Popularised talk

Lighting the Black Box: Use and Validation of Machine Learning Techniques in High-Energy Theoretical Physics

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Abstract: Machine learning (ML) techniques, in particular neural network (NN) architectures, are increasingly used in high-energy physics. After a general introduction, I will present two applications of ML techniques in theoretical high-energy physics. i) Machine learning techniques are used to determine the Parton Distribution Functions (PDFs) which describe the quark and gluon content of protons. PDFs are crucial ingredients in the precision calculations of hadronic-initiated processes, such as the proton-proton collisions of the LHC. They are intrinsically non-perturbative objects, and thus have to be determined by fitting experimental data to the theory. In these cases, using the universal approximation property of NN allows for an unbiased PDF fitting. ii) ML techniques are also used to study of the pattern of quark and gluon radiations in the final state of a collider event. The distribution of radiation around a particle is tightly linked to the nature of the particle. For example, the distribution would different if the initiating particle was a quark or a gluon, i.e "quark vs. gluon discrimination". This is a typical case of a classification problem and because it requires a large number of input variables it calls for the use of ML techniques. I will also discuss some tests used to validate the ML framework both for i) and ii). These tests compare the NN outputs with known solutions for a specific input.

KEYWORDS: Particle Physics, Standard Model