EURO Meets NeurIPS 2022 Vehicle Routing Competition

Presented by Wouter Kool

ORTEC

EAISI EINDHOVEN AI SYSTEMS INSTITUTE TU/e

EURO THE ASSOCIATION OF EUROPEAN OPERATIONAL RESEARCH SOCIETIES

EWG DSO DATA SCIENCE MEETS OPTIMIZATION

EWG VEROLOG VEHICLE ROUTING AND LOGISTICS

NEURAL INFORMATION PROCESSING SYSTEMS

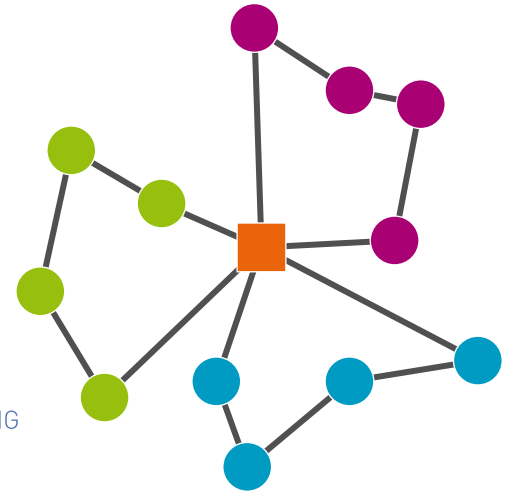
TL;DR

Goal: bring together

Operations Research and *Machine Learning*

to solve a *static* and *dynamic* VRP with time windows!

EURO Meets NeurIPS 2022 Vehicle Routing Competition



EURO
THE ASSOCIATION OF EUROPEAN OPERATIONAL RESEARCH SOCIETIES

EWG DSO
DATA SCIENCE MEETS OPTIMIZATION

EWG VEROLOG
VEHICLE ROUTING AND LOGISTICS

NEURAL INFORMATION PROCESSING SYSTEMS

ORTEC

EAISI EINDHOVEN AI SYSTEMS INSTITUTE

TU/e

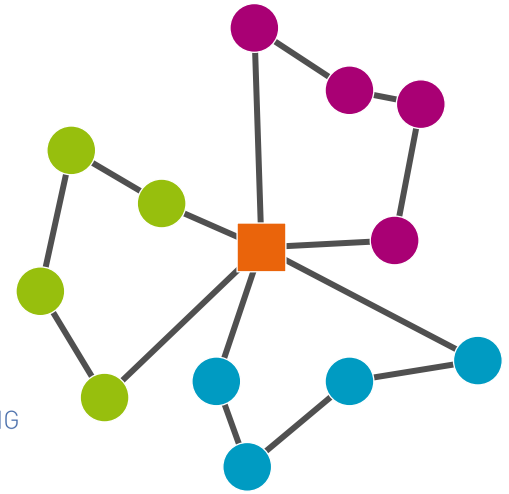
More info? https://euro-neurips-vrp-2022.challenges.ortec.com/

Organizers

- Wouter Kool (ORTEC)
- Laurens Bliek (Eindhoven University of Technology)
- Danilo Numeroso (Università di Pisa)
- Robbert Reijnen (Eindhoven University of Technology)
- Reza Refaei Afshar (Eindhoven University of Technology)
- Yingqian Zhang (Eindhoven University of Technology)
- Tom Catshoek (Delft University of Technology)
- Kevin Tierney (Bielefeld University)
- Eduardo Uchoa (Universidade Federal Fluminense)
- Thibaut Vidal (Polytechnique Montréal)
- Joaquim Gromicho (ORTEC)

EURO Meets NeurIPS 2022 Vehicle Routing Competition

EURO
THE ASSOCIATION OF EUROPEAN OPERATIONAL RESEARCH SOCIETIES



EWG DSO DATA SCIENCE MEETS OPTIMIZATION

EWG VEROLOG VEHICLE ROUTING AND LOGISTICS

NEURAL INFORMATION PROCESSING SYSTEMS

ORTEC

EAISI EINDHOVEN AI SYSTEMS INSTITUTE

TU/e

Previous challenges

VeRoLog Solver Challenge 2019

ORTEC

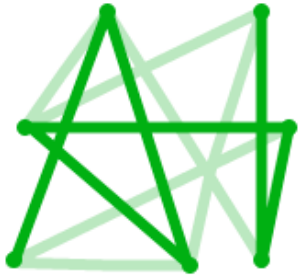
2019 Practical Vehicle Routing Challenge

VRP

DIMACS Implementation Challenge

2021/2022

Different VRP problems



AI for TSP Competition

2021 ML-oriented TSP solving

Joining forces to organize this competition!

The goal

"*Goal: bring together researchers from Operations Research and Machine Learning*

to push the state-of-the-art in solving a (static and dynamic) Vehicle Routing Problem with Time Windows!"

Why?

"

Logistics optimization (vehicle routing) is extremely important to save

- *Time*
- *Costs*
- *Environmental impact*
- *Etc.*

"

ORTEC

Why?

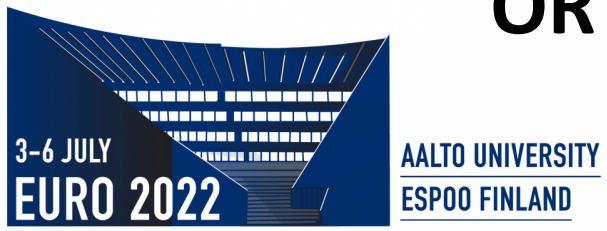
Operations Research (OR)

- OR researchers also start using ML
- but often ‘simple’ techniques
- leaving deep learning potential on the table!

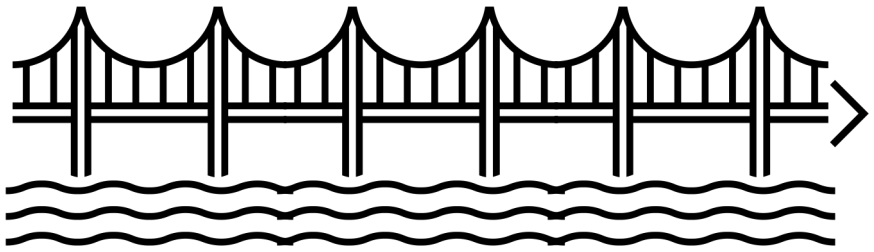
Machine Learning (ML)

- ML research for VRP is hot…
- but unable to outperform SOTA OR techniques
- and fair/independent comparison is lacking!

To get the best results, we must *bridge the gap* between OR and ML

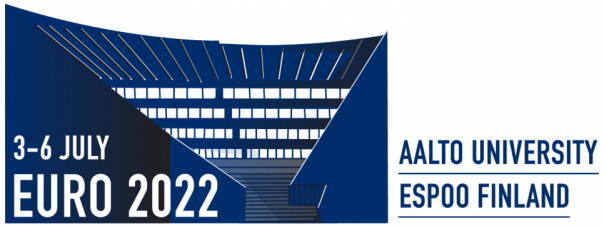


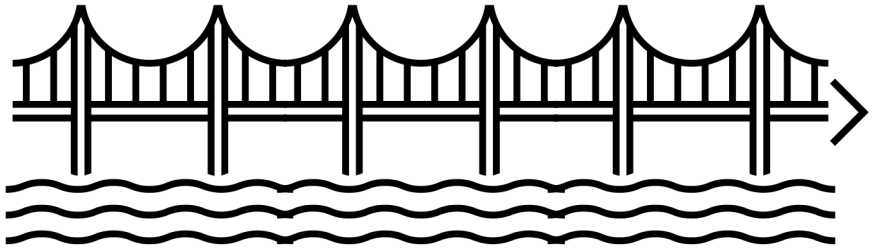
OR



ML

How?





- Starting the competition at EURO (OR) and end it at NeurIPS (ML)
- Bringing together participants from OR and ML community
- Adding real data from US-based grocery delivery service
- Providing a SOTA VRPTW baseline (Hybrid Genetic Search)
- Encouraging ML approaches by GPU availability and dynamic variant

ORTEC

EURO Meets NeurIPS 2022 Vehicle Routing Competition

NeurIPS 2022 Competition

Introduction | Timeline | Problem | Prizes | Rules | Leaderboard | Organization

Introduction

The *EURO Meets NeurIPS 2022 Vehicle Routing Competition* brings together researchers from operations research (OR) and machine learning (ML) to address the vehicle routing problem with time windows (VRPTW) as well as a dynamic VRPTW.

ORTEC

Timeline

Start of competition

Quickstart available

Start code submission

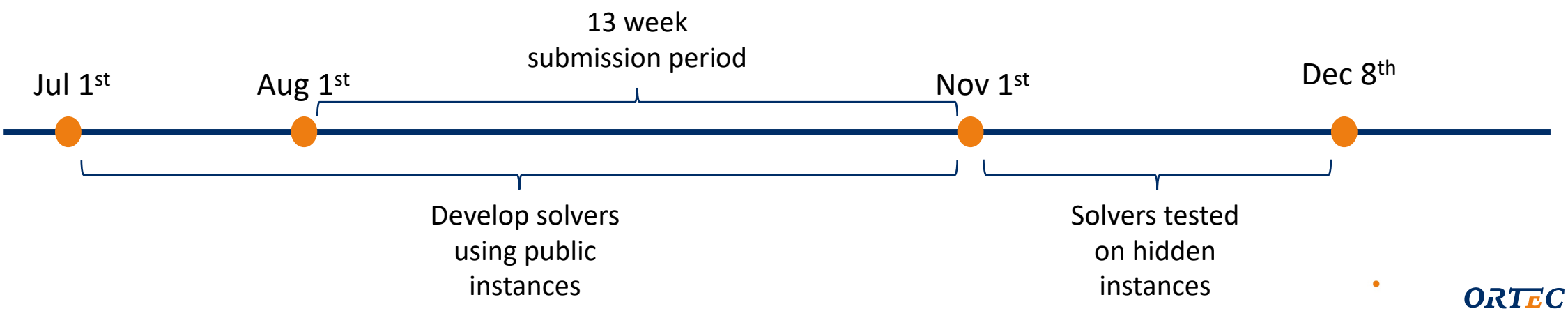
Leaderboard available

End code submission

Finalists selected

End of competition

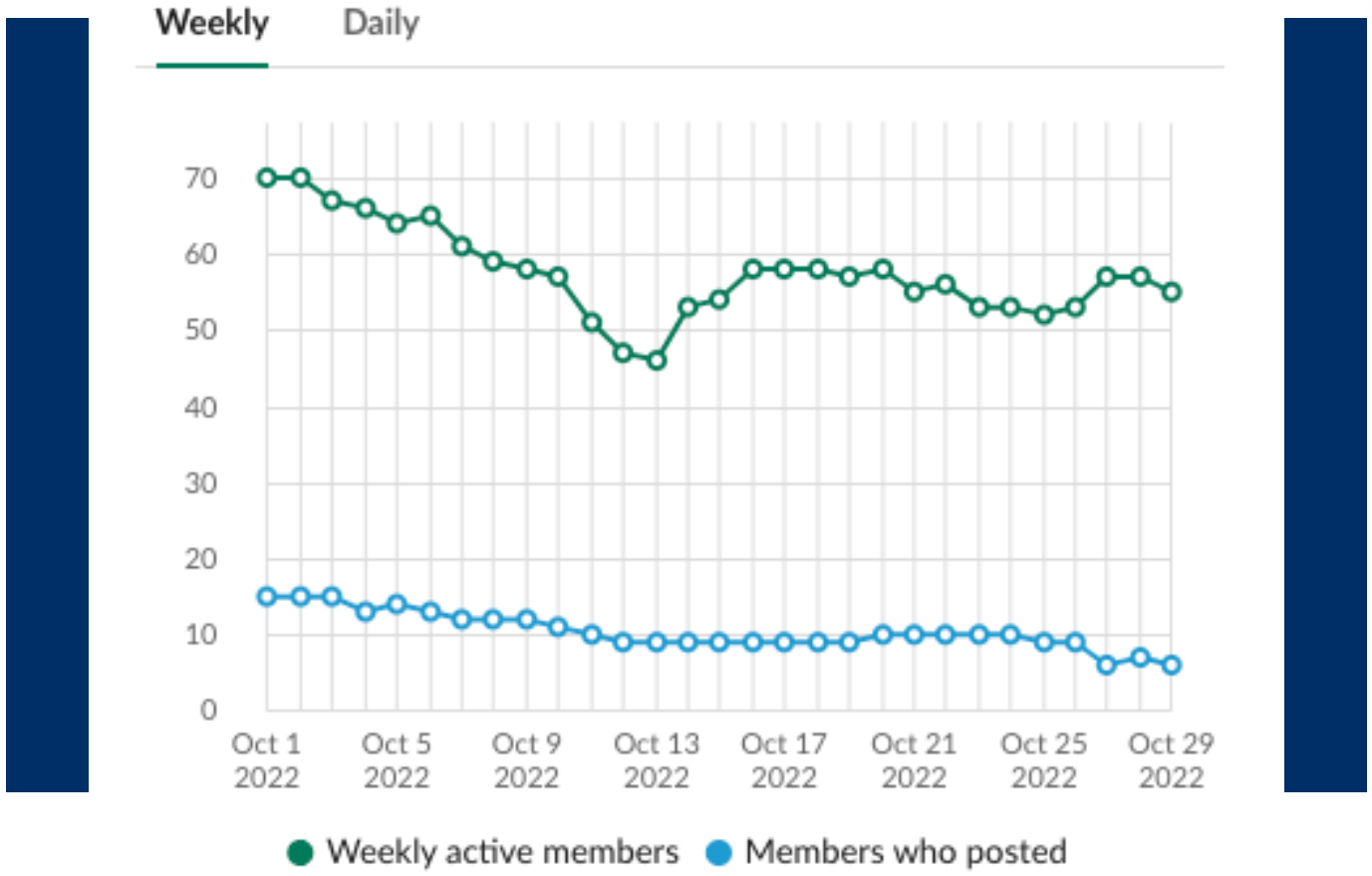
NeurIPS 2022 virtual workshop & winner announcement



Some statistics

- 150 teams registered
- 50 teams submitted
- 800 submissions

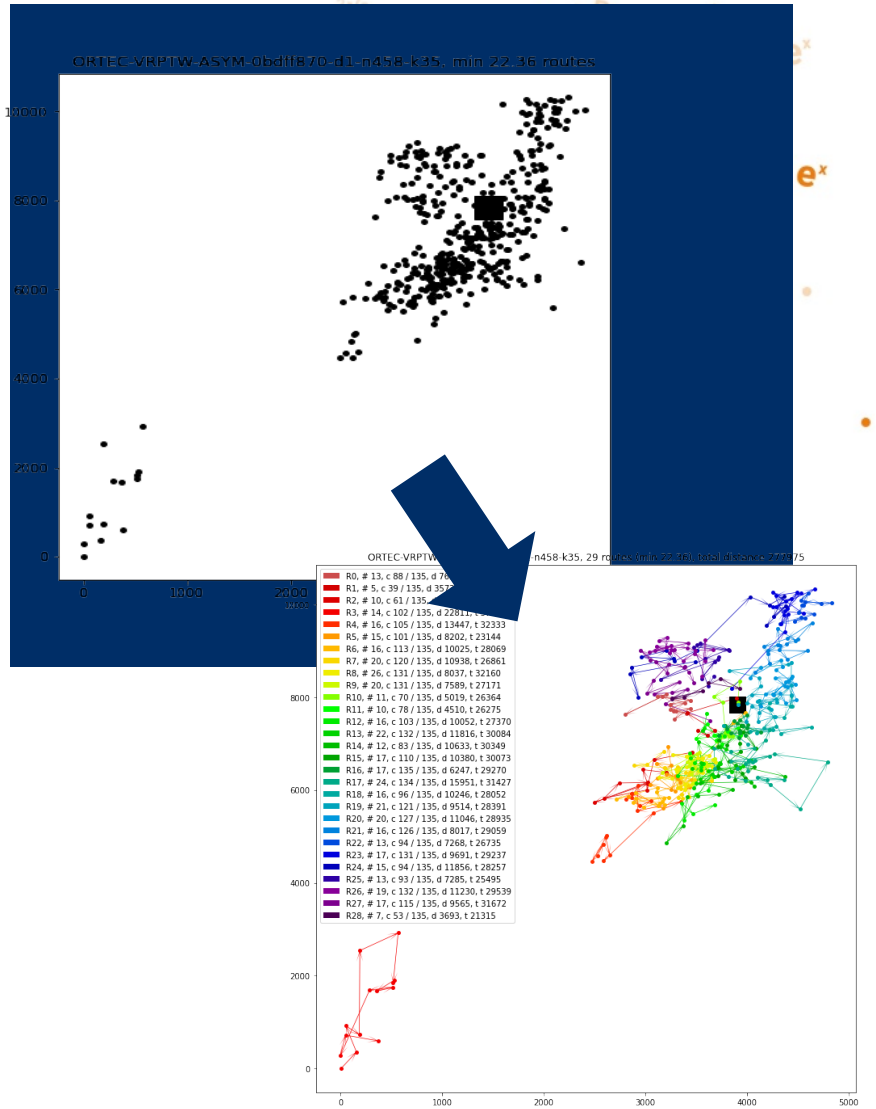
- 180 people on Slack
- 4500 messages



ORTEC

The Vehicle Routing Problem with Time Windows (VRPTW)

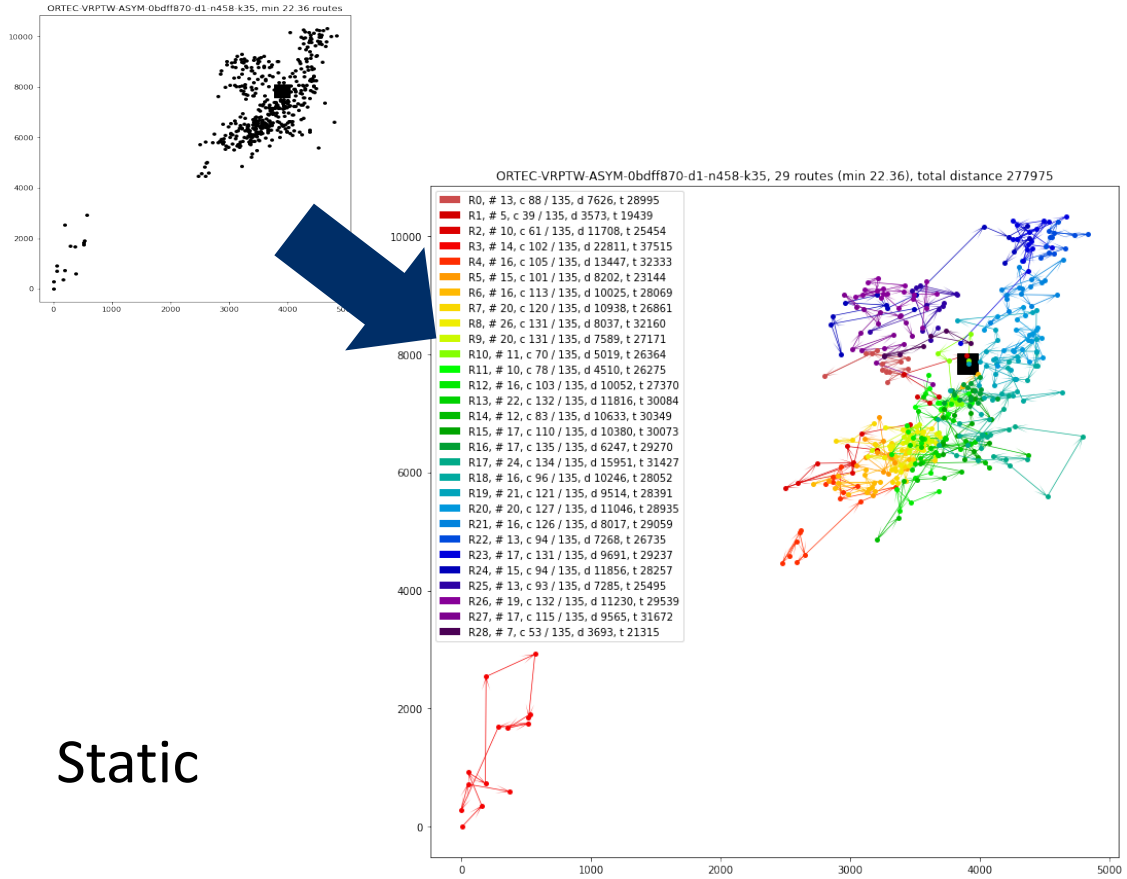
- Vehicle routing problem with limited vehicle capacities
- Every customer must be served within a time window
- Objective: minimize driving duration only*



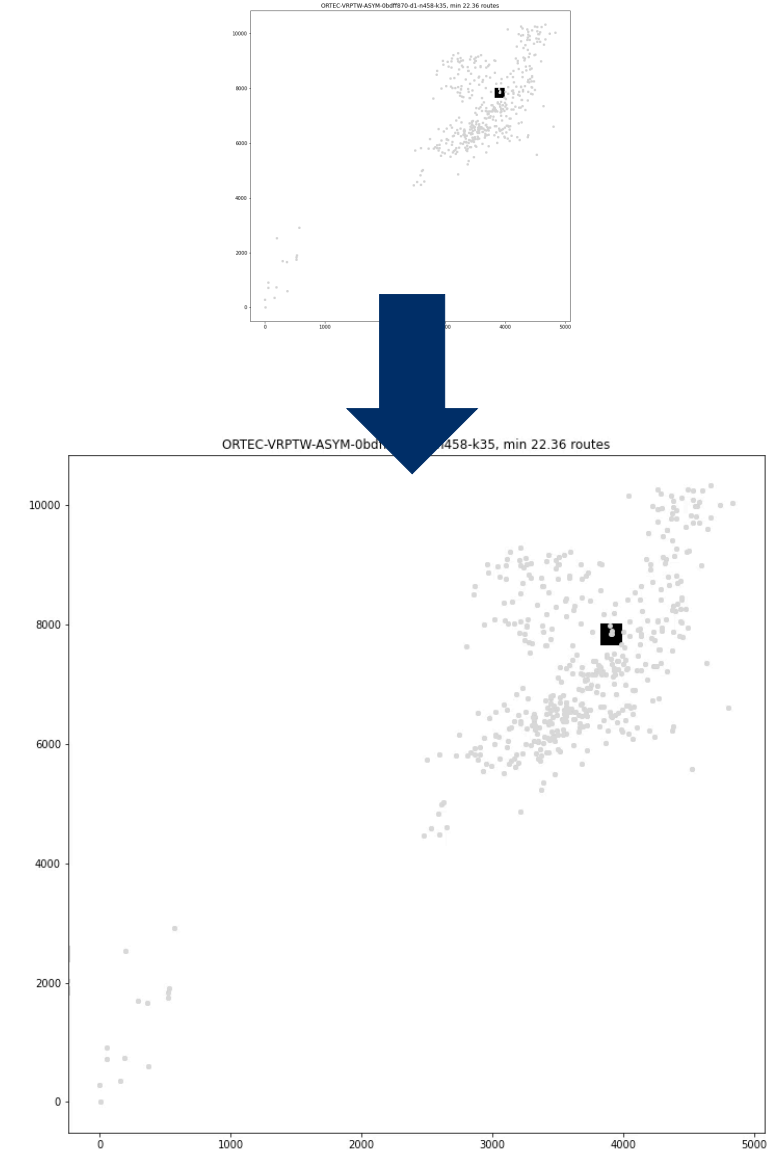
* Following DIMACS convention we do not minimize vehicles, wait time, etc.

ORTEC

Static and dynamic variant

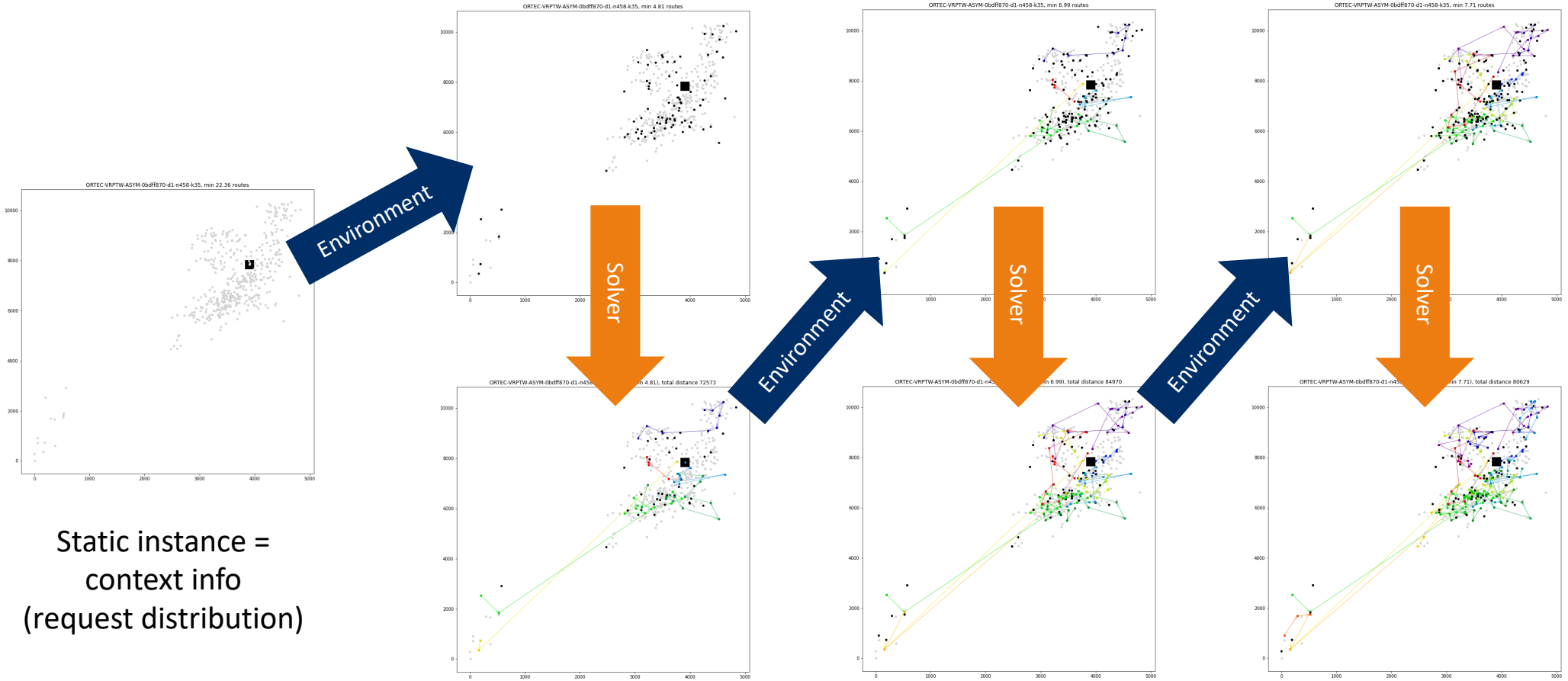


Static



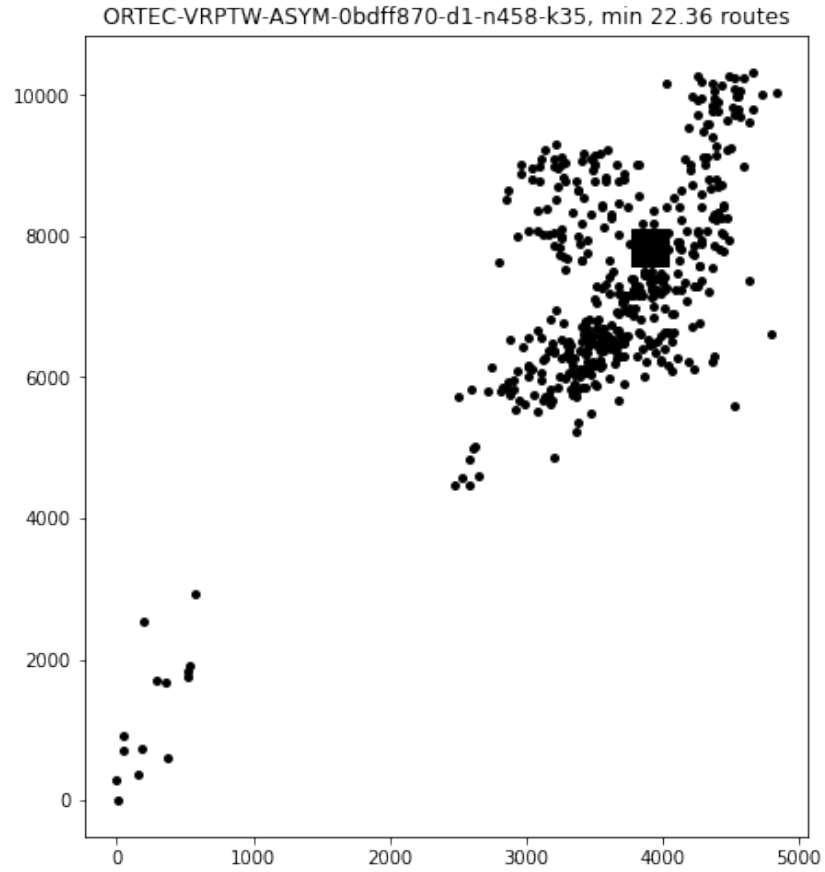
Dynamic

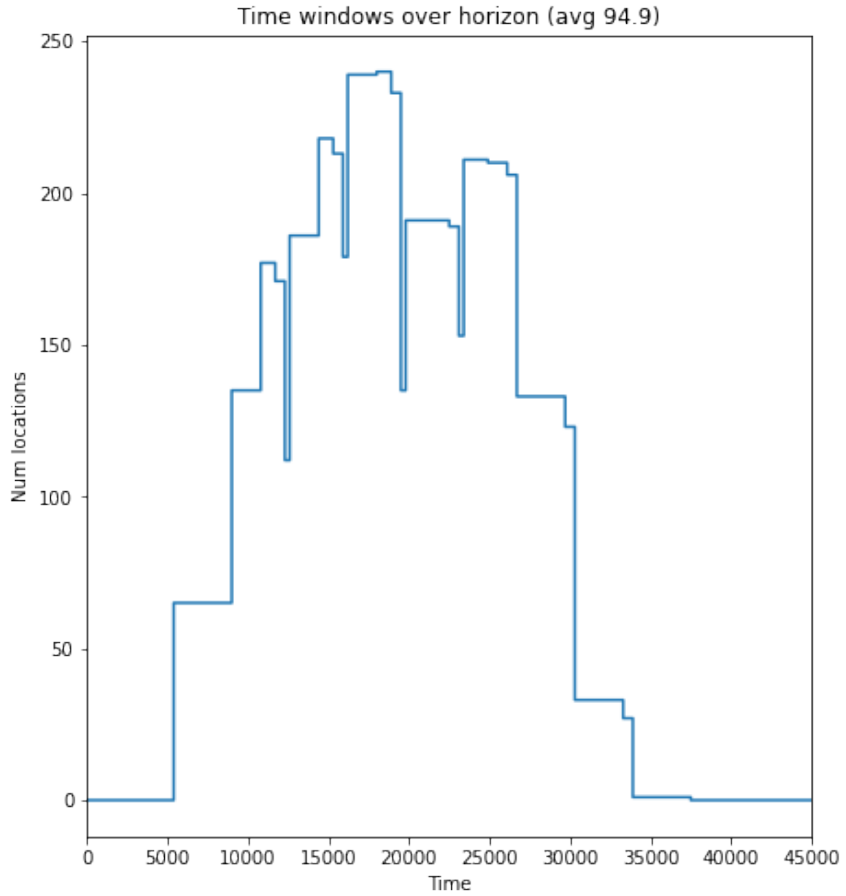
Dynamic variant

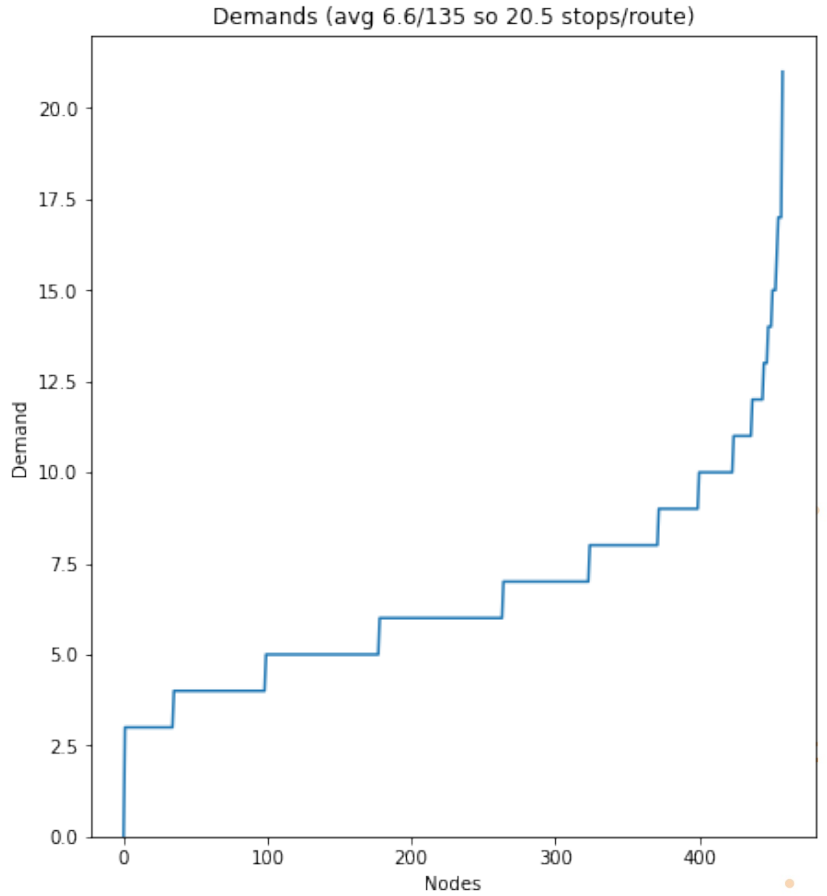


Static instance =
context info
(request distribution)

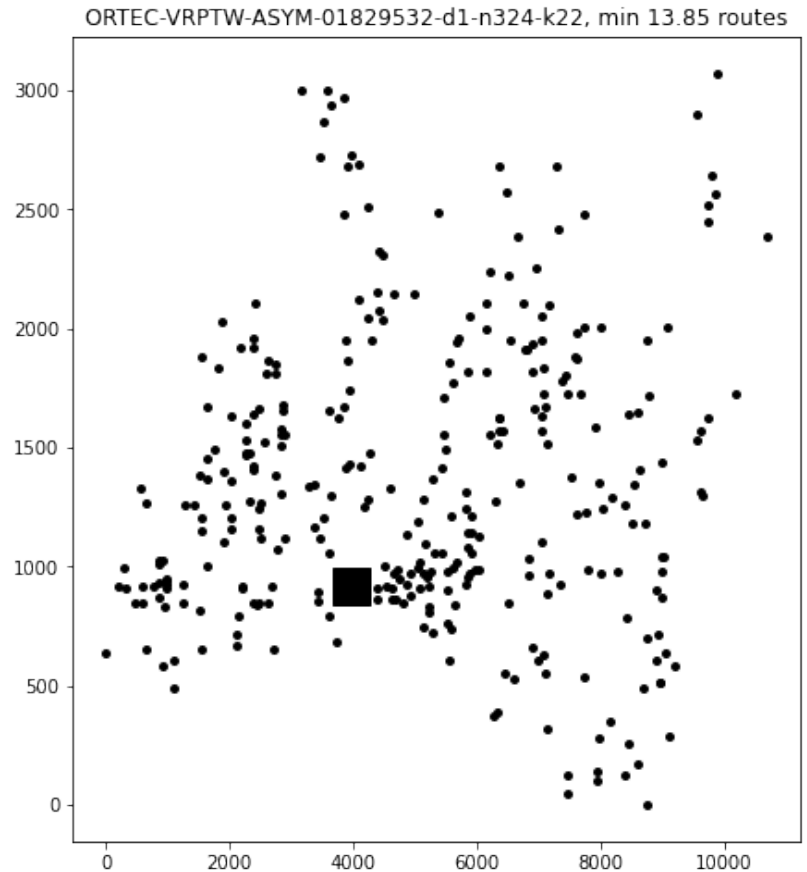
Instance ORTEC-VRPTW-ASYM-0bdff870-d1-n458-k35

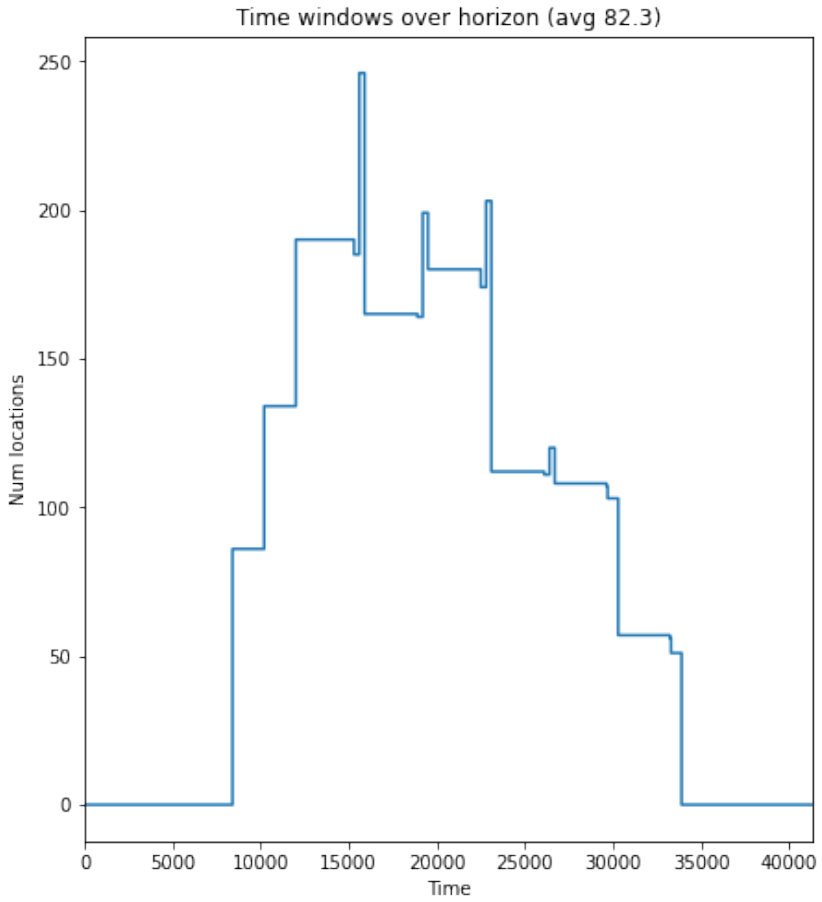


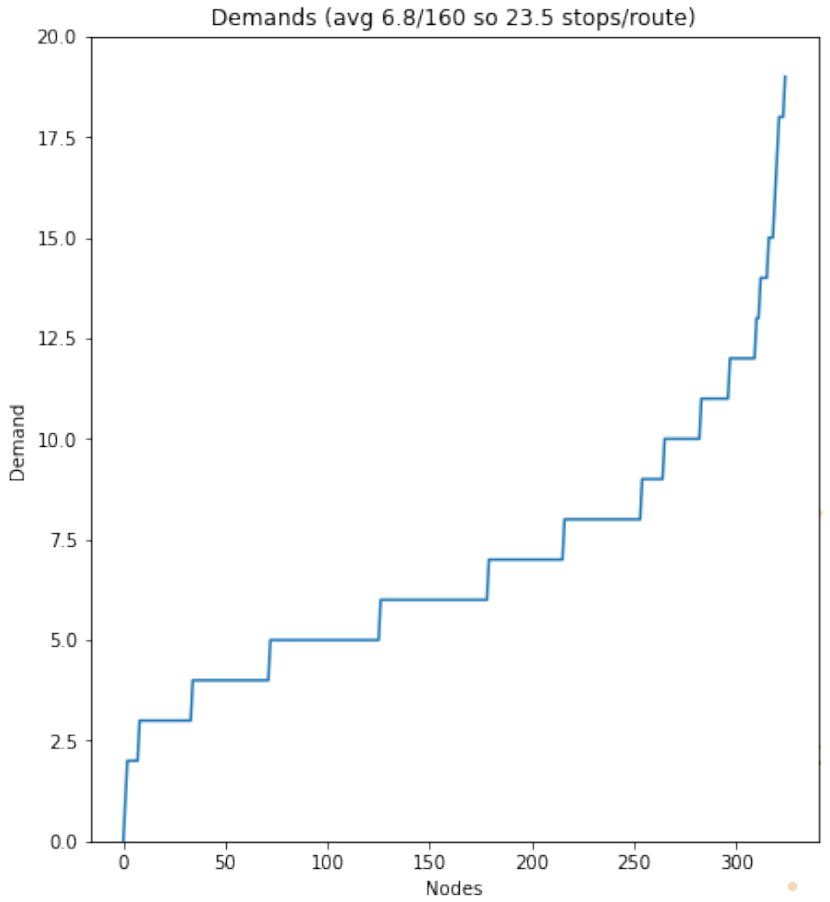




Instance ORTEC-VRPTW-ASYM-01829532-d1-n324-k22







Quickstart for EURO Meets NeurIPS 2022 Vehicle Routing Competition

Quickstart code for the EURO Meets NeurIPS 2022 Vehicle Routing Competition.

Introduction

The EURO Meets NeurIPS 2022 Vehicle Routing Competition focuses on the classic Vehicle Routing Problem with Time Windows (VRPTW), as well as a dynamic variant in which orders arrive at different epochs during the day. Important: all submitted solvers compete *on both problem variants*, which is facilitated using the provided baseline strategy to use a static solver to solve the dynamic variant. The complete description of the problem setting is provided on the main webpage of the competition.

This repository provides all the necessary code to start the competition. It includes a simple baseline method based on HGS-VRPTW as a static solver, along with examples of the use of the controller code designed to evaluate the algorithms.

Stay updated!

Note: we will keep updating this repository with additional baselines, tools, information about code submission etc. to help you get most out of this competition! To stay updated, check back regularly, follow us on Twitter and join the Slack workspace, which is also the place to ask questions! Don't forget to register your team!

Installation

The evaluation scripts are provided in Python, and the baseline solver (HGS-VRPTW) is implemented in C++. We recommend to create a virtual environment using `Python 3.8+` to run the codes. Therefore, make sure that Python is installed, along with venv and a C++ compiler and make. On Windows, we recommend using Visual Studio or using MinGW and installing make through Chocolatey (run `choco install make` as administrator). Then, run the following commands (Linux or Mac OS):

https://github.com/ortec/euro-neurips-vrp-2022-quickstart

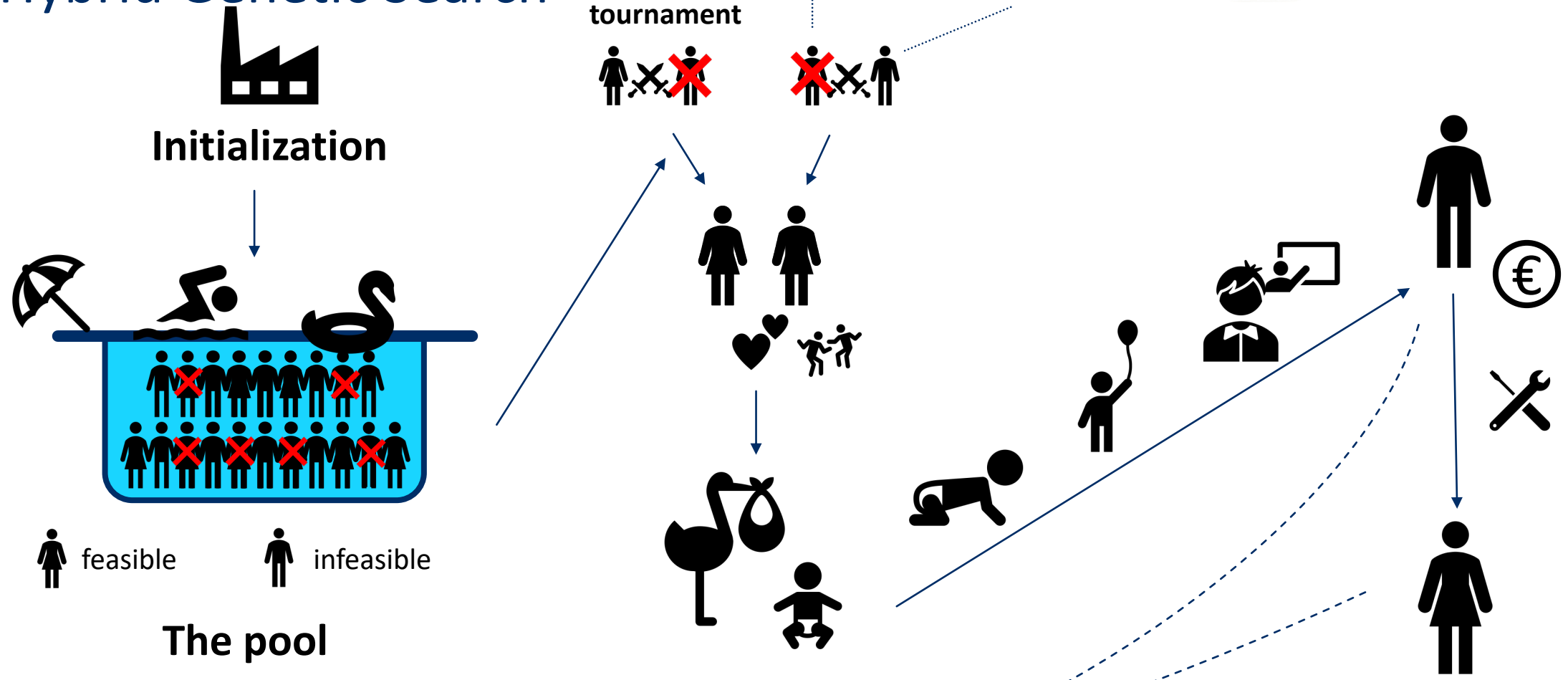
Quickstart on GitHub

- Data
- Environment
- Baselines:
  - Hybrid Genetic Search (static)
  - Greedy/Lazy/Random (dynamic)
  - Supervised/RL + GNN/DQN (dynamic)
- Tools
- Controller
- Codalab submission instructions

ORTEC

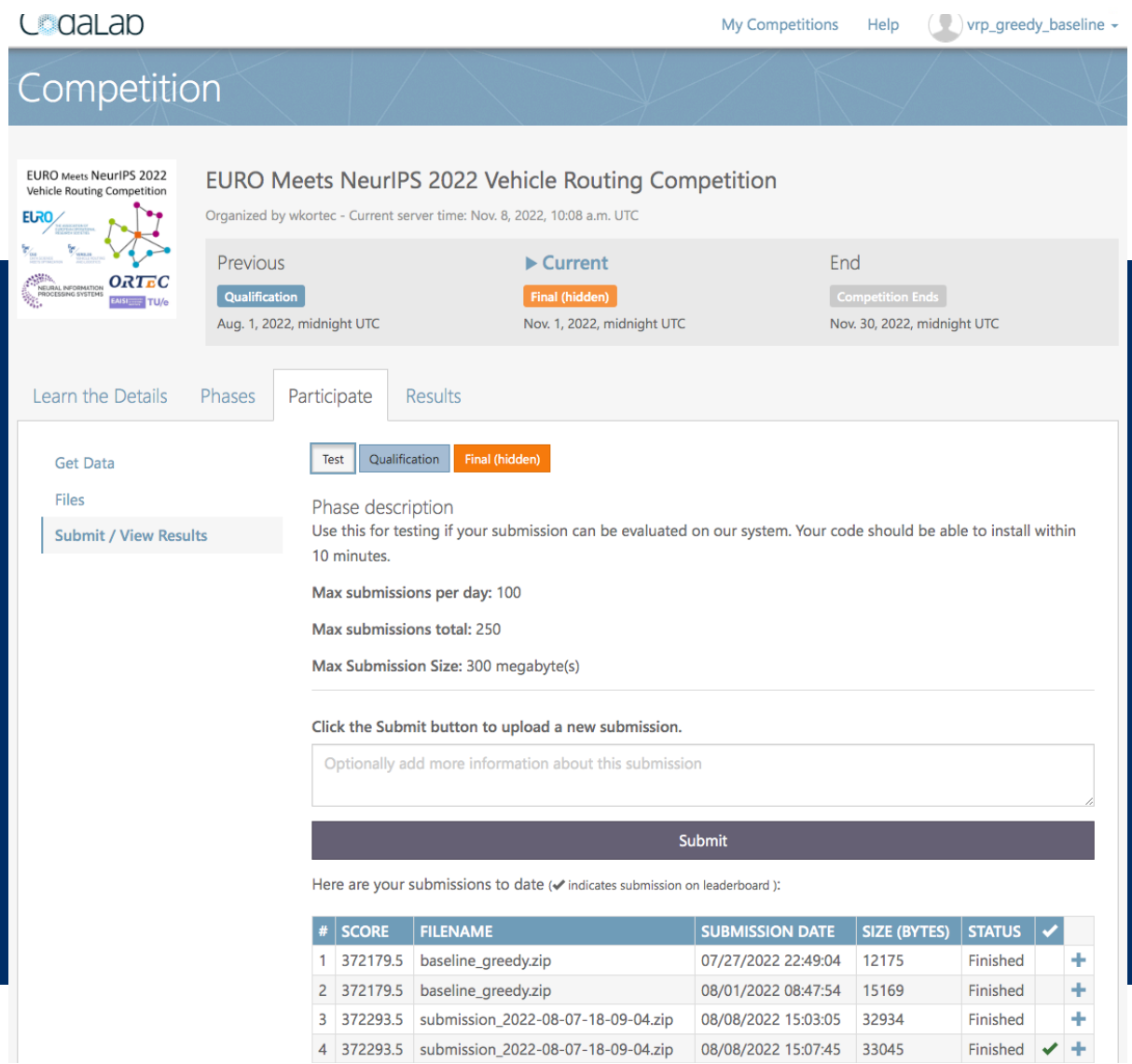
SOTA Baseline: Hybrid Genetic Search

VRPTW Winner



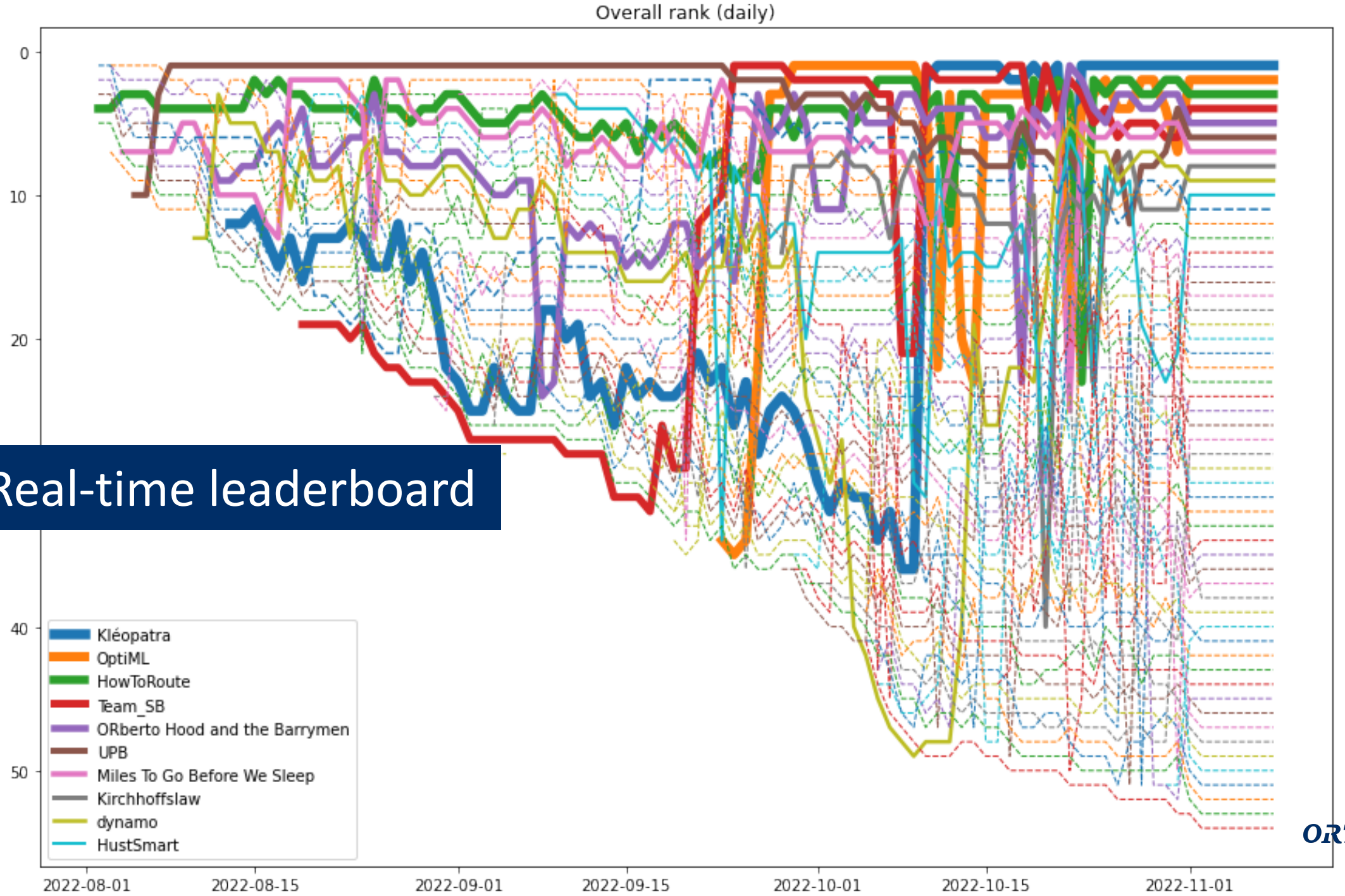
Code submission

- CodaLab platform
- GPU workers on SURF cluster
- To make submission run as jobs:
  - Docker -> Singularity
  - Custom worker that stops when queue empty
  - Monitoring script to spin up jobs
- Custom leaderboard
- Hourly logging of leaderboard
- Allowed 1 submission/day
- Testing ‘phase’ + qualification



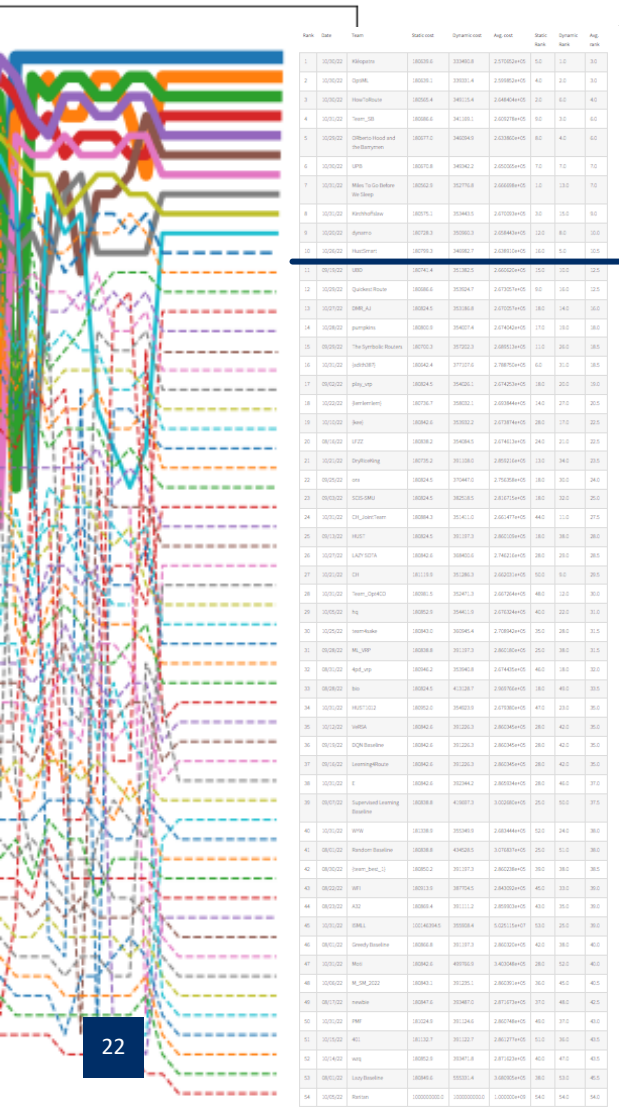
ORTEC

Real-time leaderboard



ORTEC

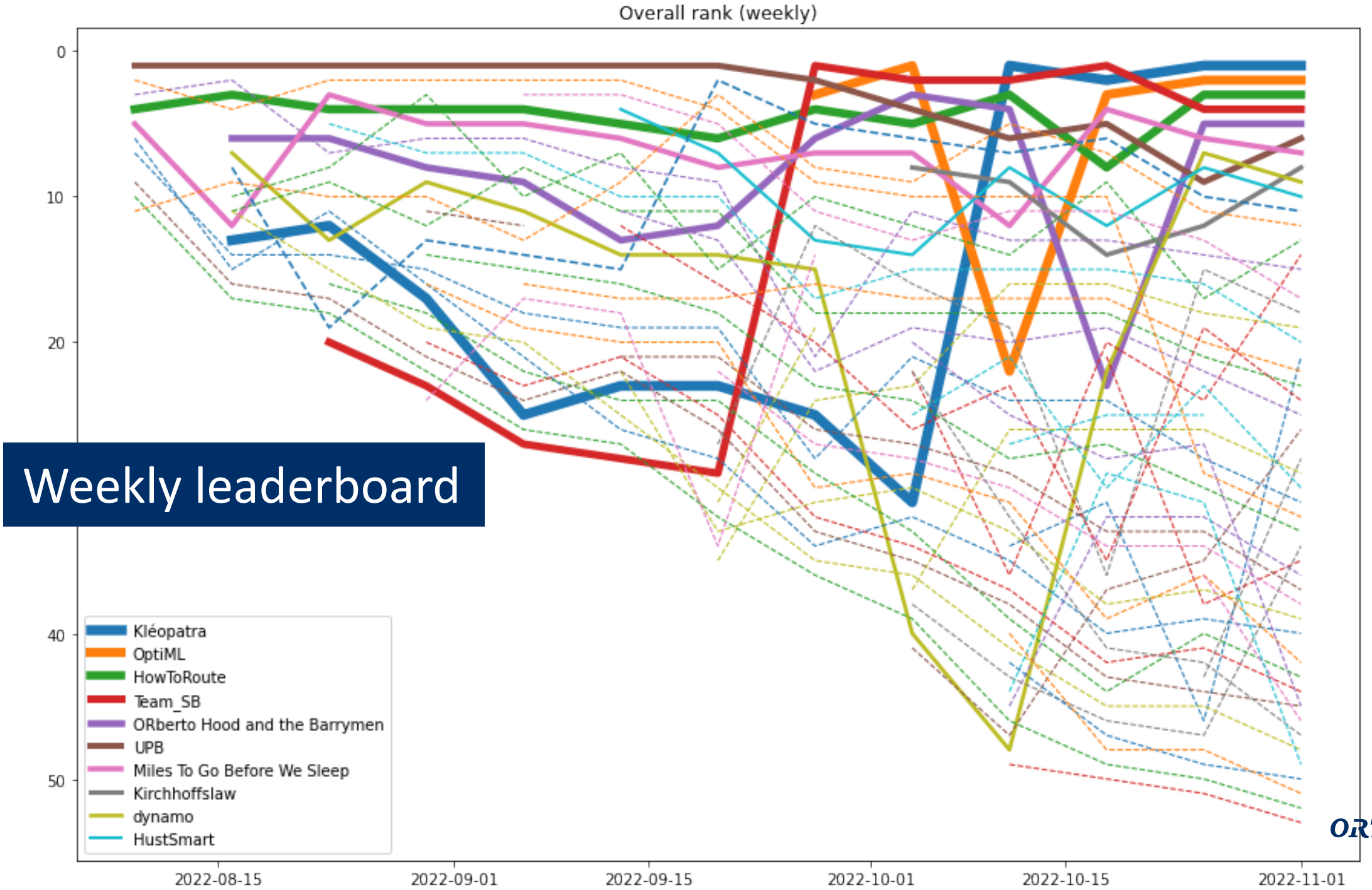
Leaderboard



Rank	Date	Team	Static cost	Dynamic cost	Avg. cost	Static Rank	Dynamic Rank	Avg. rank
1	10/30/22	Kléopatra	180639.6	333490.8	2.570652e+05	5.0	1.0	3.0
2	10/30/22	OptiML	180639.1	339331.4	2.599852e+05	4.0	2.0	3.0
3	10/30/22	HowToRoute	180565.4	349115.4	2.648404e+05	2.0	6.0	4.0
4	10/31/22	Team_SB	180686.6	341169.1	2.609278e+05	9.0	3.0	6.0
5	10/29/22	ORberto Hood and the Barrymen	180677.0	346094.9	2.633860e+05	8.0	4.0	6.0
6	10/30/22	UPB	180670.8	349342.2	2.650065e+05	7.0	7.0	7.0
7	10/31/22	Miles To Go Before We Sleep	180562.9	352776.8	2.666698e+05	1.0	13.0	7.0
8	10/31/22	Kirchhoffslaw	180575.1	353443.5	2.670093e+05	3.0	15.0	9.0
9	10/20/22	dynamo	180728.3	350960.3	2.658443e+05	12.0	8.0	10.0
10	10/26/22	HustSmart	180799.3	346982.7	2.638910e+05	16.0	5.0	10.5

ORTEC

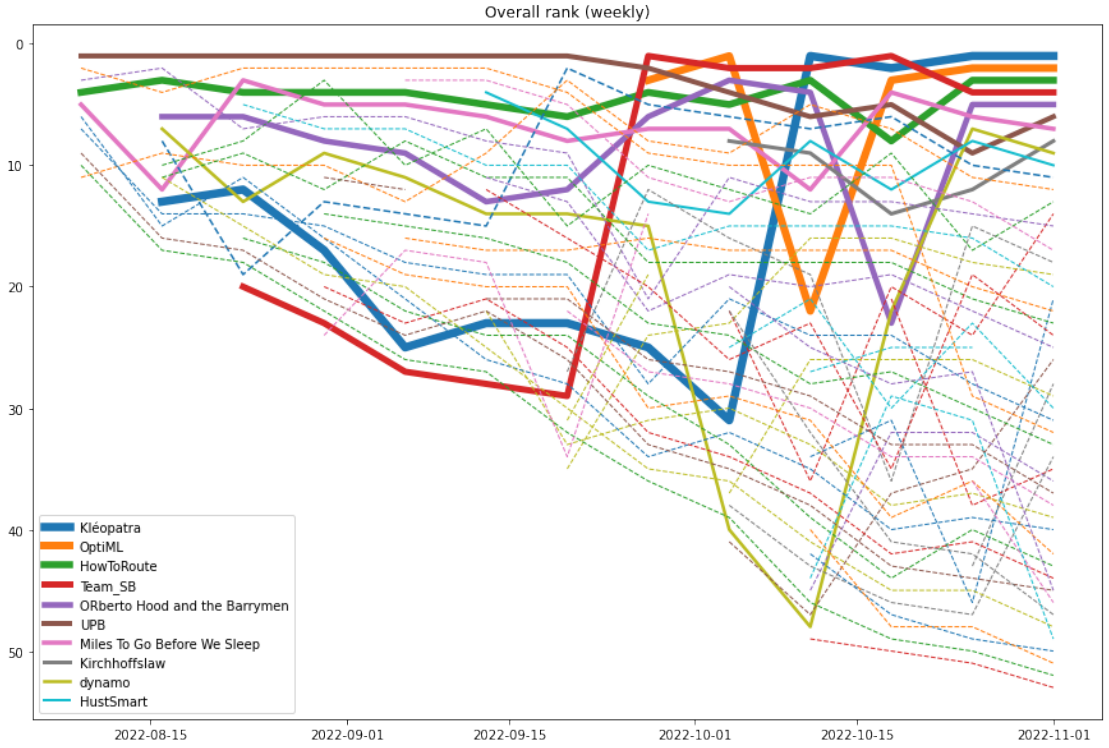
Weekly leaderboard



ORTEC

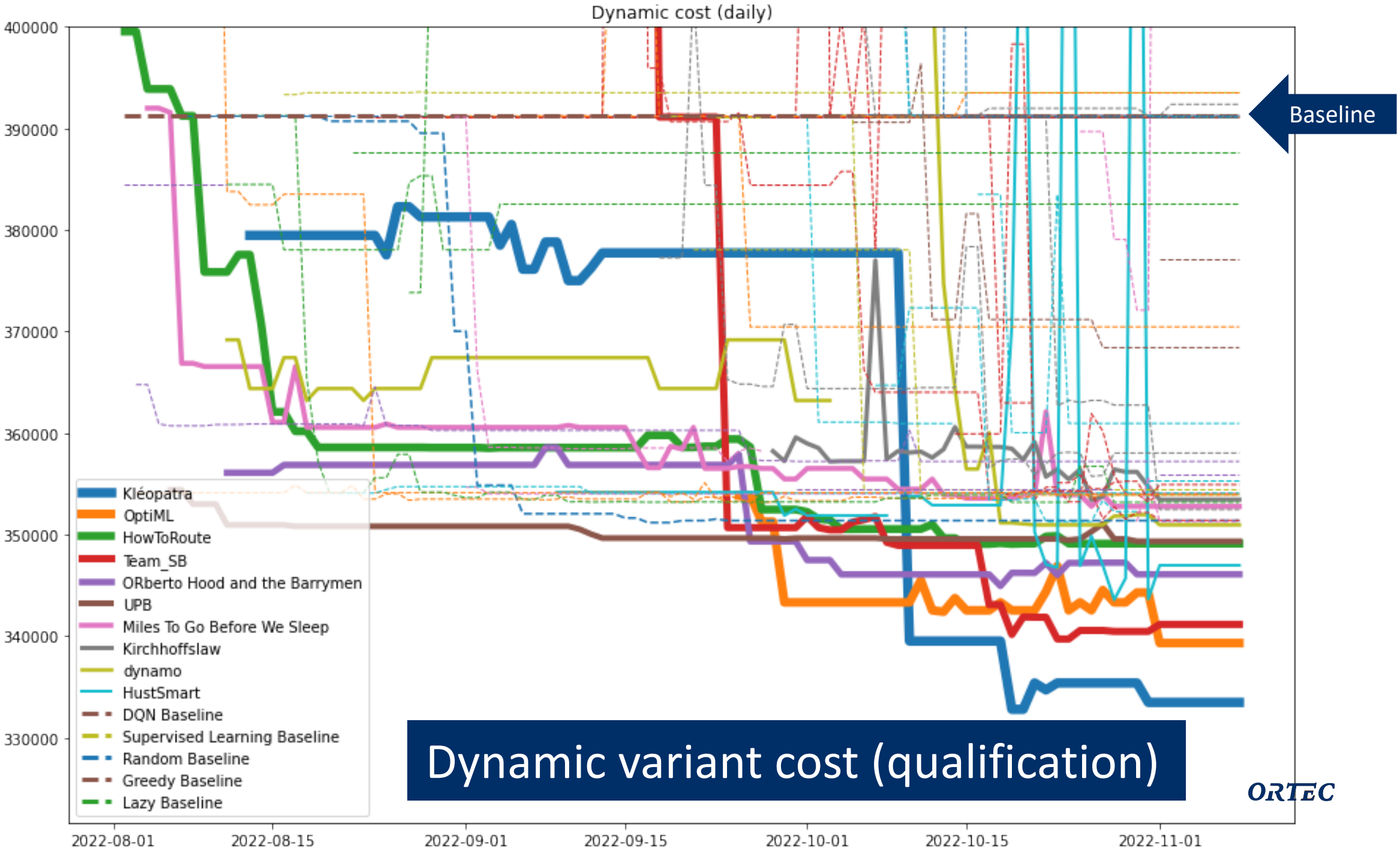
Leaderboard prizes

Weekly:
1st: 50 euros
2nd: 30 euros
3rd: 20 euros



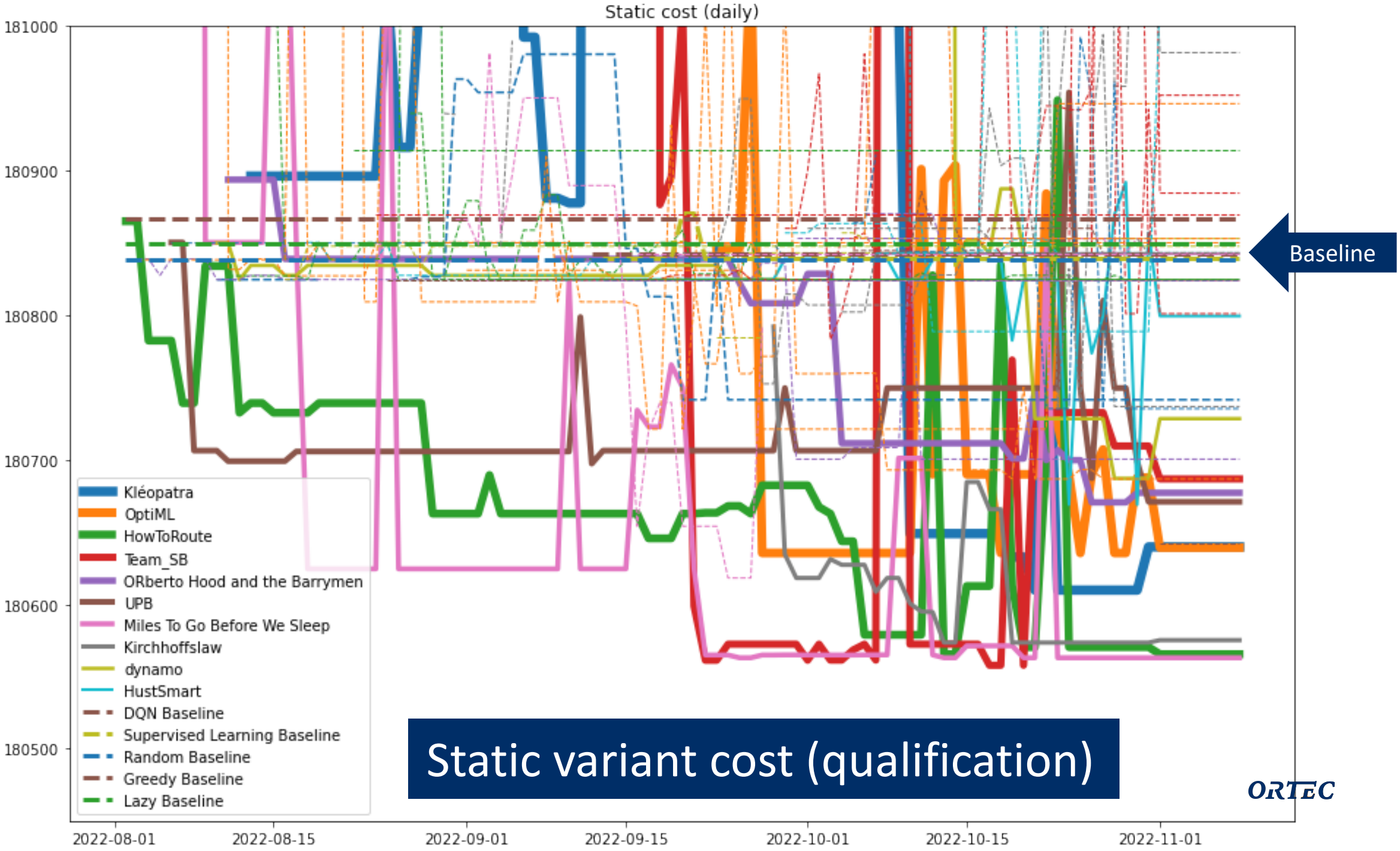
	1	2	3	leaderboard_prize
UPB	7	1	0	380
Kléopatra	3	1	0	180
Team_SB	2	2	0	160
4pd_vrp	0	5	0	150
OptiML	1	2	2	150
HowToRoute	0	0	4	80
The Symbolic Routers	0	1	1	50
play_vrp	0	0	2	40
UBD	0	1	0	30
Quickest Route	0	0	1	20
Miles To Go Before We Sleep	0	0	1	20
ORberto Hood and the Barrymen	0	0	1	20
DMR_AJ	0	0	1	20

ORTEC



Dynamic variant cost (qualification)

ORTEC



Static variant cost (qualification)

ORTEC

The finals

- Top 10 solvers from qualification phase
- 100 new instances (from same source)
- +- 2x longer runtimes
- Results announced at NeurIPS 2022 virtual workshop

- Prizes (5000+ euros):
  - 1st/2nd/3rd: 2022/750/500 euros
  - Jury prize: 250 euros
  - Young talent prize: 250 euros
  - (Leaderboard prizes: 1300 euros)

ORTEC

NeurIPS 2022 Virtual Workshop

- Keynote presentation
- 5-minute presentations of finalists
- Announcement of results
- Socials/discussion
- Wednesday Dec 7th 13:00-16:00 UTC (check local time online)

https://neurips.cc/virtual/2022/competition/50085

ORTEC

OPTIMIZED BY ORTEC
ORTEC.COM