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**UNIVERSITÄT  
BERN**  
MATHEMATICAL INSTITUTE

[www.math.unibe.ch/cas\\_aml](http://www.math.unibe.ch/cas_aml)

2021 - 2022



# CAS Advanced Machine Learning



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# CAS Advanced Machine Learning

## INTRODUCTION

In many disciplines, the amount of available data and the computing capacity are growing rapidly. This enables the application of machine learning methods on tasks previously being reserved for humans. Trained machines outperform homo sapiens in more and more cognitive tasks. As with other disruptive technology emergences, the resulting automation potential represents a huge benefit for the human society, but also comes with new challenges and risks. This CAS offers the opportunity to complement your data science competences with a formal deepening and broadening of knowledge and skills on machine learning and artificial intelligence. The format is designed to align with the participants' main study and or professional activities. The teaching and learning approaches are team and discussion oriented and designed to develop practical competency.

The program is organized into six modules and a CAS project work, running over 18 course days, given in blocks (August/September, and January/February) and on Friday afternoons in October, November and December. It targets professionals and researchers in the private and public sector. The content covers a review of machine learning methods, established applications, the research frontier and philosophical and ethical aspects. The difficulty is at a university master level and assumes own basic machine learning experience, programming skills and a higher education degree with some mathematical background. The program is applied in the sense of focusing on concepts and usage of common machine learning tools, not so much on theoretical elaboration of the mathematics, statistics and informatics.

# OBJECTIVES

Course competence is developed throughout six modules and a CAS project work. On completion the graduates will (be able to):

1. design, tune, train and measure performance of neural networks with advanced deep learning libraries;
2. understand the inner mechanisms of neural networks during training;
3. familiar with active research in machine learning;
4. understand and communicate scientific publications on machine learning and artificial intelligence;
5. familiar with the philosophy and ethics of extended and artificial intelligence;
6. familiar with one or more applied machine learning domains, the main mathematical methods for data science and machine learning or basic entrepreneurship (elective module).





# TARGET GROUPS

Aimed at students and professionals from the public and private sector that hold a degree from a university or a university of applied sciences (e.g. BSc, MSc, PhD).

**SUITABLE FOR MANAGEMENT** ▶ wanting to know how machine learning is performed, limitations and possibilities, ethical aspects

**RELEVANT FOR DATA ANALYSTS** ▶ wanting to deepen and update their machine learning skills

**APPLICABLE TO CONSULTANTS** ▶ with a desire to know and exploit the possibilities offered by machine learning methods

**INTENDED FOR RESEARCHERS** ▶ wanting to extend the machine learning application in their field

Standard data sets are provided, but participants are encouraged to bring or acquire their own. If you have any questions regarding whether this program could work for you, please do not hesitate to contact us.



# MODULES

## **MODULE 1 ► REVIEW OF MACHINE LEARNING, PRACTICAL METHODOLOGY AND APPLICATIONS (BLOCK)**

Review of basic principles, concepts, practical methodology and applications of machine learning.

## **MODULE 2 ► DEEP NETWORKS (BLOCK)**

Study of established deep network applications commonly used in industry.

## **MODULE 3 ► DEEP LEARNING RESEARCH (BLOCK MALLORCA)**

Study of new promising, but not yet widely established approaches with deep networks.

## **MODULE 4 ► SELECTED TOPICS ON MACHINE LEARNING (SEMINAR)**

Participants study selected publications on machine learning and artificial intelligence and present them to the others.

## **MODULE 5 ► PHILOSOPHY AND ETHICS OF EXTENDED COGNITION AND ARTIFICIAL INTELLIGENCE (SEMINARS)**

Artificial Intelligence as a scientific field dates back to the 1950s. This module concerns key philosophical and ethical questions and discussions triggered by the existence of intelligence outside the human brain.

## **MODULE 6 ► ELECTIVE MODULE (BLOCK)**

One 2 ECTS module on machine learning in an applied domain, mathematical methods for machine learning and data science or entrepreneurship.

## **PROJECT WORK ► 120 HOURS**

Participants define and perform a 4 ECTS project work, individually or in teams during the CAS. Support is provided by the CAS lecturers. Output is a report, computational notebooks and a presentation. The use of own data from profession or research is encouraged.

## **ALL MODULES**

The modules use online platforms with multimedia materials, tutorials and assessments to aid learning, along with classes for discussion, feedback and a chance to deepen knowledge. The duration of the modules corresponds to approximately 20 classroom hours each and module work (expected effort is 30 hours), with each complete module qualifying for 2 ECTS points. Main tools and CAS language are Python, TensorFlow and Git. Other tools may be used, then with limited support. Computational resources are offered.

# SCHEDULES AND LOCATIONS

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<b>Module 1</b> Review of Machine Learning	Aug. 24. – 27. 2021
<b>Module 2</b> Deep Networks	Aug. 31. – Sept. 3. 2021
<b>Module 3</b> Deep Learning Research	Oct. 4. – 8. 2021
<b>Module 4 and 5</b> Selected Topics on ML, Philosophy of AI	Weekly from Oct. 22. – Dec. 18. 2021, 13:15 – 17:00
<b>Module 6</b> One elective Module	Feb. 1. – 4. 2022
<b>CAS Project Work</b> Submission Deadline	Apr. 30. 2022

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All courses are held online. The physical locations are within the University of Bern campus, reached easily by foot from Bern railway station, except Module 3, which takes place outside the University. Stay and full board for Module 3 are included in the fee.





# KEY FIGURES

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**DEGREE** ▶ CAS Advanced Machine Learning (CAS AML)

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**STRUCTURE** ▶ 6 thematic modules with performance assessments.  
▶ Individual modules possible.  
▶ Project work.

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**SCOPE** ▶ 16 ECTS  
▶ Approximately 480 hours comprised of lectures, module projects, performance assessments.

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**DURATION** ▶ 1 year (2 years possible).

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**REGISTRATION** ▶ November – May.

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**START** ▶ August 2020.

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**FORMAT** ▶ Min. 18 days of presence (126 hours attendance).

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**TARGET GROUP** ▶ Public & private sector.  
▶ Reseachers.

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**CAPACITY** ▶ 24

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**LECTURERS** ▶ University of Bern.  
▶ External experts.

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**LANGUAGE** ▶ English

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**FEE** ▶ CHF 9'600.-  
▶ Employees & Students of the University of Bern CHF 5'600.

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# CAS PROGRAM FEES

Regular CAS program	CHF 9'600.-
Employees & Students of University of Bern	CHF 5'600.-

Inclusive of all modules, performance assessments, certificates, materials & teaching platforms, coffee breaks, full pension hotel (Module 3) and diploma apero. Participants must supply their own laptops.

\*If there are free places, modules can be attended individually. Prices are CHF 300.- per half day. Individual modules are accredited with certificates which are accumulated for the full CAS AML.

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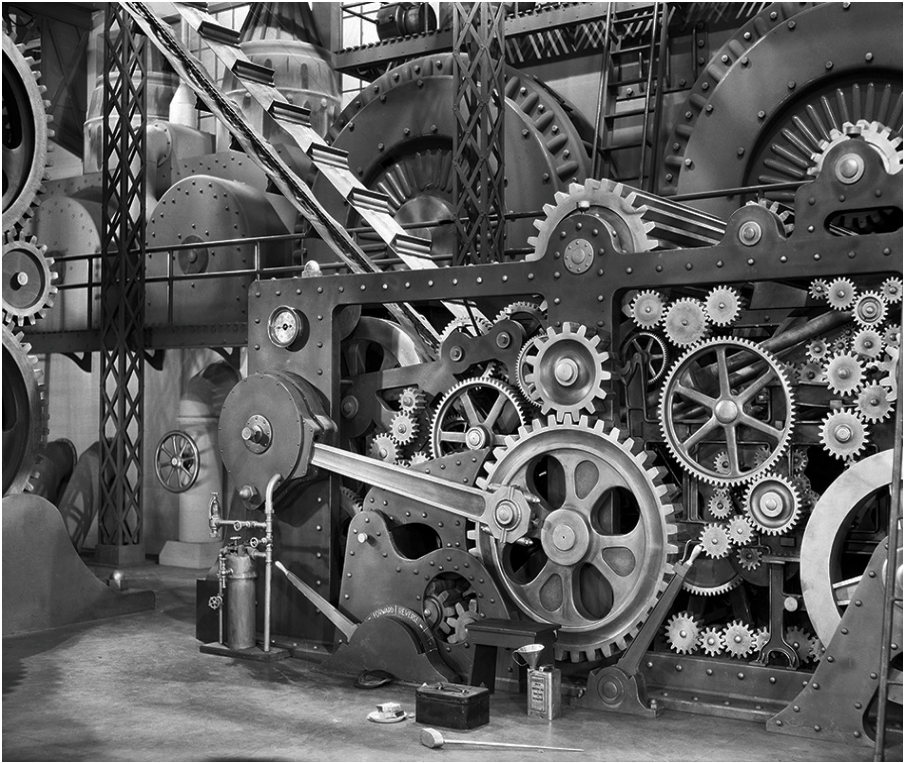
## REGISTRATION

Register via: [www.math.unibe.ch/cas\\_aml](http://www.math.unibe.ch/cas_aml)

Registered participants will receive acceptance confirmation by email and will be invited to one of the next Introduction to the CAS Advanced Machine Learning events. Attendance to one event is mandatory. Participants can cancel their registrations before the deadline without any costs. After the deadline the regulations apply. Please contact [cas-aml@math.unibe.ch](mailto:cas-aml@math.unibe.ch) for further information.

Registration opens in November and a maximum of 24 registrations can be accepted each year. Registrations are processed in the order of arrival. The CAS can only be offered if there are enough registrations by the deadline.

Deadline: End of May



# PROGRAM MANAGEMENT

Prof. Dr. Jan Draisma  
Prof. Dr. Paolo Favaro  
PD Dr. Sigve Haug (director of studies)  
Prof. Dr. Christiane Tretter  
Prof. Dr. Thomas Wihler (chair)

# LECTURERS INCLUDE

Prof. Dr. Dr. Claus Beisbart – University of Bern  
Dr. Geraldine Conti – PAG  
PD Dr. Sigve Haug – University of Bern  
Dr. Aris Marcolongo – University of Bern  
Dr. Kinga Sipos – University of Bern  
Dr. Mykhailo Vladymyrov – University of Bern  
Dr. Guillaume Witz – University of Bern



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