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Leveraging universality of jet taggers through transfer learning

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A significant challenge in the tagging of boosted objects via machine-learning technology is the prohibitive computational cost associated with training sophisticated models. Nevertheless, the universality of QCD suggests that a large amount of the information learnt in the training is common to different physical signals and experimental setups. In this article, we explore the use of transfer learning techniques to develop fast and data-efficient jet taggers that leverage such universality. We consider the graph neural networks LundNet and ParticleNet, and introduce two prescriptions to transfer an existing tagger into a new signal based either on fine-tuning all the weights of a model or alternatively on freezing a fraction of them. In the case of W-boson and top-quark tagging, we find that one can obtain reliable taggers using an order of magnitude less data with a corresponding speed-up of the training process. Moreover, while keeping the size of the training data set fixed, we observe a speed-up of the training by up to a factor of three. This offers a promising avenue to facilitate the use of such tools in collider physics experiments.

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