CISC5352 Financial programming and applications (aka Fintech data analytics)

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Office hours: W 4:30 pm-5:30 pm or by appointment.

Course Objectives

- This course aims to fostering and enhancing students' data analytics and software development capabilities in finance.
- After taking this class, students should be able to conduct state-of-the-art financial data analytics by implementing complicate financial models, trading algorithms and conducting related software development.

Course prerequisites

- This course assumes students have basic programming knowledge (e.g. python)
- Students must have mathematical maturity or preparation to understand financial models
- Students must be motivated to handle the challenges of possible large scale of programming

Reference text

- *High-Frequency Trading: A Practical Guide to Algorithmic Strategies and Trading Systems,* 2nd Edition, 2013 by Irene Aldridge, WILEY (*reference*)
- *Option Pricing Formulas*, 2nd Edition, 2006 by Haug, McGraw-Hill (*reference)*
- *Learn Algorithmic Trading,* 2019 Donadia, Packet, (*reference)*

ZOOM Meeting
`https://us02web.zoom.us/j/83192850206?pwd=eS9EdWNqQm94RlJ0bFp1YlhKcFFYQT09`

Homework

- There are 5-7 homework assignments.
- Each homework should be clearly typed. Paper-pencil based homework solution will not be accepted.
- Your homework should consist of *workable codes* and corresponding running results, in addition to typing related problem solutions or question answers.
- Each student or group should submit their homework/project via *blackboard* system.

Projects

- There are three large programming projects. At least one project will be a team project.
- The projects mainly focus on real-world Quant problem solving or related topics.
- Each team will be required to present their projects in class, if the project is a group project.

Grading

The grading will be based on the following weighted 100 points.

- Quizzes/Homework: 35%
- Projects: 30%
- Midterm: 15%
- Final: 20%

Topics to be covered

- Introduction to financial programming & analytics (I,II)
  - Introduction to financial data science
  - Pandas for financial data analytics
  - Data-driven and model driven analytics
  - Singular value decomposition
- Data retrieval and data visualization in Finance
  - Retrieve Financial data from web database

  - HFT and Cryptocurrency data retrieval
  - Financial data visualization techniques
  - Web crawling data curation
- Machine learning and AI methods in Finance (I, II)
  - Shallow and mid-level learning models and performance analysis
    - kNN, SVM, Random forests, Extra trees, Gradient boosting
    - classification measures
  - Support vector machines (SVM) in credit risk analytics
  - Hierarchical learning in option pricing
  - DBSCAN clustering for finance data
  - Dimension reduction methods in finance (PCA, KPCA, ICA, t-SNE, UMAP)
- High-frequency trading (HFT)
  - HFT characteristics
  - Volatility estimation for HFT data: section volatility
  - HFT data visualization
  - HFT trading marker discovery
  - HFT price discovery
  - HFT trading machine building using deep learning
- Deep learning in Finance
  - DNN, CNN and LSTM models
  - Cryptocurrency price discovery via LSTM
- State-of-the-art financial models (I,II)
  - Black-Scholes models and its variants
  - Monte-Carlo simulations and its speed-up
  - Barrier option pricing
- Stock risk analytics
  - Volatility and implied volatility analytics
  - Volatility estimation models
  - Alpha, Beta, Sharpe ratios
  - Root-finding methods
  - Greeks and non-Greeks-based implied volatility pricing
- Blockchain in Finance: Cryptocurrency trading machine building
- AI methods in Endowment analytics
- Big Finance data analytics (if time permits)

Course Web

- The course homepage can be accessed through *blackboard* in your *my.fordham* account.
- All lecture notes, homework, projects, and related materials will be posted there.

Course Policy

- Every student is required to attend each class/lecture meeting. If you have to miss a class for some reason, please let your instructor know in advance by email, phone call, or other ways.
- Each student shoudl turn on video in class meeting
- There is no make-up for quizzes. Late homework/project will not be accepted unless there is an acceptable reason.
- Discussion for homework/project assignments is encouraged. However, each student should turn in their own *independent work*. Copying codes and answers from Internet or other resources in homework and projects will be counted as cheating.
- Each project/homework/quiz submission must include all workable codes. Failure to do this will lea to a zero count for the assignment.

Miscellaneous

- Please let your instructor know if you have a disability that requires special arrangements.
  - Under the Americans with Disabilities Act and Section 504 of the Vocational Rehabilitation Act of 1973, all students, with or without disabilities, are entitled to equal access to the programs and activities of Fordham University. If you believe that you have a disability that may interfere with your ability to participate in the activities, coursework, or assessment of the object of this course, you may be entitled to accommodations. Please schedule a meeting to speak with someone at the Office of Disability Services (Rose Hill - O'Hare Hall, Lower Level, x0655 or at Lincoln Center – Room 207, x6282).
- The main office of the Department of Computer and Information Science is in LL 609 (Phone: 718-817-4480).