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A data-driven and model-agnostic approach to solving combinatorial assignment problems in searches for new physics

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We present a novel approach to solving combinatorial assignment problems in particle physics without the need to introduce prior knowledge or assumptions about the particles' decay. The correct assignment of decay products to parent particles is achieved in a model-agnostic fashion by introducing a novel neural network architecture, Passwd-ABC, which combines a custom layer based on attention mechanisms and dual autoencoders. We demonstrate how the network, trained purely on background events in an unsupervised setting, is capable of reconstructing correctly hypothetical new particles regardless of their mass, decay multiplicity and substructure, and produces simultaneously an anomaly score that can be used to efficiently suppress the background. This model allows to extend the suite of searches for localized excesses to include non-resonant particle pair production where the reconstruction of the two resonant masses is thwarted by combinatorics. Based on https://arxiv.org/abs/2309.05728.

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