NVIDIA CUOPT

ACCELERATING LOGISTICS AND OPERATIONAL RESEARCH

OPTIMIZING LOGISTICS AND OPERATIONS OPTIMIZATION ACROSS INDUSTRIES

Manufacturing
Optimum circuits

Transportation
Multi constraints optimization

Last Mile Delivery
Dynamic route planning

Smart Factory
Warehouse picking

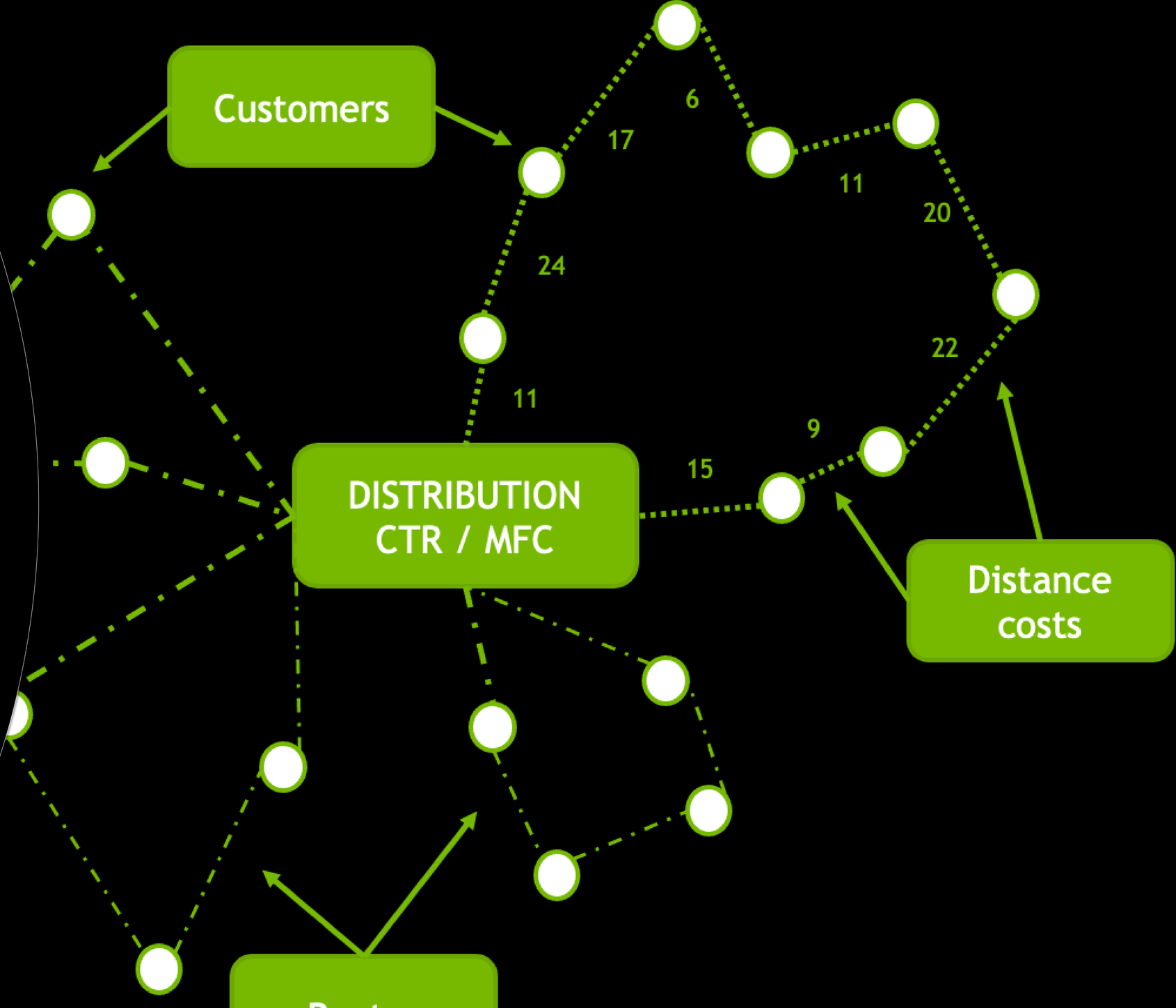
Simulation (OV)
Simulate hundreds of scenarios

Supply Chain
Scale to largest problems

NVIDIA

LOGISTICS INDUSTRY CHALLENGES

- In 2020, parcel shipping exceeded 131 billion in volume globally and it's likely to more than double by 2026.[1]
- Transport and logistics companies face changing economic and geo-political landscape within the industry.
- Last Mile Delivery (LMD) has become the most expensive portion of the logistics fulfillment chain, representing over 41% of overall supply chain costs.[2]
- Affects industries like retail, quick service restaurants (QSRs), consumer packaged goods (CPG), and manufacturing
- Challenges include shrinking delivery timelines, profitability concerns, scaling issues, and numerous evolving delivery options.
- Reducing these challenges is critical for businesses to fully optimize the final leg of the transportation journey and reduce the total cost of delivery.



[1] *Source: Pitney Bowes Parcel Shipping Index)*

[2] Source: Capgemini Research Institute, The Last-Mile Delivery Challenge).

VEHICLE ROUTING PROBLEM

- Vehicle Routing Problem (VRP) asks "What is the optimal set of routes for a fleet of vehicles to traverse in order to deliver to a given set of customers?"
- Operations Research (OR) and logistics issues at greater scale are incredibly compute intensive with massive operational costs.
- As the number of destinations increases, the corresponding number of roundtrips surpasses the capabilities of even the fastest supercomputers.
- With 10 destinations, there can be more than 300,000 roundtrip permutations and combinations. With 15 destinations, the number of possible routes could exceed a trillion.
- Adjusting for changes in these parameters due to inclement weather, a driver out sick, vehicle maintenance, and new orders greatly increases the scope of the problem.

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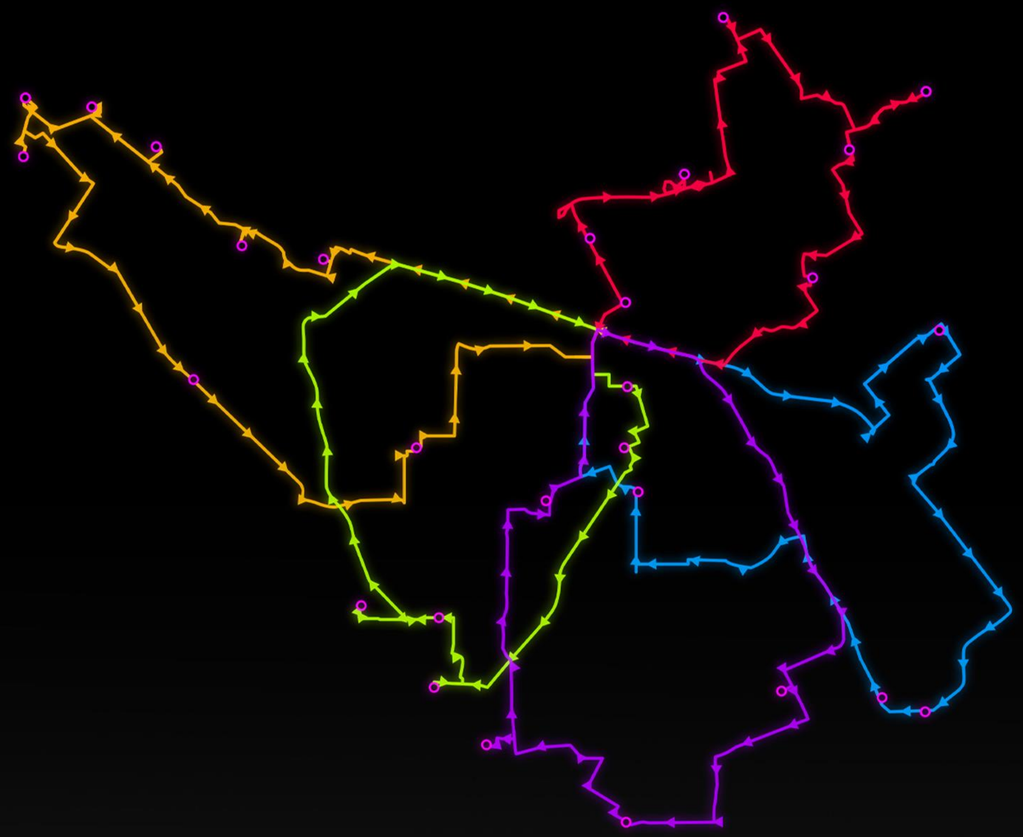
Fast, Accurate, and Scalable Route Optimization

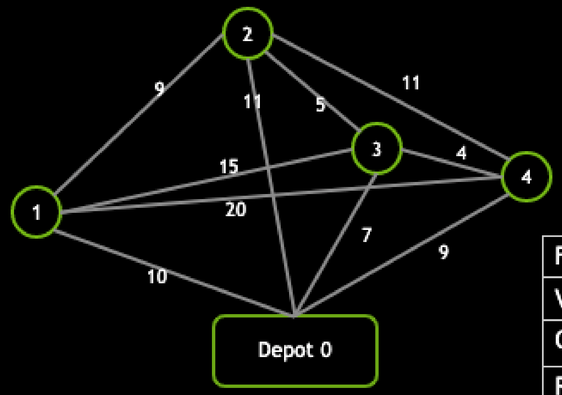
- NVIDIA cuOpt™ is a GPU-accelerated logistics solver that uses heuristics and optimizations to calculate complex vehicle routing problem variants with a wide range of constraints.

- Leverage heuristics on GPU with parallel compute
- Accelerated speed and accuracy to deliver dynamic re-optimization
- Reduces cost by saving $billions



ANATOMY OF A CUOPT PROBLEM

Input



Fleet size	8	14
Vol. Cap.	10	2
Order Cap.	10	5
Return	N	Y
Shift	4p-8p	9a-9p

$$\begin{bmatrix} 0 & 10 & 11 & 7 & 9 \\ 10 & 0 & 9 & 15 & 20 \\ 11 & 9 & 0 & 5 & 11 \\ 7 & 15 & 5 & 0 & 4 \\ 9 & 20 & 11 & 4 & 0 \end{bmatrix}$$

All-to-all cost matrix
(distance, time, …)
Google Maps API

$$\begin{bmatrix} 0 & 99 & 0 & 0 \\ 0 & 24 & 2 & 3 \\ 0 & 30 & 4 & 1 \\ 15 & 33 & 2 & 3 \\ 0 & 34 & 2 & 4 \end{bmatrix}$$

Orders
earliest, latest and duration of delivery, volumes and weights, counts

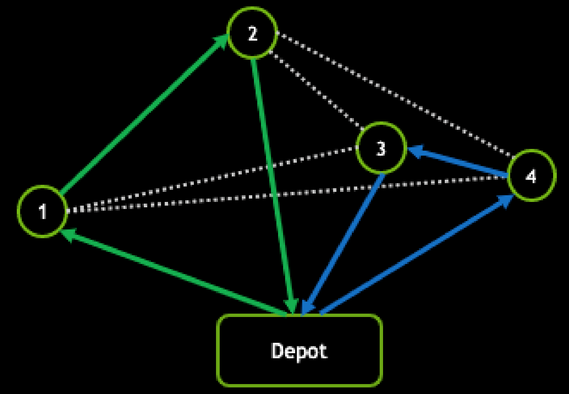
Seed generation
supervised learning?

Intensification
parallel hill climbers

Diversification
escape local minima

Select Optimal

Output



$$\begin{bmatrix} 0 & 1 & 10 \\ 0 & 2 & 21 \\ 0 & 0 & 36 \\ 1 & 4 & 9 \\ 1 & 3 & 15 \\ 1 & 0 & 24 \end{bmatrix}$$

Assignment
vehicle id, stop id, time stamp

SOFTWARE AND AVAILABILITY

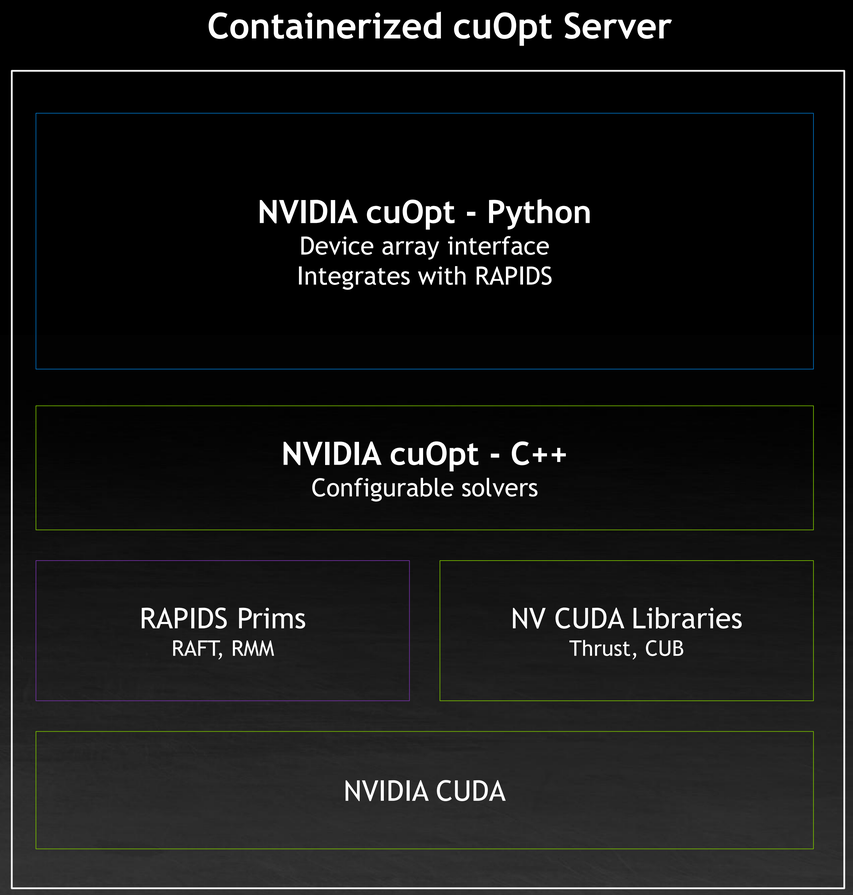
NVIDIA cuOpt provides a C++ and a Python interface that relies on NVIDIA® CUDA® libraries and RAPIDS™ primitives.

Faster integration with cuOpt containerized server – enterprise interop

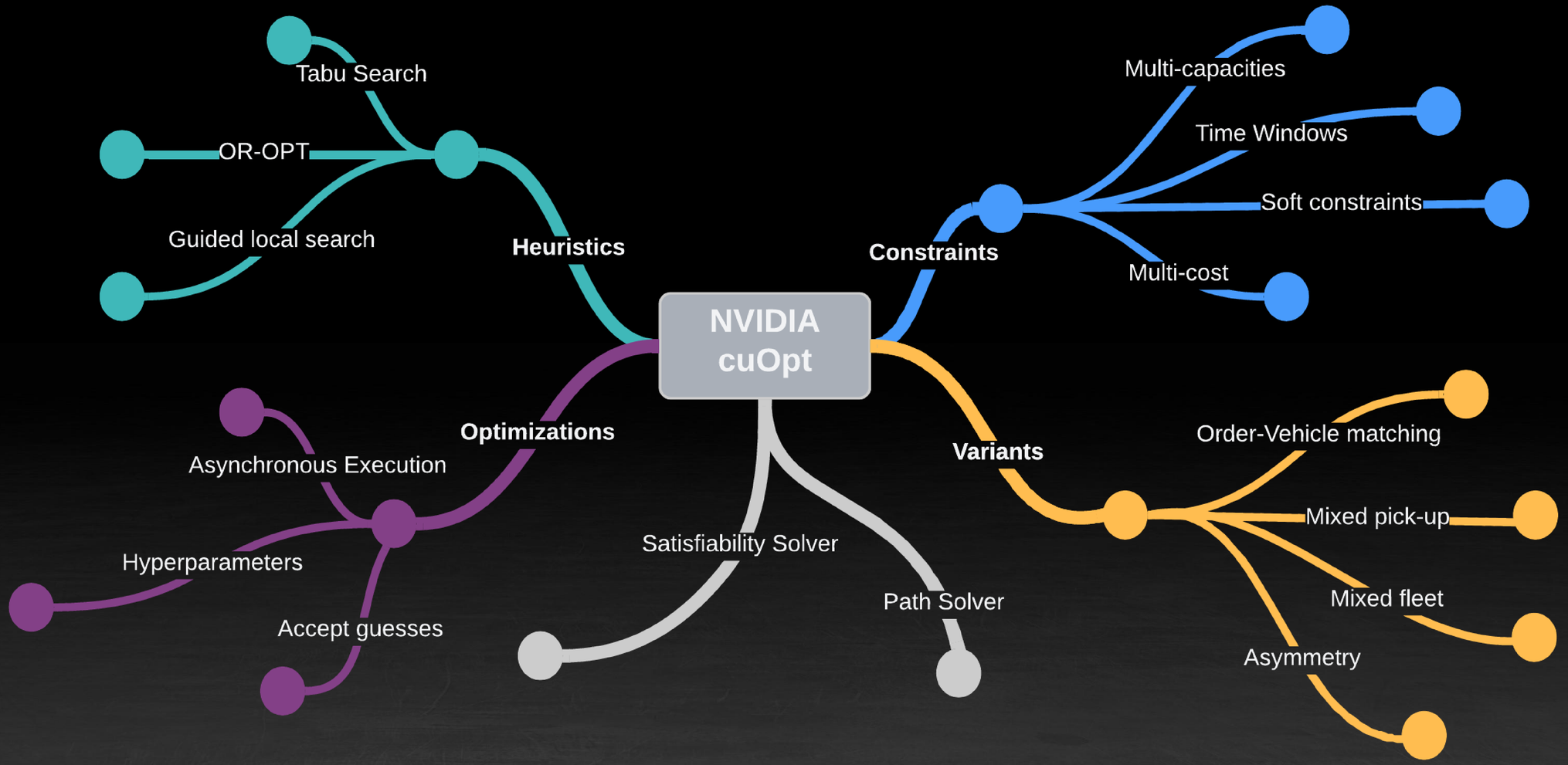
Native support for distance and time matrices with asymmetric patterns enables a smooth integration with popular map engines.

Trial version provides access to all this for testing and benchmarking with limits that prevent production use.

Still under development – not publicly released



COMPOSABLE SOLVER



KEY PRODUCT VALUE

DYNAMIC REROUTING

Rerun models and adjust for changes like down drivers, inoperable vehicles, traffic/weather disruptions, and the addition of new orders—all within SLA time constraints.

WORLD-RECORD ACCURACY

Achieve world-record accuracy with a 2.98% error gap on the Gehring & Homberger benchmark.

SCALE SEAMLESSLY

Scale out to 10000 of locations to facilitate computationally heavy use cases. NVIDIA cuOpt performs better than SOTA solutions to address innovative use cases not otherwise possible today.

REAL-TIME ANALYTICS

Route 1,000 packages in 10 seconds instead of 20 minutes (that’s 120X faster), with the same level of accuracy.

GET STARTED QUICKLY

Explore NVIDIA cuOpt Early Access notebooks and guides available on DLI.

SAVE MILLIONS

Reduce costs by up to 15% with dynamic rerouting—which saves companies billions.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THANK YOU