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import pandas as pd
import numpy as np
import os
from tqdm import tqdm
import zipfile
from PIL import Image

import tensorflow as tf
from tensorflow.keras.preprocessing.image import load_img
from tensorflow.keras.applications import MobileNetV2
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Dense, GlobalAveragePooling2D, Input
from tensorflow.keras.optimizers import Adam
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score

```

```

# 1 Unzip dataset
zip_path = "/content/archive (4).zip"
extract_dir = "/content/dataset"

with zipfile.ZipFile(zip_path, 'r') as zip_ref:
    zip_ref.extractall(extract_dir)

image_dir = "/content/dataset/UTKFace"

# 2 Create dataframe with image paths and ages
image_paths = []
age_labels = []

```

```

for filename in tqdm(os.listdir(image_dir)):
    if not filename.endswith(".jpg"):
        continue
    age = int(filename.split('_')[0])
    image_paths.append(os.path.join(image_dir, filename))
    age_labels.append(age)

```

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```

df = pd.DataFrame({
    'image_path': image_paths,
    'age': age_labels
})

```

```
df = df.sample(n=8000, random_state=42)
```

```

# 3 Load & preprocess images
def extract_features(images):
    features = []
    for image in tqdm(images):
        img = load_img(image, target_size=(128, 128)) # RGB for MobileNetV2
        img = np.array(img) / 255.0
        features.append(img)
    return np.array(features)

```

```

X = extract_features(df['image_path'])
y = np.array(df['age'])

```

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```

# 4 Train/validation/test split
from sklearn.model_selection import train_test_split

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X_train, X_temp, y_train, y_temp = train_test_split(X, y, test_size=0.3, random_state=42)
X_val, X_test, y_val, y_test = train_test_split(X_temp, y_temp, test_size=0.5, random_state=42)

# 5 Build model with MobileNetV2 backbone
base_model = MobileNetV2(weights='imagenet', include_top=False, input_tensor=Input(shape=(128, 128, 3)))
base_model.trainable = False # Freeze backbone for speed


↳ /tmp/ipython-input-2535347498.py:2: UserWarning: `input_shape` is undefined or non-square, or `rows` is not in [9
    base_model = MobileNetV2(weights='imagenet', include_top=False, input_tensor=Input(shape=(128, 128, 3)))

x = GlobalAveragePooling2D()(base_model.output)
x = Dense(64, activation='relu')(x)
output = Dense(1, activation='linear')(x) # Linear for regression

model = Model(inputs=base_model.input, outputs=output)

model.compile(optimizer=Adam(learning_rate=0.001), loss='mae', metrics=['mae'])

model.summary()
```

 Model: "functional"

Layer (type)	Output Shape	Param #	Connected to
input_layer (InputLayer)	(None, 128, 128, 3)	0	-
Conv1 (Conv2D)	(None, 64, 64, 32)	864	input_layer[0][0]
bn_Conv1 (BatchNormalizatio...	(None, 64, 64, 32)	128	Conv1[0][0]
Conv1_relu (ReLU)	(None, 64, 64, 32)	0	bn_Conv1[0][0]
expanded_conv_dept... (DepthwiseConv2D)	(None, 64, 64, 32)	288	Conv1_relu[0][0]
expanded_conv_dept... (BatchNormalizatio...	(None, 64, 64, 32)	128	expanded_conv_de...
expanded_conv_dept... (ReLU)	(None, 64, 64, 32)	0	expanded_conv_de...
expanded_conv_proj... (Conv2D)	(None, 64, 64, 16)	512	expanded_conv_de...
expanded_conv_proj... (BatchNormalizatio...	(None, 64, 64, 16)	64	expanded_conv_pr...
block_1_expand (Conv2D)	(None, 64, 64, 96)	1,536	expanded_conv_pr...
block_1_expand_BN (BatchNormalizatio...	(None, 64, 64, 96)	384	block_1_expand[0...
block_1_expand_relu (ReLU)	(None, 64, 64, 96)	0	block_1_expand_B...
block_1_pad (ZeroPadding2D)	(None, 65, 65, 96)	0	block_1_expand_r...
block_1_depthwise (DepthwiseConv2D)	(None, 32, 32, 96)	864	block_1_pad[0][0]
block_1_depthwise_... (BatchNormalizatio...	(None, 32, 32, 96)	384	block_1_depthwis...
block_1_depthwise_... (ReLU)	(None, 32, 32, 96)	0	block_1_depthwis...
block_1_project (Conv2D)	(None, 32, 32, 24)	2,304	block_1_depthwis...
block_1_project_BN (BatchNormalizatio...	(None, 32, 32, 24)	96	block_1_project[...
block_2_expand (Conv2D)	(None, 32, 32, 144)	3,456	block_1_project_...
block_2_expand_BN (BatchNormalizatio...	(None, 32, 32, 144)	576	block_2_expand[0...
block_2_expand_relu (ReLU)	(None, 32, 32, 144)	0	block_2_expand_B...
block_2_depthwise (DepthwiseConv2D)	(None, 32, 32, 144)	1,296	block_2_expand_r...
block_2_depthwise_... (BatchNormalizatio...	(None, 32, 32, 144)	576	block_2_depthwis...
block_2_depthwise_... (ReLU)	(None, 32, 32, 144)	0	block_2_depthwis...
block_2_project (Conv2D)	(None, 32, 32, 24)	3,456	block_2_depthwis...
block_2_project BN	(None, 32, 32, 24)	96	block_2_project[...