Social Issues and Professional Practice (SP)

While technical issues are central to the computing curriculum, they do not constitute a complete educational program in the field. Students must also be exposed to the larger societal context of computing to develop an understanding of the relevant social, ethical, legal and professional issues. This need to incorporate the study of these non-technical issues into the ACM curriculum was formally recognized in 1991, as can be seen from the following excerpt [2]:

> *Undergraduates also need to understand the basic cultural, social, legal, and ethical issues inherent in the discipline of computing. They should understand where the discipline has been, where it is, and where it is heading. They should also understand their individual roles in this process, as well as appreciate the philosophical questions, technical problems, and aesthetic values that play an important part in the development of the discipline.*
>
> *Students also need to develop the ability to ask serious questions about the social impact of computing and to evaluate proposed answers to those questions. Future practitioners must be able to anticipate the impact of introducing a given product into a given environment. Will that product enhance or degrade the quality of life? What will the impact be upon individuals, groups, and institutions?*
>
> *Finally, students need to be aware of the basic legal rights of software and hardware vendors and users, and they also need to appreciate the ethical values that are the basis for those rights. Future practitioners must understand the responsibility that they will bear, and the possible consequences of failure. They must understand their own limitations as well as the limitations of their tools. All practitioners must make a long-term commitment to remaining current in their chosen specialties and in the discipline of computing as a whole.*

As technological advances continue to significantly impact the way we live and work, the critical importance of social issues and professional practice continues to increase; new computer-based products and venues pose ever more challenging problems each year. It is our students who must enter the workforce and academia with intentional regard for the identification and resolution of these problems.

Computer science educators may opt to deliver this core and elective material in stand-alone courses, integrated into traditional technical and theoretical courses, or as special units in capstone and professional practice courses. The material in this familiarity area is best covered through a combination of one required course along with short modules in other courses. On the one hand, some units listed as Core Tier-1 (in particular, Social Context, Analytical Tools, Professional Ethics, and Intellectual Property) do not readily lend themselves to being covered in other traditional courses. Without a standalone course, it is difficult to cover these topics appropriately. On the other hand, if ethical and social considerations are covered only in the standalone course and not "in context," it will reinforce the false notion that technical processes are void of these other relevant issues. Because of this broad relevance, it is important that several traditional courses include modules with case studies that analyze the ethical, legal, social and professional considerations in the context of the technical subject matter of the course. Courses in areas such as software engineering, databases, computer networks, information assurance and security, and introduction to computing provide obvious context for analysis of ethical issues. However, an ethics-related module could be developed for almost any course in the curriculum. It would be explicitly against the spirit of the recommendations to have only a standalone course. Running through all of the issues in this area is the need to speak to the computing practitioner's responsibility to proactively address these issues by both moral and technical actions. The ethical issues discussed in any class should be directly related to and arise naturally from the subject matter of that class. Examples include a discussion in the database course of data aggregation or data mining, or a discussion in the software engineering course of the potential conflicts between obligations to the customer and obligations to the user and others affected by their work. Programming assignments built around applications such as controlling the movement of a laser during eye surgery can help to address the professional, ethical and social impacts of computing. Computing faculty who are unfamiliar with the content and/or pedagogy of applied ethics are urged to take advantage of the considerable resources from ACM, IEEE-CS, SIGCAS (special interest group on computers and society), and other organizations.

It should be noted that the application of ethical analysis underlies every subsection of this Social and Professional knowledge area in computing. The ACM Code of Ethics and Professional Conduct (http://www.acm.org/about/code-of-ethics) provides guidelines that serve as the basis for the conduct of our professional work. The General Moral Imperatives provide an

understanding of our commitment to personal responsibility, professional conduct, and our leadership roles.

SP. Social Issues and Professional Practice. [11 Core-Tier1 hours, 5 Core-Tier2 hours]

	Core-Tier1 hours	Core-Tier2 hours	Includes Electives
SP/Social Context	**1**	**2**	**N**
SP/Analytical Tools	**2**		**N**
SP/Professional Ethics	**2**	**2**	**N**
SP/Intellectual Property	**2**		**Y**
SP/Privacy and Civil Liberties	**2**		**Y**
SP/Professional Communication	**1**		**Y**
SP/Sustainability	**1**	**1**	**Y**
SP/History			**Y**
SP/Economies of Computing			**Y**
SP/Security Policies, Laws and Computer Crimes			**Y**

SP/Social Context

[1 Core-Tier1 hour, 2 Core-Tier2 hours]

Computers and the Internet, perhaps more than any other technologies, have transformed society over the past 75 years, with dramatic increases in human productivity; an explosion of options for news, entertainment, and communication; and fundamental breakthroughs in almost every branch of science and engineering. Social Context provides the foundation for all other SP knowledge units, especially Professional Ethics. Also see cross-referencing with Human-Computer Interaction (HCI) and Networking and Communication (NC) Knowledge Areas.

Topics:

[Core-Tier1]

- Social implications of computing in a networked world (cross-reference HCI/Foundations/social models; IAS/Fundamental Concepts/social issues)
- Impact of social media on individualism, collectivism and culture.

[Core-Tier2]

- Growth and control of the Internet (cross-reference NC/Introduction/organization of the Internet)
- Often referred to as the digital divide, differences in access to digital technology resources and its resulting ramifications for gender, class, ethnicity, geography, and/or underdeveloped countries.
- Accessibility issues, including legal requirements
- Context-aware computing (cross-reference HCI/Design for non-mouse interfaces/ ubiquitous and context-aware)

Learning Outcomes:

[Core-Tier1]

1. Describe positive and negative ways in which computer technology (networks, mobile computing, cloud computing) alters modes of social interaction at the personal level. [Familiarity]
2. Identify developers' assumptions and values embedded in hardware and software design, especially as they pertain to usability for diverse populations including under-represented populations and the disabled. [Familiarity]
3. Interpret the social context of a given design and its implementation. [Familiarity]
4. Evaluate the efficacy of a given design and implementation using empirical data. [Assessment]
5. Summarize the implications of social media on individualism versus collectivism and culture. [Usage]

[Core-Tier2]

6. Discuss how Internet access serves as a liberating force for people living under oppressive forms of government; explain how limits on Internet access are used as tools of political and social repression. [Familiarity]
7. Analyze the pros and cons of reliance on computing in the implementation of democracy (e.g. delivery of social services, electronic voting). [Assessment]
8. Describe the impact of the under-representation of diverse populations in the computing profession (e.g., industry culture, product diversity). [Familiarity]
9. Explain the implications of context awareness in ubiquitous computing systems. [Familiarity]

SP/Analytical Tools

[2 Core-Tier1 hours]

Ethical theories and principles are the foundations of ethical analysis because they are the viewpoints from which guidance can be obtained along the pathway to a decision. Each theory emphasizes different points such as predicting the outcome and following one's duties to others in order to reach an ethically guided decision. However, in order for an ethical theory to be useful, the theory must be directed towards a common set of goals. Ethical principles are the common goals that each theory tries to achieve in order to be successful. These goals include beneficence, least harm, respect for autonomy, and justice.

Topics:

- Ethical argumentation
- Ethical theories and decision-making
- Moral assumptions and values

Learning Outcomes:

1. Evaluate stakeholder positions in a given situation. [Assessment]
2. Analyze basic logical fallacies in an argument. [Assessment]
3. Analyze an argument to identify premises and conclusion. [Assessment]
4. Illustrate the use of example and analogy in ethical argument. [Usage]
5. Evaluate ethical/social tradeoffs in technical decisions. [Assessment]

SP/Professional Ethics

[2 Core-Tier1 hours, 2 Core-Tier2 hours]

Computer ethics is a branch of practical philosophy that deals with how computing professionals should make decisions regarding professional and social conduct. There are three primary influences: 1) an individual's own personal code; 2) any informal code of ethical behavior existing in the work place; and 3) exposure to formal codes of ethics. See cross-referencing with the Information Assurance and Security (IAS) Knowledge Area.

Topics:

[Core-Tier1]

- Community values and the laws by which we live
- The nature of professionalism including care, attention and discipline, fiduciary responsibility, and mentoring
- Keeping up-to-date as a computing professional in terms of familiarity, tools, skills, legal and professional framework as well as the ability to self-assess and progress in the computing field
- Professional certification, codes of ethics, conduct, and practice, such as the ACM/IEEE-CS, SE, AITP, IFIP and international societies (cross-reference IAS/Fundamental Concepts/ethical issues)
- Accountability, responsibility and liability (e.g. software correctness, reliability and safety, as well as ethical confidentiality of cybersecurity professionals)

[Core-Tier2]

- The role of the computing professional in public policy
- Maintaining awareness of consequences
- Ethical dissent and whistle-blowing
- The relationship between regional culture and ethical dilemmas
- Dealing with harassment and discrimination
- Forms of professional credentialing
- Acceptable use policies for computing in the workplace
- Ergonomics and healthy computing environments
- Time to market and cost considerations versus quality professional standards

Learning Outcomes:

[Core-Tier1]

1. Identify ethical issues that arise in software development and determine how to address them technically and ethically. [Familiarity]
2. Explain the ethical responsibility of ensuring software correctness, reliability and safety. [Familiarity]
3. Describe the mechanisms that typically exist for a professional to keep up-to-date. [Familiarity]

4. Describe the strengths and weaknesses of relevant professional codes as expressions of professionalism and guides to decision-making. [Familiarity]
5. Analyze a global computing issue, observing the role of professionals and government officials in managing this problem. [Assessment]
6. Evaluate the professional codes of ethics from the ACM, the IEEE Computer Society, and other organizations. [Assessment]

[Core-Tier2]

7. Describe ways in which professionals may contribute to public policy. [Familiarity]
8. Describe the consequences of inappropriate professional behavior. [Familiarity]
9. Identify progressive stages in a whistle-blowing incident. [Familiarity]
10. Identify examples of how regional culture interplays with ethical dilemmas. [Familiarity]
11. Investigate forms of harassment and discrimination and avenues of assistance. [Usage]
12. Examine various forms of professional credentialing. [Usage]
13. Explain the relationship between ergonomics in computing environments and people's health. [Familiarity]
14. Develop a computer usage/acceptable use policy with enforcement measures. [Assessment]
15. Describe issues associated with industries' push to focus on time to market versus enforcing quality professional standards. [Familiarity]

SP/Intellectual Property

[2 Core-Tier1 hours]

Intellectual property refers to a range of intangible rights of ownership in an asset such as a software program. Each intellectual property "right" is itself an asset. The law provides different methods for protecting these rights of ownership based on their type. There are essentially four types of intellectual property rights relevant to software: patents, copyrights, trade secrets and trademarks. Each affords a different type of legal protection. See cross-referencing with the Information Management (IM) Knowledge Area.

Topics:

[Core-Tier1]

- Philosophical foundations of intellectual property
- Intellectual property rights (cross-reference IM/Information Storage and Retrieval/intellectual property and protection)
- Intangible digital intellectual property (IDIP)
- Legal foundations for intellectual property protection
- Digital rights management
- Copyrights, patents, trade secrets, trademarks
- Plagiarism

[Elective]

- Foundations of the open source movement
- Software piracy

Learning Outcomes:

[Core-Tier1]

1. Discuss the philosophical bases of intellectual property. [Familiarity]
2. Discuss the rationale for the legal protection of intellectual property. [Familiarity]
3. Describe legislation aimed at digital copyright infringements. [Familiarity]
4. Critique legislation aimed at digital copyright infringements. [Assessment]
5. Identify contemporary examples of intangible digital intellectual property. [Familiarity]
6. Justify uses of copyrighted materials. [Assessment]
7. Evaluate the ethical issues inherent in various plagiarism detection mechanisms. [Assessment]
8. Interpret the intent and implementation of software licensing. [Familiarity]
9. Discuss the issues involved in securing software patents. [Familiarity]
10. Characterize and contrast the concepts of copyright, patenting and trademarks. [Assessment]

[Elective]

11. Identify the goals of the open source movement. [Familiarity]
12. Identify the global nature of software piracy. [Familiarity]

SP/Privacy and Civil Liberties

[2 Core-Tier1 hours]

Electronic information sharing highlights the need to balance privacy protections with information access. The ease of digital access to many types of data makes privacy rights and civil liberties more complex, differing among the variety of cultures worldwide. See cross-referencing with the Human-Computer Interaction (HCI), Information Assurance and Security (IAS), Information Management (IM), and Intelligent Systems (IS) Knowledge Areas.

Topics:

[Core-Tier1]

- Philosophical foundations of privacy rights (cross-reference IS/Fundamental Issues/philosophical issues)
- Legal foundations of privacy protection
- Privacy implications of widespread data collection for transactional databases, data warehouses, surveillance systems, and cloud computing (cross-reference IM/Database Systems/data independence; IM/Data Mining/data cleaning)
- Ramifications of differential privacy
- Technology-based solutions for privacy protection (cross-reference IAS/Threats and Attacks/attacks on privacy and anonymity)

[Elective]

- Privacy legislation in areas of practice
- Civil liberties and cultural differences
- Freedom of expression and its limitations

Learning Outcomes:

[Core-Tier1]

1. Discuss the philosophical basis for the legal protection of personal privacy. [Familiarity]
2. Evaluate solutions to privacy threats in transactional databases and data warehouses. [Assessment]

3. Describe the role of data collection in the implementation of pervasive surveillance systems (e.g., RFID, face recognition, toll collection, mobile computing). [Familiarity]
4. Describe the ramifications of differential privacy. [Familiarity]
5. Investigate the impact of technological solutions to privacy problems. [Usage]

[Elective]

6. Critique the intent, potential value and implementation of various forms of privacy legislation. [Assessment]
7. Identify strategies to enable appropriate freedom of expression. [Familiarity]

SP/Professional Communication

[1 Core-Tier1 hour]

Professional communication conveys technical information to various audiences who may have very different goals and needs for that information. Effective professional communication of technical information is rarely an inherited gift, but rather needs to be taught in context throughout the undergraduate curriculum. See cross-referencing with Human-Computer Interaction (HCI) and Software Engineering (SE) Knowledge Areas.

Topics:

[Core-Tier1]

- Reading, understanding and summarizing technical material, including source code and documentation
- Writing effective technical documentation and materials
- Dynamics of oral, written, and electronic team and group communication (cross-reference HCI/Collaboration and Communication/group communication; SE/Project Management/team participation)
- Communicating professionally with stakeholders
- Utilizing collaboration tools (cross-reference HCI/Collaboration and Communication/online communities; IS/Agents/collaborative agents)

[Elective]

- Dealing with cross-cultural environments (cross-reference HCI/User-Centered Design and Testing/cross-cultural evaluation)
- Tradeoffs of competing risks in software projects, such as technology, structure/process, quality, people, market and financial (cross-reference SE/Software Project Management/Risk)

Learning Outcomes:

[Core-Tier1]

1. Write clear, concise, and accurate technical documents following well-defined standards for format and for including appropriate tables, figures, and references. [Usage]
2. Evaluate written technical documentation to detect problems of various kinds. [Assessment]
3. Develop and deliver a good quality formal presentation. [Assessment]
4. Plan interactions (e.g. virtual, face-to-face, shared documents) with others in which they are able to get their point across, and are also able to listen carefully and appreciate the points of others, even when they disagree, and are able to convey to others what they have heard. [Usage]
5. Describe the strengths and weaknesses of various forms of communication (e.g. virtual, face-to-face, shared documents). [Familiarity]
6. Examine appropriate measures used to communicate with stakeholders involved in a project. [Usage]
7. Compare and contrast various collaboration tools. [Assessment]

[Elective]

8. Discuss ways to influence performance and results in cross-cultural teams. [Familiarity]
9. Examine the tradeoffs and common sources of risk in software projects regarding technology, structure/process, quality, people, market and financial. [Usage]
10. Evaluate personal strengths and weaknesses to work remotely as part of a multinational team. [Assessment]

SP/Sustainability

[1 Core-Tier1 hour, 1 Core-Tier2 hour]

Sustainability is characterized by the United Nations [1] as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability was first introduced in the CS2008 curricular guidelines. Topics in this emerging area can be naturally integrated into other familiarity areas and units, such as human-computer interaction and software evolution. See cross-referencing with the Human-Computer Interaction (HCI) and Software Engineering (SE) Knowledge Areas.

Topics:

[Core-Tier1]

- Being a sustainable practitioner by taking into consideration cultural and environmental impacts of implementation decisions (e.g. organizational policies, economic viability, and resource consumption).
- Explore global social and environmental impacts of computer use and disposal (e-waste)

[Core-Tier2]

- Environmental impacts of design choices in specific areas such as algorithms, operating systems, networks, databases, or human-computer interaction (cross-reference SE/Software Evaluation/software evolution; HCI/Design-Oriented HCI/sustainability)

[Elective]

- Guidelines for sustainable design standards
- Systemic effects of complex computer-mediated phenomena (e.g. telecommuting or web shopping)
- Pervasive computing; information processing integrated into everyday objects and activities, such as smart energy systems, social networking and feedback systems to promote sustainable behavior, transportation, environmental monitoring, citizen science and activism.
- Research on applications of computing to environmental issues, such as energy, pollution, resource usage, recycling and reuse, food management, farming and others.
- The interdependence of the sustainability of software systems with social systems, including the knowledge and skills of its users, organizational processes and policies, and its societal context (e.g., market forces, government policies).

Learning Outcomes:

[Core-Tier1]

1. Identify ways to be a sustainable practitioner. [Familiarity]
2. Illustrate global social and environmental impacts of computer use and disposal (e-waste). [Usage]

[Core-Tier2]

3. Describe the environmental impacts of design choices within the field of computing that relate to algorithm design, operating system design, networking design, database design, etc. [Familiarity]
4. Investigate the social and environmental impacts of new system designs through projects. [Usage]

[Elective]

5. Identify guidelines for sustainable IT design or deployment. [Familiarity]
6. List the sustainable effects of telecommuting or web shopping. [Familiarity]
7. Investigate pervasive computing in areas such as smart energy systems, social networking, transportation, agriculture, supply-chain systems, environmental monitoring and citizen activism. [Usage]
8. Develop applications of computing and assess through research areas pertaining to environmental issues (e.g. energy, pollution, resource usage, recycling and reuse, food management, farming). [Assessment]

SP/History

[Elective]

This history of computing is taught to provide a sense of how the rapid change in computing impacts society on a global scale. It is often taught in context with foundational concepts, such as system fundamentals and software developmental fundamentals.

Topics:

- Prehistory—the world before 1946
- History of computer hardware, software, networking (cross-reference AR/Digital logic and digital systems/ history of computer architecture)
- Pioneers of computing
- History of the Internet

Learning Outcomes:

1. Identify significant continuing trends in the history of the computing field. [Familiarity]
2. Identify the contributions of several pioneers in the computing field. [Familiarity]
3. Discuss the historical context for several programming language paradigms. [Familiarity]
4. Compare daily life before and after the advent of personal computers and the Internet. [Assessment]

SP/Economies of Computing

[Elective]

Economics of computing encompasses the metrics and best practices for personnel and financial management surrounding computer information systems.

Topics:

- Monopolies and their economic implications
- Effect of skilled labor supply and demand on the quality of computing products
- Pricing strategies in the computing domain
- The phenomenon of outsourcing and off-shoring software development; impacts on employment and on economics
- Consequences of globalization for the computer science profession

- Differences in access to computing resources and the possible effects thereof
- Cost/benefit analysis of jobs with considerations to manufacturing, hardware, software, and engineering implications
- Cost estimates versus actual costs in relation to total costs
- Entrepreneurship: prospects and pitfalls
- Network effect or demand-side economies of scale
- Use of engineering economics in dealing with finances

Learning Outcomes:

1. Summarize the rationale for antimonopoly efforts. [Familiarity]
2. Identify several ways in which the information technology industry is affected by shortages in the labor supply. [Familiarity]
3. Identify the evolution of pricing strategies for computing goods and services. [Familiarity]
4. Discuss the benefits, the drawbacks and the implications of off-shoring and outsourcing. [Familiarity]
5. Investigate and defend ways to address limitations on access to computing. [Usage]
6. Describe the economic benefits of network effects. [Familiarity]

SP/Security Policies, Laws and Computer Crimes

[Elective]

While security policies, laws and computer crimes are important subjects, it is essential they are viewed with the foundation of other Social and Professional knowledge units, such as Intellectual Property, Privacy and Civil Liberties, Social Context, and Professional Ethics. Computers and the Internet, perhaps more than any other technology, have transformed society over the past 75 years. At the same time, they have contributed to unprecedented threats to privacy; whole new categories of crime and anti-social behavior; major disruptions to organizations; and the large-scale concentration of risk into information systems. See cross-referencing with the Human-Computer Interaction (HCI) and Information Assurance and Security (IAS) Knowledge Areas.

Topics:

- Examples of computer crimes and legal redress for computer criminals (cross-reference IAS/Digital Forensics/rules of evidence)
- Social engineering, identity theft and recovery (cross-reference HCI/Human Factors and Security/trust, privacy and deception)
- Issues surrounding the misuse of access and breaches in security
- Motivations and ramifications of cyber terrorism and criminal hacking, “cracking”
- Effects of malware, such as viruses, worms and Trojan horses
- Crime prevention strategies
- Security policies (cross-reference IAS/Security Policy and Governance/policies)

Learning Outcomes:

1. List classic examples of computer crimes and social engineering incidents with societal impact. [Familiarity]
2. Identify laws that apply to computer crimes. [Familiarity]
3. Describe the motivation and ramifications of cyber terrorism and criminal hacking. [Familiarity]
4. Examine the ethical and legal issues surrounding the misuse of access and various breaches in security. [Usage]

5. Discuss the professional's role in security and the trade-offs involved. [Familiarity]
6. Investigate measures that can be taken by both individuals and organizations including governments to prevent or mitigate the undesirable effects of computer crimes and identity theft. [Usage]
7. Write a company-wide security policy, which includes procedures for managing passwords and employee monitoring. [Usage]

References

[1] "Our Common Future." http://grawemeyer.org/worldorder/previous-winners/1991-the-united-nations-world-commission-on-environment-and-development.html

[2] Tucker, A. (ed), B. Barnes, R. Aiken, K. Barker, K. Bruce, J. Cain, S. Conry, G. Engel, R. Epstein, D. Lidtke, M. Mulder, J. Rogers, E. Spafford, A. Turner, *Computing Curricula 1991: Report of the Joint Curriculum Task Force*, ACM Press and IEEE-CS Press, 1991.