# cnn_to_debug_1

December 5, 2025

[1]:
```
import sys
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import pickle
import torch
import torch.nn as nn
import torch.optim as optim
from torchvision import datasets, transforms, models
from torch.utils.data import DataLoader, random_split, Dataset
import os
from pyclass import TransformSubset, CNNnet
from PIL import Image
import random
```

[ ]:
```
SEED = 42

random.seed(SEED)
np.random.seed(SEED)
torch.manual_seed(SEED)
torch.cuda.manual_seed(SEED)
torch.cuda.manual_seed_all(SEED)
torch.backends.cudnn.benchmark = False
torch.backends.cudnn.deterministic = True
```

[3]:
```
class PLKDataset(Dataset):
    def __init__(self, file_path, transform=None):
        with open(file_path, 'rb') as f:
            data = pickle.load(f)
        self.images = data['images']
        self.labels = data['labels'].reshape(-1)
        self.transform = transform


    def __len__(self):
        return len(self.images)

    def __getitem__(self, idx):
```

```
        image = self.images[idx]
        label = int(self.labels[idx])

        image = Image.fromarray(image.astype('uint8'))

        if self.transform:
            image = self.transform(image)

        return image, label
```

[4]:
```
if torch.backends.mps.is_available():
    device = torch.device("mps")
    use_mps = True
elif torch.cuda.is_available():
    device = torch.device("cpu")
    use_mps = False

print(device)
```

```
mps
```

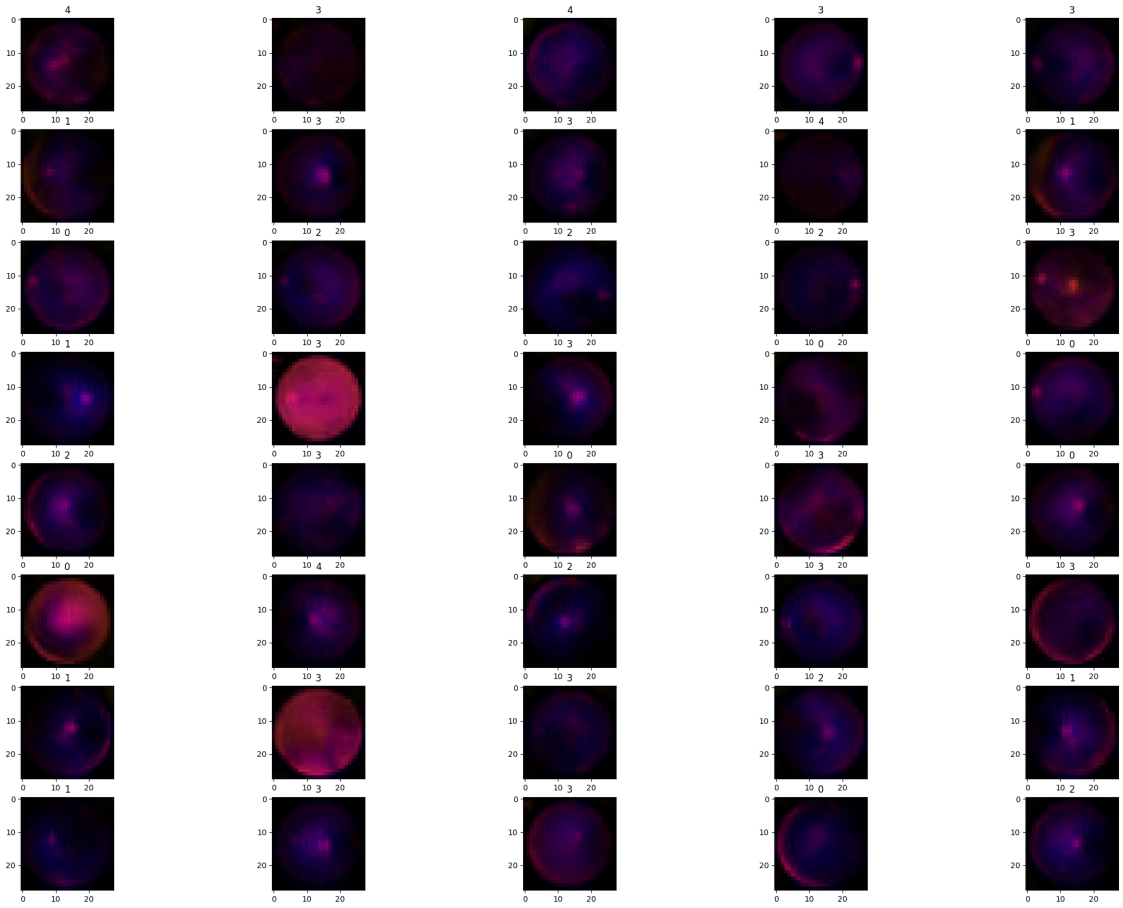
[5]:
```
dataset = PLKDataset('ift-3395-6390-kaggle-2-competition-fall-2025/train_data.
↪pkl')
```

[6]:
```
raw_images, raw_labels = dataset.images, dataset.labels
```

[7]:
```
from skimage import exposure
import cv2

bad_images= []

for i, img in enumerate(raw_images):

    img_norm = img / 255.0

    if img_norm.std() < 0.09:
        bad_images.append(i)




    r, g, b = img_norm[:,:,0], img_norm[:,:,1], img_norm[:,:,2]
    if r.mean() > g.mean() * 2 and r.mean() > b.mean() * 2:
        bad_images.append(i)



print(f"Found {len(bad_images)} bad images out of {len(raw_images)}")
```

```
mask = np.ones(len(raw_images), dtype=bool)
mask[bad_images] = False

n_show = min(40, len(bad_images))

if n_show == 0:
    print("aucune image")

else:
    plt.figure(figsize=(28,28))
    for i,idx in enumerate(bad_images[:n_show]):
        plt.subplot(11, 5, i+1)
        plt.title(raw_labels[idx])
        plt.imshow(raw_images[idx])
    plt.show()

cleaned_images = raw_images[mask]
cleaned_labels = raw_labels[mask]

dataset.images = cleaned_images
dataset.labels = cleaned_labels
```

```
Found 41 bad images out of 1080
```



[8]:
```
loader = DataLoader(dataset, batch_size=32, shuffle=True)
```

[9]:
```
def remove_green_channel(x):
    return x[[0, 2], :, :]
```

[10]:
```
IR_MEAN = [0.21396616101264954, 0.23241323232650757]
IR_STD = [0.19199922680854797, 0.17090746760368347]

train_transform = transforms.Compose([
    transforms.Resize((64, 64)),
    transforms.RandomHorizontalFlip(p=0.5),
    transforms.RandomRotation(15),
    transforms.ToTensor(),
    transforms.Lambda(remove_green_channel),
    transforms.Normalize(mean=IR_MEAN, std=IR_STD)
])

val_transform = transforms.Compose([
    transforms.Resize((64, 64)),
```

```
    transforms.ToTensor(),
    transforms.Lambda(remove_green_channel),
    transforms.Normalize(mean=IR_MEAN, std=IR_STD)
])
```

[11]:
```
from sklearn.model_selection import train_test_split

labels = dataset.labels
idx = np.arange(len(dataset))
train_idx, valid_idx = train_test_split(idx, test_size=0.2, stratify=labels,␣
 ↪random_state=42)
```

[12]:
```
from torch.utils.data import Subset

train_dataset = Subset(dataset, train_idx)
train_data = TransformSubset(train_dataset, train_transform)

val_dataset = Subset(dataset, valid_idx)
val_data = TransformSubset(val_dataset, val_transform)

train_loader = DataLoader(train_data, batch_size=64, shuffle=True,␣
 ↪pin_memory=True, drop_last=True)
val_loader   = DataLoader(val_data, batch_size=64, shuffle=False,␣
 ↪pin_memory=True, drop_last=True)
```

[13]:
```
import torch

# 1. Accéder aux images d'entraînement (déjà nettoyées)
# 'dataset.images' et 'train_idx' sont définis dans les cellules précédentes.
train_images_np = dataset.images[train_idx]

# 2. Normalisation à 0-1 et conversion au format PyTorch (B, C, H, W)
# Note: Les images NumPy sont B, H, W, C. PyTorch utilise B, C, H, W.
# Nous faisons également la mise à l'échelle à 0-1 ici.
images_normalized = torch.from_numpy(train_images_np / 255.0).permute(0, 3, 1,␣
 ↪2).float()

# 3. Calculer la Moyenne et le Std sur toutes les images (dim 0) et tous les␣
 ↪pixels (dim 2, 3)

# Calculer le Mean (à travers le batch, la hauteur et la largeur)
mean_vals = images_normalized.mean(dim=[0, 2, 3])

# Calculer le Std (à travers le batch, la hauteur et la largeur)
std_vals = images_normalized.std(dim=[0, 2, 3])

print(f"Mean (par canal): {mean_vals.tolist()}")
```

```
print(f"Std (par canal): {std_vals.tolist()}")

# 4. Appliquer les résultats
# VOS_MOYENNES = mean_vals.tolist()
# VOS_STD = std_vals.tolist()
```

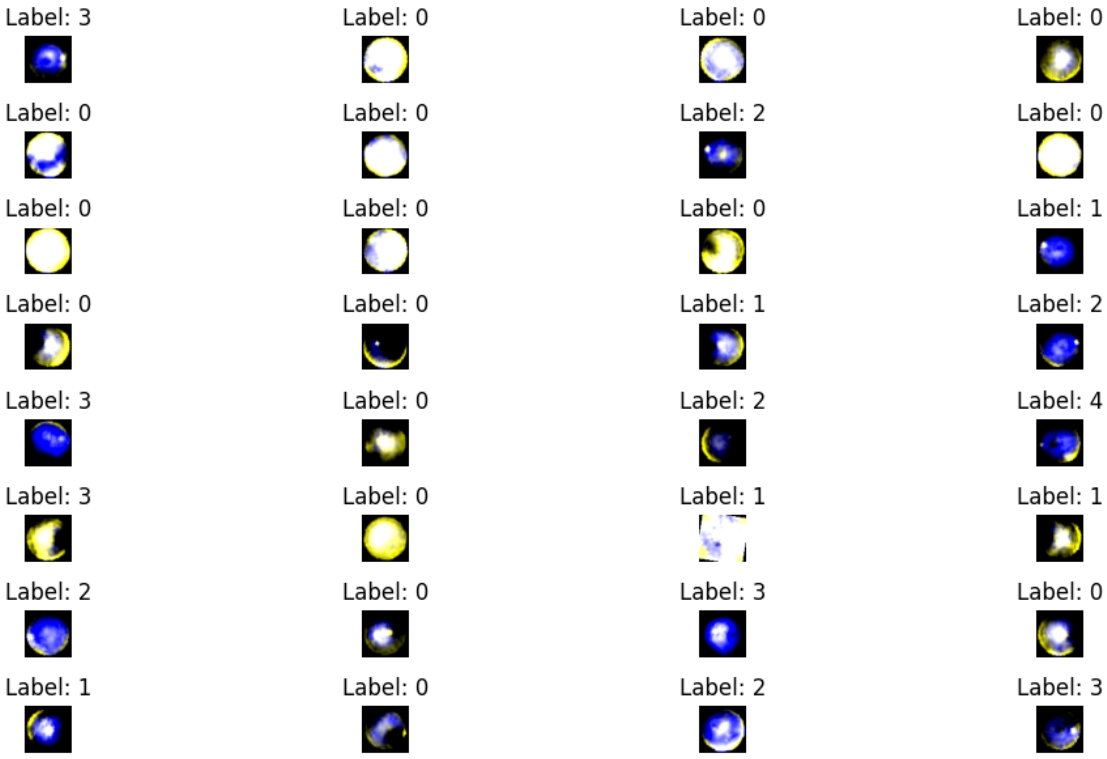
```
Mean (par canal): [0.21602368354797363, 0.005451837554574013,
0.23424026370048523]
Std (par canal): [0.19080659747123718, 0.01700294204056263, 0.1700998842716217]
```

[14]:
```
import matplotlib.pyplot as plt
import numpy as np

images, labels = next(iter(train_loader))

fig, axes = plt.subplots(8, 4, figsize=(12, 6))
for i in range(32):
    ax = axes[i // 4, i % 4]

    img_np = images[i].cpu().numpy()  # shape: (2, 64, 64)

    # Convertir 2 canaux → 3 canaux pour imshow
    # Dupliquer le premier canal (R) pour créer un faux canal vert
    img_rgb = np.stack([img_np[0], img_np[0], img_np[1]], axis=0)  # (3, 64, 64)

    img_rgb = np.transpose(img_rgb, (1, 2, 0))  # (64, 64, 3)
    ax.imshow(img_rgb)
    ax.set_title(f"Label: {labels[i].item()}")
    ax.axis('off')

plt.tight_layout()
plt.show()
```

```
/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.737774].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..3.215671].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.092301].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.4395244].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.970572].
```

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.3373997].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.6225277].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.4395244].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..3.0318472].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..3.0318472].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..4.073518].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.6838025].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..3.9713933].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.8063519].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.7607197].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.416536].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.6555967].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.3578248].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.4795531].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.8472018].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.8071728].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.3782496].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..4.093943].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..3.4811954].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.8063519].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.0310261].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.4031954].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.2557].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.1737397].
```

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.561253].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..2.1331506].
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers). Got range [-1.3598776..1.7042273].
```




[15]:
```python
from sklearn.utils.class_weight import compute_class_weight

train_labels = dataset.labels[train_idx]
classes = np.unique(train_labels)
class_weights = compute_class_weight('balanced', classes=classes,y=train_labels)
weights_tensor = torch.tensor(class_weights, dtype=torch.float32).to(device)
# Réduire le poids de la Classe 4 (améliorer la précision)
weights_tensor[4] *= 0.7

# Augmenter le poids des Classes 2 et 3 (améliorer le rappel)
weights_tensor[2] *= 1.5
weights_tensor[3] *= 1.5

# Augmenter légèrement le poids de la Classe 0 (pour son faible rappel)
weights_tensor[0] *= 1.1
```

[16]:
```
model = CNNnet().to(device)
```

[17]:
```
from torch.optim import AdamW

criterion = nn.CrossEntropyLoss(weight=weights_tensor, label_smoothing=0.1)

optimizer = optim.AdamW(model.parameters(), lr=2e-5,
                        weight_decay=10e-3
                        )
```

[18]:
```
from sklearn.metrics import accuracy_score, recall_score,␣
 ↪balanced_accuracy_score, classification_report, confusion_matrix
import torch
import numpy as np

best_val_loss = float('inf')

for epoch in range(100):
    # --- 1. ÉTAPE D'ENTRAÎNEMENT ---
    model.train()
    running_train_loss = 0

    for images, labels in train_loader:
        images = images.to(device)
        labels = labels.to(device)

        optimizer.zero_grad()
        outputs = model(images)
        loss = criterion(outputs, labels)

        loss.backward()
        optimizer.step()

        running_train_loss += loss.item()

    avg_train_loss = running_train_loss / len(train_loader)
    print(f"Epoch {epoch+1}, Train Loss = {avg_train_loss:.4f}")


    model.eval()
    preds, gts = [], []
    running_val_loss = 0

    with torch.no_grad():
        for images, labels in val_loader:
            images = images.to(device)
            labels = labels.to(device)
```

```
            outputs = model(images)


            val_loss = criterion(outputs, labels)
            running_val_loss += val_loss.item()

            _, pred = torch.max(outputs, 1)

            preds.extend(pred.cpu().numpy())
            gts.extend(labels.cpu().numpy())

    avg_val_loss = running_val_loss / len(val_loader)

    # Calcul des métriques
    all_preds = np.array(preds)
    all_labels = np.array(gts)

    bal_acc = balanced_accuracy_score(all_labels, all_preds)

    print(f"Val Loss = {avg_val_loss:.4f}, Bal Acc = {bal_acc:.4f}")

    if avg_val_loss < best_val_loss:
         best_val_loss = avg_val_loss
         torch.save(model.state_dict(), 'best_model_cnn_ir.pth')
         patience_counter = 0
    else:
         patience_counter += 1
         if patience_counter >= 15: # Ex: 5 epochs de patience
             print("Arrêt précoce (Early Stopping)!")
             break

print(classification_report(all_labels, all_preds, digits=4))
```

```
/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 1, Train Loss = 1.6929
Val Loss = 1.6756, Bal Acc = 0.2000
```

```
/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 2, Train Loss = 1.5874
Val Loss = 1.6776, Bal Acc = 0.2411

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 3, Train Loss = 1.4869
Val Loss = 1.6255, Bal Acc = 0.3107

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 4, Train Loss = 1.4666
Val Loss = 1.5688, Bal Acc = 0.3497

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 5, Train Loss = 1.4413
Val Loss = 1.5326, Bal Acc = 0.3535

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 6, Train Loss = 1.4075
Val Loss = 1.5174, Bal Acc = 0.3923

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 7, Train Loss = 1.3632
Val Loss = 1.5178, Bal Acc = 0.4324

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 8, Train Loss = 1.3441
Val Loss = 1.5115, Bal Acc = 0.3876

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 9, Train Loss = 1.3202
Val Loss = 1.5035, Bal Acc = 0.4422

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 10, Train Loss = 1.3444
Val Loss = 1.4951, Bal Acc = 0.4140

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 11, Train Loss = 1.2844
Val Loss = 1.5000, Bal Acc = 0.3940

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 12, Train Loss = 1.2639
Val Loss = 1.5006, Bal Acc = 0.3740

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 13, Train Loss = 1.2429
Val Loss = 1.4860, Bal Acc = 0.4448

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 14, Train Loss = 1.2322
Val Loss = 1.4760, Bal Acc = 0.4214

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 15, Train Loss = 1.1948
Val Loss = 1.4761, Bal Acc = 0.3994

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 16, Train Loss = 1.2062
Val Loss = 1.4754, Bal Acc = 0.4325

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 17, Train Loss = 1.1735
Val Loss = 1.4654, Bal Acc = 0.4161

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 18, Train Loss = 1.1617
Val Loss = 1.4697, Bal Acc = 0.4751

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 19, Train Loss = 1.1498
Val Loss = 1.4566, Bal Acc = 0.4479

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 20, Train Loss = 1.1529
Val Loss = 1.4569, Bal Acc = 0.4552

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 21, Train Loss = 1.1405
Val Loss = 1.4563, Bal Acc = 0.4354

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 22, Train Loss = 1.1170
Val Loss = 1.4683, Bal Acc = 0.4088

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 23, Train Loss = 1.0892
Val Loss = 1.4626, Bal Acc = 0.4603

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 24, Train Loss = 1.0670
Val Loss = 1.4618, Bal Acc = 0.4507

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 25, Train Loss = 1.0461
Val Loss = 1.4664, Bal Acc = 0.4421

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 26, Train Loss = 1.0477
Val Loss = 1.4588, Bal Acc = 0.4665

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 27, Train Loss = 1.0362
Val Loss = 1.4562, Bal Acc = 0.4939

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 28, Train Loss = 1.0390
Val Loss = 1.4532, Bal Acc = 0.4431

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 29, Train Loss = 1.0281
Val Loss = 1.4588, Bal Acc = 0.4870

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 30, Train Loss = 0.9989
Val Loss = 1.4568, Bal Acc = 0.4574

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 31, Train Loss = 0.9836
Val Loss = 1.4602, Bal Acc = 0.4854

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 32, Train Loss = 0.9853
Val Loss = 1.4762, Bal Acc = 0.4334

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 33, Train Loss = 0.9727
Val Loss = 1.4742, Bal Acc = 0.4616

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 34, Train Loss = 0.9515
Val Loss = 1.4701, Bal Acc = 0.4633

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 35, Train Loss = 0.9476
Val Loss = 1.4518, Bal Acc = 0.4867

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 36, Train Loss = 0.9235
Val Loss = 1.4469, Bal Acc = 0.5017

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 37, Train Loss = 0.9403
Val Loss = 1.4556, Bal Acc = 0.4778

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 38, Train Loss = 0.9136
Val Loss = 1.4703, Bal Acc = 0.4300

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 39, Train Loss = 0.8932
Val Loss = 1.4688, Bal Acc = 0.4403

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 40, Train Loss = 0.9055
Val Loss = 1.4541, Bal Acc = 0.4641

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 41, Train Loss = 0.8841
Val Loss = 1.4425, Bal Acc = 0.4874

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 42, Train Loss = 0.8731
Val Loss = 1.4578, Bal Acc = 0.4634

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 43, Train Loss = 0.8609
Val Loss = 1.4657, Bal Acc = 0.4585

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 44, Train Loss = 0.8585
Val Loss = 1.4420, Bal Acc = 0.4579

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 45, Train Loss = 0.8448
Val Loss = 1.4391, Bal Acc = 0.4663

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 46, Train Loss = 0.8396
Val Loss = 1.4670, Bal Acc = 0.4807

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 47, Train Loss = 0.8297
Val Loss = 1.4548, Bal Acc = 0.4734

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 48, Train Loss = 0.8123
Val Loss = 1.4696, Bal Acc = 0.4539

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 49, Train Loss = 0.8174
Val Loss = 1.4676, Bal Acc = 0.4730

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

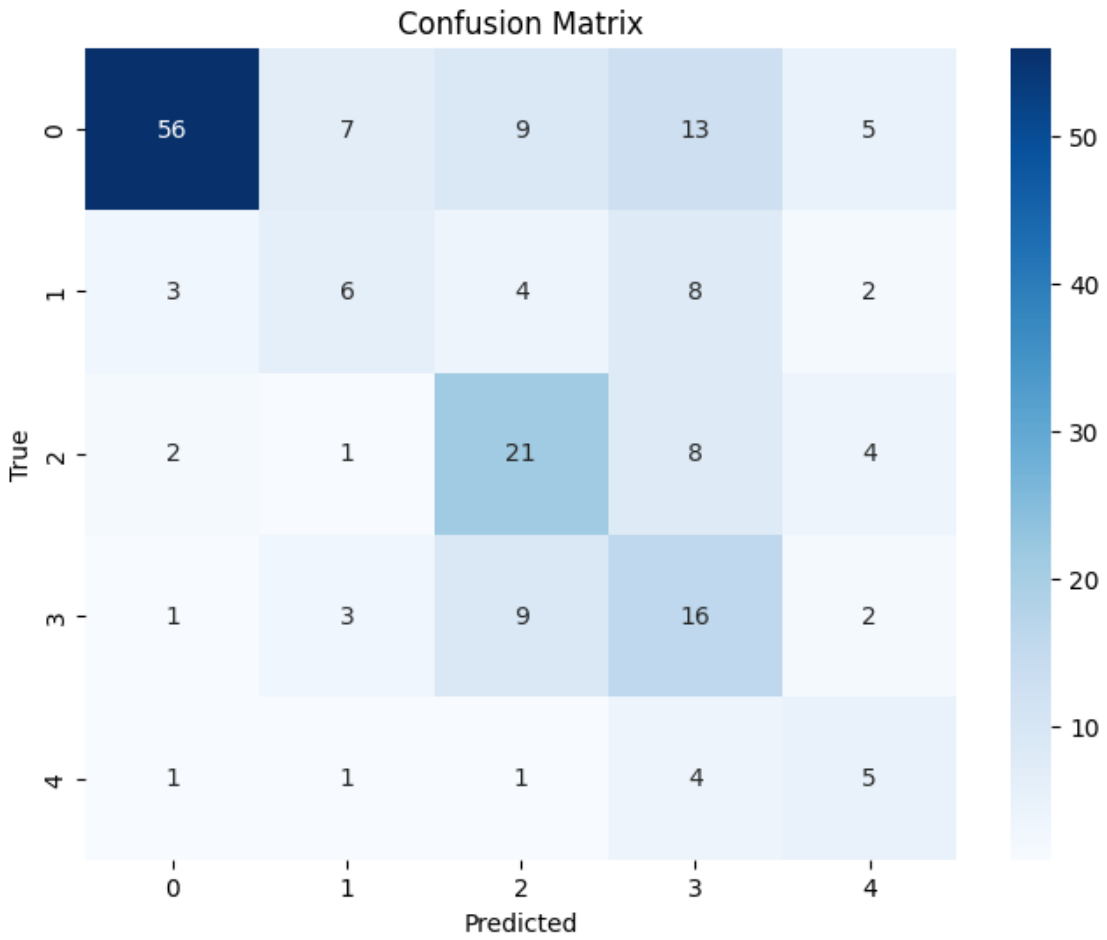
```
Epoch 50, Train Loss = 0.8132
Val Loss = 1.4556, Bal Acc = 0.4501

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 51, Train Loss = 0.7941
Val Loss = 1.4663, Bal Acc = 0.4492

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 52, Train Loss = 0.7996
Val Loss = 1.4603, Bal Acc = 0.4765

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 53, Train Loss = 0.8147
Val Loss = 1.4690, Bal Acc = 0.4739

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 54, Train Loss = 0.7689
Val Loss = 1.4762, Bal Acc = 0.4778

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 55, Train Loss = 0.7829
Val Loss = 1.4690, Bal Acc = 0.4694

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```

```
Epoch 56, Train Loss = 0.7815
Val Loss = 1.4719, Bal Acc = 0.4603

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 57, Train Loss = 0.7739
Val Loss = 1.4741, Bal Acc = 0.4803

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 58, Train Loss = 0.7619
Val Loss = 1.4810, Bal Acc = 0.4469

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 59, Train Loss = 0.7558
Val Loss = 1.4765, Bal Acc = 0.4407

/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)

Epoch 60, Train Loss = 0.7560
Val Loss = 1.4745, Bal Acc = 0.4798
Arrêt précoce (Early Stopping)!
              precision    recall  f1-score   support

           0     0.8889    0.6222    0.7320        90
           1     0.3333    0.2609    0.2927        23
           2     0.4773    0.5833    0.5250        36
           3     0.3265    0.5161    0.4000        31
           4     0.2778    0.4167    0.3333        12

    accuracy                         0.5417       192
   macro avg     0.4608    0.4798    0.4566       192
weighted avg     0.6162    0.5417    0.5621       192
```

[19]:
```
bal_acc = balanced_accuracy_score(all_labels, all_preds)
recall = recall_score(all_labels, all_preds, average='macro')
acc = accuracy_score(all_labels, all_preds)

print(f"Validation Balanced Accuracy: {bal_acc:.4f}")
print(f"Validation Recall: {recall:.4f}")
print(f"Validation Accuracy: {acc:.4f}")
print(classification_report(all_labels, all_preds, digits=4))
```

```
Validation Balanced Accuracy: 0.4798
Validation Recall: 0.4798
Validation Accuracy: 0.5417
              precision    recall  f1-score   support

           0     0.8889    0.6222    0.7320        90
           1     0.3333    0.2609    0.2927        23
           2     0.4773    0.5833    0.5250        36
           3     0.3265    0.5161    0.4000        31
           4     0.2778    0.4167    0.3333        12

    accuracy                         0.5417       192
   macro avg     0.4608    0.4798    0.4566       192
weighted avg     0.6162    0.5417    0.5621       192
```

[20]:
```
import seaborn as sns

cm = confusion_matrix(all_labels, all_preds)
plt.figure(figsize=(8, 6))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
plt.xlabel('Predicted')
plt.ylabel('True')
plt.title('Confusion Matrix')
plt.show()
```




[21]:
```
torch.save({
    "model_state_dict": model.state_dict(),
    "num_classes": 5,
}, "cnnnet.pth")
```

[22]:
```
checkpoint = torch.load("cnnnet.pth", map_location=device, weights_only=False)

model = CNNnet()

model.load_state_dict(checkpoint["model_state_dict"])
model.to(device)
model.eval()
```

[22]:
```
CNNnet(
  (conv1_1): Conv2d(2, 32, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (bn1_1): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
```

```
  (conv1_2): Conv2d(32, 32, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (bn1_2): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
  (conv2_1): Conv2d(32, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (bn2_1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
  (conv2_2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (bn2_2): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
  (conv3_1): Conv2d(64, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (bn3_1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
  (conv3_2): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (bn3_2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
  (fc1): Linear(in_features=8192, out_features=512, bias=True)
  (bn4): BatchNorm1d(512, eps=1e-05, momentum=0.1, affine=True,
track_running_stats=True)
  (dropout): Dropout(p=0.3, inplace=False)
  (fc2): Linear(in_features=512, out_features=5, bias=True)
)
```

[23]:
```
test_dataset = pickle.load(open('ift-3395-6390-kaggle-2-competition-fall-2025/
 ↪test_data.pkl', 'rb'))
test_images = test_dataset['images']


test_transform = transforms.Compose([

    transforms.Resize((64, 64)),
    transforms.ToTensor(),
    transforms.Lambda(remove_green_channel),

    transforms.Normalize(mean= [0.21396616101264954, 0.23241323232650757] ,␣
 ↪std=[0.19199922680854797, 0.17090746760368347])
])
```

[24]:
```
class TestPKLDataset(Dataset):
    def __init__(self, images, transform=None):
        self.images = images
        self.transform = transform


    def __len__(self):
        return len(self.images)

    def __getitem__(self, idx):
```

```
        image = self.images[idx]

        image = Image.fromarray(image.astype('uint8'))

        if self.transform:
            image = self.transform(image)
        return image
```

[25]:
```
test_ds = TestPKLDataset(test_images, transform=test_transform)
test_loader = DataLoader(test_ds, batch_size=64, shuffle=False, pin_memory=True)
preds = []

with torch.no_grad():
    for images in test_loader:
        images = images.to(device)
        outputs = model(images)
        _, predicted = torch.max(outputs, 1)
        preds.extend(predicted.cpu().numpy())

df = pd.DataFrame({

    "ID": np.arange(1, len(preds) + 1),
    "Label": preds
})

df.to_csv("IFT3395_YAPS_MCSV53.csv", index=False)
```

```
/Users/yamira.poldosilva/Documents/UDEM/A25/IFT3395/kaggle2/kaggle2/lib/python3.
13/site-packages/torch/utils/data/dataloader.py:692: UserWarning: 'pin_memory'
argument is set as true but not supported on MPS now, device pinned memory won't
be used.
  warnings.warn(warn_msg)
```