Customer Suggested Ordering
CCSWB – MIT Collaboration
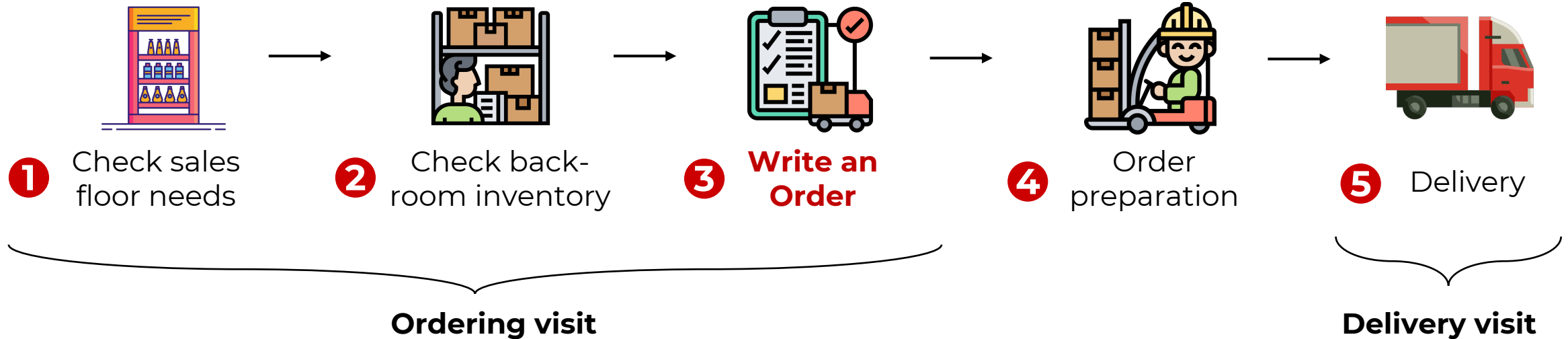### August 18, 2023

Students: **Maïwenn Danno & Hamza Zerhouni**
Supervisors: **Prof. S. Graves** *(MIT)* **& E. Elizondo** *(CCSWB)*

MIT Management
SLOAN SCHOOL

Context

Order-taking & distribution process at CCSWB

| ① Check sales floor needs | ② Check back-room inventory | ③ **Write an Order** | ④ Order preparation | ⑤ Delivery |

Ordering visit — (steps 1–3)

Delivery visit — (step 5)

Problem statement

Current pains

Average suggestions
→ Mental calculations & adjustments

Experience-dependent

Time-consuming

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Opportunities

Improve Order Suggestions:

- Can we account for **trends & seasonality** ?

- Can we facilitate **operations** ?

- Can we support **volume growth**?

Problem statement

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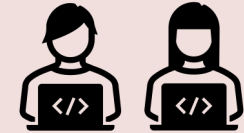
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Opportunities

Improve Order Suggestions:

- Can we account for **trends & seasonality** ?

- Can we facilitate **operations** ?

- Can we support **volume growth**?

Goal

Develop a **Customer Suggested Ordering** solution that enhances **CCSWB's sales & efficiency**

Objective

Develop a model that provides frontline employees with **reliable suggestions**, i.e.:

1. Accounts for sales trends & seasonality

2. Prevents out-of-stocks

3. Explores full stores' sales potential

4. Facilitates operations

Objective

Develop a model that provides frontline employees with **reliable suggestions**, i.e.:

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4700 Home Market Retailers in Dallas-Fort Worth

7 Trade Channels:
- Superette
- Convenience Store
- Club Store
- Supermarket
- General Merchandiser
- Hyper-Merchandiser
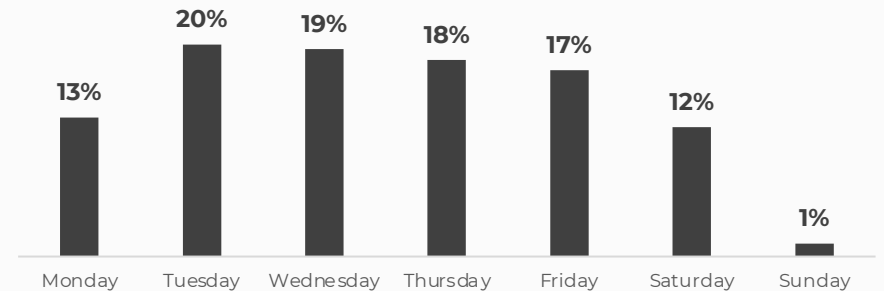- Mass-Merchandiser

1200 SKUs in 10 Categories:
- Core Sparkling
- Dairy/Soy Beverages
- Packaged Water
- Enhanced Water Beverages
- Fruit/Vegetables Still Drinks
- Juices/Nectars
- Energy Drinks
- Sport Drinks
- Coffee
- Tea

~1.4M Eq sold weekly

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
13%	20%	19%	18%	17%	12%	1%

(1 Eq = 5.7 L of beverage)

Our 4-steps solution

+70 Features

*Historic sales,
Out-of-stocks,
Demographics,
Nielsen,
Holidays,
Stores,
SKUs,...*

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Historic sales, Out-of-stocks, Demographics, Nielsen, Holidays, Stores, SKUs,...

① **Sales forecast per store, week & SKU groupings**

How much will the store buy for the next week?

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How much will the store buy for the next week?

② **Out-of-stocks prevention**

Is there enough to avoid getting out of stock?

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① **Sales forecast per store, week & SKU groupings**

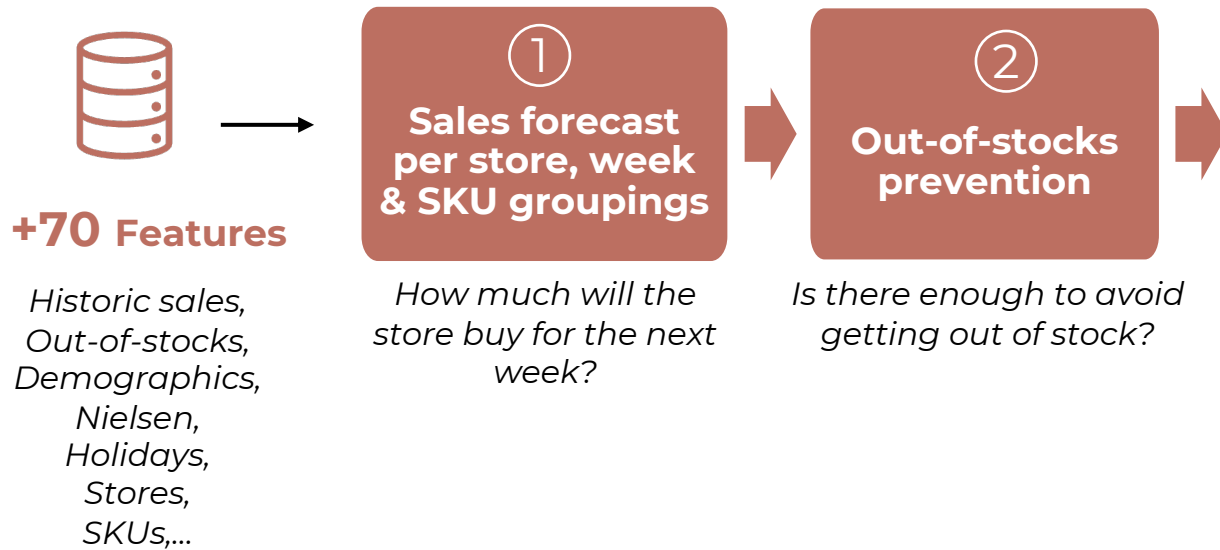*How much will the store buy for the next week?*

② **Out-of-stocks prevention**

Is there enough to avoid getting out of stock?

③ **Growth potential exploitation**

Is the store exploiting its full sales potential ?

Our 4-steps solution

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*Historic sales,
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① **Sales forecast
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exploitation**

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④ **Disaggregation
to days & SKU**

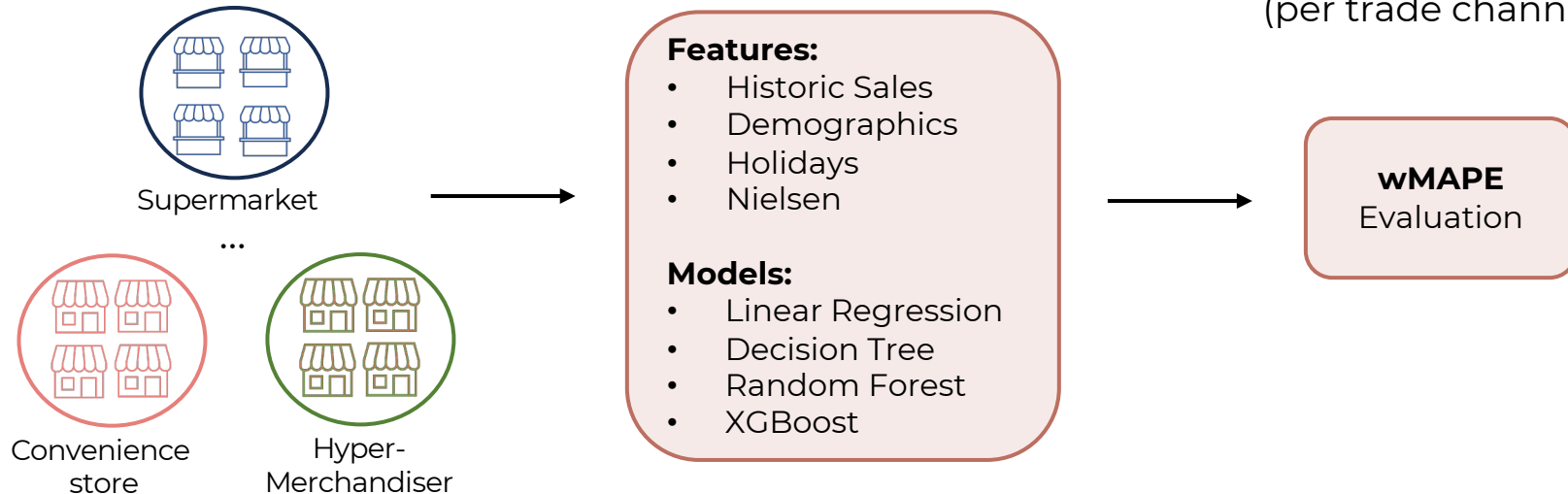*Are the suggestions
labor efficient?*

**Order
suggestions**

Step 1: Sales Forecast

Goal: Predict what stores would order during next visits

Challenges:
- Different trade channels
- Different schedules & visits frequency
- Different SKUs sold at each visit & store
- Sparse patterns

➡️ Forecast at the **store-week-SKUs grouping** level
One model per **trade channel**

1 **Stores segmentation**

Supermarket

...

Convenience store

Hyper-Merchandiser

2 **Machine Learning models**

Features:
- Historic Sales
- Demographics
- Holidays
- Nielsen

Models:
- Linear Regression
- Decision Tree
- Random Forest
- XGBoost

3 **Best model selection**
(per trade channel)

wMAPE
Evaluation

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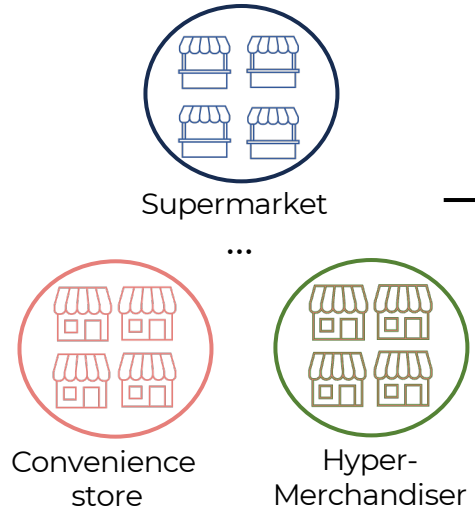# Step 1: Sales Forecast

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3 **Best model selection** (per trade channel)

wMAPE Evaluation

Application example:

Week:
June 5, 2023
5

Grouping:
Glaceau Smartwater 23.7 OZ Plastic Bottle

Store:
El Rio Grande

| Forecast | 4.4 eq |

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Step 2: Out-of-Stocks Prevention
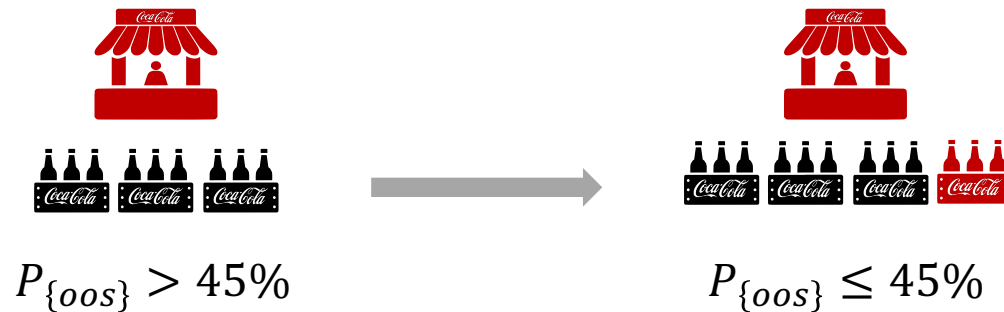
① Out-of-stock Data Extraction

- Features: Out-of-stock records, sales of the past 4 weeks, calendar

② Logistic Regression Modeling

- Estimate **probability of out-of-stock** for each SKU and store given past sales and next week forecast.

③ Reducing risk of Out-of-stock

- Increase suggestions when probability of out-of-stock exceeds 45%

$P_{\{oos\}} > 45\%$

$P_{\{oos\}} \leq 45\%$

Application example:

Week:
June 5, 2023

Grouping:
Glaceau Smartwater
23.7 OZ Plastic Bottle

Store:
El Rio Grande

| Forecast | 4.4 eq |

| With OOS model | **5.1 eq** |

+ 16 %

Step 3: Growth Potential Exploitation

❶ Estimate stores' growth potential

Leveraging previous MIT-CCSWB Capstone Sales Potential model:

**01
Data collection**
Collect information about store's **sales** & **surroundings**.

**02
Customer similarity**
Cluster stores and identify the **30 most similar** to each one.

**03
Sales forecasting**
Predict stores sales for CCSWB's & competitors' products.

**04
Growth potential estimation**
Compare forecast with weighted average of similar stores' forecast.

❷ Exploit growth potential, up to 30% suggestion increase

Application example:

Week:
June 5, 2023

Grouping:
Glaceau Smartwater 23.7 OZ Plastic Bottle

Store:
El Rio Grande

Forecast	4.4 eq
With OOS model	5.1 eq
With Potential model	6.6 eq

+ 30%

Step 4: Suggestions disaggregation

1 **Disaggregation**

> **Goal:** Suggestions per **week & grouping** ⟶ Suggestions per **day & SKU**

Using:
- Historical sales patterns
- Stores' next week schedule

Grouping		Mon	Tue	Wed	Thur	Fri	Sat	Sun
	SKU 1	%	%	%	%	%	%	%
	SKU 2	%	%	%	%	%	%	%
	SKU 3	%	%	%	%	%	%	%
	...	...	...	...	...	...	...	...

Mon ⟵⟶ (Mon, Tue, Wed)   Thur ⟵⟶ (Thur, Fri, Sat, Sun)

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Step 4: Suggestions disaggregation

① Disaggregation

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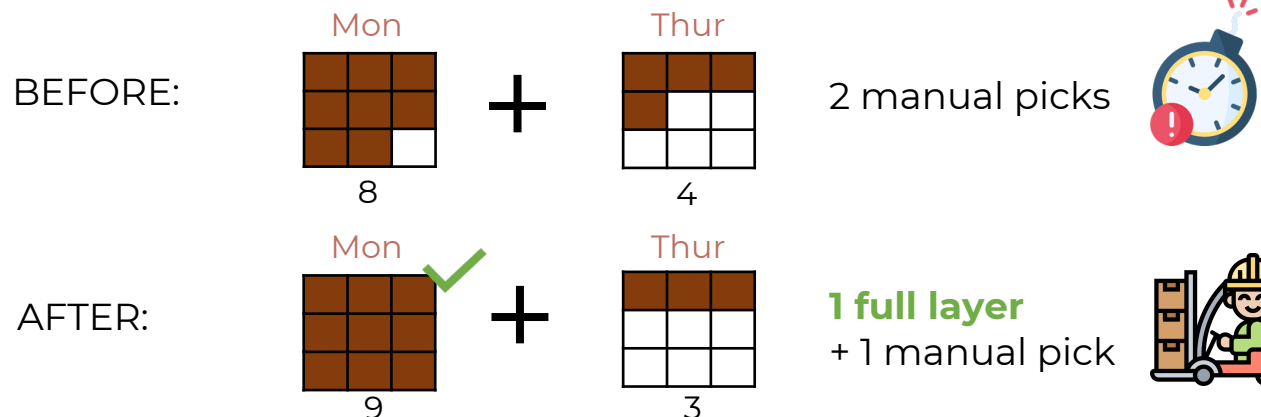| Grouping	Mon	Tue	Wed	Thur	Fri	Sat	Sun
SKU 1	%	%	%	%	%	%	%
SKU 2	%	%	%	%	%	%	%
SKU 3	%	%	%	%	%	%	%
...	...	...	...	...	...	...	...

Mon   Thur

② Layers adjustments

Goal: Promote **full layers** sales to facilitate warehouse operations

Layer picking is much more efficient than manual picking

Mon   Thur

BEFORE: 8   +   4   2 manual picks

Mon ✓   Thur

AFTER: 9   +   3   **1 full layer** + 1 manual pick

Back-testing results

① Better forecast performance

Our forecast model improves the baseline by **22%**

wMAPE

	wMAPE
Our forecast	**43%**
Baseline	55%

Predicted vs **Actual** Weekly Sales

📅 Dec 2022 – May 2023   🏪 Walmart   🍾 Diet Coke 12Oz Can

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Back-testing results

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	wMAPE
Our forecast	**43%**
Baseline	55%

Predicted vs **Actual** Weekly Sales

Legend: Actual Sales, Predicted Sales

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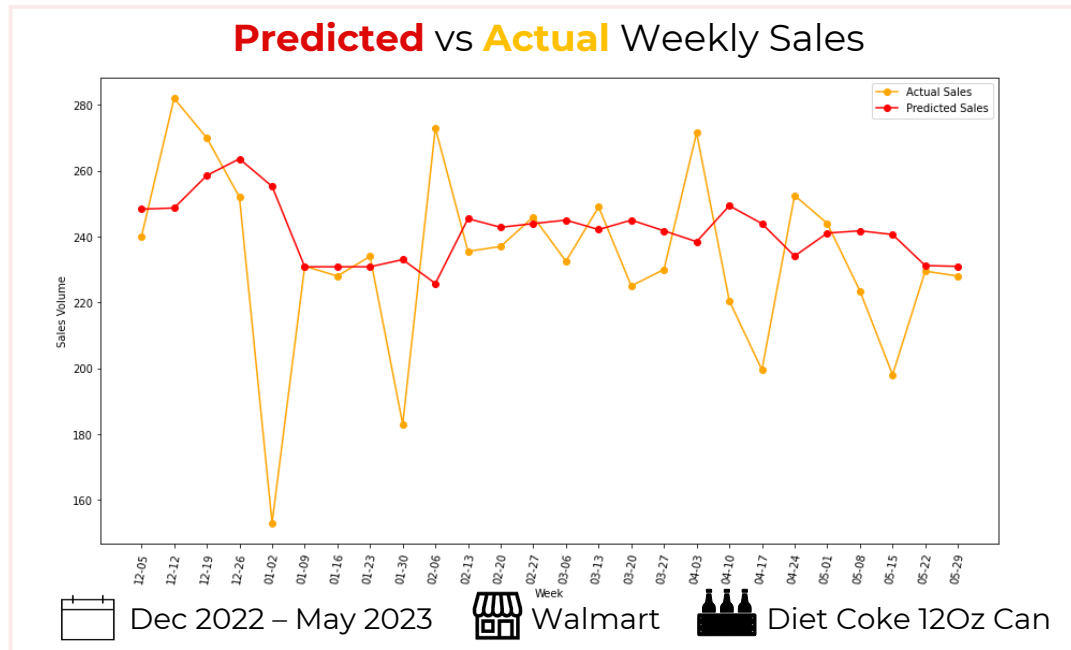
❷ +3.3% Expected Sales Captured

+ 230k Eq weekly with **oos prevention (+ 2%)**

+ 110k Eq weekly with **growth potential (+1%)**

❸ Simplified operations

62% Suggested volume can be delivered in **full layers**

📅 June 2023

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Next Steps

Model Fine-Tuning

Validate and refine
Model to ensure it is ready
for implementation.

Real-World Pilot Testing

Implement solution in
controlled pilot environment for
testing before deployment.

Tool Integration

Integrate order
suggestion model into
existing order-taking app.

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Thank you for your attention!

Thanks to CCSWB's team for hosting this Capstone project and organizing the market visits in Dallas!