Multi-View Stacking for Dementia Classification

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What is Dementia?

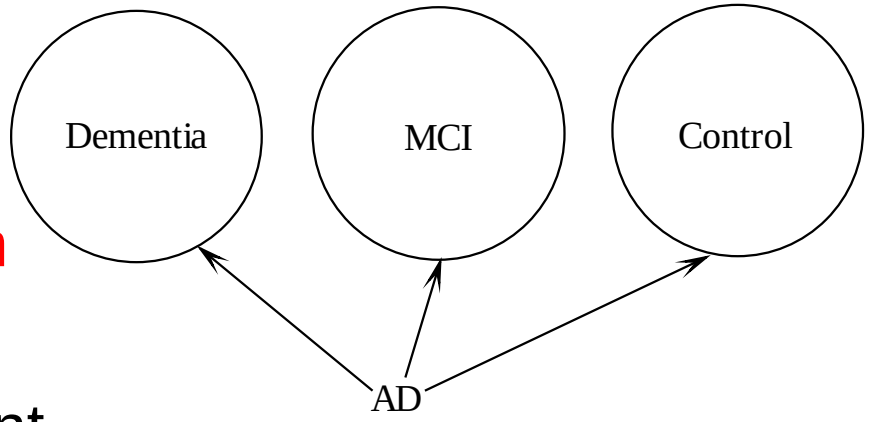
Loss of mental functions...

Causes of dementia:

- Alzheimer (AD, main cause)
- Parkinson's disease
- ...

Alzheimer: disease, symptom

Dementia $\neq$ AD, but ...



MCI: mild cognitive impairment

Early diagnosis of dementia $\longrightarrow$ classification

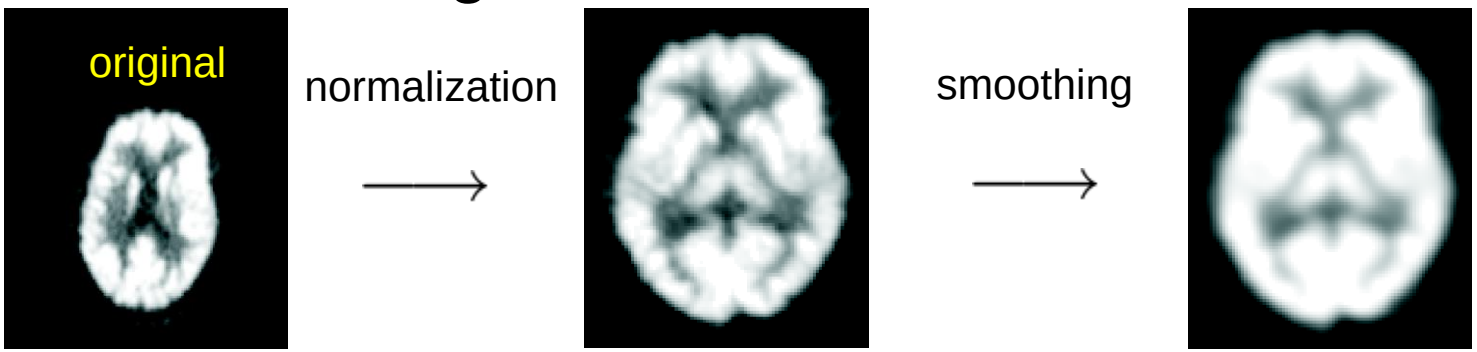
AD vs. MCI

Data Acquisition

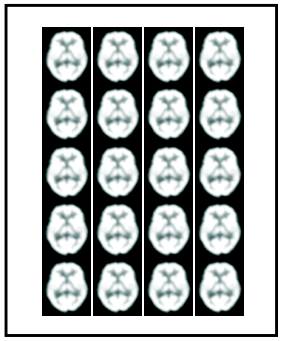
- Positron Emission Tomography (PET)
- Demographic variables (age, gender: 2)
- Neuropsychological Tests
  - Mini Mental Status Test (MMST: 1)
  - Consortium to Establish a Registry for Alzheimer's Disease (CERAD: 11)
  - Clock Drawing Test (CDT: 1)

57 AD, 70 MCI

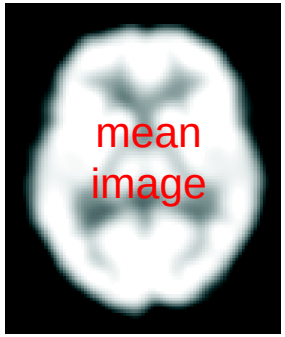
PET Processing



20 NC



voxel mean

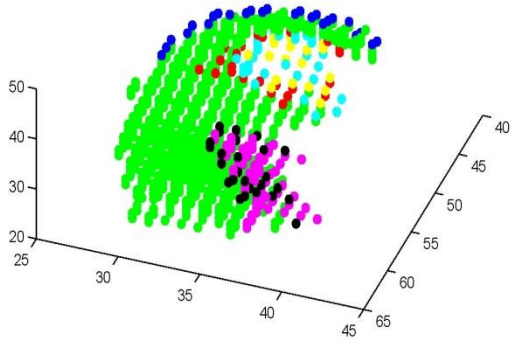


Automated Anatomical Labeling

DBSCAN
voxel value
116 brain region

many finer clusters (**connected or disconnected**)

DBSCAN (X, Y, Z)



10 Informative features

feature selection

1894 features (AD, MCI)

mean value each cluster

AD, MCI

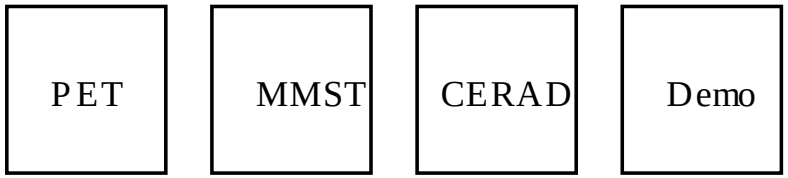
1894 finer clusters (**connected**)

example

left hippocampus

Multi-View Data

"View"



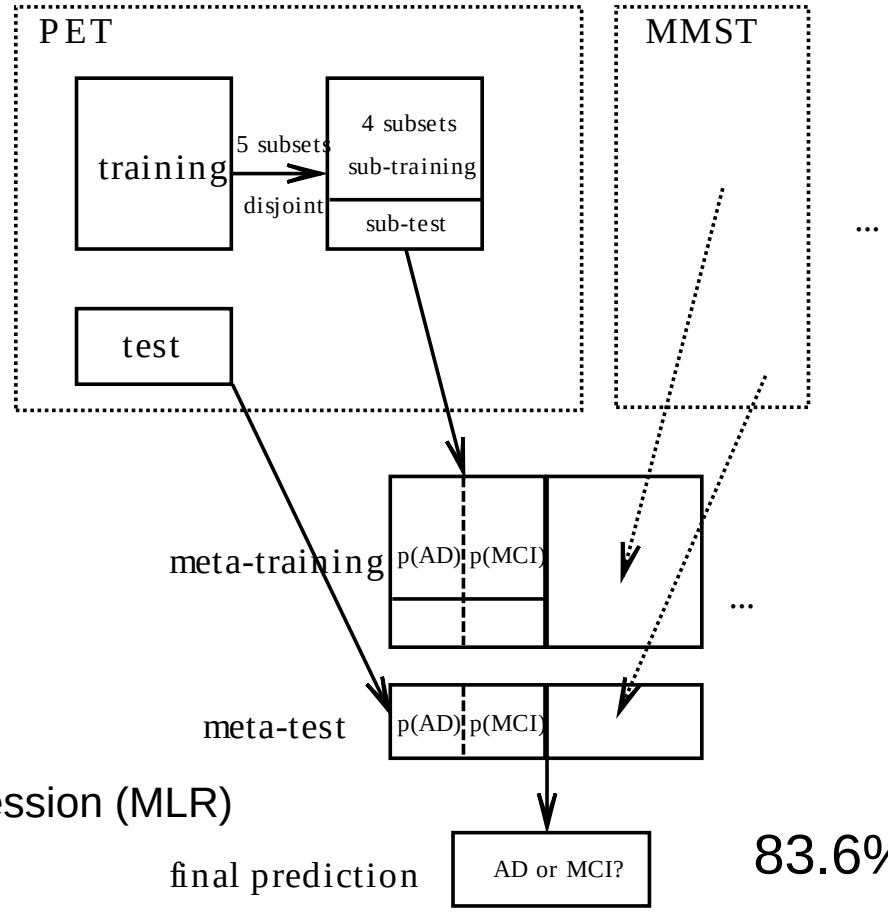
70.9 78.1 80.1 61.6 accuracy: %

K-Nearest Neighbor (KNN) classifier/learner

75.8

Multi-View Stacking [Wolpert, 92]

KNN learner



Multi-response **L**inear **R**egression (MLR)
[Ting & Witten, 99]

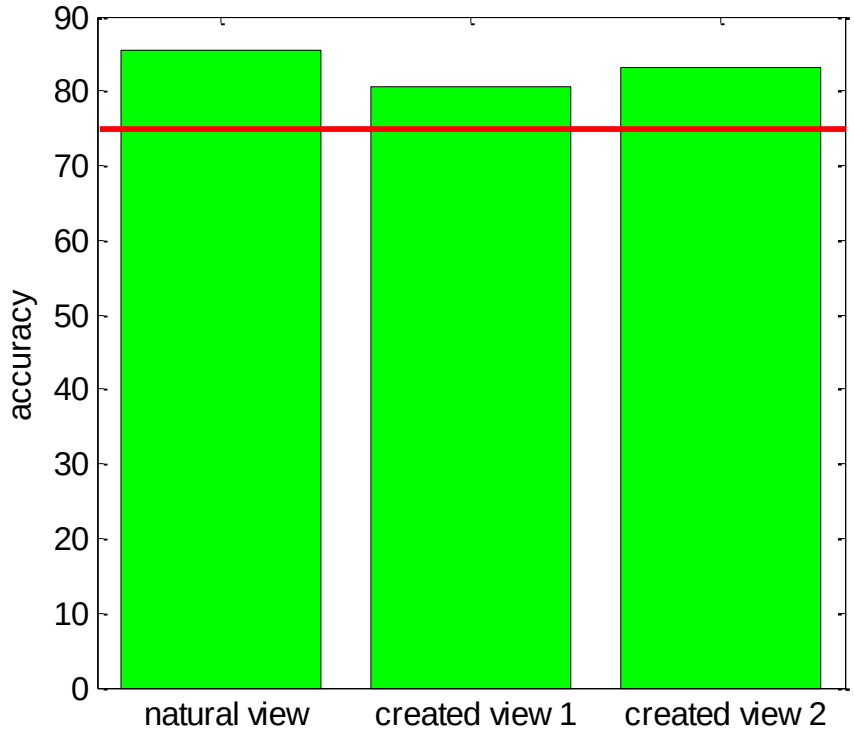
83.6% accuracy

Contribution of Individal View w.r.t. MLR

	PET	MMST	CERAD	Demo
MCI (1) p-value	α -0.1366 0.0001	**-0.3098** 0.0314	**-0.2668** 0.0157	-0.0872 0.1791
AD (2) p-value	β **0.4441** 0.0006	0.0837 0.0493	0.1973 0.0108	γ 0.1832 0.2060

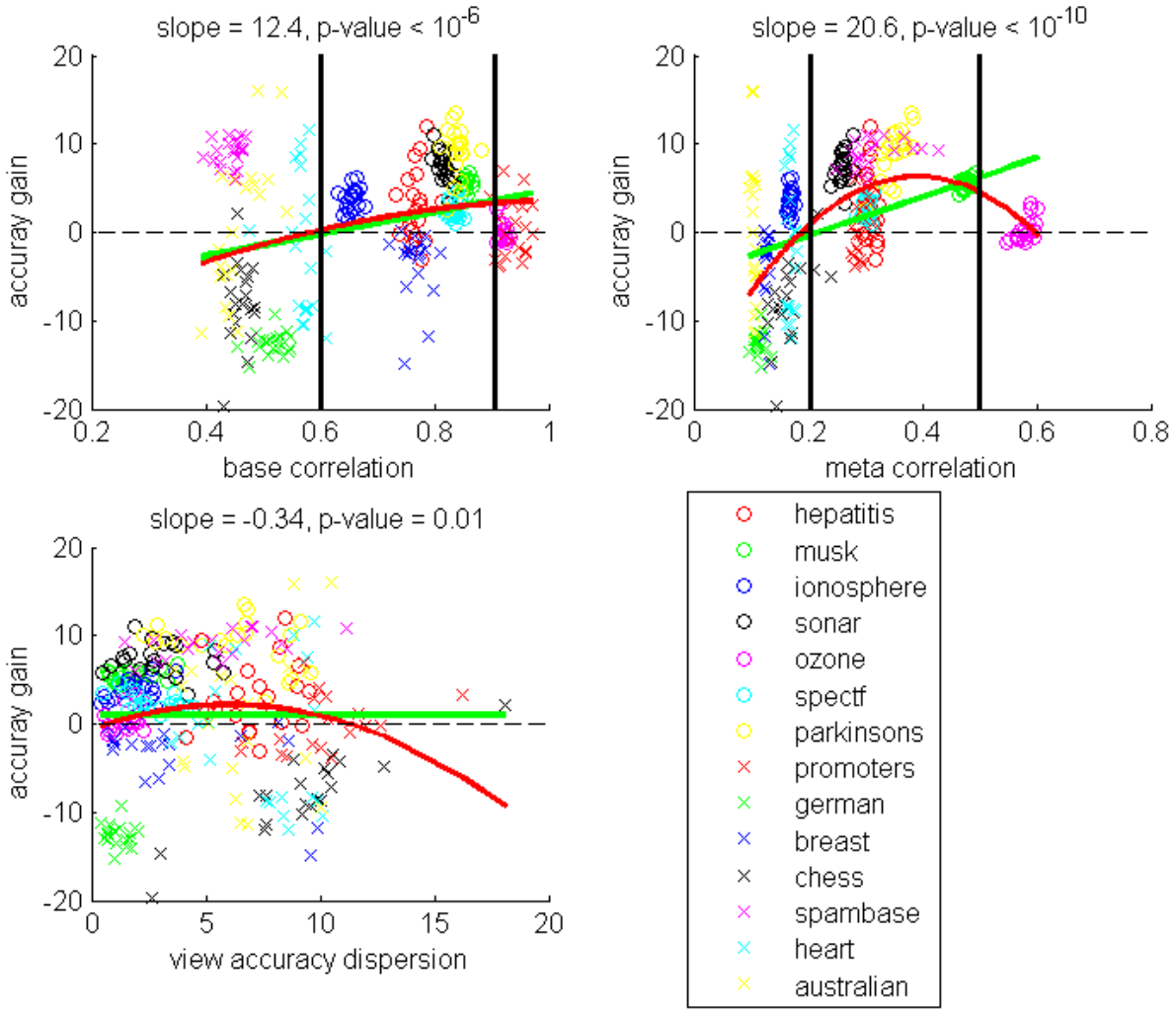
$$Y = \alpha \cdot \mathrm{PET(MCI)} + \beta \cdot \mathrm{PET(AD)} + \ldots + \gamma \cdot \mathrm{Demo(AD)} + \mathrm{const.}$$

Contributing Factors of Good Performance



	Base Correlation	Meta Correlation	Std. of Accuracy
Natural Views	**0.62**	0.28	14.5
Created Views 1	**0.60**	0.28	13.8
Created Views 2	**0.88**	0.27	12.6

$$Y = \beta \cdot X + \text{const.}$$



Summary

- **Dementia classification can benefit from various views**

- **Multi-view stacking can improve the overall system performance, if views are optimally correlated**

- **It should also be beneficial for biological data.**

Thanks for your attention!
Questions?

References

Wolpert, D., *Stacked Generalization.*, Neural Networks, 5(2), pp. 241-259., 1992

Ting K.M. and Witten I.H., Issues in stacked generalization, Journal of Artificial Intelligence Research, vol. 10, pp. 271-289,1999