A Professional Practices Course in Computer Science and Engineering

Dr. Bill D Carroll P.E., University of Texas, Arlington

Bill Carroll is Professor of Computer Science and Engineering at The University of Texas at Arlington (UTA). He has been a UTA faculty member since 1981 and has held faculty positions at Auburn University and visiting appointments at the University of California-Berkeley and the University of Washington. He has held engineering positions at Texas Instruments and General Dynamics. Carroll received B.S., M.S., and Ph.D. degrees in electrical engineering from the University of Texas at Austin. He is a Fellow of the Institute for Electrical and Electronics Engineers (IEEE) and a licensed professional engineer in Texas and Alabama.

Carroll has co-authored two textbooks, a tutorial book, and numerous papers and technical reports. He has received an American Society for Engineering Education Outstanding Young Faculty Award, two National Aeronautics and Space Administration Technology Innovation Awards, and three IEEE Computer Society Service Awards. He is an IEEE Computer Society Golden Core Member and a recipient of the IEEE Third Millennium Medal.

Carroll served as Dean of the College of Engineering at UTA from January 1, 2000 to August 31, 2011. During his service as dean, the College of Engineering experienced an enrollment growth of more than fifty percent, an increase of research expenditures from under $10M per year to more than $40M per year, and a growth of the faculty of about sixty percent. Over the same period, capital projects totaling more than $180M were started and completed.

Bob P. Weems, University of Texas, Arlington

Bob Weems is an associate professor in the Dept. of Computer Science & Engineering at UTA, commencing his career in 1985 after completing a PhD in CS at Northwestern University. His present interests are in algorithms, data structures, online computation, and preference-based matching. He served as the department’s associate chair from 2001-2010. He is involved with the evolution of the department’s undergraduate programs in Computer Engineering, Computer Science, and Software Engineering.

Dr. Bahram Khalili, University of Texas, Arlington


Received MS (1991) and PhD (1996) from SMU in Dallas, TX; and BS from University of Waterloo in Waterloo, Canada (1984). All degrees are in Computer Science.
A PROFESSIONAL PRACTICES COURSE FOR
COMPUTER SCIENCE AND ENGINEERING

1. Abstract

The coverage of ethics and professionalism in engineering and computer science programs has become standard since ABET incorporated these and other “soft skills” as student outcomes in Engineering Accreditation Commission (EAC) and Computing Accreditation Commission (CAC) accreditation criteria. Many programs have chosen to incorporate these topics in various courses across the curriculum while others have developed standalone courses. The University of Texas at Arlington (UTA) Computer Science and Engineering (CSE) Department offers ABET accredited programs in computer engineering, computer science, and software engineering. Initially, the department chose to cover ethics, contemporary issues, life-long learning, and communications primarily in the two-semester senior design course sequence. About five years ago, the department observed that this approach was not as effective as needed and decided to introduce a new standalone course covering these and other topics. This paper covers details of the course and discusses lessons learned.

2. Introduction

The course is titled Professional Practices and is currently offered as a senior-level course. Students typically take the course prior to or simultaneously with the first course in a two-semester senior design course sequence. The course is structured as five modules – professional ethics, contemporary issues, entrepreneurship, communications, and career planning as illustrated below. Students study various topics related to the ethical and social impact of computing technology and the responsibilities that engineers and computer scientists have in shaping this technology and its applications. More specifically, they explore contemporary issues such as privacy, freedom of speech, intellectual property, crime, safety, human needs, innovation, entrepreneurship, and career planning. Students enhance their written and oral communications skills by completing assignments on these and other topics. Guest speakers from industry are scheduled throughout the course to give relevance to the topics being covered.
The next section of the paper provides more detail on the motivation and background for developing the course. Section 4 is devoted to descriptions of assessments that have been used in the course for various purposes including assignment of student grades, assessment of student aptitudes, and assessment of student learning. Section 5 contains descriptions of the pedagogical elements of the course such as textbooks, assignments, guest speakers, videos, and student engagement. The five course components, i.e., professional ethics, contemporary issues, entrepreneurship, communications, and career development are detailed in Section 6. Lessons learned, future plans and conclusions are presented in Sections 7, 8, and 9 respectively. References are given in Section 10, and supporting materials are provided in the Appendix.

3. Motivation & Background

The professional practices course was developed to address difficulties with soft topic coverage in the degree plan used for many years, along with increased needs that arose from broadening the available degree programs and heightened expectations for computing curricula. Throughout the 80's and 90's, the CSE department offered a single undergraduate degree in Computer Science and Engineering. The first year of the program included a one-hour college-level common course (1104) *Introduction to Engineering* to provide exposure to the diversity of challenges in engineering, along with another one-hour departmental course (1105) *Introduction to Computer Science and Engineering* to address further topics on responsibilities and expectations for students in computing. The two-semester capstone senior design sequence (4316/4317) emphasizes an extended design experience in a team setting, but had the additional responsibility for delivering substantial knowledge and assessing student achievement on non-technical student outcomes.

This situation often led to uneven coverage of the non-technical topics from semester to semester depending upon the instructor. Students also found it very challenging to balance between learning the technical topics and soft topics simultaneously. The topics covered in the professional practices course provide a just-in-time coverage of the topics most needed at this stage, and was the primary motivation for offering this class. The new course was also needed to strengthen compliance with ABET criteria as discussed below.

In 2003, additional programs in Computer Science and Software Engineering were accredited through CAC and EAC, respectively. After a re-accreditation visit for all three programs in 2006, the Computer Science and Engineering program was renamed to Computer Engineering. Like all ABET accredited programs, each of the three programs has a list of educational objectives (PEOs). These can be found on the departmental website [http://cse.uta.edu/](http://cse.uta.edu/) but may be summarized as follows:

1. Initial employment
2. Advance in responsibilities
3. Demonstrate leadership

The PEOs are mapped to student learning outcomes and the three degree plans in the following systematic fashion. PEO 1 regards fundamentals indispensable in any effort involving
computing in the few years following graduation. PEO 2 regards broader design and teamwork responsibilities. PEO 3 includes attitudes, values, and altruism as a seasoned computing professional of the broadest perspective. When viewed this way, PEO 3 involves the following EAC and CAC student outcomes.

Engineering Accreditation Commission (EAC)

- 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

Computing Accreditation Commission (CAC)

- E. An understanding of professional, ethical, legal, security and social issues and responsibilities
- F. An ability to communicate effectively with a range of audiences
- G. An ability to analyze the local and global impact of computing on individuals, organizations, and society
- H. Recognition of the need for and an ability to engage in continuing professional development

Assessment results from fall 2008 and spring 2009 indicated that students did not uniformly demonstrate the skills and knowledge specified in the above outcomes and that PEO 3 was not being met to the extent desired. This suggested that strengthening the coverage of the related topics in the curricula was needed. There was also a desire to increase coverage of entrepreneurship and to provide more career guidance prior to the senior year. Thusly, the three-hour professional practices course covering professional ethics, contemporary issues, entrepreneurship, communications, and career planning was formulated. This approach also enabled a strengthening of the technical content of the senior design sequence.

Departmental leadership and faculty close to the situation concurred. The need for the course and its description were presented at the spring 2010 CSE Industrial Advisory Board meeting. IAB Board members were supportive of the proposed course suggesting it might help alleviate difficulties that many entry-level workers have in transitioning to the workplace and give students a better understanding of career possibilities and milestones and the nature of how enterprises function. Members were supportive in their willingness to help the course evolve and to actively participate as guest speakers. Subsequently, the course was approved and first offered in fall 2010.

4. Assessment

Measurements/metrics/grading – Students are graded on the basis of oral and written reports relating to one or more of the module topics and examinations on the lecture notes and text
materials. Specifics and frequency of assignments and examinations have varied over the history of the course based on class size and instructor preference. Currently, students are given three examinations, including the final examination, and the following four assignments.

- Professional Ethics – Students work in teams of three to analyze and report on various ethics scenarios. A short oral report and a one-page written report are required.
- Life-long Learning – Students must attend a seminar or workshop and submit a one-page written report on what they learned.
- Elevator Speech – Students deliver a three-minute personal commercial or sales pitch.
- Term Essay – Students write a 500-word essay on a contemporary issue related to computing technology or a 500-word proposal for funding of a start-up company.

Students are given letter grades in the course (A, B, C, D, F) rather than being graded Pass/Fail. There are two reasons for this. First, the College of Engineering policy requires it, and, second, it emphasizes the importance of the course. Currently, grades are based on student performance on four assignments (10-points each) and three examinations (20-points each). The assignments are discussed in more detail below. Examinations are primarily objective (true/false, multiple choice, and fill-in-the blanks) and given at the one-third and two-third points in the semester plus a final exam. A student’s final grade average will be reduced by five-points for each unexcused absence above two. Examination scores have been very consistent across the various offerings of the course with ranges from the low-seventies to 100. Means and medians have been mid-80’s.

**Self-assessment questionnaires**

Students are asked to complete a questionnaire that covers their interest/understanding level of the five class components. The purpose of this questionnaire is to better gauge their level of understanding and it is not used for any grading purposes. The complete list of questions is available in the Appendix (Table A). A sample question from each area is given below.

<table>
<thead>
<tr>
<th>Course component</th>
<th>Sample question</th>
<th>Never</th>
<th>Maybe</th>
<th>Definitely</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Ethics</td>
<td>I will reveal the intentional falsifying of numbers by my manager at work even if it could lead to losing my job</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrepreneurship</td>
<td>I will quit my corporate job and attempt an entrepreneurial activity sometimes during my career</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contemporary Issues in Computing</td>
<td>People on the right side of the digital divide always have an advantage due to their computer skills. “They always get the best jobs”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Career Planning</td>
<td>I will attend graduate school at some point in the future</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>“Formal writing is not very important for computer programmers, great programming skill is”. I agree with this statement.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pre and Post Assessments – It is important to learn how much students’ knowledge of professional ethics, contemporary issues, entrepreneurship, communication, and career development is enhanced by having taken the course. To begin getting a handle for this, pre and post assessments of knowledge are being conducted during the 2014-15 academic year. The questionnaire and results for the fall 2014 semester are detailed in the Appendix (Table B) and discussed below. Results for the spring 2015 semester will be included in the conference presentation. Pre and post assessments were not done in prior years. The introduction of the assessments is an example of the department’s continuous improvement process and is expected to continue in the future.

Assessment results suggest students had a better understanding of anonymity on the Internet (#4), privacy in the workplace (#5), technology advances and the law (#6), and the legality of hacking (#13). The results also suggest that students’ understanding of net neutrality (#11), innovation (#19), software patentability (#21), and design principles (#23) became foggier. Results were essentially unchanged on the understanding of professional ethics (#25) suggesting that students lack a clear understanding of a profession.

Myers-Briggs Assessment

Students are asked to participate in a self-recognition exercise that is based on Myers Briggs Type Indicator (MBTI)\(^1\).\(^2\). One lecture is devoted to this exercise where students are presented with four dichotomies (i.e. four pairs of opposing preferences) through four designated questions/scenarios. The four pairs of preferences or dichotomies are as follows:

- Extraversion (E) vs. Introversion (I)
- Sensing (S) vs. Intuition (N)
- Thinking (T) vs. Feeling (F)
- Judging (J) vs. Perception (P)

The four pairs of dichotomies listed above will yield a four-letter Personality type indicator such as "ISTJ". This code will help students recognize their talent area. The 16 possible combinations can be found in reference 1. However the following four combinations have been the most common results from the course.

- ISTJ (The Duty F fulfiller) – e.g., managers, computer programmers
- ESTJ (The Guardian) – e.g., financial officers, teachers
- INTP (The Thinker) – e.g., scientists, professors
- ENFP (The Inspirers) – e.g., psychologist, entrepreneur

5. Pedagogy

A number of pedagogical approaches have been used over the evolution of the course and are summarized in this section. The specifics have varied somewhat with each course offering and instructor but basic approaches have remained the same.
Textbook selection and creation – Many books have been written on ethics and related topics including those listed in the references. However, the search for a textbook to cover the diversity of topics to be included in the course was unsuccessful. Hence, two of the coauthors compiled a three-volume set of reprints, *Professional Practices in Computer Science* that was published by Pearson Learning Solutions in 2010. These books were used as required textbooks for the first three offerings of the course. Subsequently, the other co-author adopted *A Gift of Fire, 4th Edition*, as the required textbook and uses the *Professional Practices in Computer Science* volumes as supplementary textbooks.

Assignments – Formulating meaningful assignments can be challenging for a course that focuses on general concepts, soft skills and critical thinking rather than technical material. The course is not about technology but about how technology impacts the lives of both technologists and society in general. The goal is to give assignments that enhance student learning of the course material, are useful and interesting, not burdensome, and address the related ABET outcomes. An important secondary goal is to make the assignments easy to grade so that they can be returned to students in a timely manner. Different assignments have been used in the various offerings of the course and have evolved to the following.

- **Ethical scenario analysis and report.** Students work in teams of three to analyze and report on an ethical scenario from Baase, Chapter 9. Teams are given 45-minutes during class time to analyze the assigned scenario. Then they give a one-minute oral presentation of their scenario and conclusions. Teams are then required to write a one-page summary that expands on their oral report. This assignment addresses professional ethics, team work, and both oral and written communications. Students are asked in advance of the scenario analysis to form teams. An interesting observation has been that many students find this difficult.

- **Life-long learning experience.** The importance of life-long learning for computer scientists and engineers is emphasized throughout the course. To re-enforce this notion, students are required to attend a seminar, lecture, or workshop on a topic related to computer engineering, computer science, or software engineering and to submit a one-page report. This assignment addresses both life-long learning and written communication skills. Students are given two months to complete this assignment but many, if not most, wait until the last minute.

- **Elevator speech.** Students deliver a two-minute oral presentation in front of the class. The speech is expected to be a personal commercial that the student would use in a job interview or graduate school admission interview. Alternatively, the speech may be a pitch to a potential investor in a start-up company. The order of presentation is not given to the students in advance in order to provide a more realistic scenario. This assignment addresses oral communications and career development.

- **Term essay.** Students write a 500-word essay on a topic of their choice relating to contemporary issues in computer technology or entrepreneurship. Alternatively, they may write a business plan for a start-up company. This assignment addresses written communications and contemporary issues or entrepreneurship.
Entrepreneurship report. This assignment is an exercise in entrepreneurship and is completed either in pairs or individually. Students are required to select an opportunity area and explore its potential for commercialization as a start-up company. They provide a brief justification of the following eight areas -- two-sentence definition of their idea, risks, customer domain, business model, development plan, resource requirements, distribution and funding.

Formal technical report. Students are asked to write a formal report or proposal from a number of computing related selected topics. The report must include a set of required items including executive summary, body and conclusion as well as work cited and references. This assignment addresses their formal written communication requirement.

Guest speakers – Having guest speakers has proven to be a very important aspect of the course. Students enjoy the change of pace and learn valuable lessons from perspectives they do not usually get from faculty members. Four speakers per semester has proven to be the most workable number. Typical topics covered by guests have been professional ethics, entrepreneurship, career opportunities and perspectives, and job search. The authors have found that most prospective speakers are eager to help and many volunteer to return in future semesters.

Videos – Videos relating to current technically-oriented events, such as the Affordable Health Care Act rollout, are used when appropriate. A video prepared by the National Council of Engineering Examiners (NCEES) is used to emphasize the importance of professional licensure for engineers and computer scientists. One of the guest speakers shows videos used in industry for ethics training. Videos are a good change of pace and effective. However, it has proven difficult to find a good source of current videos covering topics of relevance to the course.

Student engagement – Keeping students interested and engaged can be a challenge in any course but is especially true for a course such as this one. The main method for achieving this is by getting students involved in in-class discussion of the lecture topics by asking them a lot of questions, encouraging discussion, and using brainstorming methods. Having students work in small groups in class on specific issues has also proven effective. The challenges to make this work are dealing with talkative students and with quiet or passive students. Calling on students by name is an effective way to draw out reluctant participants and also seems to encourage voluntary response to questions. In general, personalizing the discussions and activities as much as possible is very effective in getting students to get involved. Another mechanism for encouraging student engagement is requiring attendance which is, perhaps, unusual for a senior-level class but has proven effective.

6. Course Components

The selection of components to include in this course and the order of coverage was discussed in great length by the departmental curriculum committee. The following five components, in the order listed below, were selected as providing the most benefit to students and meeting curricula needs as previously discussed.
6.1. Professional Ethics

It is reasonable to expect that individuals and organizations behave ethically in personal and professional situations. This is particularly important for computing professionals given the pervasive impact their work can have on society around the global. ABET accreditation criteria have been established, as discussed above, to assure that the importance of ethics is understood by graduates of ABET accredited programs. Case studies from Baase\textsuperscript{3} and other sources are used to illustrate ethical issues that have occurred in professional practice.

However, the ethical thing to do in a given situation is not always clear cut. Ethical theories have been formulated over the centuries for the purpose of guiding individuals and society on how to behave in moral and ethical ways toward others. Professional societies, such as ACM and IEEE, have developed codes of ethics and professional practice or conduct to help guide members and others in the profession about how to conduct themselves professionally and to make good decisions when ethical issues arise in their work. Professional licensure laws have been enacted to establish legal requirements on the ethical practices.

This course emphasizes professional ethics rather ethics in general and uses case studies and discussion of contextual areas where ethical issues often arise. The following are some of the areas covered.

- Intellectual property
- Computer crime
- Work quality

6.2. Entrepreneurship

The transition to entrepreneurship is generally an ambiguous concept for students at this stage in spite of many great ideas that occupies their minds. In this segment of the course we start by exploring the role of innovation and generating entrepreneurial ideas and define what translates well to entrepreneurship and what doesn’t. The focus is to show how their engineering and scientific background can help them in design and development as well as breaking down problems into objects and processes. Also teach them what doesn’t translate to entrepreneurship is linear thinking or a formula-based approach. The general process of coming up with a business model to convert their idea to a commercial product, i.e. commercialization, while learning important side issues such as dealing with uncertainty, managing people and time-to-market is explored. CSE students interested in entrepreneurial activity are often held back by many unfounded myths such as “they need to have a great idea and must be the first mover in certain areas” in order to succeed. The entrepreneurial segment of the course typically covers the following six areas.

1. Define innovation and entrepreneurship: general commercialization and extracting value from ideas
2. Recognizing opportunity: brainstorming, and general divergent and convergent thinking
3. Start-up activities: selecting and finalizing the concept, feasibility study
4. Define business model: create and capture value, define cost derivers and success metrics
The primary purpose of the entrepreneurial segment of this course is to create enthusiasm among students and encourage their involvement in entrepreneurial activities. A clear increase in the entrepreneurial activities among students is noticeable after introducing this course. One risk area we have noticed is that some students consider putting their education on hold in order to devote all of their time to entrepreneurial activities.

### 6.3. Contemporary Issues

The term contemporary issues is used directly in EAC student outcome (j), but is implied by several CAC outcomes. Popular textbooks (Baase\(^3\), Quinn\(^6\), Johnson\(^12\)) do not use the term, presumably since the concept is pervasive across the course's topics. An advantage in offering a full-semester professional practices course is that students should be prepared for the social and technical contemporary issues for the ten years past graduation and have capabilities, resources, and interest to keep current beyond that. For the near term, these topics may partially influence remaining degree plan decisions (courses in information security, artificial intelligence, data mining, robotics). Notions such as Kurzweil's singularity and Asimov's Laws of Robotics may arise, but are largely outside the scope of the course.

Contemporary social issue areas include the digital divide, medicine, quality of on-line information, government, and education. The digital divide concerns issues of deploying computing technology to the economically disadvantaged, largely in terms of the potential of bootstrapping to a better life. It is also a component of arguments for Net Neutrality. Issues in medicine include healthcare delivery, robotic prostheses, applications of gene sequencing, and health record privacy. Issues regarding government and technology involve their interaction, especially as they evolve. Issues in education range from distance education through pre-college computing education, along with code boot camps.

Contemporary technical issue areas are often connected to social issues. These include globalization, privacy/information security, and user interfaces. Globalization, as associated with the spread of the Internet, has shrunk the planet, broadened economies, and weakened borders far more than the great advances in transportation. It is also related to privacy issues, since a compromised ID, document, or picture is largely irreparable. Consideration of user interface (UI) design issues and their future modalities, along with case studies where a UI contributed to an incident, are valuable to a maturing engineer. Unlike topics with social connections, software reuse and open source are challenging areas to discuss since trade-offs involving cost, intellectual property, and quality.

### 6.4. Career Planning

Students are very engaged in this segment of the course since “planning what is next after graduation” is on the mind of most of them while taking this class. We help them explore their options which usually fall into one of the following three paths.
• a career in computing
• attending graduate school
• other/undecided such as a non-computing career, part-time graduate studies, or an entrepreneurial activity

A number of self-assessment and psychometric questionnaires such as the Myers-Briggs Type Indicator are used in the course to help students better recognize their talent and interest areas. Students are also encouraged to join various professional societies such as IEEE or ACM to stay informed with the latest state of the computer technology and a possible means for networking with their peers. Other activities that could help their careers such as attending various job fairs, graduate school forums, internship at local industry and devoting their summer to attending a Research Experiences for Undergraduates (REU) at a local or national institution is highly encouraged.

6.5. Communication

Understanding oral and written communication in today’s business environment is essential for survival and success of students. Students learn to write and speak effectively in culturally diverse environments by learning and practicing the following communication topics.

• Ethical vs. unethical communication
• Oral presentation skills
• Writing reports and proposals
• Effective use of computer technology
• Intercultural Sensitivity
• Formal vs. informal communication

All students must deliver an oral presentation during this course. We strongly encourage and reward the use of computer technology for preparing and delivering presentations with great visual aids. Some of the students have difficulty conducting oral presentations due to lack of experience in public speaking and might suffer from mild levels of anxiety. Students learn to prepare simple audience-centered presentations with good content and visual appeal. They practice delivering and overcoming their anxiety by staying positive and focused. Writing effective reports and proposals is also a requirement for passing the communication portion of this class. Students are required to write a formal report as one of their assignments in this class.

7. Lessons Learned

The following is a brief recap of a number of lessons that have been learned during the relatively short period that this course has been offered.

• The professional practice class covers five relatively diverse components. The amount of material covered can be overwhelming and too demanding for students. To remedy this, one can consider reducing some of the covered material or possibly removing one of the components entirely. If curriculum length allows, it is also possible to split the material in two subsequent semesters.
• The size of the class has a great impact on the quality of course that can be delivered. We have found out that 30 students per class perhaps is the optimum level. When the number of students far exceeds this limit, additional sections should be offered.

• Guest speakers play a vital role in the success of this class. Students routinely express great satisfaction when guest speaker share their knowledge and experience with them. Of course the relevance and quality of the guest speakers is very important.

• Generally students expressed more satisfaction from the class when more interaction and group activities were involved. Participating in brainstorming sessions, evaluating peer presentations, and attending local chamber of commerce meetings are some notable examples.

8. Future Plans

The pre and post assessment results indicate that more emphasis or better coverage of some topics such as net neutrality, innovation, software patenting, and the computer science and engineering professions is needed. This begs the question of how this can be accomplished without sacrificing coverage in other areas. So resolving this will be a future priority.

Assessing the impact of this course on graduates a few years after graduation is needed and will be appropriately incorporated in the department’s continuous improvement process.

Profound recent events, such as the Edward Snowden whistleblowing of the National Security Agency, will be incorporated in the course. Students in computing appreciate the limitations of textbooks, and often pursue other materials on the edge of the body of knowledge. Controversies in the recent evolution of scientific publishing, as regularly summarized by M.Y. Vardi in the Communications of the ACM, are excellent contemporary issues and useful contexts for introducing students to the variety of outlets for disseminating discoveries. Some instructors may wish to incorporate such topics.

Having students with varying interests and competence levels from three programs demands some personalization. In this regard, ways to provide more flexibility in assignments will be explored.

9. Conclusion

Experiences of the past five years have demonstrated that the stand alone Professional Practices in Computer Science and Engineering course has substantially increased the level of coverage of the material when compared to the prior approach. Student success in the course coupled with recent assessment results suggest that student learning and comprehension of the topics has been enhanced.

Our university recently met the federal criteria to be designated an Hispanic-serving Institution and is also ranked among the most diverse universities in the United States in terms of race, ethnicity, gender and cultural background. The Professional Practices course reflects this diversity in race, ethnicity and culture. In some ways, this complicates the teaching of the course, but mostly, it provides an excellent opportunity for providing our students a common grounding in the ethical and communication standards they will need in their careers.
Assessment of how the course has impacted “on the job” performance of graduates has not yet been performed. However, we hope to collect such data in the future. Anecdotal evidence suggests the course has been effective. For example, three students who have taken the course have been placed in a local technology incubator as a result of exposure received in the course. Emails from several students indicate that they have been able to apply oral and written communication skills learned in this course in their jobs. Others have indicated that job search skills learned in the course have helped them find a job. Another student recently commented that communication skills learned in this course helped him gain admission to a prestigious graduate program.

The Professional Practices in Computer Science and Engineering course at The University of Texas at Arlington provides students with a set of educational experiences and opportunities that enhance and complement their technical education. By the end of the course, students have demonstrated the following.

- Knowledge of the principles of ethics and professional ethics and how they guide the practice of computer engineering, computer science, and software engineering.
- Understanding of social and career issues that stem from applications of computing technology.
- How to initiate or get involved in entrepreneurial activities.
- Ability to write and speak informatively on these issues.

The course has evolved over its five-year history through the inclusion of updated materials, a change of textbooks, assessment tools, and emphasis. However, it has remained true to the original purpose and topical coverage.

10. References

## APPENDIX

**Table A -- Self-assessment questionnaires** (place a checkmark in front of the best answer)

<table>
<thead>
<tr>
<th>Course component</th>
<th>Sample question</th>
<th>Never</th>
<th>Maybe</th>
<th>Definitely</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professional Ethics</strong></td>
<td>I will reveal the intentional falsifying of numbers by my manager at work even if it could lead to losing my job</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I fully understand the difference between Worm, Virus, and Denial of Service attacks?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you think downloading music or movies from free electronic boards is ethical?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you know what Intellectual Property (IP) is?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you think making multiple copies of a CD that you have paid for (i.e. to have a copy for home, a copy for your car, etc.) is legal?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Entrepreneurship</strong></td>
<td>I will quit my corporate job and attempt an entrepreneurial activity sometimes during my career</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I have a great idea but will not pursue it since funding it is almost impossible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A great idea must come to you like Isaac Newton discovering gravity, upon observing an apple fall from a tree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Most CEOs of Tech companies have technology background</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age plays a a great role in becoming an entrepreneur, the younger the easier</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Contemporary Issues in Computing

People on the right side of the digital divide always have an advantage due to their computer skills. "they always get the best jobs"

We should do our best to stop exporting our jobs to other countries

Computers and automation kill jobs

Telework or telecommuting is good for employees but not so good for the employers

Employees that work from home are at a disadvantage for promotion since they are less visible

### Career Planning

I will attend graduate school at some point in the future

I will not get a PhD since most tech companies feel people with PhD are overqualified and will leave their company eventually

There isn’t much salary difference between BS and MS holders when it comes to high-tech workplace

I clearly understand the steps involved in getting a PhD

You must change many jobs before you end up at the right place with the right salary

### Communication

"Formal writing is not very important for computer programmers, great programming skill is". I agree with this statement:

I think I have sufficient oral presentation experience

Most people somewhat cheat when it comes to the content of their resume

Informal communication is more important when it comes to communication at workplace

I don’t like to become a manager when I join corporate since they have to write too many proposal and reports
TABLE B. Pre and Post Assessment Questionnaire and Results (correct answers in red).

<table>
<thead>
<tr>
<th>Questions</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Which of the following best describes ethics in the general sense?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Laws of the United States</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>b. Principles or guidelines for “doing the right thing”</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>c. Codes of ethics of professional societies</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>d. Religious principles and doctrine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. None of the above</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2. Freedom from intrusion, control of personal information, and freedom from surveillance are key aspects of privacy. TRUE/FALSE?</td>
<td>42/2</td>
<td>39/2</td>
</tr>
<tr>
<td>3. Deterring or solving crimes are some of the reasons why governments want to eavesdrop, search and/or seize personal records or property. TRUE/FALSE?</td>
<td>36/8</td>
<td>40/1</td>
</tr>
<tr>
<td>4. Which of the following is a positive use of anonymity on the internet?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Protect against retaliation and embarrassment</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>b. Protect criminal and antisocial activities</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>c. Prevent leaks of sensitive information</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>d. Protect real property</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>e. None of the above</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. Employers’ monitoring of employee communications is generally considered an invasion of privacy. TRUE/FALSE?</td>
<td>13/31</td>
<td>2/39</td>
</tr>
<tr>
<td>6. Which of the following best describes the time relationship between technology advances and law?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. New law is passed in anticipation of new technology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b. New technology is exempt from old law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Changes in technology and laws are synchronized</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>d. New law lags behind new technology</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>e. There is no relationship between technology and law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The Communications Assistance for Law Enforcement Act of 1994 requires telecommunication equipment be designed to ensure that the government can intercept telephone calls. TRUE/FALSE?</td>
<td>34/10</td>
<td>37/4</td>
</tr>
<tr>
<td>9. Print media (newspapers, magazines, books, etc.) has fewer United States government restrictions on content than broadcast media (TV, radio, internet, etc). TRUE/FALSE?</td>
<td>24/20</td>
<td>23/18</td>
</tr>
<tr>
<td>10. Companies headquartered in the United States who do business in countries that control access to the internet are not obliged to follow the laws in those countries. TRUE/FALSE?</td>
<td>6/37</td>
<td>1/40</td>
</tr>
<tr>
<td>11. Advocates of Net Neutrality believe that free market forces should determine the rates and content offered by broadband service providers. TRUE/FALSE?</td>
<td>31/12</td>
<td>21/15</td>
</tr>
<tr>
<td>12. Computing technology has led to wide-spread unemployment and economic decline. TRUE/FALSE?</td>
<td>1/43</td>
<td>0/41</td>
</tr>
<tr>
<td>13. Harmless hacking has been ruled as illegal by various United States courts. TRUE/FALSE?</td>
<td>29/14</td>
<td>35/6</td>
</tr>
</tbody>
</table>
14. The Pentagon (US Department of Defense) has announced it would consider and treat some cyber-attacks as acts of war. **TRUE/FALSE?**

15. One of the key elements of effective communications is **conciseness**. **TRUE/FALSE?**

16. Not practicing an oral presentation is an effective way to overcome anxiety about the presentation? **TRUE/FALSE?**

17. A business model embodies how an entrepreneur converts a new technology to economic value and delivers that value to the customer. **TRUE/FALSE?**

18. Being sensitive to business etiquette is unimportant in today’s competitive world. **TRUE/FALSE?**

19. Innovation is concerned with the process of commercializing or extracting value from ideas. **TRUE/FALSE?**

20. Which of the following are means for protecting intellectual property in the United States?  
   a. Trade secrets  
   b. Patents  
   c. Trademarks  
   d. Copyrights  
   e. All of the above  
   **TRUE/FALSE?**

21. Software cannot be patented in the United States. **TRUE/FALSE?**

22. Computing system failures caused by data entry errors are not the responsibility of system designers. **TRUE/FALSE?**

23. Which of the following is a good principle to follow for producing good systems?  
   a. Design for real users  
   b. Do not assume existing software is safe or correct  
   c. Establish a loose organizational structure for the development team  
   d. Understand what success means  
   e. All of the above  
   **TRUE/FALSE?**

24. Life-long learning is important for computer engineers, computer scientists, and software engineers. **TRUE/FALSE?**

25. Which of the following are ways in which professional ethics differ from ethics in general?  
   a. Professionals must maintain up to date skills and knowledge  
   b. Professionals must be university graduates  
   c. Professionals must be licensed by an applicable state board  
   d. Professionals must offer services to the public  
   e. None of the above  
   **TRUE/FALSE?**