

Lab5: Image segmentation (MONAI)

3099704 AI for Digital Health (2025/2)



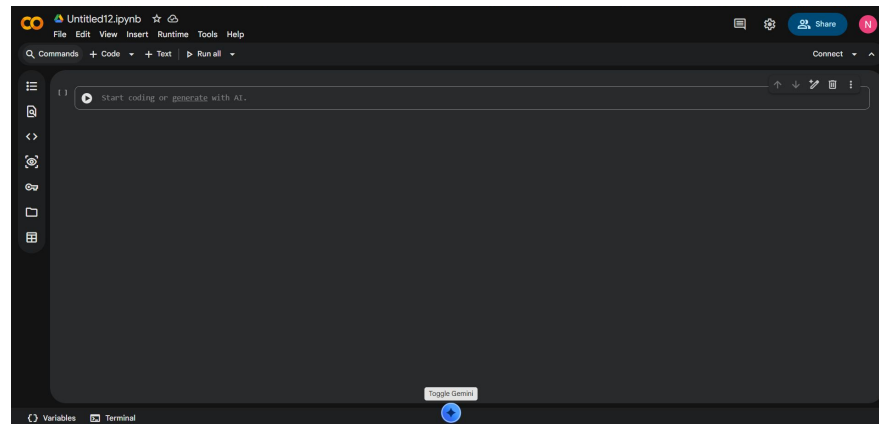
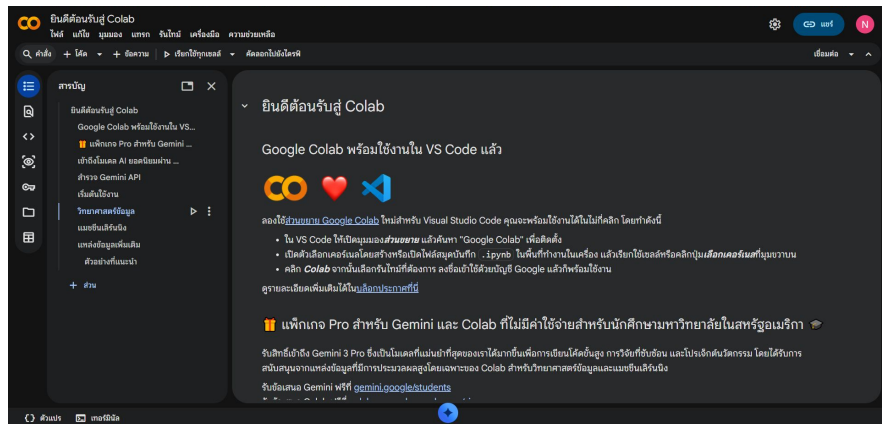
Objective

- 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

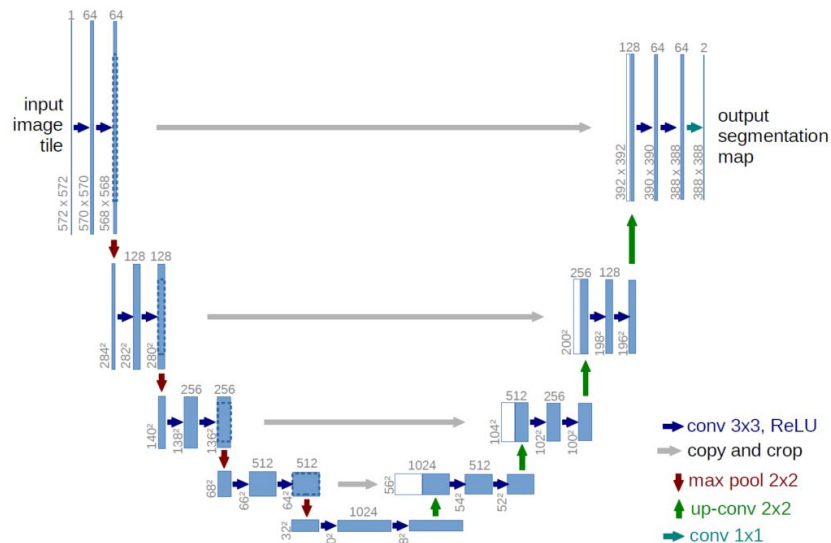
- **Data Loading:** CacheDataset supports big data and caching
- **Transforms:** monai.transforms supports 3D medical volume
- **Networks:** build-in models, such as UNet and SegResNet
- **Inferers:** sliding_window_inference enable inference 3D volumes by 2D models



UNet

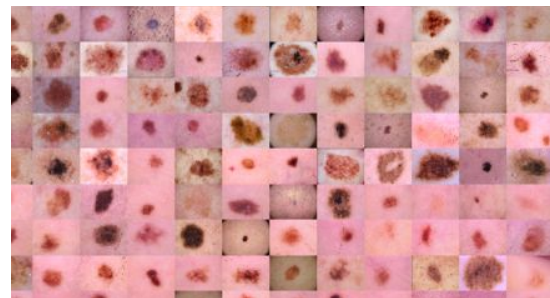
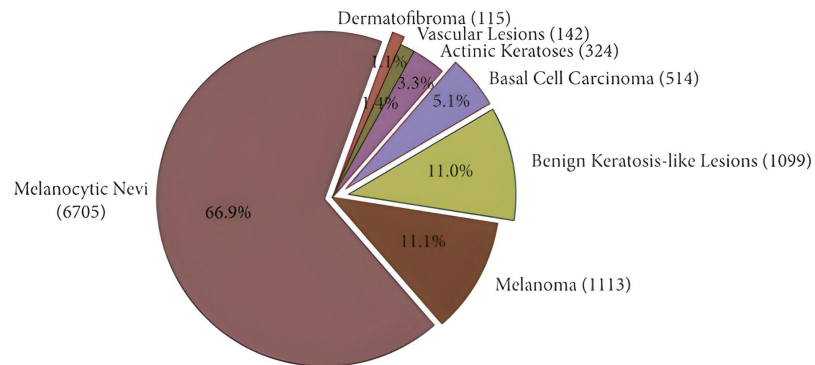
In this lab, we chose to use Unet, which has the following key architectural innovations:

- 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.



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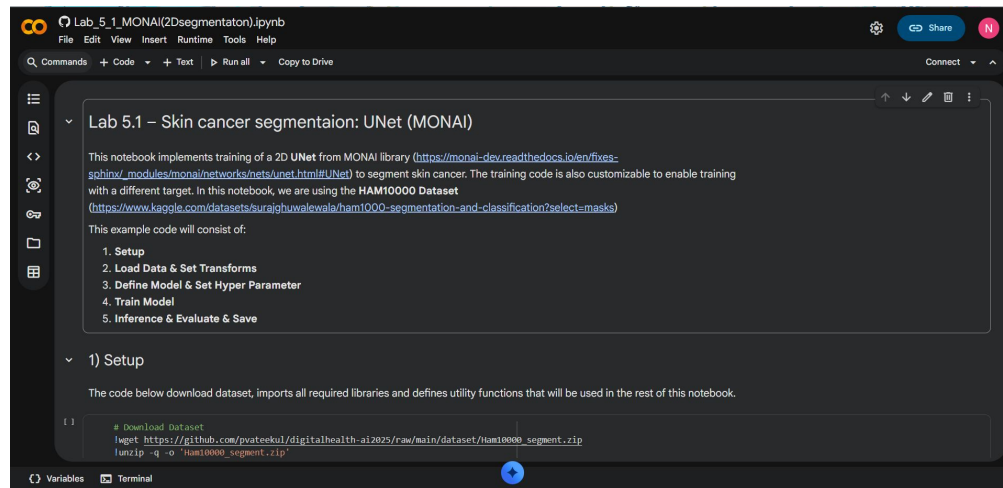


Lab5.1: UNet (2D segmentation)

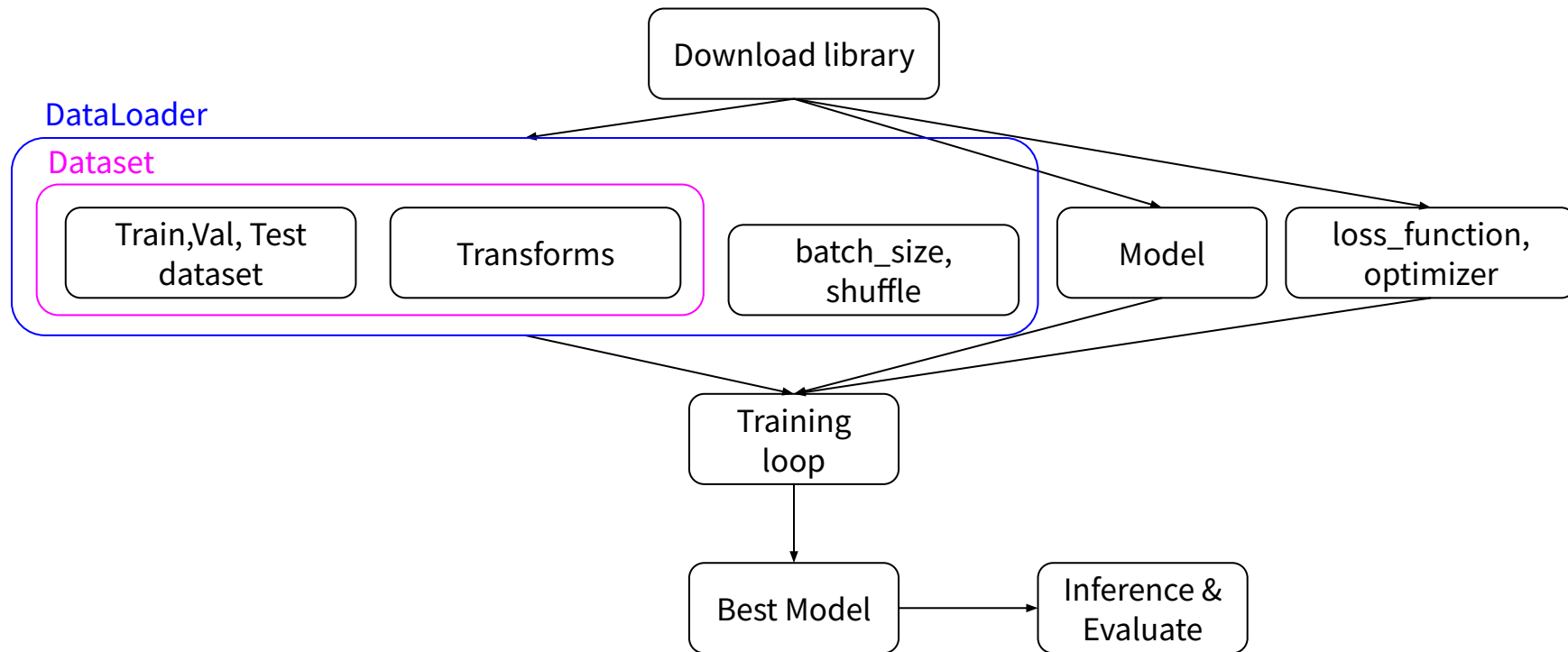
In this lab, you will create and evaluate an skin cancer segmentation model (UNet) using the **MONAI library**. Code can be executed in [Lab 5 1 MONAI\(2Dsegmentaton\)](#) on Google Colab.

This notebook will consist of:

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



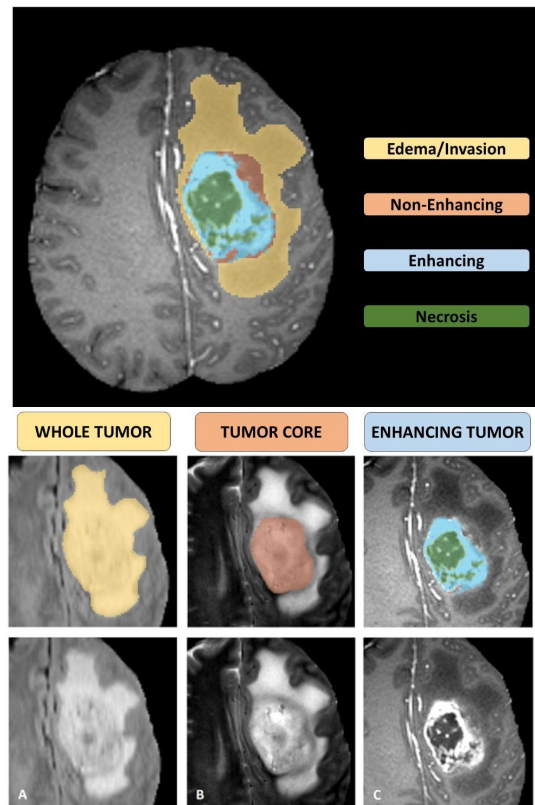
Lab5.1: UNet (2D segmentation)



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.

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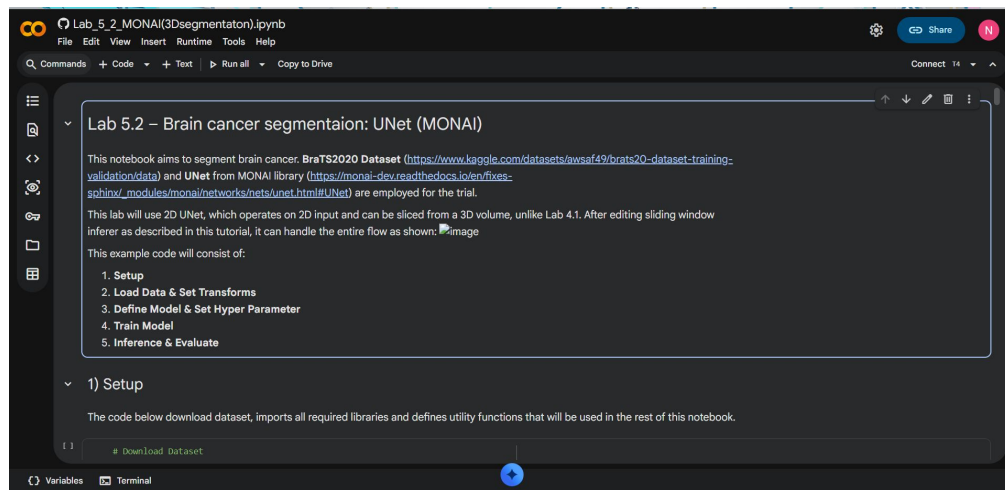
Lab5.2: UNet (3D segmentation)

In this lab, you will create and evaluate a brain tumor segmentation model(UNet). Unlike Lab 5.1, this lab focuses on a 3D segmentation task, with the main differences in the DataLoader and inference process. All code can be executed in

[Lab 5 2 MONAI\(3Dsegmentaton\).](#)

This notebook will consist of:

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



Lab5.2: UNet (3D segmentation)

