Goethe-Universität Frankfurt am Main
Fachbereich Wirtschaftswissenschaften

Professur für Betriebswirtschaftslehre,
insbesondere e-Finance

Prof. Dr. Peter Gomber

Theodor-W.-Adorno Platz 4
RuW, Postfach 69
D-60323 Frankfurt am Main

Telefon +49-69-798-34683
Telefax +49-69-798-35007
E-Mail gomber@wiwi.uni-frankfurt.de

http://www.efinance.wiwi.uni-frankfurt.de

Master Thesis:
Using Geometric Deep Learning on Social Network Sentiment to Model Herd Behaviour in Financial Markets

In January 2021, market events around the short squeeze of GameStop and other stocks demonstrated the degree to which interaction in social networks is able to influence today's financial system. Given their ever-growing reach and ubiquity, social networks have amplified the phenomena of herd behaviour and market manipulation to become an increasingly urgent challenge for market participants and regulators alike. Past research on social network sentiment and financial markets has for the most part been using some form of aggregated sentiment score to understand and anticipate market trends, yet some attention has also been given to viral information spread (e.g. Zhang et al., 2012). In general, however, analyses fail to leverage the complexity underlying social network dynamics, ignoring spatial and temporal information.

Recently, geometric deep learning has become an important strain of research that is concerned with graph neural networks (GNN) and learning patterns from spatial, non-euclidean data. Numerous updates to the original design introduced a discrete-time dynamic graph setting, meaning that a sequence of graph snapshots is used in order to convey temporal dependency (Yu et al., 2018). The latest improvement has been the adoption of a continuous-time dynamic graph setting, allowing for individual node and edge updates rather than entire graph snapshots (Rossi et al., 2020). Generally, GNN have long become popular in social network analysis, but only innovations in temporal modeling render possible use-cases in the realm of large-scale, non-euclidean time-series data.

Using geometric deep learning, the aim of this thesis is to model sentiment spread in complex social networks, and to explore how herd effects and market manipulation may be anticipated through footprints in information spread. More precisely, the student is expected to (1) identify and prepare suitable sources of unstructured data (Twitter, Reddit, …), (2) model the spread of social network sentiment using some form of GNN and (3) analyze its influence on stock and crypto markets. Sentiment analysis itself is not the main concern of this thesis, hence pre-trained models such as BERT (Devlin et al., 2019) should be used to ensure state-of-the-art results. In light of the technical complexity, the student should have experience with python programming and, ideally, bring to the table a strong interest in applied deep learning research.

Supervisor: Jonas De Paolis

Literature:

- Devlin, J., Chang, M., Lee, K., & Toutanova, K. (2019). *BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding*. arXiv:1810.04805 [cs.CL].
- Rossi, E., Chamberlain, B., Frasca, F., Eynard, D., Monti, F., & Bronstein, M. (2020). *Temporal Graph Networks for Deep Learning on Dynamic Graphs*. arXiv:2006.10637 [cs.LG].
- Yu, B., Yin, H., & Zhu, Z. (2018). *Spatio-Temporal Graph Convolutional Networks: A Deep Learning Framework for Traffic Forecasting*. arXiv:1709.04875 [cs.LG].
- Zhang, X., Fuehres, H., & Gloor, P. (2012). *Predicting Asset Value through Twitter Buzz*. In: Advances in Collective Intelligence 2011, pp. 23–34.

Postadresse: Campus Westend • Theodor-W.-Adorno Platz 4, RuW-Gebäude, Postfach 69 • D-60629 Frankfurt am Main
Besuchs- und Lieferadresse: Campus Westend • Theodor-W.-Adorno Platz 4• RuW-Gebäude, 2.OG • D-60323 Frankfurt am Main