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Artificial Intelligence techniques in KM3NeT

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KM3NeT is a research infrastructure housing two underwater Cherenkov telescopes located in the Mediterranean Sea. It consists of two configurations which are currently under construction: ARCA with 230 detection units corresponding to 1 cubic kilometre of instrumented water volume and ORCA with 115 detection units corresponding to a mass of 7 Mton. The ARCA (Astroparticle Research with Cosmics in the Abyss) detector aims at studying neutrinos with energies in the TeV-PeV range coming from distant astrophysical sources, while the ORCA (Oscillation Research with Cosmics in the Abyss) detector is optimised for atmospheric neutrino oscillation studies at energies of a few GeV. Artificial intelligence is increasingly used in KM3NeT for data processing and analysis, aiming to provide a better performance on event reconstruction and significantly faster inference times compared to traditional reconstruction techniques. Classical machine learning algorithms, mainly decision trees for event-type classification, have been in use since the beginning of the project. These have been followed by deep learning algorithms such as Convolutional Neural Networks (CNNs) and recently Graph Neural Networks (GNNs), which have been successfully employed for event classification and neutrino property regression tasks. In this talk, the artificial intelligence techniques used in KM3NeT, the advances in the various physics analyses as well as the impact on the physics reach of KM3NeT detectors will be presented.

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