AWS re:Invent

AIM323

Delight your customers with ML-based personalized recommendations

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Amazon Web Services

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Voodoo

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Voodoo

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& Machine Learning
Coursera

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Agenda

- The promise of personalization
- Introduction to Amazon Personalize
- Putting Amazon Personalize to work
- How Voodoo used Amazon Personalize for in-app game recommendations
- How Coursera improved course subscription revenue with Amazon Personalize
- Wrap-up and Q&A

Why personalization?

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Personalization offers material business benefits

Everybody's tastes, preferences, and needs are different



Help customers discover products and services they need



Improve customer engagement with your website, app, and content



Increase conversion – purchases, subscriptions, app downloads, movie & music streams



Increase revenue for your business

History of personalization at Amazon

First personalized experience on Amazon.com

Feature launched & patent filed in 1998



Early features such as “Customers who bought this also bought …” loved by all

Early investment in personalization to make shopping easy

Over two decades of research in personalization techniques

Our learnings on personalization



Rule-based strategies are not effective and are effort-intensive to maintain

Machine learning (ML)-based techniques perform well but need to solve multiple hard problems to do so



Real-time recommendations and handling Coldstart scenarios (new user/new item)



Avoid a bias for recommending popular items



One single ML algorithm is not a good fit for all personalization use cases



Building accurate and effective personalization models requires ML experts

Amazon Personalize

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Amazon

Personalize

Personalization using the same ML technology as at Amazon.com; no ML experience needed

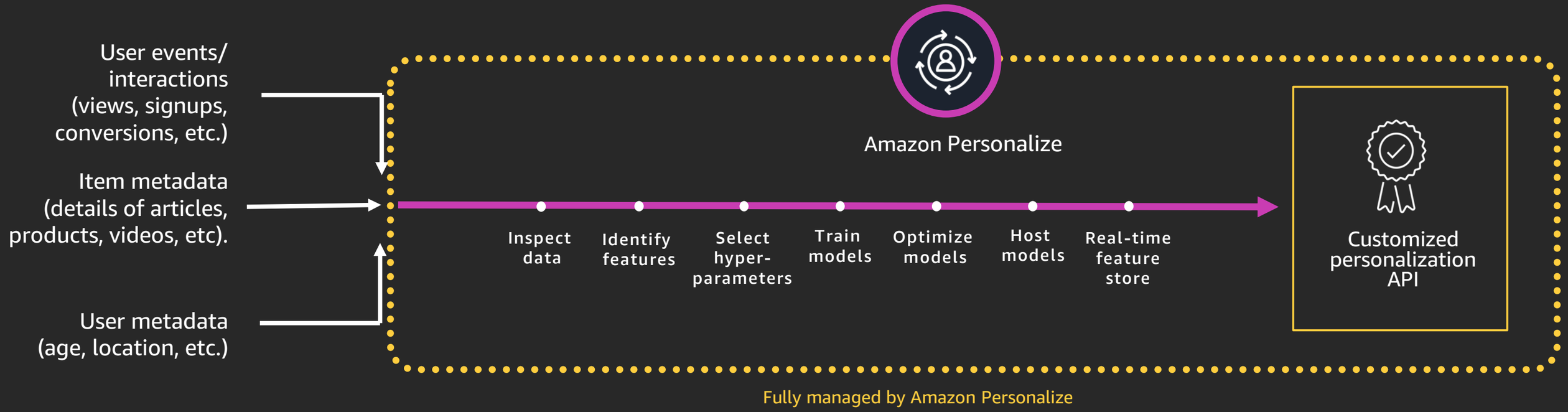
Amazon Personalize

Based on the technology that powers personalization at Amazon



Amazon Personalize

Behind the scenes



Putting Amazon Personalize to work

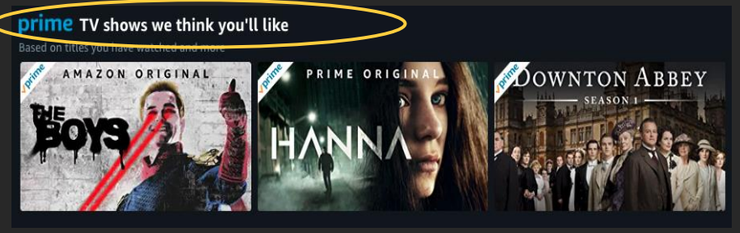
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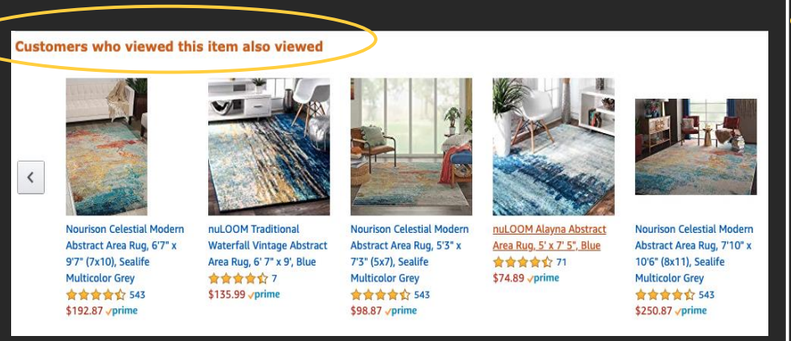
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Amazon Personalize solves foundational personalization use cases

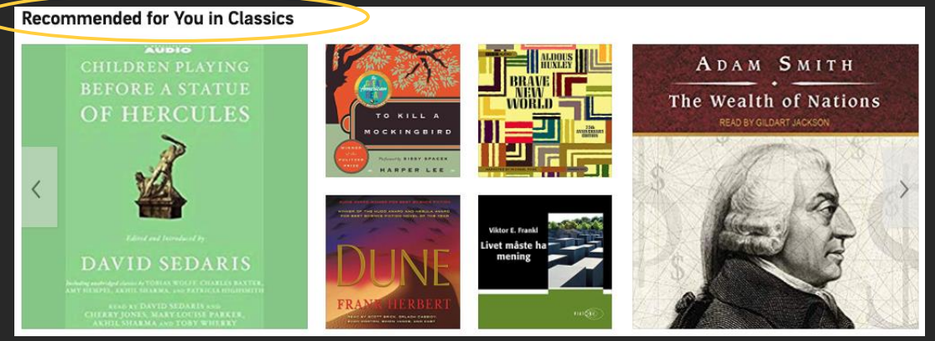
User personalization



Similar items

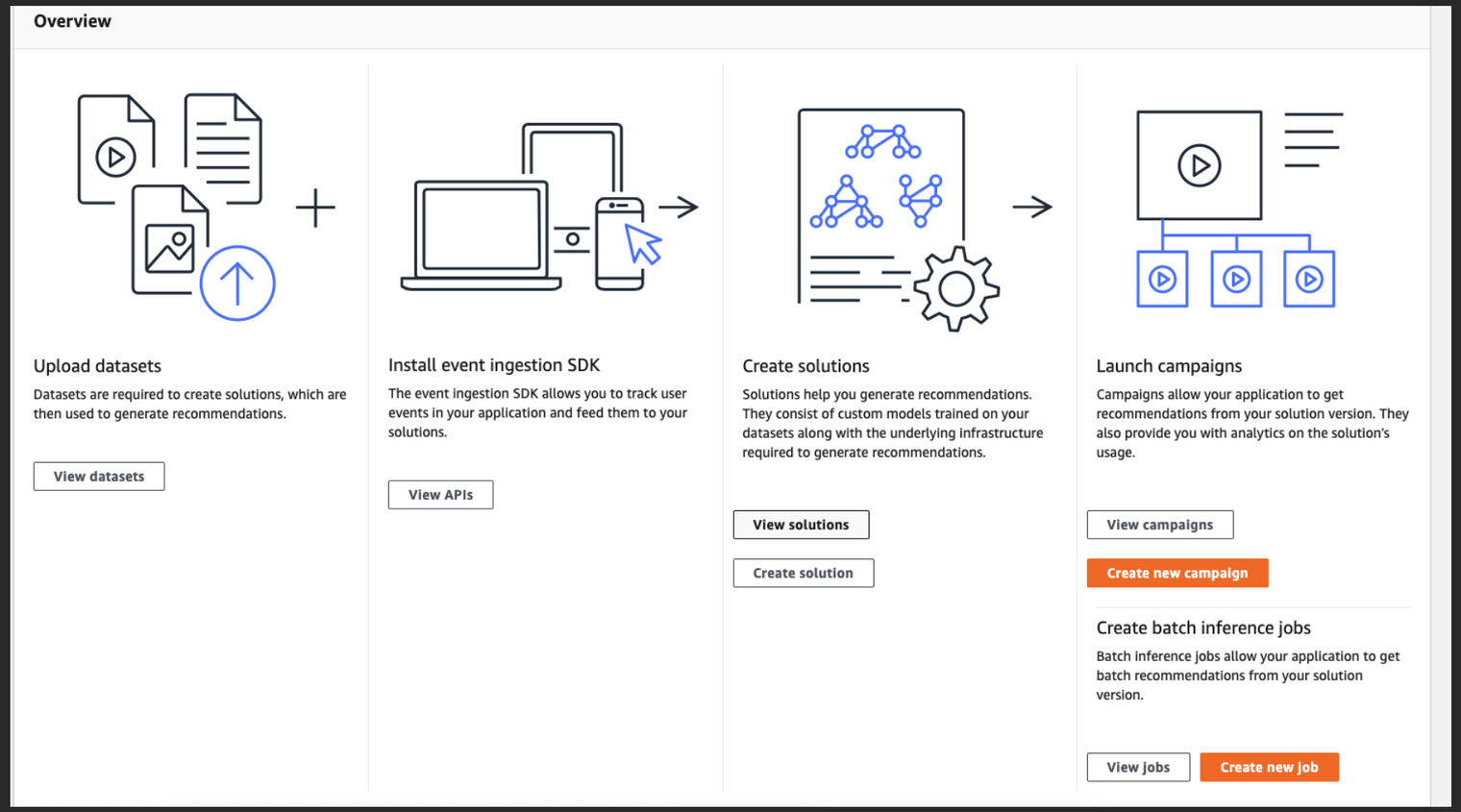


Personalized ranking



Setting up Amazon Personalize

Easy three step process



Data Ingestion

Training

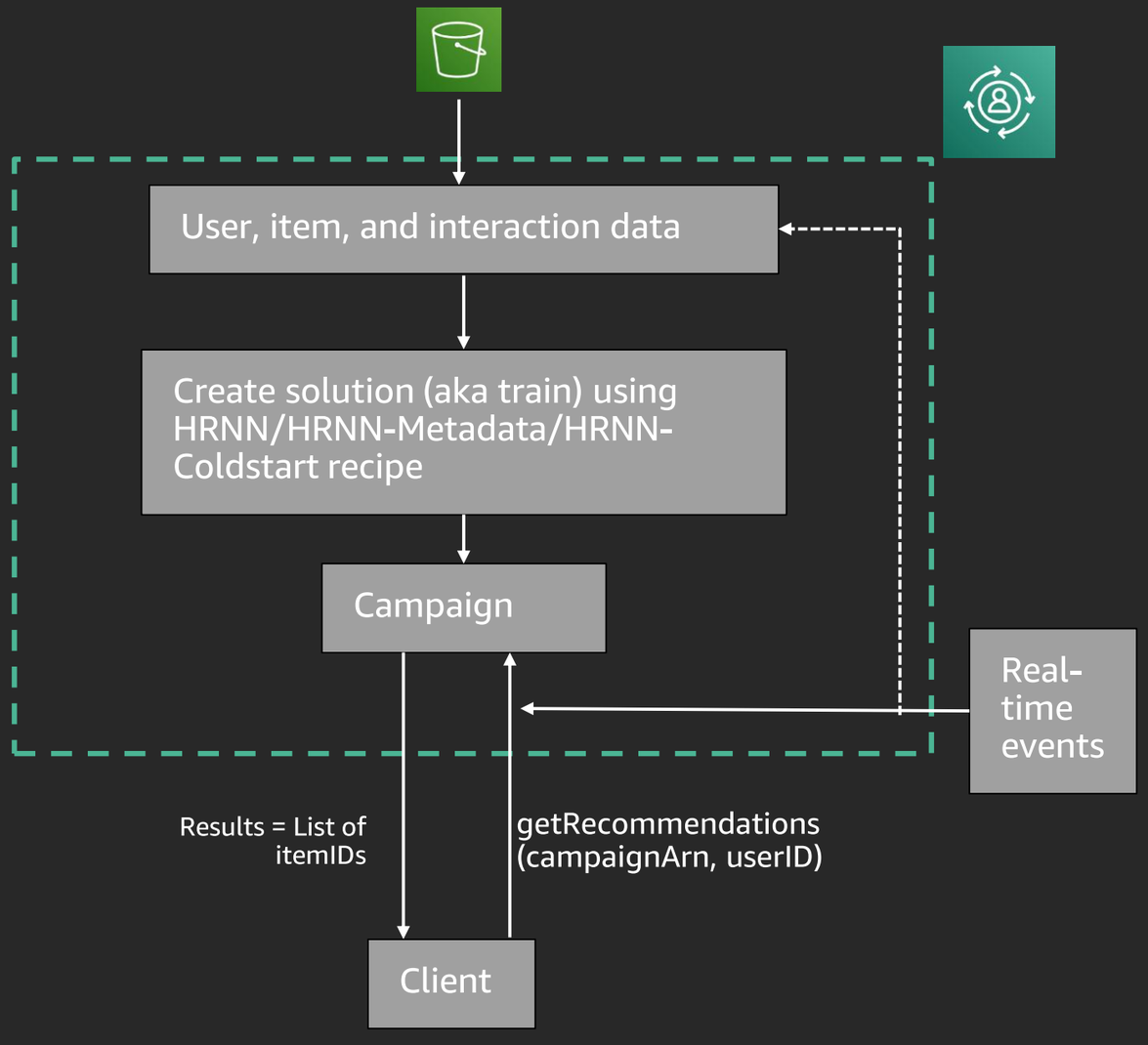
Inference

User personalization

When to use:

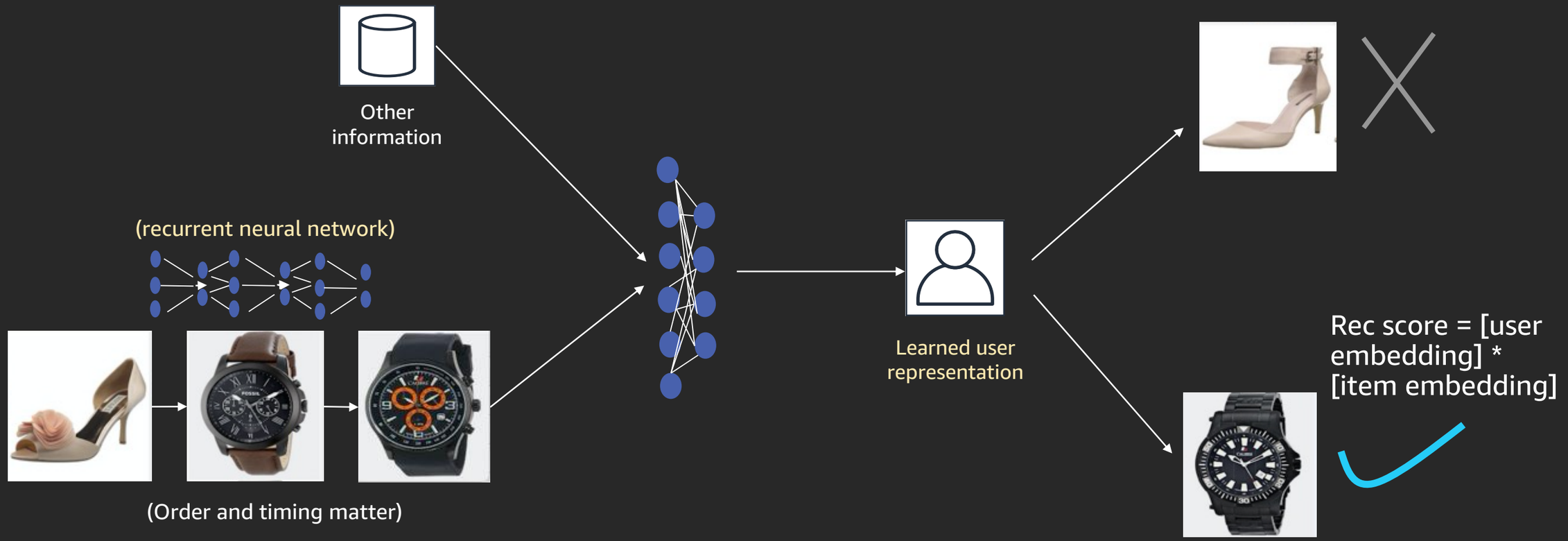
- Landing pages
- Cart recommendations
- Email promotions (often preprocessed)
- Detail pages in addition to similar items

How to use:



User personalization with sequence models

The evolution of historical interest and disinterest is a good indicator of future preferences



- ✓ Assigns more attention to recent events
- ✓ Real-time interactive responses

Cold item personalization

- Use for recommending relevant newly added items to users; special case of user personalization
- Personalized recommendations for new items
- Use via HRNN-Coldstart recipe

Braveheart (1995)	Action|Drama|War
Farinelli: il castrato (1994)	Drama|Musical
Edward Scissorhands (1990)	Drama|Fantasy|Romance
Back to the Future (1985)	Adventure|Comedy|Sci-Fi
Road Warrior, The (Mad Max 2) (1981)	Action|Adventure|Sci-Fi
Grumpy Old Men (1993)	Comedy
Halloween: The Curse of Michael Myers (Hallowe...	Horror|Thriller



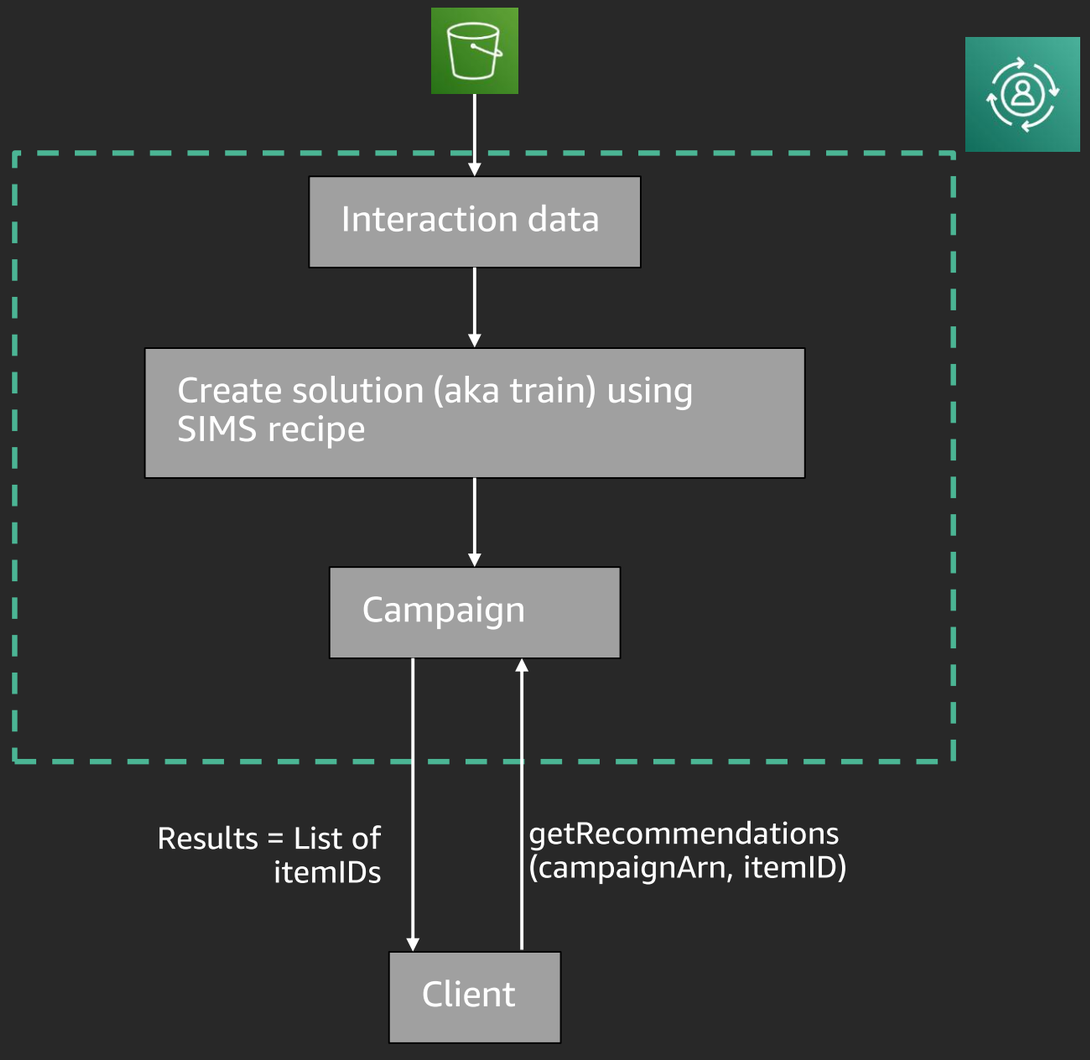
Making Contact (a.k.a. Joey) (1985)	Fantasy|Horror|Sci-Fi
Decoys (2004)	Comedy|Horror|Sci-Fi
Critters 4 (1991)	Comedy|Horror|Sci-Fi
TerrorVision (1986)	Comedy|Horror|Sci-Fi
Tremors II: Aftershocks (1996)	Comedy|Horror|Sci-Fi
Evil Aliens (2005)	Comedy|Horror|Sci-Fi
Thing with Two Heads, The (1972)	Comedy|Horror|Sci-Fi

Similar items

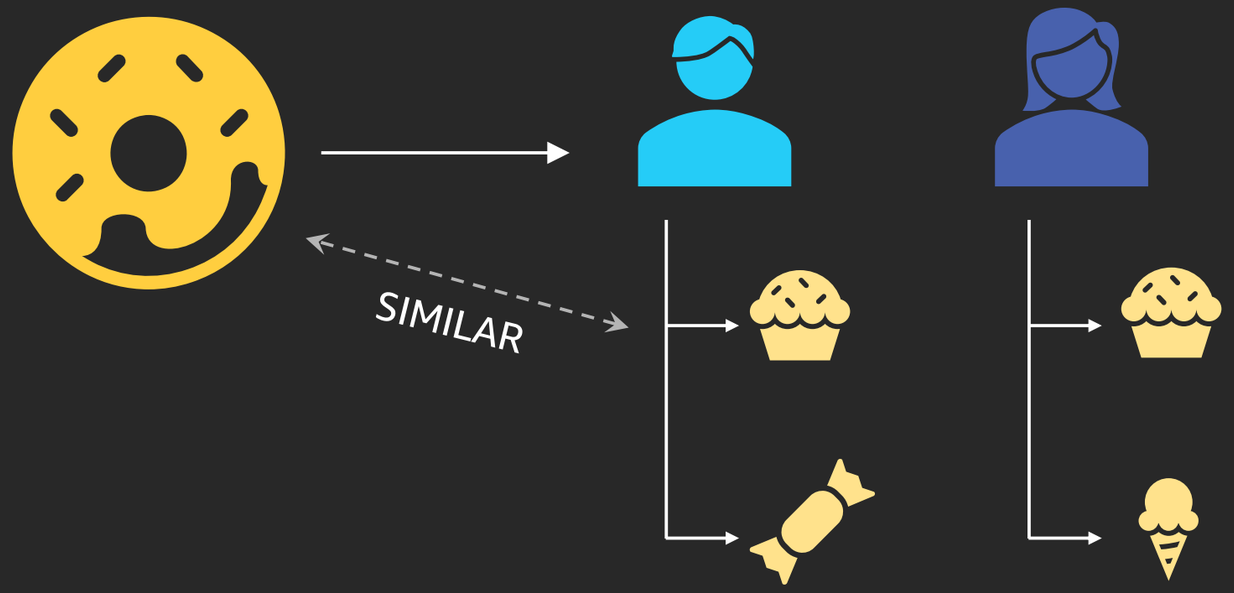
When to use:

- Item detail page – multiple variants possible with different events (users who purchased X also purchased Ys; users who clicked X also clicked on Ys)
- Up- sell recommendations (SIMS + business rules)

How to use:



Similar items recommendations using item-item collaborative filtering



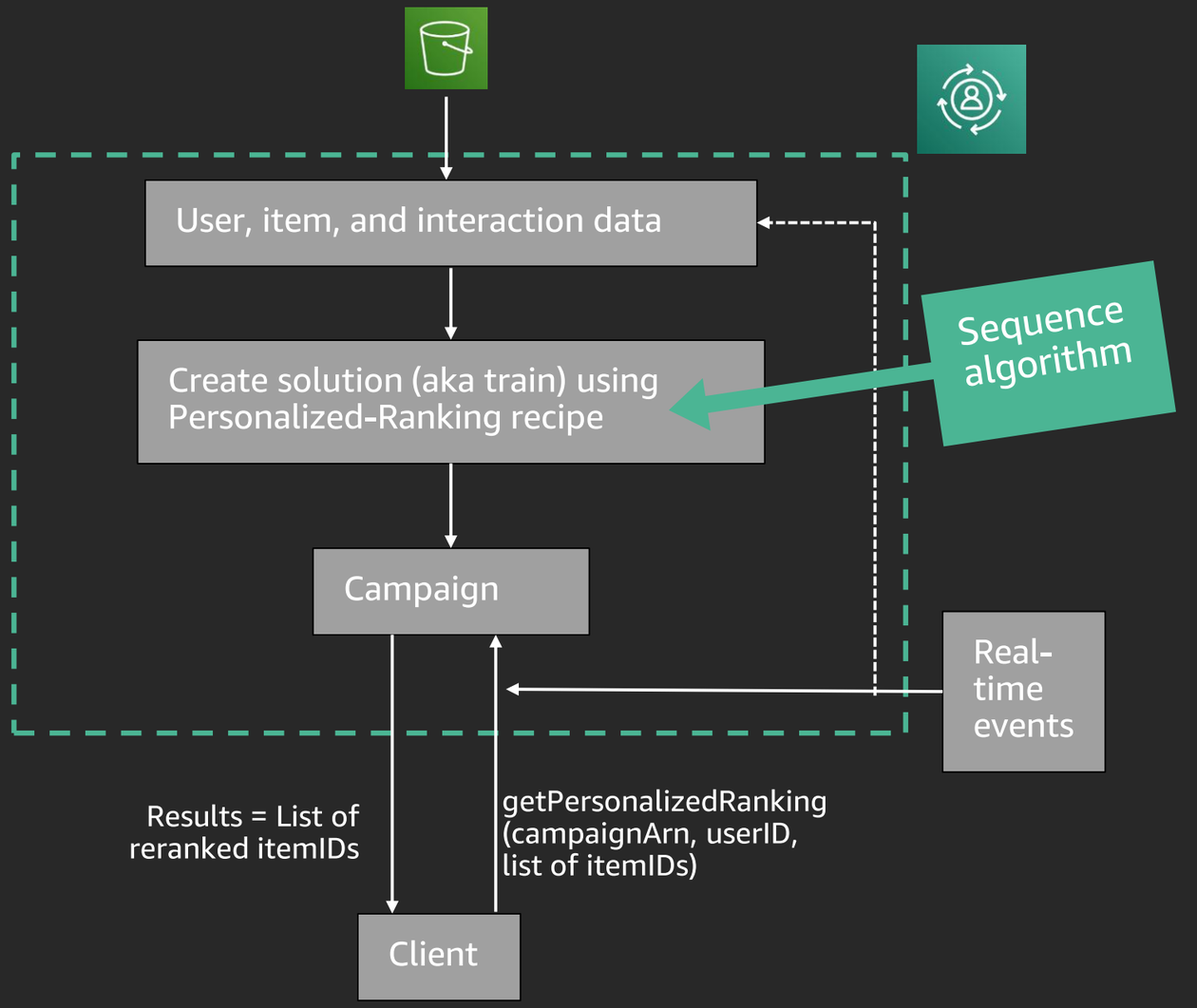
- ✓ An item is similar to another if they were interacted by same users
- ✓ Scalable; only needs interaction data to calculate similarity
- ✓ Customers can choose the popularity vs. correlation trade-off

Personalized reranking

When to use:

- Category-based recommendations
- Recommendations under business constraints (e.g., recommend only from free-to-watch movies)

How to use:



How Voodoo used Amazon Personalize for in-app content recommendations

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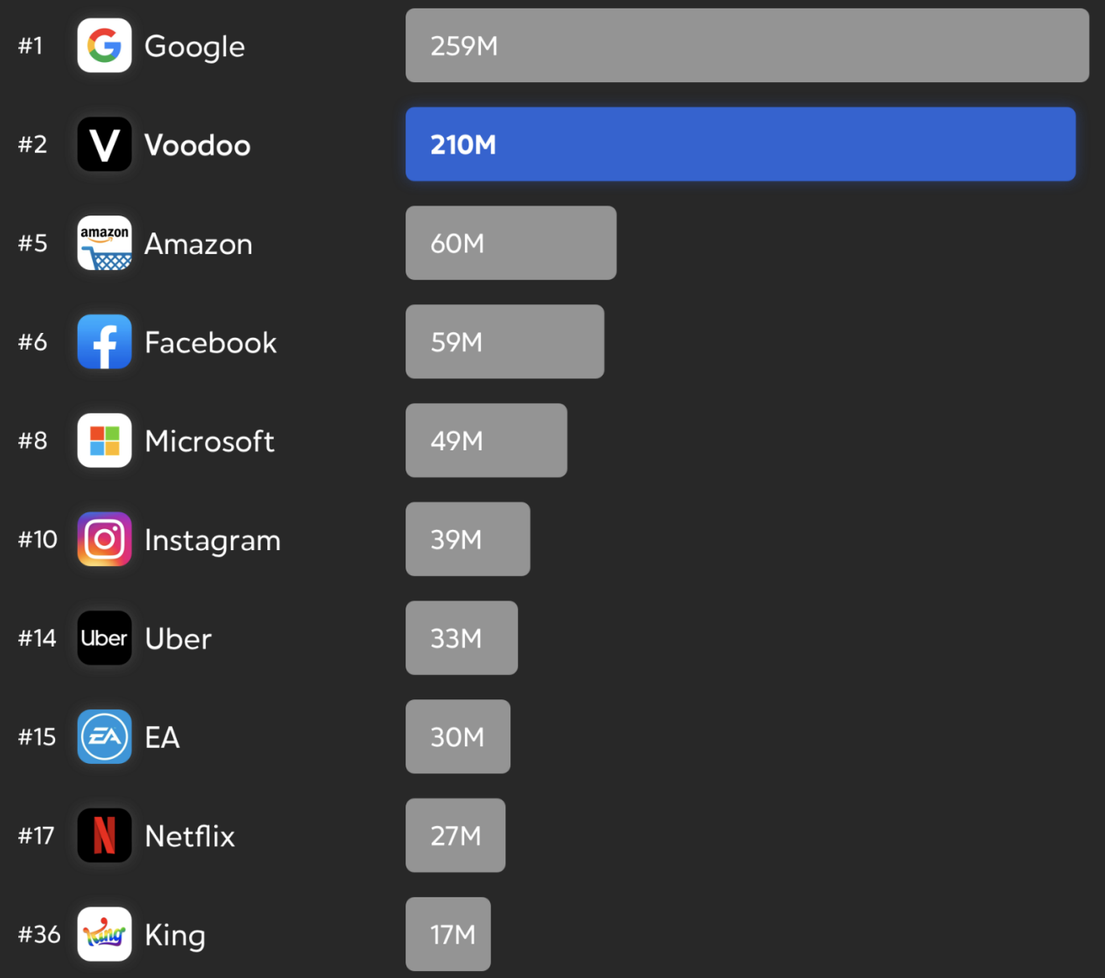
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Voodoo

Voodoo

The **number one gaming company worldwide** with the most downloads on the App Store

3 billion downloads since 2018



Before	Now
	


1
2
3

Scale



Scale



Repeat the success


Voodoo

Iterate fast > Fail & always learn > Scale

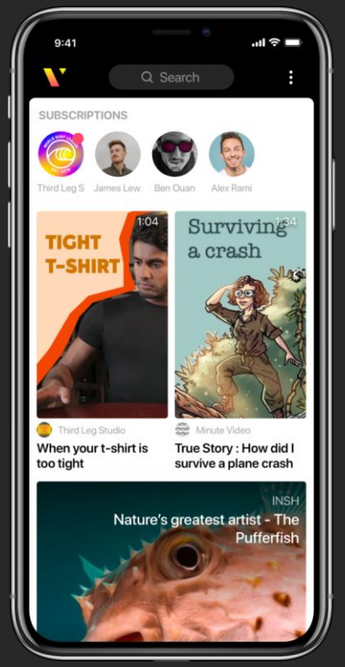
Games



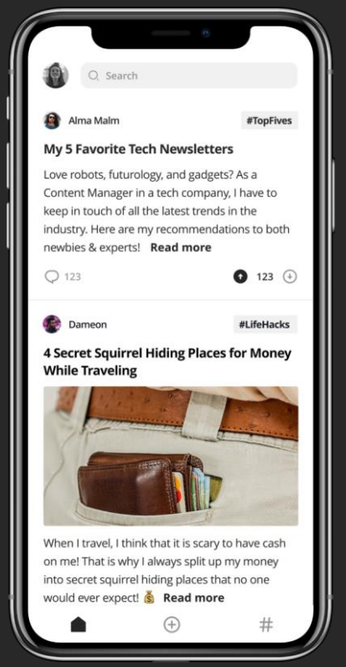
Games



Apps



Apps



Games



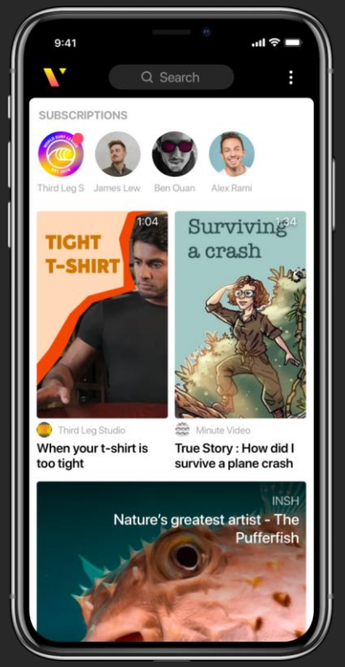
Users

Games



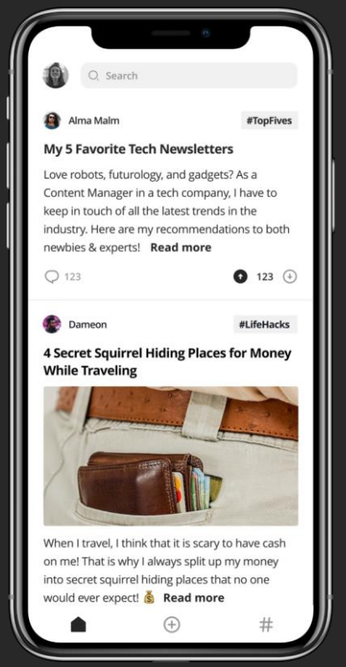
Users

Apps



Users

Apps



Data

Recommendation

AdTech

How it works

The real life

Robin Mizreh
Tech Lead @Voodoo

Cross promotion

Cross promotion

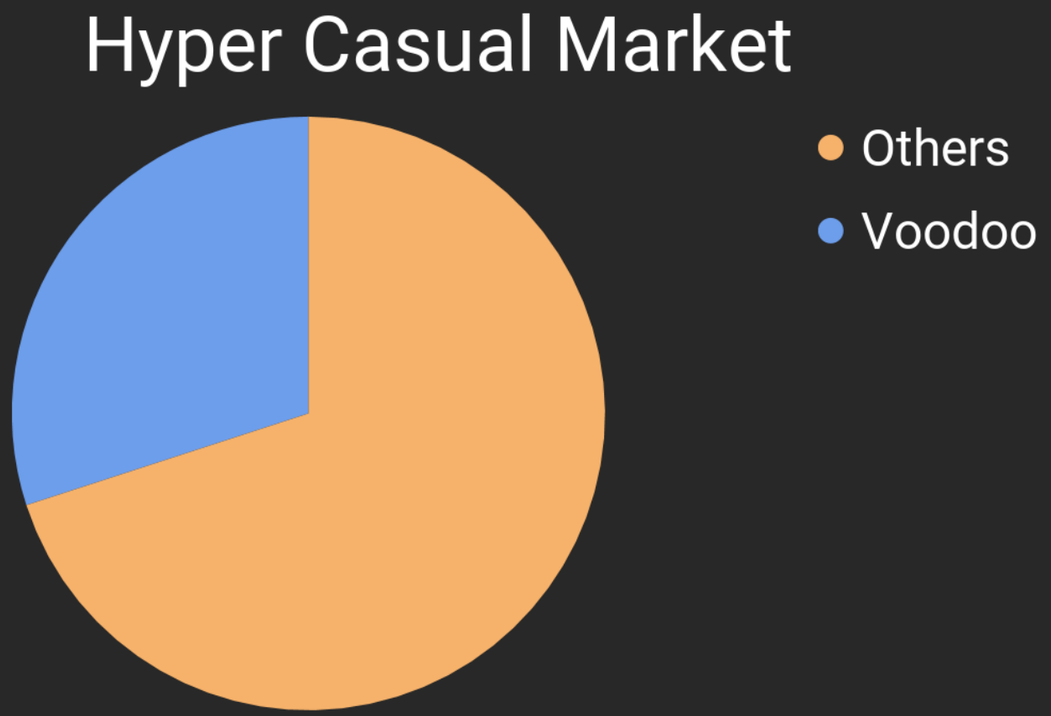
- Promote our games in our games

- Leverage our user base

Cross promotion

- Promote our games in our games

- Leverage our user base

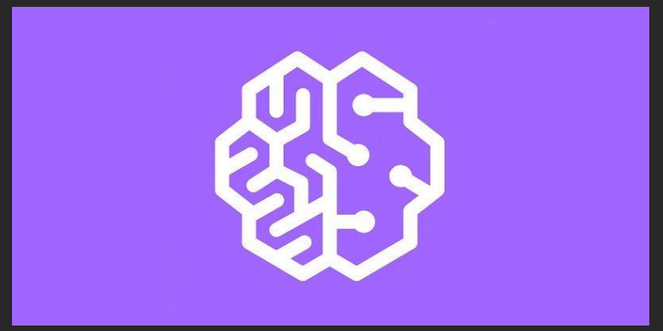


Data challenges

- World of competition
- Massive scale & High availability
- TB of data to process on a daily basis

Amazon Sagemaker

- Flexible
- Scalable
- Managed solution



Real time prediction

- Real time bid prediction
- More than 100M daily calls to our Sagemaker endpoints
- Billions of daily inferences

Non-gaming apps

Non-gaming apps

- Business diversification
- Bootstrapping app very quickly
- Iterate until find the perfect match
- Need of recommendation day 1

Amazon Personalize

- Easy to use
- Very fast to set up
- Many use cases handled out of the box



Machine learning in few steps

- Collects events from your apps
- Create your dataset
- Prepare your endpoint (Upload/train/deploy)
- Call Amazon Personalize endpoint for inferences

Our stack: Data collection





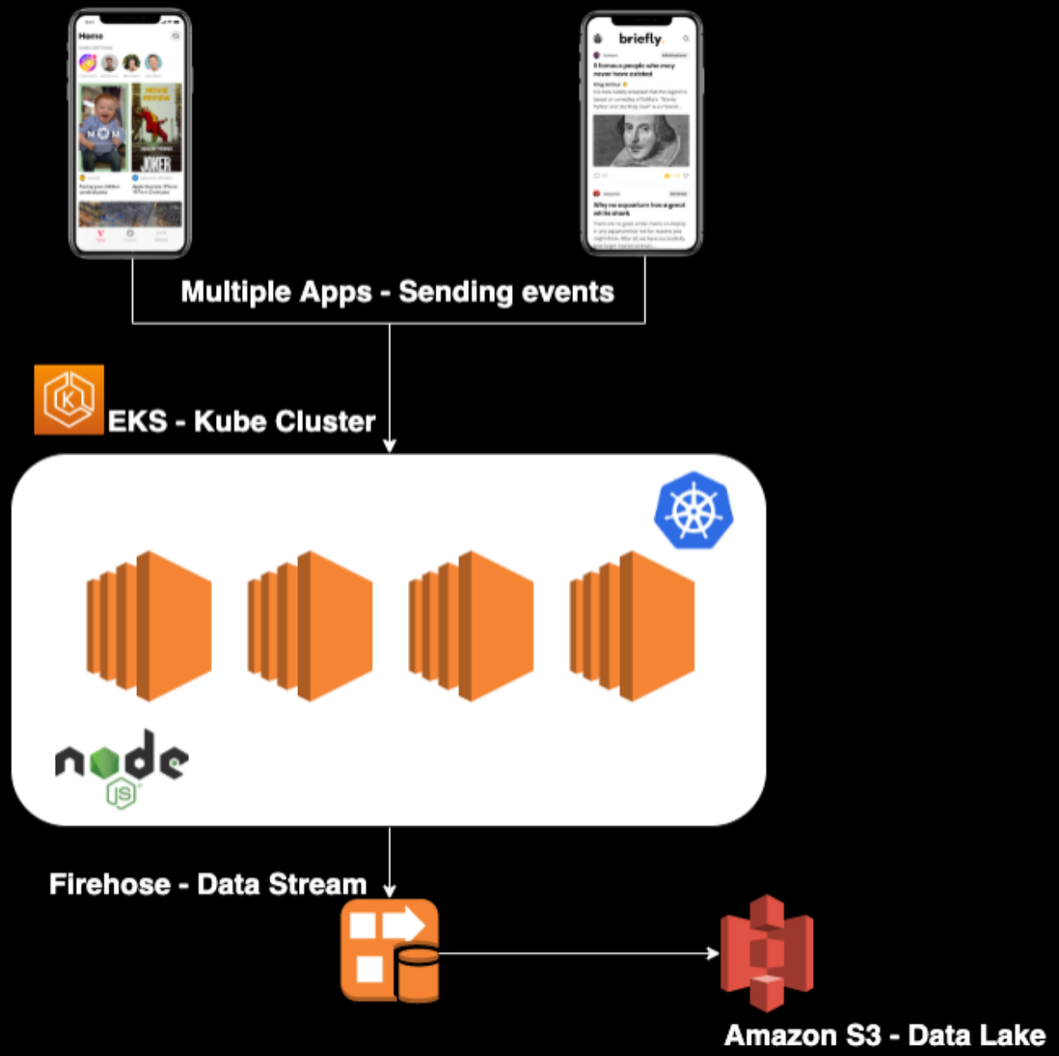
Our stack: Data collection



Our stack: Data collection



Our stack: Data collection



Our stack: Data transformation

Amazon S3 - Data Lake



Our stack: Data transformation

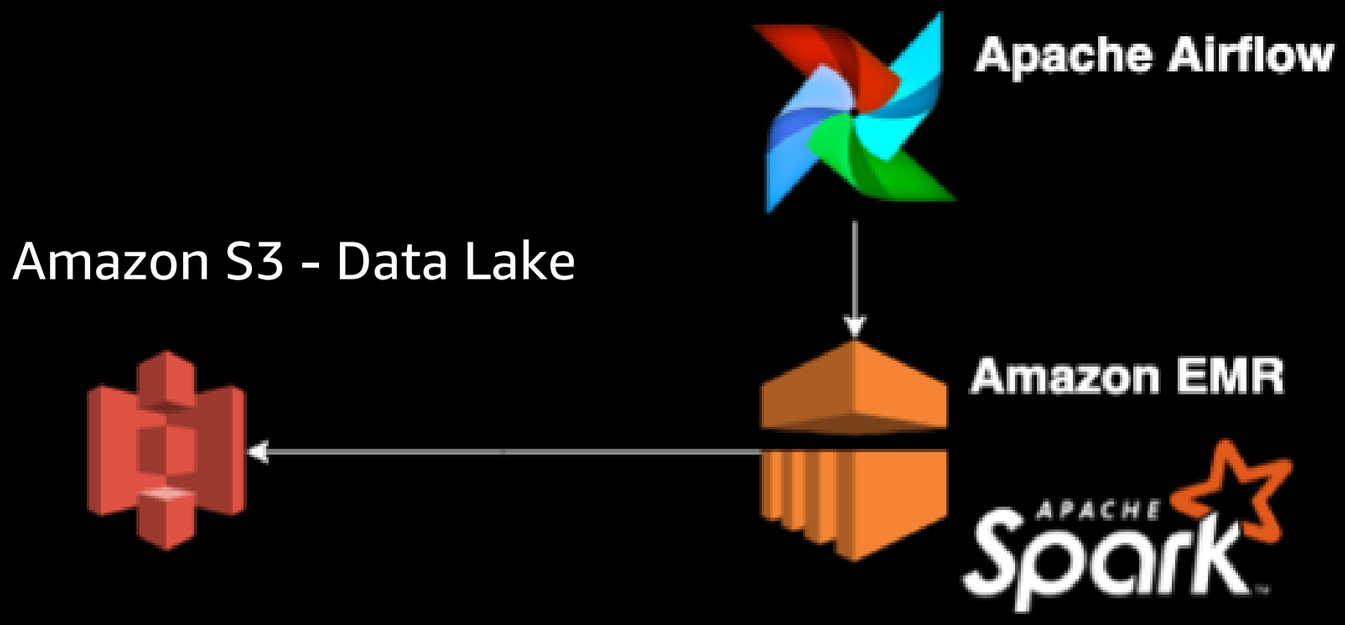


Apache Airflow

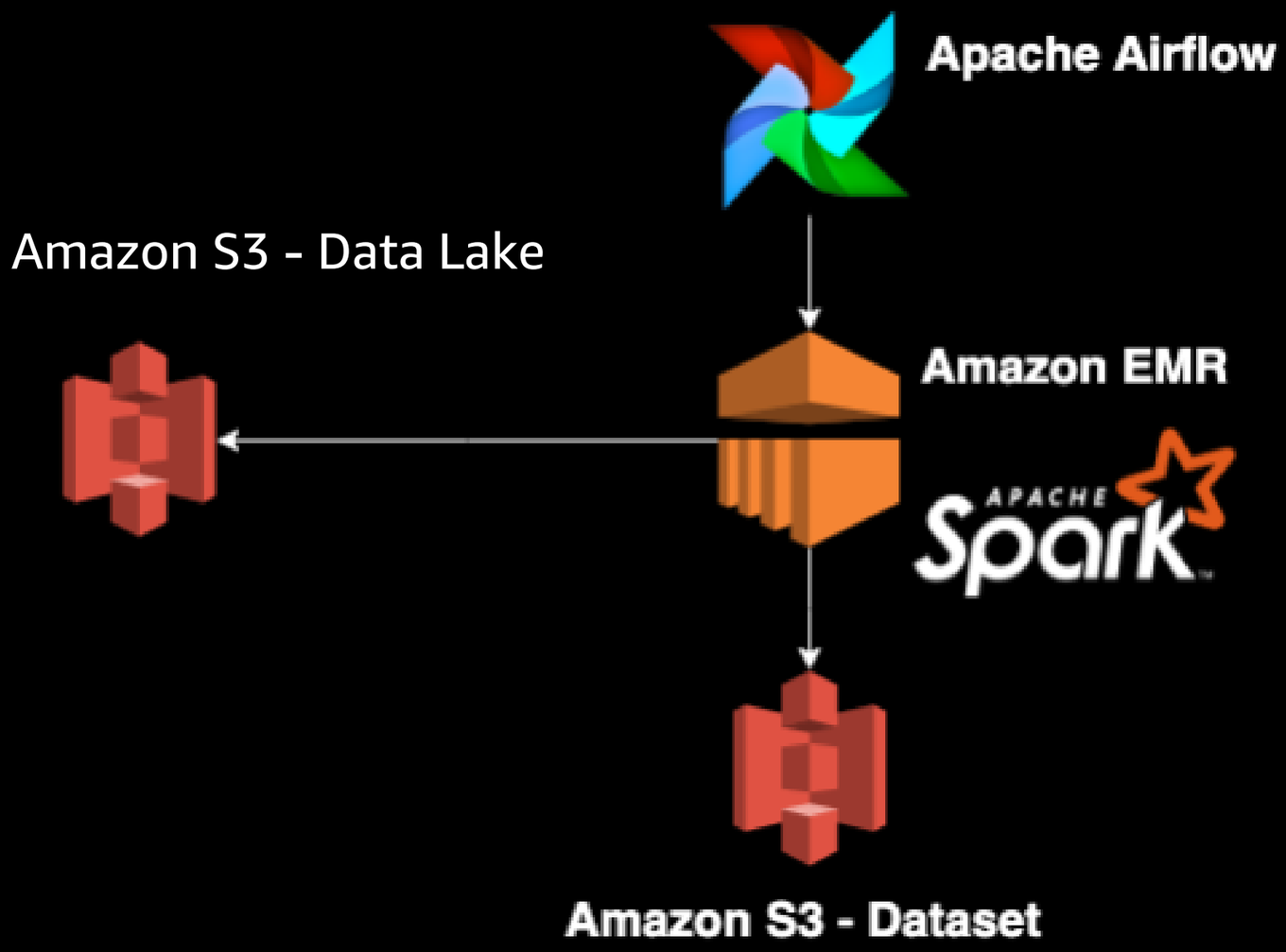
Amazon S3 - Data Lake



Our stack: Data transformation



Our stack: Data transformation



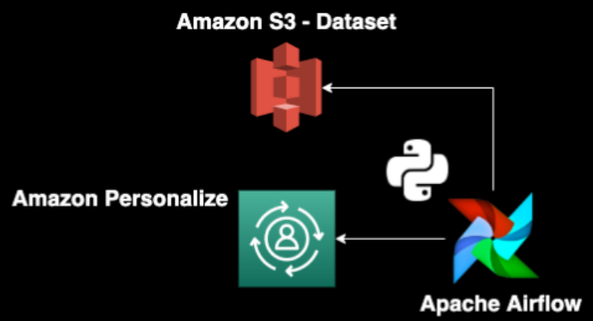
Our stack: Amazon Personalize part



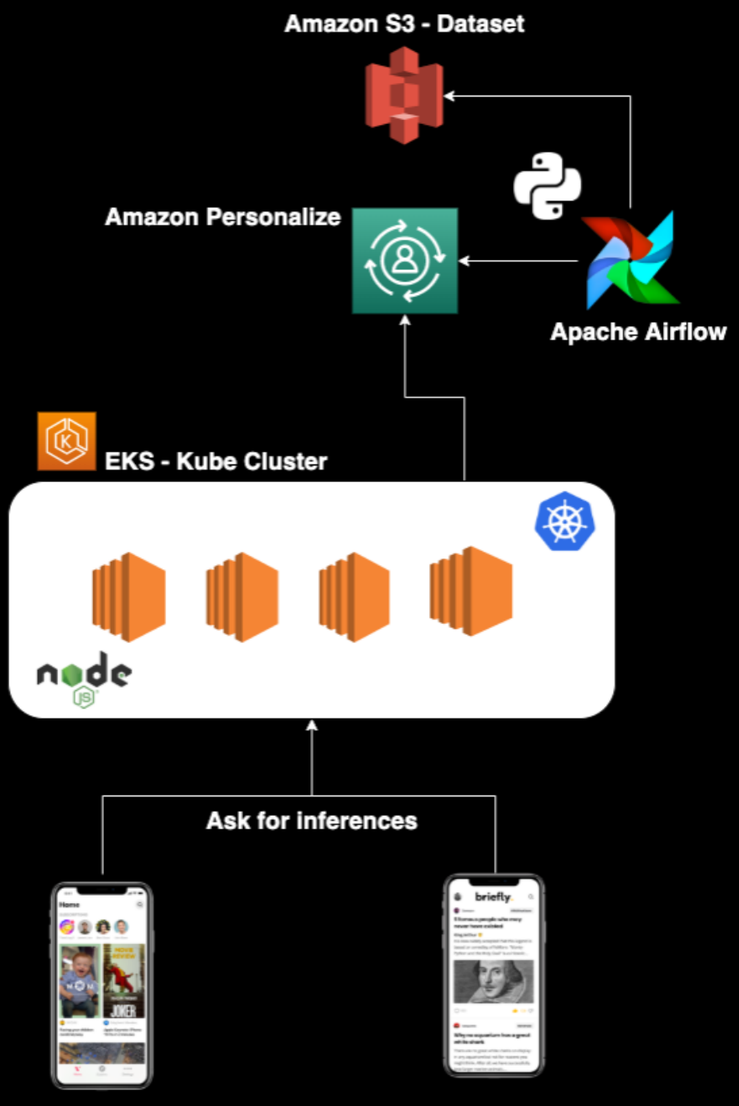
Our stack: Amazon Personalize part



Our stack: Amazon Personalize part



Our stack: Amazon Personalize part



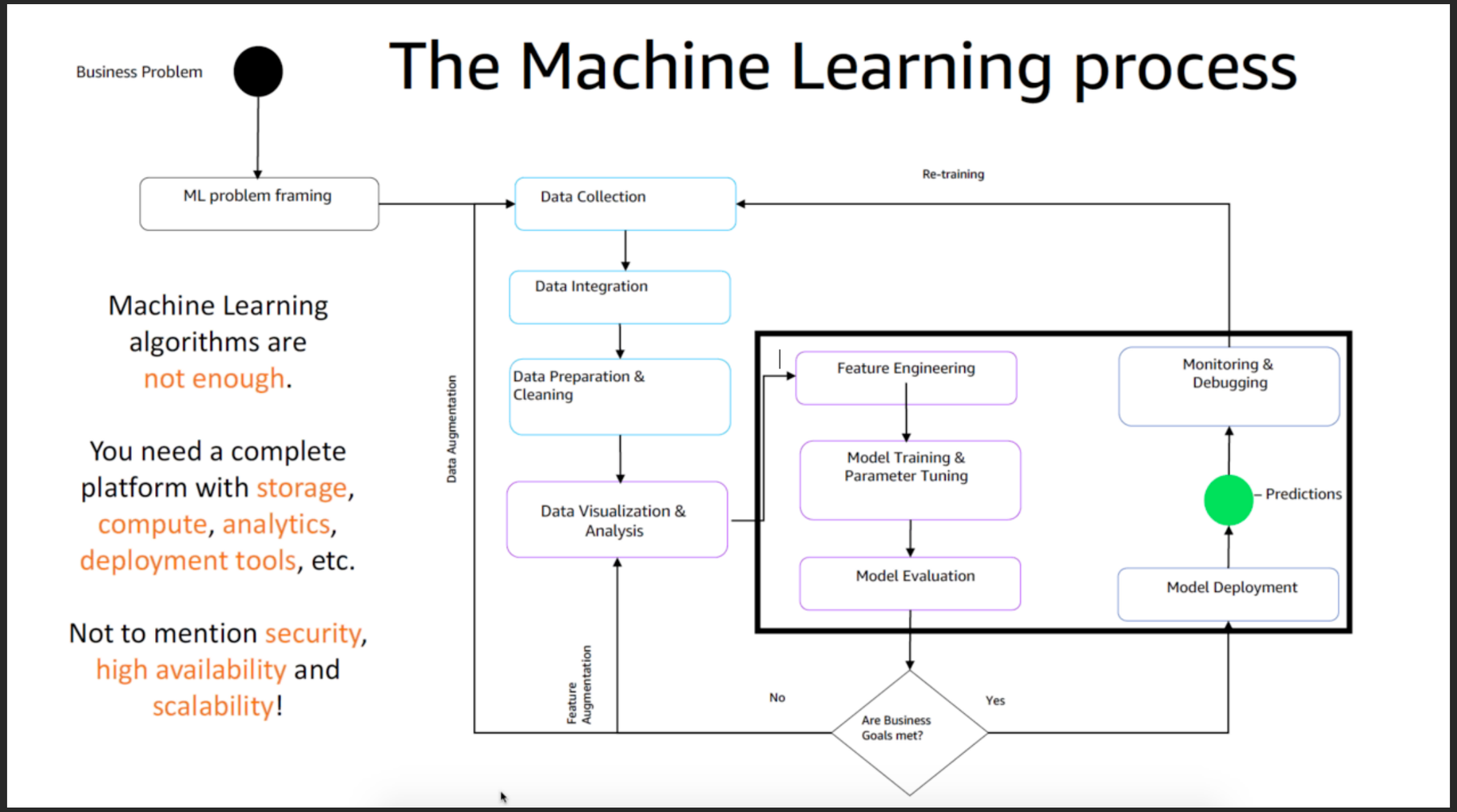
Benefits

- Global improvement of retention
- Enable to create dozen of new features every month
- Fast iteration

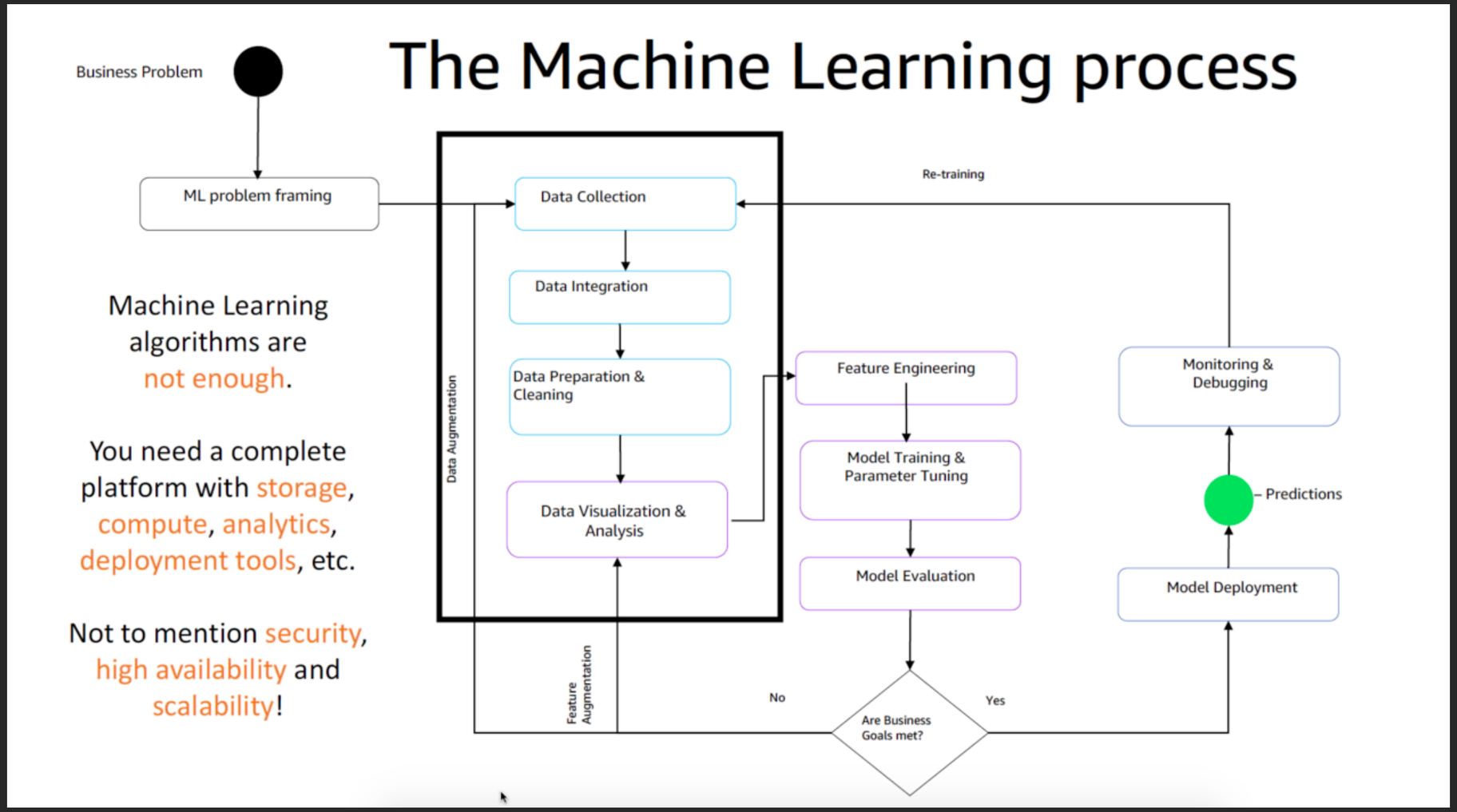
Take away

- Early customer allow us to work directly with AWS
- Always choose the technology suiting the best your use cases
- Data is the key

Take away: Machine Learning process



Take away: Machine Learning process





Thanks!

How Coursera used Amazon Personalize for recommending courses

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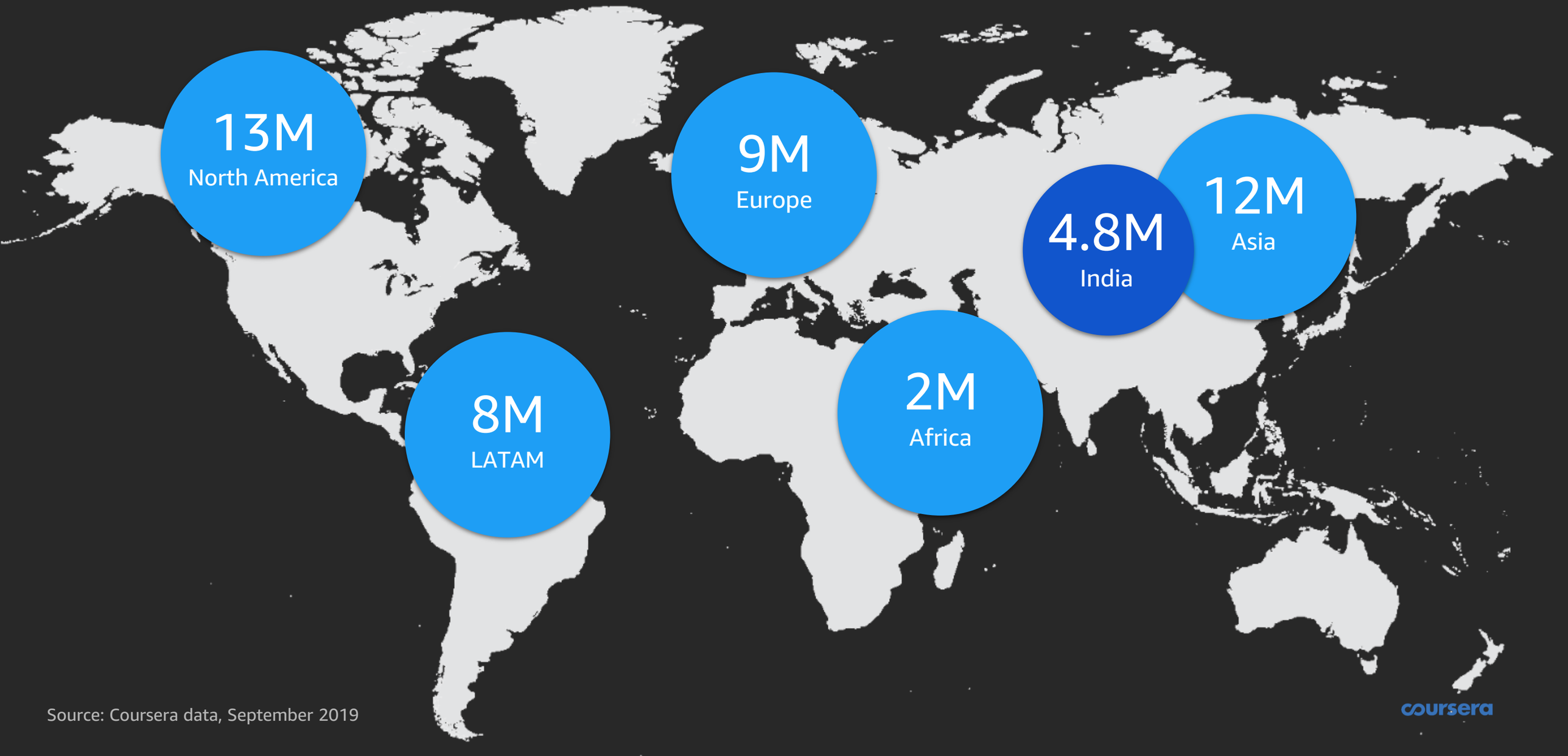
Coursera
A global learning platform

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Coursera reaches more than 44M global learners



Source: Coursera data, September 2019

coursera

2,000+ businesses have hired Coursera in 3 years



coursera

Coursera partners with governments worldwide



Singapore



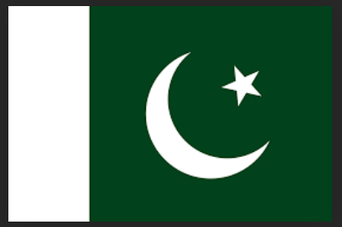
Egypt



India



UAE



Pakistan



Colombia



Kazakhstan



United States



Philippines



Australia

coursera

170 top universities offer courses on Coursera

Welcoming Coursera's
newest partner

IIM Calcutta

How can Coursera serve **the other 99%** of the 20,000 universities in the world?

Upcoming MasterTrack Certificates:

Management Science

Supply Chain Analytics

Source: Times Higher Education

coursera

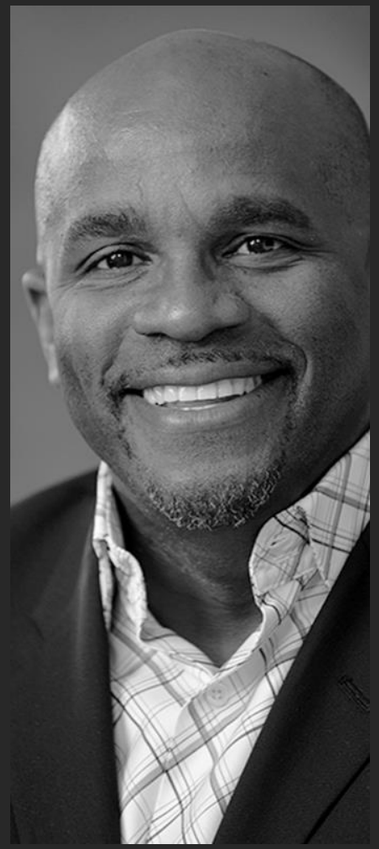
World-renowned faculty



Diana Bilimoria
Chair & Professor
Case Western Reserve University



Martin Odersky
Founder of the Scala Programming Language



Hayden Noel
Assistant Clinical Professor
University of Illinois



Cheri Alexander
Chief Innovation Officer, Michigan Ross, former CLO, General Motors



Andrew Ng
Coursera Co-Founder
Chief Scientist, Baidu
Founder, deeplearning.ai



Timothy Geithner
Former US Secretary of the Treasury



Robert Shiller
Professor of Economics
Yale University

What changed in 2019?

Rapid Machine Learning Development

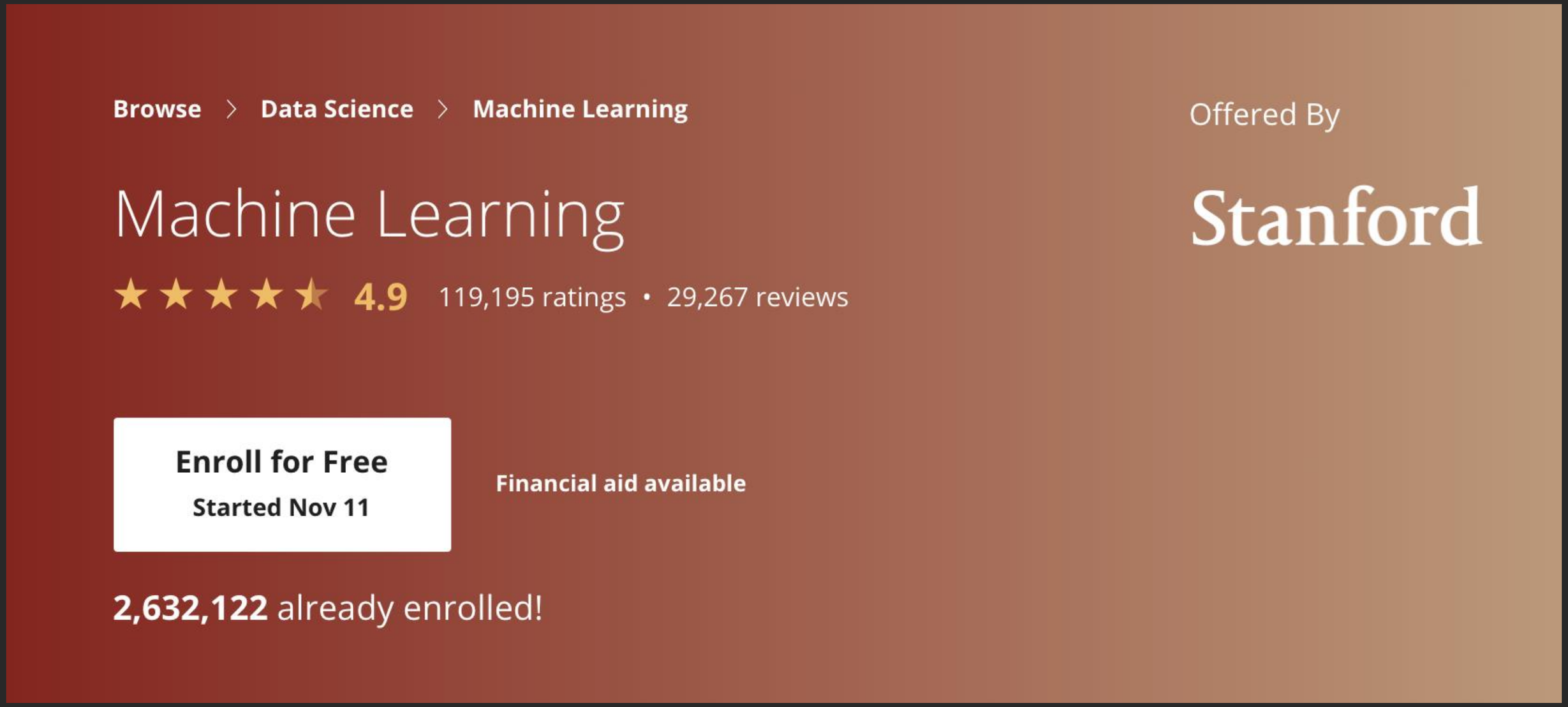
2018: Senior Data Scientist - 3 months

2019: Intern - 1 week (using Amazon)

Business/systems challenges

1. Recs for 40 Million members
2. Recs for 4 Million Unique Visitors/Day
3. Leverage 100 M+ events
4. Personalized Recs in Real-time
5. Scalable / HA Solution

Goal: Better course recommendations



Amazon Personalize SIMS recommendations

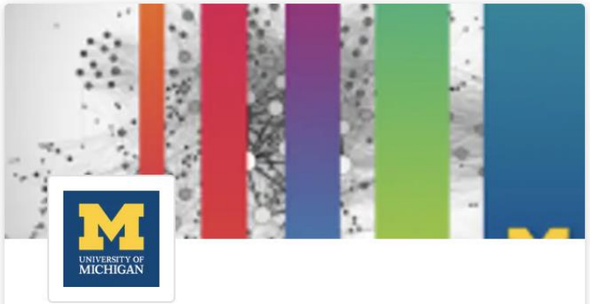
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Applied Data Science with Python

University of Michigan

5 COURSES



Machine Learning

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4 COURSES



Neural Networks and Deep Learning

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Amazon has some experience…

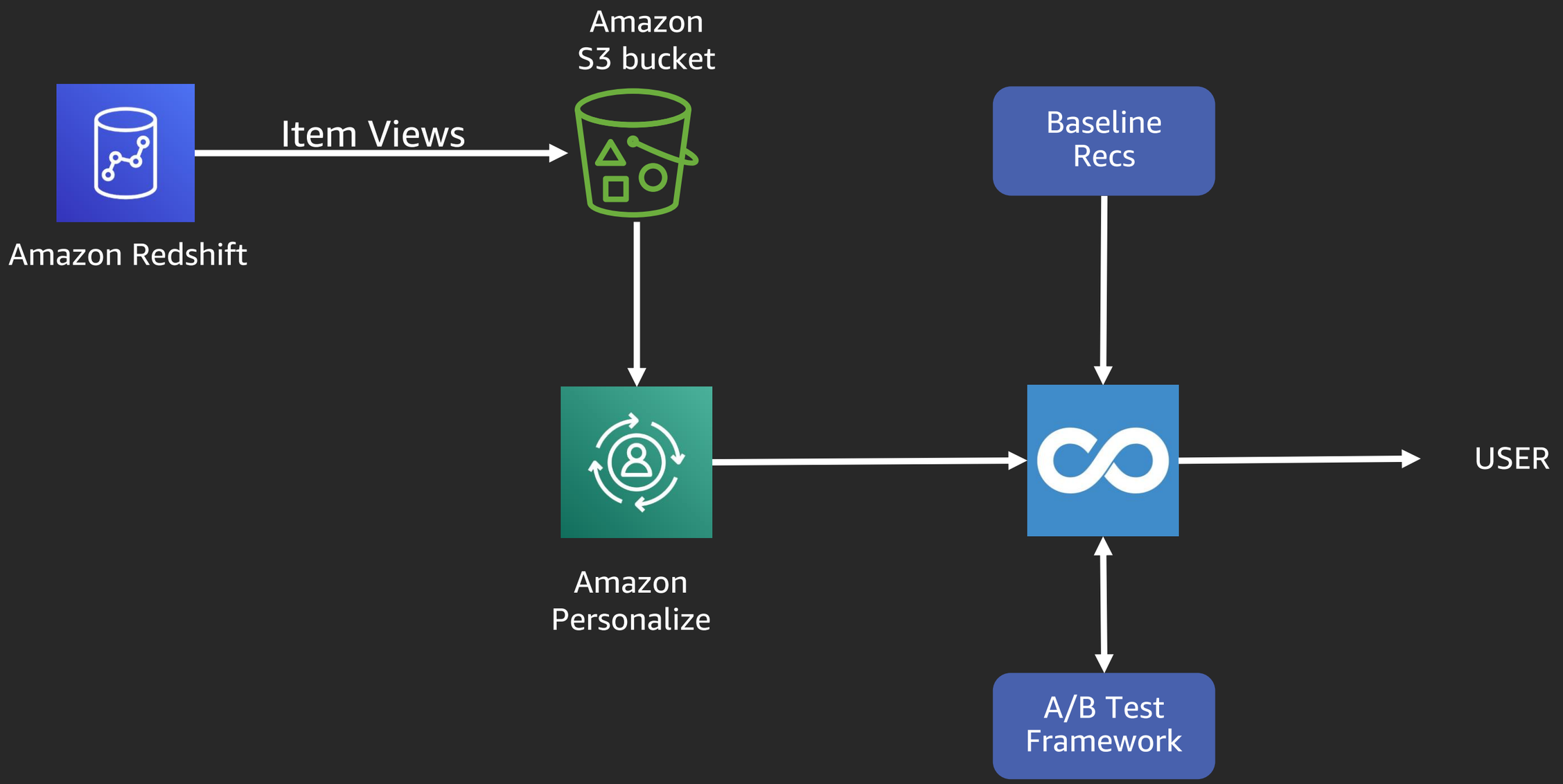
Two Decades of Recommender Systems at Amazon.com

Amazon is well-known for personalization and recommendations, which help customers discover items they might otherwise not have found. In this update to our original article, we discuss some of the changes as Amazon has grown.

For two decades now,[1] Amazon.com has been building a store for

recommendations, as well as desirable properties such as updating immediately

Architecture



Model retraining script

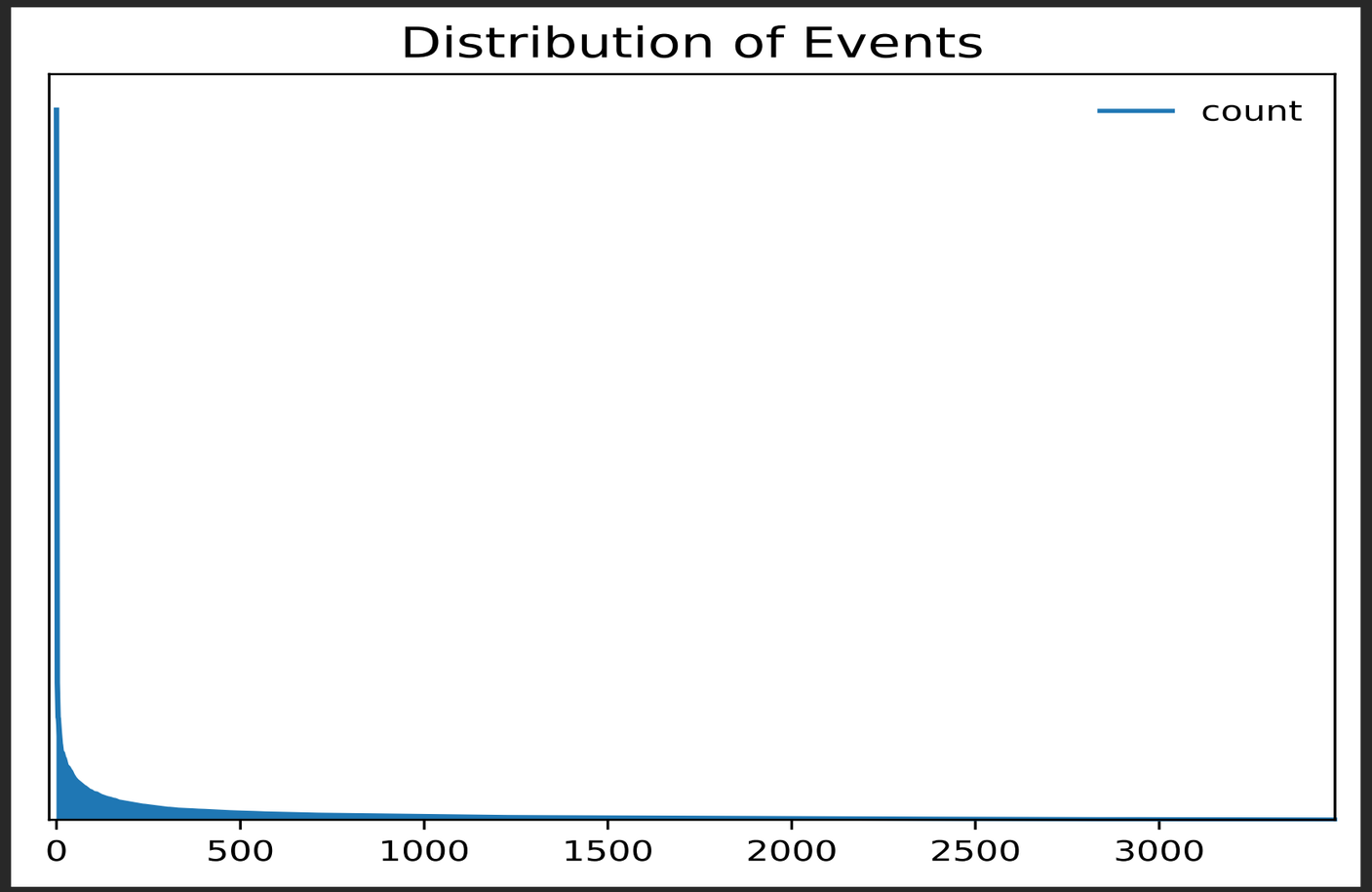
```
if __name__ == "__main__":
    retrain = Retrain("config-meta.yml")
    retrain.import_dataset("USERS")
    retrain.import_dataset("ITEMS")
    retrain.import_dataset("INTERACTIONS")

    # Train model
    solution_version_arn = retrain.start_training()
    retrain.wait_training(solution_version_arn)
    solution_version = retrain.get_latest_model()

    # Check model
    model_metrics = retrain.get_model_metrics(solution_version["solutionVersionArn"])
    logging.info(json.dumps(model_metrics, indent=2))

    # Deploy model
    retrain.update_campaign(solution_version["solutionVersionArn"])
    retrain.wait_campaign()
```

Long-tail issue for SIMS recipe



Zero or few recommendations

for rare items

Solution: Change default values:

min_cointeraction_count = 3

min_item_interaction_
count_percentile = 0.01

Results of Amazon Personalize (SIMS)

Rapid Development & Deployment

- Train: 20x faster
- Total: 3 days development

Automatically Scales

Revenue increased (A/B tested)

Next: HRNN-Metadata recipe

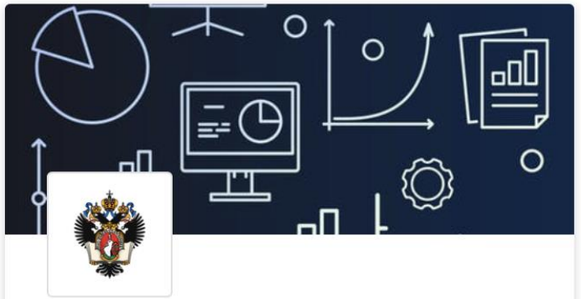
User	
Language	ru
Country	RU
Region	MOW
Device	iPhone

Item	
Language	Russian
Domain	data-science
Sub-domain	data-analysis

Interactions
User, item, timestamp
2996376, gCCEeiZdg6RDGBSdg,1556241493

Recommendations: Russian browser

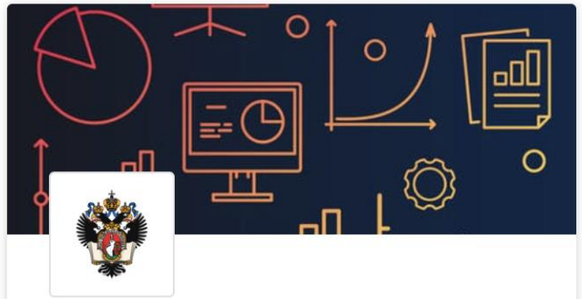
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Линейные модели с дискретными предикторами

Saint Petersburg State University

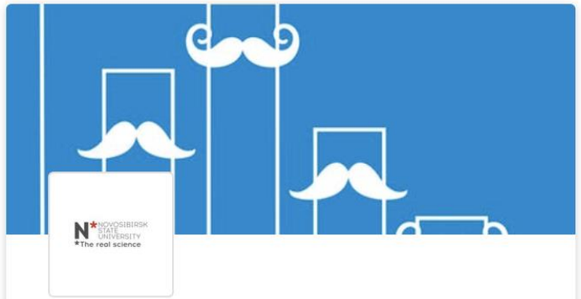
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Линейная регрессия

Saint Petersburg State University

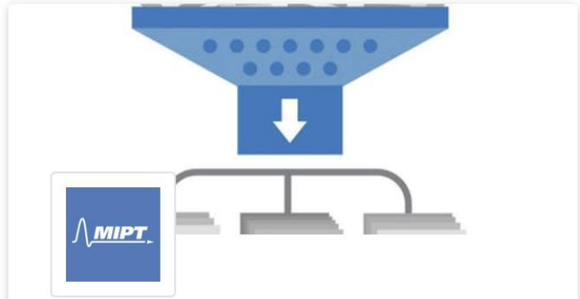
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Исследование статистически...

Novosibirsk State University

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Поиск структуры в данных

Moscow Institute of Physics and Technology

1 COURSE

Summary

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Get started on Amazon Personalize today

To get started, visit:

https://aws.amazon.com/personalize/

https://github.com/aws-samples/amazon-personalize-samples

OR

Work with an AWS partner

Partners with capabilities in Amazon Personalize



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Q&A

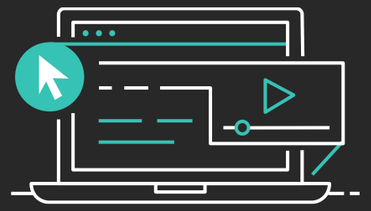
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Validate expertise with the
AWS Certified Machine Learning - Specialty exam

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