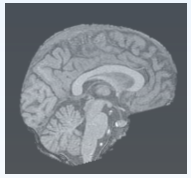
Object Classification using machine learning on fMRI scans

Abstract

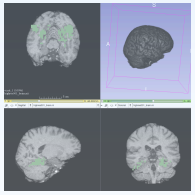
- The purpose of this study is to classify areas with large volumes of blood flow in the ventral temporal cortex with various visual stimuli presented during a functional magnetic resonance imaging session. The fMRI data was taken from six subjects (Haxby et al. 2001) who viewed a sequence of greyscale stimuli while neural volumes were recorded. To classify these recorded volumes, we use two machine learning algorithms, the K Nearest Neighbors classifier, and the Support Vector Machine classifier. For optimal results, both classifiers implement the Principal Component Analysis statistical technique to detect complex patterns in the volumes collected from the ventral temporal region. In order for a Principal Component Analysis technique to work, we reference all six of the subject's neural imaging to the reference space of a single subject's neural image. In doing so, we seek to achieve a classification accuracy of as close to perfect as possible.

- Our goal was to classify MRI scans based on what images the person viewed while getting scanned. When neurons fire in the brain, certain regions are "highlighted" with increased blood flow. We used machine learning to detect patterns of highlighted portions and determine what image the subject viewed.

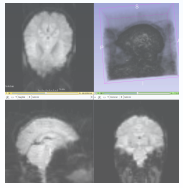
Sample MRI Scan



Label Map (mask) on fMRI

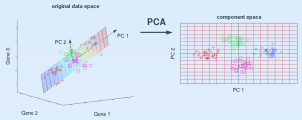


BOLD Data

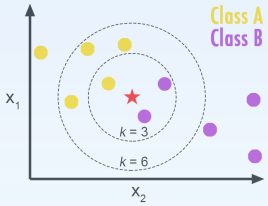


Method

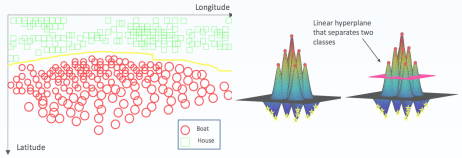
- TopK: A statistical technique that collects data strictly on brain activation values.
- PCA: A statistical technique that works by finding complex non-linear trends in the brain volumes.



- KNN Classifier: the K Nearest Neighbors classifier works by finding the majority of values in a given radius, and uses the value of the majority to declare an area that value.

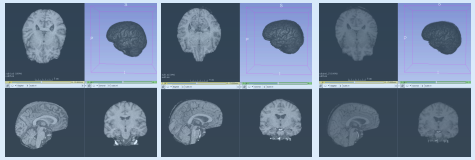


- SVM classifier: the Support Vector Machine classifier works by creating a decision surface (kernel trick), and separating the potentially different classes of volumes.



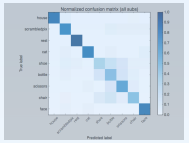
- To properly and efficiently use this information we had to reference all the brains into a single reference space.

Brain 1 Brain 5 Brain 5 into 1



Results

- When we raised the resolution of the brain scans, and referenced them to a single reference space, we got a result of 55%



Action Shots