

# SEMINAR



# SERIES

北京大学工学院

工业工程与管理系

## Ensemble Active Learning by Contextual Bandits for Manufacturing Supervised Learning Problems



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地 点: 北京大学王克桢楼 1003

**Abstract:** An Industrial Cyber-physical System (ICPS) provides a digital foundation for data-driven decision-making. However, the poor data preparation (e.g., shifting distributions, imbalanced classes) of high-speed, large-volume data streams poses significant challenges to the online deployment of offline-trained statistical models. As an alternative, updating models online based on streaming data enables continuous improvement and resilient modeling performance. In a supervised learning model (i.e., a base learner), it is typically labor-intensive to annotate all streaming samples to update the model. Hence, a data preparation method is needed to select a small but meaningful data subset to ensure model performance online. To achieve this objective, we propose an ensemble active learning method by contextual bandits. The method incorporates a set of active learning agents (i.e., acquisition criteria) explicitly designed for exploration or exploitation by a weighted combination of their acquisition decisions. The weight of each agent will be dynamically adjusted based on the usefulness of the sample to improve the performance of the base learner. With adaptive and explicit consideration of both exploration and exploitation objectives, the proposed method efficiently guides the data acquisition process by selecting informative samples to reduce the human annotation efforts. Furthermore, the evaluation of theoretical properties, numerical simulation studies, and a real case study demonstrates the effectiveness and efficiency of ensemble active learning by contextual bandits in manufacturing process modeling in ICPS.

During the seminar, the speaker will also introduce other prior published research results in manufacturing data fusion and computation services in Manufacturing Industrial Internet.

**Short Bio:** Dr. Ran Jin is an Associate Professor and the Director of Laboratory of Data Science and Visualization at the Grado Department of Industrial and Systems Engineering at Virginia Tech. He received his Ph.D. degree in Industrial Engineering from Georgia Tech, Atlanta, his Master's degrees in Industrial Engineering and in Statistics, both from the University of Michigan, Ann Arbor, and his bachelor's degree in Electronic Engineering from Tsinghua University, Beijing.

Dr. Jin's research focuses on computation services in Manufacturing Industrial Internet. His research includes data analytics in Manufacturing Industrial Internet, data fusion modeling and decision making, interface

between data quality and data-driven modeling, cognitive visualization system design, and interpretable statistical models. He published over 50 journal papers in this area. His research has been broadly used by many manufacturing companies in additive manufacturing, semiconductor manufacturing, and optical fiber manufacturing industries.

Dr. Jin served as President of Engineering Faculty Organization at Virginia Tech, Operations Officer of Faculty Senate, and Co-Chair of Commission on Research at Virginia Tech. He also served as Chair of Quality, Statistics, and Reliability subdivision in INFORMS and Associate Editor for IISE Transactions (Design and Manufacturing). Dr. Jin is currently serving as an Associate Editor for ASME Journal of Manufacturing Science and Engineering, Associate Editor for IEEE Transactions on Automation Science and Engineering, and Associate Editor for INFORMS Journal on Data Science. For more information about Dr. Jin, please visit his faculty website at Virginia Tech: <https://ise.vt.edu/ran-jin>.

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