Abstract

Alzheimer's disease (AD), the most common form of dementia, is an incurable and terminal ailment of the brain which typically affects the elderly. The development of effective treatment methods will most likely depend on early detection of the disease, and modern research efforts consequently are focused on developing accurate and sensitive diagnostic methods. This thesis uses neuroimaging data from the Alzheimer's Disease Neuroimaging Initiative (ADNI) to diagnose AD using machine learning techniques. In particular, we classify magnetic resonance imaging (MRI) and positron emission tomography (PET) scans from healthy control (HC) and AD patients using a battery of predictive algorithms: Gaussian naive Bayes, linear discriminant analysis, quadratic discriminant analysis, K-nearest neighbors, support vector machines, and a majority vote classifier. We also provide a framework for extracting MRI and PET scans from the ADNI database.

Cross-validation tests with a support vector machine classifier on 95 AD and 102 HC FDG-PET scans yields a mean diagnostic accuracy of $85\% \pm 5\%$, a specificity of $86\% \pm 7\%$, and a sensitivity of $83\% \pm 7\%$. Following the same procedure on a data set consisting of 33 AD and 43 HC 1.5T MRI scans produces a mean diagnostic accuracy of $98\% \pm 6\%$, a specificity of $100\% \pm 0\%$, and a sensitivity of $96\% \pm 11\%$. These results demonstrate that 3D brain images can effectively be used to diagnose a patient with Alzheimer's disease, although additional biomarkers may be needed to predict whether an asymptomatic individual is at risk of developing the condition.