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Machine and deep learning techniques in heavy-ion collisions with ALICE

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Over the last years, machine learning tools have been successfully applied to a wealth of problems in high-energy physics.

A typical example is the classification of physics objects.

Supervised machine learning methods allow for significant improvements in classification problems by taking into account observable correlations and by learning the optimum selection from examples, e.g. from Monte Carlo simulations.

Even more promising is the usage of deep learning techniques. Methods like deep convolutional networks might be able to catch features from low-level parameters which are not exploited by default cut-based methods.

These ideas could be particularly beneficial for measurements in heavy-ion collisions, because of the very large multiplicities. Indeed, machine learning methods potentially perform much better in systems with a large number of degrees of freedom compared to cut-based methods. Moreover, many key heavy-ion observables are most interesting at low transverse momentum where the underlying event is dominant and the signal-to-noise ratio is quite low.

In this talk, recent developments of machine and deep learning applications in heavy-ion collisions with ALICE will be presented, with focus on a deep learning based b-jet tagging approach and the measurement of low-mass dielectrons. While the b-jet tagger is based on a mixture of shallow fully-connected and deep convolutional networks, the low-mass dielectron measurement uses gradient boosting and shallow neural networks. Both methods are very promising compared to default cut-based methods.

Experimental Collaboration

ALICE

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