UBER eats

How AI Powers UBER eats

Yuanchi Ning (Uber Eats)

December 2017

Geekbang. InfoQ

QCon
全球软件开发大会

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Agenda

- Uber Eats Overview
- AI Platform
- AI Challenges
  - Challenges as a marketplace
  - Challenges of Uber Eats discovery
    - Restaurants ranking and recommendation
    - Guided Exploration

UBER eats

Uber Eats Overview

UBER eats

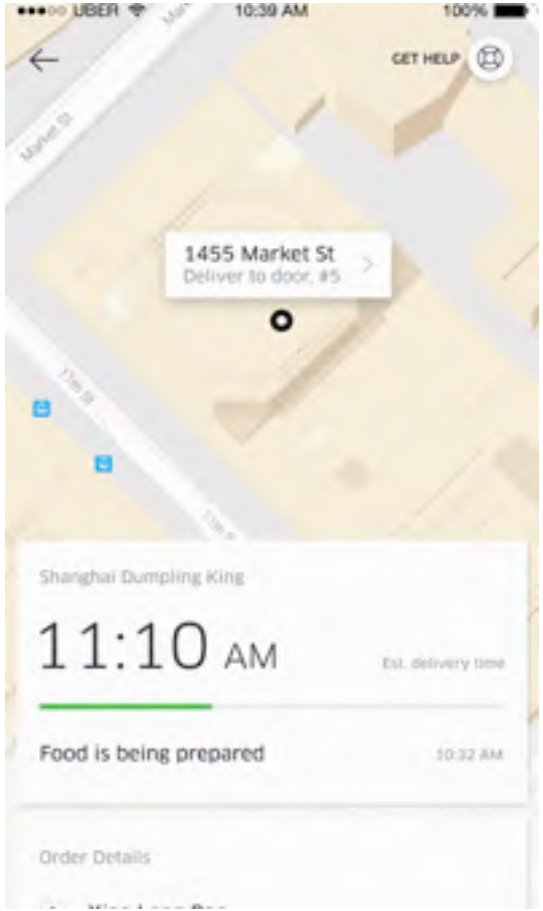
Make eating well effortless at anytime, for anyone.

Uber Eats mission

UBER eats

9:41 AM
100%
ASAP 5714 Star Ln
Crave Cupcakes Kirby
20-30 MIN
Chaste Foods
30-40 MIN

9:41 AM
ASAP 633 W 27th St
Sort Restaurants
Under 30 Minutes
Indie Fresh - Midtown West
Healthy • Vegan • Gluten Free • $$
Popular near you


10:39 AM
100%
GET HELP
1455 Market St
Deliver to door, #5
Shanghai Dumpling King
11:10 AM
Est. delivery time
Food is being prepared
10:32 AM
Order Details

Uber Eats Timeline

- March, 2009: Uber founded
- August, 2014: UberFRESH launched in LA
- April, 2015: UberFRESH rebranded to Uber Eats
- December, 2015: Uber Eats is spun off into a separate standalone app and launched in Toronto
- March, 2016: Uber Eats launched in LA, Chicago, Houston, and SF
- Today: Uber Eats launched in **200+** cities, **30+** countries, and **6** continents

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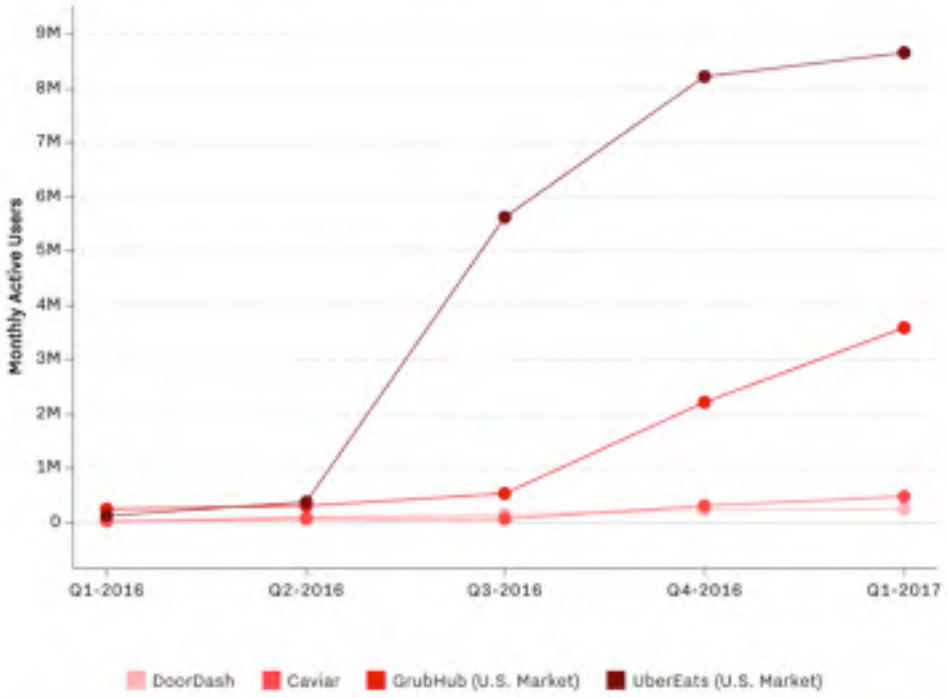
UberEats App Dominates in Most Active Users

Despite being one of the youngest large food delivery apps, UberEats has capitalized on the Uber brand and has raked highest in the most monthly active users of the top American delivery apps.



Source: Apptopia

EATER

Source: https://www.eater.com/2017/5/9/15596790/ubereats-delivery-service-rising

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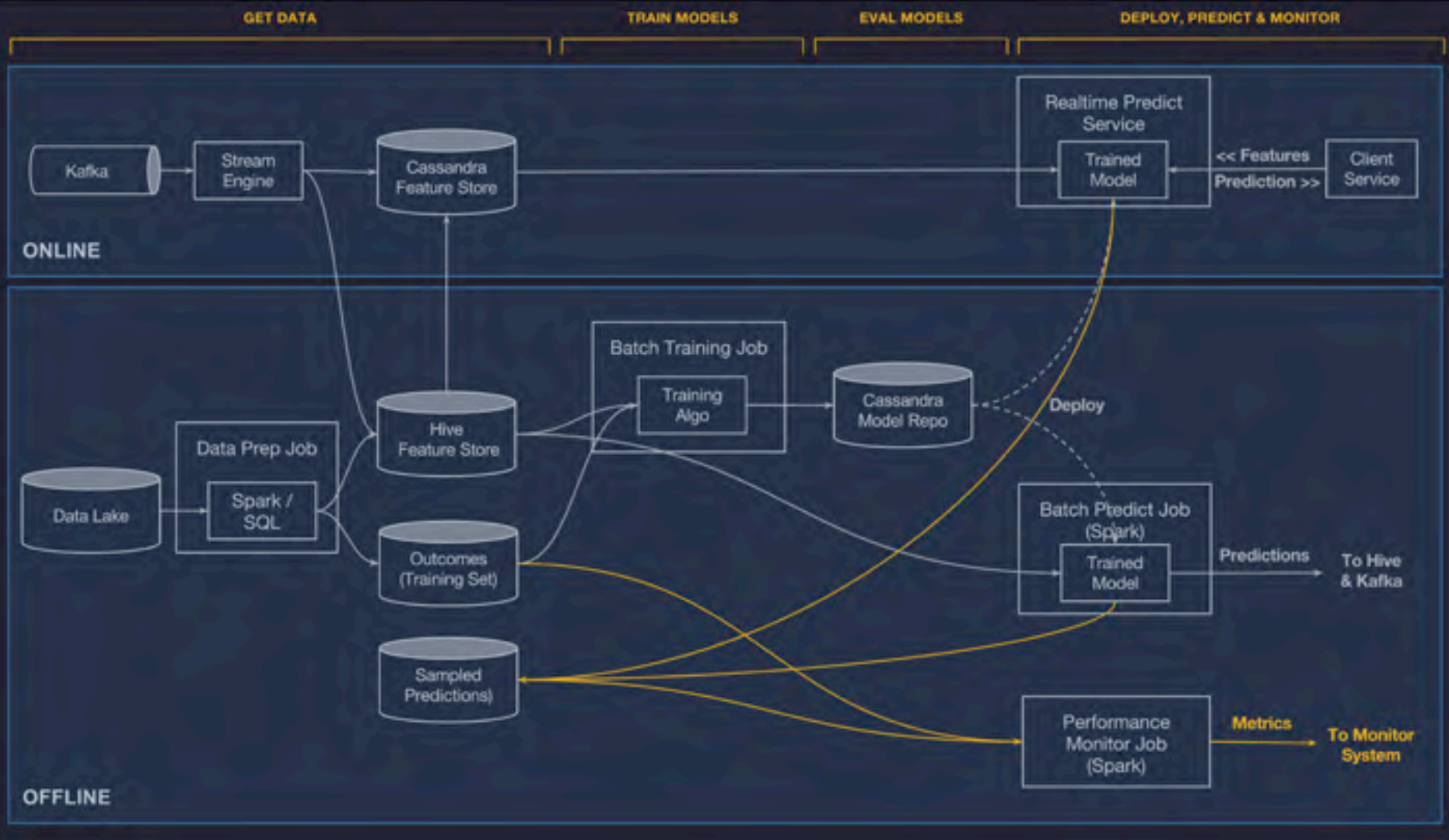
AI Platform


GET DATA
TRAIN MODELS
EVAL MODELS
DEPLOY, PREDICT & MONITOR
Kafka
Stream Engine
Cassandra Feature Store
Realtime Predict Service
Trained Model
<< Features
Prediction >>
Client Service
ONLINE
Batch Training Job
Training Algo
Cassandra Model Repo
Deploy
Hive Feature Store
Data Prep Job
Data Lake
Spark / SQL
Outcomes (Training Set)
Batch Predict Job (Spark)
Trained Model
Predictions
To Hive & Kafka
Sampled Predictions)
Performance Monitor Job (Spark)
Metrics
To Monitor System
OFFLINE

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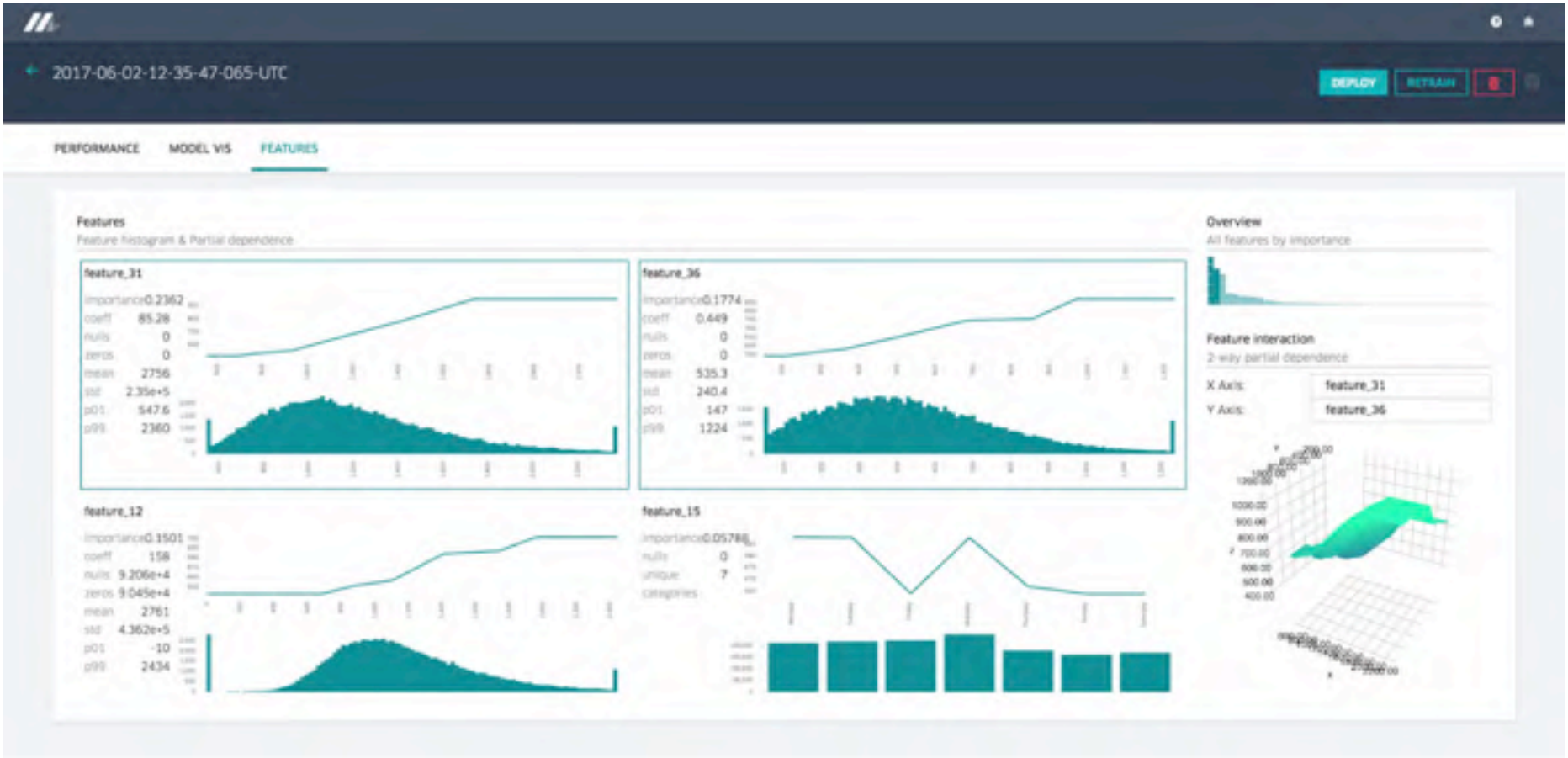
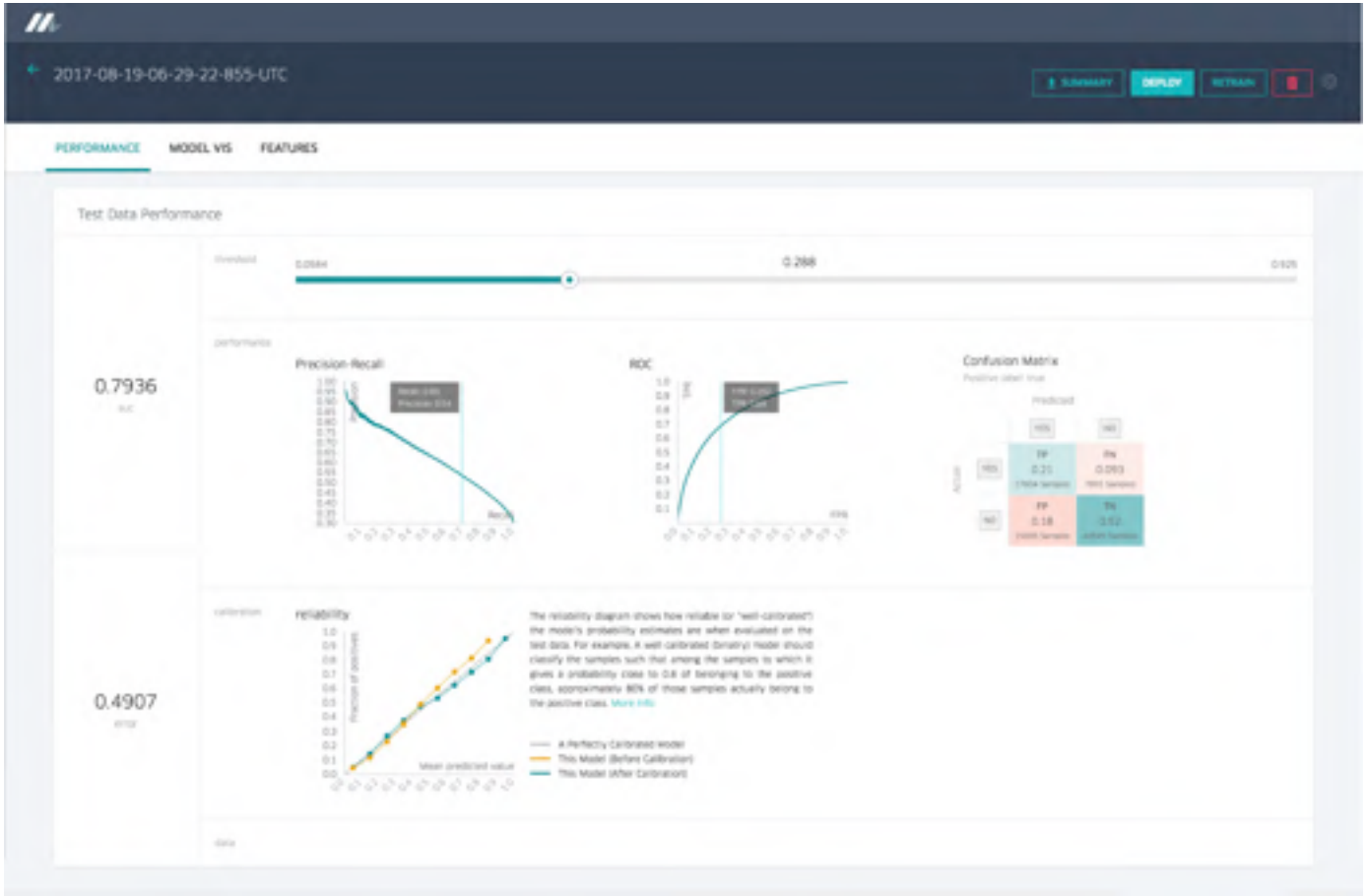
Feature Report



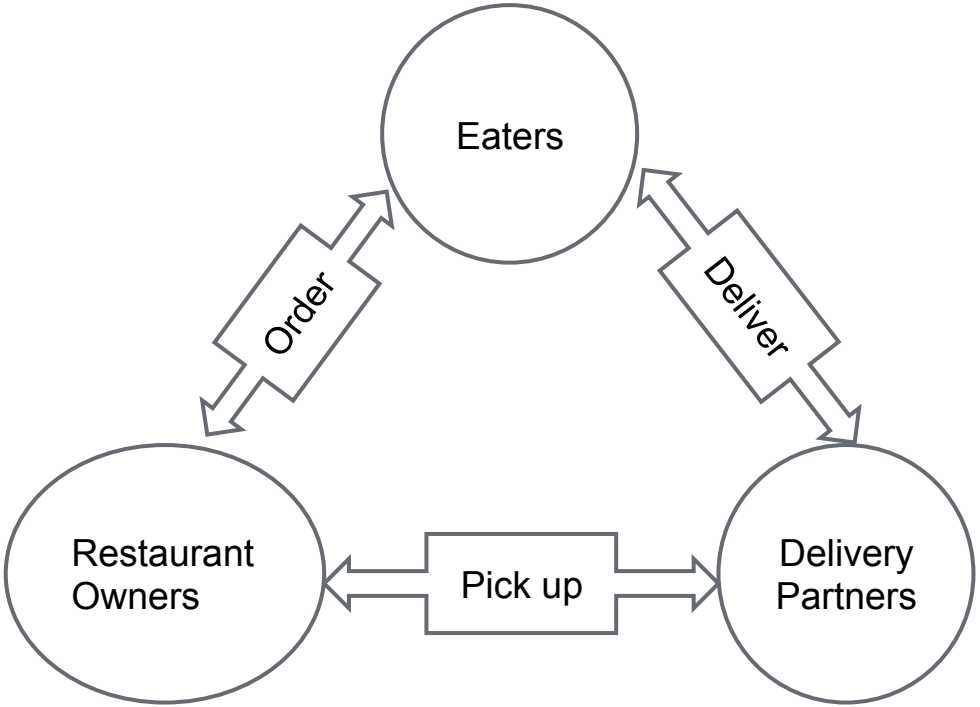
Model Accuracy Report



AI Challenges with Uber Eats

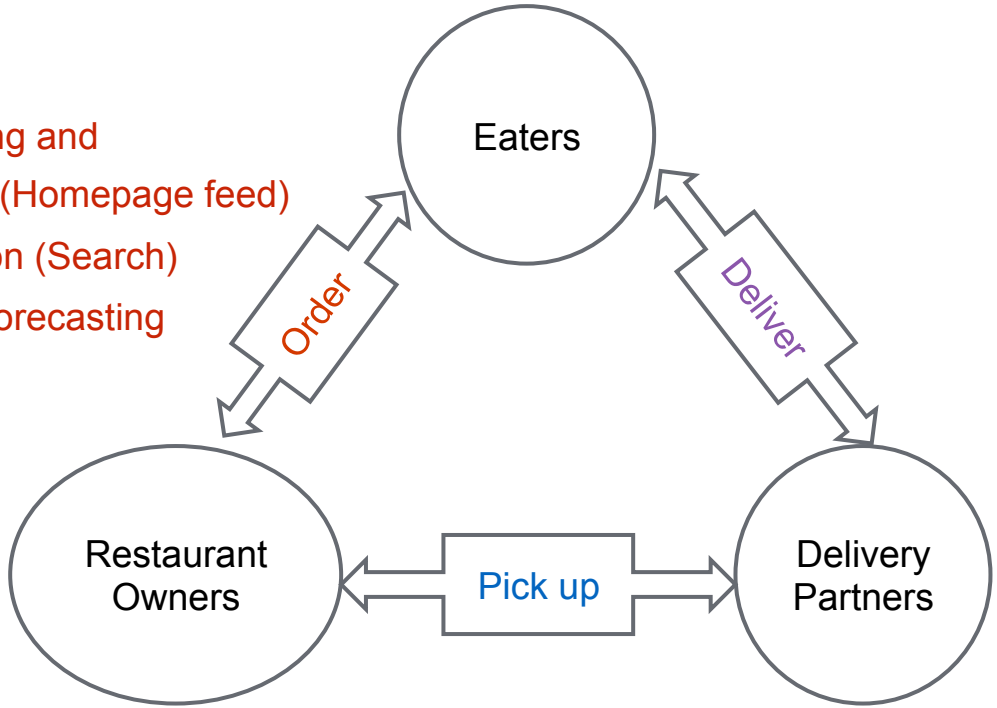
Uber Eats as a Marketplace

Make <u>eating well effortless</u> at any time, for anyone



AI & Uber Eats

- Restaurant ranking and recommendation (Homepage feed)
- Guided exploration (Search)
- Demand-supply forecasting
- ...



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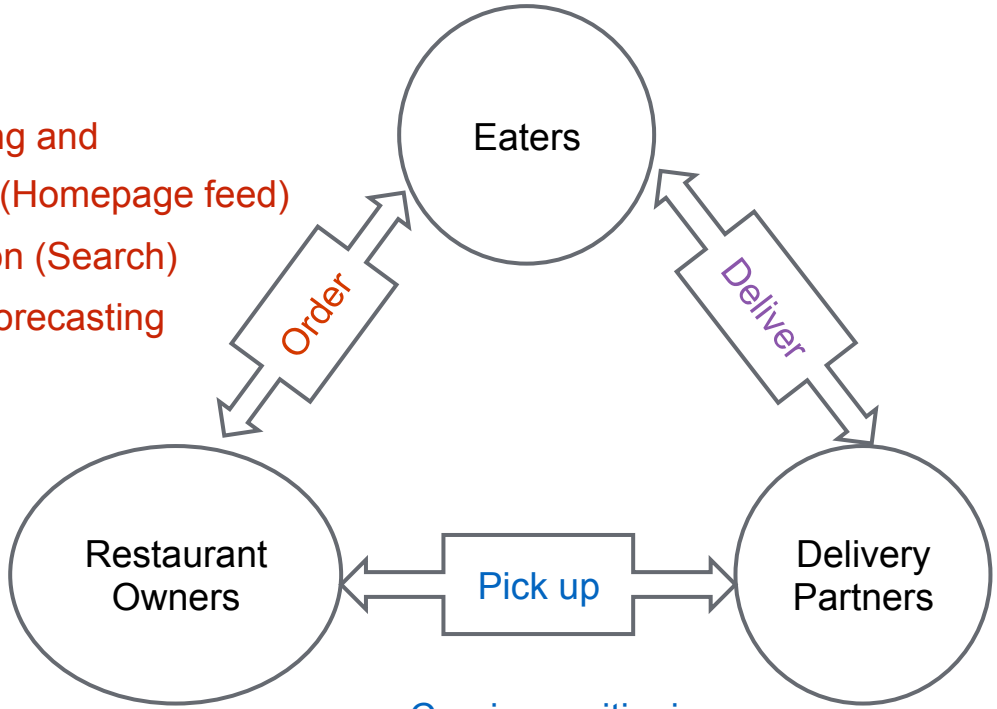

- Courier positioning
- Dispatch
- Batching

AI & Uber Eats

- Restaurant ranking and recommendation (Homepage feed)
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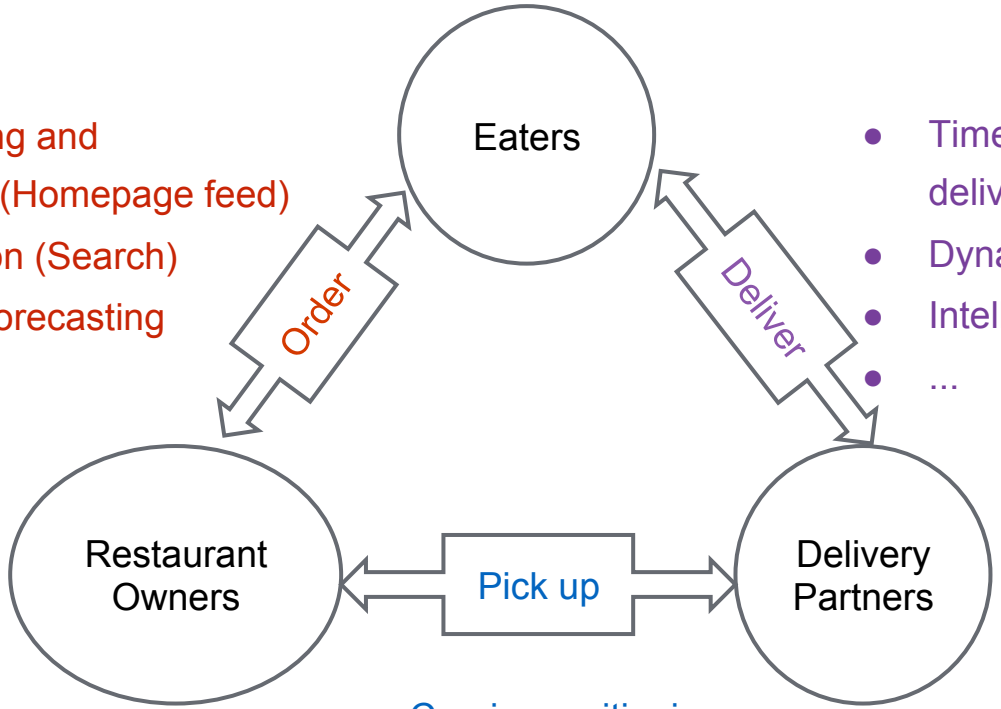
- Demand-supply forecasting
- ...

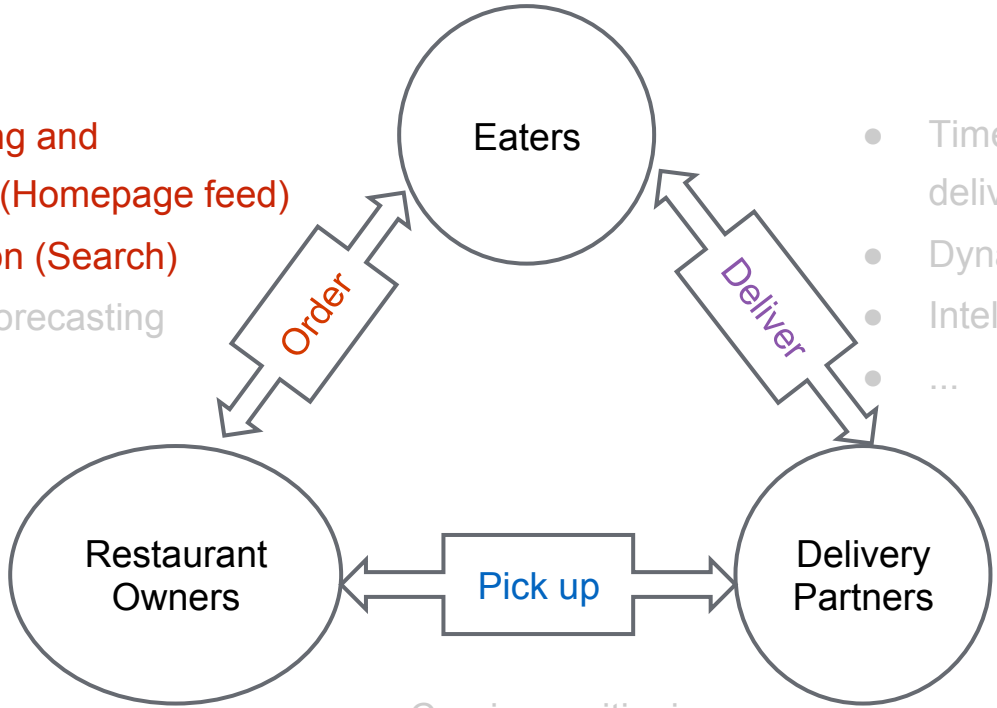


- Time prediction (estimated time of delivery)
- Dynamic pricing
- Intelligent spending
- ...

- Courier positioning
- Dispatch
- Batching

Today's Discussion: Eats Discovery

- Restaurant ranking and recommendation (Homepage feed)
- Guided exploration (Search)
- Demand-supply forecasting
- ...



- Time prediction (estimated time of delivery)
- Dynamic pricing
- Intelligent spending
- ...

- Courier positioning
- Dispatch
- Batching

UBER eats

Restaurant Ranking And Recommendation

A Few Unique Challenges

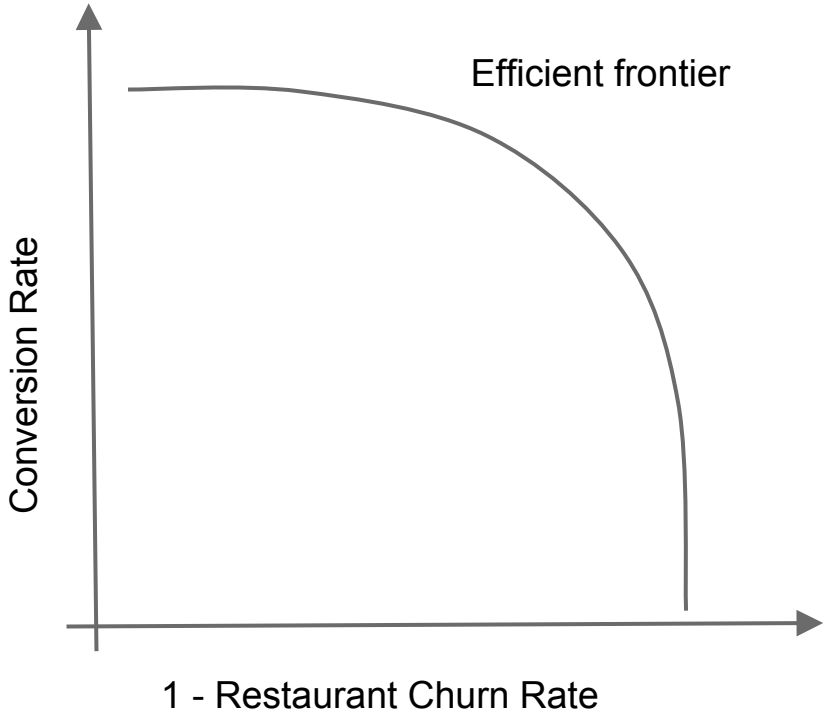
- Ranking to serve the marketplace
- Relevance vs. diversity
- Building a fair marketplace
- ...

Ranking to Serve the Marketplace

- Conventional ML Model
  - Single objective
    - Keep users **or**
    - Keep restaurant owners
  - GBDT, RankSVM

Ranking to Serve the Marketplace

- Conventional ML Model
  - Single objective
    - Keep users **or**
    - Keep restaurant owners
  - GBDT, RankSVM
- Solution: Multi-Objective Optimization
  - Multiple objectives
    - Keep users **and**
    - Keep restaurant owners
  - Linear / Quadratic Programming (LP/QP)



MOO: Multi-Objective Optimization

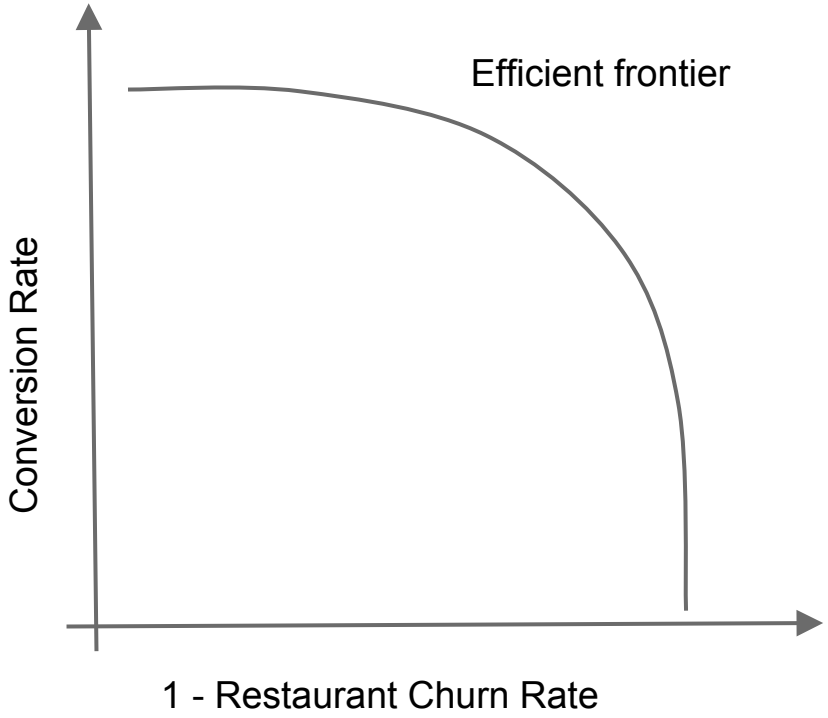
$$\max(f_1(x), f_2(x), \ldots, f_k(x))$$
$$\text{s.t.} \quad x \in X$$

$f_k(x)$ is the ML/AI model for the kth objective

For example:

$f_1(x)$ is the conversion rate ML/AI model

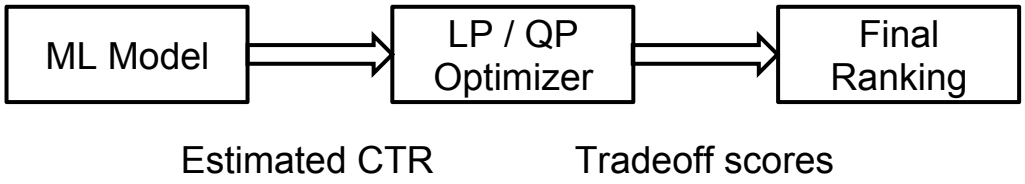
$f_2(x)$ is the 1 - restaurant churn rate ML/AI model



Challenge is to formulate the above problem as convex optimization problem (LP / QP)

MOO Example: Relevance vs. Diversity

- Pointwise ranking is greedy
- Listwise ranking is costly
- Holistic ranking
  - Estimate CTR of each restaurant with an ML Model
  - Optimize the ranking of all restaurants holistically given estimated CTR



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Building a Fair Marketplace

VS.

New / Low-Volume Restaurants

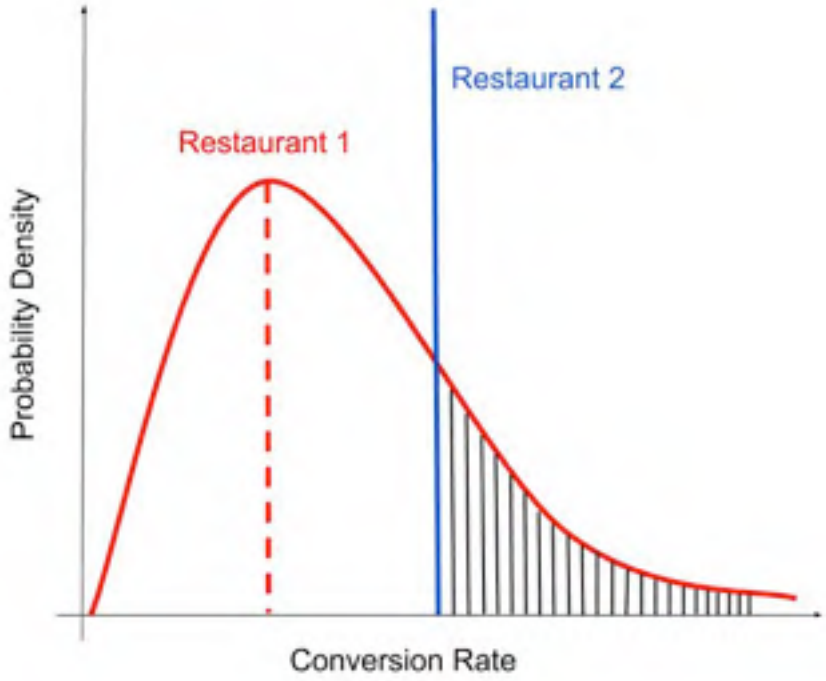
Img source: https://www.fotolia.com/p/326910

Well-Established Restaurants

Img source: https://thehalalguys.com/, https://archives.sfweekly.com/sanfrancisco/shanghai-dumpling-king/Location?oid=2192071

Explore-Exploit with Multi-Armed Bandit

- Bayesian modeling for posterior variance
  - New /low-volume restaurant - high variance
  - Well-established restaurant - low variance
- Multi-armed bandit
  - ML model to estimate the mode of conversion rate
  - Bandit algorithm for explore-exploit



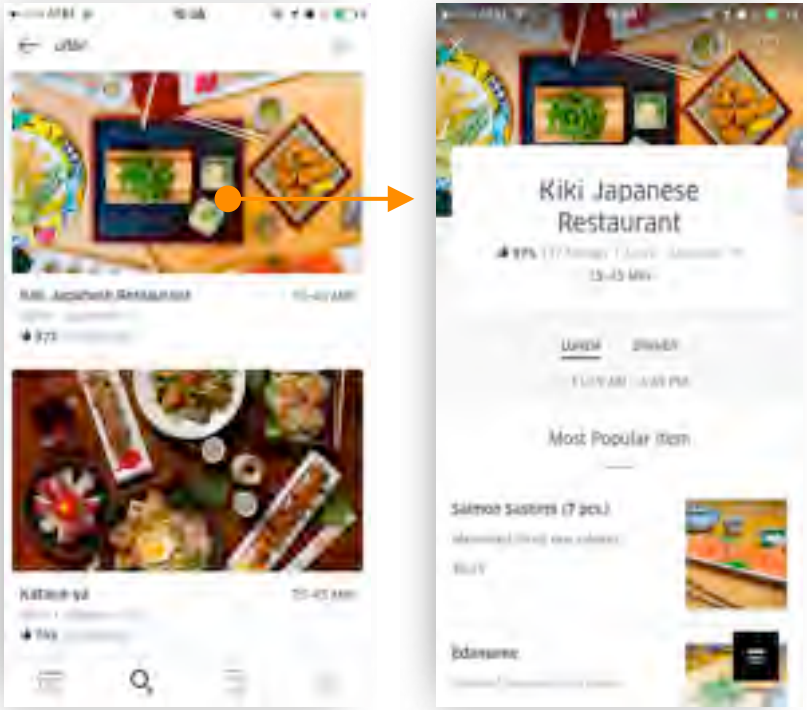
Guided Exploration (Search)

Item listicle

Search results

Challenges

- Understand user query and our food
  - Restaurant
  - Dish types
  - Cuisine types
- No results / low results
  - Not on the platform
  - Out of delivery radius / time
- Ranking
  - Personalized - but not so much



AI/ML Solutions

- Understand user query and our food - Representation Learning
  - Restaurant
  - Dish types
  - Cuisine types
- No results / low results - Food Knowledge Graph
  - Not on the platform
  - Out of delivery radius / time
- Ranking - ML/AI models
  - Personalized - but not so much

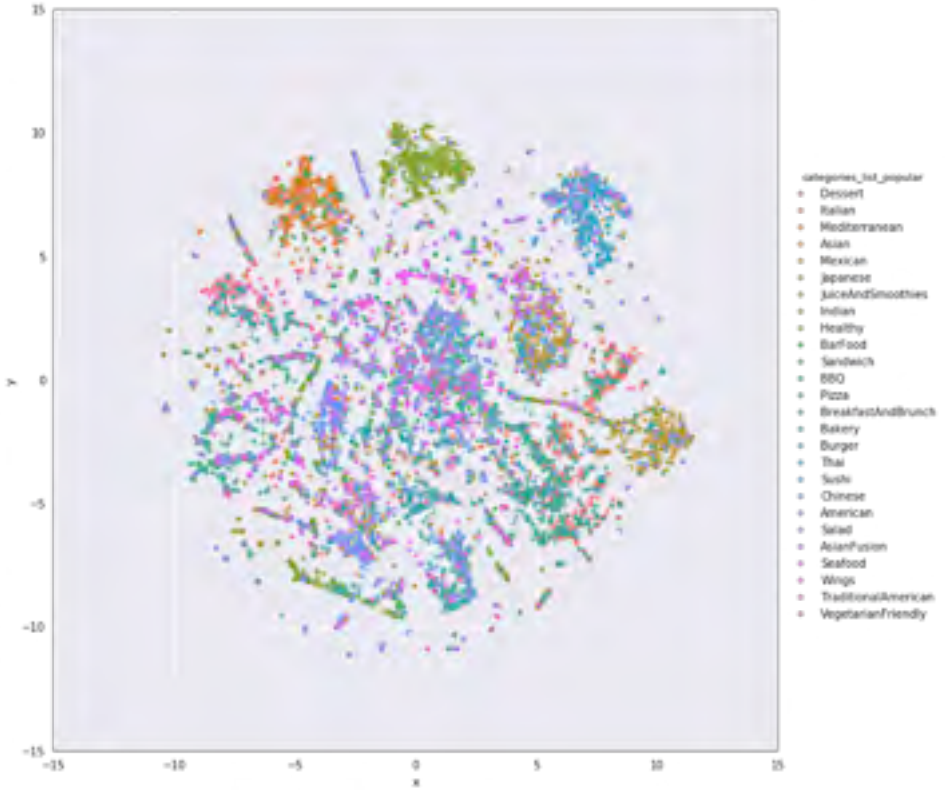
Food Graph

- Chipotle
  - Is it a restaurant?
  - Fast food?
  - Sells burritos?
  - Similar restaurants?
- Poke
  - Is it a cuisine?
  - Similar cuisines?

Illustration credit: Ting Chen @ Uber, GraphDB

Representation Learning

- Food graph-based
- Latent space-based
  - Word2Vec, GloVe
  - End-to-end deep neural network



Ranking

- Personalized model?
- Closed/missing restaurants
- In-menu search and ranking

Takeaways

- Uber Eats is a marketplace for eaters, restaurant owners and delivery partners.
- AI is the underlying **engine** that runs this marketplace.

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Thank you and bon appétit

Q & A

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