Real Life Object-oriented Design Examples for a Class of Professionals

Robin Qiu

Dept. of Information Sciences
Pennsylvania State University
Malvern, PA 19355
Email: robinqiu@psu.edu

Ying Tang

Dept. of Electrical and Computer
Engineering
Rowan University
Glassboro, NJ 08028
Email: tang@rowan.edu

Abstract -- A class for professionals could be quite different from one for college students due to a variety of backgrounds and work experience. Some of them want to make a career change; some of them want to catch up with the state-of-the-art technologies. In class, concepts, principles, and equations might be too abstract when there are no good real life examples. Object relationship modeling in object-oriented software engineering course is a good example. This article briefly shows a few cases of how real life examples can help professional students understand the covered contents, which have been experimented in class using the Rational Rose® enterprise suite. Issues on how examples get picked and how they should be explained and discussed are analyzed. A result of the experiment is given.

1. Introduction

Different from most full-time college students, professionals are usually of different course expectations, work experience, and even totally different education backgrounds when they register a course for a high degree in a part-time based professional study institution. This is especially true for a computer-related degree course (e.g. "Software Design Methods" for M.S. in Information Sciences). The significant difference among students' profiles makes teaching very challenging. For instance, if an illustrative example in a class requires a lot of background knowledge in a specific field while the majority of the class lacks the background, as a result, the example might not be understood by the majority. It certainly makes the lecture less effective. Adding more difficulties for an instructor in such a teaching/learning environment is the extremely dynamic change of students' profile of a class from semester to semester. As such, the learned experience from one semester might not be applicable for a new semester. Therefore, it is extremely important for a professional education school/center to have a proper e-learning or e-education system in place to manage students' personal information, and help instructors improve their teaching effectiveness in light of using appropriate and real life examples for a class. The ultimate goal is to retain high professional students' satisfaction by meeting their career development objectives from time to time.

There are many articles and existing commercial solutions addressing how to use enabling technologies to design and develop e-learning or e-education system, build infrastructures to deliver the promised real-time responses, or improve system effectiveness to promote the service quality [1-3, 7-8]. This article

focuses on how an e-learning system could customize the lecture deliverables based on a given professional learning circumstance. In particular, object-oriented design examples were used in a software design method course, where one of the most popular industrial software design packages (i.e. Rational Rose® enterprise suite) was adopted. The remainder of this article is organized as follows. Section 2 provides a brief discussion of e-Education system called myCareer®, which was used in customizing lecture examples based on the students' profile for a given class. Section 3 discusses a few real life examples used in a software course. At last, Section 4 gives conclusion of this article.

2. myCareer® – an e-Education System for Professionals [3]

The myCareer® web-based system, developed by GL AgilityTech, Inc., is an e-Education system for professionals with the focus on the promise of students' satisfaction. It not only combines the general administrative and management features (e.g., school administration, student registration, course management, teaching, learning, and knowledge sharing) with the interactive and multimedia supports (i.e., multipoint videoconferencing, voice over IP, online chats, and whiteboard sharing), but also provides individuals with personalized learning contents, assignments, and guidelines to meet the needs of individuals. This section briefly discusses how a knowledge-based module is implemented to ensure that the teaching process can be tailored based on different course expectations, work experience, and education backgrounds that constitute a class profile.

Two relevant features are discussed in this section. One is the mechanism for collecting individual student's profile. Another is how lecture deliverables such as contents, examples, and assignments can be tailored for a specific class when the students' profile has been archived in a given semester.

2.1 Individual Student's Profile

Each individual has to edit his/her background information before taking any course. Fig. 1 shows the screen for a student to update his/her background information. The background information can be updated from time to time and will be shared by all the instructors and the knowledge-based module. It should include all the education data, taken courses, work experience, and detailed skills related to the courses. When he/she completes a course, the course highlights will become part of his/her background information. In addition, for each registered course a student has to input his/her course expectation through the system. Fig. 2 shows an example given by a student who has registered the "Web-based Systems".

Update Background Information

Robin Qiu

Thanks for your updating your background information.

Background Information:

```
Education:
M.S. in History
B.S. in English

Work Experience:
5 years construction project management
2 years museum management

Software skills:
2 years Microsoft Access
5 years Microsoft Excel
10 years Microsoft Word
1 year Visual Basic
```

[Submit Change] [Reset]

Figure 1. Individual Background Updating Screen

Update Course Expectation

Web-based Systems

Thanks for your updating your course expectation.

Course Expectation Information:

```
I have no experience in the design and development of any web-based system. I
would like to learn some basic skills in creating a web-based system. I hope I
would be able to create a simple web-system rather than buy a very expensive
eCRM or e-business system, which helps me in managing my construction projects.
Some basic functions will be:

Archiving project information;
Editing/updating customer contact information;
Alerting me any unfinished tasks;
Recording activities;
And keeping historical data.
```

[Submit Change] [Reset]

Figure 2. Course Expectation Updating Screen

2.2 Lecture Deliverables Tailored by the Knowledge-based Module

A knowledge-based module can tailor lecture deliverables based on students' profile in a class [3]. The lecture deliverables include course lecture materials, assignments (e.g., homework, projects, reports, etc.), and exams. The general tree structure used to manipulate the archived deliverables. Fig. 3 shows an

example of a lecture material tree. The structure is constructed based a well-developed course-content XML schema. Part of attributes of each child is production rules, which can be continuously customized through addition, update, or modification manually. Furthermore when the feedbacks from individuals are collected, the relevant rules for the lecture material tree will be modified through a knowledge discovery module. As time goes the process can be continuously improved due to the comprehensive collections of deliverables and maturing rule base. So the system is capable of tailoring effective lecture deliverables for a given class.
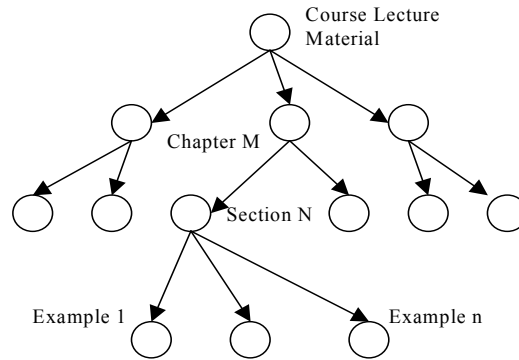

Figure 3. Content, Assignment, and Exam Tree Structure

3. Object-oriented Design Examples

This article shows how object-oriented design examples are used in a "Software Design Methods" class, in which there were a variety of professionals in terms of different course expectations, work experience, and education backgrounds. To keep classes close to the real software world that is preferred by most professional, a popular industrial package - Rational Rose® Enterprise Suite – was used in the experiment. In this section, two quite different real life examples are modeled used Rational Rose®. When the majority of a class shifts from one class profile to another, it is obvious that a different example could be used in order to ensure the dynamic atmosphere and teaching/learning effectiveness.

3.1 Rational Rose® Enterprise Suite

Rational Rose® Enterprise Suite is a promising package for the design, development, test, and documentation of an industrial software application when the object-oriented technology is applicable. By taking advantage of the unified modeling language (UML) and Rational Unified Process (RUP), it provides the tools, mechanisms, and environment for software engineering, management, and deployment [5, 6]. Therefore, the benefits of the object-oriented technology are maximized for the stakeholders.

"Successful implementation of object technology requires a method that integrates a development process and a modeling language with suitable construction techniques and tools." [6] By providing use-case, logical, process, component, and deployment views, Rational Rose® Enterprise Suite satisfies the needs of different users (e.g., software architect, system analyst, designer, and end-user) to define, model, and/or verify the design of an object-oriented solution, and provides the visual model and consistency across the life cycle of the solution.

3.2 Real Life Examples

A software solution for equipment connectivity is the first example, which is good for those who have work experience in manufacturing industry. To reduce the development cycle for equipment integration, the equipment interface should be generic and able to provide standardized methods, which allow the higher layer applications to execute control functions and perform data management. Although different types of equipment on the shop floor function differently, from the host point of view each equipment type should look like the same in terms of the mechanisms used to execute control logic and collect process data. Based on this observation, the concept of virtual equipment is formed. When the basic functions of all the equipment on the shop floor are abstracted, the generics of the equipment can be transferred into a generic Virtual Equipment Module (VEM), which can be easily implemented using the object-oriented technology. Fig. 4 shows a possible use-case model for such an application.
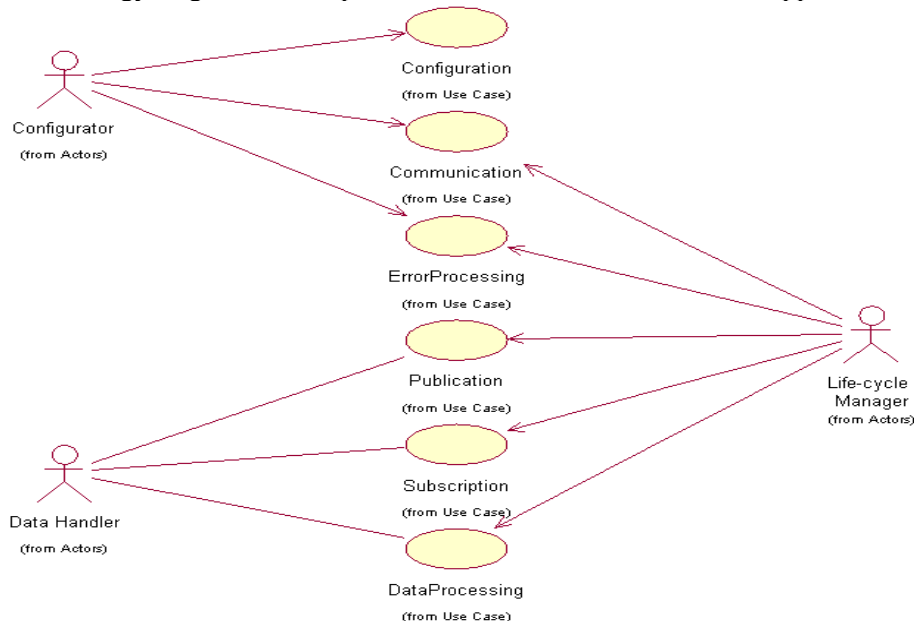

Figure 4. Example1: Use-Cases Diagram (Global View)

The second example is a real estate software application, which is more amenable to general audience without engineering backgrounds. Fig. 5 illustrates a possible global view of use-case model [4], where five actors and six use cases and their relationships are defined. The application requirements can be elicited from all the defined use cases, for instance, the flow of events for each of use cases.
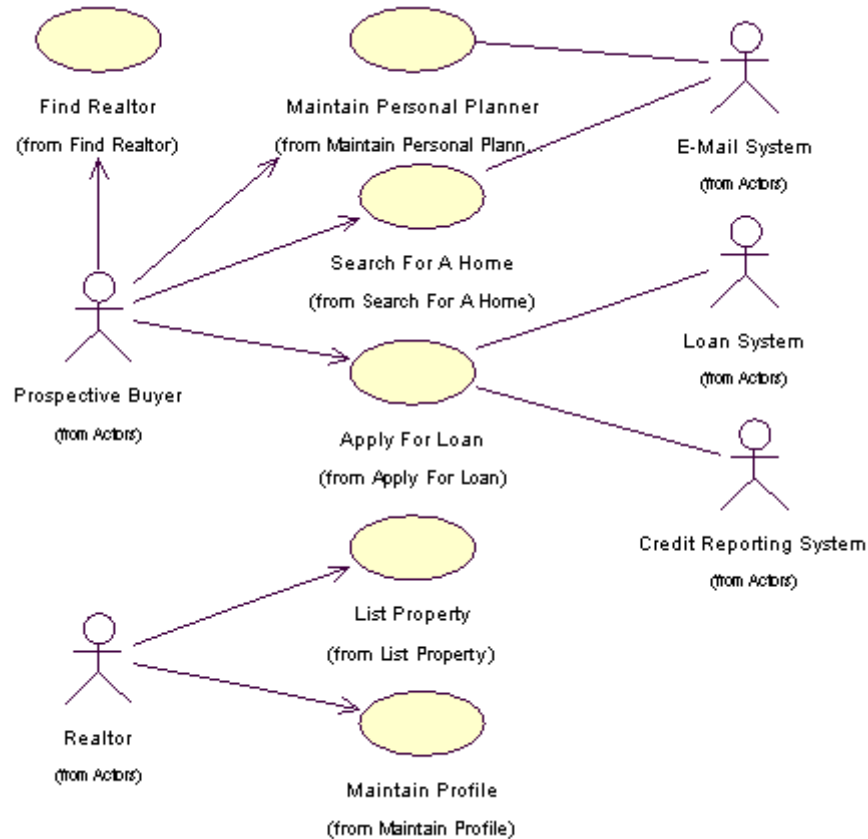
Figure 5. Example 2: Use-Cases Diagram (Global View) [4]

To demonstrate how the Rational Rose® Enterprise Suite can visually model objects relationships for the real estate software application, a sequence diagram and a class diagram were discussed in the class. Fig. 6 shows the sequence diagram of the "maintain personal planner use-case", which graphically elucidates the initiation and response sequences between relevant objects. Fig. 7 shows the classes and relationships that participate in object interactions illustrated in Fig. 6.

3.3 Selection of Appropriate Examples and Experimental Results

Although we showed only two different real–life examples in this paper, we had many other different domain examples during the experiment. For each section of the course, there were typically 5 or 6 examples. The myCareer® system picked up an appropriate example from the pool based on a given class profile.

We compared the feedbacks from two semesters. One had no myCareer® system, and another had the system and Rational Rose® Enterprise Suite. The feedbacks showed the second one with a significant improvement (about 20% based on Student Rating of Teaching Effectiveness at Penn State) in terms of students' satisfaction with the examples used in the class.
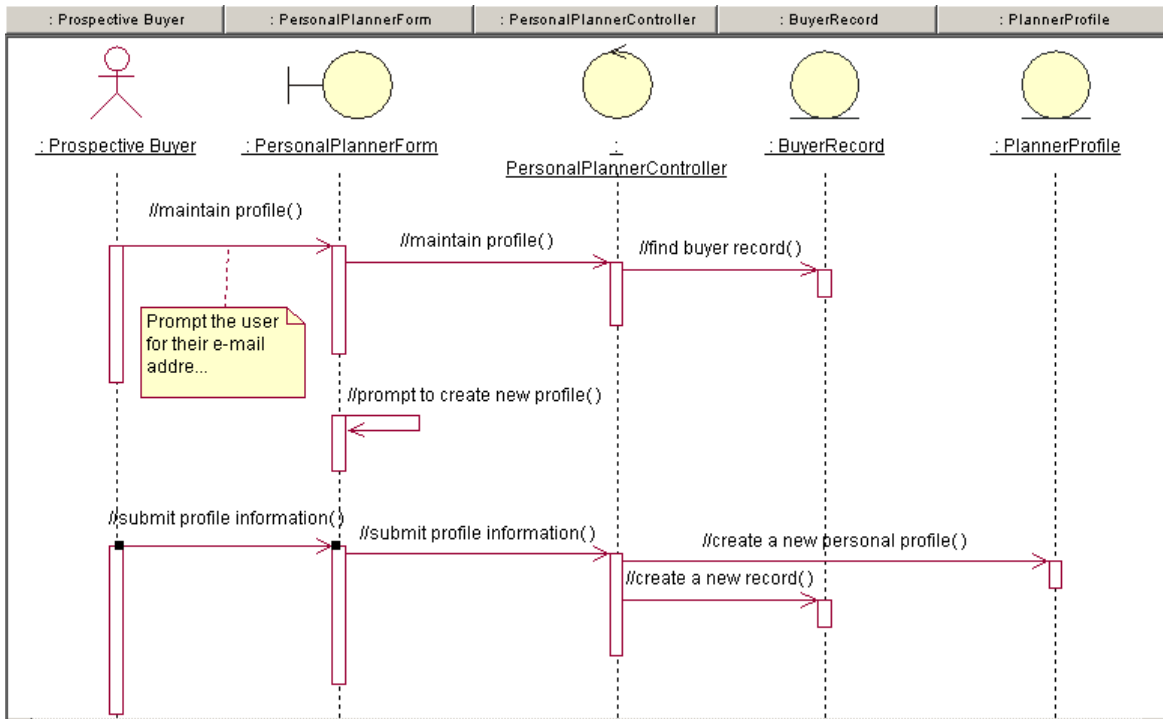
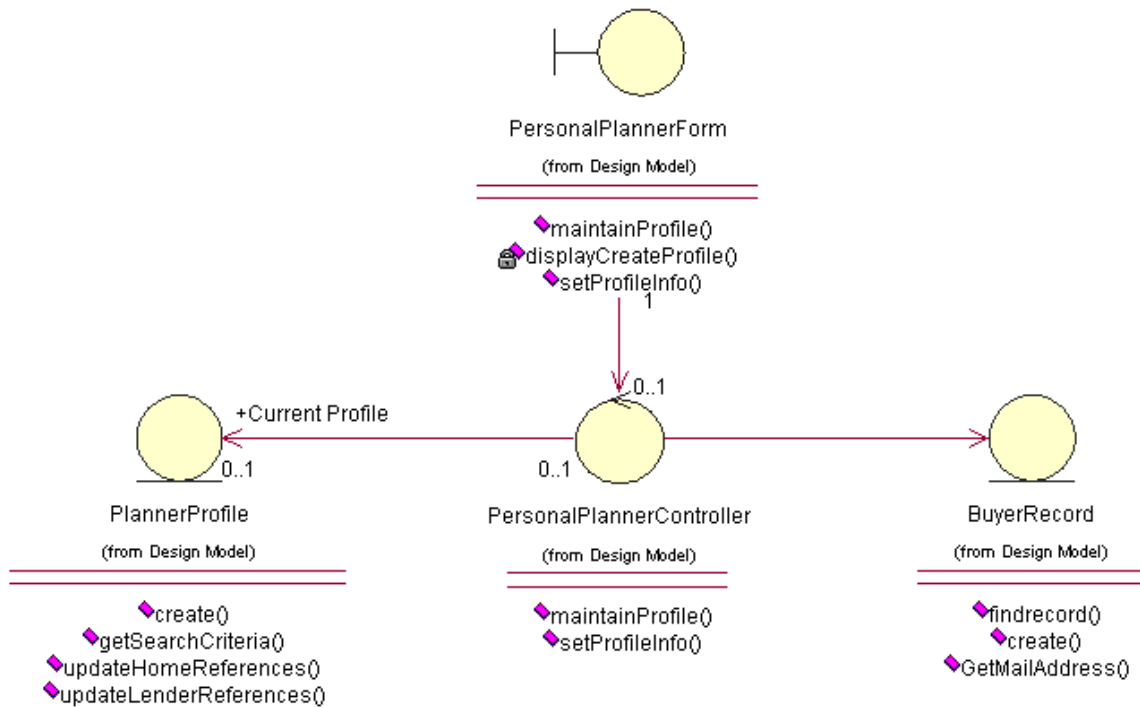Figure 6. Example 2: Sequence Diagram [4]

Figure 7. Example 2: A Class Diagram [4]

4. Conclusions

This article presented a simple concept for the improvement of teaching effectiveness under a certain circumstance such as one for professional studies. With the help of visualization tool and a knowledge-based system, examples used in the class can be selected more applicable for the majority of professionals who has a variety of work experience, course expectations, and educational backgrounds. Our experiment also demonstrated the effectiveness of the collaboration between university and industry.

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Robin Qiu is Assistant Professor of Information Science at Penn State Great Valley. He received his Ph.D. in Computer-Integrated Manufacturing System and Ph.D. Minor in Computer Science from Pennsylvania State University. His disciplines cover Industrial and Manufacturing Engineering, Computer Science, Electrical, and Mechanical Engineering. He has over 15 years of work experience in Computer-Integrated Manufacturing Systems and Enterprise Information Systems and about 50 articles published or presented.

Ying Tang is Assistant Professor of Electrical and Computer Engineering at Rowan University, Glassboro, NJ. She received the B.S. and M.S. degrees from the Northeastern University, P. R. China, in 1996 and 1998, respectively, and Ph. D degree from New Jersey Institute of Technology, Newark, NJ, in 2001. Her research interests include modeling, design and scheduling of computer-

integrated manufacturing and demanufacturing systems, Petri net applications, Networking, and discrete event systems. Dr. Tang received a Best Paper Award at the 2000 IEEE International Conference on Systems, Man and Cybernetics. At the 2001 North New Jersey IEEE Section Graduate Category Student Paper Presentation Contest, she got the first place. She is a member of the IEEE System, Man and Cybernetics and Sigma Xi.