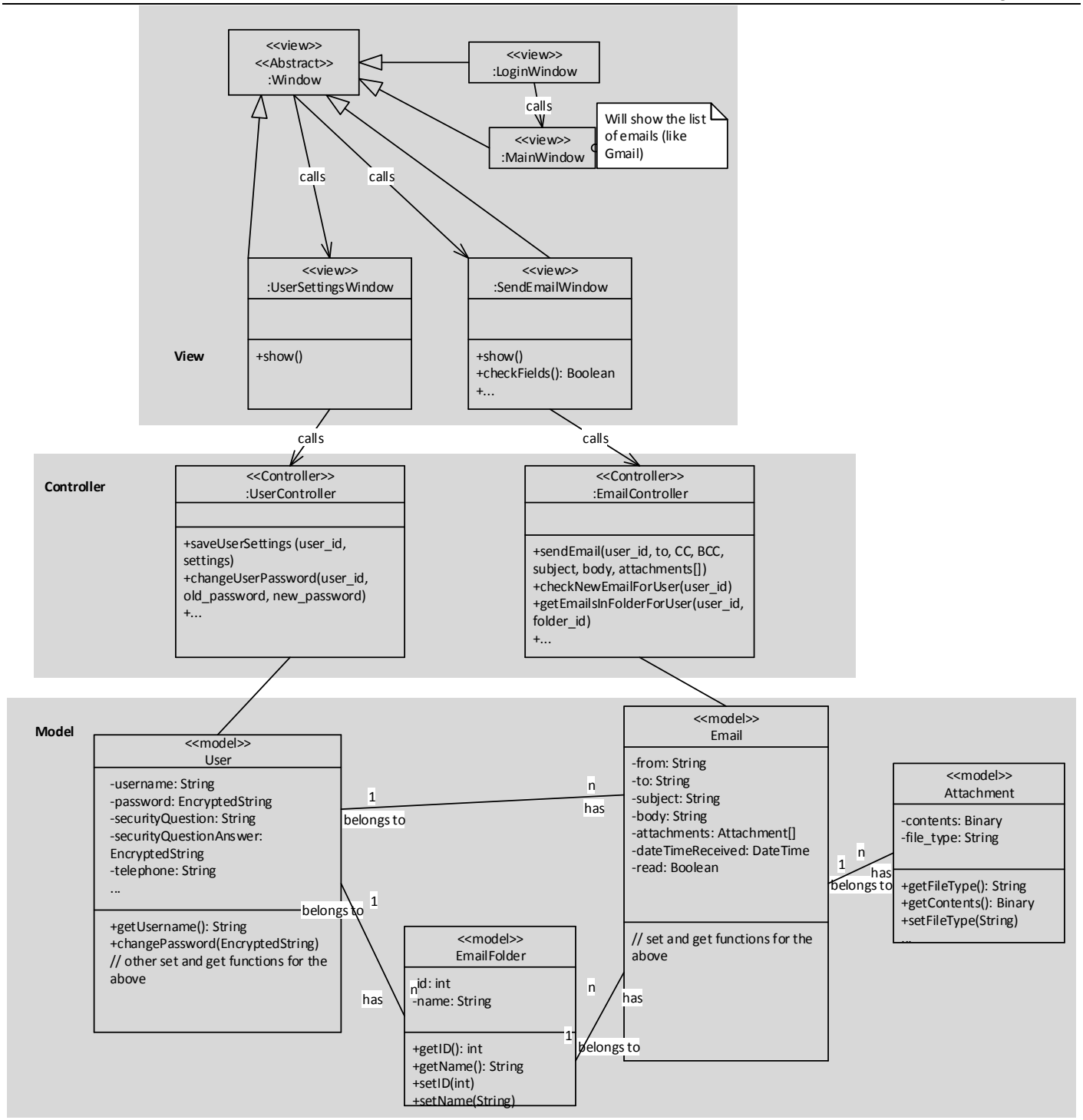


Sequence diagrams for use-case “Change user settings/preferences”:



Question-6. (20 points) VG

Draw the class diagram for this system. Each class should have its list of attributes and methods. Note that details on the class diagram should match with the function names shown on the above sequence diagrams (as discussed in class).


<<view>>
<<Abstract>>
:Window
<<view>>
:LoginWindow
calls
<<view>>
:MainWindow
Will show the list of emails (like Gmail)
calls
calls
<<view>>
:UserSettingsWindow
+show()
<<view>>
:SendEmailWindow
+show()
+checkFields(): Boolean
+...
View
calls
calls
Controller
<<Controller>>
:UserController
+saveUserSettings (user_id, settings)
+changeUserPassword(user_id, old_password, new_password)
+...
<<Controller>>
:EmailController
+sendEmail(user_id, to, CC, BCC, subject, body, attachments[])
+checkNewEmailForUser(user_id)
+getEmailsInFolderForUser(user_id, folder_id)
+...
Model
<<model>>
User
-username: String
-password: EncryptedString
-securityQuestion: String
-securityQuestionAnswer: EncryptedString
-telephone: String
...
+getUsername(): String
+changePassword(EncryptedString)
// other set and get functions for the above
1
belongs to
n
has
<<model>>
Email
-from: String
-to: String
-subject: String
-body: String
-attachments: Attachment[]
-dateTimeReceived: DateTime
-read: Boolean
// set and get functions for the above
<<model>>
Attachment
-contents: Binary
-file_type: String
+getFileType(): String
+getContents(): Binary
+setFileType(String)
...
1
has
belongs to
n
belongs to
1
has
n
<<model>>
EmailFolder
-id: int
-name: String
+getID(): int
+getName(): String
+setID(int)
+setName(String)
has
n
1
belongs to
n

Question-7. (5 points) VG

Identify a class in this system for which state-driven behavior is important and interesting, and then draw the state diagram for it, with full details (events and guard conditions).

Either of the following models would be acceptable.