

Feasibility Study IU Physics Gradebook System

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Executive Summary¹

The Physics Department of Indiana University has requested a new gradebook system. The teaching division in the department provides education in physics to undergraduate students. It is the specific client that is under consideration for the proposed information system.

The team has studied the client environment, the proposed system's characteristics, the possible technical issues for the development of the system, and evaluated possible alternative solutions. As part of this effort, the team has identified the business model of the client organization. This model consists of three sections (lecture, lab and discussion), and each of these are further divided into groups. A combination of each of the three sections forms a course. The purpose of the project is to allow for this model to be realized and therefore eliminate the need to address each section as a course like it is currently done on the OnCourse system. The Undergraduate Physics Laboratory Coordinator will be the primary source of contact in the client organization.

As part of the proposed system, we intend to provide a web interface for instructors, professors and the course coordinator to modify gradebook items and for students to view their grades. The former thus form the internal users and the latter form the external users of the system.

The hardware and software requirements for developing the system would be minimal but certain obvious risks such as those of security and failure exist. The team believes that the proposed system is feasible and expects the project to succeed. The team is, therefore, confident of carrying out the development and deployment of the proposed system.

However, the team also suggests that the client should evaluate the possibility of preserving the current system, due to risks and lack of significant benefits of switching to a new system.

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1 Introduction

This document is the final report of the feasibility analysis for the IU Physics Gradebook System project, by the feasibility analysis team.

The team has studied the client environment (Section 2), the proposed system's characteristics (Section 3), the possible technical issues for the development of the system (Section 4), and evaluated possible alternative solutions (Section 5).

The team believes that the proposed system is feasible and expects the project to succeed. However, the team also recommends the client to seriously evaluate preserving the current system as an alternative solution.

2 Client Environment

2.1 Identity

The Physics Department of Indiana University is the client of the project. Indiana University is a non-profit education institution. The Physics Department provides education in physics to undergraduate students on the campus. In addition, the department also provides undergraduate and graduate level programs in the physics major.

2.2 Organizational Structure

The client organization consists of two divisions, Research Division and Teaching Division.

2.2.1 Research Division

The Physics Department is engaged in cutting-edge research at the forefront of the field - from the study of complex biological systems to experiments on the simple yet mysterious neutrino. The research division has two sites. One is at the Swain Hall West Building (SW) in the Bloomington Campus of Indiana University. The other is at the Indiana University Cyclotron Facility (IUCF).

The research division is not of concern in this feasibility study.

2.2.2 Teaching Division

Overview The teaching division provides education in physics to undergraduate students. It is the specific client that is under consideration for the proposed information system.

The teaching division consists of associate instructors, professors and coordinators. One professor, several associate instructors and coordinators form a teaching unit that is responsible for one course. Each individual entity in the division can participate in multiple units.

In a teaching unit,

- the professor is responsible for lectures;
- the associate instructors are responsible for homework assignments, discussion SECTIONS and lab sections; students in the section are divided into GROUPS. Each instructor is accountable for one group;
- the coordinator is responsible for the administrative affairs, e.g, adding/dropping students from the roster.

Refer to Figure 1 on page 3.

The structure of the client organization is expected to remain the same during the duration of the project.

Location The teaching division is located at the Swain Hall West Building (SW) in the Bloomington Campus of Indiana University. SW is the primary site for the project.

2.3 Personnel

2.3.1 Primary Client and Contact

The Primary Client for the proposed system is Daniel Beeker, the Undergraduate Laboratory Coordinator. Daniel Beeker is the head staff for undergraduate education in the teaching unit. He has requested a new gradebook system with very clear objectives to the team.

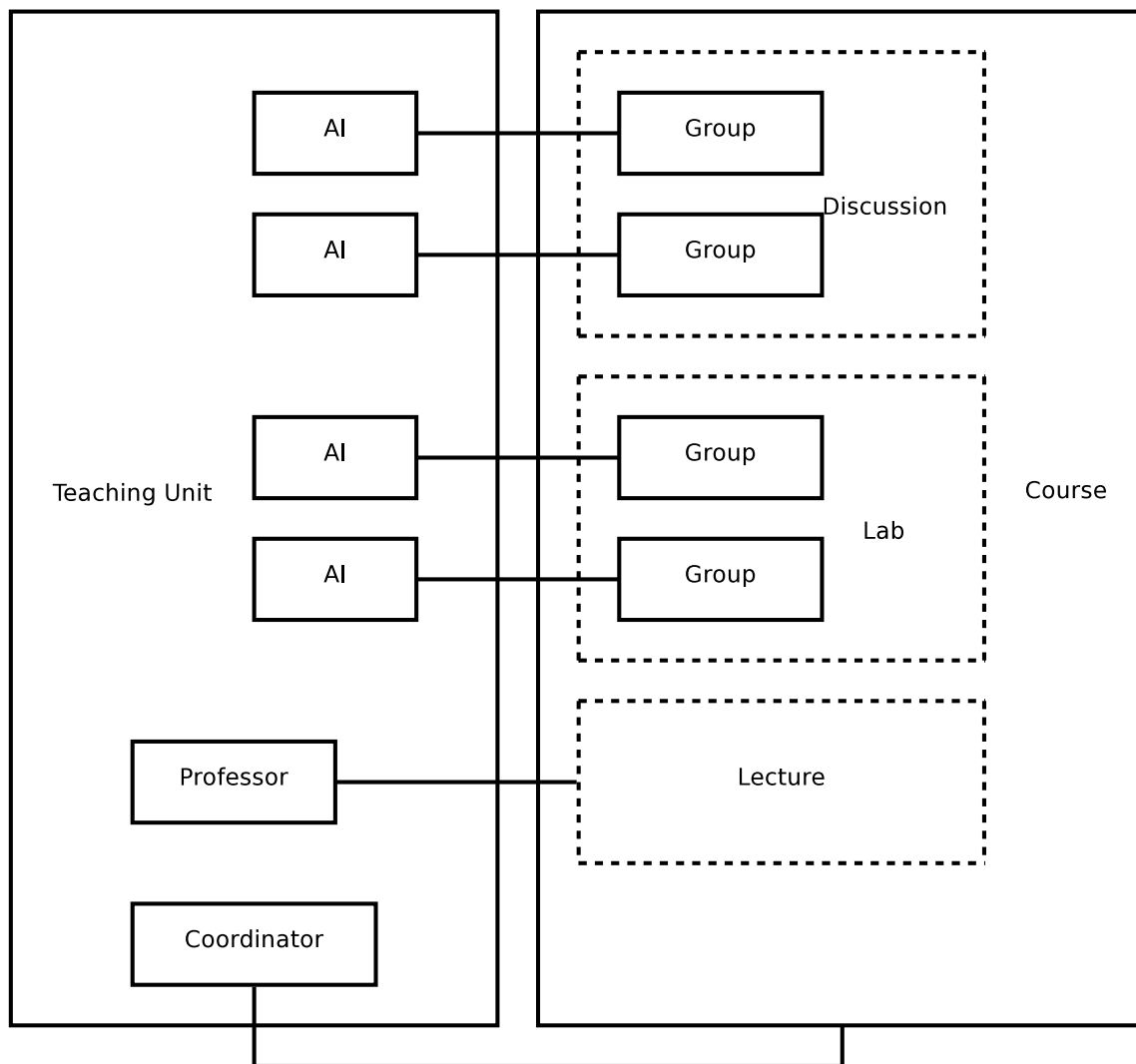


Figure 1: The Client's Business Model

The primary client has sufficient resources for ongoing operation and maintenance of the proposed system. He is also generally available in his office. It is unlikely that he will be absent for any extended periods during the course of the project.

The Primary Client can be reached at

Daniel Beeker, Undergraduate Physics Laboratory Coordinator
Phone Number: 812-855-5903
SW 115 727 E. Third St. Bloomington, IN 47405-7105
debeeker@indiana.edu

2.3.2 Information Systems Staff

The client already has an IT staff to maintain servers and computers, and does not intend to hire new staff. The current staff will be responsible for maintaining the proposed system.

2.4 Commitment

The primary client is willing to make necessary commitments to the project. As the current system does not completely meet their requirements, the client is enthusiastically looking for a substitution. The client becomes busy at the beginning and ending of each school semester, but this is not expected to distract him from the project.

A regular meeting with the primary client can be set up as required. He will also assist the project by

- reading and reviewing the Requirements Specification document and viewing the Prototype;
- providing a server for running the system, and for testing and installation phases;
- preparing test data and testing system operation.

3 System Characteristics

3.1 Goals and Objectives

3.1.1 Goals

Provide a secure environment and an improved experience for students, associate instructors, professors and staff to access/manage gradebooks.

3.1.2 Objectives

1. Provide a web interface for a student to view his or her gradings in the gradebook;
2. provide a web interface for instructors to enter and modify gradebook items;
3. provide a web interface for the professors and coordinator to review gradebook items and calculate total gradings;
4. provide a web interface for the coordinator to set up gradebook items and assign user privileges for each gradebook;
5. keep information confidential; unauthorized users have no access to the system. Authorized users have limited access to the system;
6. enable accessing gradebooks from previous years for the department coordinator;
7. enable different types of gradings for gradebook items;
8. reduce the redundancy of information.

3.2 Classes of Users

3.2.1 External Users

Students that are/were registered in physics undergraduate courses are external users to the system. The students receive gradings for the courses via the proposed system. The students have diverse backgrounds typically from all IU departments and schools. Their computer skills may be limited. Their role in the system is STUDENT.

3.2.2 Internal Users

The internal users, as stated in 2.2.2, are organized into units. Each unit is in charge of a course.

Instructor The associate instructors are the major information providers in the client organization. They are graduate students in the physics department, familiar with computers. An associate instructor gives gradings for the students registered in his or her group. An associate instructor can only access the gradebooks for the group of students he/she is teaching. The assigned role of associate instructors in the proposed system is INSTRUCTOR.

Professor A professor is the person in charge of a course. A professor has overall access to the gradebooks in the course. A professor can also modify the descriptions of the course. A professor in reality is assigned the role PROFESSOR in the system.

Coordinator A coordinator² is the co-pilot in a teaching unit. A coordinator has the privilege to add or drop students from the roster, and overall access to all gradebooks for the course. A coordinator in reality is assigned the role COORDINATOR. A professor, therefore, can also be a coordinator, but this is generally considered bad practice.

Administrator The coordinators in the teaching division are the administrators of the proposed system. They have ultimate access to the entire system, including:

- setting up courses, and corresponding teaching units;
- reviewing gradebooks for all courses and generating reports;
- making backups.

To avoid any confusion, the corresponding role of division coordinator is named as ADMINISTRATOR. In practice, the teaching division coordinators and the coordinators in teaching units are the same set of people.

²The term coordinator is abused. It also stands for the coordinator of the entire teaching division, which will be clarified in 3.2.2. This definition differs from the one given in the Project Proposal.

3.3 Scope

The proposed system will exchange information with two of the existed university information systems.

OnCourse OnCourse is the university's on-line collaboration and learning environment. The system is under the administration of the University Information Technology Services (UITs). It is the central system for the entire university to access education related course information, such as rosters and gradings. The interaction between the proposed system and OnCourse is manual: At the beginning of each semester, the administrator obtains course information and rosters from OnCourse, and imports them into the proposed system. During the period of a semester, the course coordinators keep the roster between OnCourse and the proposed system in synchronization. At the end of each semester, the coordinators export the final gradings, import them into OnCourse to send the gradings into the university's registrar office.

The gradebook management subsystem of OnCourse is the current system that the proposed system is going to upgrade.

CAS CAS is an abbreviation for Central Authorization System, a system used widely in Indiana University for authorizing credentials of individuals to access university information resources. The interaction between the proposed system and CAS is automatic, as the public API documentation is available in IU Knowledge Base. The proposed system authorizes the users via CAS system. However, the proposed system does not authorize the administrator via CAS system.

3.4 Current System

The client utilizes the grading management part of the above mentioned OnCourse(3.3) system to partially achieve the goals and objectives in 3.1. Most of the objectives are met, except for the following:

6. The client does not have control over the information stored in the current system. Gradebooks from past years are inaccessible.
7. The client cannot assign mixed gradings for the same gradebook item in the current system. As a workaround the client invents random numbers to represent non-quantifiable gradings.

8. Since the current system has no structure to support multisection courses, the client has to workaround the issue by creating many pseudo-courses for each real course; one for the combined course, and several for the each associate instructor's group. As a result, the client has to keep two identical copies of final gradings in the current system.

There is no expected data conversion between the current system and the proposed system. Source code is not directly available, but a reference implementation is available. Refer to 4.4.

3.5 System Needs

In this section the detailed needs that the proposed system shall meet in order to achieve the client's goals and objectives are listed.

3.5.1 Objects

The proposed system shall be able to store several classes of objects. See Table 1 on page 9.

3.5.2 Operations

The proposed system shall facilitate users to accomplish certain set of operations. See Table 2 on page 10.

3.5.3 Import, Export and Conversion

The proposed system shall be able to import and export any object as spreadsheets. The depth of importing and exporting shall be discussed in further documents. Expected formats are CSV³, XSL⁴ and ODS⁵. A requirement is that the proposed system shall understand the exported OnCourse roster CSV file.

The client does not require transporting existing data from the current system to the proposed system.

³tab separated text files

⁴Excel files

⁵Openoffice spreadsheet

Object	Quantity ^a	Source ^b	Attributes ^c
Student	1000	Department Coordinator	Name(String), CASName(String)
Group	100	Course Coordinator	Section+, Instructor+(Teacher), Schedule, Student*
Section	100	Course Coordinator	Course, Type(SectionType), Group*, GradeBookPrototype
Course	10	Department Coordinator	Section*, Gradebook, TeachingUnit
GradeBook	100	Course Coordinator	GradeBookItem*, Final(GradebookItem)
GradeBookItem	1000	Associate Instructor	Student, Valid(Bool), Grade(String), Log*(String)
User	100	Department Coordinator	Name(String), CASName(String)
TeachingUnit	10	Department Coordinator	Teacher+
Teacher	100	Department Coordinator	User, Role

^aOrder of Magnitude, per semester

^bdiscern with Roles in 3.2.

^c+:1 or more; *:0 or more

Table 1: Objects

Operation	Operator	Objects/Attributes Generated
Adding/Dropping	Course Coordinator	Group.Student
Adding/Dropping	Department Coordinator	Student
Grading	Associate Instructor	GradeBookItem, Group.GradeBookPrototype
Delivering Final Grades	Course Coordinator	GradeBook.Final
Initializing a Course	Course Coordinator	Course.Section, Section.Group, Group.Instructor, Group.Student, Section.GradeBookPrototype
Initializing the System	Department Coordinator	Student, User, TeachingUnit, Course, Section, Group

Table 2: Operations

4 Technical Environment

4.1 Hardware Platform

The client currently has PCs with Pentium 4 CPUs that are suitable for running Windows 2000 Server. These machines can be used for development purposes. The computing capacity of the PCs is sufficient for the proposed system. The final hardware environment might differ from that of the development machine, and therefore an installation stage is expected.

4.2 Networking

The system will be deployed on one single server, and is very unlikely to evolve into a distributed system. There is no specific requirements for a local network. On the other hand, an Internet connection is required for external users and internal users to access the system. At project site (SW), Internet access is already available.

4.3 Software Platform

The software platform of the proposed system will be built upon productive versions of several pieces of Free Software.

- for the Database management system, MySQL should be deployed;
- for the HTTP service daemon, Apache should be deployed;
- for the Web applications, PHP run-time (with development run-time) should be deployed.

A software environment that is comparable with the one mentioned above is easy to set up, and can be accessible at any personal or commercial web hosting service.

4.4 Resources during Development

The source code of the to-be-replaced system is not directly available. However, the precedent of the system is available as The Sakai open source project[1].

Documentations about the software platform are generally available on the Internet.

Other types of resources, including documents about the structure of the client organization, are severely lacking. However, since that part of the client organization that is involved in the project is relatively small, the team does not foresee the lack of documentation about the client organization to be a problem.

4.5 Client's Experience with Computers

The client's staff (associate instructors, professors, coordinators, see 3.2) are familiar with computers and have been using a similar information system for years. The primary client, Daniel Beeker has rich experience in managing such information systems. The physics department has computer technicians to provide technical support.

4.6 Project Knowledge and Skills

In this section, the relevant knowledge and skills of the team members are reviewed on an individual basis, then a summary is presented.

4.6.1 Programming Skills

- Yu relevant knowledge has not been refreshed towards current technology for a long period.
- Rohit reasonably comfortable with web development; some refreshing on databases might be needed.

4.6.2 Domain Knowledge

- Yu familiar with the domain knowledge involved in the project.
- Rohit fully familiar with knowledge required for the proposed system.

4.6.3 Abstraction Skills

- Yu experienced in abstracting; sufficient knowledge of relational databases;
- Rohit reasonably comfortable;

4.6.4 Client Communication

- Yu communication skills need to be improved, familiar with the client.
- Rohit not familiar with the client, but no difficulty in communication.

4.6.5 Summary

The team, in general meets the technical requirements to develop the proposed system. With the addition of two new members and refreshing relevant knowledge and skills, the team should be fully qualified to lead the project to a success.

5 Evaluation of Solutions

5.1 Alternative Solutions

In this section, possibilities of alternate solutions are discussed. Then follows a summary, in which the best amongst the alternatives is discussed.

5.1.1 Current System

The current system already partially meets the goals of the client. It works, and it is secure. The only problem is that the experience of the department coordinator has been uncomfortable for having been forced to apply workarounds due to the shortcomings of the current system.

The benefits of doing nothing are

- no cost for switching to a new system; therefore no cost for finding new workarounds;
- no cost for maintaining an independent information system; a new computer is cheap, but maintenance is expensive.

The critical drawbacks of doing nothing is that the client's poor experience with the current system continues. The client has to understand the hidden costs of deploying a new information system before deciding to develop it.

5.1.2 Off-the-shelf Software

There is no suitable off-the-shelf software that is specifically designed to meet the client's goals.

5.1.3 A Deep Prototype

The difficulty for the client to adapt to the current system is because of the difference in business models. The model of the current system is abstracted from simple, independent courses taught by small teaching units (see Figure 2 on page 14) , whereas the client's organization runs on interdependent courses taught by large teaching units (see Figure 1 on page 3). If the client could switch into the targeted business model of the current system, there would not be any difficulties.

However, such a deep prototype is unlikely to happen in reality. It is beyond the effort of the primary client, and the client does not have sufficient resources for the current system's target model. The team does not recommend this deep prototype as a suitable solution.

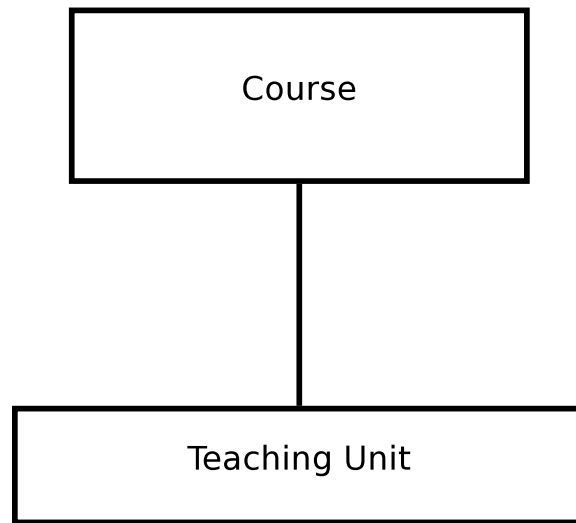


Figure 2: OnCourse Business Model

5.1.4 Multiple Systems

The client's information can be managed by a mixture of a set of electronic spreadsheets with small printed paper notes to report gradings for each individual student. This kind of mixture system has no benefits when compared with the current system. It also introduces problems, such as

- difficulty in keeping the grade reports confidential;
- difficulty in keeping track of previous gradebooks;
- a lot of redundancy of information.

The team does not recommend any similar alternatives.

5.1.5 Summary

Among the listed alternatives, the team proposes but does not recommend preserving the current system as an alternative solution for the client's problems. However, it is up to the client to decide whether or not the proposed system shall be developed and deployed.

5.2 Implications of Proposed System

5.2.1 Technical Implications

The proposed system requires installation of several pieces of softwares as prerequisites of the software platform. These new softwares may need maintenance and upgrades from time to time. Once the system is deployed, the client has to allocate human resources from the IT staff for the proposed system.

5.2.2 Operational and Managerial Implications

There is no anticipated operational and managerial implications with the introduction of the new system. The reason is that the proposed system adapts to the operational and managerial structure of the client's organization.

5.2.3 Staffing Implications

The proposed system does not

- require new/extra data entry; the amount of data extracted by the current system and that extracted by the proposed system are the same;
- eliminate/introduce any roles or positions in the organization.

The proposed system does

- eliminate/reduce tasks; there will not be any need to address each GROUP as independent courses;
- introduce new tasks; the client has to export the final grades to OnCourse;
- require training for the external users and the internal users.

5.2.4 Risks

The team anticipates several sources of risks after the proposed system is deployed:

- hardware failures: the machine that carries the system might experience hard-drive failures;
- software failures: the software platform might contain bugs that corrupt the data;
- security: hackers might get into the system and modify/steal the information in it;
- improper usage: the users are human beings; human beings make mistakes and destroy the information;
- virus: the platform might get infected by virus or malicious softwares that cause the malfunctions in the system.

Although the current system may also suffer from these risks, the risks of the proposed system could propagate to the systems administered by the administrator of the current system(UTS). The client is not directly responsible for these risks.

5.3 Conclusions

The feasibility analysis team believes that the client is suitable for developing and using the proposed system.

The team is confident of carrying out the development and deployment of the proposed system.

However, the team also suggests that the client should evaluate the possibility of preserving the current system, due to its associated risks (refer to 5.2.4) and lack of significant benefits of switching to a new system.

References

- [1] Sakai Project <http://www.sakaiproject.org/portal>

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