# Assessors Matching & Assesment Scheduling

An Applications for IQA System

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**Title -** Assessors Matching & Assesment Scheduling: An Applications for IQA System

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# Abstract

A recommending system plays an important role in daily life, and has become a valuable technology in various industries such as Youtube, Netflix, Facebook, etc. The recommending system, however, has an internal mathematical mechanism and is more alike to Artificial Intelligence. Recommending system learns from patterns or clustering from observations, and recommends a value or a solution. The core of the recommending system is Machine Learning constructs. Thus, the recommending system can support users to decide easier.

Automated planning or scheduling system is a system or algorithm that is able to manage the schedule. Scheduling system is a branch of artificial intelligence, which is popularly created by genetic algorithm. The algorithm is one of evolutionary algorithms that is inspired by Charles Darwin's theory of evolution. Scheduling system is very beneficial for some system, it is usually applied to reduce time usage and works in work environment. Therefore, scheduling system sometimes can be called 'The Future of Scheduling Management' .

Presently, there are many business problems which unnecessarily consume cost and time. For example, Internal Quality Assurance (IQA) of KMITL has the problems that cannot be optimized for now. The problems such as lack of suitable committees, poor schedule management, and cluttered and inconsistency database, which must be resolved or mitigated as much as possible.

Ultimately, in this project, we build web application and database system for IQA. Web application consists of three main features which are database management, matching system and scheduling system. Matching system uses unsupervised learning which is powerful for recommending system. Genetic algorithm is applied to scheduling system to find the most efficient schedule appointment based on the algorithm.

# Acknowledgement

This project could not be completed if the authors don't have very great advices from advisor and would like to express our deep gratitude to Asst.Prof. Dr.Chaiwat Nuthong. the authors also would like to thank Dr.Isara Anatavrasilp, Dr.Ukrit watchareeruetai and friend for giving suggestions in presentation and useful discussions. Furthermore, the authors are thankful to lecturers at International College for providing support as well as would like to give special thanks to families for their support, motivations, and encouragement. Lastly, the authors would like to express sense of gratitude to all, who directly or indirectly, have a part in this venture.

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# Chapter 1

# Introduction

This chapter provides an introduction to the thesis about implementing the proposed system of an assessors matching & assessment scheduling: an application for IQA system. The motivation and problem description is firstly described (Section 1.1), followed by the overview of the proposed system (Section 1.2). Furthermore, this chapter also includes the objective set (Section 1.3), the scope of work (Section 1.4), and the overall outline of this thesis (Section 1.5).

## 1.1 Motivation and problem description

First of all, before going through the system. There are few things need to be clarified a terminology and how the actual basic process is working for Internal Quality Assurance (IQA).

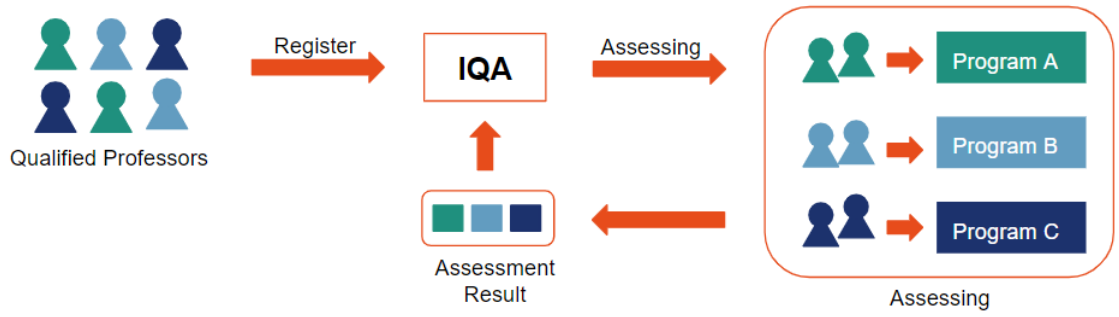


Figure 1.1: Internal quality assurance process

IQA, or Internal Quality Assurance, is the team within the college that responsible for assessing the quality of the programs, faculties, and college

itself. It main job is to send a professors who have been qualified as an IQA committee to assess the programs or faculties. After the assessment, these committee will provide an IQA team a result of the assessment. The result will be used to adjust, develop, and improve the programs, faculties, or the college.

Hence, to do an assessment of every programs, faculties, and college. It requires a huge amount of data collections whether it is an information of the programs, the committee, or the assessment result. Therefore, it is quite exhausting for an IQA team to handle and organize the following information. However, handling and organizing the data are not IQA team's major responsibility, it priority is to make use of an information and prepare an assessment schedule.

As mentioned earlier, three major problems arise, it is caused by inappropriately handling the data have been introduced. First, the data is unorganized. Second, affected from the first problem, it is complicated to retrieve an information from a dislocated data. Last, affected from the first two problems, it is hardly to make use of the data or information which is the final goals of this system.

To be precise on each problem, first, the dislocated data. IQA team itself does not have a database system that collect all of these data. A current way of collecting the data of an IQA team is to store it in an excel file or the paper format. Moreover, as for excel file, each of the member is keeping their own version of excel file as well. This leads to the problem of lost update.

Second, a complication of an information retrieval. This problem is the consequences from the previous problem. When the other department or IQA team itself is requesting (or requiring) an information such as "What is the program A's assessment result in 2016?" or "Can I have the current list of the IQA committee this year?" it is hard for an IQA team to find an information regarding to the questions. In addition, even an information has been found, the team has to check whether it is the latest information or not.

Last problem, making use of the data or information. Apart from the data collection issues, IQA committee also face another problem regarding to the matching of an IQA committees with the programs (or faculties) that they are going to assess. Some of an IQA committees have been matched to assess many programs, however, some of them do not have to assess any program at all. This leads to the problem of bias. For example, if there is two committees who have been assessed ten programs and the college have hundred programs, it means that ten percent of this college's programs are assessed by the perspective of only two people. Despite of that, there also another problem regarding to the matching system, sometime both of the

IQA committees do not have background related to the program they are assessing at all. This might leads to the problem of false judgment as well. However, since there is no database system that collects all the data together, it is almost impossible to make a visualization, prediction, or suggestion out of the data for the IQA committees to match with the suitable programs to be assessed.

## 1.2 Proposed system

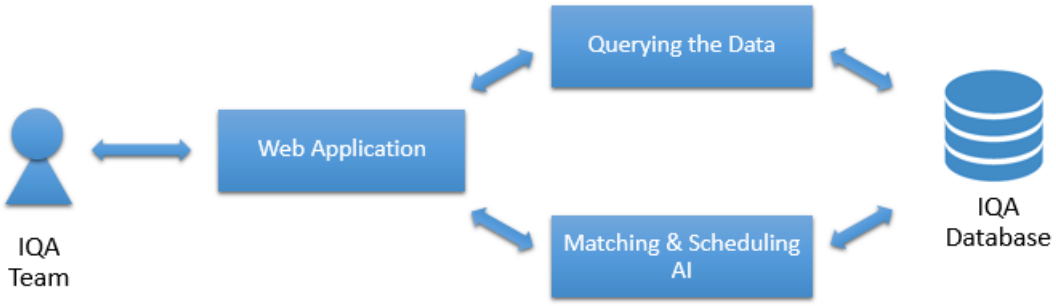


Figure 1.2: Overview of proposed system

Assessors Matching & Assessment Scheduling: An application for IQA System, as its name, our project aim to create a system which supports an IQA team with its work. However, we focus on creating a matching and scheduling system for IQA committees to assess the suitable program. Hence, to create such a system, it is a must to create a database system to collects some amount of data first. Therefore, our project is consisted of three parts which final goal is aimed to create the matching and scheduling system.

First, the database system for IQA, it will collects all an information necessary for an IQA team. It aims to re-organized and digitalize the data to make it more convenient for the future use. Second, the web application which allows an IQA team to get access and interact with an information easily. It also allows an IQA team to retrieve an information easier as well.

Third, it is final goal of the project which are matching and scheduling system. It aims to help suggesting an IQA team whether to match which committees to which programs and yields the most efficient result. It is calculated by several factors such as committee's background, past assessment, or assessment schedules. The system also do it best to spread the IQA committee work (assessing the program) equally and create the most efficient schedule out of it.

## 1.3 Objectives

An objective of this project is to develop a system that supporting an IQA team with its information management and suggesting the schedule for IQA committee assessment. These following goals are set to be achieved, in order to indicate the successfulness of the project:

- IQA database system must be created, it must be usable and contains enough information for IQA to work with.
- Web Application for IQA must be created, it must be able to access to the IQA database and present a necessary information to the user.
- Web Application for IQA must presents only an information that users allowed to access.
- Web Application for IQA must be able to export an information out to other file's format.
- The matching and scheduling system must be able to make use of the data from the IQA database and make the suitable suggestion for the IQA committees assessment.

## 1.4 Scope of work

The proposed system is designed to work under the scope as follows:

- The system is an isolated system which will only be used within IQA team or staffs related to IQA team.
- The system is not related to any existing system in KMITL.
- The system is currently support only the information of the programs not faculties nor college.

- The matching system will only be able to match the IQA committees with the programs.

Expected benefits of this system is to be used as a prototype web application for IQA in the next academic year. If it is found to be useful, the system will be proposed to the """ of KMITL for further development.

## 1.5 Thesis structure

The rest of the thesis are organized as follows:

- **Chapter 2** points out the necessary background knowledge to be understood before implementing this system.
- **Chapter 3** includes literature reviews and related works.
- **Chapter 4** describes the system and the proposed methodology in detail, by providing information, methods, and algorithms to develop the system.
- **Chapter 5** illustrates the system architecture design, user interface and interaction with the web application.
- **Chapter 6** shows and discusses the experiment results for the web application, assessors matching, and assessment scheduling.
- **Chapter 7** summarizes the proposed system and the thesis content, along with suggestions for further improvements.

# Chapter 2

# Literature reviews

This chapter describes the related works of this project and guidelines of the previous work, to be improved in this project. The literature reviews and related works part consist of Machine Learning Algorithms for Recommender System which is described (Section 2.1), follow by Class Timetable Scheduling with Genetic Algorithm in (Section 2.2). However, this semester we are focusing on web development. Therefore, there is not much research on algorithm for recommender system and scheduling.

## 2.1 Machine Learning Algorithms for Recommender System - a comparative analysis

Satya, Anand, and Mahendra has proposed the comparative analysis of machine learning algorithms for recommender system in[1]. The implementation of the system can be performed by various techniques. In the paper, they have discussed Content Based Filtering, Collaborative Filtering, Hybrid Content-Collaborative Based Filtering, k-mean clustering Based and Naive-Bayes Classifier based techniques.

They have used the MovieLens dataset and applied all the above algorithms to this dataset in order to recommend the movies and calculate the precision along with tackling the cold-start problem Cold-start problem in the recommendation system is also known as the new user problem as it creates problem of generating recommendations for the new user.

The Content Based Filtering considers the items rated by a user to formulate the future recommendations. His ratings determine his inclination and interests in order to form the basis for recommending a new item. The

rated items serve as the 'content' in the Content Based Filtering. Therefor, a new item is recommended according to the maximum number of ratings given by the user in a genre.

The Collaborative Based Filtering is the recommendation for a user is governed by other users' profiles. An item is recommended based on the ratings of other users who have similar interests as the user under consideration. This similar pattern of their ratings with the user guides the Collaborative Filtering. The notion behind the Collaborative Filtering is the recommendation of an item based on the preferences of like-minded users.

A Hybrid Filtering method is used for better precision purpose which can provide the advantages of both the content and the collaborative approaches. Suppose, the user appreciates mostly movies in $g \subset G$ genres, and the collaborating users also give high ratings to the $g \subset G$ genres, then g will be taken as the metric to recommend movies to the user.

The k-mean clustering is a non parametric classification technique, the similarity between the objects is calculated by the means of various distance measures such as Euclidean distance, Pearson Correlation, etc. The value of k determines the number of clusters to be formed. The nearest k objects are the most similar to one another. These clusters of similar objects drive the recommendation of new arriving objects. This proximity is being measured by using the Euclidean distance. In order to calculate the Euclidean distance they set rated and unrated movies as binary. Each cluster possesses the mean of all the items in the cluster as a centroid. All the objects in a cluster move towards the centroid and the centroid is updated in each iteration and keep continues until a saturation point arrives, then the centroid stops altering. By following this approach they are decreasing the search space which results in reduced computational complexity.

The Naive Bayes is based on the Bayes theorem. The probabilistic approach which is conditional probability based classifier followed by Naive Bayes Classifier determines the probability of the classification and helps in finding the uncertainty about the model. It is an efficient learning algorithm which uses the prior knowledge of the observed data. The Naive assumption is that the features are conditionally independent.

They have illustrated the analysis of the experiments performed and provide a comparison of all methods in order to compare their accuracy. They used the MovieLens dataset of 10K, 50K and 100K. The analysis of these algorithms is demonstrated based on precision measure. For each test user, they convert 30% of the user's seen movies into unseen movies and apply the described algorithms. Out of the total number of recommendations(T), the ones which are also present in the converted movies are the correct recommendations(tc).

All approaches described in the paper are compared with respect to their precision rates. The comprehensive analysis depicts the strength and the weakness of each one of them in different versions of the MovieLens dataset. According to their experiment results, Naive Bayes gives the best precision compared all the algorithms.

## 2.2 Class Timetable Scheduling with Genetic Algorithm

Rajaram and Dinesh has proposed the comparative analysis of genetic algorithm to solve class scheduling class timetable problem in[2].

Scheduling class timetable is common scheduling problem in which a set of events of classes is to be arranged or scheduled in available time slots along with limited resources such as set of rooms in which events can take place, the set of students who can attend these events, set of feature which is required by events and satisfied by rooms. A feasible timetable is one in which all events have been assigned to room and time slot so that the common constraints are satisfied.

Genetic Algorithm is population based heuristic method largely applied to solve scheduling problems. It is a search method based on principles of natural selection and genetics. The basic working of genetic algorithm is starts with initializing the population with some random solutions. After initialization, they evaluated these random solutions to determine the survival capacity of solution. Selection is an important activity used here to select proper parents to generate an individual called offspring which improves probability of survival of good solution. They applied crossover and mutation with probability [0.-0.8] to generate offspring from selected solutions so called parents and then again evaluate this offspring for its quality. If this offspring is better than available individuals in population then will replace this offspring into population otherwise discarded. They are repeating this process until termination condition is reached. Termination condition is total number of times which is wanted to execute this loop activity.

The generated random solutions in genetic algorithm are called as populations and then try to generate feasible solution with the help of operations like selection, crossover and mutation. In order to have correct selection of individual called parents who are used to generate offspring (child), they used two selection methods which are Tournament Selection II and Tournament Selection V. First method considers part of solution where second method considers proportion of solution. In tournament selection II have selected

individuals randomly by using following technique and then selected one of them as parent with the help of fitness associated with individual and again applied the same technique to select second parent.

From the paper, it is said that crossover and mutation are not sufficient to generate a solution. The results of considerable change when applying tournament selection V instead of tournament selection II shows that considering the proportion of available solutions is better that considering the part of solution and They observed better fitness with tournament V selection. According to the graph, It is proved that considering the proportion of the solution space instead of the part shows significant difference in generated output. In tournament selection II, to select parents they compared only two random individuals from population. Whereas in Tournament selection II they compared individuals from population. Probability of selecting individual as a parent is increased in Tournament Selection V.

In conclusion, Tournament Selection II is considering only two individuals from entire population and therefore sometimes good parents are actually miss to be selected. Applying tournament selection V the chance to select good parent is increased and thus the chance to generate child offspring with good quality also gets increased. Therefore, selection is an important aspect of Genetic Algorithm which can have strong impact on it's performance.

# Chapter 3

# Background Knowledge

This chapter provides background knowledge essential for project understanding. The background knowledge part covers the basics of web application development, deployment, machine learning, recommender systems, matching system, and scheduling system. The literature reviews part provides the information obtained from reviewing related works.

## 3.1 Web

## 3.2 Deploy

## 3.3 Machine learning

## 3.4 Recommender systems

## 3.5 Matching system

## 3.6 Scheduling system

# Chapter 4

# Requirement Analysis, Design and Architecture

This chapter presents analysis and design of a system which provide a broader understanding of details and specifications of the system. This chapter contains system information ranging from the requirement analysis, user interface, diagrams to class design.

## 4.1 System analysis

### 4.1.1 Requirements

The requirements set out here are following FURPS+ Category and ranked in MoSCoW order:

- **M** – Must have
- **S** – Should have
- **C** – Could have
- **W** – Would like to have

The table 4.2 describe requirements set.

| Requirement ID | Requirement Description | Priority Level (MoSCoW) | Key Analysis Points/Notes |
|---|---|---|---|
| 1. Functional | | | |
| 1.1 | The system must be able to present the user an information about study programs, assessment results, and professors that related to IQA committee or study programs. | M | |
| 1.2 | The system must be able to filtering the data and shows the result to the user according to the filter. | S | |
| 1.3 | The system must be able to insert, update, and disable an information about the study programs, assessment results, and professors. | M | |
| 1.4 | The system must be able to export the data out from the database to a different format. | M | |
| 1.5 | The system must be able match and scheduling the IQA committees for their assessment. | M | |
| 1.6 | The system must be able to notify an effect of the professor being disabled. | S | Have no idea yet. |
| 1.7 | The system must be able to receive the inbox for the questions from the users. | W | Have not discuss with an advisor yet. |
| 1.8 | The system must allow the users to reply the questions in an inbox. | W | Have not discuss with an advisor yet. |
| 2. Usability | | | |
| 2.1 | The webpage must be user friendly | M | |

Table 4.1: Table of requirements set

| Requirement ID | Requirement Description | Priority Level (MoSCoW) | Key Analysis Points/Notes |
|---|---|---|---|
| 2.2 | The webpage must have a FAQ (Frequently Asked Question) | S | Have not discuss with an advisor yet. |
| 3. Reliability | | | |
| 3.1 | The system must have a backup in case of the system failures | M | Using PostgreSQL from Heroku as a database. |
| 3.2 | The system must be able to handle every basic authentication problem such as forget the password | S | Have not discuss with an advisor yet. |
| 3.3 | The system must be protected the data from basic system attack. | S | Have no idea yet. |
| 4. Performance | | | |
| 4.1 | The system must be able to handle multiple users at the same time. | M | |
| 4.2 | The web page rendering must not take too long. | S | Have no idea yet. |
| 4.3 | An information update in the site should be as fast as possible | S | |
| 5. Supportability | | | |
| 5.1 | The system must be able to support the computer webpage | | |
| 5.2 | The system must be able to support the mobile webpage | | |

Table 4.2: Table of requirements set(cont.)

### 4.1.2 User interface

### 4.1.3 Use case

Note: As for the users, there are more, but still in the process of deciding about its permission.

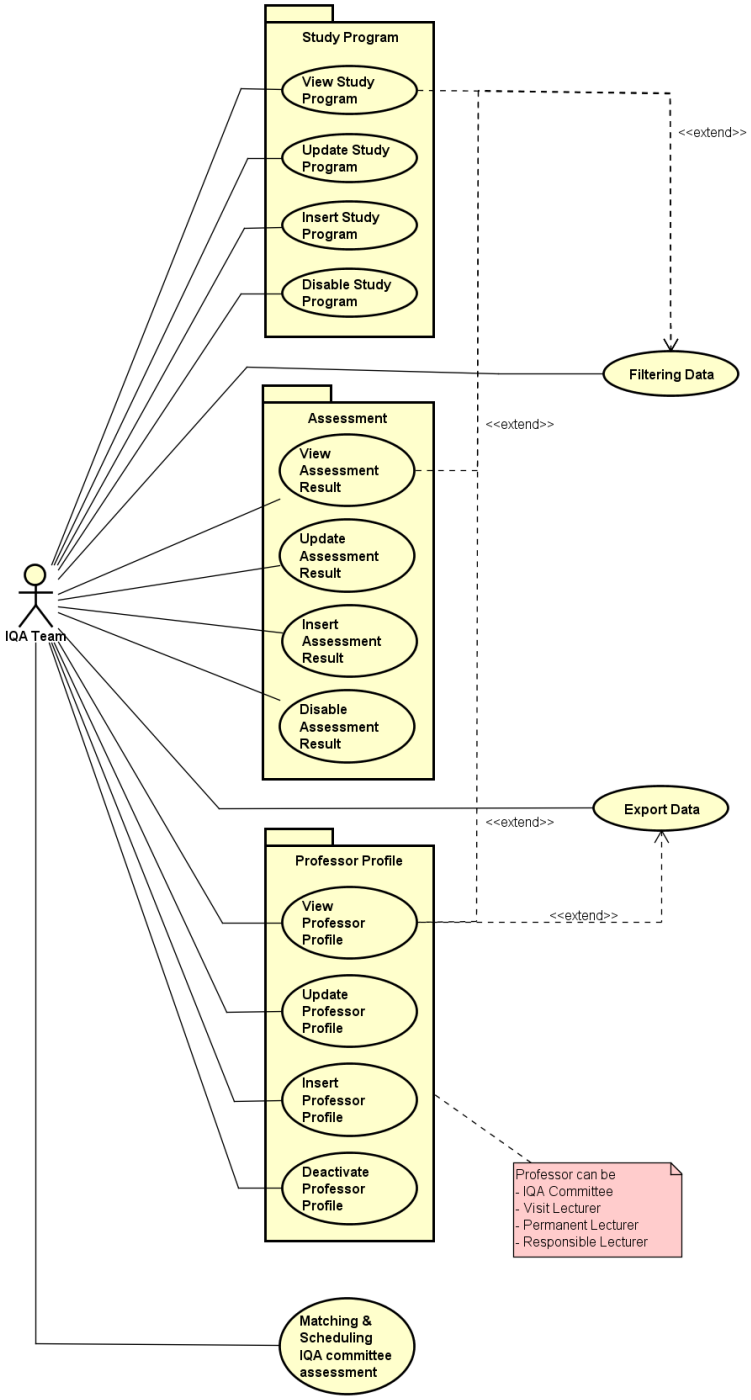


Figure 4.1: Use case

**Brief Use Case Description**

1. **View Study Program**: The user (IQA Team) must be able to see the details of the selected study program.
2. **Update Study Program**: The user (IQA Team) must be able to update the details of the selected study program.
3. **Insert Study Program**: The user (IQA Team) must be able to add new study program to the system.
4. **Disable Study Program**: The user (IQA Team) must be able to disable a study program that will no longer be used.
5. **View Assessment Result**: The user (IQA Team) must be see the details of the selected assessment result.
6. **Update Assessment Result**: The user (IQA Team) must be able to update the details of the selected assessment result.
7. **Insert Assessment Result**: The user (IQA Team) must be able to add new assessment result to the system.
8. **Disable Assessment Result**: The user (IQA Team) must be able to disable an assessment that will no longer be used.
9. **View Professor Profile**: The user (IQA Team) must be able to view the selected profile of the professor. Note that professor can either be an IQA committee, responsible lecturer, visit lecturer, or permanent lecturer.
10. **Update Professor Profile**: The user (IQA Team) must be able to update an information about the professor.
11. **Insert Professor Profile**: The user (IQA Team) must be able to add new professor profile into the system. However, the professor must be either IQA committee, responsible lecturer, visit lecturer, or permanent lecturer.
12. **Deactivate Professor Profile**: The user (IQA Team) must be able to deactivate the profile of the professor that no longer works anymore.
13. **Filtering Data**: The user (IQA Team) must be able to filter the data of study programs, assessment results, or IQA committee according to the filter such as year or faculties.

14. **Export Data**: The user (IQA Team) must be able to export the data about the study programs, assessment results, or IQA committee.

15. **Matching & Scheduling IQA Committee Assessment**: The user (IQA Team) must be able to use matching & scheduling functionality to generate the schedule for an IQA committee assessment.

## 4.2 System design

### 4.2.1 Business Modeling: Domain Model

The following diagram is the domain model that is used to represent the business concepts and the relationships between them. It shows the type of the users, an actions that can be done by users, and the relationship between the actions and the objects. Note: the red box is still in the process of deciding whether to do or not. Note2: AUN and BCUT is the assessment criteria

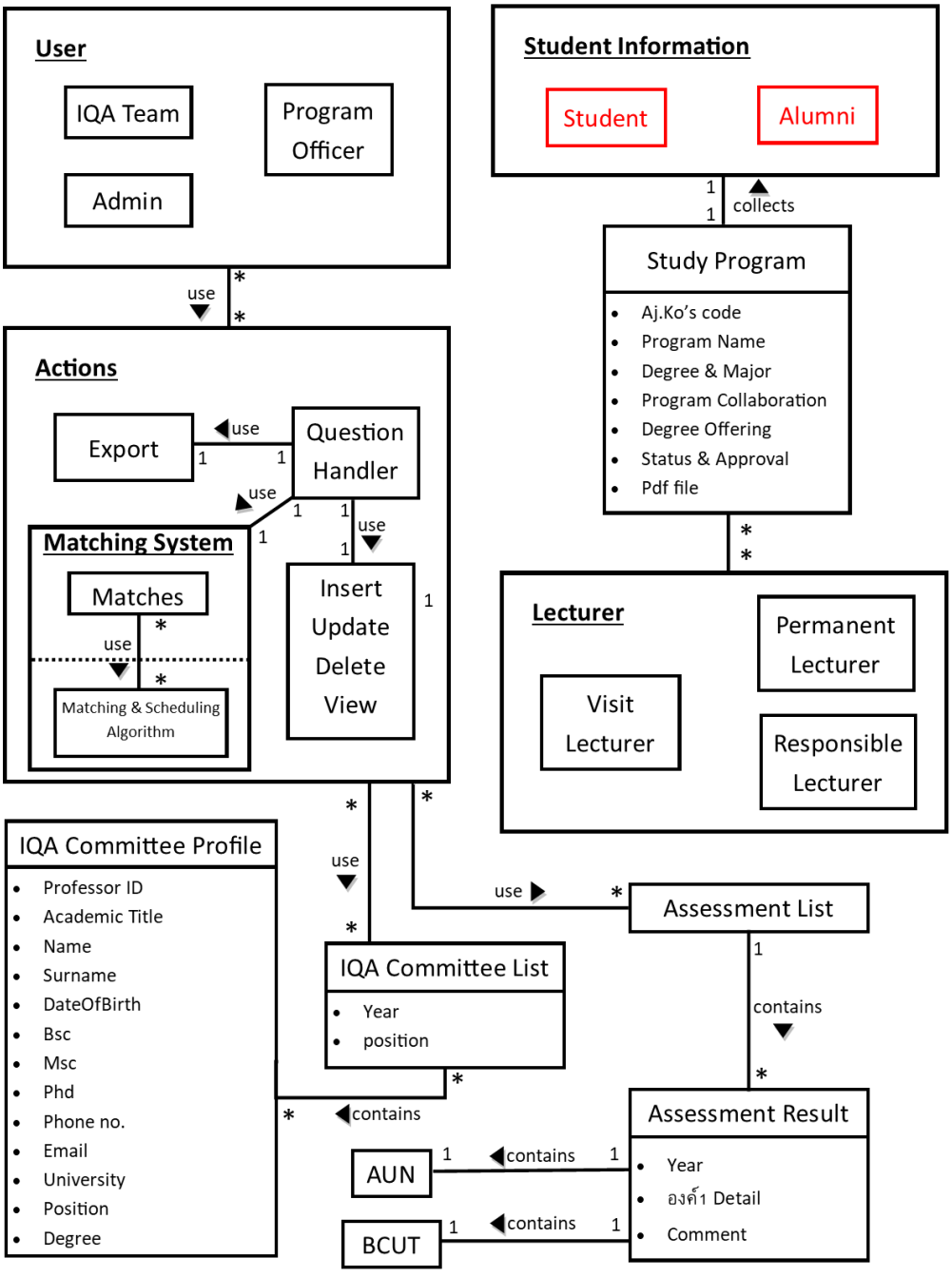


Figure 4.2: Domain model

### 4.2.2 System Architecture

As for the system architecture, it is designed using three tiers architecture, or client-server pattern. An idea of this architecture is to separate the system into three tiers, as its name, a presentation tier, a business tier, and the data tier. The presentation tier is responsible for handling the clients. It sends the request from the clients as well as receives the response from the server, and presenting it to the clients. The business tier, it is a logic part of the system, it contains an application server(s). It is used to process an incoming request from the clients and return the response back to the clients as well. Last, the data tier, it is the part of the system that is collected a data for the uses of an entire system.

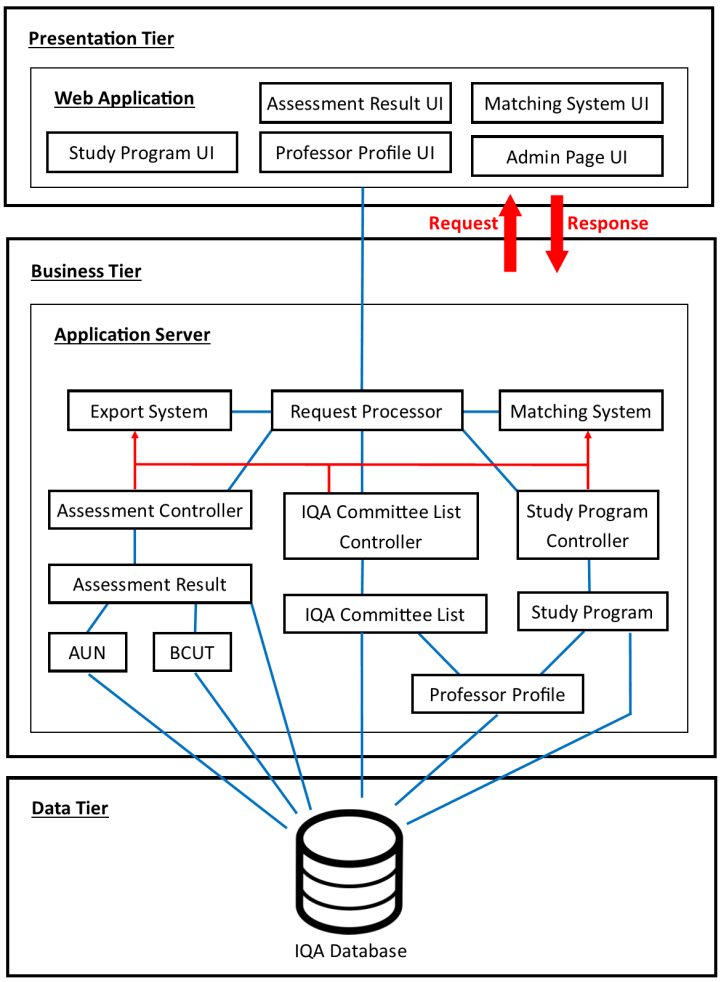


Figure 4.3: System architecture

# Chapter 5

# Experimentation

# Chapter 6

# Preliminary Result

# Chapter 7

# Conclusion

## 7.1 Summary of Thesis Achievements

Summary.

## 7.2 Applications

Applications.

## 7.3 Future Work

Future Work.

# References

[1] Satya P. S., Anand N., and Mahendra P. *Machine Learning Algorithms for Recommender System - a comparative analysis*, International Journal of Computer Applications Technology and Research, 6(2):97–100, 2017.

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