Recurrent Neural Networks

Stock Price Prediction

presented by

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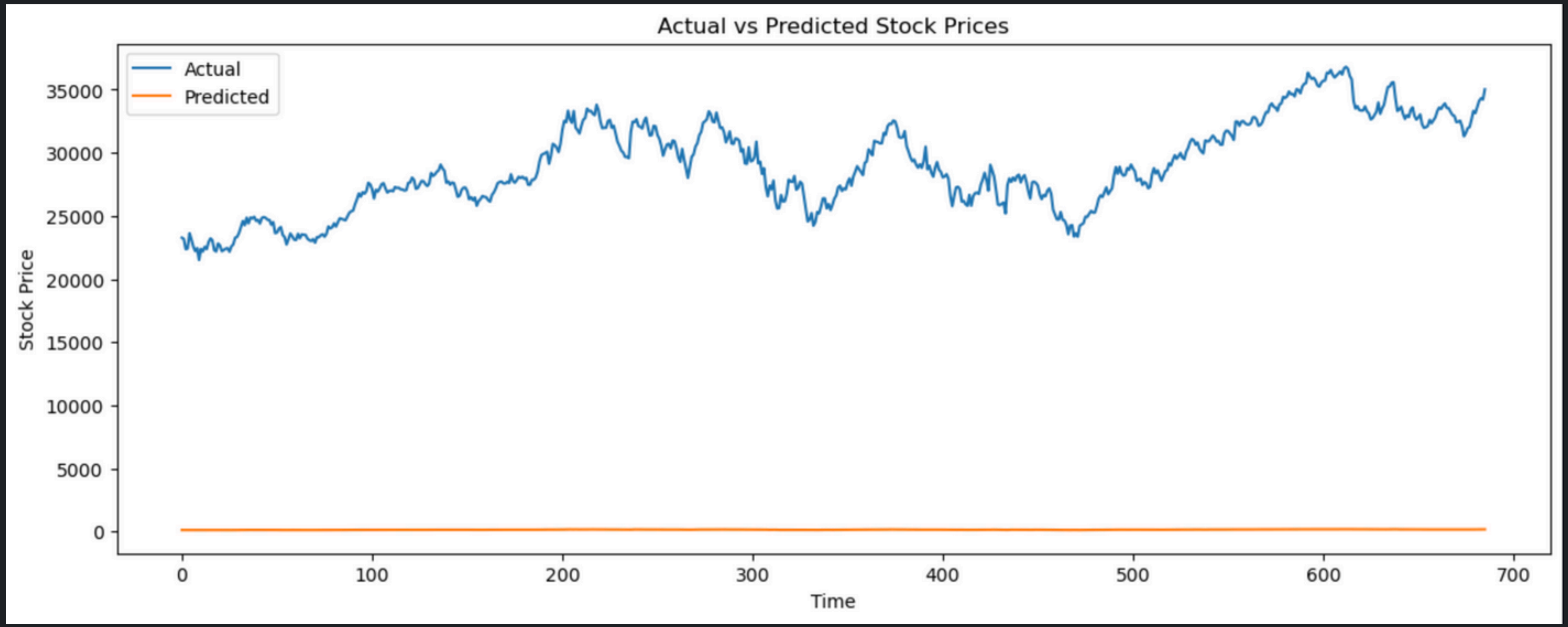
*P*roject *O*verview

- Goal: Compare LSTM and GRU for predicting AAPI stock prices
- Ivestigate how additional factors (Volume, OHLC) impact prediction performance
- Experiment with activation functions in GRU (ReLU, LeakyReLU, ELU)
- Evaluate models based on RMSE and behavior during training

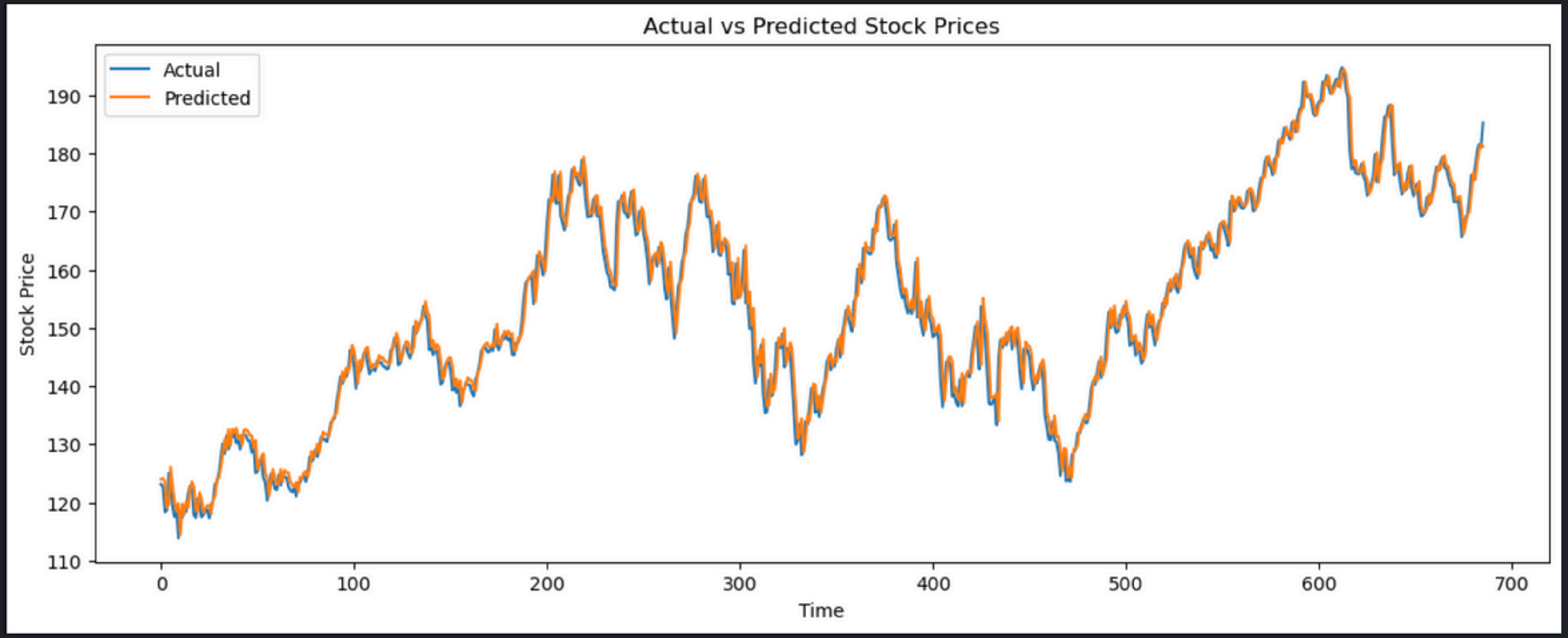
Model Observations

- LSTM struggled → produced flat and non-informative predictions
- Close-only dataset too limited → LSTM failed to converge meaningfully
- GRU handled limited data better → followed price trends, though accuracy was modest
- Reinforced need for more context (features) for models like LSTM

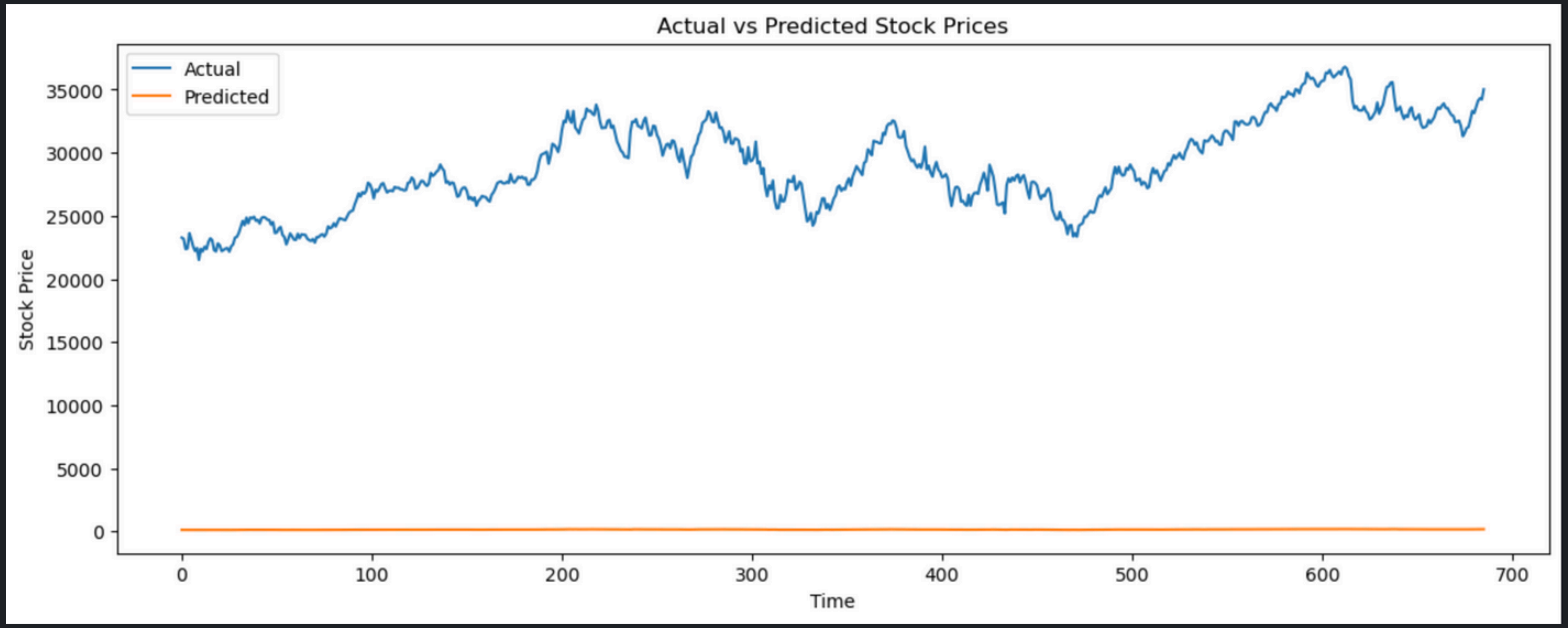


LMST (Close only)

Model Observations



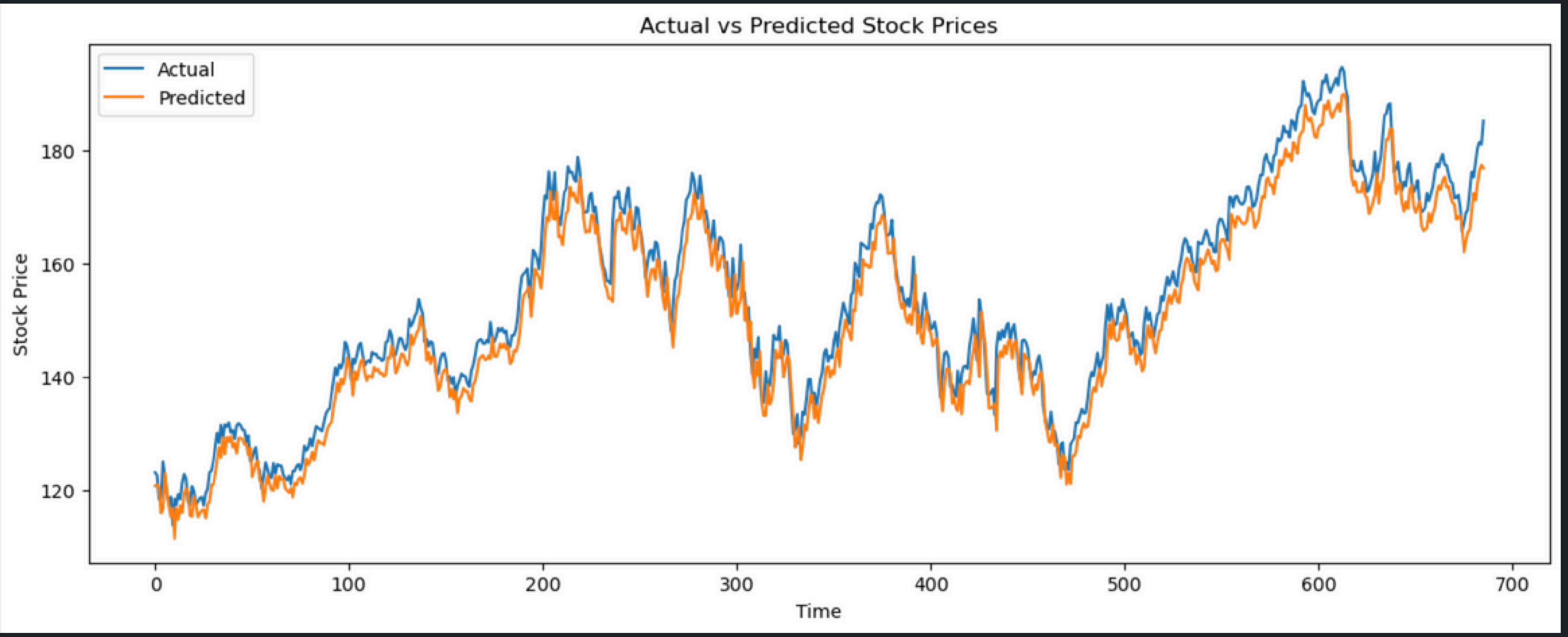
GRU (Close only)



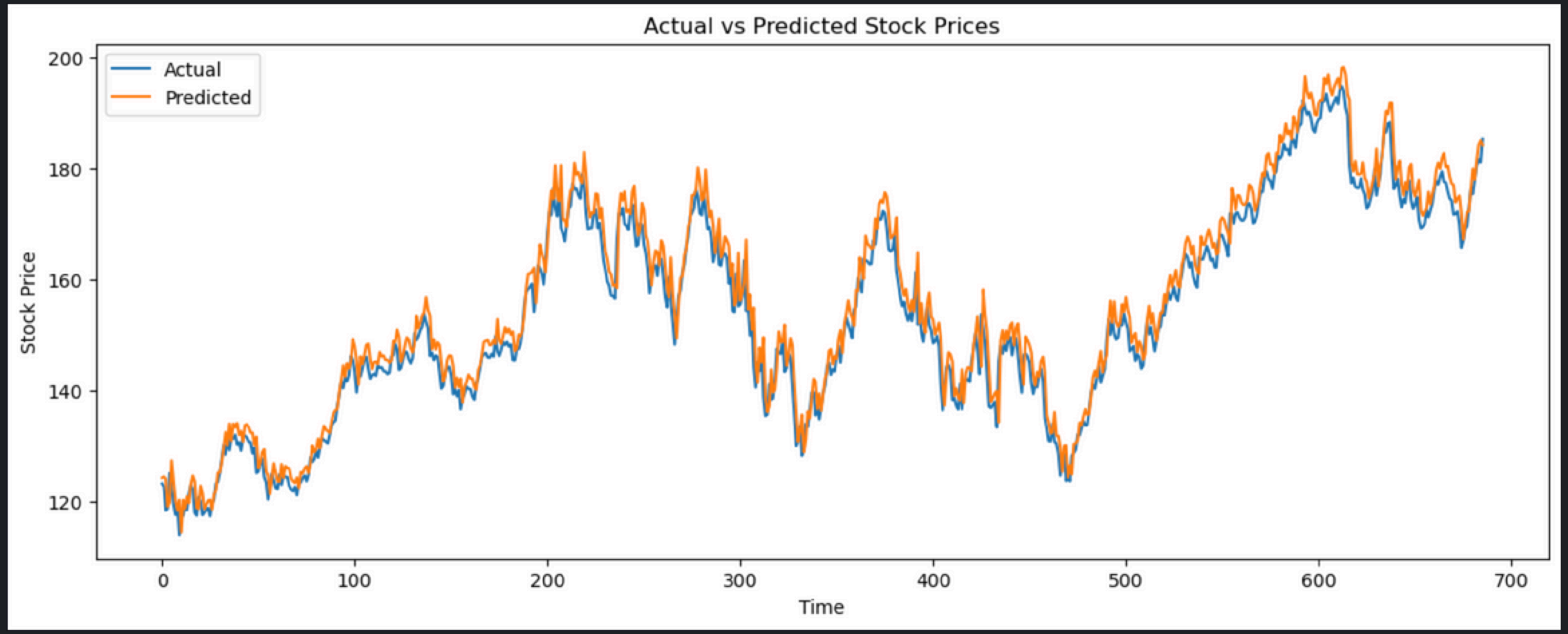
LMST (Close only)

Adding Volume

- Adding Volume improved prediction quality for both models
- GRU became much more responsive and closed the performance gap
- LSTM also performed very well, possibly matching or slightly outperforming GRU at this stage.



GRU (Close + Volume)



LSMT (Close + Volume)

OHLC + Volume → GRU Takes the Lead

Adding OHLC introduced richer feature set → GRU handled this complexity better

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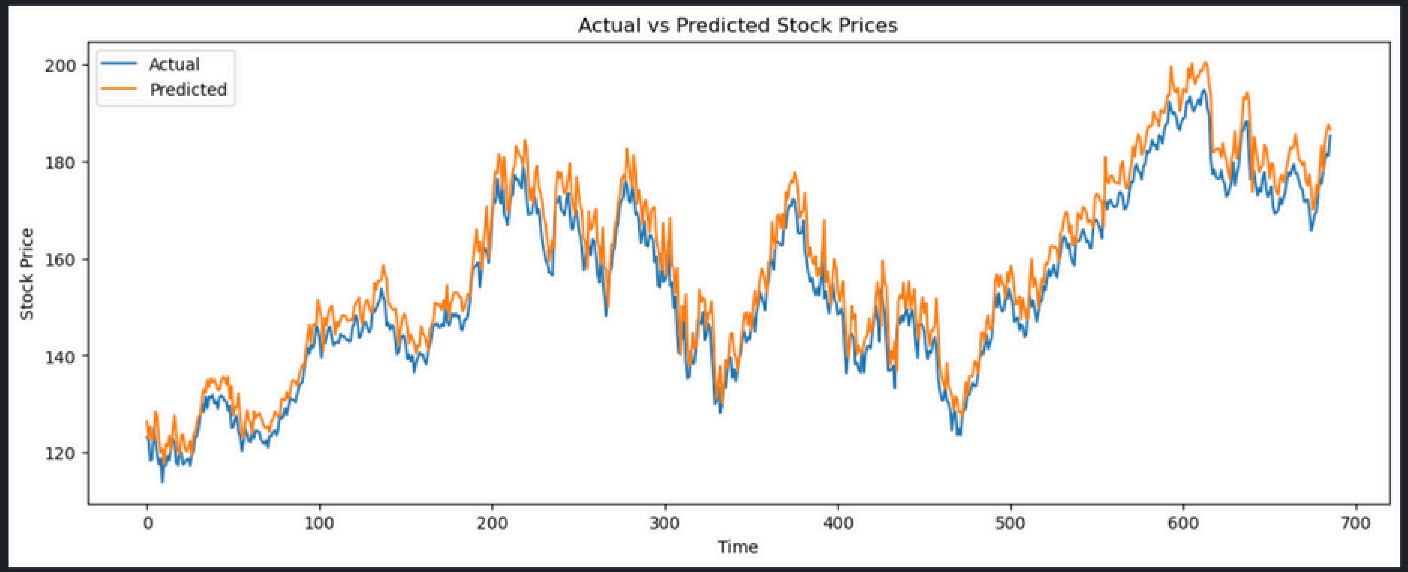
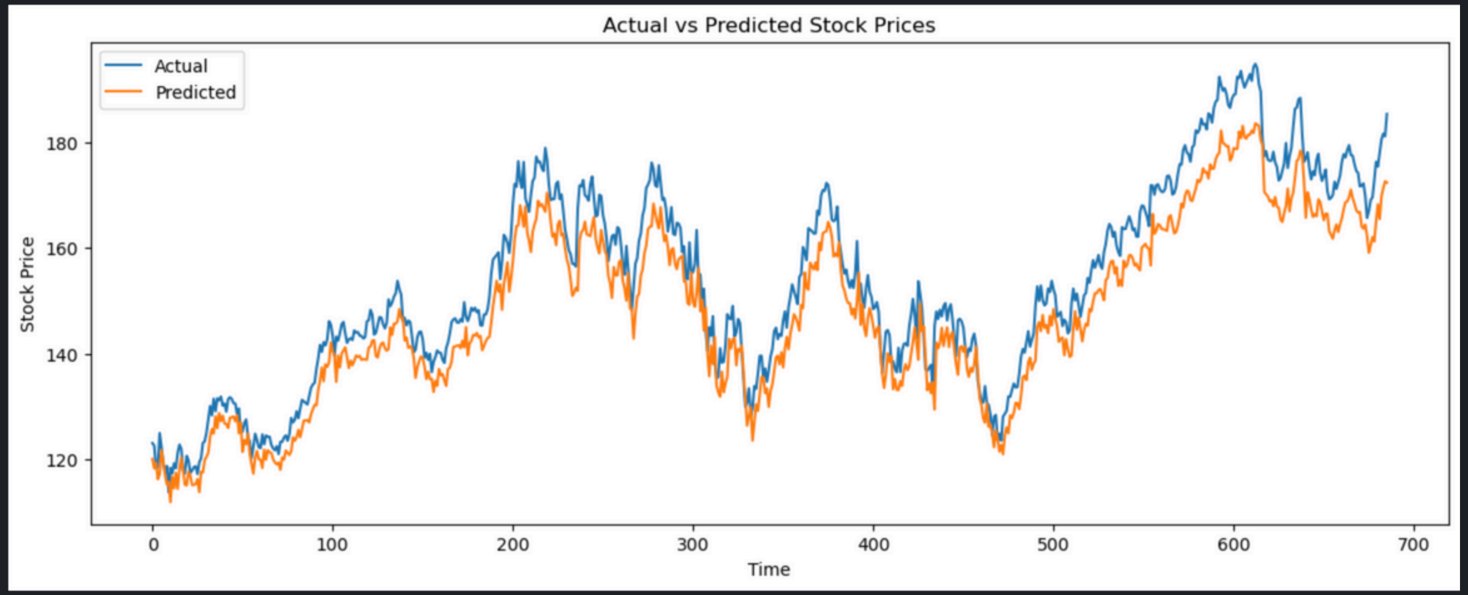
LSTM was still competitive, but GRU showed its scaling advantage



LSMT(Volume + OHLC)

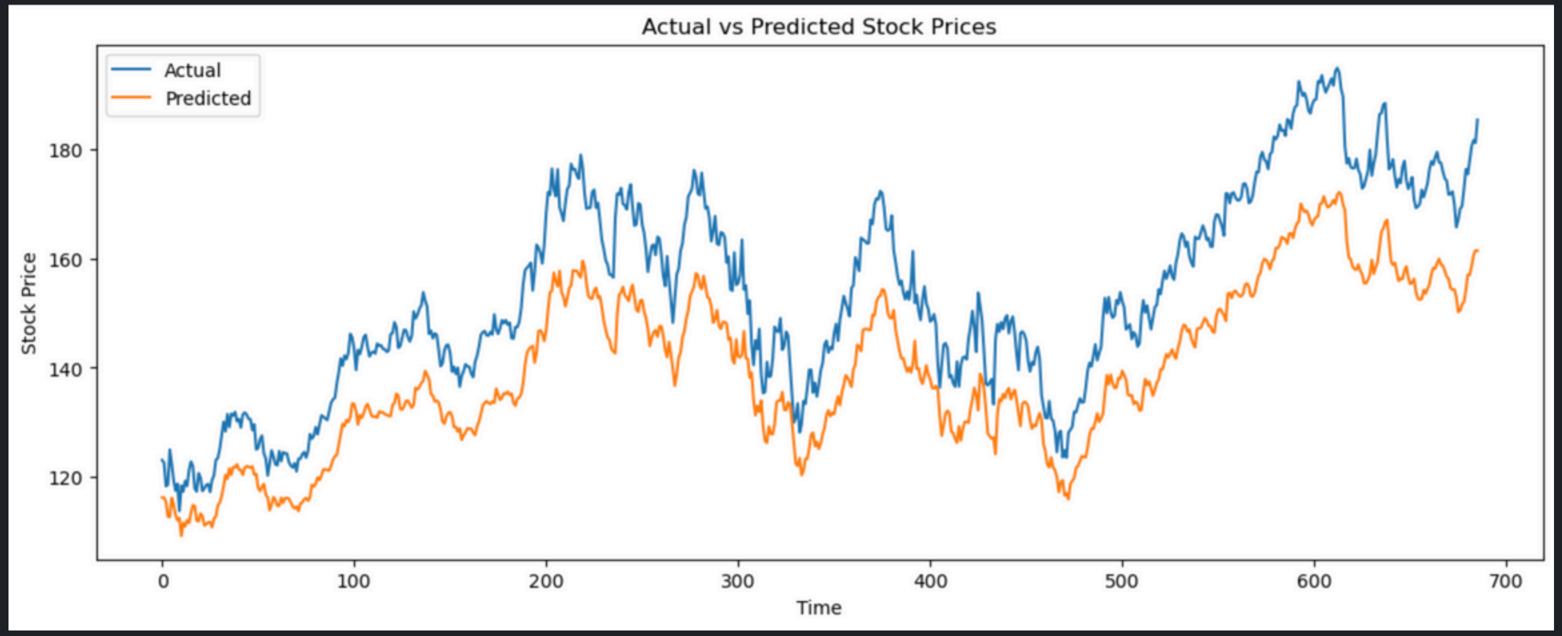


GRU(Volume + OHLC)

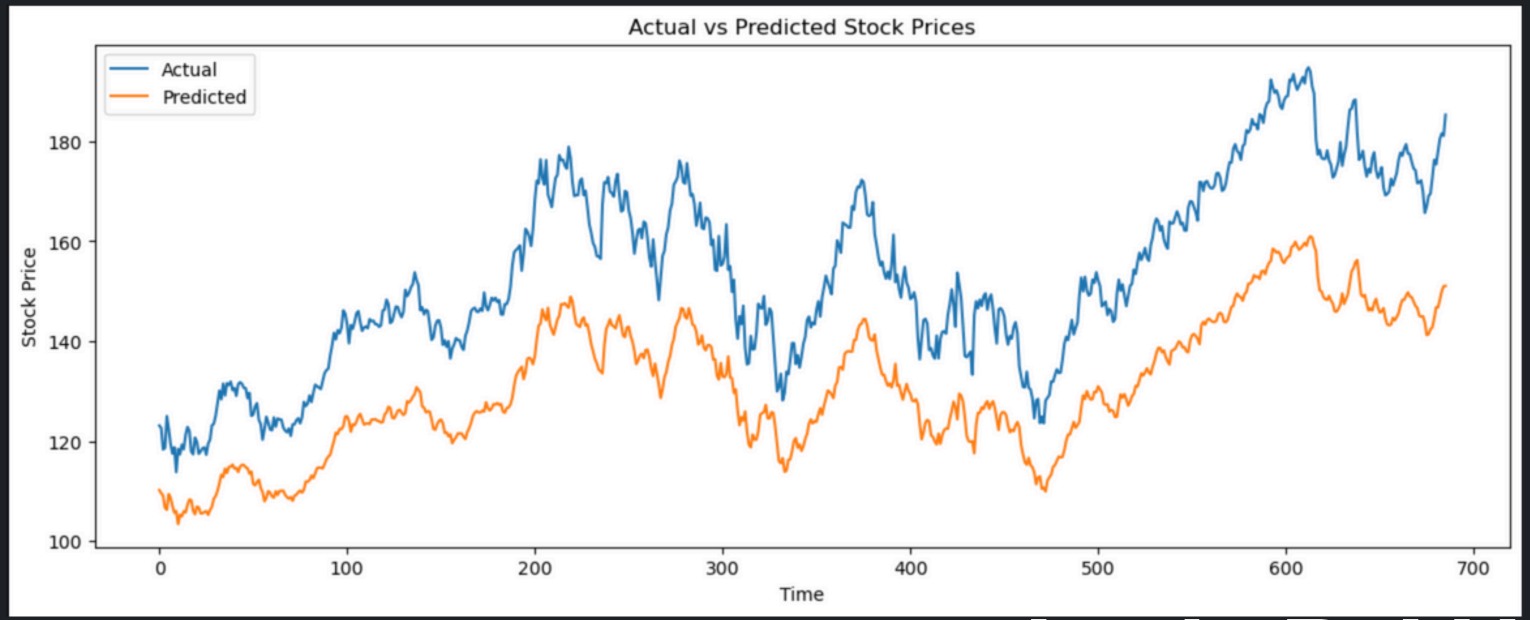
*GRU A*ctivation *F*unction *E*xperiments

- **ReLU**
  Tracked overall trend but consistently underpredicted stock prices.
- **LeakyReLU**
  Slightly improved tracking over ReLU but still fell short of actual prices.
- **ELU**
  Best performer, closely following actual prices with smaller gaps.
- **Conclusion →**
  ELU activation offered the most accurate and stable predictions overall.

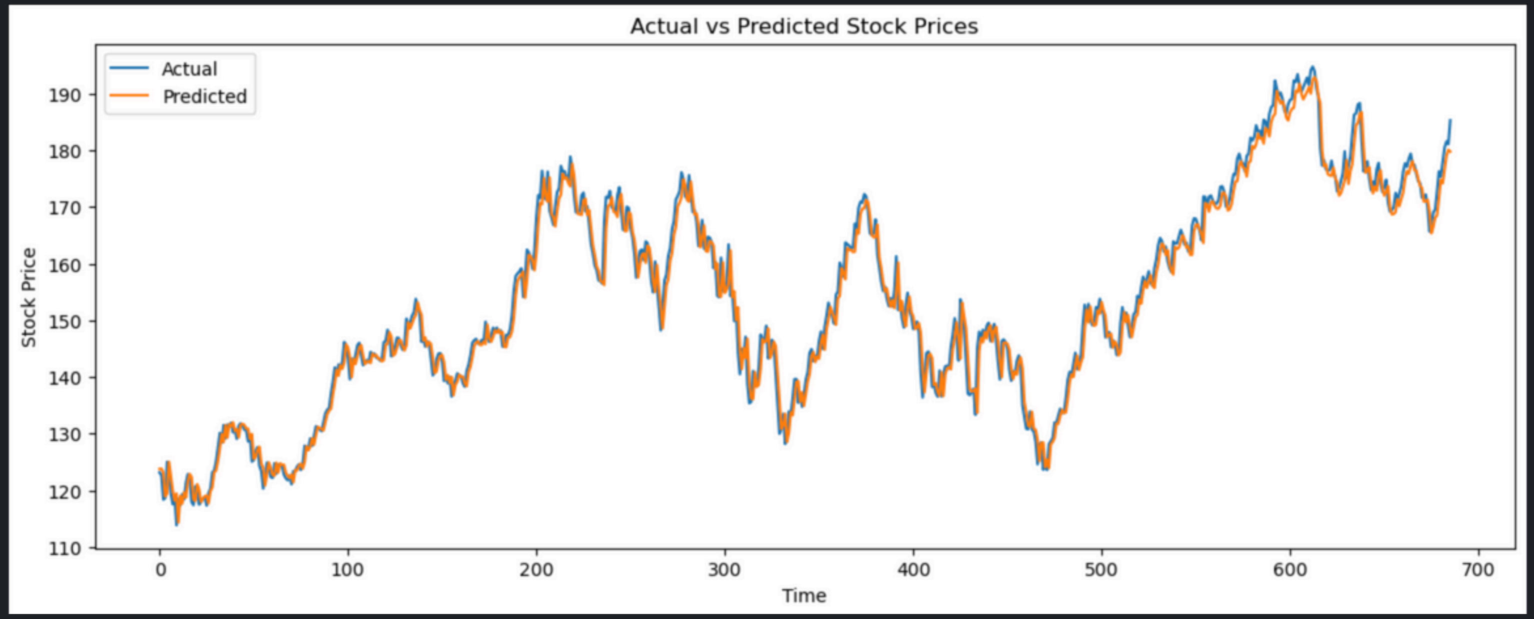
GRU Activation Function Experiments



ReLU



LeakyReLU



ELU

Challenges Encountered

- Input shape management became more difficult as features were added
- LSTM’s inability to handle Close-only highlighted risks of underfitting with limited data
- Activation experiments → small tweaks had large effects on training stability
- psutil + TensorBoard helped monitor efficiency during experiments

Key Insights and Takeaways

- **LSTM**
  better suited for more complex patterns, but requires sufficient input data
- **GRU**
  more flexible and adaptable, especially as input complexity increases
- **LeakyReLU**
  best activation function tested → stable, fast, and consistent

- **Feature selection was critical → more data helped, but only when used thoughtfully**

Future Directions

- Test models on other stocks for generalization
- Add external market indicators (ex: sentiment analysis, macroeconomic signals)
- Explore alternative architectures like Transformers for further improvements

*F*inal *R*eflection and *Q*uestions

- ***Subtle, but important differences emerged across experiments***
- ***LSTM and GRU both viable, but GRU proved more flexible overall***
- ***Future modeling success depends on carefully balancing architecture, features, and tuning***

Thank you!

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