Training With Less Data: Adapting Unsupervised Domain Adaptation Methods to Scaled Down Datasets for Visual Recognition Tasks

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One of the most significant challenges for Computer Vision AI is the difficulty of creating large datasets of labelled images for a particular task. Images must be manually labelled to ensure their correctness and even then, the images in the dataset may be inherently different to the images encountered in a real-world situation. This makes it difficult for these technologies to be implemented and used in practical scenarios. Pre-training the AI on a different dataset (the source domain) before training on the intended dataset (the target domain) can help to boost the performance of AI models when the target domain is insufficient for training on its own. Unsupervised Domain Adaptation (UDA) first trains using a labelled source domain, then trains on an unlabelled target domain. This method can be used to create models with high accuracies in situations where a large labelled dataset is not available for the specific task. Furthermore, UDA methods can be adapted to no longer require access to the source domain after using it for training, allowing the privacy of the source data to be maintained during training on the target domain. Recent developments of this method have demonstrated that it can be used to achieve much higher accuracies and can be adapted to different scenarios, such as semi-supervised scenarios where there are a few labelled examples amongst the target domain. However, the problem of collecting large amounts of data still remains as one of the biggest challenges preventing this technology from being widely adopted. This paper aims to adapt methods for performing UDA to data-deficient scenarios. The proposed solution improves UDA methods when the target domain is significantly smaller than the source domain by employing regularisation methods and performance-boosting methods for both the training data and the network architecture. This paper also examines the relationship between the size of the target domain and the resulting accuracy. By improving this relationship, we can provide a practical solution to this problem to relieve the burden of performing a large-scale data collection task on users of pre-trained models.