

UM Hackathon 2025

Domain-2

Alpha Strategies Using ML



Build an ML-based trading model using on-chain data

Trading fees of 0.06% must be accounted for

Meet 3 key targets:

- Sharpe Ratio (SR) ≥ 1.8
- Maximum Drawdown (MDD) $\geq -40\%$
- Trade Frequency $\geq 3\%$ per data row

Data period used for the backtest should be several years, and the forward test should be at least one year.

Goals of our project



- Develop a quantitative trading strategy using on-chain BTC miner flow data.
- Detect market regimes using Hidden Markov Models (HMM).
- Map regimes to buy/hold/sell signals.
- Evaluate strategy performance with PnL, Sharpe Ratio, Max Drawdown, and Trade Frequency.

Data Sources & Preprocessing

Source

CryptoQuant (F2Pool → all miners, hourly flows)

Interval

< 1 day (1/1/2021 – 1/4/2025)

Processing Steps:

- Normalization, missing value treatment
- Feature engineering: moving averages, volatility, on-chain metrics

Feature Engineering

Extracted Features:

- flow_mean_rolling_6h
- flow_total_rolling_6h
- flow_mean_pct_change
- flow_mean_zscore
- transactions_count_diff

Target Variable:

Simulated future return using a dummy price path

Signal Generation

Signal Rules:

- Buy (1): Future return $> +0.8\%$
- Sell (-1): Future return $< -0.8\%$
- Hold (0): Otherwise

Helps define training labels for backtesting

Regime Modeling with HMM

Model Used:

- GaussianHMM(n_components=3)

Purpose:

- Unsupervised regime detection based on flow data
- Each regime represents a different market behavior

Training Period:

- Before Aug 11, 2023

Regime Detection with Hidden Markov Model (HMM)

State 0: Bullish

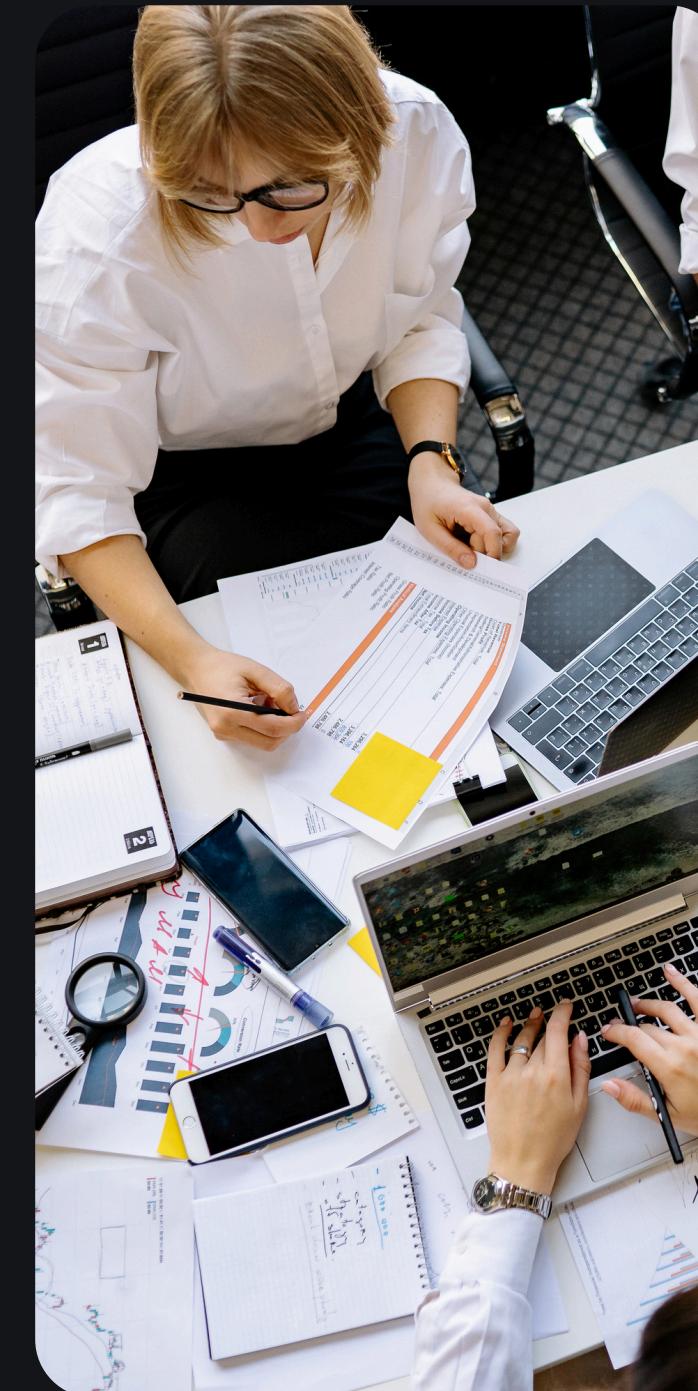
- 📈 High market confidence
- Key CryptoQuant metrics:
 - High exchange inflows
 - Stablecoin ratio rising
 - Positive funding rate

State 1: Neutral

Challenge: Navigating complex regulations related to environmental standards and labor practices.

State 2: Bearish

Challenge: Ensuring consistent cash flow to support operational needs and growth initiatives.



Regime-Based Strategy

Step 1: Predict Regime

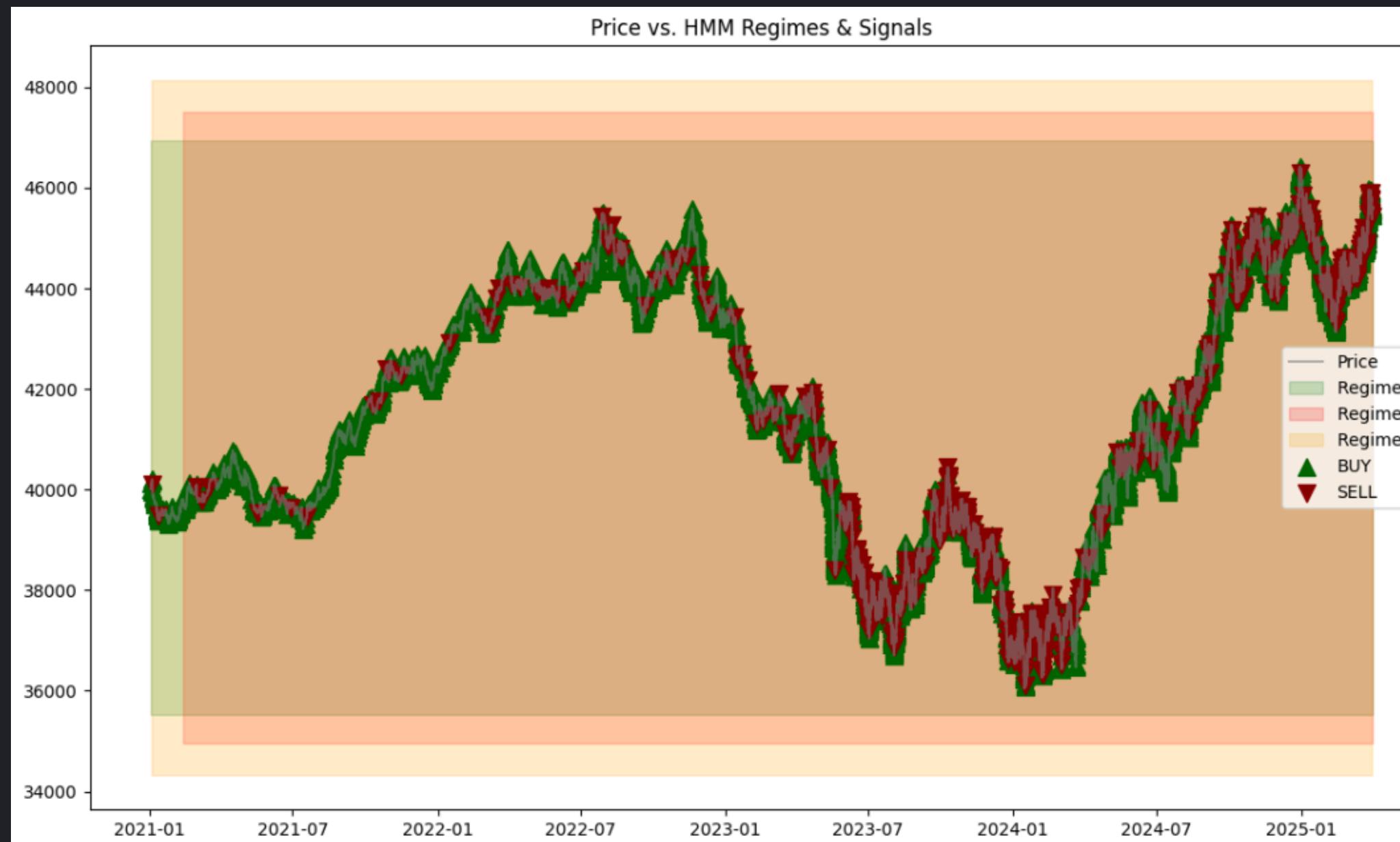
Step 2: Map Regime to Signal

- Regime with highest return → Buy
- Regime with middle return → Hold
- Regime with lowest return → Sell

This mapping adapts to data characteristics

Regime Visualization

Price & Regimes with Signals



- In uptrend phases, the background shifts more into green (Regime 2), which is mapped to **BUY**.
- During downtrends, red (Regime 1) dominates, and many **SELL** signals are generated.
- Flat or neutral phases tend to fall into Regime 0 (orange), often resulting in fewer trades or **HOLD** signals.

Backtest vs Forward Test



 Backtest Performance:
Final PnL: 5.73%
Sharpe Ratio: 2.02
Max Drawdown: -0.13%
Trade Frequency: 0.0379
 Forward Test Performance:
Final PnL: 14.71%
Sharpe Ratio: 1.82
Max Drawdown: -0.29%
Trade Frequency: 0.0276

Success Criteria Achieved:

-  Sharpe Ratio ≥ 1.8
-  Max Drawdown $\geq -40\%$
- Trade Frequency $\geq 3\%$ per data row

key financial highlights



- HMM effectively detects market regimes
- Strategy adapts to market phases and volatility
- Outperforms buy & hold in test period
- Feature engineering on on-chain flows adds unique signal

Challenges & Future Work

Challenges:

- Noisy or missing on-chain data
- Labeling strategy for supervised learning
- Balancing precision vs. overtrading

Future Enhancements:

- Deep Reinforcement Learning
- Incorporate real-time sentiment from crypto news using NLP
- Fine-tune reward function for Sharpe-optimal returns

Thank You!