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Using machine learning for data quality assurance, particle identification, and fast simulations in ALICE

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Machine learning (ML) is one of the most rapidly evolving fields of computer science. High-energy physics (HEP) with its complex detectors is an ideal place to utilize ML in its full extent. The ALICE experiment is a perfect environment to test the ML capabilities, which can automatize quality assurance (QA), particle identification, as well as perform fast simulations.

QA in ALICE is an important task in order to avoid processing low quality or redundant data, and to classify it for analysis. Currently, human experts are involved in an offline data assessment. This process is time-consuming and it typically takes days, or weeks to assess the quality of the past data taking periods. Furthermore, since after the LHC Long Shutdown 2 upgrades ALICE plans to record data at higher rates, manual data quality checks may not be feasible. We show first attempts of using ML for this purpose.

Monte Carlo (MC) simulations are important ingredients of HEP experiments. They are needed not only to compare experimental data with theory but also to calibrate the detector as well as the reconstruction and analysis software. One of the biggest tasks is propagating each generated particle through the detector medium in order to obtain the correct detector responses. This usually involves the use of Geant or other transport packages which is very time consuming. Generative Adversarial Networks (GAN) can be utilized to provide reconstructed clusters basing on input MC particles with much higher computational speed. We show results of the preliminary approach of using GANs for this purpose in ALICE.

ML can also be used for particle identification. In traditional analysis physicists usually select particles by applying an arbitrary specific selection criteria on certain detector signals, such as the TPC energy loss or TOF arrival time. We show the results of applying ML methods to select particles of interest with maximized efficiency.

Content type

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