Configuración

```
!pip install opencv-python-headless gradio
```

```
Collecting semantic-version~=2.0 (from gradio)
  Downloading semantic_version-2.10.0-py2.py3-none-any.whl.metadata (9.7 kB)
Collecting starlette<1.0,>=0.40.0 (from gradio)
  Downloading starlette-0.46.2-py3-none-any.whl.metadata (6.2 kB)
Collecting tomlkit<0.14.0,>=0.12.0 (from gradio)
  Downloading tomlkit-0.13.2-py3-none-any.whl.metadata (2.7 kB)
Requirement already satisfied: typer<1.0,>=0.12 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.15.3)
Requirement already satisfied: typing-extensions~=4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.13.2)
Collecting uvicorn>=0.14.0 (from gradio)
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Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.1->gradio) (2025.3.2)
Requirement already satisfied: websockets<16.0,>=10.0 in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.1->grad
Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (3.10)
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Requirement already satisfied: certifi in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (2025.4.26)
Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (1.0.9)
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Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio
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Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=0.28
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Downloading ruff-0.11.10-py3-none-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (11.6 MB)
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Downloading starlette-0.46.2-py3-none-any.whl (72 kB)
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Downloading uvicorn-0.34.2-py3-none-any.whl (62 kB)
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Downloading ffmpy-0.5.0-py3-none-any.whl (6.0 kB)
Downloading pydub-0.25.1-py2.py3-none-any.whl (32 kB)
Installing collected packages: pydub, uvicorn, tomlkit, semantic-version, ruff, python-multipart, groovy, ffmpy, aiofiles, starlet
Successfully installed aiofiles-24.1.0 fastapi-0.115.12 ffmpy-0.5.0 gradio-5.30.0 gradio-client-1.10.1 groovy-0.1.2 pydub-0.25.1 p
```

```
from google.colab import drive

# Ruta
drive.mount('/content/drive')

# Librerias
import os
import random
import datetime
import shutil
import re
import glob
import cv2
import gradio as grad
import tempfile
import mimetypes
import numpy as np
import seaborn as sns
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.image as img
import seaborn as sbn
```

```
from PIL import Image
from collections import Counter


# Extras
import tensorflow as tf

from tensorflow.keras import layers, models, Input, regularizers, initializers
from tensorflow.keras.models import Model, load_model
from tensorflow.keras.layers import Activation, Add, BatchNormalization, Conv2D, Dropout, MaxPooling2D, GlobalAveragePooling2D
from tensorflow.keras.utils import to_categorical, Sequence
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import array_to_img, load_img, img_to_array, ImageDataGenerator
from tensorflow.keras.callbacks import EarlyStopping, ModelCheckpoint, ReduceLROnPlateau, TensorBoard
from tensorflow.keras.optimizers import SGD

from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.utils.class_weight import compute_class_weight
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
# Extensión de TensorBoard
%load_ext tensorboard
```

Carga del dataset

```
# Rutas originales pero con las carpetas que mencionaste para validar
ruta_train_drive = "/content/drive/MyDrive/simpsons_dataset"
ruta_test_drive = "/content/drive/MyDrive/kaggle_simpson_testset"

# Ruta local (igual que antes)
ruta_train_pc = "/content/simpsons_dataset"
ruta_test_pc = "/content/test_simpsons"

# Validar si las rutas de Drive existen
print("Train OK:", os.path.exists(ruta_train_drive))
print("Test OK:", os.path.exists(ruta_test_drive))
```

```
Train OK: True
Test OK: True
```

Carpetas y personajes

```
# Tamaño de las imágenes que usaremos
IMG_SIZE = 64

# Diccionario de personajes (18 más frecuentes)
MAP_CHARACTERS = {
    0: 'abraham_grampa_simpson', 1: 'apu_nahasapeemapetilon', 2: 'bart_simpson',
    3: 'charles_montgomery_burns', 4: 'chief_wiggum', 5: 'comic_book_guy', 6: 'edna_krabappel',
    7: 'homer_simpson', 8: 'kent_brockman', 9: 'krusty_the_clown', 10: 'lisa_simpson',
    11: 'marge_simpson', 12: 'milhouse_van_houten', 13: 'moe_szyslak',
    14: 'ned_flanders', 15: 'nelson_muntz', 16: 'principal_skinner', 17: 'sideshow_bob'
}

# Función para cargar imágenes de entrenamiento
def load_train_set(dirname, map_characters, verbose=True):
    X_train = []
    y_train = []
    for label, character in map_characters.items():
        folder_path = os.path.join(dirname, character)
        if not os.path.exists(folder_path):
            continue
        images = [f for f in os.listdir(folder_path) if f.endswith(("jpg", "jpeg", "png"))]
        if verbose:
            print(f"Leyendo {len(images)} imágenes de {character}")
        for image_name in images:
            image = cv2.imread(os.path.join(folder_path, image_name))
            if image is not None:
                image = cv2.resize(image, (IMG_SIZE, IMG_SIZE))
                X_train.append(image)
                y_train.append(label)
    return np.array(X_train), np.array(y_train)

# Función para cargar imágenes de test
```

```
def load_test_set(dirname, map_characters, verbose=True):
    X_test = []
    y_test = []
    reverse_dict = {v: k for k, v in map_characters.items()}
    for filename in glob.glob(dirname + '/*.*'):
        char_name = "_".join(filename.split('/')[-1].split('_')[:-1])
        if char_name in reverse_dict:
            image = cv2.imread(filename)
            if image is not None:
                image = cv2.resize(image, (IMG_SIZE, IMG_SIZE))
                X_test.append(image)
                y_test.append(reverse_dict[char_name])
    if verbose:
        print(f"Leídas {len(X_test)} imágenes de test")
    return np.array(X_test), np.array(y_test)


X, y = load_train_set(ruta_train_drive, MAP_CHARACTERS)
X_t, y_t = load_test_set(ruta_test_drive, MAP_CHARACTERS)

print(f"Total imágenes de entrenamiento: {X.shape}")
print(f"Total imágenes de test: {X_t.shape}")
```

```
Leyendo 913 imágenes de abraham_grampa_simpson
Leyendo 623 imágenes de apu_nahasapeemapetilon
Leyendo 1342 imágenes de bart_simpson
Leyendo 1193 imágenes de charles_montgomery_burns
Leyendo 986 imágenes de chief_wiggum
Leyendo 469 imágenes de comic_book_guy
Leyendo 457 imágenes de edna_krabappel
Leyendo 2246 imágenes de homer_simpson
Leyendo 498 imágenes de kent_brockman
Leyendo 1206 imágenes de krusty_the_clown
Leyendo 1354 imágenes de lisa_simpson
Leyendo 1291 imágenes de marge_simpson
Leyendo 1079 imágenes de milhouse_van_houten
Leyendo 1452 imágenes de moe_szyslak
Leyendo 1454 imágenes de ned_flanders
Leyendo 358 imágenes de nelson_muntz
Leyendo 1194 imágenes de principal_skinner
Leyendo 877 imágenes de sideshow_bob
Leídas 890 imágenes de test
Total imágenes de entrenamiento: (18992, 64, 64, 3)
Total imágenes de test: (890, 64, 64, 3)
```

```
X = X.astype('float32') / 255.0
X_t = X_t.astype('float32') / 255.0

X_train, X_val, y_train, y_val = train_test_split(
    X, y,
    test_size=0.2,
    stratify=y,
    random_state=64
)

print(f"Imágenes para entrenar: {X_train.shape}, Para Validar: {X_val.shape}")
```

```
Imágenes para entrenar: (15193, 64, 64, 3), Para Validar: (3799, 64, 64, 3)
```

```
numero_clases = len(MAP_CHARACTERS)

model = models.Sequential([
    layers.Input(shape=(64, 64, 3)),

    layers.Conv2D(32, (3, 3), padding='same', activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    # Convolución 1
    layers.Conv2D(64, (3, 3), padding='same', activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    # Convolución 2
    layers.Conv2D(128, (3, 3), padding='same', activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    # Convolución 3
    layers.Conv2D(256, (3, 3), padding='same', activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    # Capa completamente conectada
```

```
    layers.Flatten(),
    layers.Dense(504, activation='relu'),
    layers.Dropout(0.7),

    # Capa de salida
    layers.Dense(numero_clases, activation='softmax')
])

# Compilar el modelo
model.compile(
    optimizer='adam',
    loss='sparse_categorical_crossentropy',
    metrics=['accuracy']
)

model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
batch_normalization (BatchNormalization)	(None, 64, 64, 32)	128
max_pooling2d (MaxPooling2D)	(None, 32, 32, 32)	0
conv2d_1 (Conv2D)	(None, 32, 32, 64)	18,496
batch_normalization_1 (BatchNormalization)	(None, 32, 32, 64)	256
max_pooling2d_1 (MaxPooling2D)	(None, 16, 16, 64)	0
conv2d_2 (Conv2D)	(None, 16, 16, 128)	73,856
batch_normalization_2 (BatchNormalization)	(None, 16, 16, 128)	512
max_pooling2d_2 (MaxPooling2D)	(None, 8, 8, 128)	0
conv2d_3 (Conv2D)	(None, 8, 8, 256)	295,168
batch_normalization_3 (BatchNormalization)	(None, 8, 8, 256)	1,024
max_pooling2d_3 (MaxPooling2D)	(None, 4, 4, 256)	0
flatten (Flatten)	(None, 4096)	0
dense (Dense)	(None, 504)	2,064,888
dropout (Dropout)	(None, 504)	0
dense_1 (Dense)	(None, 18)	9,090

Total params: 2,464,314 (9.40 MB)
Trainable params: 2,463,354 (9.40 MB)
Non-trainable params: 960 (3.75 KB)

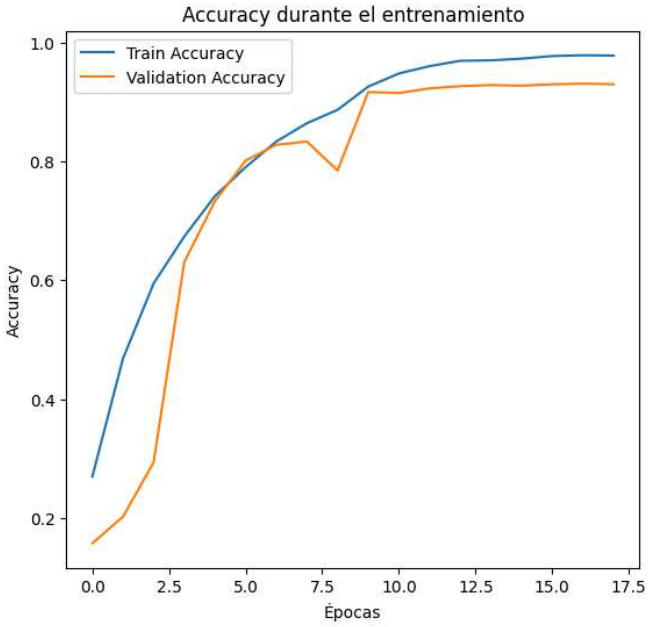
entrenamiento modelo

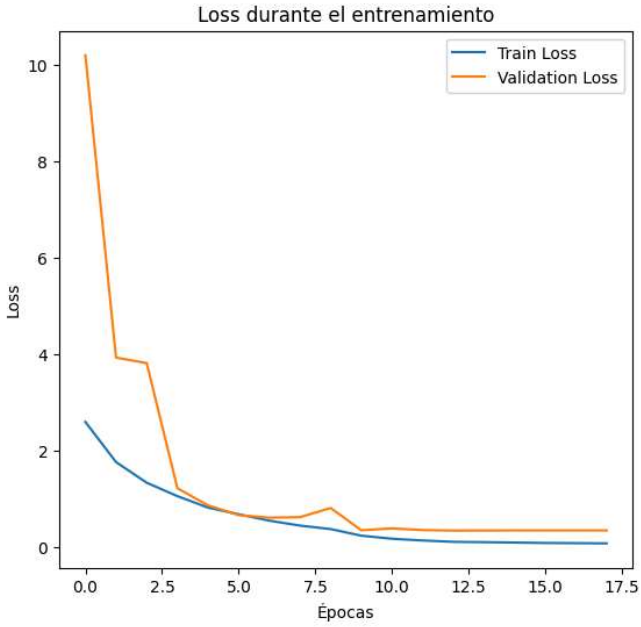
```
early_stop = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True,
    verbose=2
)

checkpoint = ModelCheckpoint(
    'best_model.h5',
    monitor='val_loss',
    save_best_only=True,
    verbose=3
)

reduce_lr = ReduceLROnPlateau(
    monitor='val_loss',
    factor=0.3,
    patience=2,
    verbose=1
)


history = model.fit(
```

```
    X_train, y_train,
    validation_data=(X_val, y_val),
    epochs=80,
    batch_size=124,
    callbacks=[early_stop, checkpoint, reduce_lr]
)
```

```
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 25ms/step - accuracy: 0.8303 - loss: 0.5494 - val_accuracy: 0.8278 - val_loss: 0.6010 - learning_r
Epoch 8/80
122/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.8699 - loss: 0.4186
Epoch 8: val_loss did not improve from 0.60095
123/123 ━━━━━━━━━━━━━━━━━━━━ 5s 25ms/step - accuracy: 0.8698 - loss: 0.4189 - val_accuracy: 0.8334 - val_loss: 0.6116 - learning_r
Epoch 9/80
123/123 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step - accuracy: 0.8861 - loss: 0.3551
Epoch 9: val_loss did not improve from 0.60095

Epoch 9: ReduceLROnPlateau reducing learning rate to 0.0003000000142492354.
123/123 ━━━━━━━━━━━━━━━━━━━━ 5s 26ms/step - accuracy: 0.8861 - loss: 0.3552 - val_accuracy: 0.7847 - val_loss: 0.8020 - learning_r
Epoch 10/80
121/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.9196 - loss: 0.2463
Epoch 10: val_loss improved from 0.60095 to 0.33883, saving model to best_model.h5
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format is
123/123 ━━━━━━━━━━━━━━━━━━━━ 5s 25ms/step - accuracy: 0.9197 - loss: 0.2458 - val_accuracy: 0.9168 - val_loss: 0.3388 - learning_r
Epoch 11/80
121/123 ━━━━━━━━━━━━━━━━━━━━ 0s 21ms/step - accuracy: 0.9489 - loss: 0.1579
Epoch 11: val_loss did not improve from 0.33883
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - accuracy: 0.9489 - loss: 0.1580 - val_accuracy: 0.9150 - val_loss: 0.3783 - learning_r
Epoch 12/80
123/123 ━━━━━━━━━━━━━━━━━━━━ 0s 21ms/step - accuracy: 0.9607 - loss: 0.1274
Epoch 12: val_loss did not improve from 0.33883

Epoch 12: ReduceLROnPlateau reducing learning rate to 9.000000427477062e-05.
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - accuracy: 0.9607 - loss: 0.1274 - val_accuracy: 0.9229 - val_loss: 0.3432 - learning_r
Epoch 13/80
121/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.9692 - loss: 0.1026
Epoch 13: val_loss improved from 0.33883 to 0.33305, saving model to best_model.h5
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format is
123/123 ━━━━━━━━━━━━━━━━━━━━ 5s 25ms/step - accuracy: 0.9692 - loss: 0.1025 - val_accuracy: 0.9266 - val_loss: 0.3331 - learning_r
Epoch 14/80
122/123 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step - accuracy: 0.9671 - loss: 0.0972
Epoch 14: val_loss did not improve from 0.33305
123/123 ━━━━━━━━━━━━━━━━━━━━ 5s 25ms/step - accuracy: 0.9671 - loss: 0.0971 - val_accuracy: 0.9284 - val_loss: 0.3341 - learning_r
Epoch 15/80
121/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.9710 - loss: 0.0869
Epoch 15: val_loss did not improve from 0.33305

Epoch 15: ReduceLROnPlateau reducing learning rate to 2.700000040931627e-05.
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - accuracy: 0.9710 - loss: 0.0868 - val_accuracy: 0.9273 - val_loss: 0.3363 - learning_r
Epoch 16/80
123/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.9760 - loss: 0.0766
Epoch 16: val_loss did not improve from 0.33305
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 25ms/step - accuracy: 0.9760 - loss: 0.0766 - val_accuracy: 0.9297 - val_loss: 0.3355 - learning_r
Epoch 17/80
121/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.9793 - loss: 0.0696
Epoch 17: val_loss did not improve from 0.33305

Epoch 17: ReduceLROnPlateau reducing learning rate to 8.100000013655517e-06.
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - accuracy: 0.9793 - loss: 0.0696 - val_accuracy: 0.9308 - val_loss: 0.3357 - learning_r
Epoch 18/80
121/123 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step - accuracy: 0.9764 - loss: 0.0705
Epoch 18: val_loss did not improve from 0.33305
123/123 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - accuracy: 0.9765 - loss: 0.0704 - val_accuracy: 0.9297 - val_loss: 0.3361 - learning_r
Epoch 18: early stopping
Restoring model weights from the end of the best epoch: 13.
```

```
# Grafico de metricas

plt.figure(figsize=(14,6))

plt.subplot(1,2,1)
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Accuracy durante el entrenamiento')
plt.xlabel('Épocas')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1,2,2)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Loss durante el entrenamiento')
plt.xlabel('Épocas')
plt.ylabel('Loss')
plt.legend()

plt.show()
```






```
model = load_model('best_model.h5')
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have yet to be built. `model.compile_metrics` will be empty until
```

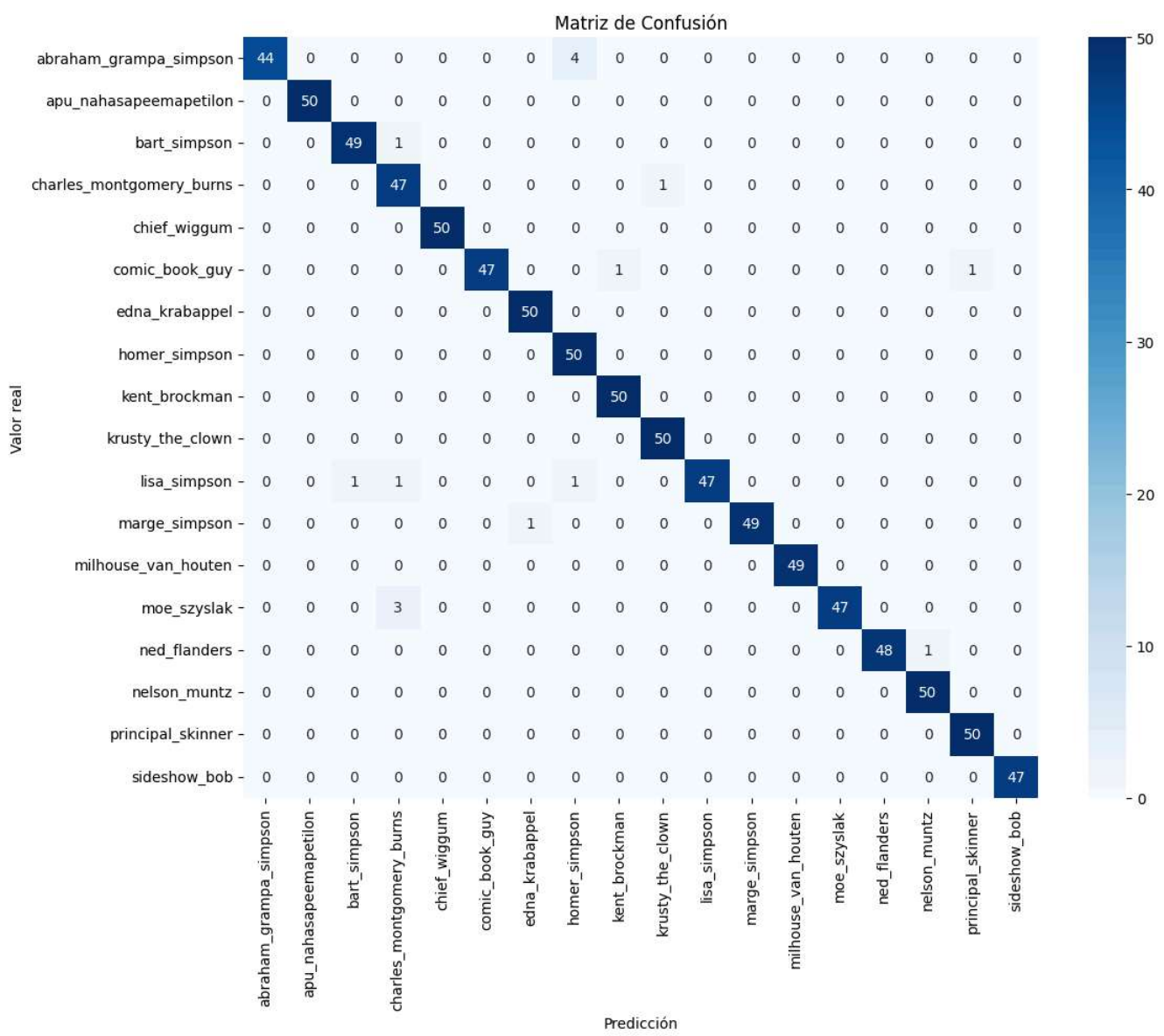
```
y_pred_probs = model.predict(X_t)
y_pred = np.argmax(y_pred_probs, axis=1)
```

```
28/28 ━━━━━━━━━━━━━━━━━━━━ 2s 30ms/step
```

```
# Reporte por clase
print("Classification Report:")
print(classification_report(y_t, y_pred, target_names=list(MAP_CHARACTERS.values())))
```

```
Classification Report:
                           precision    recall  f1-score   support

       abraham_grampa_simpson       1.00      0.92      0.96        48
       apu_nahasapeemapetilon       1.00      1.00      1.00        50
                bart_simpson       0.98      0.98      0.98        50
     charles_montgomery_burns       0.90      0.98      0.94        48
                chief_wiggum       1.00      1.00      1.00        50
              comic_book_guy       1.00      0.96      0.98        49
              edna_krabappel       0.98      1.00      0.99        50
               homer_simpson       0.91      1.00      0.95        50
               kent_brockman       0.98      1.00      0.99        50
             krusty_the_clown       0.98      1.00      0.99        50
                 lisa_simpson       1.00      0.94      0.97        50
                marge_simpson       1.00      0.98      0.99        50
            milhouse_van_houten       1.00      1.00      1.00        49
                 moe_szyslak       1.00      0.94      0.97        50
               ned_flanders       1.00      0.98      0.99        49
               nelson_muntz       0.98      1.00      0.99        50
          principal_skinner       0.98      1.00      0.99        50
               sideshow_bob       1.00      1.00      1.00        47

                   accuracy                           0.98       890
                  macro avg       0.98      0.98      0.98       890
               weighted avg       0.98      0.98      0.98       890
```

```
cm = confusion_matrix(y_t, y_pred)

plt.figure(figsize=(12,10))
sns.heatmap(cm, annot=True, fmt='d', xticklabels=MAP_CHARACTERS.values(), yticklabels=MAP_CHARACTERS.values(), cmap='Blues')
plt.title('Matriz de Confusión')
plt.xlabel('Predicción')
plt.ylabel('Valor real')
plt.xticks(rotation=90)
plt.yticks(rotation=0)
plt.tight_layout()
plt.show()
```



Generar 10 random numbers using numpy Cerrar

```
# Cargar modelo
model = load_model('best_model.h5')

# Tamaño esperado por la red
IMG_SIZE = 64

# Lista de nombres de clase
class_names = list(MAP_CHARACTERS.values())

# Función de predicción frame a frame
def predict_video(video_path):
    cap = cv2.VideoCapture(video_path)
    frame_preds = []

    while True:
        ret, frame = cap.read()
        if not ret:
            break

        # Preprocesar el frame
        frame_resized = cv2.resize(frame, (IMG_SIZE, IMG_SIZE))
        frame_norm = frame_resized.astype('float32') / 255.0
        frame_input = np.expand_dims(frame_norm, axis=0)

        # Predicción
        prediction = model.predict(frame_input, verbose=0)
```

```
            pred_class = np.argmax(prediction)
            frame_preds.append(class_names[pred_class])

    cap.release()

    # Analizar predicciones
    if not frame_preds:
        return "No se pudo procesar el video."

    top = Counter(frame_preds).items()
    result = "\n".join([f"{char}: {count} frames" for char, count in top])
    return f"Personajes detectados:\n{result}"

# Interfaz Gradio
iface = grad.Interface(
    fn=predict_video,
    inputs=grad.Video(label="Sube un video de Los Simpsons"),
    outputs=grad.Textbox(label="Resultado"),
    title="Detector de personajes de Los Simpsons",
    description="Este modelo analiza frame por frame un video y detecta los personajes de los simpsons."
)

iface.launch()
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have yet to be built. `model.compile_metrics` will be empty until y
It looks like you are running Gradio on a hosted a Jupyter notebook. For the Gradio app to work, sharing must be enabled. Automatica

Colab notebook detected. To show errors in colab notebook, set debug=True in launch()
* Running on public URL: https://baed8c9cb24d8f31eb.gradio.live

This share link expires in 1 week. For free permanent hosting and GPU upgrades, run `gradio deploy` from the terminal in the working
```

Clear Submit

Resultado

Personajes detectados:
homer_simpson: 1494 frames
sideshow_bob: 131 frames
marge_simpson: 224 frames
bart_simpson: 372 frames
lisa_simpson: 177 frames
abraham_grampa_simpson: 5 frames
edna_krabappel: 85 frames
charles_montgomery_burns: 344 frames
krusty_the_clown: 396 frames
ned_flanders: 471 frames
apu_nahasapeemapetilon: 185 frames
moe_szyslak: 101 frames
comic_book_guy: 173 frames
principal_skinner: 69 frames
nelson_muntz: 108 frames
chief_wiggum: 18 frames
kent_brockman: 4 frames