UZH ML Workshop

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UZH, Zurich

Book of Abstracts

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Which shoes fit this dress? Using product images to infer "perfect pairings" without supervision

Authors: Luca Gaegauf[1]; Markus Meierer[2]

[1] *University of Zurich*

[2] *UZH*

Corresponding Author: lucagaegauf@gmx.ch

Product recommendations are omnipresent and contribute significantly to the revenue of online retail businesses. Nevertheless, customers often complain about the quality of recommendations. A possible explanation is that the requirements of existing approaches are not always met. The increasing speed of product assortment changes challenges collaborative filter techniques, which are subject to the cold start problem. Alternative approaches such as preference- or content-based recommendations systems require detailed structured information (e.g., on product characteristics or previous customer purchase patterns), which is often not available. Addressing this challenge, the authors propose an unsupervised approach to infer recommendations across domains solely based on product images. With the increasing interest in deep learning techniques, convolutional neural networks have been used to infer single-domain recommendations based on the intrinsic information of product images (e.g., recommend alternative dresses based on the image of a dress). Albeit promising, approaches to infer cross-domain recommendations are largely unexplored. Using generative adversarial networks and convolutional neural networks to leverage the implicit information in product images, the authors propose an unsupervised approach to make recommendations across product categories (e.g., recommend shoes based on an image of a dress). The performance of the approach is assessed by benchmarking to various empirical baselines as well as surveying potential customers on the perceived quality of the recommendations. Further, the authors discuss two extensions: (1) Making recommendations for multiple other domains based on a single product image as input and (2) making cross-domain recommendations based on multiple product images as input. Concluding, theoretical and managerial implications are discussed.

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Learning Vision-based Agile Flight

Autonomous quadrotors will soon play a major role in search-and-rescue and remote-inspection missions, where a fast response is crucial. Quadrotors have the potential to navigate quickly through unstructured environments, enter and exit buildings through narrow gaps, and fly through collapsed buildings. However, their speed and maneuverability are still far from those of birds and human pilots. Autonomous, vision-based agile navigation through unknown, indoor environments poses a number of challenges for robotics research in terms of perception, state estimation, planning, and control. In this talk, I will show how machine learning methods united with the power of new, low-latency sensors, such as event-based cameras, allow drones to achieve unprecedented speed and robustness by relying solely on the use of passive cameras, inertial sensors, and onboard computing.

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Application of machine learning methods in gravitational wave astrophysics

Identifying the presence of a gravitational wave transient buried in non-stationary, non-Gaussian noise which can often contain spurious noise transients (glitches) is a very challenging task. For a given data set, transient gravitational wave searches produce a corresponding list of triggers that indicate the possible presence of a gravitational wave signal. These triggers are often the result of glitches mimicking gravitational wave signal characteristics. To distinguish glitches from genuine gravitational wave signals, search algorithms estimate a range of trigger attributes, with thresholds applied to these trigger properties to separate signal from noise. In this talk I would like to demonstrate how machine learning techniques can significantly improve the signal detection, parameter estimation of transient signals and noise removal techniques.

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Identifying Anomalous Shared E-Scooter Patterns Using Unsupervised Deep Learning

Author: Yanan Xin[1]

Co-author: Alan MacEachren [2]

[1] *ETH*

[2] *The Pennsylvania State University*

Corresponding Author: maceachren@psu.edu

Dockless e-scooters have flooded into many cities as a new type of shared vehicle, giving transportation planners great challenges in providing timely support towards setting up necessary infrastructure and regulations. Despite the need, there have been relatively few studies on shared dockless e-scooters and even less attention to identifying anomalous usage patterns. These studies are an essential to guide policymaking and assist in the management of e-scooter fleets. In this paper, we identify and analyze anomalous usage patterns of dockless e-scooters using an unsupervised deep learning approach, ConvLSTM-Autoencoder, applied to large sets of data from three e-scooter companies operating in Washington, DC. The approach used in this study has successfully identified meaningful anomalies in the dockless e-scooter data collected in the city. During the evaluation process, we were able to associate specific driving factors to specific identified anomalies, including adverse weather, large social events, government policy mandates, and company maintenance operations. Our results suggest that an unsupervised deep learning approach, specifically ConvLSTM-Autoencoder, can effectively identify abnormal usage patterns of dockless e-scooters (and similar shared vehicle use) in an automatic way with high reliability.

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Machine learning in quantum chemistry

In the past, potential energy functions for atomistic simulations have been derived using physical approximations whenever the direct application of electronic structure methods has been too demanding. For years people kept fitting potentials to develop new force field, cheap and reasonably accurate methods to carry out computer simulations.
Recent advances in machine learning offer new approaches for the representation of potential-energy surfaces by fitting large data sets from electronic structure calculations.
This talk wants to give an overview on this topic and some examples of applications as well.

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Searching for new physics with Variational Autoencoders

In this talk I will discuss my research into the use of variaitonal
autoencoders to search for new physics anomalies in di-jet events at the Large Hadron Collider. Given the nature of the workshop I will also give a broader overview of the challenge this work addresses, and discuss prospects for the use of such methods in the future.

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Financial documents processing with NLP

Processing financial documents quickly and incorporating updated information (e.g. earning calls, news and financial filings) are the keys to successful investment decision. However, as the volume of financial documents explodes, the number of financial analysts is far from enough compared with the demand for efficiency and coverage, especially during peak seasons. With the progress of Natural Language Processing (NLP), extracting valuable information from these financial text sources gain popularity among academic and industrial researchers. This talk would first provide an overview of common datasets that are public available in the field (both labeled and unlabeled), and then cover some of our researches using these datasets.

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Introduction

Corresponding Author: vinicius.mikuni@gmail.com

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Hands-on information

Corresponding Author: davide.lancierini@cern.ch

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Workshop closing

Corresponding Author: faroughy@physik.uzh.ch

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hls4ml tutorial: Ultra low-latency deep neural network inference on FPGAs

Author: Thea Aarrestad[1]

Co-author: Sioni Paris Summers [1]

[1] *CERN*

Corresponding Author: thea.aarrestad@cern.ch

Please register at the separate page for this tutorial:

https://indico.cern.ch/e/hls4mlatUZH

With edge computing, real-time inference of deep neural networks (DNNs) on custom hardware has become increasingly relevant. Smartphone companies are incorporating Artificial Intelligence (AI) chips in their design for on-device inference to improve user experience and tighten data security, and the autonomous vehicle industry is turning to application-specific integrated circuits (ASICs) to keep the latency low. While the typical acceptable latency for real-time inference in applications like those above is O(1) ms, other applications require sub-microsecond inference. For instance, high-frequency trading machine learning (ML) algorithms are running on field-programmable gate arrays (FPGAs), highly accurate devices, to make decisions within nanoseconds. At the extreme inference spectrum end of both the low-latency (as in high-frequency trading) and limited-area (as in smartphone applications) is the processing of data from proton-proton collisions at the Large Hadron Collider (LHC) at CERN. Here, latencies of O(1) microsecond is required and resources are strictly limited. In this tutorial you will get familiar with the hls4ml library. This library converts pre-trained Machine Learning models into FPGA firmware, targeting extreme low-latency inference in order to stay within the strict constraints imposed by the CERN particle detectors. You will learn techinques for model compression, including how to reduce the footprint of your model using state-of-the art techniques such as model pruning and quantization through quantization aware training. Finally, you will learn how to synthesize your model for implementation on chip. Familiarity with Machine Learnining using Python and Keras is beneficial for participating in this tutorial, but not required.

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GANs Tutorial

Corresponding Author: davide.lancierini@cern.ch

Please, visit (and apply for!) the separate page for this tutorial: https://indico.cern.ch/event/973553/

Generative Adversarial Networks (GANs) play a key role in the development of fast simulation methods in High Energy Physics. In this workshop we will explore the applications of Conditional GANs and pix2pix GANs to a toy dataset. In particular we will implement common methods to avoid mode collapse phenomena.

The workshop will follow a “code-along” approach with space for discussion on code implementation and performance of GANs in tackling fast simulation problems.

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A Machine Learning journey from customer reviews to business insights

Corresponding Author: federica.lionetto@gmail.com

Please, visit (and apply for!) the separate page for this tutorial: https://indico.cern.ch/event/974224/

Customer reviews are a powerful source of information that can help product and service providers to better understand customers’satisfaction and quickly react to match customers’needs. However,

as the amount of information available through customer reviews rapidly increases over time, the process of extracting business insights from data becomes more and more time-consuming. In this workshop, we will discuss how Natural Language Processing and Machine Learning techniques can help automate the process of converting collected data into actionable business insights. We will work with a real-world dataset of airline reviews and cover aspects related to data preparation as well as model selection, training and testing.

Mail: federica.lionetto@gmail.com

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Machine Learning techniques in gamma-ray astrophysics

Author: Alison Mitchell[1]

[1] *University of Zurich*

Corresponding Author: alison.mitchell@physik.uzh.ch

Gamma-ray Astrophysics concerns the most powerful particle accelerators in the universe and the origins of cosmic rays. In recent years, the field has continuously progressed from studies of individual sources to large-scale surveys. Due to the detection technique used by ground-based gamma-ray telescopes, machine learning has enabled considerable progress in recent years.
The data volumes acquired in modern-day astrophysics prohibit manual examination and increasingly machine learning techniques are also employed for source identification and classification. In this talk, I will explain how machine learning has benefited gamma-ray astronomy and will also introduce some of the planned astrophysical facilities of the future, along with their associated challenges.