Effective Visualization of Sparse Machine Learning Results Applied to Brain Imaging Modalities Derived from the TADPOLE Challenge

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Motivation

MRI and PET scans are commonly used for diagnosing Alzheimers disease (AD) because they are non-invasive and widely available. These scans can show brain atrophies that are solidly linked to cognitive decline and help physicians make an accurate diagnosis. Researchers run machine learning algorithms on MRI and PET scans to isolate regions of interest (ROI) in the brain most associated with an Alzheimers disease diagnosis. Taking this brain data and effectively visualizing it is important for interpreting results and seeing if machine learning results contradict or confirm prior medical understanding. Visualizations also bridge the gap between the medical communities and the public by making the data easier to understand. For example, hearing that a region of the brain is affected vs seeing that region, or related regions of the brain, is lit up. Brain visualizations allow for quick and effective communication of the results of machine learning algorithms.

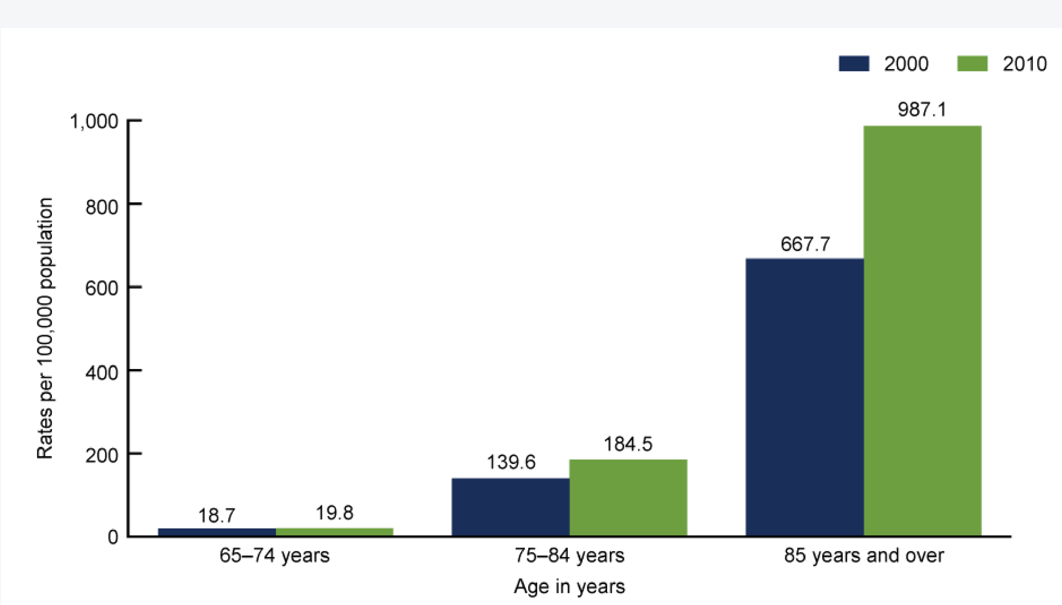

Figure 1: Age-Adjusted Death Rates for Alzheimer's Disease: United States 2000 and 2010

Methods

The Nilearn module requires a brain atlas and a weight matrix to plot brain imaging data. A brain atlas is set of coordinates that define a region in the brain correlated with a certain function: speech, movement, memory, etc. The ROIs from the TADPOLE dataset were fit so they correlated to a predefined Nilearn region. The ROI measurements were also normalized from 0-1, representing their weight or intensity. These weights were fed into Nilearn in the order of the brain atlas so that the ROIs are mapped with their corresponding intensity. The Glass Brain module from Nilearn represents white/yellow regions as low intensity and red/black regions as high intensity.

Potentially: A machine learning algorithm could be run on MRI and PET brain volume data, associating each ROI with a particular weight that corresponds to its correlation with an Alzheimers diagnosis. This w-vector could then be plotted on a brain to highlight the ROIs most important to consider when making an Alzheimers diagnosis.

MRI

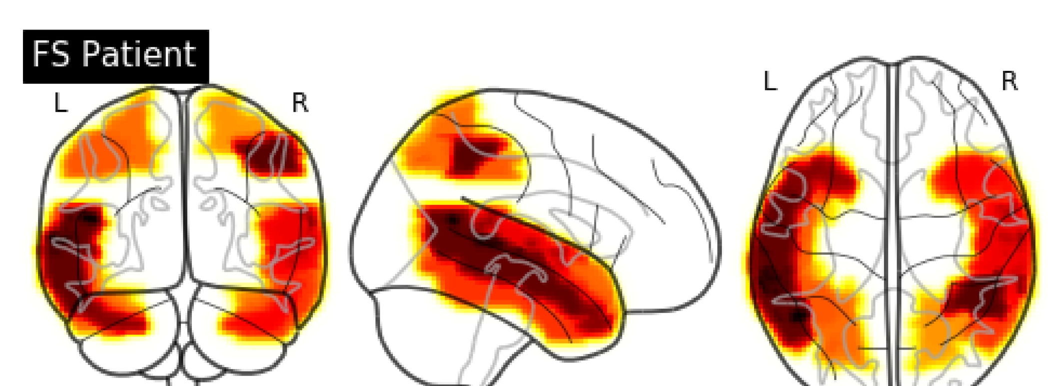

Figure 2: Example of plotting a region of MRI ROIs

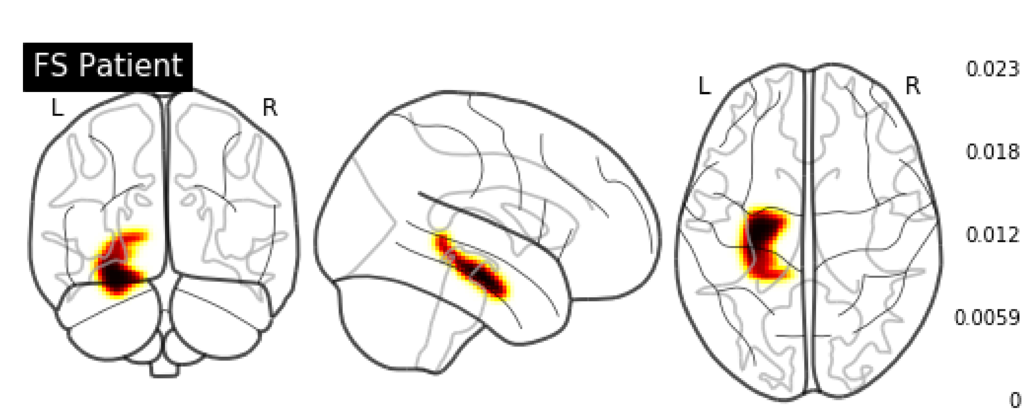

Figure 3: Example of plotting the Left Hippocampus

PET

Figure 4: Example of plotting a region of PET ROIs

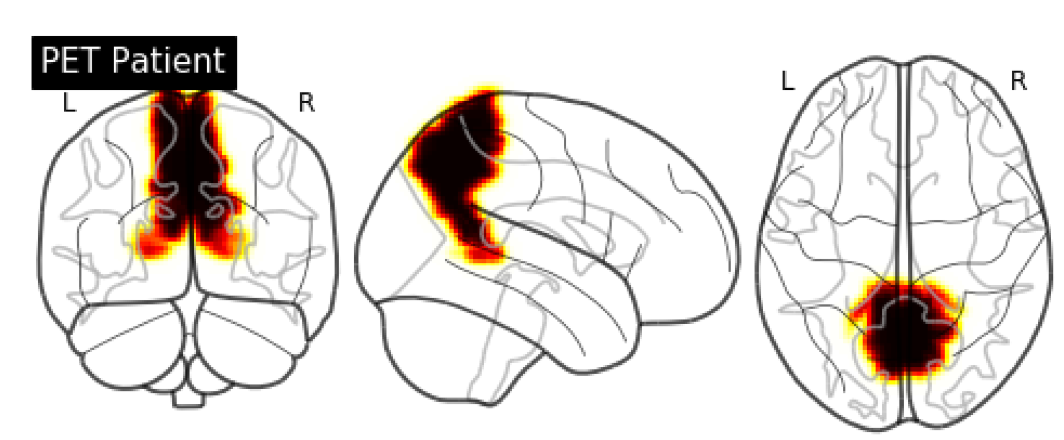

Figure 5: Example of plotting the Precuneus

Summary

Use of the Nilearn module for plotting brain imaging data can quickly and effectively show the results of a machine learning algorithm. With Nilearn, one can easily highlight general regions of importance and see if machine learning results contradict or confirm prior medical understanding.

References

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