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WUTIS Algorithmic Trading

CRNN for Volatility Predictions x Trading Times Analysis

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**Markus Gruber**

Fellow Analyst

- Model training
- Optimisation
- Backtesting

BSc. Math (TU),
MSc. Math (TU)**Denys Shkola**

Analyst / Project Lead

- Strategy
- Task management
- Implementation

BSc. Math (Uni)
- 4th Sem.**Orest Mykhailiuk**

Fellow Analyst

- Asset analysis



BSc. Math (TU)

Adapted Payday Anomaly Assumption

Short-term dependencies in high-frequency trading data inspired by payday anomalies

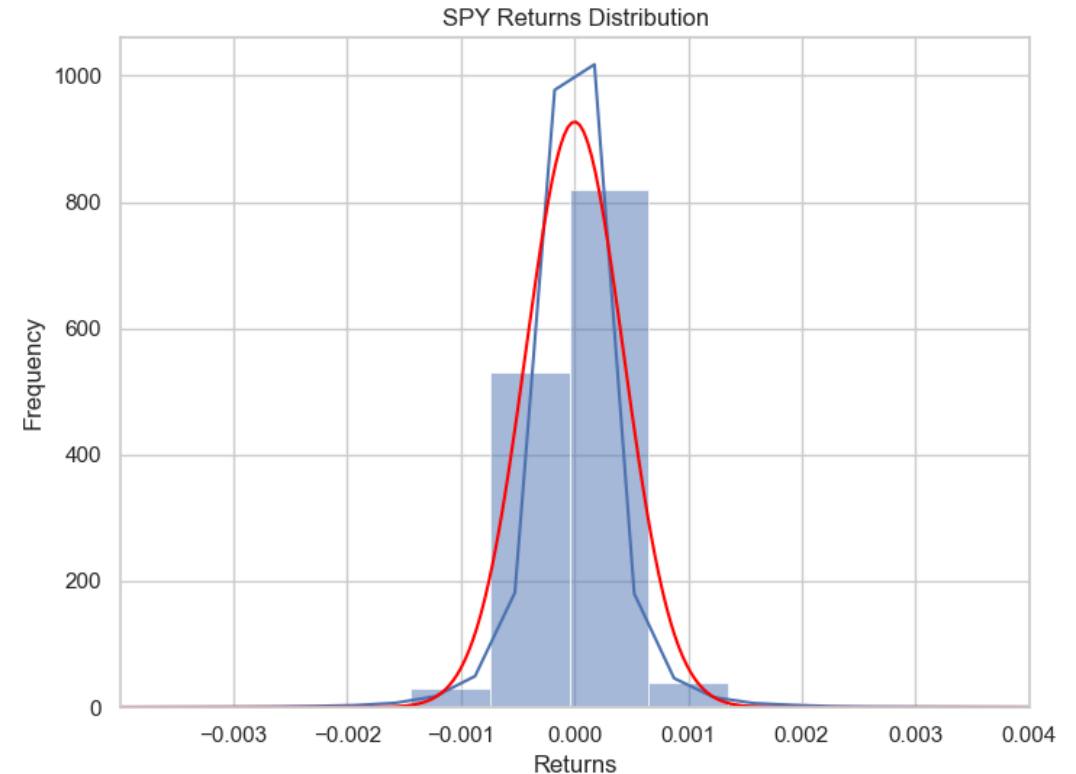
Overview

- Financial markets are driven by fast changes of volume and volatility
- Some intraday periods for particular assets are more preferable for trading activities
- Repeatable profit opportunities that can be discovered with complex models
- Volatility patterns are not uniform, some periods offer better opportunities

Usage

- Q-Learning agent is often used to capture optimal time slots within trading window using Bayesian search over parameters
- Parameters:
 - `n_days` - number of trading days from year (252)
 - `window_size` - minute window size
- After trading period parameters are picked, they are used for further processing by the model

Example: Minute data SPY Distribution



Blue: distribution of SPY (S&P500 traded index) minute returns;
Red: normal distribution.
Fetched from Alpaca API

Convolutional Recurrent Neural Network

Benefits of using combined model over bulky transformers and simple RNNs

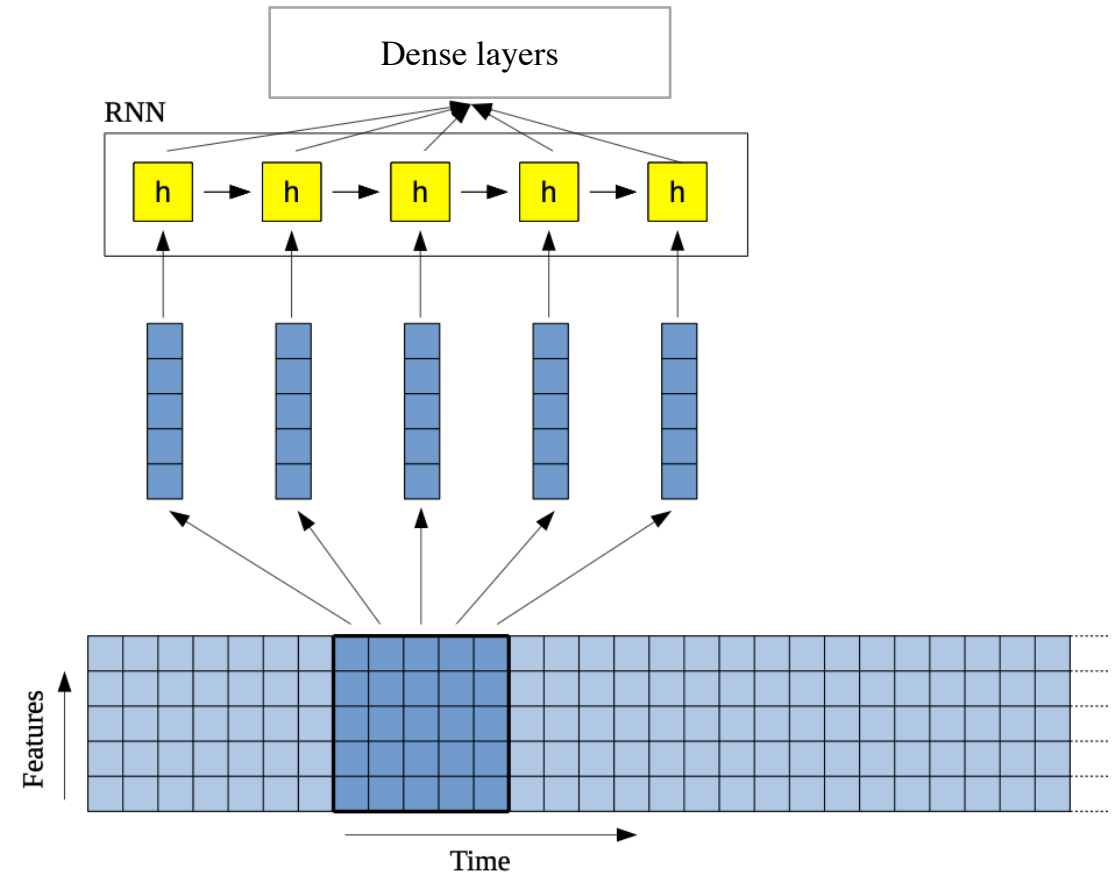
Overview

- Transformers are harder to train, whereas RNNs might not capture some data dependencies
- Convolutional layer captures dependencies of features - technical indicators
- Recurrent layer processes ordered time window data and captures time dependencies
- Model consists of:
 - Convolutional layers - capture feature dependencies
 - GRU layers - capture time-series features
 - Dense layers - additional + pass to output activated Dense neuron

Implementation

- Model is trained on preprocessed data (scaled and divided into windows)
- Indicators are fetched from raw historical broker datasets
- Datasets(Alpaca API) used for training:
 - SPY
 - VIXY
- Technical indicators: MA, RSI, BollingerB, MACD, Stochastic Oscillator.

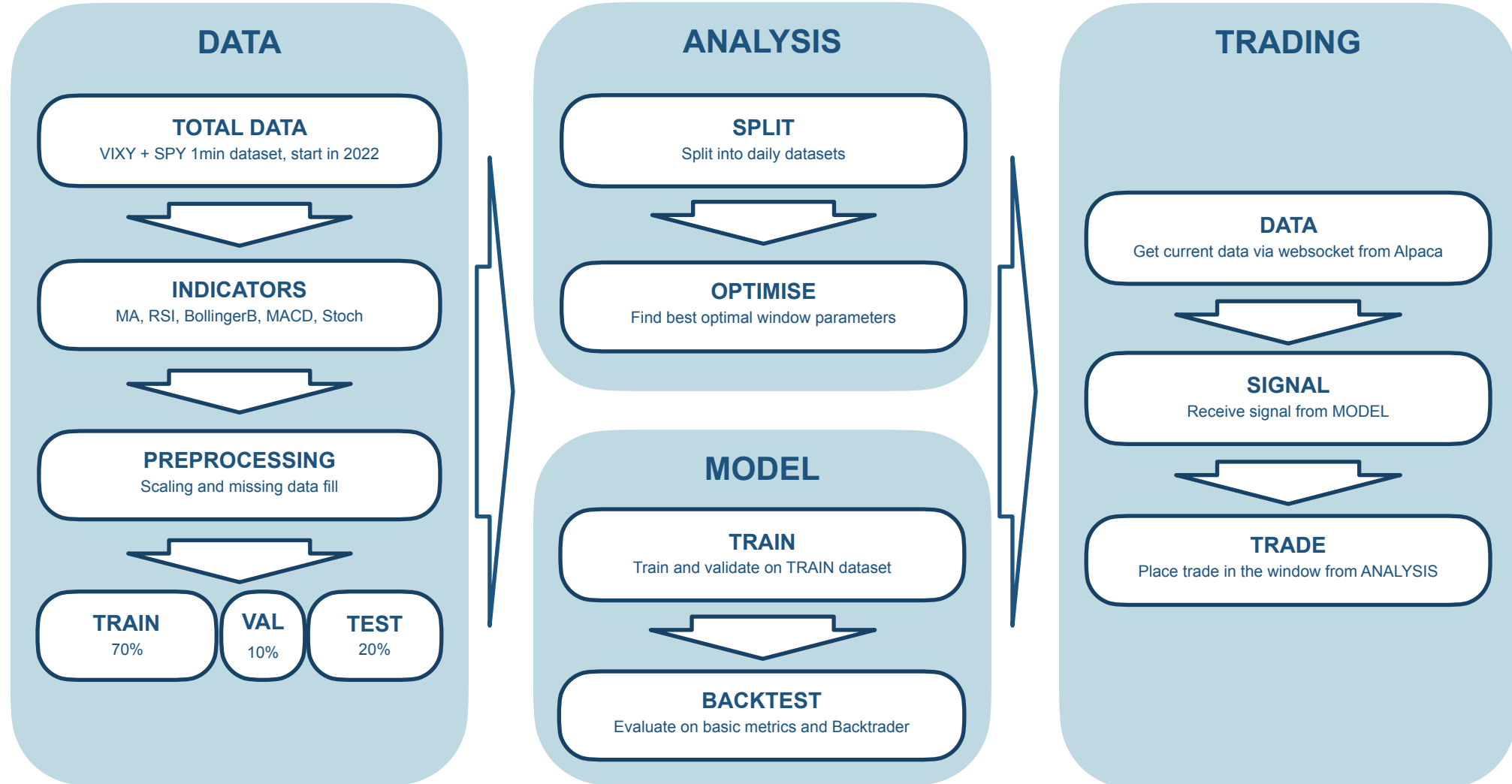
Construction of CRNN



Modified model structure(see article):
Data is sliced into trading windows that are first passed to convolutional layers. Afterwards, recurrent layers pick up the results of previous layers and pass them to dense and 1-d output neuron.

Strategy implementation

Combining Q-Learning Agent and CRNN for trading of volatility contracts



Results (raw CRNN)

Performance and risks of the simple strategy without risk adjustments

Sharpe Ratio

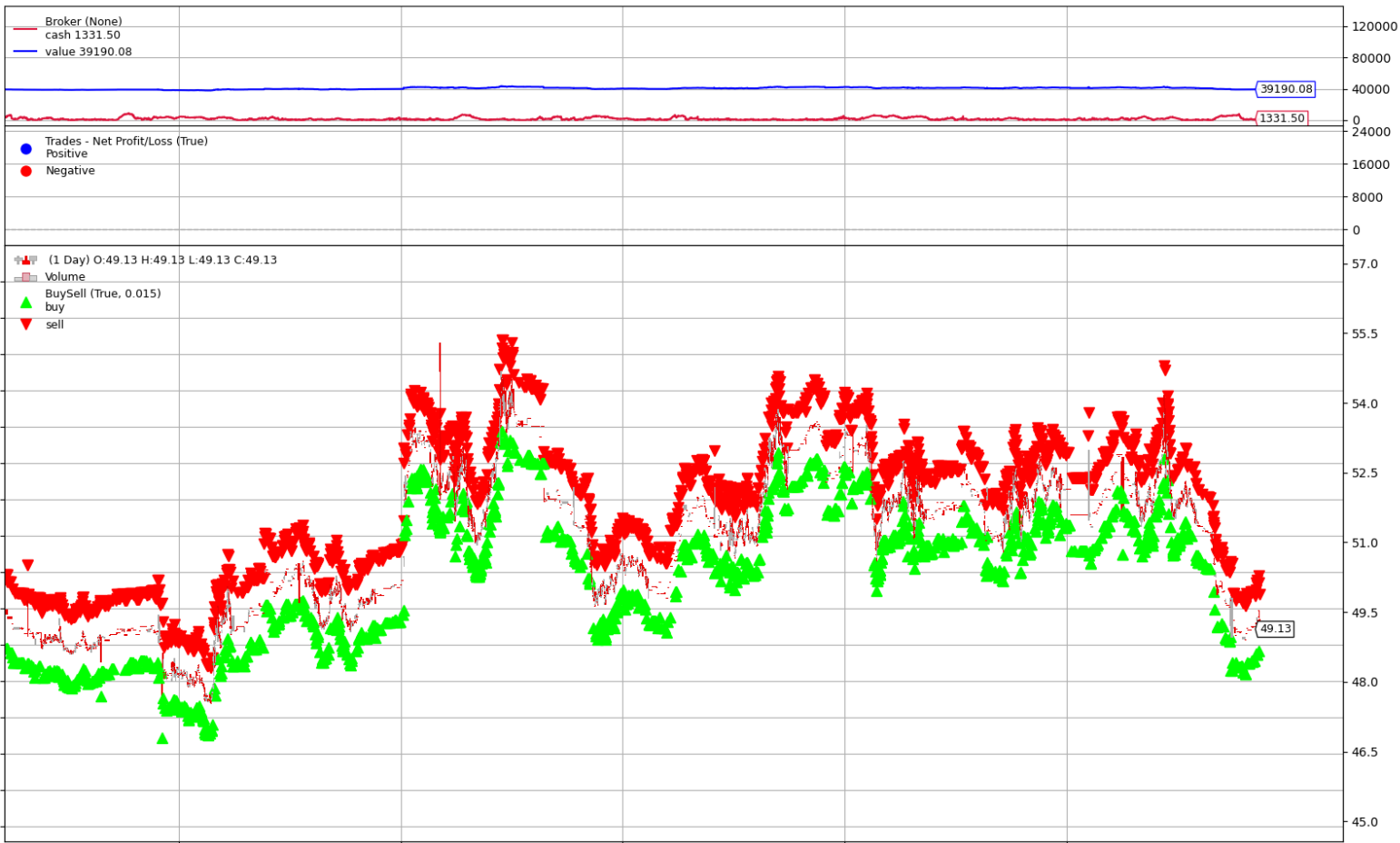
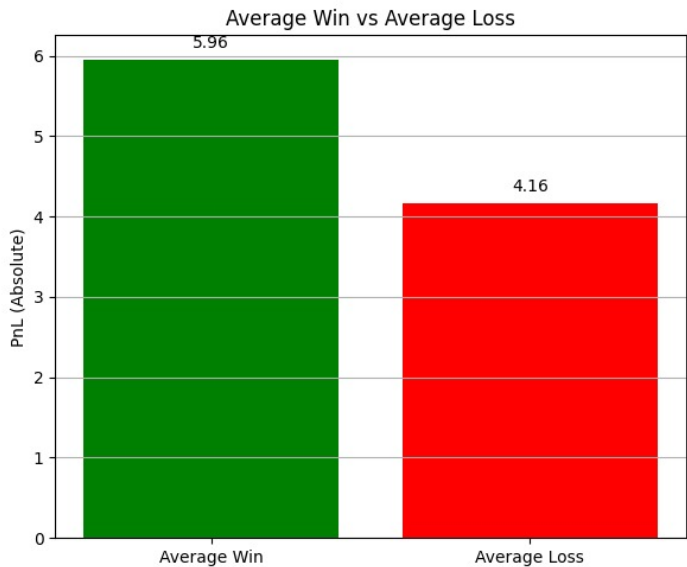
1.109

Win Ratio

55.56%

Drawdown

42%



Final PnL*

+310.17%

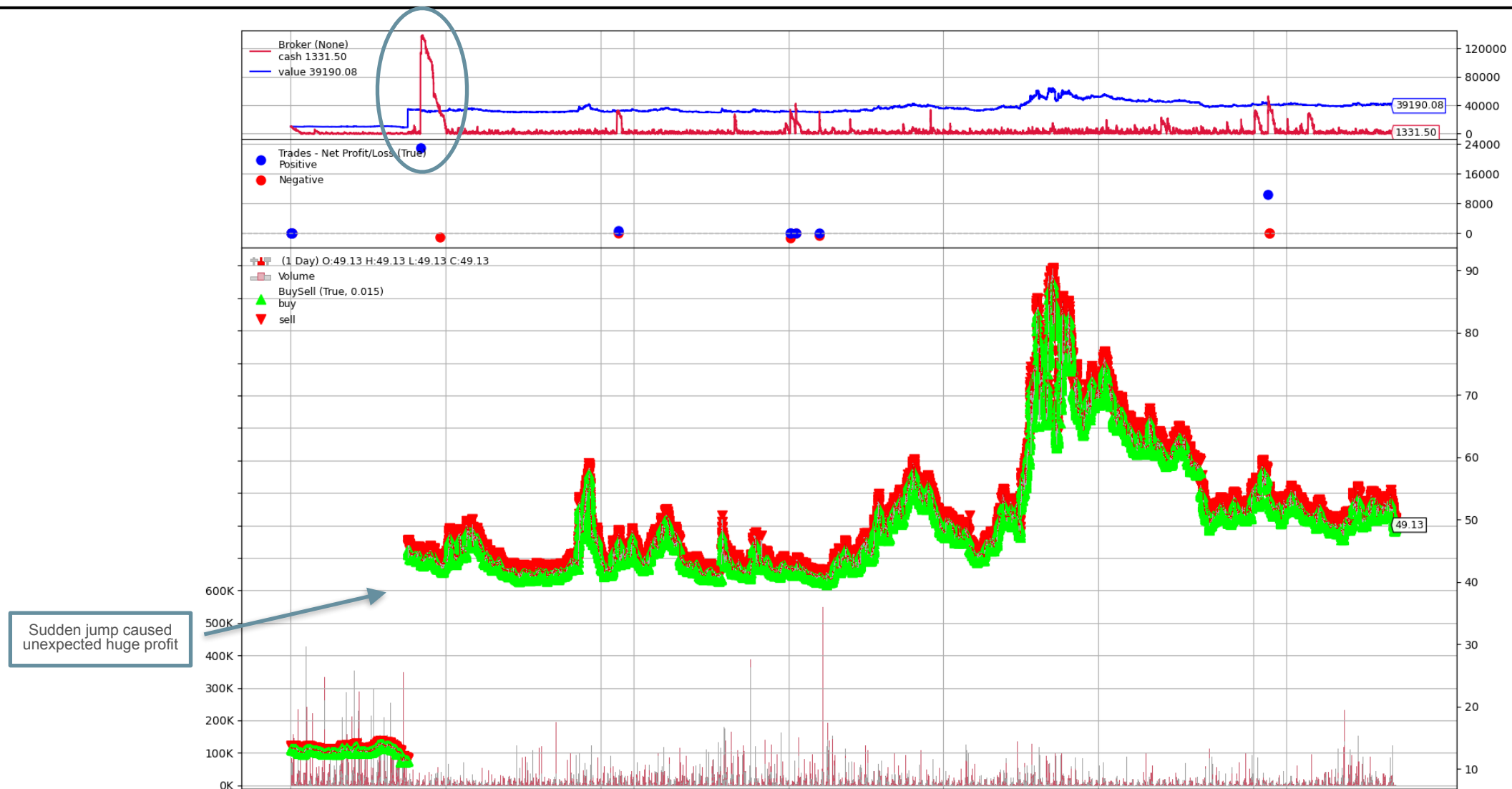
Trades

62810

*01.11.24-27.6.25

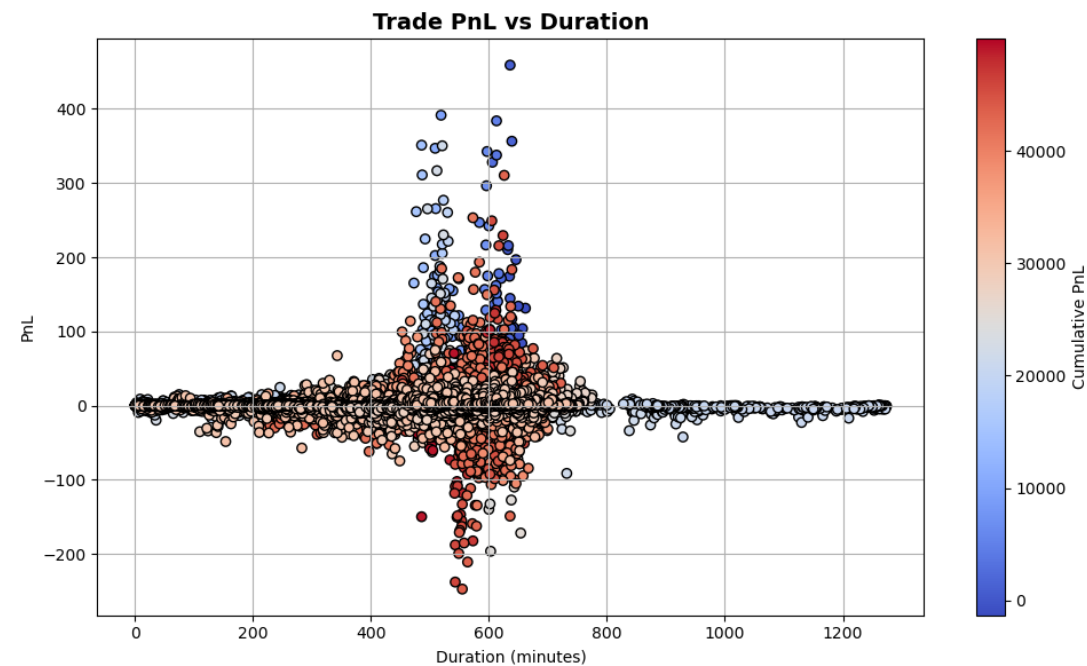
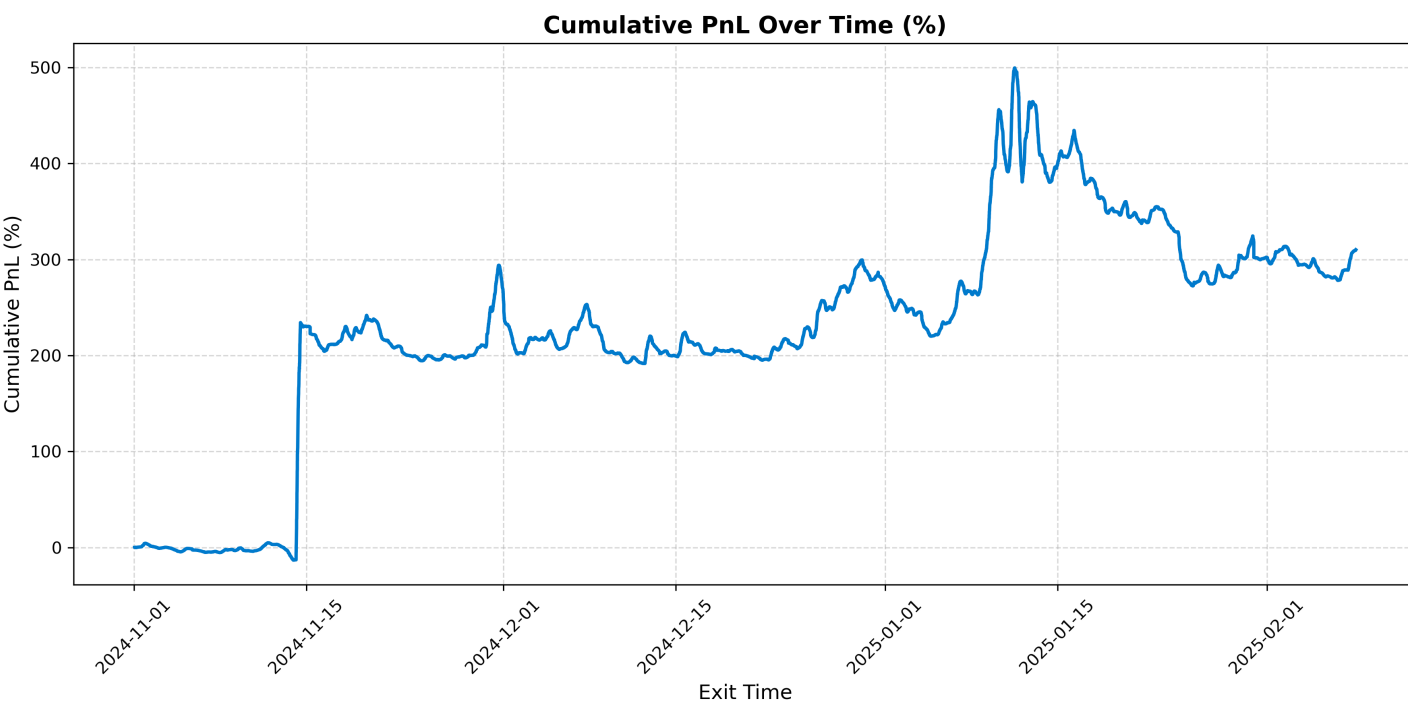
Results (raw CRNN)

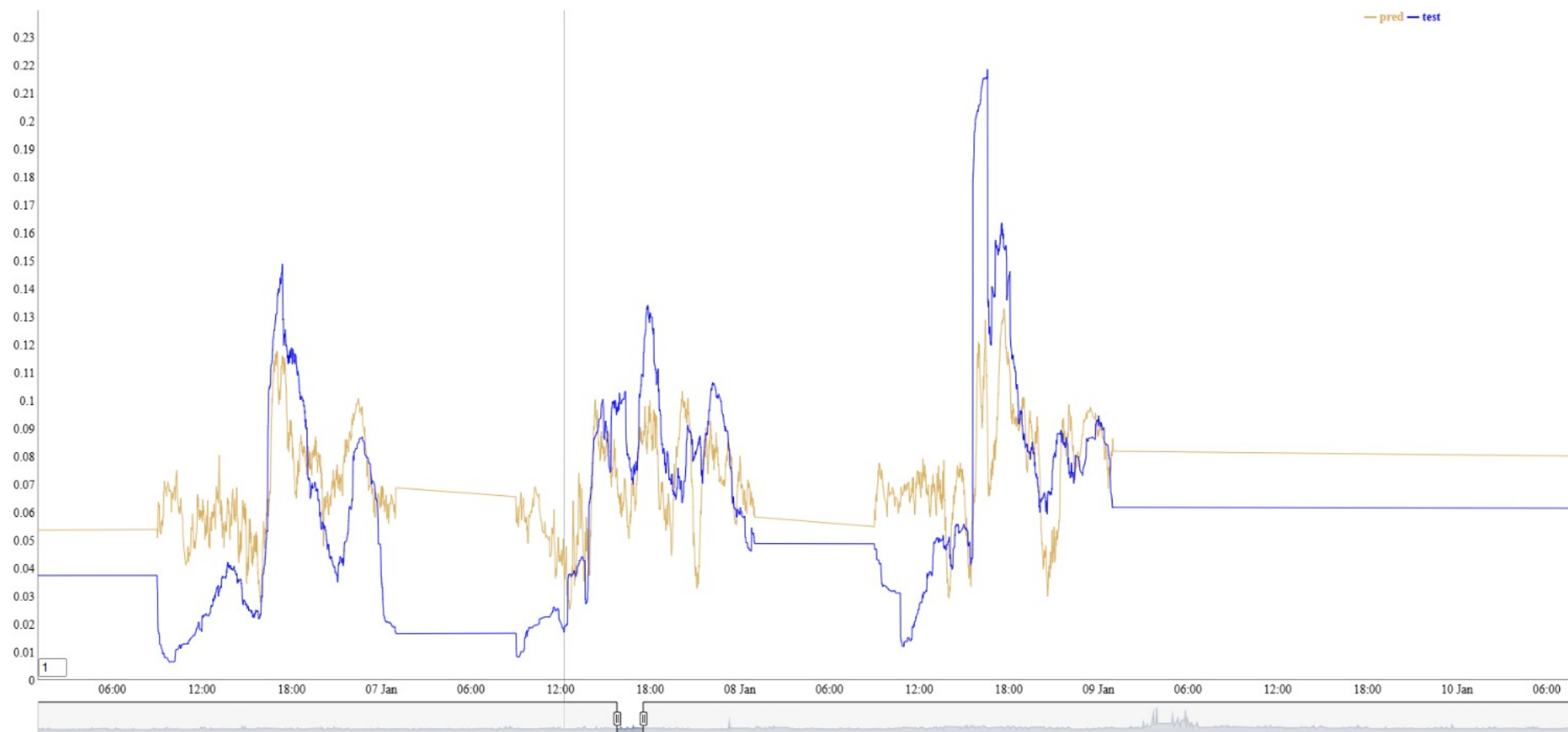
What could have gone wrong? Possible improvements



Results (raw CRNN)

What could have gone wrong? Possible improvements





Example of CRNN predictions of volatility

Contour Plot

