

Ameiy Acharya, Varsha Satish, Neelam Sinha
Centre for Brain Research, Indian Institute of Science, Bangalore

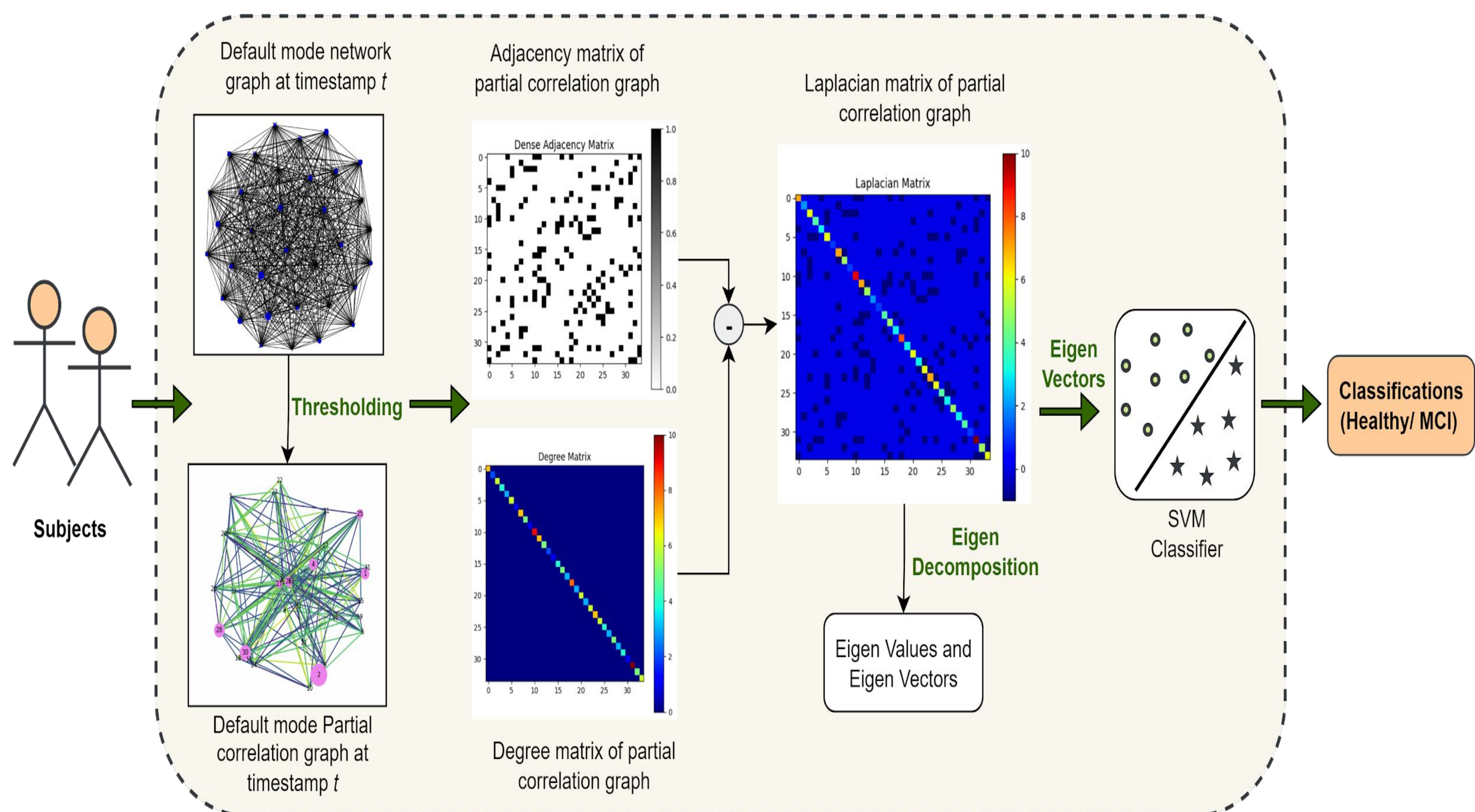
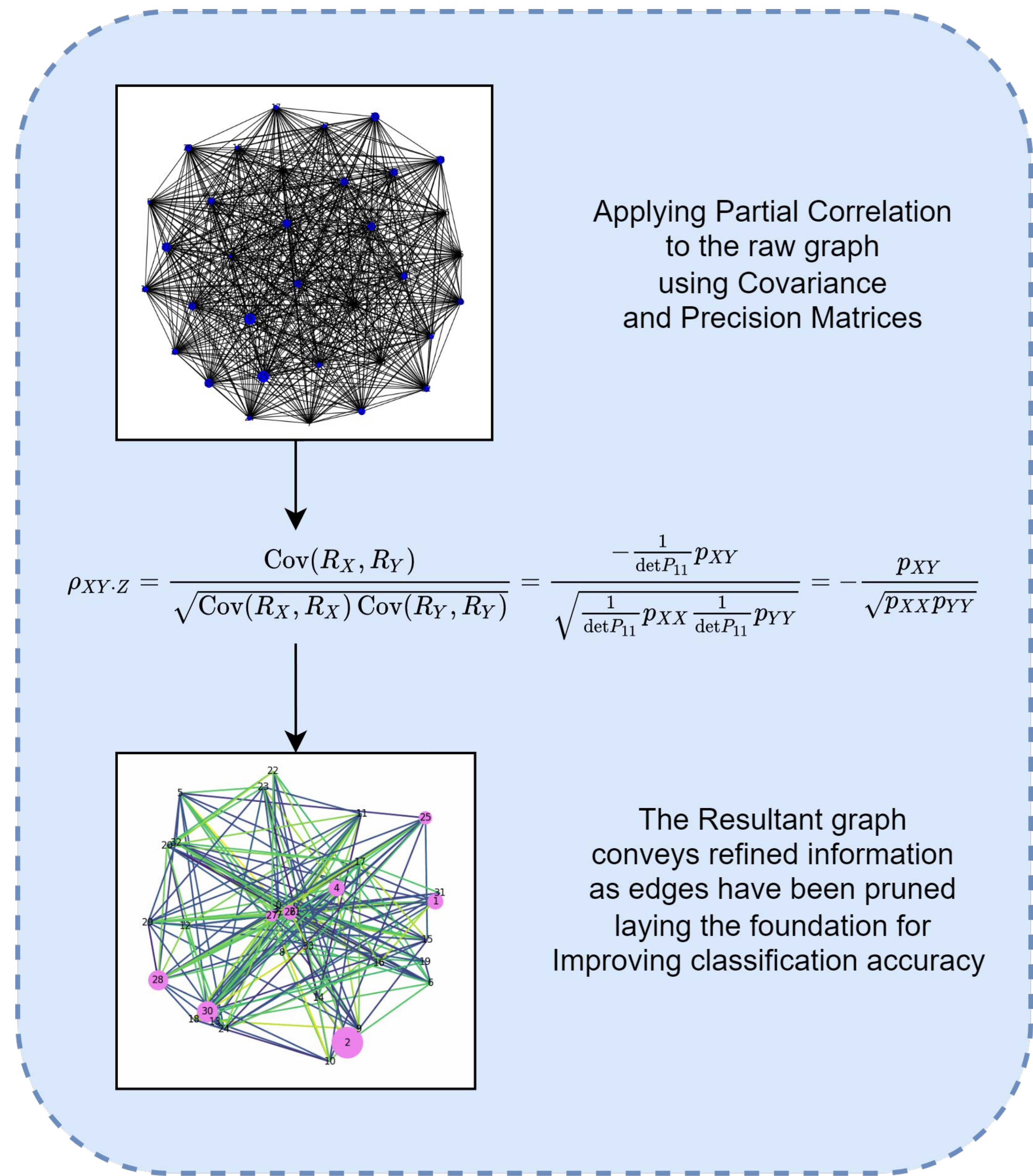
ABSTRACT : In this study, we utilize fMRI data to classify between healthy (NC) and Mild Cognitive Impairment (MCI) subjects. We construct graphs representing the Default Mode Network and employ eigen decomposition of their Laplacian matrices. The extracted eigenvectors are input to SVM, for classification.

CLINICAL RELEVANCE : Early detection of Mild Cognitive Impairment, Improved understanding of neurodegeneration

DATASET : Experiments on publicly available ADNI data, with 100 subjects, 50 NC and 50 MCI, covering 34 ROIs AND 187 timestamps each, totalling to 18,700 graphs.

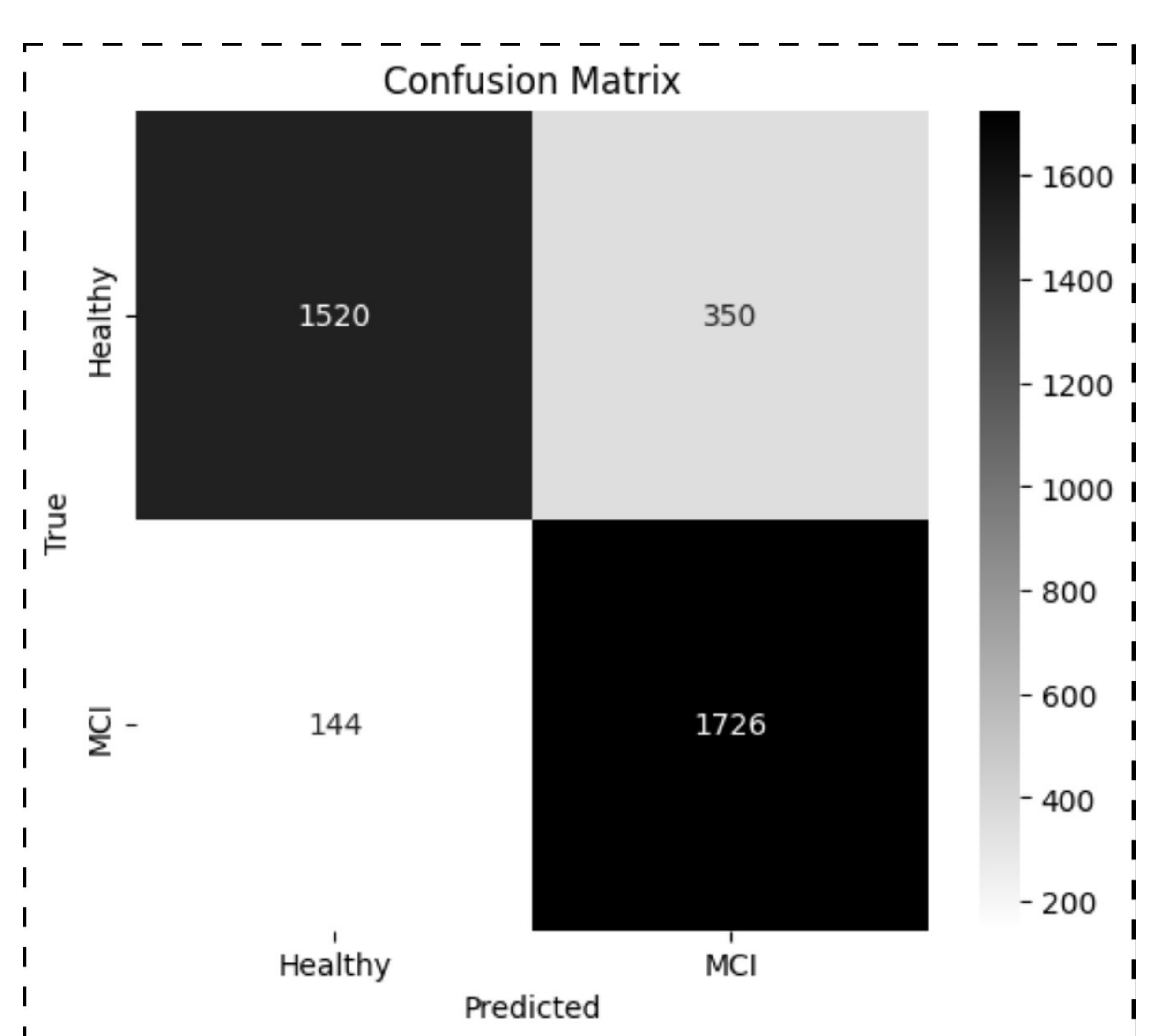
PROPOSED METHOD

- **Graph Construction** : We create graphs for each subject, using ROIs as nodes, representing node intensity, and determining edges through partial correlation.
- **Matrix Calculations** : Essential matrices (Adjacency matrix (A), Degree matrix (D), and Laplacian matrix (L)) are computed, unveiling network structure and ensuring efficient handling of large Laplacian matrices.
- **Eigen Decomposition** : Eigen decomposition of L provides eigenvalues and eigenvectors, which represent graph similarity and fed into the SVM classifier.
- **SVM Classification** : A linear SVM employs these eigenvalues to distinguish between NC and MCI graphs with a high degree of accuracy as similar graphs have similar eigenvalues



Block diagram of the proposed DMN-graph based classification method

- **RESULTS** :
 - **SVM Accuracy** : SVM achieved **86.79% classification accuracy**, surpassing logistic regression (76.45%).
 - **Precision and Recall** : Precision values for NC and MCI were 0.91 and 0.83, with corresponding Recall values at 0.81 and 0.92, respectively.
- **DISCUSSION** :
 - **Graph Utilization** : Our approach leverages DMN graphs created from ROIs using partial correlation, enhancing the classification process.
 - **Eigenvalues Significance** : The study underscores the importance of eigenvalues in distinguishing between NC and MCI subjects.
- **REFERENCES**:
 - Stam CJ, Reijneveld JC. Graph theoretical analysis of complex networks in the brain. *Nonlinear Biomed Phys.* 2007 Jul 5;1(1):3. doi: 10.1186/1753-4631-1-3. PMID: 17908336; PMCID: PMC1976403.



Confusion matrix summarizes the performance of the proposed method on the test dataset