

The Role of AI in Scientific Workflow Management

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Over the last two decades, scientific workflow management systems (WMS) have enabled the execution of complex, multi-task applications on a variety of computational platforms, including today's exascale systems. They ensure efficient execution of computational and data management tasks, adhering to their data and control dependencies. During workflow execution, WMSs monitor the execution of tasks, detect anomalies and failures, and deploy recovery mechanisms when needed. However, as workflows and cyberinfrastructure grow in scale, heterogeneity, and complexity, traditional WMS approaches face challenges in adaptability and resilience.

This talk presents recent advances in integrating AI throughout the scientific workflow lifecycle from workflow design to workflow execution. It will describe the investigation of the use of AI in the context of the existing Pegasus WMS, sharing results in AI-based workflow composition and anomaly detection. The talk will also present a novel fully distributed, resilient WMS model inspired by enhanced swarm intelligence (SI), designed to dynamically adapt to failures and optimize resource allocation. The talk will share insights into its mathematical foundations, consensus algorithms, and network overlay strategies, along with preliminary results showcasing its potential for large-scale scientific workflows.

Bio:

Ewa Deelman received her Ph.D. in Computer Science from the Rensselaer Polytechnic Institute. Following a postdoc at the UCLA she joined the University of Southern California's Information Sciences Institute (ISI) in 2000, where she serves as a Research Director and leads the Science Automation Technologies Center. She is also a Research Professor in the USC Computer Science department and a Fellow of AAAS, IEEE, and USC/ISI. Her team explores the interplay between automation and the management of scientific workflows, including performance modeling, scheduling, resource provisioning, provenance tracking, and data management. Dr. Deelman pioneered workflow planning for computations executing in distributed environments, leading to the design and development of the Pegasus Workflow Management software used today in numerous science applications. In 2015, Dr. Deelman received the HPDC Achievement Award for her contributions to the area of scientific workflows and in 2022 she received the Euro-Par Achievement Award for her outstanding contributions to parallel computing.