

CNN Challenges - Medical Imaging

- Segmentation: Lumbar spine muscle segmentation from MRI
- Classification: Classification of subjects with Alzheimer's disease (AD) from PET and MRI images
- Regression: Estimation of standard dose PET images from low dose images

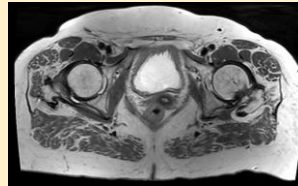
Lumbar spine muscle segmentation from MRI (I)

Background

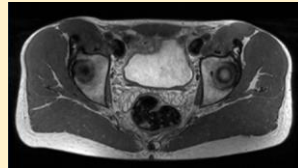
What we know about the Muscles Health?

Fatty infiltration and muscle wasting (atrophy) is associated with loss of strength and mobility and has been observed in:

- **Sarcopenia**
- Patients with **Hip Pain**
- Patients with **Osteoarthritis**
- Neurological disorders



MRI of a Patient with Fatty Atrophy

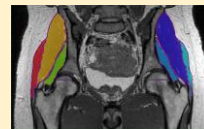


MRI of a Healthy Marathon Runner

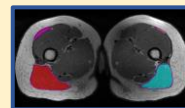
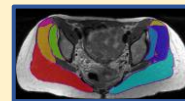
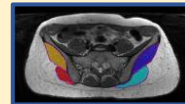
How to evaluate quantitatively muscle health?

- We need **quantitative biomarkers** for hip muscle health
- To obtain 3D quantitative metrics, the **labelling of individual muscles** is needed
- Nowadays, **manual labelling** each muscle is extremely time-demanding and **not cost-effective**, hindering the execution of clinical studies

Labelling of the Hip Abductors

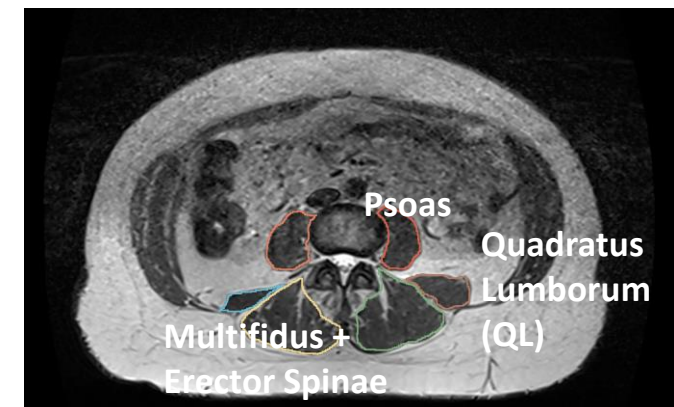
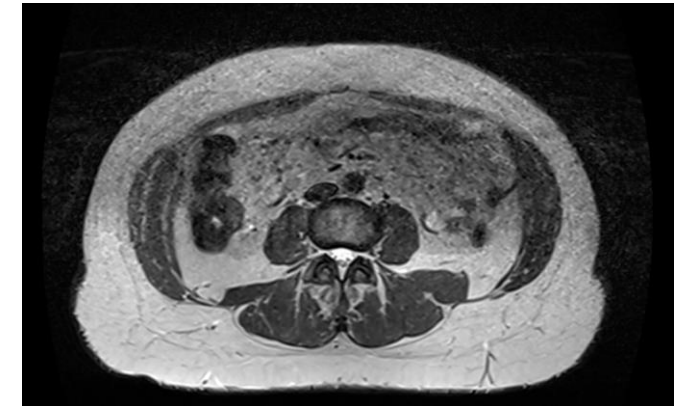


3D Analysis involves the manual labelling of more than 100 slices taking up to 2 days per MRI scan



What is this challenge about?

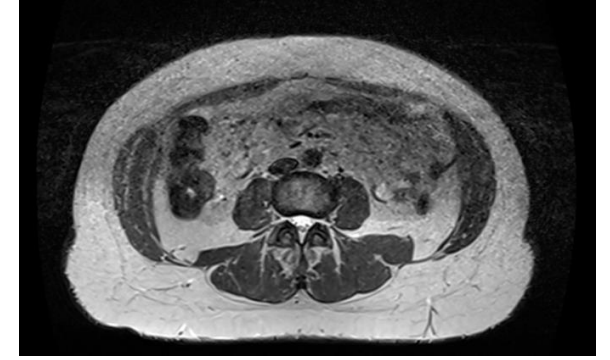
We want to segment (delineate) 3 lumbar spines muscles from a 2D slice MRI Image at the level of the L4 spine



Lumbar spine muscle segmentation from MRI (II)

- You will have a jupyter notebook that implements a 2D segmentation of the lumbar spine muscles using a U-NET CNN
- The dataset is already split into a training and validation set (it's a small dataset)
- Each element of the training set consists of a Dixon MRI image (input) and an image of manually segmented labels (output)
- An augmented dataset is also available
- The code trains the U-NET using the binary cross entropy loss

Input



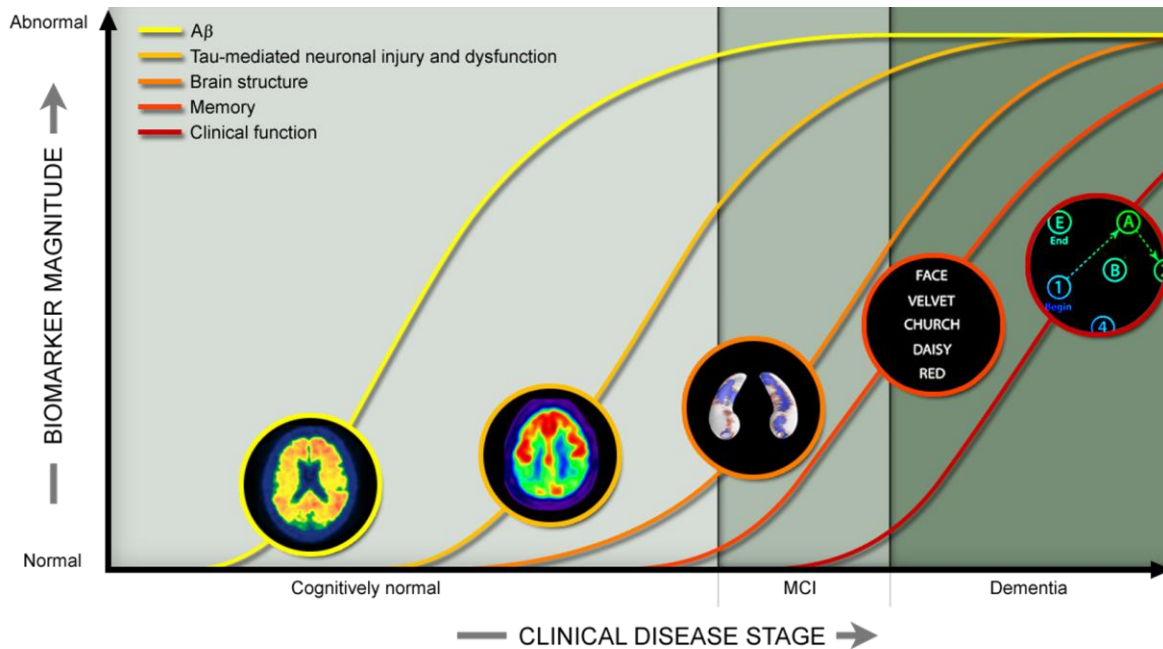
Output



Alzheimer's Disease Diagnose from PET and MRI Images (I)

Background

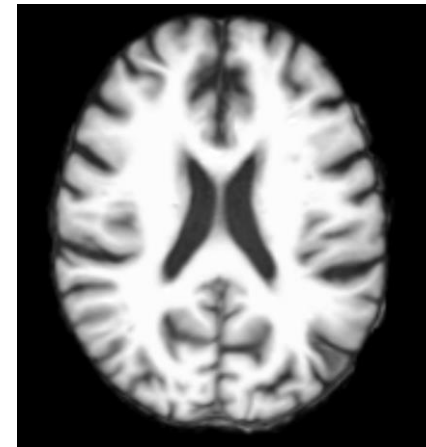
Biomarkers of Alzheimer's Disease (AD)



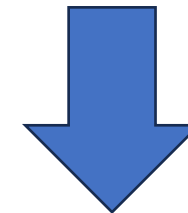
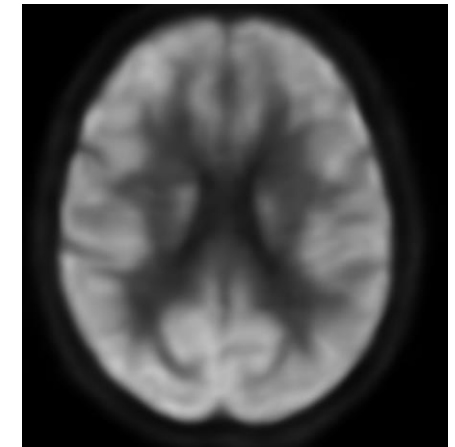
- Hypometabolism in the brain measured with PET FDG images is a biomarker of AD disease
- Brain atrophy measured with structural MRI is another biomarker of AD

What is this challenge about?

MRI Image



PET Image



Alzheimer's Disease (1) or Cognitive Normal (0)

Alzheimer's Disease Diagnose from PET and MRI Images (II)

- You will have a jupyter notebook that loads the data and a CNN-based pretrained classification model (e.g ResNet)
- You will have to build the training and validation set from PET and MRI images, and a labels indicating if each image is AD or CN
- You can train the model using the MRI, the PET images or both together with a multi-channel input