University of St.Gallen

Course and Examination Fact Sheet: Autumn Semester 2020

9,165: Financial Technology

ECTS credits: 4

Overview examination/s

(binding regulations see below)
Decentral - Written examination (100%, 90 mins.)
Examination time: term time

Attached courses

Timetable -- Language -- Lecturer
9,165,1.00 Financial Technology -- Englisch -- Barbon Andrea

Course information

Course prerequisites

- Bachelor-level mathematics, in particular basic linear algebra (vectors, matrices, matrix multiplication) and basic calculus (derivatives and optimization)
- While familiarity with python programming is not a prerequisite, basic programming skills (on any language) are required. We will have a quick introduction to python programming, complemented with additional learning material and code samples during the course. Nevertheless, preliminary knowledge in python programming allows the student to dive into more interesting examples and exercises.

Learning objectives

At the end of the course students will be familiar with some of the key factors driving the fintech revolution in the financial sector, with a focus on blockchain, machine learning and big-data. In particular, they will acquire basic knowledge of the functioning of blockchain technology, its current and potential applications.

They will be familiar with the concepts of crypto-currency and crypto-exchange. They will acquire basic understanding of the architecture of simple neural networks and more sophisticated recurrent neural networks (RNNs). Most importantly, they will learn to implement these models in practice using the Keras module for python. They will be able to choose the appropriate architecture for specific task sand understand the cross-validation framework to properly evaluate the performance of a model.

They will be able to obtain data from web-based APIs and perform basic data-analysis tasks using python and pandas. Finally, students will learn to implement and back-test a simple trading strategy on crypto-currencies based on a predictive signal generated by a neural network model.

Course content

The financial sector is experiencing a significant wave of innovation fostered by the unprecedented availability of data and the advent of new digital technologies. This class will start by providing a brief overview these developments from an historical perspective.

Next, it will introduce the concept of blockchain from both a technical and a more high-level perspective. A detailed description of the blockchain protocol will be provided, discussing key concepts like proof-of-work and cryptographic hash function. We will then discuss consolidated and potential applications of blockchain, the role of Bitcoin as a distributed payment system and its relationships with the current banking system.

The second part of the course will revolve around deep learning methods, with a particular emphasis on deep neural networks. An overview of the architecture of feedforward neural networks will be provided, discussing fundamental concepts like artificial

neurons, back-propagation, activation functions and loss functions. After discussing the theory, live coding sessions based on Jupyter notebooks will showcase simple implementations of neural networks with python. We will then move to the discussion of the training process and of performance evaluation, focusing on cross-validation and regularization techniques. A brief overview of more sophisticated neural network architectures will be given (convolutional neural networks, auto-encoders, generative adversarial networks). We will then focus on recurrent neural networks and their application to forecasting financial time-series, including a live coding session setting up a simple high-frequency trading algorithm.

The last part will combine the first two topics, with the objective to implement a simple trading strategy on crypto-currencies based on a predictive signal generated by a neural network. Students will learn to obtain price and volume data from crypto-exchanges exploiting their APIs, and to implement a basic back-testing framework in python.

Course structure

The course will take place in the first half of the fall semester and will end with a final written exam, taking place before the semester break.

There will be one class of two academic hours each week of the fall semester. During some of the lectures we will focus on theoretical aspects (e.g. the functioning of blockchain, architecture of recurrent neural networks), while some other lessons will be more practice-oriented (e.g. data scraping, crypto-exchanges, back-testing trading strategies) with live-coding sessions and learning material in the form of Jupyter notebooks. The course will end with a final written exam.

Course literature

Learning Material

- PDF slides of the lessons
- Python programs written in Jupyter notebooks

Recommended Books

- Mastering Bitcoin, by Antonoupoulos
- The Bitcoin Standard, by Ammous
- Deep Learning (2017), by Goodfellow and Bengio
- Python Machine Learning, by Raschka
- Python for Data Analysis, by McKinney

Additional course information

In the case of the President's Board having to implement new directives due to the SARS-CoV-2 pandemic in AS2020, the course information listed above will be changed as follows:

The course is conducted online via the platform Zoom;

The recordings of the course are permanently available; The lecturer informs via StudyNet on the changed implementation modalities of the course;

Course content such as guest lecture are cancelled;

The examination information listed below would be changed as follows:

The written examination are conducted online and are being recorded;

Examination information

Examination sub part/s

University of St.Gallen

1. Examination sub part (1/1)

Examination time and form
Decentral - Written examination (100%, 90 mins.)
Examination time: term time

Remark
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Examination-aid rule
Extended Closed Book
The use of aids is limited; any additional aids permitted are exhaustively listed under "Supplementary aids". Basically, the following is applicable:

- At such examinations, all the pocket calculators of the Texas Instruments TI-30 series and mono- or bilingual dictionaries (no subject-specific dictionaries) without hand-written notes are admissible. Any other pocket calculator models and any electronic dictionaries are inadmissible.
- In addition, any type of communication, as well as any electronic devices that can be programmed and are capable of communication such as notebooks, tablets, mobile telephones and others, are inadmissible.
- Students are themselves responsible for the procurement of examination aids.

Supplementary aids
Each student may bring a double-sided A4-cheat-sheet.

Examination languages
Question language: English
Answer language: English

Examination content

The exam will cover all topics discussed in the course:

- Blockchain technology
- Cryptocurrencies
- Feedforward neural networks
- Recurrent neural networks
- Data collection through APIs
- Algorithmic trading

The focus will be the comprehension of key concepts and the ability to perform critical reasoning on those.

Examination relevant literature

PDF slides of the lectures and provided Jupyter notebooks.

Additional relevant literature will be indicated in the lectures

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Please note

Please note that only this fact sheet and the examination schedule published at the time of bidding are is binding and takes precedence over other information, such as information on StudyNet (Canvas), on lecturers' websites and information in lectures etc.

Any references and links to third-party content within the fact sheet are only of a supplementary, informative nature and lie outside the area of responsibility of the University of St.Gallen.

Documents and materials are only relevant for central examinations if they are available by the end of the lecture period (CW51) at the latest. In the case of centrally organised mid-term examinations, the documents and materials up to CW 42 are relevant for testing.

Binding nature of the fact sheets:

- Course information as well as examination date (organised centrally/decentrally) and form of examination: from bidding start in CW 34 (Thursday, 20 August 2020);
- Examination information (regulations on aids, examination contents, examination literature) for decentralised examinations: in CW 42 (Monday, 12 October 2020);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised mid-term examinations: in CW 42 (Monday, 12 October 2020);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised examinations: two weeks before the end of the registration period in CW 44 (Thursday, 29 October 2020).