

# **DLP Final Project Proposal: Market Guided Stock Transformer**

Group 7

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# Outline

- Introduction - Market Guided
- MASTER - AAAI'24
- Method
- Dataset

# Introduction - Market Guided

Stock prediction features can be divided into two types:

## 1. Individual Stock Features:

- Open price, close price, etc.
- Trading volume

## 2. Shared Market Features:

- Market index
- Macroeconomic indicators, e.g. interest rate

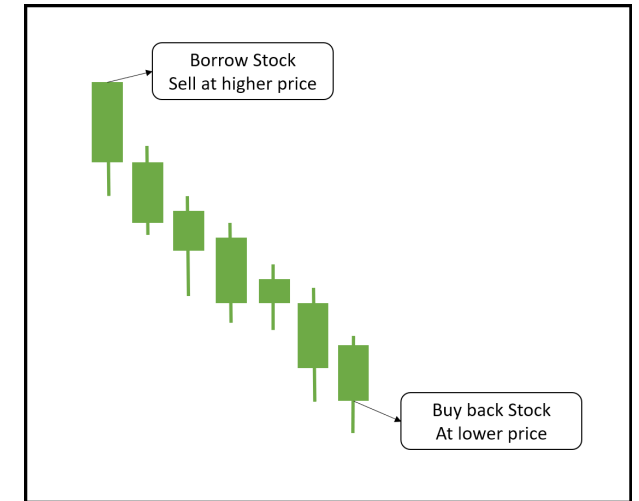
# Introduction - Market Guided

The market feature impacts the effectiveness of other features.

## Example: Short Selling

When investors believe a stock is overvalued.

1. Borrow stock, sell at high price.
2. Buy back at lower price when it falls.
3. Return to owner.



Short selling interest: the amount of stocks being short.

# Introduction - Market Guided

The market feature impacts the effectiveness of other features.

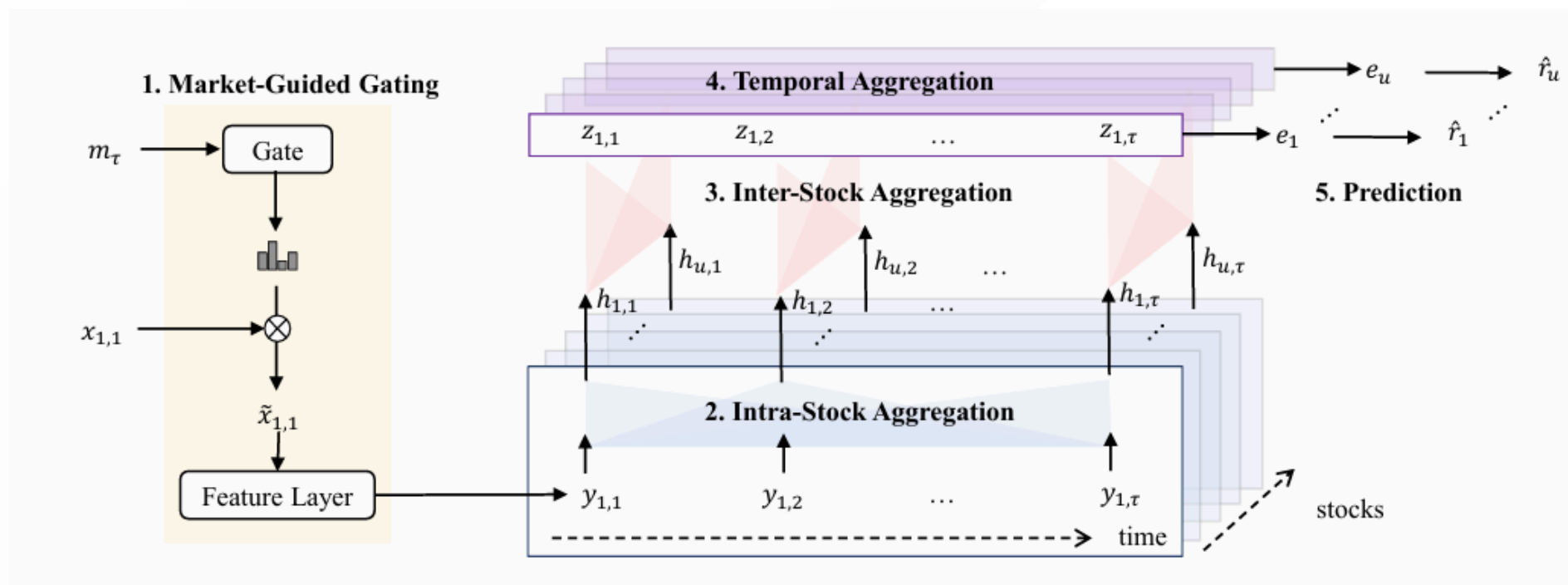
## **Example: Short Selling**

Effectiveness in different market status:

- Bull Market: short selling loses money, less concern.
- Bear Market: short selling signals pessimism, more significant.

→ **Using market status to select relevant features.**

# MASTER: Market-Guided Stock Transformer for Stock Price Forecasting <sup>[1]</sup>



# Limitation

Simple Representation of Market Status:

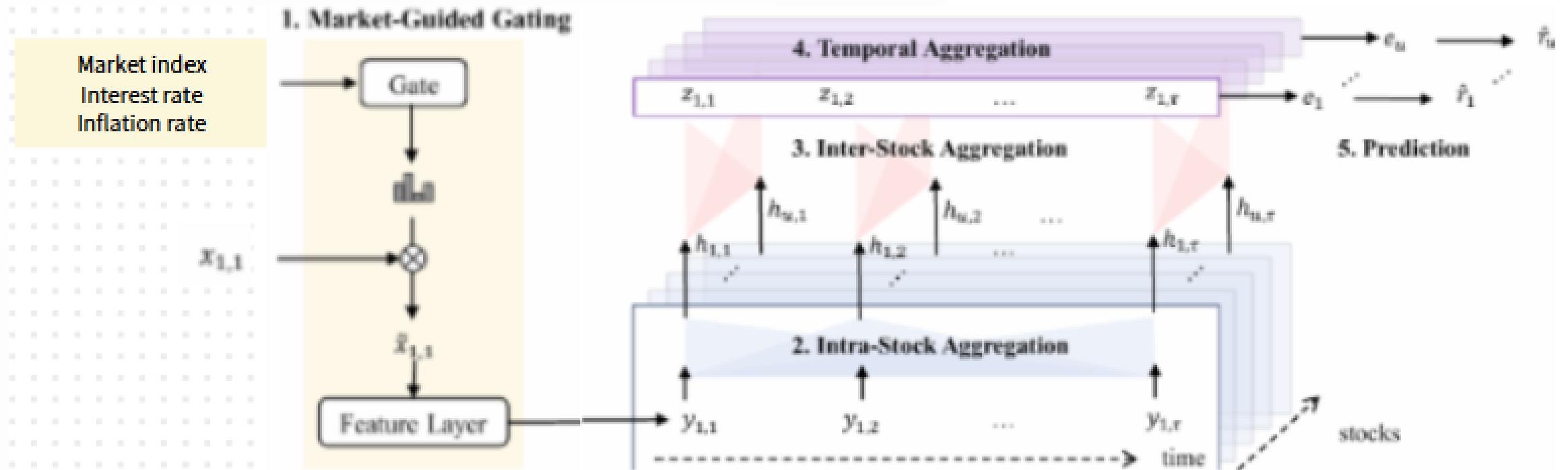
Only market index prices and trading volumes are used as inputs.

Improvements: Expanding Shared Market Features

1. Macroeconomic features
2. Industry-level features
3. News-based features

# Idea 1

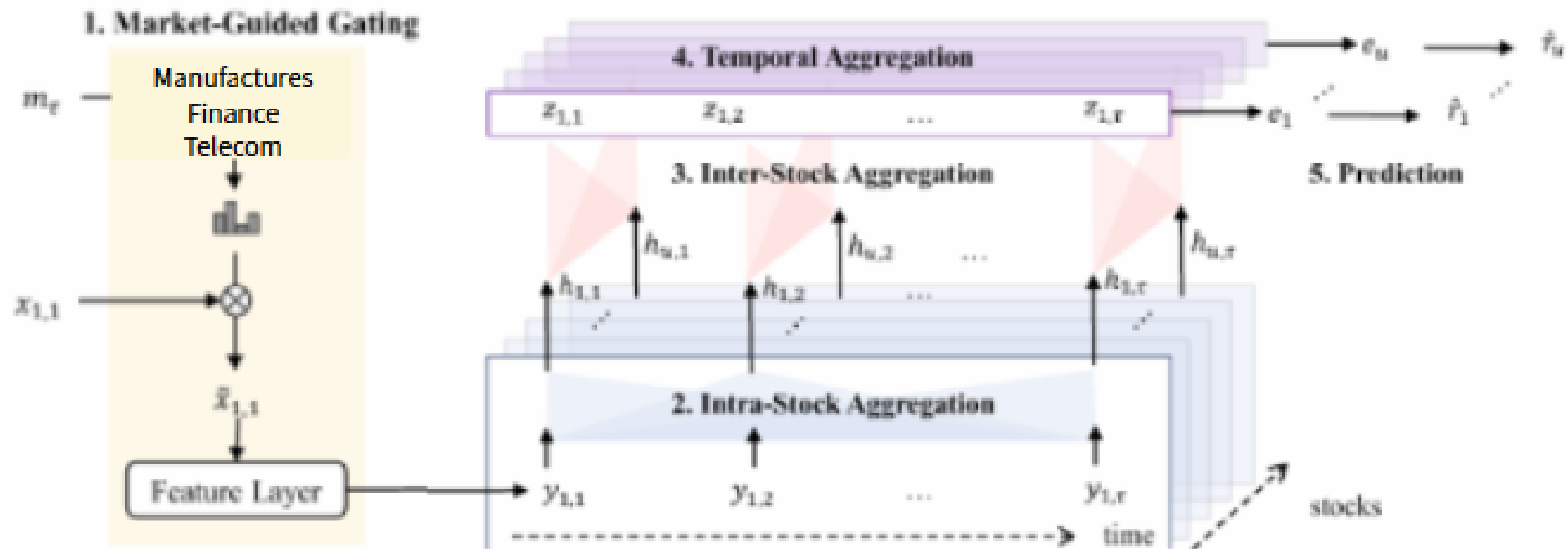
Market-guided indicators expansion for richer market dynamics





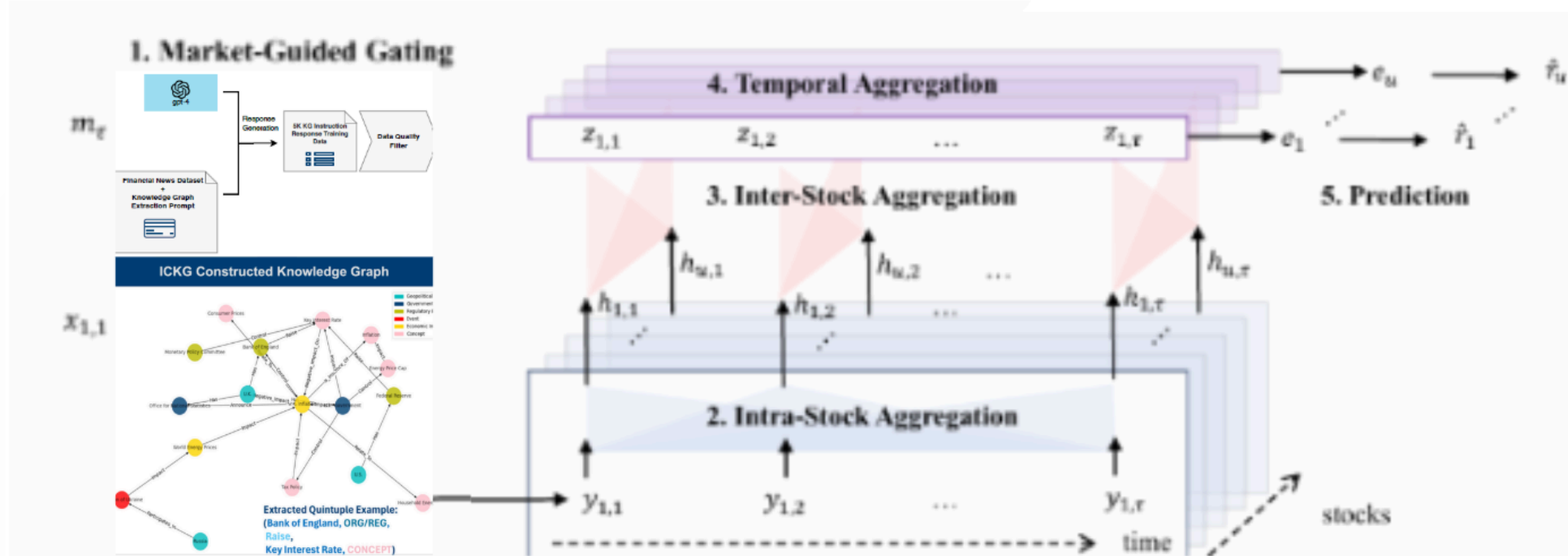
# Idea 2

Industry-level features for sector-specific behavior capture



# Idea 3

## Supply chain and news features for enhanced forecasting



- **MASTER**: dynamic stock correlations with market-guided feature
- **FinDKG**: company relationships to identify business partners<sup>[2]</sup>

# Problem Definition

Given a set of stocks  $S$  with features  $x_{u,t} \in \mathbb{R}^F$  collected at time steps  $t \in [1, \tau]$ :

For each stock, we consider:

- Individual stock features (price, volume)
- Shared market features (market index, macroeconomic indicators)
- Industry-Level feature (return)
- News-derived features (company and related party)

Output: The return ratio  $r_u = \text{Norm}_S((c_{u,\tau+d} - c_{u,\tau+1})/c_{u,\tau+1})$

# Data Description

The dataset for input of this study consists of the following data:

- **Stock prices**
- **Industry**
- **Market index**
- **Economic indicator**
- **Sentimental scores**

# Data Description (cont.)

- **Stock Price:**

- **Base:** S&P 500 constituents
- **Industry classification:** base on the Fama-French 12 industry <sup>[3]</sup>.
- **Number of stocks:** 8 firms \* 12 industries = 96 firms
- **Stock feature (daily):**
  1. price: open, high, low, close prices
  2. volume: trading volume
  3. others: short selling interest, etc.

# Data Description (cont.)

- **Industry:**  
The Fama-French 12 industry returns.
- **Market Index:**  
S&P 500 market index
- **Economic Indicators:**  
VIX, interest rates, and other economic indicators
- **Sentimental Scores:**  
News sentiment score from RavenPack

## Data Description (cont.)

| NAME                | NUMBER | TRAINING    | TEST | SOURCE      |
|---------------------|--------|-------------|------|-------------|
| Stock Price         | 96 * 5 | 2010 - 2022 | 2023 | WRDS - CRSP |
| Industry            | 12     | 2010 - 2022 | 2023 | Fama-French |
| Market Index        | 1      | 2010 - 2022 | 2023 | CRSP        |
| Economic Indicators | 1      | 2010 - 2022 | 2023 | VIX, FRED   |
| Sentimental Scores  | 6      | 2010 - 2022 | 2023 | Ravenpack   |

# Expected result

| Dataset | Model       | IC                                    | ICIR                              | RankIC                                | RankICIR                          | AR                                  | IR                                |
|---------|-------------|---------------------------------------|-----------------------------------|---------------------------------------|-----------------------------------|-------------------------------------|-----------------------------------|
| CSI300  | XGBoost     | $0.051 \pm 0.001$                     | $0.37 \pm 0.01$                   | $0.050 \pm 0.001$                     | $0.36 \pm 0.01$                   | $0.23 \pm 0.03$                     | $1.9 \pm 0.3$                     |
|         | LSTM        | $0.049 \pm 0.001$                     | <u><math>0.41 \pm 0.01</math></u> | $0.051 \pm 0.002$                     | $0.41 \pm 0.03$                   | <u><math>0.20 \pm 0.04</math></u>   | <u><math>2.0 \pm 0.4</math></u>   |
|         | GRU         | $0.052 \pm 0.004$                     | <u><math>0.35 \pm 0.04</math></u> | $0.052 \pm 0.005$                     | $0.34 \pm 0.04$                   | $0.19 \pm 0.04$                     | <u><math>1.5 \pm 0.3</math></u>   |
|         | TCN         | $0.050 \pm 0.002$                     | $0.33 \pm 0.04$                   | $0.049 \pm 0.002$                     | $0.31 \pm 0.04$                   | $0.18 \pm 0.05$                     | $1.4 \pm 0.5$                     |
|         | Transformer | $0.047 \pm 0.007$                     | $0.39 \pm 0.04$                   | $0.051 \pm 0.002$                     | <u><math>0.42 \pm 0.04</math></u> | $0.22 \pm 0.06$                     | $2.0 \pm 0.4$                     |
|         | GAT         | <u><math>0.054 \pm 0.002</math></u>   | $0.36 \pm 0.02$                   | $0.041 \pm 0.002$                     | <u><math>0.25 \pm 0.02</math></u> | $0.19 \pm 0.03$                     | $1.3 \pm 0.3$                     |
|         | DTML        | <u><math>0.049 \pm 0.006</math></u>   | $0.33 \pm 0.04$                   | <u><math>0.052 \pm 0.005</math></u>   | $0.33 \pm 0.04$                   | $0.21 \pm 0.03$                     | $1.7 \pm 0.3$                     |
|         | MASTER      | <b><math>0.064^* \pm 0.006</math></b> | <b><math>0.42 \pm 0.04</math></b> | <b><math>0.076^* \pm 0.005</math></b> | <b><math>0.49 \pm 0.04</math></b> | <b><math>0.27 \pm 0.05</math></b>   | <b><math>2.4 \pm 0.4</math></b>   |
| CSI800  | XGBoost     | $0.040 \pm 0.000$                     | $0.37 \pm 0.01$                   | $0.047 \pm 0.000$                     | $0.42 \pm 0.01$                   | $0.08 \pm 0.02$                     | $0.6 \pm 0.2$                     |
|         | LSTM        | $0.028 \pm 0.002$                     | $0.32 \pm 0.02$                   | $0.039 \pm 0.002$                     | $0.41 \pm 0.03$                   | $0.09 \pm 0.02$                     | $0.9 \pm 0.2$                     |
|         | GRU         | $0.039 \pm 0.002$                     | $0.36 \pm 0.05$                   | $0.044 \pm 0.003$                     | $0.39 \pm 0.07$                   | $0.07 \pm 0.04$                     | $0.6 \pm 0.3$                     |
|         | TCN         | $0.038 \pm 0.002$                     | $0.33 \pm 0.04$                   | $0.045 \pm 0.002$                     | $0.38 \pm 0.05$                   | $0.05 \pm 0.04$                     | $0.4 \pm 0.3$                     |
|         | Transformer | $0.040 \pm 0.003$                     | <b><math>0.43 \pm 0.03</math></b> | $0.048 \pm 0.003$                     | <b><math>0.51 \pm 0.05</math></b> | $0.13 \pm 0.04$                     | $1.1 \pm 0.3$                     |
|         | GAT         | <u><math>0.043 \pm 0.002</math></u>   | $0.39 \pm 0.02$                   | $0.042 \pm 0.002$                     | $0.35 \pm 0.02$                   | $0.10 \pm 0.04$                     | $0.7 \pm 0.3$                     |
|         | DTML        | <u><math>0.039 \pm 0.004</math></u>   | $0.29 \pm 0.03$                   | <u><math>0.053 \pm 0.008</math></u>   | $0.37 \pm 0.06$                   | <u><math>0.16 \pm 0.03</math></u>   | <u><math>1.3 \pm 0.2</math></u>   |
|         | MASTER      | <b><math>0.052^* \pm 0.006</math></b> | <u><math>0.40 \pm 0.06</math></u> | <b><math>0.066 \pm 0.007</math></b>   | <u><math>0.48 \pm 0.06</math></u> | <b><math>0.28^* \pm 0.02</math></b> | <b><math>2.3^* \pm 0.3</math></b> |

Table 1: Overall performance comparison. The best results are in bold and the second-best results are underlined. And \* denotes statistically significant improvement (measured by t-test with p-value  $< 0.01$ ) over all baselines.



## Expected result (cont.)

The set of stocks has changed from Chinese stocks to U.S. stocks  
→ Prior related works are no longer directly applicable.

We aim to compare performance between:

1. The original version of MASTER
2. MASTER with three improvements

# References

- [1] Li, T., Liu, Z., Shen, Y., Wang, X., Chen, H., & Huang, S. (2024). MASTER: Market-Guided Stock Transformer for Stock Price Forecasting. In Proceedings of the AAAI Conference on Artificial Intelligence, 38(1), 162-170.
- [2] Li, X. V., & Sanna Passino, F. (2024). FinDKG: Dynamic Knowledge Graphs with Large Language Models for Detecting Global Trends in Financial Markets. In Proceedings of the 5th ACM International Conference on AI in Finance (ICAIF '24) (pp. 573–581).

## References (cont.)

[3] Fama, E. F., & French, K. R. (1997). Industry costs of equity. Journal of financial economics, 43(2), 153-193.

**Thank you for listening.**