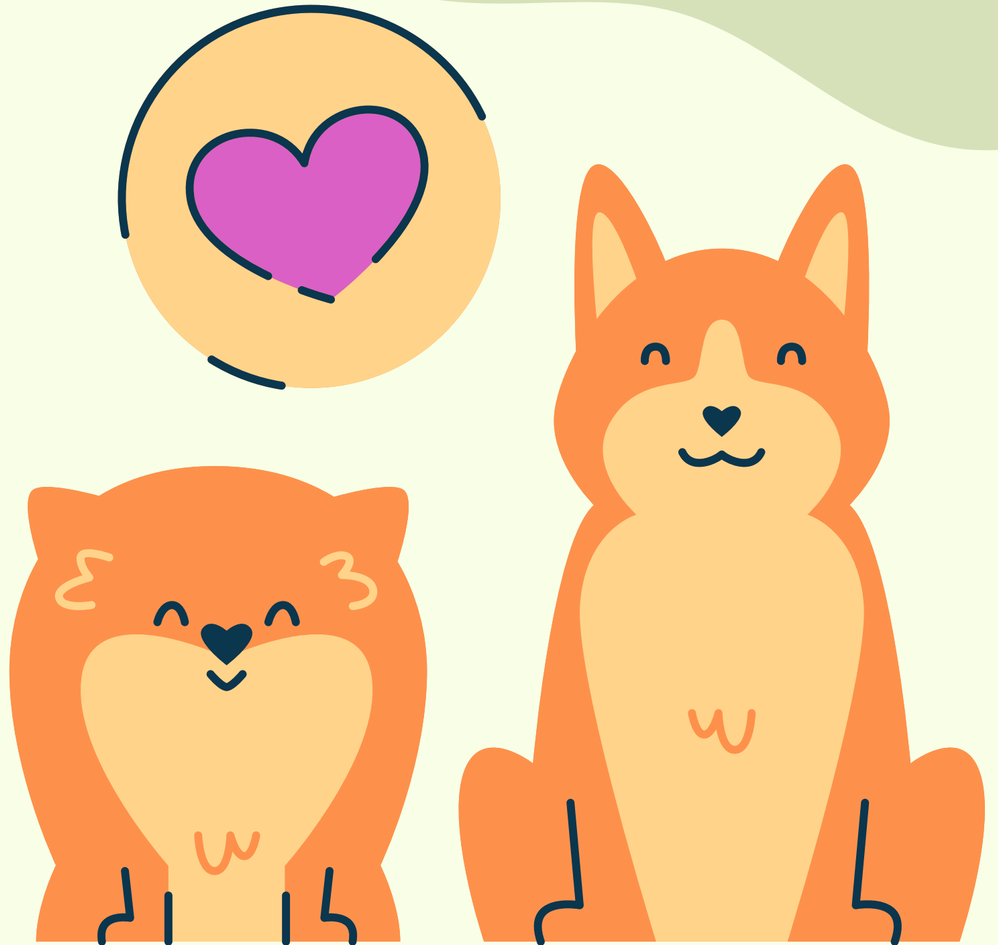
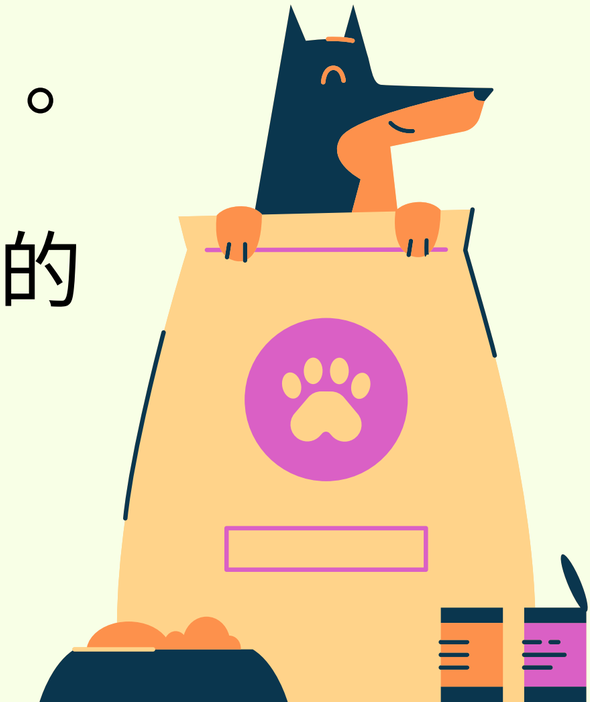
Dog Cardiomegaly Detector

第十二組
411185015 資工三 柯亭妤 411185040 資工三 李彥廷



Abstract

心臟病是狗狗主要的死因，根據統計十隻狗狗中會有一隻狗狗陷入心臟病的痛苦，而超過13歲以上的狗狗有75~80%的機率患有退化性心臟病。由此可見及早的偵測和預防心臟病是一個重要的工作。



Introduction

狗狗心臟病的前期徵兆多與心臟肥大有關，因此精準測量狗狗心臟的大小，有很大的幫助。對於狗狗心臟大小的判斷有一些相關的指標:

- HSV: (心臟長軸+心臟短軸) / 第四胸椎股長度
- aHVI: (心臟面積) / 第四胸椎股長度

然而實際應用面上， 醫生常需要花很多時間評估數值，且結果會因為不同醫生有不同的經驗，而有所差異。

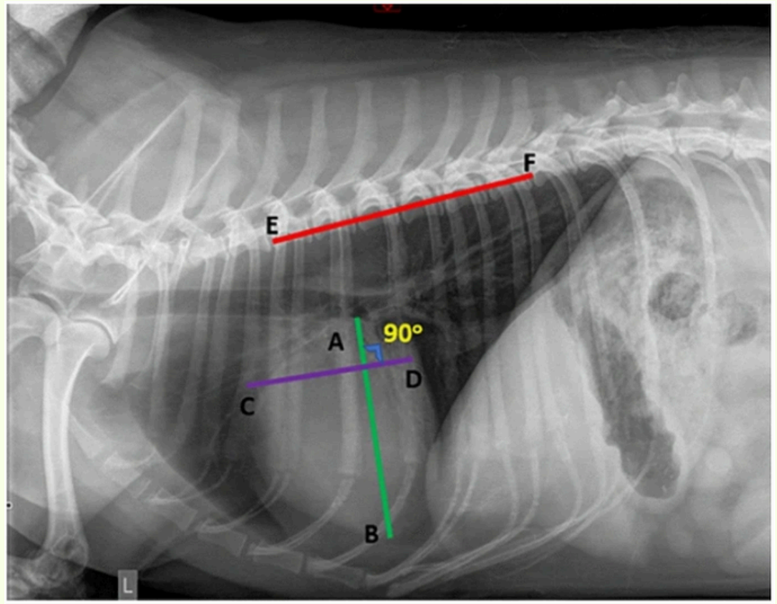
數字代表意義

犬種	正常範圍
大部份犬隻正常VHS範圍	狗：9.2-10.5 / 貓：6.7-8.1
拳師犬	10.8-12.4
鬥牛犬	11.0-14.4
波士頓梗犬	10.3-13.1
查爾斯獵犬	10.1-11.1
拉布拉多	10.2-11.4
哈巴狗	9.8-11.6
博美犬	9.6-11.4
惠比特犬	10.5-11.8

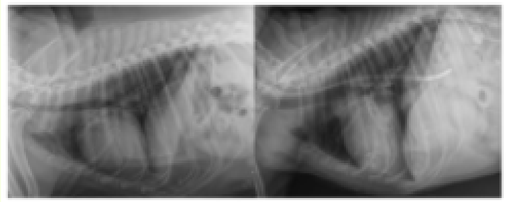
Data Set

Jialu Li and Youshan Zhang.Regressive vision transformer for dog cardiomegaly assessment.Scientific Reports, 14(1):1539, 2024

https://github.com/YoushanZhang/Dog-Cardiomegaly.git

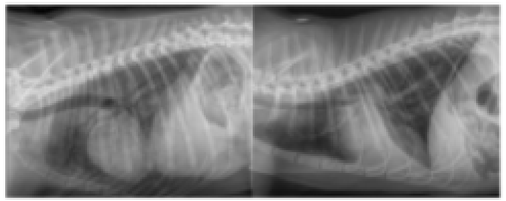


Large



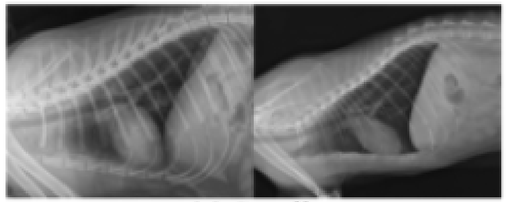
(c) Large

Normal

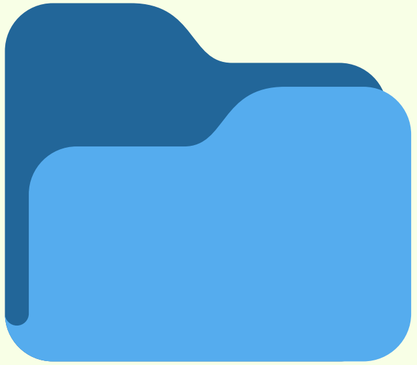


(b) Normal

Small

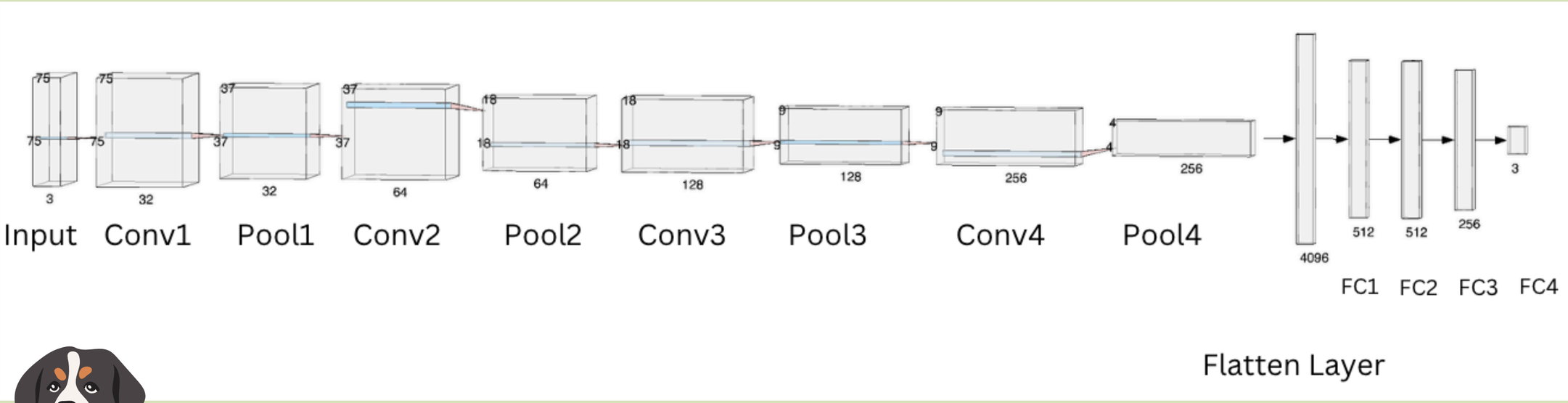


(a) Small

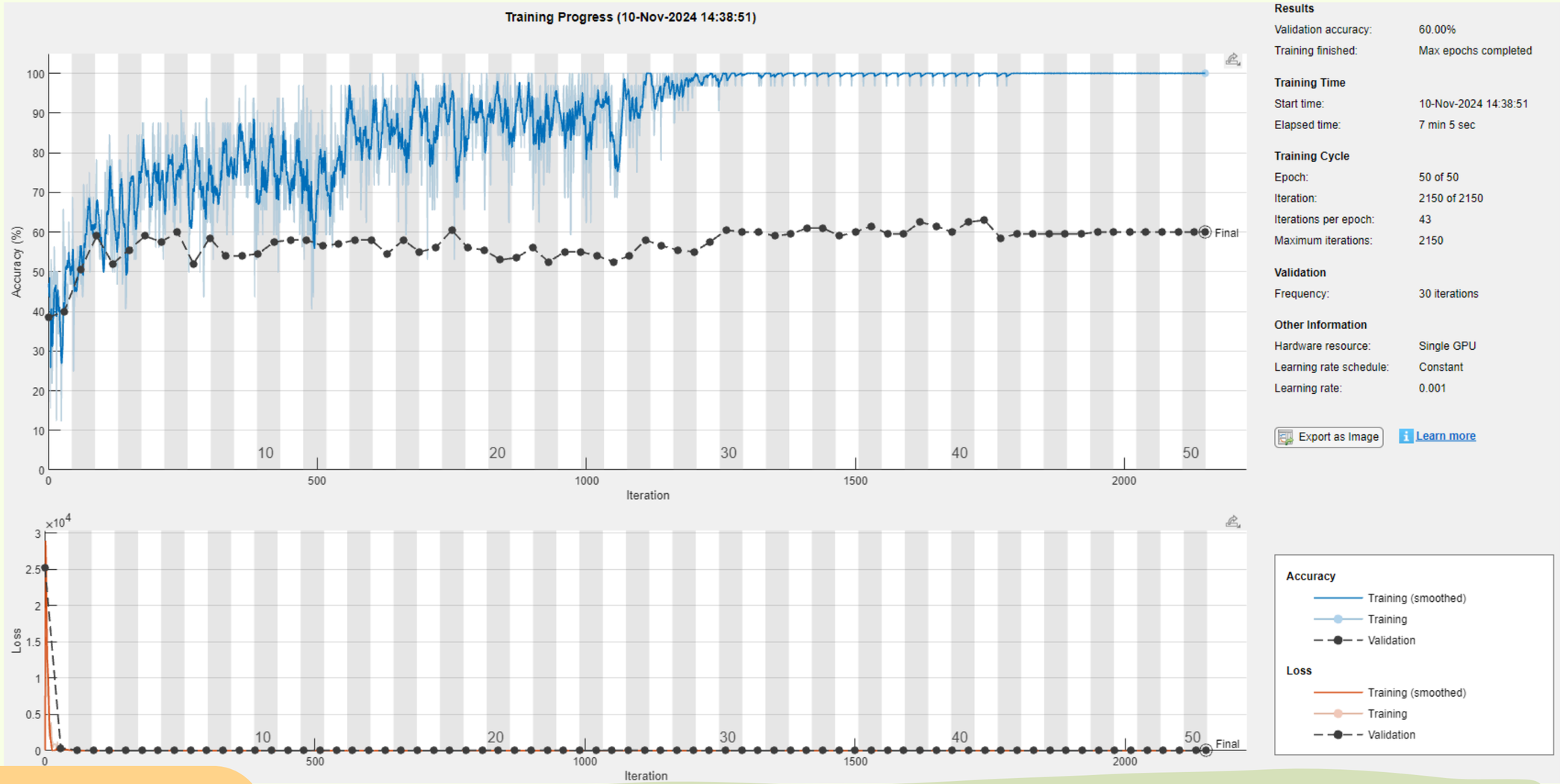


Method

Deekonda, Nikhil. "Assessing Cardiomegaly in Dogs Using a Simple CNN Model." arXiv preprint arXiv:2407.06092 (2024)



Our test

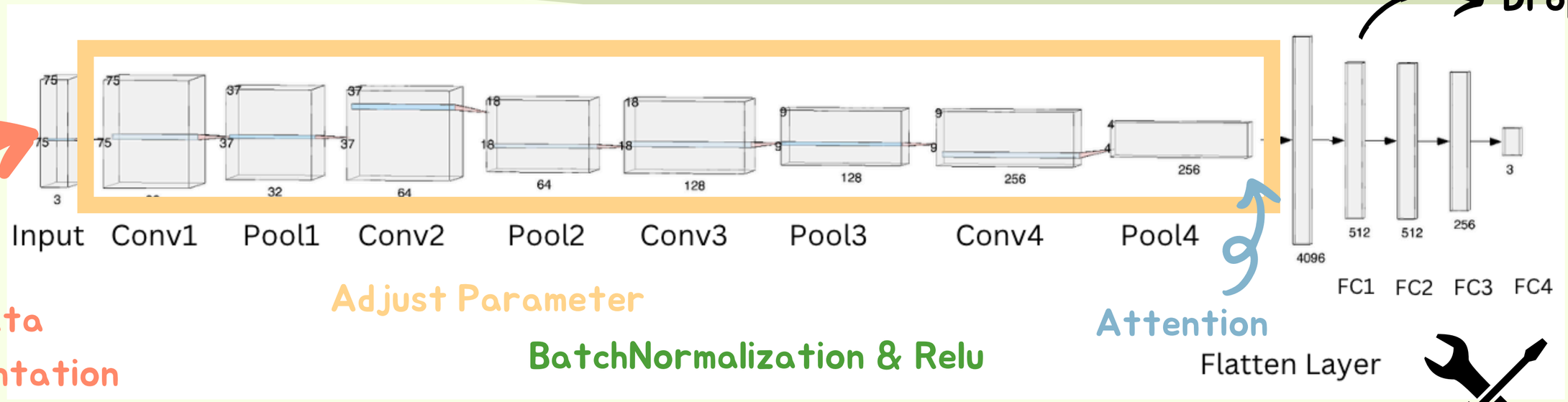


Accuracy: 60%

The model achieved an accuracy of 72% on the test dataset

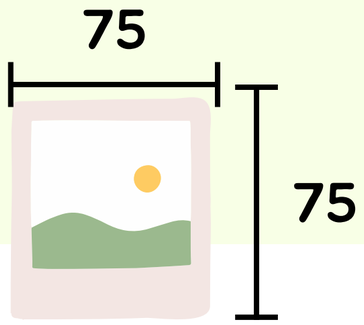
Method

Deekonda, Nikhil. "Assessing Cardiomegaly in Dogs Using a Simple CNN Model." arXiv preprint arXiv:2407.06092 (2024)

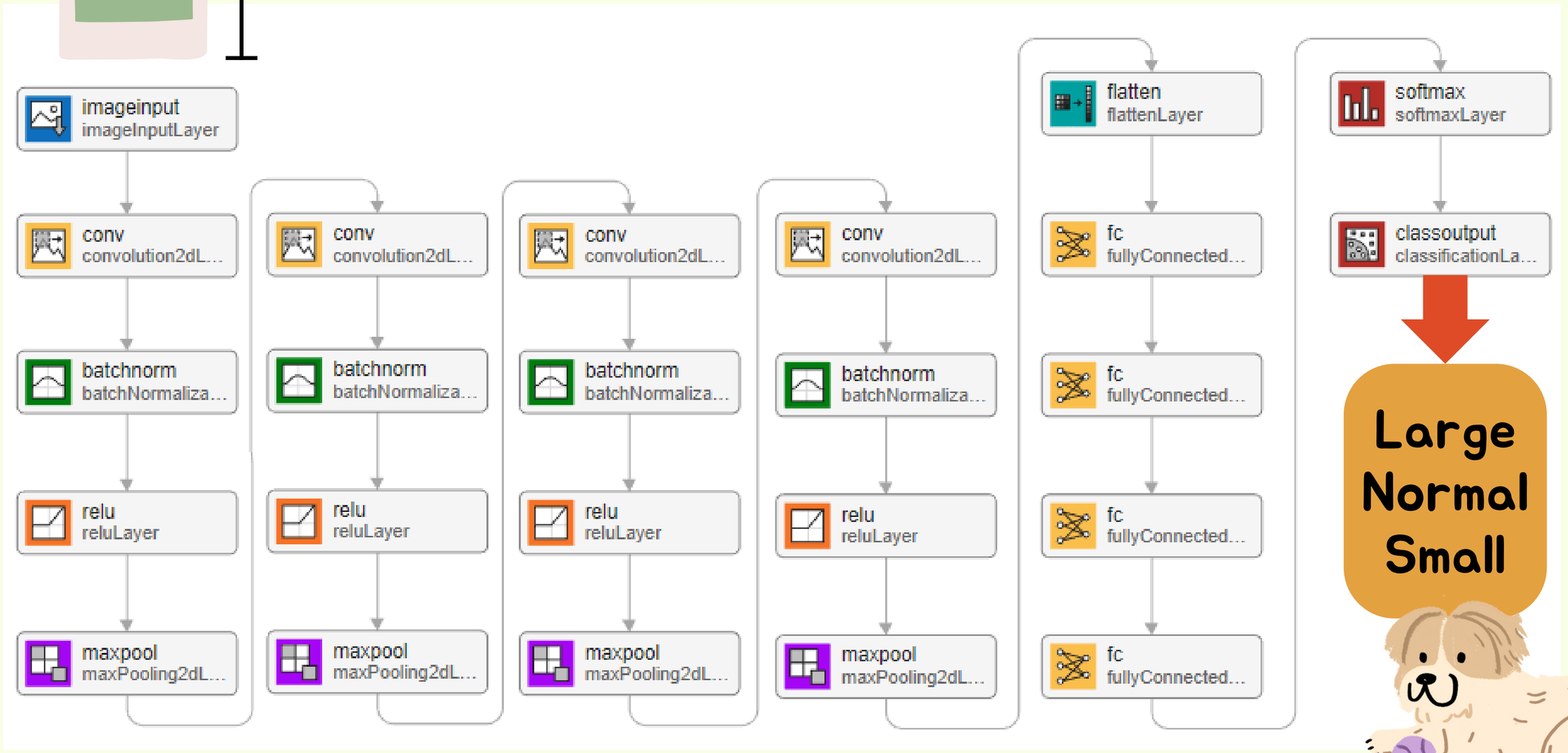


Problem:

1. 資料集過小 → **Train Data大約1500左右**
2. 完全沒有資料增強 → 原始圖片直接丟
3. 資料不平衡 → **Large的分類遠大於Small**
4. 模型太簡易 → 可能無法學習深層內容

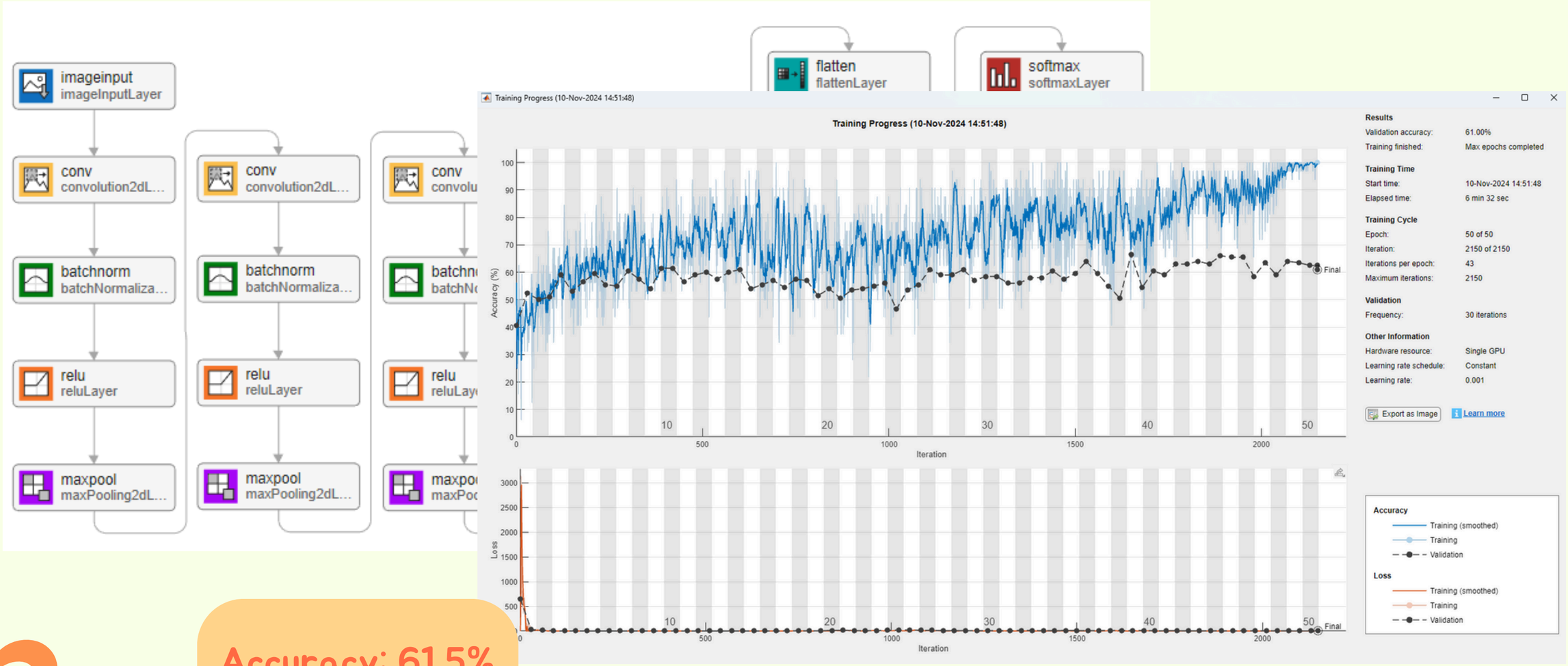


Method



Large
Normal
Small

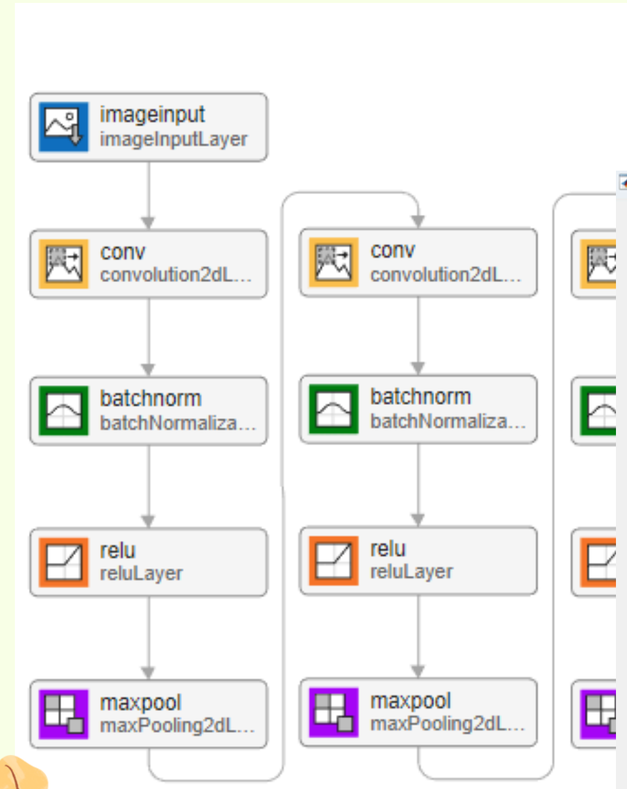
Method–Batch Normalization & ReLU

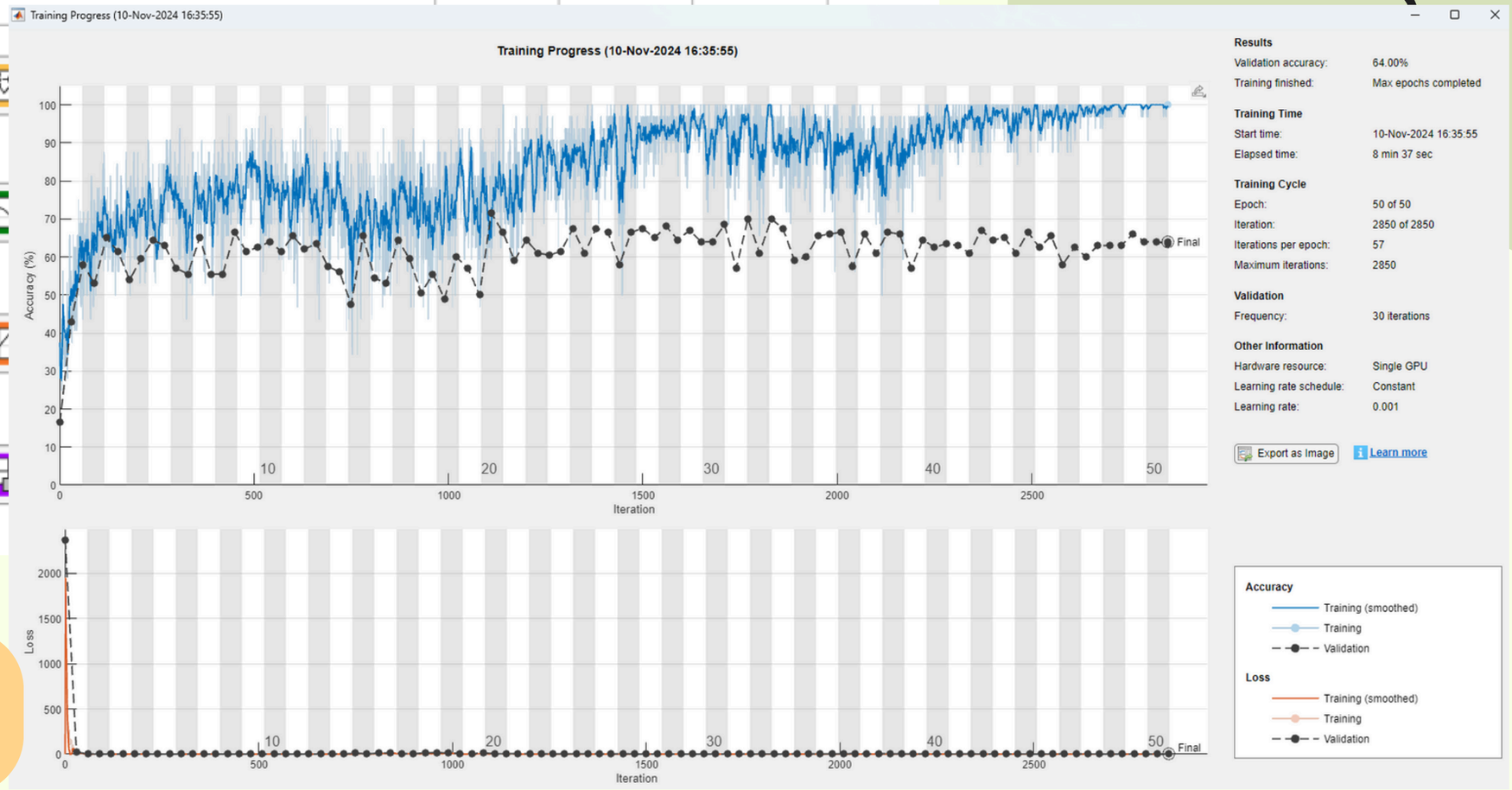


Accuracy: 61.5%

Method- 數據平衡

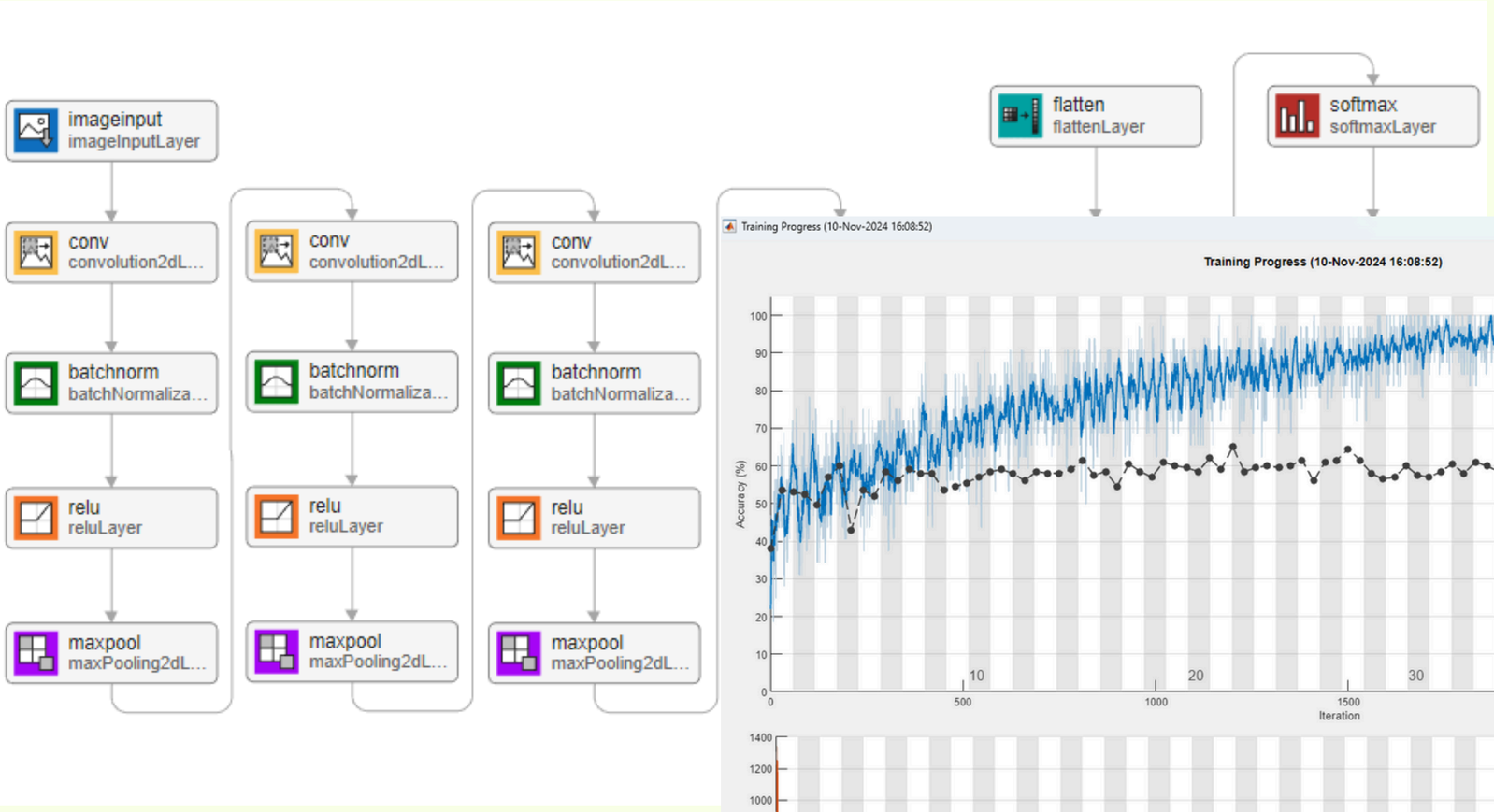
Large: 621
Normal: 621
Small: 621

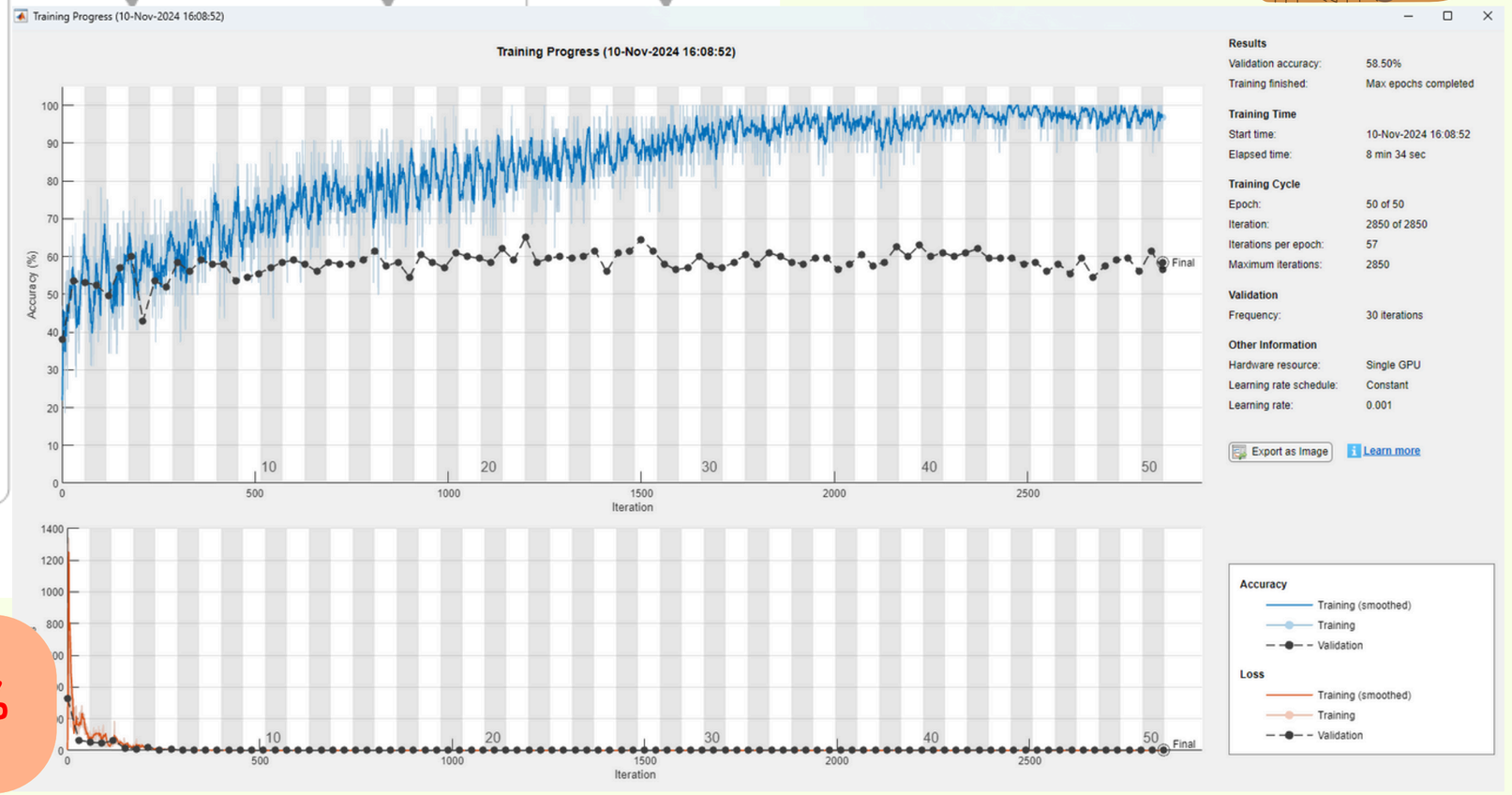




Accuracy: 64%

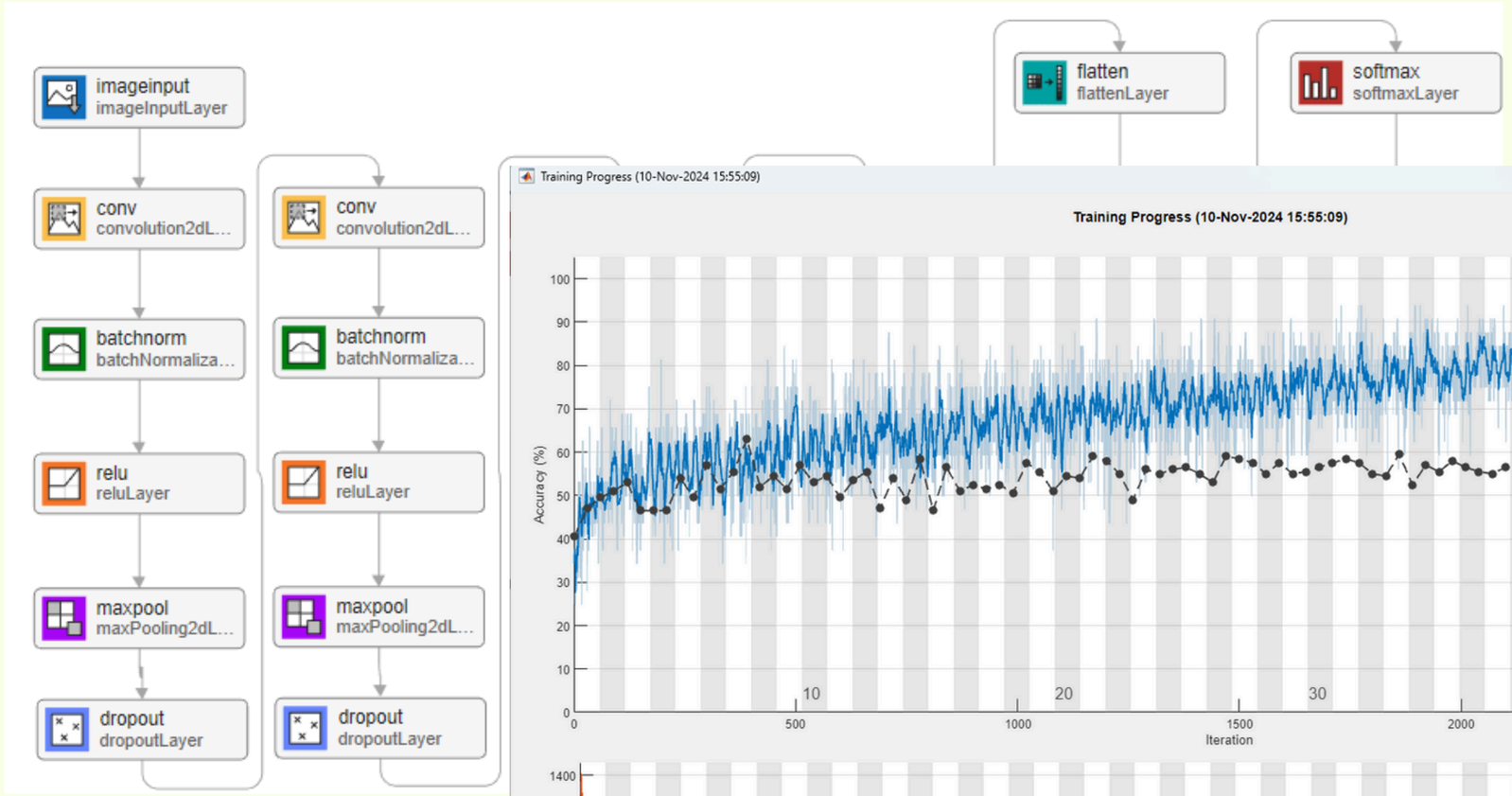
Method- 少數Drop Out &數據平衡





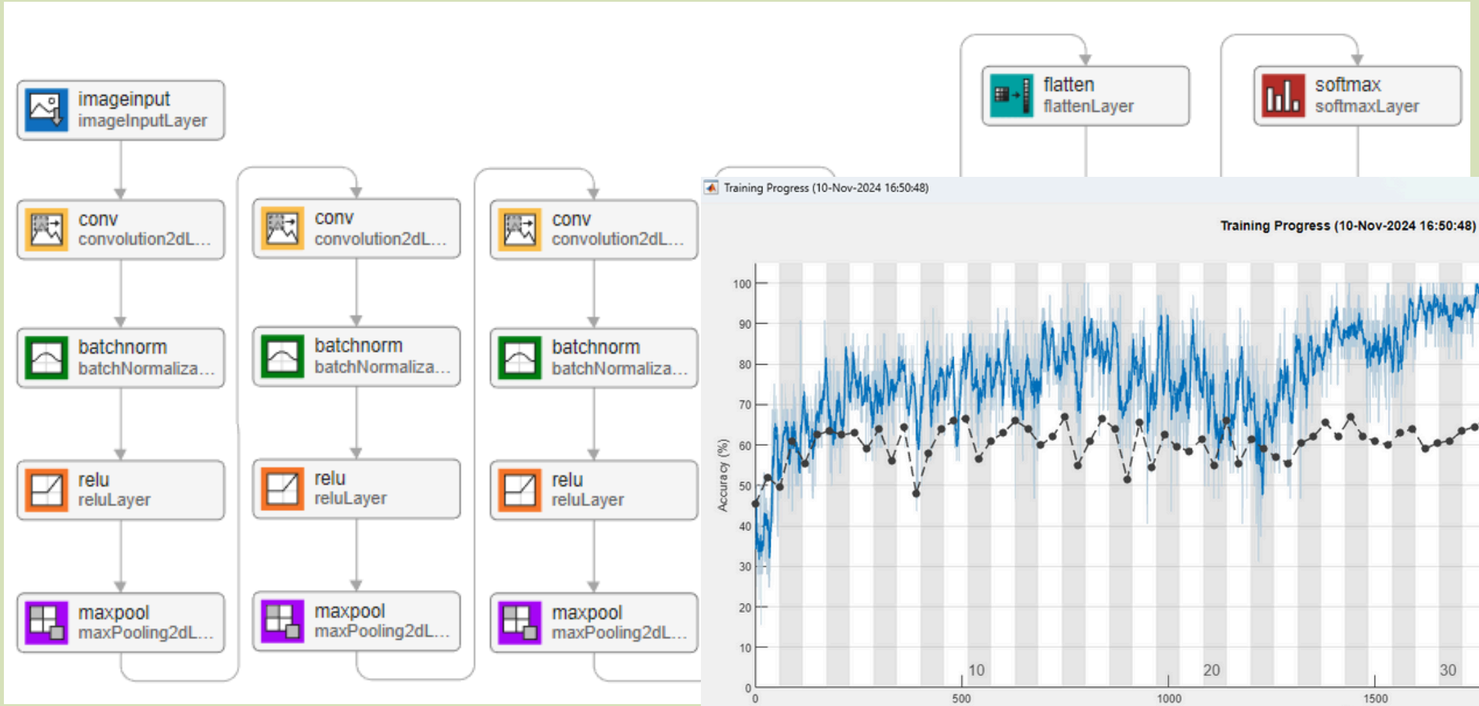
Accuracy: 67%

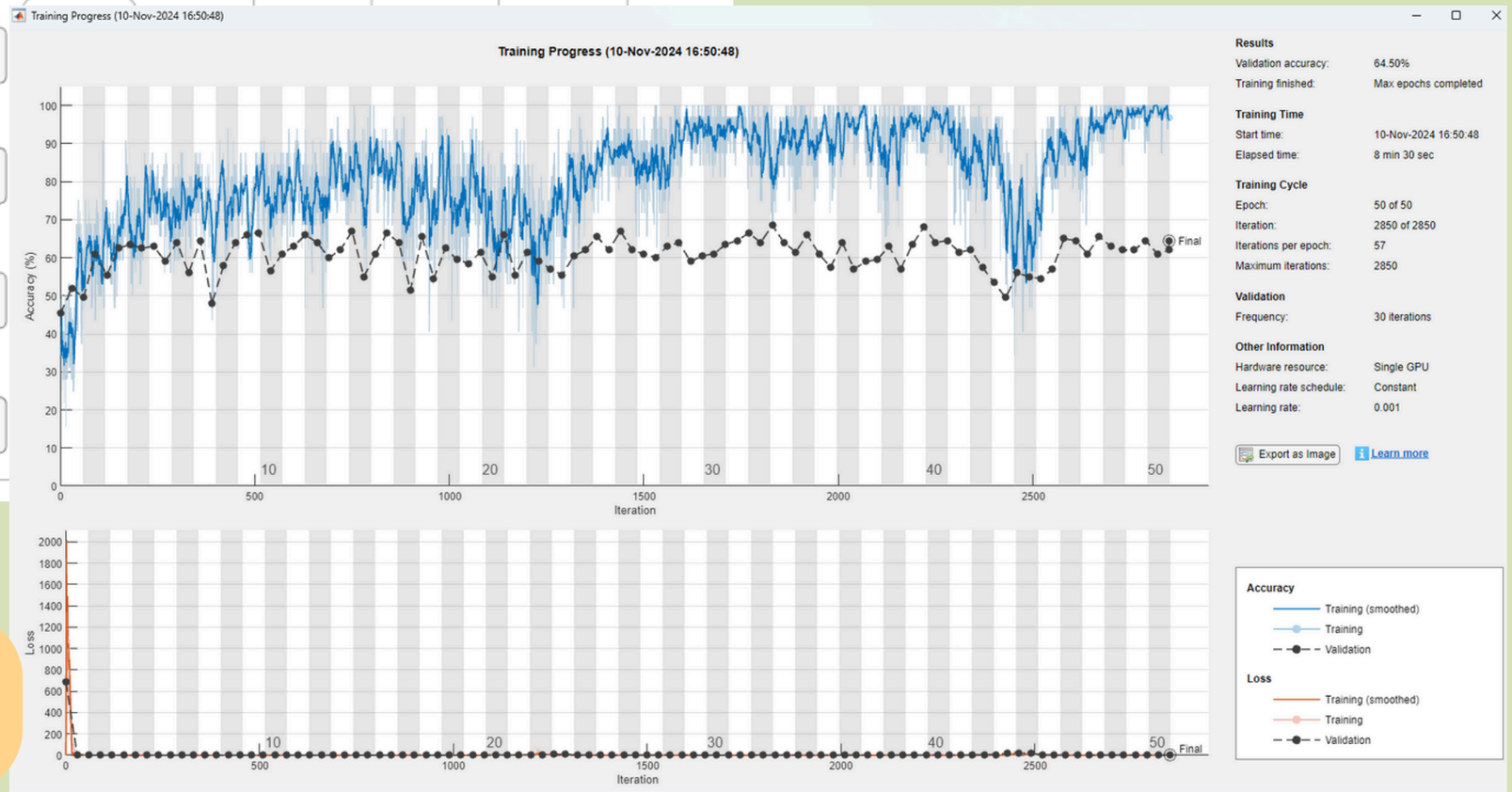
Method–Drop Out & 數據平衡



Accuracy: 58.5%

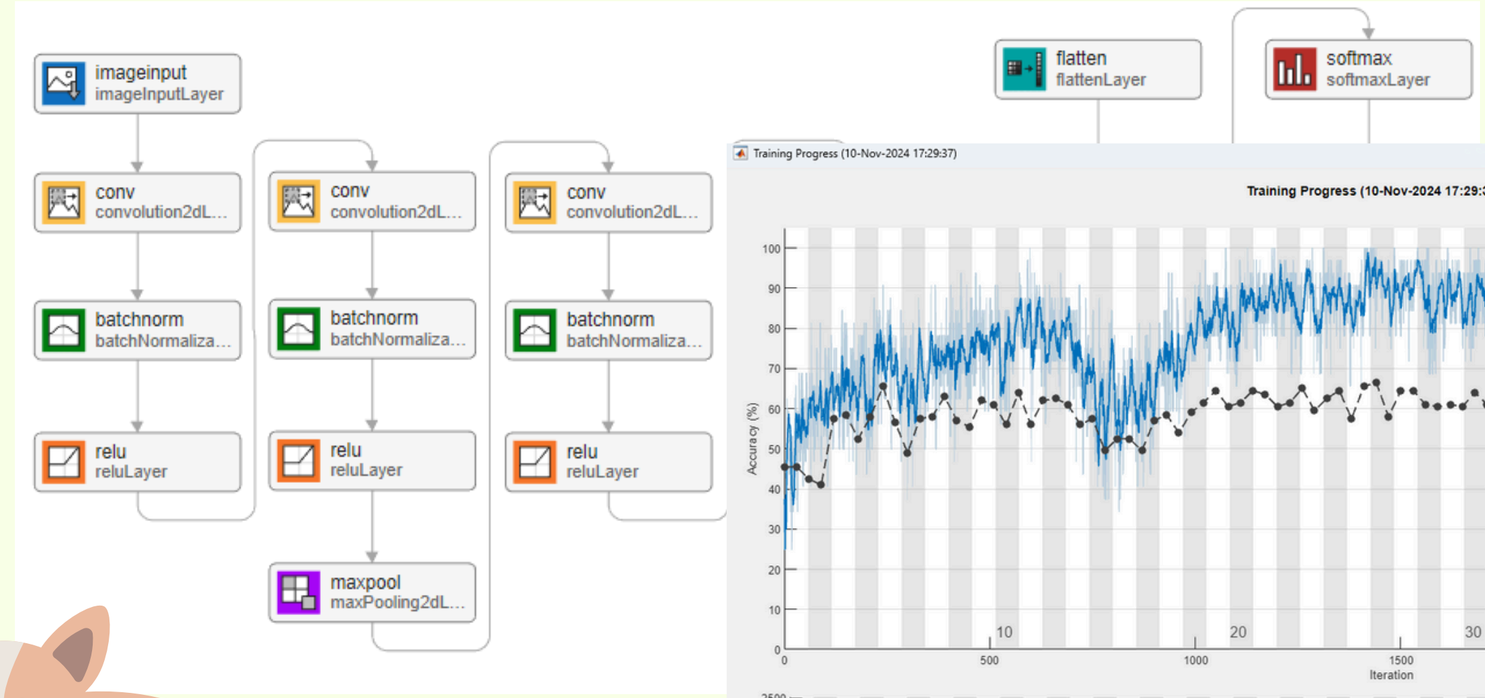
Method – 加入Shuffle & 平衡數據

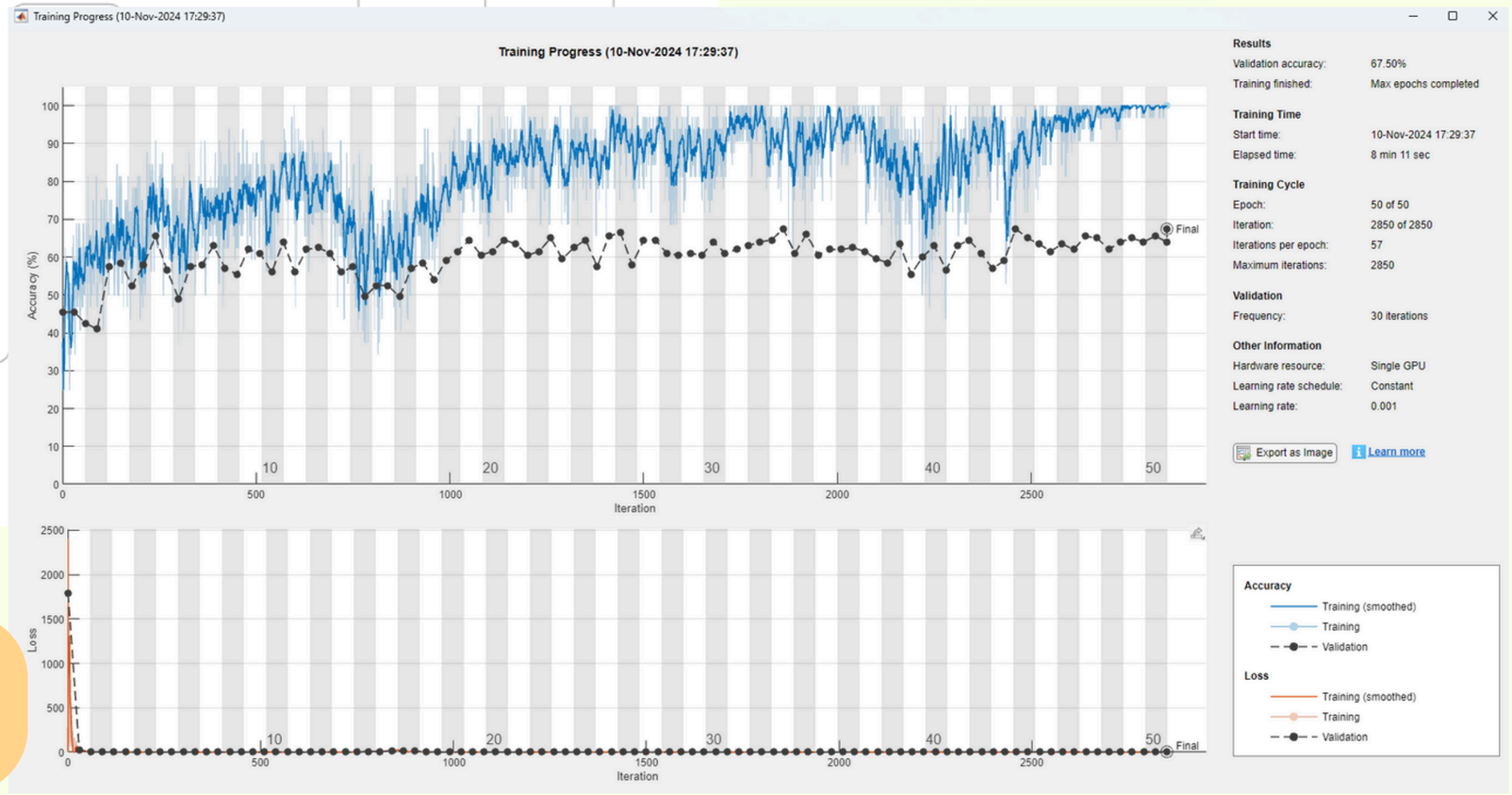


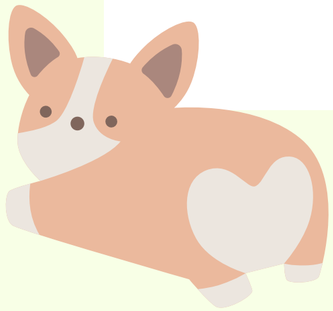


Accuracy: 64.5%

Method – 加入Shuffle & 平衡數據 & 2層Pooling



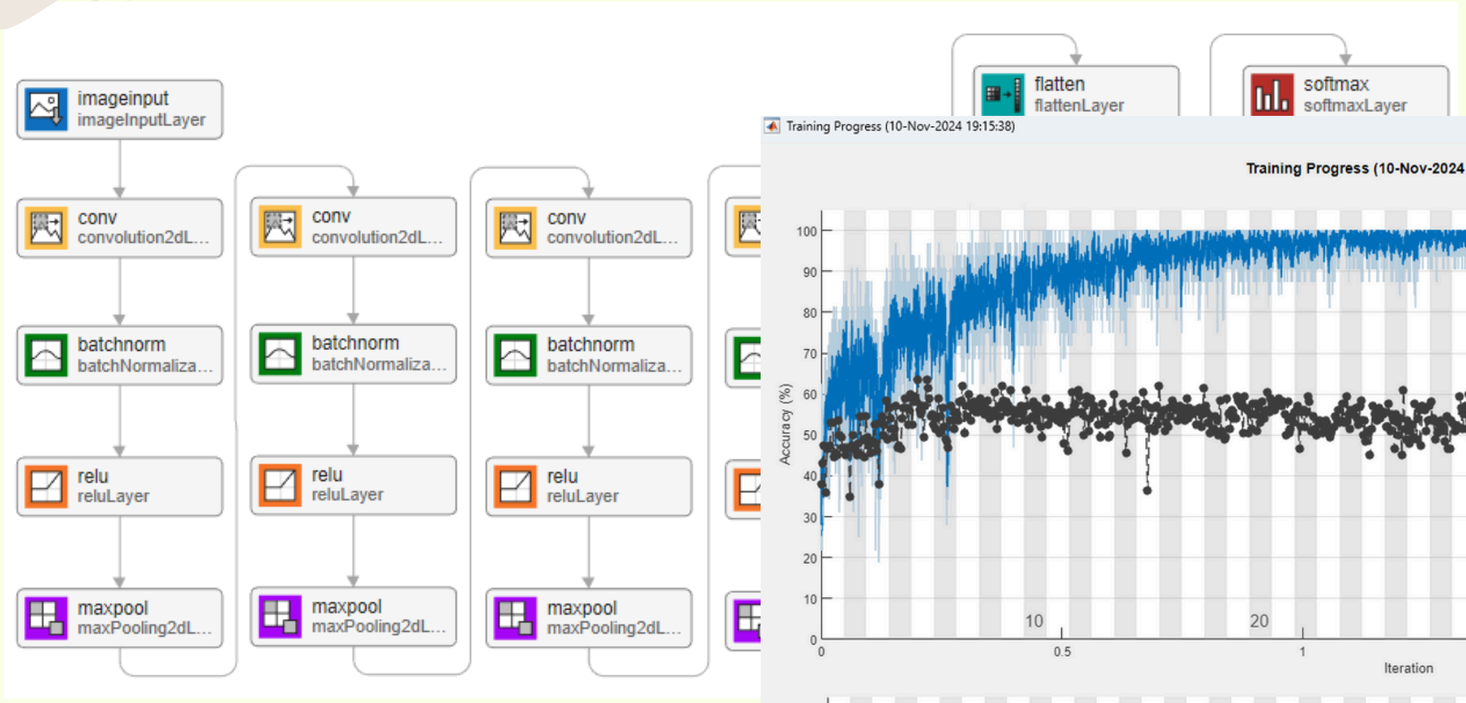


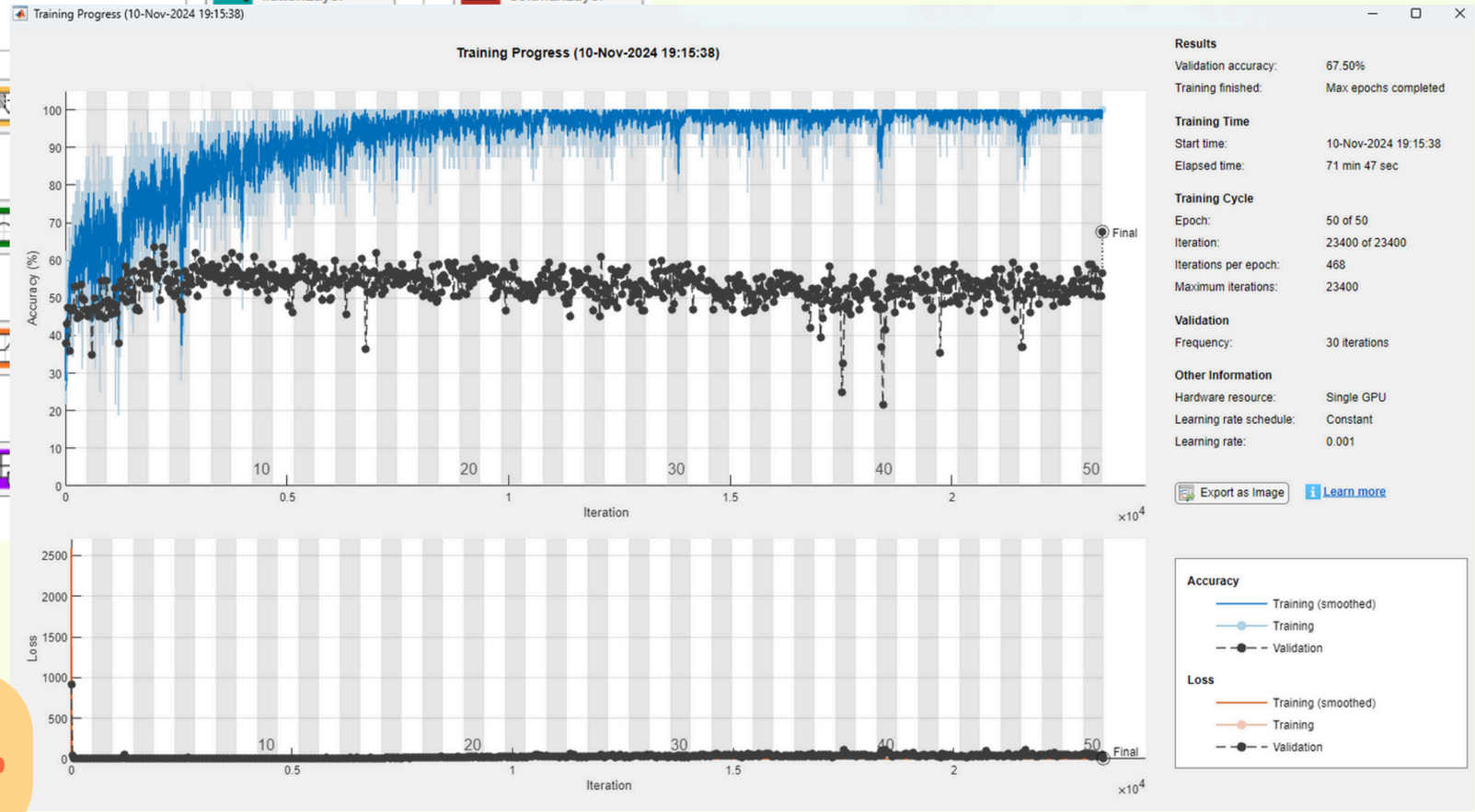


Accuracy: 67.5%

Method– 資料增加到 5000

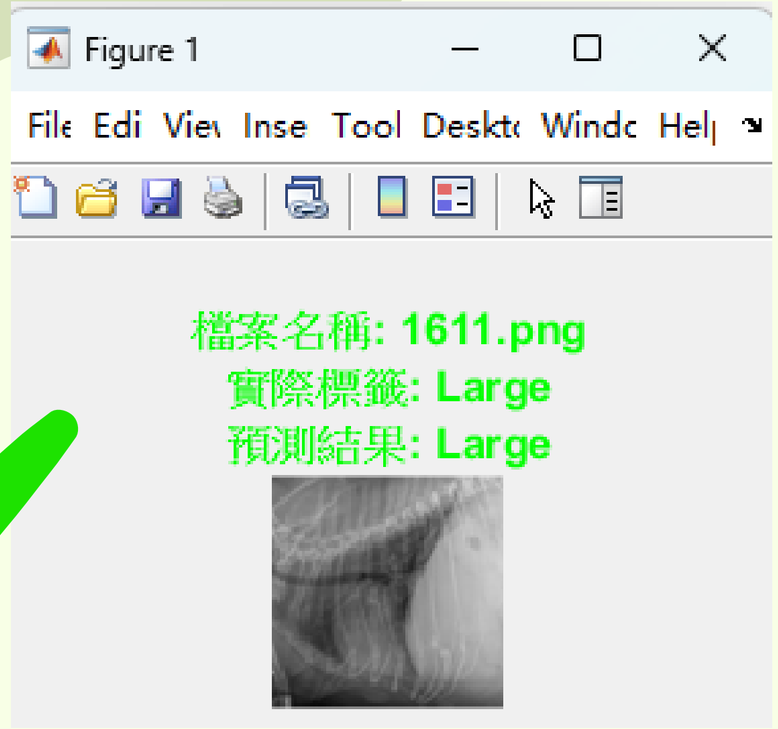
Large: 5000
Normal: 5000
Small: 5000

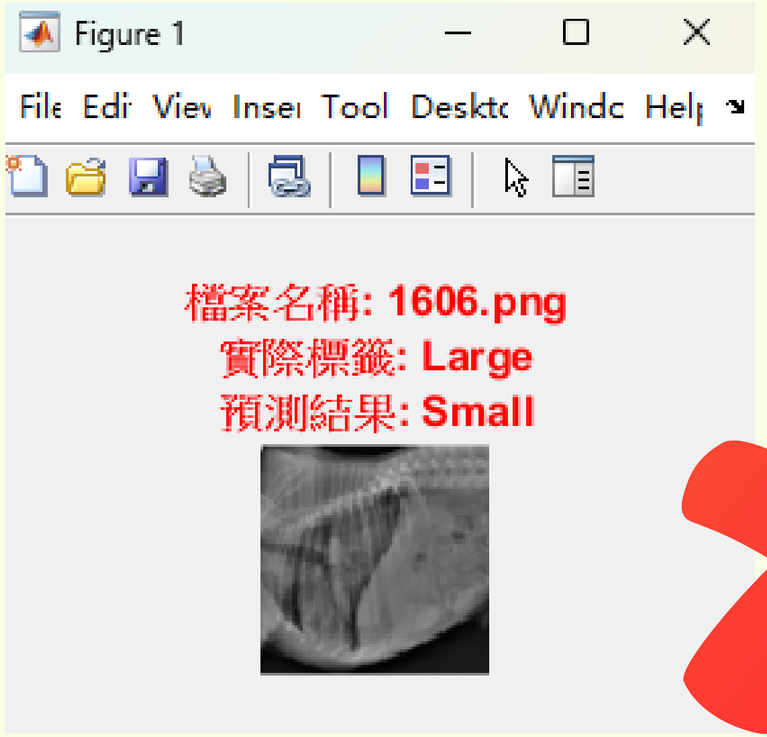


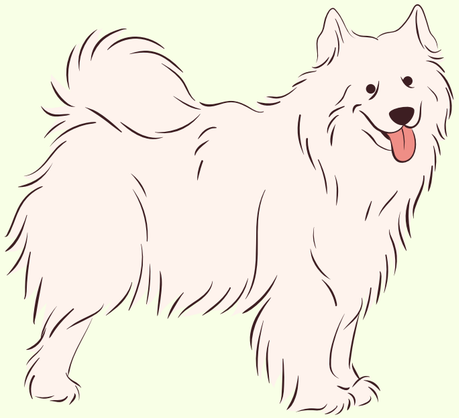


Accuracy: 67.5%

Mid Demo

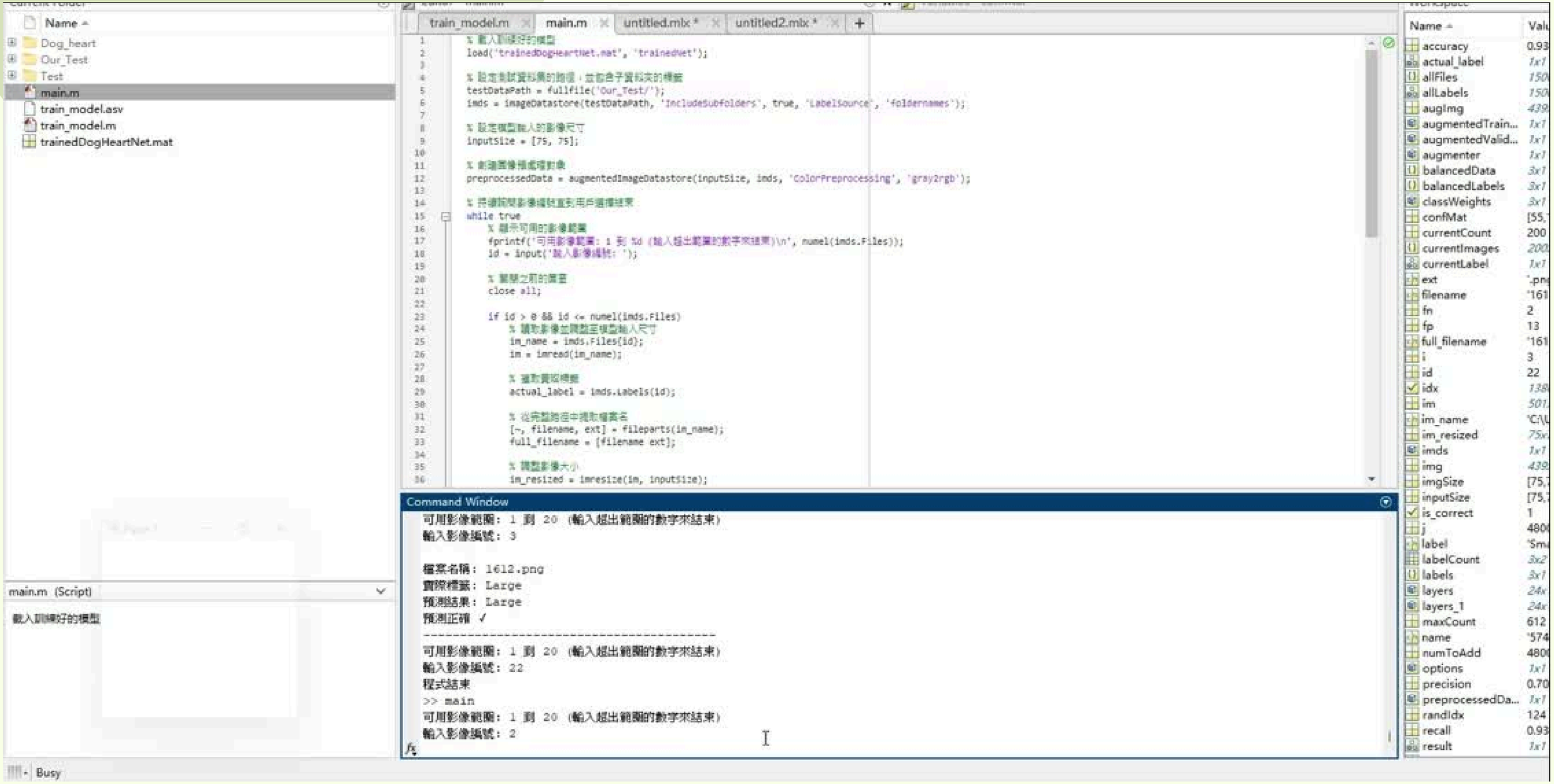






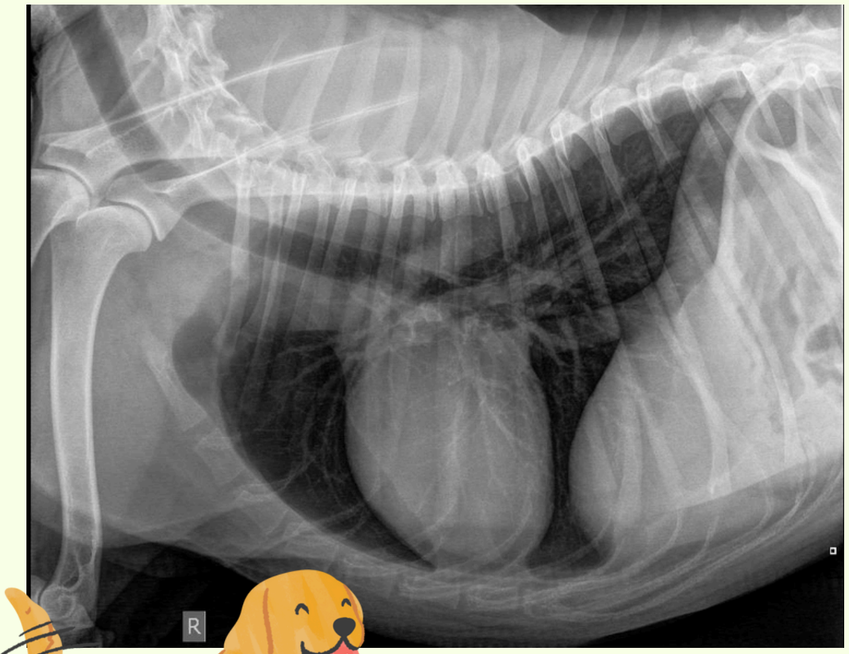
```
Command Window
>> main
可用影像範圍: 1 到 20 (輸入超出範圍的數字來結束)
輸入影像編號:
```

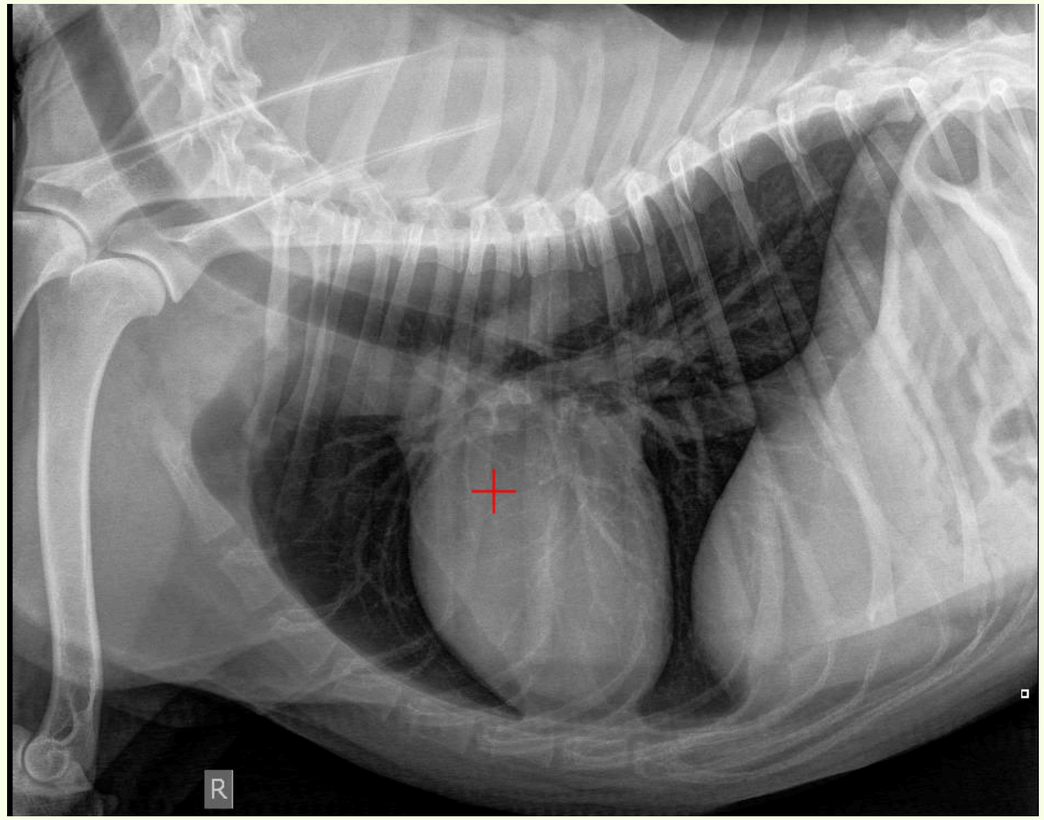
Mid Demo


Name
Dog_heart
Our_Test
Test
main.m
train_model.asv
train_model.m
trainedDogHeartNet.mat
main.m (Script)
載入訓練好的模型
train_model.m
main.m
untitled.mlx *
untitled2.mlx *
% 載入訓練好的模型
load('trainedDogHeartNet.mat', 'trainedNet');
% 設定包含要預測的影像，並給予實際的標籤
testDataPath = fullfile('Our_Test/');
imds = imageDatastore(testDataPath, 'IncludeSubfolders', true, 'LabelSource', 'foldernames');
% 設定模型輸入的影像尺寸
inputSize = [75, 75];
% 創建影像預處理對象
preprocessedData = augmentedImageDatastore(inputSize, imds, 'ColorPreprocessing', 'gray2rgb');
% 持續詢問影像編號直到用戶選擇結束
while true
% 顯示可用的影像範圍
fprintf('可用影像範圍：1 到 %d（輸入超出範圍的數字來結束）\n', numel(imds.Files));
id = input('輸入影像編號：');
% 關閉之前的圖窗
close all;
if id > 0 && id <= numel(imds.Files)
% 讀取影像並調整至模型輸入尺寸
im_name = imds.Files{id};
im = imread(im_name);
% 獲取實際標籤
actual_label = imds.Labels(id);
% 從完整路徑中提取檔案名
[~, filename, ext] = fileparts(im_name);
full_filename = [filename ext];
% 調整影像大小
im_resized = imresize(im, inputSize);
Command Window
可用影像範圍：1 到 20（輸入超出範圍的數字來結束）
輸入影像編號：3
檔案名稱：1612.png
實際標籤：Large
預測結果：Large
預測正確 ✓
可用影像範圍：1 到 20（輸入超出範圍的數字來結束）
輸入影像編號：22
程式結束
>> main
可用影像範圍：1 到 20（輸入超出範圍的數字來結束）
輸入影像編號：2
Busy

Method– 使用MATLAB先將資料集做標記

增強對比度 → 增強輪廓 → 計算心臟中心 → 標記紅色十字

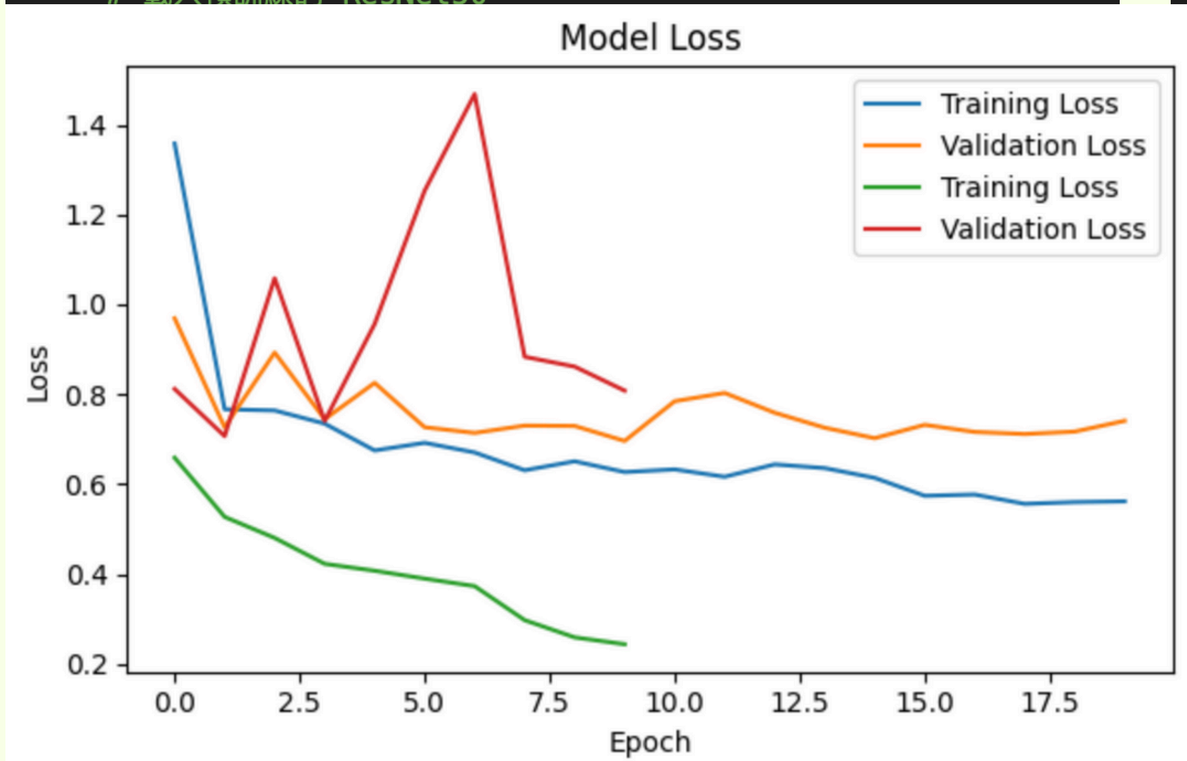


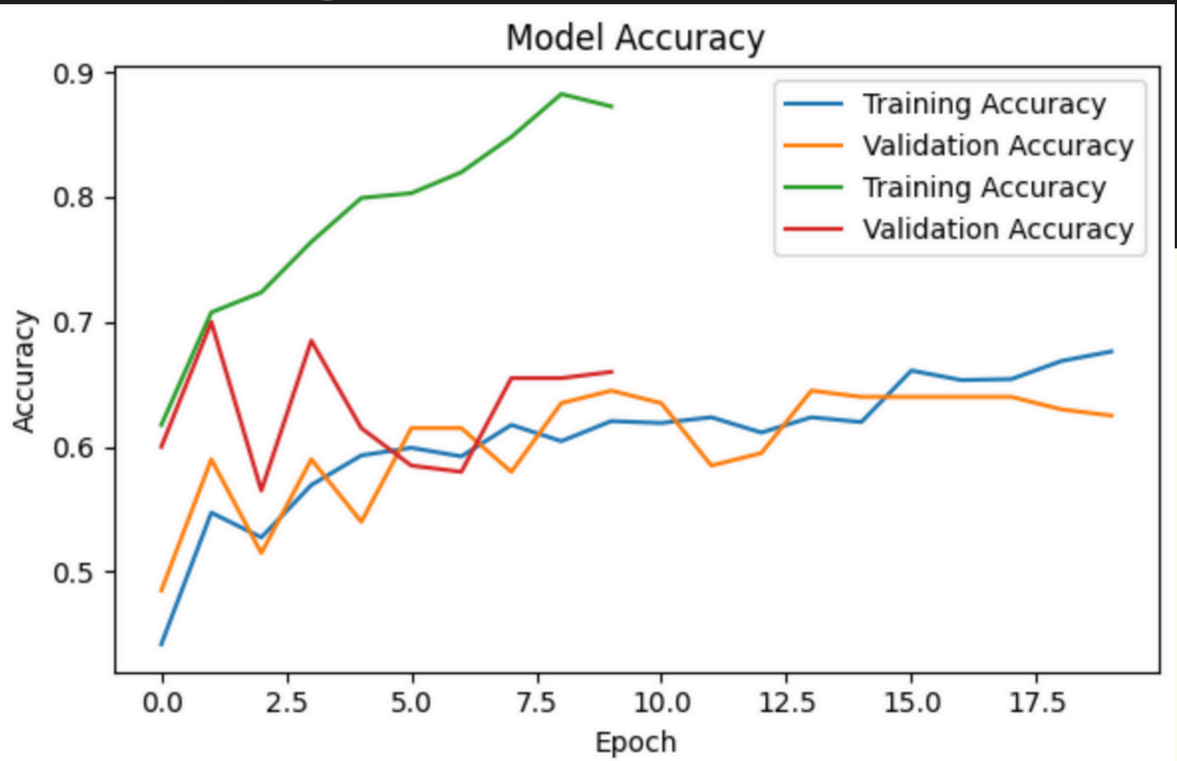


Method-
ResNet50+資料權重調整+callback函式

```
def build_resnet_model(num_classes=3):
    # 載入預訓練的 ResNet50
```

```
class_weights = compute_class_weight(
    class_weight='balanced',
```





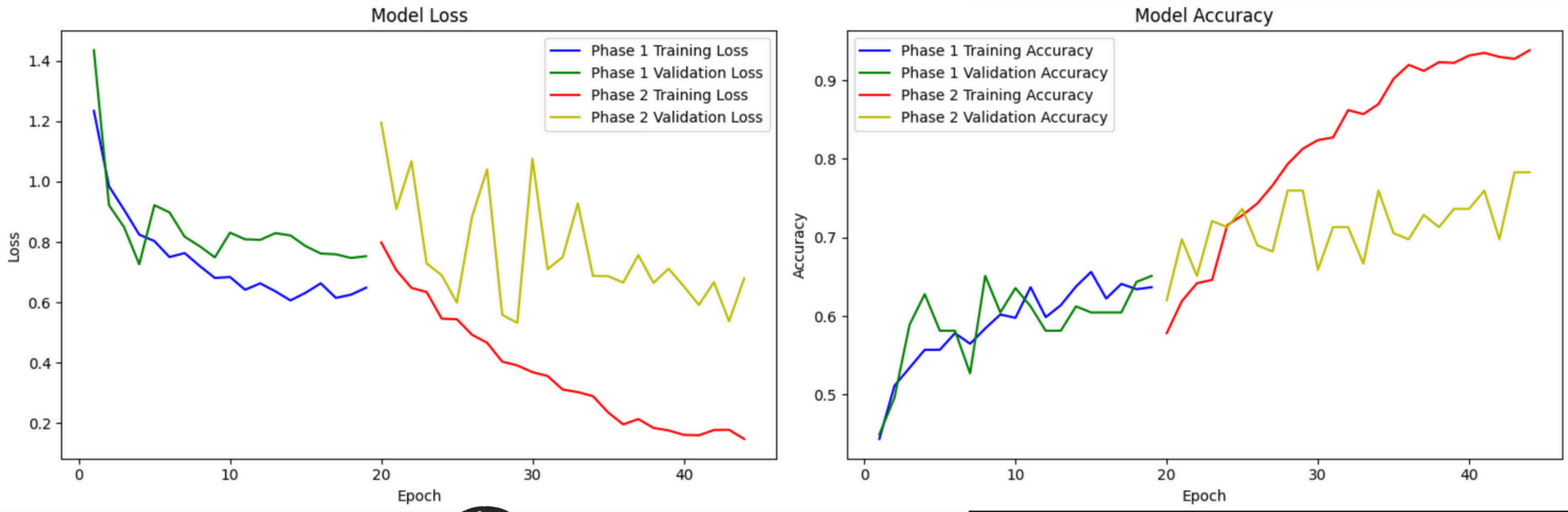

```
    model = Model(inputs=inputs, outputs=outputs)
    return model, base_model
```

```
        factor=0.2,
        patience=5,
        min_lr=1e-6
    )
```

Accuracy: 66%

Method-
加入自定義的self attention

```
def build_improved_model(num_classes=3):
    # 載入基礎模型
    base_model = ResNet50(
```



Accuracy: 78%!!!

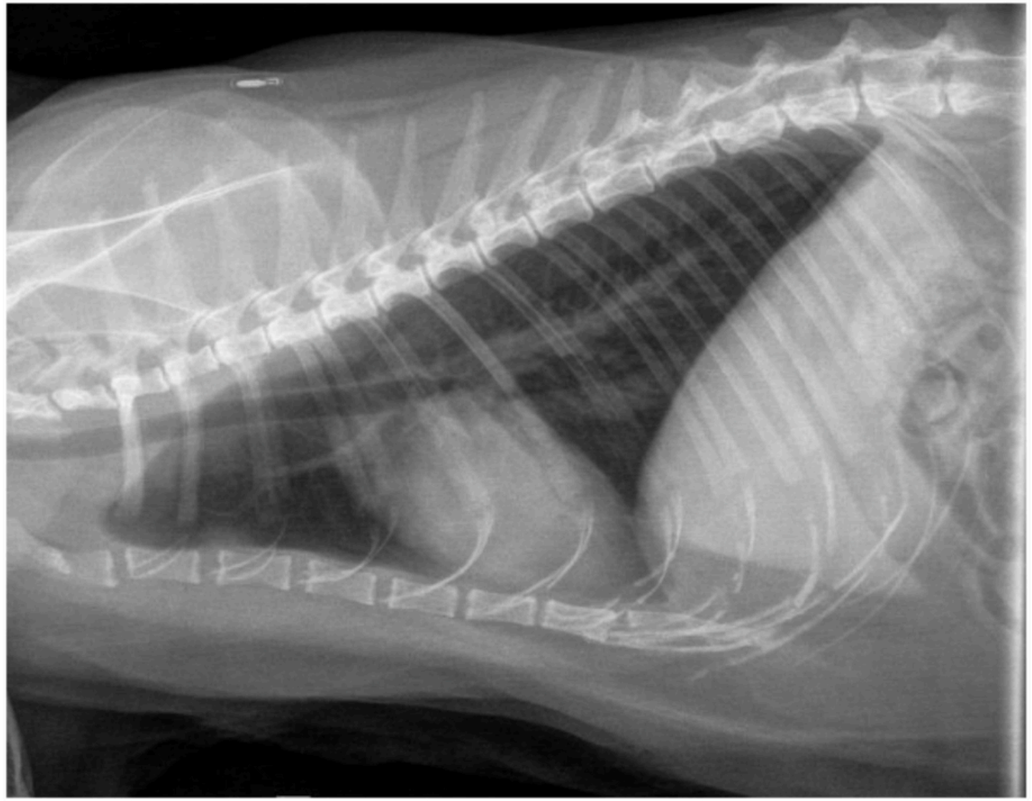
```
    x = Dense(256, activation='relu')(x)
    x = Dropout(0.3)(x)
    x = layers.BatchNormalization()(x)

    outputs = Dense(num_classes, activation='softmax')(x)

    model = Model(inputs=inputs, outputs=outputs)
    return model, base_model
```

Final Demo

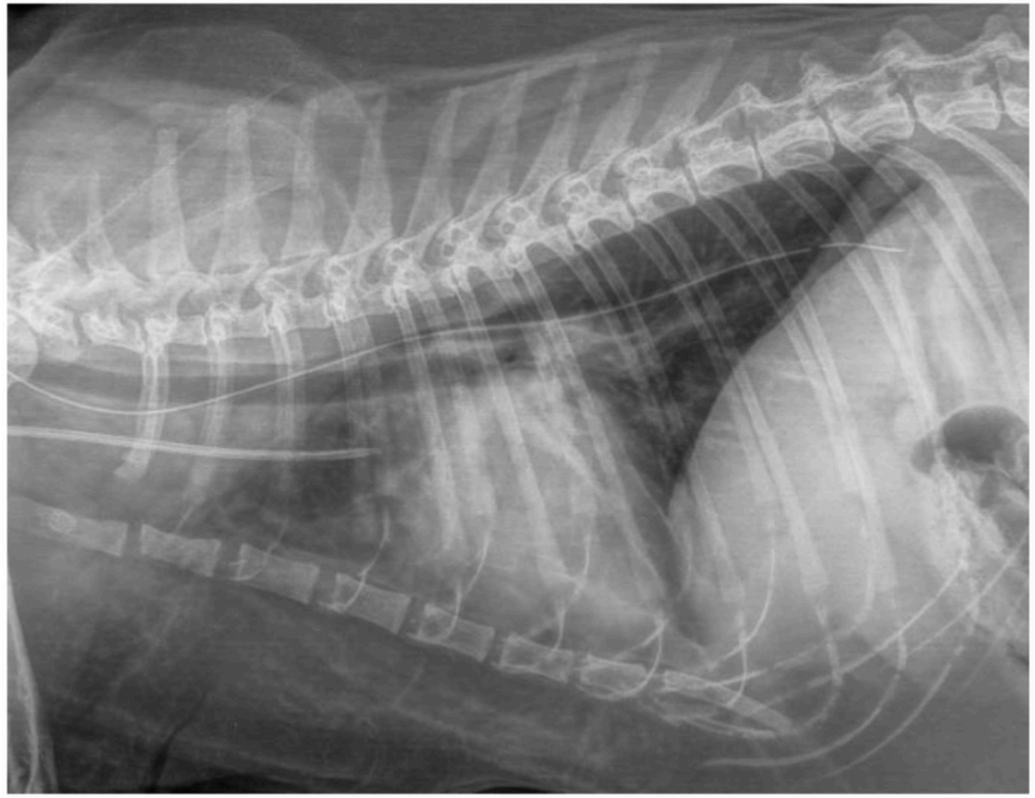
Image #1 - 1307.png
Prediction: Small (Confidence: 100.00%)
Actual Label: Small



```
Prediction probabilities for each class:
Large: 0.00%
Normal: 0.00%
Small: 100.00%

Prediction Result: ✓ Correct
```

Image #18 - 826.png
Prediction: Small (Confidence: 78.53%)
Actual Label: Normal



```
Prediction probabilities for each class:
Large: 1.07%
Normal: 20.40%
Small: 78.53%

Prediction Result: ✗ Incorrect
```

Final Demo

```
    def on_next_click(b):
        if image_number.value < total_images:
            image_number.value += 1
            on_predict_click(None)

    predict_button.on_click(on_predict_click)
    prev_button.on_click(on_prev_click)
    next_button.on_click(on_next_click)

    # 顯示界面
    display(widgets.HBox([image_number, predict_button]))
    display(widgets.HBox([prev_button, next_button]))

# 啟動演示界面
create_demo_interface()
```

Conclution

1. 資料多樣性不高: 資料集內的資料不多，可能缺乏多樣性，導致學習效果有限，且偏頗嚴重，可能間接影響到泛化能力
2. 模型過於簡易: 單純從圖片特徵判斷心臟大小，要提升精確度可能需要更複雜的模型來處理
3. **Self-Attention 要加!!**
4. **ResNet50 好猛!!**

Reference

- Deekonda, Nikhil. "Assessing Cardiomegaly in Dogs Using a Simple CNN Model." arXiv preprint arXiv:2407.06092 (2024)

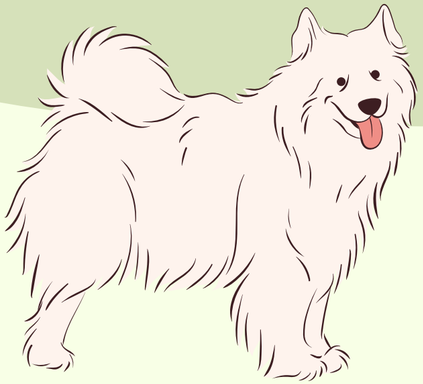
- Jialu Li and Youshan Zhang.Regressive vision transformer for dog cardiomegaly assessment.Scientific Reports, 14(1):1539, 2024

- Jeong, Y., Sung, J. An automated deep learning method and novel cardiac index to detect canine cardiomegaly from simple radiography. Sci Rep 12, 14494 (2022)

- https://dogbeing.com/en/blogs/5255e46f

- https://github.com/YoushanZhang/Dog-Cardiomegaly







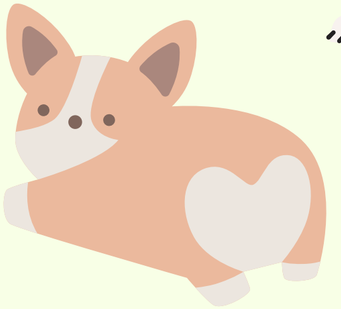













Thank You