instacart

Machine Learning Models Predicting Future Purchase

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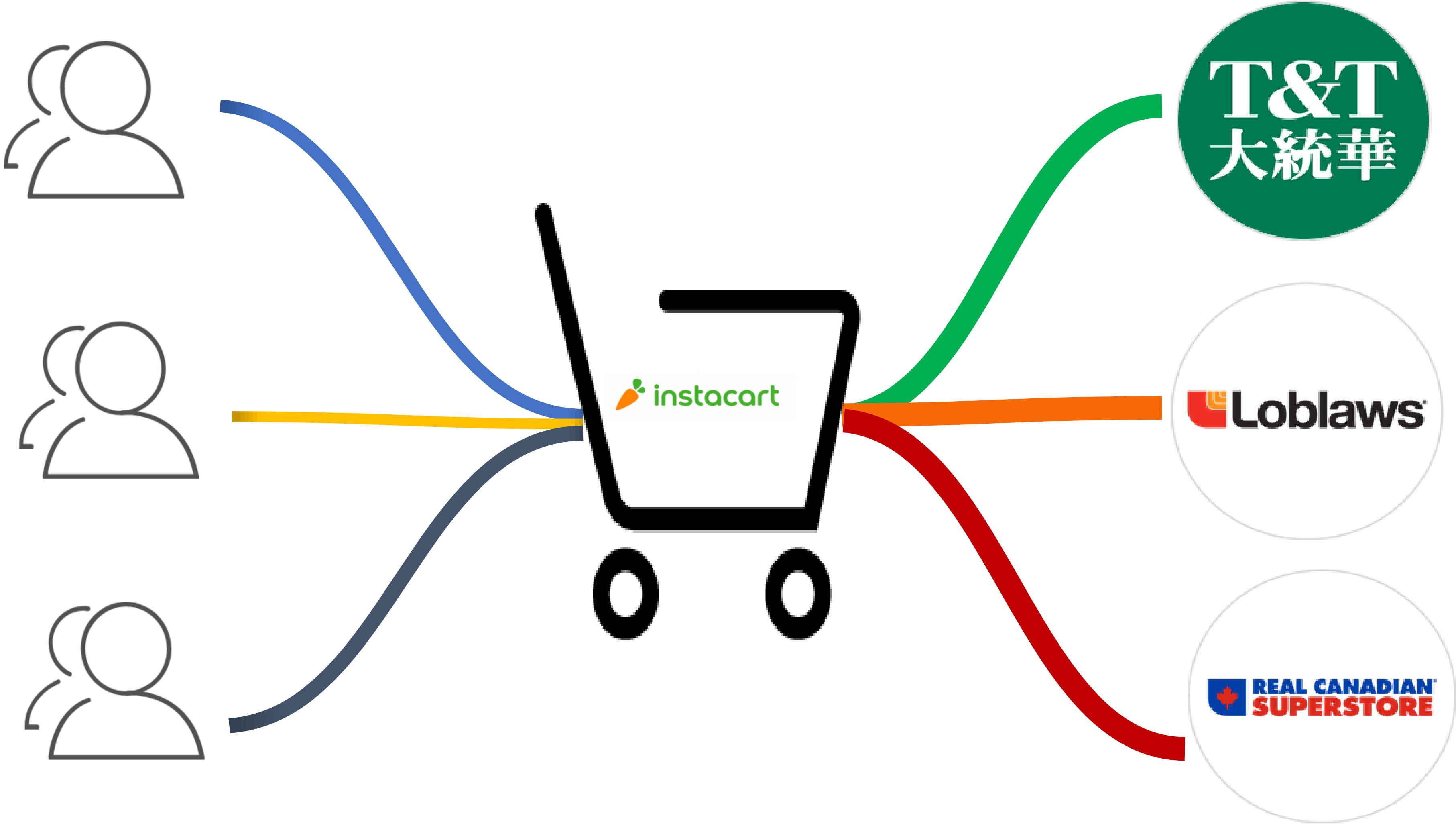
Agenda

- ➢ Introduction
- ➢ Project Goal & Data Description
- ➢ Modeling Process
- ➢ Business Implementation & Next Step
- ➢ Q&A

Instacart Business Model



Project Incentive

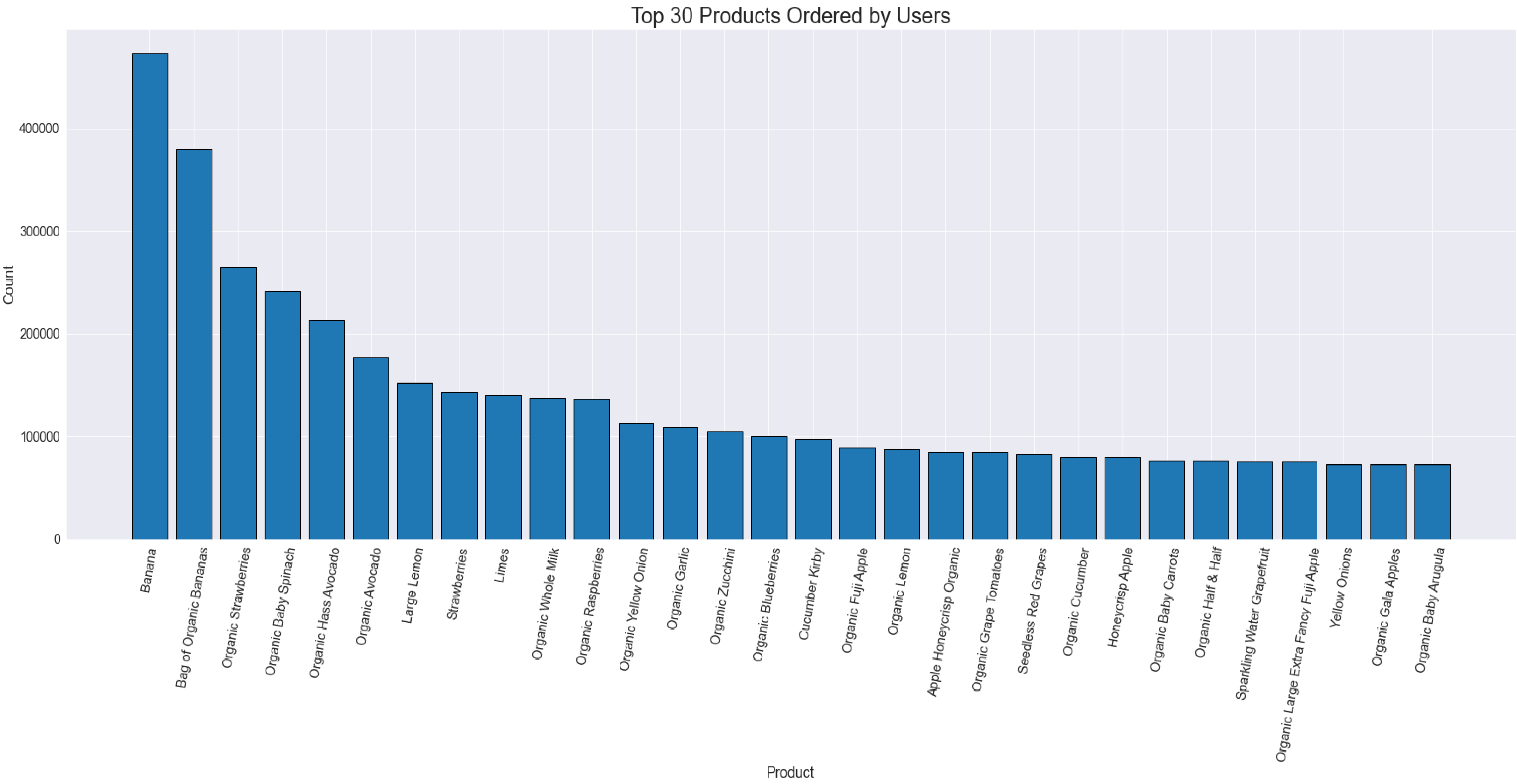
- Predict which product will the user order based on past purchasing behaviors

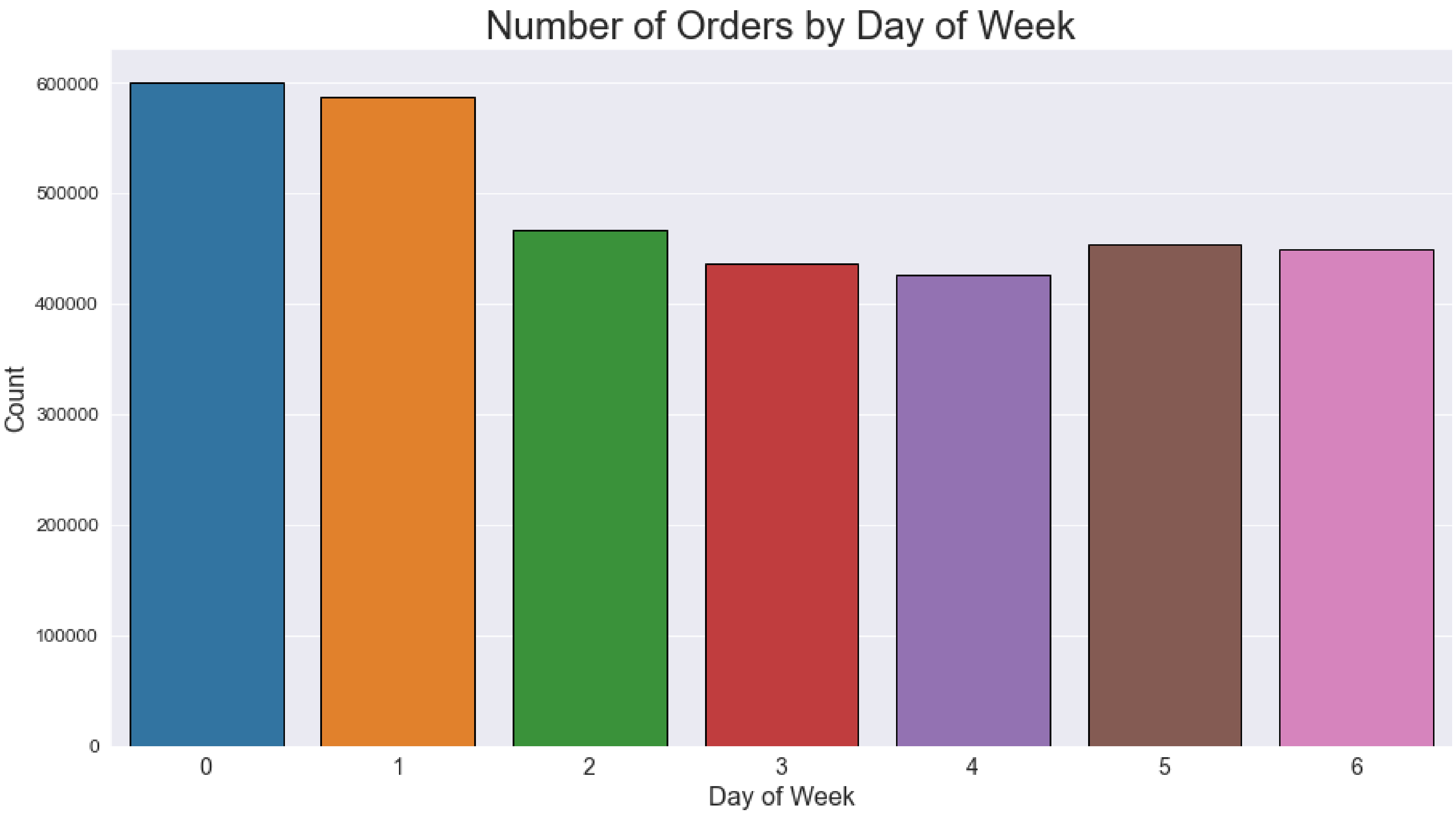
- Remind people to add predicted orders to their shopping cart

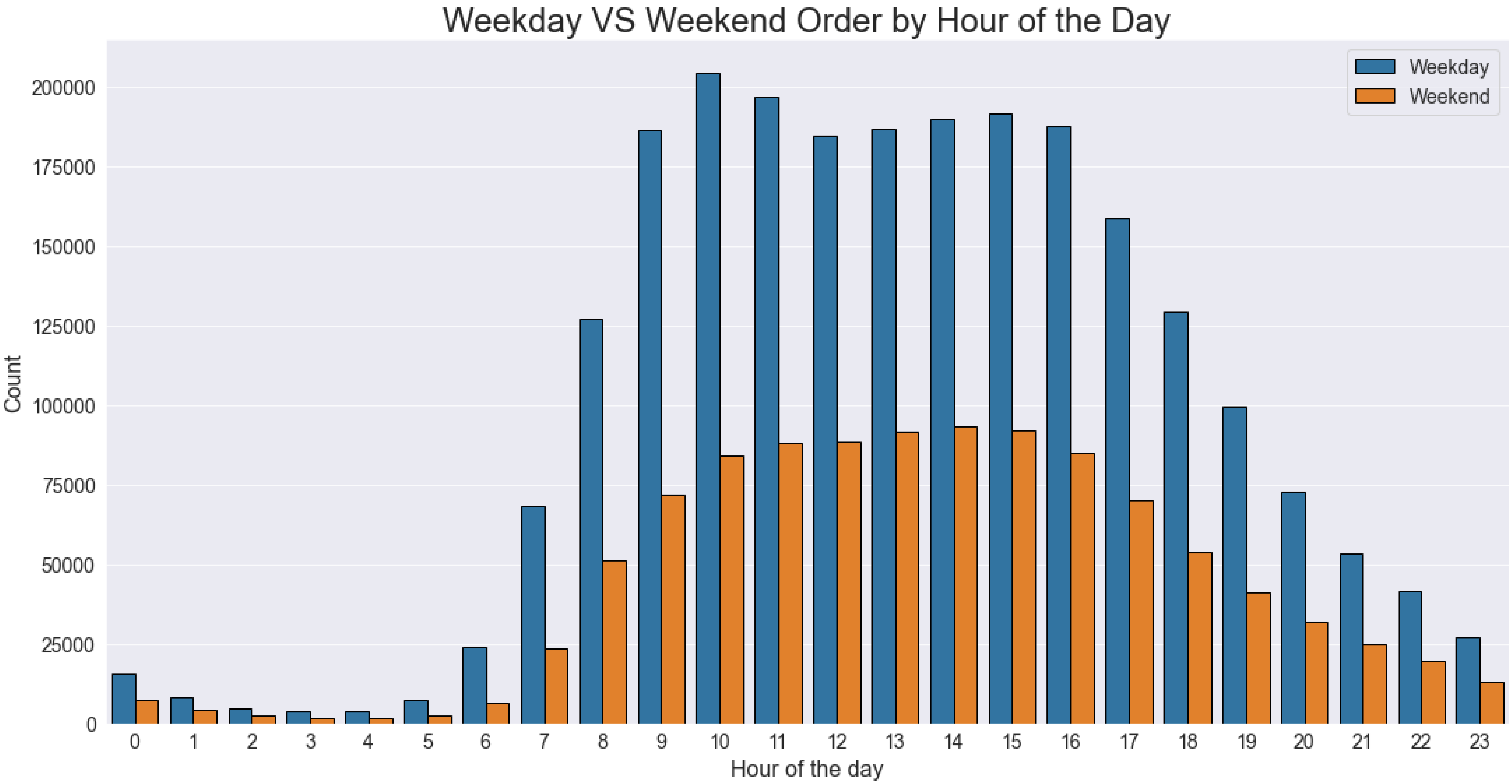
- Increase the overall items in their shopping cart to increase the revenue for stores

Data Overview

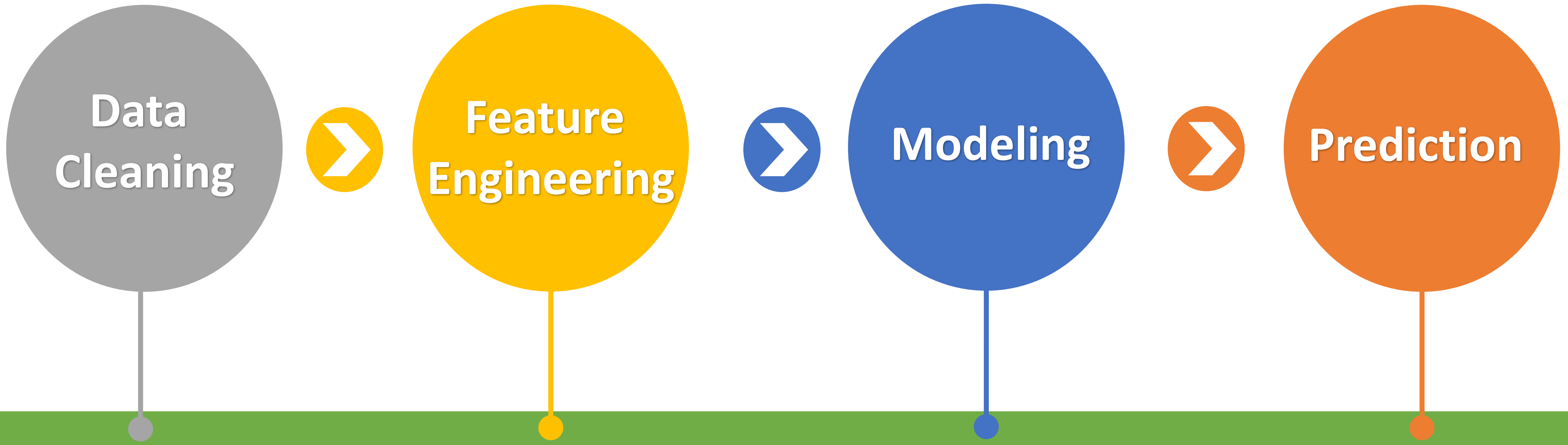
Tables	Size	Brief Description
Prior	**32M obs.**	**Orders prior to that users most recent order**
Train	**1.3M obs.**	**One of partitions of the total orders**
Order	**3M obs.**	**Details of each orders includes (DOW, hr of a day, etc.)**
Product	**49K obs.**	**Details of each product**
Department	**21 obs.**	**The department info. related to products**
Aisles	**134 obs.**	**The department info. related to products**


Top 30 Products Ordered by Users
Count
400000
300000
200000
100000
0
Banana
Bag of Organic Bananas
Organic Strawberries
Organic Baby Spinach
Organic Hass Avocado
Organic Avocado
Large Lemon
Strawberries
Limes
Organic Whole Milk
Organic Raspberries
Organic Yellow Onion
Organic Garlic
Organic Zucchini
Organic Blueberries
Cucumber Kirby
Organic Fuji Apple
Organic Lemon
Apple Honeycrisp Organic
Organic Grape Tomatoes
Seedless Red Grapes
Organic Cucumber
Honeycrisp Apple
Organic Baby Carrots
Organic Half & Half
Sparkling Water Grapefruit
Organic Large Extra Fancy Fuji Apple
Yellow Onions
Organic Gala Apples
Organic Baby Arugula
Product


Number of Orders by Day of Week
Count
600000
500000
400000
300000
200000
100000
0
0
1
2
3
4
5
6
Day of Week


Weekday VS Weekend Order by Hour of the Day
Weekday
Weekend
Count
200000
175000
150000
125000
100000
75000
50000
25000
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Hour of the day

Modeling Process



Data Cleaning

- Join Tables
- Data Sampling
- Missing Data
- Data Exploration

Feature Engineering

- User & Product Specific Information
- User Specific Information
- Data Transformation

Modeling

- Logistic Regression
- Decision Tree
- Random Forest
- Model optimization

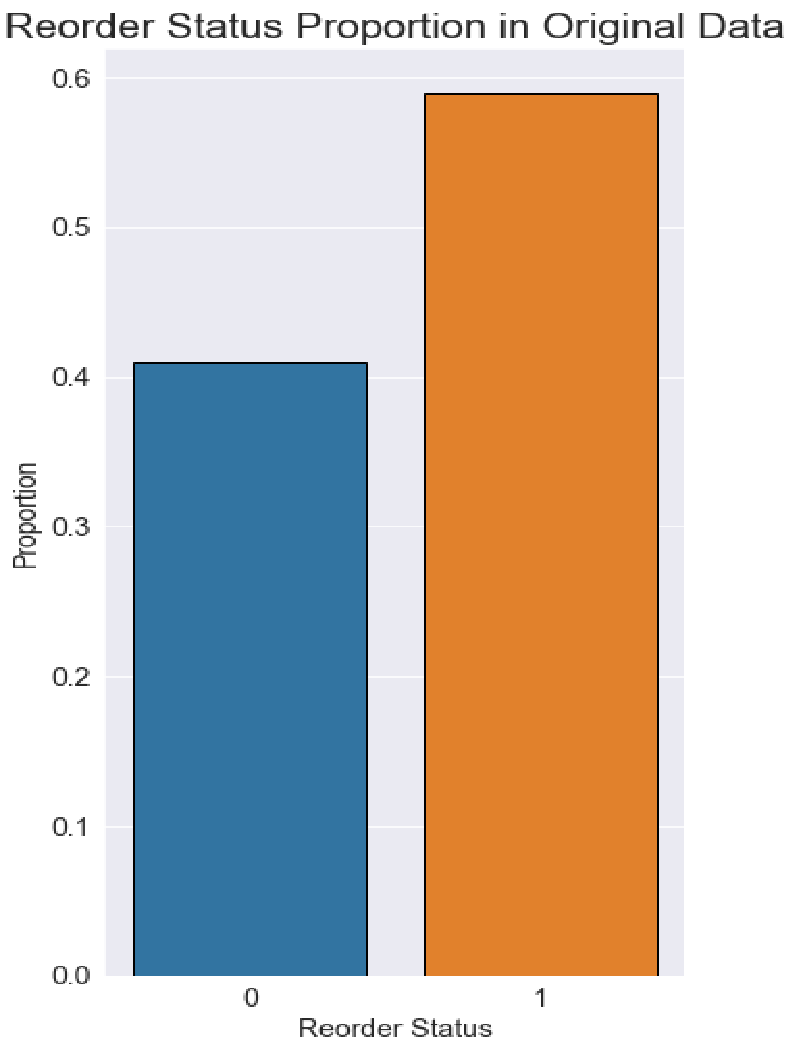
Prediction

- User buying the product again (accuracy: 85%)

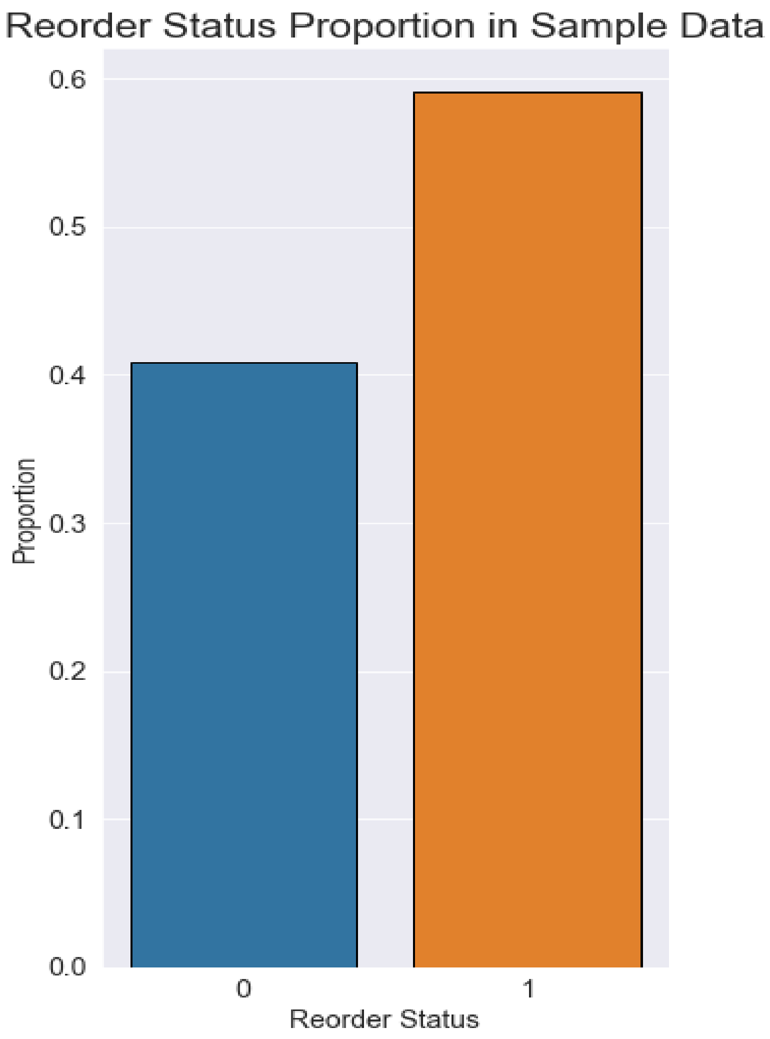
Modeling Process – Data Cleaning

- Join Relational Data
  - 16 features
  - 32M of Transactional Data
- Data Sampling
  - 5% of Original Data
  - 10,000 Users / 1.5M of Transactional Data
- Data Manipulation
- Missing Data
  - Fill in with 0 for days since prior order if they are missing

Modeling Process – Data Cleaning



Reorder Status Proportion in Original Data



Reorder Status Proportion in Sample Data

Modeling Process – Feature Engineering

- User & Product Specific Features
    - Reordered ratio for each product of each user
    - Most frequent day of week for product placed by user
    - Most frequent hour of day for product placed by user
    - Overall reorder ratio for each product

- User Specific Features
    - Average products ordered by user
    - User reordered ratio
    - Most frequent order day of week for user
    - Most frequent order hour of day for user

Modeling Process – Feature Engineering

- Convert aisle_id to dummy variables
- Total 146 features
- Train / Test Split
  - 70% Train
  - 30% Test

Modeling Process – Modeling

- Logistic Regression
  - Optimize regularization parameter: C with cross validation
  - 81% accuracy rate on train/test set
- Decision Tree
  - Optimize hyperparameter max_depth, splitter with cross validation and GridSearchCV
  - 86% accuracy rate on test set/ 87% on training set
- Random Forest
  - Optimize hyperparameter: n_estimator, max_depth, min_samples_split with cross validation and GridSearchCV
  - 86% accuracy rate on test set / 91% on training set

Modeling Process – Model Evaluation

Classification Report for Logistic Regression

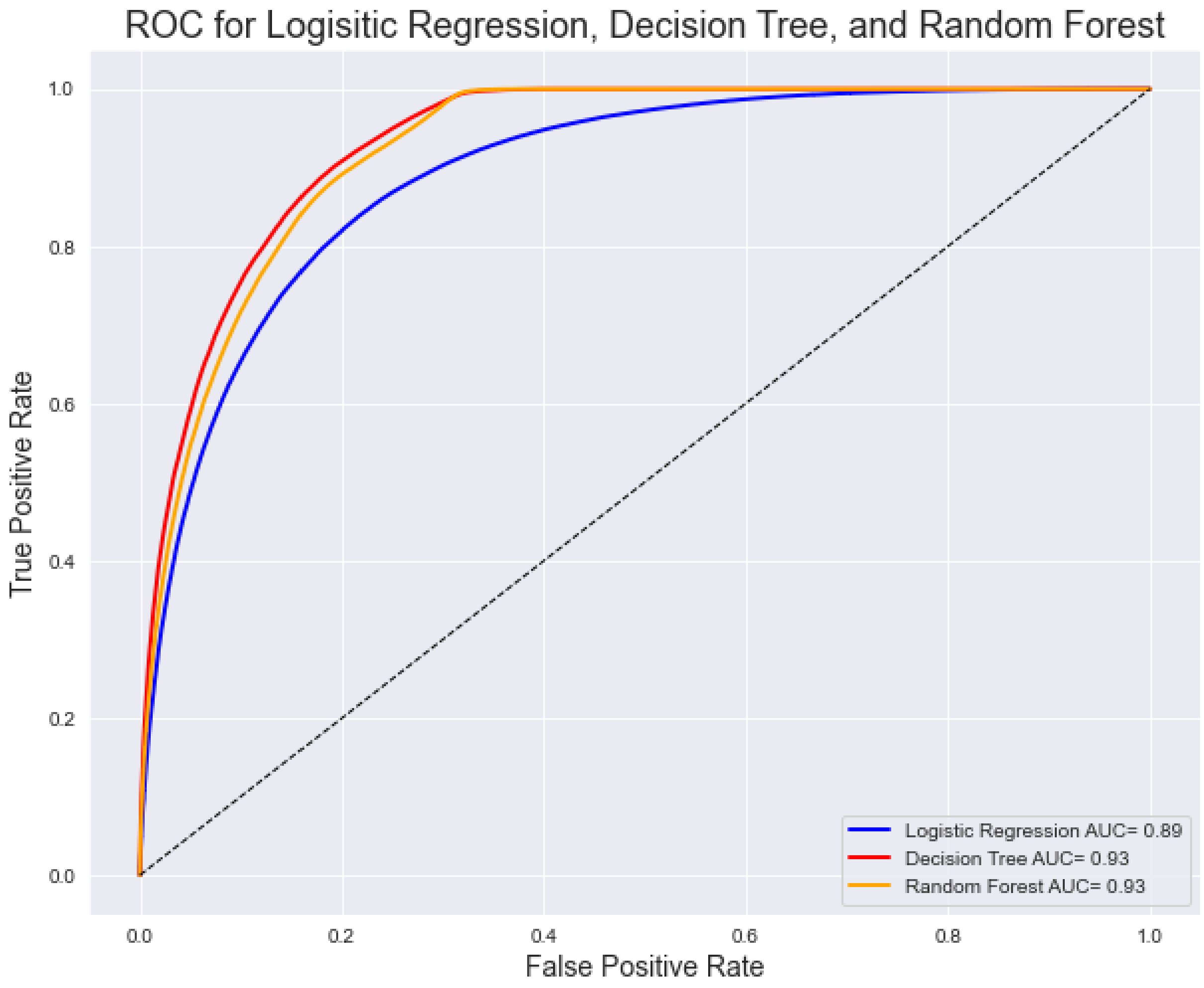
	Precision	Recall
0	0.76	0.80
1	0.85	0.82

Classification Report for Decision Tree

	Precision	Recall
0	0.93	0.73
1	0.84	0.96

Classification Report for Random Forest

	Precision	Recall
0	0.92	0.72
1	0.83	0.96



Modeling Process – Final Model

- Decision Tree
  - 86% accuracy rate on test set
  - Better AUC score compared to Logistic Regression
  - Precision and recall scores are fairly close
  - Easier and faster to build compare to Random Forest

Model Application

Product Reorder Prediction

Application

- Model: Decision Tree
- Accuracy: 86%

- Display the products when users shop
- Remind users to order the predicted products
- Set up easy reorder icon
- Promotion for those products
- Inventory management

The Next Step

- Scaled up the model with all of the data
- Product
  - Precise category assignment for each product
  - Pricing information for each product
  - Price bundling
- Customer
  - Customer demographic information
  - Customer lifetime value
  - Target marketing

Thank you

Questions?