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Recommendation Monkey

Data and Decisions

Sponser: Bill.com

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Jonas Zhang
Statistics

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Backend

Challenge

Architect and develop a scalable data science lab to analyze, predict, and recommend the most promising U.S. small and medium size industries and businesses to pursue

Data Set Characteristics

- 10.4m real transactions representing $36B in business transactions
- 5 years of financial transactions (2015 to 2019)
- 100K+ entities and 100's of Dun and Bradstreet industries

What We Did and How We Did It

Fall 2021 - “Build the Model T” and drive it around the block

- Design the architecture/code from scratch
- Test lab against 4M record data set

Winter 2022 - “Build the Ferrari” and race it

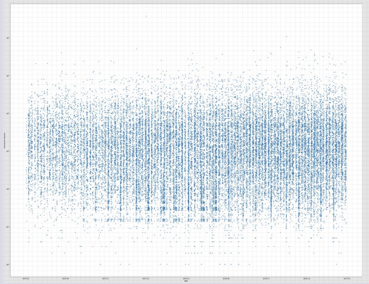
- Refactor lab for scalability
- Created a Platform
- Test lab against 10M record data set

“Bill.com is going to immediately use this scalable data science lab platform and continue to extend and scale this lab into the AWS EC2 Cloud”
-stu ogawa

System Architecture

Google colab

Big Data

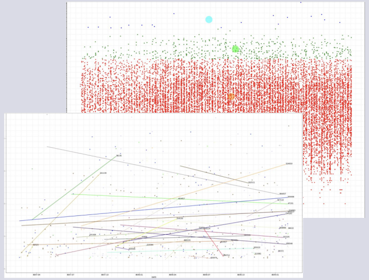


SqLite

DB Browser

Port Forwarding

Analyze/Interact



Python

PyTorch

Matplotlib

jupyter

Recommend

Invest in these Industries

1. Company1
2. Company2
3. Company3

Invest in these companies:

4. Company1
5. Company2
6. Company3

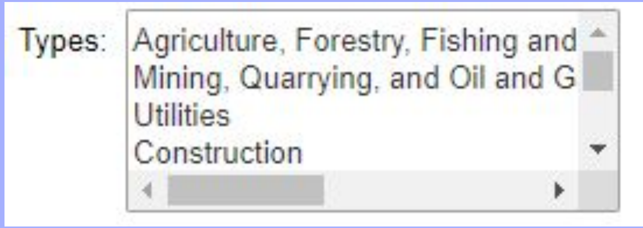
jupyter

Refactored Jupyter User Experience

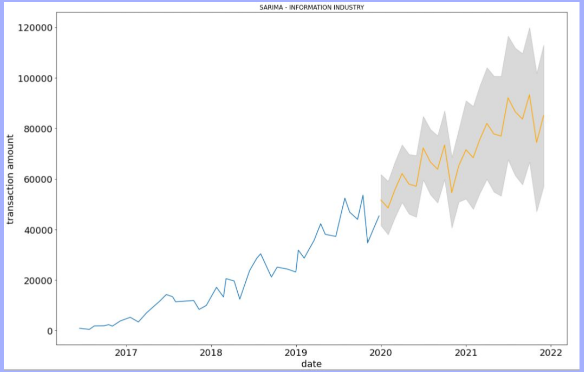
- Easier user experience navigation
- Quicker results and recommendations
- Faster computations
- Improves efficiency of statistical algorithms
- Visualization of results more user-friendly

Business Archetype Selection

Selection of Industries in Archetype

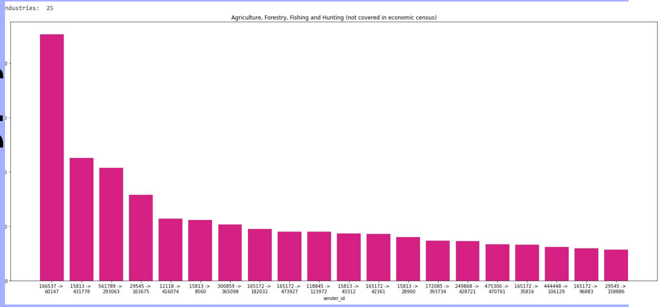


Transaction amount



Date

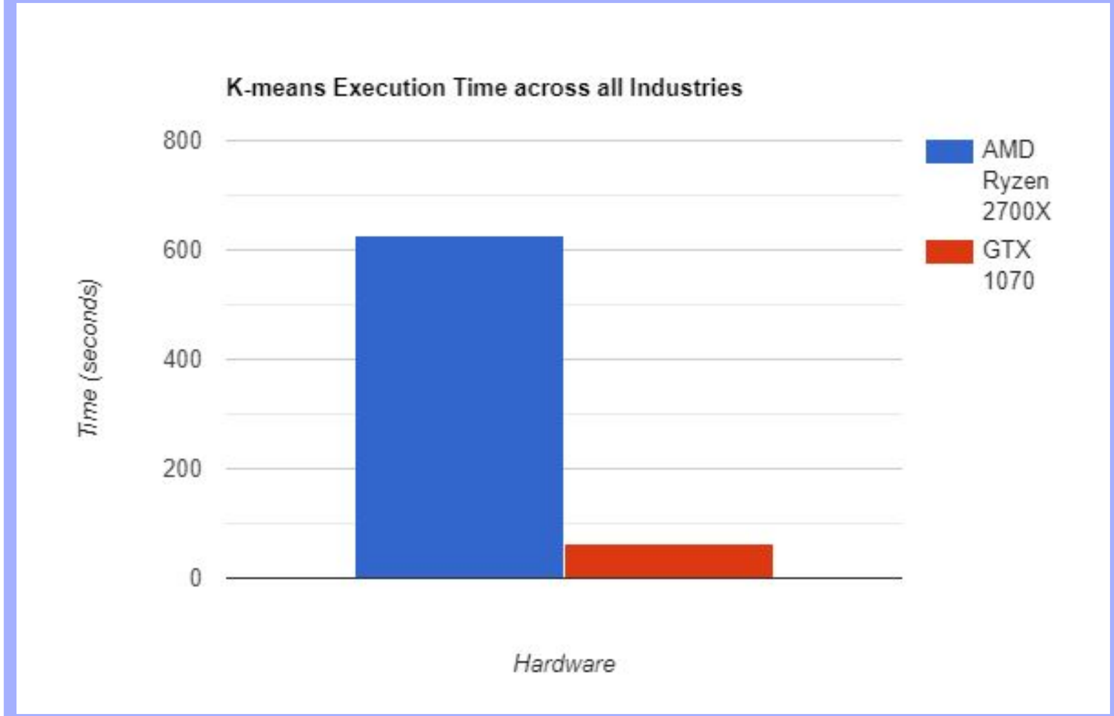
# of recurring payments



Customer & Vendor pairs

[redacted]

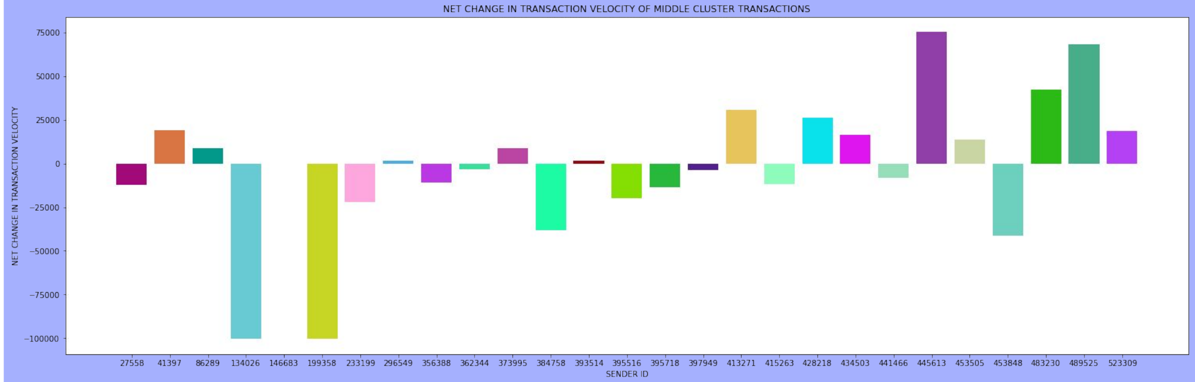
3.5 CPU vs GPU "head to head" compute experiment



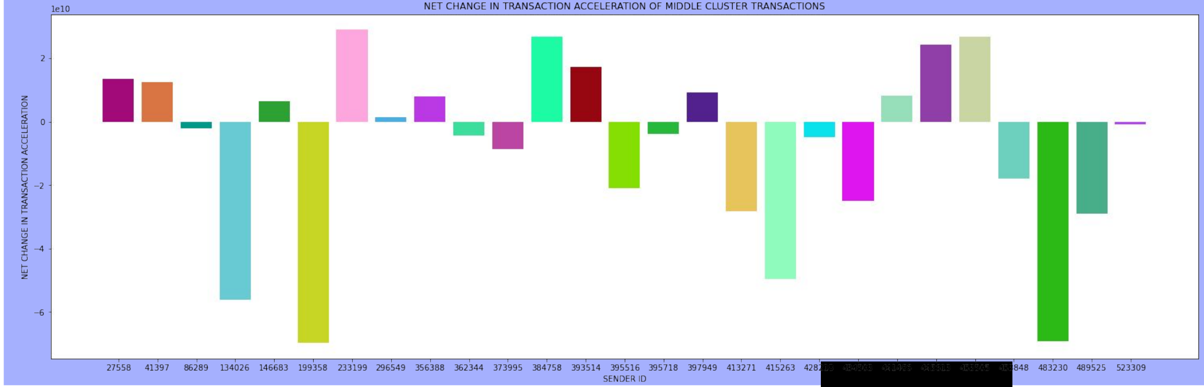
CPU: 10M records processed in 10 minutes
GPU: 10M records processed in 1 minute

- Dell laptop (2015),
  - AMD 4 core CPU
    - 16GB of RAM
  - GTX 6 core GPU
    - 4GB of RAM
  - 500GB SSD
- PyTorch ver. 1.10.1
- GPU has 10x reduction in compute time = superior hardware for scalability
- K-means computation for one industry takes ~300ms via optimization

3.3 & 3.4: Derivative Analysis on Middle Cluster of K-means



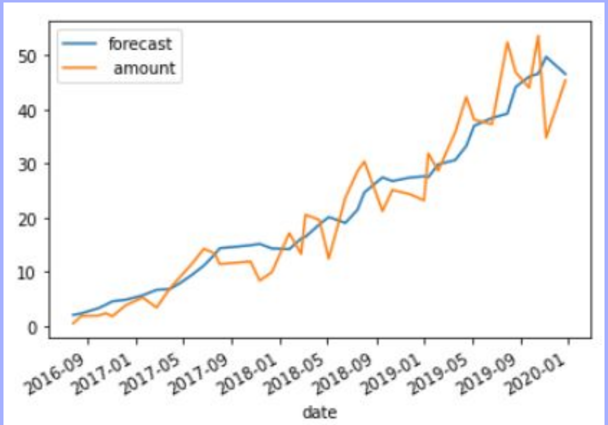
X-axis = Vendor ID
Y-axis = Net change in Trans Velocity/Acceleration



- 1st graph = change in trans amt over time
- 2nd graph = change in trans velocity over time
- We can see which vendors are increasing at an increasing rate = potential for exponential growth

Results 3 - Predict which vendors/customers increasing at an increasing rate

- Time Series moving average for long term trends
    - Four-year data forecast two-year transactions



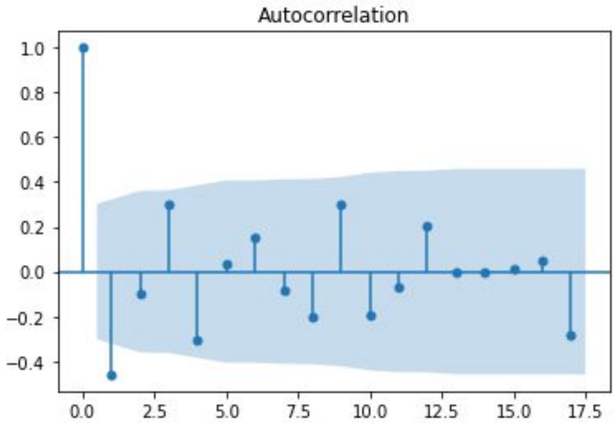
Business recommendation: use these top 20 business vendors as a “seed” / training data to perform subsequent machine learning and deep learning predictions

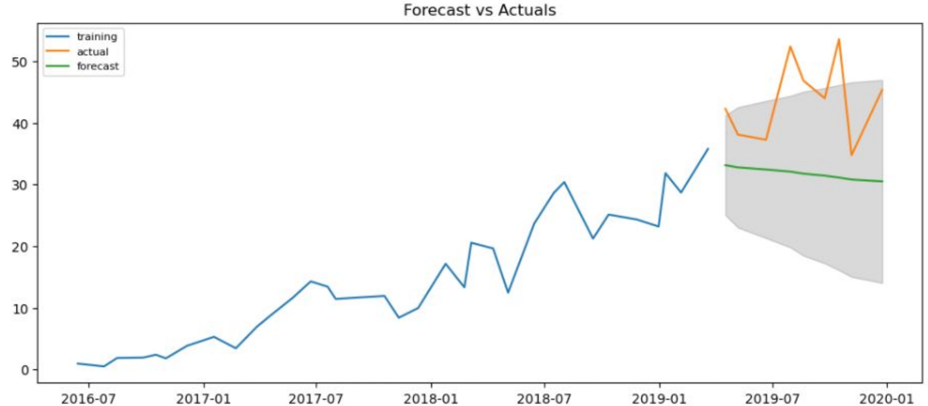
SARIMA: “moving-average” machine learning model for predicting transaction amounts of an industry

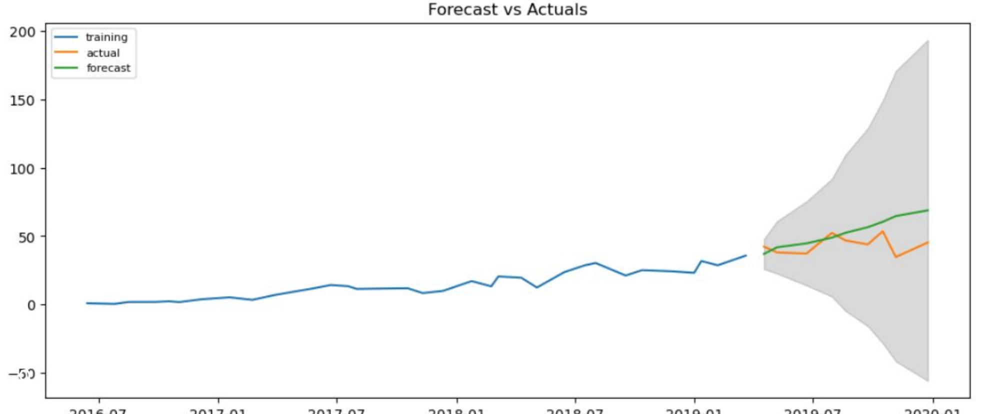
1st Step:

Train model w/ 3 years of data

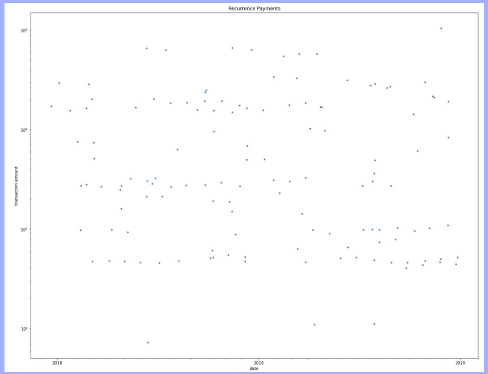
- Blue -> training data
- Green -> model’s prediction
- Orange -> actual values
- Grey -> upper/lower bounds





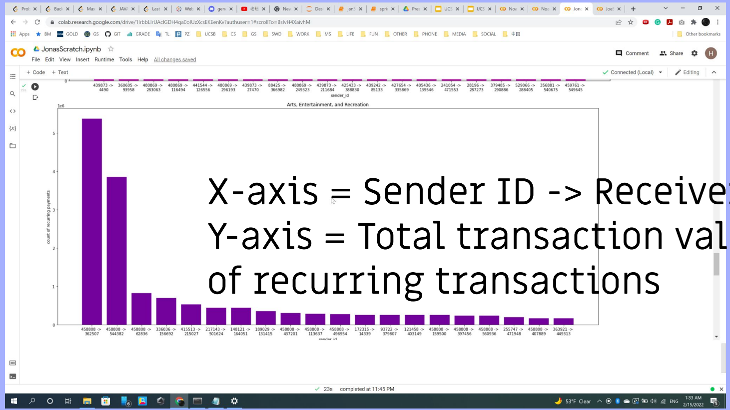


4. Prioritize and Recommend Vendor/Customers pairs with top subscription revenue



- top ten vendors with subscription based revenue
    - used LAG FUNCTION
    - Between 25-35 days, +or- 10% difference in transaction amount

Business recommendation: use the top 20 business vendors as training data to perform subsequent machine learning

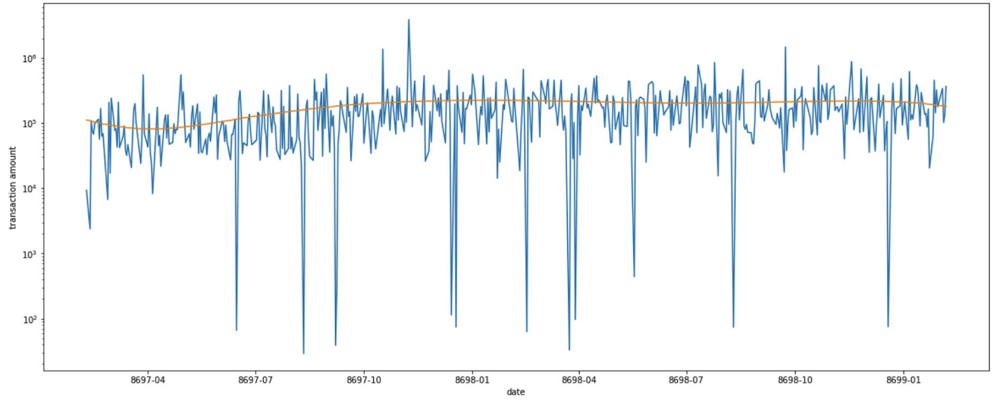


X-axis = Sender ID -> Receiver ID
Y-axis = Total transaction value of recurring transactions

2. Regression Analysis for Best Fitting Function & Future Prediction

Use Polyfit to find best fitting function with designated order/derivative

Predict future performance of a certain industry




```
coeffecient  6 :  -2.0083972261631434e-10
coeffecient  5 :  2.646004444467993e-08
coeffecient  4 :  0.00020813212973O4757
coeffecient  3 :  -0.1407057561135148
coeffecient  2 :  31.50910770644345
coeffecient  1 :  -1794.5638472317896
coeffecient  0 :  111319.54096467195
prediction:  175445.37076313526
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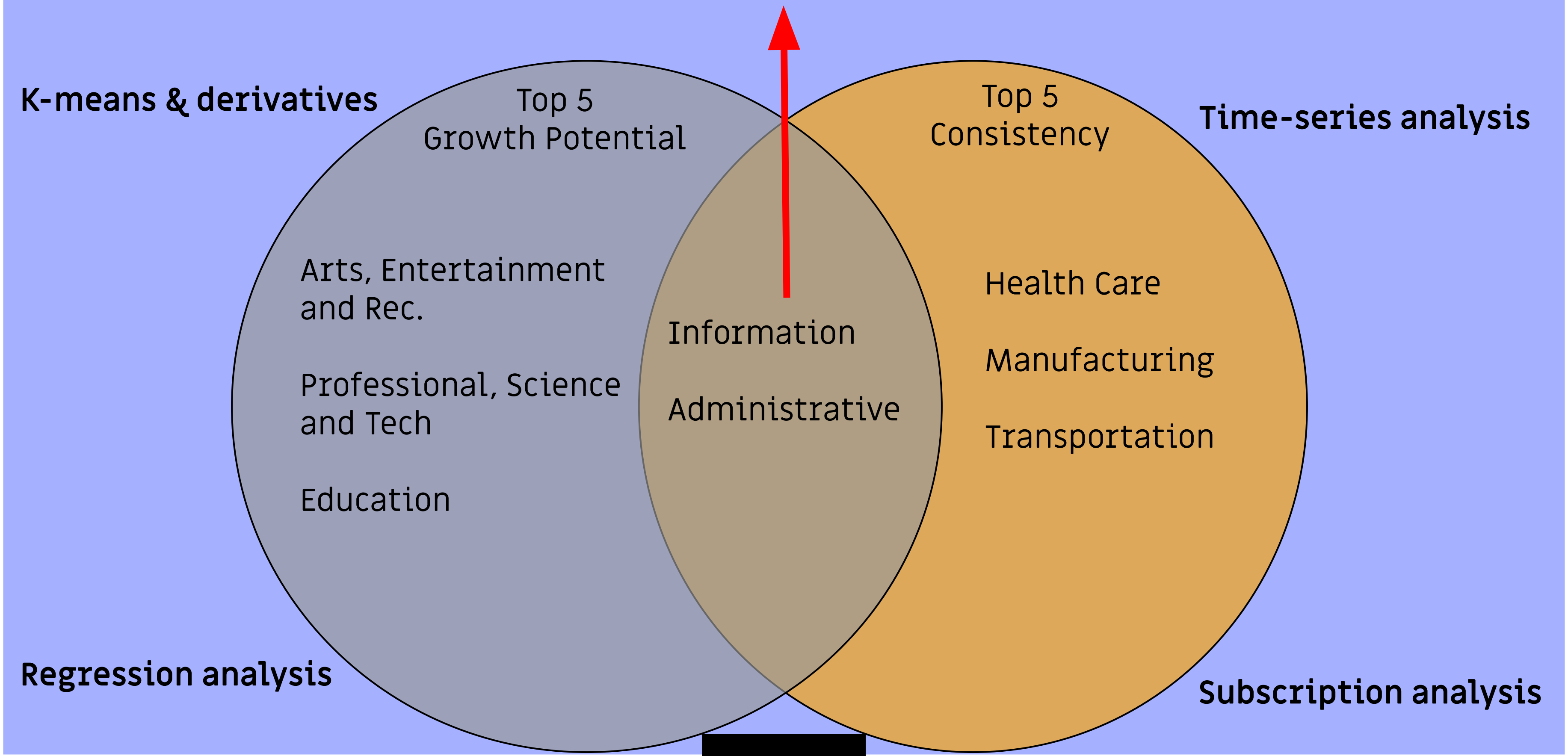
Final Recommendations



Special thanks:

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UC SANTA BARBARA
engineering

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