SMARTLIST

Used Car Price Range Prediction

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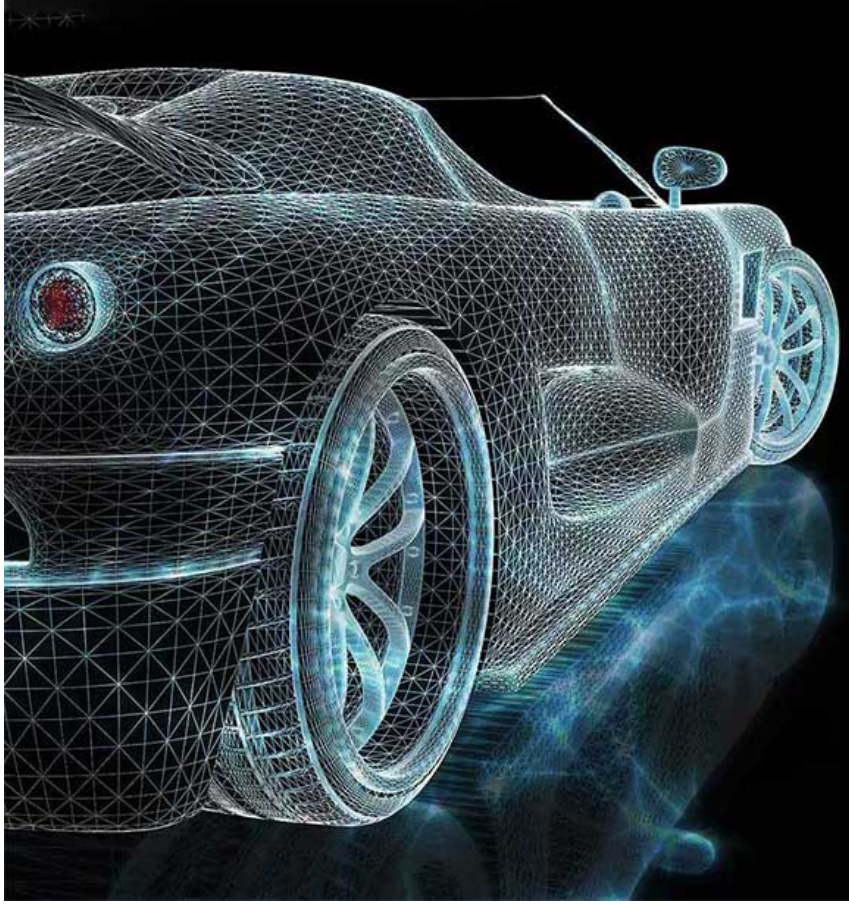
[Source Code]

Agenda



SMARTLIST

01 **Problem Statement**
What Problem | Who Cares | Why We Need

02 **Data Science Solution**
Our Solution | Potential Impact | Dataset

03 **Preprocessing & Insights**
Data Preprocessing | Key Insights

04 **Result & Conclusion**
Model Evaluation | Demo | Roadmap

Problem Statement

It takes 4 weeks to sell a used car.

How can we speed up the buying/selling process? To help both buyer and seller to achieve their goal?

Who Cares?

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Buyer

- Price Uncertainty
- Worry about Overpayment

Dealer

- Hard to manage expectation on both sides
- Long trading time

Seller

- Lack of Knowledge about Vehicle Pricing
- Missed Opportunity

What we need is TODO

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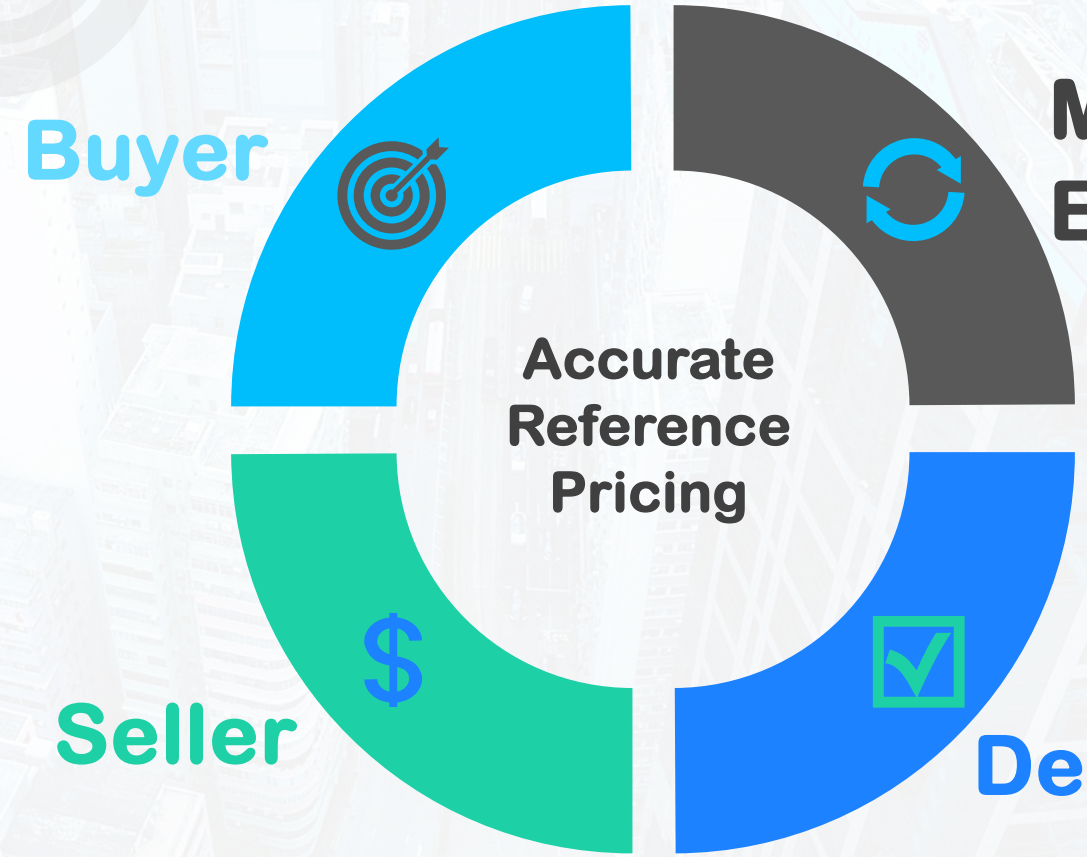



SMARTLIST
Data-Driven
Solution

Proposed Solution

SMARTLIST

Specification

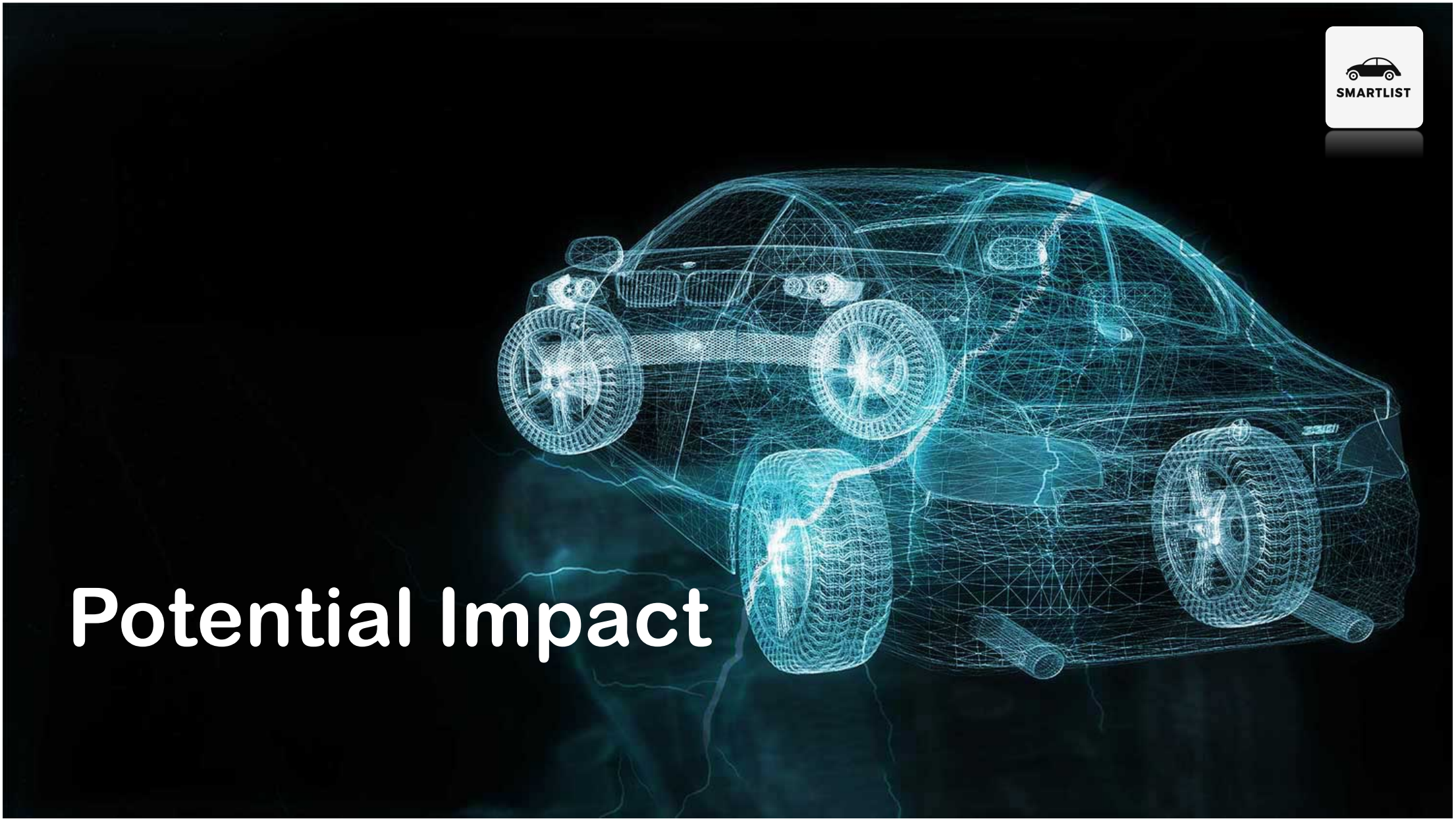
Machine Learning

Price Range

History

AI Solution

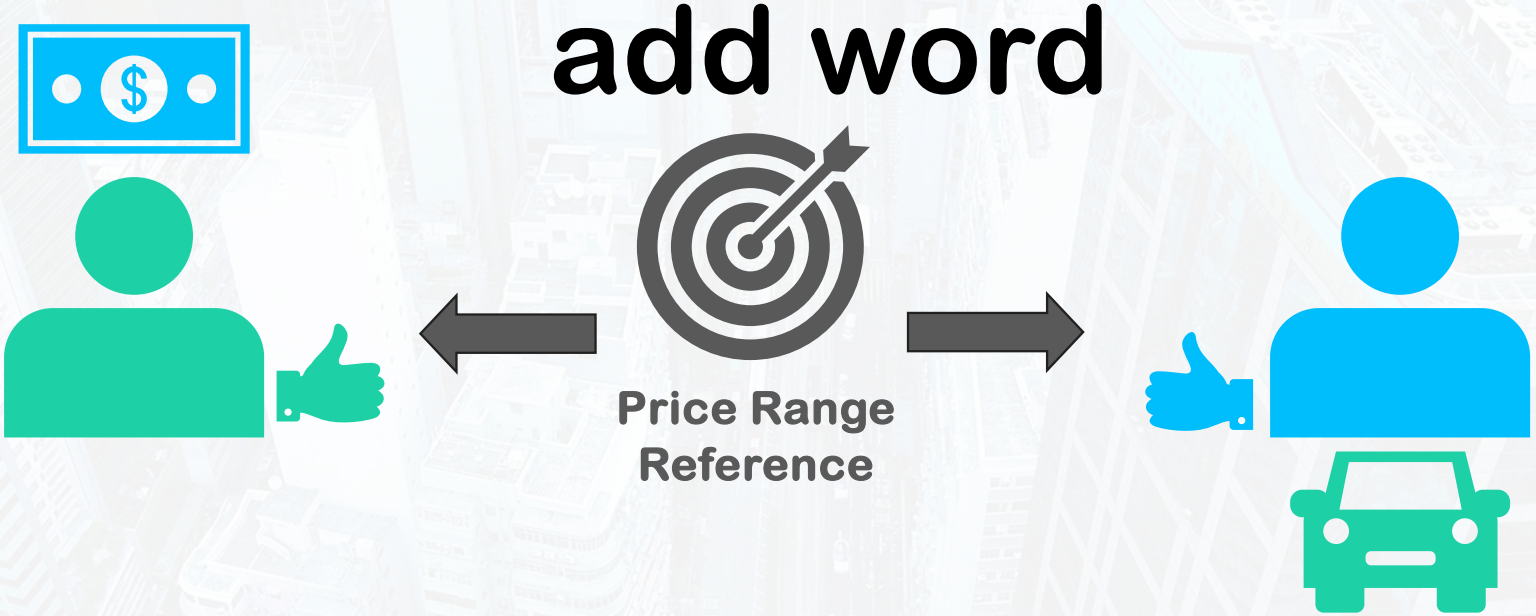
Speed Up


SMARTLIST
Potential Impact

Potential Impact TODO

SMARTLIST

add word



Save
> 1 weeks

10% in
Revenue


SMARTLIST
Dataset

Dataset

SMARTLIST

Geographical

- Canada
- USA

Temporal

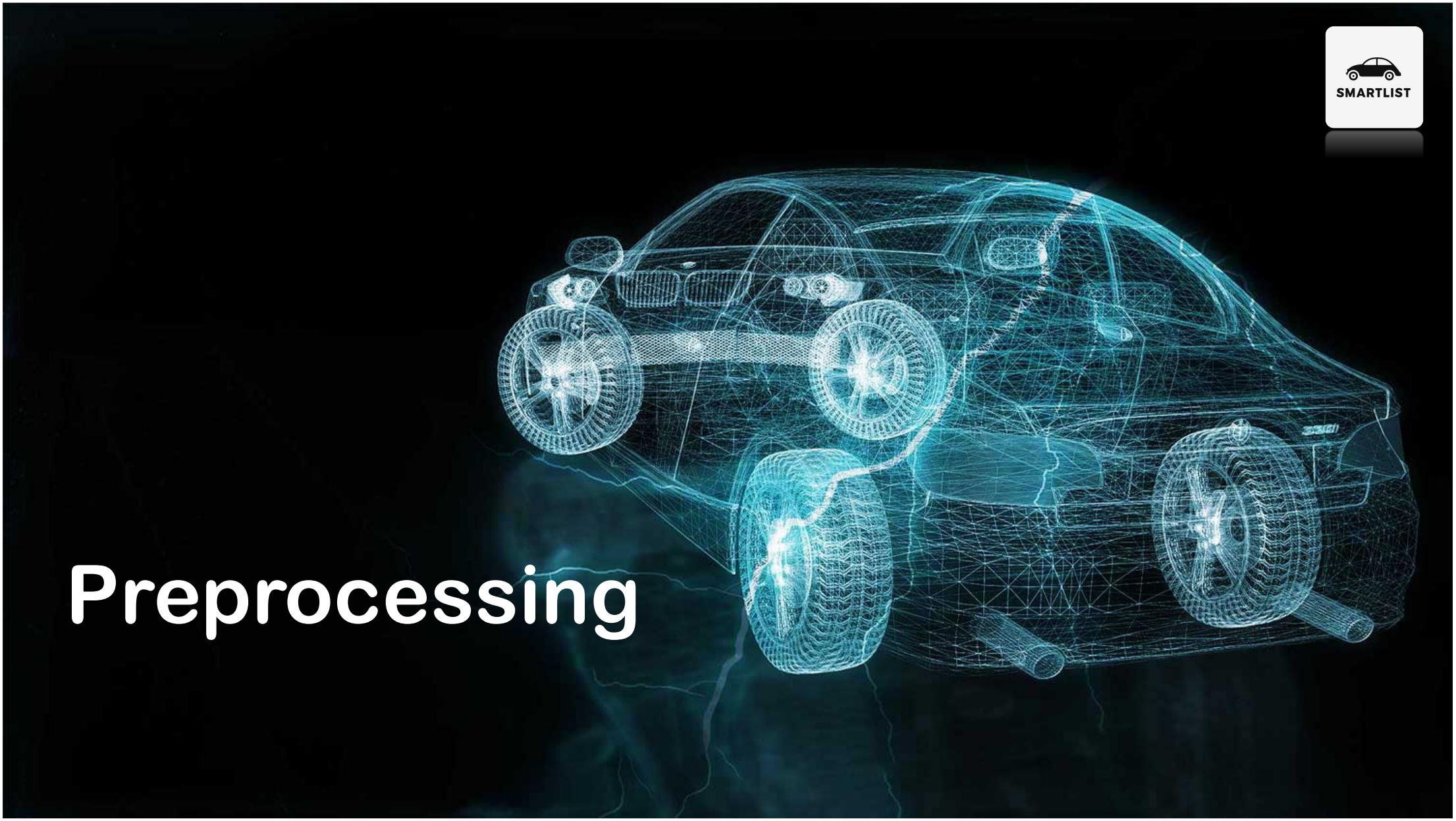
- April 2015
- June 2021

Source

- From Kaggle
- Source Link

Size

- 1.35 GB
- 7.5M Rows
  21 Columns


SMARTLIST
Preprocessing

Data Preprocessing

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1 **Label Encoding**
Transform exact price to price range.

2 **Missing Value Handling**
Fill in missing value based on the occurrence probability.

3 **Feature Flattening**
Some features are in list format which need to be transformed as vector representation.

4 **Feature Transformation**
Log transformation | One-hot Encoding | Target Encoding


SMARTLIST
Key Insights

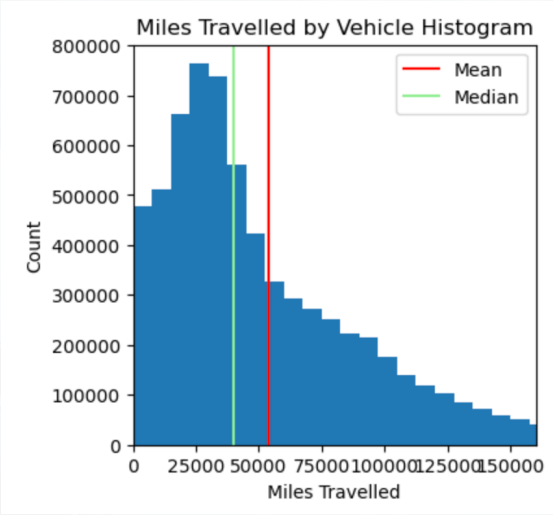
Key Insights - 1

SMARTLIST

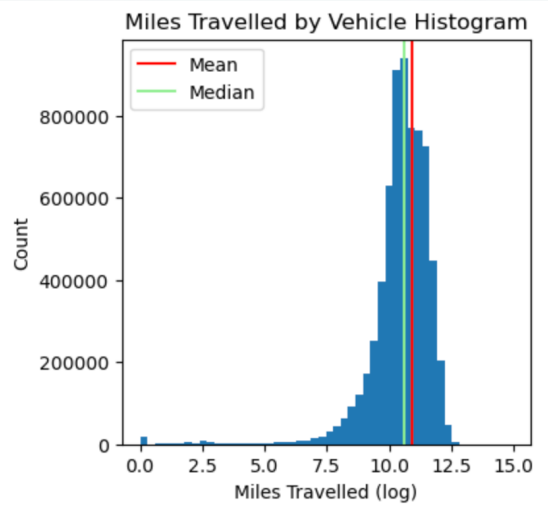
Log-Normal Distribution

- Transform the data to become “Normal Distribution”
- Many machine learning models perform better with normal distribution data / features.

Before



After

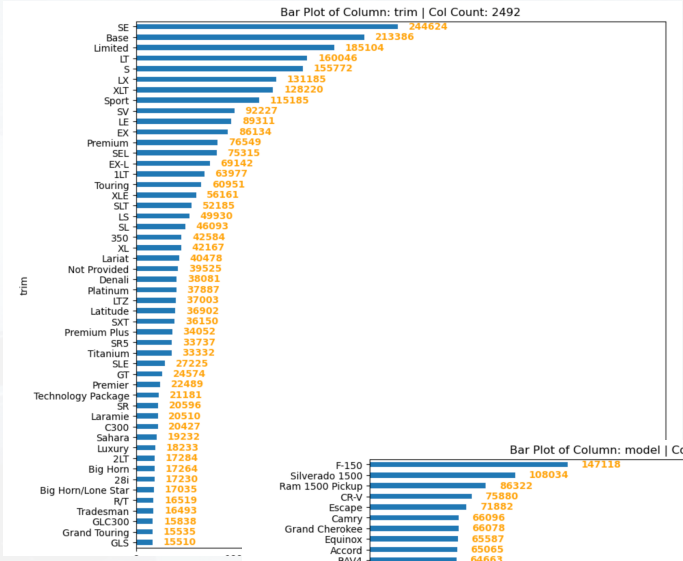


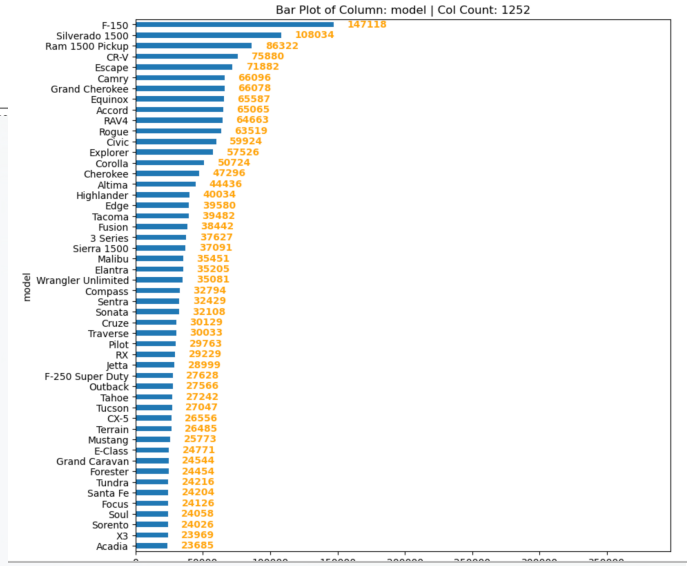
Key Insights - 2

SMARTLIST

Columns with too many values

- One-hot encoding
  - ➔ Increased Dimensions
- Count encoding






```
Column: make has 63 distinct values
Column: model has 1252 distinct values
Column: trim has 2492 distinct values
Column: city has 6095 distinct values
Column: state has 68 distinct values
```

Count Encoding

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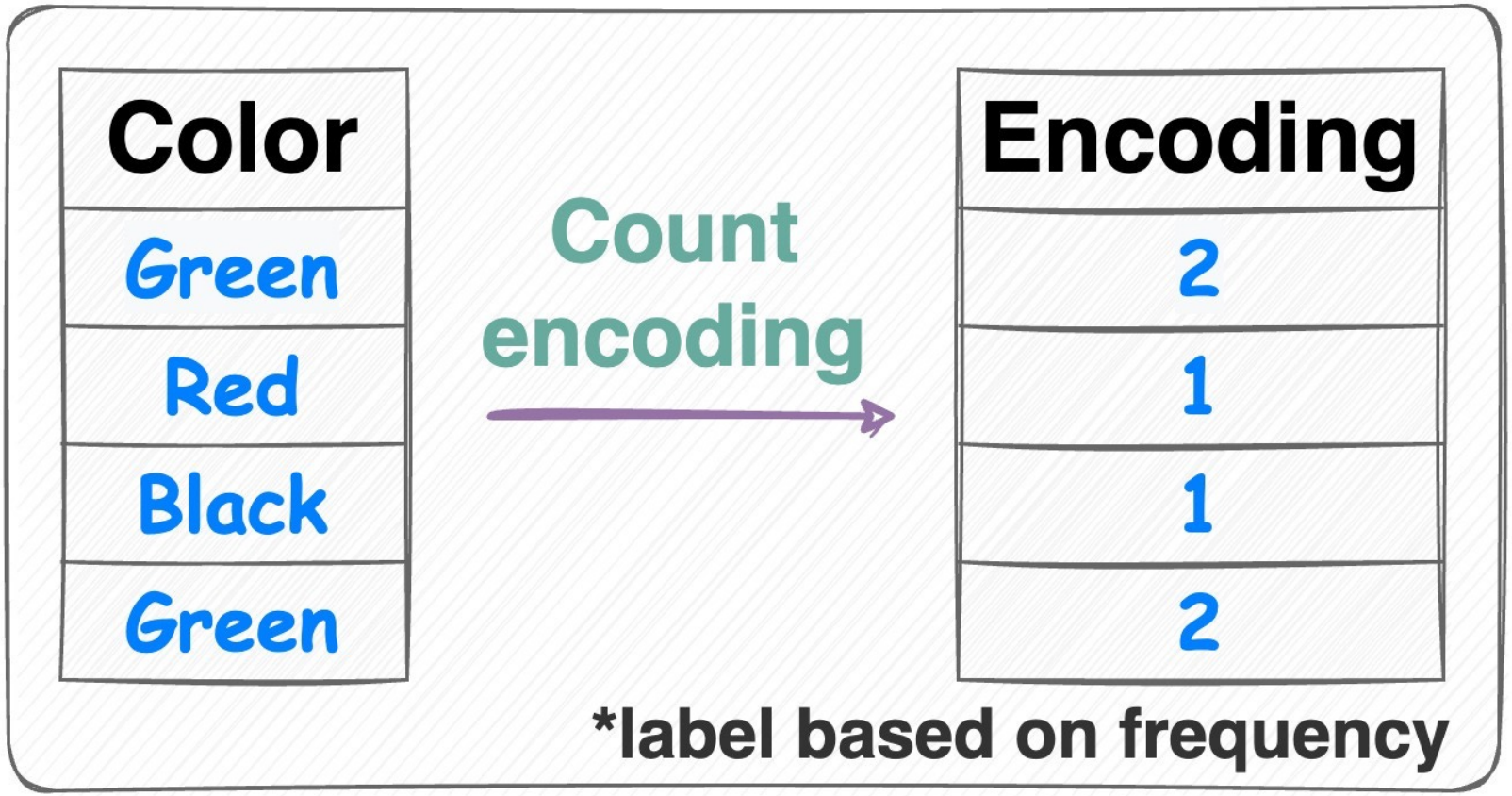
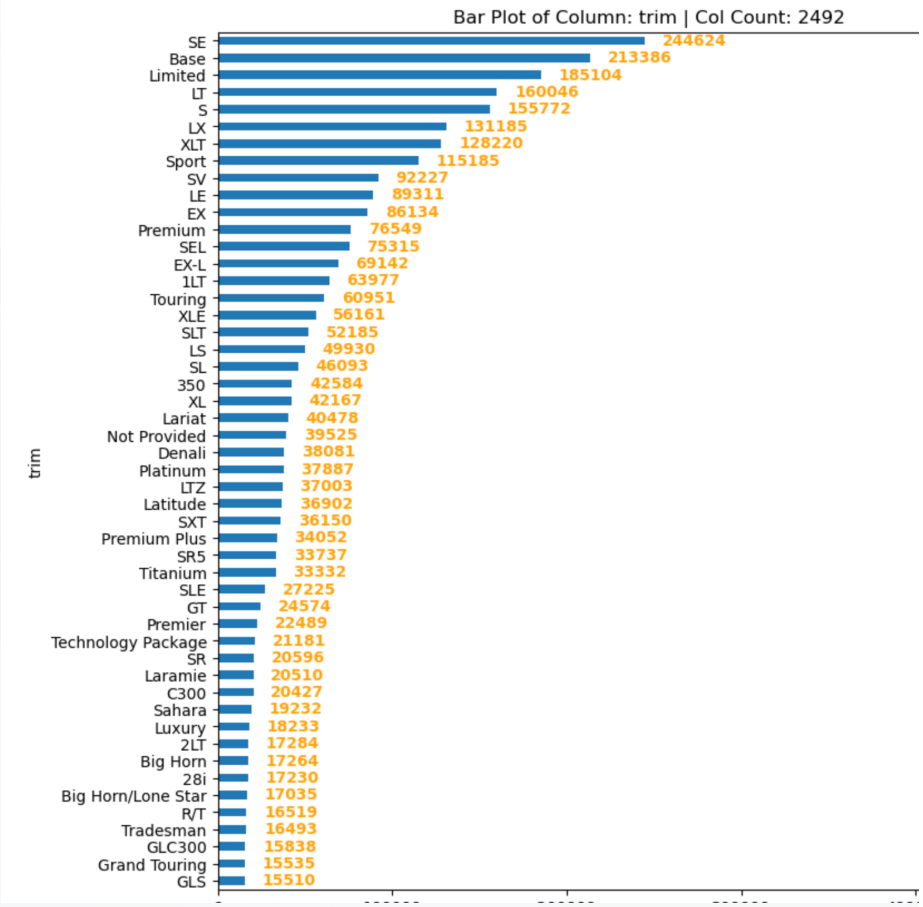


Key Insights - 2

SMARTLIST

Columns with too many values

- One-hot encoding
  - ➔ Increased Dimensions
- Count encoding
  - ➔ Extreme Value
  - ➔ Affecting the scaling steps
- Target encoding



Target Encoding

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Target Encoding

workclass	target
State-gov	0
Self-emp-not-inc	1
Private	0
Private	0
Private	1

workclass	target mean
State-gov	0
Self-emp-not-inc	1
Private	1/3

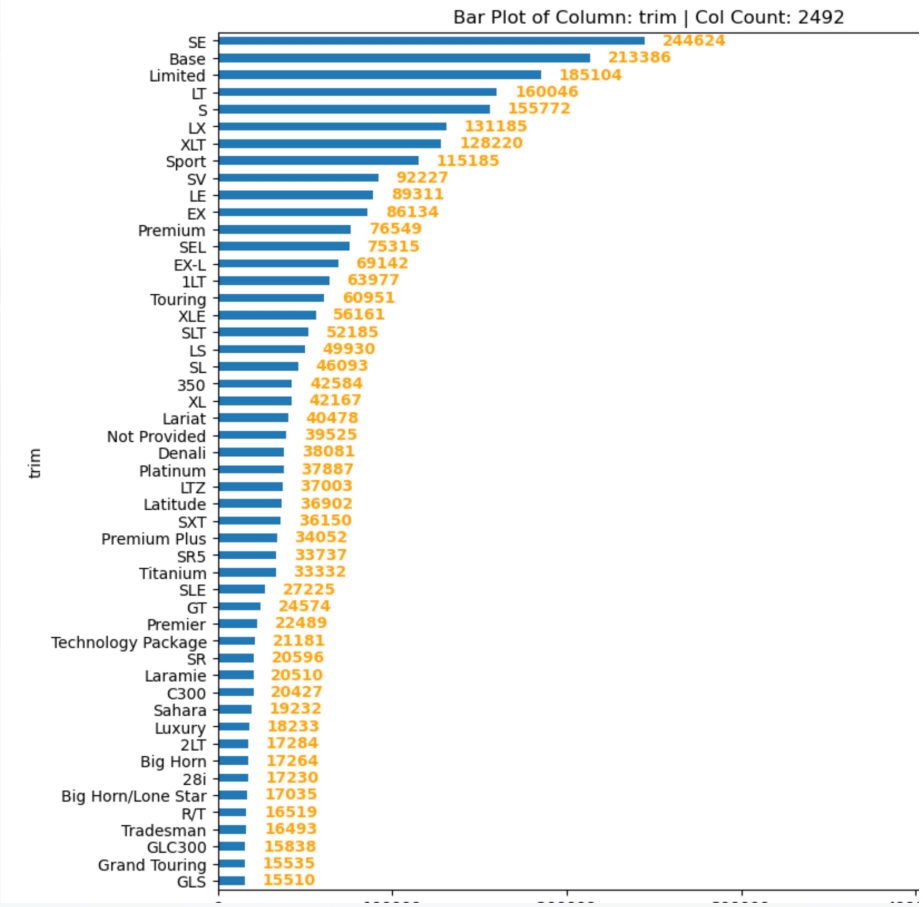
workclass
0
1
1/3
1/3
1/3

Key Insights - 2

SMARTLIST

Columns with too many values

- One-hot encoding
  - ➔ Increased Dimensions
- Count encoding
  - ➔ Extreme Value
  - ➔ Affecting the scaling steps
- Target encoding
  - ➔ Does not increase dimensions
  - ➔ Encoded values between 0 ~ 1




SMARTLIST
Model Evaluation

Model Evaluation

SMARTLIST

Model Performance (10% Data)

Model	Best Params / Params	Training F1 Score	Testing F1 Score	
Logistic Regression (Baseline)	{'C': 1, 'class_weight': 'balanced','max_iter': 10000,'penalty': 'l2'}	69.74%	69.82%	
Logistic Regression	{'C': 1000, 'class_weight': None, 'max_iter': 10000, 'penalty': 'l2'}	71.77%	71.81%	
Decision Tree	{'max_depth': 25, 'min_samples_split': 50}	82.15%	82.94%	
Adaptive Boosting (AdaBoost)	{'learning_rate': 1, 'n_estimators': 100}	85.34%	85.89%	✅
eXtreme Gradient Boosting (XGBoost)	{'max_depth': 15, 'n_estimators': 30}	85.42%	85.85%	✅
Random Forest (RF)	{'max_depth': 50, 'min_samples_split': 25, 'n_estimators': 150}	85.39%	85.82%	✅
Naïve Bayes	*Default*	45.75%	43.18%	
Neural Network	3 Hidden Layers (50,25,10) + ReLU Activation Layers + Epochs = 3	32.06%	32.38%	

Model Evaluation

SMARTLIST

Model Performance (Full Set)

Model	Best Params / Params	Training Time	Training F1 Score	Testing F1 Score
Adaptive Boosting (AdaBoost)	{'learning_rate': 1, 'n_estimators': 100}	3h 14m 20s	86.95%	87.06%
eXtreme Gradient Boosting (XGBoost)	{'max_depth': 15, 'n_estimators': 30}	34m 43s	87.32%	87.46%
Random Forest (RF)	{'max_depth': 50, 'min_samples_split': 25, 'n_estimators': 150}	20m 47s	87.30%	87.47%

Model Evaluation Criteria

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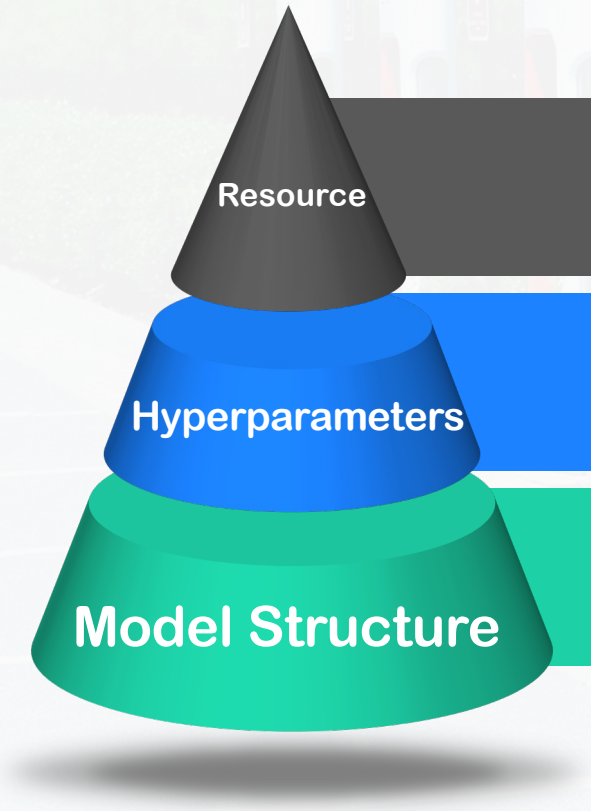

Balance between performance and resources.

Tune the hyperparameters with selected models.

Different model structures give different results.

Model Evaluation

SMARTLIST

Model Performance (Full Set)

Model	Best Params / Params	Training Time	Training F1 Score	Testing F1 Score
Adaptive Boosting (AdaBoost)	{'learning_rate': 1, 'n_estimators': 100}	3h 14m 20s	86.95%	87.06%
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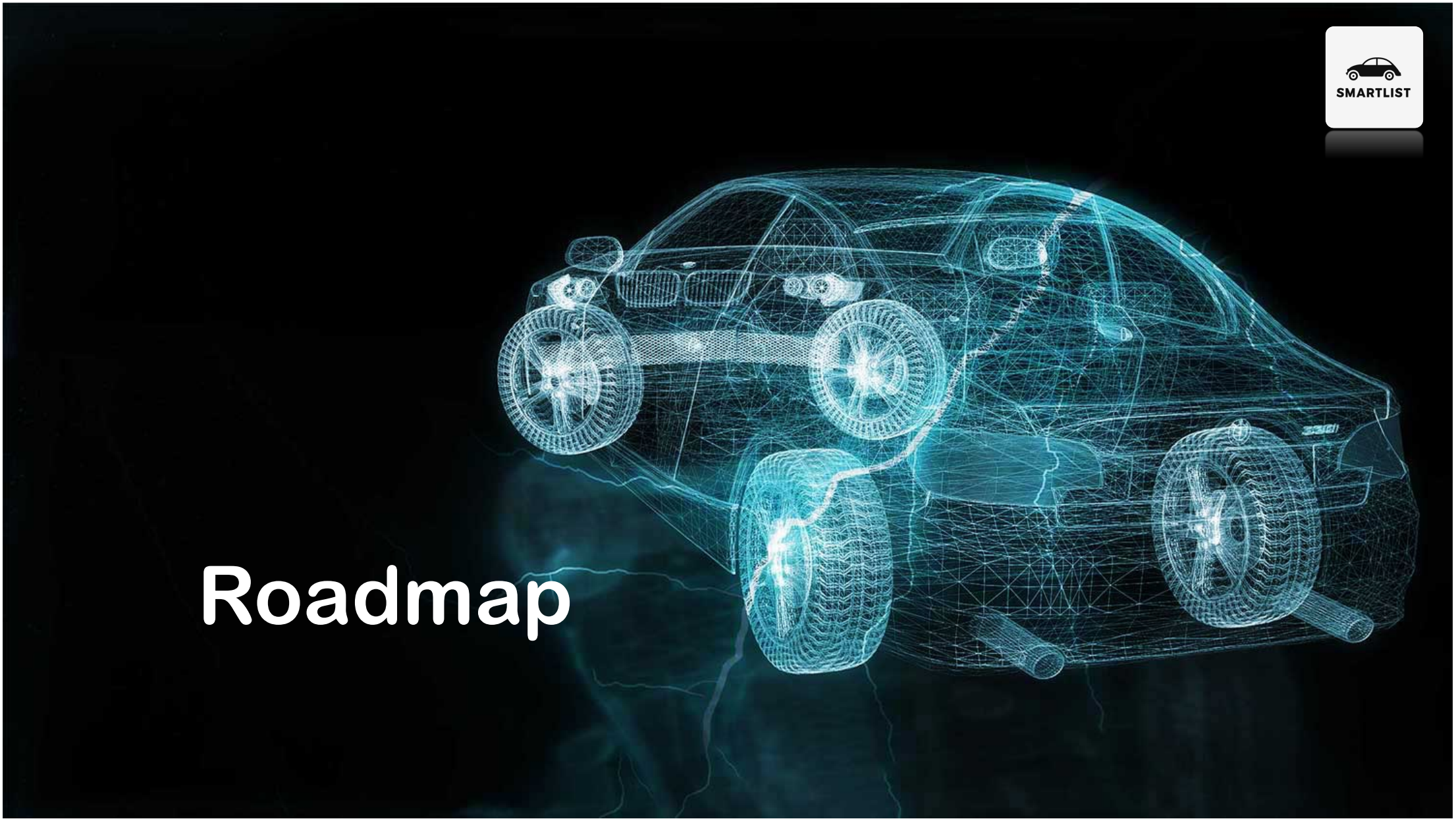
Demo Time


SMARTLIST
Roadmap

Roadmap

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Sprint 0

- Problem Space Definition
- Scope Definition
- Dataset Research

Sprint 1

- Data Cleaning
- Exploratory Data Analysis
- Statistical Analysis

Sprint 2

- Data Preprocessing
- Baseline Model Training

Future

- Extend to Regression Task
- i.e. Predicting Exact Price
- Re-train model with more data
- Continually collecting new feedback
- Challenge Ourself ➔ Beat our RF model

Sprint 3

- Advance Modelling
- Web UI Integration
- Product Delivery


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THANK YOU