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Systematics aware learning: a case study in High Energy Physics

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Experimental science often has to cope with systematic errors that coherently bias data. We analyze this issue on the analysis of data produced by experiments of the Large Hadron Collider at CERN as a case of supervised domain adaptation. The dataset used is a representative Higgs to tau tau analysis from ATLAS and released as part of the Kaggle Higgs ML challenge. Perturbations have been introduced into this dataset to mimick systematic errors. A classifier is trained to separate the Higgs signal from the background. The goal is to reduce the sensitivity of the classifier with respect to systematics uncertainty. The figure of merit is the total uncertainty, including statistical and systematics uncertainty.
Systematics-aware learning should create an efficient representation that is insensitive to perturbations induced by the systematic effects. Different techniques have been experimented with and will be reported (i) Data Augmentation (training on a mix of data generated by varying the nuisance parameter), (ii) Adversarial Learning (using the Pivot technique, an adversarial network is trained simultaneously to the classifier to reduce the classifier sensitivity) (iii) Tangent Propagation (regularizing the partial derivative of the classifier score with respect to the nuisance parameter).

Application

Physics Analysis

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