

Panel: AI for Pervasive Computing: Curse or Blessing?

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PANEL ABSTRACT

In the past years, we have witnessed a remarkable surge in the integration of machine learning within pervasive computing, revolutionizing how we interact with technology daily and build pervasive systems.

Two-thirds of the accepted PerCom 2024 papers use machine learning as a core technique in their approach. Fig. 1 illustrates a frequency analysis of the PerCom proceedings that shows that after removing traditional stop words, almost all 20 most frequent bi-grams on both editions concern machine learning thematic.

However, many works also mention shortcomings of current machine learning approaches. Recently, large-language models have shown impressive performance; when we prompt ChatGPT 4.0 with “*How can we use AI for pervasive computing?*” it generates text that most readers would confuse for being authored by a human.

We see examples for this throughout the PerCom proceedings, ranging from using ML methods to recognize higher-level information from raw sensor data (classification) over federated learning up to fine-tune large-language models by natural language inference for personality recognition in conversations. Many works also address the challenge of using AI-based methods in resource-constrained environments.

But what effect do these advancements have on the way we do research? With PerCom challenges, does AI not provide a solution, and which applications could be considered harmful?

On March 14, in the 8:30 session, a panel of three PerCom experts, some with more and some with less experience with AI and ML methods, was held to discuss this topic.

Since one of the panelists could not attend the conference, we selected the audience as the fourth panelists.

Before the panel, we collected questions related to the topic from the panelists, the keynote speakers, and randomly selected PerCom attendees. They were relating to a wide range of methods associated with the field of Artificial Intelligence and Machine Learning.

This input can be grouped into four categories:

- Technology/Systems: (How) does AI change the way PerCom systems are implemented?
- Research Methods: (How) does AI change the way we do research in PerCom?
- Research Community: (How) does AI change the way we interact in the research community?
- Society and long-term effects: What would the effects on society be if we use AI methods?

Based on a popularity vote, the panel started by discussing the second topic area, research methods. J. Cao observed that before the rise of modern AI methods, much time was spent creating models, which required a lot of interaction with domain experts. Now, it is common for PhD students to pick a publicly available data set and find out which research questions could be answered with that. However, as B. Lagesse noted, sometimes one week of GPU time could have been saved by taking one hour to a domain expert since sometimes ML methods just find out what domain experts would have already known. A. Murphy raised the question of what characterizes a valid research contribution. More than just applying ML to a dataset and reporting on the results might be needed, a view that the fourth panelist, the audience, shared.

A fact that might also influence how we select, supervise, and evaluate research might be that many professors did not receive any formal training on AI methods since it did not exist when they graduated. Fig. 2 shows that this is true for almost 40% of the audience.

The second area covered was the societal impact of AI for Pervasive Computing. It became clear that the evaluation of AI-based methods for pervasive systems needs to cover more than just reporting on metrics like F-Score or overall accuracy: If, e.g., the method performs badly on specific individuals,

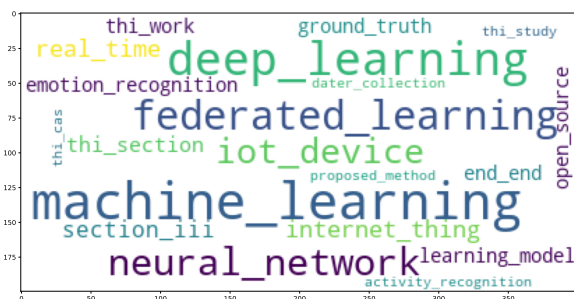


Fig. 1. Illustration of frequency analysis of bigrams in the PerCom proceedings, provided by Manuele Kirsch Pinheiro, Université Paris 1

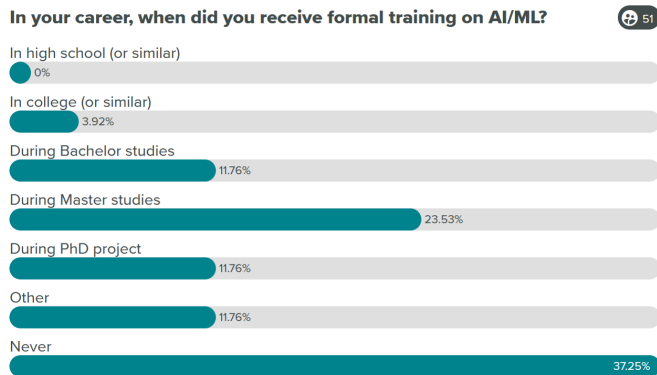


Fig. 2. Panel Audience: Formal Training on AI

there should be an analysis of what could cause these anomalies and whether this could be a systematic effect that needs to be addressed. Further, there are emerging techniques to add explainability even to black-box models and researchers should utilize these and other techniques to understand why models perform the way they do.

In a broader view, it was noted that ethical implications of AI usage could be compared with the assessment of data privacy. For the latter, regulations like the European GDPR and specialized layers can support researchers to fulfil legal and ethical constraints when performing their studies. Similarly, we might need regulations for ethical use of AI and specialized experts who could support researchers in a similar way.

This led to the question from the audience whether there should be a track on verifiable AI on one of the next PerCom editions. This could be an excellent topic for a workshop.

The final poll asked the audience whether, after this discussion, they see AI for pervasive computing as a curse or as a blessing (Fig. 3). It was allowed to vote for both options; the result was that 44 % see it as a curse, but over 88 % answered "blessing", reflecting the great opportunities many researchers experience.

ABOUT THE PANELISTS

Our expert panelists will debate the implications, opportunities, and ethical dimensions of integrating machine learning into pervasive computing systems. Discover this transformative technology's potential, pitfalls, and possibilities, and join us for an insightful conversation on whether machine learning is a curse or a blessing in pervasive computing!

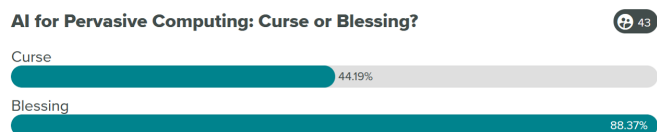
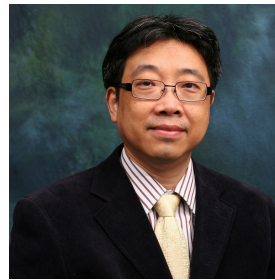


Fig. 3. Final Poll Results



Jiannong Cao is currently the Otto Poon Charitable Foundation Professor in Data Science and the Chair Professor of Distributed and Mobile Computing in the Department of Computing at the Hong Kong Polytechnic University. His research interests include edge computing and distributed systems, wireless sensing and networking, big data and AI. He published 6 co-authored and over 500 papers in major international journals and conference proceedings. He also obtained 16 patents. He received many awards for his outstanding research achievements. Dr. Cao served the Chair of the Technical Committee on Distributed Computing of IEEE Computer Society 2012-2014. He is a member of Academia Europaea, a fellow of HK Academy of Engineering Sciences, a fellow of IEEE, a fellow of CCF and a distinguished member of ACM.

He is co-author of the PerCom 2024 paper titled *Affective-NLI: Towards Accurate and Interpretable Personality Recognition in Conversation*, which uses AI and ML methods to improve dialog content with affective information and personality label descriptions, enabling accurate personality recognition in conversations.

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Brent Lagesse is an Associate Professor at the University of Washington Bothell. His work is primarily in the areas of security, mobile systems, and machine learning with a special focus on where these topics intersect. He was a Cybersecurity Fulbright Scholar at the University of Cambridge in 2018 and the Johann-von-Spox International

Guest Professor at the University of Bamberg in 2019 to 2020.

His recent work has included automatically detecting hidden webcams, reducing the cost of accurately predicting air pollution levels in indoor spaces, secure and private crowdsensing technologies, and addressing workforce needs and barriers to entry at the intersection of cybersecurity and artificial intelligence. Prior to coming to UW Bothell, he held positions as a research scientist in the cybersecurity research groups at Oak Ridge National Laboratory and BBN Technologies.



Amy L. Murphy is a senior researcher in the Energy Efficient Embedded Digital Architectures (E3DA) unit at the Fondazione Bruno Kessler in Trento, Italy. She received a B.S. in Computer Science from the University of Tulsa in 1995, and M.S. and D.Sc. degrees from Washington University in St. Louis, Missouri in 1997

and 2000 respectively. She spent five years in academia as an assistant professor at the University of Rochester, New York, and the University of Lugano, Switzerland, and one year as a visiting researcher at Politecnico di Milano, Italy. Her work focuses on applied research for smart cities from the software engineering, distributed computing, and low-power wireless networks perspectives. The theme that drives her work is to enable reliable applications for dynamic environments with particular attention to the wireless communication protocols necessary to support complex interactions among distributed devices.



Ella Peltonen is an assistant professor at the M3S research unit, University of Oulu, Finland. She gained her PhD at the University of Helsinki and did her postdoc period at the Insight Centre for Data Analytics, University College Cork, Ireland. In addition, she has undertaken research visits to the University of California, Berkeley, US, University of

Cambridge, UK, University College London, UK, and the University of Melbourne, Australia.

Her research focuses on pervasive everyday sensing, distributed machine learning in the edge-cloud continuum, and “from data to actions” including ubiquitous recommendation systems and sensing data analytics. Dr Peltonen has been granted Marc Weiser Best Paper Award in the IEEE PerCom 2015, Rising Stars in Networking and Communications 2017

by N2 Women, The European Initiative EPIC Grant 2018, and Nokia Foundation Jorma Ollila Grant 2018.

Unfortunately, Ella could not attend the panel. Instead, we selected the session audience as a fourth panelists.



The Audience were over 50 PerCom participants at different stages of their mostly scientific careers (see Fig. 4. Given the fact that the panel session was in the morning after a vibrant conference dinner, their attendance indicates a high interest in the panel topics. During the panel session, they participated by adding view points to the discussion, raising

new questions, and by contributing to online polls that have been prepared via the freemium version of Vevox¹ for the panel.



Daniela Nicklas was the panel chair. She holds the Chair of Mobile Systems at the University of Bamberg, Germany. She obtained her PhD in 2005 at the University of Stuttgart, working on the integration of large-scale spatial context models for mobile applications.

How would you characterize your job?

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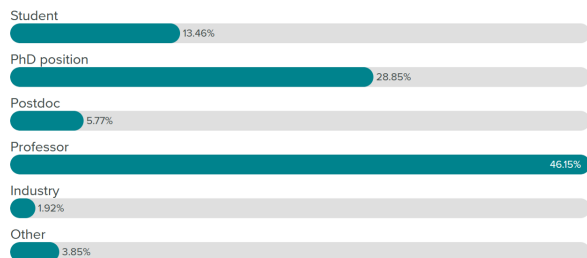


Fig. 4. Panel Audience Job Characteristics

¹<https://vevox.app>