Computer Science Curricula 2023 (CS2023): Rising to the Challenges of Change in AI, Security, and Society

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CCS CONCEPTS

• **Social and professional topics** → **Computer science education**; **Model curricula**.

KEYWORDS

Computer Science Curricular Guidelines, Societal Considerations, Professional Ethics Education, Artificial Intelligence Education, Security Education

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1 SUMMARY

Model curricula for baccalaureate computer science (CS) have been published regularly from 1968 [1] through 2013 [4]. In early 2021, the ACM, IEEE-Computer Society, and the Association for the Advancement of Artificial Intelligence (AAAI) constituted a task force to revise these curricula, which have now been released as Computer Science 2023 Curricula (CS2023) [3].

The CS2023 curricular guidelines inform educators and administrators on the **what**, **why**, and **how** to cover undergraduate CS over the next decade. Like past guidelines, CS2023 provides **curricular content** – a knowledge model largely backward compatible with CS2013, supplemented by a competency framework influenced by Computing Curricula 2020 (CC2020) [2] – and complementary **curricular practices**, which include articles by international experts on program design and delivery. Ongoing drafts of CS2023 were disseminated via the CS2023 website [3], along with regular publications or presentations at various computing education venues.

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This panel focuses on three among the 17 CS2023 knowledge areas: Society, Ethics, and the Profession (SEP), Artificial Intelligence (AI), and Security (SEC). While the other 14 knowledge areas remain important in CS education, these three have been in the news due to inadequacies in current CS education. The panelists, who served on the CS2023 steering committee, will discuss how CS2023 addresses these challenges.

Attendees will appreciate the approach taken by CS2023 toward these three hot-button items of CS education, especially constraints on curriculum design, and how CS2023 may be used to educate the next generation of CS graduates to rise to these three challenges.

2 PANEL PRESENTATION STRUCTURE

Table 1 outlines the panel structure and the next section summarizes each panelist's position on these challenges. Ample time will be available for active audience participation.

Table 1: Panel Structure

	Description	Duration
1	Introductions and Background	3 minutes
2	Overall CS2023 Vision	6 minutes
3	Panelists' Perspectives	24 minutes
4	Audience Q & A	24 minutes
5	Summary	3 minutes

3 POSITION STATEMENTS

The panelists' perspectives on CS2023 are presented here.

3.1 Sherif (Moderator) – Overall CS2023 Vision

Sherif G. Aly is a Professor and Chair of Computer Science and Engineering at the American University in Cairo (AUC). He served as a steering member of the CS2023 task force and headed the Networking and Communication Knowledge Area subcommittee. Dr. Aly also serves as an editor of the Communications of the ACM. He has specific research interests in the interdisciplinary aspect of mobile and pervasive computing. Dr. Aly has also held positions in academia and industry in the United States and Canada. He has received national and international recognition, including the AUC President's Catalyst for Change Award, the Google Faculty Research Award, and the Egypt National Prize for Scientific Research.

Dr. Aly will outline the vision and structure of CS2023, emphasizing its algorithmic and mathematical foundations. In particular, he will highlight recent challenges that require CS graduates to be better prepared to handle societal issues. Dr. Aly will introduce the panelists, facilitate audience Q & A and discussion, and summarize the session.

3.2 Becker – Society, Ethics, and the Profession

Brett A. Becker is an Assistant Professor in Computer Science at University College Dublin. He served as a steering member of the CS2023 task force and headed the Society, Ethics, and the Profession Knowledge Area subcommittee. He currently serves as ACM SIGCSE Vice-Chair and the Steering Committee Chair of CompEd, the ACM Global Computing Education Conference. Dr. Becker is also an Associate Editor at ACM Transactions on Computing Education (TOCE) and has won several recent best paper awards including at ACM ICER and the ACM SIGCSE Technical Symposium. He has authored a 2020 high school CS textbook aligned with the Irish national curriculum with 15,000 copies in schools. Dr. Becker is also an Irish National Forum Teaching and Learning Research Fellow, the highest individual national distinction the sector offers to those teaching in higher education. He holds a PhD in Parallel Computing, an MSc in Computational Science, an MA in Higher Education, a BA in Physics, and a BA in Computer Science.

The rate of change in technology and society, and how these are intertwined have made the computing profession more complex and important than ever. For instance, not long ago social media did not have the power to alter the outcome of the elections of world leaders, and fake news was not a household term. The ethical stakes at the interface between computing and society have never been higher and only look like they will increase in magnitude. How computing professionals will grapple with their increasing influence on society and how they will adapt to societal change are significant issues, particularly given the complex relationship between computing and society. Dr. Becker will present how CS2023 approached this through the knowledge, skills, and competencies that future computing professionals will need on these fronts.

3.3 Kumar – Artificial Intelligence

Amruth N. Kumar is a Professor of Computer Science at Ramapo College of New Jersey. In addition to serving as the ACM co-chair of the CS2023 task force, he led the area of Artificial Intelligence in the CS2013 report. His research interests include Intelligent Tutoring Systems and Computer Science Education Research. Dr. Kumar has developed several software tutoring suites for introductory programming including problets (problets.org), epplets (epplets.org), solvelets (solvelets.org), and auglets (auglets.org), funded by the National Science Foundation. He is a Distinguished Member of the ACM, and Senior Member and Distinguished Contributor of IEEE. He has a PhD in Computer Science from the University at Buffalo.

Artificial Intelligence has undergone a renaissance in the last ten years. AI 2.0 promises to touch every sphere of human engagement from creative to industrial. Naturally, the interest of the general public in AI has also grown by leaps and bounds, leading to institutions of higher education offering dedicated majors in AI (e.g., the University of Pennsylvania). In response, CS2023 placed additional emphasis on sub-symbolic (aka neural network) AI, the driving force behind generative AI (e.g., Large Language Models). Practical applications of AI in a variety of areas are introduced and evaluated. Given the ubiquity of AI's influence in everyday life, its implications for Society, Ethics, and the Profession have been highlighted. The connections of AI with the new and in-demand sibling discipline of Data Science are listed. It is expected that soon, AI literacy will be just as important as computational thinking as a basic universal skill, and CS will have a role to play in promoting it.

3.4 Raj – Security

Rajendra K. Raj is a Professor of Computer Science at Rochester Institute of Technology, focusing on cybersecurity, data science, and computing education. He served as co-chair of the CS2023 task force and also led the Security Knowledge Area. Interested in computing program curricula and quality, he chaired the Criteria Committee of ABET's Computing Accreditation Commission that developed new accreditation criteria for cybersecurity programs. In the 1990s, Dr. Raj designed, implemented, and led high-performance private-cloud infrastructures for a multinational financial services firm. He has a PhD from the University of Washington, Seattle, an MS from the University of Tennessee, and a BTech from IIT Madras.

Modern critical infrastructure, such as transportation, communication, and healthcare, to name a few, have suffered and continue to face rampant cyberattacks. CS graduates will need to play a greater role in designing, implementing, and operating software systems – that are robust, safe, and secure. Most of all, CS graduates need to develop a *security mindset* so that security is embedded in all their work products. The SEC area includes privacy, cryptography, secure systems, secure data, and secure code, and it relies on shared concepts pervasive in all the other CS2023 knowledge areas. The Security knowledge area also has inherent ties to Society, Ethics, and the Profession. Dr. Raj will present how CS2023 addressed the challenges of building a security mindset in CS graduates.

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REFERENCES

[1] William F. Atchison, Samuel D. Conte, John W. Hamblen, Thomas E. Hull, Thomas A. Keenan, William B. Kehl, Edward J. McCluskey, Silvio O. Navarro, Werner C. Rheinboldt, Earl J. Schweppe, William Viavant, and David M. Young. 1968. Curriculum 68: Recommendations for Academic Programs in Computer Science: A Report of the ACM Curriculum Committee on Computer Science. *Commun. ACM* 11, 3 (March 1968), 151–197. https://doi.org/10.1145/362929.362976

[2] Alison Clear, Allen Parrish, John Impagliazzo, Pearl Wang, Paolo Ciancarini, Ernesto Cuadros-Vargas, Stephen Frezza, Judith Gal-Ezer, Arnold Pears, Shingo Takada, Heikki Topi, Gerrit van der Veer, Abhijat Vichare, Les Waguespack, and Ming Zhang. 2020. Computing Curricula 2020 (CC2020): Paradigms for Future Computing Curricula. https://www.acm.org/binaries/content/assets/education/curricula-recommendations/cc2020.pdf.

[3] Amruth N. Kumar, Rajendra K. Raj, Sherif G. Aly, Monica D. Anderson, Brett A. Becker, Richard L. Blumenthal, Eric Eaton, Susan L. Epstein, Michael Goldweber, Pankaj Jalote, Douglas Lea, Michael Oudshoorn, Marcelo Pias, Susan Reiser, Christian Servin, Titus Winters, and Qiao Xiang. 2023. Computer Science Curricula 2023 Website. https://csed.acm.org

[4] Mehran Sahami, Steve Roach, Ernesto Cuadros-Vargas, Andrea Danyluk, Ronald Dodge, Sally Fincher, Robert France, Kathleen Fisher, Dan Grossman, Elizabeth Hawthorne, Randy Katz, Amruth Kumar, Rich LeBlanc, Dave Reed, Brian Robinson, Remzi Seker, and Alfred Thompson. 2013. Computer Science Curricula 2013. https://dl.acm.org/doi/pdf/10.1145/2534860