Improved Prediction on Heart Transplant Rejection Using Convolutional Autoencoder and Multiple Instance Learning on Whole-Slide Imaging

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Abstract: Endomyocardial biopsies (EMB) are currently the golden standard for the surveillance of cardiac allograft rejection. Being subjective, costly and time-consuming are the three main drawbacks of manual analysis of EMB samples. Thus, researchers have developed multiple computer-aided diagnosis (CAD) systems for whole-slide images to automate the analysis of EMB samples. Previously, we adopted pixel-level and object-level features for the prediction of cardiac allograft rejection.¹ However, handcrafting features to efficiently describe different types and grades of heart rejection can be challenging. With the success of deep learning in recent years, we can now utilize deep neural networks to learn high-level features from whole slide images. In this project, we improve the CAD system in two aspects. First, we exploit convolutional autoencoder, which is the state-of-art technique for unsupervised learning of convolutional filters, to improve the feature extraction for whole slide images. Second, upon getting the tile-based features, we plan to perform multiple instance learning (MIL) for the classification of whole slide images. To classify the slide in a MIL fashion, we will first cluster the image patches into multiple subsets. Based on the clustering results of all images patches in a slide, we will further train a classifier to predict the status of cardiac allograft rejection. We expect to observe higher prediction accuracy after applying convolutional autoencoder for feature representation and MIL for whole slide image classification.

References: