Project Ariadne – Use Case 2 / 3

RapidMiner Research

21 to 22 October 2020

Presentation Layout

- List of Use Cases
- Use Case 2 : Advanced NLOS connectivity based on metasurfaces
  - Story Line
  - Functional and Non-Functional Requirements / Challenges
- Conventional AI (constraint solving optimizations)
  - Why do we need to frame optimization simulations
  - How do they work?
- Transferring optimization results into ML model
- Transferring Ariadne Experience to RapidMiner Product
- Stay in touch

List of Use Cases

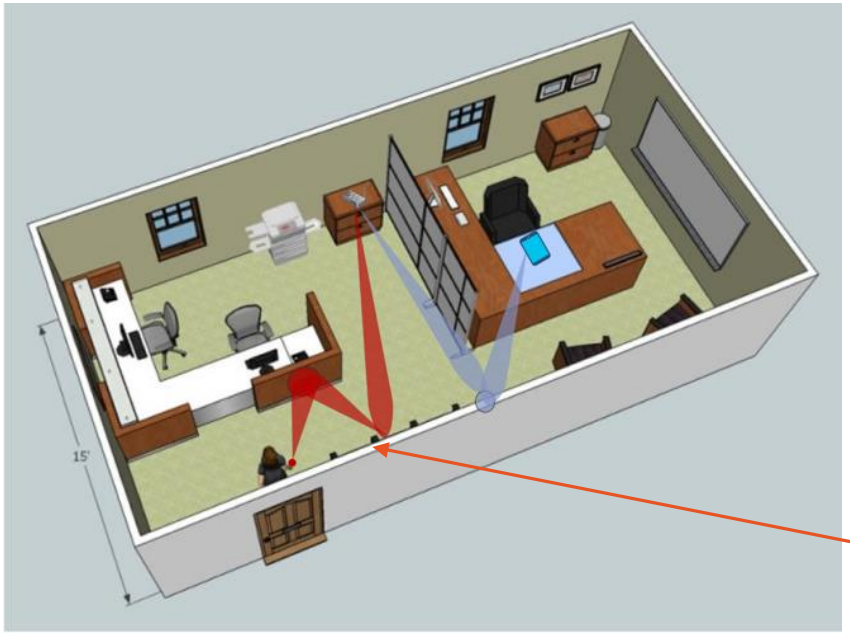
- **Use case 1**: Outdoor backhaul/fronthaul networks of fixed topology
  - Scenario 1: Long-range Line of Sight (LOS) rooftop point-to-point backhauling.
  - Scenario 2: Street-level point-to-point and point-to-multipoint backhauling/fronthauling.

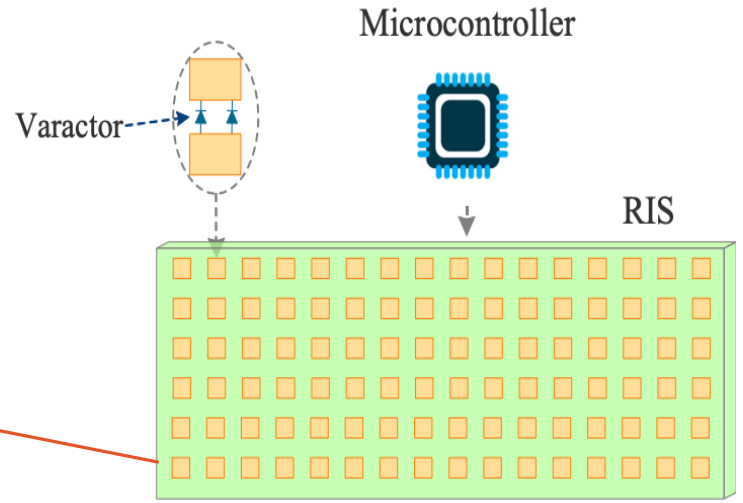
- **Use case 2**: **Advanced NLOS connectivity based on metasurfaces**
  - Scenario 1: Indoor advanced Non-Line of Sight (NLOS) connectivity based on metasurfaces
  - Scenario 2: Data kiosk

- **Use case 3**: Adhoc connectivity in moving network topology
  - Scenario 1: Dynamic front/backhaul connectivity for mobile 5G access nodes and repeaters
  - Scenario 2: V2V and V2X connectivity

Use Case 2: Indoor Advanced NLOS Connectivity

- Establish reliable NLOS communication paths





Functional Requirement

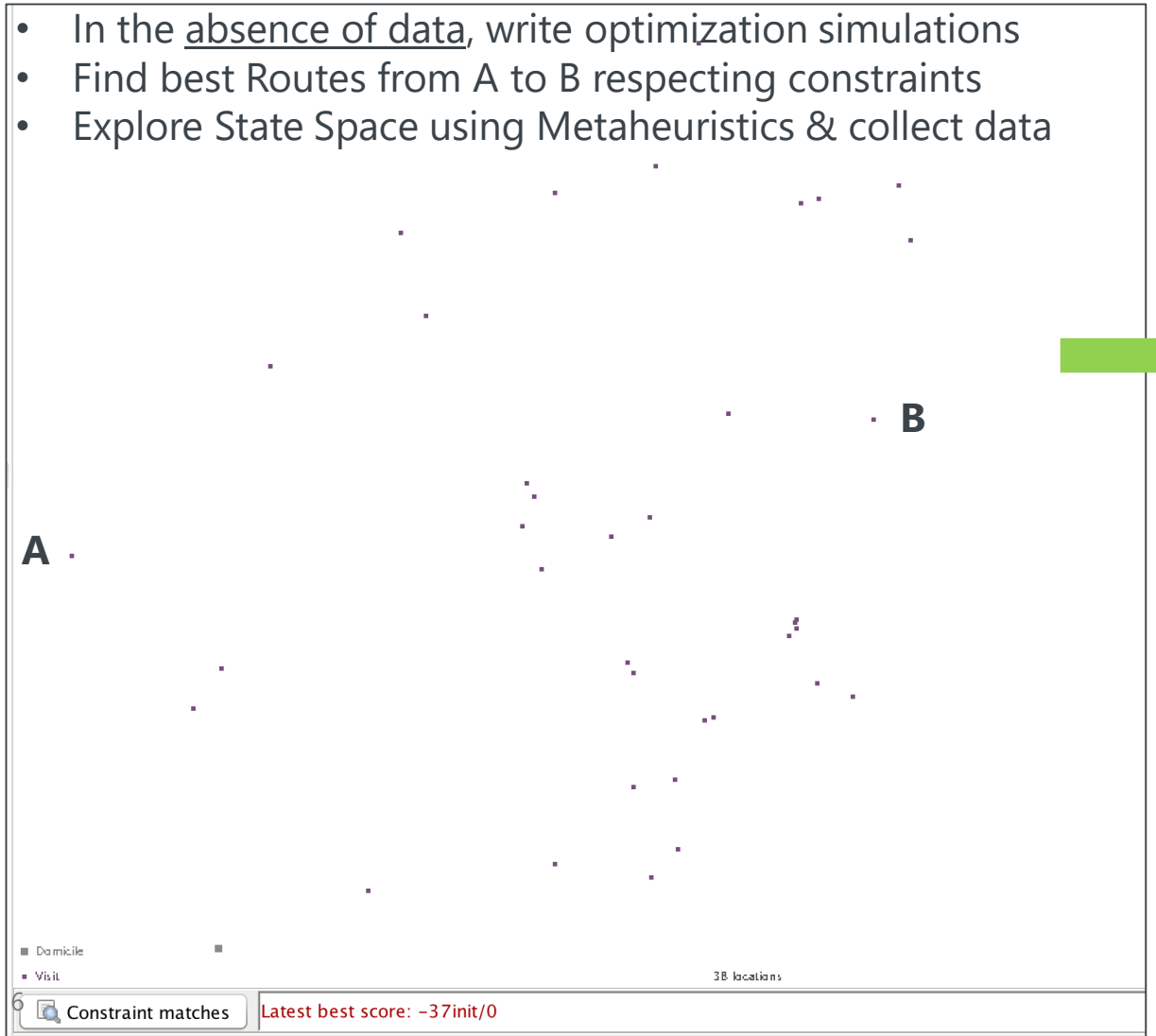
- Discover NLOS paths to reach user device with the best signal quality (Beamforming and beam allocation at the access point / DSL router)

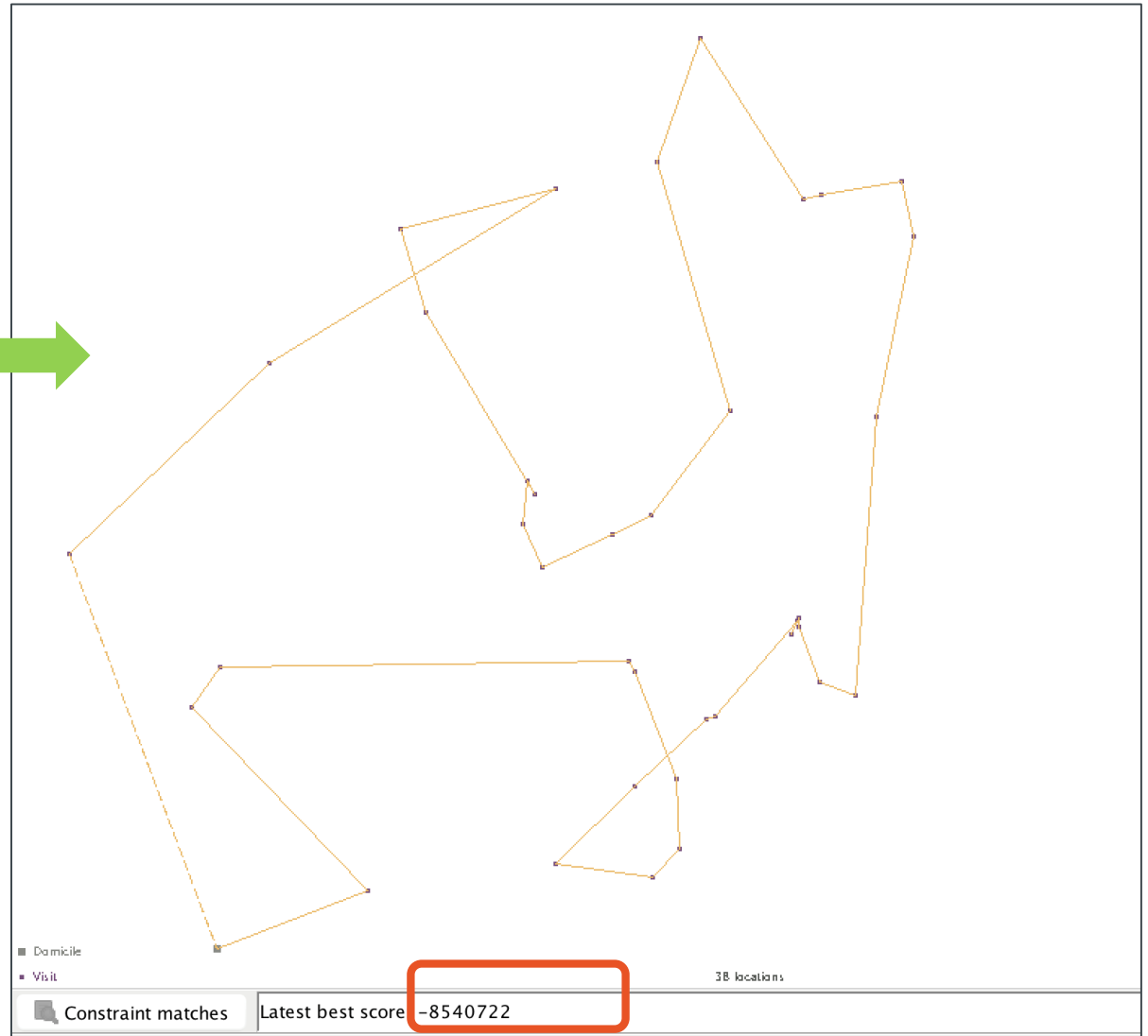
Non-functional Requirement

- Prediction / Prescription to be applied very fast at access point or at Microcontroller on chip to keep latencies very low
- 2^96 possible combinations to turn unit-cells ON or OFF (without pruning)
- Decisions to be made in microseconds

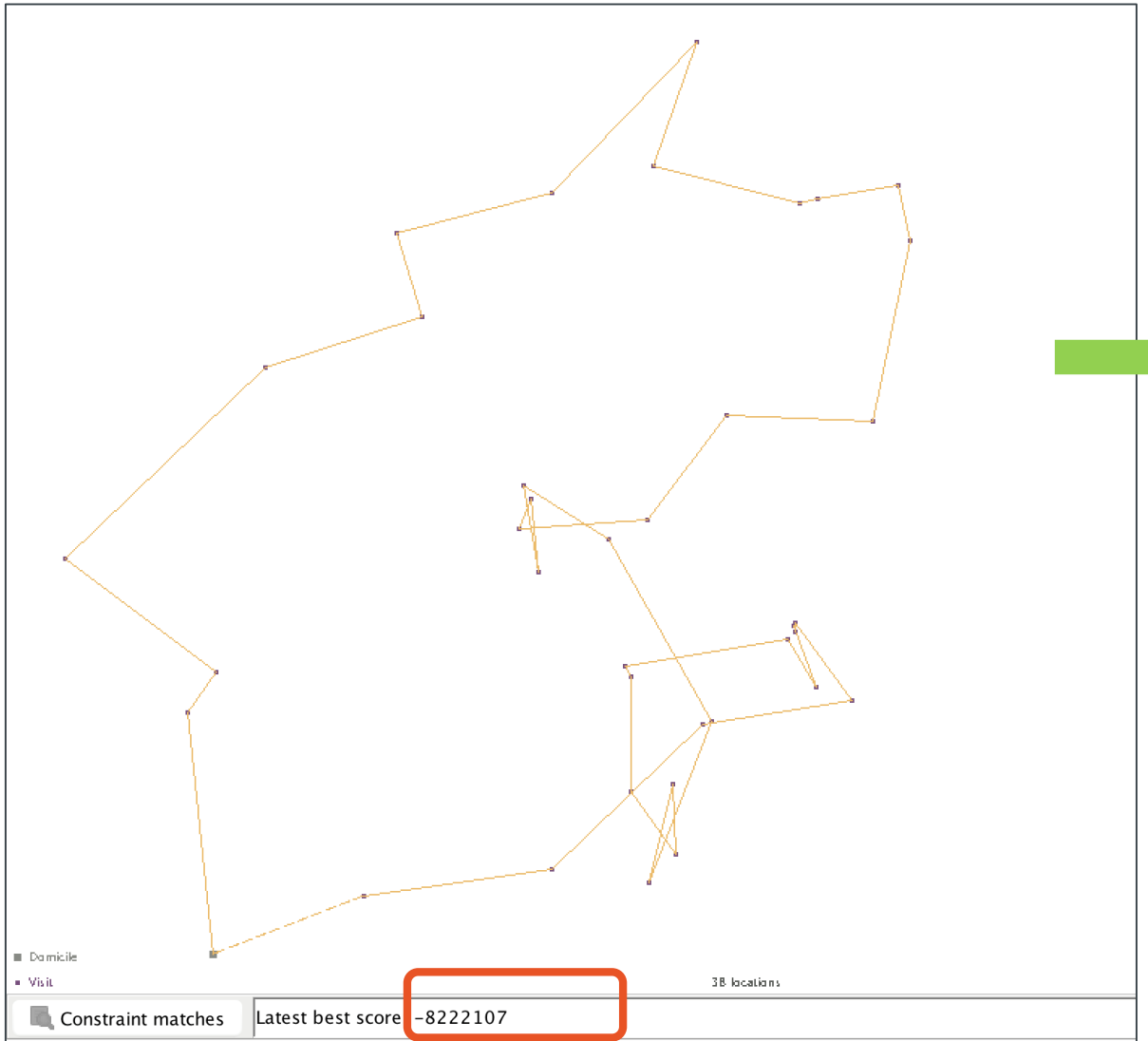
Conventional AI (constraint solving optimization)

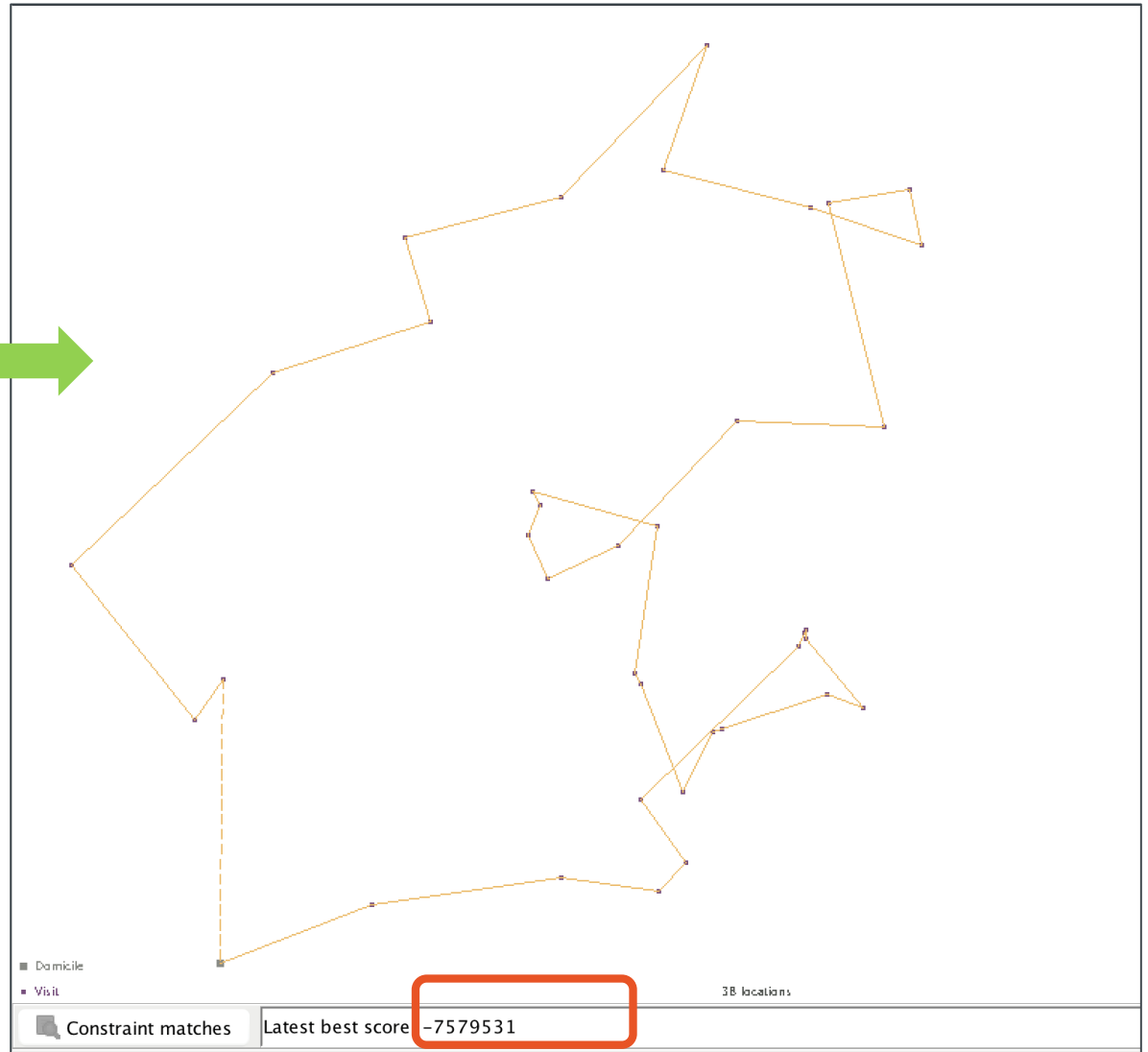
- In the absence of data, write optimization simulations
- Find best Routes from A to B respecting constraints
- Explore State Space using Metaheuristics & collect data





Conventional AI (constraint solving optimization)





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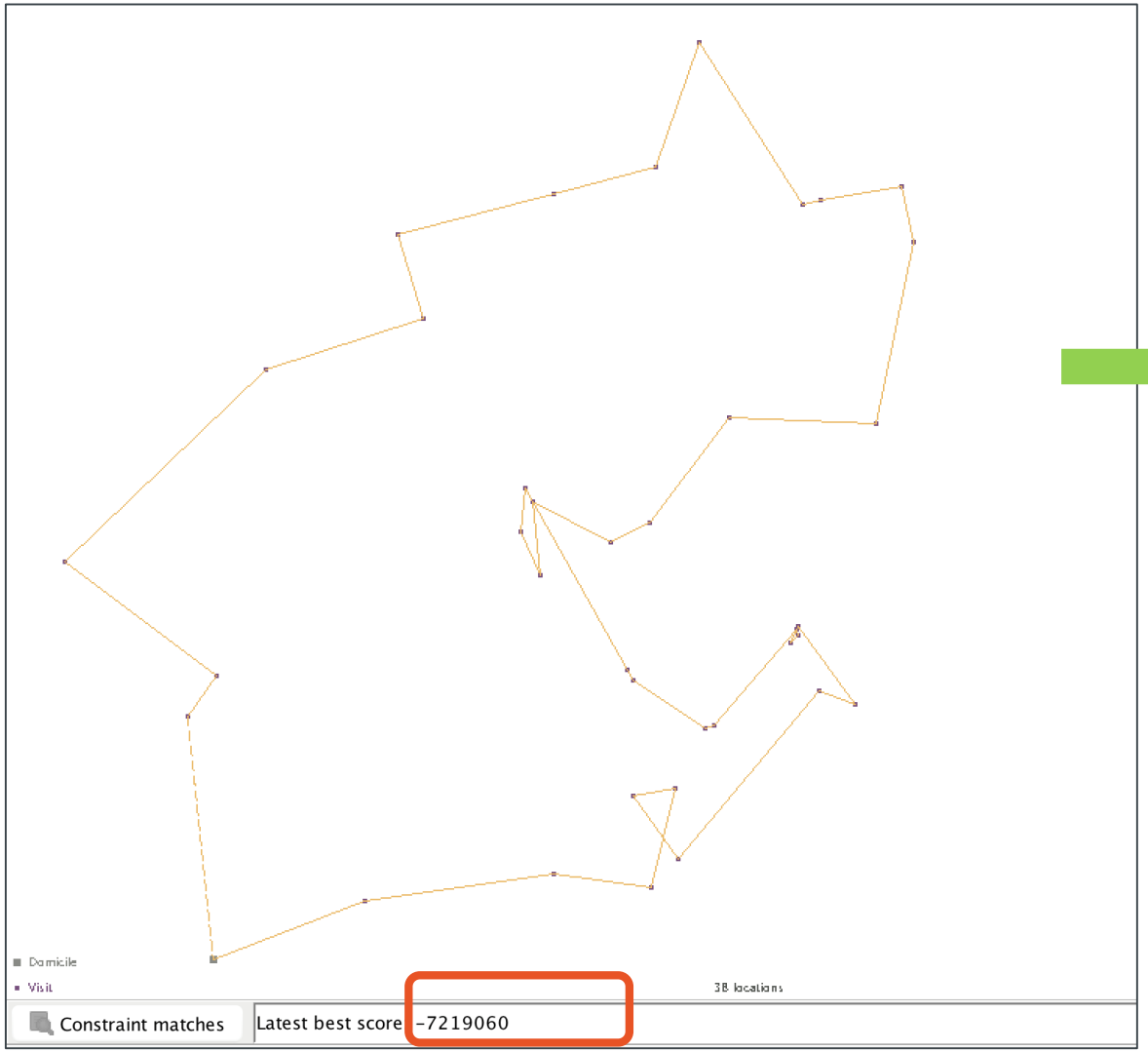
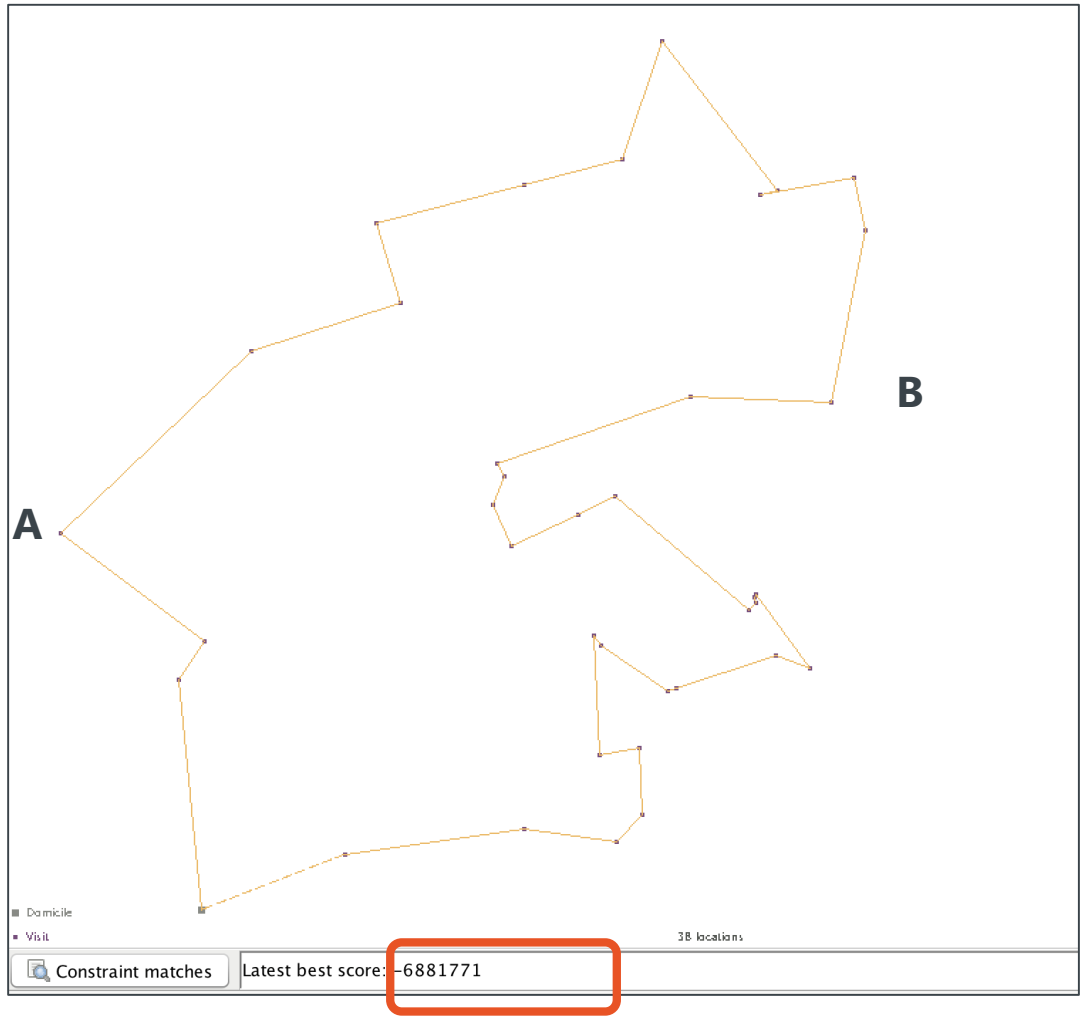


Transferring optimization results into ML model



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Historical Problem Scenarios and their Best Solutions

Train ML model to efficiently find smart routes / schedules by learning from different snapshots of the network explored during online optimization simulations

Transferring optimization results into ML model

- Collect data (network snapshot, solutions) with variation
- Map it to train ML model i.e. we *map* LHS to RHS

Left Hand Side (LHS)	Right Hand Side (RHS)
Snapshot of network: situation 1	Resource allocation solution 1.1
Snapshot of network: situation 1	Resource allocation solution 1.2
Snapshot of network: situation 2	Resource allocation solution 2.1
⋮	⋮
Snapshot of network: situation n	Resource allocation solution n

Transferring Ariadne Experience to RapidMiner Product

- **Generating and Preparing Simulation Data**
  - For various use case scenarios

- **Future Work / Work in Progress**
  - Library
    - Of customizable Optimization Problems and Solutions
  - RapidMiner Extension
    - Constraint solving optimization - being developed in Ariadne for Telco (5G, Beyond5G, 6G) domains
    - Predictive and Prescriptive analytics functions
  - Web Demonstrator
    - To showcase offline and online optimization scenarios and solutions

Stay in touch

- If our work appeals to you, you may stay in touch by following us online

  - **Website:** https://www.ict-ariadne.eu
  - **Twitter:** @AriadneIct
  - **Project Email:** contact@ict-ariadne.eu
  - **RapidMiner Ariadne Research Team Email:** ariadne@rapidminer.com

THANK YOU VERY MUCH

Dr. Edwin Yaqub
Senior Data Scientist
eyaqub@rapidminer.com
@byond2day

Rachana Desai
Research Data Scientist
rdesai@rapidminer.com
@Rachana54824175

Ralf Klinkenberg
Founder & Head of Data Science Research
rklinkenberg@rapidminer.com
@RalfKlinkenberg

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