



OPTimization for Machine Learning (OPTIMAL) Research Lab

Discipline of Mathematics, IIT Indore

Alzheimer's disease

- Alzheimer's disease is an **incurable** neurodegenerative disease primarily affecting the **elderly population**.
- Efficient **automated techniques** are needed for early diagnosis of Alzheimers.
- Many novel approaches are proposed by researchers for **classification** of Alzheimer's disease.
- We reviewed **165 papers from 2005-2019** using various feature extraction and machine learning techniques.
- The machine learning techniques are surveyed under three main categories: **support vector machine (SVM), artificial neural network (ANN), and deep learning (DL) and ensemble methods**.
- We present a **detailed review** on these three approaches for Alzheimers with possible future directions.

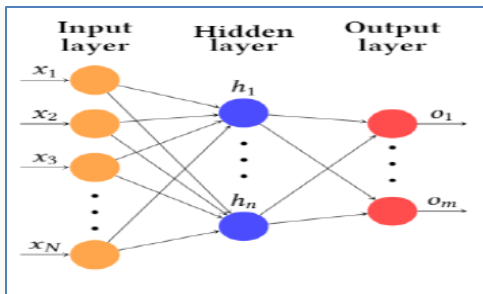


Figure 1. Architecture of neural network

Reference

M. Tanveer, B. Richhariya, R.U. Khan, A.H. Rashid, M. Prasad, P. Khanna, C.T. Lin (2019). Machine learning techniques for the diagnosis of Alzheimer's disease: A review, ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM) (To appear). [SCI Indexed with Impact Factor: 2.87]

Machine learning techniques for the diagnosis of Alzheimer's disease: A review

Year	Authors	Target	Modality	Feature extraction	Machine learning	Validation	Acc (%)
2007	Wang et al. [178]	CN vs AD	rs-fMRI	ROI	LR	-	81.1
2008	Fan et al. [41]	AD vs MCI	MRI, PET	VBM	PC	LOOCV	93
2008	Davatzikos et al. [37]	AD-FTD CN vs FTD CN vs AD	sMRI (T1)	VBM	PC	LOOCV	84.3 100 100
2009	Hinrichs et al. [57]	CN vs AD	sMRI (T1), FDG-PET	GMPs WMPs	LP	LMOCV	84
2009	Lopez et al. [106]	CN vs AD	SPECT	VAF	RF	10-fold	89 74.6
2009	Horn et al. [61]	AD vs FTD	SPECT	ROI	KNN	LOOCV	88
2009	McEvoy et al. [114]	CN vs AD	sMRI (T1)	Morphometric measures	LR	LOOCV	89
2009	Desikan et al. [38]	CN vs AD CN vs MCI	sMRI (T1)	Anatomical Regions	LR	-	95 95
2010	Plant et al. [131]	CN vs AD AD vs MCI CN vs MCI AD vs MCI vs CN	sMRI (T1)	GM WM CSF	SVM+Bayes+ VBI	LOOCV	92 95.83 97.62 75.0

Figure 2. Comparison of recent studies using deep learning and ensemble methods.

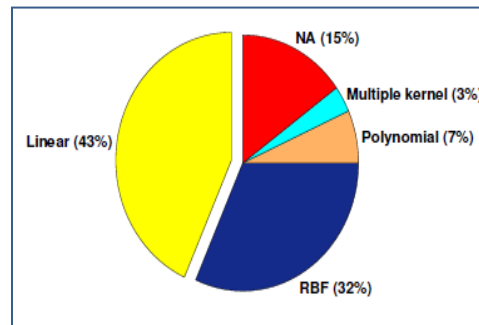


Figure 3. Plot showing usage of different types of kernels used with SVM, NA means information not available.

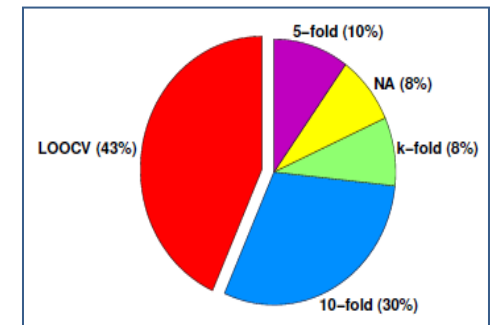


Figure 4. Plot showing usage of different types of cross validation methods used with SVM for Alzheimers, k = 2, 3, 4, 9 and 20.