

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## Contents

1.	Introduction	5
1.1	Purpose	5
1.2	Scope	5
1.3	Definitions, Acronyms, and Abbreviations	5
1.4	Overview	6
2.	Architectural Representation	6
2.1	Scenarios	6
2.2	Logical view	6
2.3	Process view	6
2.4	Development view	7
2.5	Physical view	7
3.	Architectural Goals and Constraints	7
3.1	Server side	7
3.2	Client Side	7
3.3	Security	7
3.4	Persistence	8
3.5	Reliability / Availability	8
3.6	Performance	8
3.7	Portability and reuse	8
3.8	Development tools	8
3.9	Schedule	9
4.	Use-Case View	11
4.1	Use case diagrams	11
4.2	Use-Case Realizations	14
4.2.1	User Management related use cases	14
4.2.2	Lecturer specific use cases	18
4.2.3	Student specific use cases	24
4.2.4	Admin specific use cases	27
5.	Logical View	29
5.1	Overview	29
5.1.1	Subsystems	29
5.1.2	Layering	30
5.2	Architecturally Significant Design Packages	31
5.2.1	Class diagram	31
5.2.2	ER diagram	32
6.	Process View	33
6.1	System sequence diagrams	33
6.1.1	User logs into the system	33
6.1.2	User invokes “forget password”	34
6.1.3	User changes the password	34
6.1.4	User logs out from the system	35
6.1.5	Admin creates a new user	35
6.1.6	User edits the profile	36

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

6.1.7	Lecturer creates a new MCQ	36
6.1.8	Lecturer creates a new essay question	37
6.1.9	Lecturer generates a MCQ paper using the MCQs that are already saved in the database.	37
6.1.10	Lecturer schedules a paper	38
6.1.11	Lecturer marks a paper	38
6.1.12	Lecture views results	39
6.1.13	Student attempts a MCQ paper	39
6.1.14	Student enrolls to a new subject	40
6.1.15	Admin adds a new subject	41
6.1.16	Admin adds a lecturer for a subject	41
6.1.17	Admin adds a batch of new students	41
6.2	Activity Diagrams	42
6.2.1	Student enrolls to a subject	42
6.2.2	Student attempts MCQ quiz	43
6.2.3	Student attends essay quiz	44
6.2.4	User Views grades and performance	45
6.2.5	Admin adds a new batch	46
6.2.6	Admin adds a new subject	47
6.2.7	Admin maps lecturers with subject	48
6.2.8	Lecturer Submits new MCQ	49
6.2.9	Lecturer Submits new essay	50
6.2.10	Lecturer generates MCQ paper	51
6.2.11	Lecturer generates essay paper	52
6.2.12	Lecturer schedules a paper	53
6.2.13	Lecturer marks essay paper	54
7.	Deployment View	54
8.	Implementation View	55
8.1	Overview	55
8.2	Layers	56
9.	Data View	57
9.1	ER diagram	57
9.2	MYSQL implementation	57
10.	Size and Performance	58
11.	Quality	58

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

# Software Architecture Document

## 1. Introduction

“Online examination system (OES)” is a platform to hold online examinations. It caters to many requirements of holding online examinations. The system can generate statistical data for the records. The system makes it possible to maintain a repository of questions, and then generates papers at a later stage, such that the lecturer has more flexibility over holding online quizzes. Furthermore it provides the functionality to mark the papers automatically.

This document elaborates the software architecture document for the system “Online Examination System (OES)”. The system architecture is abstracted into many views and components which are explained in detail. The document follows the 4+1 view model as the reference model for this document.

### 1.1 Purpose

This document provides a comprehensive architectural overview of the system, using a number of different architectural views to depict different aspects of the system. It is intended to capture and convey the significant architectural decisions which have been made on the system.

This document elaborates the architecture of the system in 5 different views. (4+1 view model). Both static and dynamic behavior of the system is described in this document. All the required diagrams and their descriptions are available in this document.

Using 4+1 view model makes it possible to depict the software as accurately as possible. It allows a wide range of stakeholders to find what they require in the architecture document.

### 1.2 Scope

The software architecture document applies to each static and dynamic aspect of the system. Since 4+1 view model is used as the reference model, it incorporates many view of the system, thus makes the document complete and consistent.

Under the static behavior of the system, the document discusses the class diagrams, package diagrams and other static architecture designs. Dynamic aspects of the system are elaborated using use case realizations and system sequence diagrams.

### 1.3 Definitions, Acronyms, and Abbreviations

OES – Online examination system (project name)

OOP – Object oriented programming

MVC – Model view control architecture

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 1.4 Overview

The report will present a detailed analysis of the architecture of Online Examination system. Further sections cover the architectural representation of the project including architectural representation, architectural goals and constraints and use case realizations. The later sections cover the detailed specific details of the 4 main views (logical view, process view, deployment view and implementation view) of the system. Furthermore, the document describes the data view and performance, quality views.

## 2. Architectural Representation

This section details the architecture using the views defined in the “4+1” model. The views used to document the OES (online examination system) application are:

### 2.1 Scenarios

#### **Audience:**

All the stakeholders of the system, including the end-users.

#### **Area:**

Describes the set of scenarios and/or use cases that represent some significant, central functionality of the system. Describes the actors and use cases for the system. Other than the basic work flow the documents addresses the exception cases, exception outputs, and other related use cases.

### 2.2 Logical view

#### **Audience:**

Designers, Programmers, Testing staff

#### **Area:**

Functional requirements, object hierarchy, system layers

Describes the design of object model. Also describes the subsystems of the system and their relationships.

### 2.3 Process view

#### **Audience:**

Integrators, Programmers

**Area:** Non-functional requirements, describes the design's concurrency and synchronization aspects. Elaborates the run time behavior of the system.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 2.4 Development view

### **Audience:**

Programmers, Code testers

### **Area:**

Software components: describes the modules and subsystem divisions of the system.

## 2.5 Physical view

### **Audience:**

Database administrators, System engineers, Deployment managers

### **Area:**

Persistence: describes the architecturally significant persistent elements in the data model. Describes the mapping of the software onto the hardware and shows the system's distributed aspects

## 3. Architectural Goals and Constraints

### 3.1 Server side

OES (Online examination system) will be hosted at “Hoerku” JSP server. Being a web based application, this underlying client OS can be any PC operating system. (Windows, Linux, Apple). MySQL will be used as the central database server. All communication with client has to comply with public HTTPS, TCP/IP communication protocol standards.

### 3.2 Client Side

Users will be able to access OES only online. At the initial stage this will be hosted as a standalone application, but with modifications, it can be integrated with a system like university MOODLE system, so that users may use the features using the major system (like MOODLE). Clients/users are expected to use a modern web browser such as Mozilla Firefox 10, Internet Explorer 9, Google Chrome or Safari to get full user experience. .

### 3.3 Security

Central security features are handled by the institute officials. They'll be given full access features both in the application and database levels. Creating user accounts for lecturers, students are done by the admin staff. After the users are added to the system, they'll be provided with a default password, which can be changed by the user. All the passwords are encrypted in order to ensure higher security. Responses and commits made by the students can be seen only by the relevant lecturer and admin.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 3.4 Persistence

All the data will be saved in the central server. This is a relational database that implements the 3<sup>rd</sup> normal form. (MySQL). In order to maintain ACID (Atomicity, Confidentially, Integrity, Durability) some measures have been taken such as encrypting passwords, using transactions for all database commits and etc.

### 3.5 Reliability / Availability

The system will be subjected to several testing operations (Unit testing, integration testing, system testing) before being deployed in order to make sure that the system is reliable. The MYSQL database server can respond to many number of clients at a given moment without losing consistency and data integrity. .

### 3.6 Performance

The system responds to any request under standard database and web server script timeouts (30 seconds), also system performance can depend on available hardware, network and internet connection capabilities. Especially the statistical information generation tasks may take comparatively high time. Therefore, actual performance can be determined only after the system is deployed and tested.

### 3.7 Portability and reuse

Even though OES is designed as a complete and standalone product, it's possible to extend the product to integrate in a system like MOODLE. In order to maintain reusability, all the functionalities are very well structured and layered. Best practices of RUP are followed throughout the project and the project strictly adheres to OOP standards.

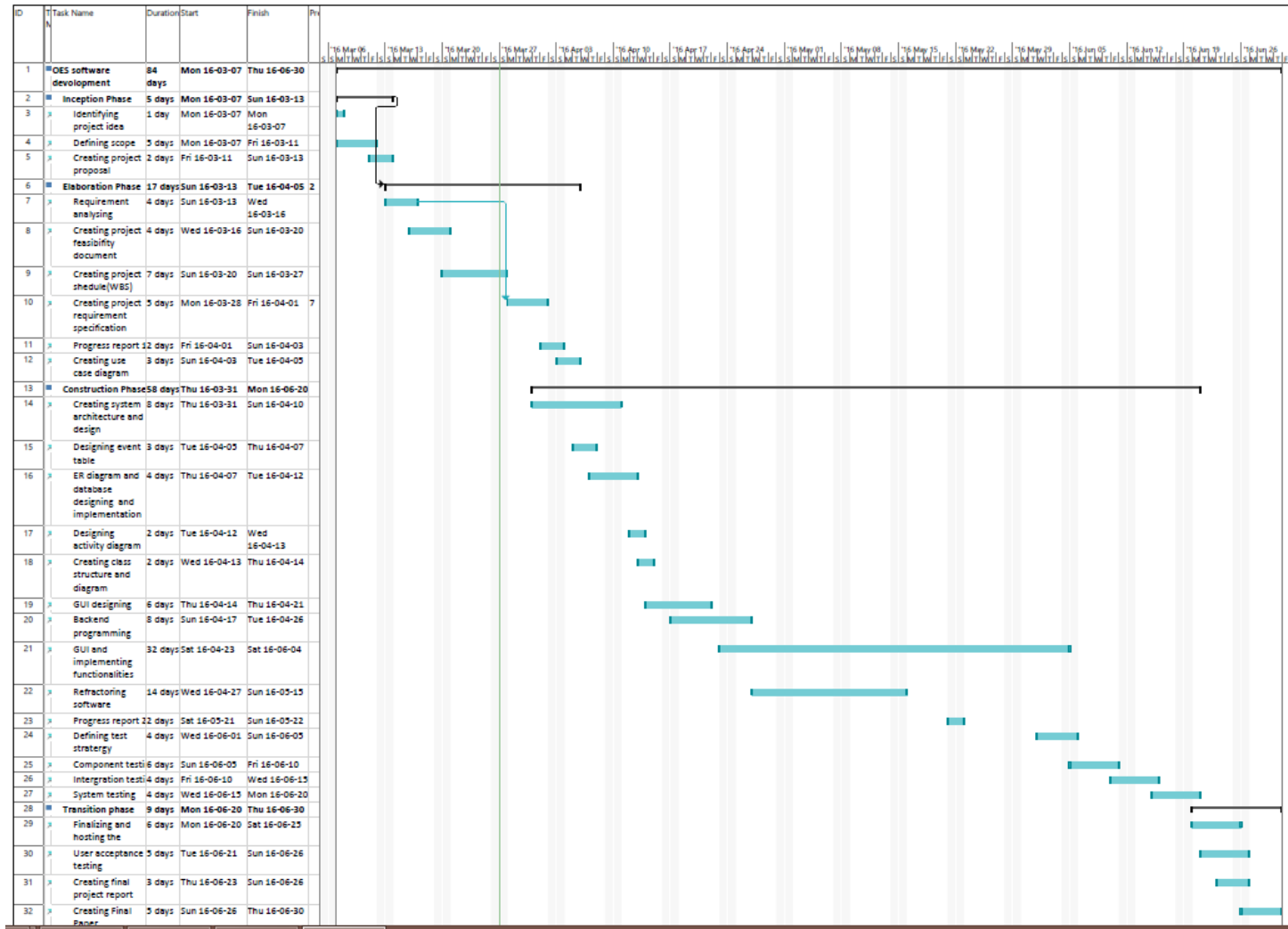
### 3.8 Development tools

The project incorporates many development tools.  
Programming: NetBeans IDE  
Database: XAMPP  
Diagrams: Draw.IO, CREATLY, GENMYMODEL  
Database connection: MYSQL connector  
Schedule: Microsoft Project

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 3.9 Schedule

The project is designed using RUP workflows. All the activities come under one of 4 main phases, Inception phase, Elaboration phase, construction phase and transition phase. All the deliverables and relevant deadlines are considered and satisfied in this work break down structure. The following diagram shows the GAANT chart of the OES.



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

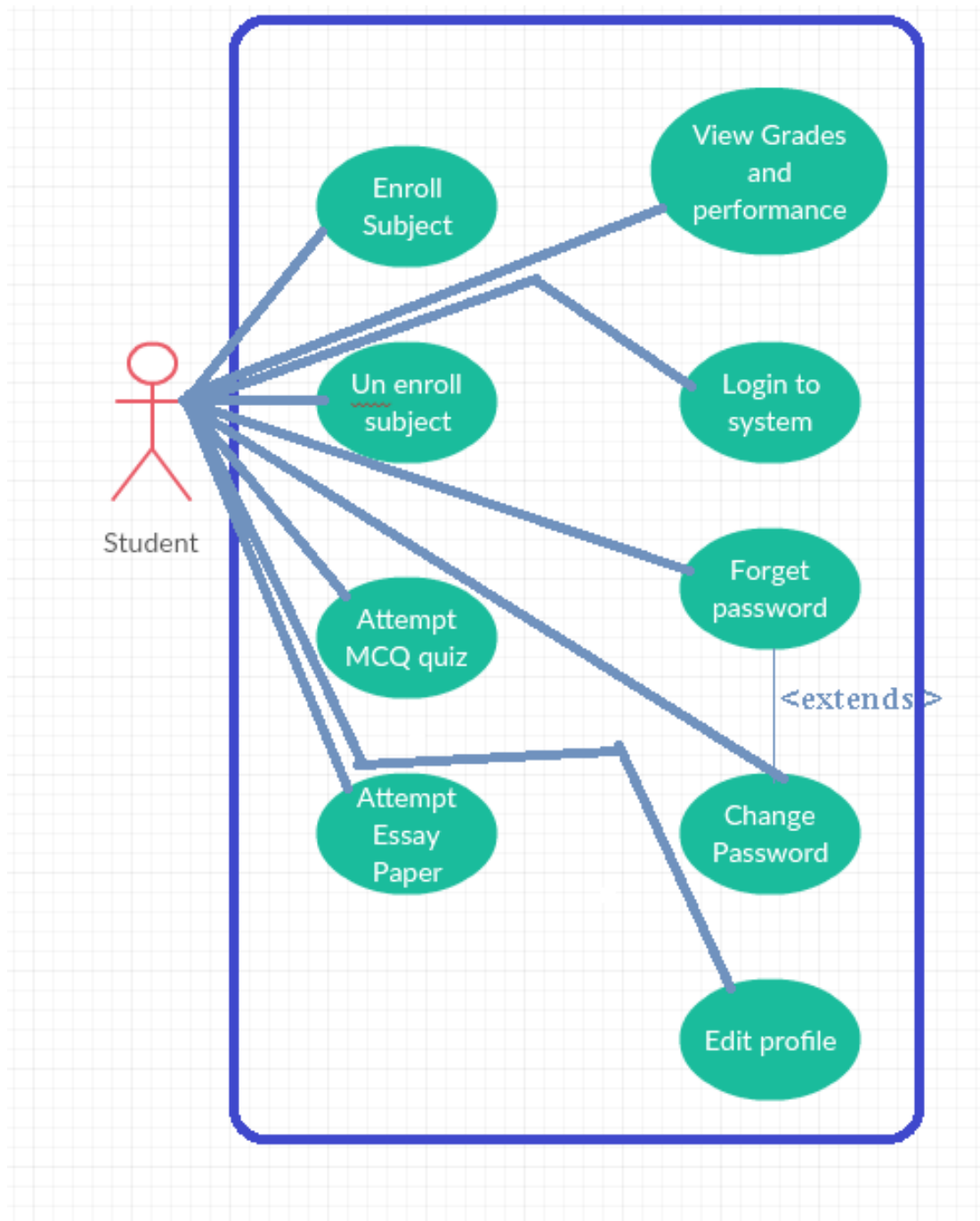
	Task Name	Durat	Start	Finish	
1	<b>▲ OES software development</b>	<b>84 days</b>	<b>Mon 16-03-07</b>	<b>Thu 16-06-30</b>	
2	<b>▲ Inception Phase</b>	<b>5 days</b>	<b>Mon 16-03-07</b>	<b>Sun 16-03-13</b>	
3	Identifying project idea	1 day	Mon 16-03-07	Mon 16-03-07	
4	Defining scope	5 days	Mon 16-03-07	Fri 16-03-11	
5	Creating project proposal	2 days	Fri 16-03-11	Sun 16-03-13	
6	<b>▲ Elaboration Phase</b>	<b>17 days</b>	<b>Sun 16-03-13</b>	<b>Tue 16-04-05</b>	<b>2</b>
7	Requirement analysing	4 days	Sun 16-03-13	Wed 16-03-16	
8	Creating project feasibility document	4 days	Wed 16-03-16	Sun 16-03-20	
9	Creating project shedule(WBS)	7 days	Sun 16-03-20	Sun 16-03-27	
10	Creating project requirement specification	5 days	Mon 16-03-28	Fri 16-04-01	7
11	Progress report 1	2 days	Fri 16-04-01	Sun 16-04-03	
12	Creating use case diagram	3 days	Sun 16-04-03	Tue 16-04-05	
13	<b>▲ Construction Phase</b>	<b>58 days</b>	<b>Thu 16-03-31</b>	<b>Mon 16-06-20</b>	
14	Creating system architecture and design	8 days	Thu 16-03-31	Sun 16-04-10	
15	Designing event table	3 days	Tue 16-04-05	Thu 16-04-07	
16	ER diagram and database designing and implementation	4 days	Thu 16-04-07	Tue 16-04-12	
17	Designing activity diagram	2 days	Tue 16-04-12	Wed 16-04-13	
18	Creating class structure and diagram	2 days	Wed 16-04-13	Thu 16-04-14	
19	GUI designing	6 days	Thu 16-04-14	Thu 16-04-21	
20	Backend programming	8 days	Sun 16-04-17	Tue 16-04-26	
21	GUI and implementing functionalities	32 days	Sat 16-04-23	Sat 16-06-04	
22	Refractoring software	14 days	Wed 16-04-27	Sun 16-05-15	
23	Progress report 2	2 days	Sat 16-05-21	Sun 16-05-22	
24	Defining test strategry	4 days	Wed 16-06-01	Sun 16-06-05	
25	Component testing	6 days	Sun 16-06-05	Fri 16-06-10	
26	Intergration testing	4 days	Fri 16-06-10	Wed 16-06-15	
27	System testing	4 days	Wed 16-06-15	Mon 16-06-20	
28	<b>▲ Transition phase</b>	<b>9 days</b>	<b>Mon 16-06-20</b>	<b>Thu 16-06-30</b>	
29	Finalizing and hosting the system	6 days	Mon 16-06-20	Sat 16-06-25	
30	User acceptance testing	5 days	Tue 16-06-21	Sun 16-06-26	
31	Creating final project report	3 days	Thu 16-06-23	Sun 16-06-26	
32	Creating Final Paper	5 days	Sun 16-06-26	Thu 16-06-30	



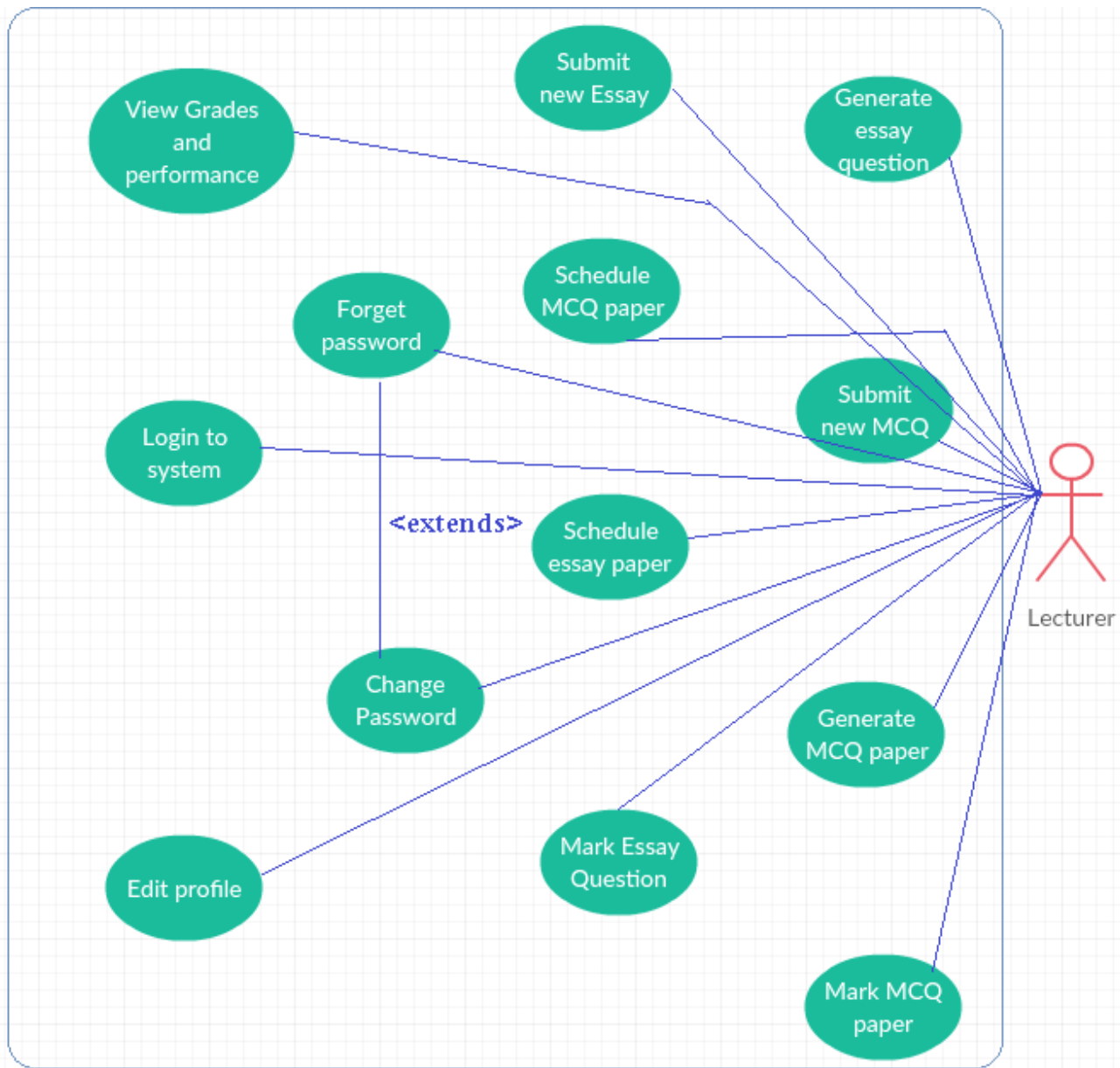
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 4. Use-Case View

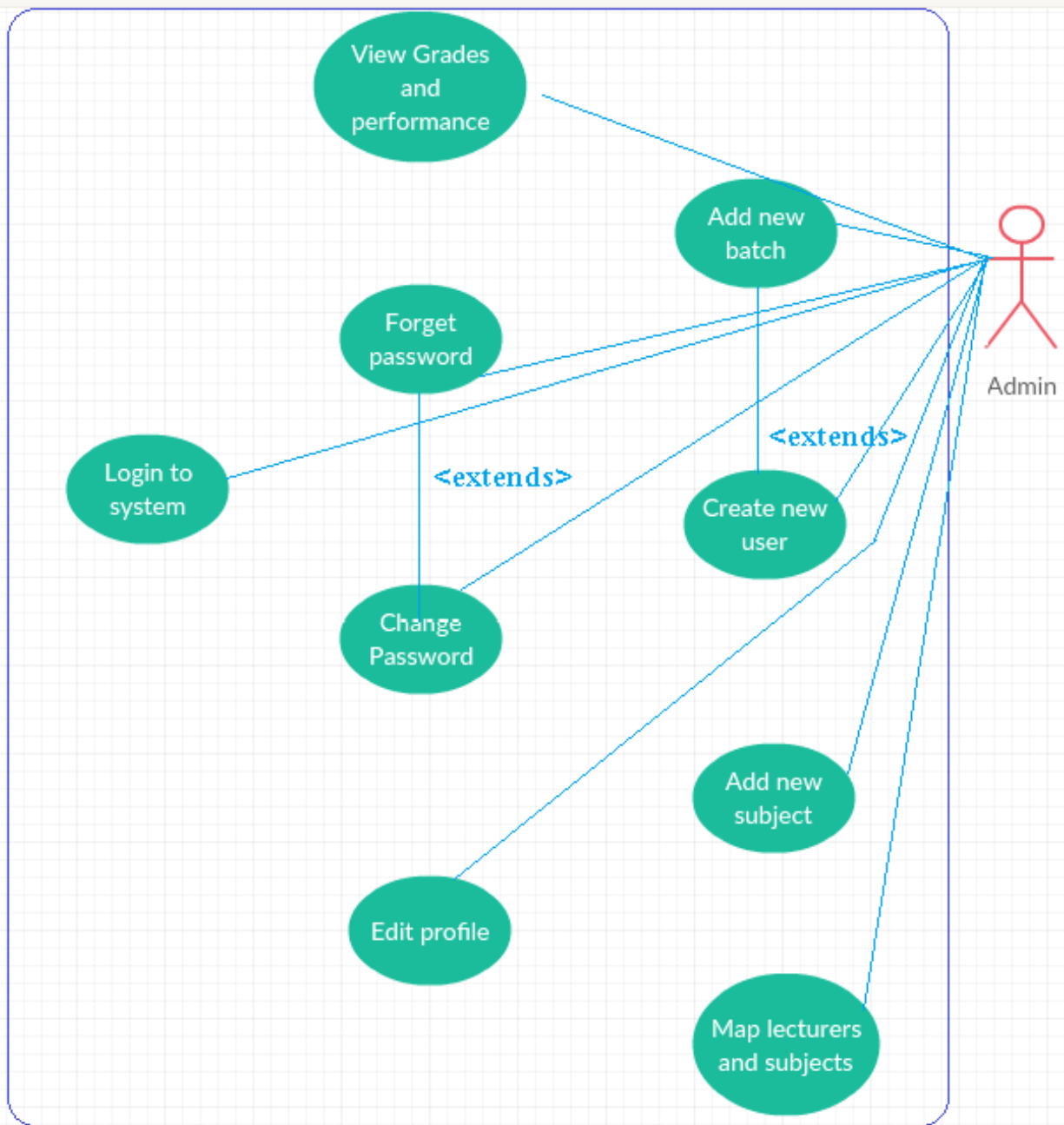
### 4.1 Use case diagrams



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 4.2 Use-Case Realizations

### 4.2.1 User Management related use cases

#### 4.2.1.1 User logs into the system

Use case name	Login to the system.
Scenario	Login to the system using username and password.
Triggering event	User enters the username and password and submit.
Brief description	When user inputs username and password, system checks for the validity and the matching of input values and redirects to the home page of user. (the home page depends on the user and user type)
Actors	Student, Lecturer, Admin
Related use cases	Null.
Preconditions	The user should be a valid user (should possess a username and password).
Post conditions	If the user is a valid user, he or she should be redirected to the correct home page.
Flow of events	User loads the login page. User inputs the username and password and then submit. System check the validity of the entered password and username. If this is a valid user, the user will get redirected to respective home page.
Exception conditions	If the entered username and password is invalid, the user will be asked to enter them again. If the user has forgotten the password, he can click “forget password”.

#### 4.2.1.2 User invokes “forget password”

Use case name	User invokes “forget password”
Scenario	When the user forgets the password, he or she can invoke forget password and go through a recovery process.
Triggering event	User clicks “forget password” button.
Brief description	When user clicks “forget password“, he can ask the

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

	system to send a mail to his email address, from which he can change the password to a new one.
Actors	Student, Lecturer, Admin
Related use cases	Login to the system.
Preconditions	The user should be a valid user, and should have an email address that is saved in the system.
Post conditions	User will be able to change the password.
Flow of events	User clicks the forget password. Then using the window, user can ask for a mail which contents a security key. User types that security key in the following interface. Then if the code is correct, user will be redirected to change password page.
Exception conditions	If the user doesn't have a pre-set email address, the user can't continue this process and the user should contact the system admin and reset the password. If the user enters the wrong code, he can re attempt and get a new code.

#### 4.2.1.3 User changes password

Use case name	User changes the password.
Scenario	The user changes his or her password.
Triggering event	User enters previous password, new password and the confirmations and submit.
Brief description	When the user goes to the "change password" section, he or she can change the password. For that the user should input the previous password again. The new password and confirm new password fields should be identical. The password should adhere to the security standards that are enforced by the application policy (more than 8 characters long, should contain alphanumeric and symbolic characters). Or else when a user forgets the password and using the code that is sent via an email the user can access the "change password" section.
Actors	Student, Lecturer, Admin
Related use cases	Login to the system, User invokes "forget password".

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Preconditions	The user should be a valid user (should possess a username and password) and should have a working account. User should remember the previous password (or else should go through forget password section).
Post conditions	User gets a new password.
Flow of events	User clicks change password control. User inputs previous password. User inputs new password and the “confirm new password” section. System checks the equality of two entered passwords, and whether the new password adheres to the password standards that are enforced. User submits the form. If the user has forgotten the previous password, he should follow the forget password scenario.
Exception conditions	If the password doesn’t adhere to the rules of the system, it would ask for another password. If the new password filed and “confirm new password” fields doesn’t match, it’ll ask to re-enter the passwords.

#### 4.2.1.4 User log outs from the system

Use case name	User logs out from the system.
Scenario	User who has currently logged into the system logs out.
Triggering event	User clicks logout button.
Brief description	When a user who has already logged in to the system clicks “logout” he’ll get log out from the system, so that the session variables will get reset.
Actors	Student, Lecturer, Admin
Related use cases	Login to the system.
Preconditions	The user have logged in to the system already.
Post conditions	User should get redirected to the login page.
Flow of events	User clicks “logout”. System removes the session values for this user User gets redirected to the login page.
Exception conditions	None.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 4.2.1.5 Create a new user

Use case name	Create a new user.
Scenario	The admin creates a new user account.
Triggering event	The admin submit a new user account creation activity.
Brief description	When a new user has to be added to the new system, the admin adds him using “create new user” work flow. If the new user is a lecturer or an admin, the user will get added separately, whereas students will get added as a batch. The new user gets a username and a password. The password can be reset later.
Actors	Admin
Related use cases	None
Preconditions	The new user should possess all the required attributes of the user entity (NIC, email, etc.)
Post conditions	New user should get access to the system.
Flow of events	New user provides the essential details to an admin. Admin performs “create new user” activity. Admin submits the form. System saves a new user account. A new username and a password is given to the new user.
Exception conditions	None

#### 4.2.1.6 User edits his own profile

Use case name	User edits the profile.
Scenario	The user edits his own user details.
Triggering event	User invokes the “edit user” configuration.
Brief description	The user who has already logged in to the system, edits his details. The username and the password can’t be changed at this point. Some other parameters such as NIC can’t be changed as well.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Actors	Student, Lecturer, Admin
Related use cases	None
Preconditions	The user should have logged in to the system already.
Post conditions	User details get updated.
Flow of events	User clicks “edit profile” tab. User submits the “edit” form. System checks for the validity of new values entered. System saves the new information.
Exception conditions	New information doesn’t adhere to the system rules: System asks the user to resubmit.

#### 4.2.2 Lecturer specific use cases

##### 4.2.2.1 Submit new MCQ

Use case name	Lecturer submits a new MCQ.
Scenario	A new MCQ is added to the system.
Triggering event	Lecturer adds a new MCQ.
Brief description	The lecturer adds a new MCQ to one of his enrolled subjects. The system checks the completeness of the question and saves it.
Actors	Lecturer, System
Related use cases	None
Preconditions	The new MCQ should possess all the required fields. The lecturer should be logged in to the system. The lecturer should be enrolled to the subject to which the new MCQ belongs.
Post conditions	New MCQ added to the specified subject.
Flow of events	Lecturer adds all the fields of “add a new MCQ” option. Lecturer submits the form. System checks for the validity of entered values. System saves the MCQ.



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Exception conditions	None.
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#### 4.2.2.2 Submit new essay questions

Use case name	Lecturer submits a new essay question.
Scenario	A new essay question is added to the system.
Triggering event	Lecturer adds a new essay question.
Brief description	The lecturer adds a new essay question to one of his enrolled subjects. The system checks the completeness of the question and saves it.
Actors	Lecturer, System
Related use cases	None
Preconditions	The new essay question should possess all the required fields. The lecturer should be logged in to the system. The lecturer should be enrolled to the subject to which the new essay question belongs.
Post conditions	New essay question added to the specified subject.
Flow of events	Lecturer adds all the fields of “add a new essay question” option. Lecturer submits the form. System checks for the validity of entered values. System saves the essay question.
Exception conditions	None.

#### 4.2.2.3 Generate papers using MCQ

Use case name	Generate MCQ paper.
Scenario	Lecturer generates a new MCQ paper.
Triggering event	Lecturer invokes create new paper option.
Brief description	The lecturer can create a new MCQ paper for a given subject. Lecturer can use the MCQs that are already saved in the database for that particular subject. This

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

	paper will be saved in the system.
Actors	Lecturer
Related use cases	Create new MCQ
Preconditions	There should be at least one MCQ for the specified subject of interest.
Post conditions	A new MCQ paper is generated for the specified subject.
Flow of events	Lecturer selects a subject out of the subjects he has enrolled in. Lecturer invokes create new MCQ paper option. Lecturer selects n number of MCQs that are there in the database. Lecturer adds a description and submit action. System saves the new paper.
Exception conditions	No MCQ is available for that subject: System sends a warning saying that no MCQ is found for that specific subject.

#### 4.2.2.4 Schedule a MCQ paper

Use case name	Schedule a new MCQ paper.
Scenario	The lecturer schedules a new MCQ paper.
Triggering event	A new paper is scheduled.
Brief description	Using the MCQ papers that are already generated previously, the lecturer can schedule them. Lecturer specifies the attributes such as starting date, time and then submit. The system validates the input values and send a notification to enrolled students of that subject.
Actors	Lecturer, Student
Related use cases	Create new MCQ paper.
Preconditions	At least one MCQ paper should exist for the specified subject.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Post conditions	A notification is sent to all enrolled students.
Flow of events	Lecturer clicks the “schedule new MCQ paper” option. System displays all the available papers. Lecturer selects one paper and specifies the related attributes such as due date, time. Lecturer submits the values. System validates the entered attributes. System sends a notification to all the enrolled students of the particular subject.
Exception conditions	No paper is available: System displays a warning message.

#### 4.2.2.5 Schedule an essay question

Use case name	Schedule a new essay paper.
Scenario	The lecturer schedules a new essay paper.
Triggering event	A new paper is scheduled.
Brief description	Using the essay papers that are already generated previously, the lecturer can schedule them. Lecturer specifies the attributes such as starting date, time and then submit. The system validates the input values and send a notification to enrolled students of that subject.
Actors	Lecturer, Student
Related use cases	Create new essay paper
Preconditions	At least one essay paper should exist for the specified subject.
Post conditions	A notification is sent to all enrolled students.
Flow of events	Lecturer clicks the “schedule new essay paper” option. System displays all the available papers. Lecturer selects one paper and specifies the related attributes such as due date, time. Lecturer submits the values. System validates the entered attributes. System sends a notification to all the enrolled students of the particular subject.
Exception conditions	No paper is available: System displays a warning message.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 4.2.2.6 Mark MCQ paper

Use case name	Mark MCQ paper.
Scenario	The system marks the MCQ paper
Triggering event	The student submits a MCQ paper. Allocated time finishes for a MCQ paper.
Brief description	When a student finishes a MCQ paper, the system automatically marks the answers. The prompts for each question is saved in the system.
Actors	Student, System
Related use cases	Attempt MCQ quiz - student
Preconditions	Student should submit the completed MCQ quiz.
Post conditions	System records the prompts of students for each question, and generate the marks.
Flow of events	Student finishes MCQ quiz. System locks the quiz. System compares student answers with the exact answers. System displays the results to the student immediately.
Exception conditions	None.

#### 4.2.2.7 Mark essay question

Use case name	Mark essay question.
Scenario	The system marks the essay question
Triggering event	The student submits an essay question. Allocated time finishes for an essay question.
Brief description	When a student finishes an essay question, the system automatically marks the answers based on keywords.
Actors	Student, System
Related use cases	Attempt essay - student

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Preconditions	Student should submit the completed essay question.
Post conditions	System records the answers of students, and generate marks.
Flow of events	Student finishes essay question. System locks the quiz. System marks the student answer based on available keywords. System displays the results to the student immediately.
Exception conditions	None.

#### 4.2.2.8 View results

Use case name	View results
Scenario	Lecturer view results of students
Triggering event	Lecturer asks for statistical information about a subject he's enrolled
Brief description	The lecturer can get statistical information about the subjects that he is offering. This includes performance of students for a particular quiz, performance of a batch and etc.
Actors	Lecturer, System
Related use cases	None
Preconditions	None
Post conditions	None
Flow of events	Lecturer invokes "view statistical info" option. System displays all the supported forms. Lecturer selects one category. System displays statistical information.
Exception conditions	None.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 4.2.3 Student specific use cases

##### 4.2.3.1 Attempt MCQ quiz

Use case name	Attempt MCQ paper.
Scenario	Student attempts an online MCQ paper.
Triggering event	Student clicks “start quiz option”.
Brief description	Student start the MCQ quiz. The timer is set. Student can mark an answer from the 5 available answers. Student then submits the paper.
Actors	Student
Related use cases	None
Preconditions	The MCQ paper should exist. The student should have enrolled to the subject.
Post conditions	The responses are recorded in the system.
Flow of events	The student invokes “start attempt” option under the specific MCQ quiz. System displays the paper. Student selects the answers from the given 5 prompts. Student submits answers. System records the prompts.
Exception conditions	None

##### 4.2.3.2 Attempt essay question

Use case name	Attempt essay question.
Scenario	Student attempts an online essay question.
Triggering event	Student clicks “start quiz option”
Brief description	Student start the essay question. The timer is set. Student enters the answer. Student then submits the paper.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Actors	Student
Related use cases	None
Preconditions	The essay question should exist. The student should have enrolled to the subject.
Post conditions	The responses are recorded in the system.
Flow of events	The student invokes “start attempt” option under the specific essay question. System displays the paper. Student enters the answer. Student submits paper. System records the prompt.
Exception conditions	None

#### 4.2.3.3 View grades and performance

Use case name	View grades and performance.
Scenario	Student views his own performance
Triggering event	Student asks for statistical information
Brief description	The student can get statistical information about the subjects that he has enrolled in. This performance history of papers.
Actors	Student, System
Related use cases	None
Preconditions	None
Post conditions	None
Flow of events	Student invokes “view statistical info” option. System displays all the supported forms. Student selects one category. System displays statistical information.
Exception conditions	None.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 4.2.3.4 Enroll for a subject

Use case name	Enroll for a new subject.
Scenario	Student enrolls to a new subject.
Triggering event	Student clicks “enroll new subject” option.
Brief description	The student can enroll for a subject that he is permitted to. All the subjects that the student can enroll are displayed in the window. The student can select one of them and submit.
Actors	Student
Related use cases	None.
Preconditions	The subject should exists and it should be permitted to be enrolled by the particular student.
Post conditions	Student enrolls to a new subject.
Flow of events	Student invokes “enroll new subject option”. System shows all the available and permitted subjects. Student selects a particular subject and click “enroll”. System saves the response.
Exception conditions	None.

#### 4.2.3.5 Un enroll for a subject

Use case name	Un enroll from a subject.
Scenario	Student un enrolls from a subject.
Triggering event	Student clicks “un enroll subject” option.
Brief description	The student can un enroll from a subject that he has already enrolled to.
Actors	Student
Related use cases	Enroll new subject.
Preconditions	The student should have enrolled to that subject previously.



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Post conditions	Student un enrolls from the particular subject.
Flow of events	Student invokes “un enroll subject option”. System shows all the enrolled subjects. Student selects a particular subject and click “un enroll”. System saves the response.
Exception conditions	None.

#### 4.2.4 Admin specific use cases

##### 4.2.4.1 Add new subject

Use case name	Add a new subject.
Scenario	Admin adds a new subject.
Triggering event	Admin selects “add a new subject” prompt.
Brief description	The admin can add a new subject to the system. Initially there will be no assigned lecturers or students.
Actors	Admin
Related use cases	None
Preconditions	None
Post conditions	A new subject is added to the system.
Flow of events	Admin clicks “add new subject” option. System displays the form. Admin inputs all the necessary attributes and submit. System saves the response.
Exception conditions	None

##### 4.2.4.2 Map lecturers with subject

Use case name	Map lecturers with subject.
Scenario	Admin maps a lecturer with a subject.
Triggering event	Admin maps a lecturer with a subject.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

Brief description	Admin maps a subject with a lecturer. A lecturer can have many number of subjects as well as a subject can have many number of lecturers.
Actors	Admin
Related use cases	None
Preconditions	Subject and the lecturer should exist.
Post conditions	Lecturer and a subject get mapped.
Flow of events	Admin selects a “Map subject” option. System shows a list of subjects and a list of lecturers. Admin selects a subject and a lecturer and click submit. The system saves the response.
Exception conditions	None.

#### 4.2.4.3 Add a new batch of students

Use case name	Add a new batch of students.
Scenario	Admin adds a new batch.
Triggering event	Admin clicks “add new batch option”.
Brief description	When a new batch of students are to be added to the system, the admin adds them as a batch rather than individual students.
Actors	Admin
Related use cases	None
Preconditions	None
Post conditions	A new batch gets initiated.
Flow of events	The admin clicks “add a new batch option”. System shows the input form. Admin inputs the parameters. Admin adds the details of all new students. Admin submits the form. System saves the response.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016
Exception conditions	None.

## 5. Logical View

### 5.1 Overview

#### 5.1.1 Subsystems

System OES (Online examination system) can be divided into 3 main sub systems.

1. User management subsystem
2. Subject management subsystem
3. Statistical data management system

##### 5.1.1.1 User management sub system

This sub system provides the facilities that covers all the user management functionalities. Main use cases that comes under this subsystem includes

- User login
- New user creation
- New Batch of students creation
- Edit profile and change password scenarios

Each user that interacts with the system is an actor of these use cases. Depending on the access levels, some actions will not be permitted.

##### 5.1.1.2 Subject management subsystem

This subsystem involves the main business login of the system. Main use cases that come under this subsystem includes

- Addition of a new subject
- Assignment of lecturers to subjects
- Student enrolments to subjects
- Submitting MCQs and essays to the system
- Generating papers
- Schedule papers
- Marking papers

##### 5.1.1.3 Statistical Data management subsystem

This is the subsystem that incorporates most of the algorithms and processing power. Previously mentioned subsystems involve data access operations, but this subsystem includes front end processing. Only the required parameters are fetched from the database, and all the processing and diagram drawing happens in

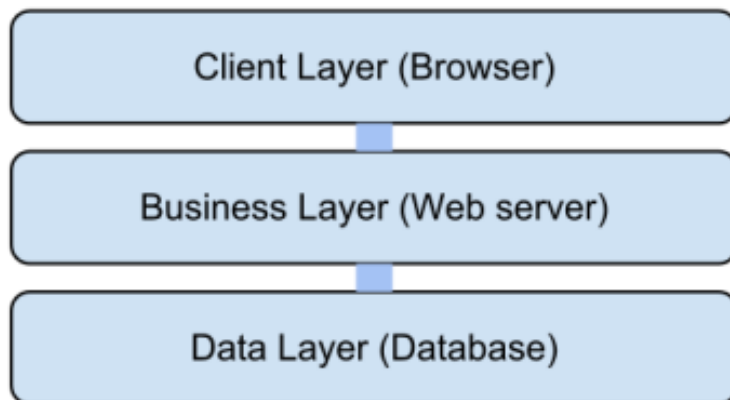
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

the front end. The system is capable of generating many number of statistical reports including

- Student performance reports
- Batch performance reports
- Performance for a single question

### 5.1.2 Layering

OES system is divided into 3 layers. The layering model of the OES application is based on a responsibility layering strategy that associates each layer with a particular responsibility. This strategy has been chosen because it isolates various system responsibilities from one another, so that it improves both system development, reusability and maintenance.

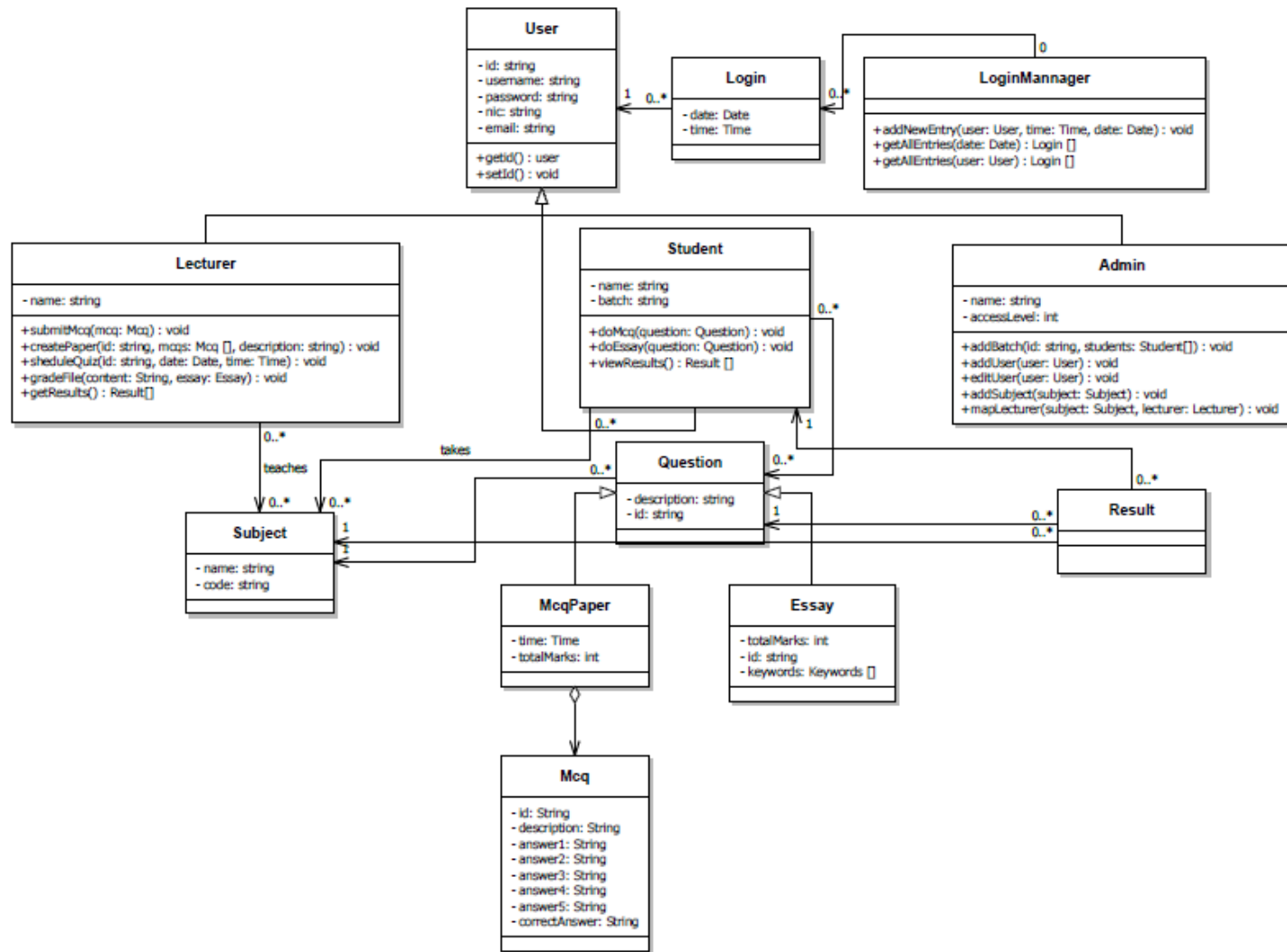


(MVC architecture model)

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 5.2 Architecturally Significant Design Packages

### 5.2.1 Class diagram



Since the diagram is not very clear in this document it's available online.

[https://drive.google.com/file/d/0B\\_key68-co6Id2NpUW9QV1JOY2c/view?usp=sharing](https://drive.google.com/file/d/0B_key68-co6Id2NpUW9QV1JOY2c/view?usp=sharing)

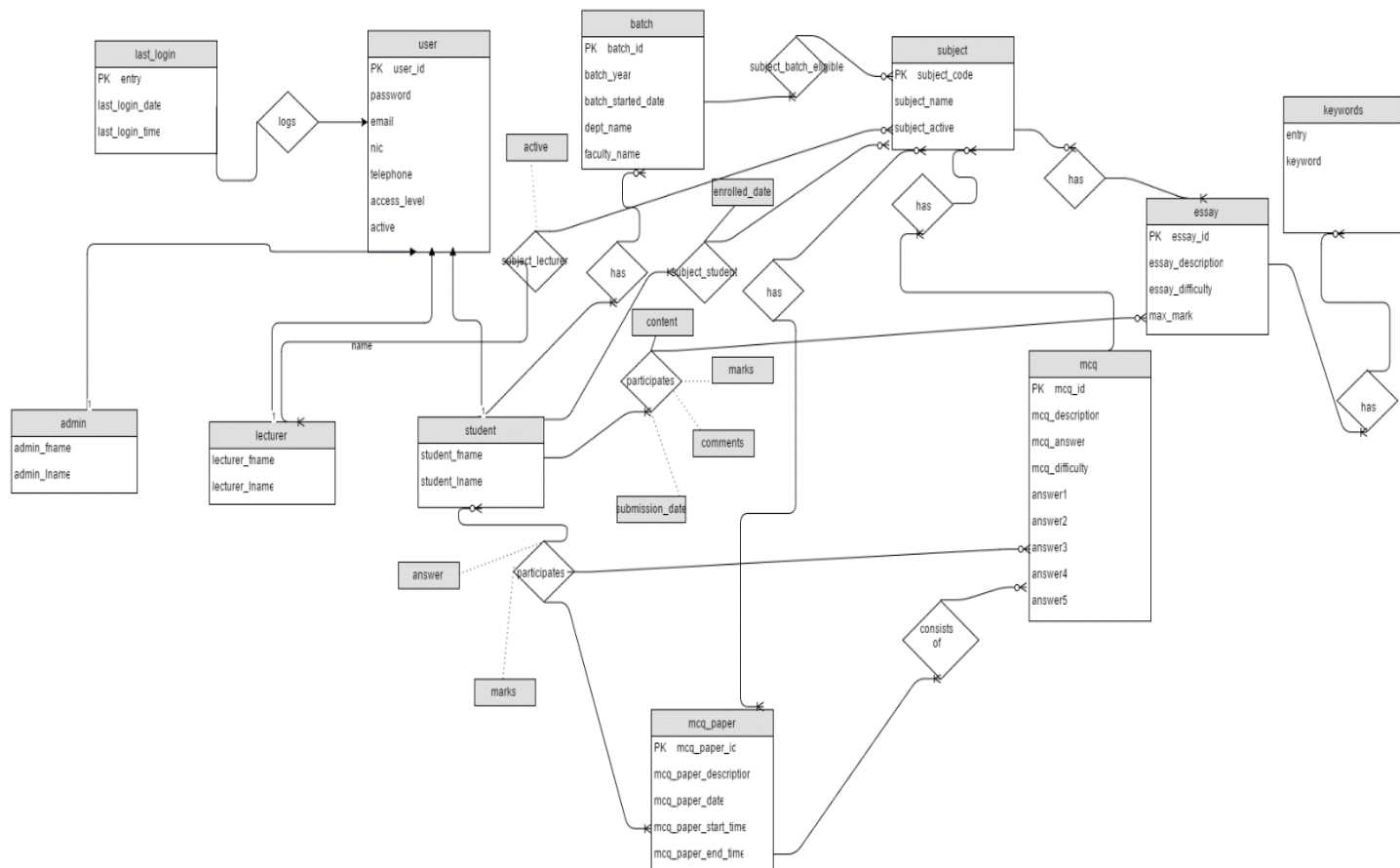
Especial design decisions

- All users are derived from the super class called "user". It's because each user of the system has common attributes and behaviours such as Id, password, name, NIC etc.
- Each subject can have many number of lecturers and each lecturer can have many number of subjects. That the reason behind having a many to many relationship between lecturer and subject.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

- Both MCQ paper and the essay paper have the same characteristics except for few attributes. Hence there exists a super class “Question” which contains the common attributes and functionalities.
- MCQ paper consists of many number of MCQs. Hence an aggregation relationship exists between MCQ paper and MCQ.
- Each student’s marks for any question paper is stored in a Result object.
- Login manager and Login classes are used to keep track of login times and dates of each user.

### 5.2.2 ER diagram



Since the diagram is not very clear it's available in the following link

[https://drive.google.com/file/d/0B\\_key68-co6ldWJpQk02cDE2TWs/view?usp=sharing](https://drive.google.com/file/d/0B_key68-co6ldWJpQk02cDE2TWs/view?usp=sharing)

Especially design decisions

- Like in the class diagram each user has a super entity called ‘user’ that holds all the major functionality.
- Each student has a batch parameter. Entity “batch” contains the details of a particular batch (started date, batch id).

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

- Entity keywords is used to store the keywords of an essay question. These words are used to get rough statistical information about student's behaviour towards an essay question.
- The relationship between student, MCQ paper and MCQ is a trinary relationship since the system has to keep track of answers for each question from each student.
- Each MCQ, paper, essay question has an associated "subject code" parameter.
- Active parameter in both user, subject represents whether the content is valid. For an example if a lecturer leave the institute, the entry for that lecturer is not deleted, but marked DEACTIVATED.
- Relationship "Student Batch Eligible" between batch and subjects represents the relationship that contains all the subjects that a particular batch of students can enrol.
- Last login entity keeps track of user login details on order to make sure the security.

## 6. Process View

### 6.1 System sequence diagrams

When user inputs username and password, system checks for the validity and the matching of input values and redirects to the home page of user. (The home page depends on the user and user type). If the entered username and password is invalid, the user will be asked to enter them again. If the user has forgotten the password, he can click "forget password".

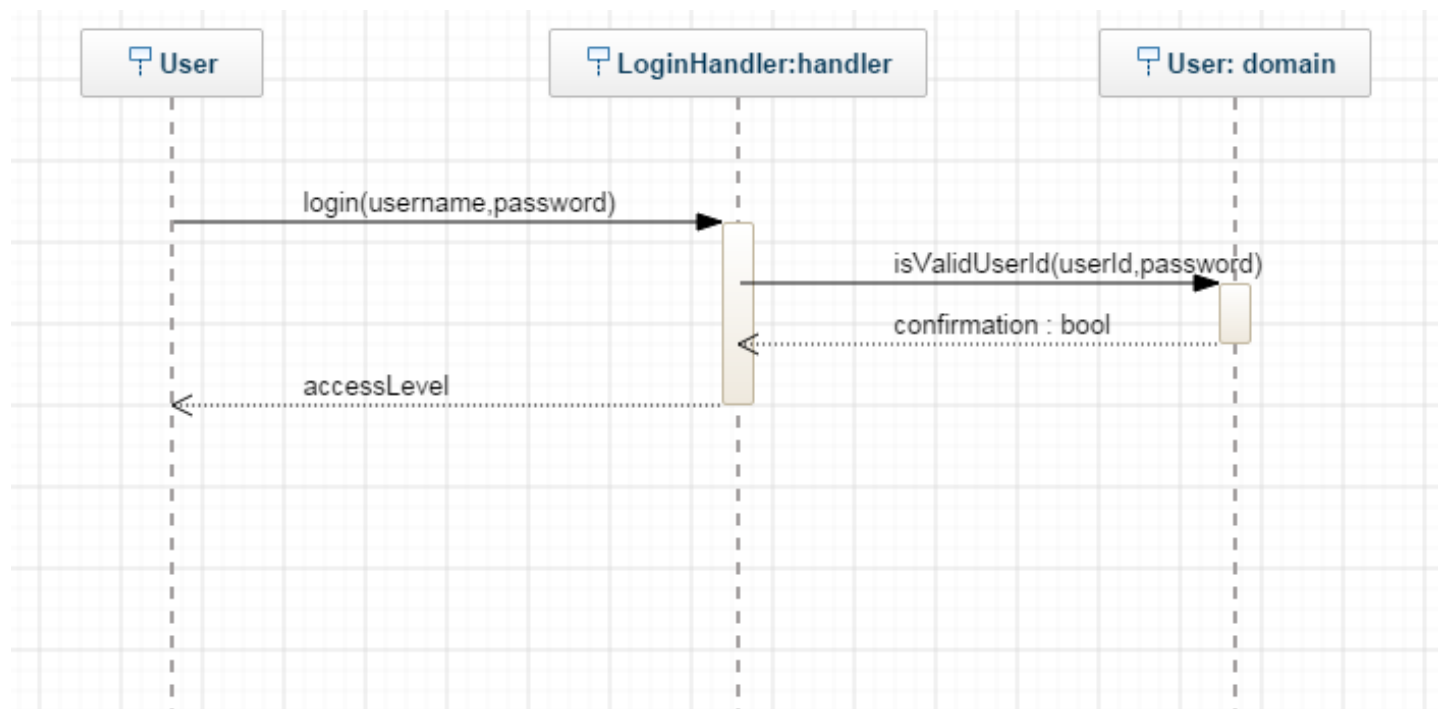
When user clicks "forget password", he can ask the system to send a mail to his email address, from which he can change the password to a new one. The user should be a valid user, and should have an email address that is saved in the system. If the user doesn't have a pre-set email address, the user can't continue this process and the user should contact the system admin and reset the password. If the user enters the wrong code, he can re attempt and get a new code.

#### 6.1.1 User logs into the system

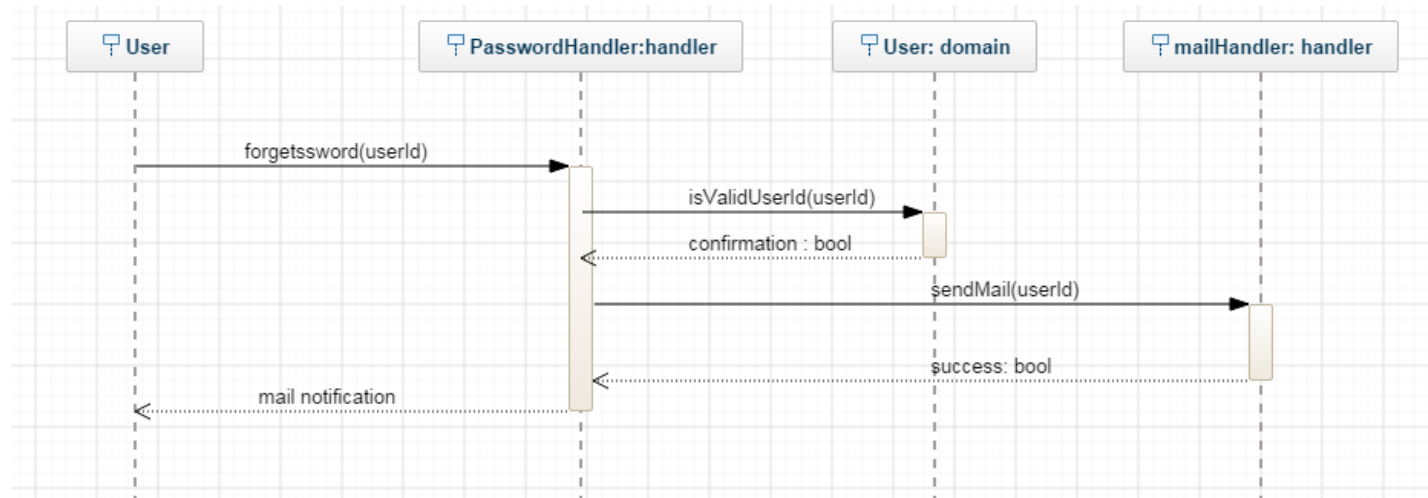
When user inputs username and password, system checks for the validity and the matching of input values and redirects to the home page of user. (The home page depends on the user and user type). If the entered username and password is invalid, the user will be asked to enter them again. If the user has forgotten the password, he can click "forget password".

When user clicks "forget password", he can ask the system to send a mail to his email address, from which he can change the password to a new one. The user should be a valid user, and should have an email address that is saved in the system. If the user doesn't have a pre-set email address, the user can't continue this process and the user should contact the system admin and reset the password. If the user enters the wrong code, he can re attempt and get a new code.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



#### 6.1.2 User invokes “forget password”



#### 6.1.3 User changes the password

When the user goes to the “change password” section, he or she can change the password. For that the user should input the previous password again. The new password and confirm new password fields should be identical. The password should adhere to the security standards that are enforced by the application policy (more than 8 characters long, should contain alphanumeric and symbolic characters).

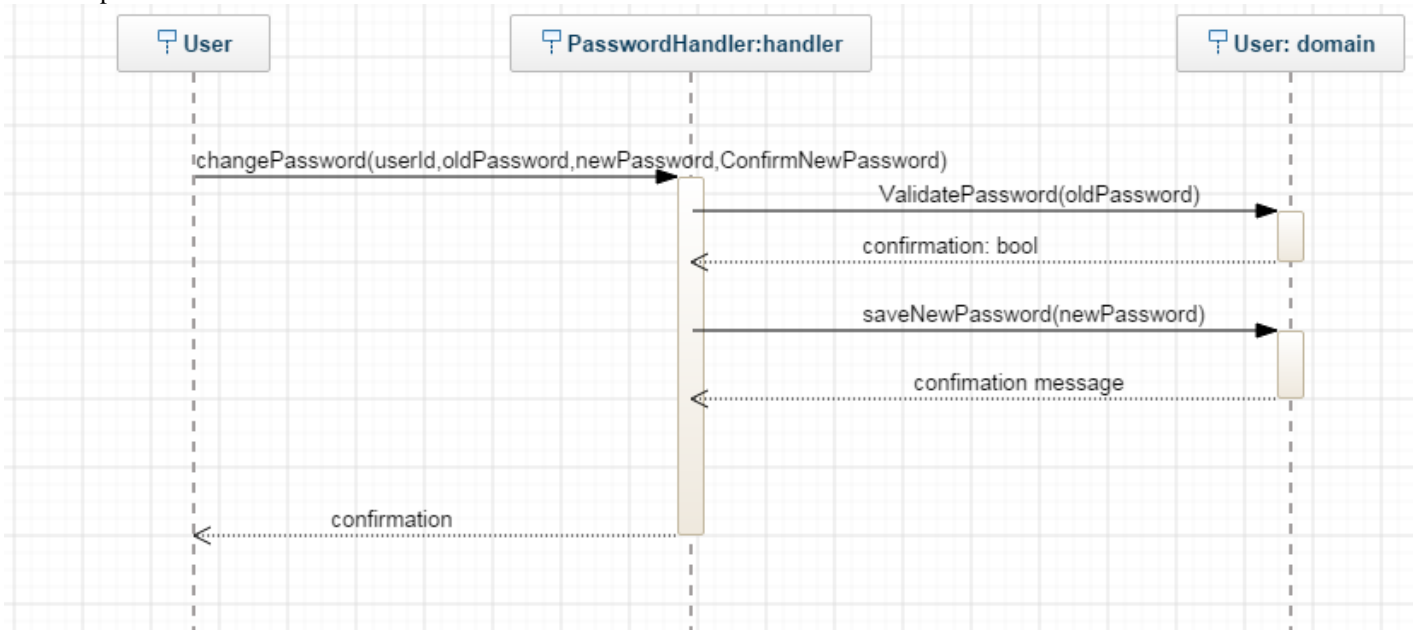
Or else when a user forgets the password and using the code that is sent via an email the user can access the “change password” section.

If the password doesn’t adhere to the rules of the system, it would ask for another password.

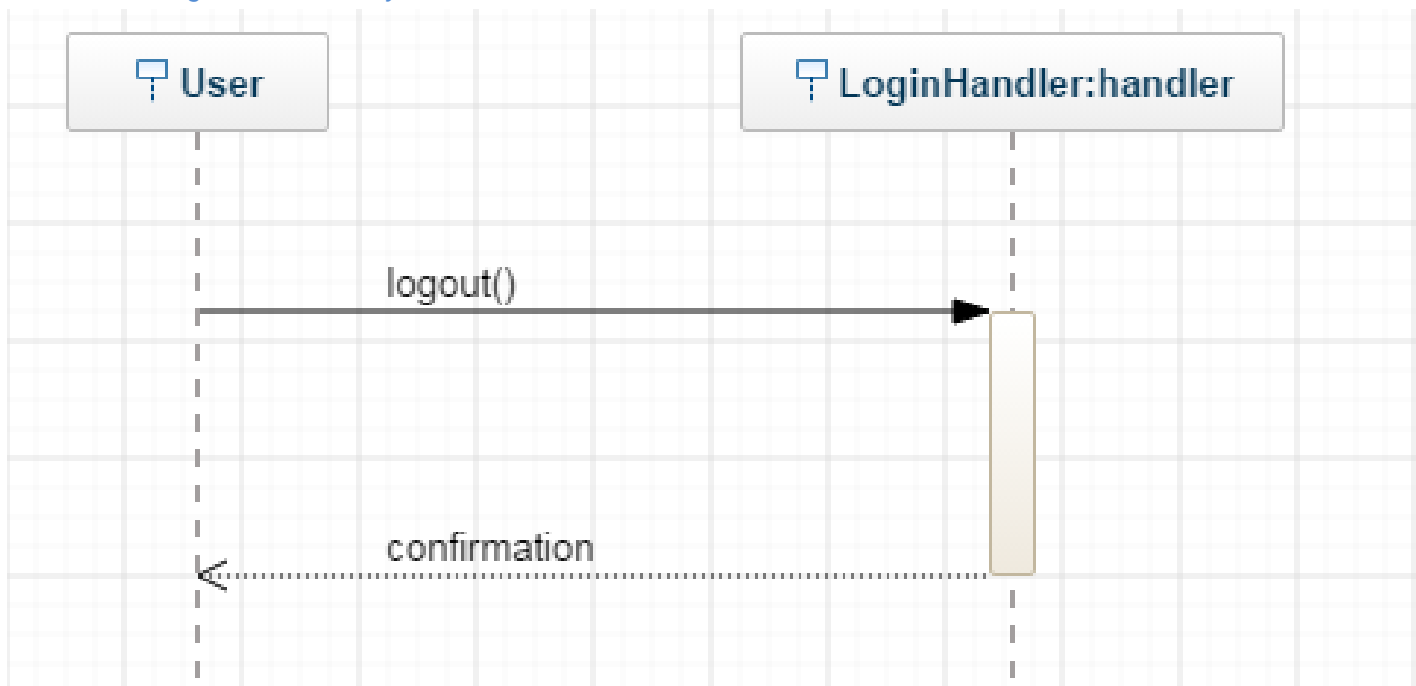


Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

If the new password filed and “confirm new password” fields doesn’t match, it’ll ask to re-enter the passwords.



#### 6.1.4 User logs out from the system

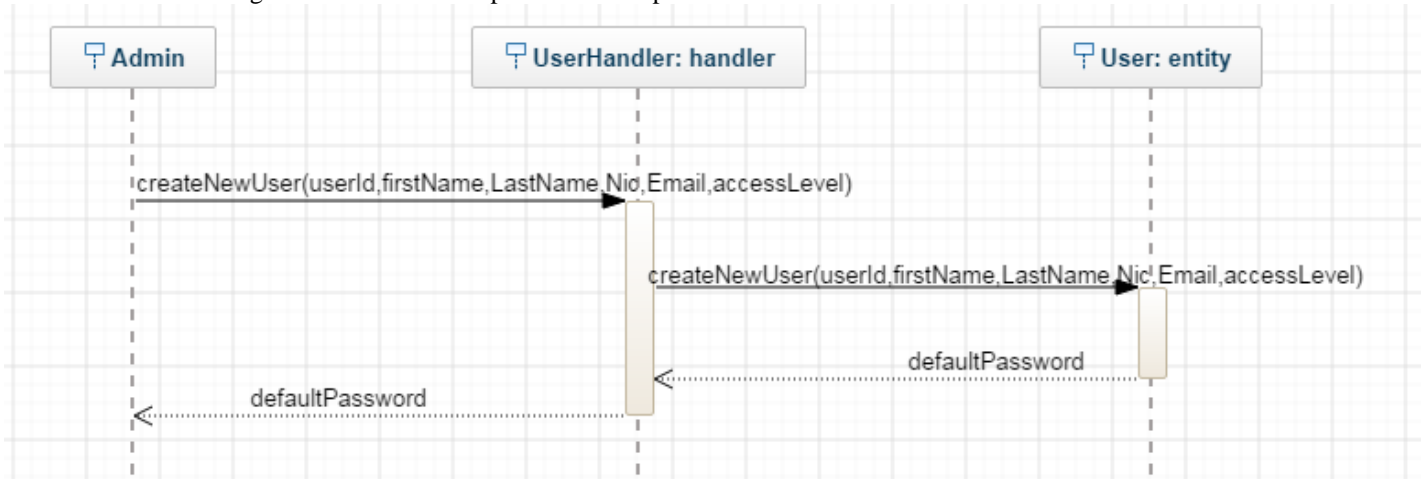


#### 6.1.5 Admin creates a new user

When a new user has to be added to the new system, the admin adds him using “create new user” work flow. If the new user is a lecturer or an admin, the user will get added separately, whereas students will get added as a batch.

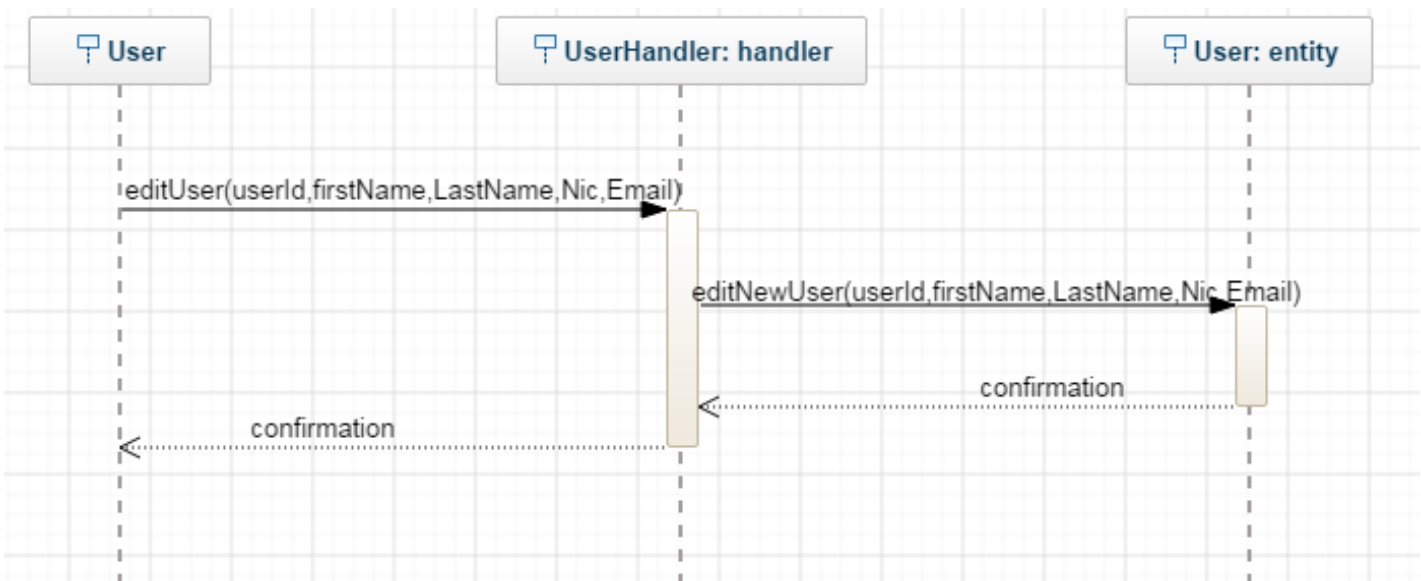
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

The new user gets a username and a password. The password can be reset later



#### 6.1.6 User edits the profile

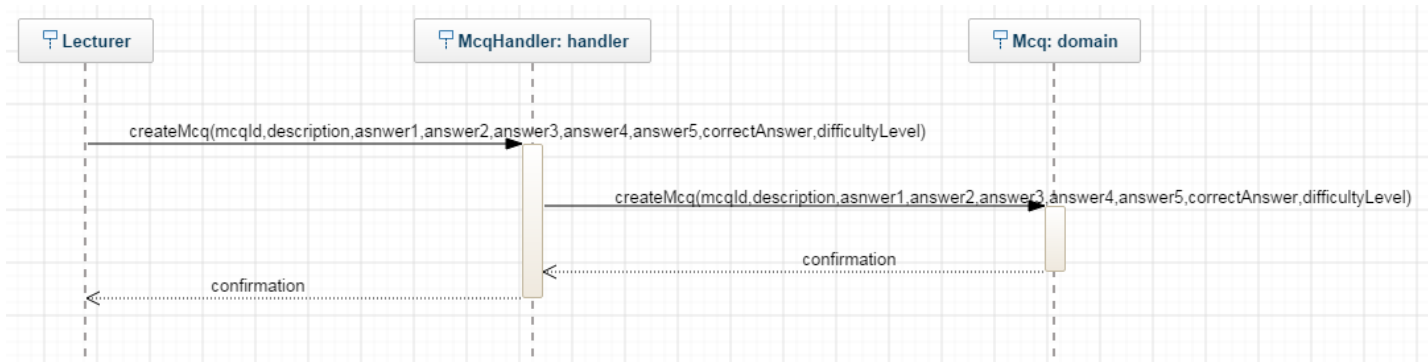
The user who has already logged in to the system, edits his details. The username and the password can't be changed at this point. Some other parameters such as NIC can't be changed as well.



#### 6.1.7 Lecturer creates a new MCQ

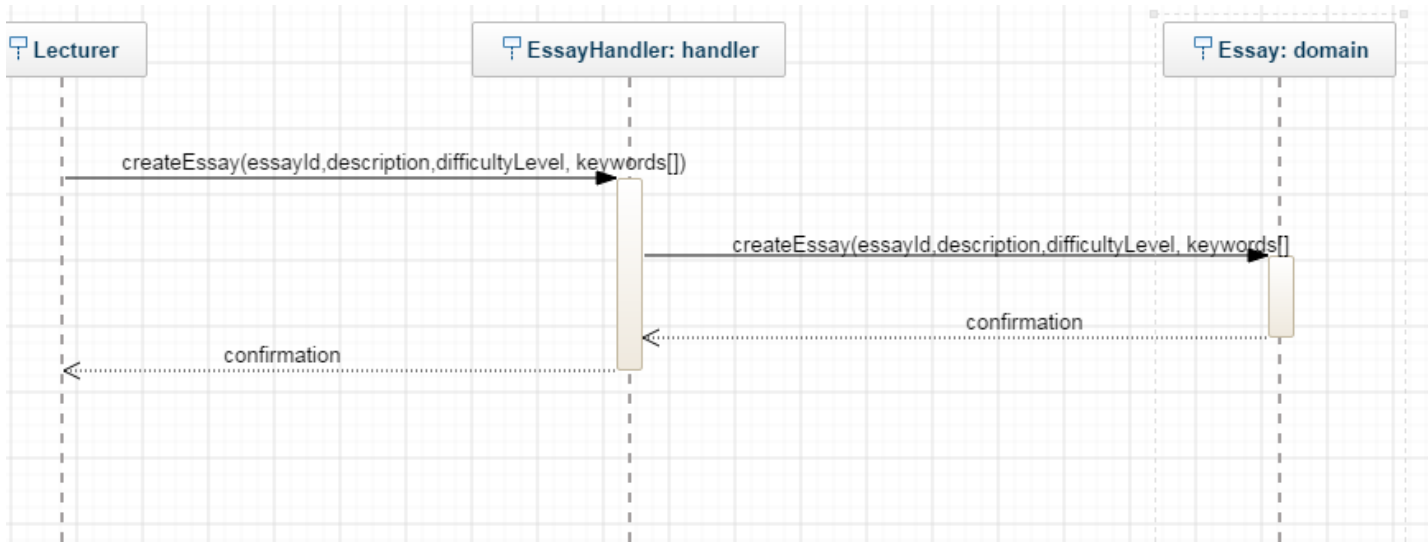
The lecturer adds a new MCQ to one of his enrolled subjects. The system checks the completeness of the question and saves it. The new MCQ should possess all the required fields. The lecturer should be logged in to the system. The lecturer should be enrolled to the subject to which the new MCQ belongs.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



### 6.1.8 Lecturer creates a new essay question

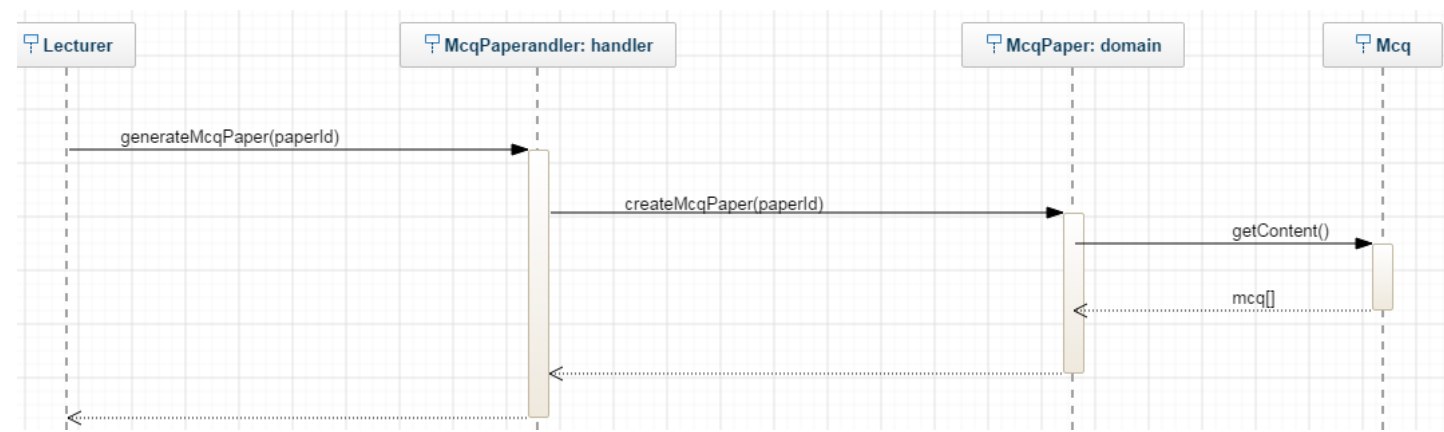
The lecturer adds a new essay question to one of his enrolled subjects. The system checks the completeness of the question and saves it. The new essay question should possess all the required fields. The lecturer should be logged in to the system. The lecturer should be enrolled to the subject to which the new essay question belongs.



### 6.1.9 Lecturer generates a MCQ paper using the MCQs that are already saved in the database.

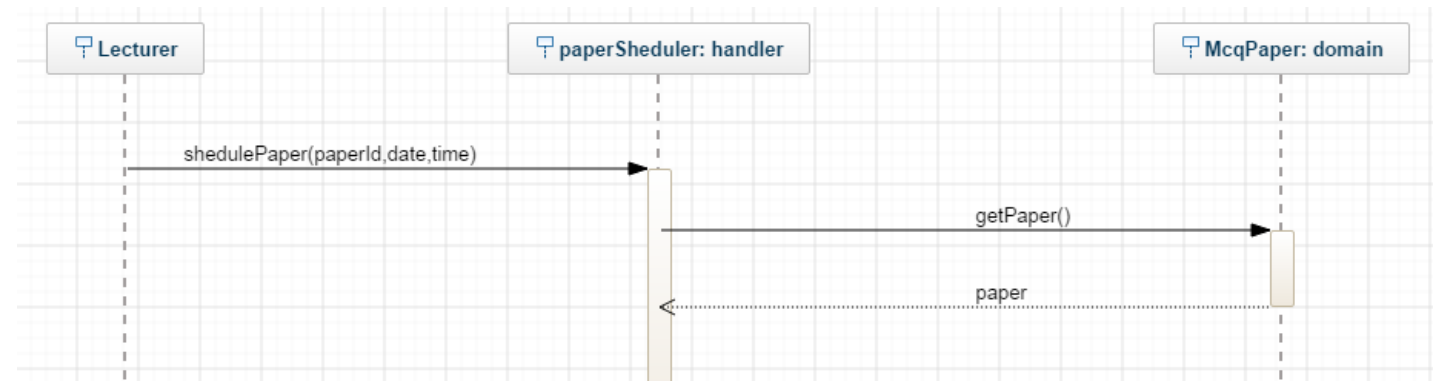
The lecturer can create a new MCQ paper for a given subject. Lecturer can use the MCQs that are already saved in the database for that particular subject. This paper will be saved in the system. There should be at least one MCQ for the specified subject of interest. If no MCQ is available for that subject the System sends a warning saying that no MCQ is found for that specific subject.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



### 6.1.10 Lecturer schedules a paper

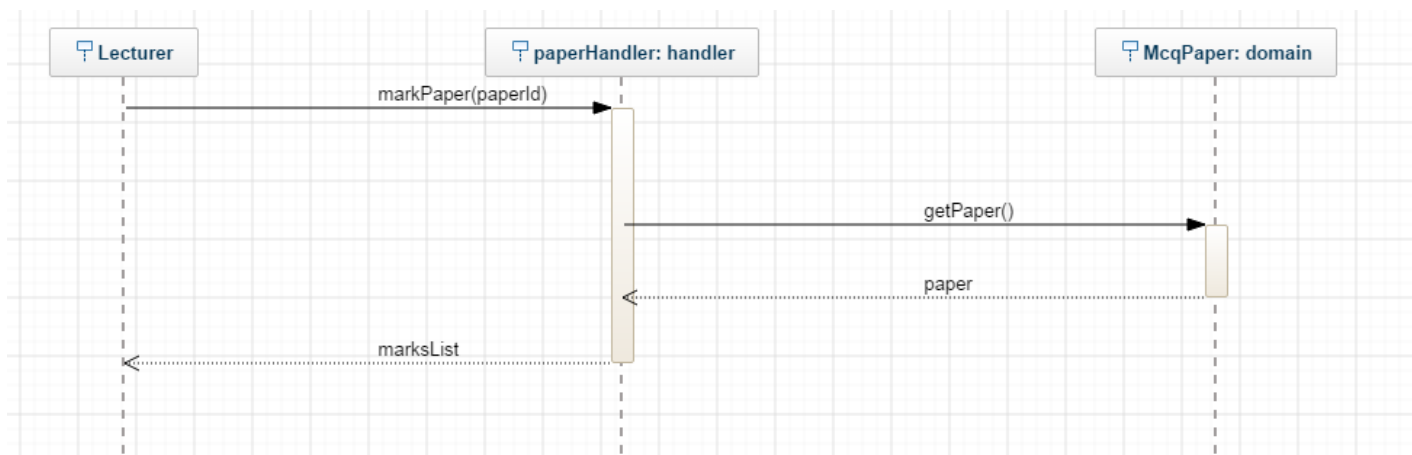
Using the MCQ papers that are already generated previously, the lecturer can schedule them. Lecturer specifies the attributes such as starting date, time and then submit. The system validates the input values and send a notification to enrolled students of that subject.  
 At least one MCQ paper should exist for the specified subject.  
 If no paper is available then the System displays a warning message.



### 6.1.11 Lecturer marks a paper

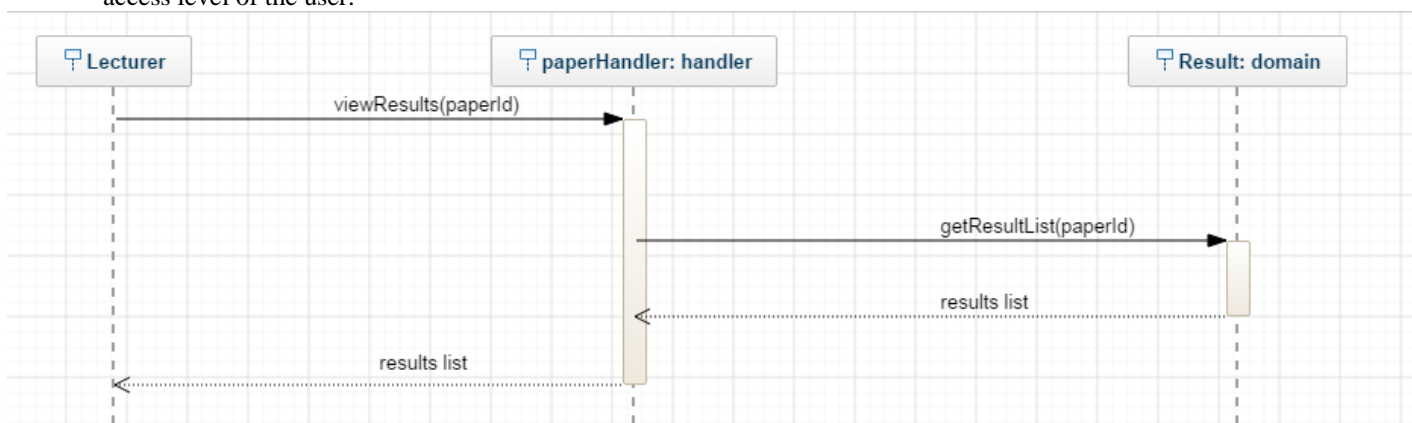
When a student finishes a MCQ paper, the system automatically marks the answers. The prompts for each question is saved in the system.  
 When a student finishes an essay question, the system automatically marks the answers based on keywords. The keywords are pre saved words that contains the core of the essay content. Unlike in MCQ papers, it’s not possible to have a system which marks the essay questions completely since there is no straight forward answer. This functionality will give a basic idea about the content and it will be use full when generating reports.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



#### 6.1.12 Lecture views results

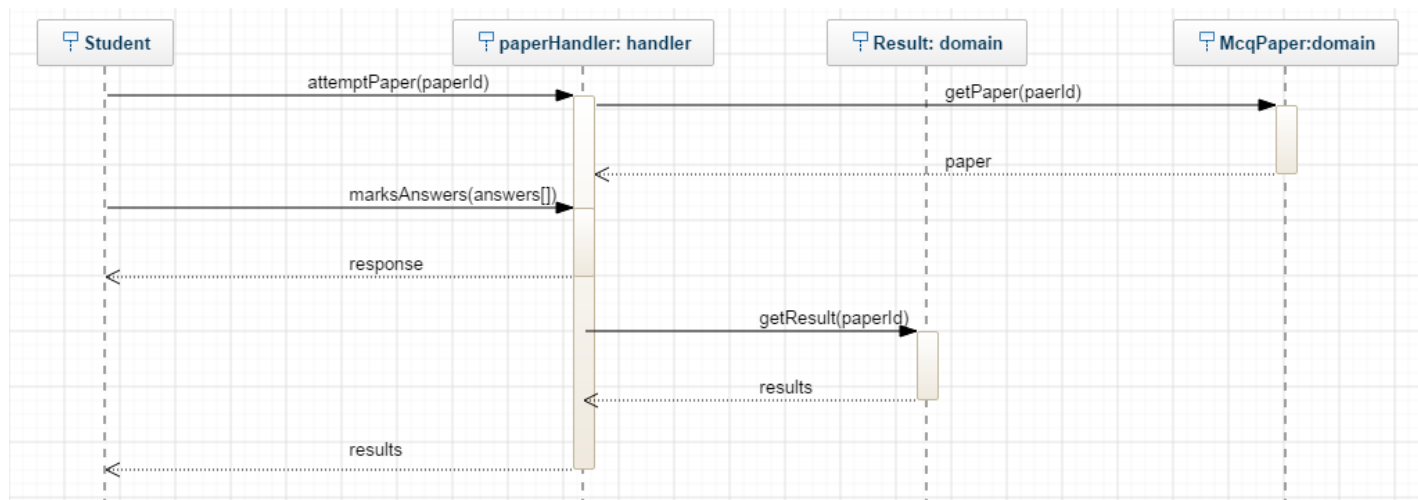
The lecturer can get statistical information about the subjects that he is offering. This includes performance of students for a particular quiz, performance of a batch and etc. These details are derived from the values that are stored in the database. The statistical information that a particular user can request depends on the access level of the user.



#### 6.1.13 Student attempts a MCQ paper

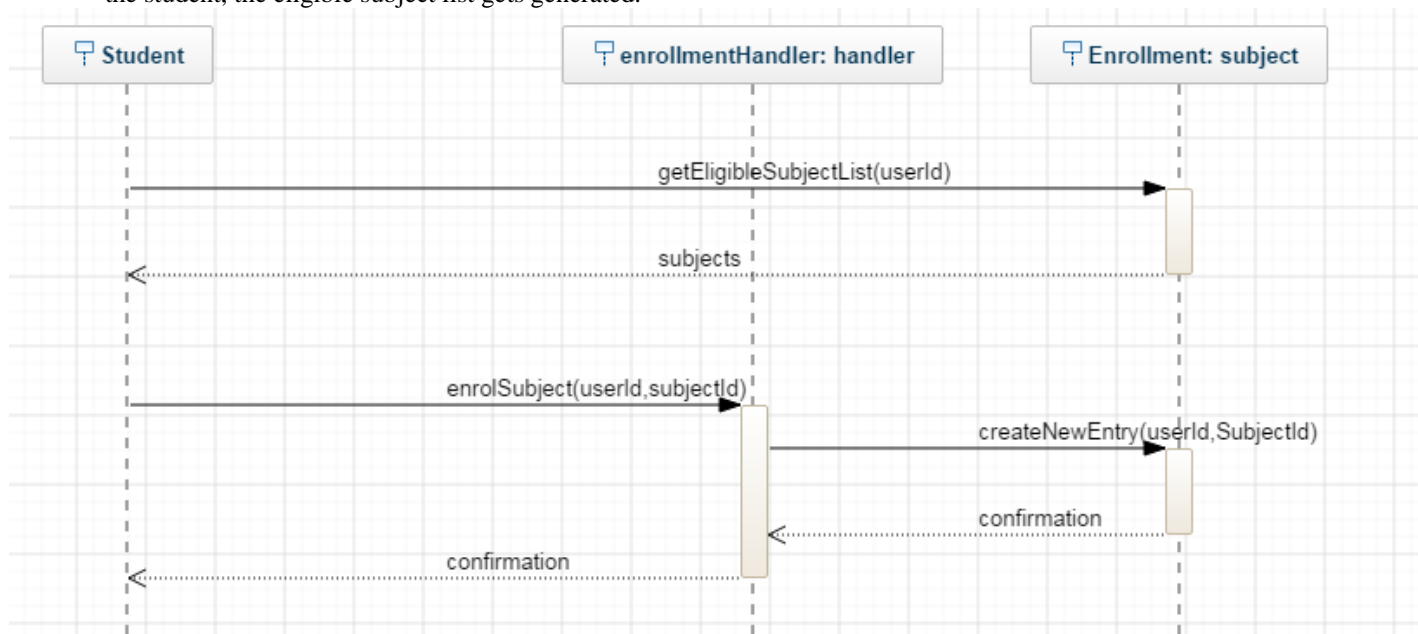
Student start the MCQ quiz. The timer is set. Student can mark an answer from the 5 available answers. Student then submits the paper. All the responses are saved and evaluated immediately. The student should have enrolled to the subject in order to access the quiz.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



#### 6.1.14 Student enrolls to a new subject

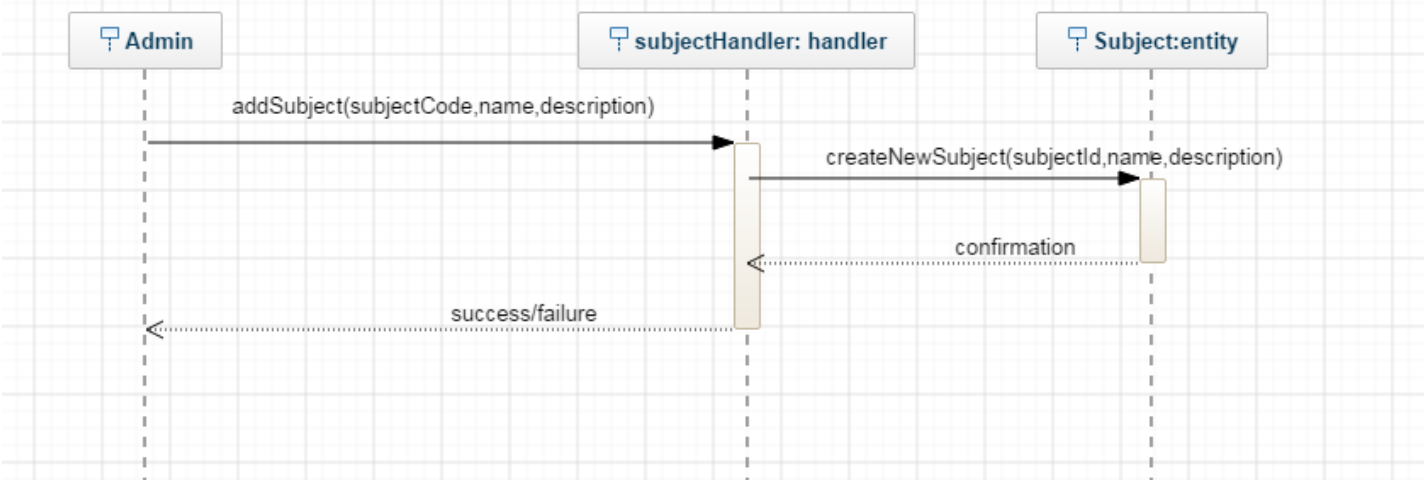
The student can enroll for a subject that he is permitted to. All the subjects that the student can enroll are displayed in the window. The student can select one of them and submit. Using the “batch id” parameter of the student, the eligible subject list gets generated.



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

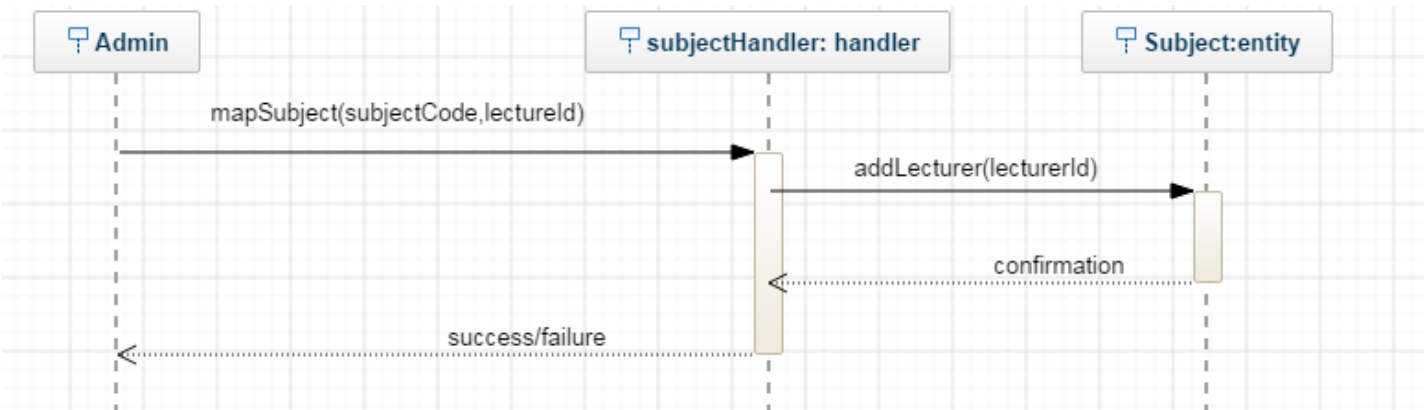
### 6.1.15 Admin adds a new subject

The admin can add a new subject to the system. Initially there will be no assigned lecturers or students. Later on the lecturers can be matched with the subject.



### 6.1.16 Admin adds a lecturer for a subject

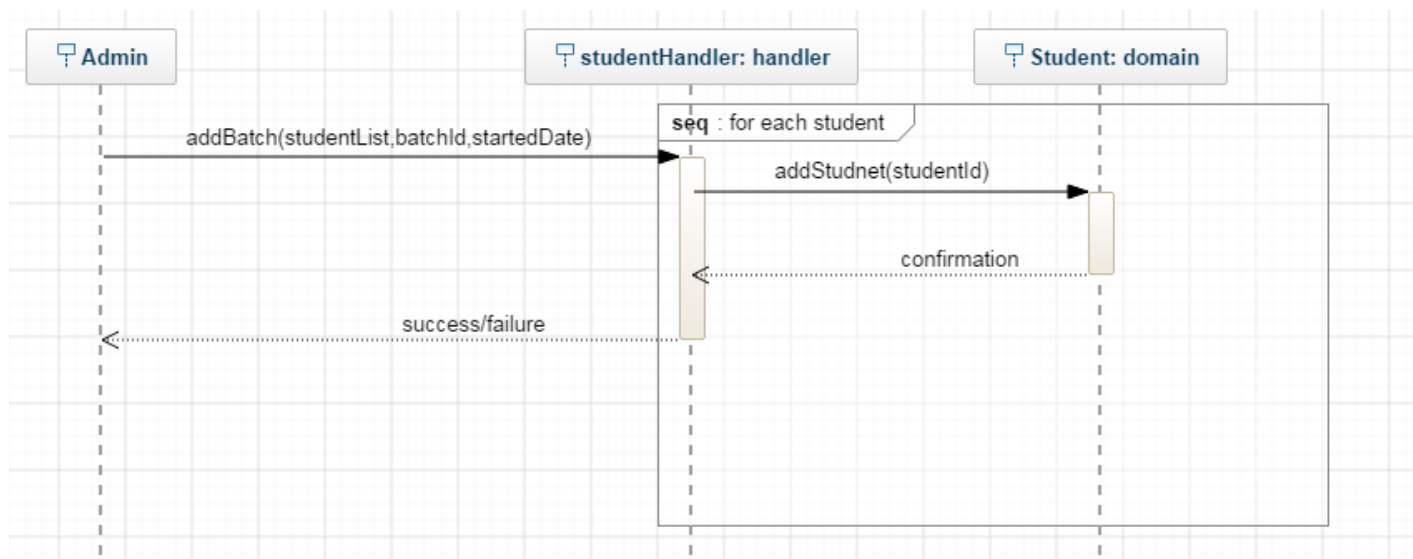
Admin maps a subject with a lecturer. A lecturer can have many number of subjects as well as a subject can have many number of lecturers. Once a lecturer is assigned to a subject, he gets access to the course page, and the subject appears under the lecturer's subject list.



### 6.1.17 Admin adds a batch of new students

When a new batch of students are to be added to the system, the admin adds them as a batch rather than individual students. In the internal process, the “add a new user” use case will be executed several times.

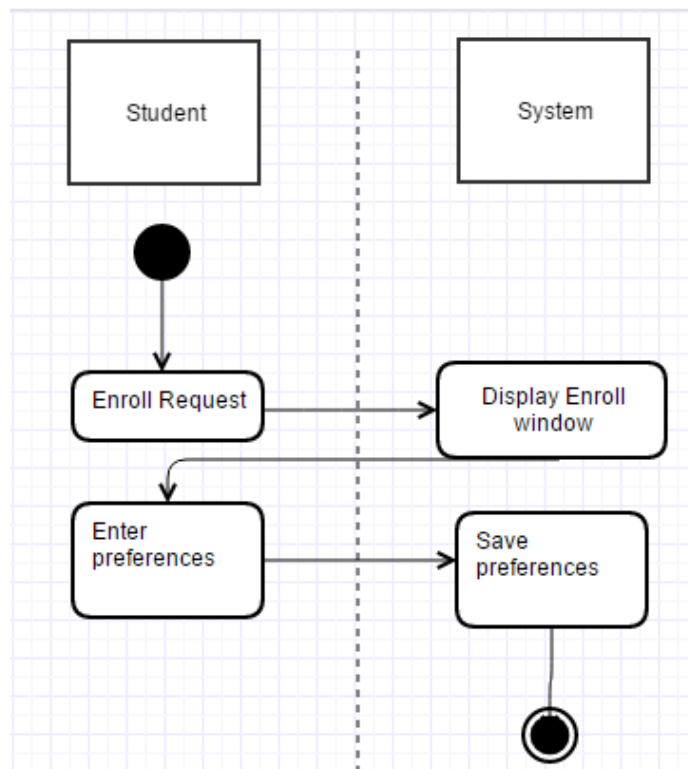
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016



## 6.2 Activity Diagrams

The activity diagrams for the main business functionalities (use cases) are as follows.

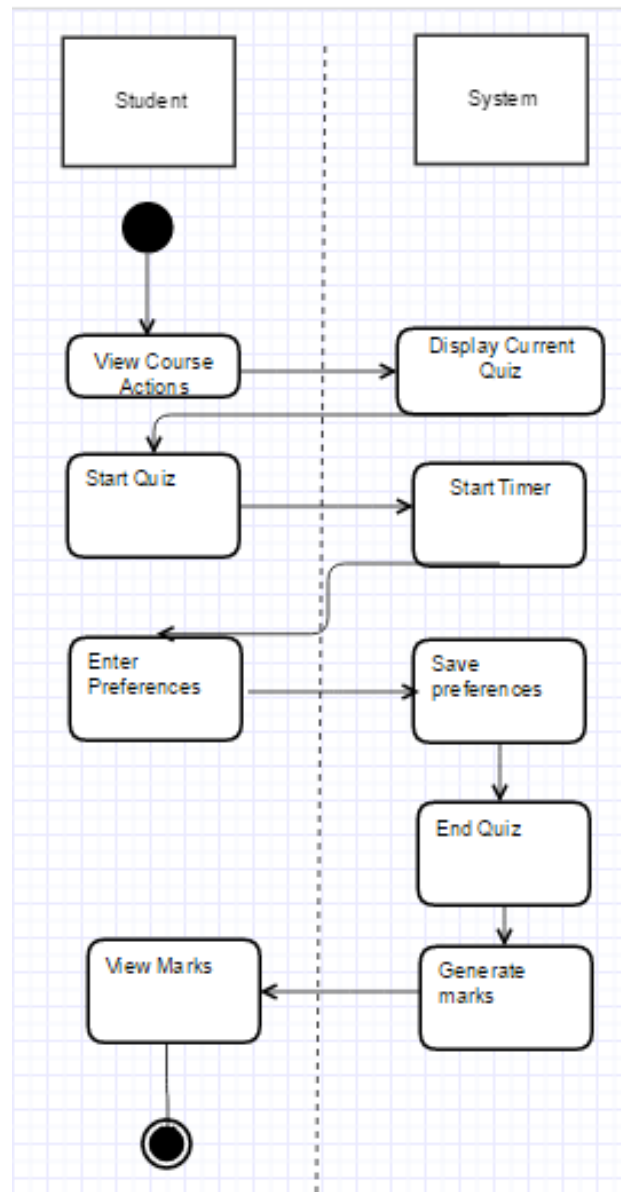
### 6.2.1 Student enrolls to a subject





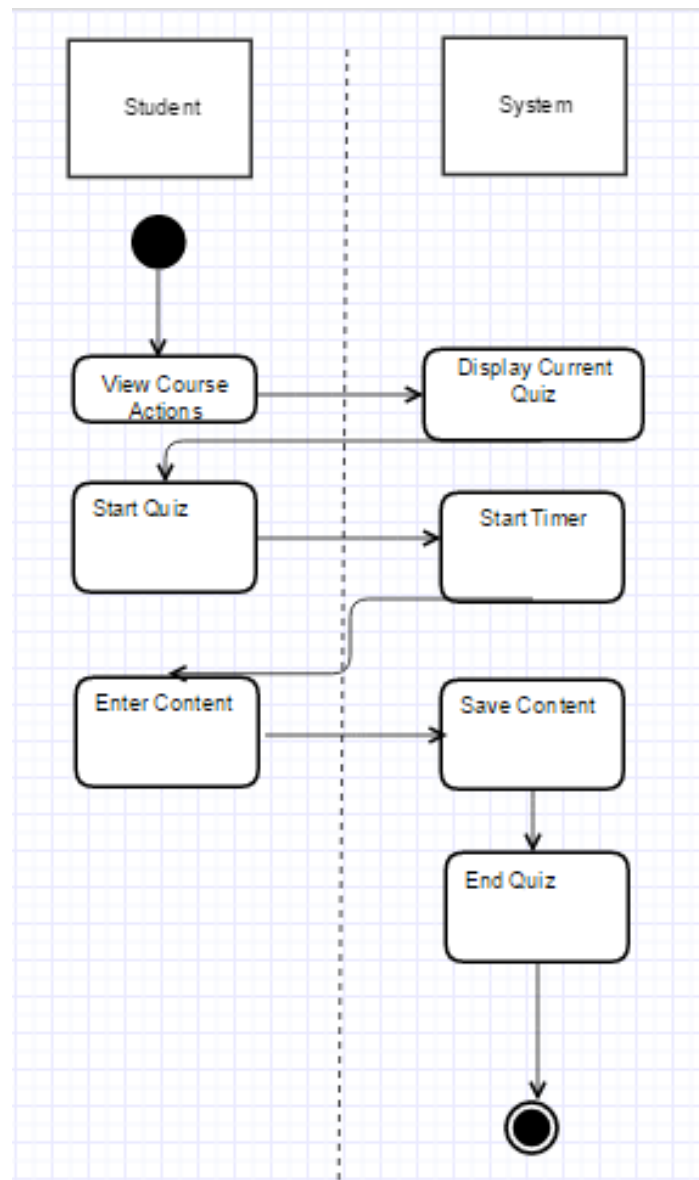
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.2 Student attempts MCQ quiz



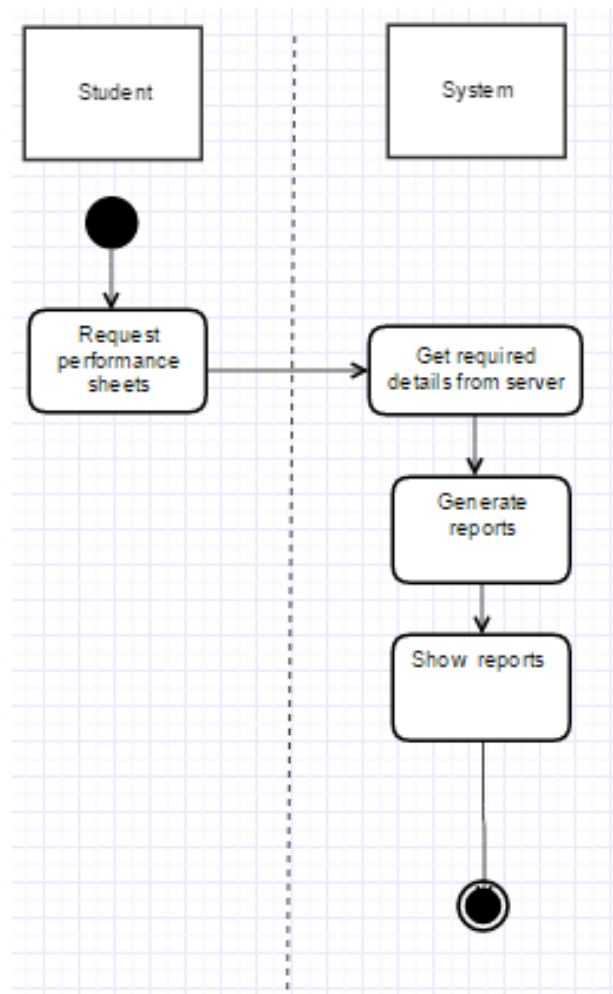
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.3 Student attends essay quiz



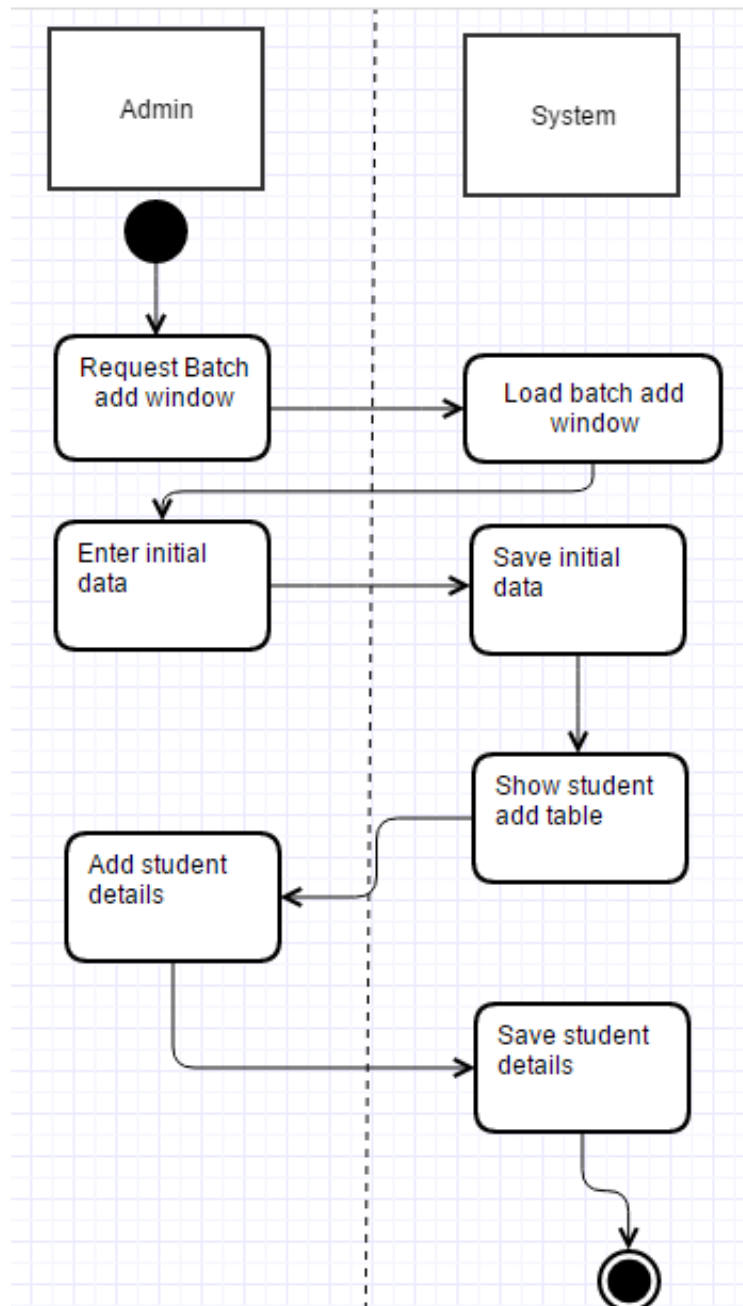
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 6.2.4 User Views grades and performance



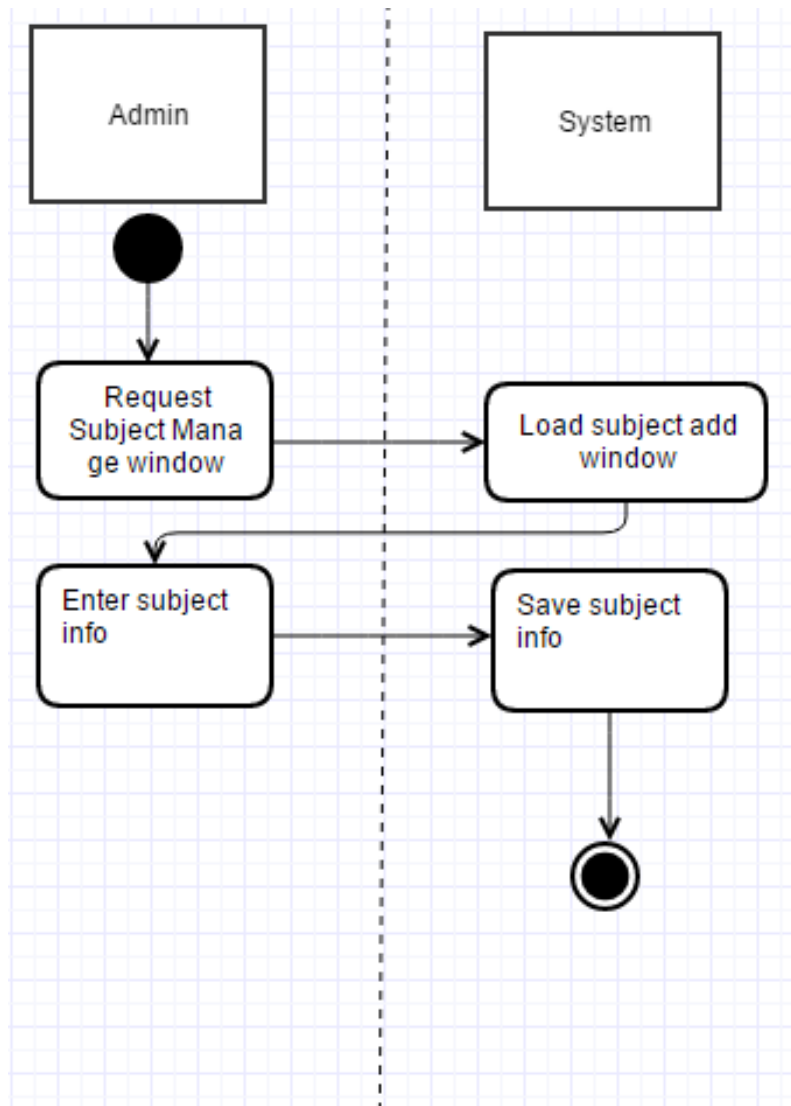
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.5 Admin adds a new batch



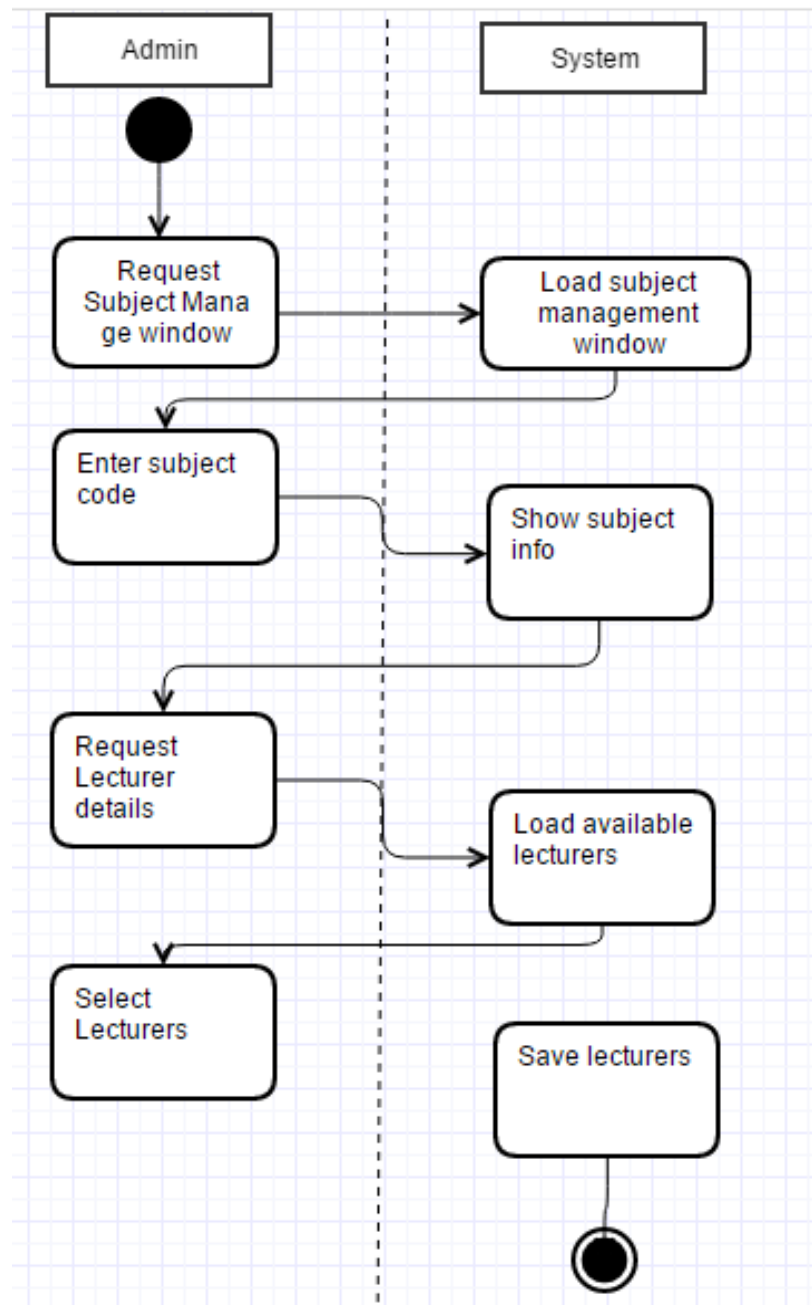
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 6.2.6 Admin adds a new subject



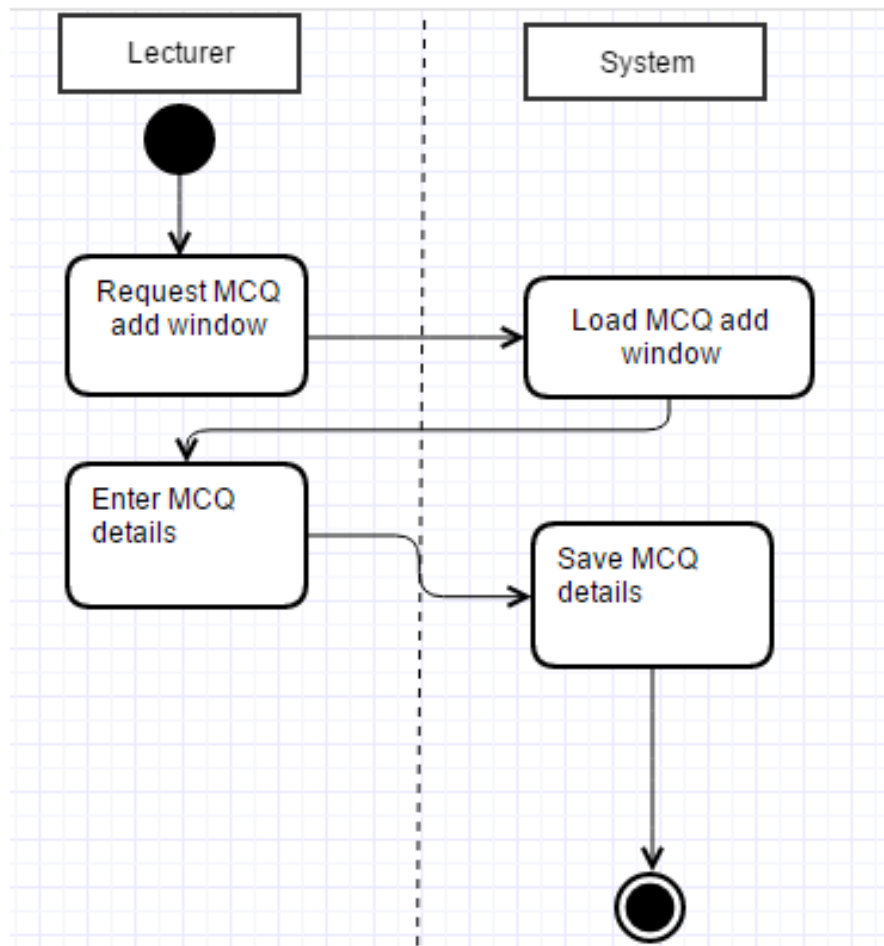
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.7 Admin maps lecturers with subject



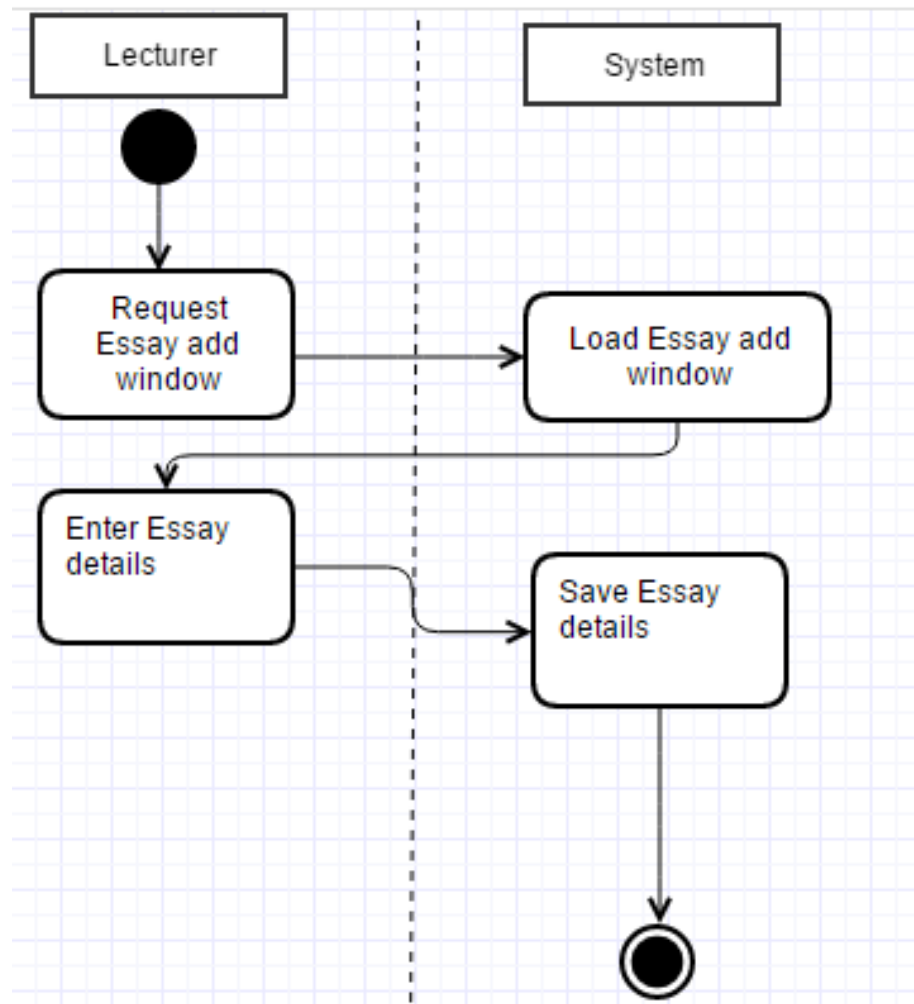
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.8 Lecturer Submits new MCQ



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

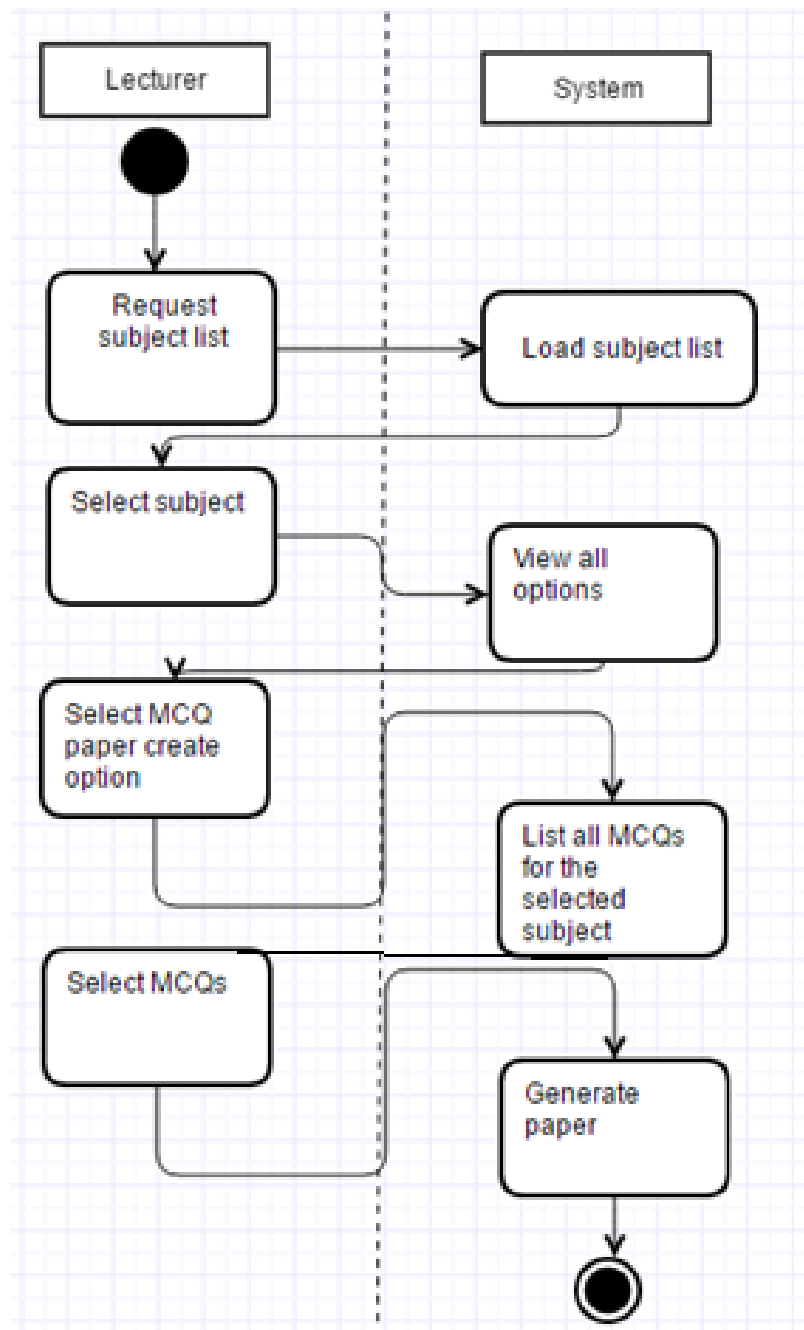
### 6.2.9 Lecturer Submits new essay





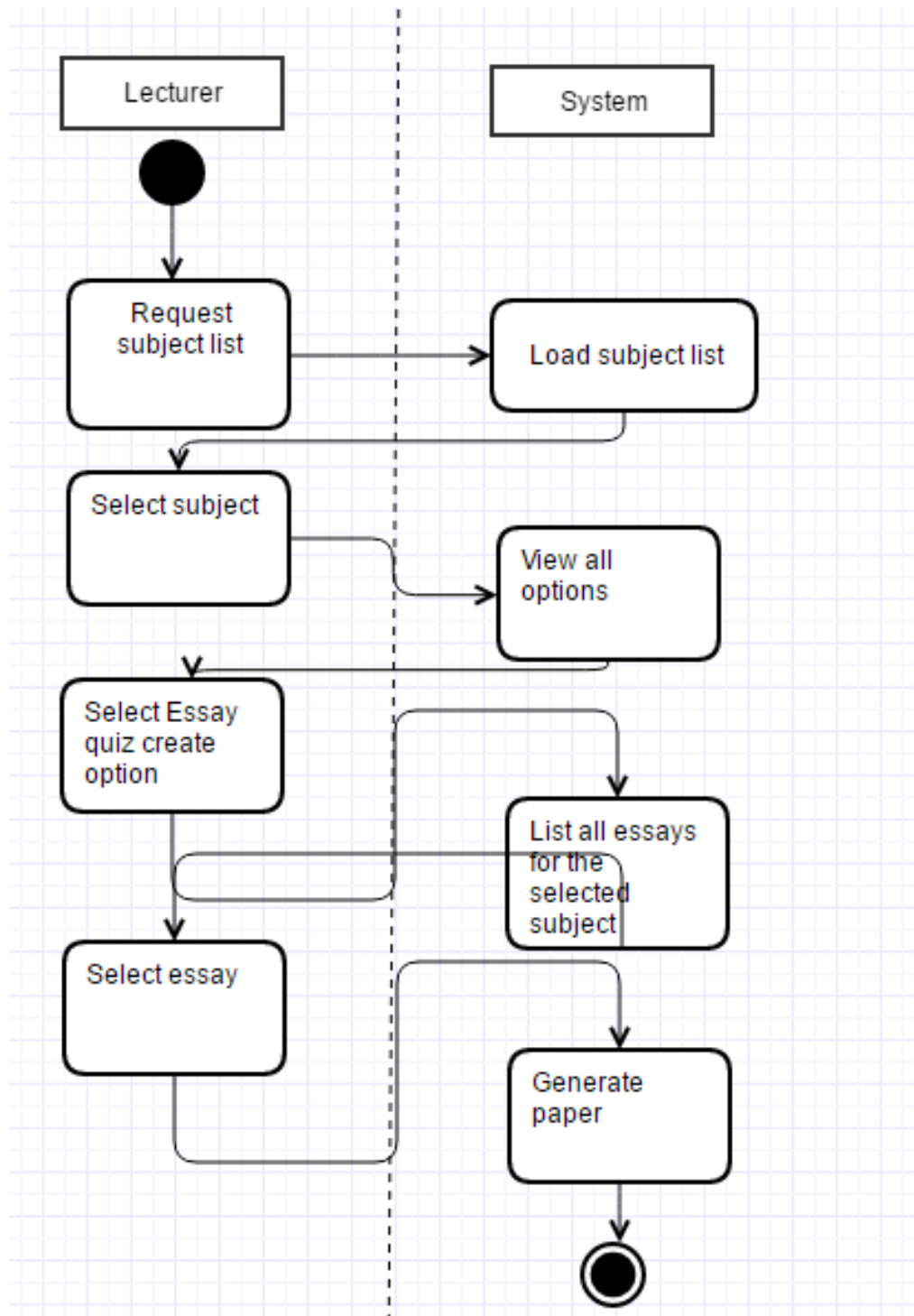
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 6.2.10 Lecturer generates MCQ paper



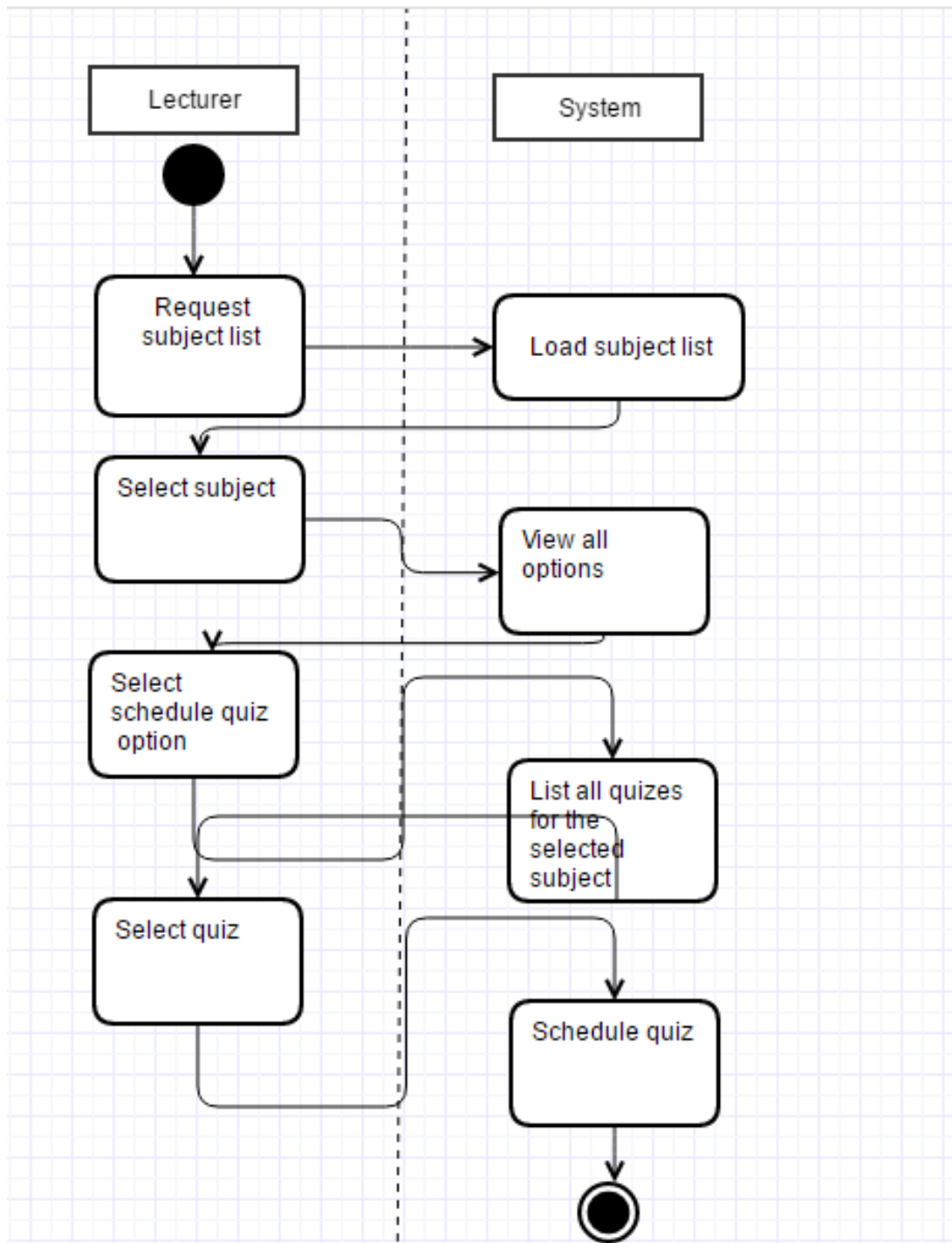
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

#### 6.2.11 Lecturer generates essay paper



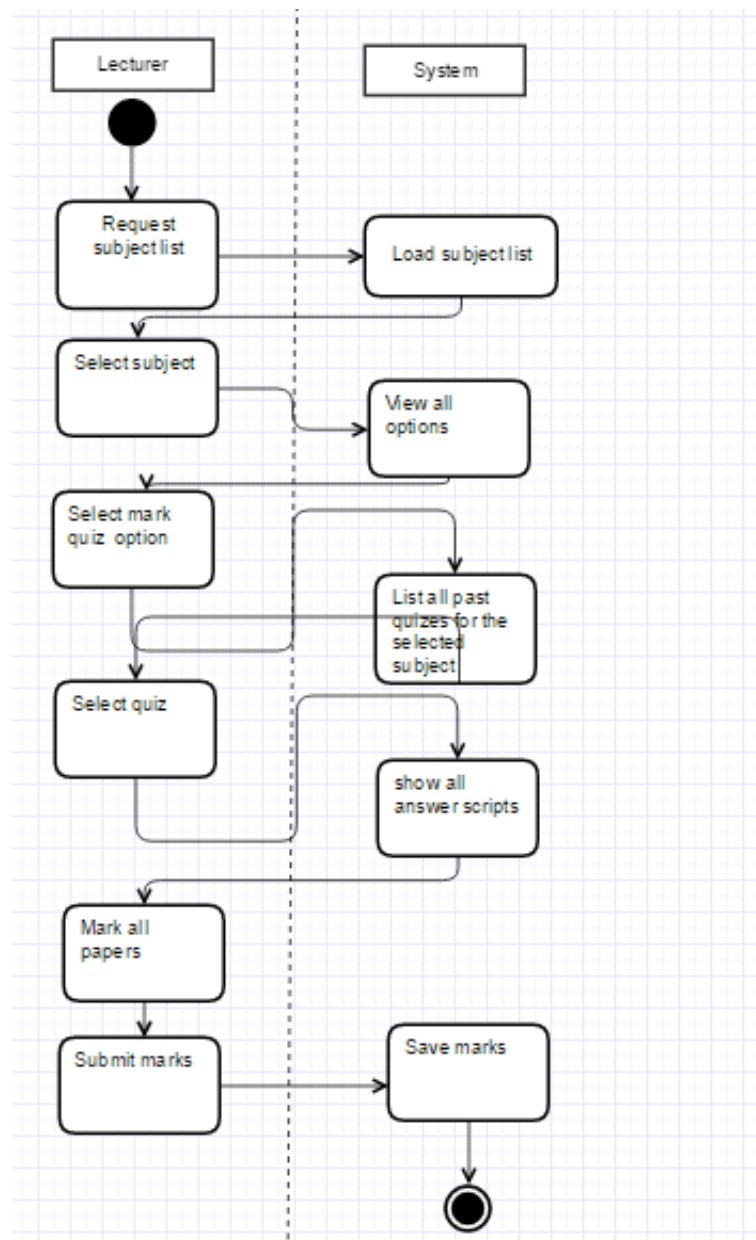
Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.12 Lecturer schedules a paper



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

### 6.2.13 Lecturer marks essay paper



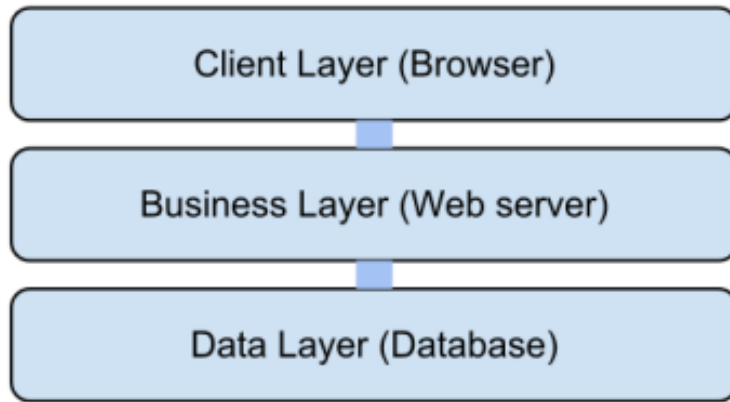
## 7. Deployment View

Being a web application this system is hosted in a remote server, (initially HEOKU hosting space). The database will be hosted in some other hosting space. Except for the statistical graph generation, all the processing is done in the backend, so that the client computer doesn't have to spend much of CPU power. In case of statistical graphs generation, all the data processing will be done in the front end, so that the client computer will need a particular level of performance.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 8. Implementation View

### 8.1 Overview



OES (online examination system) is a web application that follows the MVC architecture pattern. Main reason to use this pattern is to separate functions into layers thus improve the maintainability and reusability.

View layer (AKA client layer) contains the graphical user interfaces (web pages). The actions of these web pages are handled by controller classes. Controller classes invokes and instantiates objects of model classes that contains the business logic. Separating software packages in this manner reduces the complexity.

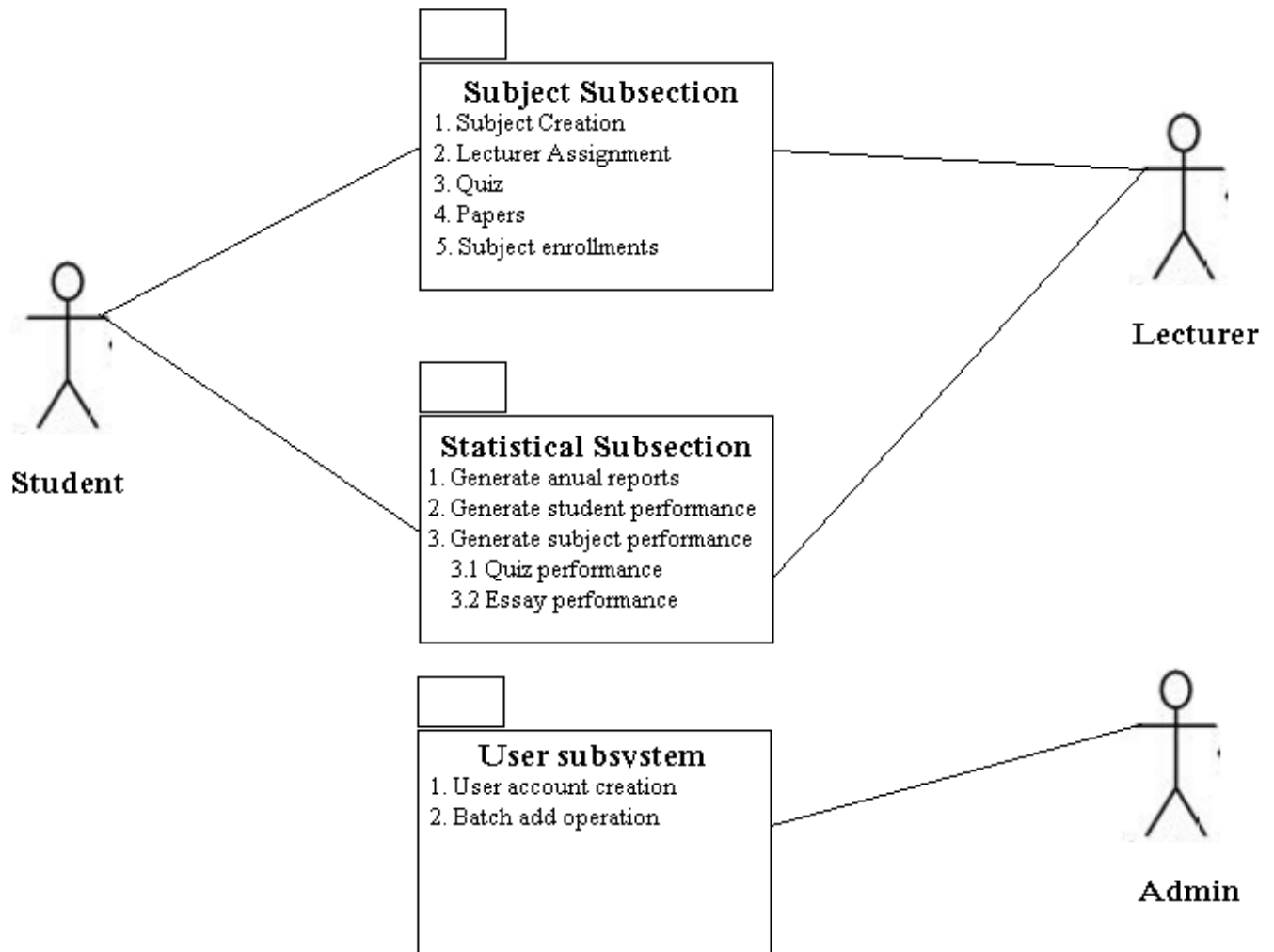
The model classes can be subdivided in to two layers. Business layer and the data access layer. Data access layer is manipulated using HIBERNATE framework. Business layer contains the main entity classes such as Student, Lecturer and etc.

The object relational mapping is done using the HIBERNATE framework. For each entity in the database there exists a class in the software that provides data access operations to that entity.

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 8.2 Layers

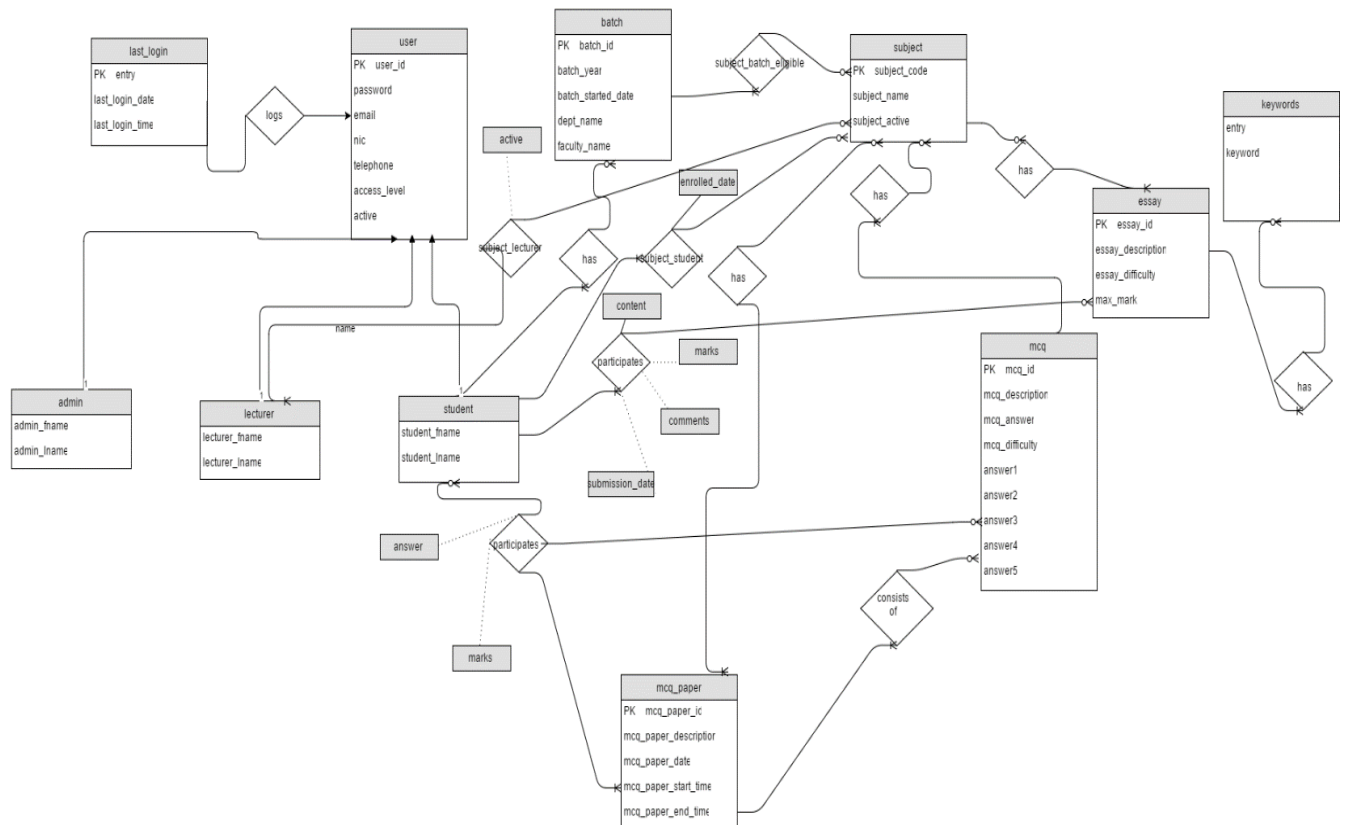
As mentioned above the software will be developed following the MVC pattern. For each sub layer, these 3 layers apply. Following is the representation of main subsystems of the system and their relevant main use cases.



Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

## 9. Data View

### 9.1 ER diagram



Since the diagram is not very clear it's available in the following link

[https://drive.google.com/file/d/0B\\_key68-co6IdWJpQk02cDE2TWs/view?usp=sharing](https://drive.google.com/file/d/0B_key68-co6IdWJpQk02cDE2TWs/view?usp=sharing)

### 9.2 MYSQL implementation

Main design concentrations of this ER diagram is mentioned above under the section “Logical view”.

The database implementation for this ER diagram is done using MYSQL. The main tables are

1. Admin
2. Batch
3. Essay
4. Essay-Student
5. Keywords
6. Last-Login

Online Examination System (OES)	Version: 1.0
Software Architecture Document	Date: 08/04/2016

7. Lecturer
8. MCQ
9. MCQ-paper
10. MCQ-paper-map
11. MCQ-paper-student
12. Student
13. Subject
14. Subject-batch-eligible
15. Subject-lecturer
16. Subject-student
17. User

Hibernate framework is used to automate the object relational mapping. From that a class is made for each table in the database, that makes it possible to access the database.

## 10. Size and Performance

Being a web application, OES will be hosted in the free web hosting space HEROKU.com. Users will not have to install any component to use this software system.

The size of the software is still not calculated, but it is in the range 100-200 MB. The MYSQL database will be hosted in another hosting space.

The client computers need to have a web browser in order to access the system. All the functionalities will be processed at the backend, except for the statistical report generation. Statistical reports will be generated in the front end, thus the process requires some computational power from the client computer.

Performance characteristics are mentioned in the section 3.6.

## 11. Quality

Architectural goals and constraints topic covers the quality parameters for the OES (online examination system).