

# 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

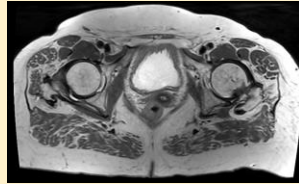
# Lumbar spine muscle segmentation from MRI (I)

## Background

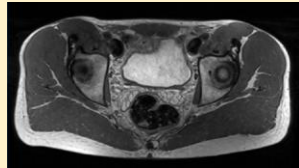
### What we know about the Muscles Health?

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

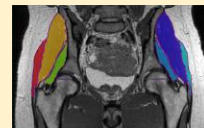


MRI of a Healthy Marathon Runner

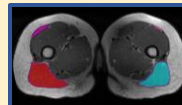
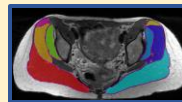
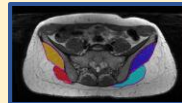
### How to evaluate quantitatively muscle health?

- 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

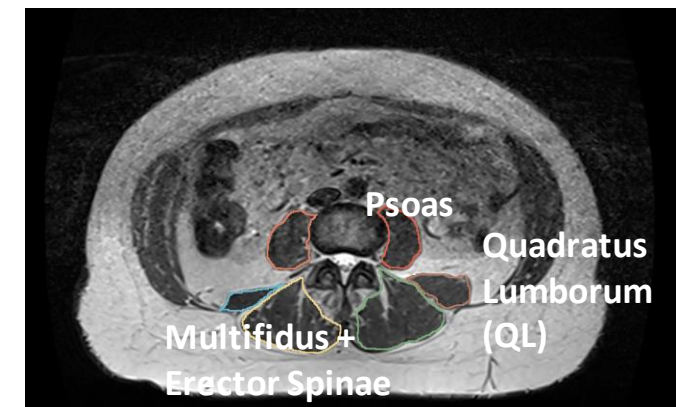
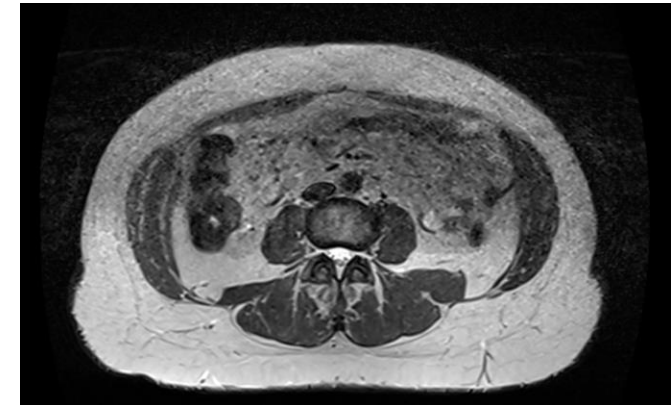


3D Analysis involves the manual labelling of more than 100 slices taking up to 2 days per MRI scan



## What is this challenge about?

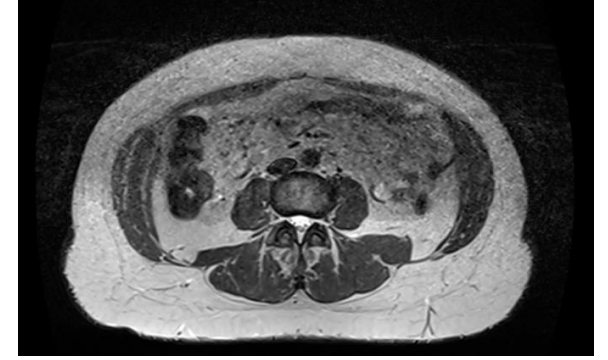
We want to segment (delineate) 3 lumbar spines muscles from a 2D slice MRI Image at the level of the L4 spine



# 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



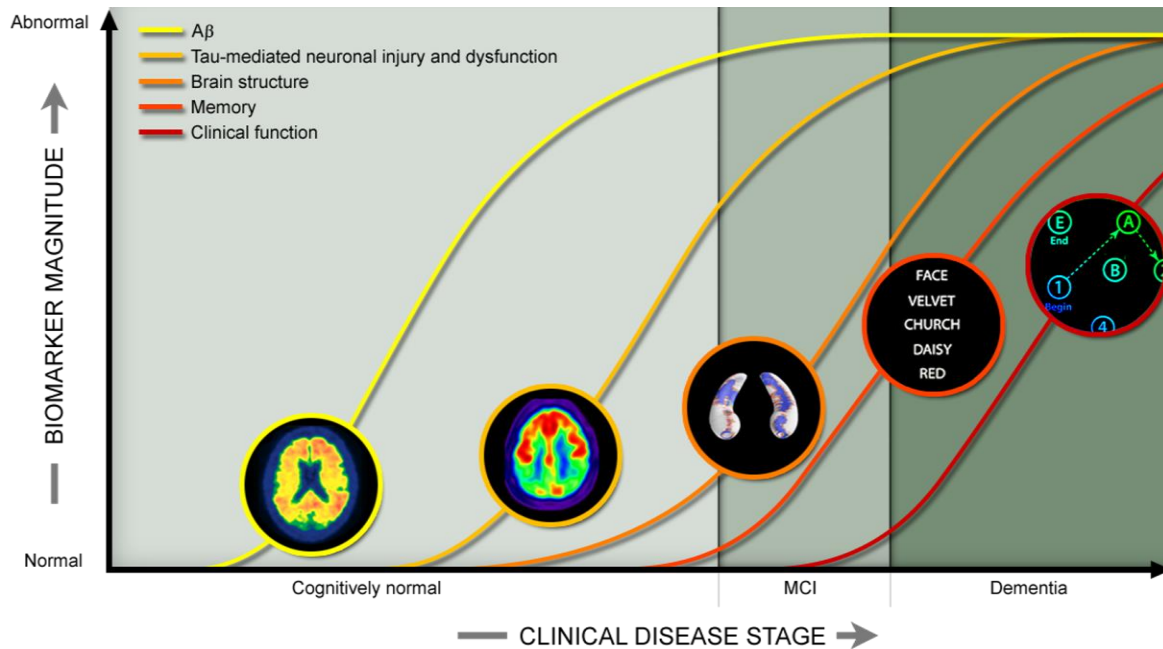
Output



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

## Background

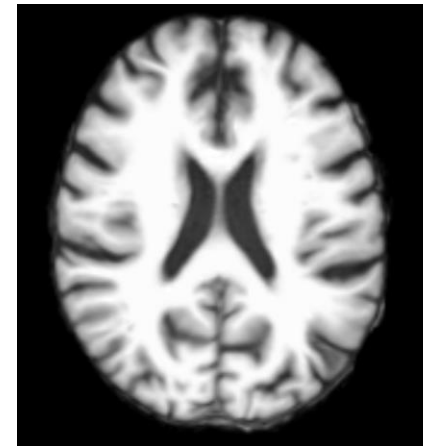
### Biomarkers of Alzheimer's Disease (AD)



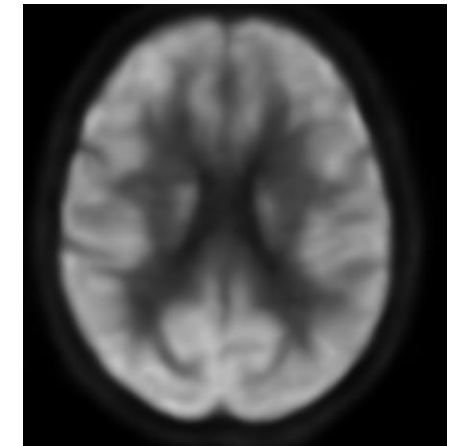
- Hypometabolism in the brain measured with PET FDG images is a biomarker of AD disease
- Brain atrophy measured with structural MRI is another biomarker of AD

## 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