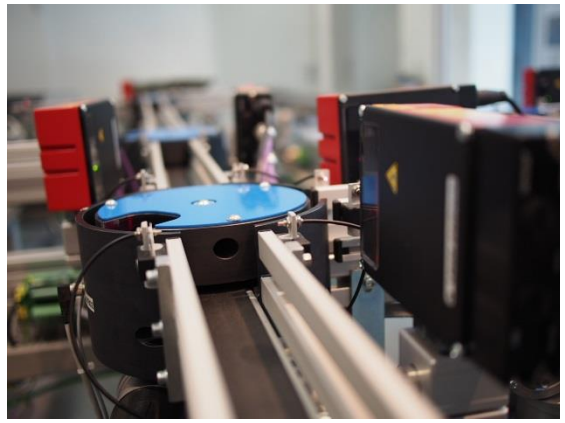

Learning Conditions of Manufacturing Actions from Execution Traces (SA/MA)

Lehrstuhl für Automatisierung und Informationssysteme
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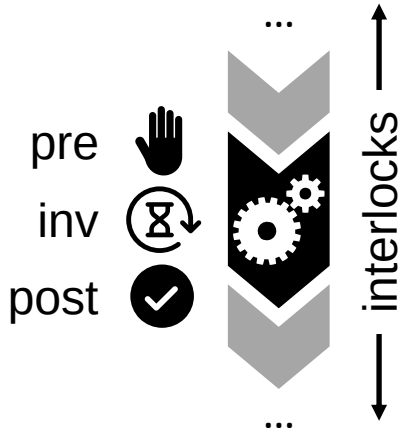
Task Description:

For the safe and reliable operation of automated manufacturing machines, executed actions must be constrained by so-called interlocks (forbidden/ enforced combinations of process variables). Action-specific conditions must be fulfilled before each action starts (pre), while it is active (invariant; inv), and after completion (post). Writing these constraints manually is labor-intensive and error-prone. However, well-tested control software of manufacturing machines already defines the constraints implicitly to always maintain safety and reliability. Previous work* shows that Behavior Trees can be learned automatically from traces of the machine's execution.



Your task is to enhance an existing control software of the xPPU demonstrator to record execution traces. You will develop a procedure to automatically synthesize conditions from Behavior Trees for each action using the traces. Possibilities to differentiate pre-/postconditions and invariant conditions as well as interlocks automatically shall be investigated. A human-in-the-loop shall verify the synthesized conditions.

Preliminaries:

- Experience and knowledge in machine learning, statistics, and Boolean algebra
- Knowledge about industrial automation and IEC 61131-3 programming
- Independent and self-reliant work ethic

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*Gugliermo et al., "Learning Behavior Trees From Planning Experts Using Decision Tree and Logic Factorization," in *IEEE R-AL*, vol. 8, no. 6, pp. 3534-3541, 2023.