Ethics for the Information Age

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Abstract – Information technology has grown at an astounding rate in recent decades, and with it have grown ethical questions and difficulties which did not exist thirty years ago. While in the past, society's laws have been in sync with the community's ethical mores and capable of addressing ethically significant issues such as theft, the rapid growth of computing capabilities and related issues has outstripped the law-making process in the United States and elsewhere, leaving many with no firm guidelines for behavior and no legal recourse when victimized. This paper describes two courses developed at the University of Tennessee at Chattanooga to deal with these issues, and how they can be used for ABET assessment.

Keywords: Ethics, Information Technology, Engineering, ABET Assessment.

INTRODUCTION

Cyberbullying, identity theft, phishing, dangers involved in social networking, cyberstalking, and hacktivism are just a few of the issues now facing not only computer engineers and computer scientists, but also the general population of business and casual computer users. Laws, and even ethical discussions, have not kept pace with the developments, leaving many unsure how to regard these issues ethically and how to proceed if victimized. The University of Tennessee at Chattanooga has developed two courses to enable students in ethical evaluation of these and other issues in emerging technologies: one a junior level class required of all Computer Science and Computer Engineering majors at the university, and the other a freshman level seminar class, designed to introduce first semester freshmen to both ethical issues and dangers inherent in the cyberworld. Each of these classes is open to students of any major; however, they can easily be used to assess ABET outcome "(f) an understanding of professional and ethical responsibility"[1] for all engineering majors, as well as some of the "soft skills" that are sometimes problematic for evaluation. This paper discusses the mechanics of the classes, current topic coverage, variations that be used to adapt the courses to more general scientific and engineering disciplines, and ways that such a course, or selected elements thereof, could be included in engineering programs already limited in hours.

WHY IS ETHICS EDUCATION NECESSARY FOR COMPUTER PROFESSIONALS?

The vast majority of the ethical issues facing computer professionals today did not exist thirty years ago, and the rapid increase in computing technology makes the issues which will affect today's students, during the span of their careers, difficult, if not impossible, to foretell. Who could have predicted, except as science fiction, the capability of cities to track their citizens' movements by means of cameras on public streets; the amount of data routinely collected electronically on average people who do not even access the internet; the opportunity for everyone with approximately $60 to use Global Positioning Systems to track their own movements, or those of others; or the advances such as neural implants or Computer Aided Tomography (CAT) scans combining medicine, computing, and engineering to provide healthcare options unimagined only a few years ago? Even if every existing ethical issue now facing computer professionals could be identified, and all could agree on the correct ethical position (a highly unlikely proposition), this would not prepare our students for the issues they will face in the future. Rather, it is necessary that students learn to identify relevant ethical issues; assemble and evaluate appropriate sources of information; form, assess, and defend ethical positions; and persuade others to adopt ethical practices, as well.

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Ways to Teach Ethics

There are many methods for teaching ethics to engineering and computer students, some requiring much more time in the curriculum than others—ranging from no class time to a full ethics course. Some of the approaches for teaching ethics outside of any curricular course are on-line training modules and simulators [2], informal activities such as "ethics bowl" competitions [3], and having students infer ethical principles from knowledge of codes of ethics and experiences of academic integrity. [4] Coverage included in other engineering courses, but not in dedicated ethics courses, can include guest lecturers, assignment of scenarios for analysis based on codes of ethics, and a pervasive "ethics across the curriculum," similar to programs for "writing across the curriculum." [3] However, given the potential for property damage and loss of life when engineers are unethical, many would agree that ethics is sufficiently important to rate a dedicated course, taught by engineers who understand the professional issues and responsibilities involved, if it were possible to fit such a course into the curriculum. Described in the following sections are two such courses: one, University Studies (UTSU) 1999, an optional freshman seminar; and the other, Computer Science (CPSC) 3610, a course required of all Computer Engineering and Computer Science majors at the University of Tennessee at Chattanooga (UTC).

USTU 1999: ETHICAL ISSUES IN THE INFORMATION AGE: CYBER-BULLYING, IDENTITY THEFT, AND PHISHING

This course, taught for the first time in fall semester 2011, is a pass/fail freshman seminar designed to raise awareness of the potential dangers for the unaware in the technological world, and prepare to students to both evaluate computer issues ethically and be able to protect themselves in cyberspace. The course description is as follows:

> Regardless of how "computer-savvy" a student is, he or she is affected by ethical issues that have developed as technology has expanded into more and more aspects of our lives. This class will examine and discuss items currently in the news, which have the potential to affect students. Topics are expected to include social networking, cyber-bullying, identity theft, phishing, and the government's proposed internet "kill switch." [5]

The goal of the course is to help students to identify, examine, formulate and discuss ethical positions on issues arising from advances in computer technology. Objectives are that by the end of the semester, the student should be able to examine some of the ethical issues arising from advances in computer technology, the moral and ethical dilemmas created by computer technology, and how traditional ethical and moral concepts can be applied to them.

This class does not have a text—weekly readings are assigned based on current news stories regarding cutting edge computer-based. issues. The grade for this class is based solely on the in-class ethical discussions and weekly short (approximately one page) writing assignments based on the readings and discussions. Students are asked both to express and defend their own ethical positions and to evaluate issues from traditional ethical viewpoints as well.

Although this class was regarded as an experiment, to see if in-coming freshmen could benefit from discussion and consideration of these ethical issues, all of the students who filled out the end of course evaluation forms said that this course had helped in their ability to evaluate data sources critically, improved their understanding of others' ethical viewpoints, increased their knowledge of security and privacy issues on the internet, and better prepared them to protect themselves in the digital world. Seventy-eight percent also said that the class helped the students refine their own ethical viewpoints, and 89%, that it made them *think*. While this instantiation of the course was investigational, initial results seem to indicate that this may be an avenue worth pursuing for the future.

CPSC 3610: ETHICAL AND SOCIAL ISSUES IN COMPUTING

This course is a junior-level course, required of all Computer Science and Computer Engineering majors. The class is also approved as a general education class under the Humanities category at UTC, and is open to students of all majors. The catalog description of the course is below:

> **Catalog Description:** This course examines the ethical and social issues arising from advances in computer technology and the responsibility that computer professionals and users have with regard to computer use by focusing on the intrinsic link between ethics and the law, how both try to define the

validity of human actions, and on the moral and ethical dilemmas created by computer technology that challenge the traditional ethical and moral concepts. [6]

Goals and Objectives of the Course

The goal of this course is to teach students to identify, examine, formulate and defend ethical, professional positions on issues arising from advances in computer technology. The objectives are that by the end of the semester, students should be able to examine the ethical issues arising from advances in computer technology, the responsibility that computer professionals and users have related to computer use, the link between ethics and the law, how to evaluate the validity of human actions, the moral and ethical dilemmas created by computer technology, and how traditional ethical and moral concepts can be applied to them.

Course Mechanics

During the first three to four weeks of the course, standard ethical approaches based on such considerations as duty (as in Kantianism), rights (such as Social Contract Theory and Rawls Theory of Social Justice), and balance of cost and benefit to the affected parties (e.g., Rule and Act Utilitarianism) [7] are covered in a standard lecture style, along with discussions of relevant computer technology-based issues from the viewpoints of different ethical theories. Also included in this portion of the course are evaluation of data sources, including recognition of biases and unstated assumptions, appeals to emotions, and *ad hominem* attacks. For the remainder of the course, issues from the text, *Ethical and Social Issues in the Information Age,* [8], are presented by teams of students, with each student making a total of two presentations during the semester. Each presentation, which counts 50 points, is averaged in with the other homework and quizzes, consisting primarily of weekly, one-page writing assignments related to issues and relevant ethical viewpoints, which count ten points each. The homework/presentation total counts as one third of the total course grade. The second third of the course grade is a combination of an exam including such items as analysis of issues, use and understanding of ethical theories, ability to construct an argument, and evaluating the quality of information sources; and a paper, approximately 5 pages, single-spaced, with at least 3 references in addition to the course text. This paper is a detailed discussion of an ethical theory, including its history, details of the theory, identification of computer technology issues to which this theory is, or would be, particularly applicable, and a discussion of how this theory agrees and/or contrasts with the student's own personal ethics. The remaining third of the grade is a final paper, of approximately 10 pages, single-spaced (references and title page do not count as part of the 10 pages), with at least 5 references in addition to the text. The paper is a detailed discussion of a current computer-related ethical issue, including details of the issue, news stories or current events related to the issue, an examination of how this issue would be regarded by proponents of different ethical theories, and a discussion of the student's ethical position on this issue, including reasoned arguments refuting those points which the student would expect to be raised by proponents of other ethical theories.

Uses in ABET Assessment

The outcomes currently assessed for the course lend themselves well to either full or partial measurement of ABET outcomes f-j:

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues. [1]

The entire coverage of the course is relevant to understanding of professional and ethical responsibility, and both midterm and final papers, the midterm test, and weekly writing assignments are all used as part of the assessment of this outcome. In addition, measured as outcomes are "Differentiate between ethical theories" and "Become aware of and understand the ACM and IEEE codes of conduct." The ability to recognize and differentiate among various ethical theories is critical for understanding of others' ethical viewpoints, and therefore the ability to form persuasive arguments, as in the professional world ethical decisions are often not made alone, but in a group setting. Codes of

ethics relevant to the computing professions are discussed; students are required to compare and contrast the different codes, and to discuss and justify any items in the codes with which they personally disagree.

Both oral and written communications are assessed. Two oral presentations for each student are assessed using a rubric including such items as effective and professional presentation, inclusion of relevant current events and appropriate discussion, and balanced coverage of different viewpoints. The two major papers in the course are assessed for correct English usage, accuracy, correct citation, and original thought. The combination of both written and oral performance evaluations give a good indication of "ability to communicate effectively." [1]

ABET outcome h, "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context," [1] is often inferred in ABET assessment from the general education component of engineering programs. However, the measured class outcomes "Understand global societal issues such as the Digital Divide and gender gap," "Understand issues surrounding intellectual property," and "Demonstrate an awareness and understanding of controversial issues relating to computing and society," are clearly relevant to this outcome as well.

Outcome i, "a recognition of the need for, and an ability to engage in life-long learning" [1] is partially assessed using a single assignment, in which students write their viewpoints both on whether it would be *wise* to pursue a computing career without updating one's skills over the course of time, and whether it would be *ethical* to do so.

Knowledge of contemporary issues is well-covered and easily assessed using the previously discussed outcomes, "Understand global societal issues such as the Digital Divide and gender gap," "Understand issues surrounding intellectual property," and "Demonstrate an awareness and understanding of controversial issues relating to computing and society," as well as the topics of the student oral presentations and final papers, which in the last semester included such issues as hactivism, biometrics, computer forensics, employee monitoring, privacy in social networking, artificial intelligence, network neutrality, risks and effects of online gaming, cyberterrorism, social networking in organizing social unrest, state-sponsored censorship/control of the internet, autonomous weapons, virtual economy in online games and the effects that economy has on the real world, and the proposed internet "kill switch."

Thus, using assessments already in place, this single course can be used to measure five ABET outcomes, including some that prove problematic for many universities.

EXTENSION TO OTHER ENGINEERING AND SCIENTIFIC DISCIPLINES

Why is Extension Necessary?

The idea of the extension was born when a student in the current CPSC 3610 said, "I know that Computer Engineers take this course, but what ethics course do the other engineers take?" When told that the other engineering majors at UTC did not take a dedicated ethics course, the student asked, "Do engineers not face any ethical dilemmas?" While some ethical content is included in other UTC engineering courses, such as the two-semester capstone design sequence, the coverage is significantly less in-depth than that in the CPSC course, and is centered largely around the various engineering societies' codes of ethics. Additionally, the current coverage contains nothing about different ethical theories and viewpoints, nor how to construct a clear, reasoned argument to convince others in a team setting (more typical of workplace situations than solo decisions) to one's ethical viewpoint. And while the ethical issues addressed in the current CPSC course are relevant to engineers, they are only a small subset of the relevant ethical issues that practicing engineers must currently face. After reflection of the amount of harm that can possibly be caused by unethical engineers, when compared to unethical practitioners of other professions, the author immediately began development of a new course aimed at engineers, scientists, and others who face the same issues of technology outstripping ethical agreement in society. The new course, The Ethics of Contemporary and Emerging Technologies , has recently been approved through the university curriculum approval process, and will first be offered in Fall, 2012.

What Resources can be Used to Extend Coverage?

The basic structure of the CPSC 3610 course can be retained for a version geared toward other leading edge technologies, with the topical issue coverage being the only change necessary. A number of good books exist which could be used as a basis for an extended course, depending on the desired primary emphasis. *Ethics in Science and Engineering*, by Speight and Foote, [9] includes discussion of ethical issues and education for those interested in

engineering and science, beginning at the high school level and continuing through postdoctoral and professional situations, including expert witness testimony. This book offers thorough coverage of issues concerning integrity in research and publication, such as falsification of data, misrepresentation of credentials, and bias in analytical methods. Extensive discussion of codes of ethics, and engineering and scientific professional societies is also included. This text is in line with the current methods of teaching engineering ethics used in many universities—that is, concentration on professional societies and codes of ethics. However, this book does not have a strong emphasis on issues related to emerging technologies—i.e., the areas where the technology has outstripped the accepted ethical and societal norms. A better text for an extended course might be one such as *Ethics of Emerging Technologies,* by Budinger and Budinger. [10] Although this book has a primary emphasis on science and medicine, as opposed to engineering directly, the current practice of medicine is so intertwined with engineering that the two are hard to distinguish—for example, in the covered topic of brain-computer interfacing, using implanted neural electrodes to sense brain activity related to physical motions that paralyzed patients can *intend* but no longer have the open neural pathways to perform, then using those sensed intentions to control external prosthetic devices, the engineering and computer aspects are inseparable from the medical issues. Another emphasis of this text is environmental ethics, with discussions of nuclear technology, "green" energy sources, and climate change, all of which could easily be tied to engineering discussions and issues. Sections on issues related to information technology are similar to those in UTC's CPSC 3610, but in much less depth. The chapter on business ethics also includes many issues relevant to engineering, including confidentiality, conflicts of interest, workplace harassment, and responsibilities of whistleblowers, both to the employer and the community. This topic coverage, added to a very strong section on ethical theories, and characterizations of ethics in terms of duty, virtue, rights, rules and justice, could make this a good choice for a single text for a course on state-of-the art technologies. Because the issues which have outstripped accepted norms also tend to be quite current, a great deal of coverage for specific issues can be found in news stories available from electronic sources; in fact, if the professor has planned sufficiently ahead to be able to take advantage of these sources, the course could be taught without a text—a significant factor given current textbook costs and economic factors.

How Can This be Squeezed into Already Crowded Curricula?

Many engineering schools cover ethics as part of courses with other primary foci, but this does not result in the depth of coverage, nor the exploration of a variety of ethical theories and viewpoints, that are key to the course described. The solution used in the case of the CPSC 3610 course, and what is planned for the new course, The Ethics of Contemporary and Emerging Technologies, is certification of the course as part of the required general education element of the program. Every ABET accredited engineering program must have "a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives." [1] A course related specifically to ethics in emerging engineering technology areas would clearly meet this constraint. More difficult is the justification of a course such as this to fulfill the specific general education requirements of a particular university. The CPSC 3610 course at UTC is certified as general education under the "Humanities" category. The guidelines necessary for this certification are the following:

- include a writing component which counts for at least 1/2 of the grade...;

- hold human experience as the center of concern;

- concentrate on significant or influential events or works of human culture and civilization;

- explore human activities as expressions of the time and place in which they occurred;

- illuminate the relationship between significant creative expression and the processes of society, politics, and everyday life;

- provide an awareness and explanation of basic human values and moralities, and demonstrate how systems of belief infuse all inquiry;

- develop students' potential for creativity, depth of feeling, critical analysis, and appreciative awareness, in both written and oral form. [11]

The writing requirement is easily met, and is under the control of the professor setting the syllabus for the course. Justification of the other criteria is more difficult, but is possible, and is outlined in the discussion below. "Hold human experience as the center of concern" [11] becomes relatively easy to justify when the definition of "ethics" is

examined. Merriam-Webster defines ethics as "the discipline dealing with what is good and bad and with moral duty and obligation," and further defines "moral" in terms of the consciousness of one's own conduct, intentions, or character together with a feeling of obligation to do right. [12] Character and moral behavior are certainly key elements of human experience, and undoubtedly infuse any serious study of ethics throughout. These definitions can also be used to justify the requirement of "provide an awareness...of basic human values and moralities," [11] and a discussion of how ethical theories can be aligned with systems of belief can satisfy the remainder of this criterion. While, undoubtedly, when the humanities guidelines were formulated, "significant or influential ... works of human culture" [11] referred primarily to works of art and literature, a case for the significance of technological and scientific accomplishments and inventions, such as the internet, Global Positioning Systems, and Green technology can certainly be made. Since emerging technologies place the context in the present day, or even in the future, "human activities as expressions of the time and place in which they occurred" [11] can easily be justified in terms of current time and society. Recognition of engineering developments and discoveries as examples of creative expression, and the political and social implications of many technological advances, such as the costs and ethical implications of extension of life by state of the art medical machinery and sensors, compared to limited medical resources and quality of life issues, can aid in justification of "relationship between significant creative expression and the processes of society, politics, and everyday life." [11] Inclusion of multiple examples of both oral and written communication, exploration of critical evaluation of information sources, and support for students to think creatively about both technological advances and ethical evaluation of them can be used to satisfy the last criterion.

While each university has its own processes and requirements for general education courses and their approval, this example shows how an engineering ethics course can be qualified under general education categories such as humanities, and so have the hours for these courses not add to the current total (limited by many states, including Tennessee), but replace other courses in the general education portion of the curriculum which might not fit the needs of engineering as well as the course described.

CONCLUSIONS

The rapid growth of computer technology has created new ethical issues which have outstripped both laws and common societal agreement as to what constitutes ethical behavior in the information age; yet the potential consequences of unethical actions are sufficiently grave to necessitate thorough study and evaluation by current and future computer professionals. This paper has described two courses, an introductory freshman seminar course and a required course for future computer professionals, to enable students to deal with leading edge issues, a description of how such courses can be fitted into crowded engineering curricula, examples of how they can be used for assessment of multiple required ABET outcomes, and a sketch of how these courses can be extended to other engineering and scientific disciplines. Since even identification and ethical agreement on every existing issue now facing computer professionals would not prepare our students for the issues they will face throughout their careers, it is critical that professional ethics education becomes a priority in future engineering programs.

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