General Motors FinTech Application

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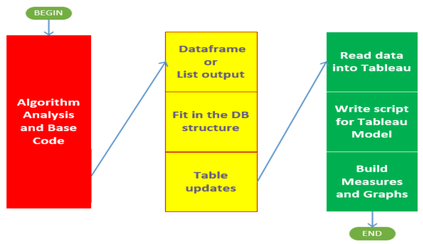
Application Need and Technical Objectives

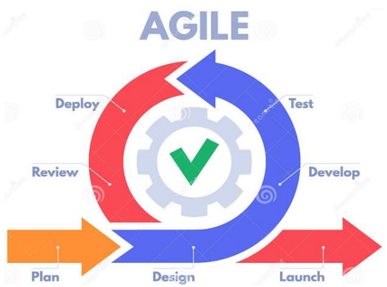
- **Stock Price Forecasting, Trading and Buy/Sell Signals**
  - Improve forecasting accuracy of existing algorithm, >50%
  - Implement new algorithms
  - User friendly Tableau interface for financial data analysts
  - Highly normalized and scalable database architecture
  - Improve forecasting accuracy of existing algorithm, >50%
  - Generate Buy, Sell or Hold Signals using different strategies
  - Ten minute To Close(TTC) custom trading strategy
- **Technical Objective**
  - 3NF, structured database design in MySQL
  - All calculations in Python using PyCharm IDE
  - Front-End User Interface in Tableau

Technical Approach and Methodology

- **Technical Build Approach**



- **Project Development Methodology**



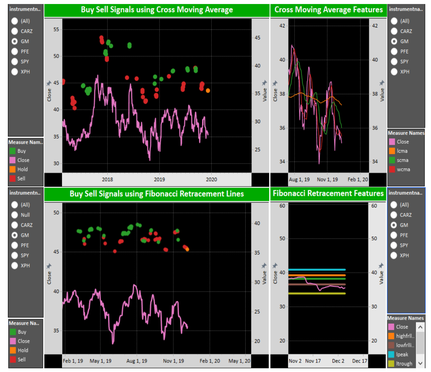
Related Work and State of Practice

- Project was a result of several previous semesters' work
- No real database existed, standalone tables
- Python code was not optimized
- Needed re-design to facilitate scalability, ease of use, and increased accuracy

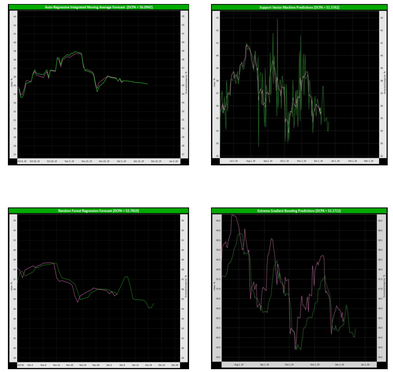
Progress and Results

Trading Simulation

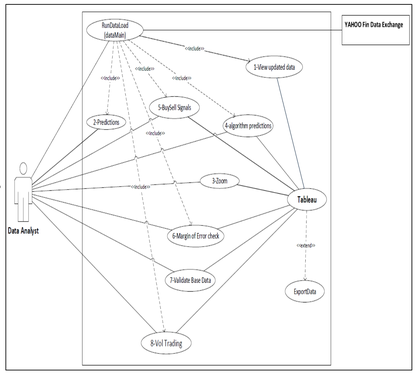
Buy-Sell-Hold Signals



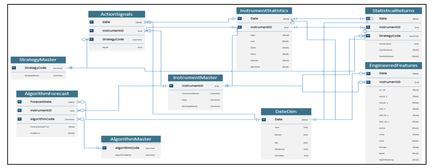
Algorithm based Forecasting



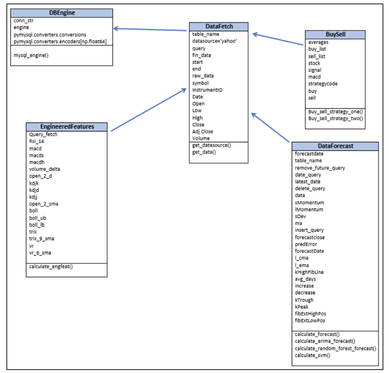
Use Case Diagram



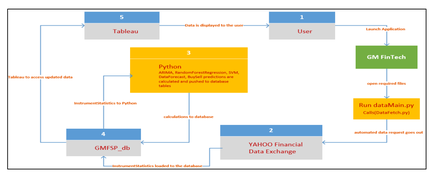
Database Architecture 3NF



Python Classes



Data Flow Diagram



Custom Trading Simulation Algorithm

Our custom trading simulation strategy uses ARIMA + Previous group's improved prediction + FRL + CMA + EMA + MACD predictions for next day

Signal Values

- If the price is predicted to go up each of the above algorithms or strategies will generate a value of 1
- if the price is predicted to go down each of the above algorithms or strategies will generate a value of -1
- If the price is predicated to stay the same, each of the above algorithms or strategies will generate a value of 0

ActionSignals' table strategycode = algo (BuySell Custom) Definition

Date	Instrument	ARIMA	PrevGroupCorr	AlgoSignal
11/11/2019	GM	Up	Up	1
11/12/2019	GM	Down	Up	0
11/13/2019	GM	Down	Down	-1

Hold = 0
Sell = -1
Buy = 1
Up = next day's prediction is higher than today's close
Down = next day's prediction is lower than today's close

StatisticalReturn' Strategy Code 'COMB' Definition (Simulator)

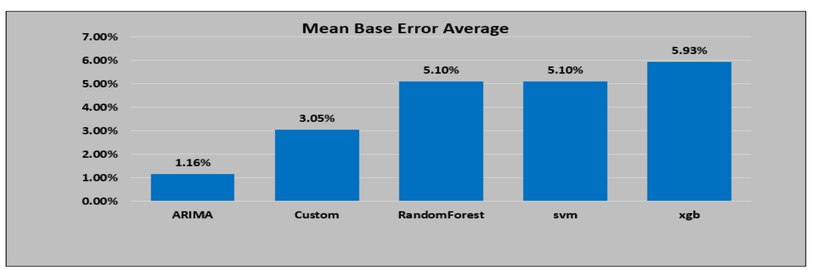
Date	Instrument	FRL	CMA	EMA	MACD	AlgoSignal	FinalSignal
11/11/2019	GM	1	-1	1	-1	1	1
11/12/2019	GM	1	1	-1	1	0	2
11/13/2019	GM	0	1	-1	0	-1	-1

Hold = 0
Sell < 0
Buy > 1

Daily Tracking of Forecasted Prices by Algorithm Compared to Actual Closing Prices

Start Date 11/19/19
End Date 12/3/19

	11/19/19	11/20/19	11/21/19	11/22/19	11/25/19	11/26/19	11/27/19	11/29/19	12/2/19	12/3/19	Overall
ARIMA	1.66%	1.87%	1.86%	1.08%	0.91%	0.89%	1.16%	0.84%	0.56%	0.75%	1.16%
Custom	4.66%	3.05%	3.63%	3.60%	3.68%	3.26%	3.35%	2.59%	1.85%	0.83%	3.05%
RandomForest	4.88%	4.94%	4.95%	5.01%	5.07%	5.08%	5.01%	4.97%	5.27%	5.84%	5.10%
svm	4.97%	5.01%	4.99%	5.02%	5.10%	5.13%	4.97%	4.95%	5.21%	5.65%	5.10%
xgb	5.48%	5.57%	5.56%	5.66%	5.93%	5.98%	5.96%	5.96%	6.36%	6.86%	5.93%
Overall	**4.33%**	**4.09%**	**4.20%**	**4.08%**	**4.14%**	**4.07%**	**4.09%**	**3.86%**	**3.85%**	**3.99%**	**4.07%**

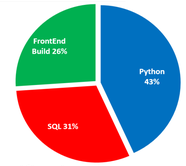


Commercialization Vision & Next Steps

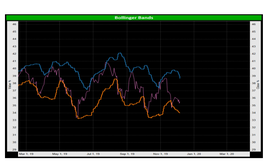
- **Next Steps**
  - Fine-tune the forecasting algorithms
  - Increase accuracy of the Trading Strategies
  - Continue to track various forecasts to improve Signal Generation
- **Commercialization**
  - Developed for a single department at General Motors, expand it
  - Release outside of GM is up to the client
  - Potential in the custom trading strategy, 68% accuracy(w/o hold)

Accomplishments, Insights and Impacts

- **Accomplishments**
  - Designed a 3NF database
  - Restructured Python classes
  - Redesigned Tableau User Interface
  - Easy to follow User Manual
  - Detailed Design and Requirement Specification documents
  - Migrated SQL Server database to MySQL
  - Debugged the previous group's forecasting formula
  - Calculations on 3 years data performed under 1.5 minutes
  - Custom trading strategy using ARIMA+CMA+FRL+EMA+MACD
  - Ten minute To Close buy, sell, or hold signals generated



- **Insights**
  - Always use close price for forecasting
  - ARIMA is the best performing algorithm, 56% DCPA
  - Trading strategy should include ARIMA in the mix
  - Directional Close Price Accuracy is the most intuitive measure
  - Signals should be generated towards the end of the trading day



- **Impacts**
  - More accurate forecasting models
  - Easily scalable
  - Modular code base
  - New Algorithms and Trading Simulation with Portfolio tracking

Acknowledgements and References

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