Artificial Intelligence and Data Sciences in Real-world Business

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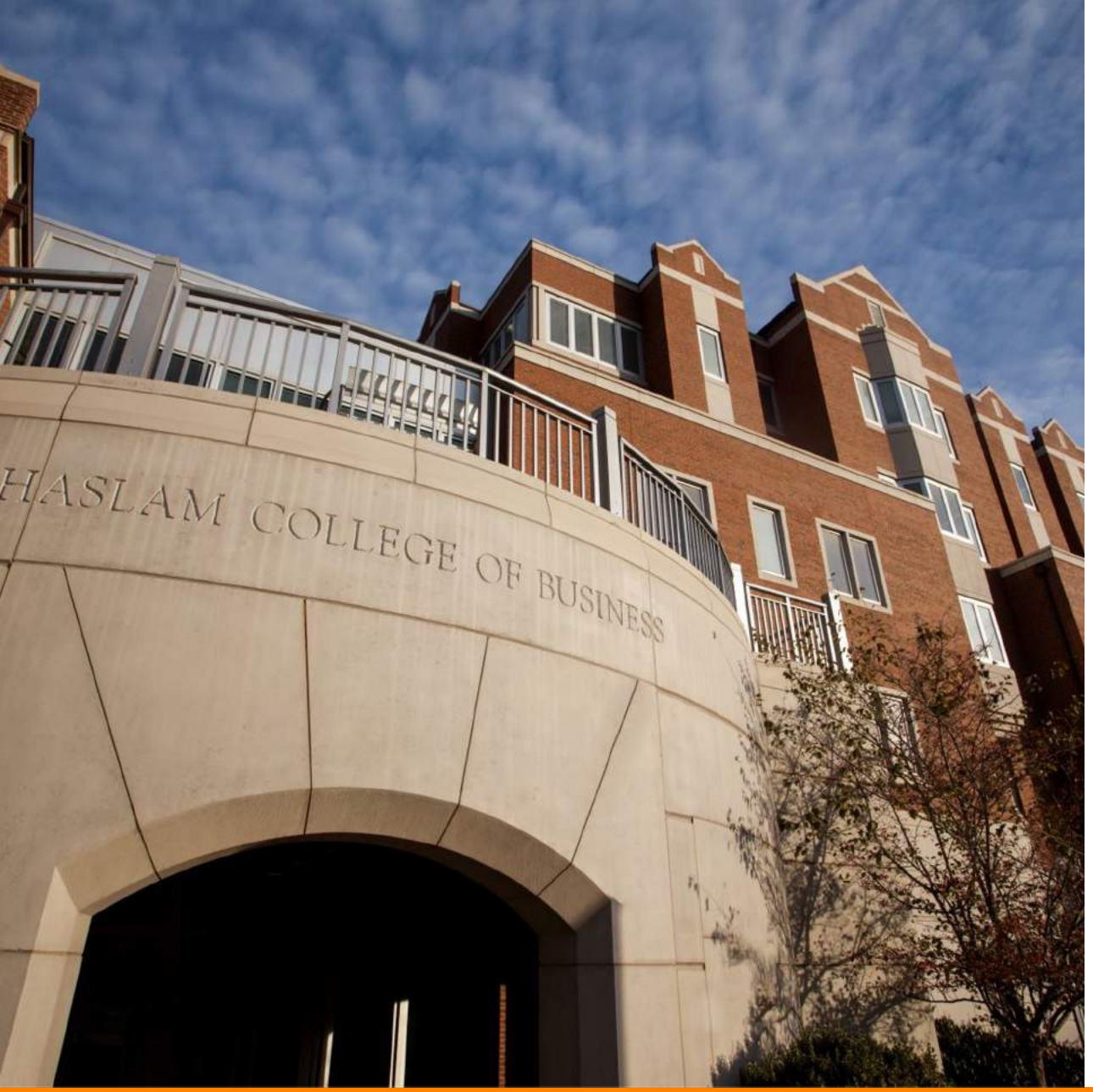


Three Case Studies

- **Demand forecasting** using Machine Learning (ML)
- **End-to-end prediction and optimization** for contract allocation using Deep Learning (DL)
- **New product ideas** using Large Language Models (LLMs)

Forecasting Global Print Demand Using ML

HP Inc. manufactures over 18,000 print-related products, selling it in over 170 countries

Getting the demand forecast right is critical

Problem

Accurate print demand forecasts increase product availability and profitability

Business Intelligence

Consensus Forecast is created by human planners

Historical Demand Data

Statistical Forecast is based on traditional time-series forecasting models

Project Focus

Machine Learning forecast is built using tree-based ML algorithm LightGBM

Additional Data

Leveraging additional datasets, (e.g., channel inventory) refines our forecasts

Continuous Improvements in methods, processes, and algorithms

Supply Planning

Printer supply strategy is aligned with forecasted demand

Granularity: SKU and Country

Cadence: Monthly

Too much inventory leads to **overage costs**

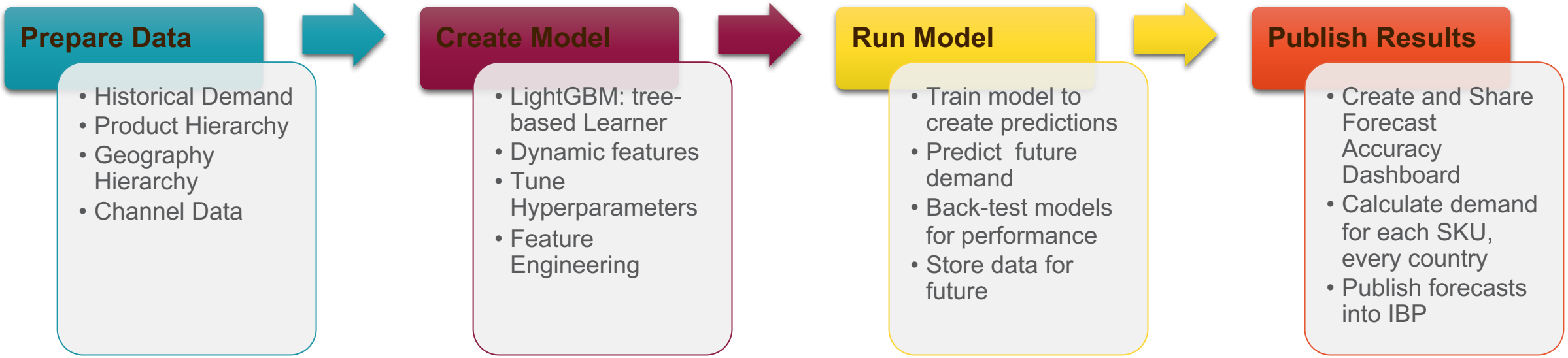
Too little inventory leads to **supply shortages**

Forecast is used by multiple process downstream: logistics, R&D, planning

Impact of bad forecasts is amplified through the process

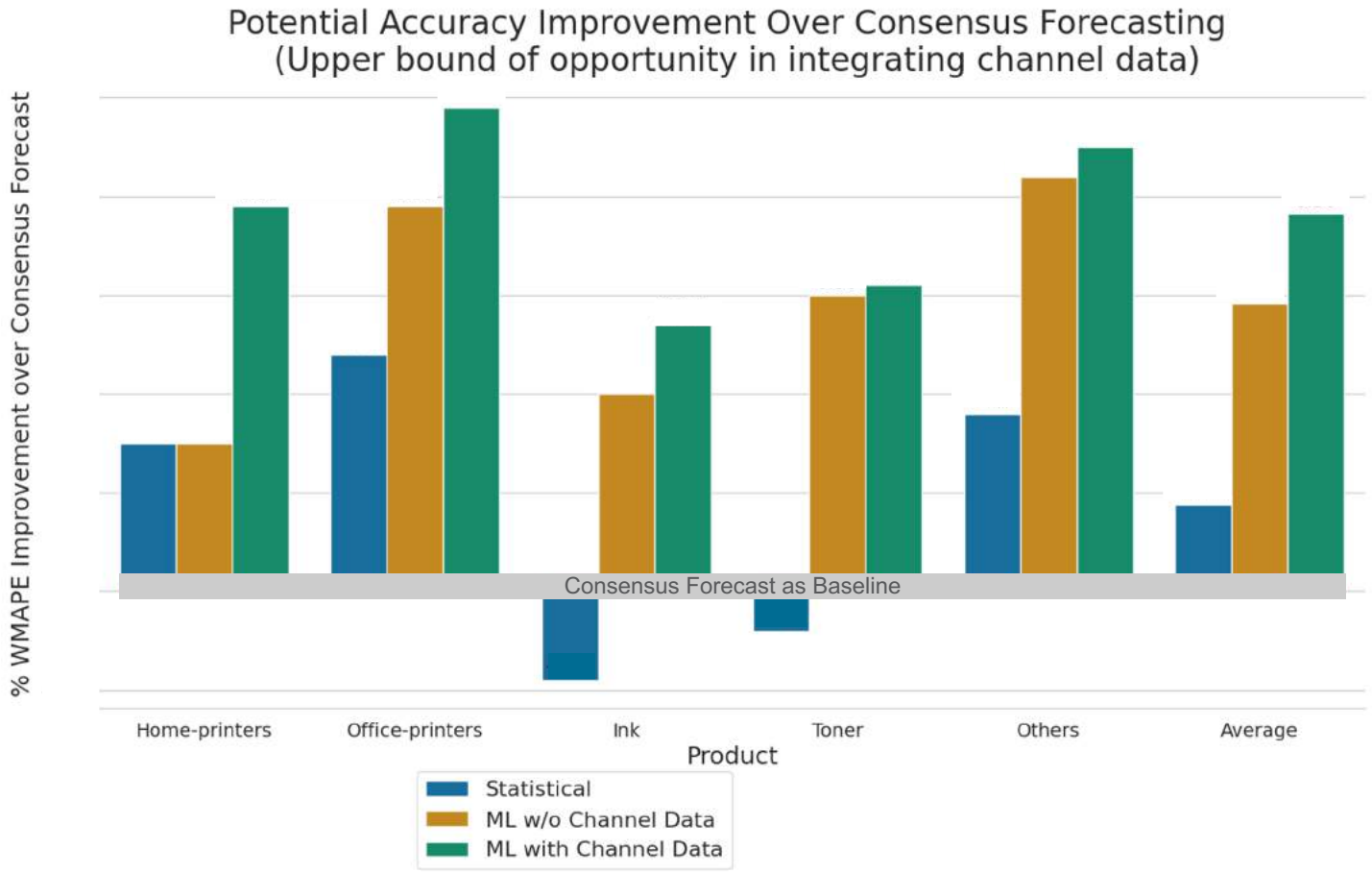
Solution

We create enterprise-level forecasting pipeline to go from data to decisions



Results

ML Forecasts are more accurate than consensus and statistical forecasts



ML forecasting performs better than Consensus and Statistical forecasting

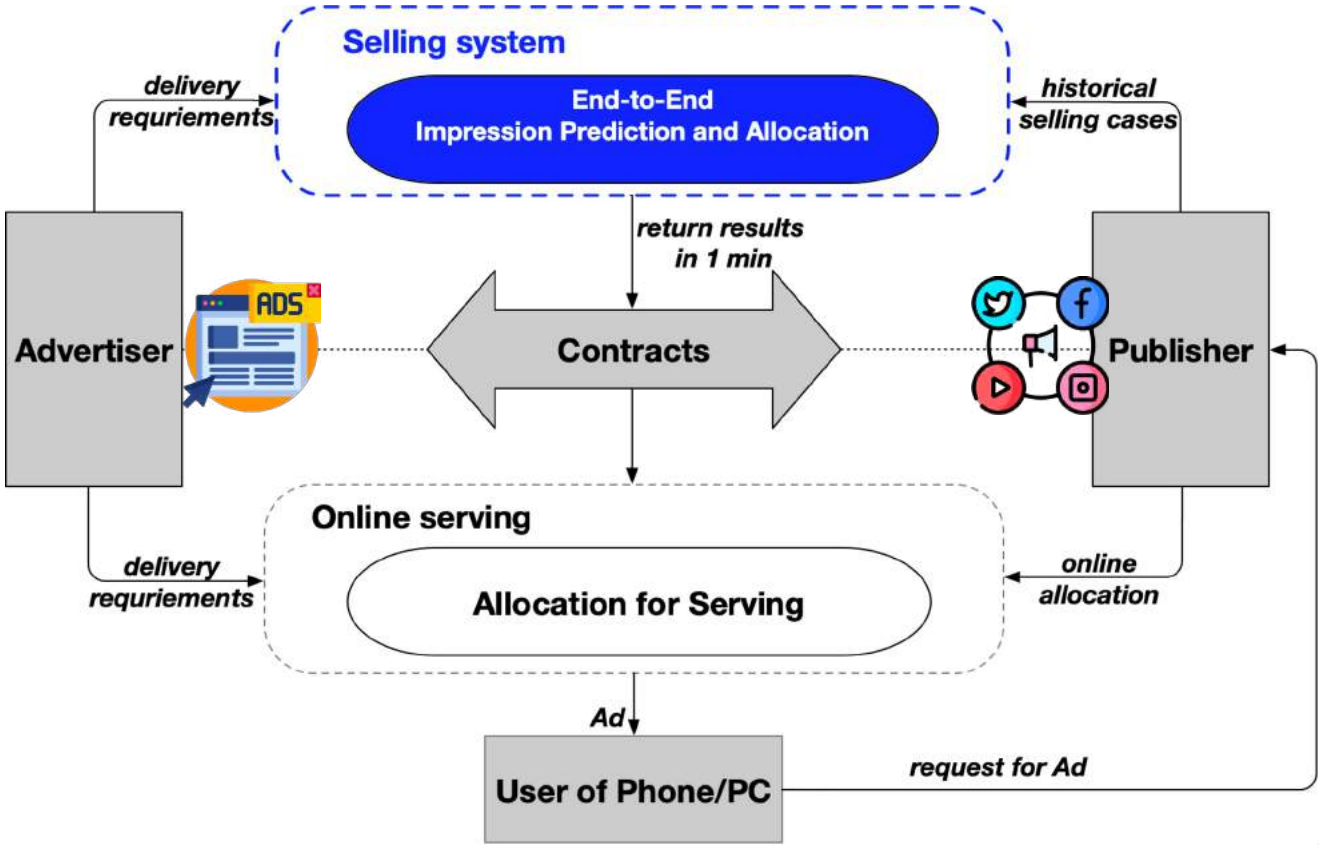
Using channel partner inventory, sell-in and sell-through volume resulted in substantial improvements as well

End-to-End Inventory Prediction and Contract Allocation for Guaranteed Delivery Advertising

In Guaranteed Delivery (GD) Advertising, advertisers secure their desired inventory of advertising impressions in advance by signing contracts with publishers weeks or months ahead of the targeting dates

End-to-End Prediction and Allocation System

System Architecture for Allocating Ads at Alibaba



➔**Our focus is Selling Systems.** The goal is to establish contracts with advertisers in advance by predicting and allocating inventory accurately

➔We sign contracts with advertisers in advance while having limited impressions inventory

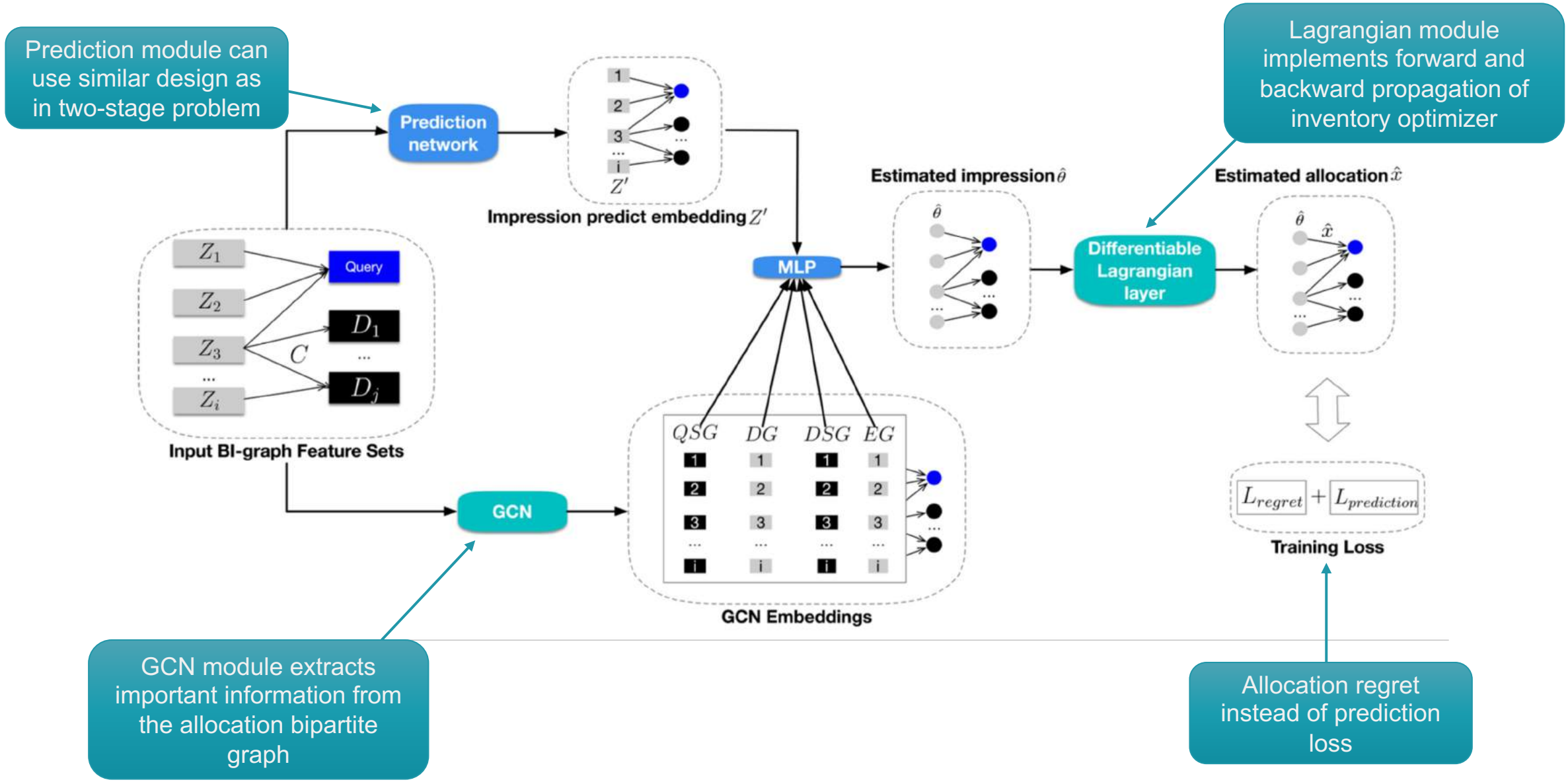
➔The objectives are to:

- Maximize inventory sales
- Prevent overselling of inventory

➔**Online Serving System** ensures

- Fulfillment of reserved contracts
- Click-Through Rate (CTR) Optimization

Architecture of Neural Lagrangian Selling (NLS) Model



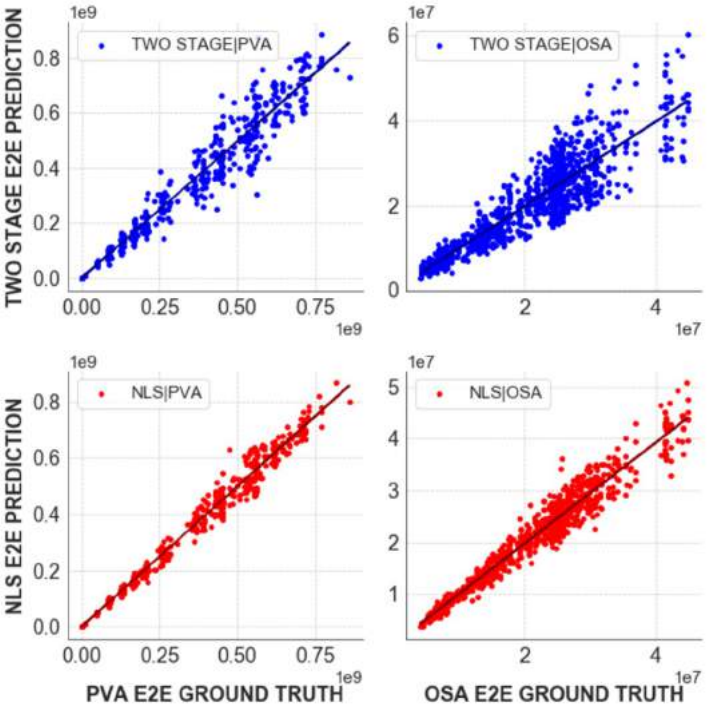
NLS outperforms all other models on most benchmarks

Methods	full targeting		single targeting		random targeting	
	ND_{pre}	ND_{reg}	ND_{pre}	ND_{reg}	ND_{pre}	ND_{reg}
Two Stage	$0.101_{\pm 0.003}$	$0.023_{\pm 2e-4}$	$0.101_{\pm 0.003}$	$0.125_{\pm 0.005}$	$0.101_{\pm 0.003}$	$0.045_{\pm 0.002}$
PF	$0.130_{\pm 0.010}$	$0.045_{\pm 0.005}$	$0.115_{\pm 0.008}$	$0.132_{\pm 0.010}$	$0.121_{\pm 0.010}$	$0.076_{\pm 0.007}$
PPG	$0.125_{\pm 0.010}$	$0.015_{\pm 1e-4}$	$0.127_{\pm 0.007}$	$0.112_{\pm 0.001}$	$0.135_{\pm 0.011}$	$0.036_{\pm 0.001}$
PL	$0.102_{\pm 0.001}$	$0.008_{\pm 1e-4}$	$0.103_{\pm 0.001}$	$0.113_{\pm 0.003}$	$0.101_{\pm 0.002}$	$0.047_{\pm 2e-4}$
NLS	$\mathbf{0.096}_{\pm 0.002}$	$\mathbf{0.007}_{\pm 2e-4}$	$\mathbf{0.097}_{\pm 0.001}$	$\mathbf{0.098}_{\pm 0.001}$	$\mathbf{0.095}_{\pm 0.001}$	$\mathbf{0.029}_{\pm 1e-4}$

Table: Experiment Results on Offline Data

Methods	PVA		OSA	
	ND_{pre}	ND_{reg}	ND_{pre}	ND_{reg}
Two Stage	$0.069_{\pm 0.002}$	$0.068_{\pm 0.004}$	$0.067_{\pm 0.002}$	$0.132_{\pm 0.005}$
PF	$0.083_{\pm 0.015}$	$0.095_{\pm 0.020}$	$0.075_{\pm 0.015}$	$0.128_{\pm 0.021}$
PPG	$0.085_{\pm 0.005}$	$0.054_{\pm 0.002}$	$0.078_{\pm 0.003}$	$0.086_{\pm 0.004}$
PL	$0.065_{\pm 0.002}$	$0.061_{\pm 0.002}$	$\mathbf{0.065}_{\pm 0.001}$	$0.136_{\pm 0.004}$
NLS	$\mathbf{0.064}_{\pm 0.003}$	$\mathbf{0.041}_{\pm 0.001}$	$0.068_{\pm 0.003}$	$\mathbf{0.058}_{\pm 0.001}$

Table: Experiment Results on Online Data



Our NLS has fewer outliers in comparison with two-stage methods

ND_{pre} and ND_{reg} are Normalized Deviations for prediction and regret

Generating New Product Ideas using LLMs

If **Apple Inc.** and **Walmart** got together to produce a new product, what would they do?

SmartCart

- Shopping cart integrated with Apple Ecosystem that uses Apple's ML expertise in product recommendations, and Walmart's expertise in inventory management
- Siri for ordering groceries and paid using Apple Pay
- Competitors: Doordash, Instacart
- Privacy concerns

iStock

- Real-time inventory management system that uses Apple's ARKit to help Walmart employees manage stock efficiently
- Real-time Augmented Reality using iPhone's camera
- AI analytics based on Walmart's supply chain principles
- Saves time over current barcode-scanning

Generative AI in Your Business

We would like to learn what are the potential use-cases and risks of generative AI in businesses. Please answer the questions with as much details as possible. **Your responses are completely anonymous.**

If you would like to get a summary of the responses, share your email at the end of the survey!

Scan QR Code or visit
tiny.utk.edu/gpt

Some recent headlines from Wall Street Journal…

AI Set to Upend the Talent Search at Ad Agencies and Brands

Generative AI could help recruiters find more diverse and specialized candidates, but job hopefuls are also using it to burnish their CVs

AI Is Generating Security Risks Faster Than Companies Can Keep Up

Rapid growth of generative AI-based software is challenging business technology leaders to keep potential cybersecurity issues in check

Generative AI Promises an Economic Revolution. Managing the Disruption Will Be Crucial.

Broad productivity and economic output gains may be coming, but knowledge workers will face a reckoning as the nature of work changes