Social 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 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 [Tucker91]:

> *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 these social and professional issues 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 knowledge 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 considerations are covered only in the standalone course and not "in context," it will reinforce the false notion that technical processes are void of ethical issues. Thus it is important that several traditional courses include modules that analyze ethical considerations in the context of the technical subject matter of the course. Courses in areas such as software engineering, databases, computer networks, 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 computer 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 and other organizations.

It should be noted that the application of ethical analysis underlies every subsection of this knowledge area on Social and Professional Issues in computing. The ACM Code of Ethics and Professional Conduct - www.acm.org/about/code-of-ethics - provide 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 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]

Topics:

[Core-Tier1]

- Social implications of computing in a networked world
- Impact of social media on individualism, collectivism and culture.

[Core-Tier2]

- Growth and control of the Internet
- The digital divide (including gender, class, ethnicity, underdeveloped countries)
- Accessibility issues, including legal requirements
- Context-aware computing

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. [Knowledge]
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. [Knowledge]
3. Interpret the social context of a given design and its implementation. [Knowledge]
4. Evaluate the efficacy of a given design and implementation using empirical data. [Evaluation]
5. Investigate the implications of social media on individualism versus collectivism and culture. [Application]

[Core-Tier2]

1. 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. [Knowledge]
2. Analyze the pros and cons of reliance on computing in the implementation of democracy (e.g. delivery of social services, electronic voting). [Evaluation]
3. Describe the impact of the under-representation of diverse populations in the computing profession (e.g., industry culture, product diversity). [Knowledge]
4. Investigate the implications of context awareness in ubiquitous computing systems. [Application]

SP/Analytical Tools

[2 Core-Tier1 hours]

Topics:

[Core-Tier1]

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

Learning Outcomes:

[Core-Tier1]

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

SP/Professional Ethics

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

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 professional in terms of knowledge, tools, skills, legal and professional framework as well as the ability to self-assess and computer fluency
- Codes of ethics, conduct, and practice such as the ACM/IEEE, SE, AITP, IFIP and international societies
- Accountability, responsibility and liability

[Core-Tier2]

- The role of the professional in public policy
- Maintaining awareness of consequences
- Ethical dissent and whistle-blowing
- 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 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. [Knowledge]
2. Recognize the ethical responsibility of ensuring software correctness, reliability and safety. [Knowledge]
3. Describe the mechanisms that typically exist for a professional to keep up-to-date. [Knowledge]
4. Describe the strengths and weaknesses of relevant professional codes as expressions of professionalism and guides to decision-making. [Knowledge]
5. Analyze a global computing issue, observing the role of professionals and government officials in managing the problem. [Evaluation]
6. Evaluate the professional codes of ethics from the ACM, the IEEE Computer Society, and other organizations. [Evaluation]

[Core-Tier2]

1. Describe ways in which professionals may contribute to public policy. [Knowledge]
2. Describe the consequences of inappropriate professional behavior. [Knowledge]
3. Identify progressive stages in a whistle-blowing incident. [Knowledge]
4. Investigate forms of harassment and discrimination and avenues of assistance [Application]
5. Examine various forms of professional credentialing [Application]
6. Identify the social implications of ergonomic devices and the workplace environment to people's health. [Knowledge]
7. Develop a computer use policy with enforcement measures. [Evaluation]
8. Describe issues associated with industries push to focus on time to market versus enforcing quality professional standards [Knowledge]

SP/ Intellectual Property

[2 Core-Tier1 hours]

Topics:

[Core-Tier1]

- Philosophical foundations of intellectual property
- Intellectual property rights
- Intangible digital intellectual property (IDIP)
- Legal foundations for intellectual property protection
- Digital rights management
- Copyrights, patents, trademarks
- Plagiarism

[Elective]

- Foundations of the open source movement
- Software piracy

Learning Outcomes:

[Core-Tier1]

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

[Elective]

1. Identify the goals of the open source movement. [Knowledge]
2. Identify the global nature of software piracy. [Knowledge]

SP/ Privacy and Civil Liberties

[2 Core-Tier1 hours]

Topics:

[Core-Tier1]

- Philosophical foundations of privacy rights
- Legal foundations of privacy protection
- Privacy implications of widespread data collection for transactional databases, data warehouses, surveillance systems, and cloud computing
- Ramifications of differential privacy
- Technology-based solutions for privacy protection

[Elective]

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

Learning Outcomes:

[Core-Tier1]

1. Discuss the philosophical basis for the legal protection of personal privacy. [Knowledge]
2. Evaluate solutions to privacy threats in transactional databases and data warehouses. [Evaluation]
3. Recognize the fundamental role of data collection in the implementation of pervasive surveillance systems (e.g., RFID, face recognition, toll collection, mobile computing). [Knowledge]
4. Recognize the ramifications of differential privacy. [Knowledge]
5. Investigate the impact of technological solutions to privacy problems. [Application]

[Elective]

1. Critique the intent, potential value and implementation of various forms of privacy legislation. [Evaluation]
2. Identify the global nature of software piracy. [Knowledge]
3. Identify strategies to enable appropriate freedom of expression. [Knowledge]

SP/ Professional Communication

[1 Core-Tier1 hour]

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
- Communicating professionally with stakeholders
- Utilizing collaboration tools

[Elective]

- Dealing with cross-cultural environments
- Tradeoffs of competing risks in software projects, such as technology, structure/process, quality, people, market and financial

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. [Application]
2. Evaluate written technical documentation to detect problems of various kinds. [Evaluation]
3. Develop and deliver a good quality formal presentation. [Evaluation]
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 that they have heard. [Application]
5. Describe the strengths and weaknesses of various forms of communication (e.g. virtual, face-to-face, shared documents) [Knowledge]
6. Examine appropriate measures used to communicate with stakeholders involved in a project. [Application]
7. Compare and contrast various collaboration tools. [Evaluation]

[Elective]

1. Discuss ways to influence performance and results in cross-cultural teams. [Knowledge]
2. Examine the tradeoffs and common sources of risk in software projects regarding technology, structure/process, quality, people, market and financial. [Application]

SP/ Sustainability

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

Sustainability was first introduced in the CS2008 curricular guidelines. Topics in this emerging area can be naturally integrated into other knowledge areas and units.

Topics:

[Core-Tier1]

- Being a sustainable practitioner, e.g., consideration of impacts of issues, such as power consumption 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, programming languages, or human-computer interaction
  (cross-reference: HCI/Embedded and Intelligent Systems/Energy-aware interfaces)

[Elective]

- Guidelines for sustainable design standards
- Systemic effects of complex computer-mediated phenomena (e.g. telecommuting or web shopping)
- Pervasive computing. Information processing that has been 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.
- Conduct research on applications of computing to environmental issues, such as energy, pollution, resource usage, recycling and reuse, food management, farming and others.

Learning Outcomes:

[Core-Tier1]

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

[Core-Tier2]

1. 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. [Knowledge]
2. Investigate the social and environmental impacts of new system designs through projects. [Application]

[Elective]

1. Identify guidelines for sustainable IT design or deployment [Knowledge]
2. List the sustainable effects of telecommuting or web shopping [Knowledge]
3. Investigate pervasive computing in areas such as smart energy systems, social networking, transportation, agriculture, supply-chain systems, environmental monitoring and citizen activism. [Application]
4. 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) [Evaluation]

SP/ History

[Elective]

Topics:

- Prehistory—the world before 1946
- History of computer hardware, software, networking
- Pioneers of computing
- History of Internet

Learning Outcomes:

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

SP/ Economies of Computing

[Elective]

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; impacts on employment and on economics
- Differences in access to computing resources and the possible effects thereof
- Costing out jobs with considerations on manufacturing, hardware, software, and engineering implications
- Cost estimates versus actual costs in relation to total costs
- Entrepreneurship: prospects and pitfalls
- Use of engineering economics in dealing with finances

Learning Outcomes:

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

SP/ Security Policies, Laws and Computer Crimes

[Elective]

Topics:

- Examples of computer crimes and legal redress for computer criminals
- Social engineering and identity theft (cross-reference: HCI/Human Factors and Security/social engineering)
- 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

Learning Outcomes:

1. List examples of classic computer crimes and social engineering incidents with societal impact. [Knowledge]
2. Identify laws that apply to computer crimes [Knowledge]
3. Describe the motivation and ramifications of cyber terrorism and criminal hacking [Knowledge]
4. Examine the ethical and legal issues surrounding the misuse of access and various breaches in security [Application]
5. Discuss the professional's role in security and the trade-offs involved. [Knowledge]
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 [Application]
7. Write a company-wide security policy, which includes procedures for managing passwords and employee monitoring. [Application]