



Risk Center Block Course - Spring 2021

Machine Learning in Finance

Its Technology in Perspective

Announcement

Machine Learning in Finance: Its Technology in Perspective

The fascinating successes of Machine Learning (ML) in language processing, image recognition or multi-player games have triggered many fantasies to apply these technologies in other fields as well, including the area of banking and finance. We are therefore witnessing a tremendous growth in the adoption of ML tools in the financial industry over the last years. According to executives, the impact of the adoption is still mixed. Why is this the case, and which are the perspectives of ML technology in banking and finance?

About the Course

This course will go through some basic concepts of ML and its most common tools and programming techniques used in latest research. At the same time, we will elaborate on the conceptual frameworks -- putting the current approaches into historic context. By opening up the conceptual foundations of AI we aim to elucidate what kind of problem of today we can translate into ML problems and which ones not. Finally, we will integrate ML applications from other areas ranging from text mining, modelling extreme events and intelligent maintenance.

Setting: Virtual and Class Room

Given uncertainty about the situation on restrictions around Covid - 19, the course will be set up as a hybrid version integrating online sessions and joint session for discussion and networking at Swiss Re Headquarters and ETH Zürich.

Who should attend?

Our block courses are designed to appeal to a wide audience of decision makers and to provide actionable information for all professionals that play a role in managing risks in their organization—not just IT professionals. This course is aimed at everybody who wants to deepen her knowledge in machine learning and its potentials in modern financial industry. An interest in the conceptual underlying and in the philosophy of ML or AI is also welcome. Different backgrounds like economics, finance, or quantitative finance are welcome. Basic programming skills (Python) are recommended in order to follow the coding examples. However, you can follow the course without the programming part as well.

Structure

The course is structured as 6 afternoon sessions (see detailed schedule on page 4)

Pre-Session (optional): Introduction to programming and basic applications

Part I: Fundamentals of ML with recent applications in Finance (Josef Teichmann, Bastian Bergmann)

Part II: Applications in Finance (Patrick Cheridito, Sebastian Becker)

Part III: Further Applications
(to take place at Swiss Re)

Course Language

The course language is English

Number of Participants

The number of participants is limited to 20.

Course Fee and Registration

CHF 2 000.-

Registration deadline is Feb 1, 2021

Certificate

Participants get a certificate for confirmation of participation.

Venue

Online via Zoom ,
ETH Main Building
Rämistrasse 101

Course Coordination

Dr. Volker Britz
ETH Risk Center
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Course Administration

Michaela Diehl
ETH Risk Center
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Course Contents

Programming On-boarding Session (optional)

It is intended for participants who are interested to implement these techniques on their own. We will cover topics like preprocessing of training data, splitting of training sets, and the implementation of neural networks as well as their training on simple examples. We will mainly focus on Python, Numpy, and Keras but, as time allows, we may also provide an outlook on other tools like sklearn or Tensorflow. All participants are requested to bring their own Laptop. Basic programming skills in Python are beneficial but not essential. During the main course, the lecturer will provide a weekly Zoom meeting during the period of the main-course where participants are welcome to ask implementation specific questions about the current topics.

Fundamentals

This part will deal with the various ML topics with insights on proofs and many coding excursions: Universal approximation theorems, stochastic gradient descent, deep networks and wavelet analysis, deep hedging, deep calibration, different network architectures, reservoir computing, time series analysis by machine learning, reinforcement learning, generative adversarial networks, and economic games.

Deep Deliberation: On Human and Artificial Intelligence

By opening up the conceptual foundations of AI we aim to elucidate what kind of problems of today we can translate into ML problems and which ones not. Human intelligence is often regarded as coming close to be a kind of «calculative» feature – that in turn sounds really appealing in the sense to have a computer to simply calculate it. We will elaborate on why this endeavor may be misleading and if there is another conceptualization of human intelligence which fits also to today's ML approach.

Pricing and hedging American-style derivatives with neural networks

The first part of this session, the theory of American and Bermudan options is reviewed. Then a concrete example is studied in more detail, and it is shown how a neural network algorithm for pricing and hedging can be implemented.

ML for Health Monitoring of Critical Systems with Rare Faults

Since machine and deep learning approaches rely on learning patterns from representative examples, one of the major challenges in applying approaches for fault detection and diagnostics tasks is the lack of labeled data, i.e. a lack of a sufficient number of representative samples of known fault patterns. Because faults are

rare in complex safety critical systems, such as aviation or railway systems, it is unfeasible to obtain sufficient samples from all possible fault types that can potentially occur. The lecture explores different approaches to tackle these challenges and benefit from the learning abilities of deep learning algorithms.

SupTech in Practice (FINMA)

SupTech – i.e., the application of innovative technology to supervise financial institutions – is used in many countries. However, the stage of national authorities in this technological journey is quite heterogeneous. First, based on two regulatory survey papers, this part will sketch the global SupTech landscape in this respect. Second, looking at the Swiss supervision approach at FINMA, we will elaborate on FINMA's SupTech approach. Both on what is already implemented at FINMA and how FINMA fosters SupTech innovation in its Data Innovation Lab.

ML in Re-Insurance

The course is organized in cooperation with SwissRe. The reinsurance perspective on Machine Learning in Finance is particularly relevant. While the financial sector at large needs effective risk assessment and portfolio management techniques, the reinsurance business goes a step further: Reinsurance companies have to pay special attention to rare, catastrophic, and systemic risks that are not easily diversified away. This creates additional challenges for an effective Machine Learning approach.

Participant Takeaways

- Understand the basics of machine learning, how it is applied to various applications and how it is processed on various platforms
- Outline the key design considerations for machine learning systems
- Understand the strengths and weaknesses of various architectures
- Outline key aspects of practical problems that are likely to impact performance
- Be able to discuss scaling issues (amount of data, dimensionality, storage, and computation)
- See through the process of applying machine learning methods in practice, foresee likely hurdles and possible remedies

Speakers and Dates

In addition to ETH lecturers, selected industry experts will share their knowledge, also from the managerial perspective, on the integration of ML tools into real world cases and business processes.

Course Directors:

Prof. Dr. Josef Teichmann

Stochastic Finance Group, MATH

ETH Risk Center

Dr. Bastian Bergmann

ETH Risk Center

ETH Risk Center

Dr. Sebastian Becker,

Risk Lab, ETH Zurich

Dr. PD Volker Britz

ETH Risk Center

Prof. Dr. Patrick Cheridito

Risk Lab, MATH

Prof. Dr. Olga Fink

Intelligent Maintenance, BAUG

Guest Speakers

Jeff Bohn,

Swiss Re Institute

Pascal Böhi

Fintegral AG

Dan Wunderli

FINMA

Dates and Times

Pre-Session: Feb 12, 2021

15.00 - 19.00 - online via Zoom

Session 1: Feb 26, 2021

15.00 - 19.00 - online via Zoom

Session 2: Mar 5, 2021

15.00 - 19.00 - online via Zoom

Session 3: Mar 19, 2021

15.00 - 19.00 - online via Zoom

Session 4: Apr 9, 2021

15.00 - 19.00 - (Location: tba)

Session 5: Apr 23, 2021

15.00 - 19.00 - (Location: tba)

Session 6: Apr 30, 2021

15.00 - 19.00 - (Location: Swiss Re)

Panel Discussion with Speakers and Networking Apero

June 2021 at ETH Zurich (Date to be announced)

Participant Takeaways

- " Good course, even though difficult at times; but then again, it is hard to satisfy all needs and some participants sounded fairly advanced. Even though not trivial, I liked the mathematical background which also makes sense given it is an ETH course.
- "The course gave me a solid introduction to the topic. I use the course as a starting point for an in-depth examination of machine learning."

Further Details and Registration: [Link](#)



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