

# Feature Store: Why, How and Lessons Learned



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# Mission



# Many Americans faced financial stress even before recent COVID impacts

## Pre-COVID, the American middle class was already under pressure

**“The average American family has yet to recover fully from the 2008 financial crisis**, the Federal Reserve found, leaving half the nation with a diminished cushion to handle surprise expenses — or the next downturn. The bottom half has less wealth today, after adjusting for inflation, than it did in 1989, according to Fed data through March of this year.”

**“Half of U.S. jobs pay less than \$18.58 an hour** and more than a third pay less than \$15, which makes it difficult to save or invest for a better future.”

**“To get by, Americans have borrowed heavily in recent years.** Total U.S. household debt is now \$13.7 trillion, surpassing the 2008 peak in dollar terms, according to the Federal Reserve Bank of New York. The surge in debt this time around is for cars and college, not mortgages.”

*--The Washington Post: “This doesn’t look like the best economy ever’: 40% of Americans say they still struggle to pay bills’; by Heather Long. (4 July, 2019)*

## The pandemic has further impacted the middle class with material headwinds

# Technology has progressed to enable a full service, digital bank

81%

of U.S. adults own a cellphone that is a smartphone <sup>1</sup>

99%

of U.S. adults ages 18-29 own a cellphone that is a smartphone <sup>1</sup>

85%

of U.S. Millennials prefer to interact with banks and retailers via a mobile experience <sup>2</sup>

1: Pew Research Center. *Mobile Fact Sheet*, February 7, 2019, available at <http://www.pewinternet.org/fact-sheet/mobile>

2: Mitek Systems, *The Millennial Influence: How Their Love of Mobile Shapes Commerce*, November 2016, available at

<https://www.miteksystems.com/sites/default/files/docs/The%20Millennial%20Influence%20-%20How%20Their%20Love%20of%20Mobile%20Shapes%20Commerce.pdf>.



# Varo was founded to be a different kind of bank - A bank for all of us



# Varo launched in 2017, using technology to meet the core banking needs of everyday Americans

## Our business

- Varo Money launched on iOS in mid-2017 and launched on Android in early 2019
- Varo filed for a national bank charter in the summer of 2017 and opened Varo Bank in Q3 2020; the first US fintech to get a national bank charter
- Varo Bank uses our proprietary, state-of-the-art technology platform

## Our impact

- On average, our target customers pay \$349 per bank account per year in fees including overdraft, ATM, FX fees
- Varo is able to serve overcharged and underserved customers largely fee free
- We save our customers hundreds of millions of dollars in fees each year, resulting in increased retained income to cover expenses or increase savings

# ML Challenges

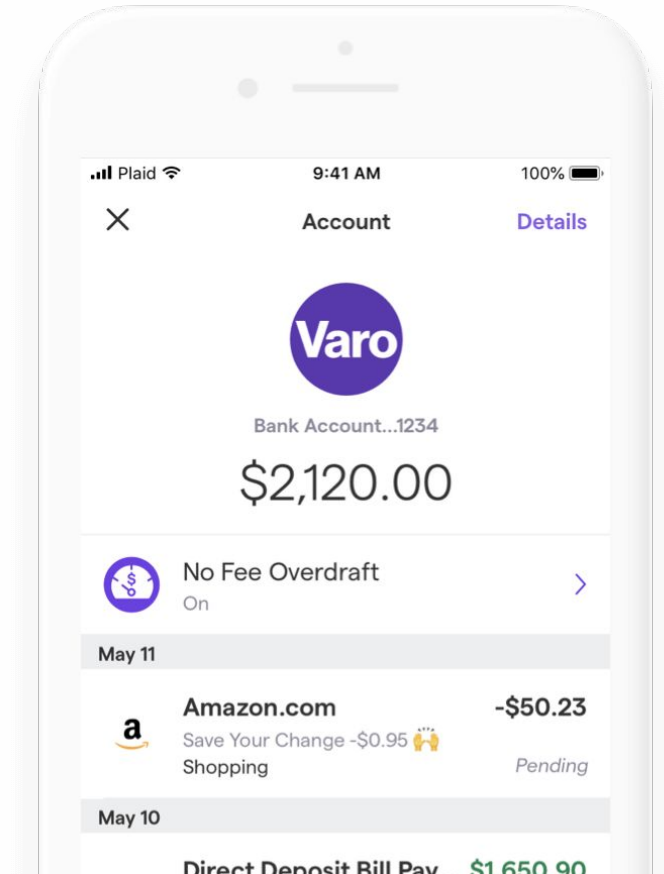
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# Case Study 1 - Identify & Prevent Fraud

## Transactions

***Goal: Identify & stop fraudulent transactions (bad actors) as early as possible***

***Avoid disruption of legitimate transactions***





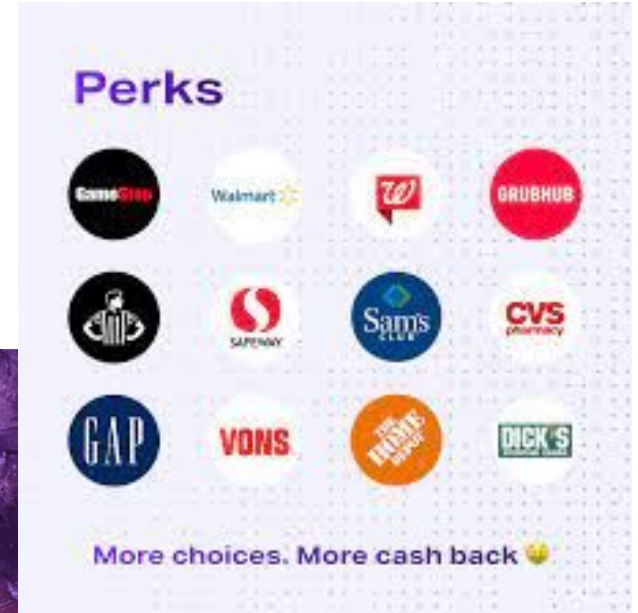
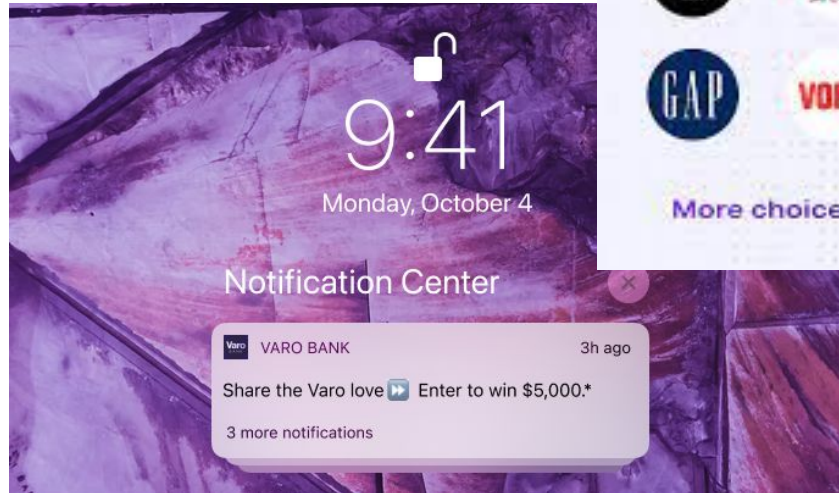
# Case Study 2 - Credit Risk Modeling

***Goal: Using financial data to predict credit risk***



# Case Study 3 - In App & Notification Recommendations

***Goal: Recommend right content at the right time to the right user***



# Case Study 4 - Predict User Financial Journey

***Goal: Predict where users are in their journey toward a financial goal and help users move towards their goal***

## How to take care of your financial health:



Create a monthly budget



Build an emergency fund



Automate what you can



Plan for retirement

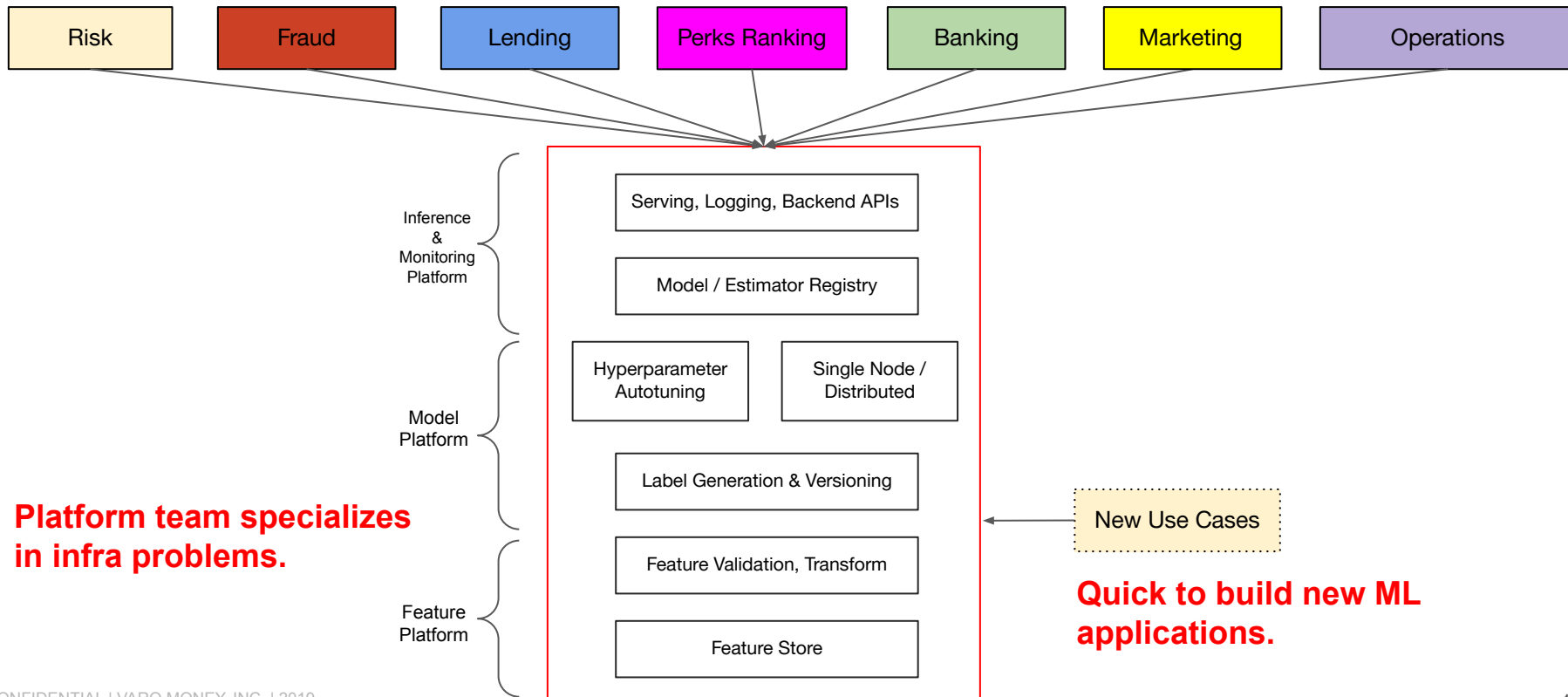


Treat yourself



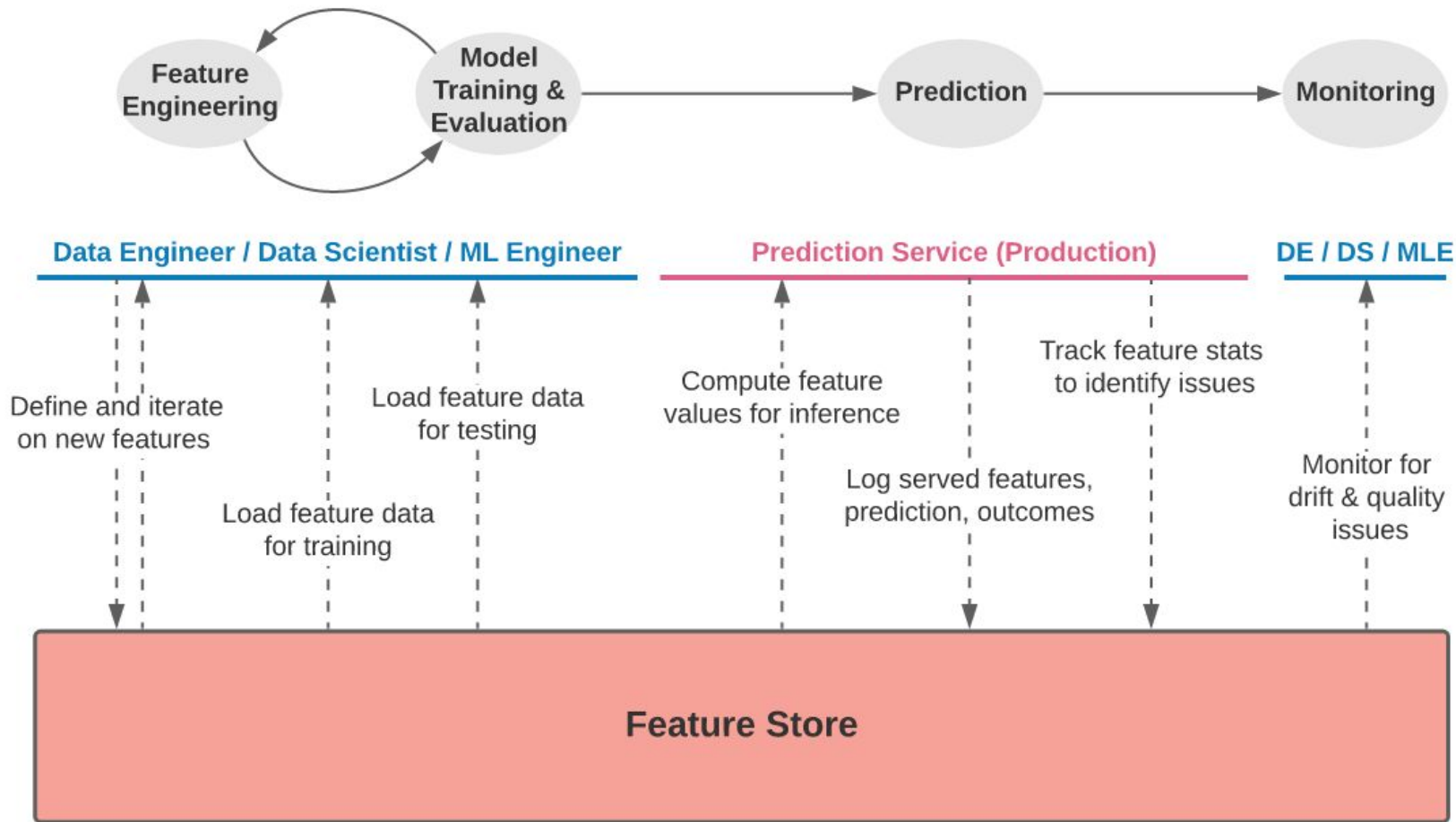
# Feature Store is the **COMMON** Denominator!

**Algo Engineering & DS teams focus on business problems, not infra problems.**



**Quick to build new ML applications.**

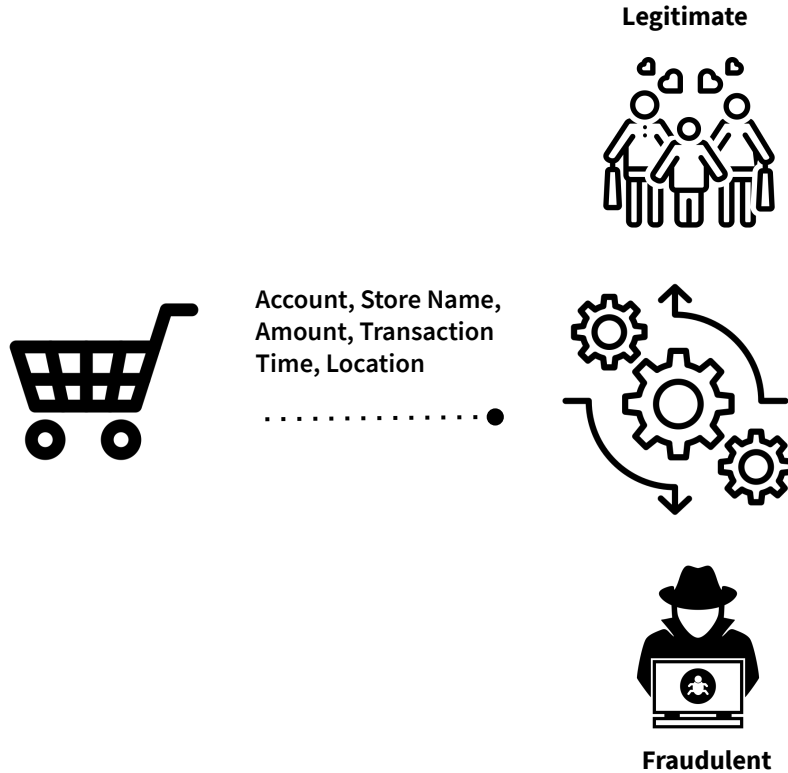
# Feature Store is KEY for ML Lifecycle!



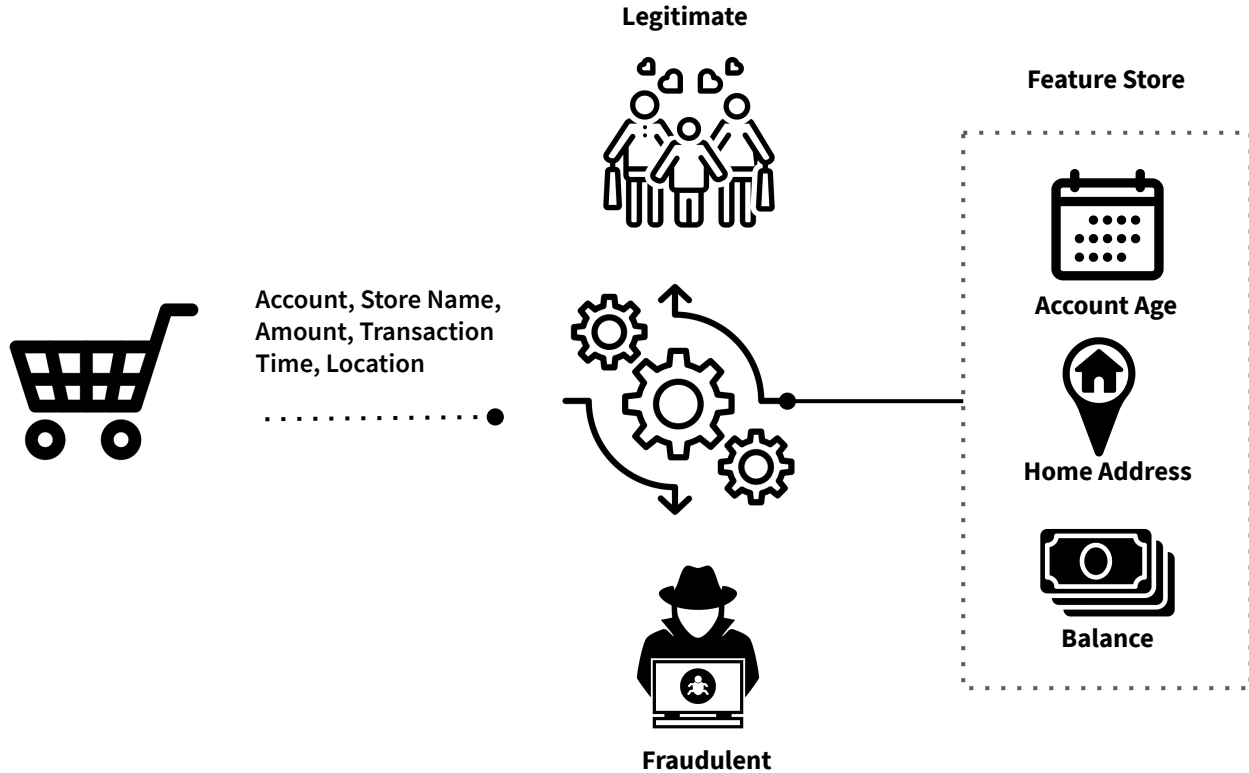
# Why Feature Store



# Model For Detecting Fraudulent Transactions

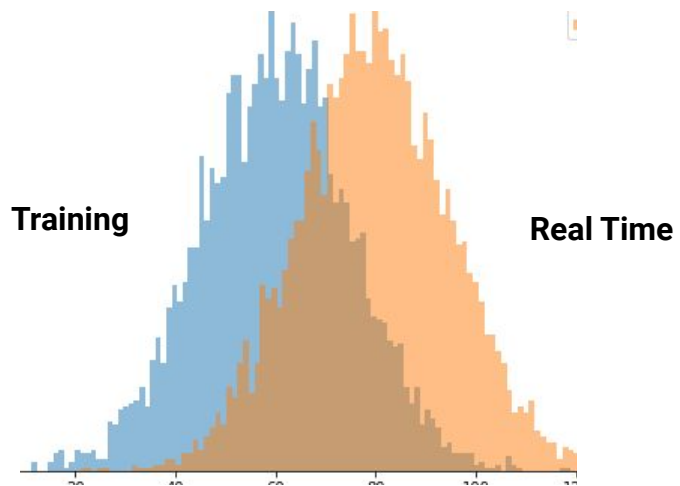


# Model For Detecting Fraudulent Transactions



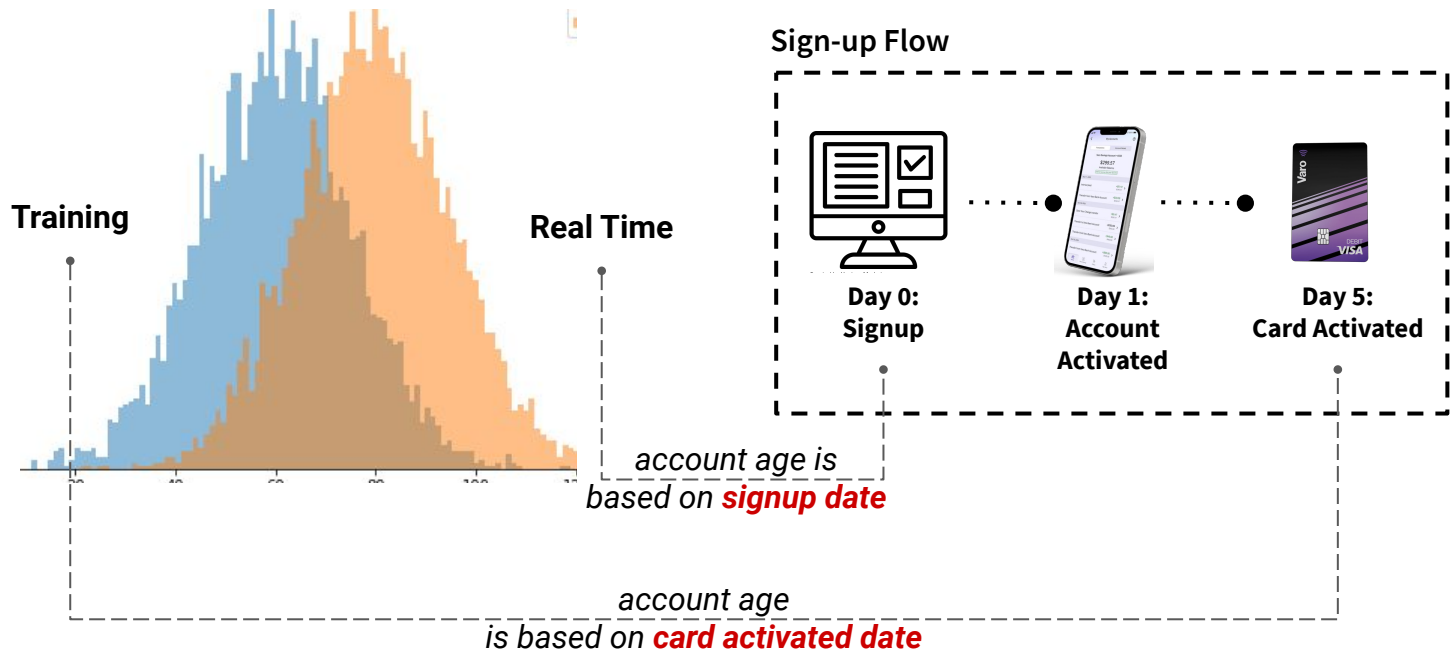
# Training / Inference Skew

Account Age



# Training / Inference Skew

## Account Age



**Feature Store is needed for  
additional data and  
to avoid training/inference skew**

# **Content of Feature Store**

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# Information Levels

## Fact

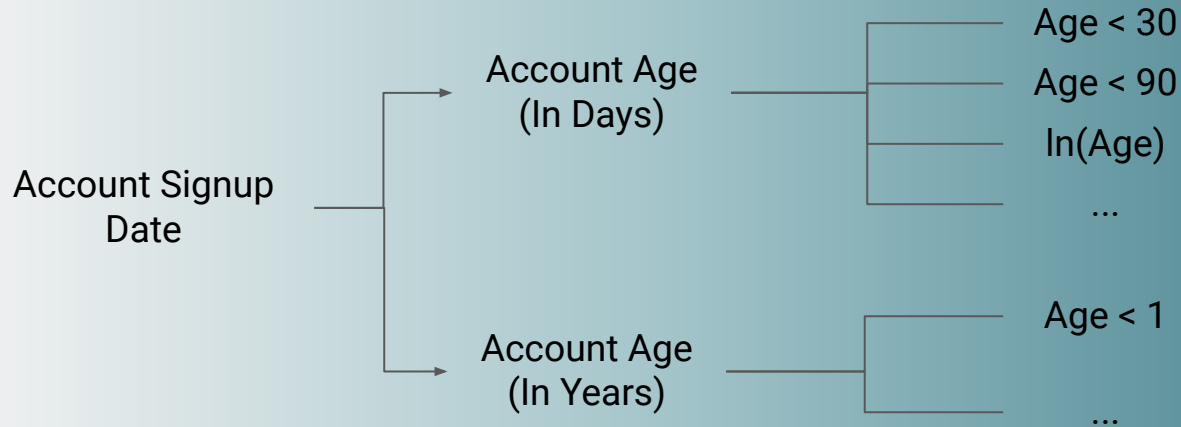
Recorded observations

## Data Transformation

Meaningful transformation that are highly shareable across business units

## Vector Transformation

Numerical vector representation for machine learning purpose



# Difference between fact and feature store

## Fact Store

- Increases re-usability
  - Better Encapsulation of Model
  - Easy to monitor
  - Fewer updates
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- Increases computation
  - Increases model complexity

## Feature Store

- Stores facts, transformations/transformed values
  - Reduces computation time
  - Reduces Model Complexity
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- Difficult to monitor
  - Breaks encapsulation (Transformations are specific to models)
  - Reduces reusability of features
  - More frequent updates

# Feature Store @ Varo



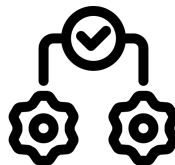
## Maximize Reusability

Encourage facts over vector transformations.



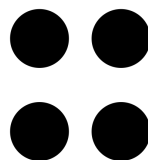
## Discoverability

Manage metadata and make features easily discoverable



## Consistency Over Accuracy

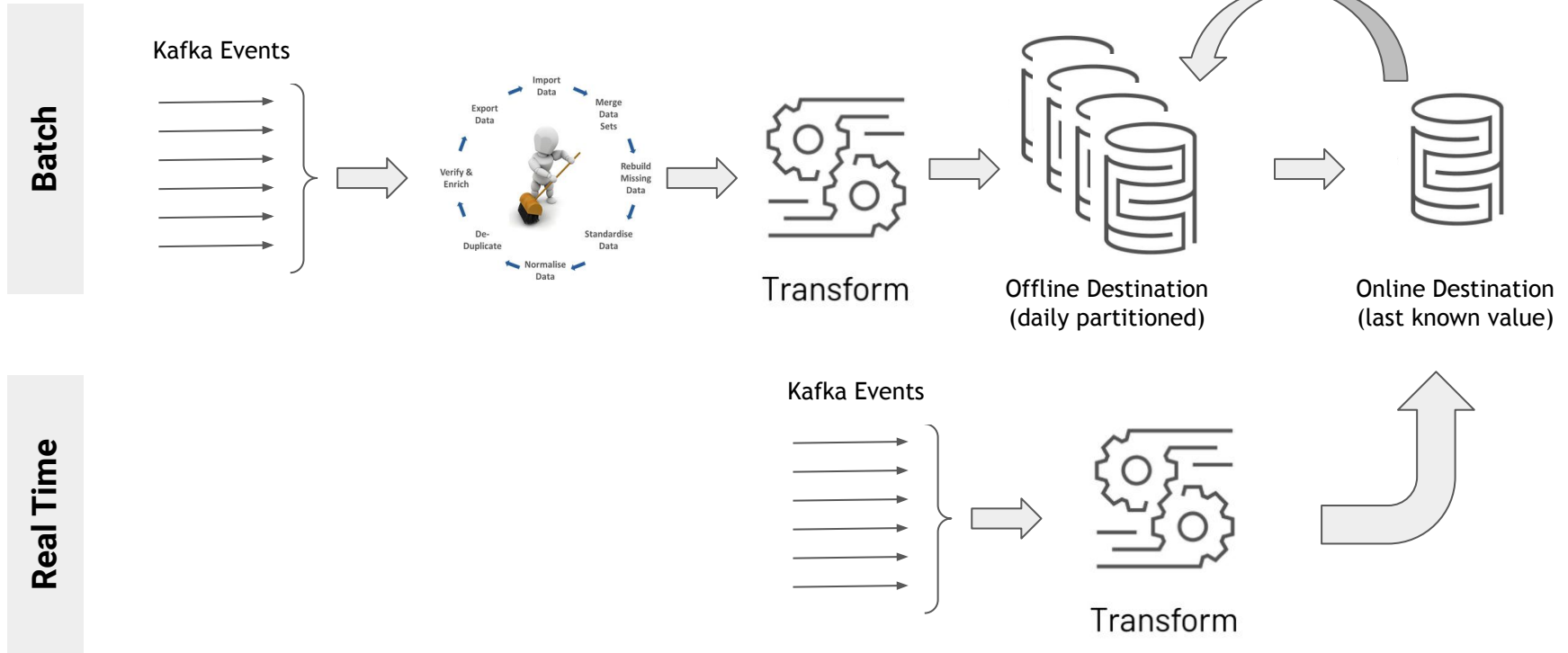
Reducing training/inference skew is more than accuracy of features.



## Independent Features

Keep data transformations independent to avoid backfill challenges

# Feature Store @ Varo



# Moving Forward

# Appendix



# Varo

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## Appendix