Lab5: Image segmentation (MONAI)

3099704 AI for Digital Health (2025/2)

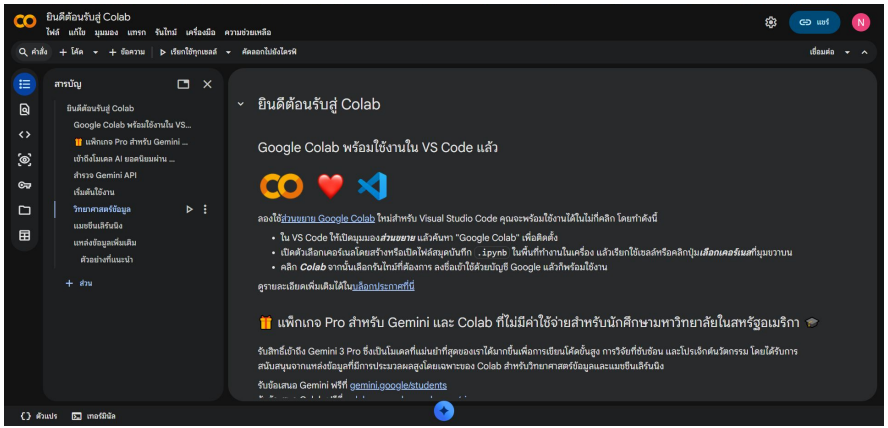
Objective

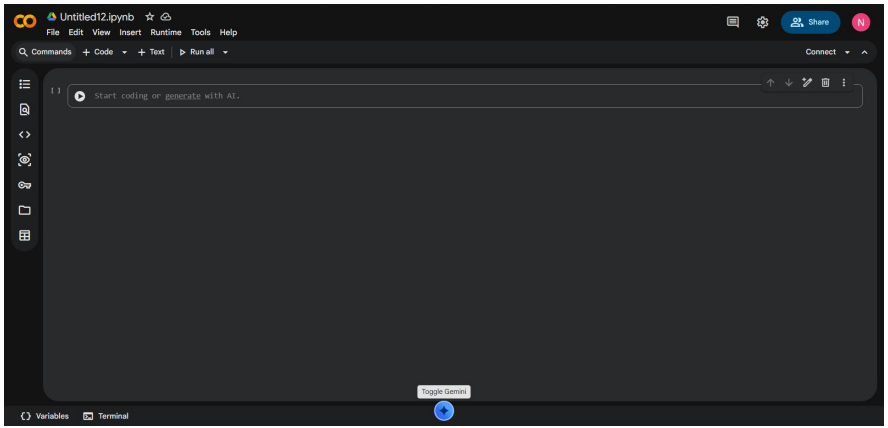
- Create segmentation model

- Use the **MONAI library** to build deep learning model (UNet)

Material

- With **Google Colab**, you don't need to install any software. All you need is a Google account, and you can start using it right away. Simply visit: https://colab.research.google.com/ or select NEW NOTEBOOK to start a new file.





Pytorch VS MONAI

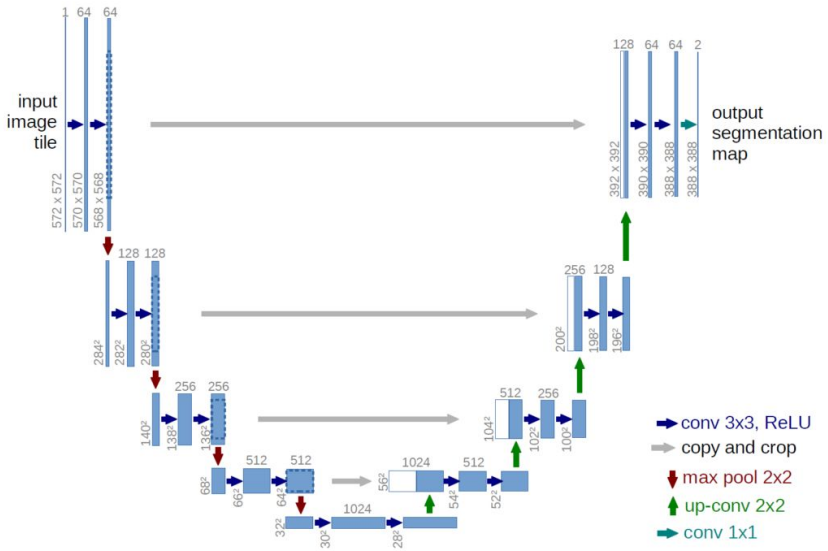
PyTorch is a general-purpose framework for deep learning, while MONAI is built on PyTorch but adds specialized functions for medical imaging tasks, such as

- **Data Loading:** CacheDataset supports big data and caching
- **Transforms:** monai.transforms supports 3D medical volume
- **Networks:** build-in models, such as UNet and SegResNet
- **Inferers:** sliding_window_inference enable inference 3D volumes by 2D models

UNet

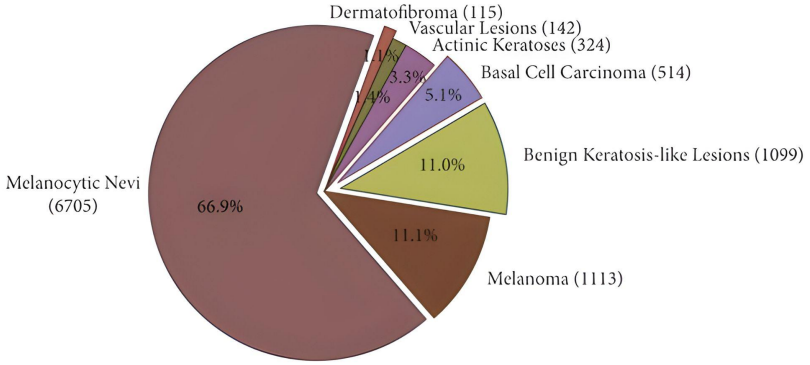
In this lab, we chose to use Unet, which has the following key architectural innovations:

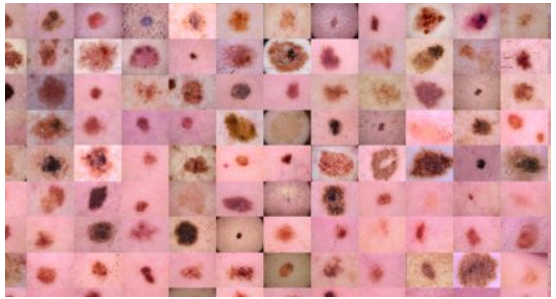
- The left side (**encoder**) progressively downsamples the image to capture context.
- The right side (**decoder**) upsamples to recover spatial resolution for pixel-level predictions.
- **Skip Connections** are directly connected feature maps from the encoder to the decoder at corresponding levels.



Dataset: Skin Cancer MNIST (HAM10000)

- The dataset consists of 10015 images with 10013 labeled objects belonging to 7 skin cancer classes.
- The data contains image in JPG format and documents in JSON format
- In the experiment, we reduced the amount of data and formatted it to simplify the experiment.



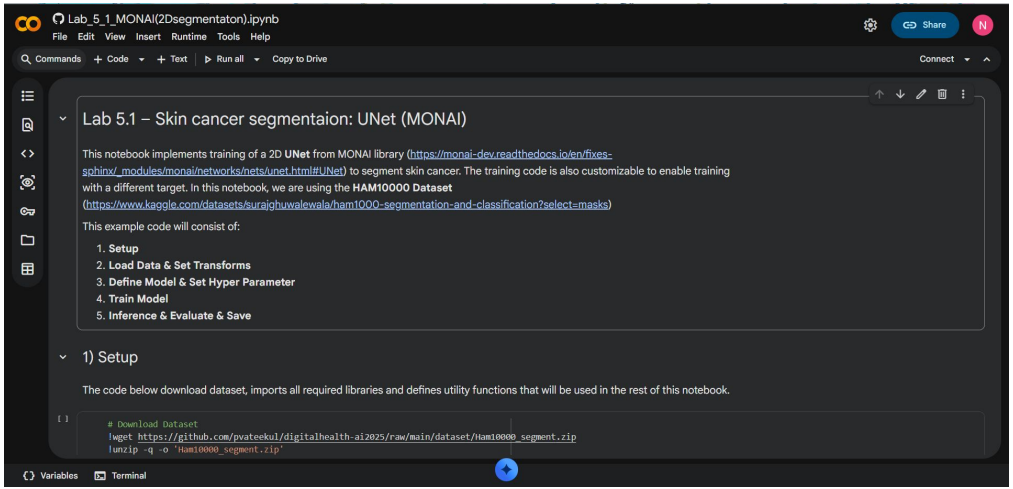


Lab5.1: UNet (2D segmentation)

In this lab, you will create and evaluate an skin cancer segmentation model (UNet) using the **MONAI library**. Code can be executed in Lab_5_1_MONAI(2Dsegmentaton) on Google Colab.

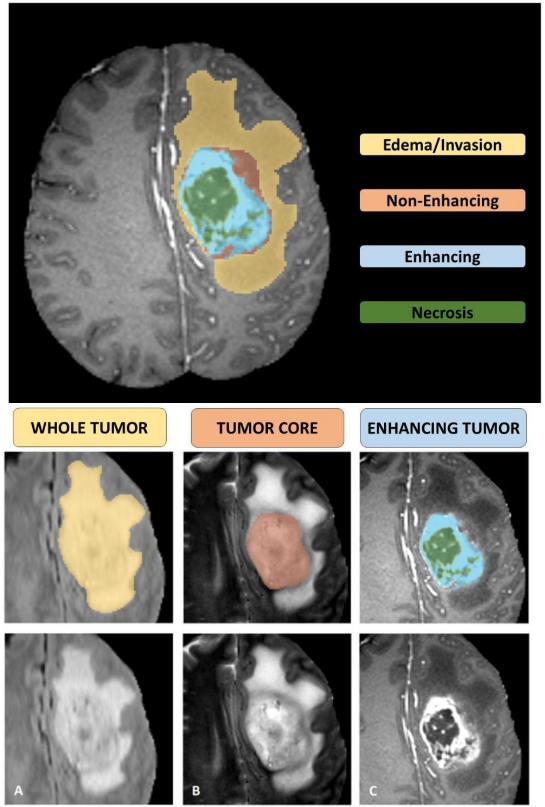
This notebook will consist of:

1) Setup
2) Load Data & Set Transforms
3) Define Model & Set Parameter
4) Train Model
5) Inference & Evaluate & save



Dataset: Brain Tumor Segmentation 2020 Dataset (BraTS2020)

- BraTS 2020 is dataset for brain tumor segmentation, consisting of T1, T1ce, T2, FLAIR with tumors, which contains image in nii.gz format
- BraTS 2020 includes **369 training cases**, with further validation/test subjects provided for evaluation.
- In the experiment, we reduced the amount of data and formatted it to simplify the experiment.



Lab5.2: UNet (3D segmentation)

In this lab, you will create and evaluate an brain tumor segmentation model (UNet) using the **MONAI library**. Code can be executed in Lab_5_2_MONAI(3Dsegmentaton) on Google Colab.

This notebook will consist of:

1) Setup
2) Load Data & Set Transforms
3) Define Model & Set Parameter
4) Train Model
5) Inference & Evaluate & save