“AI for Financial Portfolio Management”

DeepFinance Project

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DeepFinance

European Union
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ARISTOTLE UNIVERSITY OF THESSALONIKI
SPEEDLAB DATASCOUTING

The Project

- DeepFinance aims to develop
  - A platform for semantic and sentiment analysis of social media streams using Deep Learning
  - Unified tools for financial portfolio management that can fuse multi-modal information from various sources, including social media streams

Financial Portfolio Management

- Algorithmic financial agents are capable of executing very fast decisions - High Frequency Trading
- Unaffected by personal feelings, as human agents tend to be
- Input data is typically historical data regarding the traded assets
  - Assets such as stocks, FOREX, Cryptocurrencies, et.c
  - Data such as price or exchange rates progress, limit order book data, etc.
- This type of data can be noisy
- And doesn’t fully reflect the state of the market
  - Which is affected - and affects - public sentiment regarding the traded assets
- Sentiment data is being increasingly adopted by trading agencies alongside price data

Sentiment Analysis from Social Media Streams

- Several issues
  - Which sources are important?
  - How to assign weights to important sources?
  - Which DL model to use to extract sentiment data?
    - NLP models not trained for financial lingo, finetuned models needed
    - Costly data annotation
  - How to process specific features such as hashtags, character limits, etc.?
  - Cost of acquiring sentiment data worth it?
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DeepFinance Goals

1. Developing Deep Learning tools for Automated Portfolio Management
    a. Improving upon previous tools, such as rule-based methods
    b. Increasing robustness by dealing with the non-stationarity of the input, their uncorrelatedness and randomness
2. Developing a Semantic Analysis platform for data collected from Social Media streams
    a. Analysis and extraction of sentiment information from large amounts of data
    b. Allowing the exploration of cause-effect relationships
3. Integration of the Semantic Analysis tools into the Deep Learning based trading tools
    a. Taking into account sentiment information
    b. Developing multi-modal Deep Learning and Deep Reinforcement Learning algorithms

Research & Main Findings

- 7 journal papers (+1 currently under review)
- 5 publications in conference proceedings
- 1 publicly available dataset

- Main research directions:
  - Supervised Learning, i.e., predicting quantized price movement
  - Adaptive Input Normalization, to deal with non-stationarity
  - Deep Reinforcement Learning, i.e., training DRL trading agents to directly optimize profit and avoid price quantization
  - Training multimodal agents that take into account sentiment information

Research & Main Findings

Portfolio Management - Supervised Learning

- Temporal Logistic Neural Bag-of-Features for Financial Time series Forecasting leveraging Limit Order Book Data
  - Tackling the high-dimensionality, velocity and variety of the Limit Order Book data
  - Novel adaptive scaling mechanism, replacing Gaussian-based density estimation with a logistic kernel
- Forecasting Financial Time Series using Robust Deep Adaptive Input Normalization
  - Financial timeseries are highly volatile and non-stationary
  - Proposed an an adaptive input normalization layer that can learn to identify the distribution from which the input data were generated and then apply the most appropriate normalization scheme
- Transferring trading strategy knowledge to deep learning models
  - Deep Learning models can extract knowledge from the actions of trading agents
  - Combining expert knowledge with AI
- Online Knowledge Distillation for Financial Timeseries Forecasting
  - Ensemble-based online distillation method
  - Significantly reduced effects of noisy data and noisy labels

Research & Main Findings

Portfolio Management - Reinforcement Learning

- Price Trailing for Financial Trading using Deep Reinforcement Learning
  - Reinforcement learning discards the need for price quantization
  - Novel reward that ensures consistent rewards, discarding the need for price quantization
- Diversity-driven Knowledge Distillation for Financial Trading using Deep Reinforcement Learning
  - Teacher agents are trained in different subsets of RL environment, learning diverse policies
  - Student agents are trained using distillation from the trained teachers
  - Diversified ensembles of teachers trained to perform trading for different currencies lead to better performance of students
- Deep Adaptive Group-based Input Normalization for Financial Trading
  - Noisy and non-stationary nature of financial data aggravate the already unstable training of DRL models
  - Novel differentiable, parameterized normalization scheme that allows for learning how the data should be normalized

Research & Main Findings

Sentiment Analysis

- Multi-source Financial Sentiment Analysis for Detecting Bitcoin Price Change Indications using Deep Learning
  - Evaluating the impact of using different DL models as sentiment extractors
  - Employing an unsupervised training pipeline for further improving their performance
  - Proposed an effective multi-source sentiment fusion approach

- CRYPTOSENTIMENT: A Dataset and Baseline for Sentiment-aware Deep Reinforcement Learning for Financial Trading
  - Fine-grained cryptocurrency sentiment dataset
  - Investigating the impact of multi-modal features on cryptocurrency trading

Research & Main Findings

Portfolio Management using Sentiment Data - Supervised Learning

- Learning Sentiment-aware Trading Strategies for Bitcoin leveraging Deep Learning-based Financial News Analysis
  - Examining whether the use of sentiment information is beneficial when training DL agents for trading
  - Improving the performance of MLPs, CNNs and RNNs
- Sentiment-Aware Distillation for Bitcoin Trend Forecasting Under Partial Observability
  - Exploiting sentiment information as a source of additional supervision during the training process
  - Allowing for operating the agent under partial observability, i.e., without requiring sentiment information as input during inference

Research & Main Findings

Portfolio Management using Sentiment Data - Reinforcement Learning

- A Sharpe Ratio Based Reward Scheme in Deep Reinforcement Learning for Financial Trading
  - The Sharpe ratio is used to evaluate a portfolio's risk-adjusted performance
  - Proposed a Sharpe ratio-based reward shaping approach for optimizing DRL agents while mitigating the risk that occurs in the agent's decisions
- Deep Reinforcement Learning for Financial Trading using Multi-modal Features
  - Training multimodal DRL agents using sentiment data
  - Learning weighting strategies for the modalities, allowing the models to be tuned accordingly

Workshop Presentations

09:00	**DeepFinance Project** Prof. Anastasios Tefas, AUTH
09:10	**Introduction to Financial Time-series and Recent Advances in Supervised Learning for Financial Trading** Dr Paraskevi Nousi, AUTH
09:45	**Introduction to Deep Reinforcement Learning and Recent Advances for Financial Trading** Dr Nikolaos Passalis, AUTH
10:30	**Automated Management of Financial Portfolios** Konstantinos Kechagias, SpeedLab AG
11:00	**Coffee Break**

Workshop Presentations

11:30	**Training Intelligent Portfolio Management Agents using Reinforcement Learning** Stergios Chairistanidis, SpeedLab AG
12:00	**Bayesian learning for limit-order book price prediction** Dr Martin Magris and Prof. Alexandros Iosifidis, Aarhus University
12:30	**Variational Bayes for volatility modelling** Dr Martin Magris, Aarhus University
13:00	**Extracting and Leveraging Sentiment Data from Online Sources in Deep Reinforcement Learning Agents for Portfolio Management** Loukia Avramelou, AUTH
13:15	**Training Deep Reinforcement Learning Agents for Portfolio Management with a Sharpe ratio based Reward** George Rodinos, AUTH

Certificates

- Write all questions you may have using the zoom chat.
- To get a certificate of attendance, register with your email at deepfinance.csd.auth.gr/workshop
- Random checks will be taken throughout the workshop to check attendance
- The certificates will be sent via email, contact person: paranous@csd.auth.gr