Lab3: Image classification

3099704 AI for Digital Health (2025/2)

Objective

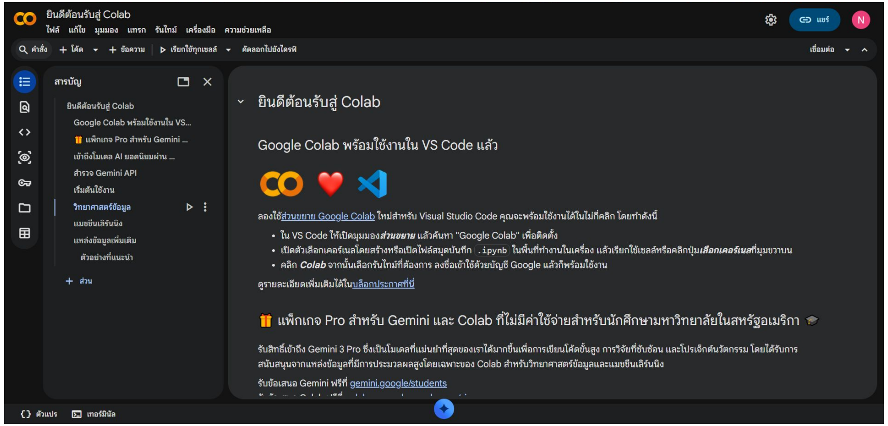
- **Create and train** image classification models with Teachable Machine and the PyTorch library.
- **Tune hyperparameters** of image classification models.
- **Inference & evaluate** performance each model

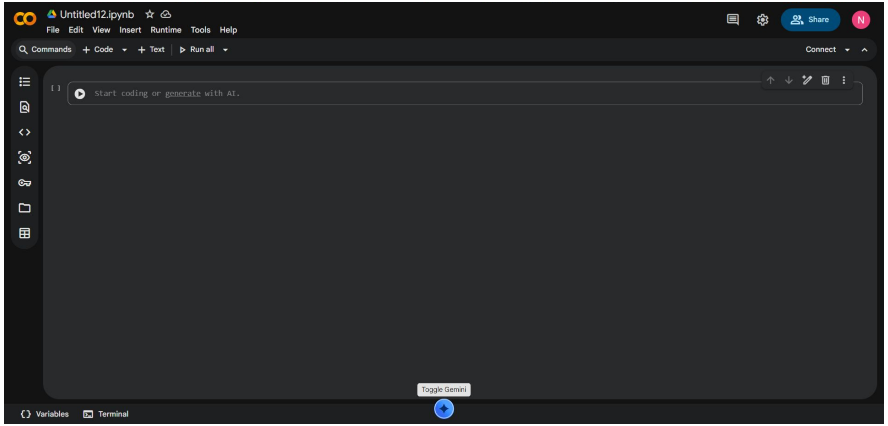
Material

- **Google Colab** is a free cloud-based platform that run jupyter notebook (Python code) in a browser, without needing local setup.
- **Teachable Machine** is a web-based tool by Google that trains machine learning models for images, audio, or poses without coding.
- **PyTorch, TenserFlow** is an deep learning library that enables building, training, and deploying neural networks using Python

Material

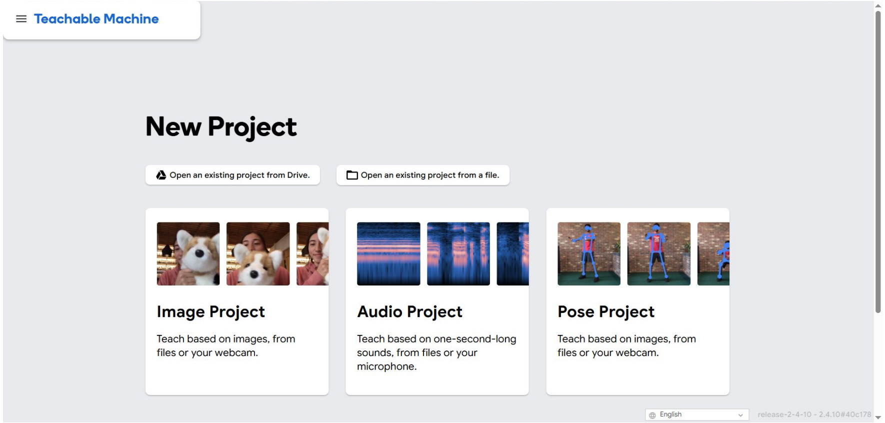
- With **Google Colab**, you don't need to install any software. All you need is a Google account, and you can start using it right away. Simply visit: https://colab.research.google.com/ or select NEW NOTEBOOK to start a new file.

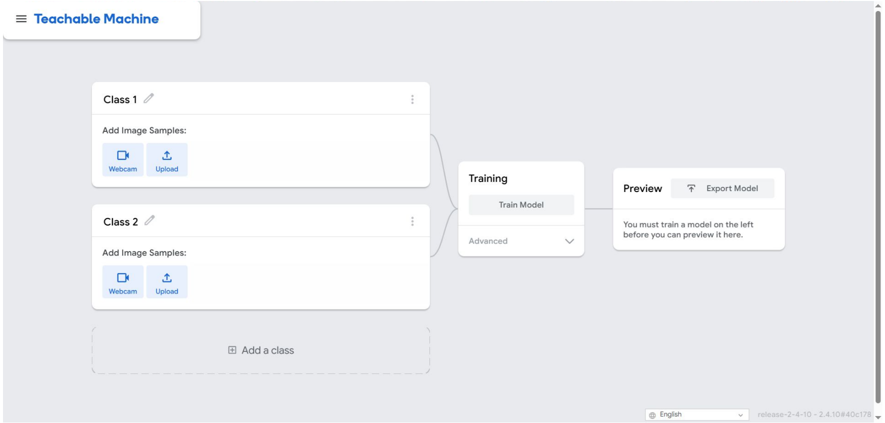




Material

- **Teachable Machine** is a web-based tool from Google that allows you to easily create models without writing code or installing software. Simply access it through your web browser at https://teachablemachine.withgoogle.com/



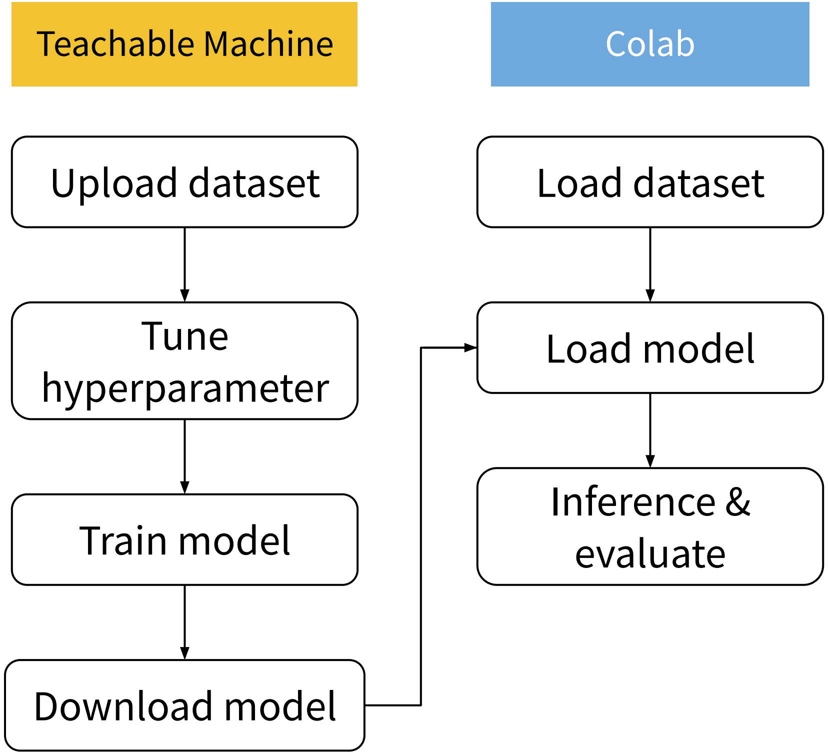


Material

- **TensorFlow and PyTorch** are deep learning libraries used with Python. They can be run either on a local computer or on Google Colab, and can be installed easily using the `pip install` command.

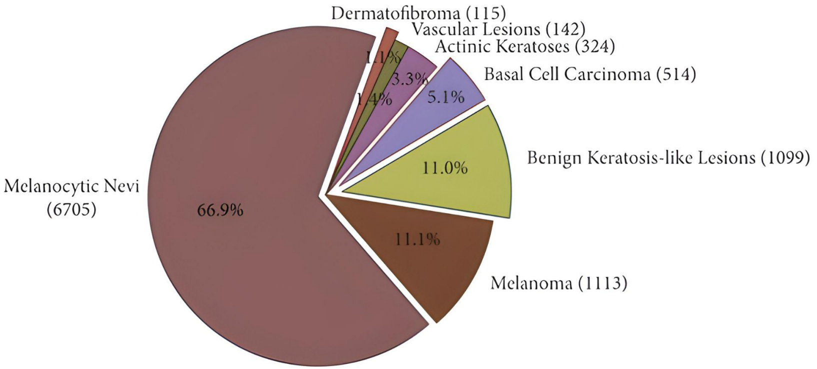
Lab3.1: MobileNet (Teachable Machine)

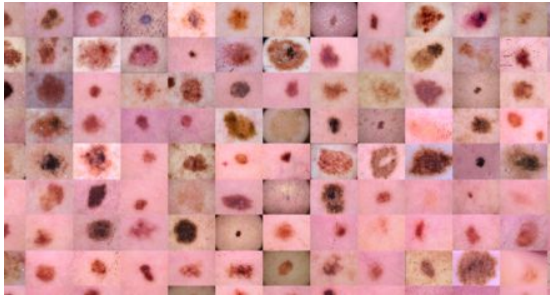
In this lab, you will create an image classification model using **Teachable Machine** and then evaluate its performance using a **Google Colab notebook.**



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.

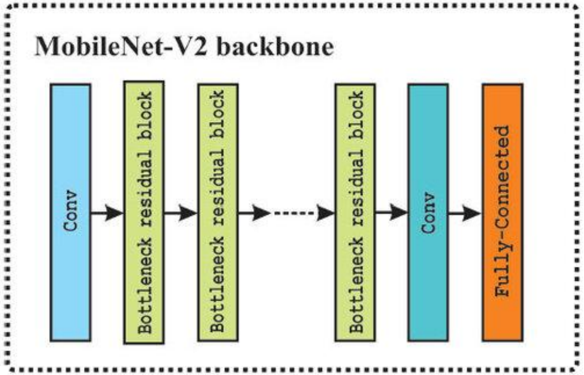


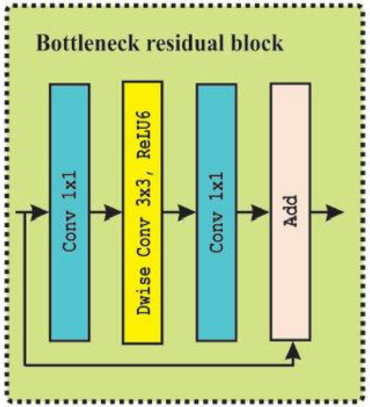


Lab3.1: MobileNet (Teachable Machine)

The image model in Teachable Machine is MobileNetV2, with the following details:

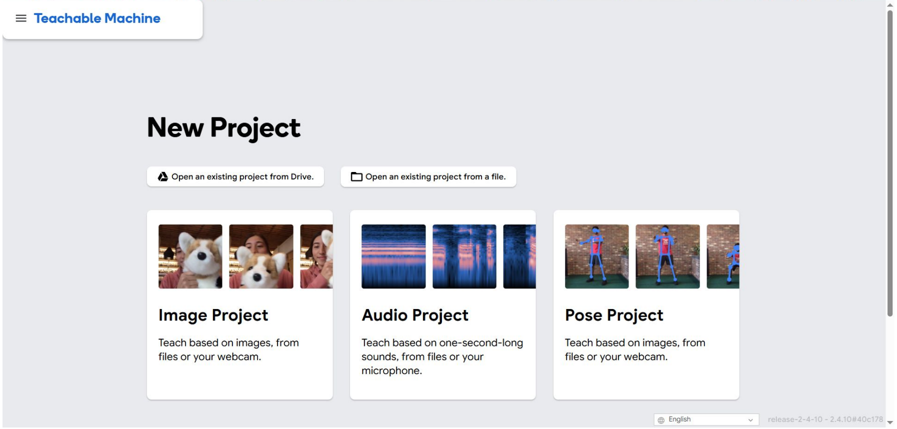
- There are 3 layers for bottleneck block.
- This time, the **first layer** is **1×1 convolution with ReLU6(capping activations at 6).**
- The **second layer** is the **depthwise convolution**.
- The **third layer** is another **1×1 convolution but without any non-linearity.**

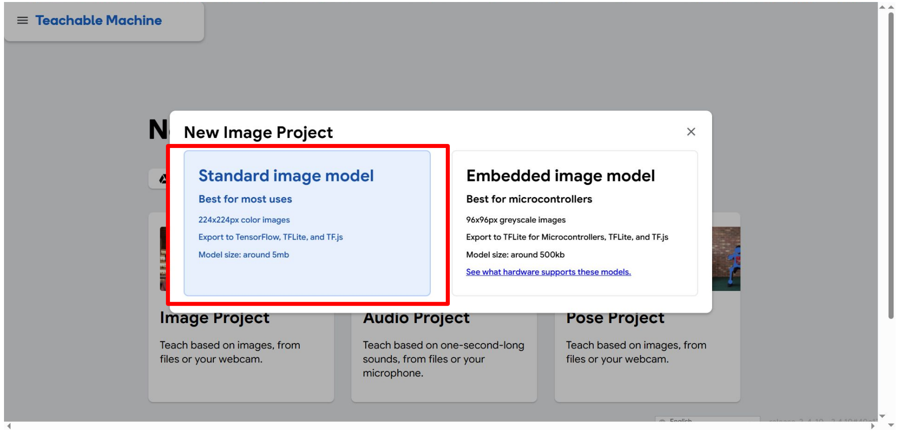




Lab3.1: MobileNet (Teachable Machine)

1) Create image project(standard image model) in Teachable Machine





Lab3.1: MobileNet (Teachable Machine)

2) Download the dataset from [GitHub](), then upload the image samples and set labels in **Teachable Machine.** The dataset consists of seven classes: Melanoma (MEL), Melanocytic nevi (NV), Basal cell carcinoma (BCC), Actinic keratoses (AKIEC), Benign keratosis lesions (BKL), Dermatofibroma (DF), and Vascular lesions (VASC).

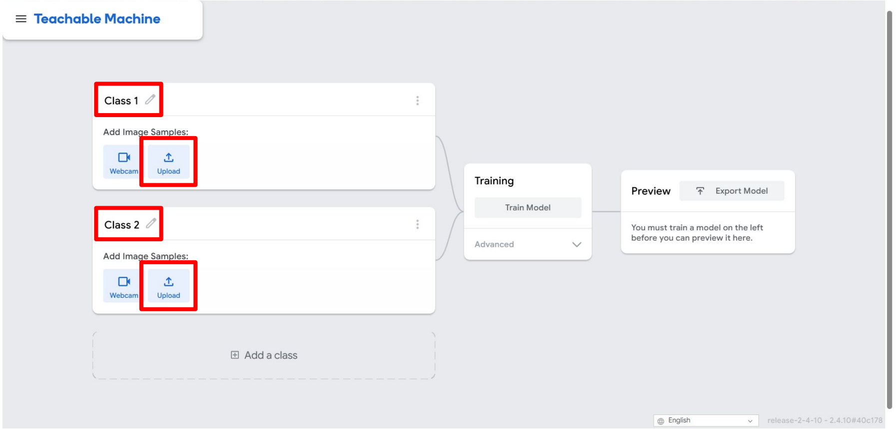
HAM10000_TM directory

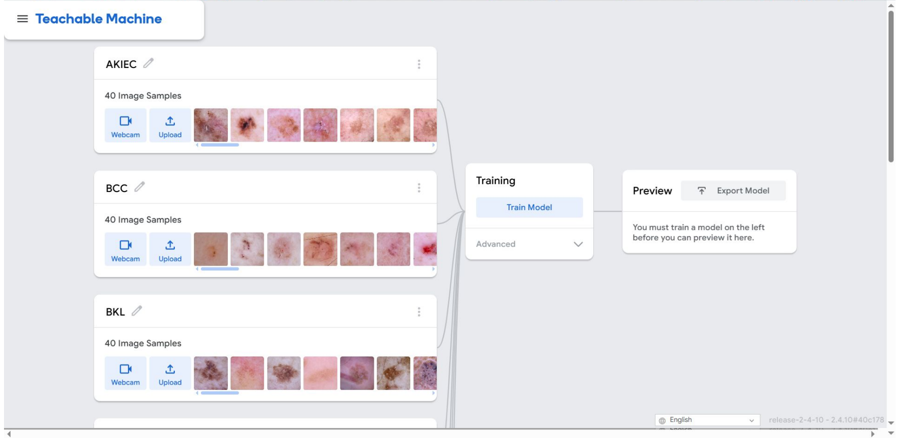
```
HAM10000_TM
├── train/
    ├── AKIEC/
    .   ├── ISIC_0024329.jpg (original image)
    .   .
    └── VASC/
```

Lab3.1: MobileNet (Teachable Machine)

2) Download the dataset from GitHub, then upload the image samples and set labels in **Teachable Machine.**

*When uploading the dataset, you don't need to worry about the class order.**

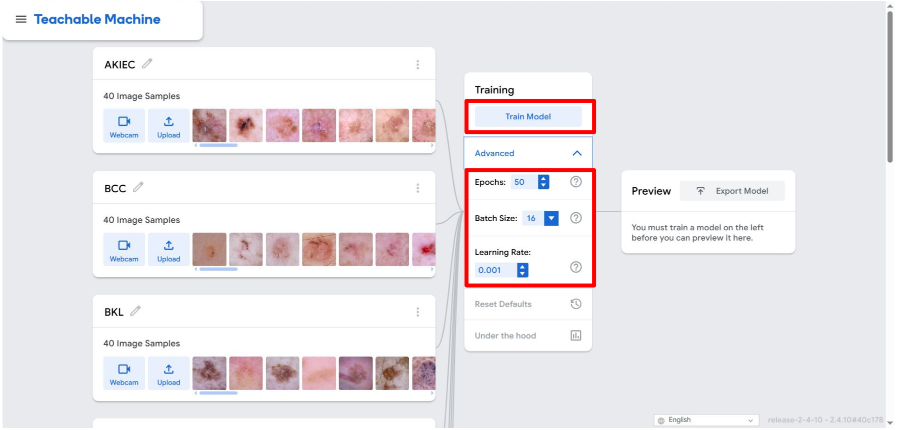




Lab3.1: MobileNet (Teachable Machine)

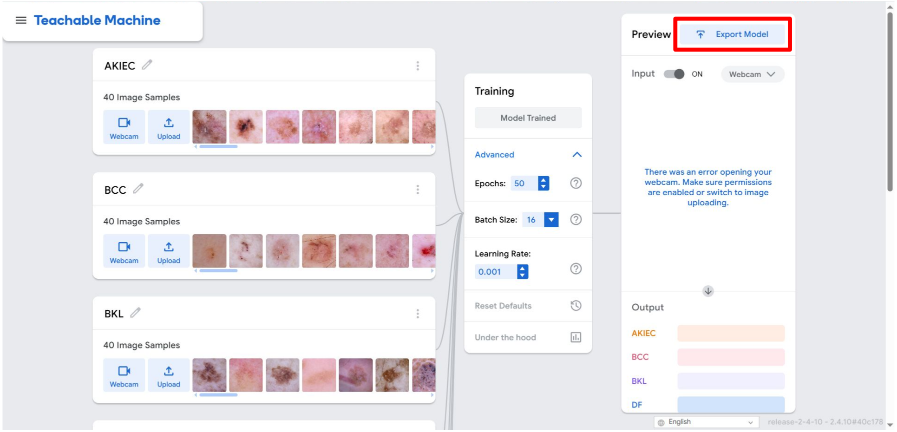
3) Tune hyperparameter & Train model
    a) epoch: [5, 20, 50, 100]
    b) learning rate: [0.00001, 0.001, 0.1]

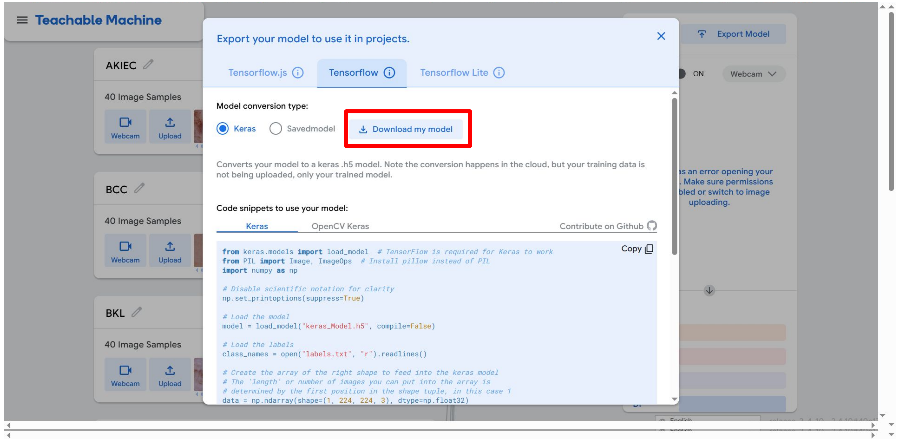
We will evaluate each model in Colab and compare their results to find the best model.



Lab3.1: MobileNet (Teachable Machine)

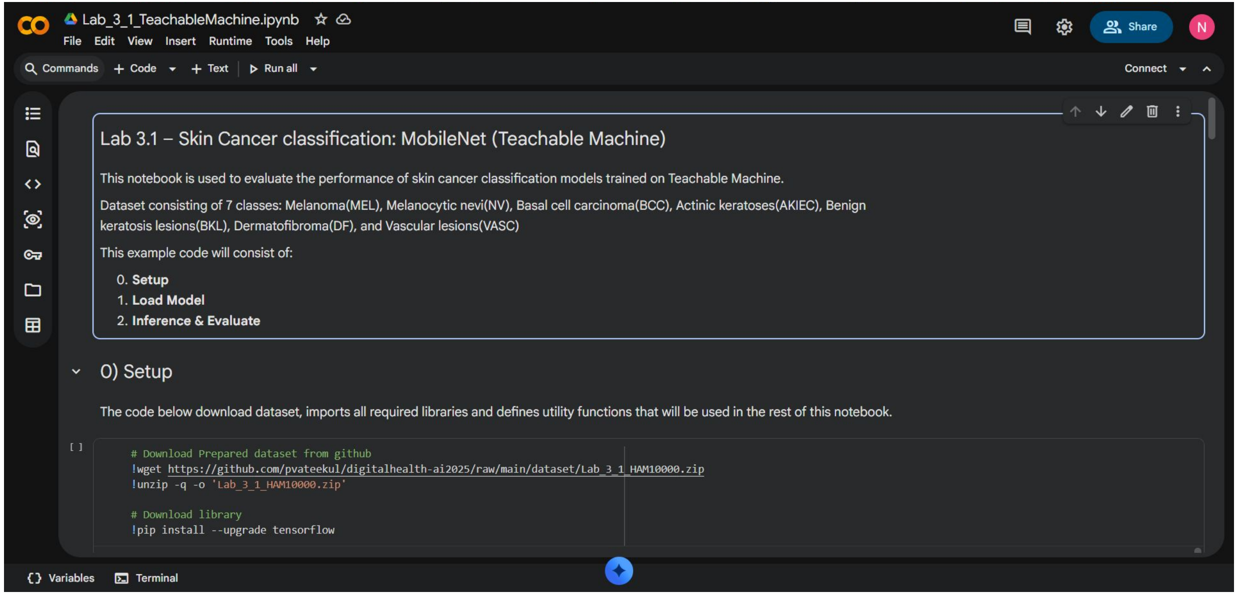
4) Export the model in TensorFlow format. You will receive a ZIP file containing two files: (1) keras_model.h5, which stores the model weights, and (2) labels.txt, which defines the class labels and their order.





Lab3.1: MobileNet (Teachable Machine)

5) Open [Lab_3_1_TeachableMachine.ipynb]() in Colab, upload the ZIP file exported from Teachable Machine, and then run the code in the notebook to evaluate the model's performance.



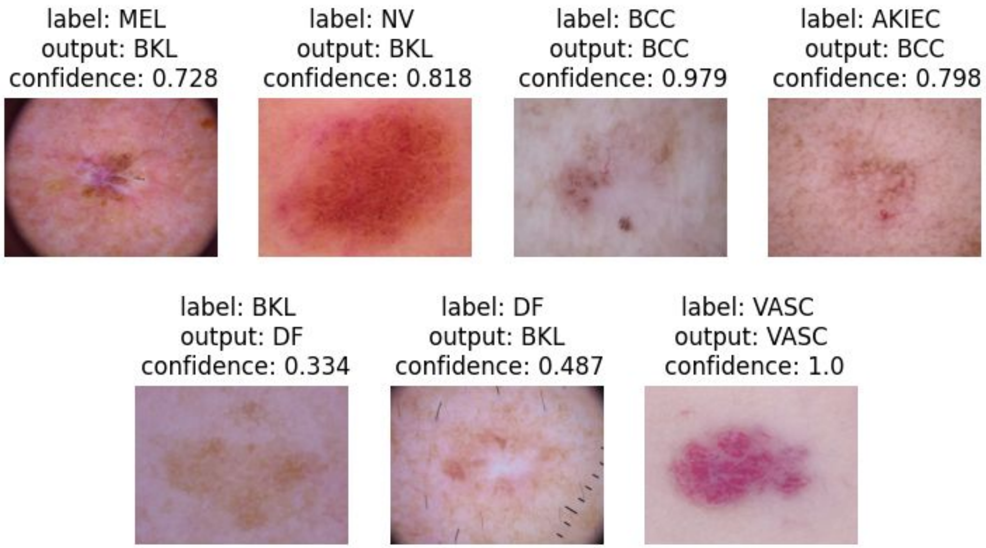
Lab3.1: MobileNet (Teachable Machine)

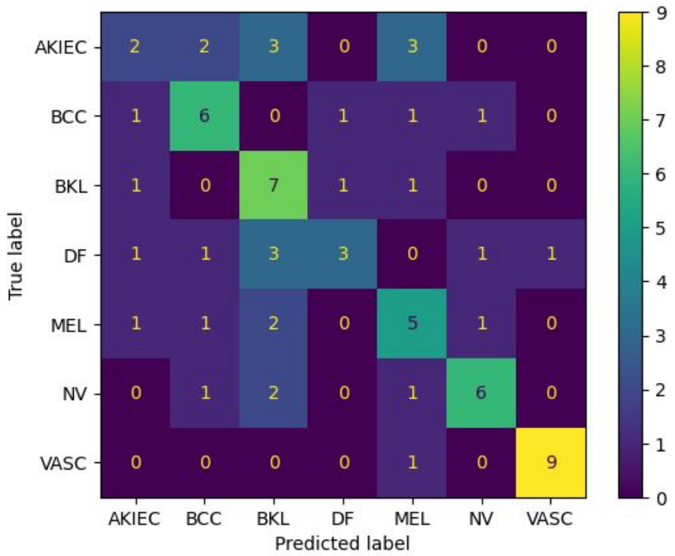
6) Results may vary between runs due to random seed initialization and hyperparameter tuning; however, the overall performance should be similar to the results shown on this page.

	precision	recall	f1-score	support
AKIEC	0.3333	0.2000	0.2500	10
BCC	0.5455	0.6000	0.5714	10
BKL	0.4118	0.7000	0.5185	10
DF	0.6000	0.3000	0.4000	10
MEL	0.4167	0.5000	0.4545	10
NV	0.6667	0.6000	0.6316	10
VASC	0.9000	0.9000	0.9000	10
accuracy			0.5429	70
macro avg	0.5534	0.5429	0.5323	70
weighted avg	0.5534	0.5429	0.5323	70

Lab3.1: MobileNet (Teachable Machine)

6) Results may vary between runs due to random seed initialization and hyperparameter tuning; however, the overall performance should be similar to the results shown on this page.

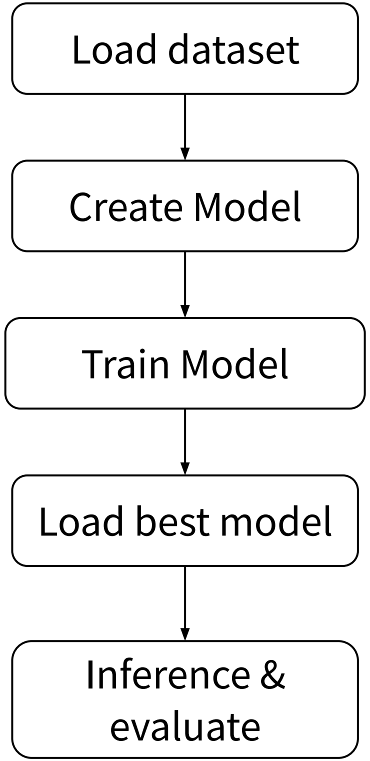




Lab3.2: EfficientNet (Pytorch)

Colab

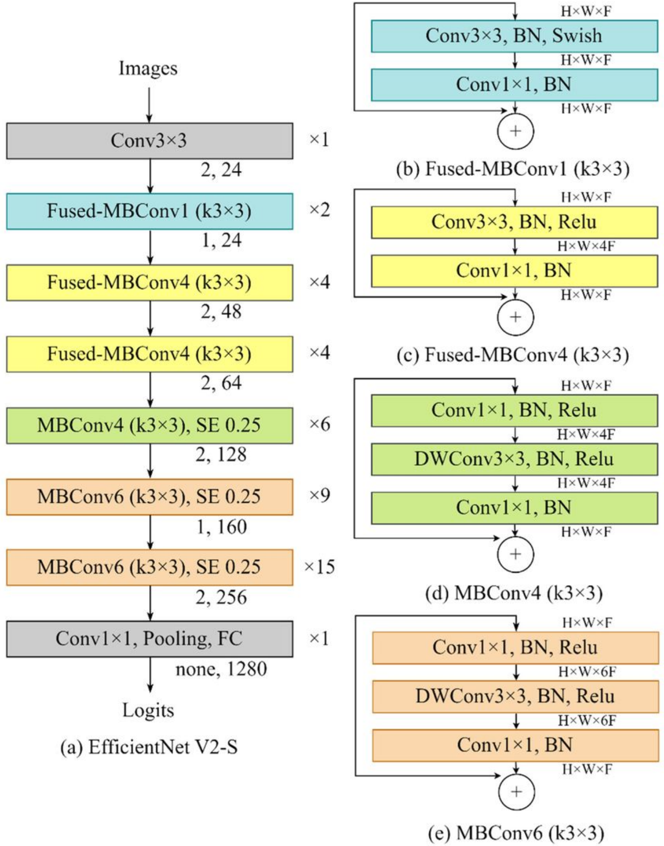
In this lab, you will create an image classification model and then evaluate its performance using **Pytorch library**



Lab3.2: EfficientNet (Pytorch)

In this lab, we chose to use EfficientNetV2, which has the following key architectural innovations:

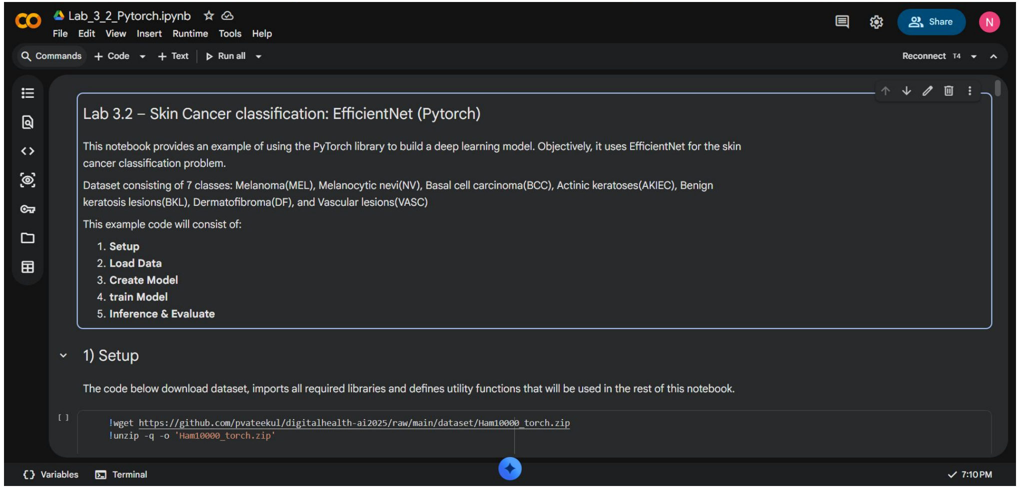
- **Fused-MBConv Blocks:** Replace standard MBConv with a fused 3×3 conv for faster computation without adding many parameters.
- **Smaller Kernels and Expansion Ratios:** The architecture favors smaller 3x3 kernel sizes and smaller expansion ratios within the MBConv blocks, which reduces memory access overhead.
- **Removal of the Final Stage:** The final stride-1 stage of the original EfficientNet is removed to further lower parameter count and memory consumption.



Lab3.2: EfficientNet (Pytorch)

Run Lab_3_2_PyTorch.ipynb (in colab)

1) Setup
2) Load Data
3) Create Model
4) train Model
5) Inference & Evaluate



Lab3.2: EfficientNet (Pytorch)

Results may vary between runs due to random seed initialization and hyperparameter tuning; however, the overall performance should be similar to the results shown on this page.

	precision	recall	f1-score	support
MEL	0.4444	0.8000	0.5714	10
NV	0.7000	0.7000	0.7000	10
BCC	0.6250	0.5000	0.5556	10
AKIEC	0.5385	0.7000	0.6087	10
BKL	0.7500	0.6000	0.6667	10
DF	1.0000	0.3000	0.4615	10
VASC	1.0000	1.0000	1.0000	10
accuracy			0.6571	70
macro avg	0.7226	0.6571	0.6520	70
weighted avg	0.7226	0.6571	0.6520	70

Lab3.2: EfficientNet (Pytorch)

Results may vary between runs due to random seed initialization and hyperparameter tuning; however, the overall performance should be similar to the results shown on this page.