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The Deep Forest and its Modifications

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A new machine learning model proposed by Zhou and Feng and called the Deep Forest (DF) is considered. This is a multilevel cascade of ensembles of decision tree forests, which can be viewed as an alternative to Deep Neural Networks. By taking into account the shortcomings of the DF, several new modifications are proposed, including the Improved DF, the Siamese DF, the Discriminative DF, the DF for domain adaptation, the neural DF. The main idea underlying the DF modifications is to introduce weights assigned to trees or subsets of probability distributions of classes. The weights can be regarded as training parameters of the Deep Forest and are determined in order to minimize a loss function defined by an application problem or by some goal of the solve problem. It is shown that many modifications can be reduced to solving standard quadratic optimization problems. The numerical experiments illustrate the proposed DF modifications.