

Society, Ethics and Professionalism (SEP)

Preamble

While technical issues are central to the computing curriculum, they do not constitute a complete educational program in the broader context. 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 from CS1991 [1]:

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 and ethical issues and professional practice continues to increase in importance and consequence; new computer-based products and platforms pose ever more challenging problems each year. It is our students who will enter industry and academia with intentional regard for the identification and resolution of these issues. Computer science educators may opt to deliver this material in stand-alone courses, integrated into traditional technical and theoretical courses, dedicated courses, some combination of both, or as special units as part of capstone, project, and professional practice courses. The material in this knowledge area is perhaps best covered through a combination of one required course along with aspects integrated in other technical courses. On the one hand, some topics in knowledge units listed as CS Core may not readily lend themselves to being covered in other more traditional computer science courses. Without a standalone course, it is difficult to cover these topics appropriately. On the other hand, if social, ethical and professional considerations are covered only in the standalone course and not in the context of other courses, it will reinforce the false notion that technical processes are void of these important issues. Because of this broad relevance, it is

important that several traditional courses include aspects such as 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 graphics, computer networks, information assurance and security, and introduction to computing provide obvious context for analysis of such issues. However, an ethics-related module could be developed for almost any course in the curriculum. It would be explicitly against the spirit of these 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 ethical and technical actions. The ethical issues discussed in any course should be directly related to and arise naturally from the subject matter of that course. Examples include a discussion in a database course of the societal, ethical and professional aspects 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 by non-computer scientists can help to address the social, ethical and professional 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 (ACM 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 Society, Ethics and Professionalism knowledge area in computing. The ACM Code of Ethics and Professional Conduct¹, the IEEE Code of Ethics², and the AAI Code of Ethics and Professional Conduct³ provide guidelines and case studies 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. It falls to computing educators to highlight the domain-specific role of these topics for our students, but programs should certainly be willing to lean heavily on complementary courses from the other humanities and social sciences.

Changes since CS 2013: Since 2013 all computing communities have become much more aware, and active, in areas of Justice, Equity, Diversity and Inclusion. All computing students deserve a just, equitable, diverse, and inclusive learning environment. However, computing students have a unique duty to ensure that when put to practice, their skills, knowledge, and competencies are applied in just, equitable, diverse, and inclusive ways. For these reasons, and as these issues are inherently a part of Society, Ethics, and Professionalism, a new knowledge unit has been added that addresses these issues.

Major changes from CS2013:

- Inclusion of SEP/Diversity, Equity, and Inclusion knowledge unit

[1] ACM/IEEE-CS Joint Curriculum Task Force, Computing Curricula 1991 (1991), ACM Press and IEEE Computer Society Press.

¹ www.acm.org/about/code-of-ethics

² <https://www.ieee.org/about/corporate/governance/p7-8.html>

³ <https://aaai.org/Conferences/code-of-ethics-and-conduct.php>

Core Hours

Knowledge Units	CS Core	KA Core
Social Context	3	2
Methods for Ethical Analysis	2	1
Professional Ethics	2	2
Intellectual Property	1	1
Privacy and Civil Liberties	2	1
Professional Communication	2	1
Sustainability	1	1
History	0	1
Economies of Computing	0	1
Security Policies, Laws and Computer Crimes	2	1
Equity, Diversity and Inclusion	2	2
Total	17	14

Knowledge Units

SEP/Social Context

Computers and the Internet, perhaps more than any other technology, have transformed society over the past several decades, 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 SEP knowledge units, especially Professional Ethics.

Topics:

[CS Core]

1. Social implications of computing in a hyper-networked world where the capabilities of artificial intelligence are rapidly evolving
2. Impact of social media and artificial intelligence on individual well-being, political ideology, and cultural ideology
3. Impact of involving computing technologies, particularly artificial intelligence, biometric technologies and algorithmic decision-making systems, in civic life (e.g. facial recognition technology, biometric tags, resource distribution algorithms, policing software)

[KA Core]

1. Growth and control of the internet, computing, and artificial intelligence

2. 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
3. Accessibility issues, including legal requirements and dark patterns
4. Context-aware computing

Illustrative Learning Outcomes:

[CS Core]

1. Describe different ways that computer technology (networks, mobile computing, cloud computing) mediates social interaction at the personal and social group level.
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.
3. Interpret the social context of a given design and its implementation.
4. Evaluate the efficacy of a given design and implementation using empirical data.
5. Articulate the implications of social media use for different identities, cultures, and communities.

[KA Core]

1. Discuss the internet's role in facilitating communication between citizens, government, and each other.
2. Analyze the effects of reliance on computing in the implementation of democracy (e.g. delivery of social services, electronic voting).
3. Describe the impact of the under-representation of people from historically minoritized populations in the computing profession (e.g., industry culture, product diversity).
4. Explain the implications of context awareness in ubiquitous computing systems.
5. Access to the internet and computing technologies - how this affects different societies.
6. Discuss why/how internet access can be viewed as a human right.

SEP/Methods for Ethical Analysis

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 assumptions and methods for determining the ethicality of a given action. It is important for students to recognize that different decisions in different contexts may require different ethical theories to arrive at the best outcome, and what constitutes 'best' will be culturally determined within a given context and viewpoint. Applying methods for ethical analysis requires both an understanding of the underlying principles and assumptions guiding a given tool and an awareness of the social context for that decision. Traditional ethical frameworks as provided by western philosophy can be useful, but they are not all-inclusive. Effort must be taken to include decolonial, indigenous and historically marginalized ethical perspectives whenever possible. No theory will be universally applicable to all contexts, nor is any single ethical framework the 'best.' Engagement across various ethical schools of thought is important for students to develop the critical thinking needed in judiciously applying methods for ethical analysis of a given situation.

Topics:

[CS Core]

1. Avoiding fallacies and misrepresentation in argumentation
2. Ethical theories and decision-making (philosophical and social frameworks)
3. Recognition of the role culture plays in our understanding, adoption, design, and use of computing technology

[KA Core]

1. Professional checklists
2. Evaluation rubrics
3. Stakeholder analysis
4. Standpoint theory

Illustrative Learning Outcomes:

[CS Core]

1. Recognize and describe how a given cultural context impacts decision making.
2. Illustrate the use of example and analogy in ethical argument.
3. Analyze and avoid basic logical fallacies in an argument.
4. Analyze an argument to identify premises and conclusion.

[KA Core]

1. Evaluate all stakeholder positions in relation to their cultural context in a given situation.
2. Evaluate the potential for introducing or perpetuating ethical debt (deferred consideration of ethical impacts or implications) in technical decisions.

SEP/Professional Ethics

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) The individual's own personal ethical code, 2) Any informal or formal code of ethical behavior existing in the workplace, applicable licensures or certifications, and 3) Exposure to formal codes of ethics.

Topics:

[CS Core]

1. Community values and the laws by which we live
2. The nature of professionalism including care, attention and discipline, fiduciary responsibility, and mentoring
3. Keeping up-to-date as a computing professional in terms of familiarity, tools, skills, legal and professional frameworks as well as the ability to self-assess and progress in the computing field
4. Professional certification, codes of ethics, conduct, and practice, such as the ACM/IEEE-CS, SE, AITP, IFIP and international societies
5. Accountability, responsibility and liability (e.g. software correctness, reliability and safety, as well as ethical confidentiality of cybersecurity professionals)
6. Introduction to theories describing the human creation and use of technology including instrumentalism, sociology of technological systems, disability justice, neutrality thesis, pragmatism, utilitarianism, and decolonial theories
7. Develop strategies for recognizing and reporting designs, systems, software, and professional conduct (or their outcomes) that may violate law or professional codes of ethics.

[KA Core]

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

Illustrative Learning Outcomes:

[CS Core]

1. Identify ethical issues that arise in software design, development practices, and software deployment
2. Determine how to address ethical issues.
3. Explain the ethical responsibility of ensuring software correctness, reliability and safety including from where this responsibility arises (e.g. ACM/IEEE/AAAI Codes of Ethics, laws and regulations, organizational policies).
4. Describe the mechanisms that typically exist for a professional to keep up-to-date in ethical matters.
5. Describe the strengths and weaknesses of relevant professional codes as expressions of professionalism and guides to decision-making.
6. Analyze a global computing issue, observing the role of professionals and government officials in managing this problem.
7. Describe the philosophical underpinnings of the creation of software and how it informs our decisions of how to use it.

[KA Core]

1. Describe ways in which professionals may contribute to public policy.
2. Describe the consequences of inappropriate professional behavior.
3. Be familiar with whistleblowing and have access to knowledge to guide one through an incident.
4. Provide examples of how regional culture interplays with ethical dilemmas.
5. Discuss forms of harassment and discrimination and avenues of assistance.
6. Examine various forms of professional credentialing.
7. Explain the relationship between ergonomics in computing environments and people's health.
8. Describe issues associated with industries' push to focus on time to market versus enforcing quality professional standards.

SEP/Intellectual Property

Intellectual property refers to a range of intangible rights of ownership in any product of the human intellect, such as a software program. Laws which vary by country, provide 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.

Topics:

[CS Core]

1. Philosophical foundations of intellectual property

2. Intellectual property rights
3. Intangible digital intellectual property (IDIP)
4. Legal foundations for intellectual property protection

[KA Core]

1. Digital rights management
2. Copyrights, patents, trade secrets, trademarks
3. Plagiarism
4. Foundations of the open source movement
5. Software piracy

Illustrative Learning Outcomes:

[CS Core]

1. Discuss the philosophical bases of intellectual property in an appropriate context (e.g. country, etc.).
2. Describe legislation aimed at digital copyright infringements.
3. Critique legislation aimed at digital copyright infringements.
4. Identify contemporary examples of intangible digital intellectual property.
5. Justify uses of copyrighted materials.
6. Evaluate the ethical issues inherent in various plagiarism detection mechanisms.

[KA Core]

1. Interpret the intent and implementation of software licensing.
2. Weigh the conflicting issues involved in securing software patents.
3. Characterize and contrast the concepts of copyright, patenting and trademarks.
4. Explain the rationale for the legal protection of intellectual property in the appropriate context (e.g. country, etc.).
5. Identify the goals of the open source movement.
6. Characterize the global nature of software piracy.

SEP/Privacy and Civil Liberties

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.

Topics:

[CS Core]

1. Privacy implications of widespread data collection for transactional databases, data warehouses, surveillance systems, and cloud computing
2. Ramifications of differential privacy
3. Technology-based solutions for privacy protection
4. Civil liberties and cultural differences

[KA Core]

1. Philosophical foundations of privacy rights
2. Legal foundations of privacy protection in relevant jurisdictions

3. Privacy legislation in areas of practice
4. Freedom of expression and its limitations

Illustrative Learning Outcomes:

[CS Core]

1. Evaluate solutions to privacy threats in transactional databases and data warehouses.
2. Describe the role of data collection in the implementation of pervasive surveillance systems (e.g., RFID, face recognition, toll collection, mobile computing).
3. Describe the ramifications of differential privacy.
4. Investigate the impact of technological solutions to privacy and security issues (e.g. Differential Privacy).

[KA Core]

1. Discuss the philosophical basis for the legal protection of personal privacy in an appropriate context (e.g. country, etc.).
2. Critique the intent, potential value and implementation of various forms of privacy legislation.
3. Identify strategies to enable appropriate freedom of expression.

SEP/Professional Communication

Professional communication conveys 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. Like most skills, it requires practice.

Topics:

[CS Core]

1. Interpreting, summarizing, and synthesizing technical material, including source code and documentation
2. Writing effective technical documentation and materials (tutorials, reference materials, API documentation)
3. Identifying, describing, and employing (clear, polite, concise) oral, written, and electronic team and group communication.
4. Understanding and enacting awareness of audience in communication by communicating effectively with different customers, stakeholders, and leadership
5. Utilizing collaboration tools
6. Recognizing and avoiding the use of rhetorical fallacies when resolving technical disputes
7. Understanding accessibility and inclusivity requirements for addressing professional audiences

[KA Core]

1. Demonstrate cultural competence in written and verbal communication
2. Using synthesis to concisely and accurately convey tradeoffs in competing values driving software projects including technology, structure/process, quality, people, market and financial
3. Use writing to solve problems or make recommendations in the workplace, such as raising ethical concerns or addressing accessibility issues

Illustrative Learning Outcomes:

[CS Core]

1. Understand the importance of writing concise and accurate technical documents following well-defined standards for format and for including appropriate tables, figures, and references.
2. Evaluate written technical documentation for technical accuracy, concision, lack of ambiguity, and awareness of audience.
3. Develop and deliver an audience aware, accessible, and organized formal presentation.
4. Plan interactions (e.g. virtual, face-to-face, shared documents) with others in ways that invite inclusive participation, model respectful consideration of others' contributions, and explicitly value diversity of ideas.
5. Recognize and describe qualities of effective communication (e.g. virtual, face-to-face, shared documents).

[KA Core]

1. Discuss ways to influence performance and results in diverse and cross-cultural teams.
2. Evaluate personal strengths and weaknesses to work remotely as part of a team drawing from diverse backgrounds and experiences.

SEP/Sustainability

Sustainability is [defined](#) by the United Nations as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Alternatively it is the “balance between the environment, equity and economy.” ([UCLA Sustainability](#)). As computing extends into more and more aspects of human existence, we are already seeing estimates that 10% of global electricity usage is spent on computing, and that percentage seems prone to continue growing. Further, electronics contribute individually to demand for rare earth elements, mineral extraction, and countless e-waste concerns. Students should be prepared to engage with computing with a background that recognizes these global and environmental costs, and their potential long term effects on the environment and local communities.

Topics:

[CS Core]

1. Being a sustainable practitioner by taking into consideration environmental, social, and cultural impacts of implementation decisions (e.g. algorithmic bias/outcomes, , economic viability, and resource consumption)
2. Explore local/regional/global social and environmental impacts of computing systems use and disposal (e-waste)
3. Discuss the tradeoffs involved in proof-of-work and proof-of-stake algorithms

[KA Core]

1. Guidelines for sustainable design standards
2. Systemic effects of complex computer-mediated phenomena (e.g. social media, offshoring, remote work)
3. 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
4. Conduct research on applications of computing to environmental issues, such as energy, pollution, resource usage, recycling and reuse, food management / production, and others
 5. How the sustainability of software systems are interdependent 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)

Illustrative Learning Outcomes:

[CS Core]

1. Identify ways to be a sustainable practitioner.
2. For any given project (software artifact, hardware, etc) enumerate the environmental impacts of its deployment. (e.g. energy consumption, contribution to e-waste, impact of manufacturing)
3. Illustrate global social and environmental impacts of computer use and disposal (e-waste).
4. List the sustainable effects of modern practices and activities such as telecommuting, web shopping, or cryptocurrency mining.

[KA Core]

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.
2. Investigate the social and environmental impacts of new system designs.
3. Identify guidelines for sustainable IT design or deployment.
4. Investigate pervasive computing in areas such as smart energy systems, social networking, transportation, agriculture, supply-chain systems, environmental monitoring and citizen activism.
5. Assess computing applications in respect to environmental issues (e.g. energy, pollution, resource usage, recycling and reuse, food management and production).

SEP/History

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 development fundamentals. History is important because it provides a mechanism for understanding why our computing systems operate the way they do, the societal contexts in which these approaches arose, and how those continue to echo through the discipline today.

Topics:

[KA Core]

1. Age I: Prehistory—the world before ENIAC (1946): Ancient analog computing (Stonehenge, Antikythera mechanism, Salisbury Cathedral clock, etc.), Euclid, Lovelace, Babbage, Gödel, Church, Turing, pre-electronic (electro-mechanical and mechanical) hardware
2. Age II: Early modern (digital) computing - ENIAC, UNIVAC, Bombes (Bletchley Park codebreakers), mainframes, etc.
3. Age III: Modern (digital) computing - PCs, modern computer hardware, Moore's Law

4. Age IV: Internet - networking, internet architecture, browsers and their evolution, standards, big players (Google, Amazon, Microsoft, etc.), distributed computing
5. Age V: Cloud - smart phones (Apple, Android, and minor ones), cloud computing, remote servers, software as a service (SaaS), security and privacy, social media
6. Age VI: Emerging AI-assisted technologies including decision making systems, recommendation systems, generative AI and other machine learning driven tools and technologies

Illustrative Learning Outcomes:

[KA Core]

1. Identify significant trends in the history of the computing field.
2. Identify the contributions of several pioneers in the computing field.
3. Discuss the historical context for important moments in history of computing, such as: the move from vacuum tubes to transistors (TRADIC), the first real operating system (OS 360), Xerox PARC and the first Apple computer with a GUI, the creation of specific programming language paradigms, the first computer virus, the creation of the internet, the creation of the WWW, the dot com bust, Y2K, the introduction of smart phones, etc.
4. Compare daily life before and after the advent of personal computers and the Internet.

SEP/Economies of Computing

The economies of computing are important to those who develop and provide computing resources and services to others as well as society in general. They are equally important to users of these resources and services, both professional and non-professional.

Topics:

[KA Core]

1. Economies of providers: regulated and unregulated, monopolies and open-market. “Walled Gardens” in tech environments
2. The knowledge and attention economies
3. Effect of skilled labor supply and demand on the quality of computing products
4. Pricing strategies in the computing domain: subscriptions, planned obsolescence, software licenses, open-source, free software
5. Outsourcing and off-shoring software development; impacts on employment and on economics
6. Consequences of globalization for the computer science profession and users
7. Differences in access to computing resources and the possible effects thereof
8. Automation and its effect on job markets, developers, and users
9. Economies of scale, startups, entrepreneurship, philanthropy
10. How computing is changing personal finance: Blockchain and cryptocurrencies, mobile banking and payments, SMS payment in developing regions, etc.

Illustrative Learning Outcomes:

[KA Core]

1. Summarize concerns about monopolies in tech, walled gardens vs open environments, etc.

2. Identify several ways in which the information technology industry and users are affected by shortages in the labor supply.
3. Outline the evolution of pricing strategies for computing goods and services.
4. Explain the social effects of the knowledge and attention economies.
5. Summarize the consequences of globalization and nationalism in the computing industry.
6. Describe the effects of automation on society, and job markets in particular.
7. Detail how computing has changed the corporate landscape
8. Outline how computing has changed personal finance and the consequences of this, both positive and negative.

SEP/Security Policies, Laws and Computer Crimes

While security policies, laws and computer crimes are important, 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; new categories of computer crime and anti-social behavior; major disruptions to organizations; and the large-scale concentration of risk into information systems.

Topics:

[CS Core]

1. Examples of computer crimes and legal redress for computer criminals
2. Social engineering, computing-enabled fraud, and recovery
3. Identify what constitutes computer crime, such as Issues surrounding the misuse of access and breaches in security
4. Motivations and ramifications of cyber terrorism and criminal hacking, “cracking”
5. Effects of malware, such as viruses, worms and Trojans

[KA Core]

1. Crime prevention strategies
2. Security policies

Illustrative Learning Outcomes:

[CS Core]

1. List classic examples of computer crimes and social engineering incidents with societal impact.
2. Identify laws that apply to computer crimes.
3. Describe the motivation and ramifications of cyber terrorism and criminal hacking.
4. Examine the ethical and legal issues surrounding the misuse of access and various breaches in security.
5. Discuss the professional's role in security and the trade-offs involved.

[KA Core]

1. Investigate measures that can be taken by both individuals and organisations including governments to prevent or mitigate the undesirable effects of computer crimes and identity theft.

2. Write a company-wide security policy, which includes procedures for managing passwords and employee monitoring.

SEP/Diversity, Equity, and Inclusion

Computer Science has had—since its inception as a field—a diversity problem. Despite being a creative, highly compensated field with myriad job (and other) opportunities; racial and gender and other inequities in representation are pervasive. For too many students, their first computer science course is their last. There are many factors including the legacy of systemic racism, ableism, sexism, classism, and other injustices that contribute to the lack of diverse identities within computer science, and there is no single, quick fix.

CS2023's sponsoring organizations are ACM, IEEE CS, and AAAI. Each of those organizations [<https://www.acm.org/diversity-inclusion/about#DEIPrinciples>, <https://www.ieee.org/about/diversity-index.html>, <https://aaai.org/Organization/diversity-statement.php>] place a high value on diversity, equity and inclusion; and our computer science classrooms should promote and model those principles. We should welcome and seek diversity—the gamut of human differences including gender, gender identity, race, politics, ability and attributes, religion, nationality, etc.—in our classrooms, departments and campuses. We should strive to make our classrooms, labs and curricula accessible and to promote inclusion; the sense of belonging we feel in a community where we are respected and wanted. To achieve equity, we must allocate resources, promote fairness, and check our biases to ensure persons of all identities achieve success.

Explicitly infusing diversity, equity, and inclusion across the computer science curriculum demonstrates its importance for the department, institution, and our field—all of which likely have a DEI statement and/or initiative. This emphasis on DEI is important ethically and a bellwether issue of our time. Not only does data support that diverse teams outperform homogeneous ones, but diverse teams may have prevented egregious technology failures in the headlines such as facial recognition misuse, airbag injuries and deaths.

Topics:

[CS Core]

1. How identity impacts and is impacted by computing environments (academic and professional) and technologies
2. The benefits of diverse development teams and the impacts of teams that are not diverse.
3. Inclusive language and charged terminology, and why their use matters
4. Inclusive behaviors and why they matter
5. Technology and accessibility
6. How computing professionals, via the software they create, can influence and impact justice, diversity, equity, and inclusion both positively and negatively

[KA Core]

1. Highlight experts (practitioners, graduates, and upper level students) who reflect the identities of the classroom and the world
2. Benefits of diversity and harms caused by a lack of diversity
3. Historic marginalization due to technological supremacy and global infrastructure challenges to equity and accessibility

Illustrative Learning Outcomes:

[CS Core]

1. Define and distinguish equity, equality, diversity, and inclusion.
2. Describe the impact of power and privilege in the computing profession as it relates to culture, industry, products, and society.
3. What language, practices, and behaviors may make someone feel included in a workplace and/or a team, and why is it relevant. Avoiding charged terminology, see *Words Matter* (<https://www.acm.org/diversity-inclusion/words-matter>).
4. Evaluate the accessibility of your classroom or lab. Evaluate the accessibility of your webpage. (See <https://www.w3.org/WAI/>.)
5. Work collegially and respectfully with team members who do not share your identity. It is not enough to merely assign team projects. Faculty should prepare students for teamwork and monitor, mentor, and assess the effectiveness of their student teams throughout a project.
6. Compare the demographics of your institution's computer science and STEM majors to the overall institutional demographics. Do they differ? If so, what factors contribute to inequitable access, engagement, and achievement in computer science among marginalized groups.
7. Compare the demographics of your institution to the overall community demographics. Do they differ? If so, what factors contribute to inequitable access, engagement, and achievement among marginalized groups.
8. Identify developers' assumptions and values embedded in hardware and software design, especially as they pertain to usability by diverse populations.

[KA Core]

1. Highlight experts (practitioners, graduates, and upper level students—current and historic) who reflect the identities of the classroom and the world.
2. Identify examples of the benefits that diverse teams can bring to software products, and those where a lack of diversity have costs.
3. Give examples of systemic changes that could positively address diversity, equity, and inclusion in a familiar context (i.e. in an introductory computing course).

Professional Dispositions

- Professionalism - Relatively little in the practice of computing is entirely independent - we rely on others extensively, whether that is in the form of teamwork, customer relationships, leadership roles, academic research, etc. Being able to interact with others, regardless of identity, background, etc, is essential to success for both individuals and the industry as a whole.
- Responsibility - Responsibility, attention to detail, and awareness of potential social impact are highly desirable for computing graduates.
- Critical Self-reflection - Being able to inspect one's own actions, thoughts, biases, privileges, and motives will help in discovering places where professional activity is not up to current standards. Understand both conscious and unconscious bias and continuously work to counteract them.
- Responsiveness - Ability to quickly and accurately respond to changes in the field and adapt in a professional manner, such as shifting from in-person office work to

remote work at home. These shifts require us to rethink our entire approach to what is considered “professional.”

- Proactiveness - Being professional in the workplace means finding new trends (e.g. in accessibility or inclusion) and understanding how to implement them immediately for a more professional working environment.
- Cultural Competence - Prioritize cultural competence—the ability to work with people from cultures different from your own—by using inclusive language, watching for and counteracting conscious and unconscious bias, and encouraging honest and open communication.

Math Requirements

Shared Concepts and Crosscutting Themes

Shared Concepts:

- Justice (SEP/Equity, Diversity, Equity and Inclusion) with all KAs
- Equity (SEP/Equity, Diversity, Equity and Inclusion) with all KAs
- Diversity (Equity, Diversity, Equity and Inclusion) with all KAs
- Inclusion (Equity, Diversity, Equity and Inclusion) with all KAs
- Social implications of computing in a hyper-networked world where the capabilities of artificial intelligence are rapidly evolving (SEP/Social Context) with
 - AI/
 - HCI/Foundations/social models
 - IAS/Fundamental Concepts/social issues)
- Growth and control of the Internet (SEP/Social Context) with NC/Introduction/organization of the Internet)
- Context-aware computing (SEP/Social Context) with HCI/Design for non-mouse interfaces/ ubiquitous and context-aware)
- Professional certification, codes of ethics, conduct, and practice, such as the ACM/IEEE-CS, SE, AITP, IFIP and international societies (SEP/Professional Ethics with IAS/Fundamental Concepts/ethical issues
- Intellectual property rights (SEP/Intellectual Property) with IM/Information Storage and Retrieval/intellectual property and protection
- Privacy implications of widespread data collection for transactional databases, data warehouses, surveillance systems, and cloud computing (SEP/Privacy and Civil Liberties) with
 - IM/Database Systems/data independence
 - IM/Data Mining/data cleaning
- Technology-based solutions for privacy protection (SEP/Privacy and Civil Liberties) with IAS/Threats and Attacks/attacks on privacy and anonymity
- Philosophical foundations of privacy rights (SEP/Privacy and Civil Liberties) with IS/Fundamental Issues/philosophical issues
- Identifying, describing, and employing (clear, polite, concise) oral, written, and electronic team and group communication (SEP/Professional Communication) with
 - HCI/Collaboration and Communication/group communication

- SE/Project Management/team participation
- Utilizing collaboration tools (SEP/Professional Communication) with HCI/Collaboration and Communication/online communities)
- Understanding accessibility (SEP/Professional Communication) with HCI/*
- Demonstrate cultural competence in written and verbal communication (SEP/Professional Communication) with
 - HCI/User-Centered Design and Testing/cross-cultural evaluation
- Using synthesis to concisely and accurately convey tradeoffs in competing values driving software projects including technology, structure/process, quality, people, market and financial (SEP/Professional Communication) with SE/Software Project Management/Risk
- Age III: Modern (digital) computing - PCs, modern computer hardware (SEP/History) with AR/Digital logic and digital systems/ history of computer architecture
- Examples of computer crimes and legal redress for computer criminals (SEP/Security Policies, Laws and Computer Crimes) with IAS/Digital Forensics/rules of evidence
- Social engineering, computing-enabled fraud, and recovery (SEP/Security Policies, Laws and Computer Crimes) with HCI/Human Factors and Security/trust, privacy and deception
- Security policies (SEP/Security Policies, Laws and Computer Crimes) with IAS/Security Policy and Governance/policies

Crosscutting themes:

- Justice
- Equity
- Diversity
- Inclusion
- Societal Issues
- Ethics
- Professionalism

Course Packaging Suggestions

At a minimum the CS Core learning outcomes are best covered in the context of courses covering other knowledge areas. Ideally the KA Core hours are also.

At some institutions a stand-alone course (possibly at a mid-level) may be offered covering the CS Core knowledge units:

- Social Context: 3 hours
- Methods for Ethical Analysis: 2 hours
- Professional Ethics: 2 hours
- Intellectual Property: 1 hour
- Privacy and Civil Liberties: 2 hours
- Professional Communication: 2 hours
- Sustainability: 1 hour
- Security Policies, Laws and Computer Crimes: 2 hours
- Justice, Equity, Diversity and Inclusion: 2 hours

At some institutions a stand-alone course at the mid- or advanced-level may be offered covering the CS Core and KA Core knowledge units:

- Social Context: 5 hours
- Methods for Ethical Analysis: 3 hours
- Professional Ethics: 4 hours
- Intellectual Property: 2 hours
- Privacy and Civil Liberties: 3 hours
- Professional Communication: 3 hours
- Sustainability: 2 hours
- History: 1 hour
- Economies of Computing: 1 hour
- Security Policies, Laws and Computer Crimes: 3 hours
- Justice, Equity, Diversity and Inclusion: 4 hours

Competency Specifications

- **Task 1:** Assess the ethical and societal implications of deploying a given AI-powered service/software/product
- **Competency Statement:** Determine who will be affected and how
- **Competency area:** Theory
- **Competency unit:** Deployment / Evaluation / Consumer Acceptance / Adaptation to social issues
- **Required knowledge areas and knowledge units:**
 - AI/Fundamental Issues
 - SEP/Social Context
 - SEP/Methods for Ethical Analysis
 - SEP/Privacy and Civil Liberties
 - SEP/Justice, Equity, Diversity and Inclusion
- **Required skill level:** Explain / Evaluate
- **Core level:** CS core

- **Task 2:** Assess the legal and ethical implications of collecting and using customer/user data
- **Competency Statement:** Analyze the nature of the data and determine the relevant legal and ethical issues that may arise in the collection and use of that data
- **Competency area:** Theory
- **Competency unit:** Evaluation / Consumer Acceptance / Adaptation to social issues
- **Required knowledge areas and knowledge units:**
 - DM/Data Security & Privacy
 - SEP/Methods for Ethical Analysis
 - SEP/Privacy and Civil Liberties

- SEP/Justice. Equity, Diversity and Inclusion
- **Required skill level:** Explain / Evaluate
- **Core level:** CS core

- **Task 3:** Evaluate the role culture plays in who adopts a given service/software/product, how they may use it, and how this impacts equity and society
- **Competency Statement:** Apply the appropriate methods of ethical analysis to determine the social context(s) applicable and the potential ethical effects
- **Competency area:** Theory
- **Competency unit:** Deployment / Evaluation / Adaptation to social issues
- **Required knowledge areas and knowledge units:**
 - SEP/Social Context
 - SEP/Methods for Ethical Analysis
 - SEP/Privacy and Civil Liberties
 - SEP/Justice. Equity, Diversity and Inclusion
- **Required skill level:** Explain / Evaluate
- **Core level:** CS core

- **Task 4:** Document the accountability, responsibility and liability a company assumes when releasing a given service/software/product
- **Competency Statement:** Gather the appropriate information and present it in a coherent and useful manner
- **Competency area:** Application / Theory
- **Competency unit:** Requirements / Deployment / Documentation
- **Required knowledge areas and knowledge units:**
 - SEP/Professional Ethics
 - SEP/Intellectual Property
 - SEP/Privacy and Civil Liberties
 - SEP/Professional Communication
 - SEP/Justice. Equity, Diversity and Inclusion
- **Required skill level:** Explain
- **Core level:** CS core

- **Task 5:** Develop a strategy for a team to keep up to date with ethical, legal, and professional issues in relation to company strategy
- **Competency Statement:** Apply the ability to assess company strategy and formulate a plan to communicate the relevant information to a team through appropriate professional documentation and communication
- **Competency area:** Application / Theory

- **Competency unit:** Requirements / Design / Development / Documentation / Evaluation / Management / Adaptation to social issues / Improvement
- **Required knowledge areas and knowledge units:**
 - SEP/Professional Communication
 - SEP/Professional Ethics
- **Required skill level:** Explain / Evaluate / Develop
- **Core level:** CS core

- **Task 6:** Incorporate legal and ethical privacy requirements into a given service/software/product's development cycle
- **Competency Statement:** Identify and analyze appropriate requirements and develop a plan to communicate a plan to ensure the requirements are implemented
- **Competency area:** Software / Theory
- **Competency unit:** Requirements / Design / Development / Documentation Management / Improvement
- **Required knowledge areas and knowledge units:**
 - SEP/Professional Ethics
 - SEP/Privacy and Civil Liberties
 - SEP/Professional Communication
- **Required skill level:** Explain / Develop
- **Core level:** CS core

- **Task 7:** Demonstrate cultural awareness and cultural competence in written and verbal communication
- **Competency Statement:** Professionally communicate with required stakeholders with cultural sensitivity
- **Competency area:** Theory
- **Competency unit:** Documentation / Adaptation to social issues
- **Required knowledge areas and knowledge units:**
 - SEP/Social Context
 - SEP/Professional Communication
 - SEP/Justice. Equity, Diversity and Inclusion
- **Required skill level:** Explain
- **Core level:** CS core

- **Task 8:** Contribute to a company or team's sustainability policy
- **Competency Statement:** Effectively integrate knowledge of sustainability with company or team strategy and mission
- **Competency area:** Theory
- **Competency unit:** Design / Development / Integration / Documentation / Improvement

- **Required knowledge areas and knowledge units:**
 - SEP/Professional Communication
 - SEP/Sustainability
- **Required skill level:** Explain / Evaluate / Develop
- **Core level:** CS core

- **Task 9:** Convey the benefits of diverse development teams and user bases on company culture and the services/software/products the company provides, as well as the impacts that a lack of diversity can have on these
- **Competency Statement:** Professionally communicate knowledge of the impacts of diversity
- **Competency area:** Theory
- **Competency unit:** Documentation / Management / Adaptation to social issues / Improvement
- **Required knowledge areas and knowledge units:**
 - SEP/Professional Communication
 - SEP/Justice. Equity, Diversity and Inclusion
- **Required skill level:** Explain
- **Core level:** CS core

- **Task 10:** Contribute to the design and implementation of systemic changes that could positively address diversity, equity, and inclusion in the company's employees and the user base
- **Competency Statement:** Apply knowledge of diversity, equity, and inclusion in an effective manner in the given context
- **Competency area:** Application / Theory
- **Competency unit:** Requirements / Design / Consumer Acceptance / Adaptation to social issues / Improvement
- **Required knowledge areas and knowledge units:**
 - SEP/Professional Communication
 - SEP/Justice. Equity, Diversity and Inclusion
- **Required skill level:** Explain / Apply / Evaluate / Develop
- **Core level:** CS core

Committee

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Appendix: Core Topics and Skill Levels

KA	KU	Topic	Skill	Core	Hours
SEP	Social Context	<ol style="list-style-type: none"> 1. Social implications of computing in a hyper-networked world where the capabilities of artificial intelligence are rapidly evolving 2. Impact of social media and artificial intelligence on individual well-being, political ideology, and cultural ideology 3. Impact of involving computing technologies, particularly artificial intelligence, biometric technologies and algorithmic decision-making systems, in civic life (e.g. facial recognition technology, biometric tags, resource distribution algorithms, policing software) 	Evaluate	CS	3
SEP	Social Context	<ol style="list-style-type: none"> 1. Growth and control of the internet, computing, and artificial intelligence 2. 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 developing nations 3. Accessibility issues, including legal requirements and dark patterns 4. Context-aware computing 	Explain	KA	2
SEP	Methods for Ethical Analysis	<ol style="list-style-type: none"> 1. Avoiding fallacies and misrepresentation in argumentation 2. Ethical theories and decision-making (philosophical and social frameworks and epistemologies) 	Apply	CS	2

		3. Recognition of the role culture plays in our understanding, adoption, design, and use of computing technology			
SEP	Methods for Ethical Analysis	<ol style="list-style-type: none"> 1. Professional checklists 2. Evaluation rubrics 3. Stakeholder analysis 4. Standpoint theory 	Develop	KA	1
SEP	Professional Ethics	<ol style="list-style-type: none"> 1. Community values and the laws by which we live 2. The nature of professionalism including care, attention and discipline, fiduciary responsibility, and mentoring 3. Keeping up-to-date as a computing professional in terms of familiarity, tools, skills, legal and professional frameworks as well as the ability to self-assess and progress in the computing field 4. Professional certification, codes of ethics, conduct, and practice, such as the ACM/IEEE-CS, SE, AITP, IFIP and international societies 5. Accountability, responsibility and liability (e.g. software correctness, reliability and safety, as well as ethical confidentiality of cybersecurity professionals) 6. Introduction to theories describing the human creation and use of technology including instrumentalism, sociology of technological systems, disability justice, neutrality thesis, pragmatism, utilitarianism, and decolonial theories 7. Develop strategies for recognizing and reporting designs, systems, software, and professional conduct (or their outcomes) that may violate law or professional codes of ethics 	Evaluate	CS	2
SEP	Professional Ethics	<ol style="list-style-type: none"> 1. The role of the computing professional in public policy 2. Maintaining awareness of consequences 3. Ethical dissent and whistle-blowing 4. The relationship between regional culture and ethical dilemmas 5. Dealing with harassment and discrimination 6. Forms of professional credentialing 7. Acceptable use policies for computing in the workplace 8. Ergonomics and healthy computing environments 	Explain	KA	2

		9. Time to market and cost considerations versus quality professional standards			
SEP	Intellectual Property	<ol style="list-style-type: none"> 1. Philosophical foundations of intellectual property 2. Intellectual property rights 3. Intangible digital intellectual property (IDIP) 4. Legal foundations for intellectual property protection 	Explain	CS	1
SEP	Intellectual Property	<ol style="list-style-type: none"> 1. Digital rights management 2. Copyrights, patents, trade secrets, trademarks 3. Plagiarism 4. Foundations of the open source movement 5. Software piracy 	Apply	KA	1
SEP	Privacy and Civil Liberties	<ol style="list-style-type: none"> 1. Privacy implications of widespread data collection for transactional databases, data warehouses, surveillance systems, and cloud computing 2. Ramifications of differential privacy 3. Technology-based solutions for privacy protection 4. Civil liberties and cultural differences 	Explain	CS	2
SEP	Privacy and Civil Liberties	<ol style="list-style-type: none"> 1. Philosophical foundations of privacy rights 2. Legal foundations of privacy protection in relevant jurisdictions 3. Privacy legislation in areas of practice 4. Freedom of expression and its limitations 	Assess	KA	1
SEP	Professional Communication	<ol style="list-style-type: none"> 1. Interpreting, summarising, and synthesising technical material, including source code and documentation 2. Writing effective technical documentation and materials (tutorials, reference materials, API documentation) 3. Identifying, describing, and employing (clear, polite, concise) oral, written, and electronic team and group communication. 4. Understanding and enacting awareness of audience in communication by communicating effectively with different customers, stakeholders, and leadership 5. Utilising collaboration tools 6. Recognizing and avoiding the use of rhetorical fallacies when resolving technical disputes 7. Understanding accessibility and inclusivity requirements for addressing professional audiences 	Apply	CS	2

SEP	Professional Communication	<ol style="list-style-type: none"> 1. Demonstrate cultural competence in written and verbal communication 2. Using synthesis to concisely and accurately convey tradeoffs in competing values driving software projects including technology, structure/process, quality, people, market and financial 3. Use writing to solve problems or make recommendations in the workplace, such as raising ethical concerns or addressing accessibility issues 	Apply	KA	1
SEP	Sustainability	<ol style="list-style-type: none"> 1. Being a sustainable practitioner by taking into consideration environmental, social, and cultural impacts of implementation decisions (e.g. algorithmic bias/outcomes, , economic viability, and resource consumption) 2. Explore local/regional/global social and environmental impacts of computing systems use and disposal (e-waste) 3. Discuss the tradeoffs involved in proof-of-work and proof-of-stake algorithm 	Apply	CS	1
SEP	Sustainability	<ol style="list-style-type: none"> 1. Guidelines for sustainable design standards 2. Systemic effects of complex computer-mediated phenomena (e.g. social media, offshoring, remote work) 3. 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 4. Conduct research on applications of computing to environmental issues, such as energy, pollution, resource usage, recycling and reuse, food management / production, and others 5. How the sustainability of software systems are interdependent 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) 	Evaluate	KA	1
SEP	History	<ol style="list-style-type: none"> 1. Age I: Prehistory—the world before ENIAC (1946): Ancient analog computing (Stonehenge, Antikythera mechanism, 	Explain	KA	1

		<p>Salisbury Cathedral clock, etc.), Euclid, Lovelace, Babbage, Gödel, Church, Turing, pre-electronic (electro-mechanical and mechanical) hardware</p> <ol style="list-style-type: none"> 2. Age II: Early modern (digital) computing - ENIAC, UNIVAC, Bombes (Bletchley Park codebreakers), mainframes, etc. 3. Age III: Modern (digital) computing - PCs, modern computer hardware, Moore's Law 4. Age IV: Internet - networking, internet architecture, browsers and their evolution, standards, big players (Google, Amazon, Microsoft, etc.), distributed computing 5. Age V: Cloud - smart phones (Apple, Android, and minor ones), cloud computing, remote servers, software as a service (SaaS), security and privacy, social media 6. Age VI: Emerging AI-assisted technologies including decision making systems, recommendation systems, generative AI and other machine learning driven tools and technologies 			
SEP	Economies of Computing	<ol style="list-style-type: none"> 1. Economies of providers: regulated and unregulated, monopolies and open-market. "Walled Gardens" in tech environments 2. The knowledge and attention economies 3. Effect of skilled labor supply and demand on the quality of computing products 4. Pricing strategies in the computing domain: subscriptions, planned obsolescence, software licenses, open-source, free software 5. Outsourcing and off-shoring software development; impacts on employment and on economics 6. Consequences of globalization for the computer science profession and users 7. Differences in access to computing resources and the possible effects thereof 8. Automation and its effect on job markets, developers, and users 9. Economies of scale, startups, entrepreneurship, philanthropy 10. How computing is changing personal finance: Blockchain and cryptocurrencies, mobile banking and payments, SMS payment in developing regions, etc. 	Explain	KA	1
SEP	Security Policies, Laws	<ol style="list-style-type: none"> 1. Examples of computer crimes and legal redress for computer criminals 	Explain	CS	2

	and Computer Crimes	<ol style="list-style-type: none"> 2. Social engineering, computing-enabled fraud, and recovery 3. Identify what constitutes computer crime, such as Issues surrounding the misuse of access and breaches in security 4. Motivations and ramifications of cyber terrorism and criminal hacking, “cracking” 5. Effects of malware, such as viruses, worms and Trojans 			
SEP	Security Policies, Laws and Computer Crimes	<ol style="list-style-type: none"> 1. Crime prevention strategies 2. Security policies 	Apply	KA	1
SEP	Equity, Diversity and Inclusion	<ol style="list-style-type: none"> 1. How identity impacts and is impacted by computing environments (academic and professional) and technologies 2. The benefits of diverse development teams and the impacts of teams that are not diverse. 3. Inclusive language and charged terminology, and why their use matters 4. Inclusive behaviors and why they matter 5. Technology and accessibility 6. How computing professionals, via the software they create, can influence and impact justice, diversity, equity, and inclusion both positively and negatively 	Explain	CS	2
SEP	Equity, Diversity and Inclusion	<ol style="list-style-type: none"> 1. Highlight experts (practitioners, graduates, and upper level students) who reflect the identities of the classroom and the world 2. Benefits of diversity and harms caused by a lack of diversity 3. Historic marginalization due to technological supremacy and global infrastructure challenges to equity and accessibility 	Evaluate	KA	2