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Exploiting Social Network Application Programming Interfaces in Computing and Engineering Education with Project-based Learning

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***Abstract*— Colleges and universities today are ever-increasingly adopting social media or networks to recruit, retain and engage students. For college admission personnel, it is hard to envision any easier way to find, approach and communicate with high school students and graduates. Efforts have also been made by researchers and educators to use social networks to invoke and promote student learning in computing and engineering, or engage students in computing and engineering society. In this paper, we present our practice and experiences in inspiring computing and engineering students through project based learning using Application Programming Interfaces (APIs) provided by social networks. An overview of APIs that come with popular social networks is provided first. Our project based learning with efforts on standardizing social network programming interfaces is described in detail. Also discussed are some other social network related projects in computing and engineering coursework and students' feedback regarding our project based learning model.**

***Keywords*— Social Networks, Application Programming Interface (API), Project-based Learning, Computing and Engineering Education**

I. INTRODUCTION

Social Networks, such as Facebook, Twitter, LinkedIn, Google+ and Instagram, have become an inevitable part of daily life for college students. The majority of college students today have more or less experienced certain social networks. It is normal to see college students on campus keep on refreshing social media even when they are juggling between academic buildings. Students use social networks to stay connected with their friends, track the real time events in the world and on campus, research academic publications for their term paper assignments, and play networked computer games. Like any technological inventions, social networks are impacting our students in both positive and negative ways. While many may view social networks being distractive in classroom so that many instructors forbid students from using social networks during lecture sessions, social networks could also be effective and efficient learning-assistant tools, for communication among students and teachers and for collecting data and referencing literature.

Many research studies have been done on using social networks to enhance education in general and/or computer science education in particular. Alt C. etc introduced a model to promote students' interest in computer science using social networks with a non-programming based approach [1]. According to the article, this approach and model had been effective in attracting students from female and other under-represented groups. In [2], Ku Y. etc presented an approach to teaching Computer Science over Facebook. The authors concluded that students' learning attitude was improved, although there was no major difference in students learning achievements. In [3], social networks have been used as a collaborative learning environment for engaging computer science students. The online learning environment, called Peerspace, integrates a set of Web 2.0 tools and may be used to facilitate collaborative learning and social communication. A similar approach can also been seen in [4], in which students were required to build a Virtual Classroom Game based on Facebook platform as their final year project.

Project Based Learning is a learning model that makes use of meaningful projects to motivate and engage students. According to [20], learning environments that are project based have certain key features, such as a driving question or a question to be answered, authentic inquiry, collaboration, and tangible products. Studies have been done is adopting project based learning in engineering education [21] and computer science education [22].

In this paper, we introduce our practice and experiments of using social network APIs as project based learning environments in intermediate and advanced computing and engineering courses. These computing and engineering courses include, but not limited to, Directed Research in Computer Science, Software Engineering, Database Management System, Information and Network Security, and Computer Organization and Robotics. Students taking

these courses form teams to study a variety of social network APIs and work on projects ranging from uniform social network APIs and application frameworks, social media data query languages, to a hardware-software co-design based Raspberry Pi social media data monitor. Through these projects, students were motivated not only to practice their software design and programming, but also to examine the design and implementation procedure of standardized APIs and application frameworks. More advanced software engineering topics and potential research projects, such as design patterns, RESTful API and architecture, Web services and customized application frameworks, are also exposed so that students were poised to carry forward their learning outcomes to their graduate studies. The initial result of our practice and experiments has been presented in a conference [19].

The rest of this paper is organized as follows. In next section, we provide an overview of social network APIs that have been made available for several major social networks, such as FaceBook, Twitter and Instagram. In the subsequent two sections, we present our efforts as faculty-directed undergraduate research projects in standardizing social network APIs and its Java variant. Then we discuss some other social network based system design and development projects that our students have worked on for other computer science classes. At last we discuss student feedback briefly and summarize this paper.

II. Overview of Social Network APIs

Major social networks, such as Facebook, Twitter, Instagram, provide an application programming interface (API) or a set of APIs to enable third party applications to interact with their networks for data retrieval or other purposes. Facebook provides a set of APIs [5] with a variety of programming paradigms in its Facebook Platform initiatives. A number of software development kits (SDK) are also made available by Facebook to support various programming languages and operating systems. Examples are Swift SDK, JavaScript SDK, PHP SDK, iOS SDK and Android SDK.

Twitter also provides a number of libraries to support APIs as specified by Twitter [6], which includes Streaming API and REST API. A third party application may connect to Twitter APIs using TLS and/or OAuth. Once the connection is established successfully, the application will be able to access Twitter data with API objects. Based on their APIs, Twitter also has a collection of Twitter libraries to support a variety of operating systems and programming languages. The programming libraries are available for C/C++, Java, Perl, PHP, JavaScript, T-SQL etc..

As a social network focus on online photo and video sharing, Instagram provides an API platform to enable third party developers to build value-added apps and services [7]. Compared to APIs from FaceBook and Twitter, the Instagram API has limited features. First, it supports JavaScript programming in a SandBox mode, which means you may only access certain number of most recent posts for a particular user (20 most recent posts now). Second, only limited programming libraries, currently only Python and Ruby, are available and even these two libraries are not actively maintained by Instagram.

LinkedIn also comes with its REST API [16] that supports JSON data format. Several SDKs are also available for LinkedIn developers, which include JavaScript SDK and SDKs for Andriod and iOS mobile developers, respectively. Other social networks, such as Youtube and Google+, also provide their APIs. Our student projects, as discussed in the following three sections, are based on APIs from FaceBook, Twitter, Instagram and LinkedIn.

III. Student Project 1: OSNC

As discussed earlier, major social networks provide their own APIs, and each of these APIs may come with programming libraries for a variety of operating systems and programming languages. While third party developers would appreciate the programmatic access to social networks' data and capabilities, they may soon feel overwhelmed with the number of different APIs and the various programming paradigm in APIs from different social network when they try to integrate social network contents and capabilities from multiple social networks into their applications. One question comes naturally: can we have a standard in the API, or application programming interface for social networks?

The idea of a standardized API has been proven feasible in other areas. For example, in database area, there are hundreds of database management systems (DBMS) from different vendors and/or open source community. Fortunately, modern database developers don't have to learn the proprietary APIs that come with these DBMS products. Instead, they could either use ODBC (Open Database Connectivity) [11] or JDBC (Java Database Connectivity) [10] to connect to a database, submit query, and fetch results. ODBC and JDBC are two standard industry APIs for database access.

In our directed research, database management system and computer organization classes, a team of students, who were funded by a state grant, were assigned to on this question and attempt to find sensible answer to this. After closely examining ODBC standard document, the student team, working closely with their faculty advisor, proposed an Open Social Network Connectivity (OSNC) specification.

As part of its specification, OSNC defines several categories of function prototypes to encapsulate the procedures necessary interaction between applications and social networks. These functions, while being programming language neutral, are specified in syntax similar to functions in C programming language. The OSNC specification also includes a set of well steps to interact with social networks, which can be summarized as follows.

1. Connecting to Social Network.
2. Querying Social Network Capabilities and Encodings.

3. Submitting Command String to Social Network.
4. Fetching Result or Putting Data.
5. Disconnecting from Social Network.

The most popular encoding formats supported by social networks today are XML or JSON. These are two formats supported in the initial OSNC specification. The Open Social Network Connectivity specification will also come with an application framework. The specification describes the OSNC application framework in Figure 1.

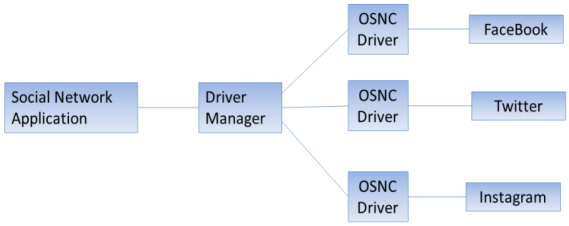

Fig. 1. OSNC Application Framework

The deliverables from the student team are the initial OSNC specification, which includes the description of OSNC framework, and an experimental OSNC driver for Twitter. Students also gave several presentations to lower level programming classes to showcase their project and discuss software engineering topics such as standards, specifications, application frameworks, and design patterns. Social networks were the intriguing point in their presentations and it helped greatly in retaining students in computer science program and recruiting students into the next offering of the advance software engineering class.

IV. Student Project 2: JSNC

The social network based software development project is proven attractive and exciting among students. In the subsequent offering of Directed Research based Advanced Software Engineering class, another team of students chose to work on the Java variant of Open Social Network Connectivity. The student team worked on this Java project during Fall semester. The team leader, who was funded by a state grant over the previous summer, worked closely with the faculty advisor on the rough draft of architecture specification and major Java interfaces and classes. This ascertained that the student team has a good foundation and guidance to carry out the project smoothly.

Design patterns are one of the essential course contents in software development and based on invited talks from industry speakers, design patterns are widely applied in modern application development and it would be very beneficial if students graduated from computing majors could have solid understanding in design patterns. As a result, our students are eager to adopt design pattern ideas in the project. The student team, after consulting with their faculty advisor, decided to adopt Plugin application framework to implement JSNC drivers and DriverManager, in which DriverManager is implemented as a container framework and each driver is implemented as a plugin. Using Plugin application framework facilitates the collaboration among student team members.

Figure 2 shows the architecture of our Java variant of OSNC and it is named as Java Social Network Connectivity (JSNC). As shown in Figure 2, we replaced Instagram with LinkedIn in the reference implementation due to the added Instagram restrictions.

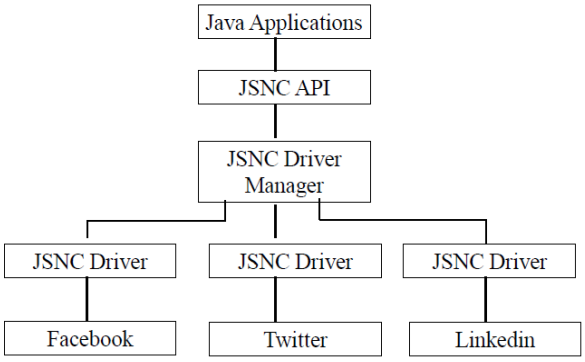

Fig. 2. JSNC Framework

Since students, especially their team leader, were equipped with familiarity with social network APIs and the initial draft architectural design were in place during the beginning of semester, the student team put their focus on developing JSNC drivers. Two approaches were found available to implement these experimental JSNC drivers: from scratch or implementing Java wrappers on top of the available Java APIs for the corresponding social networks. The student team chose the Java Wrapper approach.

Both OSNC and JSNC projects provide essential elements in project based learning. Most students are using social media quite often so these projects closely relate to the real life. Students have to work on the application framework specifications, verifying the specifications by developing OSNC/JSNC drivers and sample applications. Both projects are comprehensive and require teamwork, so communication and collaboration are critical. Over the time, student teams had to present the progress to the class. In the end of semester, student teams had to make posters and make presentation to larger audience. Each of them makes an ideal option for a semester long team project.

V. Other Student Project Ideas

Our open social network API project also had positive influence in freshmen and sophomore students. In the past two years, students and student teams in introductory or intermediate software development classes have also worked on several social network programming projects. Three of these projects are discussed here.

A. Twitter Monitoring System with Raspberry Pi

Monitoring Twitter activities from their young kids may be of interest of many parents because there are simply too many things happening over Twitter and not

all of them are proper for young kids. Raspberry Pi Twitter monitor, as shown in [13], is a popular student project idea over the Web. It is an ideal project for students in introductory computer science class it involves computer hardware, networking, programming, and hardware-software co-design concepts. In addition, it is affordable as the cost of each Raspberry Pi unit is below $100. With support from an internal and state funding, we have acquired 20 Raspberry Pi units for students to work on a variety of hardware and software co-design projects. Among these projects, the design and development of Raspberry Pi Twitter monitor systems are the most popular.

B. Social Network Query Language

Students in our Database Management System class have worked in the specification of a query language for social networks. The query language has its syntax similar to LINQ (Language Integrated Query) [15] from Microsoft Inc. The motivation, requirements, and design of a similar Social Network Query Language, which was conducted by other researchers, can be seen in [14]. However, the syntax of the query language and commands from our student project has significant difference from the one as discussed in [14], because our syntax is more towards LINQ syntax.

C. Integrated Social Media Management Tool

Based on OSNC and JSNC application framework, a student team in our capstone class proposed and developed an application prototype to provide an integrated management and access environment for Twitter, FaceBook and Instagram. The end product for this project is to have a Java desktop that has similar features as shown on [23].

D. Design Patterns for Social Network Applications

Many social network based applications have become available nowadays, and certainly more are being developed. As discussed earlier, standardizing social network APIs will facilitate the development of social network applications. Similarly, building design patterns for social network applications will also be beneficial for social network application developers. Since design patterns are popular subject for senior students in our computing majors, a few students have formed a team to work in this area. The initial design patterns from the team are based on what they have studied from [18], which described the initial design patterns for online based social network applications. This project is still an on-going one.

VI. STUDENT FEEDBACKS

The feedback we collected in the end of each semester is very positive. Students felt they had much better understanding about topics in software engineering, software development, information and network security, and database management system, such as Web APIs, application framework, design patterns, component-based software architecture, authentication, RESTful Web application development, JSON and XML encodings, and database query languages. Students wrote in the course evaluation that they were initially puzzled by the necessity of design patterns and application framework for professional software development, but after the class they did understand this necessity completely. Other students mentioned that in they were confused about the difference between ODBC and ODBC drivers, and now the difference became so clear, and they had been able to explain this to other students who were in Database Management System class.

These projects also significantly helped students in their job placement. The skills students acquired from the above social network related projects, such as programming, documenting and drafting standard social network API proposals, and presenting their project results, are all the impressive components in their portfolios. Several graduating senior students in the class were offered full time job by Department of Defense contracting companies during the semester. They mentioned that their experiences from the social networking based projects had great impact on securing their job offers.

Some comparative studies have been done to compare learning performance between student teams who have done social network based computing and engineering projects and other student teams who worked on projects on other computing/engineering areas. In a directed research class we just completed recently, there were 11 student teams and 2 of these teams worked on social network based projects. In the end of semester we conducted a peer-review in which each student team would grade all other teams' projects. The peer review results show that the two teams work on social network based projects greatly outperform other teams. These two teams scored 93% and 94% respectively, while the class average was 86% from peer evaluation.

VII. SUMMARY AND CONCLUSIONS

In this paper, we describe our practice and experiences in adopting social network APIs as project-based learning methodology in computer science education. Previous research studies have showed that social networks, as communication and involvement tools, may motivate students to choose computer science as their field of study. Our practice and experiences demonstrate that social networks can also bring us many intriguing software development and engineering project ideas for a variety of computing and engineering courses. These projects fit very well in Project Based Learning (PBL) model. They are meaningful, comprehensive and engaging, and encourage communication, collaboration and teamwork. Students also get chance to practice their presentation skills. Overall these projects provide another aspect in attracting and retaining students in computer science, computer engineering and other related computing fields of study, because students felt these projects were practical, interesting and closely related to their modern daily life.

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