

Alzheimer's Disease Detection

MRI classification through CNN

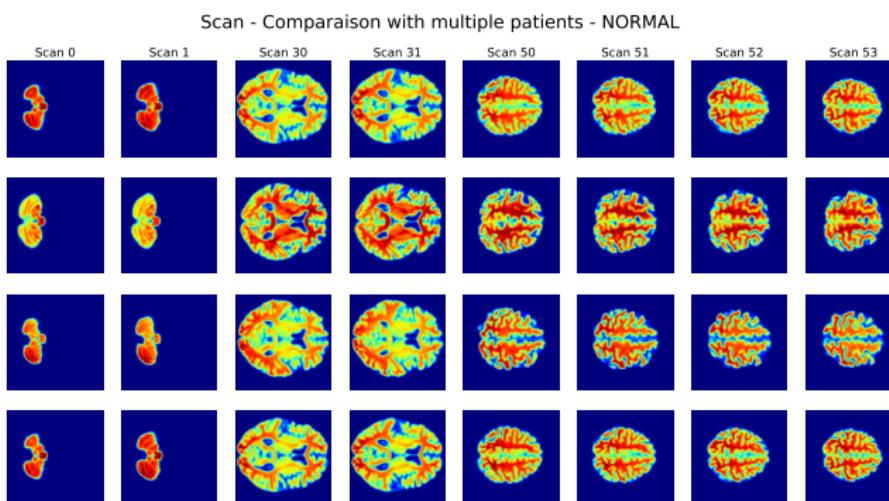
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NTDS Project, 2017



Introduction

- Analyse brain MRI images in order to diagnose Alzheimer's disease.



Introduction

- ▶ Analyse brain MRI images in order to diagnose Alzheimer's disease ¹².
- ▶ **186 806** brain MRI images from **3013** scans. Each scan consists of **62** layers of the brain
- ▶ Classified in 3 diagnosis.
 - ▶ **Normal** : Healthy brain.
 - ▶ **MCI** : Mild cognitive impairment.
 - ▶ **AD** : Alzheimers disease.

¹MRIs : [kaggle.com](https://www.kaggle.com/)

²Description : github.com

Data Mining

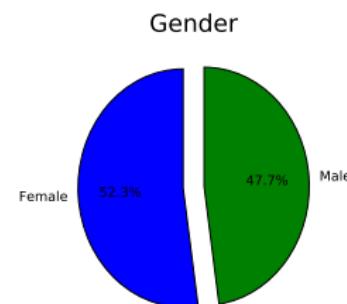
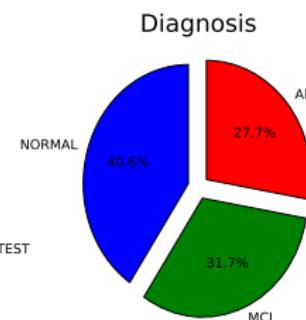
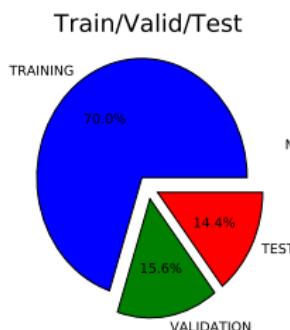
- ▶ **Lookup table:**

- ▶ **Train/Valid/Test** : Set the data belongs to.
- ▶ **Date** : MRI scan date.
- ▶ **Diagnosis** : Normal, MCI(Mild Cognitive Impairment), AD(Alzheimer's Disease)
- ▶ **Sex** : Female or Male.
- ▶ **Age** : Age of the patient when MRI scan was performed.

- ▶ **MRI**: All MRI, split into multiple files (around 6000 images per file).

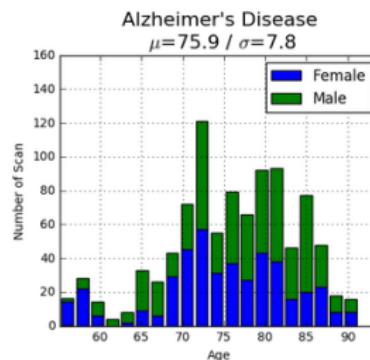
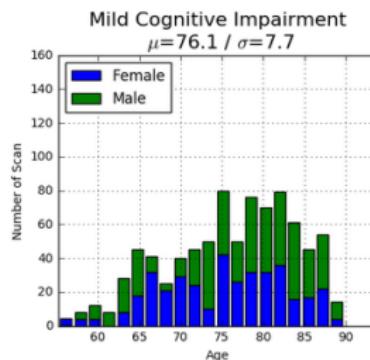
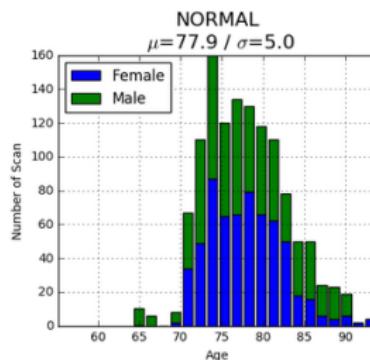
Data Mining

Overall repartition



Data Mining

Patient repartition according to age

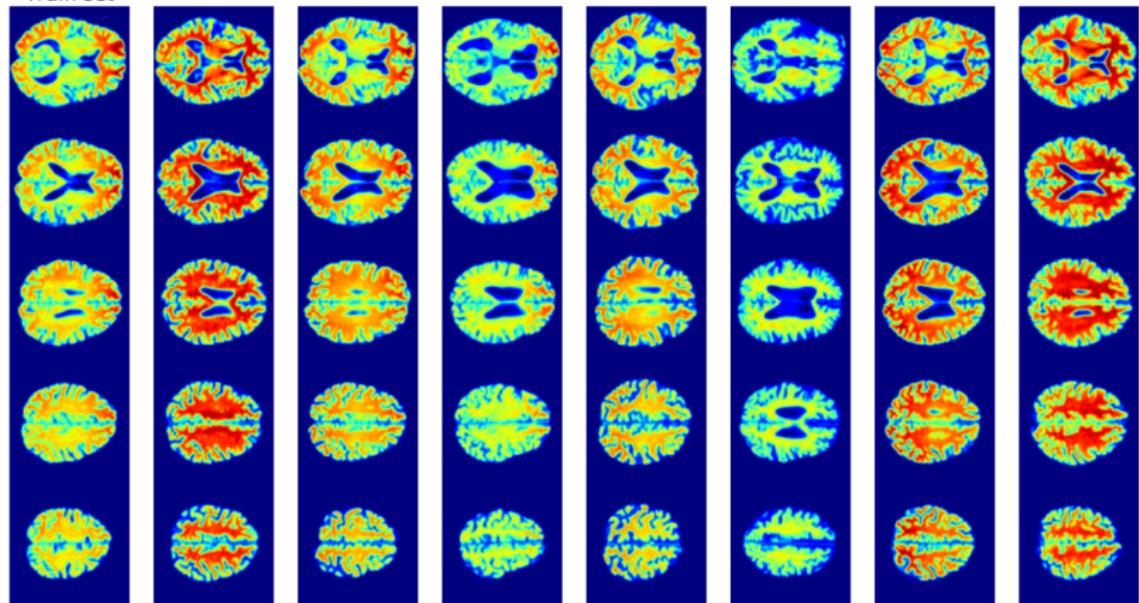


- ▶ Correlation Diagnosis - Age : -0.13
- ▶ Correlation Diagnosis - Sex : 0.04

CNN

Images selected to run CNN

Train set

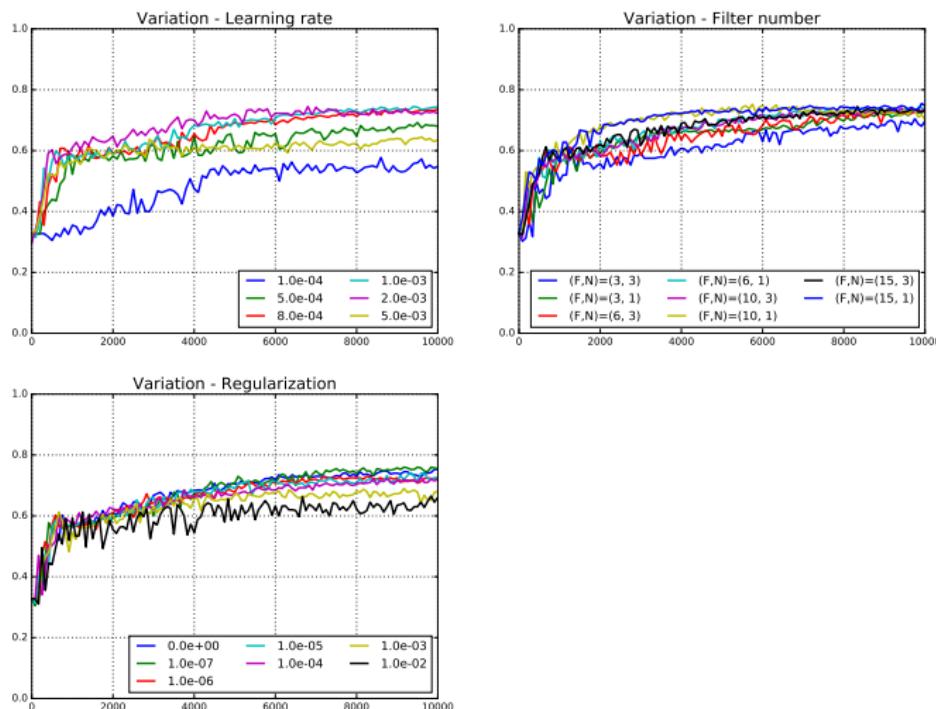


First Model - CLx-FC3

$$y = \text{softmax}(\text{ReLU}(x * W_{CL} + b_{CL})W_{FC} + b_{FC})$$

First Model - CLx-FC3

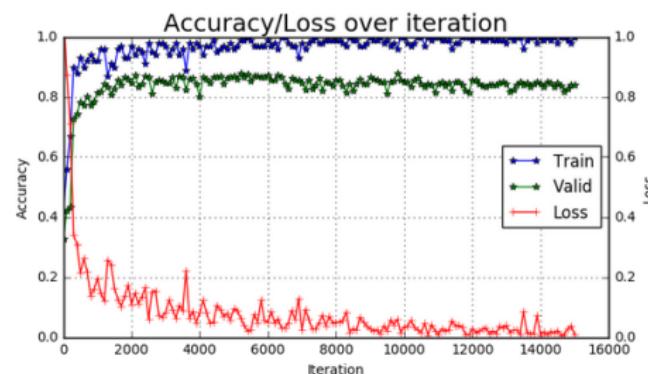
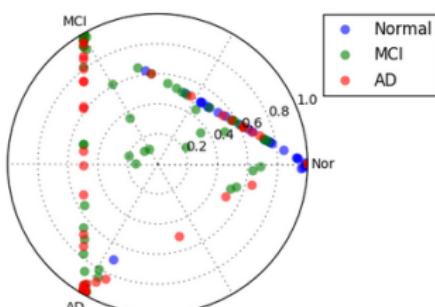
Validation accuracy - Sweep parameters



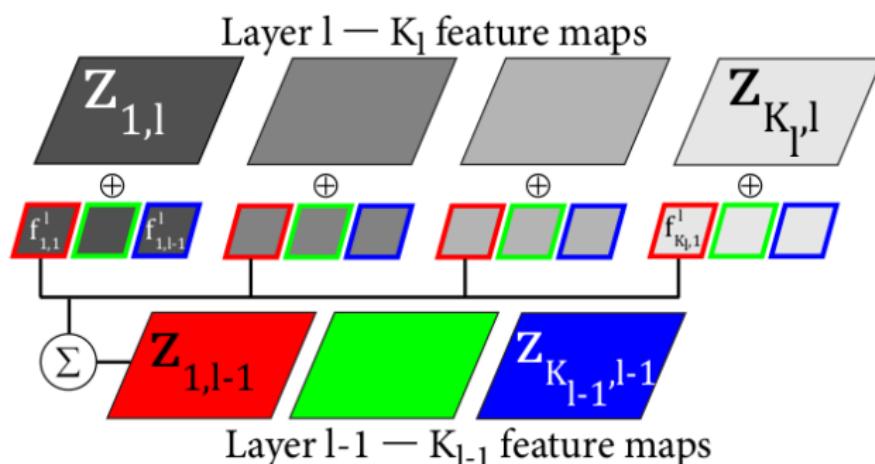
First Model - CL20-FC3

Best parameters (Reg = 1e-7, LR=1e-3, F=20, N=15000)

Validation - Prob. class.



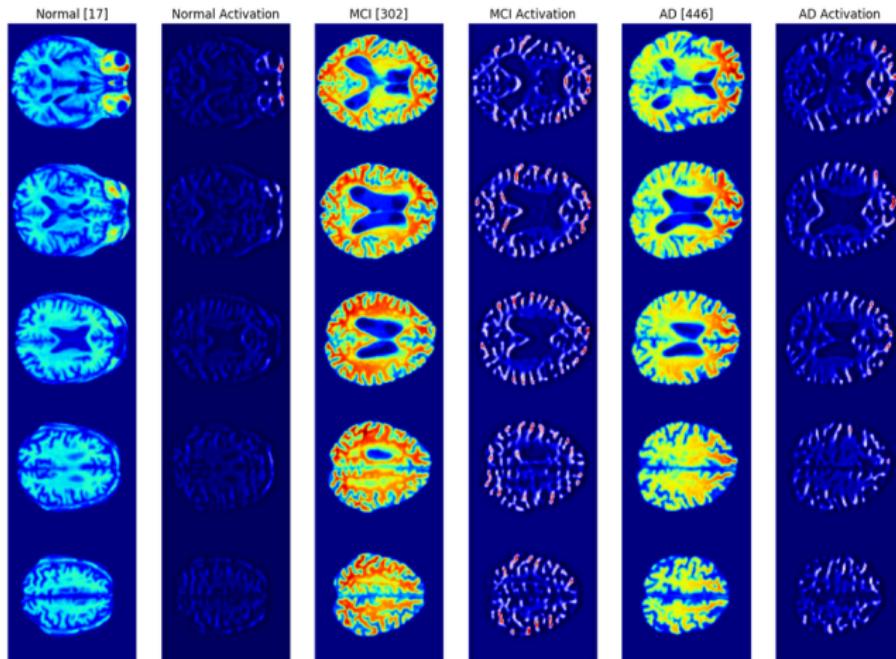
First Model - Deconvolution



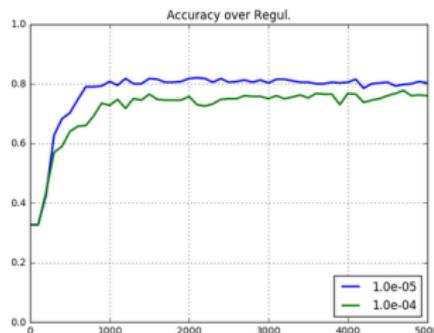
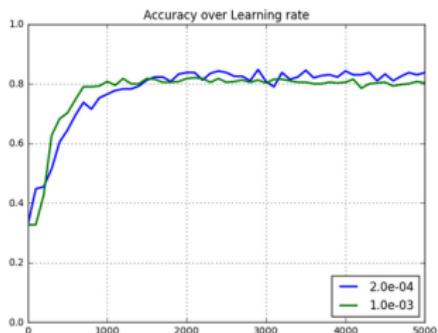
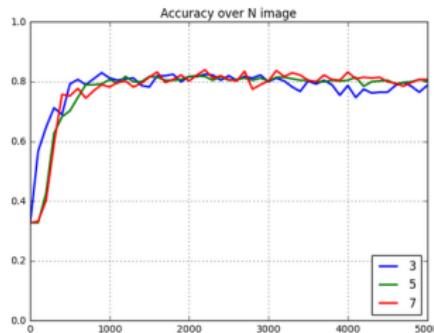
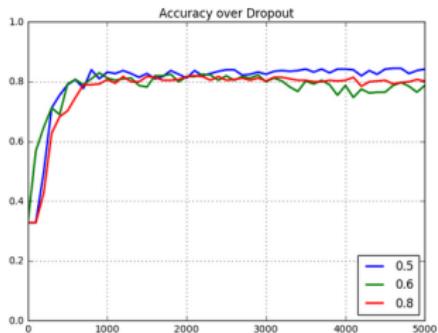
¹ Deconvolutional Networks, M. D. Zeiler, D. Krishnan, G. W. Taylor and R. Fergus

² Visualizing and Understanding Convolutional Networks, M. D. Zeiler and R. Fergus

First Model - Deconvolution



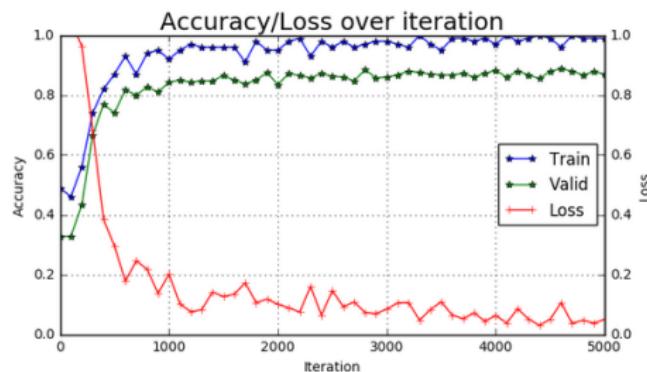
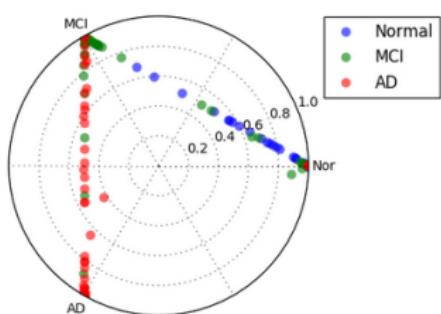
Second Model - CLx-MP4-CLx-MP4-FC512-FC3



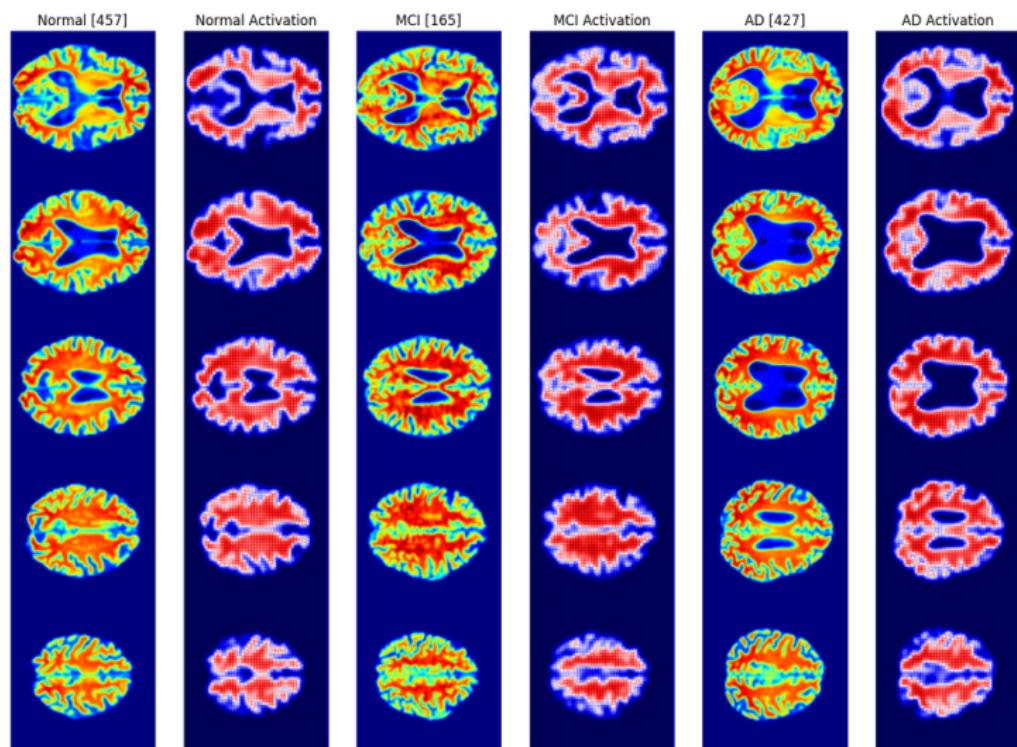
Second Model - CL10-MP4-CL20-MP4-FC512-FC3

Best parameters (Reg = 1e-5, LR=1e-3, F1=10, F2=20, N=5000)

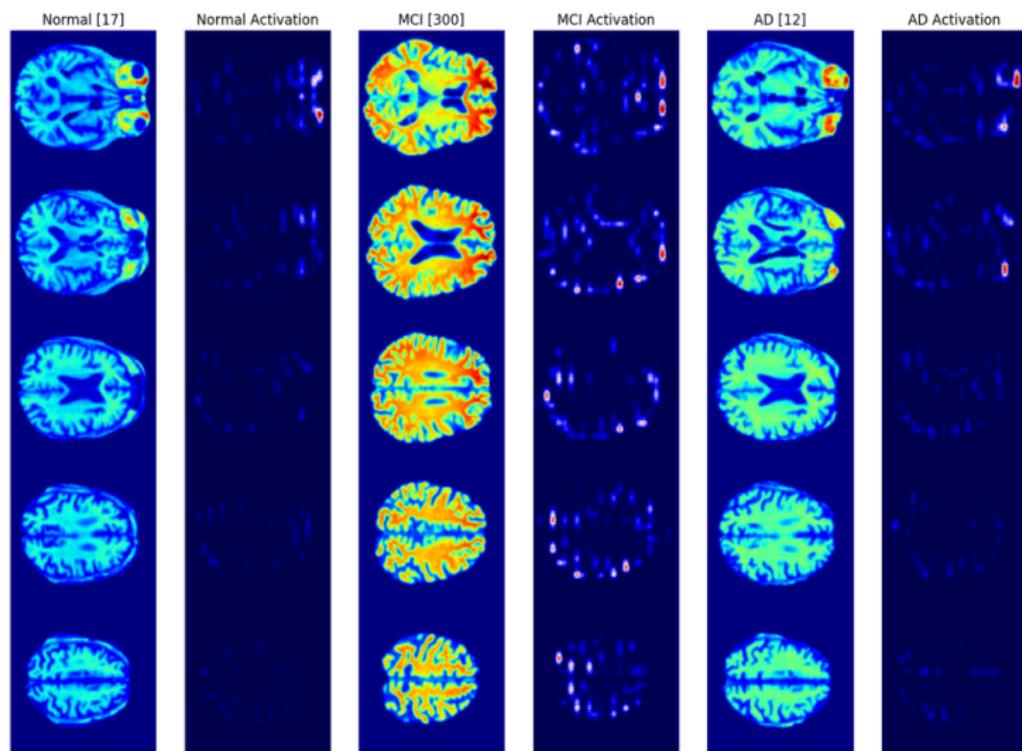
Validation - Prob. class.



Second Model - Deconvolution - 1st CL



Second Model - Deconvolution - 2nd CL



Results

- ▶ Accuracy on test set is similar for both models (2nd: 84%, 1st: 85%).
- ▶ Better separation between Normal and AD for model 2.
- ▶ Computational time for model 2 much faster (2nd: 5h, 1st: 11h).

Let's get further

- ▶ Decrease the size of the input images.
- ▶ Deconvolution to determine if the images used were relevant or not for the classification.
- ▶ Running CNN on GPU or clusters.
- ▶ More images

Thank you for your attention

Questions ?