Brain Cells Phenotyping via Unsupervised Machine Learning Using Autoencoder and Clustering

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In brain research, an important step after staining and imaging the different brain cells is their phenotyping. In this research, we work with patches of images, taken with CLARITY and aim to develop an unsupervised neural network, consisting of autoencoder and clustering layers, to classify if the input image patch contains a cell or not. So far, the cell types which we have tested the algorithm on, are Microglia and Inhibitory neurons. We feed both the patches to an autoencoder with a small latent space so that it can learn to extract the most fundamental information about the input, including if it contains a cell. We perform clustering on this compressed data and expect that the encoded vectors of "positive" and "negative" samples would differ from each other and thus form clusters in space. We run K-Means clustering on the latent space's output. The results so far do not prove that the compressed negative and positive samples form distinct clusters, however, the positive samples gather close to each other in space, which shows that the pictures with cells show similar features that the autoencoder is indeed learning. To make use of that and to reach a state where clusterization is possible, we are implementing and integrating other clustering algorithms and approaches, such as outliers removal, that could lead to an improvement of results.

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