Medical Image segmentation

Health

Project 10

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Plan

Introduction

Video

To present our project

Medical Image segmentation

Heart

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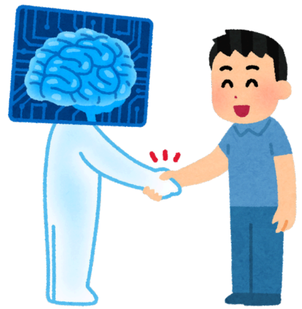
Project's Goal



Design and implement a hybrid CNN-Transformers architecture for medical image segmentation

Evaluate the model

Develop a user-friendly interface for the use of medical professionals

Methodology

1

Research

Read papers and bibliography

2

Code Implementation

Try to implement the architecture we found

3

Client's consultation

Check if our results satisfy our client

Project Management / Ressource

Microsoft Teams

Visual Studio Code

Trello

GitHub

python™

Notion

PyTorch

Dataset Overview

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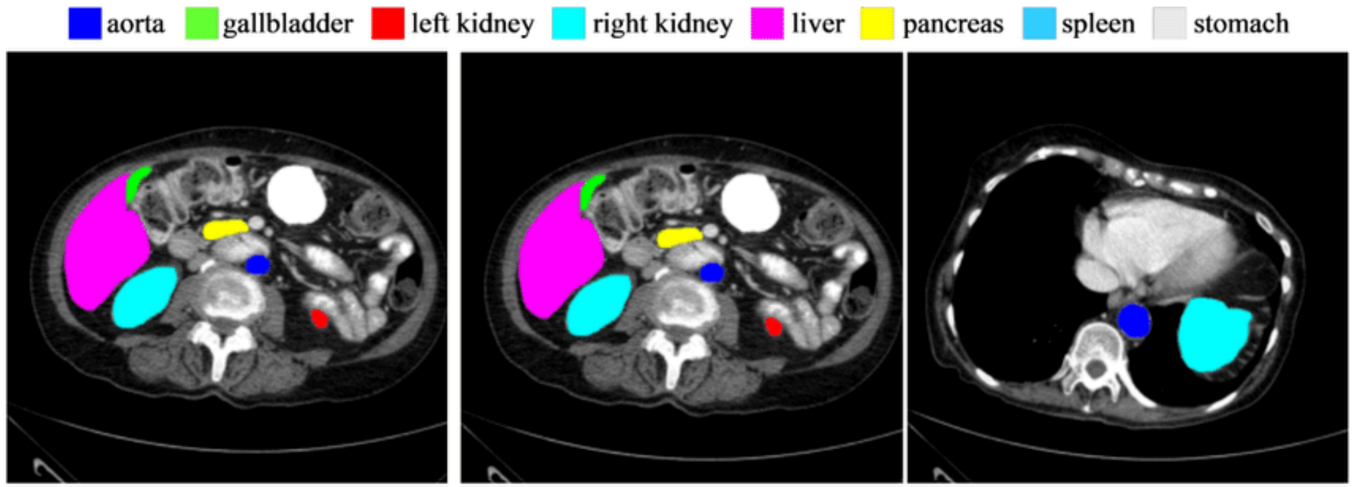
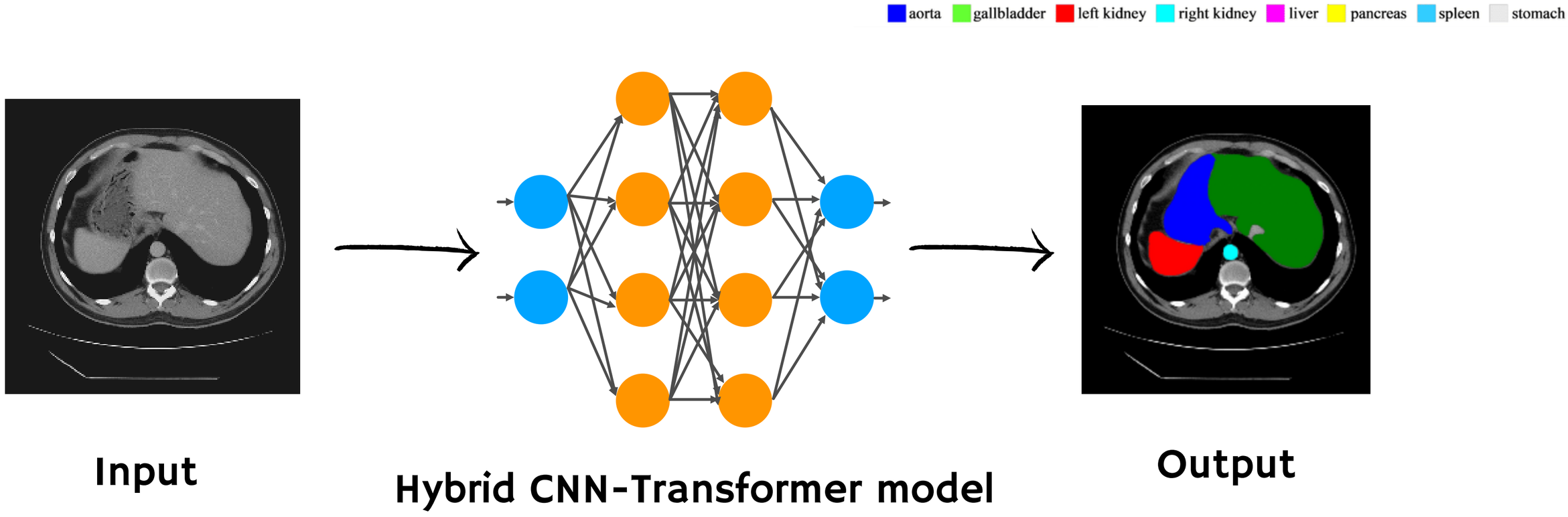
Dataset

Synapse Dataset:

- Public dataset
- 30 CT scans with 3779 axial abdominal clinical CT images
- 18 samples into the training set
- 12 samples into testing set



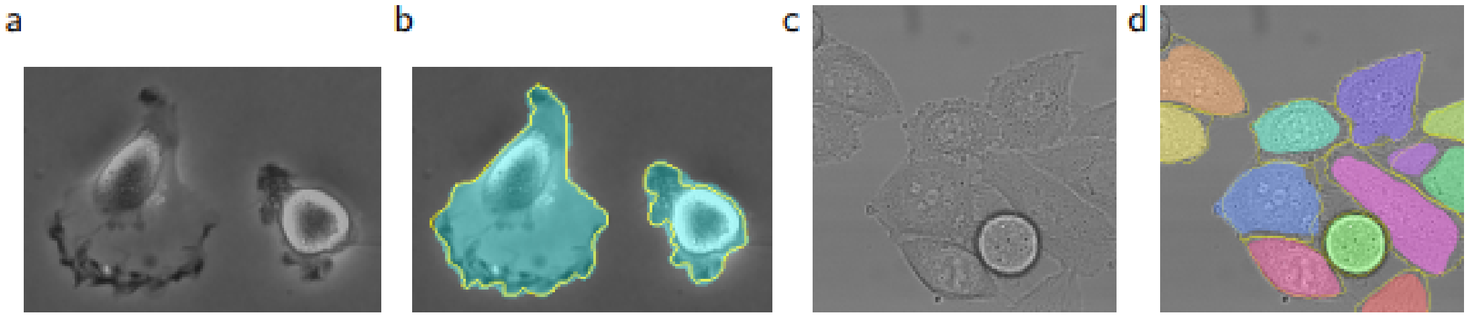
System overview

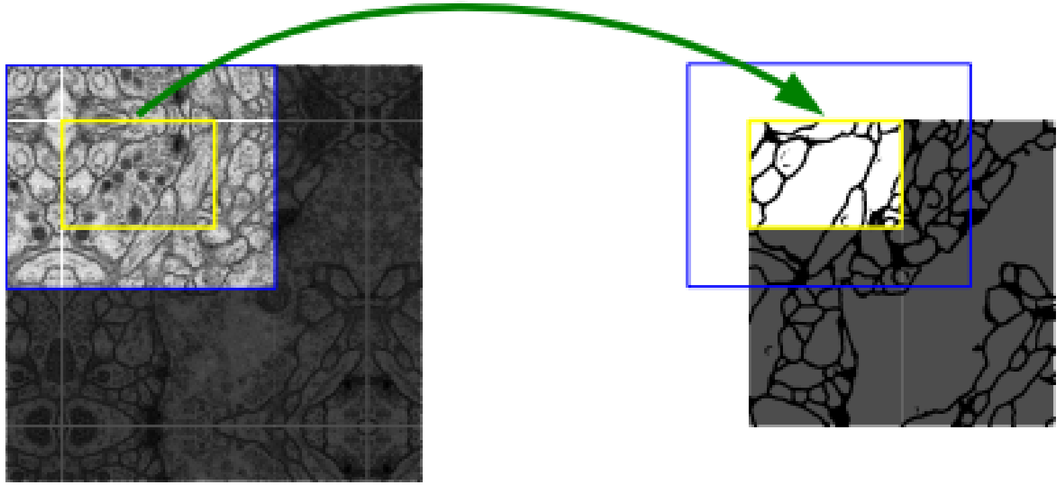


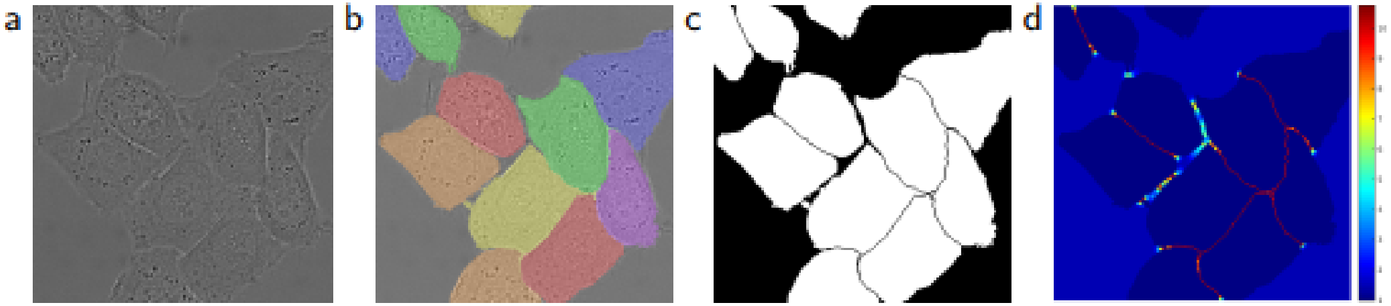
Architectures and Results

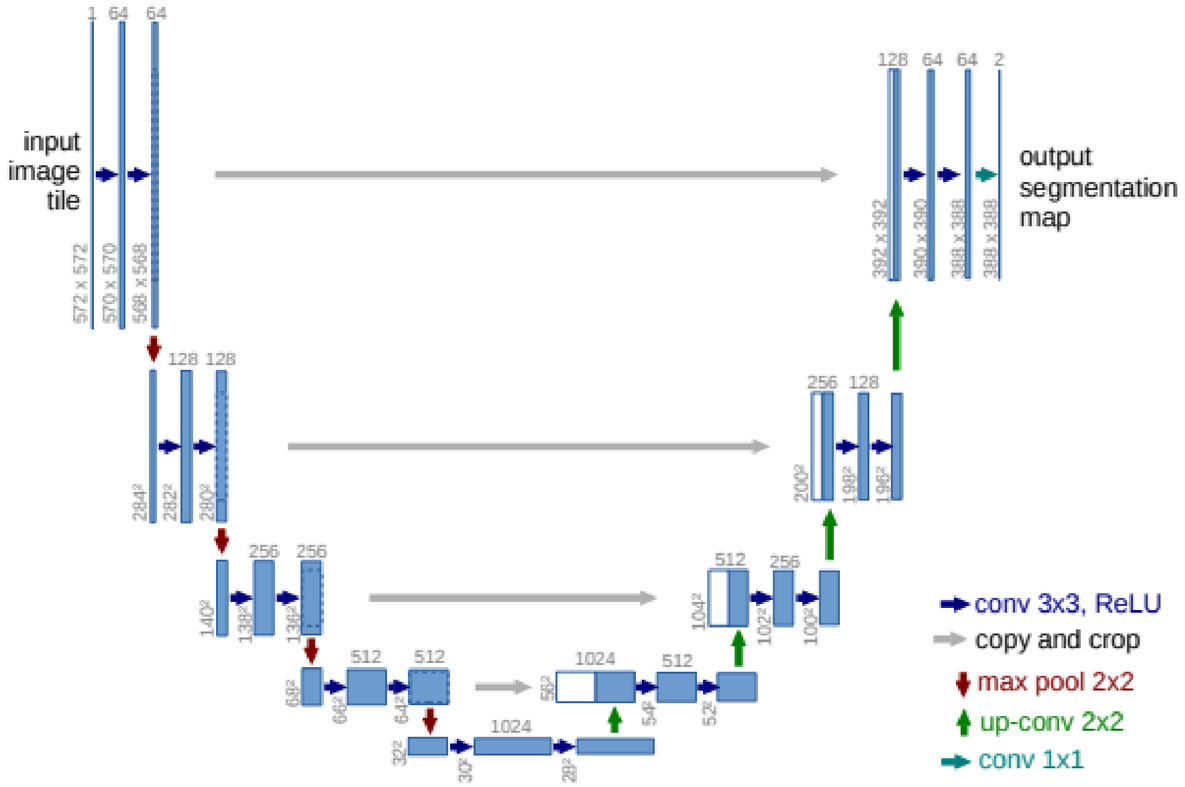
These are the key architectures we tested; others were also evaluated but are not presented here.

U-net: Convolutional Networks for Biomedical Image Segmentation







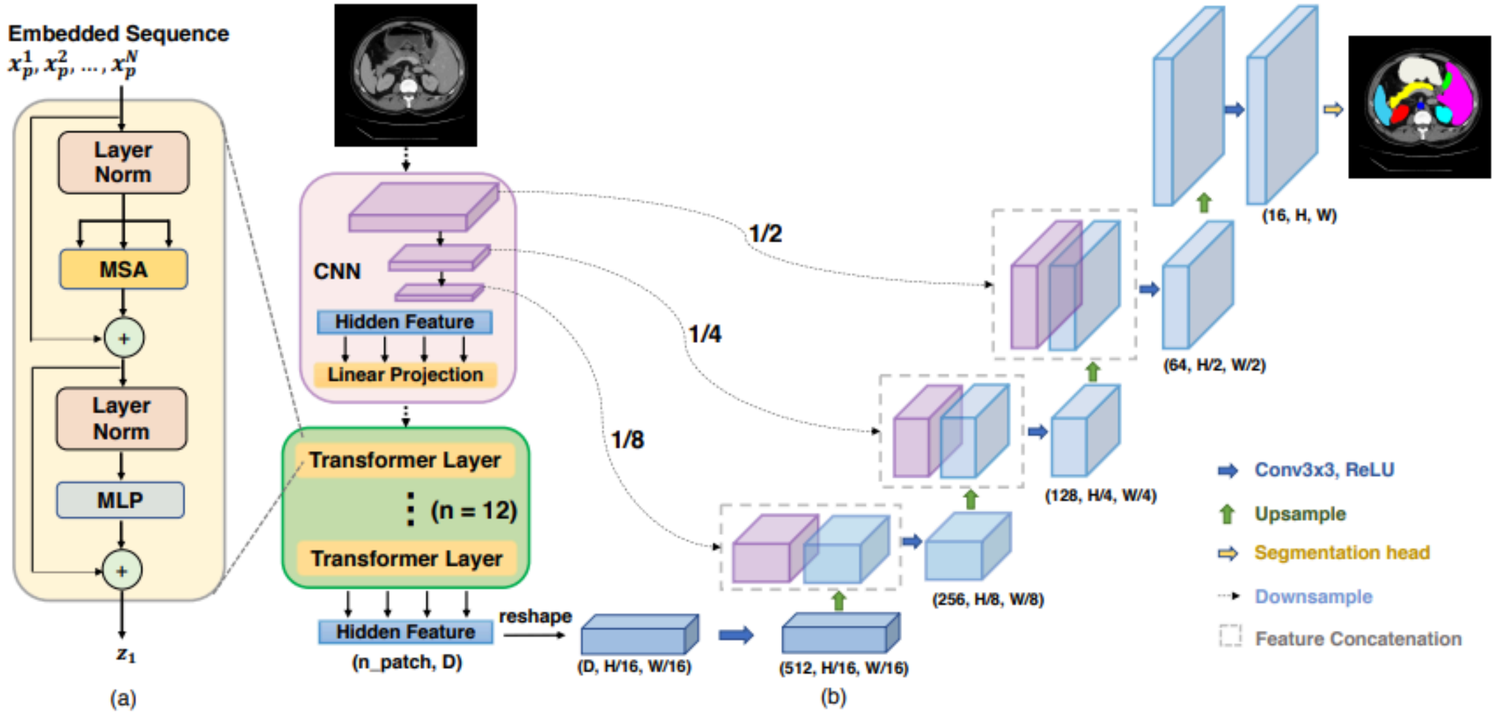


Architecture

- Encoder
- Decoder
- Skip connections

Source: https://arxiv.org/pdf/2102.04306

TransUnet: Transformer Unet

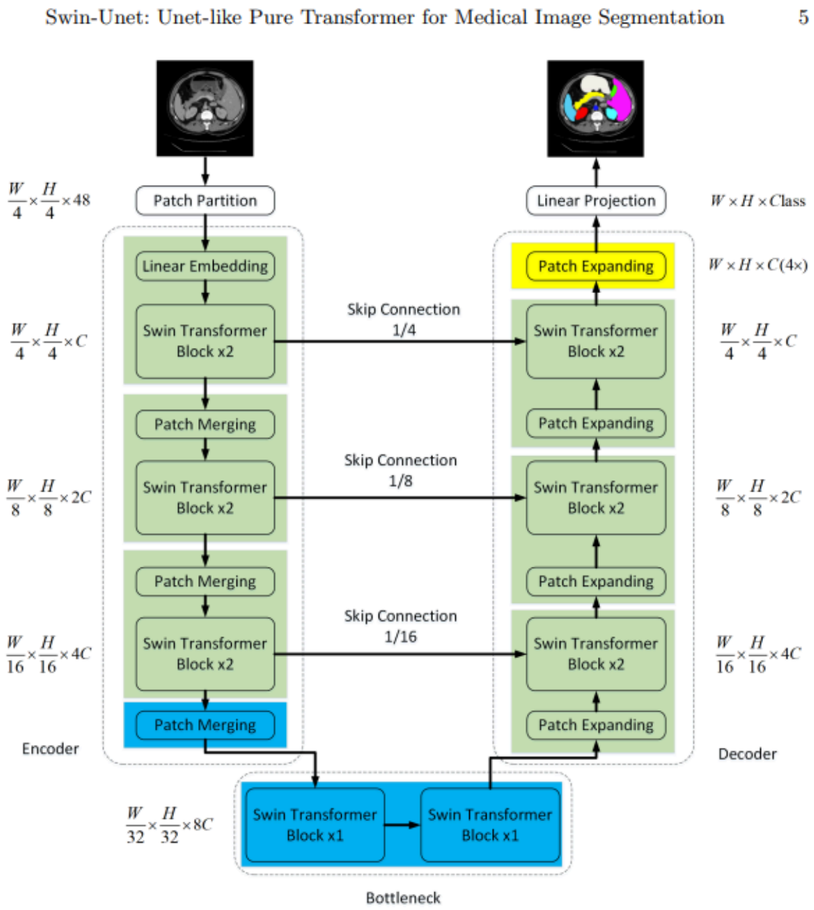


Architecture

- Transformer
- CNN
- Encoder/Decoder
- Skip connections

Source: https://arxiv.org/pdf/2102.04306

SwinUnet: Swin Transformer Unet

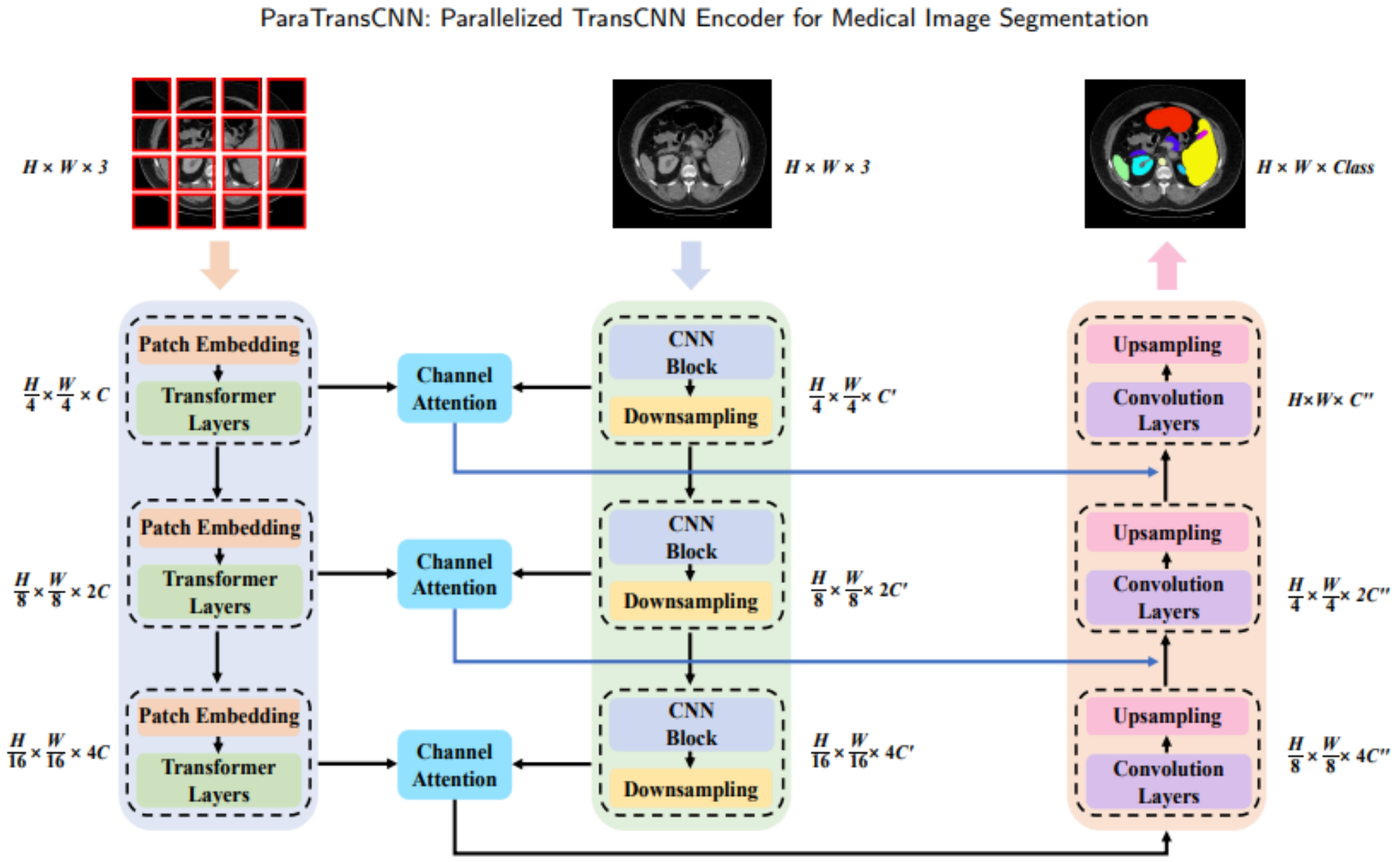


Source: https://arxiv.org/pdf/2111.14791

Architecture

- Unet based architecture
- Swin Transformer blocks
- Skip connections

ParaTransCNN : Parallelized TransCNN



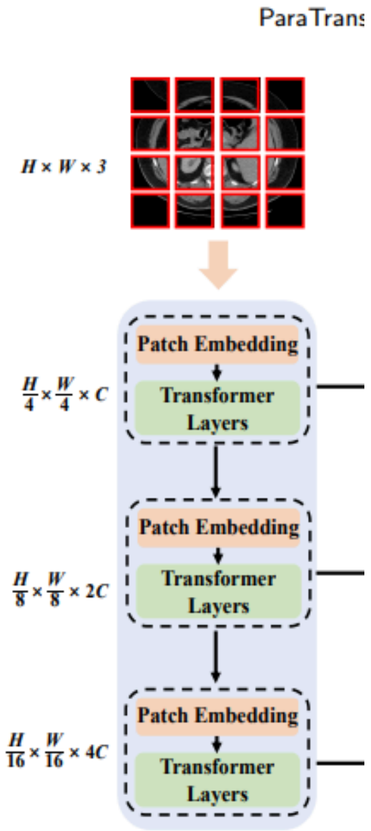
Source: https://arxiv.org/abs/2401.15307

Architecture

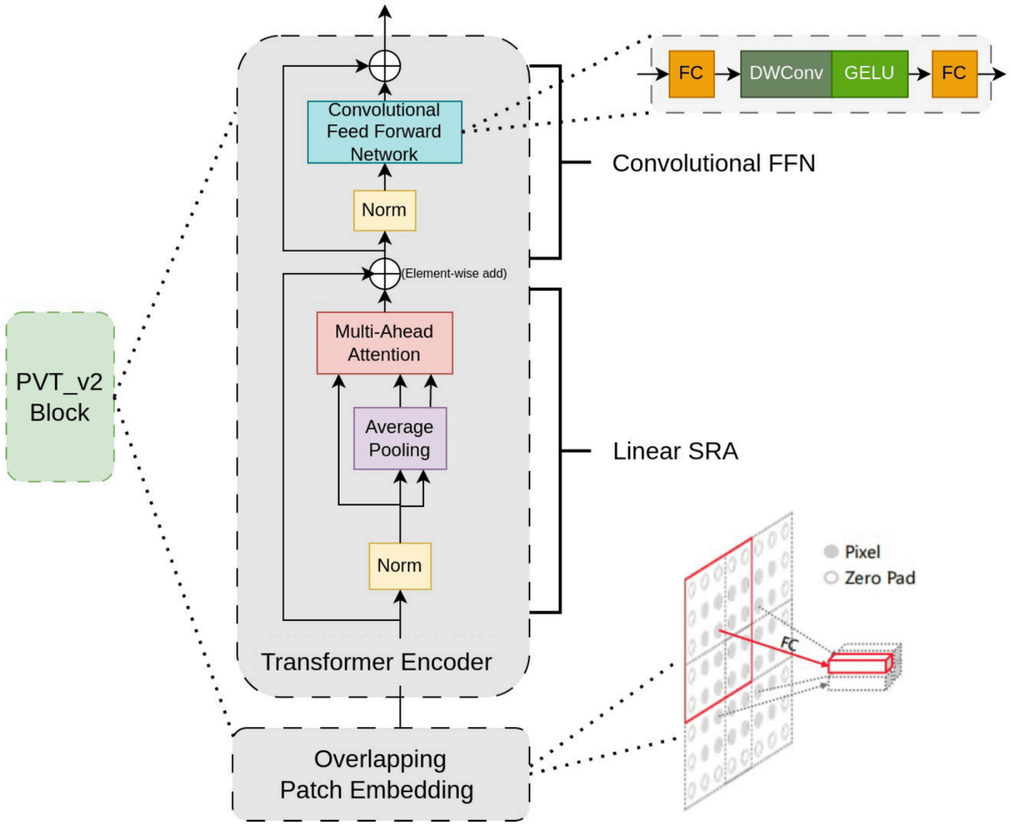
- Transformer
- CNN
- Decoder
- Channel Attention
- Skip connections

Modifications made on the model Architecture : ParaPVTCNN

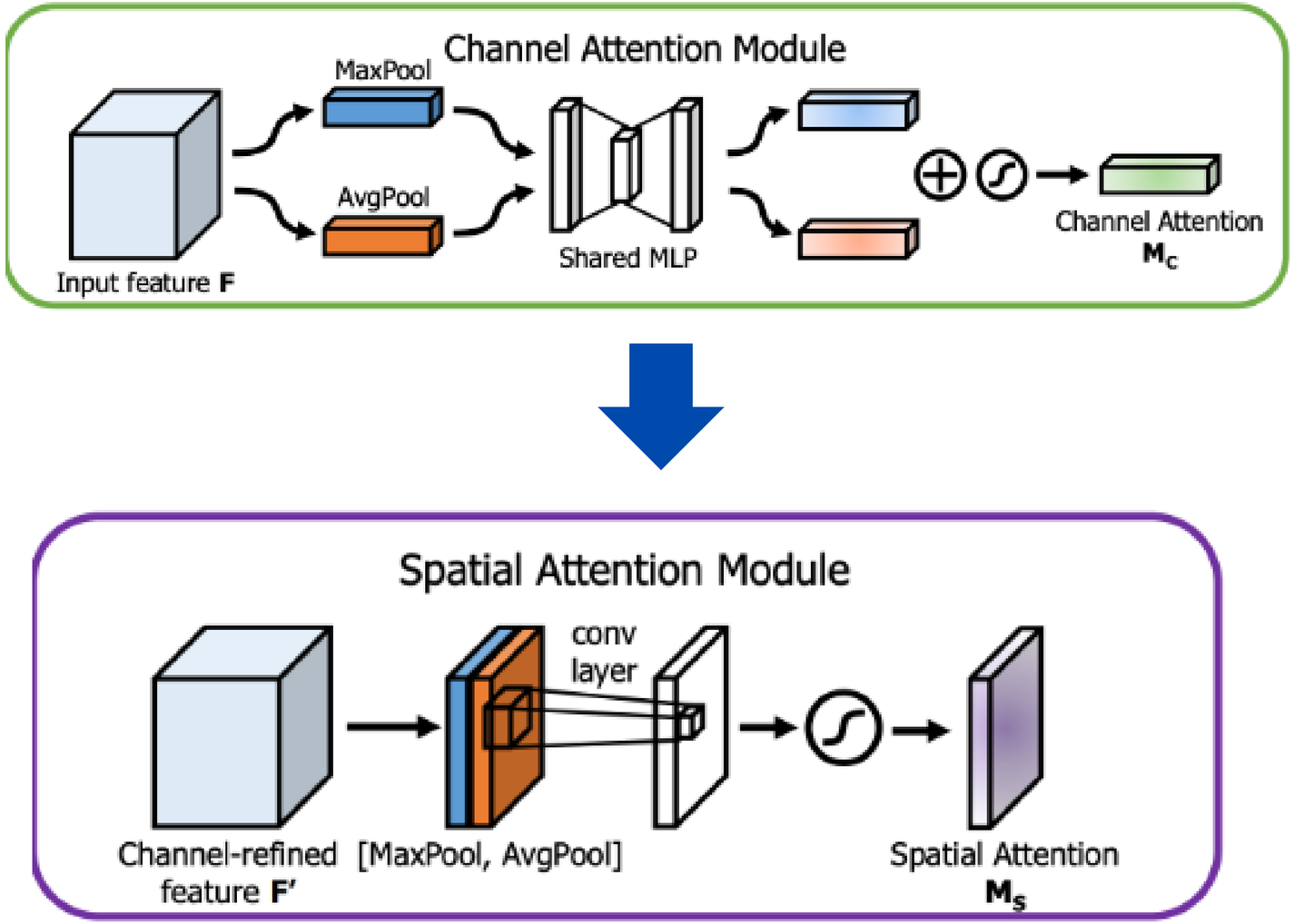
Transformer

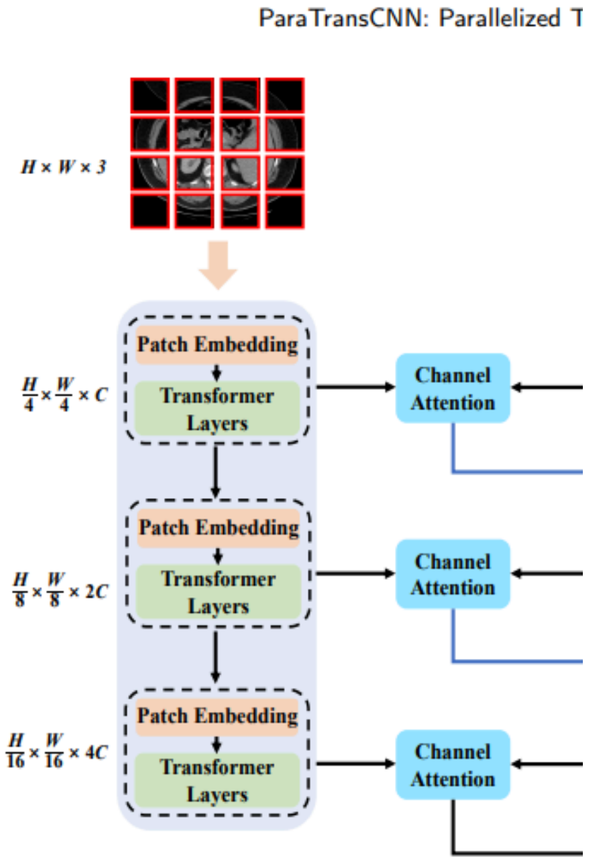


Pyramid Vision Transformer

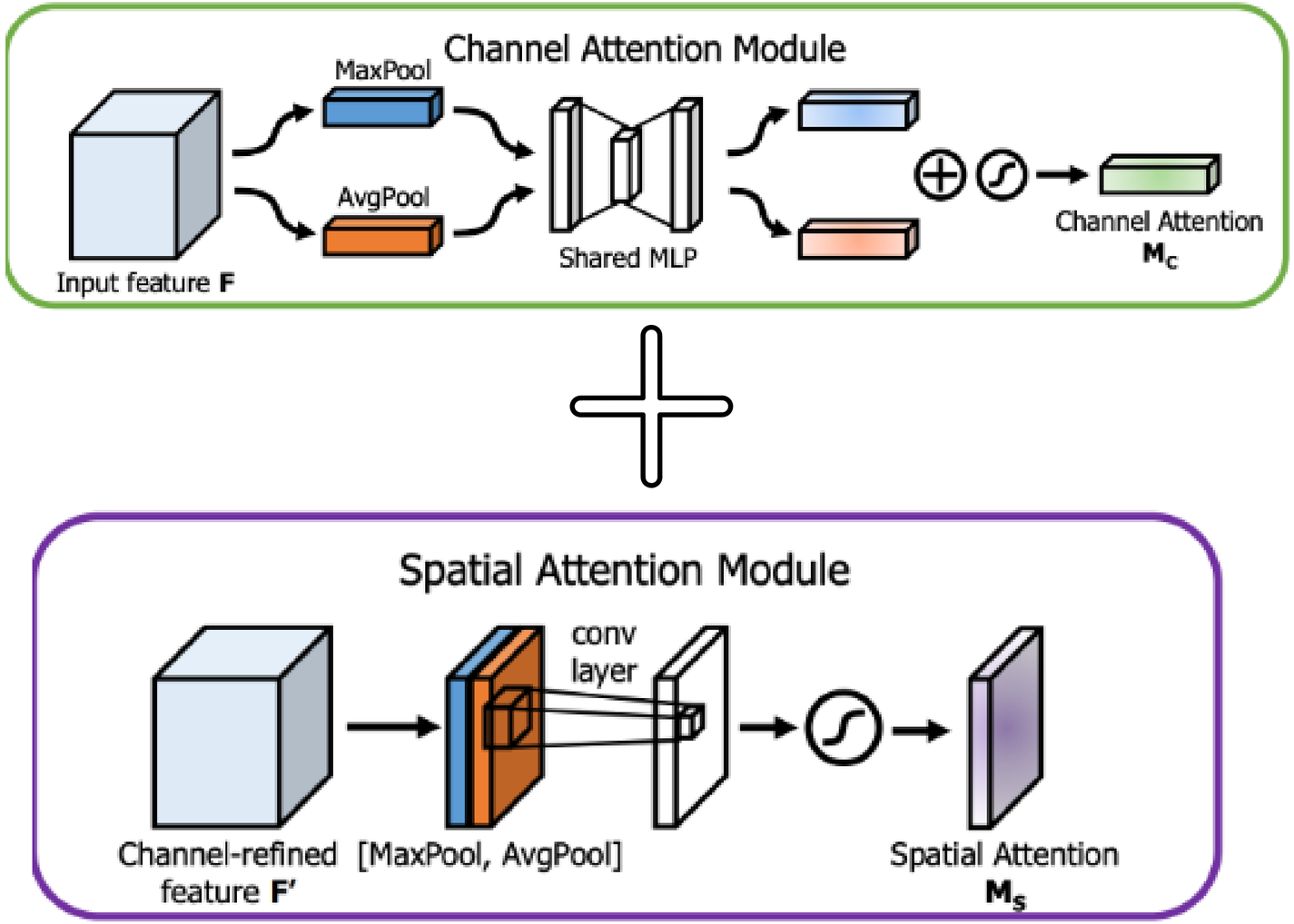


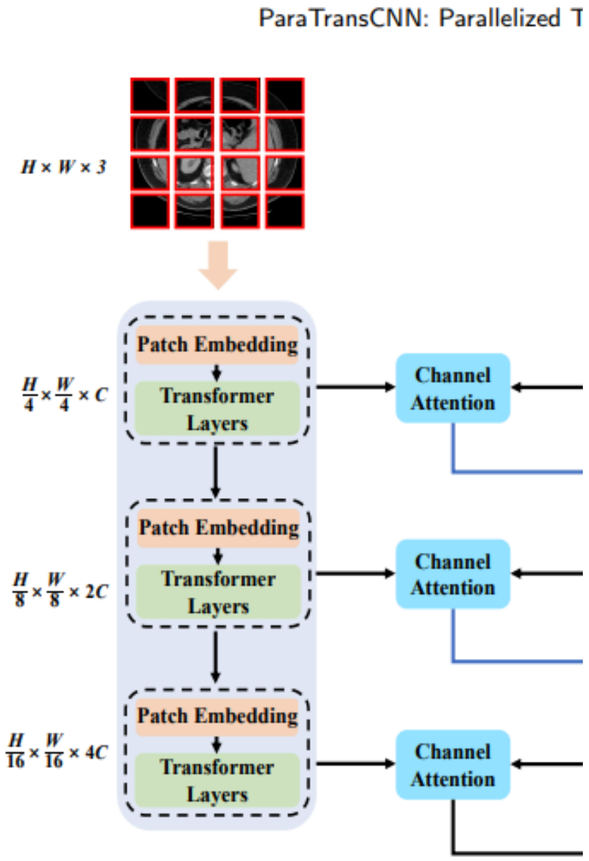
Modifications made on the model Architecture





Modifications made on the model Architecture





Metrics used

Dice score

It provides a clear measure of the overlap between predicted and actual segmentations, ensuring a balanced consideration of both false positives and false negatives.

HD95

It provides a boundary accuracy and robustness to outliers. Its focus on the 95th percentile distance makes it a reliable and informative measure, especially in applications requiring precise boundary delineation.

Results and Impact of modifications

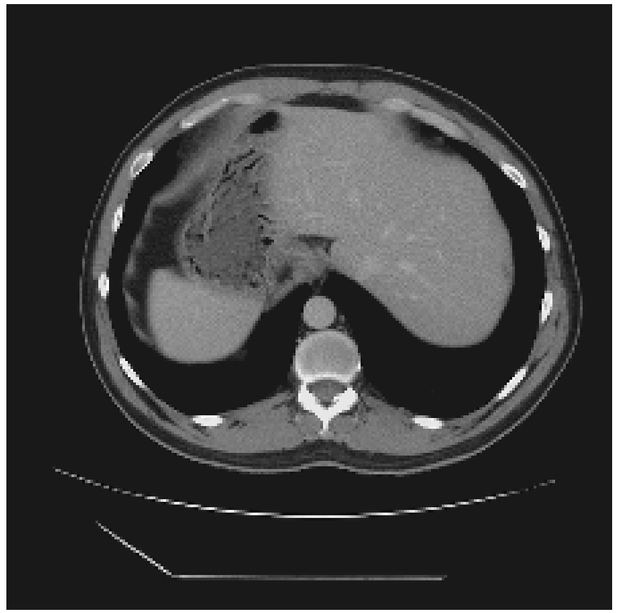
Models	Dataset	Batchsize	Max epochs	Max iterations	Mean Dice	Mean hd95
ParaPVTCNN	Synapse	24	100	20000	0.81	21.48
ParaPVTCNN_CA_SA	Synapse	24	150	20000	0.80	21.10
ParaPVTCNN_SA	Synapse	24	150	20000	0.77	25.33

Table 1: Metrics of our trained models

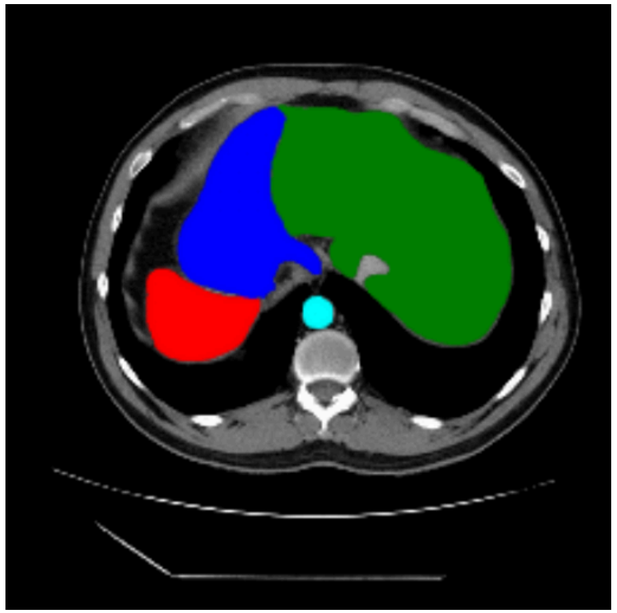
Models	Dataset	Mean Dice	Mean hd95
ParaTransCNN	Synapse	0.83	15.86
TransUnet	Synapse	0.77	31.69
SwinUnet	Synapse	0.78	21.55

Table 2: Metrics of models in the literature review

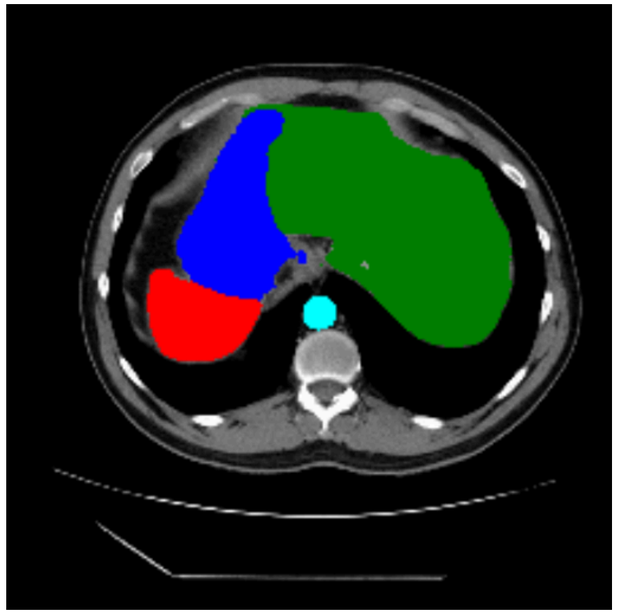
Results and Impact of modifications



Input



Expected output



ParaPVTCNN's predicted output

Interface for our Project

The code is available on our GitHub:

https://github.com/AdrienJO/Medical-Image-Segmentation-Using-Hybrid-Architectures

Areas For Improvement

1

2

3

Research

Read more papers to get more inspiration and try to add new blocks to our main model

Model

ParaTransCnn Modification:

- Try the other versions of PVT
- Play with the Hyperparameters

Interface

Work more on the Interface that we presented

Difficulties encountered

1

The project's purpose

We found it difficult to pinpoint the project's purpose, as the initial objectives

2

Testing the models

The hardware available to test and train each model was insufficient

3

PyTorch library

Learning the PyTorch library, which we had never used before,represented a significant challenge

4

Time

We did not have the same schedule to work together

Conclusion