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AlzPred-SVV: Free Web Tool for Alzheimer Prediction using Spectroscopy Voxel Volume

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Abstract: Neuroimaging data from magnetic resonance techniques are widely used as non-invasive biomarkers for the evaluation and early diagnosis of Alzheimer's Disease (AD). Alzheimer Prediction by Spectroscopy Voxel Volume is a free Web tool to predict the AD diagnosis (AlzPred-SVV: http://bio-aims.udc.es/AlzPredSVV.php). The inputs are two variables related to a voxel acquired in the left hippocampus: The total volume and the volume of CSF contained in the voxel. The classification method is based on Machine Learning techniques. The tool is based on an HTML/PHP user interface with a Python/Java implementation of the model.

Keywords: Magnetic Resonance Spectroscopy; Alzheimer's Disease; Machine-learning; Single-Layer Perceptron;

1. Introduction

Several magnetic resonance techniques have been proposed as non-invasive imaging bio-markers for the evaluation of disease progression and early diagnosis of AD [1] and mild cognitive impairment (MCI), a transitional state between healthy ageing and AD [2]. The analysis of these biomarkers allows the study of differences between groups but they are not applicable on a single-subject level and do not improve the clinical diagnosis potential. Machine-learning techniques have been identified as promising tools in neuroimaging data for individual class prediction [3]. Magnetic resonance spectroscopy (^{1}H-MRS) is a useful technique in the study of the AD [4-5]. We found that just the volumes of grey and white matter (GM,WM) and cerebro-spinal fluid (CSF) within the spectroscopic voxel provide a high correlation with the diagnosed groups showing a strong potential for classify healthy controls, MCI and AD subjects [6].

2. Results and Discussion

Alzheimer Prediction by Spectroscopy Voxel Volume (AlzPred-SVV) is a free Web tool (bio-aims.udc.es/AlzPredSVV.php) to predict the AD diagnosis, based on only 2 variables related to the spectroscopic voxel in the left hippocampus: The total voxel volume and volume of CSF contained in the voxel (Figure 1). This tool is on the free portal Bio-AIMS [7] that offers models based on Artificial Intelligence, Computational Biology and Bioinformatics. The website provides the values of predicted class and error prediction achieved by the model. Inputs should be written using the format *<Label Total_vol CSF_vol>* up to a maximum of 10 rows. Figure 1 shows an example for 4 inputs, labelled as Case1 to Case4 varying the voxel volumes and the CSF proportions. Results are displayed in Figure 2, showing the prediction for each case: 3 inputs are classified as AD with different error predictions and the other one as healthy control.

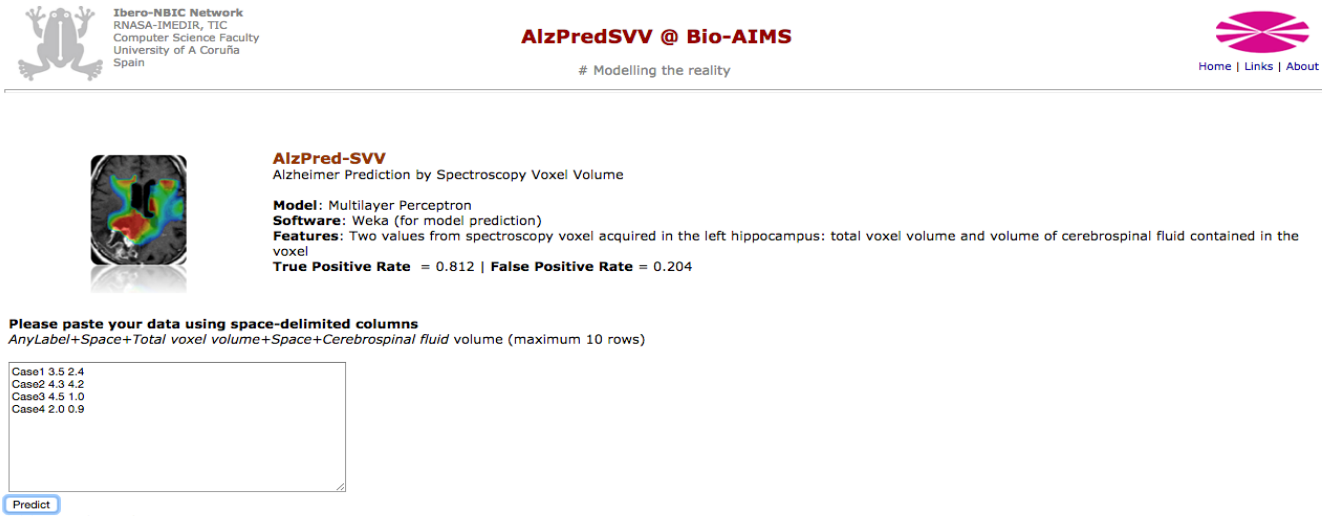

Figure 1. AlzPred-SVV website

```
Process ID = 21679563b3bbcbbedb
... please wait ....
Calculating ...
Result file = Results/21679563b3bbcbbedb/AlzPredSVV.calc.txt

AlzPred-SVV @ Bio-AIMS
Alzheimer Prediction by Spectroscopy Voxel Volume
Features: 2 volumes (Total volume of the spectroscopic voxel and Cerebrospinal fluids) in left hippocampus
True Positive Rate  = 0.812 | False Positive Rate = 0.204
Results = http://bio-aims.udc.es/Results/21679563b3bbcbbedb/AlzPredSVV.calc.txt
2015-11-05 12:21:33

=== INPUT DATA ===

Case1 3.5 2.4
Case2 4.3 4.2
Case3 4.5 1.0
Case4 2.0 0.9

=== Predictions on test data ===

 inst#     actual  predicted error prediction
     1        1:?       1:EA       0.997
     2        1:?       1:EA       1
     3        1:?  2:CONTROL       0.525
     4        1:?       1:EA       0.546
```

Figure 2. Output results from AlzPred-SVV

3. Materials and Methods

A gender-matched cohort of 260 subjects was used to test and evaluate the effectiveness of machine-learning schemes for single-subject level classification of individuals affected by different stages of dementia based on ^{1}H-MRS data [6]. The collection of Weka algorithms was used for this purpose. The study found that the best classifier is a single-layer perceptron with only 2 spectroscopic voxel volumes in the left hippocampus (AUROC:0.86; True positives rate: 0.81; False positives rate:0.20). This model was implemented in AlzPred-SVV. The tool is based on an HTML/PHP user interface with a Python/Java implementation of the model.

4. Conclusions

MR modalities produce extremely high-dimensional raw data that can contain inherent patterns related to AD and machine-learning methods provide tools to observe inherent disease-related patterns in the data. This fact is presented in this work, where just the proportion of CSF within the spectroscopic voxel can discriminate AD from MCI patients and from healthy controls. AlzPred-SVV is an easy-to-use web application that can be useful for both clinicians and patients.

Acknowledgments

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Conflicts of Interest

The authors declare no conflict of interest.

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