

```

1 حذف جميع البيانات المرتبطة لتسهيل عملية الربط من جديد #
2
3 %reset -sf
4
5

```

```

1 ربط كولا ب ب الريدف #
2 from google.colab import drive
3 drive.mount('/content/drive')

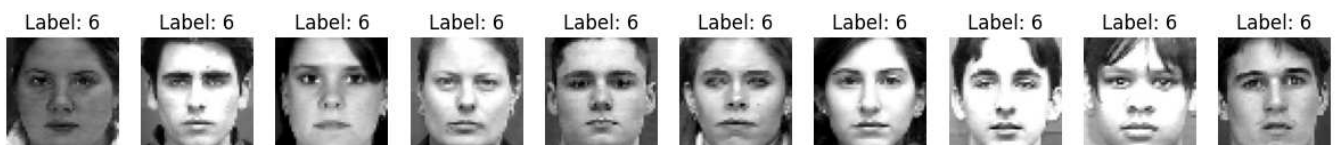
```

Mounted at /content/drive

```

1 استيراد الحزم الأساسية #
2 import pandas as pd
3 import numpy as np
4 import matplotlib.pyplot as plt
5
6 # تحميل ملفات CSV
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
8
9 دالة تحسين جودة الصورة (تباين + تنعيم + حدة + تكبير) #
10 df_ck = pd.read_csv(csv_path)
11
12 دالة لعرض عينات الصور بعد تحسينها #
13 def display_ck_images(df, num_samples=5):
14     plt.figure(figsize=(15,5))
15     for i in range(num_samples):
16         pixel_values = [int(p) for p in df.iloc[i]['pixels'].split()]
17         image = np.array(pixel_values).reshape(48, 48)
18         label = df.iloc[i]['emotion']
19 # رسم الصورة
20     plt.subplot(1, num_samples, i+1)
21     plt.imshow(image, cmap='gray')
22     plt.title(f'Label: {label}')
23     plt.axis('off')
24     plt.show()
25 # استدعاء الدالة لعرض أول 5 صور بعد تحسينها
26 display_ck_images(df_ck, num_samples=10)
27

```



```
1 # استدعاء الدالة لعرض أول 5 صور بعد تحسينها
2 import cv2
3
4 # Grayscale و RGB إلى صورة CSV تحويل أول صورة في
5 pixel_values = [int(p) for p in df_ck.iloc[0]['pixels'].split()]
6 image_48 = np.array(pixel_values, dtype='uint8').reshape(48, 48)
7
8 # RGB تحويل إلى 3 قنوات لتصبح
9 image_rgb = cv2.cvtColor(image_48, cv2.COLOR_GRAY2RGB)
10
11 # 128 إلى الحجم إعادةx128
12 image_rgb_resized = cv2.resize(image_rgb, (128,128))
13 image_gray = cv2.cvtColor(image_rgb_resized, cv2.COLOR_RGB2GRAY)
14
15 # تجهيز الشكل لعرض صورتين جنباً إلى جنب
16
17 plt.subplot(1,2,1)
18 plt.imshow(image_rgb_resized)
19 plt.title("RGB Image Resized")
20 plt.axis("off")
21
22 plt.subplot(1,2,2)
23 plt.imshow(image_gray, cmap='gray')
24 plt.title("Grayscale Image")
25 plt.axis("off")
26 # عرض الشكل النهائي بالصور
27
28 plt.show()
29 # طباعة أبعاد الصورة الملونة بعد التصغير
30
31 print(f"Dimensions of RGB Image: {image_rgb_resized.shape}")
32
```



RGB Image Resized



Grayscale Image



Dimensions of RGB Image: (128, 128, 3)

```

1 import pandas as pd
2 import numpy as np
3 import matplotlib.pyplot as plt
4 import cv2
5
6 # تحميل ملف CSV
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
8 df_ck = pd.read_csv(csv_path)
9
10 # تحسين الصورة (تباين وحدة) مع التأكد من القناة الواحدة والنوع
11 def enhance_image(image):
12     # وقناة واحدة uint8 تأكيد التحويل إلى
13     if len(image.shape) == 3:
14         image = cv2.cvtColor(image, cv2.COLOR_RGB2GRAY)
15     image = image.astype('uint8')
16
17     image_enhanced = cv2.equalizeHist(image)
18     gaussian = cv2.GaussianBlur(image_enhanced, (9,9), 10.0)
19     image_sharp = cv2.addWeighted(image_enhanced, 1.5, gaussian, -0.5, 0)
20     return image_sharp
21
22 # عرض الصور مع اظهار مربعات البكسل
23 def display_ck_images(df, num_samples=5):
24     plt.figure(figsize=(20,5))
25     for i in range(num_samples):
26         pixel_values = [int(p) for p in df.iloc[i]['pixels'].split()]
27         image = np.array(pixel_values).reshape(48, 48).astype('uint8')
28
29         # تحسين الصورة
30         image = enhance_image(image)
31

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32     label = df.iloc[i]['emotion']
33
34     plt.subplot(1, num_samples, i+1)
35     plt.imshow(image, cmap='gray', interpolation='nearest') # البكسل واضح
36     plt.title(f'Label: {label}', fontsize=12)
37     plt.axis('off')
38
39     plt.tight_layout()
40     plt.show()
41
42 # استدعاء الدالة
43 display_ck_images(df_ck, num_samples=5)
44

```



```

1 import pandas as pd
2 import numpy as np
3 import matplotlib.pyplot as plt
4 import cv2
5
6 # تحميل البيانات
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
8 df_ck = pd.read_csv(csv_path)
9
10 # حدة + تكبير + تحسين الصورة: CLAHE +
11 def enhance_image(image):
12     image = image.astype('uint8')
13
14     # تحسين التباين باستخدام CLAHE
15     clahe = cv2.createCLAHE(clipLimit=2.0, tileGridSize=(8,8))
16     image_clahe = clahe.apply(image)
17
18     # تعزيز الحواف: Laplacian filter
19     laplacian = cv2.Laplacian(image_clahe, cv2.CV_8U)
20     enhanced = cv2.addWeighted(image_clahe, 1.5, laplacian, -0.5, 0)
21
22     # تكبير الصورة حتى تظهر التفاصيل
23     enhanced_resized = cv2.resize(enhanced, (192,192), interpolation=cv2.INTER
24

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25     return enhanced_resized
26
27 # عرض الصور مع تفاصيل واضحة ومربعات بكسل كبيرة
28 def display_ck_images(df, num_samples=5):
29     plt.figure(figsize=(20,5))
30     for i in range(num_samples):
31         pixel_values = [int(p) for p in df.iloc[i]['pixels'].split()]
32         image = np.array(pixel_values).reshape(48, 48).astype('uint8')
33
34         # تحسين الصورة وتكبيرها
35         enhanced_image = enhance_image(image)
36         label = df.iloc[i]['emotion']
37
38         plt.subplot(1, num_samples, i+1)
39         plt.imshow(enhanced_image, cmap='gray', interpolation='nearest')
40         plt.title(f'Label: {label}', fontsize=12)
41         plt.axis('off')
42
43     plt.tight_layout()
44     plt.show()
45
46 # عرض الصور المحسنة
47 display_ck_images(df_ck, num_samples=5)
48

```



```

1 import pandas as pd
2 import numpy as np
3 import matplotlib.pyplot as plt
4 import cv2
5
6 # تحميل البيانات
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
8 df_ck = pd.read_csv(csv_path)
9
10 def enhance_image(image):
11     image = image.astype('uint8')
12
13     # تحسين التباين باستخدام CLAHE

```

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14 clahe = cv2.createCLAHE(clipLimit=2.0, tileGridSize=(8,8))
15 image_clahe = clahe.apply(image)
16
17 # تحسين الحدة باستخدام unsharp masking
18 gaussian = cv2.GaussianBlur(image_clahe, (0,0), sigmaX=1.0)
19 image_sharp = cv2.addWeighted(image_clahe, 1.5, gaussian, -0.5, 0)
20
21 return image_sharp
22
23 def display_ck_images(df, num_samples=5):
24     plt.figure(figsize=(20,5))
25     for i in range(num_samples):
26         pixel_values = [int(p) for p in df.iloc[i]['pixels'].split()]
27         image = np.array(pixel_values).reshape(48, 48).astype('uint8')
28
29         # تحسين الصورة
30         enhanced_image = enhance_image(image)
31         label = df.iloc[i]['emotion']
32
33         plt.subplot(1, num_samples, i+1)
34         plt.imshow(enhanced_image, cmap='gray', interpolation='bicubic') #
35         plt.title(f'Label: {label}', fontsize=12)
36         plt.axis('off')
37
38     plt.tight_layout()
39     plt.show()
40
41 # عرض الصور المحسنة بمظهر ناعم
42 display_ck_images(df_ck, num_samples=5)
43

```



```

1 import pandas as pd
2 import numpy as np
3 import matplotlib.pyplot as plt
4 import cv2
5
6 # تحميل البيانات
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'

```

```
8 df_ck = pd.read_csv(csv_path)
9
10 def enhance_image(image):
11     image = image.astype('uint8')
12
13     # تحسين التباين باستخدام CLAHE
14     clahe = cv2.createCLAHE(clipLimit=2.0, tileGridSize=(8,8))
15     image_clahe = clahe.apply(image)
16
17     # لتنعيم الضوضاء مع الحفاظ على الحواف Bilateral فلتير
18     bilateral = cv2.bilateralFilter(image_clahe, d=9, sigmaColor=75, sigmaSp
19
20     # حدة مع Unsharp Mask
21     gaussian = cv2.GaussianBlur(bilateral, (0,0), sigmaX=1.5)
22     image_sharp = cv2.addWeighted(bilateral, 1.7, gaussian, -0.7, 0)
23
24     # بوضوح عالي 256x256 تكبير الصورة إلى 256
25     image_resized = cv2.resize(image_sharp, (256,256), interpolation=cv2.INT
26
27     return image_resized
28
29 def display_ck_images(df, num_samples=5):
30     plt.figure(figsize=(25,5))
31     for i in range(num_samples):
32         pixel_values = [int(p) for p in df.iloc[i]['pixels'].split()]
33         image = np.array(pixel_values).reshape(48, 48).astype('uint8')
34
35         # تحسين الصورة وتكبيرها
36         enhanced_image = enhance_image(image)
37         label = df.iloc[i]['emotion']
38
39         plt.subplot(1, num_samples, i+1)
40         plt.imshow(enhanced_image, cmap='gray')
41         plt.title(f'Label: {label}', fontsize=14)
42         plt.axis('off')
43
44     plt.tight_layout()
45     plt.show()
46
47 # عرض الصور المحسنة بجودة فائقة
48 display_ck_images(df_ck, num_samples=5)
49
50
```



```

1 import os
2 from PIL import Image
3 import matplotlib.pyplot as plt
4 # تحديد مسار مجلد صور قاعدة بيانات JAFFE
5
6 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
7     # صورة num_samples المرور على أول
8
9 def display_jaffe_samples(directory, num_samples=5):
10     images = [f for f in os.listdir(directory) if f.endswith('.tiff')]
11     plt.figure(figsize=(15,5))
12     for i, img_name in enumerate(images[:num_samples]):
13         img_path = os.path.join(directory, img_name)
14         img = Image.open(img_path)
15         plt.subplot(1, num_samples, i+1)
16         plt.imshow(img, cmap='gray')
17         plt.title(img_name)
18         plt.axis('off')
19     plt.show()
20 # استدعاء الدالة لعرض أول 10 صور من قاعدة بيانات JAFFE
21
22 display_jaffe_samples(jaffe_path, num_samples=10)
23

```



```

1 import os
2 from PIL import Image
3 import torch
4 from torch.utils.data import Dataset, DataLoader
5 from torchvision import transforms
6
7 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
8
9 # Index إلى رقم label إنشاء قاموس لتحويل كل

```

```

10 class JaffeDataset(Dataset):
11     def __init__(self, root_dir, transform=None):
12         self.root_dir = root_dir
13         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".")]
14         self.transform = transform
15         self.labels = [self.get_label(f) for f in self.image_files]
16         self.labe
17

```

```

1 import os
2 from PIL import Image
3 import torch
4 from torch.utils.data import Dataset, DataLoader
5 from torchvision import transforms
6
7 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
8 #4. لتحميل الصور والتسميات JaffeDataset تعريف كلاس
9
10 class JaffeDataset(Dataset):
11     def __init__(self, root_dir, transform=None):
12         self.root_dir = root_dir
13         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".")]
14         self.transform = transform
15         self.labels = [self.get_label(f) for f in self.image_files]
16         self.label_map = {label: idx for idx, label in enumerate(sorted(set(
17             self.labels_idx = [self.label_map[label] for label in self.labels]
18
19     def get_label(self, filename):
20         return filename.split('.')[1] # AN, HA, etc.
21
22     def __len__(self):
23         return len(self.image_files)
24
25     def __getitem__(self, idx):
26         img_path = os.path.join(self.root_dir, self.image_files[idx])
27         image = Image.open(img_path).convert('RGB')
28         if self.transform:
29             image = self.transform(image)
30         label = self.labels_idx[idx]
31         return image, label
32
33
34 #4. تطبيق التحويلات على الصور (Preprocessing)
35
36
37 transform = transforms.Compose([

```

```

38     transforms.Resize((128,128)),
39     transforms.ToTensor()
40 ])
41 # تحميل البيانات داخل DataLoader
42
43 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
44 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
45
46
47 1 import pandas as pd
48 2 import numpy as np
49 3
50 4 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
51 5 df_ck = pd.read_csv(csv_path)
52 6
53 7 class CKPlusDataset(Dataset):
54 8     def __init__(self, dataframe, transform=None):
55 9         self.df = dataframe
56 10        self.transform = transform
57 11
58 12    def __len__(self):
59 13        return len(self.df)
60 14
61 15    def __getitem__(self, idx):
62 16        pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
63 17        image = np.array(pixel_values, dtype='uint8').reshape(48, 48)
64 18        image = cv2.cvtColor(image, cv2.COLOR_GRAY2RGB)
65 19        image = cv2.resize(image, (128,128))
66 20        image = Image.fromarray(image)
67 21        label = self.df.iloc[idx]['emotion']
68 22        if self.transform:
69 23            image = self.transform(image)
70 24        return image, label
71 25
72 26 ck_dataset = CKPlusDataset(df_ck, transform=transform)
73 27 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
74 28
75
76 1 from torchvision import models
77 2 import torch.nn as nn
78 3 # تحديد الجهاز المناسب للتدريب (GPU أو CPU):
79 4
80 5
81 6 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
82 7

```

```

8 num_classes_jaffe = len(set(jaffe_dataset.labels))
9 num_classes_ck = df_ck['emotion'].nunique()
10
11 # تعديل الطبقة النهائية لتناسب مع عدد الفئات في MobileNetV2 تحميل:
12
13 model = models.mobilenet_v2(pretrained=False)
14 model.classifier[1] = nn.Linear(model.last_channel, num_classes_jaffe) # ل
15 model = model.to(device)
16
17 # (Optimizer) والمُحسِّن (Loss Function) تعريف دالة الخسارة:
18
19 criterion = nn.CrossEntropyLoss()
20 optimizer = torch.optim.Adam(model.parameters(), lr=0.001)
21

```

```

→ /usr/local/lib/python3.11/dist-packages/torchvision/models/_utils.py:208: UserWarning:
  warnings.warn(
/usr/local/lib/python3.11/dist-packages/torchvision/models/_utils.py:223: UserWarning:
  warnings.warn(msg)

```

```

1 # # (Dropout و BatchNorm) تفعيل وضع التدريب
2
3
4 epochs = 3
5 for epoch in range(epochs):
6     model.train()
7     running_loss, correct = 0.0, 0
8     for inputs, labels in jaffe_loader:
9         inputs, labels = inputs.to(device), labels.to(device)
10        optimizer.zero_grad()
11        outputs = model(inputs)
12        loss = criterion(outputs, labels)
13        loss.backward()
14        optimizer.step()
15        _, preds = torch.max(outputs, 1)
16        correct += torch.sum(preds == labels.data)
17        running_loss += loss.item() * inputs.size(0)
18        # حساب دقة وخسارة العنصر
19    epoch_acc = correct.double() / len(jaffe_dataset)
20    print(f'JAFKE Epoch {epoch+1}: Accuracy={epoch_acc:.4f}, Loss={running_l
21

```

```

→ JAFKE Epoch 1: Accuracy=0.0141, Loss=3.5984
JAFKE Epoch 2: Accuracy=0.0469, Loss=3.3067
JAFKE Epoch 3: Accuracy=0.0704, Loss=3.2142

```

```

1 model.classifier[1] = nn.Linear(model.last_channel, num_classes_ck)
2 model = model.to(device)
3
4 for epoch in range(3):
5     model.train()
6     running_loss, correct = 0.0, 0
7     for inputs, labels in ck_loader:
8         inputs, labels = inputs.to(device), labels.to(device)
9         optimizer.zero_grad()
10        outputs = model(inputs)
11        loss = criterion(outputs, labels)
12        loss.backward()
13        optimizer.step()
14        _, preds = torch.max(outputs, 1)
15        correct += torch.sum(preds == labels.data)
16        running_loss += loss.item() * inputs.size(0)
17
18    epoch_acc = correct.double() / len(ck_dataset)
19    print(f'CK+ Epoch {epoch+1}: Accuracy={epoch_acc:.4f}, Loss={running_loss:.4f}')
20

```

 CK+ Epoch 1: Accuracy=0.5815, Loss=1.5426
 CK+ Epoch 2: Accuracy=0.7011, Loss=1.0489
 CK+ Epoch 3: Accuracy=0.7348, Loss=0.9035

```

1 from google.colab import drive
2 drive.mount('/content/drive')
3
4 import cv2
5 import numpy as np
6 import matplotlib.pyplot as plt
7 from PIL import Image
8

```

 Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount()

```

1 import cv2
2 resized_image = cv2.resize(image, (128, 128), interpolation=cv2.INTER_CUBIC)

```



```
-----  
error                                Traceback (most recent call last)  
/tmp/ipython-input-71-1231681638.py in <cell line: 0>()  
    1 import cv2  
----> 2 resized_image = cv2.resize(image, (128, 128), interpolation=cv2.INTER_CUBIC)  
  
error: OpenCV(4.11.0) /io/opencv/modules/imgproc/src/resize.cpp:4208: error:  
(-215:Assertion failed) !ssize.empty() in function 'resize'
```

1 Start coding or generate with AI.



Resized RGB Image



Double-click (or enter) to edit

```
1 plt.figure(figsize=(10,10), dpi=200) # dpi = dots per inch  
2 plt.imshow(image)  
3 plt.axis('off')  
4 plt.show()  
5
```



```
-----  
NameError                                Traceback (most recent call last)  
/tmp/ipython-input-1-2671325200.py in <cell line: 0>()  
----> 1 plt.figure(figsize=(10,10), dpi=200) # dpi = dots per inch  
      2 plt.imshow(image)  
      3 plt.axis('off')  
      4 plt.show()
```

NameError: name 'plt' is not defined

```
1 gray_image = cv2.imread('/content/drive/MyDrive/Datasets/jaffe/KA.AN1.39.tif')  
2
```

```
1 rgb_image = cv2.cvtColor(gray_image, cv2.COLOR_GRAY2RGB)  
2 resized_rgb = cv2.resize(rgb_image, (128,128), interpolation=cv2.INTER_CUBIC)  
3  
4 plt.imshow(resized_rgb)  
5 plt.title('Resized RGB Image')  
6 plt.axis('off')  
7 plt.show()  
8
```



Resized RGB Image



```
1 import pandas as pd  
2 import numpy as np  
3 import cv2
```

```
4 from PIL import Image
5 from torch.utils.data import Dataset, DataLoader
6 from torchvision import transforms
7 import os
8
9 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
10
11 class CKPlusDataset(Dataset):
12     def __init__(self, dataframe, transform=None):
13         self.df = dataframe
14         self.transform = transform
15
16     def __len__(self):
17         return len(self.df)
18
19     def __getitem__(self, idx):
20         pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
21         image = np.array(pixel_values, dtype='uint8').reshape(48, 48)
22         image = cv2.cvtColor(image, cv2.COLOR_GRAY2RGB)
23         image = cv2.resize(image, (128,128))
24         image = Image.fromarray(image)
25         label = self.df.iloc[idx]['emotion']
26         if self.transform:
27             image = self.transform(image)
28         return image, label
29
30 df_ck = pd.read_csv(csv_path)
31
32 transform = transforms.Compose([
33     transforms.ToTensor()
34 ])
35
36 ck_dataset = CKPlusDataset(df_ck, transform=transform)
37 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
38 num_classes_ck = df_ck['emotion'].nunique()
39
```

```
1 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
2
3 class JaffeDataset(Dataset):
4     def __init__(self, root_dir, transform=None):
5         self.root_dir = root_dir
6         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".
7         self.transform = transform
8         self.labels = [self.get_label(f) for f in self.image_files]
9         self.label_map = {label: idx for idx, label in enumerate(sorted(set(
```

```

10         self.labels_idx = [self.label_map[label] for label in self.labels]
11
12     def get_label(self, filename):
13         return filename.split('.')[1] # AN, HA, etc.
14
15     def __len__(self):
16         return len(self.image_files)
17
18     def __getitem__(self, idx):
19         img_path = os.path.join(self.root_dir, self.image_files[idx])
20         image = Image.open(img_path).convert('RGB')
21         if self.transform:
22             image = self.transform(image)
23         label = self.labels_idx[idx]
24         return image, label
25
26 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
27 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
28 num_classes_jaffe = len(set(jaffe_dataset.labels))
29

```

```

1 import torch
2 import torch.nn as nn
3
4 class SimpleCNN(nn.Module):
5     def __init__(self, num_classes):
6         super(SimpleCNN, self).__init__()
7         self.model = nn.Sequential(
8             nn.Conv2d(3, 32, kernel_size=3, stride=1, padding=1),
9             nn.ReLU(),
10            nn.MaxPool2d(2),
11
12            nn.Conv2d(32, 64, kernel_size=3, stride=1, padding=1),
13            nn.ReLU(),
14            nn.MaxPool2d(2),
15
16            nn.Conv2d(64, 128, kernel_size=3, stride=1, padding=1),
17            nn.ReLU(),
18            nn.MaxPool2d(2),
19
20            nn.Flatten(),
21            nn.Linear(128 * 16 * 16, 128),
22            nn.ReLU(),
23            nn.Dropout(0.5),
24            nn.Linear(128, num_classes)
25        )

```

```
26
27     def forward(self, x):
28         return self.model(x)
29

1 from torchvision import models
2
3 def get_mobilenetv2(num_classes):
4     model = models.mobilenet_v2(pretrained=False)
5     model.classifier[1] = nn.Linear(model.last_channel, num_classes)
6     return model
7

1 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
2
3 model = get_mobilenetv2(num_classes_jaffe)
4 model = model.to(device)
5 optimizer = torch.optim.Adam(model.parameters(), lr=0.001)
6 criterion = nn.CrossEntropyLoss()
7
8 epochs = 5
9 train_losses, train_accs = [], []
10
11 for epoch in range(epochs):
12     model.train()
13     running_loss, correct = 0.0, 0
14     for inputs, labels in jaffe_loader:
15         inputs, labels = inputs.to(device), labels.to(device)
16         optimizer.zero_grad()
17         outputs = model(inputs)
18         loss = criterion(outputs, labels)
19         loss.backward()
20         optimizer.step()
21
22         running_loss += loss.item() * inputs.size(0)
23         _, preds = torch.max(outputs, 1)
24         correct += torch.sum(preds == labels.data)
25
26     epoch_loss = running_loss / len(jaffe_dataset)
27     epoch_acc = correct.double() / len(jaffe_dataset)
28
29     train_losses.append()
30     train_accs.append(epoch_acc.item())
31
```

```
32     print(f"Epoch {epoch+1}/{epochs}: Loss={epoch_loss:.4f}, Accuracy={epoch_
33
```

```

➞ /usr/local/lib/python3.11/dist-packages/torchvision/models/_utils.py:208: UserWarning: 
  warnings.warn(
/usr/local/lib/python3.11/dist-packages/torchvision/models/_utils.py:223: UserWarning: 
  warnings.warn(msg)

```

```

-----
TypeError                                Traceback (most recent call last)
/tmp/ipython-input-67-188733086.py in <cell line: 0>()
    27     epoch_acc = correct.double() / len(jaffe_dataset)
    28
--> 29     train_losses.append()
    30     train_accs.append(epoch_acc.item())
    31

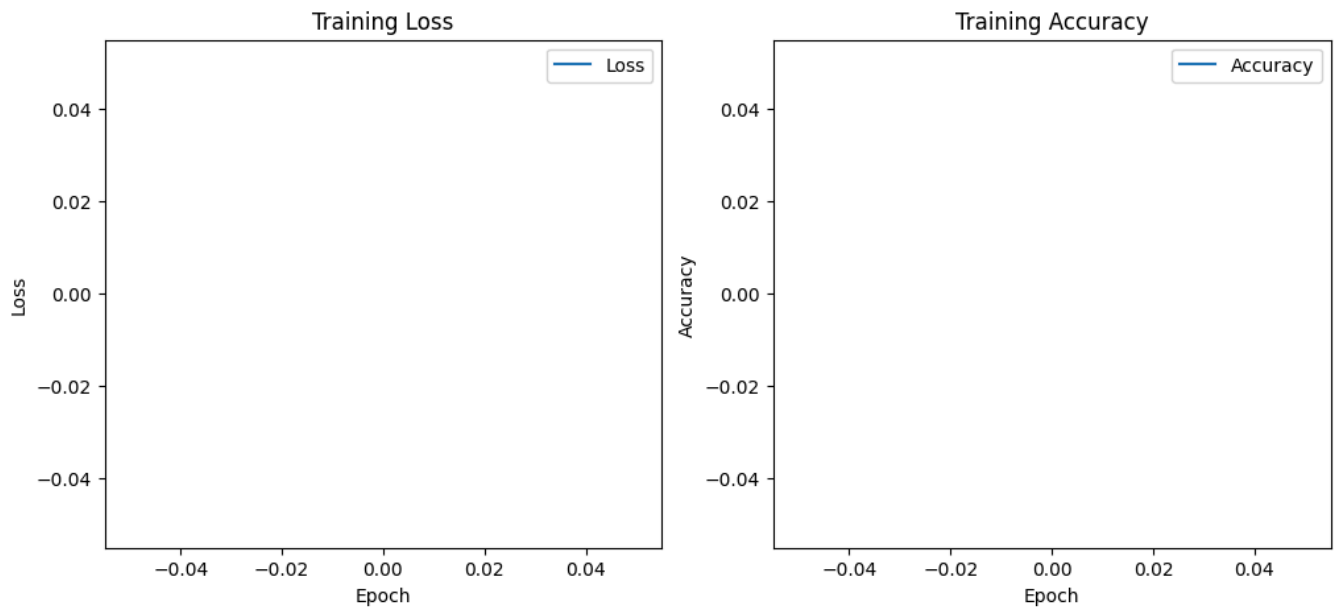
```

TypeError: list.append() takes exactly one argument (0 given)

```

1 import matplotlib.pyplot as plt
2
3 plt.figure(figsize=(12,5))
4
5 plt.subplot(1,2,1)
6 plt.plot(train_losses, label='Loss')
7 plt.title('Training Loss')
8 plt.xlabel('Epoch')
9 plt.ylabel('Loss')
10 plt.legend()
11
12 plt.subplot(1,2,2)
13 plt.plot(train_accs, label='Accuracy')
14 plt.title('Training Accuracy')
15 plt.xlabel('Epoch')
16 plt.ylabel('Accuracy')
17 plt.legend()
18
19 plt.show()
20

```



```

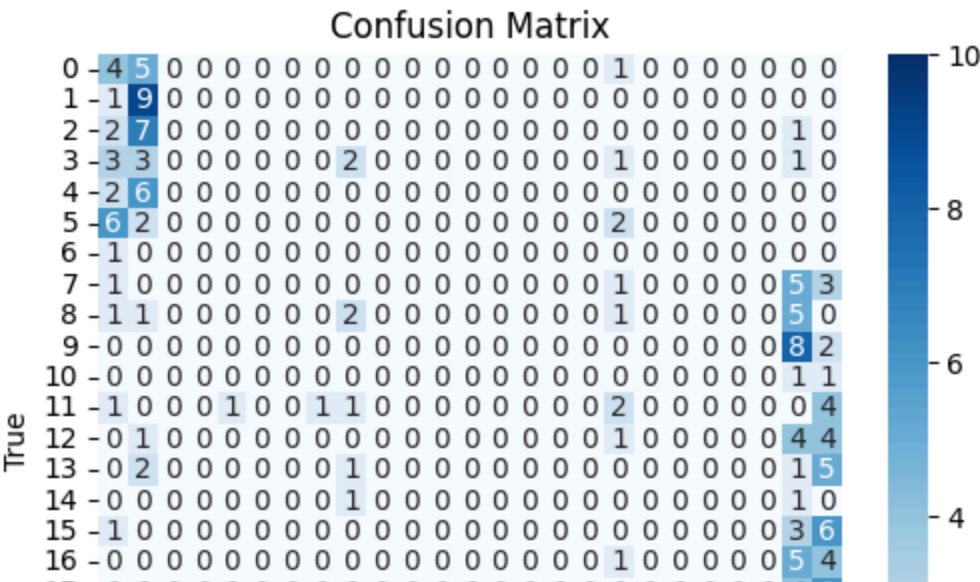
1 from sklearn.metrics import confusion_matrix, classification_report
2 import seaborn as sns
3
4 y_true = []
5 y_pred = []
6
7 model.eval()
8 with torch.no_grad():
9     for inputs, labels in jaffe_loader:
10         inputs = inputs.to(device)
11         outputs = model(inputs)
12         _, preds = torch.max(outputs, 1)
13         y_true.extend(labels.numpy())
14         y_pred.extend(preds.cpu().numpy())
15
16 cm = confusion_matrix(y_true, y_pred)
17 print("Classification Report:\n", classification_report(y_true, y_pred))
18
19 plt.figure(figsize=(6,5))
20 sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
21 plt.title('Confusion Matrix')
22 plt.xlabel('Predicted')
23 plt.ylabel('True')
24 plt.show()
25

```

```
➡ /usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedWarning:
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedWarning:
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedWarning:
  _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
```

Classification Report:

	precision	recall	f1-score	support
0	0.14	0.40	0.21	10
1	0.25	0.90	0.39	10
2	0.00	0.00	0.00	10
3	0.00	0.00	0.00	10
4	0.00	0.00	0.00	8
5	0.00	0.00	0.00	10
6	0.00	0.00	0.00	1
7	0.00	0.00	0.00	10
8	0.29	0.20	0.24	10
9	0.00	0.00	0.00	10
10	0.00	0.00	0.00	2
11	0.00	0.00	0.00	10
12	0.00	0.00	0.00	10
13	0.00	0.00	0.00	9
14	0.00	0.00	0.00	2
15	0.00	0.00	0.00	10
16	0.00	0.00	0.00	10
17	0.00	0.00	0.00	10
18	0.00	0.00	0.00	10
19	0.00	0.00	0.00	10
20	0.00	0.00	0.00	10
21	0.00	0.00	0.00	1
22	0.00	0.00	0.00	10
23	0.14	1.00	0.24	10
24	0.04	0.20	0.07	10
accuracy			0.13	213
macro avg	0.03	0.11	0.05	213
weighted avg	0.04	0.13	0.05	213



```

17 -0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 4 6
18 -2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 4 0 1 0 0 0 2 1

```

```

1 import os
2 import numpy as np
3 import torch
4 from torch.utils.data import Dataset, DataLoader
5 from torchvision import datasets, transforms as T, models
6 from torch import nn, optim
7 import warnings
8 warnings.filterwarnings("ignore")
9 from tqdm import tqdm
10 from sklearn.metrics import confusion_matrix, accuracy_score, precision_score
11 import matplotlib.pyplot as plt
12 import seaborn as sns
13 from PIL import Image
14 import cv2
15 import pandas as pd
16

```

```

1 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
2
3 class JaffeDataset(Dataset):
4     def __init__(self, root_dir, transform=None):
5         self.root_dir = root_dir
6         self.image_files = [f for f in os.listdir(root_dir) if f.endswith('.')]
7         self.transform = transform
8         self.labels = [self.get_label(f) for f in self.image_files]
9         self.label_map = {label: idx for idx, label in enumerate(sorted(set(
10             self.labels_idx = [self.label_map[label] for label in self.labels]
11
12     def get_label(self, filename):
13         return filename.split('.')[1] # AN, HA, etc.
14
15     def __len__(self):
16         return len(self.image_files)
17
18     def __getitem__(self, idx):
19         img_path = os.path.join(self.root_dir, self.image_files[idx])
20         image = Image.open(img_path).convert('RGB')
21         if self.transform:
22             image = self.transform(image)
23         label = self.labels_idx[idx]
24         return image, label
25
26 transform = T.Compose([
27     T.RandomHorizontalFlip(),

```

```

28     T.RandomVerticalFlip(),
29     T.RandomRotation(10),
30     T.Resize((128,128)),
31     T.ToTensor()
32 ])
33
34 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
35 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
36 num_classes_jaffe = len(set(jaffe_dataset.labels))
37

```

```

1 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
2
3 class JaffeDataset(Dataset):
4     def __init__(self, root_dir, transform=None):
5         self.root_dir = root_dir
6         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".
7         self.transform = transform
8         self.labels = [self.get_label(f) for f in self.image_files]
9         self.label_map = {label: idx for idx, label in enumerate(sorted(set(
10        self.labels_idx = [self.label_map[label] for label in self.labels]
11
12    def get_label(self, filename):
13        return filename.split('.')[1] # AN, HA, etc.
14
15    def __len__(self):
16        return len(self.image_files)
17
18    def __getitem__(self, idx):
19        img_path = os.path.join(self.root_dir, self.image_files[idx])
20        image = Image.open(img_path).convert('RGB')
21        if self.transform:
22            image = self.transform(image)
23        label = self.labels_idx[idx]
24        return image, label
25
26 transform = T.Compose([
27     T.RandomHorizontalFlip(),
28     T.RandomVerticalFlip(),
29     T.RandomRotation(10),
30     T.Resize((128,128)),
31     T.ToTensor()
32 ])
33
34 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
35 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)

```

```
36 num_classes_jaffe = len(set(jaffe_dataset.labels))
37

1 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
2
3 model = models.resnet18(pretrained=False)
4 model.fc = nn.Linear(model.fc.in_features, num_classes_jaffe)
5 model = model.to(device)
6
7 criterion = nn.CrossEntropyLoss()
8 optimizer = optim.AdamW(model.parameters(), lr=0.001)
9 scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
10

1 def train_model(model, criterion, optimizer, scheduler, num_epochs=2):
2     for epoch in range(num_epochs):
3         print(f"Epoch {epoch+1}/{num_epochs}")
4         print('-' * 10)
5
6         model.train()
7         running_loss = 0.0
8         running_corrects = 0
9
10        for inputs, labels in jaffe_loader:
11            inputs, labels = inputs.to(device), labels.to(device)
12
13            optimizer.zero_grad()
14            outputs = model(inputs)
15            loss = criterion(outputs, labels)
16            loss.backward()
17            optimizer.step()
18
19            _, preds = torch.max(outputs, 1)
20            running_loss += loss.item() * inputs.size(0)
21            running_corrects += torch.sum(preds == labels.data)
22
23        scheduler.step()
24        epoch_loss = running_loss / len(jaffe_dataset)
25        epoch_acc = running_corrects.double() / len(jaffe_dataset)
26
27        print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
28    return model
29
30 model = train_model(model, criterion, optimizer, scheduler, num_epochs=2)
31
```



Epoch 1/2

Loss: 3.5536 Acc: 0.0282

Epoch 2/2

Loss: 3.4113 Acc: 0.0235

```

1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():
5     for inputs, labels in jaffe_loader:
6         inputs = inputs.to(device)
7         outputs = model(inputs)
8         probabilities = torch.softmax(outputs, dim=1)
9         preds = torch.argmax(probabilities, axis=1)
10
11     y_true.extend(labels.numpy())
12     y_pred.extend(preds.cpu().numpy())
13     y_proba.extend(probabilities.cpu().numpy())
14
15 y_true = np.array(y_true)
16 y_pred = np.array(y_pred)
17 y_proba = np.array(y_proba)
18
19
20 #
21
22 def evaluate_model(model_name, y_true, y_pred, y_proba):
23     labels = list(jaffe_dataset.label_map.keys())
24     accuracy = accuracy_score(y_true, y_pred)
25     precision = precision_score(y_true, y_pred, average='weighted', zero_div
26     recall = recall_score(y_true, y_pred, average='weighted')
27     f1 = f1_score(y_true, y_pred, average='weighted')
28     cm = confusion_matrix(y_true, y_pred)
29
30     print(f"[{model_name}] Accuracy: {accuracy:.4f}")
31     print("Precision:", precision)
32     print("Recall:", recall)
33     print("F1-score:", f1)
34     print("Classification Report:\n", classification_report(y_true, y_pred,
35
36
37     plt.figure(figsize=(6,5))
38     sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=labels, y
39     plt.title('Confusion Matrix')
40     plt.show()

```

21

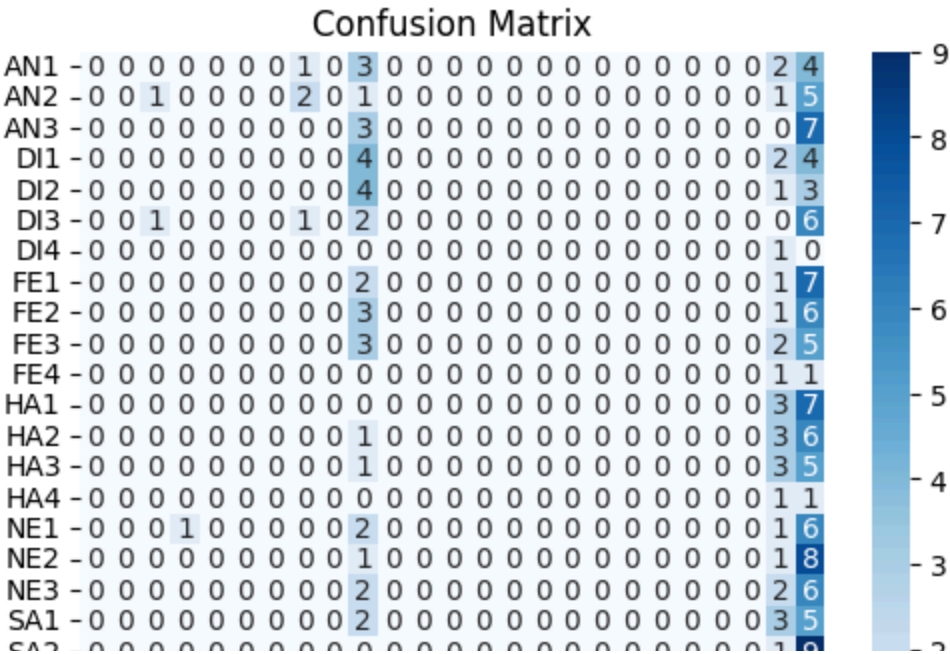
22 `evaluate_model("ResNet18 on JAFFE", y_true, y_pred, y_proba)`

23



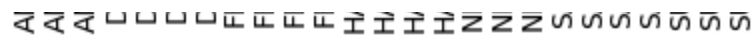
[ResNet18 on JAFFE] Accuracy: 0.0563
Precision: 0.009428280207561158
Recall: 0.056338028169014086
F1-score: 0.015584813227189222
Classification Report:

	precision	recall	f1-score	support
AN1	0.00	0.00	0.00	10
AN2	0.00	0.00	0.00	10
AN3	0.00	0.00	0.00	10
DI1	0.00	0.00	0.00	10
DI2	0.00	0.00	0.00	8
DI3	0.00	0.00	0.00	10
DI4	0.00	0.00	0.00	1
FE1	0.00	0.00	0.00	10
FE2	0.00	0.00	0.00	10
FE3	0.08	0.30	0.12	10
FE4	0.00	0.00	0.00	2
HA1	0.00	0.00	0.00	10
HA2	0.00	0.00	0.00	10
HA3	0.00	0.00	0.00	9
HA4	0.00	0.00	0.00	2
NE1	0.00	0.00	0.00	10
NE2	0.00	0.00	0.00	10
NE3	0.00	0.00	0.00	10
SA1	0.00	0.00	0.00	10
SA2	0.00	0.00	0.00	10
SA3	0.00	0.00	0.00	10
SA5	0.00	0.00	0.00	1
SU1	0.00	0.00	0.00	10
SU2	0.07	0.30	0.12	10
SU3	0.05	0.60	0.09	10
accuracy			0.06	213
macro avg	0.01	0.05	0.01	213
weighted avg	0.01	0.06	0.02	213





```
1 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
2 df_ck = pd.read_csv(csv_path)
3
```



```

1 # تعريف CKPlusDataset الذي يرث من torch.utils.data.Dataset
2 # إلى شكل يمكن التعامل معه بالتدريب DataFrame المخزنة في CK+ هذا الكلاس مخصص لتحويل بيانات
3
4 class CKPlusDataset(Dataset):
5     def __init__(self, dataframe, transform=None):
6         self.df = dataframe
7         self.transform = transform
8         # عدد العينات في البيانات، أي عدد الصفوف في DataFrame
9
10    def __len__(self):
11        return len(self.df)
12        # تحويل القائمة إلى مصفوفة NumPy 48x48 بشكل صورة رمادية
13        # وتحويلها إلى تدرج رمادي PIL إلى كائن صورة NumPy تحويل الصورة من
14        # (augmentations + Resize + ToTensor) تطبيق التحويلات
15
16    def __getitem__(self, idx):
17        pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
18        image = np.array(pixel_values, dtype='uint8').reshape(48, 48)
19        image = cv2.cvtColor(image, cv2.COLOR_GRAY2RGB)
20        image = cv2.resize(image, (128,128))
21        image = Image.fromarray(image)
22        label = self.df.iloc[idx]['emotion']
23        if self.transform:
24            image = self.transform(image)
25        return image, label-
26
27 # تعريف مجموعة التحويلات التي سنطبق على صور CK+
28
29 transform = T.Compose([
30     T.RandomHorizontalFlip(),
31     T.RandomVerticalFlip(),
32     T.RandomRotation(10),
33     T.Resize((128,128)),
34     T.ToTensor()
35 ])
36
37 ck_dataset = CKPlusDataset(df_ck, transform=transform)
38 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
39 num_classes_ck = df_ck['emotion'].nunique()
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```

6 optimizer = optim.AdamW(model.parameters(), lr=0.001)
7 scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
8
1 epochs = 2
2 for epoch in range(epochs):
3     print(f"\nEpoch {epoch+1}/{epochs}")
4     model.train()
5     running_loss, correct = 0.0, 0
6
7     for inputs, labels in ck_loader:
8         inputs, labels = inputs.to(device), labels.to(device)
9         optimizer.zero_grad()
10        outputs = model(inputs)
11        loss = criterion(outputs, labels)
12        loss.backward()
13        optimizer.step()
14
15        _, preds = torch.max(outputs, 1)
16        correct += torch.sum(preds == labels.data)
17        running_loss += loss.item() * inputs.size(0)
18
19    epoch_loss = running_loss / len(ck_dataset)
20    epoch_acc = correct.double() / len(ck_dataset)
21    print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
22

```



Epoch 1/2
Loss: 1.4377 Acc: 0.6152

Epoch 2/2
Loss: 1.1417 Acc: 0.6815

```

1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():
5     for inputs, labels in ck_loader:
6         inputs = inputs.to(device)
7         outputs = model(inputs)
8         probabilities = torch.softmax(outputs, dim=1)
9         preds = torch.argmax(probabilities, axis=1)
10
11    y_true.extend(labels.numpy())
12    y_pred.extend(preds.cpu().numpy())

```

```
13         y_proba.extend(probabilities.cpu().numpy())
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[ResNet18 on CK+] Accuracy: 0.6098

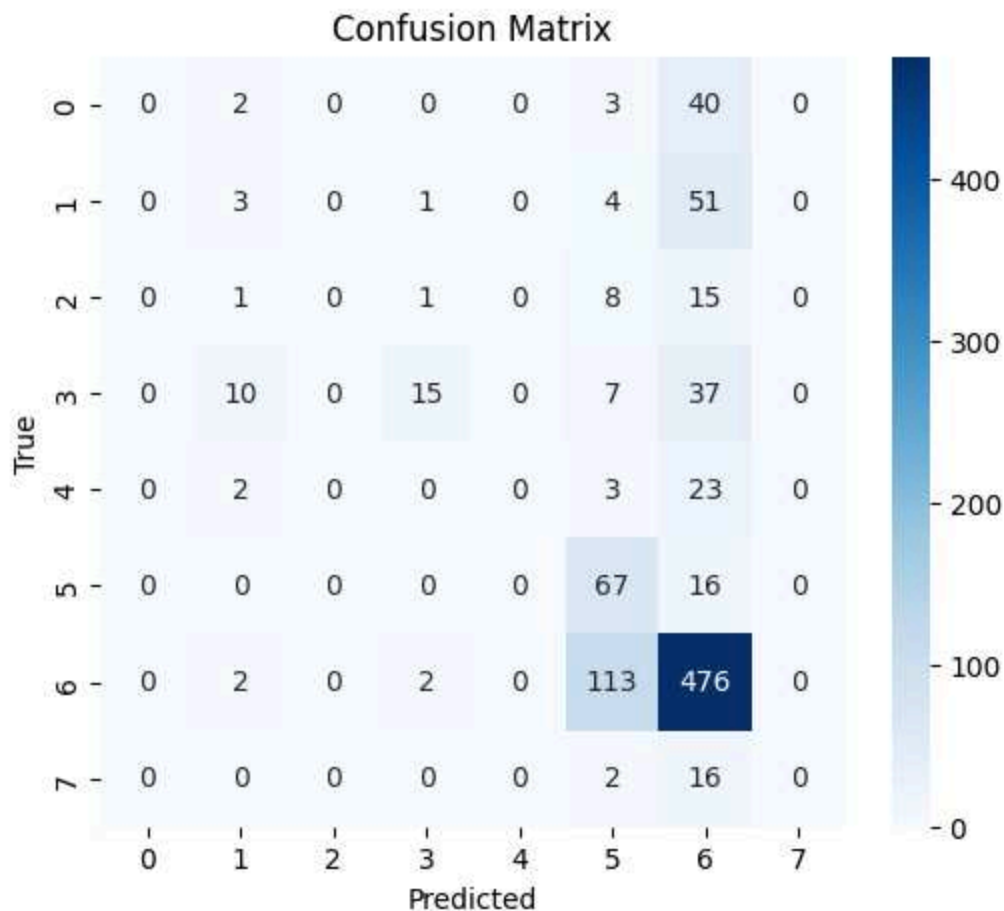
Precision: 0.5532431203647419

Recall: 0.6097826086956522

F1-score: 0.5564397009156161

Classification Report:

	precision	recall	f1-score	support
0	0.00	0.00	0.00	45
1	0.15	0.05	0.08	59
2	0.00	0.00	0.00	25
3	0.79	0.22	0.34	69
4	0.00	0.00	0.00	28
5	0.32	0.81	0.46	83
6	0.71	0.80	0.75	593
7	0.00	0.00	0.00	18
accuracy			0.61	920
macro avg	0.25	0.23	0.20	920
weighted avg	0.55	0.61	0.56	920



```

1 model = models.mobilenet_v2(pretrained=False)
2 model.classifier[1] = nn.Linear(model.last_channel, num_classes_ck)
3 model = model.to(device)
4
5 criterion = nn.CrossEntropyLoss()

```

```

6 optimizer = optim.AdamW(model.parameters(), lr=0.001)
7 scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
8

1 epochs = 2
2 for epoch in range(epochs):
3     print(f"\nEpoch {epoch+1}/{epochs}")
4     model.train()
5     running_loss, correct = 0.0, 0
6
7     for inputs, labels in ck_loader:
8         inputs, labels = inputs.to(device), labels.to(device)
9         optimizer.zero_grad()
10        outputs = model(inputs)
11        loss = criterion(outputs, labels)
12        loss.backward()
13        optimizer.step()
14
15        _, preds = torch.max(outputs, 1)
16        correct += torch.sum(preds == labels.data)
17        running_loss += loss.item() * inputs.size(0)
18
19    epoch_loss = running_loss / len(ck_dataset)
20    epoch_acc = correct.double() / len(ck_dataset)
21    print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
22

```



```

Epoch 1/2
Loss: 1.4453 Acc: 0.6250

```

```

Epoch 2/2
Loss: 1.4050 Acc: 0.6326

```

```

1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():
5     for inputs, labels in ck_loader:
6         inputs = inputs.to(device)
7         outputs = model(inputs)
8         probabilities = torch.softmax(outputs, dim=1)
9         preds = torch.argmax(probabilities, axis=1)
10
11    y_true.extend(labels.numpy())
12    y_pred.extend(preds.cpu().numpy())

```

```

13     y_proba.extend(probabilities.cpu().numpy())
14

```

```

1 evaluate_model("MobileNetV2 on CK+", y_true, y_pred, y_proba)
2

```

➞ [MobileNetV2 on CK+] Accuracy: 0.6424

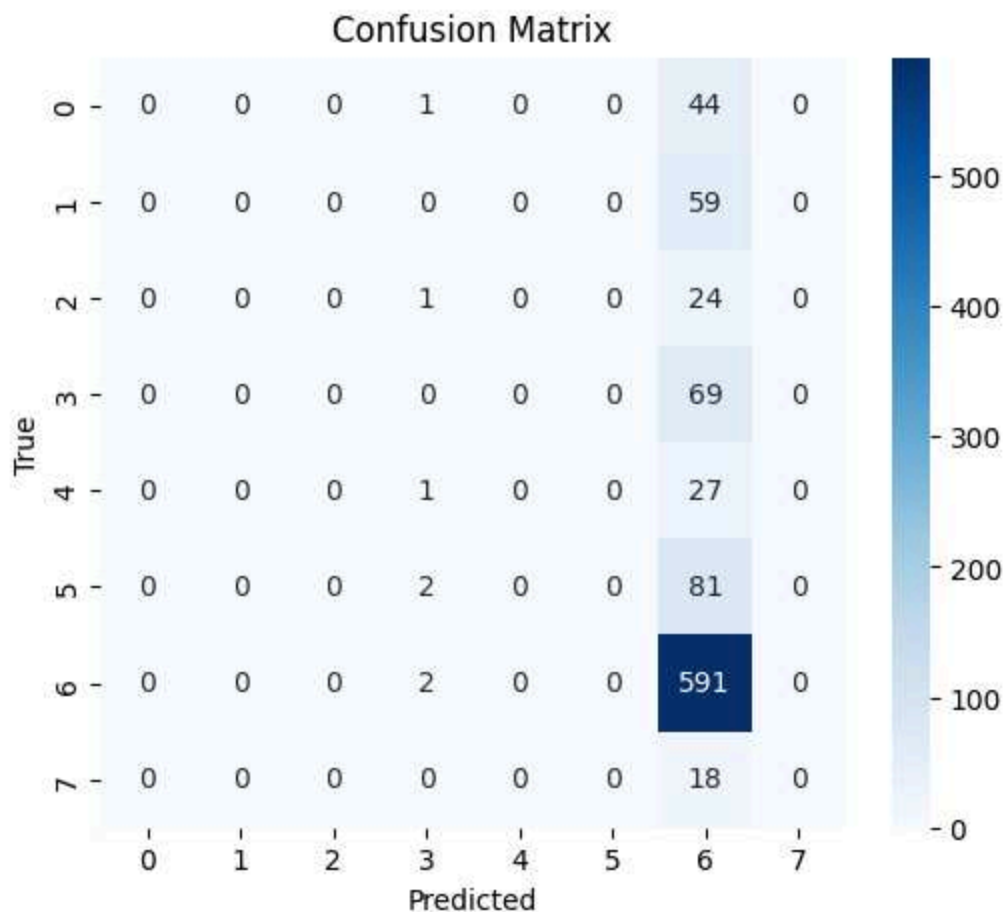
Precision: 0.4172377256059812

Recall: 0.6423913043478261

F1-score: 0.505893816040187

Classification Report:

	precision	recall	f1-score	support
0	0.00	0.00	0.00	45
1	0.00	0.00	0.00	59
2	0.00	0.00	0.00	25
3	0.00	0.00	0.00	69
4	0.00	0.00	0.00	28
5	0.00	0.00	0.00	83
6	0.65	1.00	0.78	593
7	0.00	0.00	0.00	18
accuracy			0.64	920
macro avg	0.08	0.12	0.10	920
weighted avg	0.42	0.64	0.51	920



```

1 import pandas as pd
2 import numpy as np
3 import torch
4 from torch.utils.data import Dataset, DataLoader
5 from torchvision import transforms, models
6 from PIL import Image
7 import cv2
8
9 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
10 df_ck = pd.read_csv(csv_path)
11
12 # التأكد من الفئات وعددها
13 print("الفئات المتوفرة:", df_ck['emotion'].unique())
14 num_classes_ck = df_ck['emotion'].nunique()
15 print("عدد الفئات:", num_classes_ck)
16
17 # تصحيح: إزالة أي فئة خارج النطاق إذا وجدت
18 df_ck = df_ck[df_ck['emotion'] < num_classes_ck].reset_index(drop=True)
19

```

↩ [5 2 4 1 0 7 3 6] الفئات المتوفرة:
عدد الفئات: 8

```

1 class CKPlusDataset(Dataset):
2     def __init__(self, dataframe, transform=None):
3         self.df = dataframe
4         self.transform = transform
5
6     def __len__(self):
7         return len(self.df)
8
9     def __getitem__(self, idx):
10        pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
11        image = np.array(pixel_values, dtype='uint8').reshape(48, 48)
12        image = cv2.cvtColor(image, cv2.COLOR_GRAY2RGB)
13        image = cv2.resize(image, (128,128))
14        image = Image.fromarray(image)
15        label = self.df.iloc[idx]['emotion']
16        if self.transform:
17            image = self.transform(image)
18        return image, label
19
20 transform = transforms.Compose([
21     transforms.RandomHorizontalFlip(),
22     transforms.RandomVerticalFlip(),
23     transforms.RandomRotation(10),

```

```

24     transforms.Resize((128,128)),
25     transforms.ToTensor()
26 ])
27
28 ck_dataset = CKPlusDataset(df_ck, transform=transform)
29 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
30
31
32 1 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
33 2
34 3 model = models.efficientnet_b0(pretrained=False)
35 4 model.classifier[1] = torch.nn.Linear(model.classifier[1].in_features, num_c
36 5 model = model.to(device)
37 6
38 7 criterion = torch.nn.CrossEntropyLoss()
39 8 optimizer = torch.optim.AdamW(model.parameters(), lr=0.001)
40 9 scheduler = torch.optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.'
41 10
42
43 1 def train_model(model, criterion, optimizer, scheduler, num_epochs=2):
44 2     for epoch in range(num_epochs):
45 3         print(f"\nEpoch {epoch+1}/{num_epochs}")
46 4         model.train()
47 5         running_loss, correct = 0.0, 0
48 6
49 7         for inputs, labels in ck_loader:
50 8             inputs, labels = inputs.to(device), labels.to(device)
51 9
52 10            optimizer.zero_grad()
53 11            outputs = model(inputs)
54 12            loss = criterion(outputs, labels)
55 13            loss.backward()
56 14            optimizer.step()
57 15
58 16            _, preds = torch.max(outputs, 1)
59 17            correct += torch.sum(preds == labels.data)
60 18            running_loss += loss.item() * inputs.size(0)
61 19
62 20            scheduler.step()
63 21            epoch_loss = running_loss / len(ck_dataset)
64 22            epoch_acc = correct.double() / len(ck_dataset)
65 23            print(f"Loss: {epoch_loss:.4f}, Accuracy: {epoch_acc:.4f}")
66 24     return model
67 25

```

```
1 model = train_model(model, criterion, optimizer, scheduler, num_epochs=2)
2
```



```
Epoch 1/2
Loss: 1.5492, Accuracy: 0.6033
```

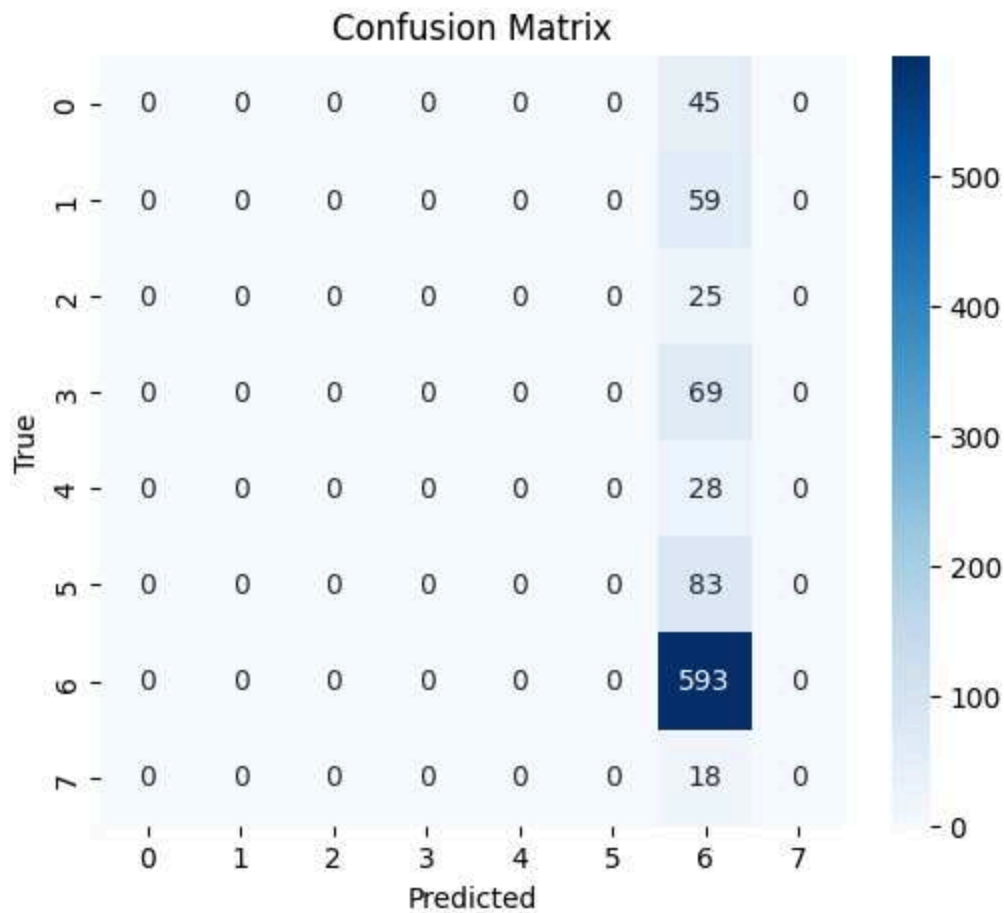
```
Epoch 2/2
Loss: 1.3721, Accuracy: 0.6391
```

```
1 from sklearn.metrics import accuracy_score, precision_score, recall_score, f
2 import seaborn as sns
3 import matplotlib.pyplot as plt
4
5 y_true, y_pred = [], []
6
7 model.eval()
8 with torch.no_grad():
9     for inputs, labels in ck_loader:
10         inputs = inputs.to(device)
11         outputs = model(inputs)
12         _, preds = torch.max(outputs, 1)
13
14         y_true.extend(labels.numpy())
15         y_pred.extend(preds.cpu().numpy())
16
17 cm = confusion_matrix(y_true, y_pred)
18 print("Classification Report:\n", classification_report(y_true, y_pred))
19
20 plt.figure(figsize=(6,5))
21 sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
22 plt.title('Confusion Matrix')
23 plt.xlabel('Predicted')
24 plt.ylabel('True')
25 plt.show()
26
```



Classification Report:

	precision	recall	f1-score	support
0	0.00	0.00	0.00	45
1	0.00	0.00	0.00	59
2	0.00	0.00	0.00	25
3	0.00	0.00	0.00	69
4	0.00	0.00	0.00	28
5	0.00	0.00	0.00	83
6	0.64	1.00	0.78	593
7	0.00	0.00	0.00	18
accuracy			0.64	920
macro avg	0.08	0.12	0.10	920
weighted avg	0.42	0.64	0.51	920



```

1 model = models.densenet121(pretrained=False)
2 model.classifier = nn.Linear(model.classifier.in_features, num_classes_ck)
3 model = model.to(device)
4
5 optimizer = optim.AdamW(model.parameters(), lr=0.001)
6 model = train_model(model, criterion, optimizer, exp_lr_scheduler, num_epoch
7

```



Epoch 1/1
Loss: 1.4313, Accuracy: 0.6315

```

1 model = models.vgg16(pretrained=False)
2 model.classifier[6] = nn.Linear(model.classifier[6].in_features, num_classes)
3 model = model.to(device)
4
5 optimizer = optim.AdamW(model.parameters(), lr=0.001)
6 model = train_model(model, criterion, optimizer, exp_lr_scheduler, num_epoch
7

```



Epoch 1/1
Loss: 2.7828, Accuracy: 0.6402

```

1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():
5     for inputs, labels in ck_loader:
6         inputs = inputs.to(device)
7         outputs = model(inputs)
8         probabilities = torch.softmax(outputs, dim=1)
9         preds = torch.argmax(probabilities, axis=1)
10
11     y_true.extend(labels.numpy())
12     y_pred.extend(preds.cpu().numpy())
13     y_proba.extend(probabilities.cpu().numpy())
14
15 y_true = np.array(y_true)
16 y_pred = np.array(y_pred)
17 y_proba = np.array(y_proba)
18
19 evaluate_model("اسم الموديل", y_true, y_pred, y_proba)
20

```



[اسم الموديل] Accuracy: 0.0196
Precision: 0.0029644095683425842
Recall: 0.01956521739130435