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Data Science Seminar Series

Data Science and Cyber-Infrastructures for Scientific Cleanrooms

Klara Nahrstedt, Ph.D.
Professor
University of Illinois at Urbana-Champaign

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Scientific domains such as Materials Science and Semiconductor Fabrication, include diverse users and show delays between acquiring scientific data from scientific instruments such as microscopes and gathering insights from the data. These scientific cycles must be shortened, and it will require a major transformation how we collect digital data about physical artifacts from scientific instruments in cleanrooms, and how we make the digital data available to different users and varying computational tools for developing new insights and speeding up the discoveries in science.

In this talk we present a real-time micro-service operating infrastructures and underlying data management services for scientific workflows that focus on the immense potential of capturing, curating, correlating, and coordinating digital data in a real-time and trusted manner before fully archiving and publishing them for wide access and sharing.

Specifically, we will discuss the operating and data management cyber-infrastructure system, called 4CeeD, where our micro-service-based approach helps to improve flexibility of workflow composition and execution, and enable fine-grained scheduling at task level, considering task sharing across multiple workflows. Furthermore, the self-adaptive micro-service management employs integration of feedback control, deep learning, and optimization frameworks to offer resource adaptation without any advanced knowledge of workflow structures. We will also discuss a unique usage of edge computing infrastructure system, called BRACELET, to enable integration of aging instruments to be integrated into the micro-service operating infrastructure. The evaluation of the 4CeeD system shows robust prediction of resource usage and adaptation under dynamic workloads, real-time service to users to offload, curate and analyze data, and access to diverse instruments. We will conclude the talk with a discussion about instrumenting cleanrooms with IoT sensory devices to establish sensing cyber-infrastructure, called SENSELET, to sense and acquire the micro-climate data around the scientific instruments, correlate them with corresponding instrument data, and enable verification of experimental results in scientific cleanrooms.

The 4CeeD, BRACELET, and SENSELET cyberinfrastructure research is a joint work with Dr. Phuong Ngyuen, Dr. Tarek Elgamal, Beitong Tian, Patrick Su, Robert Kaufman, Prof. John Dallesasse, Ragini Gupta, Gianni Pezzarossi, Steve Konstanty, and Todd Nicholson

Klara Nahrstedt is the Grainger Distinguished Chair in Engineering Professor in the Computer Science Department, and Director of Coordinated Science Laboratory in the Grainger College of Engineering at the University of Illinois at Urbana-Champaign. Her research interests are directed toward end-to-end Quality of Service (QoS) and resource management in large scale multimedia distributed systems and networks, and real-time security and privacy in cyber-physical systems. She is the recipient of the IEEE Communication Society Leonard Abraham Award for Research Achievements, University Scholar, Humboldt Award, IEEE Computer Society Technical Achievement Award, ACM SIGMM Technical Achievement Award. Klara Nahrstedt received her Diploma in Mathematics from Humboldt University, Berlin, Germany in 1985. In 1995 she received her PhD from the University of Pennsylvania in the Department of Computer and Information Science. She is the Fellow o ACM, IEEE, AAAS, Member of the German National Academy of Sciences (Leopoldina Society) and Member of the National Academy of Engineering.