Long-term Rapid Scenario Planning in the Semiconductor Industry using Deep Reinforcement Learning

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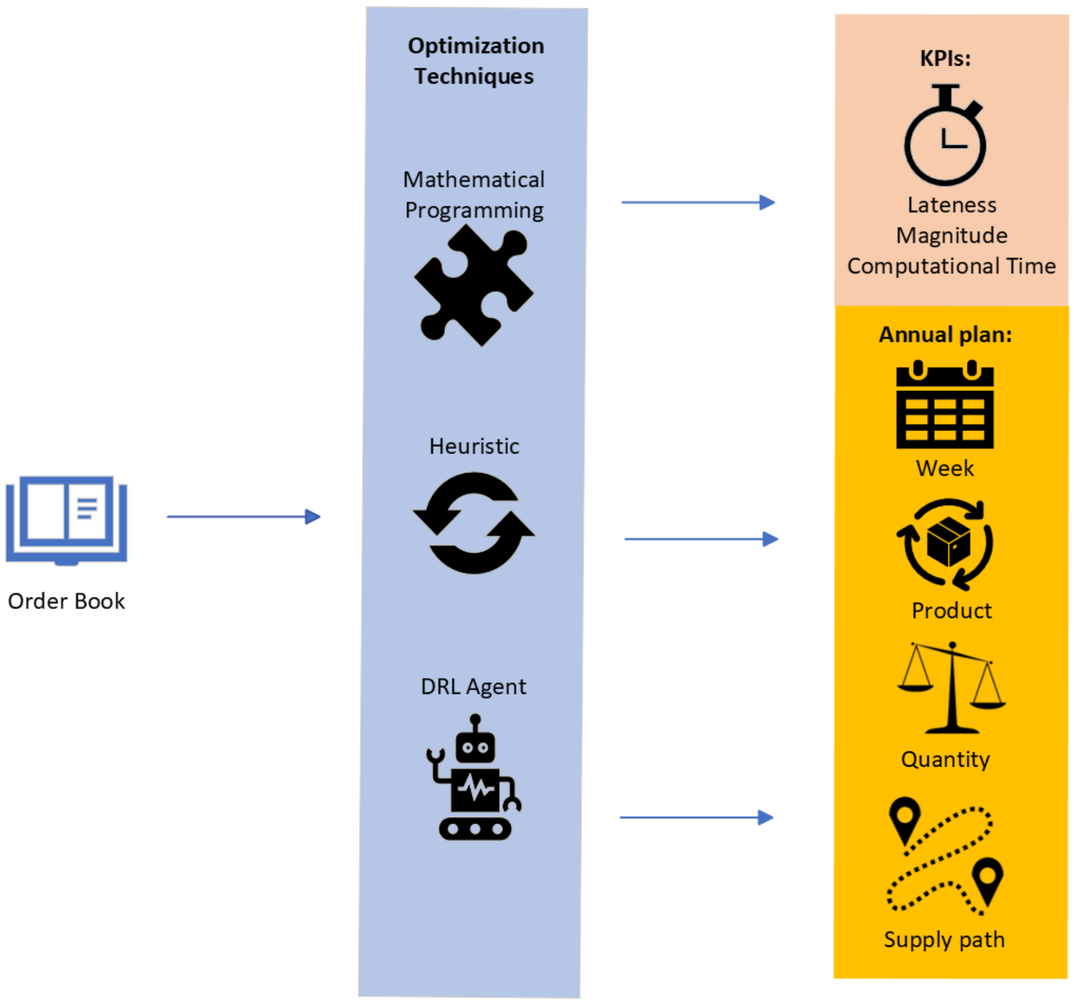
Introduction

NXP seeks faster and more adaptable methods for generating production schedules for their semiconductor back-end supply chain. This thesis aims to create a flexible planning algorithm to solve the scheduling problem by reducing computational time while ensuring acceptable performance.

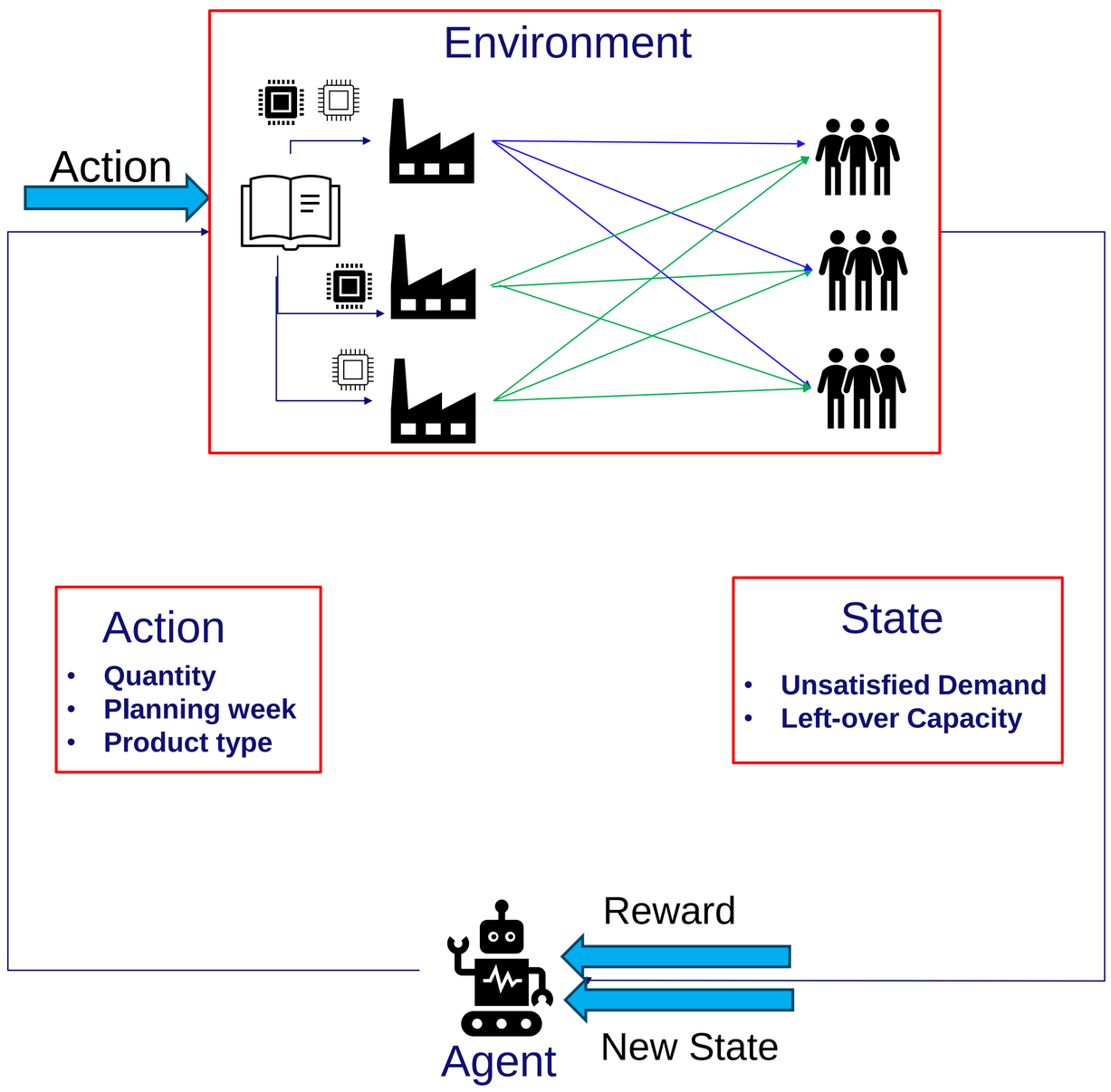
How can DRL be used for long-term data-driven supply chain scheduling focused on the semiconductor back-end supply chain?

Methods

To generate production schedules, we employ a blend of optimization techniques, including Mathematical Programming (MP), Deep Reinforcement Learning (DRL), and Dispatching Prioritizing Decision rules (DPRs). Each method offers distinct advantages and drawbacks. The overarching objective of all optimization methods is to minimize order lateness and magnitude within predefined constraints.



Deep Reinforcement Learning



Results

Optimization Method	Quality	Run Time order of magnitude	Extendable ?
Mathematical Programming	*****	> 1 hour	yes
DRL	****	< 1 sec	yes
Tailored DPR	****	< 1 sec	not realistic
Generic DPR	*	< 1 sec	yes

Hand-tailoring is needed when extending the supply chain; however, while the DRL and MP models can be adapted to these new circumstances, tailored DPRs become obsolete. This is because larger, more complex problems cannot be solved using logical reasoning, especially when the semiconductor supply chain characteristics like dual-sourcing supply paths and product-resource unique variables (e.g. usage rates, yields) are not considered. That is why other optimization models (such as MP, DPR, or metaheuristics) are needed and why traditional DPRs (that assume simplified supply chains) will not work.

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