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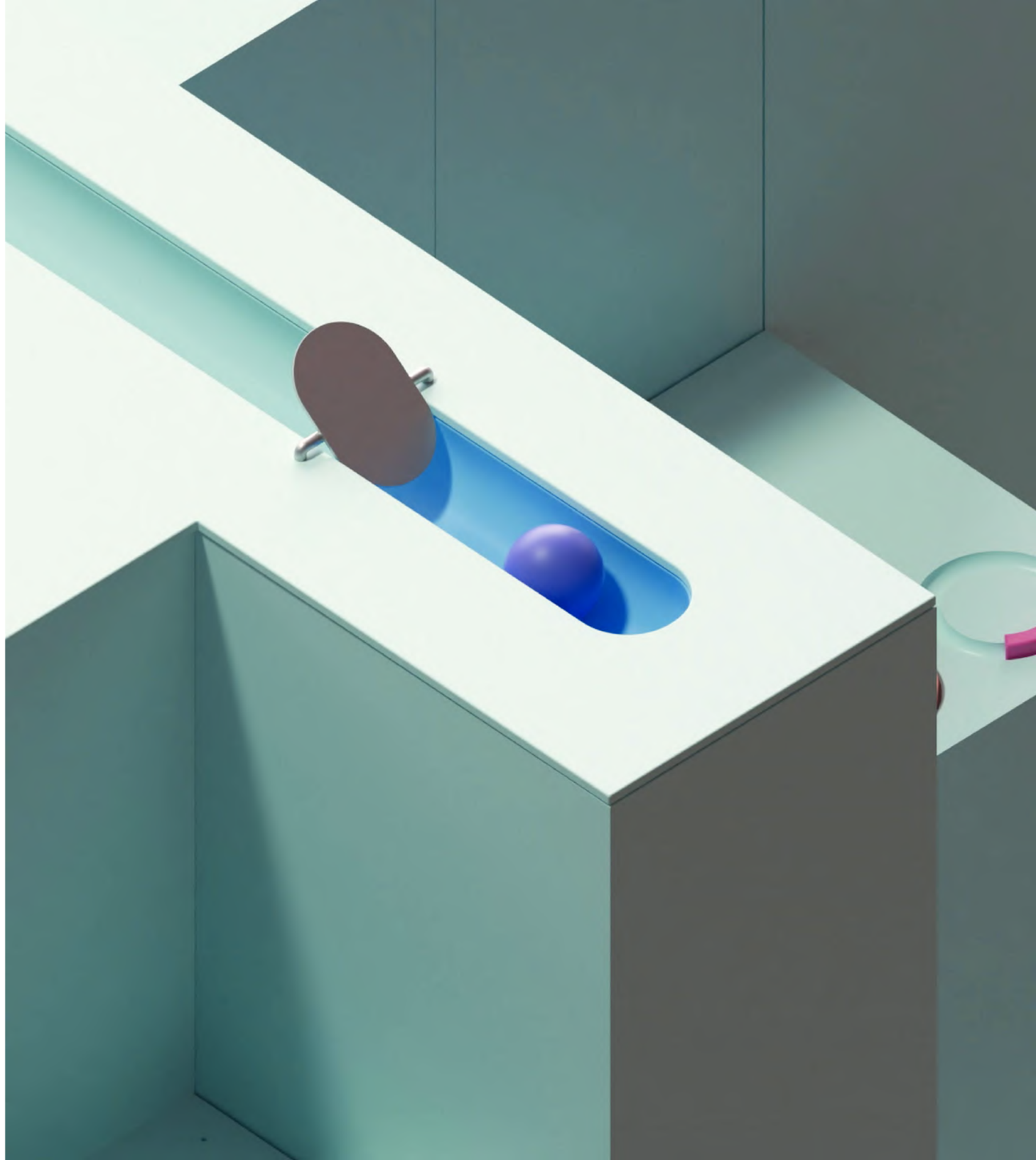
Optimizing Supply Chains with AI

Optimizing Supply Chains with Machine Learning, Data Analytics, and Data Science for better Sustainability and a better tomorrow



Agenda

01 Team

02 Demonstration

03 Overview

04 ML pipeline

05 Optimization

06 Frontend and Backend

Team

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M.Sc Data Science

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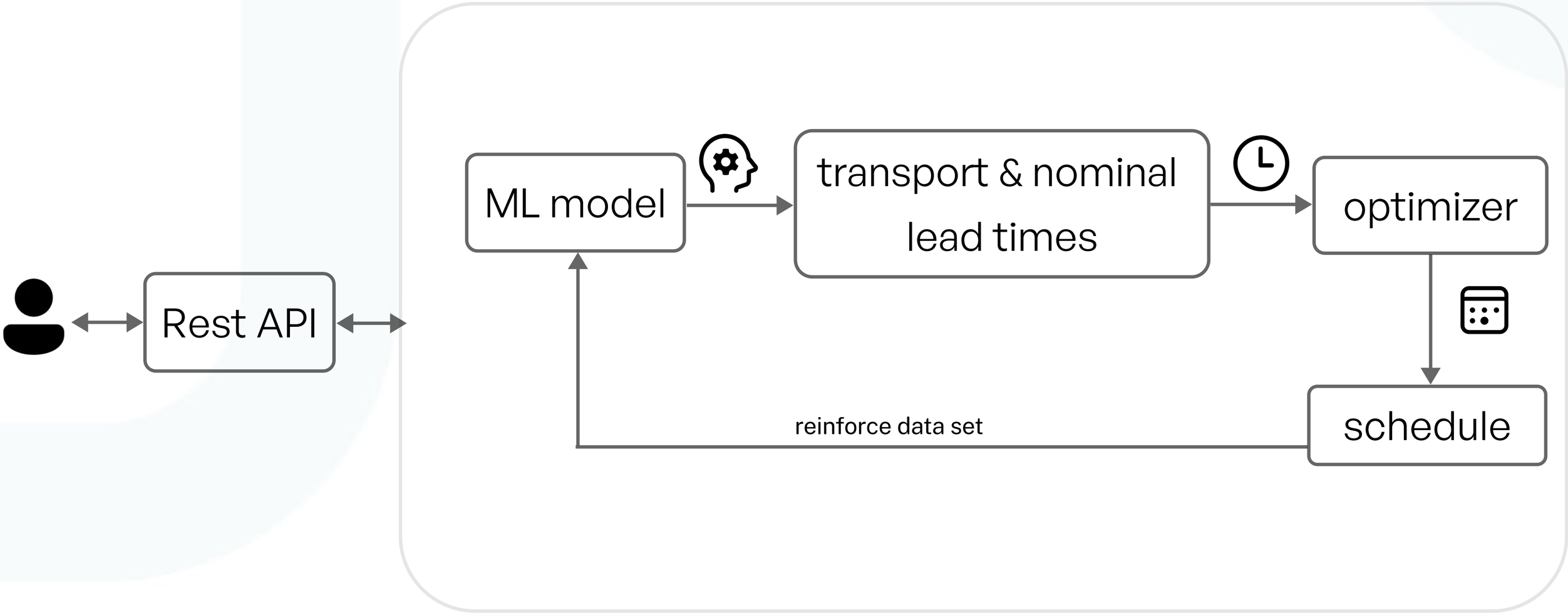
Demonstration

Overview



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ML pipeline

Components

of the Machine Learning pipeline

- ✓ **Sanity check and data preprocessing**
- ✓ **Dataset assembly**

- ✓ **(Additional) Feature engineering**
- ✓ **Data Augmentation**

- ✓ **The Model: XGBoost**

Data preprocessing

How to extract and correct the data

Extract

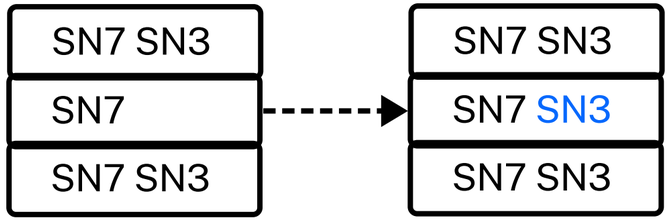
Transfer data

- Use the csv file for now

Missing containers

Detect and correct container cycles

- Input the missing values
- finding the appropriate dates



Dataset assemby

Key considerations

- ✓ **Granularity: from containers to ships**
- ✓ **Data is (quite) vanilla: simple model is the way to go**

- ✓ **Sequential nature of data: hard for simple models → prediction drift**

- ✓ **Making predictions use all training data**
- ✓ **Exploit aggregated information on trips**
- ✓ **Engineer extra features that describe a particular scenario**

Feature Engineering

How to generate more than 20 new features with the given data?

Obvious Features

- Duration of each step
- Container Quantity
- Direction (A→E or E→ A ?)

Other Meaningful Features

- Weather related data (Snowing, Precipitations, Wind Gusts, Seasons, ...)
- Working Days / Weekend

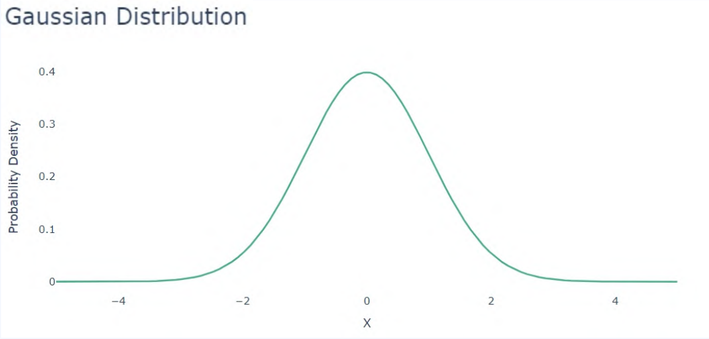
Ideas for Additionnal Features

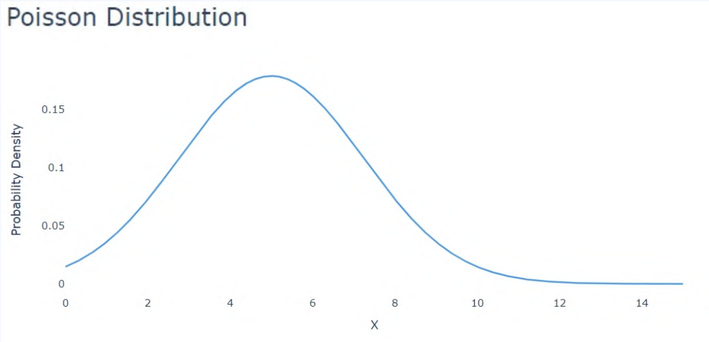
- Harbor Traffic
- Ocean currents
- ...

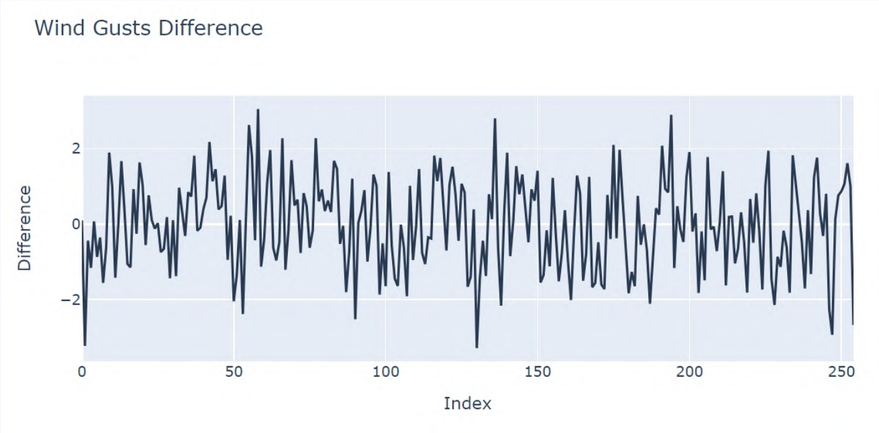
Data Augmentation

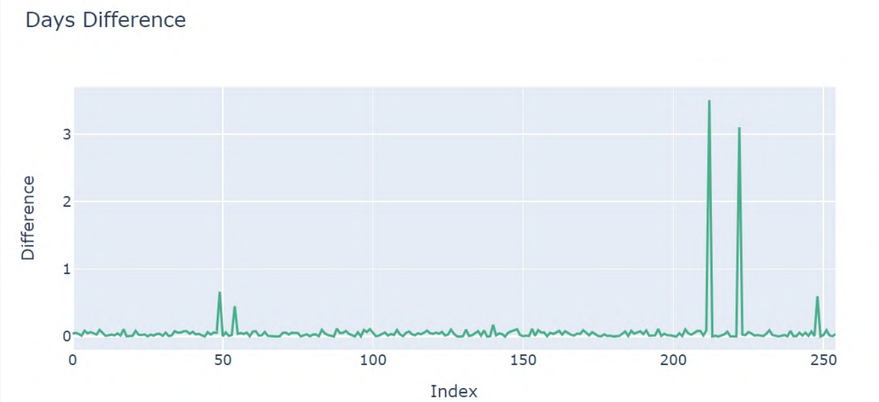
The More the Merrier!

What noise to choose?



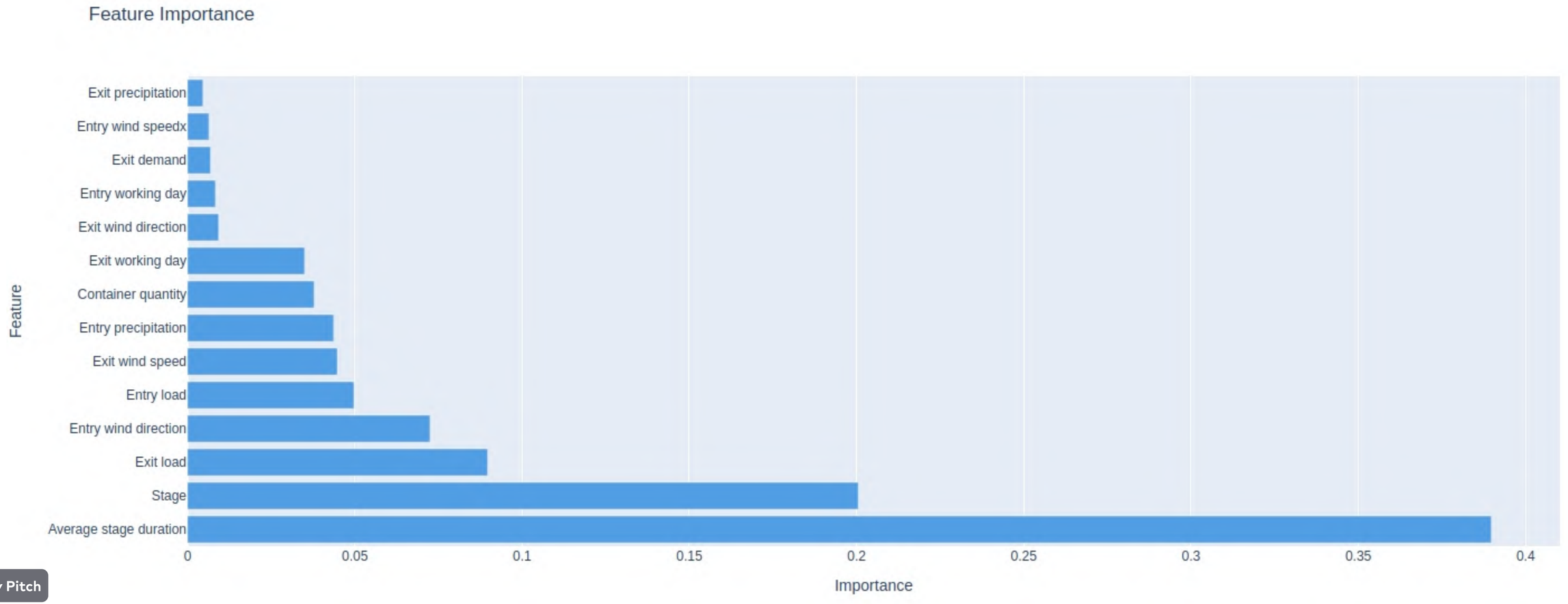






ML Model

- ✓ **Objective: Predict the expected number of days it takes for a stage**
- ✓ **Choice → XGBoost regressor: fast and explainable results**



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Optimization

Optimization

Use MILP (Mixed Integer Linear Programming) to find the optimal schedule

Objective

Minimise CO_2 emissions and On Time Delivery

Input

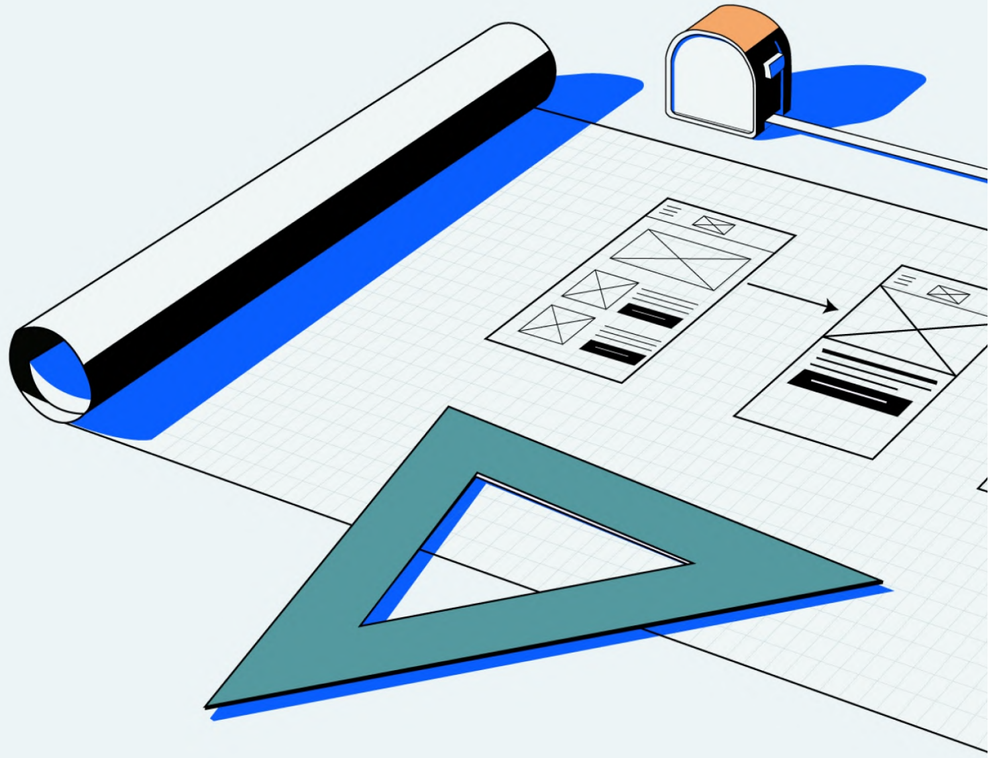
Travel time from ML model and Booster orders

Output

Optimal schedule for the next three months

Constraints

Number of containers, travel time, availability of ship, etc.



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Front and Backend

Frontend and Backend

- ✓ **Interactive web applications**
- ✓ **Extensive library of components for data visualization**

Benefits

- User input handling for dynamic content
- Integration with external data sources and services

Benefits

What do we offer?

Sustainability Accountability

comprehensive visibility into every step of the supply chain

- monitor and track the environmental and social impacts of their operations
- transparent reporting on factors such as carbon emissions

Supply Chain Analytics

identifies inefficiencies within the supply chain and suggests improvements to enhance resource utilization

- minimize waste, and reduce costs
- streamlining processes, optimizing transportation routes, and managing inventory levels more effectively, companies can achieve higher operational efficiency while simultaneously reducing their environmental footprint

Optimization

aggregates and analyzes vast amounts of data from various sources across the supply chain, offering valuable insights into trends

- leveraging advanced analytics techniques
- make informed decisions to mitigate risks, respond swiftly to market fluctuations, and capitalize on opportunities for innovation and growth

Future Ideas

More Sustainability metrics

- Resource Efficiency
- Waste Reduction
- Lifecycle Analysis

Forecasting demand & cost analysis

- Supply Chain Resilience Forecasting
- Scenario Planning for Sustainability Risks

Evaluate Performance of participants of supply chain

- Supply Chain Transparency and Traceability
- Collaborative Performance Improvement Initiatives

Future Ideas

Evaluate Performance of participants of supply chain

Forecasting the demand & Cost analysis

Supporting evidence

What makes us positive we can trust the results?

- Data point 1
- Data point 2
- Data point 3

Source: Maze

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Thank you