Contribution ID: **16** Type: **Oral**

Evolutionary algorithms for hyperparameter optimization in machine learning for application in high energy physics

Thursday, 27 October 2022 15:30 (20 minutes)

In contemporary high energy physics (HEP) experiments the analysis of vast amounts of data represents a major challenge. In order to overcome this challenge various machine learning (ML) methods are employed. However, in addition to the choice of the ML algorithm a multitude of algorithm-specific parameters, referred to as hyperparameters, need to be specified in practical applications of ML methods. The optimization of these hyperparameters, which is often performed manually, has a significant impact on the performance of the ML algorithm. In this talk we explore several evolutionary algorithms that allow to determine optimal hyperparameters for a given ML task in a fully automated way. Additionally, we study the capability of the two most promising hyperparameter optimisation algorithms, particle swarm optimization and bayesian optimization, for utilising the highly parallel computing architecture that is typical for the field of HEP.

Significance

ML methods are in common use in HEP data analyses, but very few studies have been performed of the task of finding optimal hyperparameter values. Algorithms that allow to determine optimal hyperparameter values in a fully automated way are presented in this talk. Furthermore, we present results on how well different hyperparameter optimization algorithms parallelise on modern computing architectures, such as computing clusters and the Worldwide LHC Computing Grid (WLCG).

References

Tani, L., Rand, D., Veelken, C. et al. Evolutionary algorithms for hyperparameter optimization in machine learning for application in high energy physics. Eur. Phys. J. C 81, 170 (2021). https://doi.org/10.1140/epjc/s10052-021-08950-y

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Experiment context, if any

None

Primary authors: VEELKEN, Christian (National Institute of Chemical Physics and Biophysics (EE)); TANI, Laurits (National Institute of Chemical Physics and Biophysics (EE)); RAND, Diana (National Institute of Chemical Physics and Biophysics (EE)); KADASTIK, Mario (National Institute of Chemical Physics and Biophysics (EE))

Presenter: TANI, Laurits (National Institute of Chemical Physics and Biophysics (EE))

Session Classification: Track 2: Data Analysis - Algorithms and Tools

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