Optimize®

by The Algorithm People

It's Not Just About Distance

Exploring the complex world of logistics and where optimization, AI & machine learning have an impact

Optimize®

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Overview

- Who Are We?
  Who are Optimize and what we do
- Optimisation Example
  Demonstrate optimisation
- AI & Machine Learning
  Where is it used to make a difference
- The Future
  Where can AI and ML lead In the context of logistics

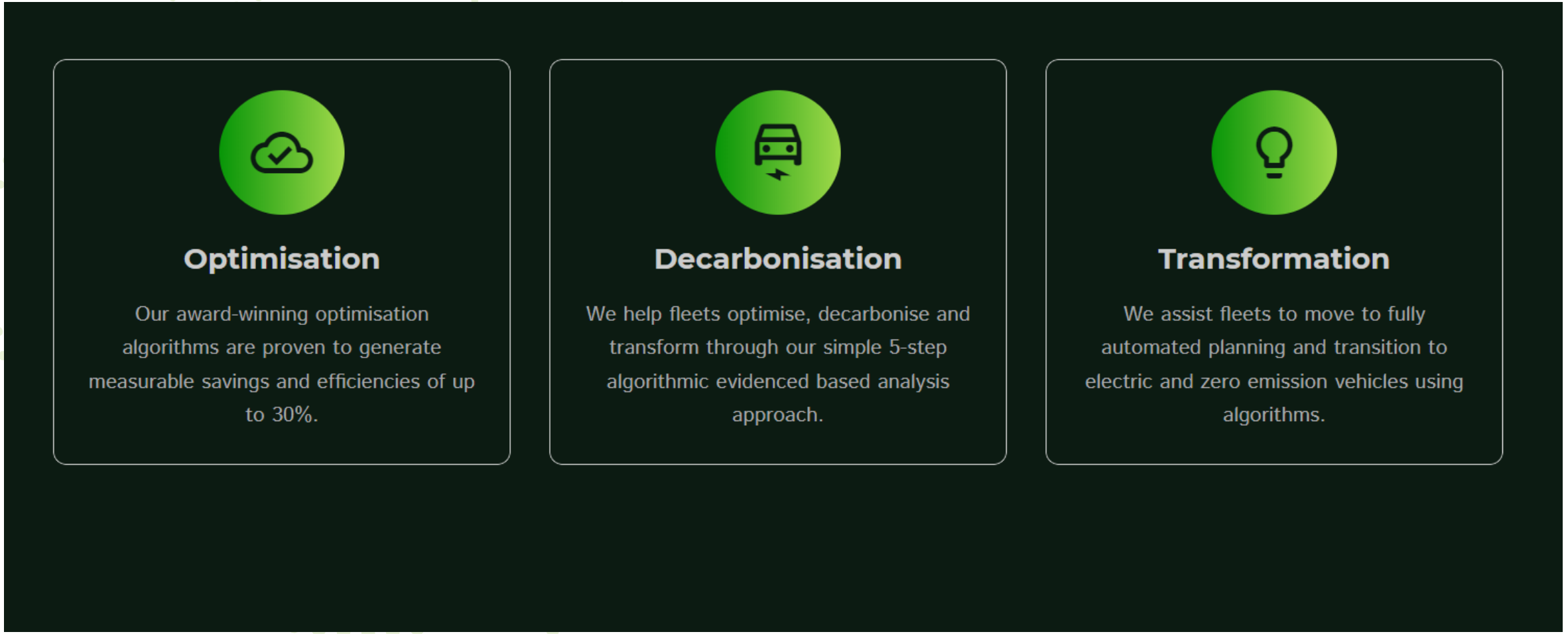
Who Are We?

Who am I?

- Dr Ross Conroy
- PhD In Artificial Intelligence
- 4 Years at FCDO
- 2 Years Completing KTP
- Now Head of R&D at Optimize since April

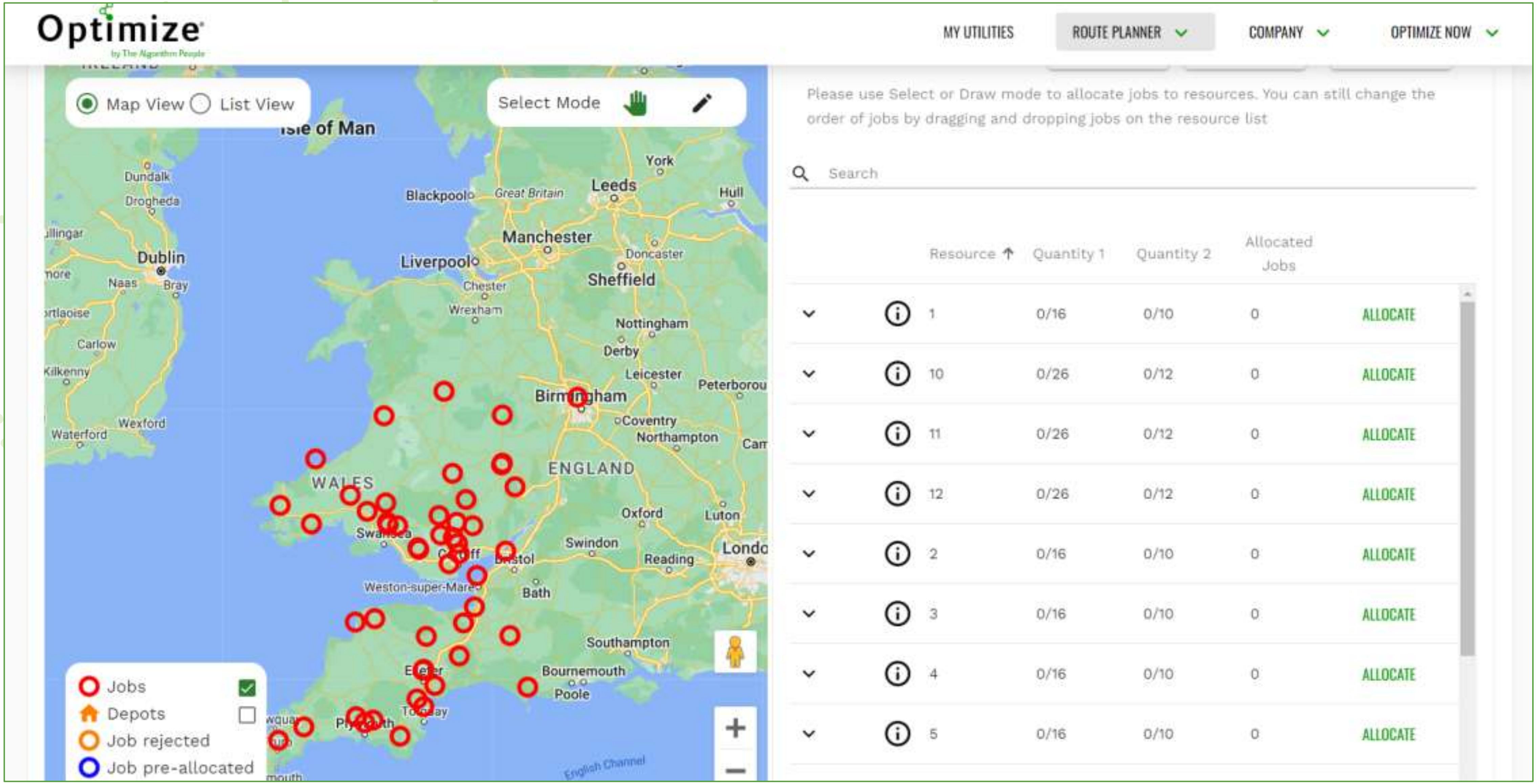
Team Optimize

What We Do ...


Optimisation
Our award-winning optimisation algorithms are proven to generate measurable savings and efficiencies of up to 30%.
Decarbonisation
We help fleets optimise, decarbonise and transform through our simple 5-step algorithmic evidenced based analysis approach.
Transformation
We assist fleets to move to fully automated planning and transition to electric and zero emission vehicles using algorithms.

Scheduling ≠ Optimization

How We Do It


Optimize
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MY UTILITIES
ROUTE PLANNER
COMPANY
OPTIMIZE NOW
Map View
List View
Select Mode
Isle of Man
Dundalk
Drogheda
Dublin
Naas
Bray
Carlow
Kilkenny
Wexford
Waterford
Blackpool
Great Britain
Leeds
York
Hull
Manchester
Liverpool
Doncaster
Sheffield
Chester
Wrexham
Nottingham
Derby
Leicester
Peterborou
Birmingham
Coventry
Northampton
WALES
ENGLAND
Swansea
Oxford
Luton
Swindon
Reading
Bristol
Weston-super-Mare
Bath
Southampton
Bournemouth
Poole
Exeter
Torquay
Plymouth
English Channel
Jobs
Depots
Job rejected
Job pre-allocated
Please use Select or Draw mode to allocate jobs to resources. You can still change the order of jobs by dragging and dropping jobs on the resource list
Search
Resource | Quantity 1 | Quantity 2 | Allocated Jobs
1 | 0/16 | 0/10 | 0 | ALLOCATE
10 | 0/26 | 0/12 | 0 | ALLOCATE
11 | 0/26 | 0/12 | 0 | ALLOCATE
12 | 0/26 | 0/12 | 0 | ALLOCATE
2 | 0/16 | 0/10 | 0 | ALLOCATE
3 | 0/16 | 0/10 | 0 | ALLOCATE
4 | 0/16 | 0/10 | 0 | ALLOCATE
5 | 0/16 | 0/10 | 0 | ALLOCATE

69

Million Customer Miles Saved

73,000

Tonnes of CO2 Saved in 2022

24%

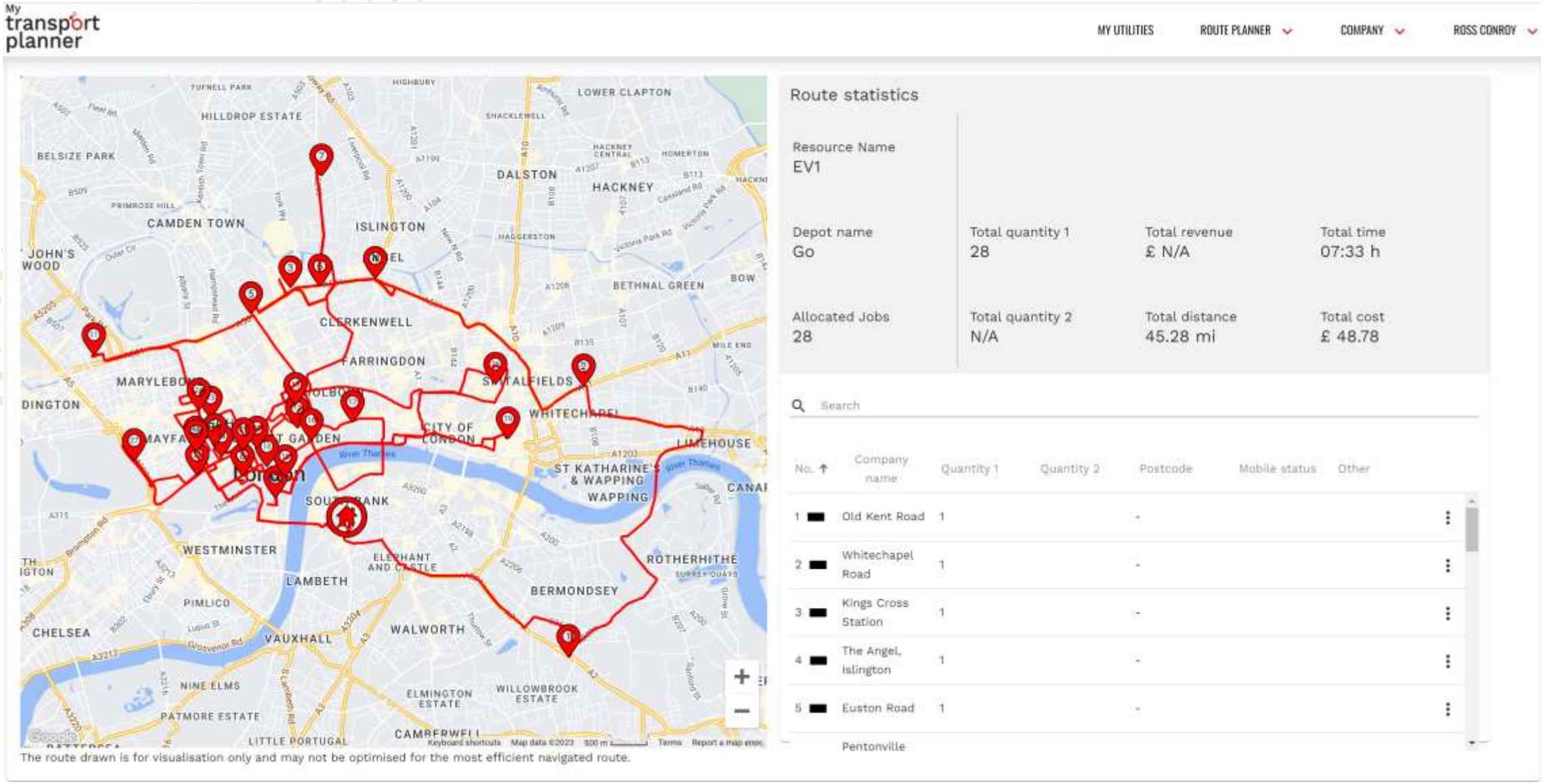
Average Reduction in Emissions & Costs

19%

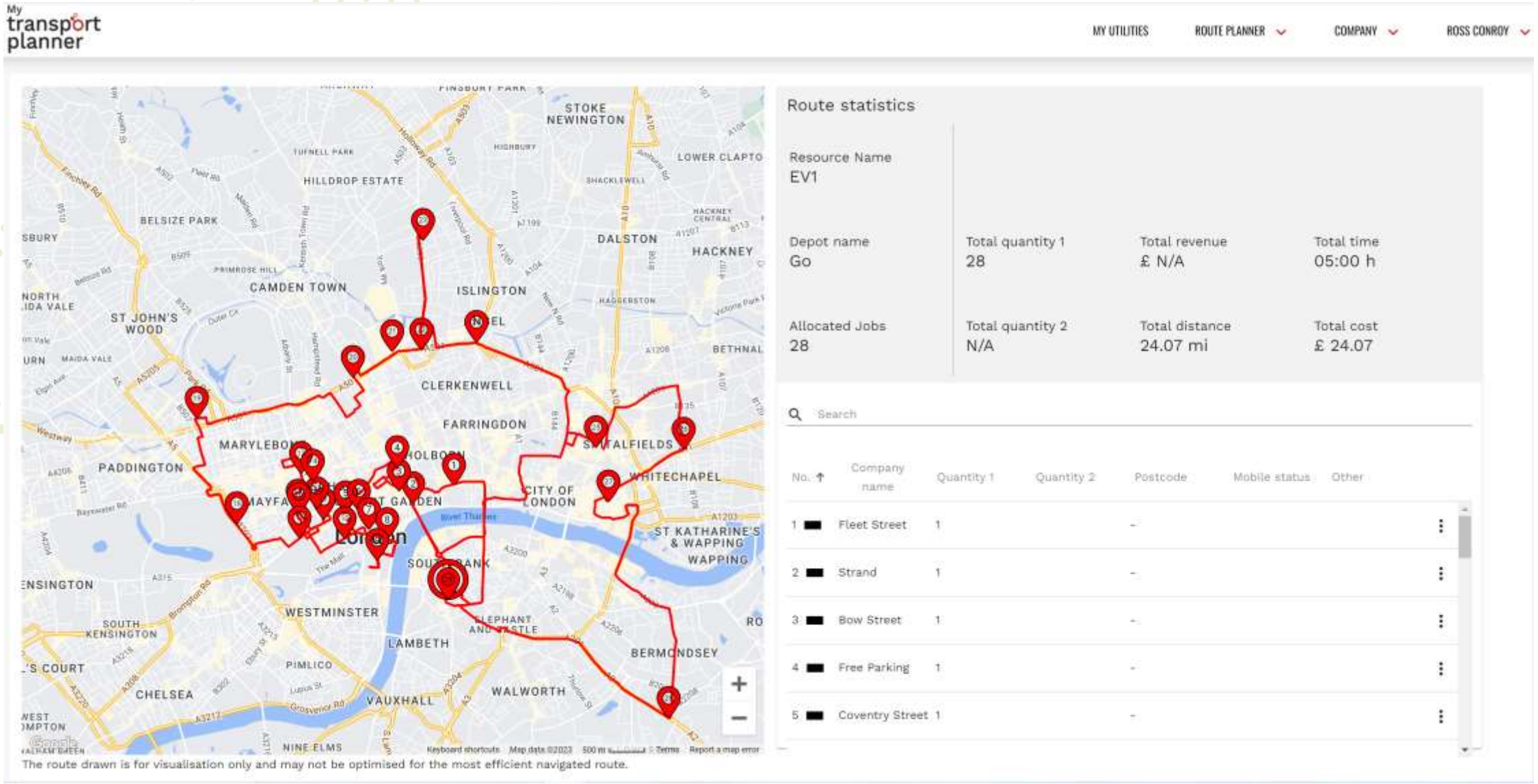
Average Increase in Productivity & Utilisation

Monopoly Example

Monopoly Example Before



Monopoly Example (Optimized)



More Constraints

- EU driving laws
  - Driving time
  - Minimum unbroken rest times
  - Max driving per week
  - Max driving per fortnight
- Max time in vehicle
  - Fresh produce
  - Takeaway delivery
- Time windows
  - Only receive deliveries at certain times
  - Shift patterns
  - Idle time
  - Lateness penalties
- Skills
  - Tail lift
  - Refrigeration
  - Hazardous materials
  - Wheelchair access
- Capacities
  - Volume
  - Weight
  - Palette footprints
- Range
  - Affected by weight on vehicle
- Prerequisite job completion

What Does Optimal Look Like?

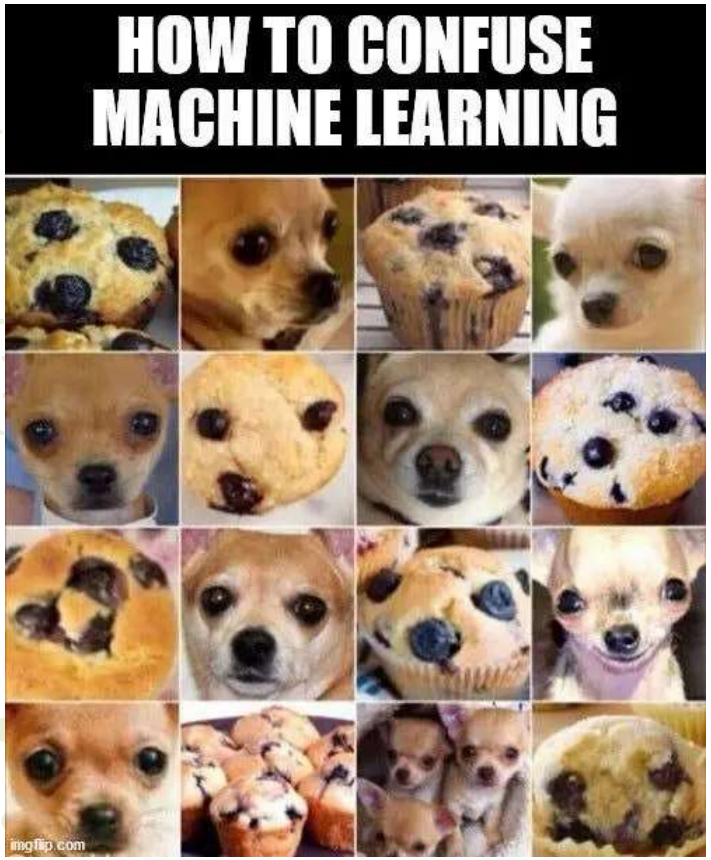
- Lowest mileage
- Least cost £££
- Fastest completion time
- Least number of vehicles used
- Lowest carbon emissions
- Lowest idle time
- Maximum number of jobs fulfilled
- Least re-fuelling / re-charging stops
- Resource utilisation (min / max)
- Maximum ROI

AI & Machine Learning

Pitfalls of AI & Machine Learning

People with no idea about AI saying it will take over the world:

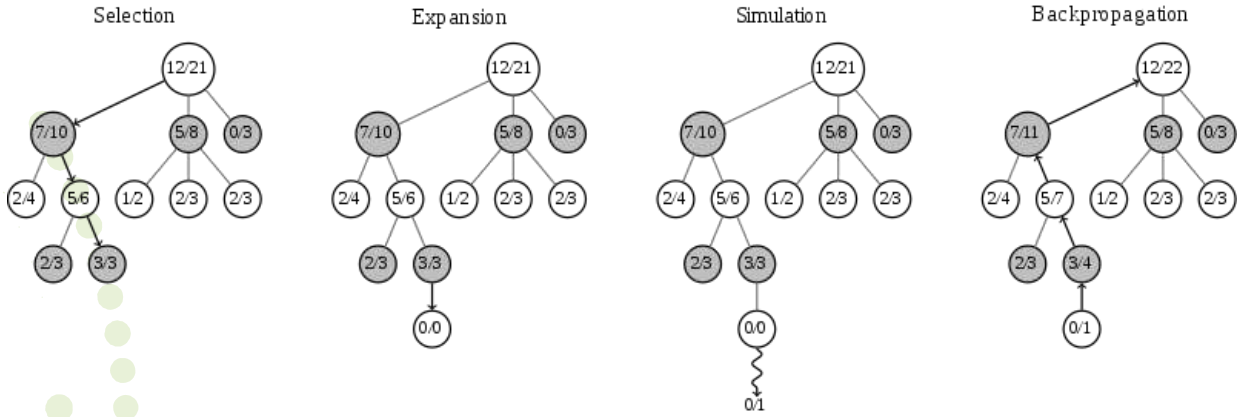
My Neural Network:



Selecting a Solver - Monte Carlo Tree Search

- No one size fits all solver
- Anytime Algorithm
- Algorithm of Algorithms
- How to determine which solver is best?
- Ideal methods change over time.
  - Early stages focus towards getting jobs onto vehicles
  - Late stages focus towards finding improvements

What is Monte Carlo Tree Search?



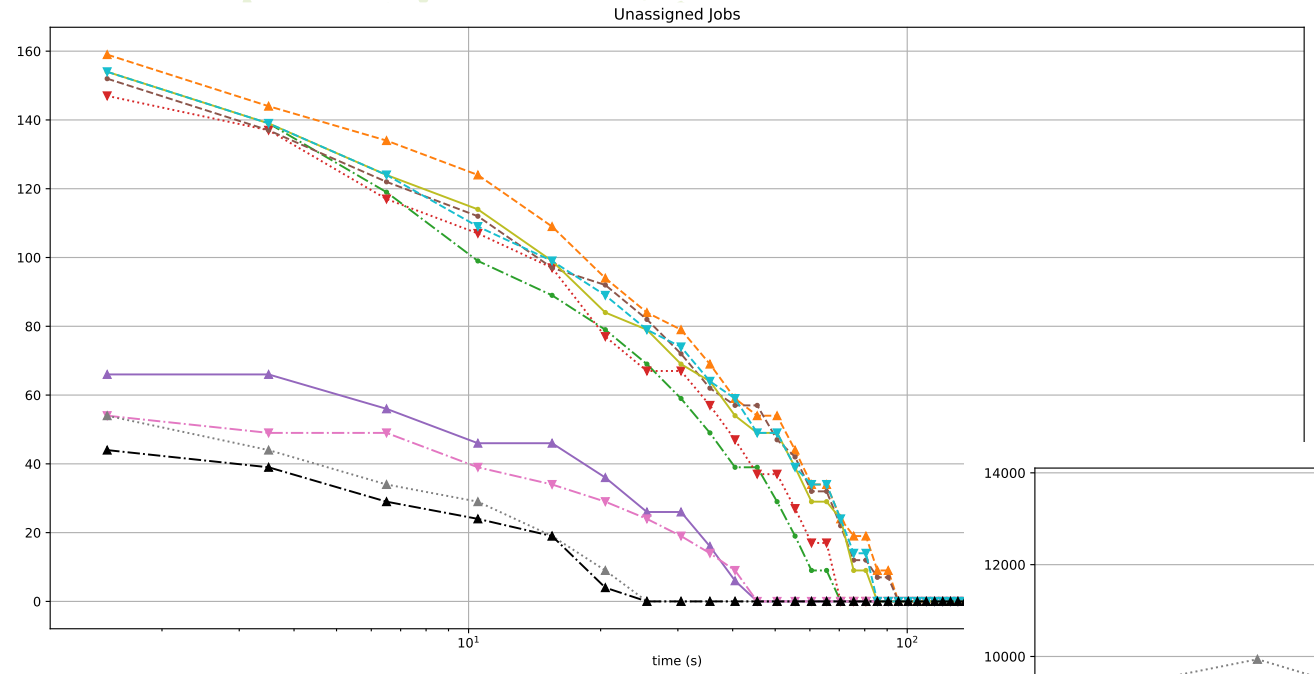
https://www.chessprogramming.org/Monte-Carlo_Tree_Search

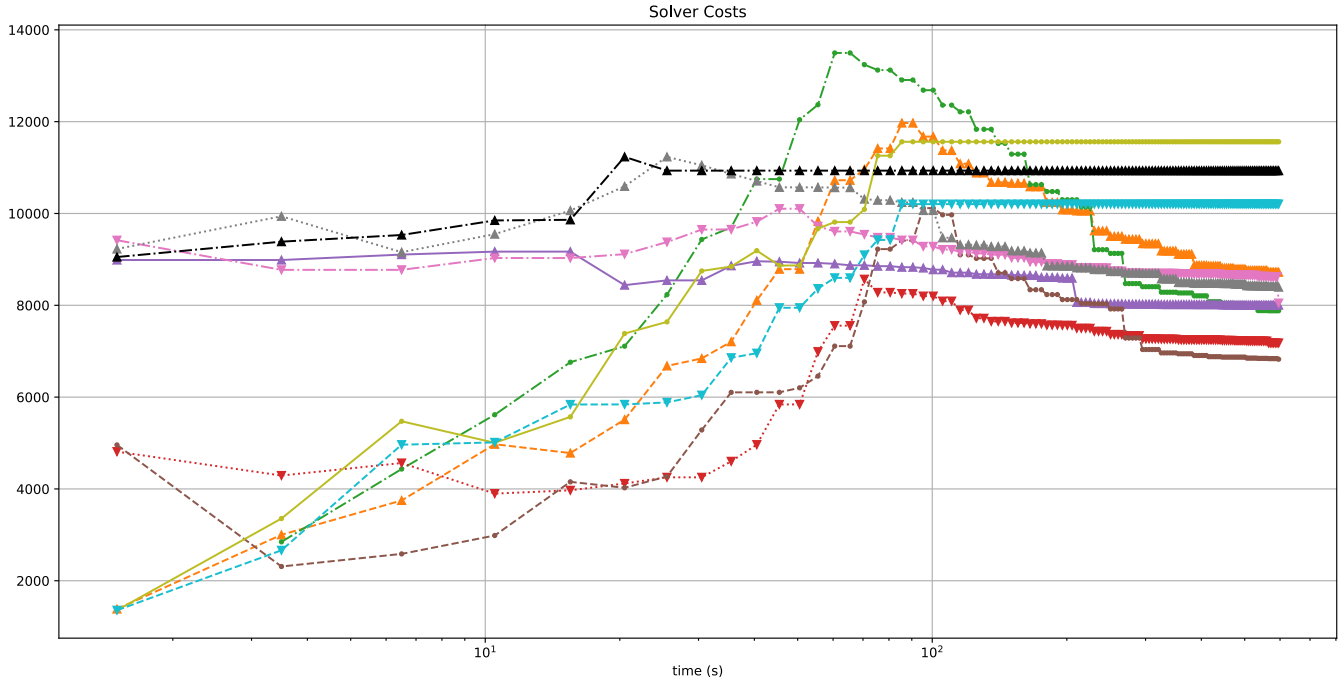
- Chess AI, High Level Example
  - Choose a move to follow based on a weighting (UCB calculated from W/L and simulations count)
  - Simulate a games to completion
  - Update weights from win loose result
  - Repeat until stopped
  - Choose the move with the most wins
- More iterations = greater difficulty
- Focuses on likely wins while keeping exploration just in case

Monte Carlo Tree Search Solver Selection

- High Level Process (Each iteration of optimizer)
  - Calculate weightings (UCB calculated from win loss count & times sub solver has been ran)
  - Select highest weighted solver
  - Run solver n times (usually n = 1)
  - Improvement made = win, else = loss
  - If loss then discard result
  - Increment win loss count
- Why this method works
  - Focusses on sub solvers which have proved to make past improvements
  - Maintains exploration which in turn allows alternate solvers to “jump in”
  - When alternate solver makes improvements its weighting increases

Monte Carlo Tree Search Results





The Future

The Future of AI and Machine Learning for Optimisation

- Machine Learning from Telematics
  - Driver behaviours
  - Traffic patterns
  - More accurate Plans
  - Improved ETA's
- Responsive AI Planning
  - Responding to real-time data feeds
  - Changing plans on-the-fly
- Quantum computing
  - Not there yet, not enough q-bits for full optimisation
  - Closer to truly optimal plan
  - Quantum machine learning