A Health IT Application Domain Course for a Traditional IT Program

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ABSTRACT
IT2008 specifically mentioned health care as an area of probable interest for “application domain classes”. This paper documents our initial foray into providing a domain specific course in Health Information Technology (HIT) for Seniors in an IT Program. Many believe that IT can be a major contributor to improving efficiency of health care delivery. The increasing use of IT in health care promises to transform services with improved quality and reduced cost. Publicly and privately funded projects are aiming to speed up the adoption and meaningful use of HIT and to protect privacy, enhance security, while improving interoperability. The buildup of infrastructure and the ongoing operation and maintenance require additional HIT workforce to deliver the promised benefits. Studies estimate that tens of thousands of IT professional will be needed in the coming years in the United States alone. However, most of the “health informatics” courses currently in academic curriculum are offered in health science programs targeted for future health care professionals who are IT users. Little curriculum has been developed to train engineering and technology students who are already fluent in the core IT competencies for a profession in the health care domain. We have piloted a senior level course to introduce current HIT topics, standards, requirements and issues with hands-on lab activities and programming exercises where students learn some common technical skills required for an HIT professional.

Categories and Subject Descriptors
K.3.2[COMPUTER & INFORMATION SCIENCE EDUCATION] Curriculum. J.3 [LIFE & MEDICAL SCIENCES]

General Terms
Health Information Technology Education

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1. INTRODUCTION
IT2008 specifically mentioned health care as an area of probable interest for “application domain classes”. [12] Many believe that IT can be a major contributor to improving efficiency of health care delivery. The increasing use of IT in health care promises to transform services with improved quality and reduced cost [1]. Publicly and privately funded projects are aiming to speed the adoption and meaningful use of health information technology (HIT) and to protect privacy, enhance security, and improve interoperability. The buildup of infrastructure and the ongoing operation and maintenance require additional HIT workforce to deliver the promised benefits. Studies estimate that tens of thousands of IT professional will be needed in the coming years in the United States alone [2]. It is commonly recognized that the well-trained HIT professional should not only be competent in core IT skills, but also have knowledge in health care specific topics, standards, requirements and issues [3]. However, we found that most of the introductory HIT courses currently in academia are offered as “informatics” courses in health science programs targeted for future health care professionals who are IT users. Little curriculum has been developed to train engineering and technology students who are already fluent in the core IT competencies with health care specific technical skills for a professional in the domain. Even though we were able to locate few formal requirements to characterize the HIT workforce and the technical competencies required for the profession, we have developed a senior level course to introduce current HIT topics, standards, requirements and issues with hands-on lab activities and programming exercises. The course introduces students to common technical skills required for an HIT professional.

According to Heath, approximately 26% of the HIT staff works in the roles of application programmers, network and security administrators [3]. These positions tend to require more technical background than other support or management types of IT positions. Students graduating from computing disciplines such as computer science
(CS), information technology (IT), or computer engineering (CE) are well suited to fill the increasing need of the health care providers. Nevertheless, based on recent departmental survey, out of approximately two hundred graduates (bachelors and masters) from our IT program during the last five years, only one of them currently works in the health care sector. Anecdotal evidence shows that students tend to stay away from HIT job opportunities because they do not understand the job requirements and often get discouraged by the long list of acronyms in the job descriptions. We developed this course with the intention to remove the mental barrier and to encourage students to explore potential IT career in the health care industry.

2. BACKGROUND

We are aware of at least one academic institution that has leveraged an IT program from both the Health Information Management and the Health IT perspectives[16]. Marymount University has and HIT emphasis for their IT major consisting of 5 courses in HIM and an HIM major that leverages a similar number of IT courses. It is not clear how they have addressed the curricular issues we found. In addition, we did not have the resources to develop an entire emphasis track in HIT and were looking to provide students with a solid introduction to the HIT domain in a single course.

Our introductory HIT course was developed with computer science and information technology students in mind. The goal is to prepare them for technical positions in the HIT workforce such as programmers, network or security administrators. As we designed the syllabus of this course, we encountered the following challenges:

- Lack of technical competency guidelines for engineering and technology students
- Lack of textbook with appropriate depth of coverage for technical subjects
- Lack of materials for hands-on lab activities and programming exercises

The International Medical Informatics Association (IMIA) has made recommendations on education in biomedical and health informatics [4]. The majority of the recommendations were focused on educational programs for health care workers (physicians, nurses, pharmacist, etc.) and administrators (electronic health records). One small section of the general recommendations were written for computer science or information technology programs, which suggested topics should be covered in addition to the “core” CS/IT knowledge and skills, including information systems in health care, standards for communication and interoperability. However, the breadth and depth of these technical topics should be different when taught to CS/IT students compared to health science students. The American Medical Informatics Association’s (AMIA) 10x10 program aims to promote HIT education and listed detailed outline of suggested course content [5]. But it also focuses on IT users instead of IT professionals.

An extensive evaluation was conducted to find a textbook with sufficient technical detail for IT and CS students. Among the books we reviewed [6][7][8][9][10][11], the majority target the health science students or health care workers and lack sufficient technical depth for students in the computing discipline. While Benson [7] contains an appropriate level of detail, it only covers data modeling, HL7 and interoperability. Other books have varying degrees of coverage of different subjects. For example, Wager [8] has a comprehensive chapter on security and Shortliffe [6] has good technical details in chapters on imaging systems.

Hands-on lab activities and programming exercises are commonly used computing courses to supplement the lectures with practical experience. There are many topics in the course that are well suited for such practical assignments which benefit the students, for example, setting up a picture archiving and communication system (PACS) network with real commercial software can enhance the learning experience on the topic of image systems. Unfortunately, few references can be found to such materials being used in HIT academic curriculum.

The purpose of this document is to share what we learned in our attempt to address these challenges while creating a positive, dynamic and practical learning experience for the targeted students. We are not presenting this as an optimal or model course, rather we illustrate the need and provide an example of a technically focused course in the HIT curriculum. We also wish to initiate a discussion about the form and content of such a course.

3. COURSE CONTENT

First of all, we assume that the students are already competent in the core IT subjects and concepts as described in IT2008 [12]:

- Operating systems: authentication, access control, system administration
- Computer networks: TCP/IP and other protocols, network management
- Database: data modeling, database management, applications
- Information assurance and security: risk assessment, risk management, incident response, and exposure to penetration testing
3.1 Textbook
As most of healthcare information systems books are designed to introduce IT concepts to healthcare professionals, we have yet to find an ideal book that introduces healthcare systems to IT students or professionals who are already familiar with technologies in general but want to learn more specifics about how they are applied in a healthcare environment. The texts we found lack with sufficient technical details for engineering and technology students who are already familiar with XML, programming (Java or similar high level language), networking, internet protocols, systems administration, and security. We used portions of the following three books to cover the indicated topics:
- Shortliff [6]: introduction, imaging systems, EHR, standards, health care organizations
- Benson [7]: interoperability, data modeling, HL7 (v2 & v3), SNOMED
- Wager [8]: clinical information systems, technologies in health care, security (HIPAA rules)

In our case, [6][7] were available as electronic books in our university library which reduced the financial burden on the students.

Based on the textbooks selected, the lecture modules of the course are as follows,
- Introduction to health informatics, terminologies
- Biomedical and health care data, acquisition, storage and use
- Electronic health record systems and other health care applications
- Imaging systems, DICOM protocols and PACS
- Data modeling
- HL7, SNOMED and other interoperability standards
- Consumer and public health informatics
- Security, HIPAA rules
- Clinical decision support systems
- Ethics

3.2 Online resources
In order to fully understand current topics, research, regulatory/policy initiatives and issues in the healthcare system, it is important to leverage online resources for current information that is not available in textbooks. Students are required to research different healthcare IT focused informational websites and sign up at least one online news feed, for example, Healthcare IT News (http://www.healthcareitnews.com/), where they read about technology news, industry initiatives, and funded projects. Class lectures often began with a few minutes of discussion on these fresh topics. We also encourage students to frequently check the HIT related job postings on various career websites to increase their exposure on the variety of HIT positions and their required skills.

Online webinars are also great resources for the students to learn about the state of the art commercial systems from industry leading vendors such as Hewlett-Packard, IBM, and Oracle. Vendor neutral services such as Healthcare IT News often sponsor webinars presenting various enterprise health care solutions provided by variety of vendors. There are also case studies presented as webinars which can be valuable addition to the lectures, for example, a case study of hospital network security was conducted at Sarasota Memorial Health Care System and the result was presented online where students learned about real-world attacks and risk management. We carefully selected a few webinars to supplement the lectures on related subjects. As technologies advance, we expect that new webinars will be available each time the course is taught.

Official publications from US Department of Health and Human Services (HHS) on HIPAA rules can be useful when discussing topics such as security standards and implementations [13]. For example, title 45, part 164.306-316 describes detailed requirements for administrative, physical and technical safeguards.

3.3 HANDS-ON LAB MODULES
In our preparation for the course we evaluated a large number online resources, open source projects and commercial software offerings to identify practical exercises which would provide more interactive and dynamic learning experiences. The following lab modules were included in the course:

3.3.1 HIPAA training
While every health care worker needs to undergo HIPAA training and be certified, we require the students to learn by doing a real-world HIPAA training course. Many free and commercial training courses are available online. We chose the free service provided by New York State at http://www.oasas.state.ny.us/hipaa/onlinetraining.cfm

3.3.2 EMR/EHR systems
With so many open source and commercial EMR/EHR systems available in the health care industry supporting variety of features and user interfaces, it is impossible to show all of them to the students. The objective of this module is to have the students try one and understand the practical needs for EMR/EHR systems. We chose the open source OpenEMR system because of its easy-to-use online demo website
and consumes data across many departments with nurses, physicians and billing. Each of them generates distinct departments such as admission, labs, health care organizations are complex business entities. This is a two week module. They use week one to setup the server and development environment; week two to go through some simple BizTalk tutorials to learn the basics; week three to work on a tutorial of simple end-to-end HL7 application; week four to write a query/response HL7 application; week five to learn about HL7 message enrichment. Installation instruction and tutorials are available at MSDN (http://msdn.microsoft.com/en-us/library/ee409374(v=BTS.10).aspx).

3.3.3 Imaging systems
The purpose of this module is for the student to learn about the imaging systems by setting up a simple PACS network and using a full-featured DICOM workstation. While there are many open source and free PACS and DICOM tools, they tend to be somewhat limited in features or difficult to use. We found some commercial PACS/DICOM tools from IMAGE Information Systems (http://www.image-systems.biz/en/home.html) that are quite easy to use, and they offer downloadable thirty days full-featured trial version which is sufficient for a two to three week module. There is also a large collection of free demo DICOM images available for download at the same website. Students are assigned to work in pairs and setup a client-server connection with each other using the iQ-VIEW PACS tool (http://www.image-systems.biz/en/products/iq-system-pacs/workstation-software/iq-view.html) and send/retrieve images. Using the 3D CT demo images, students are asked to use the full-featured 3D workstation software iQ-VIEW 3D (http://www.image-systems.biz/en/products/iq-system-pacs/workstation-software/iq-view-3d.html) to view and process the CT images in 3D.

3.3.4 HL7
The health care industry has standardized on HL7 protocol for many HIT applications. Understanding HL7 and being able to program HL7 applications is essential for our targeted CS/IT students who already had multiple computer programming courses. Among the many open source and commercial HL7 soft library, we found the Java-based HAPI project (http://hl7api.sourceforge.net/) to be reasonably easy to use and well documented. Students are assigned 1) install the software library and use it to 2) write a simple application to parse HL7 messages, 3) send/receive messages over a TCP/IP connection. This is a two week module.

3.3.5 Enterprise application framework
Health care organizations are complex business entities consist of distinct departments such as admission, labs, nurses, physicians and billing. Each of them generates and consumes data across many departments with information about patients, billing, procedures and medications. An enterprise business-to-business (B2B) service architecture is often used to effectively dispatch data between the departments or organizations.

Commercial software such as Oracle B2B and Microsoft BizTalk are commonly used in health care systems because of their built-in support for HL7 protocols. BizTalk software has ample online resources and is free for academic use through MSDN Academic Alliance license (http://msdn.microsoft.com/en-us/academic/default.aspx). The students are given the assignment to create simple HL7 workflow management application using Microsoft BizTalk Accelerator for HL7 (BTAHL7) to facilitate business processes including simple end-to-end and query/response scenarios.

This is a five weeks module because of the complexity of the software architecture and development environment. While students understand the concept of B2B integration, they had no practical development experiences from the prerequisite core IT curriculum. They use week one to setup the server and development environment; week two to go through some simple BizTalk tutorials to learn the basics; week three to work on a tutorial of simple end-to-end HL7 application; week four to write a query/response HL7 application; week five to learn about HL7 message enrichment. Installation instruction and tutorials are available at MSDN (http://msdn.microsoft.com/en-us/library/ee409374(v=BTS.10).aspx).

4. EVALUATION
The evaluation process is still ongoing as we are continuing development of this course and have just finished teaching it for the first time. During the semester while the course was being taught, we constantly communicated with students and collected feedback regarding their ability to complete the hands-on lab and programming exercises and the amount of time they spent on each assignment. A survey was conducted at the end of the semester to assess the course outcomes. Students generally felt positive about the course and thought they achieved the course learning outcomes. They particularly enjoyed the practical exercises and the coverage of update-to-date technology initiatives. Two of the graduating seniors interviewed with a national leading EMR/EHR system vendor for programmer positions. Both of them had a positive experience and one reportedly has accepted a full time position.

A collaboration group was organized at 2011 ACM Technical Symposium of Computer Science Education (SIGCSE) for CS/IT faculty who are teaching or developing courses to tie together computing disciplines and biomedical or health care applications. The course content we developed has been shared with the group and is being used at institutions such as University of British Columbia and St John’s University. Evaluation and feedback from the other faculty will be collected and used to adjust future offerings of this course.

5. CONCLUSION
While most medical informatics educational programs have focused on training researchers [15], there is increasing interest in developing HIT curriculum within the computing disciplines such as computer science and
information technology. We recognize the need for IT professionals with health care specific knowledge and skills. We hope our experience will help other faculty who are interested in teaching the subject but do not have the resources to develop a new course from scratch. And we are dedicated to work with the faculty collaboration group to continually improve the learning experience for our students.

6. REFERENCES