

GNN-based stock selection and Qlib practice

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In-depth

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GNN informs stock selection by examining inter-stock relations

This is the 42nd in-depth report of our research series on AI technology. It introduces Graph Neural Networks (GNN) and examines its effectiveness in informing stock selection decisions via Microsoft's open-source AI-oriented quantitative investment platform Qlib. Traditional multi-factor stock selection models typically regard stocks as mutually independent samples, despite the complex connections between them, eg, up/down-stream relations and market thematic relations. The strength of the GNN approach lies in its ability to capture such relations in stock predictions. Qlib has realized graph attention network (GATs_ts). We tested the effectiveness of the GATs_ts approach in selecting constituents of the CSI 300 index based on share prices and trading volume. For the backtesting period (2010 - early February 2021) the GATs_ts model yielded an annualized excess return (relative to the CSI 300) of 28.9% (vs LSTM's 25.7%), and an information ratio of 2.94 (vs LSTM's 2.64).

GNN aggregates neighboring nodes' characteristics to central nodes

GNN broadens the application of deep learning from image/voice processing to graph data structure, and is widely used in areas such as fraud detection/shopping recommendation. Developed from the graph signal and spectral graph convolution theory, GNN seeks to explicitly or implicitly map the connections between samples. It aligns each sample with a node, and aggregates the characteristics of neighboring nodes toward central nodes to keep the nodes up-to-date. Graph convolutional networks (GCN), GraphSAGE and graph attention networks (GAT) are three main types of GNNs. GCN is a transductive learning approach to stock prediction which involves retraining the model after new samples are added; GraphSAGE/GAT perform inductive learning using aggregators/attention mechanisms, to directly predict the performance of new samples, making them suitable for stock markets where samples are changing dynamically.

Spatial-temporal graph networks suitable for quantitative trading

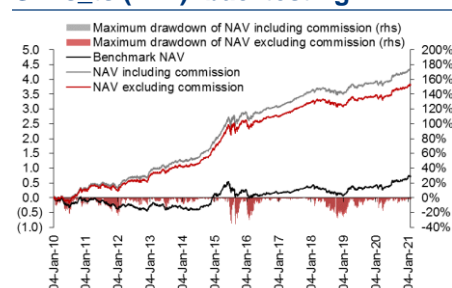
Spatial-temporal graph networks (STGNs) primarily combine recurrent neural network with GNN to acquire additional spatial-temporal information of raw data, and are therefore suitable for quantitative stock selection. Relational Stock Ranking (RSR) and GATs_ts are STGNs. The former uses LSTM to capture time series characteristics of stocks on the sequential embedding layer, explicitly maps connections between stocks, and then uses dynamic temporal graph convolution to learn inter-stock interactions on the relationship embedding layer, before ranking the stocks by return on investment. Similarly, GATs_ts uses GAT's global attention mechanism in the dynamic temporal graph convolution module, implicitly explores the effects of all the nodes on the central nodes without explicitly mapping the stock market, and then aggregates the resulting data into the central nodes.

Alpha158/GATs_ts based selection of CSI 300 constituents via Qlib

Source codes of the single-layer GATs_ts now available on Qlib were adapted to build multi-layer GATs_ts. We predicted daily returns on CSI 300 constituents using Qlib's Alpha158vwap factor library and the GATs_ts model, and created a daily-adjustment portfolio based on the TopkDropout strategy. For the backtesting period (4 Jan 2010-2 Feb 2021), relative to CSI 300, the annualized excess return of the single-layer GATs_ts model is 28.89%, information ratio is 2.94, and the excess return maximum drawdown is -16.92%, outperforming both the LSTM and multi-layer GATs_ts models.

Risks: risks associated with Qlib, as the platform is still undergoing development, and some functionalities remain to be tested. Past market patterns identified using AI based on historical data may fail in predicting future trends. Overfitting may occur with AI models.

GATs_ts (K=1): backtesting NAV



Source: Qlib, Wind, Huatai Research

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