Librerias y descargas

```
import os
import pandas as pd
import numpy as np
from numpy import asarray
from numpy import save
import shutil
import math
import librosa
import librosa.display
import soundfile as sf
import numpy as np
import random
from keras.models import model_from_json
from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix
from IPython.display import Audio
from IPython.core.display import display
from scipy.io import wavfile
import matplotlib.pyplot as plt
import pprint
import statistics
import seaborn as sns
from tqdm.notebook import tqdm

from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
import subprocess

try:
        import speechmetrics as sm
except ImportError:
        print('Instalando paquetes...')
        subprocess.check_call(["python", '-m', 'pip', 'install', 'git+https://github.com/aliutkus/speechmetrics#egg=speechmetrics[cpu]
        import speechmetrics as sm
```

```
Instalando paquetes...
```

```
%%capture
!git clone https://github.com/speechbrain/speechbrain/
!pip install speechbrain
!pip install transformers
import speechbrain as sb
from speechbrain.dataio.dataio import read_audio
from speechbrain.pretrained import SepformerSeparation as separator
```

```
%%capture
!pip install -U asteroid
import asteroid
from asteroid.models import BaseModel
from asteroid.models import ConvTasNet
import soundfile as sf
```

Funcion de union de audios y metricas

```
window = 8
metrics = sm.load(['relative.pesq', 'relative.stoi', 'relative.sisdr'], window)
```

```
Loaded  speechmetrics.relative.pesq
Loaded  speechmetrics.relative.sisdr
Loaded  speechmetrics.relative.stoi
```

```
def merge_audios(audio1_path, audio2_path, overlap_percentage, volume_ratio):

    if volume_ratio > 0:
      flag_val = 1
    elif volume_ratio < 0:
      flag_val = 2
    else:
      flag_val = 0

   # Cargar los archivos de audio
    audio1, sr = librosa.load(audio1_path, sr=None)
    audio2, sr = librosa.load(audio2_path, sr=None)

    # Obtener la duración de cada audio
    duration1 = len(audio1) / sr
    duration2 = len(audio2) / sr

    # Determinar el audio más largo y el más corto
    if duration1 >= duration2:
        long_audio = audio1
```

```
        short_audio = audio2
    else:
        long_audio = audio2
        short_audio = audio1

    # Asegurarse de que el audio más corto tenga la misma duración que el más largo
    long_audio = long_audio[:len(short_audio)]

    audio1 = short_audio
    audio2 = long_audio

    # Ajustar el volumen del segundo audio según la razón en dB
    rms_audio1 = librosa.feature.rms(y = audio1).mean()
    rms_audio2 = librosa.feature.rms(y = audio2).mean()

    # Calcular el valor RMS de cada audio
    dB_rms_audio1 = 10*math.log(rms_audio1)
    dB_rms_audio2 = 10*math.log(rms_audio2)

    # Calcular la relación de amplitud entre los audios
    relacion_amplitud = volume_ratio - (dB_rms_audio1 - dB_rms_audio2)
    relacion_amplitud += rms_audio1

    # Ajustar el volumen del audio2 utilizando el factor de ajuste
    factor_ajuste = math.pow(10, relacion_amplitud / 10)
    audio1_ajustado = audio1 * factor_ajuste


    # Calcular la duración de la superposición
    overlap_samples = int(len(audio1_ajustado) * overlap_percentage)

    audio1_padded = np.pad(audio1_ajustado, (overlap_samples, 0), mode='constant')


    # Obtener la duración de cada audio
    duration1 = len(audio1_padded) / sr
    duration2 = len(audio2) / sr

    # Determinar el audio más largo y el más corto
    if duration1 >= duration2:
        long_audio = audio1_padded
        short_audio = audio2
    else:
        long_audio = audio2
        short_audio = audio1_padded

    # Asegurarse de que el audio más corto tenga la misma duración que el más largo
    short_audio = np.pad(short_audio, (0, len(long_audio) - len(short_audio)))


    # Combinar los audios
    merged_audio = long_audio + short_audio

    # Normalizar el audio
    merged_audio = librosa.util.normalize(merged_audio)

    return merged_audio, sr, flag_val
```

SER

Se especifica las emociones y la frecuencia de muestreo que usara el modelo

```
# Cargar arquitectura del modelo desde archivo JSON
with open('/content/drive/MyDrive/Tesis/modeloRCTS_8k_3emot.json', 'r') as json_file:
    loaded_model_json = json_file.read()
MODEL = model_from_json(loaded_model_json)

# Cargar pesos al modelo
MODEL.load_weights("/content/drive/MyDrive/Tesis/pesosRCTS_8k_3emot.h5")
```

```
!pip install pydub
from pydub import AudioSegment, effects
from tensorflow.keras.utils import to_categorical
```

```
Collecting pydub
  Downloading pydub-0.25.1-py2.py3-none-any.whl (32 kB)
Installing collected packages: pydub
Successfully installed pydub-0.25.1
```

```
# longo = 180000
#longo = 128000 # 16k
longo = 64000 # 8k
def preprocess_audio(path):
    y, sr = librosa.load(path, sr=None)

    # raw_audio = AudioSegment.from_file(path)
    # samples = np.array(raw_audio.get_array_of_samples(), dtype='float32')

    samples = librosa.util.normalize(y)
```

```
    trimmed, _ = librosa.effects.trim(samples, top_db=25)
    if len(trimmed) < longo:
      padded = np.pad(trimmed, (0, longo-len(trimmed)), 'constant')
    else:
      padded = trimmed[:longo]
    return padded, sr

emotion_dic = {
    'neutral' : 0,
    'happy'   : 1,
    'angry'   : 2
}

def encode(label):
    return emotion_dic.get(label)
```

```
zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

def extract_features(path):
    try:
        y, sr = preprocess_audio(path)

        y = librosa.util.normalize(y)

        # display(Audio(y, rate=sr))
        # print('Frecuencia de muestreo = ', sr)

        zcr = librosa.feature.zero_crossing_rate(y, frame_length=FRAME_LENGTH, hop_length=HOP_LENGTH)
        rms = librosa.feature.rms(y=y, frame_length=FRAME_LENGTH, hop_length=HOP_LENGTH)
        mfccs = librosa.feature.mfcc(y=y, sr=sr, n_mfcc=13, hop_length=HOP_LENGTH)

        zcr_list.append(zcr)
        rms_list.append(rms)
        mfccs_list.append(mfccs)

    except:
        print(f"Failed for path: {path}")
```

Mezcla de audios

Base de datos

Creacion

```
# Datos a 8 kHz
datos_osiles = pd.read_csv('/content/drive/MyDrive/Tesis/datos_osiles_8k.csv')

print(datos_osiles.shape)
datos_osiles.head()
```

```
(5659, 6)
```

	path1	emotion1	persona1	path2	emotion2	persona2
0	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	angry	C_88	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	happy	C_39
1	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_84	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	angry	C_73
2	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_64	/content/drive/MyDrive/Tesis/RCST_8k/TESS/YAF_...	disgust	T_YAF
3	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	sad	C_72	/content/drive/MyDrive/Tesis/RCST_8k/TESS/YAF_...	fear	T_YAF
4	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	happy	C_15	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_10

```
mini_acum = datos_osiles[datos_osiles['emotion1'].isin(['happy', 'neutral', 'angry'])]
mini_acum = mini_acum[mini_acum['emotion2'].isin(['happy', 'neutral', 'angry'])]
#mini_acum = mini_acum[mini_acum['emotion1'] != mini_acum['emotion2']]
print(mini_acum.shape)
```

```
(1319, 6)
```

```
mini = datos_osiles.sample(600)
print(mini.shape)
mini.head()
```

(600, 6)

	path1	emotion1	persona1	path2	emotion2	persona2
1654	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_30	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_56
4326	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	happy	C_86	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_87
5121	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	fear	C_70	/content/drive/MyDrive/Tesis/RCST_8k/TESS/YAF_...	fear	T_YAF
125	/content/drive/MyDrive/Tesis/RCST_8k/Ravdess/0...	neutral	R_19	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	angry	C_81
4121	/content/drive/MyDrive/Tesis/RCST_8k/TESS/YAF_...	happy	T_YAF	/content/drive/MyDrive/Tesis/RCST_8k/CremaD/10...	disgust	C_22

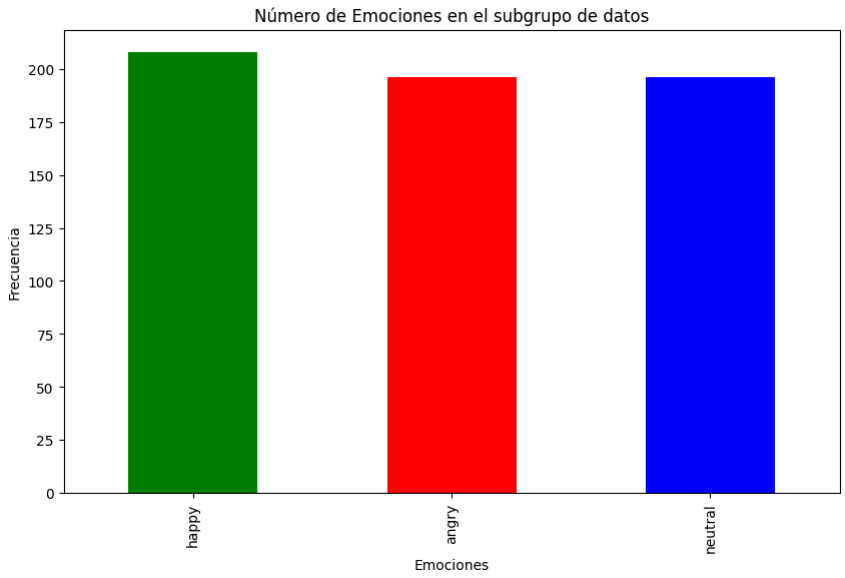
```
mini.to_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_6emot.csv', index=False)
```

Carga

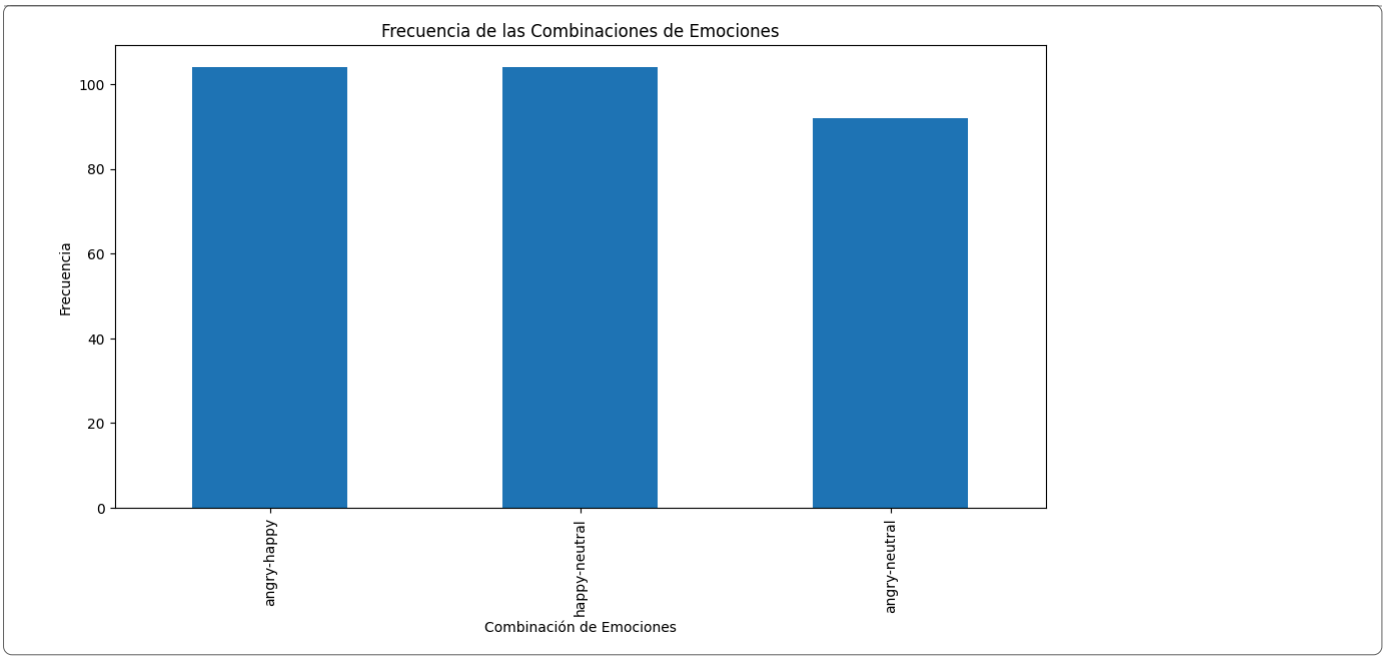
```
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
# mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot_rep.csv')

limite = len(mini) # Barra de progreso
limite
```

```
300
```

```
# Grafica de la distribucion de meocines cuando se eligen muestras de manera aleatoria
emotions = pd.concat([mini["emotion1"], mini["emotion2"]])

# Contar la frecuencia de cada emoción
emotion_counts = emotions.value_counts()

# Crear el gráfico de barras
plt.figure(figsize=(10, 6))
emotion_counts.plot(kind='bar', color = ['green', 'red', 'blue'])
plt.xlabel('Emociones')
plt.ylabel('Frecuencia')
plt.title('Número de Emociones en el subgrupo de datos')
plt.show()
```




```
combinacion = mini[["emotion1", "emotion2"]].apply(lambda x: "-".join(sorted(x)), axis=1)

# Contar la frecuencia de cada combinación de emociones
combinacion_counts = combinacion.value_counts()

# Crear el gráfico de barras
plt.figure(figsize=(12, 6))
combinacion_counts.plot(kind='bar')
plt.xlabel('Combinación de Emociones')
plt.ylabel('Frecuencia')
plt.title('Frecuencia de las Combinaciones de Emociones')
plt.show()
```



Overlap y volumen

```
opciones_overlap = [0.2, 0.4, 0.6, 0.8, 1]
#opciones_overlap = [0]
opciones_volume = [-3, -2, -1, 0, 1, 2, 3]
#opciones_volume = [0]

vector_volumen = [random.choice(opciones_volume) for _ in range(600)]
vector_overlap = [random.choice(opciones_overlap) for _ in range(600)]
```

```
save('vector_volumen.npy', vector_volumen)
shutil.copyfile("vector_volumen.npy", "/content/drive/MyDrive/Tesis/vector_volumen_6emot.npy")
```

```
'/content/drive/MyDrive/Tesis/vector_volumen_6emot.npy'
```

```
save('vector_overlap.npy', vector_overlap)
shutil.copyfile("vector_overlap.npy", "/content/drive/MyDrive/Tesis/vector_overlap_3emot_overlap.npy")
```

```
'/content/drive/MyDrive/Tesis/vector_overlap_3emot_overlap.npy'
```

```
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
vector_overlap = np.load('/content/drive/MyDrive/Tesis/vector_overlap_3emot_overlap.npy')
```

Añadir ruido

```
def sum_noise(merged_audio):
  ruta_ruido = "/content/drive/MyDrive/Tesis/WHAM noise/sub_300_8k/"

  archivos_ruido = os.listdir(ruta_ruido)

  # Cargar el archivo de audio normal
  audio_normal = merged_audio

  # Seleccionar un archivo de ruido aleatoriamente
  archivo_ruido = archivos_ruido[acum_indice]
  archivo_ruido = ruta_ruido + archivo_ruido

  # Cargar el archivo de ruido
  audio_ruido, sr = librosa.load(archivo_ruido, sr=None)

  # Ajustar la duración del ruido a la duración del audio normal
  if len(audio_ruido) > len(audio_normal):
      audio_ruido = audio_ruido[:len(audio_normal)]
  else:
      audio_ruido = audio_ruido + audio_ruido[:len(audio_normal) - len(audio_ruido)]

  audio_ruido /= (2/3)

  # Combinar el audio normal con el ruido
  audio_combinado = audio_normal + audio_ruido

  return audio_combinado
```

```
def save_preprocess(audio_path, destination_path, new_sr = 8000, top_db = 20, frame_length = 2048):
  # Obtener el nombre del archivo original
  file_name = os.path.basename(audio_path)

  # Cargar el archivo de audio
  y, sr = librosa.load(audio_path,sr=None)
```

```
  # Resamplear el audio a la nueva tasa de muestreo
  y_resampled = librosa.resample(y, orig_sr=sr, target_sr=new_sr)

  # Normalizar el audio
  normalized_y = librosa.util.normalize(y_resampled)

  # Construir la ruta de destino con el mismo nombre de archivo
  normalized_audio_path = os.path.join(destination_path, file_name)

  # Guardar el audio normalizado como un archivo
  sf.write(normalized_audio_path, normalized_y, new_sr)
```

```
# Creacion y guardado de preprocesamiento para ruido
ruta_ruido = "/content/drive/MyDrive/Tesis/WHAM noise/sub_300/"
archivos_ruido = os.listdir(ruta_ruido)

destination_path = '/content/drive/MyDrive/Tesis/WHAM noise/sub_300_8k/'
os.makedirs(destination_path, exist_ok=True)

for audio_path in archivos_ruido:
  audio_path = ruta_ruido + audio_path
  save_preprocess(audio_path, destination_path, new_sr = 8000);
```

Añadir Reverberancia

Modelos de Speechbrain

SEPFORMER

```
## SEPARADORES ANECOICOS
#model = separator.from_hparams(source="speechbrain/sepformer-wsj02mix", savedir='pretrained_models/sepformer-wsj02mix')
#model = separator.from_hparams(source="speechbrain/sepformer-libri2mix", savedir='pretrained_models/sepformer-libri2mix')

## SEPARADORES CON RUIDO
#model = separator.from_hparams(source="speechbrain/sepformer-wham", savedir='pretrained_models/sepformer-wham')
#model = separator.from_hparams(source="speechbrain/sepformer-whamr", savedir='pretrained_models/sepformer-whamr')
```

Separacion con Speechbrain

Sepformer con librimix - anecoico -norep

```
model = separator.from_hparams(source="speechbrain/sepformer-libri2mix", savedir='pretrained_models/sepformer-libri2mix')
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
Downloading (…)ain/hyperparams.yaml: 100%  4.59k/4.59k [00:00<00:00, 126kB/s]
Downloading encoder.ckpt: 100%  17.3k/17.3k [00:00<00:00, 680kB/s]
Downloading masknet.ckpt: 100%  113M/113M [00:06<00:00, 21.2MB/s]
Downloading decoder.ckpt: 100%  17.3k/17.3k [00:00<00:00, 735kB/s]
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)
  # display(Audio(merged_audio, rate=sr))

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()
```

```
  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  # MEtricas
  reference1 = row.path1
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'

  extract_features('person_one.wav')
  extract_features('person_two.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                    300/300 [40:10<00:00, 7.19s/it]
19/19 [==============================] - 3s 60ms/step
0.5416666666666666
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

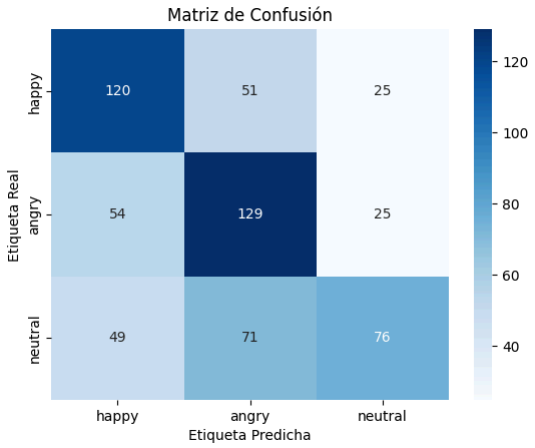
```
SISDR: 7.732113846439562
PESQ: 1.8855587768554687
STOI: 0.7300978665260247
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 28.91816845075391
PESQ: 4.2978515625
STOI: 0.9982365085713312
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
```

```
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



Sepformer con wsj0 - anecoico -norep

```
model = separator.from_hparams(source="speechbrain/sepformer-wsj02mix", savedir='pretrained_models/sepformer-wsj02mix')
```

```
Downloading (…)ain/hyperparams.yaml: 100%  1.51k/1.51k [00:00<00:00, 46.9kB/s]
Downloading masknet.ckpt: 100%  113M/113M [00:06<00:00, 23.2MB/s]
Downloading encoder.ckpt: 100%  17.3k/17.3k [00:00<00:00, 608kB/s]
Downloading decoder.ckpt: 100%  17.2k/17.2k [00:00<00:00, 448kB/s]
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)

  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()

  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'

  extract_features('person_one.wav')
  extract_features('person_two.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)
```

```
    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                    300/300 [33:07<00:00, 6.17s/it]
19/19 [==============================] - 1s 36ms/step
0.45666666666666667
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

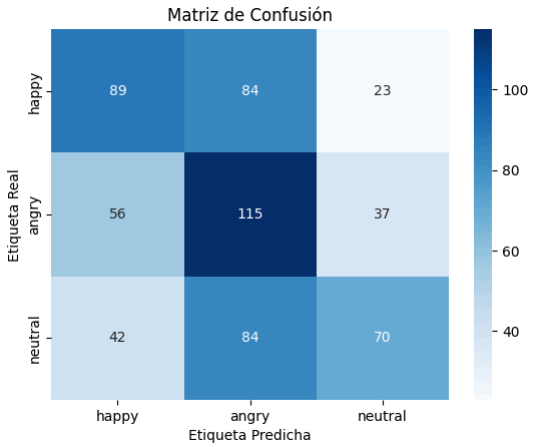
```
SISDR: 3.6378242667450564
PESQ: 1.5176223824421564
STOI: 0.6595247926579936
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 28.653246904546577
PESQ: 3.9235408306121826
STOI: 0.9932915385275204
```

Sepformer con wsj0 - anecoico -rep

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



Sepformer con librimix - anecoico -rep

```
model = separator.from_hparams(source="speechbrain/sepformer-libri2mix", savedir='pretrained_models/sepformer-libri2mix')
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot_rep.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_rep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()

  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'

  extract_features('person_one.wav')
  extract_features('person_two.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
```

```
    else:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))

    scores1 = metrics(test1, reference1)
    scores2 = metrics(test2, reference2)

    pesq.append(float(list(scores1.values())[0]))
    sisdr.append(float(list(scores1.values())[1]))
    stoi.append(float(list(scores1.values())[2]))
    pesq.append(float(list(scores2.values())[0]))
    sisdr.append(float(list(scores2.values())[1]))
    stoi.append(float(list(scores2.values())[2]))

    acum_indice+=1
    barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                    300/300 [38:06<00:00, 7.47s/it]
19/19 [==============================] - 1s 58ms/step
0.5566666666666666
```

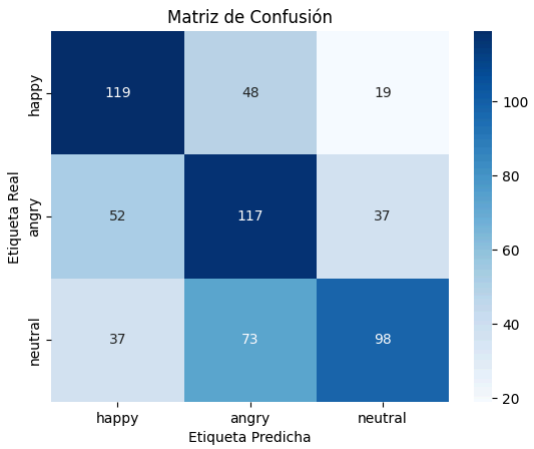
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: 7.926985648991822
PESQ: 1.885368383526802
STOI: 0.7419438161742588
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 32.06199189647031
PESQ: 4.301904678344727
STOI: 0.9977075902167064
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



```
model = separator.from_hparams(source="speechbrain/sepformer-wsj02mix", savedir='pretrained_models/sepformer-wsj02mix')
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot_rep.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_rep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)

  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()

  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'

  extract_features('person_one.wav')
  extract_features('person_two.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
```

```
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                                    300/300 [33:19<00:00, 6.67s/it]
19/19 [==============================] - 1s 36ms/step
0.49333333333333335
```

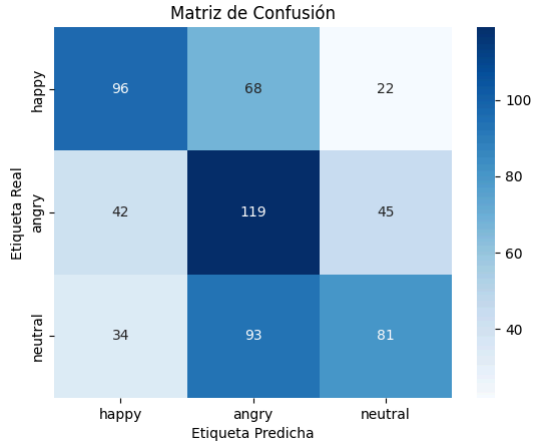
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: 3.7019078803050545
PESQ: 1.5194130696853
STOI: 0.6711845707852748
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 25.22285901269363
PESQ: 4.149238109588623
STOI: 0.9932663130956001
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



Sepformer con librimix - anecoico -norep - overlap

```
model = separator.from_hparams(source="speechbrain/sepformer-libri2mix", savedir='pretrained_models/sepformer-libri2mix')
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
vector_overlap = np.load('/content/drive/MyDrive/Tesis/vector_overlap_3emot_overlap.npy')
limite = len(mini) # Barra de progreso
limite
```

```
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
```

```
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]
  overlap_percentage = vector_overlap[acum_indice]

  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()

  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  audio1, _ = librosa.load(row.path1, sr=None)
  overlap_samples = int(len(audio1) * overlap_percentage)
  audio1_padded = np.pad(audio1, (overlap_samples, 0), mode='constant')

  sf.write('reference_one.wav', audio1_padded, rate)

  reference1 = 'reference_one.wav'
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'

  extract_features('person_one.wav')
  extract_features('person_two.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = 'reference_one.wav'
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                    300/300 [54:52<00:00, 10.10s/it]
19/19 [==============================] - 1s 38ms/step
0.44666666666666666
```

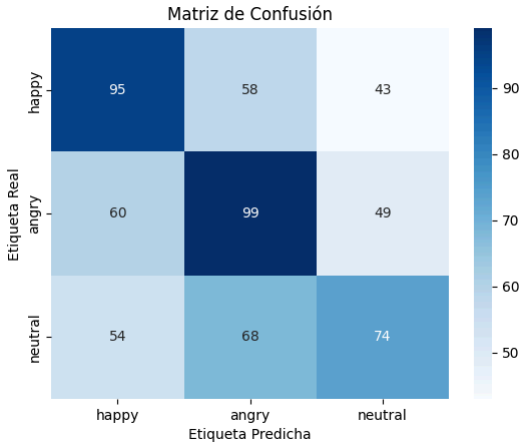
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: -16.74613296849455
PESQ: 2.0617997616529466
STOI: 0.4566531251445033
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 48.52450905404474
PESQ: 4.612381458282471
STOI: 0.9999302674439101
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



RUIDO

Sepformer con librimix - ruidoso -norep

```
# model = separator.from_hparams(source="speechbrain/sepformer-wsj02mix", savedir='pretrained_models/sepformer-wsj02mix') #40%
# model = separator.from_hparams(source="speechbrain/sepformer-wham", savedir='pretrained_models/sepformer-wham') # 35 %
model = separator.from_hparams(source="speechbrain/sepformer-whamr", savedir='pretrained_models/sepformer-whamr') # 35 %
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
mini = mini.head(10)
limite = len(mini) # Barra de progreso
limite
```

```
10
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

sisdr_impro = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]
```

```
    merged_audio_0, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)
    display(Audio(merged_audio_0, rate=sr))

    merged_audio = sum_noise(merged_audio_0)
    display(Audio(merged_audio, rate=sr))

    score_impro = metrics(merged_audio, merged_audio_0, rate = sr)
    sisdr_impro.append(float(list(score_impro.values())[1]))

    sf.write('merge.wav', merged_audio, rate)

    est_sources = model.separate_file(path='merge.wav')
    person_two = est_sources[:, :, 1].detach().cpu().squeeze()
    person_one = est_sources[:, :, 0].detach().cpu().squeeze()

    sf.write('person_one.wav', person_one, rate)
    sf.write('person_two.wav', person_two, rate)

    # MEtricas
    reference1 = row.path1
    reference2 = row.path2

    test1 = 'person_one.wav'
    test2 = 'person_two.wav'

    extract_features('person_one.wav')
    extract_features('person_two.wav')

    scores = metrics(test2, reference2)
    com_metrics = float(list(scores.values())[1])

    if com_metrics < 0:
      scores = metrics(test2, reference1)

      if float(list(scores.values())[1]) < com_metrics:
        emotion_list.append(encode(row.emotion1))
        emotion_list.append(encode(row.emotion2))
      else:
        reference2 = row.path1
        reference1 = row.path2
        emotion_list.append(encode(row.emotion2))
        emotion_list.append(encode(row.emotion1))
    else:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))

    scores1 = metrics(test1, reference1)
    scores2 = metrics(test2, reference2)

    pesq.append(float(list(scores1.values())[0]))
    sisdr.append(float(list(scores1.values())[1]))
    stoi.append(float(list(scores1.values())[2]))
    pesq.append(float(list(scores2.values())[0]))
    sisdr.append(float(list(scores2.values())[1]))
    stoi.append(float(list(scores2.values())[2]))

    acum_indice+=1
    barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                                    10/10 [01:43<00:00, 10.23s/it]
```

0:00 / 0:01

0:00 / 0:01

0:00 / 0:02

0:00 / 0:02

0:00 / 0:02

0:00 / 0:02

0:00 / 0:01

0:00 / 0:01

0:00 / 0:01

0:00 / 0:01

0:00 / 0:01

0:00 / 0:01

0:00 / 0:03

0:00 / 0:03

0:00 / 0:02

0:00 / 0:02

0:00 / 0:02

0:00 / 0:02

0:00 / 0:01

0:00 / 0:01

```
1/1 [==============================] - 0s 55ms/step
0.35
```

```
print('SISDR noise:', statistics.mean(sisdr_impro))
```

```
SISDR noise: -5.413615241646767
```

```
sisdr_impro
```

```
[-4.5861756801605225,
 -6.146858334541321,
 -5.862518548965454,
 -11.534870862960815,
 3.05460125207901,
 -9.155336022377014,
 -4.988559782505035,
 -2.4736815690994263,
 -10.331848859786987,
 -2.1109040081501007]
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: -9.024457115495325
PESQ: 1.1090214848518372
STOI: 0.44258237948829604
```

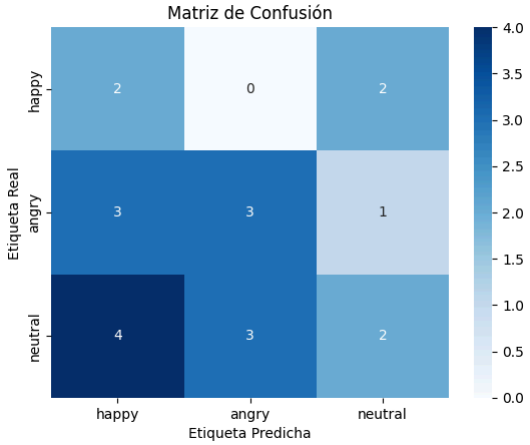
```
impro =  [x - y for x, y in zip(sisdr_impro, sisdr)]
print(statistics.mean(impro))
```

```
4.326491866242677
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 3.2569636489431257
PESQ: 1.335123062133789
STOI: 0.758667307184102
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



Separacion con Asteroid

CONVTASNET

```
#model2 = ConvTasNet.from_pretrained("JorisCos/ConvTasNet_Libri2Mix_sepclean_8k") ##
#model2 = ConvTasNet.from_pretrained("mpariente/ConvTasNet_WHAM_sepclean") ##

#model2 = ConvTasNet.from_pretrained("JorisCos/ConvTasNet_Libri2Mix_sepnoisy_8k") ##
```

ConvTasNet con librimix - anecoico - norep

```
model2 = ConvTasNet.from_pretrained("JorisCos/ConvTasNet_Libri2Mix_sepclean_8k")

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:649: FutureWarning: 'cached_download' is the legacy way to download files from the HF hub, please co
  warnings.warn(
Downloading pytorch_model.bin: 100%                    20.3M/20.3M [00:01<00:00, 11.7MB/s]
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)
```

```
    model2.separate('merge.wav',force_overwrite=True)

    person_one, _ = librosa.load('merge_est1.wav', sr=None)
    person_two, _ = librosa.load('merge_est2.wav', sr=None)

    reference1 = row.path1
    reference2 = row.path2

    test1 = 'merge_est1.wav'
    test2 = 'merge_est2.wav'

    extract_features('merge_est1.wav')
    extract_features('merge_est2.wav')

    scores = metrics(test2, reference2)
    com_metrics = float(list(scores.values())[1])

    if com_metrics < 0:
      scores = metrics(test2, reference1)

      if float(list(scores.values())[1]) < com_metrics:
        emotion_list.append(encode(row.emotion1))
        emotion_list.append(encode(row.emotion2))
      else:
        reference2 = row.path1
        reference1 = row.path2
        emotion_list.append(encode(row.emotion2))
        emotion_list.append(encode(row.emotion1))
    else:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))

    scores1 = metrics(test1, reference1)
    scores2 = metrics(test2, reference2)

    pesq.append(float(list(scores1.values())[0]))
    sisdr.append(float(list(scores1.values())[1]))
    stoi.append(float(list(scores1.values())[2]))
    pesq.append(float(list(scores2.values())[0]))
    sisdr.append(float(list(scores2.values())[1]))
    stoi.append(float(list(scores2.values())[2]))

    acum_indice+=1
    barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred)
# 0.178 accuracy
```

```
Progreso: 100%                                    300/300 [10:41<00:00, 1.92s/it]
19/19 [==============================] - 1s 61ms/step
0.43
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

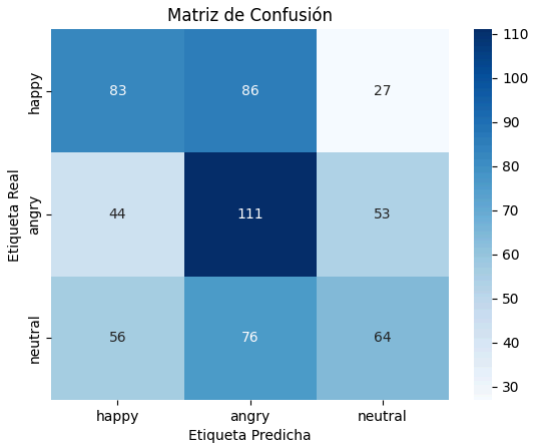
```
SISDR: 3.7518701772826177
PESQ: 1.4554403867324193
STOI: 0.6437991309616539
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 19.599085167880258
PESQ: 3.4571919441223145
STOI: 0.9875276092373811
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
```

```
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



ConvTasNet con wsj0 - anecoico - norep

```
model2 = ConvTasNet.from_pretrained("mpariente/ConvTasNet_WHAM_sepclean") ##

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:649: FutureWarning: 'cached_download' is the legacy way to download files from the HF hub, please co
  warnings.warn(
Downloading pytorch_model.bin: 100%                    20.3M/20.3M [00:01<00:00, 12.0MB/s]
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  model2.separate('merge.wav',force_overwrite=True)

  person_one, _ = librosa.load('merge_est1.wav', sr=None)
  person_two, _ = librosa.load('merge_est2.wav', sr=None)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'merge_est1.wav'
  test2 = 'merge_est2.wav'

  extract_features('merge_est1.wav')
  extract_features('merge_est2.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)
```

```
    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred)
# 0.178 accuracy
```

```
Progreso: 100%                                    300/300 [10:44<00:00, 1.99s/it]
19/19 [==============================] - 1s 59ms/step
0.3883333333333333
```

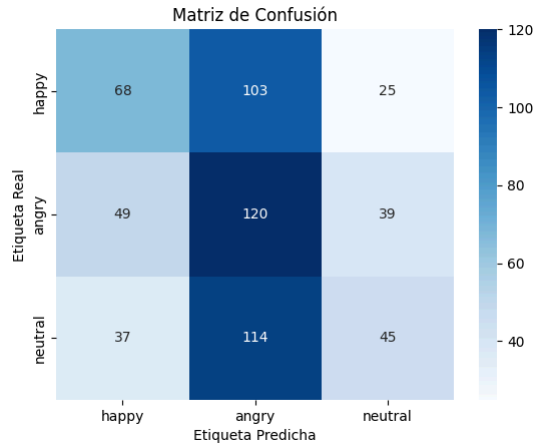
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: -0.2709480461842056
PESQ: 1.2758050976196924
STOI: 0.5717534097417092
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 20.148285393785855
PESQ: 3.404099464416504
STOI: 0.9752689950618187
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



ConvTasNet con librimix - anecoico - rep

```
model2 = ConvTasNet.from_pretrained("JorisCos/ConvTasNet_Libri2Mix_sepclean_8k")

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot_rep.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_rep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:649: FutureWarning: 'cached_download' is the legacy way to download files from the HF hub, please co
  warnings.warn(
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  model2.separate('merge.wav',force_overwrite=True)

  person_one, _ = librosa.load('merge_est1.wav', sr=None)
  person_two, _ = librosa.load('merge_est2.wav', sr=None)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'merge_est1.wav'
  test2 = 'merge_est2.wav'

  extract_features('merge_est1.wav')
  extract_features('merge_est2.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
```

```
    else:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))

    scores1 = metrics(test1, reference1)
    scores2 = metrics(test2, reference2)

    pesq.append(float(list(scores1.values())[0]))
    sisdr.append(float(list(scores1.values())[1]))
    stoi.append(float(list(scores1.values())[2]))
    pesq.append(float(list(scores2.values())[0]))
    sisdr.append(float(list(scores2.values())[1]))
    stoi.append(float(list(scores2.values())[2]))

    acum_indice+=1
    barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred)
# 0.178 accuracy
```

```
Progreso: 100%                                    300/300 [10:44<00:00, 2.05s/it]
19/19 [==============================] - 1s 37ms/step
0.46
```

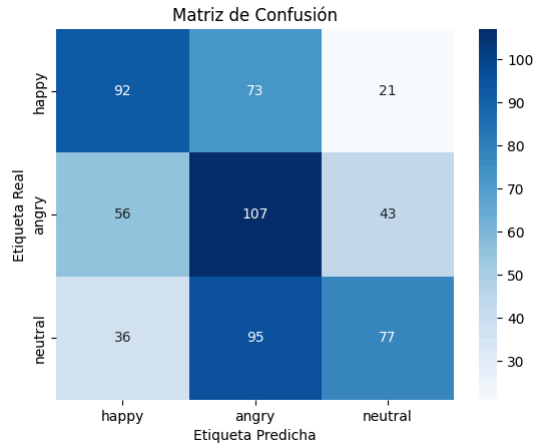
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: 3.7253353567911325
PESQ: 1.4373587314287821
STOI: 0.6532798571273712
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 22.27668680020153
PESQ: 3.849868059158325
STOI: 0.986500193134602
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



ConvTasNet con wsj0 - anecoico - rep

```
model2 = ConvTasNet.from_pretrained("mpariente/ConvTasNet_WHAM_sepclean") ##

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot_rep.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_rep.npy')
limite = len(mini) # Barra de progreso
limite
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:649: FutureWarning: 'cached_download' is the legacy way to download files from the HF hub, please co
  warnings.warn(
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  model2.separate('merge.wav',force_overwrite=True)

  person_one, _ = librosa.load('merge_est1.wav', sr=None)
  person_two, _ = librosa.load('merge_est2.wav', sr=None)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'merge_est1.wav'
  test2 = 'merge_est2.wav'

  extract_features('merge_est1.wav')
  extract_features('merge_est2.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
```

```
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred)
# 0.178 accuracy
```

```
Progreso: 100%                                    300/300 [10:46<00:00, 2.61s/it]
19/19 [==============================] - 1s 38ms/step
0.3516666666666667
```

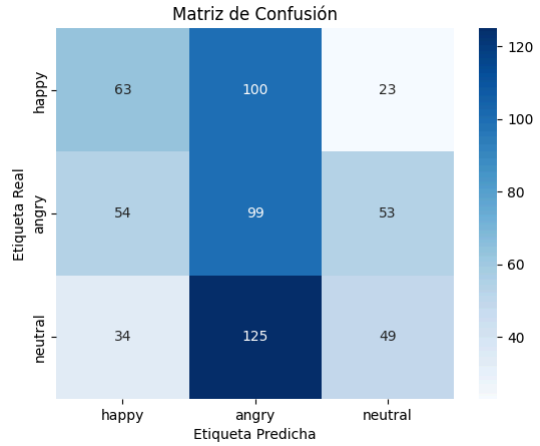
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: -0.6547423560260759
PESQ: 1.2422235876321792
STOI: 0.5730197626735011
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 15.725092579071827
PESQ: 3.0504884719848633
STOI: 0.9751701784801634
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



ConvTasNet con librimix - anecoico - norep - overlap

```
model2 = ConvTasNet.from_pretrained("JorisCos/ConvTasNet_Libri2Mix_sepclean_8k")

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_3emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_3emot_norep.npy')
vector_overlap = np.load('/content/drive/MyDrive/Tesis/vector_overlap_3emot_overlap.npy')
limite = len(mini) # Barra de progreso
limite
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:649: FutureWarning: 'cached_download' is the legacy way to download files from the HF hub, please co
  warnings.warn(
300
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []
```

```
pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0


for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]
  overlap_percentage = vector_overlap[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  model2.separate('merge.wav',force_overwrite=True)

  audio1, _ = librosa.load(row.path1, sr=None)
  overlap_samples = int(len(audio1) * overlap_percentage)
  audio1_padded = np.pad(audio1, (overlap_samples, 0), mode='constant')

  sf.write('reference_one.wav', audio1_padded, rate)

  reference1 = 'reference_one.wav'
  reference2 = row.path2

  test1 = 'merge_est1.wav'
  test2 = 'merge_est2.wav'

  extract_features('merge_est1.wav')
  extract_features('merge_est2.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred)
```

```
Progreso: 100%                                    300/300 [17:03<00:00, 3.52s/it]
19/19 [==============================] - 1s 39ms/step
0.47
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
```

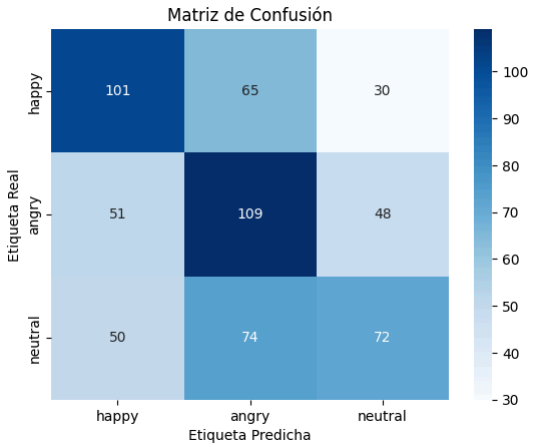
```
print('STOI:', statistics.mean(stoi))
```

```
SISDR: -25.18320752787932
PESQ: 1.775996442437172
STOI: 0.35574483139812324
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 38.83268206555167
PESQ: 4.565000534057617
STOI: 0.9991507178941885
```

```
# Etiquetas específicas para cada clase
etiquetas = ['happy', 'angry', 'neutral']

# Calcular la matriz de confusión utilizando la función confusion_matrix() de sklearn.metrics
cm = confusion_matrix(emotion_list, y_pred)

# Crear un mapa de calor de la matriz de confusión utilizando seaborn y matplotlib
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues", xticklabels=etiquetas, yticklabels=etiquetas)

# Configurar las etiquetas de los ejes
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")

# Mostrar la matriz de confusión
plt.show()
```



Demas

SER 6 emotions

Se especifica las emociones y la frecuencia de muestreo que usara el modelo

```
# Cargar arquitectura del modelo desde archivo JSON
with open('/content/drive/MyDrive/Tesis/modeloRCTS_8k_temp_2.json', 'r') as json_file:
    loaded_model_json = json_file.read()
MODEL = model_from_json(loaded_model_json)

# Cargar pesos al modelo
MODEL.load_weights("/content/drive/MyDrive/Tesis/pesosRCTS_8k_temp_2.h5")
```

```
# longo = 180000
#longo = 128000 # 16k
longo = 64000 # 8k
def preprocess_audio(path):
    y, sr = librosa.load(path, sr=None)

    # raw_audio = AudioSegment.from_file(path)
    # samples = np.array(raw_audio.get_array_of_samples(), dtype='float32')

    samples = librosa.util.normalize(y)

    trimmed, _ = librosa.effects.trim(samples, top_db=25)
    if len(trimmed) < longo:
      padded = np.pad(trimmed, (0, longo-len(trimmed)), 'constant')
    else:
      padded = trimmed[:longo]
    return padded, sr

emotion_dic = {
    'neutral' : 0,
    'happy'   : 1,
    'sad'     : 2,
    'angry'   : 3,
```

```
    'fear'    : 4,
    'disgust' : 5
}

def encode(label):
    return emotion_dic.get(label)
```

```
zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

def extract_features(path):
    try:
        y, sr = preprocess_audio(path)

        y = librosa.util.normalize(y)

        # display(Audio(y, rate=sr))
        # print('Frecuencia de muestreo = ', sr)

        zcr = librosa.feature.zero_crossing_rate(y, frame_length=FRAME_LENGTH, hop_length=HOP_LENGTH)
        rms = librosa.feature.rms(y=y, frame_length=FRAME_LENGTH, hop_length=HOP_LENGTH)
        mfccs = librosa.feature.mfcc(y=y, sr=sr, n_mfcc=13, hop_length=HOP_LENGTH)

        zcr_list.append(zcr)
        rms_list.append(rms)
        mfccs_list.append(mfccs)

    except:
        print(f"Failed for path: {path}")
```

Separacion

Sepformer con librimix - anecoico -norep

```
model = separator.from_hparams(source="speechbrain/sepformer-libri2mix", savedir='pretrained_models/sepformer-libri2mix')
mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_6emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_6emot.npy')
limite = len(mini) # Barra de progreso
limite
```

```
600
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)
  # display(Audio(merged_audio, rate=sr))

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()

  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  # MEtricas
  reference1 = row.path1
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'
```

```
    extract_features('person_one.wav')
    extract_features('person_two.wav')

    scores = metrics(test2, reference2)
    com_metrics = float(list(scores.values())[1])

    if com_metrics < 0:
      scores = metrics(test2, reference1)

      if float(list(scores.values())[1]) < com_metrics:
        emotion_list.append(encode(row.emotion1))
        emotion_list.append(encode(row.emotion2))
      else:
        reference2 = row.path1
        reference1 = row.path2
        emotion_list.append(encode(row.emotion2))
        emotion_list.append(encode(row.emotion1))
    else:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))

    scores1 = metrics(test1, reference1)
    scores2 = metrics(test2, reference2)

    pesq.append(float(list(scores1.values())[0]))
    sisdr.append(float(list(scores1.values())[1]))
    stoi.append(float(list(scores1.values())[2]))
    pesq.append(float(list(scores2.values())[0]))
    sisdr.append(float(list(scores2.values())[1]))
    stoi.append(float(list(scores2.values())[2]))

    acum_indice+=1
    barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
Progreso: 100%                                    600/600 [1:21:23<00:00, 8.06s/it]
38/38 [==============================] - 2s 36ms/step
0.3516666666666667
```

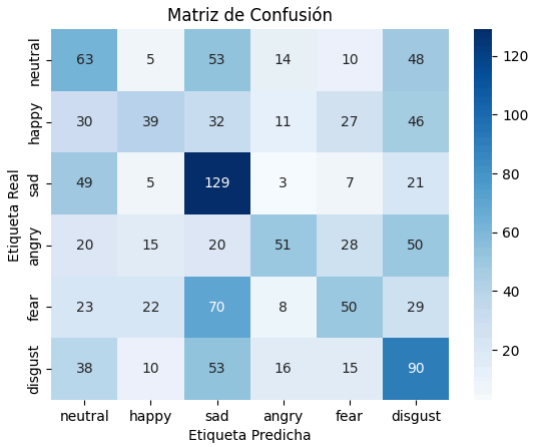
```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
SISDR: 7.225421143889173
PESQ: 1.8405850006143252
STOI: 0.7020681120667707
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 27.30568712096265
PESQ: 4.404636859893799
STOI: 0.9981861126249616
```

```
labels = ['neutral', 'happy', 'sad', 'angry', 'fear', 'disgust']
#labels = ['neutral', 'happy','angry']

cm = confusion_matrix(emotion_list, y_pred, labels=range(6))
# cm = confusion_matrix(np.argmax(y_class, axis=1), y_pred, labels=range(3))

sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=labels, yticklabels=labels)
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")
plt.show()
```



Sepformer con wsj0 - anecoico -norep

```
model = separator.from_hparams(source="speechbrain/sepformer-wsj02mix", savedir='pretrained_models/sepformer-wsj02mix')
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512
rate = 8000

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)

  merged_audio, sr, _= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  est_sources = model.separate_file(path='merge.wav')
  person_two = est_sources[:, :, 1].detach().cpu().squeeze()
  person_one = est_sources[:, :, 0].detach().cpu().squeeze()

  sf.write('person_one.wav', person_one, rate)
  sf.write('person_two.wav', person_two, rate)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'person_one.wav'
  test2 = 'person_two.wav'

  extract_features('person_one.wav')
  extract_features('person_two.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
```

```
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

# Finalizar la barra de progreso
barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred) # 0.533333333
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
labels = ['neutral', 'happy', 'sad', 'angry', 'fear', 'disgust']
#labels = ['neutral', 'happy','angry']

cm = confusion_matrix(emotion_list, y_pred, labels=range(6))
# cm = confusion_matrix(np.argmax(y_class, axis=1), y_pred, labels=range(3))

sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=labels, yticklabels=labels)
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
plt.title("Matriz de Confusión")
plt.show()
```

ConvTasNet con librimix - anecoico - norep

```
model2 = ConvTasNet.from_pretrained("JorisCos/ConvTasNet_Libri2Mix_sepclean_8k")

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_6emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_6emot.npy')
limite = len(mini) # Barra de progreso
limite
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:649: FutureWarning: 'cached_download' is the legacy way to download files from the HF hub, please co
  warnings.warn(
600
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)
```

```
  model2.separate('merge.wav',force_overwrite=True)

  person_one, _ = librosa.load('merge_est1.wav', sr=None)
  person_two, _ = librosa.load('merge_est2.wav', sr=None)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'merge_est1.wav'
  test2 = 'merge_est2.wav'

  extract_features('merge_est1.wav')
  extract_features('merge_est2.wav')

  scores = metrics(test2, reference2)
  com_metrics = float(list(scores.values())[1])

  if com_metrics < 0:
    scores = metrics(test2, reference1)

    if float(list(scores.values())[1]) < com_metrics:
      emotion_list.append(encode(row.emotion1))
      emotion_list.append(encode(row.emotion2))
    else:
      reference2 = row.path1
      reference1 = row.path2
      emotion_list.append(encode(row.emotion2))
      emotion_list.append(encode(row.emotion1))
  else:
    emotion_list.append(encode(row.emotion1))
    emotion_list.append(encode(row.emotion2))

  scores1 = metrics(test1, reference1)
  scores2 = metrics(test2, reference2)

  pesq.append(float(list(scores1.values())[0]))
  sisdr.append(float(list(scores1.values())[1]))
  stoi.append(float(list(scores1.values())[2]))
  pesq.append(float(list(scores2.values())[0]))
  sisdr.append(float(list(scores2.values())[1]))
  stoi.append(float(list(scores2.values())[2]))

  acum_indice+=1
  barra_progreso.update(1)

barra_progreso.close()

X = np.concatenate((
    np.swapaxes(zcr_list, 1, 2),
    np.swapaxes(rms_list, 1, 2),
    np.swapaxes(mfccs_list, 1, 2)),
    axis=2
)
X = X.astype('float32')

y_pred = np.argmax(MODEL.predict(X), axis=1)

emotion_list = np.array(emotion_list)

accuracy_score(emotion_list, y_pred)
# 0.178 accuracy
```

```
Progreso: 100%                                    600/600 [23:00<00:00, 2.08s/it]
38/38 [==============================] - 2s 58ms/step
0.2725
```

```
print('SISDR:', statistics.mean(sisdr))
print('PESQ:', statistics.mean(pesq))
print('STOI:', statistics.mean(stoi))
```

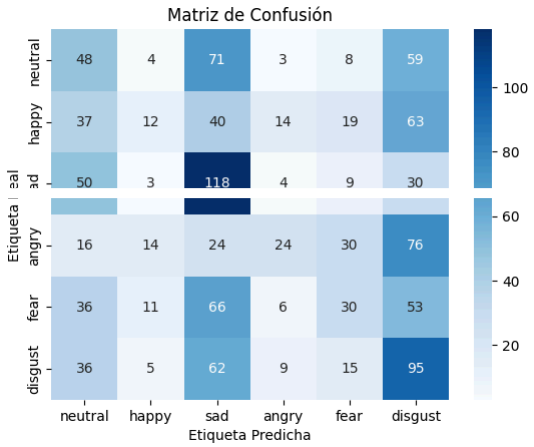
```
SISDR: 3.3909876266956425
PESQ: 1.452250007490317
STOI: 0.6156162717522399
```

```
print('SISDR:', max(sisdr))
print('PESQ:', max(pesq))
print('STOI:', max(stoi))
```

```
SISDR: 20.581461276931492
PESQ: 3.7953941822052
STOI: 0.9858198676513078
```

```
labels = ['neutral', 'happy', 'sad', 'angry', 'fear', 'disgust']
#labels = ['neutral', 'happy','angry']

cm = confusion_matrix(emotion_list, y_pred, labels=range(6))
# cm = confusion_matrix(np.argmax(y_class, axis=1), y_pred, labels=range(3))

sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=labels, yticklabels=labels)
plt.xlabel("Etiqueta Predicha")
plt.ylabel("Etiqueta Real")
```

```
plt.title("Matriz de Confusión")
plt.show()
```



ConvTasNet con wsj0 - anecoico - norep

```
model2 = ConvTasNet.from_pretrained("mpariente/ConvTasNet_WHAM_sepclean") ##

mini = pd.read_csv('/content/drive/MyDrive/Tesis/directorio_mezcla_6emot.csv')
vector_volumen = np.load('/content/drive/MyDrive/Tesis/vector_volumen_6emot.npy')
limite = len(mini) # Barra de progreso
limite
```

```
barra_progreso = tqdm(total=limite, desc="Progreso")

zcr_list = []
rms_list = []
mfccs_list = []
emotion_list = []

pesq = []
sisdr = []
stoi = []

FRAME_LENGTH = 2048
HOP_LENGTH = 512

acum_indice = 0

overlap_percentage = 0

for index, row in mini.iterrows():
  volume_ratio = vector_volumen[acum_indice]

  audio1, _ = librosa.load(row.path1, sr=None)
  audio2, _ = librosa.load(row.path2, sr=None)
  merged_audio, sr, flag= merge_audios(row.path1, row.path2, overlap_percentage, volume_ratio)

  sf.write('merge.wav', merged_audio, rate)

  model2.separate('merge.wav',force_overwrite=True)

  person_one, _ = librosa.load('merge_est1.wav', sr=None)
  person_two, _ = librosa.load('merge_est2.wav', sr=None)

  reference1 = row.path1
  reference2 = row.path2

  test1 = 'merge_est1.wav'
  test2 = 'merge_est2.wav'

  extract_features('merge_est1.wav')
  extract_features('merge_est2.wav')
```