A SMART WAY to AVOID TRAIN DELAYS

HU-MATHS-IN
Hungarian Service Network for Mathematics in Industry and Innovations

CHALLENGES

Smart, green and integrated transport

The Industrial Problem

Accenture, as a partner of Swiss Federal Railways and Deutsche Bahn was interested in finding computationally efficient methods to provide decisions for train re-routing problems in an on-line fashion, when trains on the transport network are prone to stochastic failures.

INCLUDE THE MORE APPROPRIATED INDUSTRIAL SECTOR

Research group

Name of Research Group

SZÉCHENYI EGYETEM
UNIVERSITY OF GYŐR

The research group contains two senior researchers, two junior ones and several master students, all with a keen interest in reinforcement learning.

Company

Accenture

accenture

Accenture is an international software company offering consultancy and implementation to various industries world-wide.

SZÉCHENYI 2020
MAGYARORSZÁG KORMÁNYA
Európai Unió
Európai Strukturális és Befektetési Alapok
BEFEKTETÉS A JÖVŐBE

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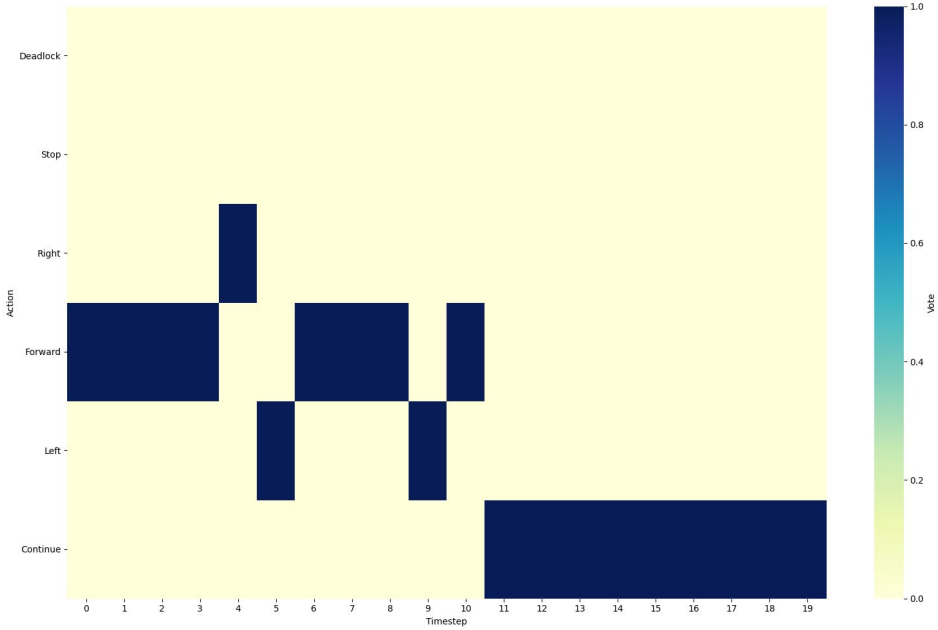
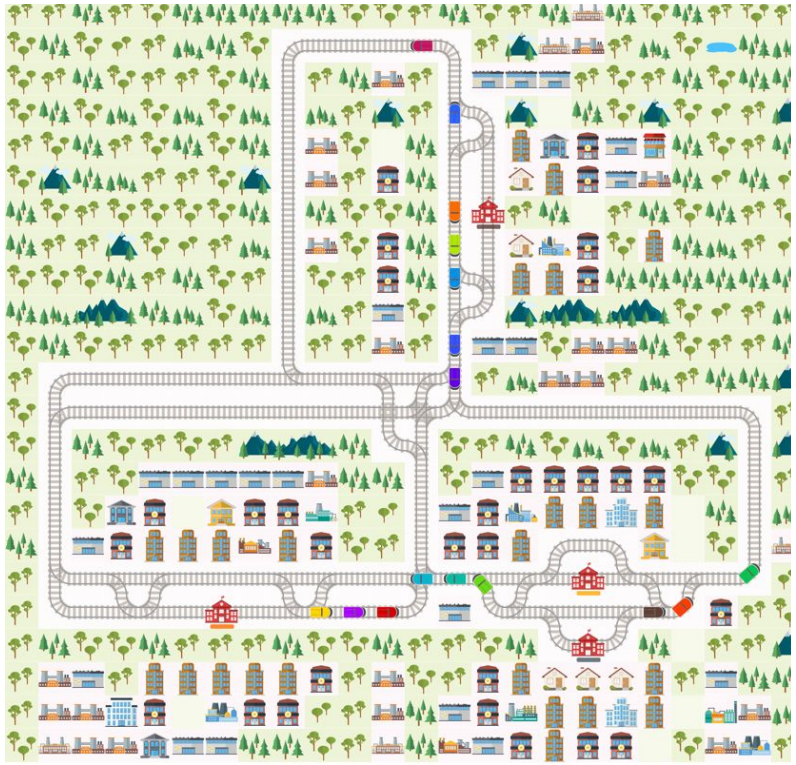
Challenges & Goals

- Solution to train rescheduling problems due to stochastic failures in the transport network
- To minimize total travel time
- Evaluate different state space representations
- Ensure optimal solutions on small-scale problems
- Lear optimal policies for large networks





A sample network of rail tracks and the actions taken by a train as a function of time.

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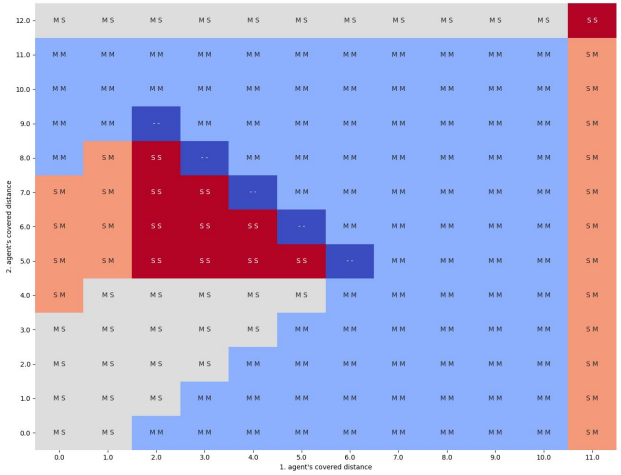
Mathematical and computational methods and techniques applied

- Dynamic programming is used to solve typical, small scale problems
- A* search is used to construct a set of interesting local scenarios
- A novel state space representation and problem decomposition is defined
- Reinforcement learning is used to learn optimal policies.

A typical conflicting scenario for two trains



An optimal policy for two trains in an H-shaped flatland

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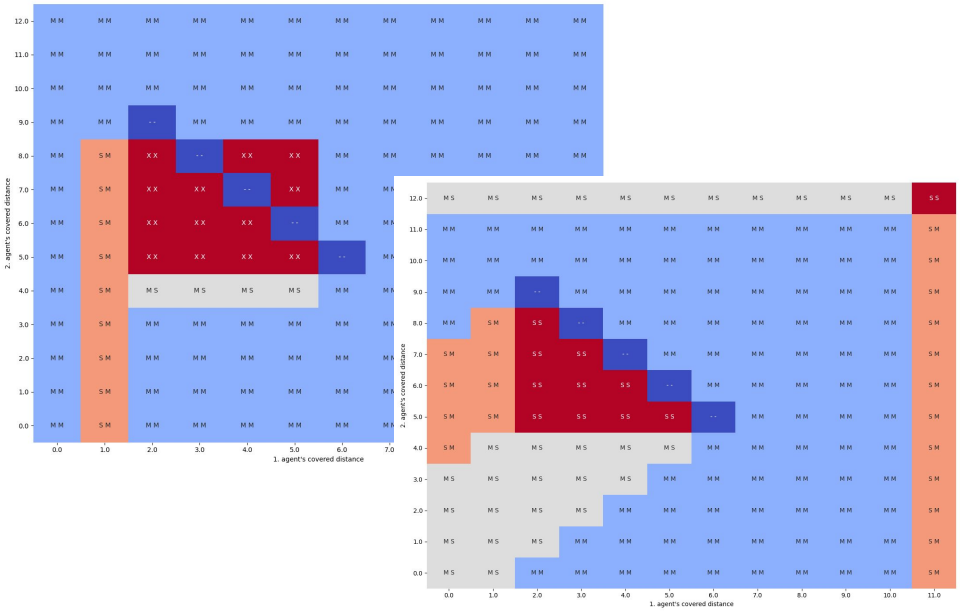
Results & Benefits to the company

- **Results**
  - Evaluation framework for strategies
  - Formal problem decomposition for 2-train problems
  - Analytic solution to small-scale problems
- **Benefits**
  - Increased understanding of the problem
  - Discovery of important edge cases that routing software should check



Comparision of analytic and calculated optimal policies

Real life does not reveal every important aspect of a problem. Formal analysis and a fresh set of eyes help.