3rd ATLAS Machine Learning Workshop

Report of Contributions

https://indico.cern.ch/e/aml2018

Contribution ID: **1** Type: **not specified**

Constraining Effective Field Theories with Machine Learning

Wednesday 17 October 2018 09:00 (20 minutes)

We present powerful new analysis techniques to constrain effective field theories at the LHC. By leveraging the structure of particle physics processes, we extract extra information from Monte-Carlo simulations, which can be used to train neural network models that estimate the likelihood ratio. These methods scale well to processes with many observables and theory parameters, do not require any approximations of the parton shower or detector response, and can be evaluated in microseconds. We show that they allow us to put significantly stronger bounds on dimension-six operators than existing methods, demonstrating their potential to improve the precision of the LHC legacy constraints.

Application

Physics Analysis

Authors: BREHMER, Johann; CRANMER, Kyle; LOUPPE, Gilles; PAVEZ, Juan

Presenters: BREHMER, Johann; CRANMER, Kyle; LOUPPE, Gilles; PAVEZ, Juan

Session Classification: External To Atlas

Contribution ID: **11** Type: **not specified**

Systematics aware learning: a case study in High Energy Physics

Wednesday 17 October 2018 09:50 (20 minutes)

Experimental science often has to cope with systematic errors that coherently bias data. We analyze this issue on the analysis of data produced by experiments of the Large Hadron Collider at CERN as a case of supervised domain adaptation. The dataset used is a representative Higgs to tau tau analysis from ATLAS and released as part of the Kaggle Higgs ML challenge. Perturbations have been introduced into this dataset to mimick systematic errors. A classifier is trained to separate the Higgs signal from the background. The goal is to reduce the sensitivity of the classifier with respect to systematics uncertainty. The figure of merit is the total uncertainty, including statistical and systematics uncertainty.
Systematics-aware learning should create an efficient representation that is insensitive to perturbations induced by the systematic effects. Different techniques have been experimented with and will be reported (i) Data Augmentation (training on a mix of data generated by varying the nuisance parameter), (ii) Adversarial Learning (using the Pivot technique, an adversarial network is trained simultaneously to the classifier to reduce the classifier sensitivity) (iii) Tangent Propagation (regularizing the partial derivative of the classifier score with respect to the nuisance parameter).

Application

Physics Analysis

Authors: ROUSSEAU, David (LAL-Orsay, FR); ESTRADE, Victor (LRI); GUYON, Isabelle; GERMAIN, Cecile (Universite Paris Sud)

Presenter: ESTRADE, Victor (LRI)

Session Classification: External To Atlas

Contribution ID: **21** Type: **not specified**

The TrackML tracking challenge : status report at half time

Wednesday 17 October 2018 11:35 (20 minutes)

LHC experiments need to reconstruct the trajectory of particles from the few precise measurements in the detector. One major process is to « connect the dots », that is associate together the points left by each particle. The complexity of the process is growing exponentially with the LHC luminosity, so that new algorithms are needed. The TrackML challenge is a two phases competition to tackle the issue: 100.000 points to be associated into 10.000 tracks in less than 100 seconds. The first phase (with no speed incentive) has run on Kaggle over the summer, while the second one (with a strong speed incentive) is just starting on Codalab https://sites.google.com/site/trackmlparticle/ . I will summarize the preliminary findings and perspective.

Application

Object ID

Authors: ROUSSEAU, David (LAL-Orsay, FR); SALZBURGER, Andreas (CERN); CALAFIURA, Paolo (Lawrence Berkeley National Lab. (US)); FARRELL, Steven (Lawrence Berkeley National Lab (US)); KIEHN, Moritz (Universite de Geneve (CH)); AMROUCHE, Sabrina (Université de Geneve (CH)); GOLLING, Tobias (Universite de Geneve (CH)); GERMAIN, Cecile (Universite Paris Sud); ESTRADE, Victor (LRI); GLIGOROV, Vladimir (Centre National de la Recherche Scientifique (FR)); GRAY, Heather (LBNL); GUYON, Isabelle; INNOCENTE, Vincenzo (CERN); HUSHCHYN, Mikhail (Yandex School of Data Analysis (RU)); MOYSE, Edward (University of Massachusetts (US)); USTYUZHANIN, Andrey (Yandex School of Data Analysis (RU)); Dr VLIMANT, Jean-Roch (California Institute of Technology (US)); YILMAZ, Yetkin (LAL-Orsay (FR))

Presenter: SALZBURGER, Andreas (CERN)

Session Classification: External To Atlas

Track Classification: External

Contribution ID: **23** Type: **not specified**

The Lund Jet Plane

Wednesday 17 October 2018 11:10 (20 minutes)

Lund diagrams, a representation of the phase space within jets, have long been used in discussing parton showers and resummations. We point out here that they can also serve as a powerful tool for experimentally characterising the radiation pattern within jets. We briefly comment on some of their analytical properties and highlight their scope for constraining Monte Carlo simulations. We then examine the use of the Lund plane for boosted electroweak boson tagging. When used as an input to deep-learning methods it yields high performance. Furthermore, much of that performance can be reproduced by using the Lund plane as an input to simpler log-likelihood type discriminators. This suggests a potential for unique insight and experimental validation of the features being used by machine-learning approaches. In the context of our discussion, we also highlight the importance of accounting for detector effects when considering the performance of machine-learning approaches.

Application

Object ID

Authors: DREYER, Frederic Alexandre (Oxford); SALAM, Gavin (CERN); SOYEZ, Gregory (IPhT, CEA Saclay)

Presenter: DREYER, Frederic Alexandre (Oxford)

Session Classification: External To Atlas

Track Classification: External

Contribution ID: **31** Type: **not specified**

DeepFlavour and Tensorflow in CMSSW

Wednesday 17 October 2018 12:25 (20 minutes)

Jet classification, especially focused towards heavy-flavour jets, is of paramount importance for CMS. Modern ML techniques have been applied to this classification task resulting in a new generation of DeepLearning-based taggers that sport an improved performance. DeepFlavour, DeepAK8 and DeepDoubleB/C are the latest incarnations of these new family of classifiers that have been developed by the experiment. After the development, a significant effort has been invested into the deployment of such new classifiers in the complex CMS reconstruction software, CMSSW. In this presentation we will review the improvements in the ML modelling as well as the technical difficulties encountered in such classifiers in the real world of computing operations.

Application

Author: VERZETTI, Mauro (CERN)

Presenter: VERZETTI, Mauro (CERN)

Session Classification: External To Atlas

Contribution ID: **32** Type: **not specified**

How to train taggers on data

Wednesday 17 October 2018 09:25 (20 minutes)

The machine learning methods currently used in high energy particle physics often rely on Monte Carlo simulations of signal and background. A problem with this approach is that it is not always possible to distinguish whether the machine is learning physics or simply an artefact of the simulation. In this presentation I will explain how it is possible to perform a new physics search with a tagger that has been trained entirely on background data. I will show how jets of particles produced at the LHC, are prime targets for such an approach. To this end, we use an unsupervised learning method (Adversarial Auto Encoder), trained entirely on background jets, to detect any anomalous result as a new physics signal. I will show a range of applications for this approach, and describe how to practically include it in an experimental analysis by mass-decorrelating the network output in an adversarial framework and performing a bump hunt.

Application

Author: THOMPSON, Jennifer (ITP Heidelberg)

Presenter: THOMPSON, Jennifer (ITP Heidelberg)

Session Classification: External To Atlas

Contribution ID: **33** Type: **not specified**

HiggsML challenge with optimized DNN

Wednesday 17 October 2018 10:15 (20 minutes)

A lot of work done in advancing the performance of deep-learning approaches often takes place in the realms of image recognition - many papers use famous benchmark datasets, such as Cifar or Imagenet, to quantify the advantages their idea offers. However it is not always obvious, when reading such papers, whether the concepts presented can also be applied to problems in other domains and still offer improvements.
One such example of another domain is the task of event classification in high-energy particle-collisions, such as those which occur at the LHC. In this presentation, a classifier trained on publicly available physics data (from the HiggsML Kaggle challenge) is used to test the domain transferability of several recent Machine-Learning concepts.
A system utilising relatively recent concepts, such as cyclical learning-rate schedules and data-augmentation, is found to slightly outperform the winning solution of the HiggsML challenge, whilst requiring less than 10% of the training time, no further feature engineering, and less specialised hardware

Application

Author: STRONG, Giles Chatham (LIP Laboratorio de Instrumentacao e Fisica Experimental de Part)

Presenter: STRONG, Giles Chatham (LIP Laboratorio de Instrumentacao e Fisica Experimental de Part)

Session Classification: External To Atlas

Contribution ID: **47** Type: **not specified**

HEP Machine Learning on HPCs

Wednesday 17 October 2018 12:00 (20 minutes)

Overview of current efforts and plans in HEP to use HPCs for Machine Learning.

Application

Other

Author: FARBIN, Amir (University of Texas at Arlington (US))

Presenter: FARBIN, Amir (University of Texas at Arlington (US))

Session Classification: External To Atlas