MICHIGAN STATE UNIVERSITY

Project Plan Presentation

Carrier Performance Index Engine

The Capstone Experience

Team RPM

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From Students…
…to Professionals

Project Sponsor Overview



- International logistics and supply chain company headquartered in Royal Oak, MI
- Partners with 13,500+ carriers to successfully meet customer needs
- Institutional values: Resilience, Reliability, Respect
- Operates across North America, Europe, including Mexico and Canada

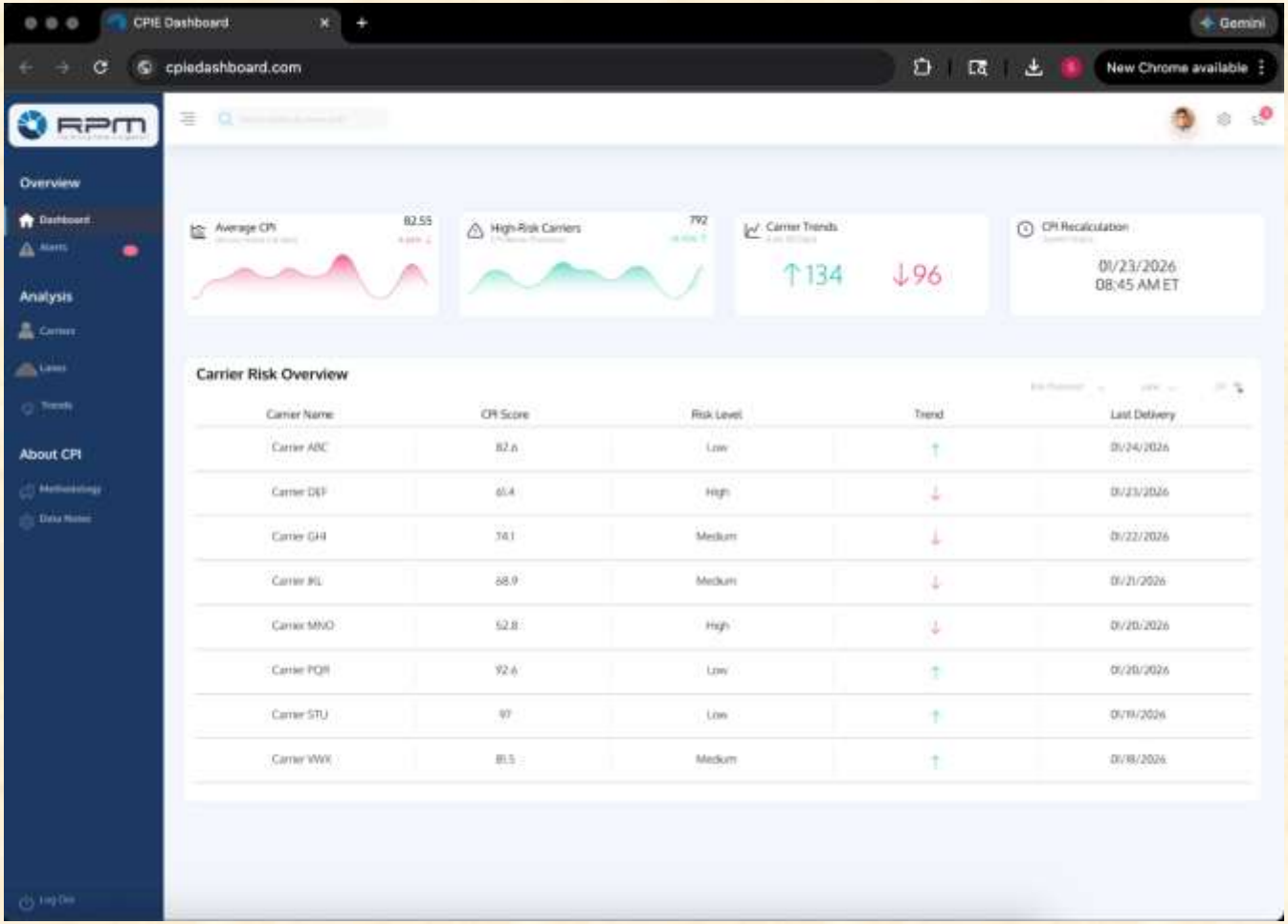
Project Functional Specifications

- Problem Statement: Current CPI calculations are inconsistent and time-consuming
- Solution: Automated CPIE model and scoring system powered by:
  - Continuous learning algorithm
  - Historical operational data
  - Real time updates as shipments completed
- Value:
  - Automated and uniform scoring model across all business units

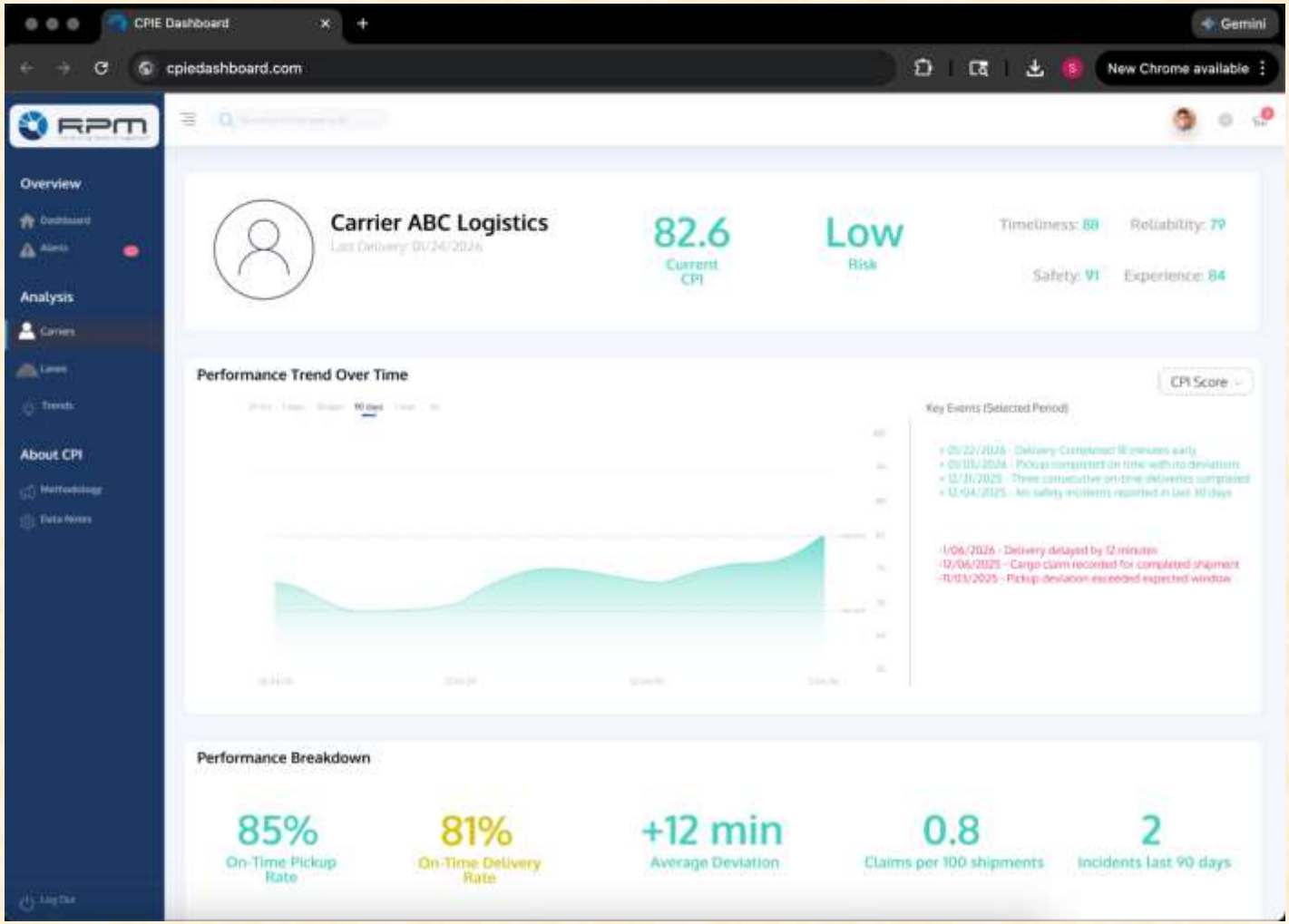
Project Design Specifications

- Web-based application with intuitive dashboard
- Uses Streamlit for full-stack deployment
  - Consolidates tooling while matching company's internal architecture
- Process:
  - User logs into the interface
  - Retrieves real time CPIE scores
  - Make business decisions based on CPIE score and semantic data points
  - Loop continues for each carrier

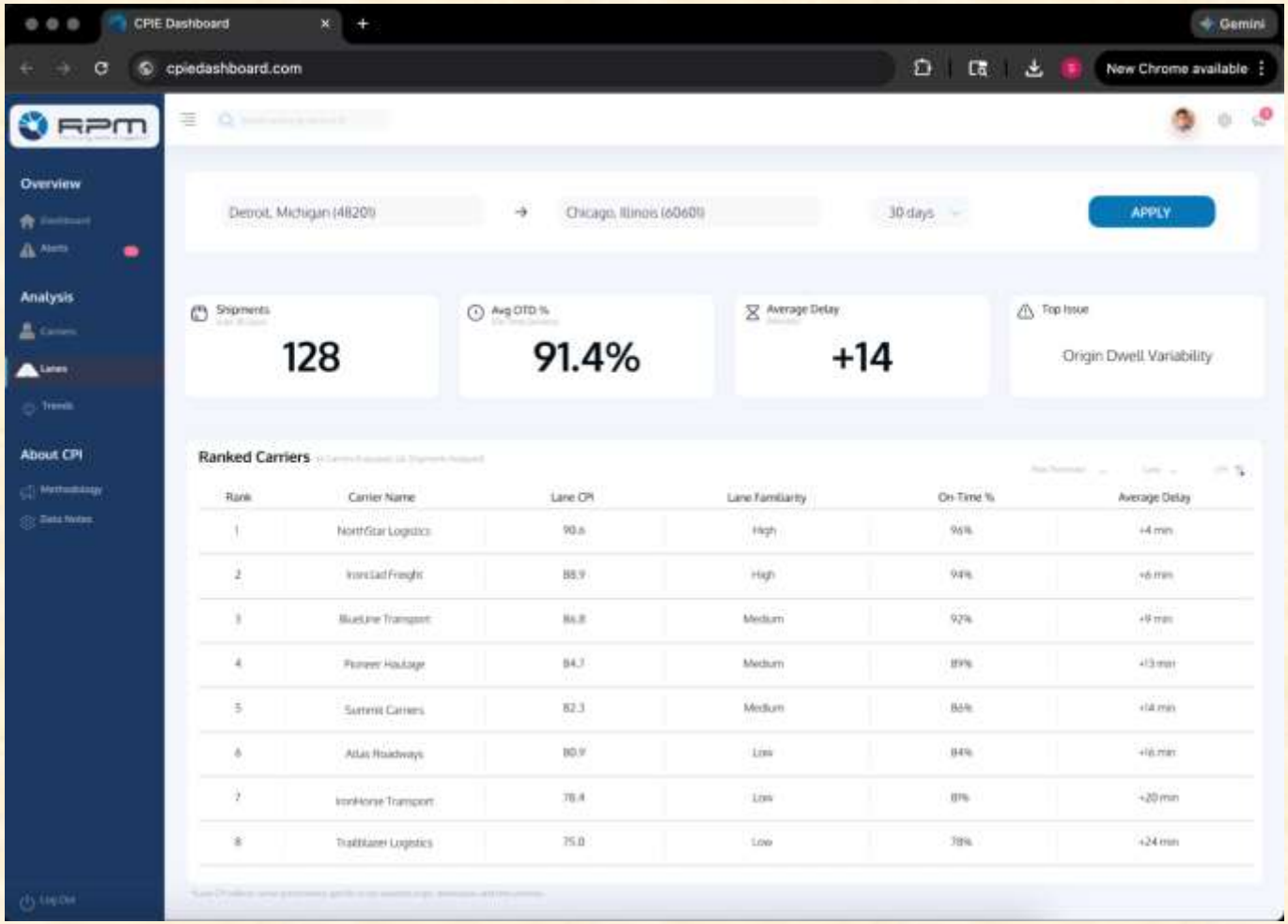
Screen Mockup: Main Dashboard



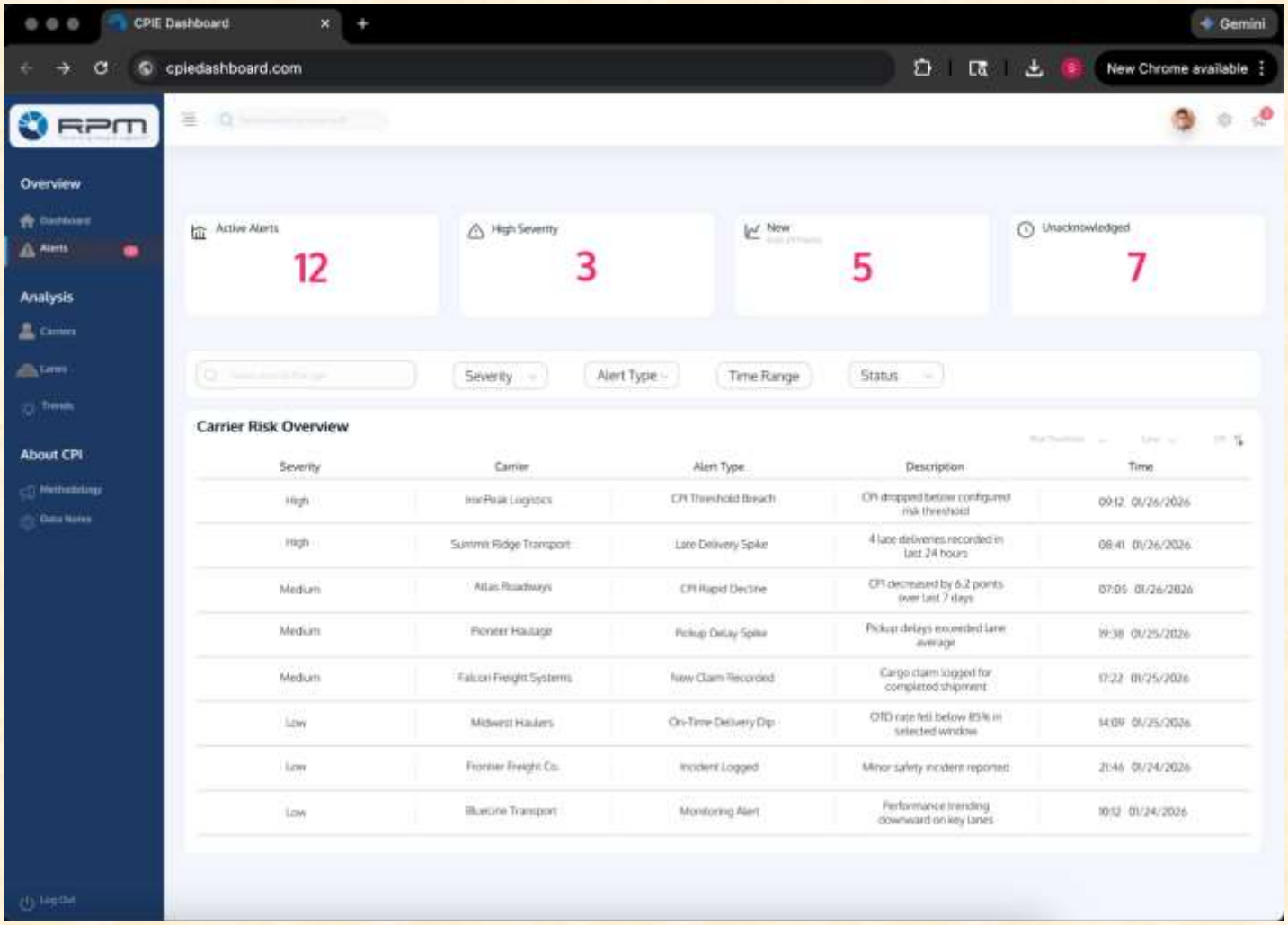
Screen Mockup: Carrier Detail View



Screen Mockup: Lane/Route Performance



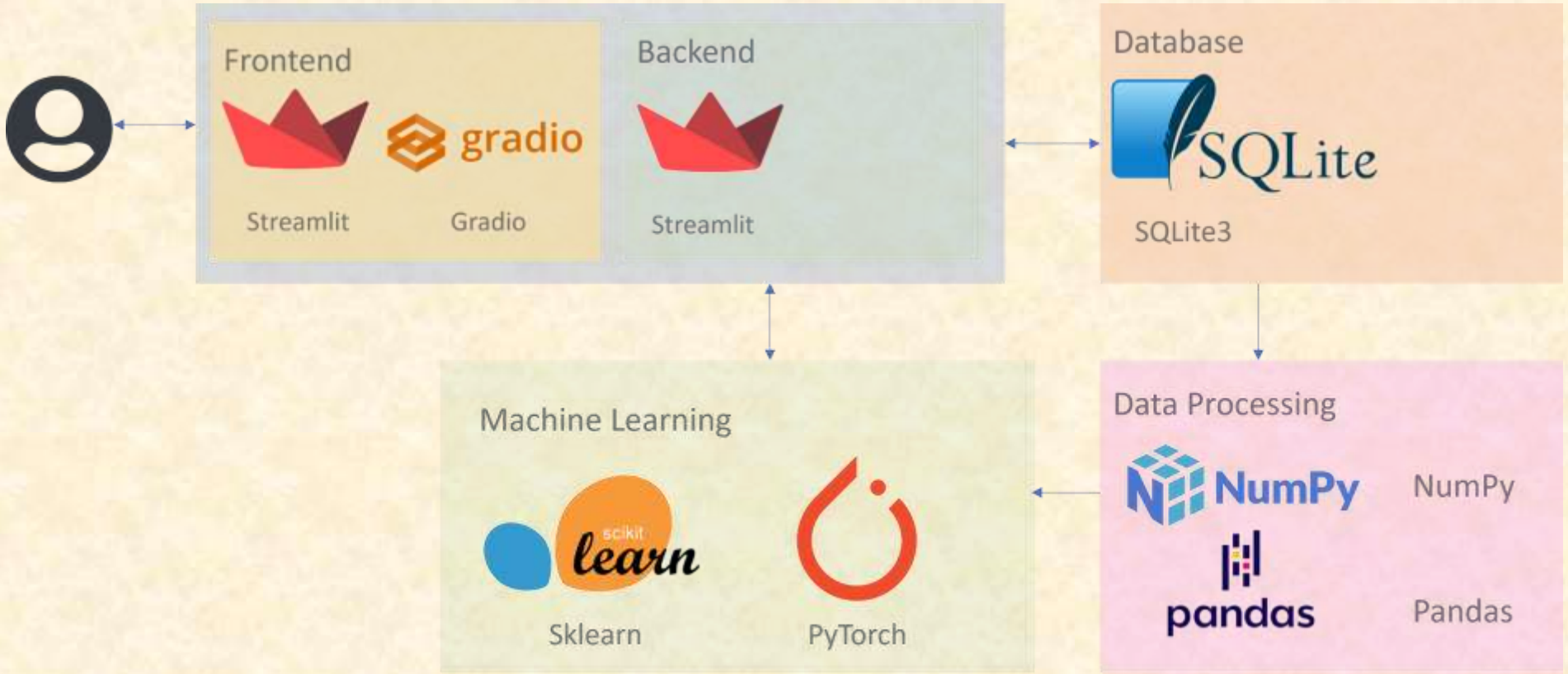
Screen Mockup: Alerts and Risk Monitoring



Project Technical Specifications

- Binary Logistic Regression for multi-dimensional performance prediction (OTD, OTP, FTA)
- Hierarchical clustering algorithm for carrier segmentation and archetype identification
- Regularized maximum likelihood estimation with L2 (Ridge) penalty for model complexity control
- Exponentially Weighted Moving Averages (EWMA) for temporal adaptation and drift correction
- Bayesian conjugate prior integration for cold-start mitigation in low-volume scenarios

Project System Architecture



Project System Components

- Hardware Platforms
  - Cloud-based computational infrastructure (Azure) with distributed processing capabilities
  - GPU-accelerated training nodes for expedited hyperparameter optimization
  - Edge computing instances for real-time inference with sub-second latency requirements
- Software Platforms / Technologies
  - Python with scikit-learn for logistic regression implementation and hierarchical clustering
  - NumPy for numerical linear algebra operations and statistical computations
  - Pandas for feature engineering pipeline and temporal data manipulation
  - SQLite for time-series freight data persistence and querying

Project Risks

- Continuous data ingestion
  - Processing the continuous stream of data.
  - Creating data processing layer that can normalize data coming from multiple sources.
- Consistent engine improvement
  - Asymmetry in newly ingested data points.
  - Implement stratified sampling and training approach.
- Difference in assumptions from synthetic data vs. real data
  - Input features matrix of the real data is not full rank.
  - Design the system to handle variations in data rather than rely on stern synthetic data assumptions.
- Carriers with sparse data points
  - When a carrier enters our database, they will have significantly less data points than those previously in our database.
  - Implement a Bayesian Inference based improvement, with prior data of industry average performance.

Questions?

