MLIA Final Projects

- Please note that each paper has related code released online. Feel free to use it!
- All tasks will need to be performed on our provided images.
- Good luck and enjoy!

T3 (3 teams): this is for groups with THREE-member only!

*** **Papers for tumor segmentation project:**

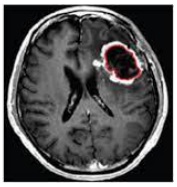

Fig. 1: An example of brain tumor segmentation.

[1] Swin UNETR: Swin Transformers for Semantic Segmentation of Brain Tumors in MRI Images

[https://arxiv.org/abs/2201.01266]

[2] Self Pre-training with Masked Autoencoders for Medical Image Classification and Segmentation

[https://arxiv.org/abs/2203.05573]

*** **Papers for image classification project (healthy vs. MCI. vs. Alzheimer's disease):**

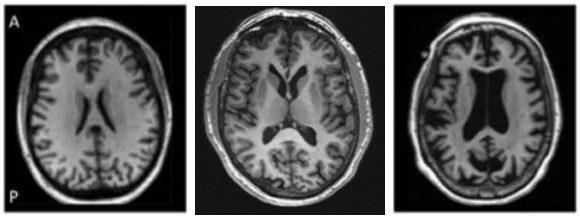

Fig. 2: An example of healthy (left) vs. MCI (middle) vs. disease (right).

[3] Supervised Contrastive Learning

[https://arxiv.org/pdf/2004.11362v5]

T4 (12 teams): this is for groups with FOUR-member only!

*** **Papers for pairwise image registration project:**

Tasks: (a) Train and test the model below on brain MR images; (b) To understand the generalizability of the registration models on complex datasets. Train the model on datasets (MNIST) and test the performance on unseen datasets (Google Draw).

[1] Fourier-Net+: Leveraging Band-Limited Representation for Efficient 3D Medical Image Registration

[https://arxiv.org/pdf/2307.02997]

[2] TransMorph: Transformer for unsupervised medical image registration

[https://arxiv.org/abs/2111.10480]

[3] DiffuseMorph: Unsupervised Deformable Image Registration Using Diffusion Model

[https://arxiv.org/abs/2112.05149]

[4] uniGradICON: A Foundation Model for Medical Image Registration

[https://arxiv.org/pdf/2403.05780]

*** **Papers for spatiotemporal image registration**

Dataset: A dataset with video sequences (2D x T) cardiac MR images (download from here: https://www.creatis.insa-lyon.fr/Challenge/acdc/databases.html). Use all images in the "Training Dataset" for training, and the 'Testing Dataset' for testing.

[5] TLRN: Temporal Latent Residual Networks For Large Deformation Image Registration

[https://pmc.ncbi.nlm.nih.gov/articles/PMC11929566/]

[6] MAE-TransRNet: An improved transformer-ConvNet architecture with masked autoencoder for cardiac MRI registration

[https://pubmed.ncbi.nlm.nih.gov/36968818/]

*** **Papers for image regression project**

Dataset: A dataset with cardiac CMR video sequences (2D x T) that encode heart motions with provided ground truth labels.

Task: (a) First train a segmentation model [***U-Net: Convolutional Networks for Biomedical Image Segmentation, https://arxiv.org/pdf/1505.04597***] to segment heart contours from all

images; **(b)** Implement a regression task using the predicted heart contours as inputs, selecting a network from the list below:

[7] ViViT: A Video Vision Transformer [https://arxiv.org/abs/2103.15691]

[8] Sequencer: Deep LSTM for Image Classification [https://arxiv.org/pdf/2205.01972]

*** **Papers for image generation project**

Dataset: Each team is required to download the dataset from https://github.com/bearpaw/sysu-shape-dataset/tree/master including all images of airplane, bicycle, boat, car, motorbike (e.g. https://github.com/bearpaw/sysu-shape-dataset/tree/master/motorbike/images).

Task: Each team will implement an image generation task using selected network from the list below:

[9] Denoising Diffusion Probabilistic Models
[https://arxiv.org/abs/2006.11239]
[10] Diffusion Models Beat GANs on Image Synthesis
[https://arxiv.org/pdf/2105.05233]
[11] High-Resolution Image Synthesis with Latent Diffusion Models
[https://openaccess.thecvf.com/content/CVPR2022/papers/Rombach_High-Resolution_Image_Synthesis_With_Latent_Diffusion_Models_CVPR_2022_paper.pdf]
[12] NVAE: A Deep Hierarchical Variational Autoencoder
[https://arxiv.org/pdf/2007.03898]