



# AI in Computing Education from Research to Practice

Bitam Akram  
North Carolina State University  
Raleigh, North Carolina, USA  
bakram@ncsu.edu

Juho Leinonen  
Aalto University  
Espoo, Finland  
juho.2.leinonen@aalto.fi

Narges Norouzi  
University of California Berkeley  
Berkeley, California, USA  
norouzi@berkeley.edu

James Prather (Moderator)  
Abilene Christian University  
Abilene, Texas, USA  
jrp09a@acu.edu

Lisa Zhang  
University of Toronto  
Toronto, Ontario, Canada  
lczhang@cs.toronto.edu

## ABSTRACT

The panel comprises a diverse set of Computing educators working on AI in education. The panelists will address four areas of AI in Computing education: 1) AI for introductory CS classrooms, 2) Investigating opportunities presented by LLMs, 3) LLM-based tool development, and 4) Ethics and inclusion in AI curriculum. The panel will share experiences and discuss opportunities and challenges in AI education with the community.

## CCS CONCEPTS

• **Social and professional topics** → **Computing education**.

## KEYWORDS

Artificial intelligence, large language models, computing education

### ACM Reference Format:

Bitam Akram, Juho Leinonen, Narges Norouzi, James Prather (Moderator), and Lisa Zhang. 2024. AI in Computing Education from Research to Practice. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 2 (SIGCSE 2024)*, March 20–23, 2024, Portland, OR, USA. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3626253.3631657>

## 1 SUMMARY

The emergence of advanced Artificial Intelligence (AI) technologies, including generative AI approaches, brought ample opportunities and challenges in Computing education. While educators have the freedom to integrate AI tools and curricular content within their classrooms, classes will inevitably face unprecedented changes.

In this panel, panelists will discuss their experience and vision for including AI-focused learning technologies and curriculum and their perceived challenges and opportunities this integration presents. They discuss effective research methodologies to ensure proper design, implementation, and evaluation of AI-based technology and curriculum.

---

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).  
*SIGCSE 2024, March 20–23, 2024, Portland, OR, USA*  
© 2024 Copyright held by the owner/author(s).  
ACM ISBN 979-8-4007-0424-6/24/03.  
<https://doi.org/10.1145/3626253.3631657>

## 2 PANEL STRUCTURE

The panel comprises early-career Computing educators with diverse backgrounds from three different countries. Collectively, the panel will share their experiences and insights on AI in Computing education from research to practice. The panelists would like to use this opportunity to share opportunities and challenges of adopting AI, especially Large Language Models (LLMs), in Computing education. We also plan to use the platform to hear the audience's opinions and concerns and brainstorm avenues to address them as a community. Since the topic is broad and requires a culmination of expertise, the four panelists will discuss their perspectives for 10 minutes each, leaving 35 minutes for audience Q&A.

## 3 POSITION STATEMENTS

### 3.1 Bitam Akram: AI for Introductory CS Classrooms

Bitam Akram is an Assistant Research Professor at North Carolina State University with extensive experience in research and practice in introductory programming classrooms. She leads multiple NSF-funded projects for designing an AI-enabled classroom assistant for enhancing instruction in introductory programming courses [6, 7] and fostering persistence among underrepresented students in Computing [1, 5]. With the recent advances in AI technology and the drastic increase in CS enrollments, it is imperative to leverage the advantages of emerging AI technologies to foster novice students' learning by offering scalable and adaptive pedagogical support. The advances in AI not only entail the need to enhance introductory Computing education through adaptive technology but also pronounce the importance of integrating AI as an integral part of the introductory CS curriculum. The early introduction to opportunities and challenges provided by AI can positively affect students' career aspirations about AI and bring about the imperative awareness of ethical and responsible AI.

### 3.2 Juho Leinonen: Investigating the Opportunities Presented by LLMs in Computing Education: Research and Integration

Juho Leinonen is an Academy Research Fellow at Aalto University and has researched the potential opportunities that LLMs provide for Computing education, including giving a keynote and leading a working group on the topic at ITiCSE 2023. His research has found

many applications of LLMs for Computing education, ranging from enhancing programming error messages [9] to automatic creation of personalized programming exercises [15] and natural language explanations of source code [8]. Integrating LLMs into Computing education practice could revolutionize how Computing is taught. At this critical juncture, research on LLMs and their integration into teaching is not just a trend but a necessity. Prohibiting the use of AI in Computing education is unfeasible, as models are freely available, and students are already using them. Thus, we should not only integrate LLMs into teaching but actively teach students how to use them productively while highlighting their limitations, such as the potential to create biased content and the tendency to hallucinate. Embracing this technological advancement is crucial to preparing students for the generative AI era.

### 3.3 Narges Norouzi: LLM-based Tool Development in Computing Education

Recently, LLMs have been utilized to provide innovative solutions that enrich students' learning experiences. These tools span a variety of applications, such as personalized programming assistance, instant code analysis, comprehensive explanations, question generation, and chatbots. Narges Norouzi is an Assistant Teaching Professor at the University of California, Berkeley. She has been involved in building instructional technology that utilizes AI for intelligence tutoring and adaptive grading systems [11, 14]. She has recently focused on developing and deploying LLM-based instructional technologies in two main areas: 1) providing real-time tutoring support to students in CS1 [16] and 2) a browser extension tool for facilitating responses to student questions on course discussion forums [10, 12]. On this panel, she will share her experience building LLM-based tools in Computing education and associated challenges. She will also share with the community the potential avenues for further utilization of artificial intelligence, particularly LLMs, to improve Computing education.

### 3.4 James Prather (Moderator)

James Prather has been a researcher at the intersection of Human-Computer Interaction and Computing education since 2017. His previous work focused on programming error messages and novice programmer metacognition. Since early 2022, he has worked on the impact of large language models in Computing education [2, 3, 9]. He has given keynote talks and was involved in related ITiCSE working groups spanning all issues that will be discussed on the panel, and as such, is a suitable moderator to lead the conversation.

### 3.5 Lisa Zhang: Ethics and Inclusion in AI Curriculum for Computing

Lisa Zhang is an Assistant Professor Teaching Stream at the University of Toronto Mississauga. She has taught various machine learning courses since 2018 and was named one of the EAAI New and Future AI Educators in 2020. She developed and taught the inaugural offering of Artificial Intelligence Fundamental, which teaches deep learning concepts with little math. She has developed many experiential learning labs for various courses, many of which

are accepted into EAAI's Model AI assignments [4, 13]. She is interested in ways to structure machine learning courses to support a range of learners [17].

As AI becomes more relevant in our society, it is now more important than ever to consider how AI education approaches help or hinder broadening participation in the field. Identifying and mitigating barriers and challenges that students face in AI is an approach to broadening participation. For example, one barrier typically vocalized by students is the math requirements in theoretical ML courses, so supporting students through reviewing mathematics and statistics prerequisites could be an approach to reducing the impact of this barrier.

## REFERENCES

- [1] Bitu Akram, Susan Fisk, Spencer Yoder, Cynthia Hunt, Thomas Price, Lina Battestilli, and Tiffany Barnes. 2022. Increasing Students' Persistence in Computer Science through a Lightweight Scalable Intervention. In *ITiCSE'22*.
- [2] Brett A Becker, Paul Denny, James Finnie-Ansley, Andrew Luxton-Reilly, James Prather, and Eddie Antonio Santos. 2023. Programming Is Hard—Or at Least It Used to Be: Educational Opportunities And Challenges of AI Code Generation. (2023).
- [3] James Finnie-Ansley, Paul Denny, Brett A Becker, Andrew Luxton-Reilly, and James Prather. 2022. The robots are coming: Exploring the implications of openai codex on introductory programming. In *Proceedings of the 24th Australasian Computing Education Conference*.
- [4] Michael Guerzhoy, Lisa Zhang, and Georgy Noarov. 2019. AI education matters: building a fake news detector. *AI Matters* 5, 3 (2019).
- [5] Rachel Harred, Tiffany Barnes, Susan R Fisk, Bitu Akram, Thomas W Price, and Spencer Yoder. 2023. Do Intentions to Persist Predict Short-Term Computing Course Enrollments: A Scale Development, Validation, and Reliability Analysis. In *SIGCSE'23*.
- [6] Muntasir Hoq, Peter Brusilovsky, and Bitu Akram. 2023. Analysis of an Explainable Student Performance Prediction Model in an Introductory Programming Course. In *EDM'23*.
- [7] Muntasir Hoq, Sushanth Reddy Chilla, Melika Ahmadi Ranjbar, Peter Brusilovsky, and Bitu Akram. 2023. SANN: Programming Code Representation Using Attention Neural Network with Optimized Subtree Extraction. In *CKM'23*.
- [8] Juho Leinonen, Paul Denny, Stephen MacNeil, Sami Sarsa, Seth Bernstein, Joanne Kim, Andrew Tran, and Arto Hellas. 2023. Comparing Code Explanations Created by Students and Large Language Models. In *ITiCSE'23*.
- [9] Juho Leinonen, Arto Hellas, Sami Sarsa, Brent Reeves, Paul Denny, James Prather, and Brett A Becker. 2023. Using Large Language Models to Enhance Programming Error Messages. In *SIGCSE'23*.
- [10] M. Miroyan, C. Mitra, R. Jain, V. Kumud, G. Ranade, and Narges Norouzi. 2024. RetLLM-E: Retrieval-Prompt Strategy for Question-Answering on Student Discussion Forums. In *Proceedings of the AAAI Conference on Artificial Intelligence*.
- [11] M. Miroyan, S. Weng, R. Shah, L. Yan, and Narges Norouzi. 2024. EIT: Earnest Insight Toolkit for Evaluating Students' Earnestness in Interactive Lecture Participation Exercises. In *SIGCSE'24*.
- [12] C. Mitra, M. Miroyan, R. Jain, V. Kumud, G. Ranade, and Narges Norouzi. 2024. Elevating Learning Experiences: Leveraging Large Language Models as Student-Facing Assistants in Discussion Forums. In *SIGCSE'24 V. 2*.
- [13] Todd W Neller, Stephen Keeley, Michael Guerzhoy, Wolfgang Hoenig, Jiaoyang Li, Sven Koenig, Ameet Soni, Krista Thomason, Lisa Zhang, Bibin Sebastian, et al. 2020. Model AI Assignments 2020. In *Proceedings of the AAAI conference on artificial intelligence*, Vol. 34.
- [14] Narges Norouzi and Amir Mazaheri. 2023. Context-Aware Analysis of Group Submissions for Group Anomaly Detection and Performance Prediction. In *Proceedings of the AAAI Conference on Artificial Intelligence*, Vol. 37.
- [15] Sami Sarsa, Paul Denny, Arto Hellas, and Juho Leinonen. 2022. Automatic generation of programming exercises and code explanations using large language models. In *ICER'22*.
- [16] J.D. Zamfirescu-Pereira, L. Qi, B. Hartmann, J. DeNero, and Narges Norouzi. 2024. Conversational Programming with LLM-Powered Interactive Support in an Introductory Computer Science Course. In *NeurIPS'23 Workshop: Generative AI for Education (GAIED)*.
- [17] Lisa Zhang and Sonya Allin. 2023. Just-In-Time Prerequisite Review for a Machine Learning Course. In *Proceedings of the 25th Western Canadian Conference on Computing Education*.