# Neurodegeneration assessment from MRI

## Method

The presence of neurodegeneration in the MRI was identified using the naïve Bayes method [1]. The basic idea here is that if the presence of neurodegeneration (N) is known, for a group of subjects, given the values of some MRI variables, we can assess N for another group of subjects using the same input variables. So, we should use a cohort with known values for N and some related MRI measurements as training data.

ADNI [2] cohort was used as training database. ADNI is a global effort to provide Alzheimer’s Disease data for research. ADNI provides a big amount of imaging and clinical data free of charge to registered investigators. Moreover, the data is conveniently supplied in a packaged database, as part of a project known as ADNIMERGE [3]. For this assessment we use R 4.0.2 [4] and its implementation of naïve bayes algorithm as well as the ADNIMERGE database in R format.

In order to simplify the data treatment, we chose only the subjects diagnosed as dementia and cognitive normal at baseline. Just baseline MRI data were considered, for a total of 1222 data points. As independent variables, volumes from hippocampus, entorhinal cortex, middle temporal cortex and lateral ventricles, as well as subject’s age and estimated intracraneal volume, were chosen. Subjects diagnosed with dementia were considered as neurodegeneration positive (N+) and subjects diagnosed as cognitive normal were evaluated as neurodegeneration negative (N-). This data was used to feed the algorithm.

First, in order to test the algorithm, ADNI data was spliced into two databases. First, one was used to feed the algorithm and the last was used to assess N values. When results were compared to original N, we got that our method have an accuracy of 82%, sensitivity of 82% and specificity of 80% for N classification.

Then, all subjects’s MRI of the study were processed with Freesurfer 7.2 [5]. The proper volumetrics variables were built according to ADNIMERGE procedure and the N values were assessed for study subjects.

## Refs

* [1] *Domingos, Pedro; Pazzani, Michael (1997).* [*"On the optimality of the simple Bayesian classifier under zero-one loss"*](http://citeseer.ist.psu.edu/domingos97optimality.html)*.* [*Machine Learning*](https://en.wikipedia.org/wiki/Machine_Learning_(journal))*.* ***29*** *(2/3): 103–137.* [*doi*](https://en.wikipedia.org/wiki/Doi_(identifier))*:*[*10.1023/A:1007413511361*](https://doi.org/10.1023%2FA%3A1007413511361)*.*
* [2] http://adni.loni.usc.edu/
* [3] the ADNI team (2021). *ADNIMERGE: Alzheimer's Disease Neuroimaging Initiative*. R package version 0.0.1
* [4] R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>
* [5] Fischl B. FreeSurfer. Neuroimage. 2012 Aug 15;62(2):774-81. doi: 10.1016/j.neuroimage.2012.01.021. Epub 2012 Jan 10. PMID: 22248573; PMCID: PMC3685476