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Overview of ML for Gravitational Waves

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At an increasing number of interferometer sites with constantly-changing detector conditions, AI can play an important role in real-time and offline data processing. In this talk, we develop novel algorithms and training schemes that sift through noise and instrumental glitches to detect gravitational waves (GW) from compact binary coalescences (CBCs). For real-time processing, we create custom low-latency pipelines and packages for time-series analysis including parallel processing of hardware accelerators, inference as a service (iaas), and non-linear noise regression using autoencoders. We improve the efficiency of ML idea-to-deployment using end-to-end model iteration, optimization, and analysis which can be trained/tested with full observation runs and mock data. Beyond CBCs, we establish source-agnostic anomaly detection algorithms using Transformers and LSTMs to build embedded spaces that identify glitches and search for a variety of hypothesized astrophysical sources that may emit GWs in the LIGO frequency band including supernovae, neutron star glitches, and cosmic strings from the early universe. In presenting at ML4Jets, we hope to establish a bridge between the high energy and gravitational-wave communities, introducing our open data and frameworks under the A3D3/ML4GW organization that make time-series generation and analysis simple.

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