Machine learning in Neuroradiology I
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Machine learning has emerged as a powerful method of performing spatial pattern analysis and data classification. The multivariate nature of these approaches allows them to take into consideration correlations present in the data, overcoming limitations of standard analytical approaches. The prediction capabilities of machine learning methods are ideal for many clinical applications. One area of neuroimaging research where these techniques have gained attention is in the early detection and diagnosis of Alzheimer’s disease (AD). Machine learning techniques could be of great utility for their potential to uncover subtle atrophy patterns in the neuroimaging data that otherwise are very difficult to detect by a human expert using traditional analyses and diagnostic techniques [1]. Analysis of MR imaging data (and especially structural data) is particularly challenging due to the high dimensionality of the problem (e.g. number of voxels vs the typical subject sample size). Dimension reduction is frequently used to make the classification problem tractable. Dimension reduction can be based on regions of interest (ROIs), principal components analysis (PCA) or combinations of filters (univariate statistics) and classifiers [2]. Large scale classification approaches have been used in the setting of AD achieving high degrees of accuracy without resorting to feature reduction [3]. While this is an area of active algorithmic development, publicly available machine learning packages can facilitate investigations into a variety of disease processes.

A particularly attractive aspect of machine learning approaches is the ability to provide classification probabilities, similar to the diagnostic approach of image interpretation. Using sophisticated image segmentation methods (which themselves also may make use of machine learning) for feature extraction, machine learning may significantly alter the current diagnostic paradigm. These methods are making in-roads into diagnosis and classification of brain-tumors [4], neurodegenerative disease, as well as prediction of progression and cognitive outcome [5-8]. This talk will highlight some of this recent work and potential of these methods to impact neuroradiologic practice.

References


