Min Cost Flow Optimization Model For Truck Delivery Case

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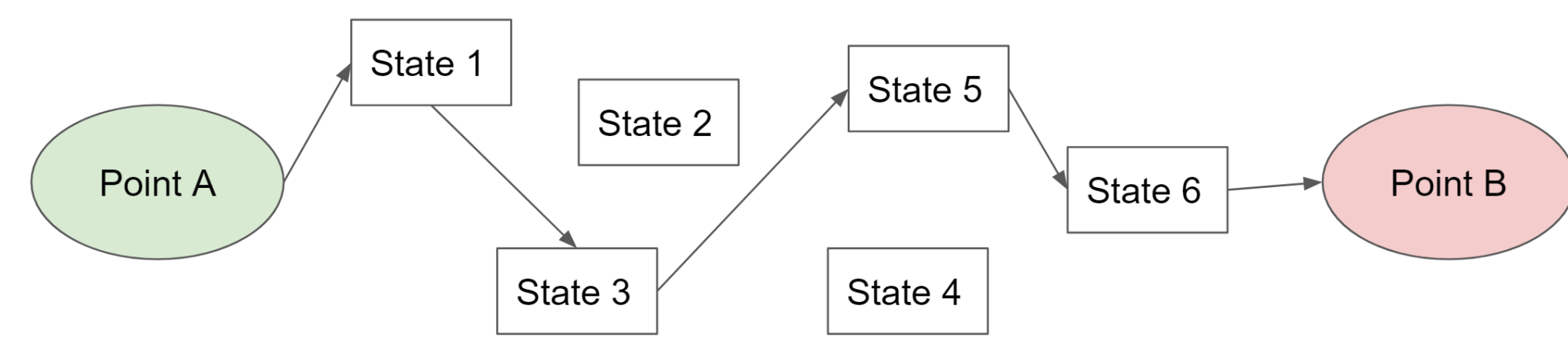
Abstract

Route optimization is heavily used in logistics to help uncover the optimal path of transportation by minimizing total cost as an objective. Min cost flow optimization model can achieve this objective by setting up a flow network constraint. **This poster demonstrates how our team implemented this optimization model to a truck delivery business case scenario at the University of Wisconsin-Madison.**
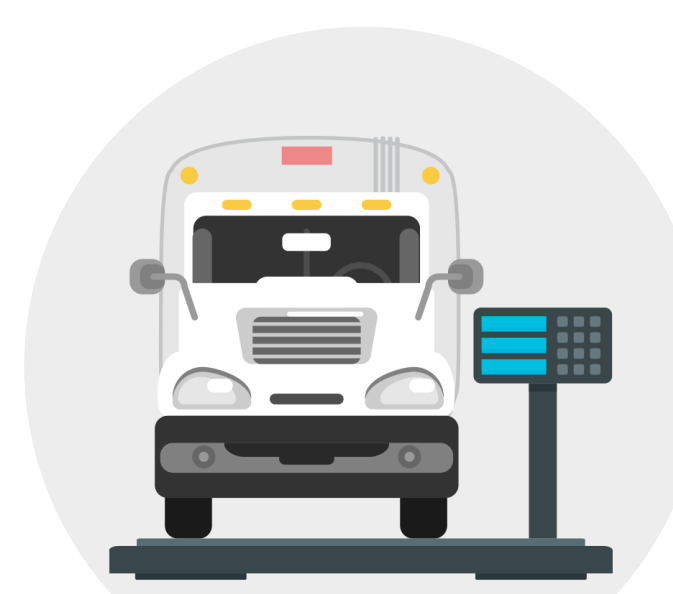
Figure 1.

- Yellow: States used in model optimization
- Dotted yellow: State of departure
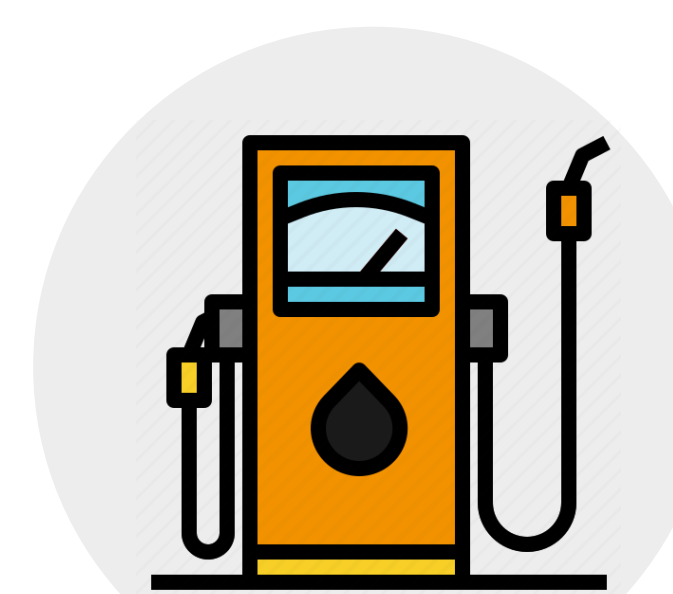- Hatched: State of arrival

Business Scenario Context

A logistics company wants to optimize their delivery route for 6 different truck classes from Texas to Washington (*Figure 1*). Taking consideration into varying fixed state toll rates on truck class, toll rates on weight capacities and diesel consumption, this company wants to know the cheapest route for each truck class.
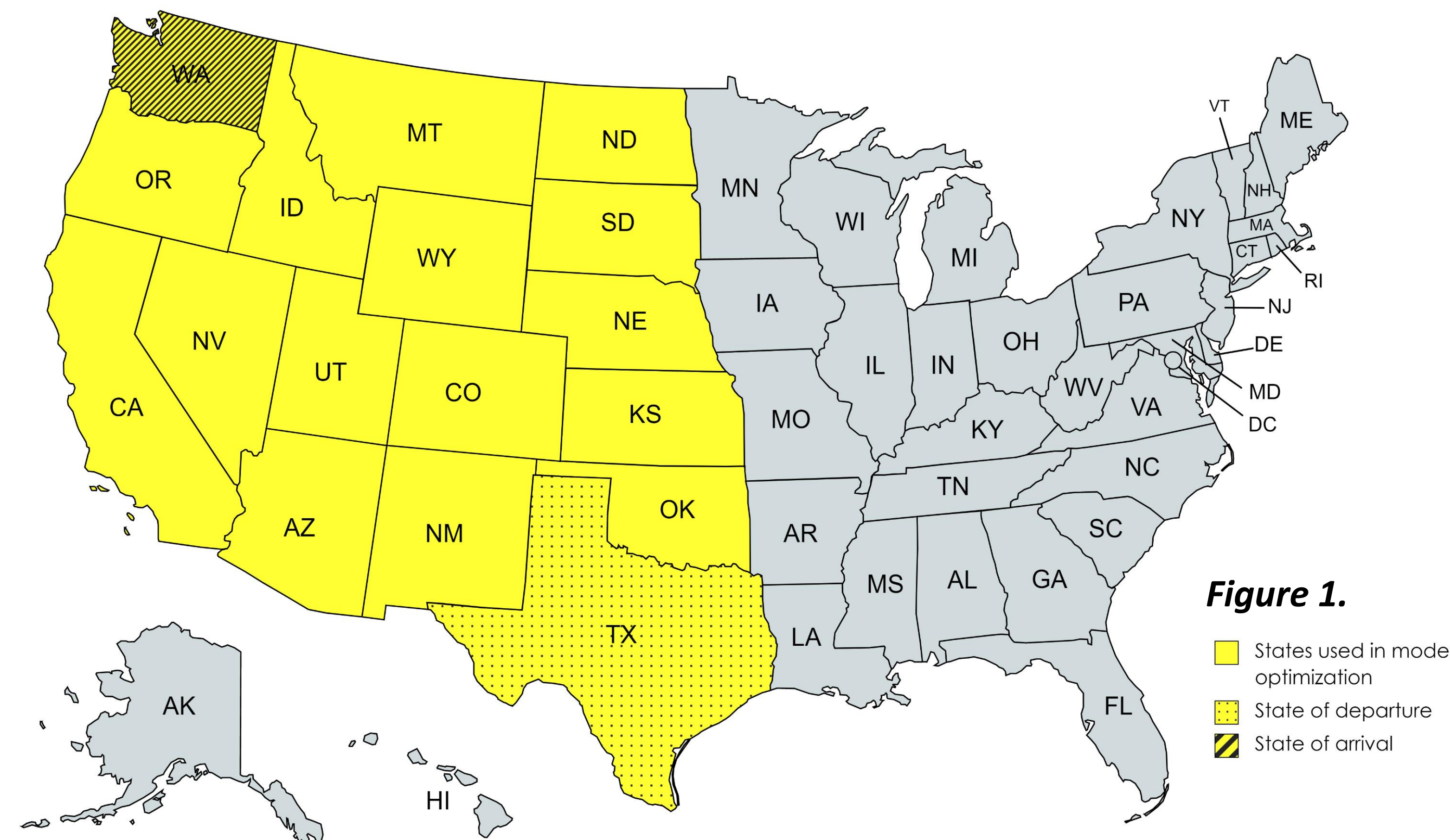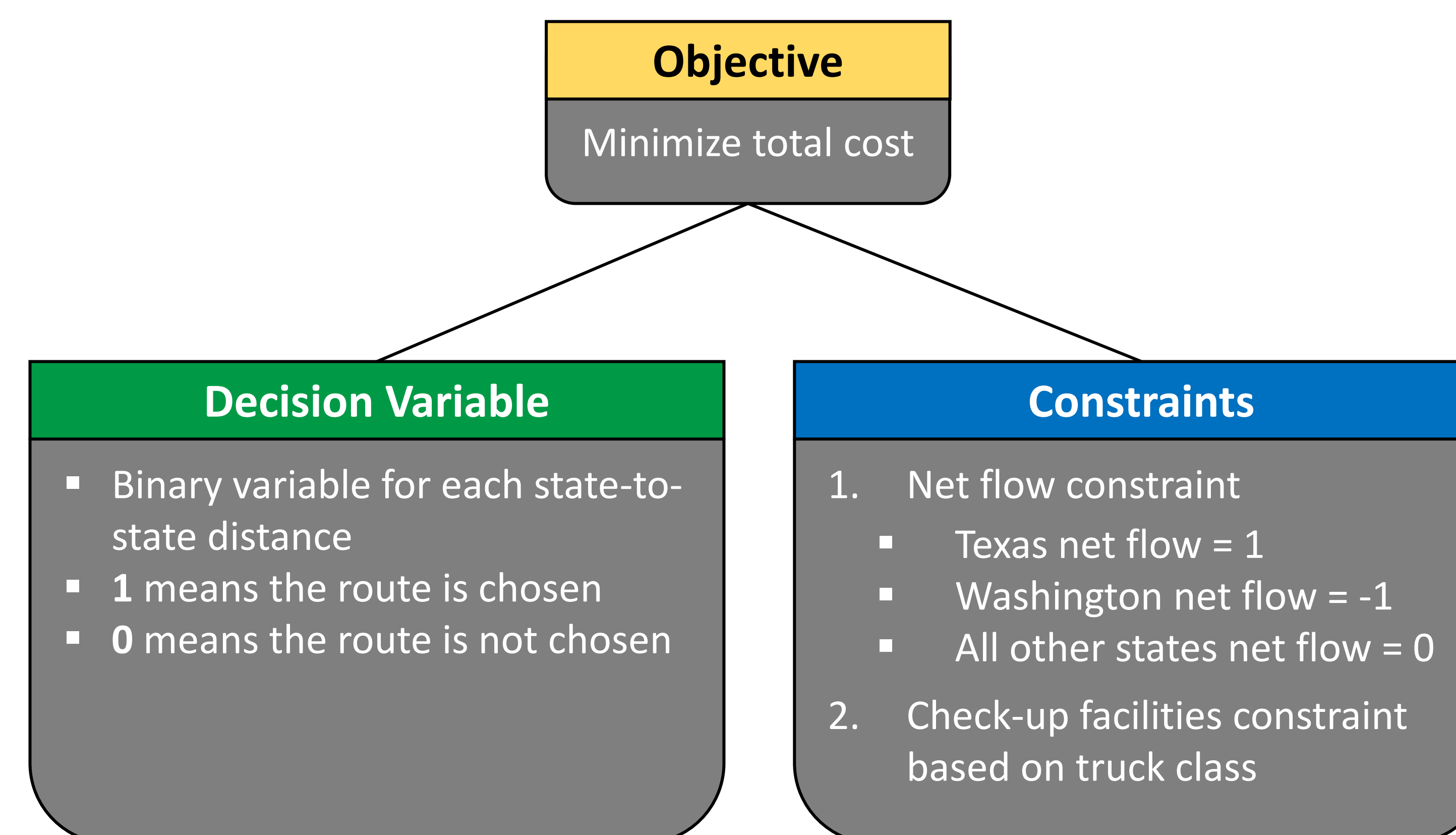
- Toll Rates
- Weight Capacity
- Fuel Cost

MILP Model Parameters

Objective
Minimize total cost

Decision Variable
- Binary variable for each state-to-state distance
- **1** means the route is chosen
- **0** means the route is not chosen

Constraints
1. Net flow constraint
   - Texas net flow = 1
   - Washington net flow = -1
   - All other states net flow = 0
2. Check-up facilities constraint based on truck class

Key Model Assumptions

- Average US diesel price is used to calculate total cost
- States with higher standard of living will have higher toll rates
- Each truck class will handle their corresponding maximum carrying capacity
- A state's central point is used to calculate the distance between two states (Default in Google Map API)

## MILP Model Setup & Deployment

Excel

- Applied **Data validation**, **VLOOKUP**, **INDEXMATCH**, **SUMPRODUCT** and **SUMIF** in model structuring
- Used **Simplex LP** in **Solver** for model optimization
- Applied **Conditional formatting** in displaying optimal routes
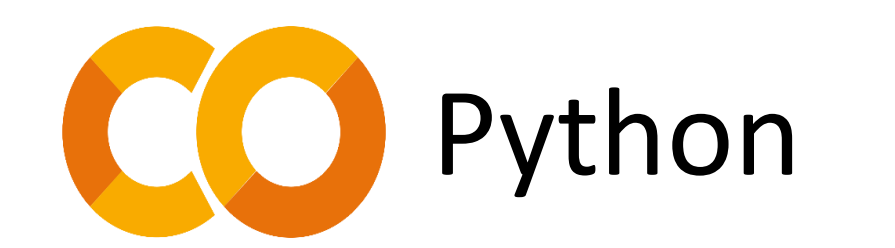
Python

- Used **Pandas** to create data frames for indexing, variable assignments and iterations
- Created **Input function** that allows users to select the truck class they want to optimize
- Used **GLPK** package in **Pyomo** (Python-based optimization package) to set up parameters and solve the model
- Used **Plotly** library to visualize optimal routes on map

Map Visualization of Optimal Route
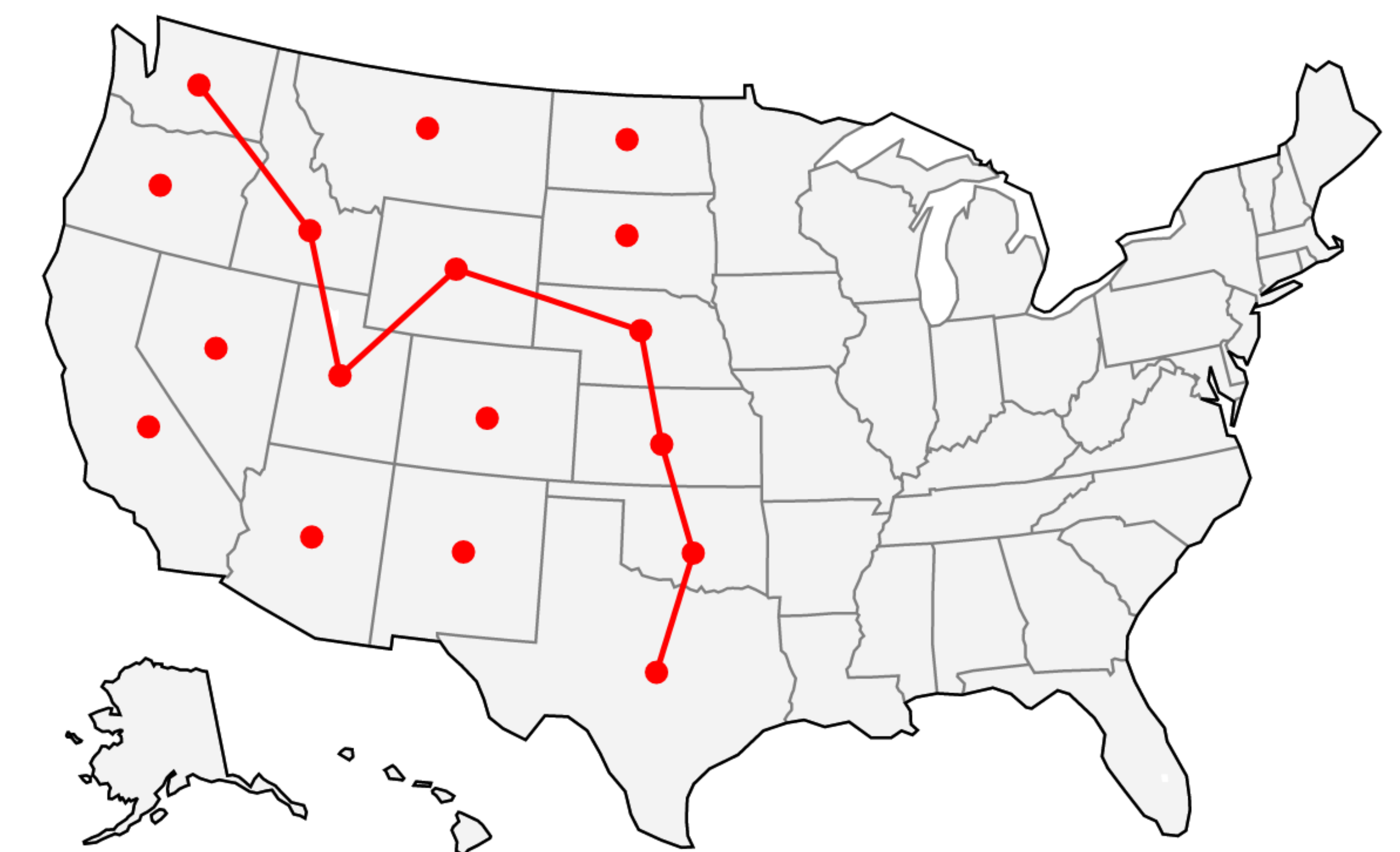
Optimal Path for Truck Class 4
Truck passes through Check-up facilities in NE and UT

Contact

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Statements of Contribution

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