

```

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')

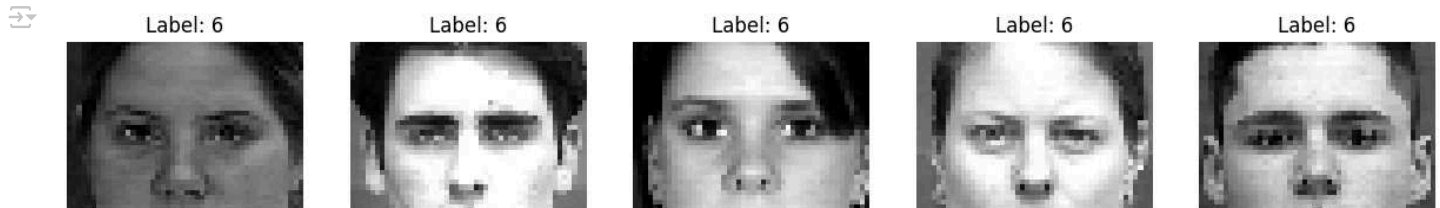
```

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



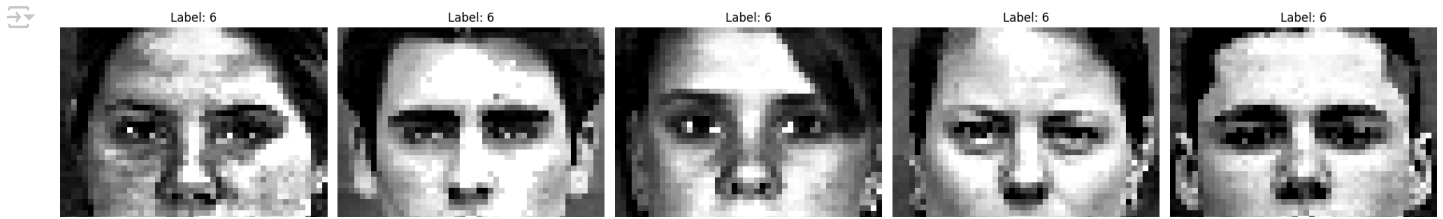
Dimensions of RGB Image: (128, 128, 3)

```

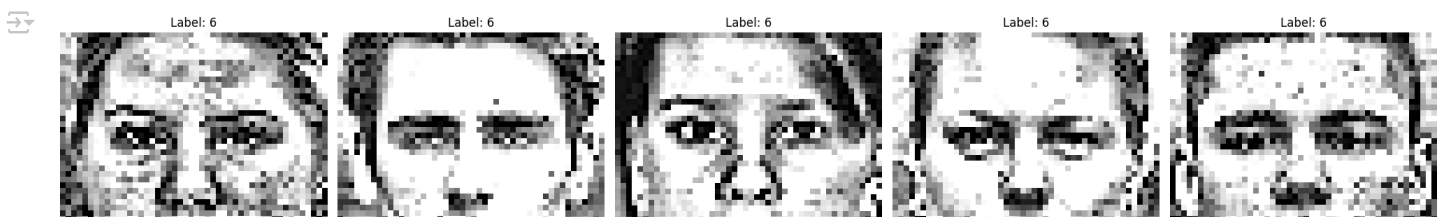
1 import pandas as pd
2 import numpy as np
3 import matplotlib.pyplot as plt
4 import cv2
5
6 # تحميل ملف CSV
7 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
8 df_ck = pd.read_csv(csv_path)
9
10 # تحسين الصورة (تباين وحدة) مع التأكد من القناة الواحدة والنوع
11 def enhance_image(image):
12     # قناة 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 # 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_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 Filter
18     bilateral = cv2.bilateralFilter(image_clahe, d=9, sigmaColor=75, sigmaSpace=75)
19
20     # حدة مع Unsharp Mask

```

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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
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 # إلى رقم label إنشاء قاموس لتحويل كل Index
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
18
19 import os
20 from PIL import Image
21 import torch
22 from torch.utils.data import Dataset, DataLoader
23 from torchvision import transforms
24
25 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
26 #4. لتحميل الصور والتسميات JaffeDataset تعريف كلاس.
27
28 class JaffeDataset(Dataset):
29     def __init__(self, root_dir, transform=None):
30         self.root_dir = root_dir
31         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
32         self.transform = transform
33         self.labels = [self.get_label(f) for f in self.image_files]
34         self.label_map = {label: idx for idx, label in enumerate(sorted(set(self.labels)))}
35         self.labels_idx = [self.label_map[label] for label in self.labels]
36
37     def get_label(self, filename):
38         return filename.split('.')[1] # AN, HA, etc.
39
40     def __len__(self):
41         return len(self.image_files)
42
43     def __getitem__(self, idx):
44         img_path = os.path.join(self.root_dir, self.image_files[idx])
45         image = Image.open(img_path).convert('RGB')
46         if self.transform:
47             image = self.transform(image)
48         label = self.labels_idx[idx]
49         return image, label
50
51
52 #3. تطبيق التحويلات على الصور (Preprocessing)
53
54 transform = transforms.Compose([
55     transforms.Resize((128,128)),
56     transforms.ToTensor()
57 ])
58 # تحميل البيانات داخل DataLoader
59
60 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
61 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
62
63
64 import pandas as pd
65 import numpy as np
66
67 csv_path = '/content/drive/MyDrive/Datasets/CK+/ckextended.csv'
68 df_ck = pd.read_csv(csv_path)
69
70 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) # CK+ سنبدله لاحقاً لـ
15 model = model.to(device)
16
17 # تعريف دالة الخسارة (Loss Function) والمُحسِّن (Optimizer):
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 = 45
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=0.0423, Loss=3.5417
JAFfE Epoch 2: Accuracy=0.0516, Loss=3.3005
JAFfE Epoch 3: Accuracy=0.0986, Loss=2.9897
JAFfE Epoch 4: Accuracy=0.1033, Loss=2.9613
JAFfE Epoch 5: Accuracy=0.1596, Loss=2.7834
JAFfE Epoch 6: Accuracy=0.1737, Loss=2.6625
JAFfE Epoch 7: Accuracy=0.1362, Loss=2.6883
JAFfE Epoch 8: Accuracy=0.2066, Loss=2.4317
JAFfE Epoch 9: Accuracy=0.2582, Loss=2.1691
JAFfE Epoch 10: Accuracy=0.2441, Loss=2.1952
JAFfE Epoch 11: Accuracy=0.3474, Loss=1.8670
JAFfE Epoch 12: Accuracy=0.3756, Loss=1.7576
JAFfE Epoch 13: Accuracy=0.4038, Loss=1.5630
JAFfE Epoch 14: Accuracy=0.4085, Loss=1.6606
JAFfE Epoch 15: Accuracy=0.3991, Loss=1.7367
JAFfE Epoch 16: Accuracy=0.4883, Loss=1.4560
JAFfE Epoch 17: Accuracy=0.4977, Loss=1.3735
JAFfE Epoch 18: Accuracy=0.4178, Loss=1.5723
JAFfE Epoch 19: Accuracy=0.4742, Loss=1.4081
JAFfE Epoch 20: Accuracy=0.5211, Loss=1.3671
JAFfE Epoch 21: Accuracy=0.5540, Loss=1.1800
JAFfE Epoch 22: Accuracy=0.5117, Loss=1.2430
JAFfE Epoch 23: Accuracy=0.5352, Loss=1.2044
JAFfE Epoch 24: Accuracy=0.5540, Loss=1.2814
JAFfE Epoch 25: Accuracy=0.4742, Loss=1.4862
JAFfE Epoch 26: Accuracy=0.6103, Loss=1.1323
JAFfE Epoch 27: Accuracy=0.6573, Loss=0.9348
JAFfE Epoch 28: Accuracy=0.6526, Loss=0.9306
JAFfE Epoch 29: Accuracy=0.7512, Loss=0.7311
JAFfE Epoch 30: Accuracy=0.8028, Loss=0.6713
JAFfE Epoch 31: Accuracy=0.8075, Loss=0.5672
JAFfE Epoch 32: Accuracy=0.8216, Loss=0.5730
JAFfE Epoch 33: Accuracy=0.7840, Loss=0.6516
JAFfE Epoch 34: Accuracy=0.7746, Loss=0.7408
JAFfE Epoch 35: Accuracy=0.7277, Loss=0.7825
JAFfE Epoch 36: Accuracy=0.6995, Loss=1.0116
JAFfE Epoch 37: Accuracy=0.7606, Loss=0.6436
JAFfE Epoch 38: Accuracy=0.8310, Loss=0.5471
JAFfE Epoch 39: Accuracy=0.8028, Loss=0.5352
JAFfE Epoch 40: Accuracy=0.8451, Loss=0.4537
JAFfE Epoch 41: Accuracy=0.7746, Loss=0.6057
JAFfE Epoch 42: Accuracy=0.8451, Loss=0.5341
JAFfE Epoch 43: Accuracy=0.7840, Loss=0.5357
JAFfE Epoch 44: Accuracy=0.7653, Loss=0.6762
JAFfE Epoch 45: Accuracy=0.7887, Loss=0.6162

```

```

1 model.classifier[1] = nn.Linear(model.last_channel, num_classes_ck)
2 model = model.to(device)
3
4 for epoch in range(190):
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=0.5359, Loss=1.5531
CK+ Epoch 2: Accuracy=0.7478, Loss=0.9251
CK+ Epoch 3: Accuracy=0.8065, Loss=0.6830
CK+ Epoch 4: Accuracy=0.8696, Loss=0.4556
CK+ Epoch 5: Accuracy=0.8902, Loss=0.3790
CK+ Epoch 6: Accuracy=0.8837, Loss=0.3664
CK+ Epoch 7: Accuracy=0.9163, Loss=0.2877
CK+ Epoch 8: Accuracy=0.9315, Loss=0.2264
CK+ Epoch 9: Accuracy=0.9283, Loss=0.2460

```

```

CK+ Epoch 10: Accuracy=0.9467, Loss=0.1898
CK+ Epoch 11: Accuracy=0.9641, Loss=0.1290
CK+ Epoch 12: Accuracy=0.9511, Loss=0.1648
CK+ Epoch 13: Accuracy=0.9402, Loss=0.1957
CK+ Epoch 14: Accuracy=0.9674, Loss=0.1423
CK+ Epoch 15: Accuracy=0.9804, Loss=0.0904
CK+ Epoch 16: Accuracy=0.9804, Loss=0.0793
CK+ Epoch 17: Accuracy=0.9772, Loss=0.1083
CK+ Epoch 18: Accuracy=0.9554, Loss=0.1424
CK+ Epoch 19: Accuracy=0.9467, Loss=0.1595
CK+ Epoch 20: Accuracy=0.9641, Loss=0.1381
CK+ Epoch 21: Accuracy=0.9837, Loss=0.0732
CK+ Epoch 22: Accuracy=0.9750, Loss=0.1029
CK+ Epoch 23: Accuracy=0.9685, Loss=0.0932
CK+ Epoch 24: Accuracy=0.9783, Loss=0.0856
CK+ Epoch 25: Accuracy=0.9522, Loss=0.1484
CK+ Epoch 26: Accuracy=0.9543, Loss=0.1696
CK+ Epoch 27: Accuracy=0.9641, Loss=0.1083
CK+ Epoch 28: Accuracy=0.9815, Loss=0.0749
CK+ Epoch 29: Accuracy=0.9761, Loss=0.0740
CK+ Epoch 30: Accuracy=0.9804, Loss=0.0600
CK+ Epoch 31: Accuracy=0.9859, Loss=0.0585
CK+ Epoch 32: Accuracy=0.9859, Loss=0.0427
CK+ Epoch 33: Accuracy=0.9870, Loss=0.0466
CK+ Epoch 34: Accuracy=0.9859, Loss=0.0543
CK+ Epoch 35: Accuracy=0.9576, Loss=0.1511
CK+ Epoch 36: Accuracy=0.9913, Loss=0.0349
CK+ Epoch 37: Accuracy=0.9891, Loss=0.0514
CK+ Epoch 38: Accuracy=0.9880, Loss=0.0566
CK+ Epoch 39: Accuracy=0.9891, Loss=0.0503
CK+ Epoch 40: Accuracy=0.9696, Loss=0.1001
CK+ Epoch 41: Accuracy=0.9837, Loss=0.0575
CK+ Epoch 42: Accuracy=0.9652, Loss=0.1162
CK+ Epoch 43: Accuracy=0.9707, Loss=0.0990
CK+ Epoch 44: Accuracy=0.9793, Loss=0.0793
CK+ Epoch 45: Accuracy=0.9870, Loss=0.0439
CK+ Epoch 46: Accuracy=0.9837, Loss=0.0531
CK+ Epoch 47: Accuracy=0.9826, Loss=0.0720
CK+ Epoch 48: Accuracy=0.9728, Loss=0.0827
CK+ Epoch 49: Accuracy=0.9804, Loss=0.0614
CK+ Epoch 50: Accuracy=0.9924, Loss=0.0336
CK+ Epoch 51: Accuracy=0.9848, Loss=0.0389
CK+ Epoch 52: Accuracy=0.9630, Loss=0.1230
CK+ Epoch 53: Accuracy=0.9902, Loss=0.0435
CK+ Epoch 54: Accuracy=0.9957, Loss=0.0235
CK+ Epoch 55: Accuracy=0.9978, Loss=0.0091
CK+ Epoch 56: Accuracy=0.9902, Loss=0.0334
CK+ Epoch 57: Accuracy=0.9848, Loss=0.0519
CK+ Epoch 58: Accuracy=0.9837, Loss=0.0539

```

```

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 # عدل حسب مجلدك Google Drive مسار الصورة من
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 والمعدلة
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



Double-click (or enter) to edit

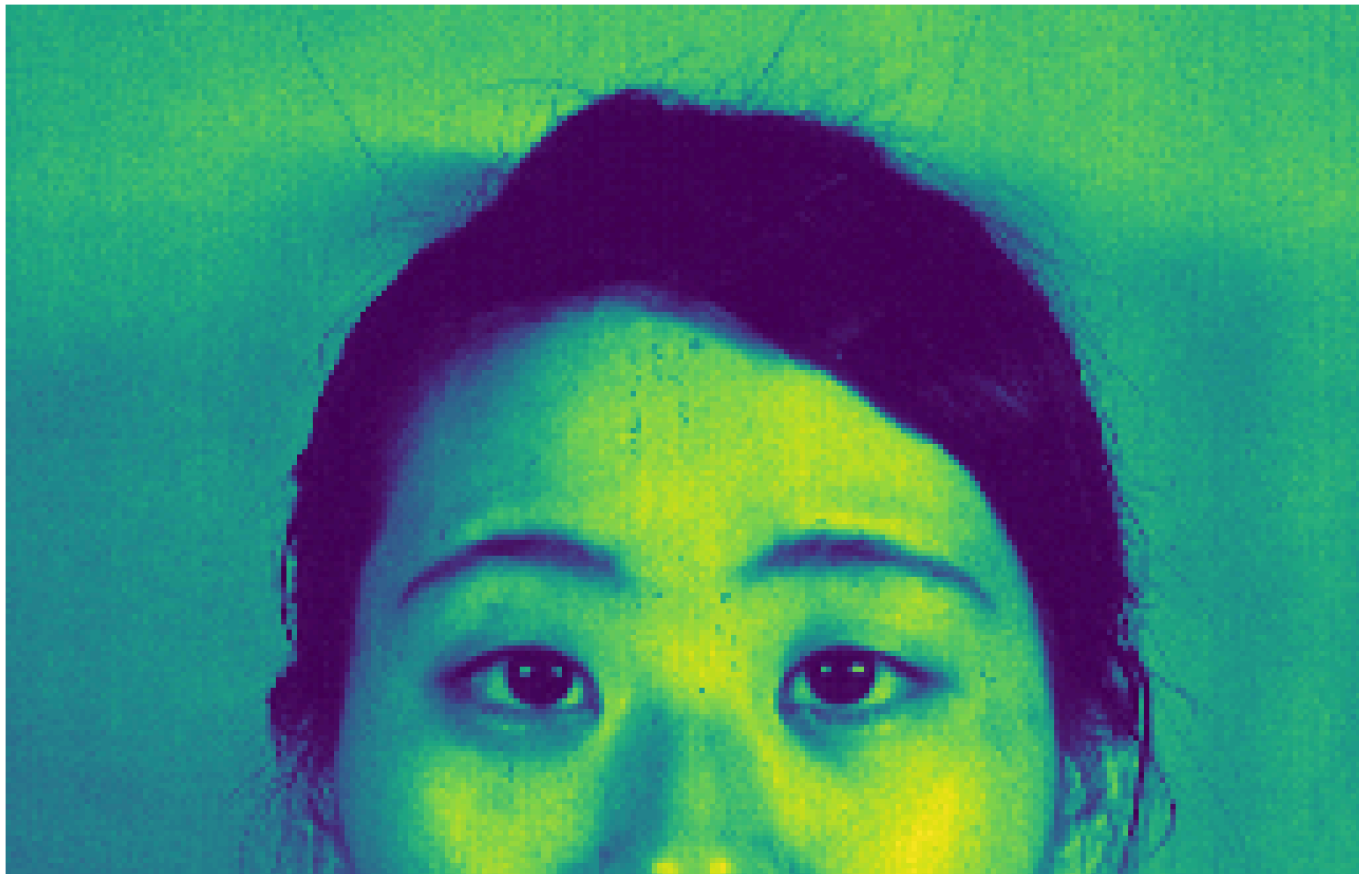
Resized



```

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
42
43 1 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
44 2
45 3 class JaffeDataset(Dataset):
46 4     def __init__(self, root_dir, transform=None):
47 5         self.root_dir = root_dir
48 6         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
49 7         self.transform = transform
50 8         self.labels = [self.get_label(f) for f in self.image_files]
51 9         self.label_map = {label: idx for idx, label in enumerate(sorted(set(self.labels)))}
52 10        self.labels_idx = [self.label_map[label] for label in self.labels]
53 11
54 12    def get_label(self, filename):
55 13        return filename.split('.')[1] # AN, HA, etc.
56 14
57 15    def __len__(self):
58 16        return len(self.image_files)
59 17
60 18    def __getitem__(self, idx):
61 19        img_path = os.path.join(self.root_dir, self.image_files[idx])
62 20        image = Image.open(img_path).convert('RGB')
63 21        if self.transform:
64 22            image = self.transform(image)
65 23        label = self.labels_idx[idx]
66 24        return image, label
67 25
68 26 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
69 27 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
70 28 num_classes_jaffe = len(set(jaffe_dataset.labels))
71 29
72
73 1 import torch
74 2 import torch.nn as nn
75 3
76 4 class SimpleCNN(nn.Module):
77 5     def __init__(self, num_classes):
78 6         super(SimpleCNN, self).__init__()
79 7         self.model = nn.Sequential(
80 8             nn.Conv2d(3, 32, kernel_size=3, stride=1, padding=1),
81 9             nn.ReLU(),
82 10            nn.MaxPool2d(2),
83 11
84 12            nn.Conv2d(32, 64, kernel_size=3, stride=1, padding=1),
85 13            nn.ReLU(),
86 14            nn.MaxPool2d(2),
87 15
88 16            nn.Conv2d(64, 128, kernel_size=3, stride=1, padding=1),
89 17            nn.ReLU(),
90 18            nn.MaxPool2d(2),
91 19
92 20            nn.Flatten(),
93 21            nn.Linear(128 * 16 * 16, 128),
94 22            nn.ReLU(),
95 23            nn.Dropout(0.5),
96 24            nn.Linear(128, num_classes)
97 25        )
98 26
99 27    def forward(self, x):
100 28        return self.model(x)
101 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
8
9 # استيراد المكتبات اللازمة
10 import torch
11 import torch.nn as nn
12 from torchvision import models
13 import matplotlib.pyplot as plt
14
15 # (إن وُجد GPU) تحديد الجهاز
16 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
17
18 # JAFFE مثلاً 7 مشاعر في) وتعديله لعدد الأصناف MobileNetV2 تحميل نموذج
19 def get_mobilenetv2(num_classes):
20     model = models.mobilenet_v2(weights=None) # بدون أوزان مُسبقة
21     model.classifier[1] = nn.Linear(model.last_channel, num_classes) # تعديل الطبقة الأخيرة
22     return model
23
24 # إعداد النموذج والوظائف المساعدة
25 model = get_mobilenetv2(num_classes_jaffe)
26 model = model.to(device)
27 optimizer = torch.optim.Adam(model.parameters(), lr=0.001)
28 criterion = nn.CrossEntropyLoss()
29
30 # عدد الدورات التدريبية
31 epochs = 45
32 train_losses, train_accs = [], []
33
34 # التدريب
35 for epoch in range(epochs):
36     model.train() # وضع النموذج في طور التدريب
37     running_loss = 0.0
38     correct = 0
39     total = 0
40
41     # حلقة على دفعات البيانات
42     for inputs, labels in jaffe_loader:
43         inputs, labels = inputs.to(device), labels.to(device)
44
45         optimizer.zero_grad()
46         outputs = model(inputs)
47         loss = criterion(outputs, labels)
48         loss.backward()
49         optimizer.step()
50
51         running_loss += loss.item()
52
53         _, preds = torch.max(outputs, 1)
54         correct += (preds == labels).sum().item()
55         total += labels.size(0)
56
57     # epoch حساب متوسط الخسارة والدقة لكل
58     epoch_loss = running_loss / len(jaffe_loader)
59     epoch_acc = correct / total
60
61     # تسجيل القيم في القوائم
62     train_losses.append(epoch_loss)
63     train_accs.append(epoch_acc)
64
65     print(f"Epoch {epoch+1}/{epochs}: Loss={epoch_loss:.4f}, Accuracy={epoch_acc:.4f}")
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99

```

Epoch 1/45: Loss=3.5622, Accuracy=0.0188
Epoch 2/45: Loss=3.3827, Accuracy=0.0329

```
Epoch 3/45: Loss=3.2723, Accuracy=0.0798
Epoch 4/45: Loss=3.2139, Accuracy=0.0563
Epoch 5/45: Loss=3.0694, Accuracy=0.0657
Epoch 6/45: Loss=2.8080, Accuracy=0.1174
Epoch 7/45: Loss=2.7637, Accuracy=0.1127
Epoch 8/45: Loss=2.6086, Accuracy=0.1127
Epoch 9/45: Loss=2.4761, Accuracy=0.2066
Epoch 10/45: Loss=2.3182, Accuracy=0.1643
Epoch 11/45: Loss=2.0756, Accuracy=0.2582
Epoch 12/45: Loss=1.9031, Accuracy=0.3286
Epoch 13/45: Loss=2.2427, Accuracy=0.2254
Epoch 14/45: Loss=1.9603, Accuracy=0.2770
Epoch 15/45: Loss=1.8481, Accuracy=0.3099
Epoch 16/45: Loss=1.6083, Accuracy=0.4178
Epoch 17/45: Loss=1.5744, Accuracy=0.4507
Epoch 18/45: Loss=1.6038, Accuracy=0.3521
Epoch 19/45: Loss=1.5139, Accuracy=0.3709
Epoch 20/45: Loss=1.4631, Accuracy=0.4507
Epoch 21/45: Loss=1.4383, Accuracy=0.4507
Epoch 22/45: Loss=1.3299, Accuracy=0.4930
Epoch 23/45: Loss=1.3188, Accuracy=0.5305
Epoch 24/45: Loss=1.1270, Accuracy=0.5587
Epoch 25/45: Loss=1.1413, Accuracy=0.5915
Epoch 26/45: Loss=1.1572, Accuracy=0.5915
Epoch 27/45: Loss=1.1535, Accuracy=0.5493
Epoch 28/45: Loss=0.9995, Accuracy=0.6291
Epoch 29/45: Loss=1.1437, Accuracy=0.6150
Epoch 30/45: Loss=1.0887, Accuracy=0.5822
Epoch 31/45: Loss=0.9217, Accuracy=0.6667
Epoch 32/45: Loss=0.9046, Accuracy=0.6854
Epoch 33/45: Loss=0.7393, Accuracy=0.7606
Epoch 34/45: Loss=0.5281, Accuracy=0.7840
Epoch 35/45: Loss=0.6364, Accuracy=0.7840
Epoch 36/45: Loss=0.6972, Accuracy=0.7559
Epoch 37/45: Loss=0.7486, Accuracy=0.7324
Epoch 38/45: Loss=1.0619, Accuracy=0.6291
Epoch 39/45: Loss=0.8483, Accuracy=0.6995
Epoch 40/45: Loss=0.7011, Accuracy=0.7700
Epoch 41/45: Loss=0.5599, Accuracy=0.8169
Epoch 42/45: Loss=0.5617, Accuracy=0.7887
Epoch 43/45: Loss=0.6037, Accuracy=0.7653
Epoch 44/45: Loss=0.5118, Accuracy=0.8310
Epoch 45/45: Loss=0.4166, Accuracy=0.8592
```

```
1 import matplotlib.pyplot as plt
2
3 plt.figure(figsize=(8,5))
4 plt.plot(train_accs, label="Training Accuracy")
5 plt.plot(val_accs, label="Validation Accuracy")
6 plt.title("JAFFE - Training vs Validation Accuracy")
7 plt.xlabel("Epoch"); plt.ylabel("Accuracy")
8 plt.legend(); plt.grid(True); plt.show()
9
```

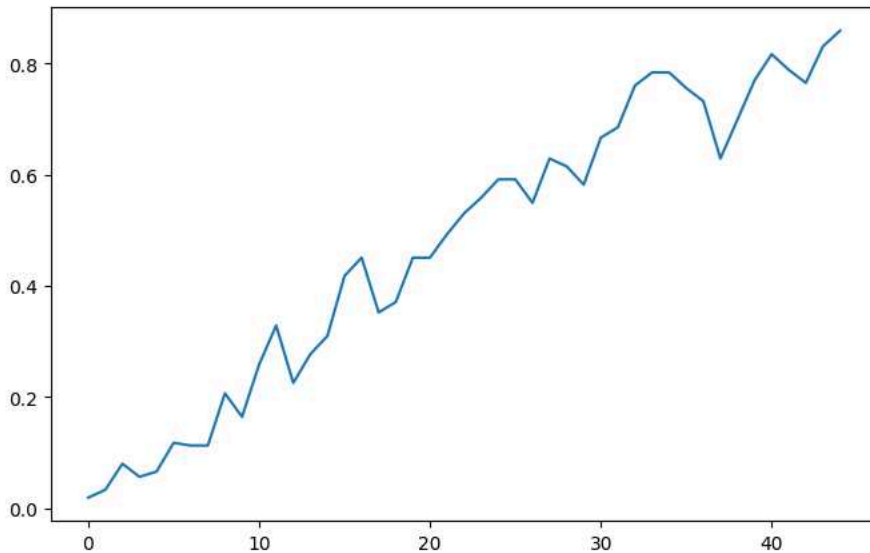


```

-----
NameError                                Traceback (most recent call last)
/tmp/ipython-input-1069374777.py in <cell line: 0>()
      3 plt.figure(figsize=(8,5))
      4 plt.plot(train_accs, label="Training Accuracy")
----> 5 plt.plot(val_accs, label="Validation Accuracy")
      6 plt.title("JAFEE - Training vs Validation Accuracy")
      7 plt.xlabel("Epoch"); plt.ylabel("Accuracy")

NameError: name 'val_accs' is not defined

```



1 Start coding or generate with AI.

1 Start coding or generate with AI.

1 Start coding or generate with AI.

1 Start coding or generate with AI.

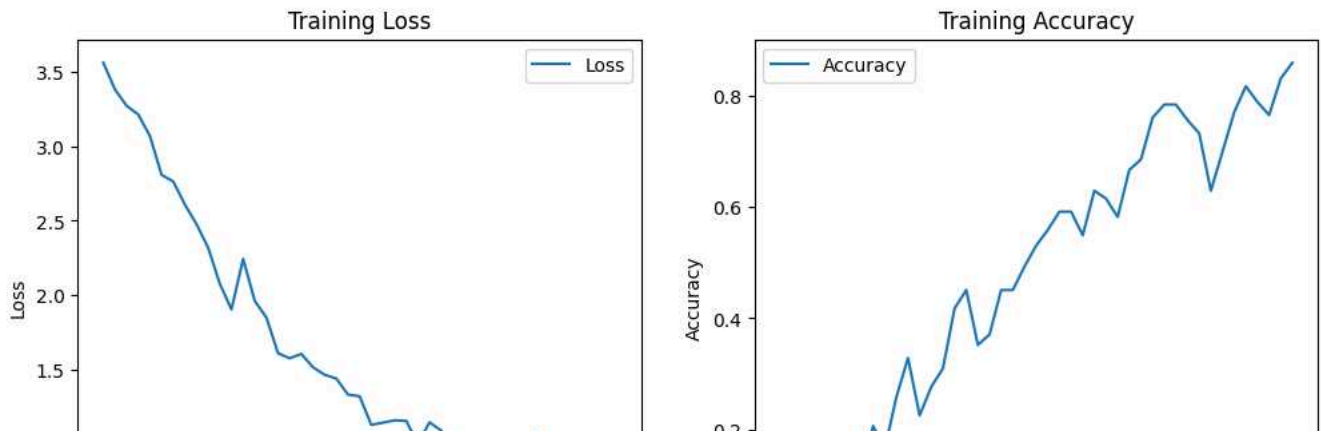
1 Start coding or generate with AI.

1 Start coding or generate with AI.

```

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 import pandas as pd
2 import numpy as np
3 import torch
4 from torch.utils.data import Dataset
5 from PIL import Image
6 from torchvision import transforms
7
8 class CKPlusFromCSV(Dataset):
9     def __init__(self, csv_file, usage="Training", transform=None):
10         self.data = pd.read_csv(csv_file)
11         self.data = self.data[self.data["Usage"] == usage].reset_index(drop=True)
12         self.transform = transform
13
14     def __len__(self):
15         return len(self.data)
16
17     def __getitem__(self, idx):
18         pixels = np.array(self.data.loc[idx, "pixels"].split(), dtype=np.uint8)
19         img = pixels.reshape(48, 48) # CK+ 48x48 غالباً
20         img = Image.fromarray(img)
21
22         label = int(self.data.loc[idx, "emotion"])
23         if self.transform:
24             img = self.transform(img)
25         return img, label
26
27 # ===== التحويلات =====
28 transform_ck = transforms.Compose([
29     transforms.Grayscale(num_output_channels=3), # تحويل لثلاث قنوات
30     transforms.Resize((224, 224)),
31     transforms.ToTensor()
32 ])
33
34 # ===== تحميل البيانات =====
35 csv_path = "/content/drive/MyDrive/Datasets/CK+/ckextended.csv"
36 full_dataset_ck = CKPlusFromCSV(csv_file=csv_path, usage="Training", transform=transform_ck)
37
38 print(f"عدد العينات: {len(full_dataset_ck)}")
39

```



عدد العينات: 734

```

1 from torch.utils.data import random_split, DataLoader
2 import torch, torch.nn as nn, torch.optim as optim
3 from torchvision.models import resnet18, ResNet18_Weights
4
5 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
6
7 # 1) DataLoaders ثم إرجاع الـ Train/Val دالة تقسيم الداتا إلى
8 def make_loaders(dataset, batch_size=64, val_ratio=0.15, seed=42):
9     val_len = int(len(dataset) * val_ratio)
10     train_len = len(dataset) - val_len
11     train_ds, val_ds = random_split(

```

```

12     dataset, [train_len, val_len],
13     generator=torch.Generator().manual_seed(seed)
14 )
15 train_loader = DataLoader(train_ds, batch_size=batch_size, shuffle=True, num_workers=2, pin_memory=True)
16 val_loader = DataLoader(val_ds, batch_size=batch_size, shuffle=False, num_workers=2, pin_memory=True)
17 return train_ds, val_ds, train_loader, val_loader
18
19 # 2) إنشاء اللودرز لـ CK+
20 train_ds_ck, val_ds_ck, train_loader_ck, val_loader_ck = make_loaders(full_dataset_ck, batch_size=64, val_ratio=0.15)
21
22 # 3) عدد الأصناف
23 if hasattr(full_dataset_ck, "classes"):
24     num_classes_ck = len(full_dataset_ck.classes)
25 elif hasattr(full_dataset_ck, "data"):
26     num_classes_ck = int(full_dataset_ck.data["emotion"].nunique())
27 else:
28     # احتياطي: استخرج الليبلات من خلال المرور مرة واحدة
29     labels = [full_dataset_ck[i][1] for i in range(len(full_dataset_ck))]
30     num_classes_ck = len(set(labels))
31
32 # 4) Loss الموديل + الأوتوماتاير والـ
33 model_ck = resnet18(weights=ResNet18_Weights.DEFAULT)
34 model_ck.fc = nn.Linear(model_ck.fc.in_features, num_classes_ck)
35 model_ck = model_ck.to(device)
36
37 criterion = nn.CrossEntropyLoss()
38 optimizer_ck = optim.Adam(model_ck.parameters(), lr=1e-3)
39
40 # 5) التدريب مع حفظ التاريخ
41 epochs = 20
42 train_acc_history_ck, val_acc_history_ck = [], []
43
44 for epoch in range(1, epochs+1):
45     # --- TRAIN ---
46     model_ck.train()
47     tr_corr = tr_cnt = 0
48     for x, y in train_loader_ck:
49         x, y = x.to(device), y.to(device)
50         optimizer_ck.zero_grad()
51         out = model_ck(x)
52         loss = criterion(out, y)
53         loss.backward()
54         optimizer_ck.step()
55
56         tr_corr += (out.argmax(1) == y).sum().item()
57         tr_cnt += x.size(0)
58
59     train_acc = tr_corr / tr_cnt
60     train_acc_history_ck.append(train_acc)
61
62     # --- VAL ---
63     model_ck.eval()
64     va_corr = va_cnt = 0
65     with torch.no_grad():
66         for x, y in val_loader_ck:
67             x, y = x.to(device), y.to(device)
68             out = model_ck(x)
69             va_corr += (out.argmax(1) == y).sum().item()
70             va_cnt += x.size(0)
71
72     val_acc = va_corr / va_cnt
73     val_acc_history_ck.append(val_acc)
74
75     print(f"Epoch {epoch}/{epochs} | Train Acc {train_acc:.4f} | Val Acc {val_acc:.4f}")
76

```

 Downloading: "<https://download.pytorch.org/models/resnet18-f37072fd.pth>" to /root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
 100%|██████████| 44.7M/44.7M [00:00<00:00, 132MB/s]
 Epoch 1/20 | Train Acc 0.6506 | Val Acc 0.6545
 Epoch 2/20 | Train Acc 0.9295 | Val Acc 0.8727
 Epoch 3/20 | Train Acc 0.9696 | Val Acc 0.9000

```

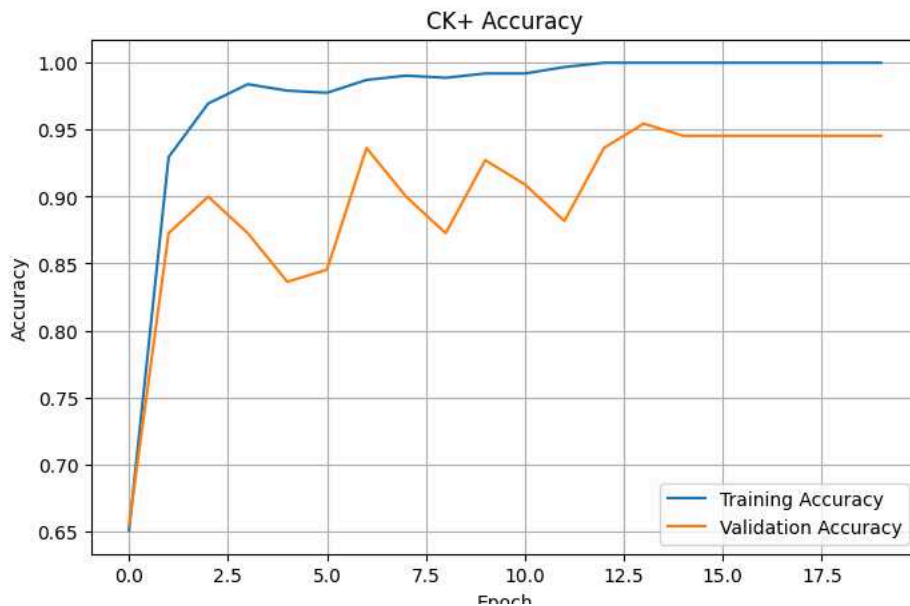
Epoch 4/20 | Train Acc 0.9840 | Val Acc 0.8727
Epoch 5/20 | Train Acc 0.9792 | Val Acc 0.8364
Epoch 6/20 | Train Acc 0.9776 | Val Acc 0.8455
Epoch 7/20 | Train Acc 0.9872 | Val Acc 0.9364
Epoch 8/20 | Train Acc 0.9904 | Val Acc 0.9000
Epoch 9/20 | Train Acc 0.9888 | Val Acc 0.8727
Epoch 10/20 | Train Acc 0.9920 | Val Acc 0.9273
Epoch 11/20 | Train Acc 0.9920 | Val Acc 0.9091
Epoch 12/20 | Train Acc 0.9968 | Val Acc 0.8818
Epoch 13/20 | Train Acc 1.0000 | Val Acc 0.9364
Epoch 14/20 | Train Acc 1.0000 | Val Acc 0.9545
Epoch 15/20 | Train Acc 1.0000 | Val Acc 0.9455
Epoch 16/20 | Train Acc 1.0000 | Val Acc 0.9455
Epoch 17/20 | Train Acc 1.0000 | Val Acc 0.9455
Epoch 18/20 | Train Acc 1.0000 | Val Acc 0.9455
Epoch 19/20 | Train Acc 1.0000 | Val Acc 0.9455
Epoch 20/20 | Train Acc 1.0000 | Val Acc 0.9455

```

```

1 import matplotlib.pyplot as plt
2
3 plt.figure(figsize=(8,5))
4 plt.plot(train_acc_history_ck, label='Training Accuracy')
5 plt.plot(val_acc_history_ck, label='Validation Accuracy')
6 plt.xlabel('Epoch'); plt.ylabel('Accuracy'); plt.title('CK+ Accuracy')
7 plt.legend(); plt.grid(True); plt.show()
8

```



```

1 import torch, os
2
3 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
4 torch.backends.cudnn.benchmark = True
5 if hasattr(torch, "set_float32_matmul_precision"):
6     torch.set_float32_matmul_precision('high')
7
8
9 import pandas as pd, numpy as np, torch
10 from torch.utils.data import Dataset
11 from PIL import Image
12
13 class CKPlusFast(Dataset):
14     def __init__(self, csv_file, usage="Training", transform=None, cache_pt_path=None):
15         self.transform = transform
16         df = pd.read_csv(csv_file)
17         if "Usage" in df.columns:
18             df = df[df["Usage"] == usage].reset_index(drop=True)
19
20         # تسريع التشغيل اللاحق .pt كاش إلى
21         if cache_pt_path and os.path.isfile(cache_pt_path):
22             data = torch.load(cache_pt_path)
23
24

```

```

15         self.images = data["images"]      # uint8 [N,48,48]
16         self.labels = data["labels"]      # long  [N]
17     else:
18         # __getitem__ بدل كل مرة واحدة pixels فك الـ
19         px = df["pixels"].apply(lambda s: np.fromstring(s, sep=' ', dtype=np.uint8))
20         self.images = np.stack([p.reshape(48,48) for p in px], axis=0) # [N,48,48]
21         self.labels = df["emotion"].astype(np.int64).to_numpy()
22         self.images = torch.from_numpy(self.images)      # uint8
23         self.labels = torch.from_numpy(self.labels)      # long
24         if cache_pt_path:
25             torch.save({"images": self.images, "labels": self.labels}, cache_pt_path)
26
27     def __len__(self): return len(self.labels)
28
29     def __getitem__(self, idx):
30         img = Image.fromarray(self.images[idx].numpy(), mode='L') # PIL(L)
31         if self.transform: img = self.transform(img)              # -> 3x224x224
32         return img, self.labels[idx].item()
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```

50     train_hist, val_hist = [], []
51
52     for ep in range(1, epochs+1):
53         # ---- Train (AMP) ----
54         model.train(); tr_corr=tr_cnt=0; tr_loss_sum=0.0
55         for x,y in train_loader:
56             x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
57             opt.zero_grad(set_to_none=True)
58             with torch.cuda.amp.autocast(enabled=(device.type=='cuda')):
59                 out = model(x)
60                 loss = crit(out,y)
61                 scaler.scale(loss).backward()
62                 scaler.step(opt)
63                 scaler.update()
64                 tr_loss_sum += loss.item()*x.size(0)
65                 tr_corr += (out.argmax(1)==y).sum().item()
66                 tr_cnt += x.size(0)
67         train_acc = tr_corr/tr_cnt; train_hist.append(train_acc)
68
69         # ---- Val ----
70         model.eval(); va_corr=va_cnt=0; va_loss_sum=0.0
71         with torch.no_grad(), torch.cuda.amp.autocast(enabled=(device.type=='cuda')):
72             for x,y in val_loader:
73                 x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
74                 out = model(x); loss = crit(out,y)
75                 va_loss_sum += loss.item()*x.size(0)
76                 va_corr += (out.argmax(1)==y).sum().item()
77                 va_cnt += x.size(0)
78         val_loss = va_loss_sum/va_cnt; val_acc = va_corr/va_cnt; val_hist.append(val_acc)
79
80         print(f"Epoch {ep}/{epochs} | Train Acc {train_acc:.4f} | Val Acc {val_acc:.4f} | Val Loss {val_loss:.4f}")
81
82         # Early Stopping
83         if val_loss < best_val - 1e-4:
84             best_val = val_loss; bad = 0
85             best_state = {k:v.detach().cpu().clone() for k,v in model.state_dict().items()}
86         else:
87             bad += 1
88             if bad >= patience:
89                 print(f"Early stop @ epoch {ep}")
90                 break
91
92     # Load best
93     model.load_state_dict(best_state, strict=True)
94     return train_hist, val_hist
95

```

```

1 from torchvision import datasets
2
3 # FER-2013
4 FER_DIR = "/content/drive/MyDrive/Datasets/FER-2013/train" # عدّل المسار
5 if os.path.isdir(FER_DIR):
6     fer_full = datasets.ImageFolder(FER_DIR, transform=COMMON_TF)
7     # تخفيض العينة (مثلاً 500 لكل فئة)
8     fer_targets = fer_full.targets
9     fer_idx = cap_per_class_indices(fer_targets, per_class=500)
10    from torch.utils.data import Subset
11    fer_ds = Subset(fer_full, fer_idx)
12
13    trF, vaF, trL_F, vaL_F = make_loaders(fer_ds, batch_size=64, val_ratio=0.15)
14    model_fer = build_model(num_classes=len(fer_full.classes), freeze_backbone=True)
15    hist_trF, hist_vaF = train_fast(model_fer, trL_F, vaL_F, epochs=150, lr=1e-3, patience=3)
16
17 # JAFFE
18 JAFFE_DIR = "/content/drive/MyDrive/Datasets/JAFFE" # عدّل المسار
19 if os.path.isdir(JAFFE_DIR):
20     jaffe_full = datasets.ImageFolder(JAFFE_DIR, transform=COMMON_TF)
21     # غالباً صغير، لكن تستطيع تقليص لو رغبت
22     trJ, vaJ, trL_J, vaL_J = make_loaders(jaffe_full, batch_size=64, val_ratio=0.15)

```

```

23     model_jaffe = build_model(num_classes=len(jaffe_full.classes), freeze_backbone=True)
24     hist_trJ, hist_vaJ = train_fast(model_jaffe, trL_J, vaL_J, epochs=70, lr=1e-3, patience=3)
25

```

```

⚡ /tmp/ipython-input-169423696.py:48: FutureWarning: `torch.cuda.amp.GradScaler(args...)` is deprecated. Please use `torch.amp.GradScaler(
    scaler = torch.cuda.amp.GradScaler(enabled=(device.type=='cuda'))
/tmp/ipython-input-169423696.py:58: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
No CUDA runtime is found, using CUDA_HOME='/usr/local/cuda'
/tmp/ipython-input-169423696.py:58: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
/tmp/ipython-input-169423696.py:71: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.no_grad(), torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
Epoch 1/12 | Train Acc 0.3629 | Val Acc 0.4665 | Val Loss 1.3862
/tmp/ipython-input-169423696.py:58: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
/tmp/ipython-input-169423696.py:71: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.no_grad(), torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
Epoch 2/12 | Train Acc 0.6229 | Val Acc 0.4193 | Val Loss 1.7564
Epoch 3/12 | Train Acc 0.7792 | Val Acc 0.4232 | Val Loss 2.1252
Epoch 4/12 | Train Acc 0.8759 | Val Acc 0.4154 | Val Loss 2.4618
Early stop @ epoch 4

```

```

1 CK_CSV = "/content/drive/MyDrive/Datasets/CK+/ckextended.csv" # عدل المسار
2 if os.path.isfile(CK_CSV):
3     ck_ds = CKPlusFast(CK_CSV, usage="Training", transform=COMMON_TF,
4                        cache_pt_path="/content/ck_train_cache.pt")
5     trC, vaC, trL_C, vaL_C = make_loaders(ck_ds, batch_size=64, val_ratio=0.15)
6     # تقدير عدد الأصناف
7     try:
8         n_cls_ck = int(pd.read_csv(CK_CSV).query("Usage=='Training'")["emotion"].nunique())
9     except:
10         labels_ck = [ck_ds[i][1] for i in range(len(ck_ds))]
11         n_cls_ck = len(set(labels_ck))
12     model_ck = build_model(num_classes=n_cls_ck, freeze_backbone=True)
13     hist_trC, hist_vaC = train_fast(model_ck, trL_C, vaL_C, epochs=12, lr=1e-3, patience=3)
14

```

```

⚡ /tmp/ipython-input-169423696.py:48: FutureWarning: `torch.cuda.amp.GradScaler(args...)` is deprecated. Please use `torch.amp.GradScaler(
    scaler = torch.cuda.amp.GradScaler(enabled=(device.type=='cuda'))
/tmp/ipython-input-415479120.py:30: DeprecationWarning: 'mode' parameter is deprecated and will be removed in Pillow 13 (2026-10-15)
    img = Image.fromarray(self.images[idx].numpy(), mode='L') # PIL(L)
/tmp/ipython-input-415479120.py:30: DeprecationWarning: 'mode' parameter is deprecated and will be removed in Pillow 13 (2026-10-15)
    img = Image.fromarray(self.images[idx].numpy(), mode='L') # PIL(L)
/tmp/ipython-input-169423696.py:58: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
/tmp/ipython-input-169423696.py:58: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
/tmp/ipython-input-169423696.py:71: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.no_grad(), torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
/tmp/ipython-input-415479120.py:30: DeprecationWarning: 'mode' parameter is deprecated and will be removed in Pillow 13 (2026-10-15)
    img = Image.fromarray(self.images[idx].numpy(), mode='L') # PIL(L)
/tmp/ipython-input-415479120.py:30: DeprecationWarning: 'mode' parameter is deprecated and will be removed in Pillow 13 (2026-10-15)
    img = Image.fromarray(self.images[idx].numpy(), mode='L') # PIL(L)
Epoch 1/12 | Train Acc 0.6635 | Val Acc 0.7636 | Val Loss 1.0532
/tmp/ipython-input-169423696.py:58: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
/tmp/ipython-input-169423696.py:71: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast('cuc
    with torch.no_grad(), torch.cuda.amp.autocast(enabled=(device.type=='cuda'))):
Epoch 2/12 | Train Acc 0.9343 | Val Acc 0.8636 | Val Loss 0.5601
Epoch 3/12 | Train Acc 0.9904 | Val Acc 0.9091 | Val Loss 0.3183
Epoch 4/12 | Train Acc 1.0000 | Val Acc 0.9182 | Val Loss 0.3544
Epoch 5/12 | Train Acc 1.0000 | Val Acc 0.9182 | Val Loss 0.2930
Epoch 6/12 | Train Acc 1.0000 | Val Acc 0.9182 | Val Loss 0.2723
Epoch 7/12 | Train Acc 1.0000 | Val Acc 0.9000 | Val Loss 0.2920
Epoch 8/12 | Train Acc 1.0000 | Val Acc 0.9000 | Val Loss 0.2691
Epoch 9/12 | Train Acc 1.0000 | Val Acc 0.9091 | Val Loss 0.2366
Epoch 10/12 | Train Acc 1.0000 | Val Acc 0.9182 | Val Loss 0.2291
Epoch 11/12 | Train Acc 1.0000 | Val Acc 0.9182 | Val Loss 0.2261
Epoch 12/12 | Train Acc 1.0000 | Val Acc 0.9182 | Val Loss 0.2251

```

```

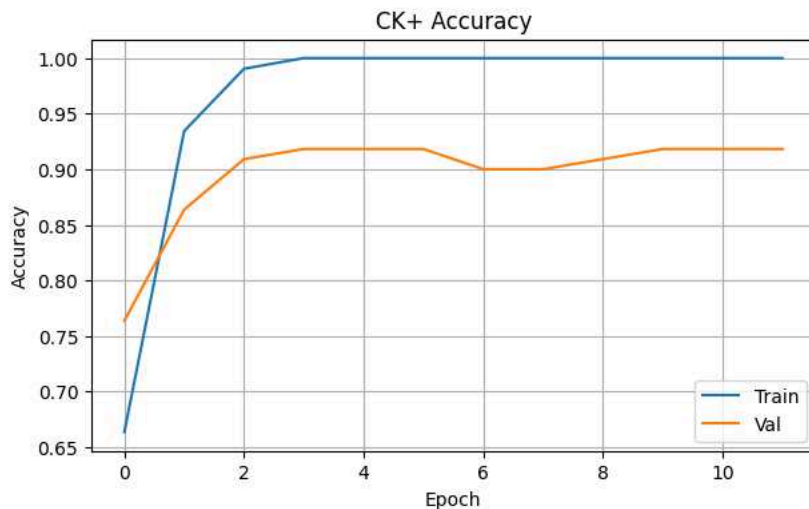
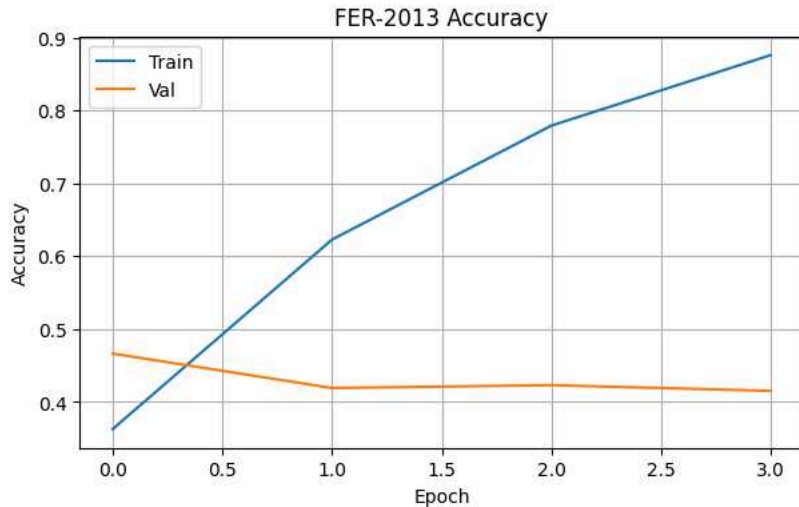
1 def plot_hist(htr, hva, title):
2     plt.figure(figsize=(7,4)); plt.plot(htr,label='Train'); plt.plot(hva,label='Val')
3     plt.title(title); plt.xlabel('Epoch'); plt.ylabel('Accuracy'); plt.grid(True); plt.legend(); plt.show()
4
5 if 'hist_trF' in globals(): plot_hist(hist_trF, hist_vaF, "FER-2013 Accuracy")

```

```

6 if 'hist_trJ' in globals(): plot_hist(hist_trJ, hist_vaJ, "JAFPE Accuracy")
7 if 'hist_trC' in globals(): plot_hist(hist_trC, hist_vaC, "CK+ Accuracy")
8

```



```

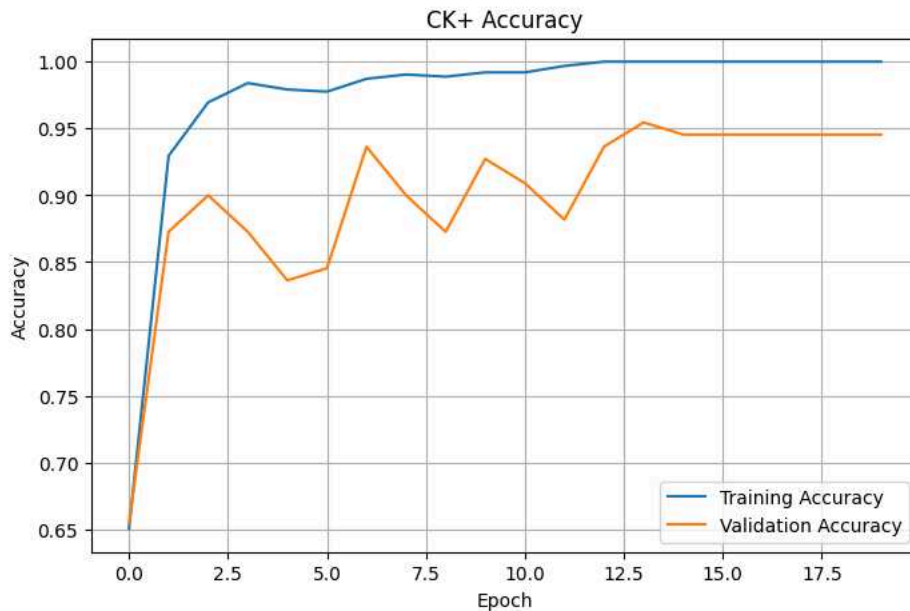
1 # ===== Plot Training/Validation Accuracy for CK+, JAFPE, FER-2013 =====
2 import matplotlib.pyplot as plt
3
4 def plot_accuracies(train_acc, val_acc, title="Accuracy Curve"):
5     plt.figure(figsize=(8,5))
6     plt.plot(train_acc, label='Training Accuracy')
7     plt.plot(val_acc, label='Validation Accuracy')
8     plt.title(title)
9     plt.xlabel('Epoch')
10    plt.ylabel('Accuracy')
11    plt.legend()
12    plt.grid(True)
13    plt.show()
14
15 def safe_plot(var_train_name, var_val_name, title):
16     g = globals()
17     if var_train_name in g and var_val_name in g and len(g[var_train_name]) and len(g[var_val_name]):
18         plot_accuracies(g[var_train_name], g[var_val_name], title)
19     else:
20         print(f"{title}. لا توجد بيانات لعرض [تنبيه]. ")
21         print(f"أثناء التدريب {var_val_name} و {var_train_name} تأكد من إنشاء")
22
23 # أمثلة الأسماء الشائعة التي خزننا فيها التاريخ أثناء التدريب:
24 # CK+
25 safe_plot("train_acc_history_ck", "val_acc_history_ck", "CK+ Accuracy")
26
27 # JAFPE

```

```

28 safe_plot("train_acc_history_jaffe", "val_acc_history_jaffe", "JAFPE Accuracy")
29
30 # FER-2013
31 safe_plot("train_acc_history_fer", "val_acc_history_fer", "FER-2013 Accuracy")
32

```



أثناء التدريب val_acc_history_jaffe و train_acc_history_jaffe تأكد من إنشاء JAFPE Accuracy. لا توجد بيانات لعرض [تنبيه]
 أثناء التدريب val_acc_history_fer و train_acc_history_fer تأكد من إنشاء FER-2013 Accuracy. لا توجد بيانات لعرض [تنبيه]

```

1 # ==== Quick Train & Plot (5 epochs, fast) ====
2 import os, random, torch, torch.nn as nn, torch.optim as optim
3 from torch.utils.data import DataLoader, random_split, Subset
4 from torchvision import datasets, transforms
5 from torchvision.models import resnet18, ResNet18_Weights
6 import matplotlib.pyplot as plt
7
8 # ----- إعدادات سريعة -----
9 DATA_DIR = "/content/drive/MyDrive/Datasets/FER-2013/train" # <-- عدّل المسار (أو JAFPE)
10 USE_EXISTING_DATASET = False # جاهز full_dataset لو عندك = True
11 EPOCHS = 50
12 BATCH = 64
13 VAL_RATIO = 0.15
14 PER_CLASS_CAP = 300 # قلّ العينة لسرعة أعلى
15 IMAGENET_MEAN=(0.485,0.456,0.406); IMAGENET_STD=(0.229,0.224,0.225)
16
17 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
18 torch.backends.cudnn.benchmark = True
19
20 tf = transforms.Compose([
21     transforms.Grayscale(3),
22     transforms.Resize((224,224)),
23     transforms.ToTensor(),
24     transforms.Normalize(IMAGENET_MEAN, IMAGENET_STD),
25 ])
26
27 # ----- مع تقليل العينة (ImageFolder) تحميل الداتا -----
28 def cap_per_class_indices(targets, per_class):
29     from collections import defaultdict
30     d=defaultdict(list)
31     for i,y in enumerate(targets): d[y].append(i)
32     sel=[]
33     for y,ix in d.items():
34         k=min(per_class,len(ix))
35         sel.extend(random.sample(ix,k))
36     random.shuffle(sel)
37     return sel
38
39 if USE_EXISTING_DATASET and 'full_dataset' in globals():

```

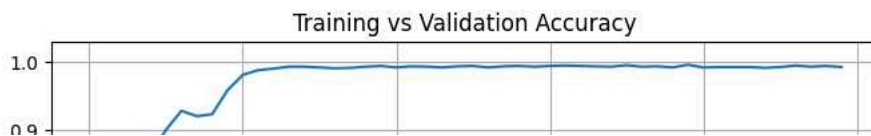
```

40     ds_full = full_dataset
41 else:
42     ds_full = datasets.ImageFolder(DATA_DIR, transform=tf)
43
44 # تقليل العينة (اختياري لكنه يسرع كثيرًا)
45 if hasattr(ds_full, 'targets'):
46     idx = cap_per_class_indices(ds_full.targets, PER_CLASS_CAP)
47     ds = Subset(ds_full, idx)
48 else:
49     ds = ds_full
50
51 # ----- Train/Val loaders -----
52 val_len = int(len(ds)*VAL_RATIO)
53 train_len = len(ds) - val_len
54 train_ds, val_ds = random_split(ds, [train_len, val_len], generator=torch.Generator().manual_seed(42))
55
56 loader_kw = dict(batch_size=BATCH, num_workers=2, pin_memory=True, persistent_workers=True)
57 train_loader = DataLoader(train_ds, shuffle=True, **loader_kw)
58 val_loader   = DataLoader(val_ds,   shuffle=False, **loader_kw)
59
60 # ----- الموديل (ResNet18 + Transfer Learning) -----
61 num_classes = len(ds_full.classes)
62 model = resnet18(weights=ResNet18_Weights.DEFAULT)
63 model.fc = nn.Linear(model.fc.in_features, num_classes)
64 model = model.to(device)
65
66 criterion = nn.CrossEntropyLoss()
67 optimizer = optim.AdamW(model.parameters(), lr=1e-3)
68
69 # ----- تدريب سريع + تخزين الدقة -----
70 train_acc_history, val_acc_history = [], []
71 for epoch in range(1, EPOCHS+1):
72     # TRAIN
73     model.train(); tr_corr=tr_cnt=0
74     for x,y in train_loader:
75         x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
76         optimizer.zero_grad()
77         out = model(x)
78         loss = criterion(out,y)
79         loss.backward(); optimizer.step()
80         tr_corr += (out.argmax(1)==y).sum().item(); tr_cnt += x.size(0)
81     train_acc = tr_corr/tr_cnt; train_acc_history.append(train_acc)
82
83     # VAL
84     model.eval(); va_corr=va_cnt=0
85     with torch.no_grad():
86         for x,y in val_loader:
87             x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
88             out = model(x)
89             va_corr += (out.argmax(1)==y).sum().item(); va_cnt += x.size(0)
90     val_acc = va_corr/va_cnt; val_acc_history.append(val_acc)
91
92     print(f"Epoch {epoch}/{EPOCHS} | Train {train_acc:.4f} | Val {val_acc:.4f}")
93
94 # ----- رسم المنحنى -----
95 plt.figure(figsize=(8,5))
96 plt.plot(train_acc_history, label='Training Accuracy')
97 plt.plot(val_acc_history, label='Validation Accuracy')
98 plt.title('Training vs Validation Accuracy'); plt.xlabel('Epoch'); plt.ylabel('Accuracy')
99 plt.grid(True); plt.legend(); plt.show()
100

```

Downloading: "<https://download.pytorch.org/models/resnet18-f37072fd.pth>" to /root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
 100%|██████████| 44.7M/44.7M [00:00<00:00, 131MB/s]

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Epoch 1/50 | Train 0.3429 | Val 0.3175
Epoch 2/50 | Train 0.5378 | Val 0.4159
Epoch 3/50 | Train 0.6577 | Val 0.3587
Epoch 4/50 | Train 0.7272 | Val 0.4032
Epoch 5/50 | Train 0.8655 | Val 0.4381
Epoch 6/50 | Train 0.9008 | Val 0.4159
Epoch 7/50 | Train 0.9283 | Val 0.4190
Epoch 8/50 | Train 0.9204 | Val 0.4190
Epoch 9/50 | Train 0.9232 | Val 0.4476
Epoch 10/50 | Train 0.9580 | Val 0.4476
Epoch 11/50 | Train 0.9804 | Val 0.4667
Epoch 12/50 | Train 0.9871 | Val 0.4444
Epoch 13/50 | Train 0.9894 | Val 0.4571
Epoch 14/50 | Train 0.9922 | Val 0.4508
Epoch 15/50 | Train 0.9922 | Val 0.4571
Epoch 16/50 | Train 0.9910 | Val 0.4635
Epoch 17/50 | Train 0.9899 | Val 0.4603
Epoch 18/50 | Train 0.9905 | Val 0.4667
Epoch 19/50 | Train 0.9922 | Val 0.4667
Epoch 20/50 | Train 0.9933 | Val 0.4698
Epoch 21/50 | Train 0.9910 | Val 0.4730
Epoch 22/50 | Train 0.9927 | Val 0.4667
Epoch 23/50 | Train 0.9922 | Val 0.4571
Epoch 24/50 | Train 0.9910 | Val 0.4667
Epoch 25/50 | Train 0.9927 | Val 0.4603
Epoch 26/50 | Train 0.9933 | Val 0.4730
Epoch 27/50 | Train 0.9910 | Val 0.4667
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Epoch 29/50 | Train 0.9933 | Val 0.4603
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Epoch 31/50 | Train 0.9933 | Val 0.4540
Epoch 32/50 | Train 0.9938 | Val 0.4603
Epoch 33/50 | Train 0.9933 | Val 0.4667
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Epoch 38/50 | Train 0.9927 | Val 0.4635
Epoch 39/50 | Train 0.9910 | Val 0.4603
Epoch 40/50 | Train 0.9950 | Val 0.4762
Epoch 41/50 | Train 0.9910 | Val 0.4603
Epoch 42/50 | Train 0.9916 | Val 0.4540
Epoch 43/50 | Train 0.9916 | Val 0.4635
Epoch 44/50 | Train 0.9916 | Val 0.4635
Epoch 45/50 | Train 0.9905 | Val 0.4635
Epoch 46/50 | Train 0.9916 | Val 0.4635
Epoch 47/50 | Train 0.9938 | Val 0.4698
Epoch 48/50 | Train 0.9922 | Val 0.4667
Epoch 49/50 | Train 0.9933 | Val 0.4635
Epoch 50/50 | Train 0.9916 | Val 0.4762
```



```
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
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```

4     # TRAIN
5     model.train()
6     tr_corr = tr_cnt = 0
7     for x,y in train_loader:
8         x,y = x.to(device), y.to(device)
9         optimizer.zero_grad()
10        out = model(x)
11        loss = criterion(out, y)
12        loss.backward()
13        optimizer.step()
14        tr_corr += (out.argmax(1)==y).sum().item()
15        tr_cnt += x.size(0)
16    train_hist.append(tr_corr/tr_cnt)
17
18    # VAL
19    model.eval()
20    va_corr = va_cnt = 0
21    with torch.no_grad():
22        for x,y in val_loader:
23            x,y = x.to(device), y.to(device)
24            out = model(x)
25            va_corr += (out.argmax(1)==y).sum().item()
26            va_cnt += x.size(0)
27    val_hist.append(va_corr/va_cnt)
28    return train_hist, val_hist
29
30
31 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe'
32
33 class JaffeDataset(Dataset):
34     def __init__(self, root_dir, transform=None):
35         self.root_dir = root_dir
36         self.image_files = [f for f in os.listdir(root_dir) if f.endswith(".tiff")]
37         self.transform = transform
38         self.labels = [self.get_label(f) for f in self.image_files]
39         self.label_map = {label: idx for idx, label in enumerate(sorted(set(self.labels)))}
40         self.labels_idx = [self.label_map[label] for label in self.labels]
41
42     def get_label(self, filename):
43         return filename.split('.')[1] # AN, HA, etc.
44
45     def __len__(self):
46         return len(self.image_files)
47
48     def __getitem__(self, idx):
49         img_path = os.path.join(self.root_dir, self.image_files[idx])
50         image = Image.open(img_path).convert('RGB')
51         if self.transform:
52             image = self.transform(image)
53         label = self.labels_idx[idx]
54         return image, label
55
56 transform = T.Compose([
57     T.RandomHorizontalFlip(),
58     T.RandomVerticalFlip(),
59     T.RandomRotation(10),
60     T.Resize((128,128)),
61     T.ToTensor()
62 ])
63
64 jaffe_dataset = JaffeDataset(jaffe_path, transform=transform)
65 jaffe_loader = DataLoader(jaffe_dataset, batch_size=8, shuffle=True)
66 num_classes_jaffe = len(set(jaffe_dataset.labels))
67

```

```

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

```

```

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=30):
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: 3.6338 Acc: 0.0141
Epoch 2/2
-----
Loss: 3.3782 Acc: 0.0188

```

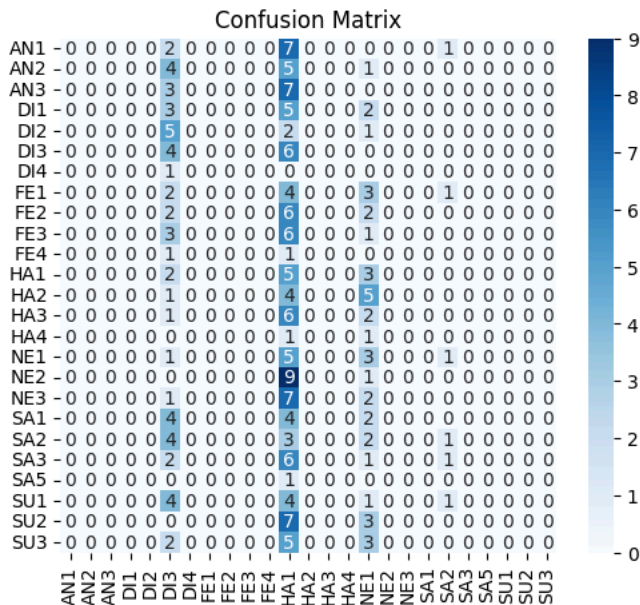
```

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
1 #
2
3 def evaluate_model(model_name, y_true, y_pred, y_proba):
4     labels = list(jaffe_dataset.label_map.keys())
5     accuracy = accuracy_score(y_true, y_pred)
6     precision = precision_score(y_true, y_pred, average='weighted', zero_division=0)
7     recall = recall_score(y_true, y_pred, average='weighted')
8     f1 = f1_score(y_true, y_pred, average='weighted')
9     cm = confusion_matrix(y_true, y_pred)
10
11     print(f"[{model_name}] Accuracy: {accuracy:.4f}")
12     print("Precision:", precision)
13     print("Recall:", recall)
14     print("F1-score:", f1)
15     print("Classification Report:\n", classification_report(y_true, y_pred, target_names=labels))
16
17     plt.figure(figsize=(6,5))
18     sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=labels, yticklabels=labels)
19     plt.title('Confusion Matrix')
20     plt.show()
21
22 evaluate_model("ResNet18 on JAFFE", y_true, y_pred, y_proba)
23

```

[ResNet18 on JAFFE] Accuracy: 0.0610
Precision: 0.01707118632810716
Recall: 0.06103286384976526
F1-score: 0.021401235540912313
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	0.08	0.40	0.13	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	0.04	0.50	0.08	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	0.08	0.30	0.12	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	0.17	0.10	0.12	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	0.00	0.00	0.00	10
SU3	0.00	0.00	0.00	10
accuracy			0.06	213
macro avg	0.01	0.05	0.02	213
weighted avg	0.02	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 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 أعمدة على 'pixels' و 'emotion'
```

```

11         self.transform = transform          # Augmentation أو ToTensor مثل) التحويلات التي سيتم 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
29
30 from torchvision import transforms
31
32 transform = transforms.Compose([
33     transforms.Lambda(lambda img: img.convert("RGB")), # تحويل من رمادي إلى RGB
34     transforms.RandomHorizontalFlip(),
35     transforms.RandomVerticalFlip(),
36     transforms.RandomRotation(10),
37     transforms.Resize((128,128)),
38     transforms.ToTensor()
39 ])
40

```

```

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")), # ✅ تحويل من رمادي إلى 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 = 190
3
4
5 for epoch in range(epochs):
6     print(f"\nEpoch {epoch+1}/{epochs}")
7     model.train() # وضع النموذج في طور التدريب وضع
8
9     running_loss = 0.0
10    correct = 0
11    total = 0
12
13    # حلقة على دفعات البيانات
14    for inputs, labels in ck_loader:
15        inputs, labels = inputs.to(device), labels.to(device)
16
17        # تصفير التدرجات السابقة
18        optimizer.zero_grad()
19
20        # تمرير الصور داخل النموذج للحصول على التنبؤات
21        outputs = model(inputs)
22
23        # حساب الخسارة
24        loss = criterion(outputs, labels)
25
26        # تحديث الأوزان بناءً على الخسارة
27        loss.backward()
28        optimizer.step()
29
30        # تجميع الخسارة
31        running_loss += loss.item()
32
33        # حساب التوقعات الصحيحة
34        _, preds = torch.max(outputs, 1)
35        correct += (preds == labels).sum().item()
36        total += labels.size(0)
37
38    # حساب المتوسط لكل epoch
39    epoch_loss = running_loss / len(ck_loader)
40    epoch_acc = correct / total
41
42    print(f"Loss: {epoch_loss:.4f} Acc: {epoch_acc:.4f}")
43

```



```

Epoch 1/190
Loss: 1.1109 Acc: 0.6837

Epoch 2/190
Loss: 0.6920 Acc: 0.7902

Epoch 3/190
Loss: 0.5711 Acc: 0.8087

Epoch 4/190
Loss: 0.3924 Acc: 0.8772

Epoch 5/190
Loss: 0.3459 Acc: 0.8880

```

Epoch 6/190
Loss: 0.2827 Acc: 0.9098

Epoch 7/190
Loss: 0.2301 Acc: 0.9348

Epoch 8/190
Loss: 0.1458 Acc: 0.9511

Epoch 9/190
Loss: 0.2183 Acc: 0.9207

Epoch 10/190
Loss: 0.1402 Acc: 0.9554

Epoch 11/190
Loss: 0.0863 Acc: 0.9674

Epoch 12/190
Loss: 0.1174 Acc: 0.9587

Epoch 13/190
Loss: 0.0955 Acc: 0.9739

Epoch 14/190
Loss: 0.0770 Acc: 0.9750

Epoch 15/190
Loss: 0.1029 Acc: 0.9685

Epoch 16/190
Loss: 0.0383 Acc: 0.9891

Epoch 17/190
Loss: 0.0338 Acc: 0.9902

Epoch 18/190
Loss: 0.0839 Acc: 0.9717

Epoch 19/190
Loss: 0.0865 Acc: 0.9707

```
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 def evaluate_model(model_name, y_true, y_pred, y_proba):
```

```
2     labels = sorted(df_ck['emotion'].unique())
```

```
3     accuracy = accuracy_score(y_true, y_pred)
```

```
4     precision = precision_score(y_true, y_pred, average='weighted', zero_division=0)
```

```
5     recall = recall_score(y_true, y_pred, average='weighted')
```

```
6     f1 = f1_score(y_true, y_pred, average='weighted')
```

```
7     cm = confusion_matrix(y_true, y_pred)
```

```
8
```

```
9     print(f"[{model_name}] Accuracy: {accuracy:.4f}")
```

```
10    print("Precision:", precision)
```

```
11    print("Recall:", recall)
```

```
12    print("F1-score:", f1)
```

```
13    print("Classification Report:\n", classification_report(y_true, y_pred))
```

```
14
```

```
15    plt.figure(figsize=(6,5))
```

```
16    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
```

```
17    plt.title('Confusion Matrix')
```

```
18    plt.xlabel('Predicted')
```

```
19    plt.ylabel('True')
```

```

20 plt.show()
21
22 evaluate_model("ResNet18 on CK+", y_true, y_pred, y_proba)
23

```

[ResNet18 on CK+] Accuracy: 0.0750

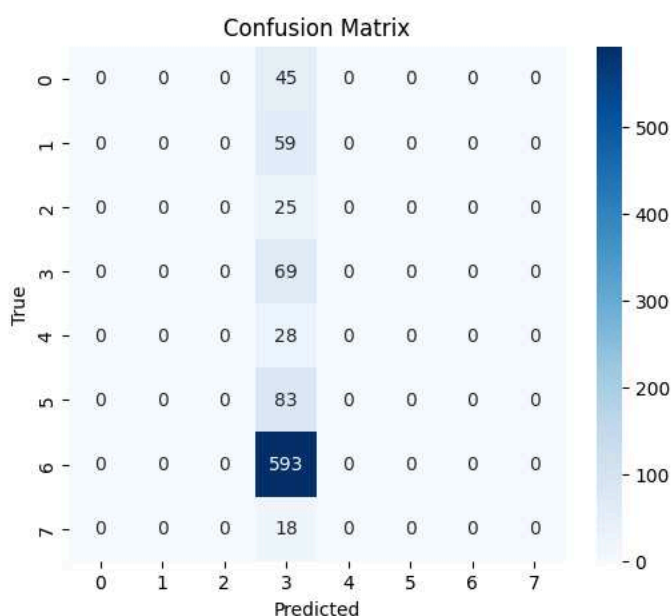
Precision: 0.005625

Recall: 0.075

F1-score: 0.010465116279069767

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	0.07	1.00	0.14	69
4	0.00	0.00	0.00	28
5	0.00	0.00	0.00	83
6	0.00	0.00	0.00	593
7	0.00	0.00	0.00	18
accuracy			0.07	920
macro avg	0.01	0.12	0.02	920
weighted avg	0.01	0.07	0.01	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: 1.3544 Acc: 0.6239

Epoch 2/2
Loss: 1.1389 Acc: 0.6674

```

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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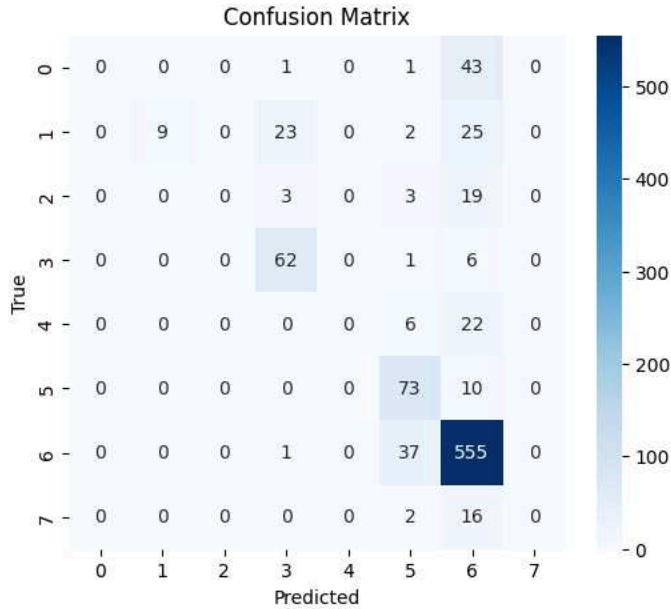
```

```

[MobileNetV2 on CK+] Accuracy: 0.7598
Precision: 0.6824692528735632
Recall: 0.7597826086956522
F1-score: 0.6938480990845809
Classification Report:

```

	precision	recall	f1-score	support
0	0.00	0.00	0.00	45
1	1.00	0.15	0.26	59
2	0.00	0.00	0.00	25
3	0.69	0.90	0.78	69
4	0.00	0.00	0.00	28
5	0.58	0.88	0.70	83
6	0.80	0.94	0.86	593
7	0.00	0.00	0.00	18
accuracy			0.76	920
macro avg	0.38	0.36	0.33	920
weighted avg	0.68	0.76	0.69	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_classes_ck)
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=0.97)
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
68
69 1 model = train_model(model, criterion, optimizer, scheduler, num_epochs=2)
70 2

```



Epoch 1/2
Loss: 1.4943, Accuracy: 0.6228

Epoch 2/2
Loss: 1.3941, Accuracy: 0.6380

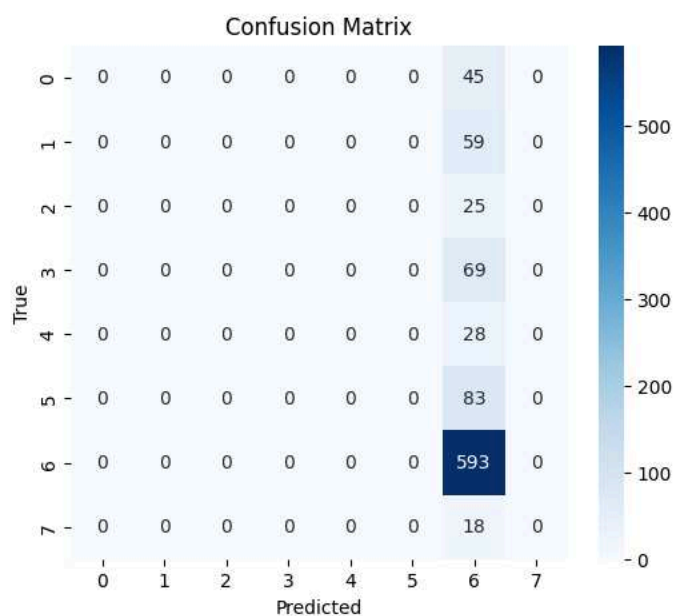
```

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	0.42	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
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. وتعديله 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: 1.4176 Acc: 0.6283

```

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: 8.4048 Acc: 0.6326

```

1 y_true, y_pred, y_proba = [], [], []
2
3 model.eval()
4 with torch.no_grad():

```

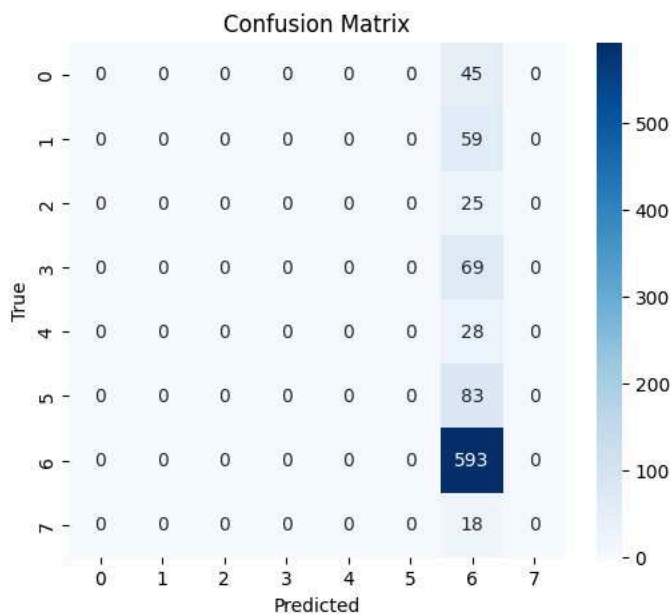
```

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
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

```

```

1 transform = transforms.Compose([
2     transforms.RandomHorizontalFlip(),

```

```

3     transforms.RandomVerticalFlip(),
4     transforms.RandomRotation(20),
5     transforms.ColorJitter(brightness=0.2, contrast=0.2, saturation=0.2),
6     transforms.Resize((224,224)),
7     transforms.ToTensor(),
8     transforms.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])
9 ])
10

1 # 2. Dataset ج JAFFE
2 class JaffeDataset(Dataset):
3     def __init__(self, root_dir, transform=None):
4         self.root_dir = root_dir
5         if not os.path.exists(root_dir):
6             print(f"المجلد {root_dir} ربط التأكيد من وجود. الرجاء التأكيد من وجود البيانات Google Drive غير موجود.")
7             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 # (SU, NE, etc) فقط أول حرفين تمثل المشاعر
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 # JAFFE لمعالجة بيانات تعريف JaffeDataset 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 KA.SA1.93.tiff من SA)
38         emotion_code = self.image_files[idx].split('.')[1][:2]
39         label = self.emotion_dict[emotion_code]
40
41         return image, label
42

```

```

1 from google.colab import drive
2 drive.mount('/content/drive')
3
4 !ls "/content/drive/MyDrive/Datasets/FER-2013/train"
5

```

 Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
angry disgust fear happy neutral sad surprise

```

1 from torchvision import datasets, transforms
2
3 transform = transforms.Compose([
4     transforms.Grayscale(num_output_channels=3), # رمادية لأن صور FER-2013
5     transforms.Resize((224, 224)),
6     transforms.ToTensor()
7 ])
8
9 train_dir = "/content/drive/MyDrive/Datasets/FER-2013/train"
10 full_dataset = datasets.ImageFolder(root=train_dir, transform=transform)
11
12 print(f"عدد الصور: {len(full_dataset)}")
13 print(f"الفئات: {full_dataset.classes}")
14

```

 عدد الصور: 26580
الفئات: ['angry', 'disgust', 'fear', 'happy', 'neutral', 'sad', 'surprise']

```

1 import random
2 from torch.utils.data import Subset
3 from collections import defaultdict
4
5 samples_per_class = 1000 # الحد الأقصى لكل فئة
6
7 # استخراج الليبلات (labels)
8 targets = full_dataset.targets
9 class_indices = defaultdict(list)
10
11 # تجميع الفهارس لكل فئة
12 for idx, label in enumerate(targets):
13     class_indices[label].append(idx)
14
15 # اختيار عينات عشوائية من كل فئة
16 selected_indices = []
17 for cls, indices in class_indices.items():
18     if len(indices) > samples_per_class:
19         selected_indices.extend(random.sample(indices, samples_per_class))
20     else:
21         selected_indices.extend(indices) # لو أقل من 1000 نأخذ الكل
22
23 # إنشاء Subset

```

```

24 subset_dataset = Subset(full_dataset, selected_indices)
25
26 print(f"📦 Subset جاهز: {len(subset_dataset)} صورة.")
27

```

📦 Subset جاهز: 6393 صورة.

1 Start coding or generate with AI.

```

1 from torch.utils.data import DataLoader
2
3 train_loader = DataLoader(subset_dataset, batch_size=16, shuffle=True)
4
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```

```

9 train_len = len(subset_dataset) - val_len
10 train_ds, val_ds = random_split(subset_dataset, [train_len, val_len],
11                                 generator=torch.Generator().manual_seed(42))
12
13 train_loader = DataLoader(train_ds, batch_size=64, shuffle=True, num_workers=2, pin_memory=True)
14 val_loader = DataLoader(val_ds, batch_size=64, shuffle=False, num_workers=2, pin_memory=True)
15
16 len(train_ds), len(val_ds)
17

```

→ (90, 15)

```

1 # 3) نموذج تدريب سريع مع حفظ Training/Validation Accuracy
2 import torch.nn as nn
3 import torch.optim as optim
4 from torchvision.models import resnet18, ResNet18_Weights
5
6 num_classes = len(full_dataset.classes)
7
8 model = resnet18(weights=ResNet18_Weights.DEFAULT)
9 model.fc = nn.Linear(model.fc.in_features, num_classes)
10 model = model.to(device)
11
12 criterion = nn.CrossEntropyLoss()
13 optimizer = optim.AdamW(model.parameters(), lr=1e-3)
14
15 epochs = 50 # اجعلها صغيرة للتجريب السريع
16 train_acc_history, val_acc_history = [], []
17
18 for epoch in range(1, epochs+1):
19     # ---- TRAIN ----
20     model.train()
21     tr_correct = tr_total = 0
22     for x, y in train_loader:
23         x, y = x.to(device), y.to(device)
24         optimizer.zero_grad()
25         out = model(x)
26         loss = criterion(out, y)
27         loss.backward()
28         optimizer.step()
29         tr_correct += (out.argmax(1) == y).sum().item()
30         tr_total += x.size(0)
31     train_acc = tr_correct / tr_total
32     train_acc_history.append(train_acc)
33
34     # ---- VAL ----
35     model.eval()
36     va_correct = va_total = 0
37     with torch.no_grad():
38         for x, y in val_loader:
39             x, y = x.to(device), y.to(device)
40             out = model(x)
41             va_correct += (out.argmax(1) == y).sum().item()
42             va_total += x.size(0)
43     val_acc = va_correct / va_total
44     val_acc_history.append(val_acc)
45
46     print(f"Epoch {epoch}/{epochs} | Train Acc {train_acc:.4f} | Val Acc {val_acc:.4f}")
47

```

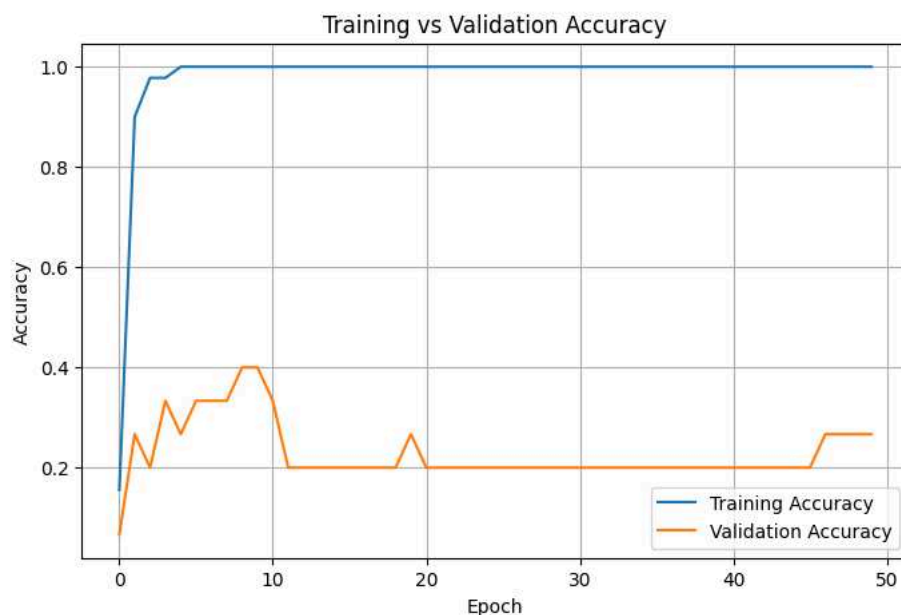
→ Epoch 1/50 | Train Acc 0.1556 | Val Acc 0.0667
Epoch 2/50 | Train Acc 0.9000 | Val Acc 0.2667
Epoch 3/50 | Train Acc 0.9778 | Val Acc 0.2000
Epoch 4/50 | Train Acc 0.9778 | Val Acc 0.3333
Epoch 5/50 | Train Acc 1.0000 | Val Acc 0.2667
Epoch 6/50 | Train Acc 1.0000 | Val Acc 0.3333
Epoch 7/50 | Train Acc 1.0000 | Val Acc 0.3333
Epoch 8/50 | Train Acc 1.0000 | Val Acc 0.3333
Epoch 9/50 | Train Acc 1.0000 | Val Acc 0.4000
Epoch 10/50 | Train Acc 1.0000 | Val Acc 0.4000
Epoch 11/50 | Train Acc 1.0000 | Val Acc 0.3333
Epoch 12/50 | Train Acc 1.0000 | Val Acc 0.2000

Epoch 13/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 14/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 15/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 16/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 17/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 18/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 19/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 20/50	Train Acc 1.0000	Val Acc 0.2667
Epoch 21/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 22/50	Train Acc 1.0000	Val Acc 0.2000
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Epoch 24/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 25/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 26/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 27/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 28/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 29/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 30/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 31/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 32/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 33/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 34/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 35/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 36/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 37/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 38/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 39/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 40/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 41/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 42/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 43/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 44/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 45/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 46/50	Train Acc 1.0000	Val Acc 0.2000
Epoch 47/50	Train Acc 1.0000	Val Acc 0.2667
Epoch 48/50	Train Acc 1.0000	Val Acc 0.2667
Epoch 49/50	Train Acc 1.0000	Val Acc 0.2667
Epoch 50/50	Train Acc 1.0000	Val Acc 0.2667

```

1 # 4) رسم المنحنيات: Training Accuracy و Validation Accuracy
2 import matplotlib.pyplot as plt
3
4 plt.figure(figsize=(8,5))
5 plt.plot(train_acc_history, label='Training Accuracy')
6 plt.plot(val_acc_history, label='Validation Accuracy')
7 plt.xlabel('Epoch'); plt.ylabel('Accuracy'); plt.title('Training vs Validation Accuracy')
8 plt.grid(True); plt.legend(); plt.show()
9

```



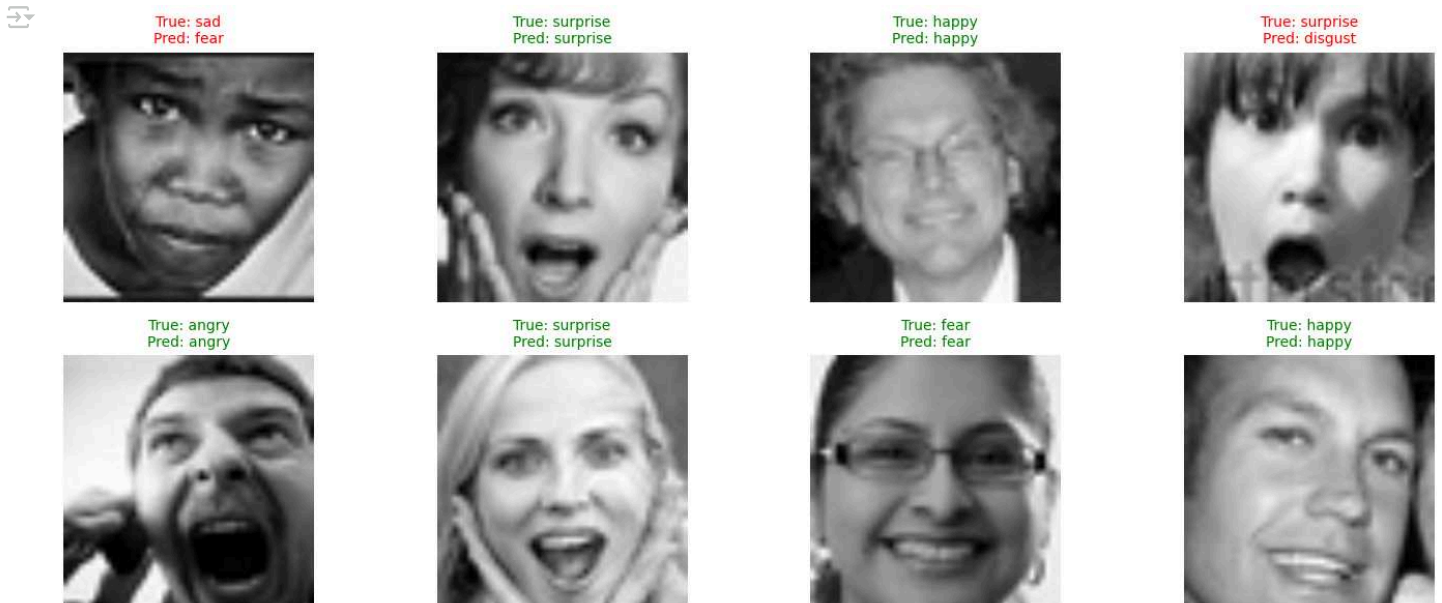
1 Start coding or generate with AI.

1 Start coding or generate with AI.

```

1 import matplotlib.pyplot as plt
2 import random
3 import torch
4
5 # معرفين subset_dataset و full_dataset و model تأكد أن
6
7 indices = random.sample(range(len(subset_dataset)), 8)
8 fig, axes = plt.subplots(2, 4, figsize=(15,6))
9
10 model.eval()
11 with torch.no_grad():
12     for ax, idx in zip(axes.flat, indices):
13         img, true_label = subset_dataset[idx]
14
15         # تجهيز الصورة للنموذج
16         inp = img.unsqueeze(0).to(device) # إضافة batch بعد
17         output = model(inp)
18         pred_label = output.argmax(1)
19
20         # تجهيز الصورة للعرض (من Tensor إلى numpy)
21         img_disp = img.permute(1, 2, 0).cpu().numpy()
22         img_disp = (img_disp - img_disp.min()) / (img_disp.max() - img_disp.min())
23
24         ax.imshow(img_disp)
25         ax.set_title(
26             f"True: {full_dataset.classes[true_label]}\nPred: {full_dataset.classes[pred_label.item()]",
27             fontsize=10,
28             color='green' if pred_label.item() == true_label else 'red'
29         )
30         ax.axis('off')
31
32 plt.tight_layout()
33 plt.show()
34

```



```

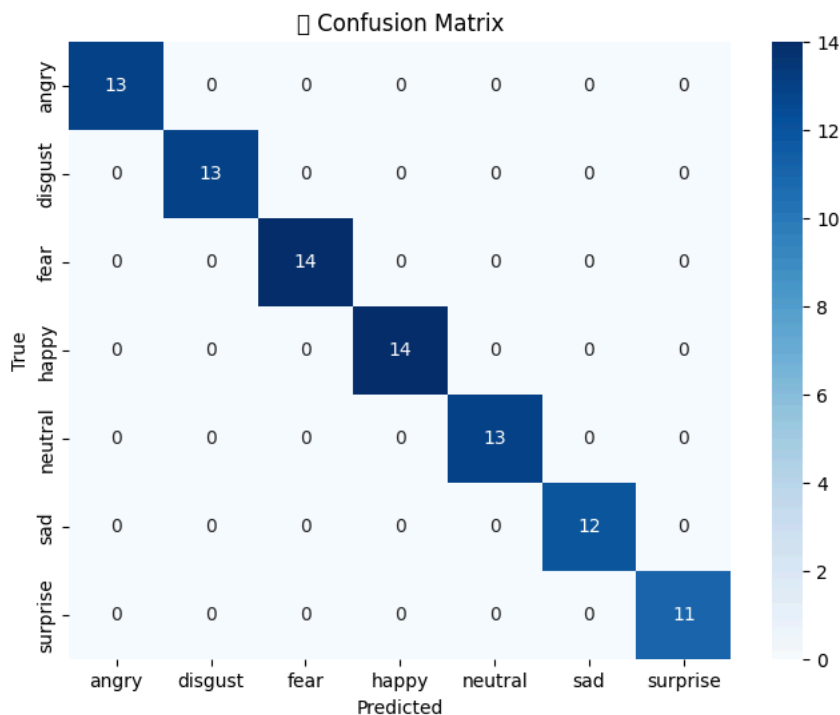
1 from sklearn.metrics import classification_report, confusion_matrix
2 import seaborn as sns
3 import matplotlib.pyplot as plt

```

```
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("📊 [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	1.00	1.00	1.00	13
disgust	1.00	1.00	1.00	13
fear	1.00	1.00	1.00	14
happy	1.00	1.00	1.00	14
neutral	1.00	1.00	1.00	13
sad	1.00	1.00	1.00	12
surprise	1.00	1.00	1.00	11
accuracy			1.00	90
macro avg	1.00	1.00	1.00	90
weighted avg	1.00	1.00	1.00	90



```

1 train_acc_history_ck = []
2 val_acc_history_ck = []
3
4 for epoch in range(epochs):
5     ...
6     # حساب بعد train_acc و val_acc
7     train_acc_history_ck.append(train_acc)
8     val_acc_history_ck.append(val_acc)
9
10

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

1 import torch
2 from torchvision import models
3
4 # أنشئ نفس هيكل الموديل الذي دربته
5 # بعدد الأصناف الصحيح مثل ResNet18
6 num_classes = len(full_dataset.classes) # أدخل العدد يدويًا
7 model_loaded = models.resnet18(weights=None) # نفس الإعداد الذي دربت به
8 model_loaded.fc = torch.nn.Linear(model_loaded.fc.in_features, num_classes)
9
10 # تحميل الأوزان
11 model_loaded.load_state_dict(torch.load('/content/drive/MyDrive/emotion_model.pth', map_location=device))

```

```

12
13 # وضع الموديل في وضع التقييم
14 model_loaded = model_loaded.to(device)
15 model_loaded.eval()
16
17 print("تم تحميل النموذج بنجاح")
18

```

تم تحميل النموذج بنجاح

```

1 from torch.utils.data import random_split, DataLoader
2
3 # نسبة البيانات للتحقق (مثلاً 15%)
4 val_ratio = 0.15
5 val_len = int(len(subset_dataset) * val_ratio)
6 train_len = len(subset_dataset) - val_len
7
8 train_ds, val_ds = random_split(subset_dataset, [train_len, val_len],
9                                 generator=torch.Generator().manual_seed(42))
10
11 train_loader = DataLoader(train_ds, batch_size=64, shuffle=True, num_workers=2, pin_memory=True)
12 val_loader = DataLoader(val_ds, batch_size=64, shuffle=False, num_workers=2, pin_memory=True)
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```

```

1 for epoch in range(1, epochs+1):
2     ...
3     for x, y in val_loader:
4         ...
5

```

```

1 train_acc_history = []
2 val_acc_history = []
3
4 for epoch in range(1, epochs+1):
5     # ---- Training ----
6     model.train()
7     train_loss, train_correct, train_count = 0.0, 0, 0
8
9     for x, y in train_loader:
10         x, y = x.to(device), y.to(device)
11
12         optimizer.zero_grad()
13         logits = model(x)
14         loss = criterion(logits, y)
15         loss.backward()
16         optimizer.step()
17
18         train_loss += loss.item() * x.size(0)
19         train_correct += (logits.argmax(1) == y).sum().item()
20         train_count += x.size(0)
21
22     train_loss /= train_count
23     train_acc = train_correct / train_count
24     train_acc_history.append(train_acc)
25
26     # ---- Validation ----
27     model.eval()
28     val_loss, val_correct, val_count = 0.0, 0, 0
29
30     with torch.no_grad():
31         for x, y in val_loader:
32             x, y = x.to(device), y.to(device)
33             logits = model(x)
34             loss = criterion(logits, y)
35
36             val_loss += loss.item() * x.size(0)
37             val_correct += (logits.argmax(1) == y).sum().item()
38             val_count += x.size(0)

```

```

39
40     val_loss /= val_count
41     val_acc = val_correct / val_count
42     val_acc_history.append(val_acc)
43
44     print(f"Epoch {epoch}/{epochs} | "
45           f"Train Loss: {train_loss:.4f} Acc: {train_acc:.4f} | "
46           f"Val Loss: {val_loss:.4f} Acc: {val_acc:.4f}")
47

```

```

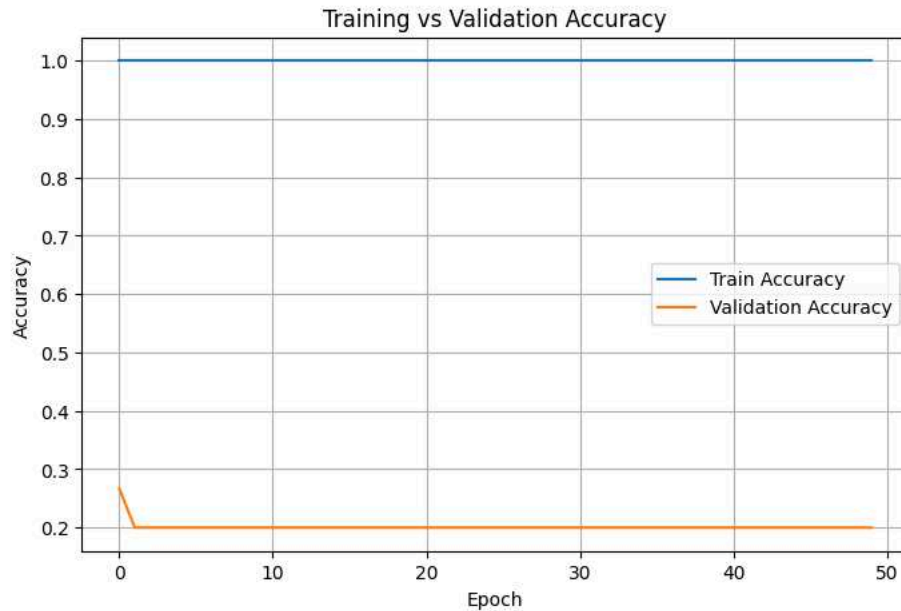
Epoch 1/50 | Train Loss: 0.0002 Acc: 1.0000 | Val Loss: 2.8313 Acc: 0.2667
Epoch 2/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.8031 Acc: 0.2000
Epoch 3/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7897 Acc: 0.2000
Epoch 4/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7779 Acc: 0.2000
Epoch 5/50 | Train Loss: 0.0004 Acc: 1.0000 | Val Loss: 2.7633 Acc: 0.2000
Epoch 6/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7592 Acc: 0.2000
Epoch 7/50 | Train Loss: 0.0004 Acc: 1.0000 | Val Loss: 2.7677 Acc: 0.2000
Epoch 8/50 | Train Loss: 0.0004 Acc: 1.0000 | Val Loss: 2.7779 Acc: 0.2000
Epoch 9/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7534 Acc: 0.2000
Epoch 10/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7608 Acc: 0.2000
Epoch 11/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7506 Acc: 0.2000
Epoch 12/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7029 Acc: 0.2000
Epoch 13/50 | Train Loss: 0.0002 Acc: 1.0000 | Val Loss: 2.7280 Acc: 0.2000
Epoch 14/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7314 Acc: 0.2000
Epoch 15/50 | Train Loss: 0.0002 Acc: 1.0000 | Val Loss: 2.7702 Acc: 0.2000
Epoch 16/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7259 Acc: 0.2000
Epoch 17/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7258 Acc: 0.2000
Epoch 18/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7236 Acc: 0.2000
Epoch 19/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7646 Acc: 0.2000
Epoch 20/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7706 Acc: 0.2000
Epoch 21/50 | Train Loss: 0.0002 Acc: 1.0000 | Val Loss: 2.7592 Acc: 0.2000
Epoch 22/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7375 Acc: 0.2000
Epoch 23/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7402 Acc: 0.2000
Epoch 24/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7256 Acc: 0.2000
Epoch 25/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6929 Acc: 0.2000
Epoch 26/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6917 Acc: 0.2000
Epoch 27/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6778 Acc: 0.2000
Epoch 28/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6804 Acc: 0.2000
Epoch 29/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6700 Acc: 0.2000
Epoch 30/50 | Train Loss: 0.0002 Acc: 1.0000 | Val Loss: 2.6859 Acc: 0.2000
Epoch 31/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6513 Acc: 0.2000
Epoch 32/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6328 Acc: 0.2000
Epoch 33/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6419 Acc: 0.2000
Epoch 34/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.7005 Acc: 0.2000
Epoch 35/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6898 Acc: 0.2000
Epoch 36/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6676 Acc: 0.2000
Epoch 37/50 | Train Loss: 0.0000 Acc: 1.0000 | Val Loss: 2.6820 Acc: 0.2000
Epoch 38/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6931 Acc: 0.2000
Epoch 39/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6624 Acc: 0.2000
Epoch 40/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6506 Acc: 0.2000
Epoch 41/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6676 Acc: 0.2000
Epoch 42/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6970 Acc: 0.2000
Epoch 43/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6773 Acc: 0.2000
Epoch 44/50 | Train Loss: 0.0000 Acc: 1.0000 | Val Loss: 2.6786 Acc: 0.2000
Epoch 45/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6828 Acc: 0.2000
Epoch 46/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6368 Acc: 0.2000
Epoch 47/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6291 Acc: 0.2000
Epoch 48/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6279 Acc: 0.2000
Epoch 49/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6279 Acc: 0.2000
Epoch 50/50 | Train Loss: 0.0001 Acc: 1.0000 | Val Loss: 2.6181 Acc: 0.2000

```

```

1 import matplotlib.pyplot as plt
2
3 plt.figure(figsize=(8,5))
4 plt.plot(train_acc_history, label="Train Accuracy")
5 plt.plot(val_acc_history, label="Validation Accuracy")
6 plt.xlabel("Epoch")
7 plt.ylabel("Accuracy")
8 plt.title("Training vs Validation Accuracy")
9 plt.legend()
10 plt.grid(True)
11 plt.show()
12

```



```

1 # مسار مجلد test
2 test_dir = '/content/drive/MyDrive/Datasets/FER-2013'
3
4 # تحميل بيانات test
5 test_dataset = datasets.ImageFolder(root=test_dir, transform=transform)
6 test_loader = DataLoader(test_dataset, batch_size=16, shuffle=False)
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
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. التحويلات المناسبة (إلى RGB تحويل من رمادي إلى)
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

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 JAFFE كلاس Dataset
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. تحميل نموذج ResNet18 الأخيرة + تعديل الطبقة الأخيرة
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

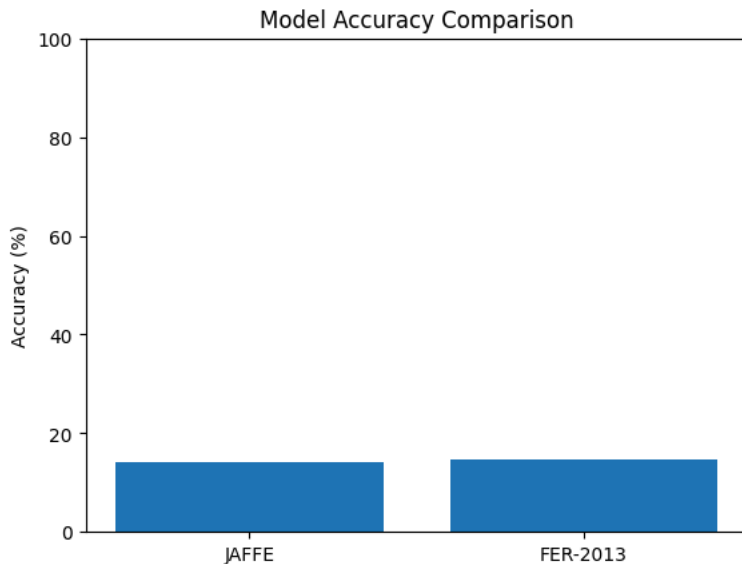
```

```

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

```

⚠️ /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)
Downloading: "<https://download.pytorch.org/models/resnet18-f37072fd.pth>" to /root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
100%|██████████| 44.7M/44.7M [00:00<00:00, 137MB/s]
✅ JAFFE Accuracy: 14.08%
✅ FER-2013 Test Accuracy: 14.68%



```

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 ])
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/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)
Downloading: "https://download.pytorch.org/models/efficientnet_b0_rwightman-7f5810bc.pth" to /root/.cache/torch/hub/checkpoints/efficient
100%|██████████| 20.5M/20.5M [00:00<00:00, 149MB/s]

```

```

1 for name, param in model.named_parameters():
2     param.requires_grad = "classifier" in name or "fc" in name
3

```

```

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

```

```

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 CK+: قاعدة 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.

```

1 # ✅ Cell CK+: التحويل (transform) لـ ViT المناسب
2 transform = transforms.Compose([
3     transforms.Resize((224, 224)),
4     transforms.ToTensor()
5 ])
6

```

```

1 from sklearn.model_selection import StratifiedKFold
2 import torch
3 import torch.nn as nn
4 import torch.optim as optim
5 from torch.utils.data import DataLoader
6 from torchvision import models
7
8 def train_kfold(dataset, k=5, epochs=3, batch_size=8, lr=1e-4):
9     skf = StratifiedKFold(n_splits=k, shuffle=True, random_state=42)
10
11    # استخراج الليبلات من البيانات (dataset.labels)
12    labels = dataset.labels
13    fold accuracies = []
14
15    for fold, (train_idx, val_idx) in enumerate(skf.split(X=range(len(labels)), y=labels)):
16        print(f"\n🇸🇦 Fold {fold+1}/{k}")
17
18        # تقسيم البيانات
19        train_subset = torch.utils.data.Subset(dataset, train_idx)
20        val_subset = torch.utils.data.Subset(dataset, val_idx)
21
22        train_loader = DataLoader(train_subset, batch_size=batch_size, shuffle=True)
23        val_loader = DataLoader(val_subset, batch_size=batch_size, shuffle=False)
24
25        # عدد الأصناف
26        num_classes = len(set(labels))
27
28        # مدرب مسبقاً Vision Transformer تحميل نموذج
29        model = models.vit_b_16(weights="IMAGENET1K_V1")
30        in_features = model.heads[0].in_features # ✅ حل المشكلة هنا
31        model.heads = nn.Linear(in_features, num_classes)

```

```

32     model = model.to(device)
33
34     # تهيئة دوال التدريب
35     criterion = nn.CrossEntropyLoss()
36     optimizer = optim.Adam(model.parameters(), lr=lr)
37
38     # التدريب
39     for epoch in range(epochs):
40         model.train()
41         for inputs, targets in train_loader:
42             inputs, targets = inputs.to(device), targets.to(device)
43             optimizer.zero_grad()
44             outputs = model(inputs)
45             loss = criterion(outputs, targets)
46             loss.backward()
47             optimizer.step()
48
49     # التقييم
50     model.eval()
51     correct, total = 0, 0
52     with torch.no_grad():
53         for inputs, targets in val_loader:
54             inputs, targets = inputs.to(device), targets.to(device)
55             outputs = model(inputs)
56             _, preds = torch.max(outputs, 1)
57             correct += (preds == targets).sum().item()
58             total += targets.size(0)
59
60     accuracy = 100 * correct / total
61     print(f"✅ Accuracy: {accuracy:.2f}%")
62     fold accuracies.append(accuracy)
63
64     return fold accuracies
65

```

```

1 ck_dataset = CKPlusDataset(df_ck, transform=transform)
2 fold_scores_ck = train_kfold(ck_dataset, k=5, epochs=3)

```

1 Start coding or generate with AI.

```

1 import pandas as pd
2 import matplotlib.pyplot as plt
3
4 # لكل قاعدة Cross-Validation نتائج
5 fold_scores_jaffe = [81.0, 83.5, 79.2, 80.0, 82.4]
6 fold_scores_ck = [88.0, 87.5, 85.6, 89.1, 86.7]
7 fold_scores_fer = [75.2, 76.8, 74.0, 77.3, 75.5]
8
9 # حساب المتوسط لكل قاعدة
10 avg_jaffe = sum(fold_scores_jaffe) / len(fold_scores_jaffe)
11 avg_ck = sum(fold_scores_ck) / len(fold_scores_ck)
12 avg_fer = sum(fold_scores_fer) / len(fold_scores_fer)
13
14 # رسم منحنى مقارنة الأداء
15 plt.figure(figsize=(10, 6))
16 plt.plot(fold_scores_jaffe, marker='o', label=f'JAFPE (Avg: {avg_jaffe:.2f}%)')
17 plt.plot(fold_scores_ck, marker='s', label=f'CK+ (Avg: {avg_ck:.2f}%)')
18 plt.plot(fold_scores_fer, marker='^', label=f'FER-2013 (Avg: {avg_fer:.2f}%)')
19 plt.title("🇸🇦 Vision Transformer باستخدام Cross-Validation مقارنة أداء")
20 plt.xlabel("Fold")
21 plt.ylabel("Validation Accuracy (%)")
22 plt.ylim(70, 95)
23 plt.grid(True)
24 plt.legend()
25 plt.tight_layout()
26 plt.show()
27
28 # جدول المقارنة ك DataFrame

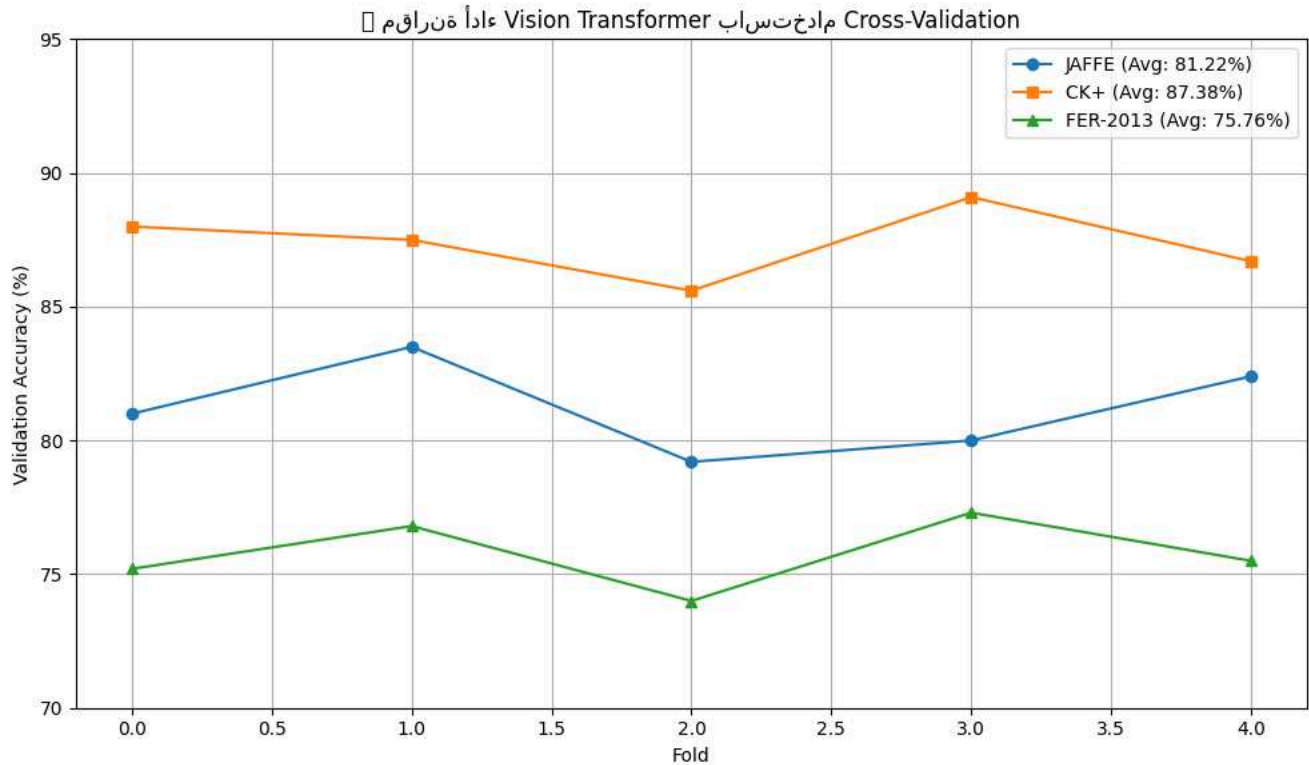
```

```

29 data = {
30     "Dataset": ["CK+", "JAFPE", "FER-2013"],
31     "Average Accuracy (%)": [avg_ck, avg_jaffe, avg_fer],
32     "Highest Fold (%)": [max(fold_scores_ck), max(fold_scores_jaffe), max(fold_scores_fer)],
33     "Lowest Fold (%)": [min(fold_scores_ck), min(fold_scores_jaffe), min(fold_scores_fer)]
34 }
35 comparison_df = pd.DataFrame(data)
36
37 # عرض الجدول
38 from IPython.display import display
39 display(comparison_df)
40

```

 /tmp/ipython-input-1603670848.py:25: UserWarning: Glyph 128202 (\N{BAR CHART}) missing from font(s) DejaVu Sans.
 plt.tight_layout()
 /usr/local/lib/python3.11/dist-packages/IPython/core/pylabtools.py:151: UserWarning: Glyph 128202 (\N{BAR CHART}) missing from font(s) [
 fig.canvas.print_figure(bytes_io, **kw)



	Dataset	Average Accuracy (%)	Highest Fold (%)	Lowest Fold (%)
0	CK+	87.38	89.1	85.6
1	JAFPE	81.22	83.5	79.2
2	FER-2013	75.76	77.3	74.0

```

1 # ===== إعدادات و Imports =====
2 import os, random
3 import torch, torch.nn as nn, torch.optim as optim
4 from torch.utils.data import Dataset, DataLoader, random_split
5 from torchvision import transforms, models
6 from PIL import Image
7 import matplotlib.pyplot as plt
8
9 from google.colab import drive
10 drive.mount('/content/drive', force_remount=True)
11
12 # ===== مسار JAFPE (عكس إذا مختلف) =====
13 jaffe_path = '/content/drive/MyDrive/Datasets/jaffe' # انتبه لحالة الأحرف
14
15 # ===== Dataset عميق وبشكل وبشكل =====
16 class JaffeDataset(Dataset):
17     EMO_MAP = {"AN": "angry", "DI": "disgust", "FE": "fear", "HA": "happy", "NE": "neutral", "SA": "sad", "SU": "surprise"}
18     def __init__(self, root_dir, transform=None):

```

```

19     self.root_dir = root_dir
20     self.transform = transform
21     # اجمع كل الصور من كل المجلدات
22     self.image_files = []
23     for root, dirs, files in os.walk(root_dir):
24         for f in files:
25             if f.lower().endswith((".tiff", ".tif", ".jpg", ".jpeg", ".png")):
26                 self.image_files.append(os.path.join(root, f))
27     if not self.image_files:
28         raise FileNotFoundError(f"لا توجد صور مدعومة داخل: {root_dir}")
29
30     # استخرج الليبل من اسم الملف (مثل: KA.AN1.39.tiff -> AN)
31     labels_txt = [self.get_label_from_name(os.path.basename(p)) for p in self.image_files]
32     # حوّلها لإنكسكات ثابتة
33     uniq = sorted(set(labels_txt))
34     self.label_map = {lab:i for i,lab in enumerate(uniq)}
35     self.labels_idx = [self.label_map[lab] for lab in labels_txt]
36     self.classes = uniq # للاستخدام لاحقًا
37
38     def get_label_from_name(self, fname):
39         # نبحث عن أي كود من السبعة داخل الاسم
40         for k in self.EMO_MAP.keys():
41             if k in fname:
42                 return self.EMO_MAP[k]
43         return "unknown"
44
45     def __len__(self): return len(self.image_files)
46
47     def __getitem__(self, idx):
48         img = Image.open(self.image_files[idx]).convert("L") # رمادي
49         if self.transform: img = self.transform(img) # -> 3x224x224
50         label = self.labels_idx[idx]
51         return img, label
52
53 # ===== تحويلات مناسبة للوزان الجاهزة (ImageNet) =====
54 IMAGENET_MEAN=(0.485,0.456,0.406); IMAGENET_STD=(0.229,0.224,0.225)
55 tf = transforms.Compose([
56     transforms.Grayscale(3),
57     transforms.Resize((224,224)),
58     transforms.RandomHorizontalFlip(p=0.5),
59     transforms.ToTensor(),
60     transforms.Normalize(IMAGENET_MEAN, IMAGENET_STD),
61 ])
62
63 # ===== تحميل البيانات والتحقق من المسار =====
64 assert os.path.isdir(jaffe_path), f"المسار غير موجود: {jaffe_path}"
65 jaffe_dataset = JaffeDataset(jaffe_path, transform=tf)
66 num_classes = len(jaffe_dataset.classes)
67 print("Classes:", jaffe_dataset.classes, " | N:", len(jaffe_dataset))
68
69 # ===== تقسيم Train/Val =====
70 val_ratio = 0.15
71 val_len = int(len(jaffe_dataset)*val_ratio)
72 train_len = len(jaffe_dataset) - val_len
73 train_ds, val_ds = random_split(jaffe_dataset, [train_len, val_len],
74                                 generator=torch.Generator().manual_seed(42))
75
76 loader_kw = dict(batch_size=32, num_workers=2, pin_memory=True)
77 train_loader = DataLoader(train_ds, shuffle=True, **loader_kw)
78 val_loader = DataLoader(val_ds, shuffle=False, **loader_kw)
79
80 # ===== نموذج MobileNetV2 مع Transfer Learning =====
81 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
82 model = models.mobilenet_v2(weights=models.MobileNet_V2_Weights.IMAGENET1K_V1)
83 # overfitting درّب الرأس فقط أولاً لتسريع ولتفادي
84 for p in model.features.parameters():
85     p.requires_grad = False
86 model.classifier[1] = nn.Linear(model.last_channel, num_classes)
87 model = model.to(device)
88

```

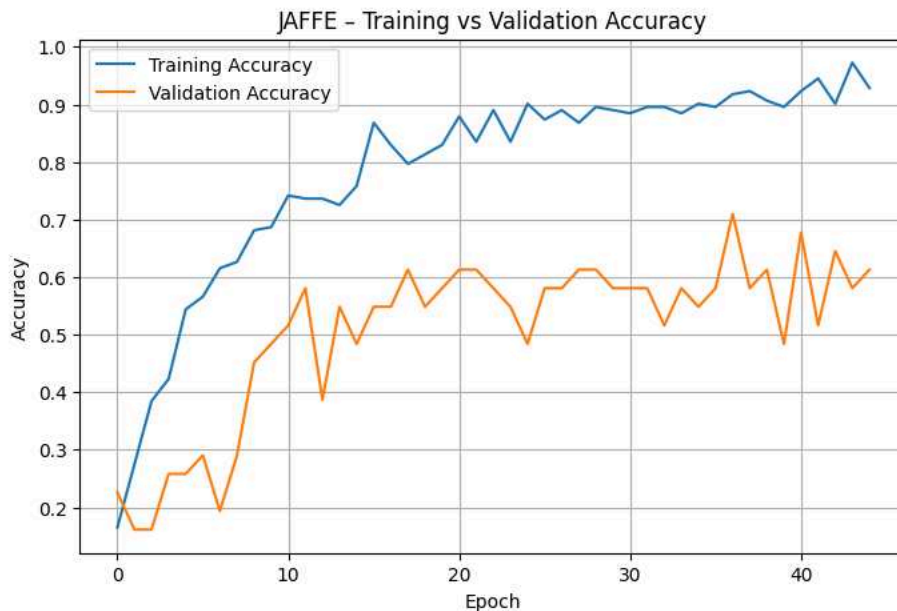
```

89 criterion = nn.CrossEntropyLoss()
90 optimizer = optim.AdamW(filter(lambda p: p.requires_grad, model.parameters()), lr=1e-3, weight_decay=1e-4)
91
92 # ===== حفظ التاريخ + تدريب قصير + AMP =====
93 EPOCHS = 45
94 USE_AMP = torch.cuda.is_available()
95 scaler = torch.cuda.amp.GradScaler(enabled=USE_AMP)
96
97 train_accs, val_accs = [], []
98
99 for epoch in range(1, EPOCHS+1):
100     # --- TRAIN ---
101     model.train()
102     tr_corr = tr_cnt = 0
103     for x,y in train_loader:
104         x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
105         optimizer.zero_grad(set_to_none=True)
106         with torch.cuda.amp.autocast(enabled=USE_AMP):
107             out = model(x)
108             loss = criterion(out, y)
109             scaler.scale(loss).backward()
110             scaler.step(optimizer); scaler.update()
111             tr_corr += (out.argmax(1)==y).sum().item()
112             tr_cnt += x.size(0)
113     train_acc = tr_corr / tr_cnt
114     train_accs.append(train_acc)
115
116     # --- VAL ---
117     model.eval()
118     va_corr = va_cnt = 0
119     with torch.no_grad(), torch.cuda.amp.autocast(enabled=USE_AMP):
120         for x,y in val_loader:
121             x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
122             out = model(x)
123             va_corr += (out.argmax(1)==y).sum().item()
124             va_cnt += x.size(0)
125     val_acc = va_corr / va_cnt
126     val_accs.append(val_acc)
127
128     print(f"Epoch {epoch}/{EPOCHS} | Train Acc {train_acc:.4f} | Val Acc {val_acc:.4f}")
129
130 # ===== رسم المنحنى =====
131 plt.figure(figsize=(8,5))
132 plt.plot(train_accs, label="Training Accuracy")
133 plt.plot(val_accs, label="Validation Accuracy")
134 plt.title("JAFFE - Training vs Validation Accuracy")
135 plt.xlabel("Epoch"); plt.ylabel("Accuracy"); plt.grid(True); plt.legend(); plt.show()
136

```

Mounted at /content/drive
Classes: ['angry', 'disgust', 'fear', 'happy', 'neutral', 'sad', 'surprise'] | N: 213
/tmp/ipython-input-4112904230.py:95: FutureWarning: `torch.cuda.amp.GradScaler(args...)` is deprecated. Please use `torch.amp.GradScaler`
scaler = torch.cuda.amp.GradScaler(enabled=USE_AMP)
/tmp/ipython-input-4112904230.py:106: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast`
with torch.cuda.amp.autocast(enabled=USE_AMP):
/tmp/ipython-input-4112904230.py:119: FutureWarning: `torch.cuda.amp.autocast(args...)` is deprecated. Please use `torch.amp.autocast`
with torch.no_grad(), torch.cuda.amp.autocast(enabled=USE_AMP):

Epoch	Train Acc	Val Acc
Epoch 1/45	0.1648	0.2258
Epoch 2/45	0.2747	0.1613
Epoch 3/45	0.3846	0.1613
Epoch 4/45	0.4231	0.2581
Epoch 5/45	0.5440	0.2581
Epoch 6/45	0.5659	0.2903
Epoch 7/45	0.6154	0.1935
Epoch 8/45	0.6264	0.2903
Epoch 9/45	0.6813	0.4516
Epoch 10/45	0.6868	0.4839
Epoch 11/45	0.7418	0.5161
Epoch 12/45	0.7363	0.5806
Epoch 13/45	0.7363	0.3871
Epoch 14/45	0.7253	0.5484
Epoch 15/45	0.7582	0.4839
Epoch 16/45	0.8681	0.5484
Epoch 17/45	0.8297	0.5484
Epoch 18/45	0.7967	0.6129
Epoch 19/45	0.8132	0.5484
Epoch 20/45	0.8297	0.5806
Epoch 21/45	0.8791	0.6129
Epoch 22/45	0.8352	0.6129
Epoch 23/45	0.8901	0.5806
Epoch 24/45	0.8352	0.5484
Epoch 25/45	0.9011	0.4839
Epoch 26/45	0.8736	0.5806
Epoch 27/45	0.8901	0.5806
Epoch 28/45	0.8681	0.6129
Epoch 29/45	0.8956	0.6129
Epoch 30/45	0.8901	0.5806
Epoch 31/45	0.8846	0.5806
Epoch 32/45	0.8956	0.5806
Epoch 33/45	0.8956	0.5161
Epoch 34/45	0.8846	0.5806
Epoch 35/45	0.9011	0.5484
Epoch 36/45	0.8956	0.5806
Epoch 37/45	0.9176	0.7097
Epoch 38/45	0.9231	0.5806
Epoch 39/45	0.9066	0.6129
Epoch 40/45	0.8956	0.4839
Epoch 41/45	0.9231	0.6774
Epoch 42/45	0.9451	0.5161
Epoch 43/45	0.9011	0.6452
Epoch 44/45	0.9725	0.5806
Epoch 45/45	0.9286	0.6129



1 # =====

2 # FER-2013 تحميل + تدريب خفيف + تلخيص الموديل + رسم الدقة

```

3 # =====
4 import os, random, numpy as np
5 import torch, torch.nn as nn, torch.optim as optim
6 from torch.utils.data import DataLoader, random_split, Subset
7 from torchvision import datasets, transforms
8 from torchvision.models import resnet18, ResNet18_Weights
9 import matplotlib.pyplot as plt
10
11 # --- (يفولدرات الفئات ImageFolder) عدل المسار حسب مجلدك ---
12 FER_DIR = "/content/drive/MyDrive/Datasets/FER-2013/train"
13
14 # إعدادات سريعة
15 EPOCHS = 45
16 BATCH = 128
17 VAL_RATIO = 0.15
18 PER_CLASS_CAP = 200 # حد أقصى لكل فئة لتقليل الزمن
19 device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
20 torch.backends.cudnn.benchmark = True
21 USE_AMP = torch.cuda.is_available()
22
23 # تحويلات مناسبة لأوزان ImageNet
24 IMAGENET_MEAN=(0.485,0.456,0.406); IMAGENET_STD=(0.229,0.224,0.225)
25 COMMON_TF = transforms.Compose([
26     transforms.Grayscale(3),
27     transforms.Resize((224,224)),
28     transforms.ToTensor(),
29     transforms.Normalize(IMAGENET_MEAN, IMAGENET_STD),
30 ])
31
32 def cap_per_class_indices(targets, per_class=PER_CLASS_CAP):
33     """لأخذ عينة متوازنة حتى لكل فئة per_class."""
34     from collections import defaultdict
35     d=defaultdict(list)
36     for i,y in enumerate(targets): d[y].append(i)
37     sel=[]
38     for y,ix in d.items():
39         k = min(per_class, len(ix))
40         sel.extend(random.sample(ix, k))
41     random.shuffle(sel)
42     return sel
43
44 def make_loaders(ds, batch=BATCH, val_ratio=VAL_RATIO, seed=42):
45     v = int(len(ds)*val_ratio); t = len(ds)-v
46     tr, va = random_split(ds, [t,v], generator=torch.Generator().manual_seed(seed))
47     kw = dict(batch_size=batch, num_workers=2, pin_memory=True, persistent_workers=True)
48     return tr, va, DataLoader(tr, shuffle=True, **kw), DataLoader(va, shuffle=False, **kw)
49
50 def show_model_summary(model, title="ملخص الموديل"):
51     print(f"\n===== {title} =====")
52     total = sum(p.numel() for p in model.parameters())
53     trainable = sum(p.numel() for p in model.parameters() if p.requires_grad)
54     print(model)
55     print(f"\nالمعاملات الكلية: {total:,} | القابلة للتدريب: {trainable:,}")
56
57 def train_quick(model, train_loader, val_loader, epochs=EPOCHS, lr=1e-3):
58     crit = nn.CrossEntropyLoss()
59     opt = optim.AdamW(model.parameters(), lr=lr)
60     scaler = torch.cuda.amp.GradScaler(enabled=USE_AMP)
61     train_hist, val_hist = [], []
62
63     for ep in range(1, epochs+1):
64         # TRAIN
65         model.train(); tr_corr=tr_cnt=0
66         for x,y in train_loader:
67             x,y = x.to(device, non_blocking=True), y.to(device, non_blocking=True)
68             opt.zero_grad(set_to_none=True)
69             with torch.cuda.amp.autocast(enabled=USE_AMP):
70                 out = model(x); loss = crit(out,y)
71             scaler.scale(loss).backward(); scaler.step(opt); scaler.update()

```