

```

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

```

```

1 ربط كولا ب ب الرديف#
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=5)
27

```



```

1 استدعاء الدالة لعرض أول 5 صور بعد تحسينها #
2 import cv2
3
4 # تحويل CSV إلى صورة RGB و Grayscale
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 # تحويل إلى 3 قنوات لتصبح RGB
9 image_rgb = cv2.cvtColor(image_48, cv2.COLOR_GRAY2RGB)
10
11 # إعادة الحجم إلى 128x128
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 بالصورة
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
32         label = df.iloc[i]['emotion']
33
34         plt.subplot(1, num_samples, i+1)
35         plt.imshow(image, cmap='gray', interpolation='nearest') # اظهار 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

```



```

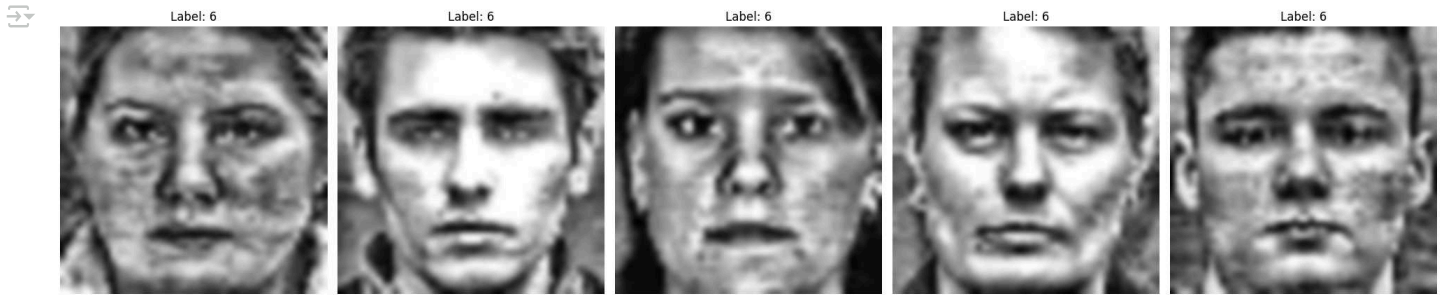
1 import pandas as pd
2 import numpy as np
3 import matplotlib.pyplot as plt
4 import cv2
5
6 # تحميل البيانات
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
8 df_ck = pd.read_csv(csv_path)
9
10 # تحسين الصورة: CLAHE + تكبير + حدة
11 def enhance_image(image):
12     image = image.astype('uint8')
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_NEAREST)
24
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
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') # عرض ناعم وطبيعي
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 فلتر
18     bilateral = cv2.bilateralFilter(image_clahe, d=9, sigmaColor=75, sigmaSpace=75)
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.INTER_CUBIC)
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

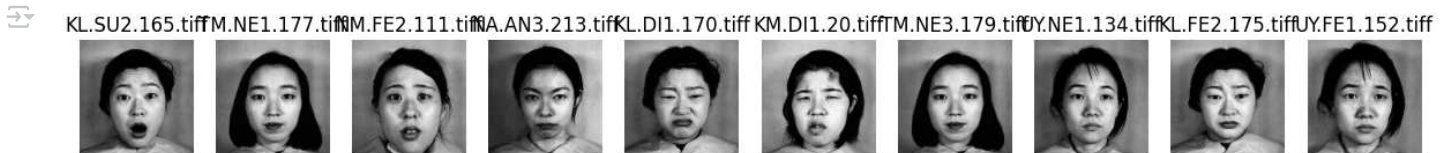
```



```

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 المرور على أول num_samples
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(".tiff")]
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. تحميل 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(".tiff")]
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(self.labels)))}
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 #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

```

```

1 import pandas as pd
2 import numpy as np
3
4 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
5 df_ck = pd.read_csv(csv_path)
6
7 class CKPlusDataset(Dataset):
8     def __init__(self, dataframe, transform=None):
9         self.df = dataframe
10         self.transform = transform
11
12     def __len__(self):
13         return len(self.df)
14
15     def __getitem__(self, idx):
16         pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
17         image = np.array(pixel_values, dtype='uint8').reshape(48, 48)
18         image = cv2.cvtColor(image, cv2.COLOR_GRAY2RGB)
19         image = cv2.resize(image, (128,128))
20         image = Image.fromarray(image)
21         label = self.df.iloc[idx]['emotion']
22         if self.transform:
23             image = self.transform(image)
24         return image, label
25
26 ck_dataset = CKPlusDataset(df_ck, transform=transform)

```

```
27 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
28
```

```
1 from torchvision import models
2 import torch.nn as nn
3 # تحديد الجهاز المناسب للتدريب (GPU أو CPU):
4
5
6 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
7
8 num_classes_jaffe = len(set(jaffe_dataset.labels))
9 num_classes_ck = df_ck['emotion'].nunique()
10
11 # JAFFE: وتعديل 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) # سنبدله لاحقاً لـ CK+
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: The parameter 'pretrained' is deprecated since 0. warnings.warn(
/usr/local/lib/python3.11/dist-packages/torchvision/models/_utils.py:223: UserWarning: Arguments other than a weight enum or `None` for 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'JAFFE Epoch {epoch+1}: Accuracy={epoch_acc:.4f}, Loss={running_loss/len(jaffe_dataset):.4f}')
21
```

 JAFFE Epoch 1: Accuracy=0.0235, Loss=3.5953
JAFFE Epoch 2: Accuracy=0.0610, Loss=3.3084
JAFFE Epoch 3: Accuracy=0.0986, Loss=3.1817

```
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/len(ck_dataset):.4f}')
20

```

 CK+ Epoch 1: Accuracy=0.5272, Loss=1.5148
 CK+ Epoch 2: Accuracy=0.7022, Loss=1.0179
 CK+ Epoch 3: Accuracy=0.7413, Loss=0.8430

```

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("/content/drive", force_remount=True).

```

1 import cv2
2 import matplotlib.pyplot as plt
3 import numpy as np
4
5 # عدّل حسب مجلدك مسار الصورة من Google Drive
6 image_path = '/content/drive/MyDrive/Datasets/jaffe/NM.NE3.94.tiff'
7
8 # تحميل الصورة
9 image = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE) # غالباً رمادية jaffe الصور في
10
11 # التحقق من التحميل
12 if isinstance(image, np.ndarray):
13     # تغيير الحجم
14     resized_image = cv2.resize(image, (128, 128), interpolation=cv2.INTER_CUBIC)
15
16     # عرض الصورة الأصلية والمعدّلة
17     plt.figure(figsize=(10,5), dpi=150)
18
19     plt.subplot(1, 2, 1)
20     plt.imshow(image, cmap='gray')
21     plt.title("Original")
22     plt.axis('off')
23
24     plt.subplot(1, 2, 2)
25     plt.imshow(resized_image, cmap='gray')
26     plt.title("Resized")
27     plt.axis('off')
28
29     plt.show()
30 else:
31     print("❌ لم يتم تحميل الصورة. تأكد من المسار.")
32

```



Original

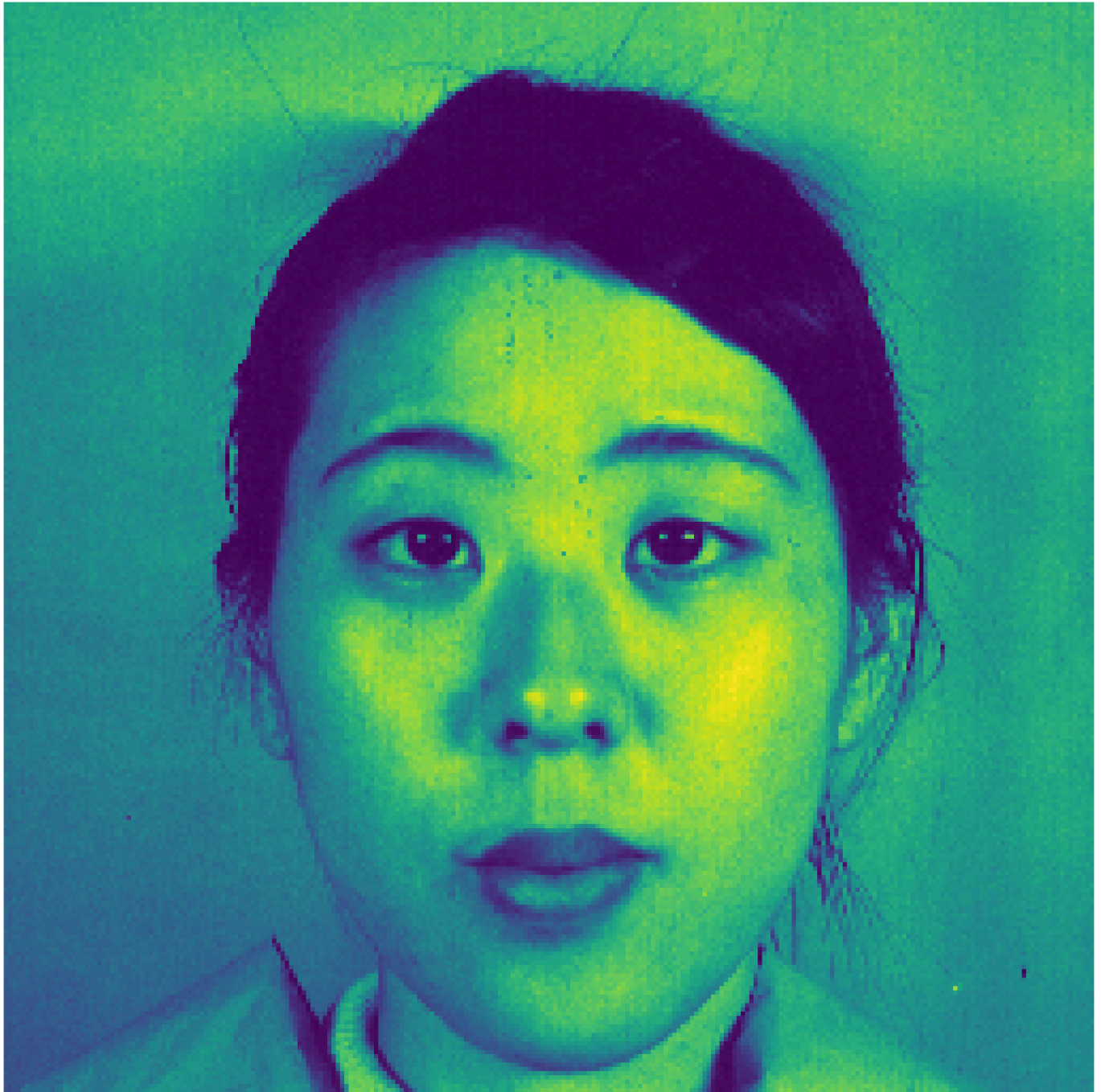


Resized



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
```



```

1 gray_image = cv2.imread('/content/drive/MyDrive/Datasets/jaffe/KA.AN1.39.tiff', cv2.IMREAD_GRAYSCALE)
2

```

```

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 #ربط البيانات مع التحويل المطلوب CKPlusDataset يتم إنشاء كائن من كلاس.
12 class CKPlusDataset(Dataset):
13     def __init__(self, dataframe, transform=None):
14         self.df = dataframe
15         self.transform = transform
16
17     def __len__(self):
18         return len(self.df)
19
20     def __getitem__(self, idx):
21         pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
22         image = np.array(pixel_values, dtype='uint8').reshape(48, 48)
23         image = cv2.cvtColor(image, cv2.COLOR_GRAY2RGB)
24         image = cv2.resize(image, (128,128))
25         image = Image.fromarray(image)
26         label = self.df.iloc[idx]['emotion']
27         if self.transform:
28             image = self.transform(image)
29         return image, label
30
31 df_ck = pd.read_csv(csv_path)
32
33 transform = transforms.Compose([
34     transforms.ToTensor()
35 ])
36
37 ck_dataset = CKPlusDataset(df_ck, transform=transform)
38 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
39 #عدد الأصناف (المشاعر) في قاعدة البيانات
40 num_classes_ck = df_ck['emotion'].nunique()
41

```

```

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(".tiff")]
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(self.labels)))}
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 # استيراد المكتبات اللازمة
2 import torch
3 import torch.nn as nn
4 from torchvision import models
5 import matplotlib.pyplot as plt
6
7 # (إن وُجد GPU) تحديد الجهاز
8 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
9
10 # JAFFE مثلاً 7 مشاعر في) وتعديله لعدد الأصناف MobileNetV2 تحميل نموذج
11 def get_mobilenetv2(num_classes):
12     model = models.mobilenet_v2(weights=None) # بدون أوزان مُسبقة
13     model.classifier[1] = nn.Linear(model.last_channel, num_classes) # تعديل الطبقة الأخيرة
14     return model
15
16 # إعداد النموذج والوظائف المساعدة
17 model = get_mobilenetv2(num_classes_jaffe)
18 model = model.to(device)
19 optimizer = torch.optim.Adam(model.parameters(), lr=0.001)
20 criterion = nn.CrossEntropyLoss()
21
22 # عدد الدورات التدريبية
23 epochs = 5
24 train_losses, train_accs = [], []

```

```

25
26 # التدريب
27 for epoch in range(epochs):
28     model.train() # وضع النموذج في طور التدريب
29     running_loss = 0.0
30     correct = 0
31     total = 0
32
33     # حلقة على دفعات البيانات
34     for inputs, labels in jaffe_loader:
35         inputs, labels = inputs.to(device), labels.to(device)
36
37         optimizer.zero_grad()
38         outputs = model(inputs)
39         loss = criterion(outputs, labels)
40         loss.backward()
41         optimizer.step()
42
43         running_loss += loss.item()
44
45         _, preds = torch.max(outputs, 1)
46         correct += (preds == labels).sum().item()
47         total += labels.size(0)
48
49     # حساب متوسط الخسارة والدقة لكل epoch
50     epoch_loss = running_loss / len(jaffe_loader)
51     epoch_acc = correct / total
52
53     #  تسجيل القيم في القوائم
54     train_losses.append(epoch_loss)
55     train_accs.append(epoch_acc)
56
57     print(f"Epoch {epoch+1}/{epochs}: Loss={epoch_loss:.4f}, Accuracy={epoch_acc:.4f}")
58

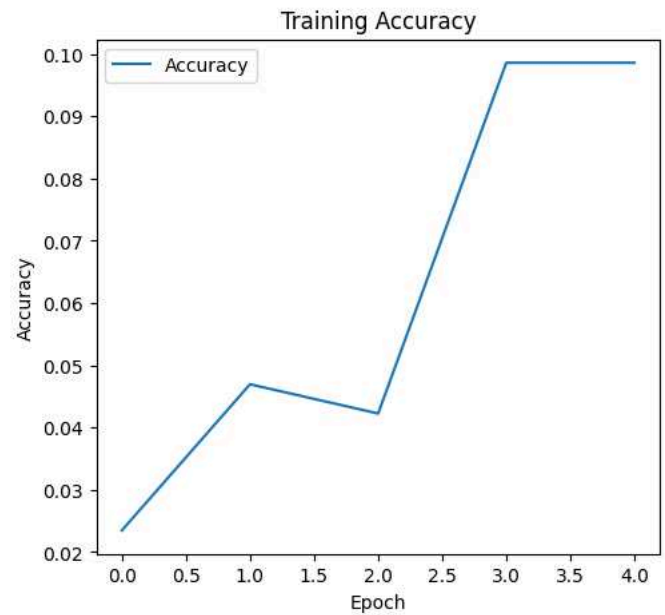
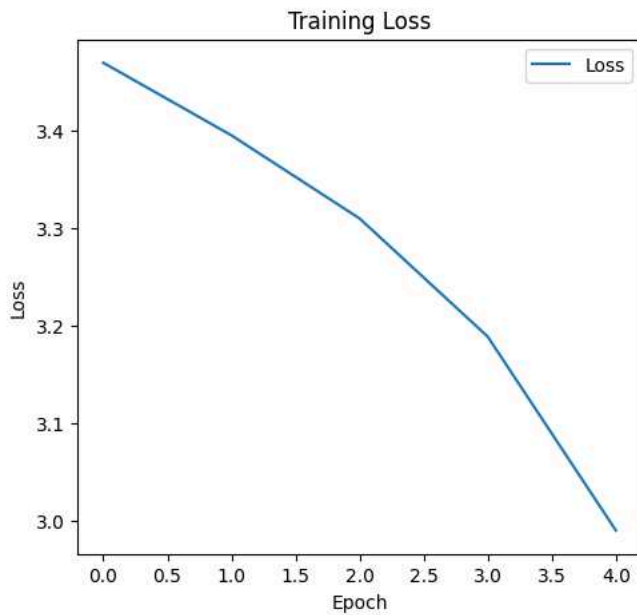
```

 Epoch 1/5: Loss=3.4699, Accuracy=0.0235
 Epoch 2/5: Loss=3.3954, Accuracy=0.0469
 Epoch 3/5: Loss=3.3100, Accuracy=0.0423
 Epoch 4/5: Loss=3.1887, Accuracy=0.0986
 Epoch 5/5: Loss=2.9897, Accuracy=0.0986

```

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

```

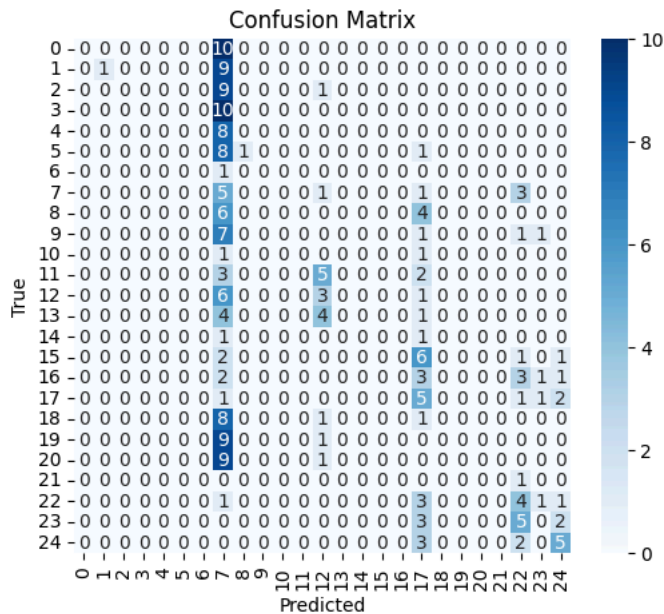
```

/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedMetricWarning: Precision is ill-defined and be
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedMetricWarning: Precision is ill-defined and be
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedMetricWarning: Precision is ill-defined and be
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))

```

Classification Report:

	precision	recall	f1-score	support
0	0.00	0.00	0.00	10
1	1.00	0.10	0.18	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	0.04	0.50	0.08	10
8	0.00	0.00	0.00	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	0.18	0.30	0.22	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	0.14	0.50	0.21	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	0.19	0.40	0.26	10
23	0.00	0.00	0.00	10
24	0.42	0.50	0.45	10
accuracy			0.11	213
macro avg	0.08	0.09	0.06	213
weighted avg	0.09	0.11	0.07	213



```

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, recall_score, f1_score, classification_
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
17
18 1 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
19 2
20 3 class JaffeDataset(Dataset):
21     def __init__(self, root_dir, transform=None):
22         self.root_dir = root_dir
23         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
24         self.transform = transform
25         self.labels = [self.get_label(f) for f in self.image_files]
26         self.label_map = {label: idx for idx, label in enumerate(sorted(set(self.labels)))}
27         self.labels_idx = [self.label_map[label] for label in self.labels]
28
29     def get_label(self, filename):
30         return filename.split('.')[1] # AN, HA, etc.
31
32     def __len__(self):
33         return len(self.image_files)
34
35     def __getitem__(self, idx):
36         img_path = os.path.join(self.root_dir, self.image_files[idx])
37         image = Image.open(img_path).convert('RGB')
38         if self.transform:
39             image = self.transform(image)
40         label = self.labels_idx[idx]
41         return image, label
42
43 transform = T.Compose([
44     T.RandomHorizontalFlip(),
45     T.RandomVerticalFlip(),
46     T.RandomRotation(10),
47     T.Resize((128,128)),
48     T.ToTensor()
49 ])
50
51 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
52 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
53 num_classes_jaffe = len(set(jaffe_dataset.labels))
54

```

```

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(".tiff")]
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(self.labels)))}
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
38
39 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
40
41 model = models.resnet18(pretrained=False)
42 model.fc = nn.Linear(model.fc.in_features, num_classes_jaffe)
43 model = model.to(device)
44
45 criterion = nn.CrossEntropyLoss()
46 optimizer = optim.AdamW(model.parameters(), lr=0.001)
47 scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
48
49
50 def train_model(model, criterion, optimizer, scheduler, num_epochs=2):
51     for epoch in range(num_epochs):
52         print(f"Epoch {epoch+1}/{num_epochs}")
53         print('-' * 10)
54
55         model.train()
56         running_loss = 0.0
57         running_corrects = 0
58
59         for inputs, labels in jaffe_loader:
60             inputs, labels = inputs.to(device), labels.to(device)
61
62             optimizer.zero_grad()
63             outputs = model(inputs)
64             loss = criterion(outputs, labels)
65             loss.backward()
66             optimizer.step()
67
68             _, preds = torch.max(outputs, 1)
69             running_loss += loss.item() * inputs.size(0)
70             running_corrects += torch.sum(preds == labels.data)
71
72         scheduler.step()
73         epoch_loss = running_loss / len(jaffe_dataset)
74         epoch_acc = running_corrects.double() / len(jaffe_dataset)
75
76         print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
77     return model
78
79 model = train_model(model, criterion, optimizer, scheduler, num_epochs=2)
80

```

```

Epoch 1/2
-----
Loss: 3.5585 Acc: 0.0235
Epoch 2/2
-----
Loss: 3.4331 Acc: 0.0516

```

```

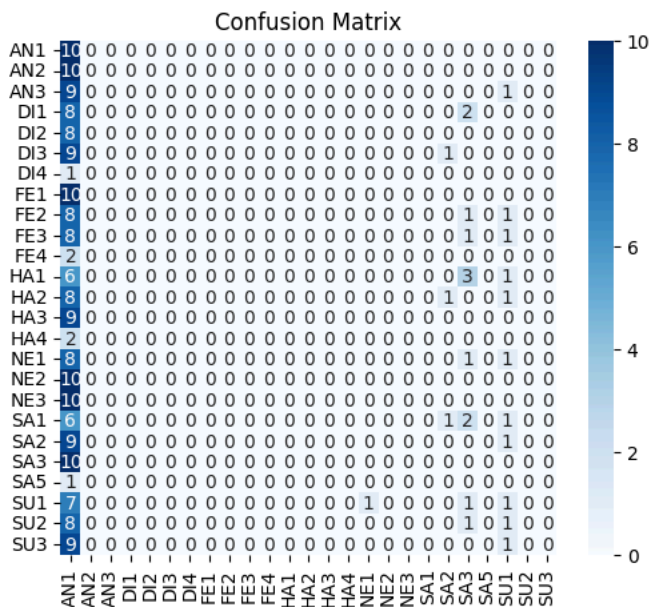
1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():
5     for inputs, labels in jaffe_loader:
6         inputs = inputs.to(device)
7         outputs = model(inputs)

```

```
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_division=0)
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, target_names=labels))
35
36     plt.figure(figsize=(6,5))
37     sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=labels, yticklabels=labels)
38     plt.title('Confusion Matrix')
39     plt.show()
40
41 evaluate_model("ResNet18 on JAFFE", y_true, y_pred, y_proba)
```

[ResNet18 on JAFFE] Accuracy: 0.0516
Precision: 0.006792137641751454
Recall: 0.051643192488262914
F1-score: 0.009261920730733607
Classification Report:

	precision	recall	f1-score	support
AN1	0.05	1.00	0.10	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	0.00	0.00	0.00	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	0.09	0.10	0.10	10
SU2	0.00	0.00	0.00	10
SU3	0.00	0.00	0.00	10
accuracy			0.05	213
macro avg	0.01	0.04	0.01	213
weighted avg	0.01	0.05	0.01	213



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

```
1 from torch.utils.data import Dataset
2 from PIL import Image
3 import numpy as np
4
5 # Dataset الذي يرث من CKPlusDataset تعريف كلاس
6 # DataLoader إلى بيانات صور يمكن قراءتها بالـ DataFrame المخزنة في CK+ هذا الكلاس يستخدم لتحويل بيانات
7
8 class CKPlusDataset(Dataset):
9     def __init__(self, dataframe, transform=None):
10         self.df = dataframe # DataFrame على أعمدة: 'pixels' و 'emotion'
```

```

11         self.transform = transform          # (مثل ToTensor أو Augmentation) تطبيقها على الصور
12
13     def __len__(self):
14         return len(self.df)                  # عدد العينات في مجموعة البيانات
15
16     def __getitem__(self, idx):
17         # تحويل سلسلة البكسلات إلى مصفوفة أرقام صحيحة
18         pixel_values = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
19
20         # CK+ (حسب قاعدة) 48x48 حجم 48 تحويل البكسلات إلى صورة 2
21         image = np.array(pixel_values).reshape(48, 48).astype(np.uint8)
22
23         # torchvision.transforms للتعامل مع PIL تحويل الصورة إلى كائن
24         image = Image.fromarray(image)
25
26         # تطبيق التحويلات المحددة إن وجدت
27         if self.transform:
28             image = self.transform(image)
29
30         # استخراج التصنيف (Label) من DataFrame
31         label = int(self.df.iloc[idx]['emotion'])
32
33         return image, label # هذا السطر الصحيح
34

```

```

1 from torchvision import transforms
2 from torch.utils.data import DataLoader
3
4 # تعريف التحويلات التي تطبق على كل صورة
5 transform = transforms.Compose([
6     transforms.RandomHorizontalFlip(),
7     transforms.RandomVerticalFlip(),
8     transforms.RandomRotation(10),
9     transforms.Resize((128,128)),
10    transforms.ToTensor()
11 ])
12
13 # إنشاء مجموعة البيانات واللودر
14 ck_dataset = CKPlusDataset(df_ck, transform=transform)
15 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
16
17 # حساب عدد المشاعر (الكلاسات)
18 num_classes_ck = df_ck['emotion'].nunique()
19
20
21 model = models.resnet18(pretrained=False)
22 model.fc = nn.Linear(model.fc.in_features, num_classes_ck)
23 model = model.to(device)
24
25 criterion = nn.CrossEntropyLoss()
26 optimizer = optim.AdamW(model.parameters(), lr=0.001)
27 scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
28

```

```

1 from torchvision import transforms
2
3 transform = transforms.Compose([
4     transforms.Lambda(lambda img: img.convert("RGB")), # تحويل من رمادي إلى RGB
5     transforms.RandomHorizontalFlip(),
6     transforms.RandomVerticalFlip(),
7     transforms.RandomRotation(10),
8     transforms.Resize((128,128)),
9     transforms.ToTensor()
10 ])
11

```

```

1 transforms.Lambda(lambda img: img.convert("RGB"))
2 from torchvision import transforms
3
4 transform = transforms.Compose([
5     transforms.Lambda(lambda img: img.convert("RGB")), # ✅ RGB ضروري: تحويل من رمادي إلى
6     transforms.Resize((128, 128)),
7     transforms.ToTensor()
8 ])
9 ck_dataset = CKPlusDataset(df_ck, transform=transform)
10 ck_loader = DataLoader(ck_dataset, batch_size=8, shuffle=True)
11

```

```

1 # تحديد عدد الدورات (epochs)
2 epochs = 2
3
4 for epoch in range(epochs):
5     print(f"\nEpoch {epoch+1}/{epochs}")
6     model.train() # وضع النموذج في طور التدريب
7
8     running_loss = 0.0
9     correct = 0
10    total = 0
11
12    # حلقة على دفعات البيانات
13    for inputs, labels in ck_loader:
14        inputs, labels = inputs.to(device), labels.to(device)
15
16        # تصفير التدرجات السابقة
17        optimizer.zero_grad()
18
19        # تمرير الصور داخل النموذج للحصول على التنبؤات
20        outputs = model(inputs)
21
22        # حساب الخسارة
23        loss = criterion(outputs, labels)
24
25        # تحديث الأوزان بناءً على الخسارة
26        loss.backward()
27        optimizer.step()
28
29        # تجميع الخسارة
30        running_loss += loss.item()
31
32        # حساب التوقعات الصحيحة
33        _, preds = torch.max(outputs, 1)
34        correct += (preds == labels).sum().item()
35        total += labels.size(0)
36
37    # حساب المتوسط لكل epoch
38    epoch_loss = running_loss / len(ck_loader)
39    epoch_acc = correct / total
40
41    print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
42

```



```

Epoch 1/2
Loss: 1.1035 Acc: 0.6870

Epoch 2/2
Loss: 0.6713 Acc: 0.8033

```

```

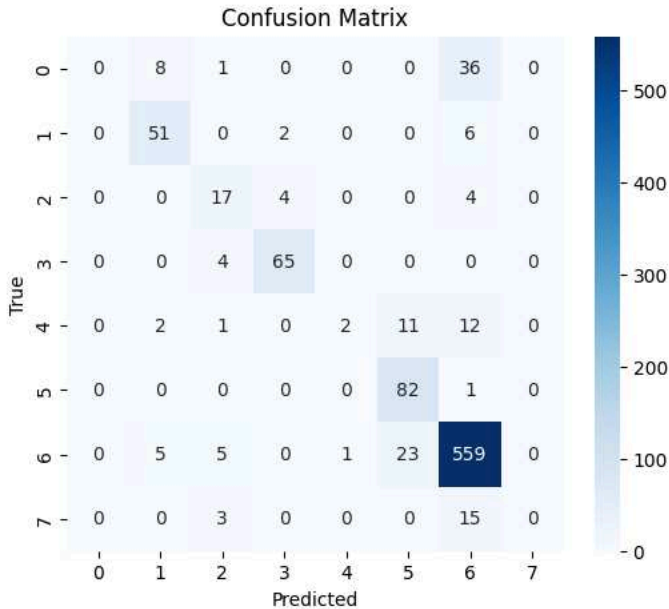
1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():
5     for inputs, labels in ck_loader:
6         inputs = inputs.to(device)
7         outputs = model(inputs)
8         probabilities = torch.softmax(outputs, dim=1)

```

```
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: 0.8435
Precision: 0.7863965504284712
Recall: 0.8434782608695652
F1-score: 0.8045334134304265
Classification Report:

	precision	recall	f1-score	support
0	0.00	0.00	0.00	45
1	0.77	0.86	0.82	59
2	0.55	0.68	0.61	25
3	0.92	0.94	0.93	69
4	0.67	0.07	0.13	28
5	0.71	0.99	0.82	83
6	0.88	0.94	0.91	593
7	0.00	0.00	0.00	18
accuracy			0.84	920
macro avg	0.56	0.56	0.53	920
weighted avg	0.79	0.84	0.80	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
9
10 epochs = 2
11 for epoch in range(epochs):
12     print(f"\nEpoch {epoch+1}/{epochs}")
13     model.train()
14     running_loss, correct = 0.0, 0
15
16     for inputs, labels in ck_loader:
17         inputs, labels = inputs.to(device), labels.to(device)
18         optimizer.zero_grad()
19         outputs = model(inputs)
20         loss = criterion(outputs, labels)
21         loss.backward()
22         optimizer.step()
23
24         _, preds = torch.max(outputs, 1)
25         correct += torch.sum(preds == labels.data)
26         running_loss += loss.item() * inputs.size(0)
27
28     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: 1.4625 Acc: 0.6261

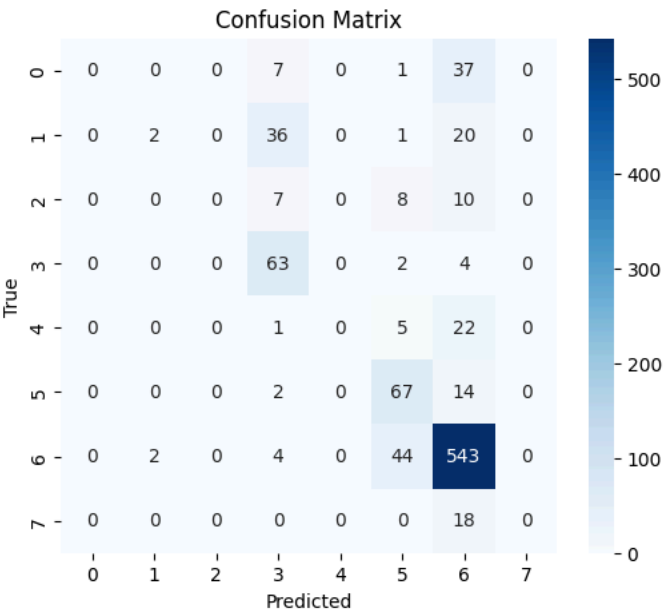
Epoch 2/2
Loss: 1.1965 Acc: 0.6478

```
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
16 evaluate_model("MobileNetV2 on CK+", y_true, y_pred, y_proba)
17
```



[MobileNetV2 on CK+] Accuracy: 0.7337
Precision: 0.6426138517801354
Recall: 0.7336956521739131
F1-score: 0.666479494818964
Classification Report:

	precision	recall	f1-score	support
0	0.00	0.00	0.00	45
1	0.50	0.03	0.06	59
2	0.00	0.00	0.00	25
3	0.53	0.91	0.67	69
4	0.00	0.00	0.00	28
5	0.52	0.81	0.64	83
6	0.81	0.92	0.86	593
7	0.00	0.00	0.00	18
accuracy			0.73	920
macro avg	0.30	0.33	0.28	920
weighted avg	0.64	0.73	0.67	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:
8 عدد الفئات:

```

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 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
33
34 model = models.efficientnet_b0(pretrained=False)
35 model.classifier[1] = torch.nn.Linear(model.classifier[1].in_features, num_classes_ck)
36 model = model.to(device)
37
38 criterion = torch.nn.CrossEntropyLoss()
39 optimizer = torch.optim.AdamW(model.parameters(), lr=0.001)
40 scheduler = torch.optim.lr_scheduler.StepLR(optimizer, step_size=3, gamma=0.97)
41
42
43 def train_model(model, criterion, optimizer, scheduler, num_epochs=2):
44     for epoch in range(num_epochs):
45         print(f"\nEpoch {epoch+1}/{num_epochs}")
46         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
10            optimizer.zero_grad()
11            outputs = model(inputs)
12            loss = criterion(outputs, labels)
13            loss.backward()
14            optimizer.step()
15
16            _, preds = torch.max(outputs, 1)
17            correct += torch.sum(preds == labels.data)
18            running_loss += loss.item() * inputs.size(0)
19
20        scheduler.step()
21        epoch_loss = running_loss / len(ck_dataset)
22        epoch_acc = correct.double() / len(ck_dataset)
23        print(f"Loss: {epoch_loss:.4f}, Accuracy: {epoch_acc:.4f}")
24    return model
25

```

```

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

```



```

Epoch 1/2
Loss: 1.4815, Accuracy: 0.6120

```

```

Epoch 2/2
Loss: 1.3556, Accuracy: 0.6380

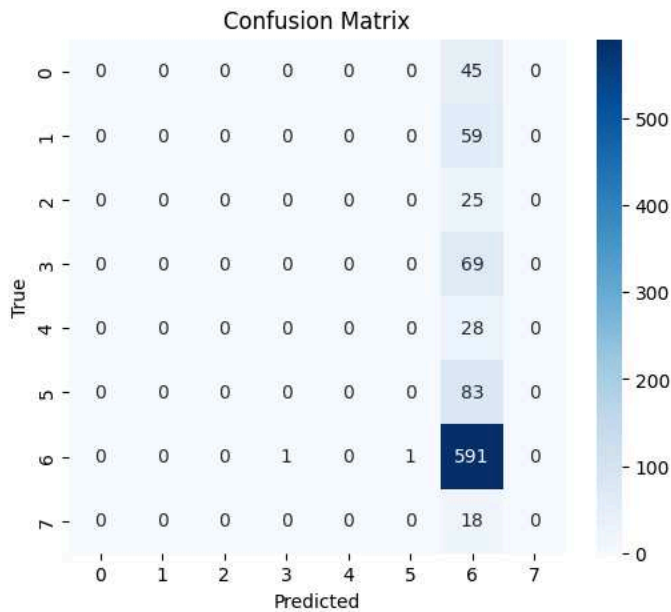
```

```

1 from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix, classification_report
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	0.41	0.64	0.50	920	



```

1 import torch
2 import torch.nn as nn
3 import torch.optim as optim
4 from torchvision import models
5 from torch.optim import lr_scheduler
6
7 # 1. تعريف عدد الكلاسات حسب بيانات CK+
8 num_classes_ck = df_ck['emotion'].nunique()
9
10 # 2. تعديل DenseNet121 تحميل نموذج
11 model = models.densenet121(pretrained=False)
12 model.classifier = nn.Linear(model.classifier.in_features, num_classes_ck)
13 model = model.to(device)
14
15 # 3. تعريف الخسارة، المحسن، وجدولة التعلم
16 criterion = nn.CrossEntropyLoss()
17 optimizer = optim.AdamW(model.parameters(), lr=0.001)
18 exp_lr_scheduler = lr_scheduler.StepLR(optimizer, step_size=7, gamma=0.1)
19
20 # 4. تعريف دالة التدريب
21 def train_model(model, criterion, optimizer, scheduler, num_epochs=1):
22     for epoch in range(num_epochs):
23         print(f"\nEpoch {epoch+1}/{num_epochs}")
24         model.train()
25         running_loss = 0.0
26         correct = 0
27         total = 0
28
29         for inputs, labels in ck_loader:
30             inputs, labels = inputs.to(device), labels.to(device)
31
32             optimizer.zero_grad()

```

```

33         outputs = model(inputs)
34         loss = criterion(outputs, labels)
35         loss.backward()
36         optimizer.step()
37
38         running_loss += loss.item()
39         _, preds = torch.max(outputs, 1)
40         correct += (preds == labels).sum().item()
41         total += labels.size(0)
42
43         scheduler.step()
44         epoch_loss = running_loss / len(ck_loader)
45         epoch_acc = correct / total
46         print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
47     return model
48
49 # 5. تنفيذ التدريب
50 model = train_model(model, criterion, optimizer, exp_lr_scheduler, num_epochs=1)
51

```



Epoch 1/1
Loss: 1.3935 Acc: 0.6250

```

1 model = models.vgg16(pretrained=False)
2 model.classifier[6] = nn.Linear(model.classifier[6].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_epochs=1)
7

```



Epoch 1/1
Loss: 2.9183 Acc: 0.6272

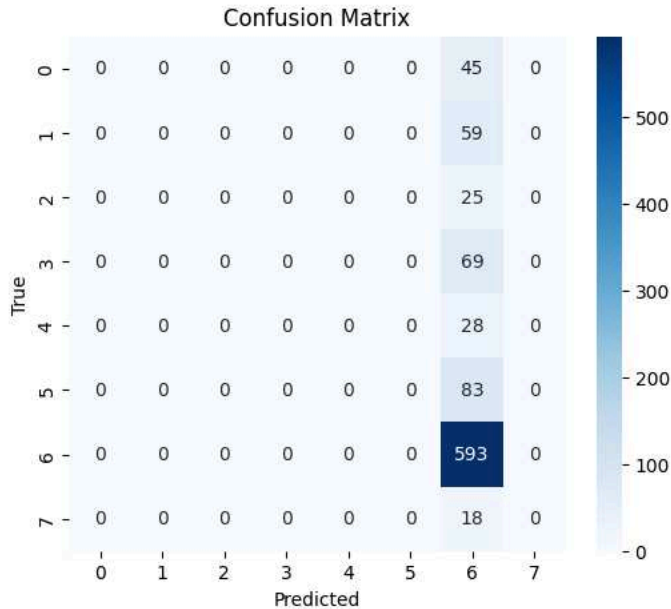
```

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: 0.6446
 Precision: 0.41546431947069945
 Recall: 0.6445652173913043
 F1-score: 0.5052573349808903
 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 import torch
2 import torch.nn as nn
3 import torch.optim as optim
4 from torchvision import models, transforms
5 from torch.utils.data import Dataset, DataLoader
6 from PIL import Image
7 import os
8 import cv2
9 import numpy as np

10

11 transform = transforms.Compose([
12     transforms.RandomHorizontalFlip(),
13     transforms.RandomVerticalFlip(),
14     transforms.RandomRotation(20),
15     transforms.ColorJitter(brightness=0.2, contrast=0.2, saturation=0.2),
16     transforms.Resize((224,224)),
17     transforms.ToTensor(),
18     transforms.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])
19 ])

20
21 # 2. Dataset
22 class JaffeDataset(Dataset):
23     def __init__(self, root_dir, transform=None):
24         self.root_dir = root_dir
25         if not os.path.exists(root_dir):
26             print(f"المجلد {root_dir} غير موجود. الرجاء التأكد من ربط {root_dir} المجلد")
27         self.image_files = []

```

```

8         else:
9             self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
10            self.transform = transform
11
12    def __len__(self):
13        return len(self.image_files)
14
15    def __getitem__(self, idx):
16        img_path = os.path.join(self.root_dir, self.image_files[idx])
17        image = Image.open(img_path).convert('RGB')
18        if self.transform:
19            image = self.transform(image)
20        label = int(self.image_files[idx].split('.')[1]) # استخراج التصنيف من اسم الملف أو حسب التنظيم المتبع
21        return image, label

```

```

1 emotion_labels = set()
2
3 for f in os.listdir(jaffe_path):
4     if f.endswith(".tiff"):
5         parts = f.split('.')
6         if len(parts) >= 2:
7             emotion_labels.add(parts[1]) # نأخذ الرمز الأول فقط ← "SU2" مثل
8
9 # فقط أول حرفين تمثل المشاعر (SU, NE, etc)
10 emotion_labels = set([label[:2] for label in emotion_labels])
11 num_classes_jaffe = len(emotion_labels)
12

```

```

1 import os
2 from PIL import Image
3 import torch
4 from torch.utils.data import Dataset
5 from torchvision import transforms
6
7 # لمعالجة بيانات JaffeDataset تعريف كلاس
8 class JaffeDataset(Dataset):
9     def __init__(self, root_dir, transform=None):
10         self.root_dir = root_dir
11         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
12         self.transform = transform
13
14         # تعريف قاموس تحويل رموز المشاعر إلى أرقام
15         self.emotion_dict = {
16             'AN': 0, # Angry
17             'DI': 1, # Disgust
18             'FE': 2, # Fear
19             'HA': 3, # Happy
20             'NE': 4, # Neutral
21             'SA': 5, # Sad
22             'SU': 6 # Surprise
23         }
24
25     def __len__(self):
26         return len(self.image_files)
27
28     def __getitem__(self, idx):
29         # تحميل الصورة
30         image_path = os.path.join(self.root_dir, self.image_files[idx])
31         image = Image.open(image_path).convert('L') # الصورة رمادية
32
33         # تطبيق التحويلات إن وجدت
34         if self.transform:
35             image = self.transform(image)
36
37         # استخراج رمز المشاعر من اسم الملف (مثلًا SA من KA.SA1.93.tiff)
38         emotion_code = self.image_files[idx].split('.')[1][:2]
39         label = self.emotion_dict[emotion_code]
40

```

```

41         return image, label
42

1 import os
2 import shutil
3 import random
4 from torchvision import datasets, transforms, models
5 from torch.utils.data import DataLoader, Subset
6 import torch
7 import torch.nn as nn
8 import torch.optim as optim
9
10
11
12 # 2. المسار الكامل إلى مجلد التدريب
13 train_dir = '/content/drive/MyDrive/Datasets/FER-2013/train'
14
15 # 3. إعداد التحويلات
16 transform = transforms.Compose([
17     transforms.Resize((128, 128)),
18     transforms.ToTensor(),
19 ])
20
21 # 4. تحميل جميع البيانات ثم تصفية 100 صورة لكل فئة
22 full_dataset = datasets.ImageFolder(root=train_dir, transform=transform)
23
24 # إنشاء قائمة جديدة تحتوي على 100 عينة لكل فئة فقط
25 samples_per_class = 100
26 targets = full_dataset.targets
27 class_indices = {cls: [] for cls in range(len(full_dataset.classes))}

1
2 # إنشاء قائمة جديدة تحتوي على 100 عينة لكل فئة فقط
3 samples_per_class = 100
4 targets = full_dataset.targets
5 class_indices = {cls: [] for cls in range(len(full_dataset.classes))}
6
7 # جمع المؤشرات حسب الفئة
8 for idx, label in enumerate(targets):
9     if len(class_indices[label]) < samples_per_class:
10         class_indices[label].append(idx)
11
12 # دمج المؤشرات معًا
13 final_indices = [idx for indices in class_indices.values() for idx in indices]
14 subset_dataset = Subset(full_dataset, final_indices)

1
2 # 5. تجهيز DataLoader
3 train_loader = DataLoader(subset_dataset, batch_size=16, shuffle=True)
4
5 # 6. تجهيز النموذج
6 device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
7 model = models.resnet18(pretrained=False)
8 model.fc = nn.Linear(model.fc.in_features, len(full_dataset.classes))
9 model = model.to(device)
10
11 # 7. التدريب
12 criterion = nn.CrossEntropyLoss()
13 optimizer = optim.Adam(model.parameters(), lr=0.001)
14
15 epochs = 3
16 for epoch in range(epochs):
17     model.train()
18     running_loss, correct = 0.0, 0
19     for inputs, labels in train_loader:
20         inputs, labels = inputs.to(device), labels.to(device)
21         optimizer.zero_grad()
22         outputs = model(inputs)

```

```

23     loss = criterion(outputs, labels)
24     loss.backward()
25     optimizer.step()
26     _, preds = torch.max(outputs, 1)
27     correct += torch.sum(preds == labels.data)
28     running_loss += loss.item() * inputs.size(0)
29
30     epoch_loss = running_loss / len(subset_dataset)
31     epoch_acc = correct.double() / len(subset_dataset)
32     print(f"Epoch {epoch+1}/{epochs}, Loss: {epoch_loss:.4f}, Accuracy: {epoch_acc:.4f}")

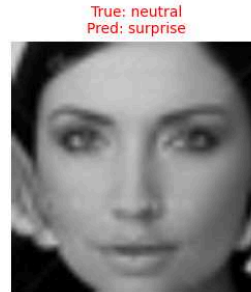
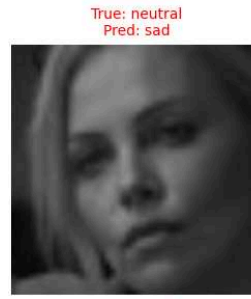
```

Epoch 1/3, Loss: 2.0855, Accuracy: 0.1443
 Epoch 2/3, Loss: 1.8829, Accuracy: 0.2357
 Epoch 3/3, Loss: 1.7912, Accuracy: 0.3114

```

1  # عرض 8 صور من العينة مع تنبؤات النموذج
2  import matplotlib.pyplot as plt
3  import random
4
5  # subset_dataset اختيار عينات عشوائية من
6  indices = random.sample(range(len(subset_dataset)), 8)
7  fig, axes = plt.subplots(2, 4, figsize=(15,6))
8
9  model.eval()
10 with torch.no_grad():
11     for i, idx in enumerate(indices):
12         image, true_label = subset_dataset[idx]
13         img_input = image.unsqueeze(0).to(device)
14         output = model(img_input)
15         _, pred_label = torch.max(output, 1)
16
17         ax = axes[i // 4, i % 4]
18         ax.imshow(image.permute(1, 2, 0)) # تحويل C x H x W إلى H x W x C
19         ax.axis('off')
20         ax.set_title(
21             f"True: {full_dataset.classes[true_label]}\nPred: {full_dataset.classes[pred_label.item()]",
22             fontsize=10,
23             color='green' if pred_label.item() == true_label else 'red'
24         )
25
26 plt.tight_layout()
27 plt.show()
28
29

```



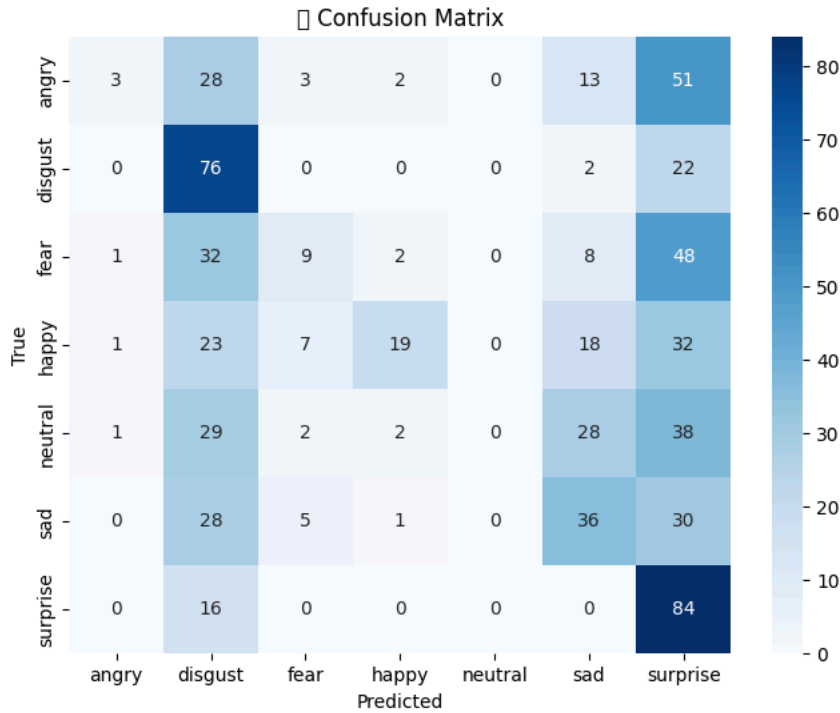
```

1 from sklearn.metrics import classification_report, confusion_matrix
2 import seaborn as sns
3 import matplotlib.pyplot as plt
4 import numpy as np
5
6 # 1. التنبؤ بالنتائج على نفس مجموعة التدريب المستخدمة.
7 y_true = []
8 y_pred = []
9
10 model.eval()
11 with torch.no_grad():
12     for inputs, labels in train_loader:
13         inputs = inputs.to(device)
14         labels = labels.to(device)
15         outputs = model(inputs)
16         _, preds = torch.max(outputs, 1)
17         y_true.extend(labels.cpu().numpy())
18         y_pred.extend(preds.cpu().numpy())
19
20 # 2. حساب النتائج
21 print("\n [Classification Report]")
22 print(classification_report(y_true, y_pred, target_names=full_dataset.classes))
23
24 # 3. مصفوفة الالتباس
25 cm = confusion_matrix(y_true, y_pred)
26
27 plt.figure(figsize=(8,6))
28 sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
29             xticklabels=full_dataset.classes,
30             yticklabels=full_dataset.classes)
31 plt.title("🔍 Confusion Matrix")
32 plt.xlabel("Predicted")
33 plt.ylabel("True")
34 plt.show()
35

```

 [Classification Report]

	precision	recall	f1-score	support
angry	0.50	0.03	0.06	100
disgust	0.33	0.76	0.46	100
fear	0.35	0.09	0.14	100
happy	0.73	0.19	0.30	100
neutral	0.00	0.00	0.00	100
sad	0.34	0.36	0.35	100
surprise	0.28	0.84	0.41	100
accuracy			0.32	700
macro avg	0.36	0.32	0.25	700
weighted avg	0.36	0.32	0.25	700



```

1 # حفظ النموذج بعد التدريب
2 torch.save(model.state_dict(), 'emotion_model.pth')
3
4 # حفظ النموذج داخل Google Drive
5 torch.save(model.state_dict(), '/content/drive/MyDrive/emotion_model.pth')
6
7
8 # اختبار النموذج
9 model.eval()
10 correct, total = 0, 0
11 with torch.no_grad():
12     for inputs, labels in test_loader:
13         inputs, labels = inputs.to(device), labels.to(device)
14         outputs = model(inputs)
15         _, preds = torch.max(outputs, 1)
16         total += labels.size(0)
17         correct += (preds == labels).sum().item()
18
19 print(f"✅ Test Accuracy: {100 * correct / total:.2f}%")
20

```

 Test Accuracy: 15.52%

```

1 import os
2 from PIL import Image
3 import torch
4 import torch.nn as nn
5 import torch.optim as optim
6 from torch.utils.data import Dataset, DataLoader
7 from torchvision import transforms, models
8 import matplotlib.pyplot as plt
9
10 # 1. لصور Dataset كلاس JAFFE
11 class JaffeDataset(Dataset):
12     def __init__(self, root_dir, transform=None):
13         self.root_dir = root_dir
14         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
15         self.transform = transform
16         self.emotion_dict = {
17             'AN': 0, 'DI': 1, 'FE': 2,
18             'HA': 3, 'NE': 4, 'SA': 5, 'SU': 6
19         }
20
21     def __len__(self):
22         return len(self.image_files)
23
24     def __getitem__(self, idx):
25         image_path = os.path.join(self.root_dir, self.image_files[idx])
26         image = Image.open(image_path).convert('L') # رمادية
27
28         if self.transform:
29             image = self.transform(image)
30
31         emotion_code = self.image_files[idx].split('.')[1][:2]
32         label = self.emotion_dict[emotion_code]
33
34         return image, label
35
36 # 2. RGB تحويل من رمادي إلى التحويلات المناسبة
37 transform = transforms.Compose([
38     transforms.Lambda(lambda img: img.convert("RGB")),
39     transforms.Resize((128, 128)),
40     transforms.ToTensor()
41 ])
42
43 # 3. تحميل البيانات
44 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
45 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
46 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=False)
47
48 # 4. عدد الفئات (7 مشاعر)
49 num_classes = 7
50 device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
51
52 # 5. تحميل النماذج وتعديل طبقات الإخراج
53 resnet = models.resnet18(pretrained=True)
54 resnet.fc = nn.Linear(resnet.fc.in_features, num_classes)
55 resnet = resnet.to(device)
56
57 mobilenet = models.mobilenet_v2(pretrained=True)
58 mobilenet.classifier[1] = nn.Linear(mobilenet.classifier[1].in_features, num_classes)
59 mobilenet = mobilenet.to(device)
60
61 # 6. دالة التقييم
62 def evaluate_model(model, dataloader, device):
63     model.eval()
64     correct = 0
65     total = 0
66     with torch.no_grad():
67         for inputs, labels in dataloader:
68             inputs, labels = inputs.to(device), labels.to(device)
69             outputs = model(inputs)

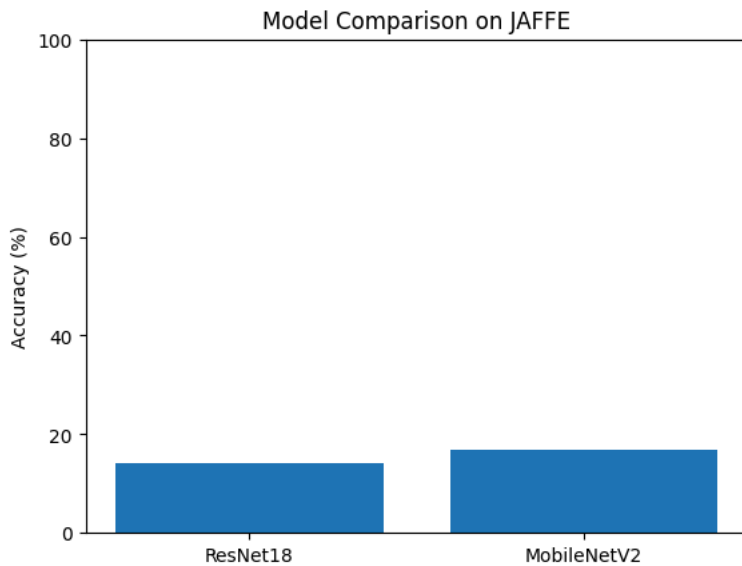
```

```

70         _, preds = torch.max(outputs, 1)
71         correct += (preds == labels).sum().item()
72         total += labels.size(0)
73     accuracy = 100 * correct / total
74     return accuracy
75
76 # 7. حساب الدقة لكل نموذج (قد تكون قليلة إذا لم يتم تدريبهم)
77 resnet_acc = evaluate_model(resnet, jaffe_loader, device)
78 mobilenet_acc = evaluate_model(mobilenet, jaffe_loader, device)
79
80 # 8. عرض النتائج
81 print(f"✅ ResNet18 Accuracy: {resnet_acc:.2f}%")
82 print(f"✅ MobileNetV2 Accuracy: {mobilenet_acc:.2f}%")
83
84 # 9. رسم بياني للمقارنة
85 results = {
86     'ResNet18': resnet_acc,
87     'MobileNetV2': mobilenet_acc
88 }
89
90 plt.bar(results.keys(), results.values())
91 plt.ylabel("Accuracy (%)")
92 plt.title("Model Comparison on JAFFE")
93 plt.ylim(0, 100)
94 plt.show()
95

```

 ResNet18 Accuracy: 14.08%
 MobileNetV2 Accuracy: 16.90%



```

1 import os
2 from PIL import Image
3 import torch
4 import torch.nn as nn
5 import torch.optim as optim
6 from torch.utils.data import Dataset, DataLoader
7 from torchvision import transforms, models, datasets
8 import matplotlib.pyplot as plt
9
10 # 1. لصور Dataset كلاس JAFFE
11 class JaffeDataset(Dataset):
12     def __init__(self, root_dir, transform=None):
13         self.root_dir = root_dir
14         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
15         self.transform = transform
16         self.emotion_dict = {
17             'AN': 0, 'DI': 1, 'FE': 2,
18             'HA': 3, 'NE': 4, 'SA': 5, 'SU': 6
19         }

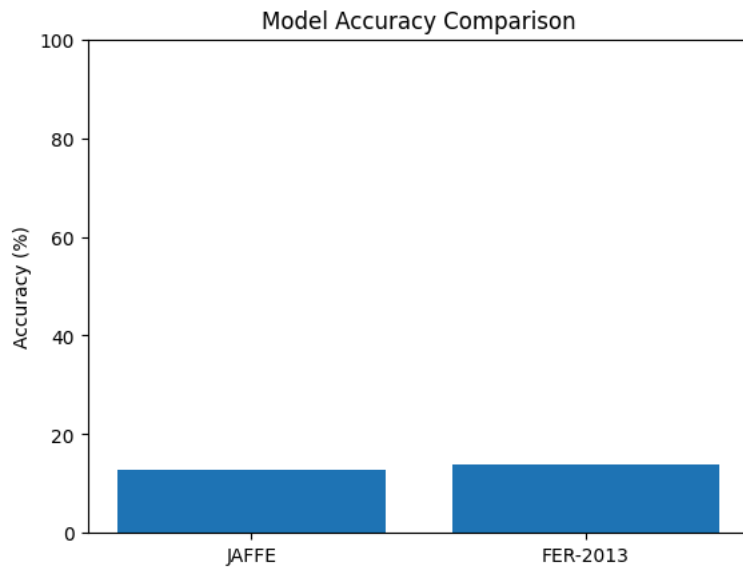
```

```

20
21 def __len__(self):
22     return len(self.image_files)
23
24 def __getitem__(self, idx):
25     image_path = os.path.join(self.root_dir, self.image_files[idx])
26     image = Image.open(image_path).convert('L') # رمادية
27     if self.transform:
28         image = self.transform(image)
29     emotion_code = self.image_files[idx].split('.')[1][:2]
30     label = self.emotion_dict[emotion_code]
31     return image, label
32
33 # 2. إعداد التحويلات
34 transform = transforms.Compose([
35     transforms.Lambda(lambda img: img.convert("RGB")),
36     transforms.Resize((128, 128)),
37     transforms.ToTensor()
38 ])
39
40 # 3. تحميل بيانات JAFFE
41 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
42 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
43 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=False)
44
45 # 4. مدرب مسبقًا + تعديل الطبقة الأخيرة ResNet18 تحميل نموذج
46 num_classes = 7
47 device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
48
49 resnet = models.resnet18(pretrained=True)
50 resnet.fc = nn.Linear(resnet.fc.in_features, num_classes)
51 resnet = resnet.to(device)
52
53 # 5. دالة تقييم الدقة
54 def evaluate_model(model, dataloader, device):
55     model.eval()
56     correct, total = 0, 0
57     with torch.no_grad():
58         for inputs, labels in dataloader:
59             inputs, labels = inputs.to(device), labels.to(device)
60             outputs = model(inputs)
61             _, preds = torch.max(outputs, 1)
62             correct += (preds == labels).sum().item()
63             total += labels.size(0)
64     return 100 * correct / total
65
66 # 6. تقييم النموذج على JAFFE
67 acc_jaffe = evaluate_model(resnet, jaffe_loader, device)
68 print(f"✅ JAFFE Accuracy: {acc_jaffe:.2f}%")
69
70 # 7. تقييم النموذج على FER-2013/test
71 test_dir = '/content/drive/MyDrive/Datasets/FER-2013/test'
72 test_dataset = datasets.ImageFolder(root=test_dir, transform=transform)
73 test_loader = DataLoader(test_dataset, batch_size=16, shuffle=False)
74
75 acc_fer = evaluate_model(resnet, test_loader, device)
76 print(f"✅ FER-2013 Test Accuracy: {acc_fer:.2f}%")
77
78 # 8. عرض النتائج في رسم بياني
79 results = {
80     'JAFFE': acc_jaffe,
81     'FER-2013': acc_fer
82 }
83
84 plt.bar(results.keys(), results.values())
85 plt.ylabel("Accuracy (%)")
86 plt.title("Model Accuracy Comparison")
87 plt.ylim(0, 100)
88 plt.show()
89

```

✓ JAFFE Accuracy: 12.68%
 ✓ FER-2013 Test Accuracy: 13.78%



```

1 # مثال: آخر 2 بلوك في فك تجميد بعض الطبقات فقط
2 for name, param in model.named_parameters():
3     if "layer4" in name or "fc" in name:
4         param.requires_grad = True
5     else:
6         param.requires_grad = False
7
8 # منخفض learning rate إعادة التدريب بـ
9 optimizer = optim.Adam(filter(lambda p: p.requires_grad, model.parameters()), lr=1e-4)
10
11
12 transform = transforms.Compose([
13     transforms.RandomHorizontalFlip(),
14     transforms.RandomRotation(20),
15     transforms.ColorJitter(brightness=0.3, contrast=0.3),
16     transforms.Resize((128, 128)),
17     transforms.ToTensor()
18 ])
19
20
21 from sklearn.model_selection import train_test_split
22
23 # تقسيم بدوي للفهرس
24 indices = list(range(len(full_dataset)))
25 train_idx, val_idx = train_test_split(indices, test_size=0.2, stratify=targets)
26
27 train_set = Subset(full_dataset, train_idx)
28 val_set = Subset(full_dataset, val_idx)
29
30 train_loader = DataLoader(train_set, batch_size=16, shuffle=True)
31 val_loader = DataLoader(val_set, batch_size=16, shuffle=False)
32
33
34 from torchvision import models
35 import torch.nn as nn
36
37 # عدد المشاعر
38 num_classes = len(full_dataset.classes) # أو test_dataset.classes حسب السياق
39
40 # تحميل النماذج المدربة مسبقًا
41 resnet = models.resnet18(pretrained=True)
42 mobilenet = models.mobilenet_v2(pretrained=True)
43
44 #
45
46

```

```

12 resnet.fc = nn.Linear(resnet.fc.in_features, num_classes)
13 mobilenet.classifier[1] = nn.Linear(mobilenet.classifier[1].in_features, num_classes)
14

```

```

1 from torchvision import transforms
2
3 transform = transforms.Compose([
4     transforms.RandomHorizontalFlip(),
5     transforms.RandomRotation(20),
6     transforms.RandomResizedCrop(128, scale=(0.8, 1.0)),
7     transforms.ColorJitter(brightness=0.2, contrast=0.2),
8     transforms.ToTensor(),
9 ])
10

```

```

1 from torchvision.models import efficientnet_b0
2 model = efficientnet_b0(pretrained=True)
3 model.classifier[1] = nn.Linear(model.classifier[1].in_features, num_classes)
4

```

Downloading: "https://download.pytorch.org/models/efficientnet_b0_rwightman-7f5810bc.pth" to /root/.cache/torch/hub/checkpoints/efficientnet_b0_rwightman-7f5810bc.pth [100%|██████████| 20.5M/20.5M [00:00<00:00, 114MB/s]]

```

1 for name, param in model.named_parameters():
2     param.requires_grad = "classifier" in name or "fc" in name
3
4
5 scheduler = torch.optim.lr_scheduler.StepLR(optimizer, step_size=5, gamma=0.1)
6
7
8 from sklearn.metrics import classification_report
9 print(classification_report(y_true, y_pred, target_names=full_dataset.classes))
10

```

	precision	recall	f1-score	support
angry	0.50	0.03	0.06	100
disgust	0.33	0.76	0.46	100
fear	0.35	0.09	0.14	100
happy	0.73	0.19	0.30	100
neutral	0.00	0.00	0.00	100
sad	0.34	0.36	0.35	100
surprise	0.28	0.84	0.41	100
accuracy			0.32	700
macro avg	0.36	0.32	0.25	700
weighted avg	0.36	0.32	0.25	700

```

1 # تقييم النموذج على بيانات التحقق أو التدريب
2 correct = 0
3 total = 0
4 model.eval()
5
6 with torch.no_grad():
7     for inputs, labels in train_loader: # أو test_loader
8         inputs, labels = inputs.to(device), labels.to(device)
9         outputs = model(inputs)
10        _, preds = torch.max(outputs, 1)
11        correct += (preds == labels).sum().item()
12        total += labels.size(0)
13
14 accuracy = 100 * correct / total
15 print(f"✅ Final Accuracy: {accuracy:.2f}%")
16

```

✅ Final Accuracy: 10.32%

```

1 إنشاء قائمتين لتخزين نتائج التدريب #
2
3 train_losses = []
4 train_accuracies = []
5
6 for epoch in range(epochs):
7     model.train()
8     running_loss = 0.0
9     correct = 0
10    total = 0
11    # بيانات التدريب (batch) تمرير كل دفعة بيانات
12
13    for inputs, labels in train_loader:
14        inputs, labels = inputs.to(device), labels.to(device)
15        optimizer.zero_grad()
16        outputs = model(inputs)
17        loss = criterion(outputs, labels)
18        loss.backward()
19        optimizer.step()
20
21        _, preds = torch.max(outputs, 1)
22        correct += torch.sum(preds == labels).item()
23        total += labels.size(0)
24        running_loss += loss.item()
25    # حساب متوسط الخسارة والدقة لهذا الـ epoch
26
27    epoch_loss = running_loss / len(train_loader)
28    epoch_acc = correct / total
29    train_losses.append(epoch_loss)
30    train_accuracies.append(epoch_acc)
31
32    # طباعة النتائج
33
34    print(f"Epoch {epoch+1}/{epochs}, Loss: {epoch_loss:.4f}, Accuracy: {epoch_acc:.4f}")
35

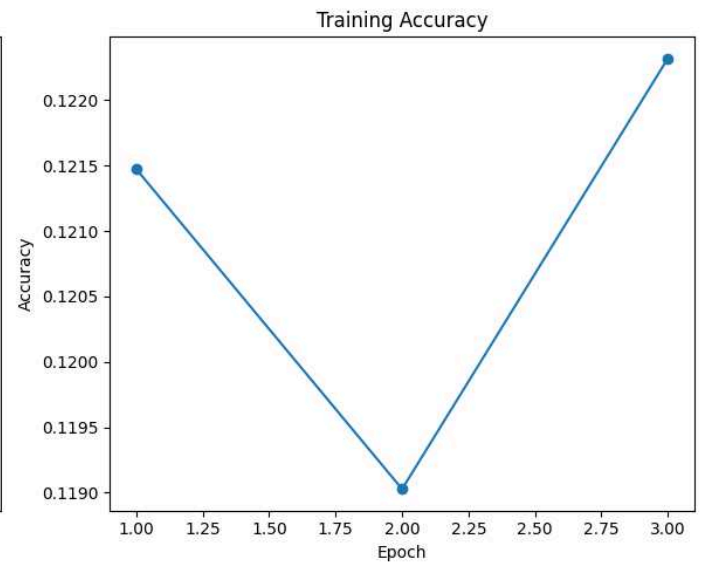
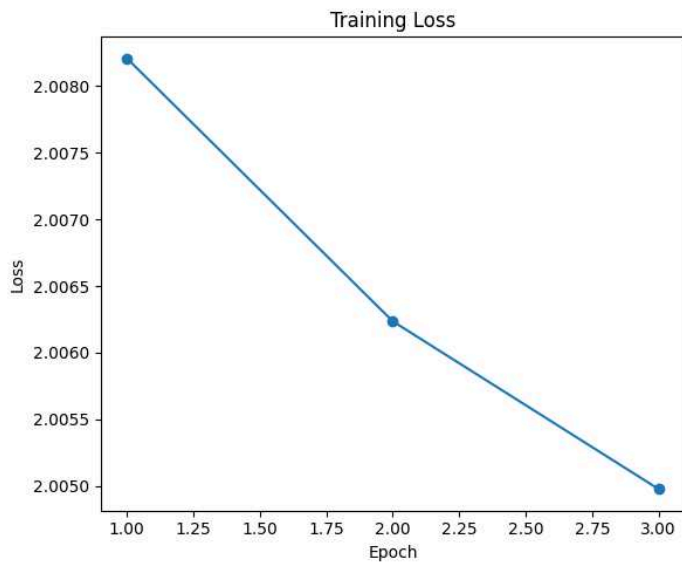
```

Epoch 1/3, Loss: 2.0082, Accuracy: 0.1215
 Epoch 2/3, Loss: 2.0062, Accuracy: 0.1190
 Epoch 3/3, Loss: 2.0050, Accuracy: 0.1223

```

1 import matplotlib.pyplot as plt
2
3 epochs_range = range(1, epochs + 1)
4 plt.figure(figsize=(12, 5))
5
6 # Loss Curve
7 plt.subplot(1, 2, 1)
8 plt.plot(epochs_range, train_losses, marker='o')
9 plt.title('Training Loss')
10 plt.xlabel('Epoch')
11 plt.ylabel('Loss')
12
13 # Accuracy Curve
14 plt.subplot(1, 2, 2)
15 plt.plot(epochs_range, train_accuracies, marker='o')
16 plt.title('Training Accuracy')
17 plt.xlabel('Epoch')
18 plt.ylabel('Accuracy')
19
20 plt.tight_layout()
21 plt.show()
22

```



```

1 import random
2 # عينة عشوائية من 8 صور
3 indices = random.sample(range(len(subset_dataset)), 8)
4 fig, axes = plt.subplots(2, 4, figsize=(15,6))
5 # تأكد أن النموذج في وضع التقييم
6 model.eval()
7 with torch.no_grad():
8     for i, idx in enumerate(indices):
9         image, true_label = subset_dataset[idx]
10        img_input = image.unsqueeze(0).to(device)
11        output = model(img_input)
12        _, pred_label = torch.max(output, 1)
13
14        ax = axes[i // 4, i % 4]
15        ax.imshow(image.permute(1, 2, 0)) # تحويل إلى HWC
16        ax.axis('off')
17        ax.set_title(
18            f"True: {full_dataset.classes[true_label]}\nPred: {full_dataset.classes[pred_label.item()]}",
19            color='green' if pred_label.item() == true_label else 'red'
20        )
21        # عرض التسمية الحقيقية والمتوقعة
22 plt.tight_layout()
23 plt.show()
24

```



```

1 # ✅ Cell 1: تحميل المكتبات الأساسية
2 import os
3 import random
4 import numpy as np
5 import pandas as pd
6 from PIL import Image
7 import torch
8 import torch.nn as nn
9 import torch.optim as optim
10 from torch.utils.data import Dataset, DataLoader, Subset
11 from torchvision import transforms, models
12 from sklearn.model_selection import StratifiedKFold
13 import matplotlib.pyplot as plt
14 from tqdm import tqdm
15 import warnings
16 warnings.filterwarnings("ignore")
17 device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
18 print("Using device:", device)
19

```

Using device: cpu

```

1 # ✅ Cell 2: Augmentation + Preprocessing (مع متوافقة ViT)
2 transform = transforms.Compose([
3     transforms.Resize((224, 224)), # ✅ مطلوب ViT-B_16
4     transforms.RandomHorizontalFlip(),
5     transforms.RandomRotation(10),
6     transforms.ColorJitter(brightness=0.2, contrast=0.2),
7     transforms.ToTensor()
8 ])
9

```

```

1 # ✅ Cell 3: JAFFE لقاعدة Dataset كلاس (مصححة)
2 class JaffeDataset(Dataset):
3     def __init__(self, root_dir, transform=None):
4         self.root_dir = root_dir
5         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
6         self.label_map = {'AN':0, 'DI':1, 'FE':2, 'HA':3, 'NE':4, 'SA':5, 'SU':6} # ✅ تم تحريكه للأعلى
7         self.labels = [self.get_label(f) for f in self.image_files]

```

```

8         self.transform = transform
9
10    def get_label(self, filename):
11        code = filename.split('.')[1][:2]
12        return self.label_map.get(code, 0)
13
14    def __len__(self):
15        return len(self.image_files)
16
17    def __getitem__(self, idx):
18        img_path = os.path.join(self.root_dir, self.image_files[idx])
19        image = Image.open(img_path).convert("RGB")
20        label = self.labels[idx]
21        if self.transform:
22            image = self.transform(image)
23        return image, label
24
25

```

1 #  Cell 4: وتعديله حسب عدد الفئات Vision Transformer تحميل نموذج

```

2 from torchvision.models import vit_b_16
3
4 def get_vit_model(num_classes):
5     model = vit_b_16(pretrained=True)
6     model.heads.head = nn.Linear(model.heads.head.in_features, num_classes)
7     return model.to(device)
8

```

1 #  Cell 5: K-Fold Cross Validation تدريب النموذج باستخدام

```

2 def train_kfold(dataset, k=5, epochs=3, batch_size=8, lr=1e-4):
3     skf = StratifiedKFold(n_splits=k, shuffle=True, random_state=42)
4     labels = dataset.labels
5     fold accuracies = []
6
7     for fold, (train_idx, val_idx) in enumerate(skf.split(np.zeros(len(labels)), labels)):
8         print(f"\n📁 Fold {fold+1}/{k}")
9
10        train_subset = Subset(dataset, train_idx)
11        val_subset = Subset(dataset, val_idx)
12
13        train_loader = DataLoader(train_subset, batch_size=batch_size, shuffle=True)
14        val_loader = DataLoader(val_subset, batch_size=batch_size, shuffle=False)
15
16        model = get_vit_model(num_classes=7)
17        optimizer = optim.Adam(model.parameters(), lr=lr)
18        criterion = nn.CrossEntropyLoss()
19
20        for epoch in range(epochs):
21            model.train()
22            running_loss, correct, total = 0.0, 0, 0
23
24            for inputs, labels in train_loader:
25                inputs, labels = inputs.to(device), labels.to(device)
26                optimizer.zero_grad()
27                outputs = model(inputs)
28                loss = criterion(outputs, labels)
29                loss.backward()
30                optimizer.step()
31                running_loss += loss.item()
32                _, preds = torch.max(outputs, 1)
33                correct += (preds == labels).sum().item()
34                total += labels.size(0)
35
36            train_acc = 100 * correct / total
37            print(f" Epoch {epoch+1}/{epochs} - Loss: {running_loss:.4f} - Accuracy: {train_acc:.2f}%")
38
39        # Evaluation on validation set
40        model.eval()
41        correct, total = 0, 0

```

```

42         with torch.no_grad():
43             for inputs, labels in val_loader:
44                 inputs, labels = inputs.to(device), labels.to(device)
45                 outputs = model(inputs)
46                 _, preds = torch.max(outputs, 1)
47                 correct += (preds == labels).sum().item()
48                 total += labels.size(0)
49         val_acc = 100 * correct / total
50         fold accuracies.append(val_acc)
51         print(f"✅ Fold {fold+1} Validation Accuracy: {val_acc:.2f}%")
52
53     avg_acc = sum(fold accuracies) / len(fold accuracies)
54     print(f"\n🇲🇪 متوسط الدقة بعد {k}-Fold: {avg_acc:.2f}%")
55     return fold accuracies
56

```

```

1 # ✅ Cell 6: تشغيل Cross-Validation قاعدة JAFFE
2 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
3 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
4 fold_scores = train_kfold(jaffe_dataset, k=5, epochs=3)
5

```



```

📁 Fold 1/5
Epoch 1/3 - Loss: 45.9319 - Accuracy: 11.18%
Epoch 2/3 - Loss: 45.5905 - Accuracy: 11.76%
Epoch 3/3 - Loss: 44.2825 - Accuracy: 11.76%
✅ Fold 1 Validation Accuracy: 13.95%

📁 Fold 2/5
Epoch 1/3 - Loss: 47.6721 - Accuracy: 17.06%
Epoch 2/3 - Loss: 44.2056 - Accuracy: 12.35%
Epoch 3/3 - Loss: 44.2212 - Accuracy: 11.76%
✅ Fold 2 Validation Accuracy: 11.63%

📁 Fold 3/5
Epoch 1/3 - Loss: 47.0767 - Accuracy: 13.53%
Epoch 2/3 - Loss: 44.4361 - Accuracy: 11.76%
Epoch 3/3 - Loss: 43.9874 - Accuracy: 8.82%
✅ Fold 3 Validation Accuracy: 13.95%

📁 Fold 4/5
Epoch 1/3 - Loss: 46.5798 - Accuracy: 14.04%
Epoch 2/3 - Loss: 45.2788 - Accuracy: 13.45%
Epoch 3/3 - Loss: 44.1608 - Accuracy: 12.28%
✅ Fold 4 Validation Accuracy: 14.29%

📁 Fold 5/5
Epoch 1/3 - Loss: 45.8935 - Accuracy: 12.28%
Epoch 2/3 - Loss: 43.9983 - Accuracy: 10.53%
Epoch 3/3 - Loss: 44.0432 - Accuracy: 11.70%
✅ Fold 5 Validation Accuracy: 14.29%

🇲🇪 متوسط الدقة بعد 5 -Fold: 13.62%

```

```

1 # ✅ Cell CK+: لقاعدة Dataset كلاس CK+
2 class CKPlusDataset(Dataset):
3     def __init__(self, dataframe, transform=None):
4         self.df = dataframe
5         self.transform = transform
6
7     def __len__(self):
8         return len(self.df)
9
10    def __getitem__(self, idx):
11        pixels = [int(p) for p in self.df.iloc[idx]['pixels'].split()]
12        image = np.array(pixels).reshape(48, 48).astype(np.uint8)
13        image = Image.fromarray(image).convert("RGB") # تأكد من RGB
14        if self.transform:
15            image = self.transform(image)
16        label = int(self.df.iloc[idx]['emotion'])
17        return image, label
18

```

1 Start coding or generate with AI.

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