Department of Physics

UNIVERSITY OF OXFORD

Machine Learning and Physics Seminar Series

Thursday, 24 October 2019 at 2.30pm
Dennis Sciama Lecture Theatre, Denys Wilkinson building

Two computing challenges for particle physics: the tracking challenge and event simulation with generative adversarial networks

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LAL Orsay

I will expand on two specific lines of effort to solve the computational challenge at the future High Luminosity LHC. (i) 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 to 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 10 seconds. The first phase (with no speed incentive) has run on Kaggle over the summer 2018, while the second one (with a strong speed incentive) has just finished on Codalab this spring. I will summarize the preliminary findings and perspective. (ii) The growing LHC luminosity also increases the need of very high statistics and accurate event simulations. More than 200.000 processor cores worldwide are crunching numbers continuously to deliver event simulations, within the current baseline technique (Geant4 like) which is to simulate particles one by one. The recent Generative Adversarial Network technique allows to train an algorithm to generate images similar to an input set, whether celebrity faces, hotel rooms … or particle showers in a calorimeter or even full LHC events. Once trained, the speed gain is potentially several order of magnitude. I will report on several strategies short-cutting the baseline approach that have now passed the proof of concept stage.

I am a senior particle physicist at LAL-Orsay (CNRS/IN2P3 and Univ. Paris-Sud/Université Paris Saclay). After many years at the forefront of software developments for the ATLAS experiment on the Large Hadron Collider at CERN until the Higgs boson discovery in 2012, I was looking for something different. A chance encounter at the cafeteria with a Machine Learning (what was that?) scientist decided it. With Higgs physics always on my mind, I organized the Higgs ML challenge in 2014, and the tracking ML challenge in 2018-2019. I have co-coordinated the ATLAS ML forum and now the LHC Interexperiment Machine Learning forum. I’m keen on both riding and promoting the ML wave in particle physics and science in general.