

(German/English) Simulation of Complex Production Environments for Reinforcement Learning

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Research Questions

Modern production planning is an extremely complex process with multiple influencing factors and competing goals, making it a challenging task for humans. A promising approach to tackle the decision-making complexity in production environments involves the use of data-driven intelligent systems for production planning and control [1]. Despite multiple advances in the field of deep learning for complex planning tasks, the adoption of learning-based methods in the production context is slow. One of the major barriers is that such novel methods as reinforcement learning require a high number of interactions with the production environment to learn. This is only possible through the use of simulated production environments. This work will contribute towards the creation of generic, open-source, and fast production simulations designed specifically for the training of deep learning models.

Research Methodology

As a first step, a literature review on approaches to model production environments will be conducted. Based on the literature review several design choices covering process modeling and technical implementation of the production simulation will be made. Main criteria for design choices include simulation simplicity and speed, use of open-source technologies, compatibility with reinforcement learning through following the OpenAI gym toolkit interface, as well as high reconfiguration capabilities to mimic different production types. Additionally, a possibility to use process models created from real production data with the help of process mining methods should be considered. Finally, a set of evaluations including the use of real production data for process modeling and compatibility with existing reinforcement learning algorithms will be conducted.

Objectives and expected Results

The aim of this work is the creation of computationally efficient and flexible simulation of production environments specifically designed for reinforcement learning applications in production planning. The scope of the work can be adjusted following the individual interests and type of work.

Requirements:

- At least basic previous programming experience and willingness to learn
- Experience or willingness to learn new skills in the area of agile development, data science, process mining and operations research
- Independent and proactive working attitude

[1] C. Liu, et al. (2020). Actor-Critic Deep Reinforcement Learning for Solving Job Shop Scheduling Problems. IEEE Access, 8