In the fall of 2019, ACTSC 974/STAT 974 will be offered under the following theme: **AI in Finance and Business Analytics.** This informal description of the course is tentative in nature and made available in haste (at the request of some interested students) and it may still subject to changes as it is being further updated until the first day of class.

![AI, DS and ML+DL](image)

Figure 0.1: AI, DS and ML+DL

1 Course Description

This course will discuss basic concepts and underlying principles of artificial intelligence (AI), delving, in particular, into fundamentals of machine learning (ML), including deep learning (DL), and drawing important insights from *various applications* in Finance and Business Analytics. By exploring applications of (ML) and (DL), this course encourages students to creatively put readily-available (AI) technologies into tackling issues encountered in Finance and Business Analytics.

2 Instructors

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TA: To be assigned

3 Time and Place

Time: 01:00-02:20 T, Th
Place: M3-3103

4 Textbooks

1. An Introduction to Statistical Learning, with applications in R (ISLR) by James, Witten, Hastie, and Tibshirani.
2. The Elements of Statistical Learning (ESL), Second Edition, by Hastie, Tibshirani, and Friedman.
3. MIT: Deep Learning (DL) by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.

Additional references will be provided as the syllabus is further updated up until the first day of class.

5 R Instructional Materials

1. An Introduction to Machine Learning
2. Machine Learning with R and H2O
3. R Interface for ”H2O"
5. R Interface to ”Keras”
6. R interface to Keras
7. Using TensorFlow and R

Additional references will be provided as the syllabus is further updated up until the first day of class.

6 Python Instructional Materials

1. Python-Numpy Tutorials
2. Scikit-learn Tutorials
3. Jupyter Notebook Tutorials

4. PyTorch Tutorials

5. Deep Learning: Do-it-yourself with PyTorch

6. Tensorflow Tutorials

7. MXNet Tutorials

8. Theano Tutorials

Additional references will be provided as the syllabus is further updated up until the first day of class.

7 Lectures

1. Overview of Artificial Intelligence in Finance and Business Analytics

2. Supervised Learning
   
   (a) Machine Learning
   
   i. Regression, Classification, Variable Selection, and Model Validation
   
   ii. Decision Tree, Random Forest and Boosting
   
   iii. Reinforcement Learning

   (b) Deep Learning
   
   i. Artificial Neural Network
   
   ii. Recurrent Neural Network
   
   iii. Long Short Term Memory

3. Unsupervised Learning
   
   (a) Principal Component Analysis
   
   (b) Autoencoders
   
   (c) Variational Autoencoders
   
   (d) Generative Adversarial Networks
8 Computing

Computing is both the highlight and the emphasis of this course and it is done in R primarily, and Python if it is needed and/or when it is more convenient to use. In particular, about 40% of the classes are devoted to R/Python Labs and Applications.

9 Applications

The focus of this course is on AI applications in Finance and Business Analytics. In Financial applications, careful consideration will be taken with regard to features unique to financial data. Applications will in general touch on several important areas in financial time-series prediction, including (but not exclusively) credit decisions, risk management, algorithmic/high-frequency/quantitative trading, factor investing, personalized banking, financial fraud detection and prevention, and (business) process automation. Applications to portfolio optimization and portfolio analysis, financial derivative pricing as well as asset pricing in general will also be explored in this course, time permitting.

10 Homework and Projects

There will be five homework assignments, which will make up for 40% of the total course grade. They are designed specifically to get you familiarized with basic methods of AI and to build up your coding proficiency with R/Python by writing R/Python codes to implement these methods. You can work in groups for the assignments. However, you are expected to write up and submit your own version of the completed assignment, and display a high level of independent learning, initiative, and creativity.

Most of the grades will come from two Group Project Reports (GPRs), GPR #1 and GPR #2, which will make up for 60% of the total course grade. Submission of both GPRs are mandatory in order to pass the course. Students are encouraged to form a team consisting of at least two members and at most four members. The first project involves getting you acquainted with a particular application of AI of your choice subject to an approval by the instructor. Once an application has been identified, each group is expected to study it in depth, write a report describing the selected application, including a critical literature review of several studies in the chosen application area.

For GPR #2, each group will implement the application of your choice as a follow up to GPR #1. By implementation, I mean that each group will write R/Python codes, train learning algorithms, and perform data analysis on the selected application, and write a research report describing this application, discussing in detail the implementation stage and the results obtained from this stage, and offering a set of workable recommendations based on the research output.
Details of homework and projects will be provided as the syllabus is further updated up until the first day of class.