Model	Parameters	Size
VGG16	138,357,544	528 MB
VGG19	143,667,240	548 MB
ResNet50	25,636,712	98 MB
Inception-V3	23,851,784	92 MB
DenseNet-121	8,062,504	31 MB
Xception	22,910,480	88 MB
MobileNet	4,253,864	16 MB

Model	Depth	Trainable Parameters	Size	# of Weights	# of Biases
VGG16	16	138,357,544	528 MB	138,357,544	0
VGG19	19	143,667,240	548 MB	143,667,240	0
ResNet50	50	25,636,712	98 MB	25,583,592	53,120
Inception-V3	159	23,851,784	92 MB	23,768,712	83,072
DenseNet-121	121	8,062,504	31 MB	7,978,856	83,648
Xception	126	22,910,480	88 MB	22,855,840	54,640
MobileNet	88	4,253,864	16 MB	4,253,384	480

Orden de a cuerdo a cantidad de Weights:

1. VGG19
2. Resnet50
3. DenseNet-121
4. MobileNet

Orden de acuerdo a profundidad:

Inception-V3
DenseNet-121
Resnet50
Mobile Net

Modelos seleccionados:

- ResNet50: Este modelo tiene un alto rendimiento en la clasificación de imágenes en general, gracias a su arquitectura profunda y su capacidad para aprender características de alto nivel a partir de características de bajo nivel. La estructura de salto de conexión residual de ResNet también ayuda a prevenir el problema de desvanecimiento de gradiente, lo que puede mejorar la precisión de la clasificación. Además, ResNet50 tiene un tamaño de modelo moderado en comparación con otros modelos más grandes, lo que lo hace más fácil de entrenar y menos propenso al sobreajuste.
- DenseNet-121: Este modelo también tiene una arquitectura profunda, pero utiliza conexiones densas entre capas para mejorar aún más el flujo de información en la red. DenseNet-121 es conocido por su eficiencia y facilidad de entrenamiento, ya que el tamaño del modelo es relativamente pequeño y tiene menos parámetros que otros modelos más grandes. Además, el modelo ha demostrado ser efectivo en problemas de clasificación de imágenes, incluidos los problemas de clasificación multietiqueta.
- Inception-V3: Este modelo se enfoca en mejorar la eficiencia computacional de las redes neuronales convolucionales, al mismo tiempo que mantiene un alto rendimiento en la clasificación de imágenes. Inception-V3 utiliza una estructura de red modular y varias operaciones de convolución para mejorar la eficiencia computacional. Además, Inception-V3 tiene un tamaño de modelo moderado y es fácil de entrenar, lo que lo hace ideal para aplicaciones de clasificación de imágenes multietiqueta.
- MobileNet: Este modelo se destaca por su eficiencia en términos de uso de recursos computacionales y su capacidad para ejecutarse en dispositivos con recursos limitados. MobileNet utiliza capas convolucionales separables en profundidad para reducir el costo computacional y el tamaño del modelo, lo que lo hace adecuado para aplicaciones en dispositivos móviles o en la nube con recursos limitados. A pesar de su tamaño reducido, MobileNet ha demostrado ser efectivo en tareas de clasificación de imágenes, incluida la clasificación multietiqueta.

EVALUACIÓN DE ESPECTROGRAMAS

Para la generación de los espectrogramas se decidió probar dos acercamientos:

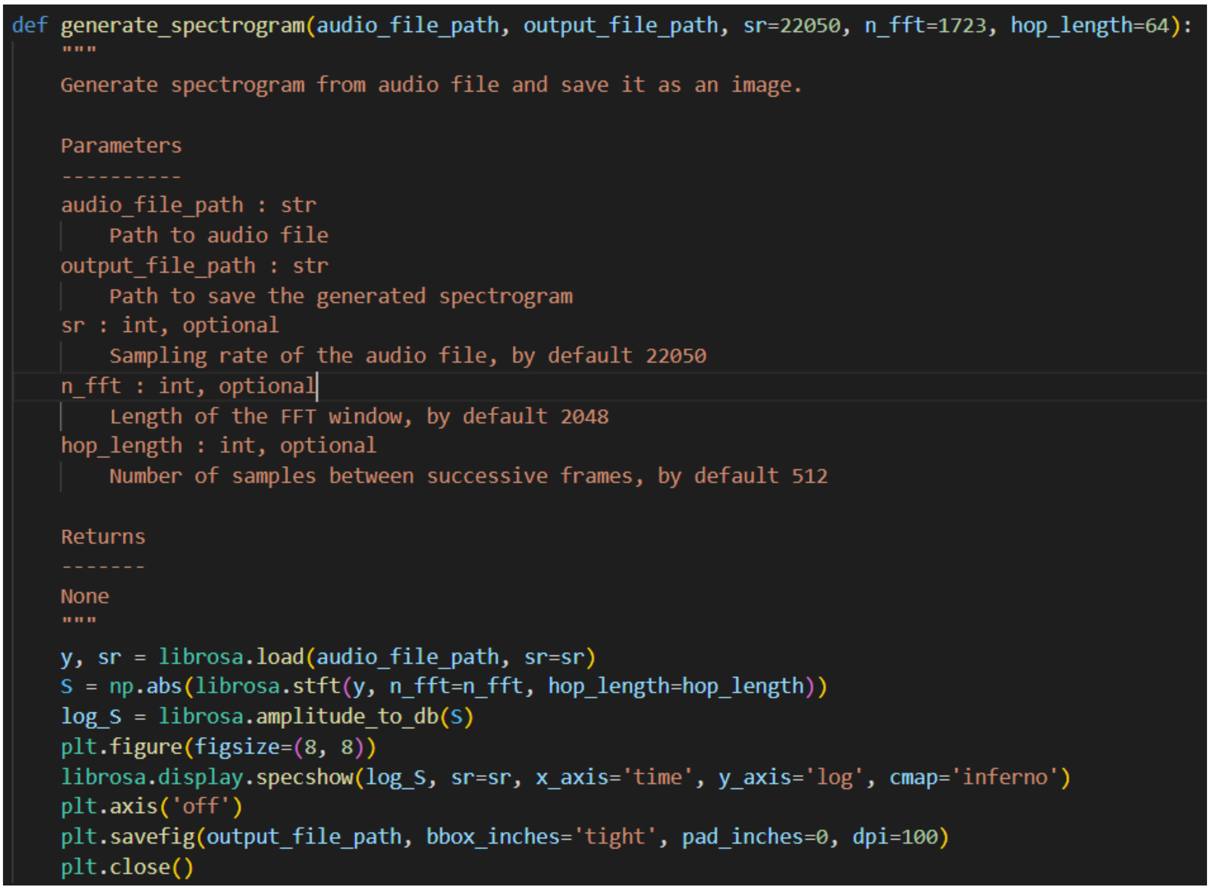
- Uso de SFFT y specshow, función de librosa.
- Uso de melspectrogram función de librosa.

Para modificar parámetros y encontrar la mejor forma de visualización de los llamados en los espectrogramas se usó la siguiente formula: FFT Length = (Sample Rate * Duration) / Hop Length

El Sample Rate de nuestros audios es = 22050Hz
Nuestra duración de los audios es de = 5sec
Se fué modificando el Hop Lenght en base a potencias de 2 disminuyendo desde 512 y despejando el valor de FFT Lenght con cada variación

A continuación los códigos utilizados:

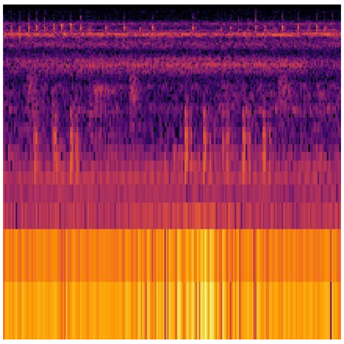
SFFT y specshow:



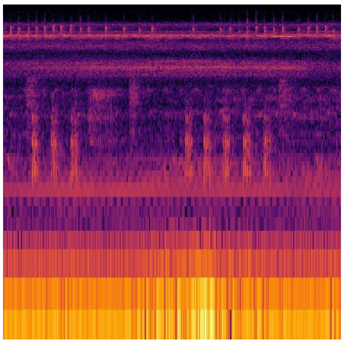
```python
def generate_spectrogram(audio_file_path, output_file_path, sr=22050, n_fft=1723, hop_length=64):
    """
    Generate spectrogram from audio file and save it as an image.

    Parameters
    ----------
    audio_file_path : str
        Path to audio file
    output_file_path : str
        Path to save the generated spectrogram
    sr : int, optional
        Sampling rate of the audio file, by default 22050
    n_fft : int, optional
        Length of the FFT window, by default 2048
    hop_length : int, optional
        Number of samples between successive frames, by default 512

    Returns
    -------
    None
    """
    y, sr = librosa.load(audio_file_path, sr=sr)
    S = np.abs(librosa.stft(y, n_fft=n_fft, hop_length=hop_length))
    log_S = librosa.amplitude_to_db(S)
    plt.figure(figsize=(8, 8))
    librosa.display.specshow(log_S, sr=sr, x_axis='time', y_axis='log', cmap='inferno')
    plt.axis('off')
    plt.savefig(output_file_path, bbox_inches='tight', pad_inches=0, dpi=100)
    plt.close()
```

Los siguientes fueron los resultados de variar los parámetros de esta función:

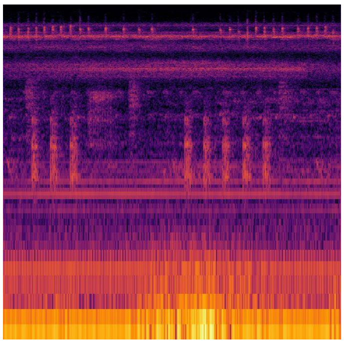
N_FFT= 215 / Hop_Lenght = 512



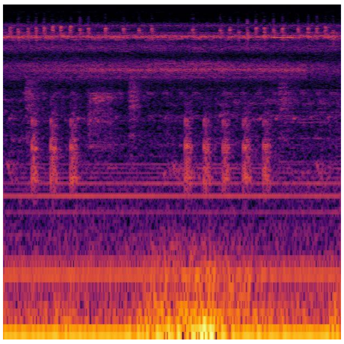
N_FFT= 431 / Hop_Lenght = 256



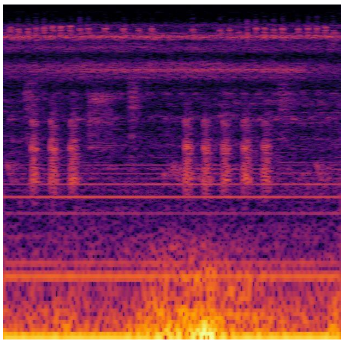
N_FFT= 861 / Hop_Lenght = 128



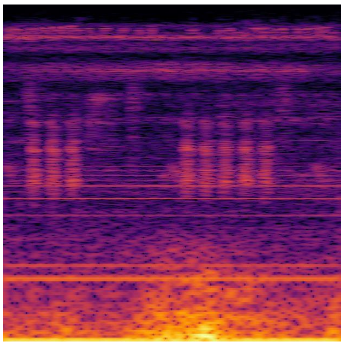
N_FFT= 1722 / Hop_Lenght = 64



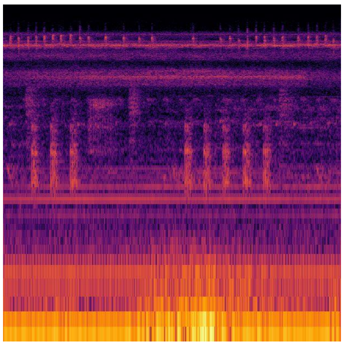
N_FFT= 3445 / Hop_Lenght = 32



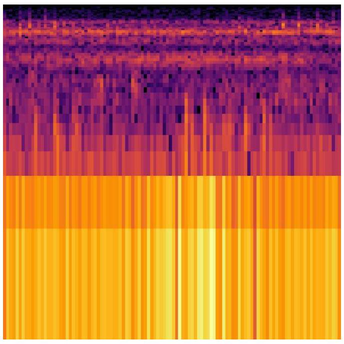
N_FFT= 6890 / Hop_Lenght = 16



sr = 26214 / N_fft = 1024
Hop_Lenght = 128

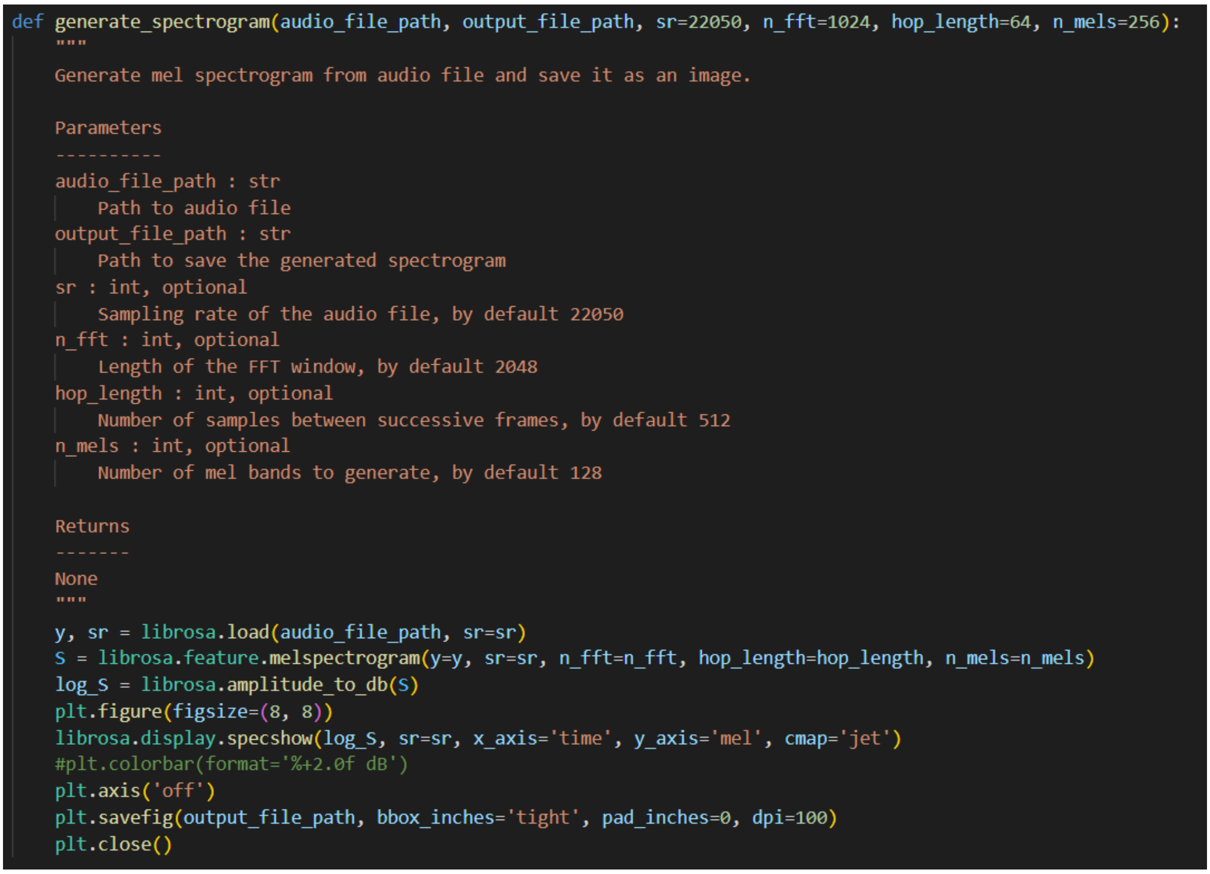


Hop_Lenght = 1024 / N_fft = 107



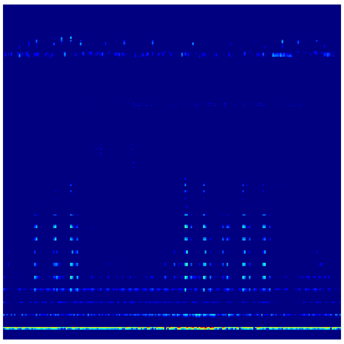
A partir de estas pruebas de concluyó que este método de obtención de espectrograma no es apropiado para la aplicación que se desea emplear, pues los llamados no se pueden identificar fácilmente y en algunos casos no se puede distinguir casi nada, sin embargo se concluyo que la combinación de parámetros Hop_Lenght = 64, N_FFT = 1722 generó la mejor imagen de todas las pruebas, por lo que se partió de estos parámetros en la siguiente prueba con los espectrogramas de Mel

Mel Spectrogram:

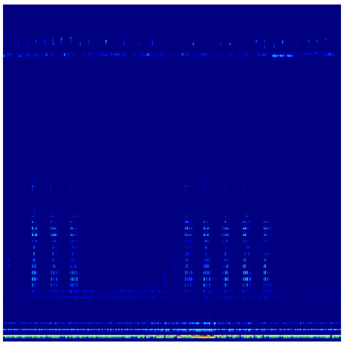


```python
def generate_spectrogram(audio_file_path, output_file_path, sr=22050, n_fft=1024, hop_length=64, n_mels=256):
    """
    Generate mel spectrogram from audio file and save it as an image.

    Parameters
    ----------
    audio_file_path : str
        Path to audio file
    output_file_path : str
        Path to save the generated spectrogram
    sr : int, optional
        Sampling rate of the audio file, by default 22050
    n_fft : int, optional
        Length of the FFT window, by default 2048
    hop_length : int, optional
        Number of samples between successive frames, by default 512
    n_mels : int, optional
        Number of mel bands to generate, by default 128

    Returns
    -------
    None
    """
    y, sr = librosa.load(audio_file_path, sr=sr)
    S = librosa.feature.melspectrogram(y=y, sr=sr, n_fft=n_fft, hop_length=hop_length, n_mels=n_mels)
    log_S = librosa.amplitude_to_db(S)
    plt.figure(figsize=(8, 8))
    librosa.display.specshow(log_S, sr=sr, x_axis='time', y_axis='mel', cmap='jet')
    #plt.colorbar(format='%+2.0f dB')
    plt.axis('off')
    plt.savefig(output_file_path, bbox_inches='tight', pad_inches=0, dpi=100)
    plt.close()
```

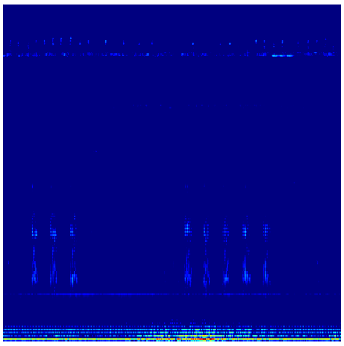
Los siguientes fueron los resultados de variar los parámetros de esta función:



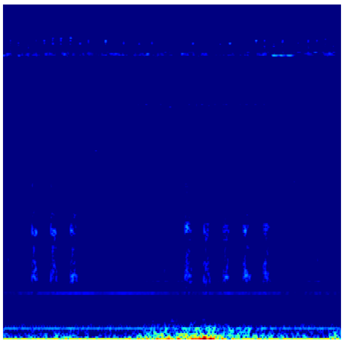
N_FFT= 215 / Hop_Lenght = 512



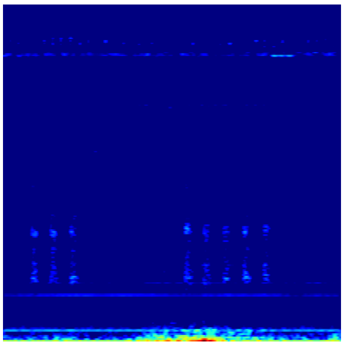
N_FFT= 431 / Hop_Lenght = 256



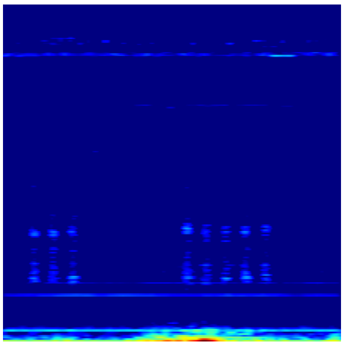
N_FFT= 861 / Hop_Lenght = 128



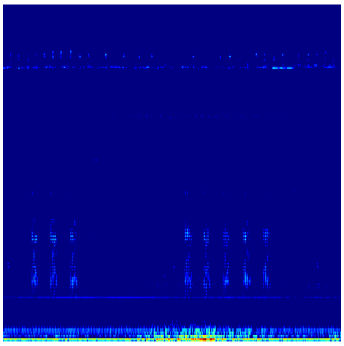
N_FFT= 1722 / Hop_Lenght = 64



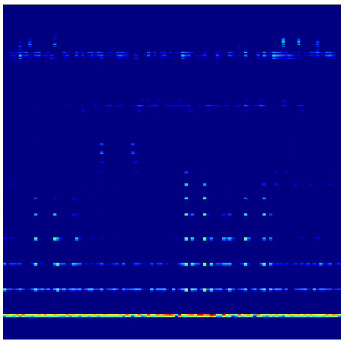
N_FFT= 3445 / Hop_Lenght = 32



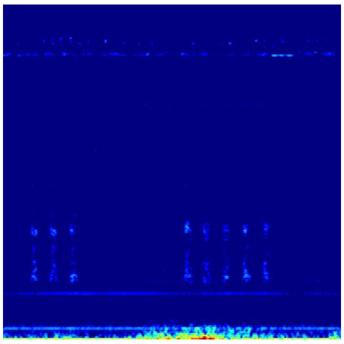
N_FFT= 6890 / Hop_Lenght = 16



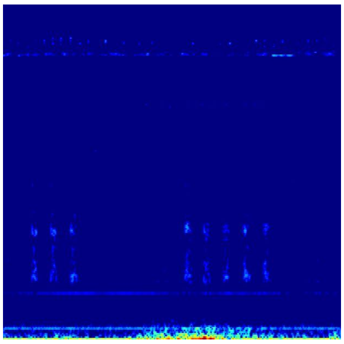
sr = 26214 / N_fft = 1024
Hop_Lenght = 128



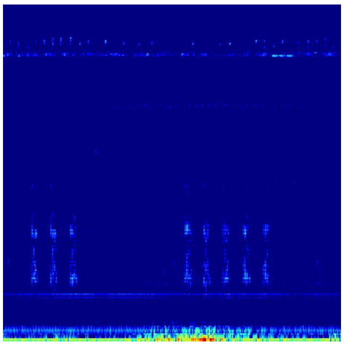
Hop_Lenght = 1024 / N_fft = 107



N_FFT = 2048 / Hop_Lenght = 64
/N_Mels = 256



N_FFT = 1722 / Hop_Lenght = 64 /
N_Mels = 256



N_FFT = 1024 / Hop_Lenght = 64 /
N_Mels = 256

De estas pruebas se concluyó que el conjunto de parámetros: **N_FFT = 1024 / Hop_Lenght = 64 /N_Mels = 256** fué el que mejor resultado visual entregó, por lo que se va a proceder a realizar entrenamientos de los modelos definidos con el dataset compuesto por imágenes obtenidas de esta forma.

EVALUATION PLAN

To create a testing plan for these models, we need to consider the following steps:

Data preprocessing: First, we need to preprocess the data in the same way for all the models. We will resize the images to a fixed size (224x224) and normalize the pixel values.

Splitting the data: We need to split the dataset into training, validation, and testing sets. We will use 70% of the data for training, 20% for validation, and 10% for testing.

Model selection: We will train and test four models: MobileNet, Inception-V3, DenseNet-121, and ResNet50. All the models will be pretrained on the ImageNet dataset and fine-tuned on the target dataset. We will use binary cross-entropy loss and sigmoid activation function for multi-label classification.

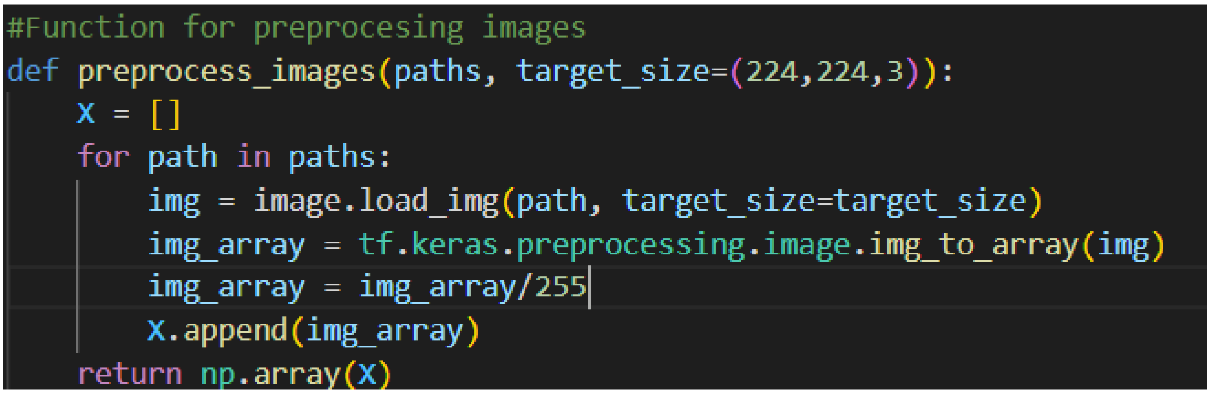
Hyperparameter tuning: We will perform hyperparameter tuning to find the best learning rate, batch size, and number of epochs for each model. We will use the validation set for this purpose.

Evaluation: Finally, we will evaluate the performance of each model on the testing set. We will use the following evaluation metrics: accuracy, precision, recall, F1-score, and ROC AUC, Hamming Loss. We will compare the performance of the models and select the one with the best performance(F1 score).

Here is the detailed testing plan for the models:

Data preprocessing:
Resize the images to a fixed size of (224, 224).
Normalize the pixel values to the range [0, 1].

We are currently doing this with this function:



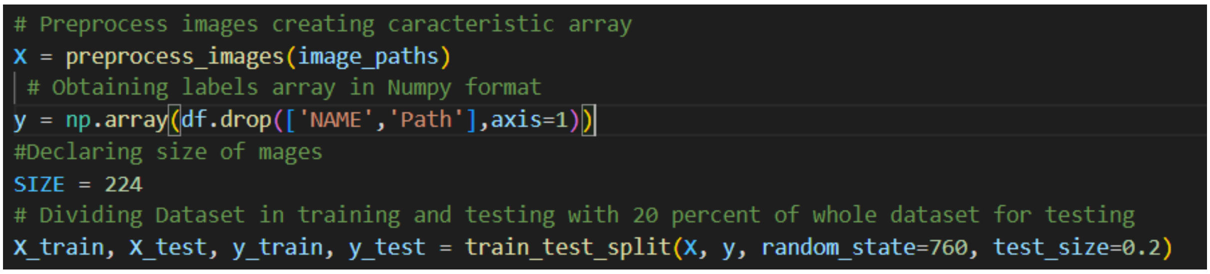
```
#Function for preprocesing images
def preprocess_images(paths, target_size=(224,224,3)):
    X = []
    for path in paths:
        img = image.load_img(path, target_size=target_size)
        img_array = tf.keras.preprocessing.image.img_to_array(img)
        img_array = img_array/255
        X.append(img_array)
    return np.array(X)
```

Splitting the data:
Split the dataset into training, validation, and testing sets.
Use 70% of the data for training, 20% for validation, and 10% for testing.

366 folders with 11 audios each is our total dataset, we extract 37 folders and isolated from the training and validation dataset, this will be our testing dataset, we ensure we encounter here all possibilities of labels.

For the train and validation dataset we use sklearn train split function and split the dataset in 80% for training and 20% for validation, remember this is over the 329 remaining folders.

Images of the code implemented below:



```
# Preprocess images creating caracteristic array
X = preprocess_images(image_paths)
# Obtaining labels array in Numpy format
y = np.array(df.drop(['NAME','Path'],axis=1))
#Declaring size of mages
SIZE = 224
# Dividing Dataset in training and testing with 20 percent of whole dataset for testing
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=760, test_size=0.2)
```

Our dataset is not balanced, this may give issues in performance.

Model selection:

Train and test four models: MobileNet, Inception-V3, DenseNet-121, and ResNet50.
Pretrain the models on the ImageNet dataset.
Fine-tune the models on the target dataset with binary cross-entropy loss and sigmoid activation function.
Use early stopping and model Check-Pointing to prevent overfitting.
Use the Adam optimizer with a learning rate of 0.001.

Hyperparameter tuning:

Perform hyperparameter tuning to find the best learning rate, batch size, and number of epochs for each model.
Use the validation set for this purpose.
Vary the learning rate from 0.00001 to 0.01 in steps of 0.1.
Vary the batch size between 16,32,64 the selected one because of memory issues was **32**.
Vary the number of epochs from 10 to 100 in steps of 10, an early stopping was implemented to avoid overfitting and the epoch size fixed in 100.
Evaluation:
Evaluate the performance of each model on the testing set.
Use the following evaluation metrics: accuracy, precision, recall, F1-score, and ROC AUC.
Compare the performance of the models and select the one with the best performance.

RESULTS

MobileNet

Model Name	Accuracy	Precision	Recall	F1	ROC AUC	PR AUC	Hamming Loss
MobileNet_Reg_L2_lr_0001_batch_32.h5	0.468	0.811	0.550	0.656	0.904	0.74	0.097
MobileNet_Reg_L2_lr_00001_batch_32.h5	0.5	0.798	0.593	0.680	0.927	0.768	0.094
MobileNet_lr_00001_batch_32.h5	0.436	0.732	0.513	0.60	0.9274	0.734	0.113
MobileNet_lr_0001_batch_32.h5	0.462	0.764	0.556	0.643	0.927	0.756	0.103
MobileNet_lr_001_batch_32.h5	0.506	0.718	0.588	0.647	0.932	0.737	0.108

Best model: **MobileNet_Reg_L2_lr_00001_batch_32.h5**

ResNet50

Model Name	Accuracy	Precision	Recall	F1	ROC AUC	PR AUC	Hamming Loss
Resnet50_Reg_L2_lr_0001_Batch32.h5	0.430	0.692	0.481	0.567	0.920	0.602	0.123
Resnet50_Reg_L2_lr_00001_Batch32.h5	0.417	0.682	0.449	0.541	0.904	0.621	0.128
Resnet50_lr_00001_Batch32.h5	0.436	0.684	0.475	0.561	0.910	0.644	0.125
Resnet50_lr_0001_Batch32.h5	0.436	0.673	0.497	0.572	0.904	0.563	0.125
Resnet50_lr_001_Batch32.h5	0.120	0.814	0.117	0.205	0.909	0.646	0.153
Resnet50_lr_01_Batch32.h5	0.0	0.0	0.0	0.0	0.889	0.526	0.169

Best model: Resnet50_lr_0001_Batch32.h5

InceptionV3

Model Name	Accuracy	Precision	Recall	F1	ROC AUC	PR AUC	Hamming Loss
InceptionV3_Reg_L2_lr00001_Batch_32.h5	0.405	0.673	0.508	0.579	0.903	0.669	0.124
InceptionV3_Reg_L2_lr0001_Batch_32.h5	0.386	0.708	0.454	0.553	0.887	0.634	0.123
InceptionV3_lr00001_Batch_32.h5	0.360	0.675	0.433	0.527	0.910	0.635	0.131
InceptionV3_lr0001_Batch_32.h5	0.443	0.686	0.550	0.611	0.914	0.669	0.118
InceptionV3_lr001_Batch_32.h5	0.392	0.723	0.4759	0.574	0.921	0.698	0.119
InceptionV3_lr01_Batch_32.h5	0.0	0.0	0.0	0.0	0.890	0.544	0.169

Best model: InceptionV3_Reg_L2_lr00001_Batch_32.h5

DenseNet121

Model Name	Accuracy	Precision	Recall	F1	ROC AUC	PR AUC	Hamming Loss
DenseNet121_lr_0001_epoch_25_batch_32.h5	**0.405**	**0.743**	**0.465**	**0.572**	**-**	**-**	**0.11**
DenseNet_Reg_l2_lr01.h5	**0.0**	**0.5**	**0.005**	**0.01**	**0.88**	**0.492**	**0.16**
DenseNet_Reg_l2_lr0001.h5	**0.417**	**0.708**	**0.518**	**0.598**	**0.896**	**0.632**	**0.117**
DenseNet_Reg_l2_lr001.h5	**0.360**	**0.768**	**0.390**	**0.517**	**0.932**	**0.676**	**0.12**
DenseNet_Reg_l2_lr01.h5	**0.0**	**0.5**	**0.005**	**0.010**	**0.882**	**0.492**	**0.169**

Best Model: DenseNet121_lr_0001_epoch_25_batch_32.h5

2+ Layers Models

Model Name	Accuracy	Precision	Recall	F1	ROC AUC	PR AUC	Hamming Loss
DenseNet121_2L_lr_001.h5	0.437	0.740	0.519	0.610	0.853	0.553	0.112
DenseNet121_2L_lr_0001.h5	0.456	0.711	0.576	0.637	0.922	0.667	0.111
DenseNet121_2L_lr_00001.h5	0.494	0.770	0.572	0.656	0.918	0.681	0.101
MobileNet_2L_lr_001.h5	0.234	0.671	0.283	0.398	0.909	0.646	0.145
MobileNet_2L_lr_0001.h5	0.551	0.743	0.663	0.700	0.929	0.756	0.095
MobileNet_2L_lr_00001.h5	0.487	0.728	0.588	0.651	0.903	0.696	0.106
Resnet_2L_lr_001.h5	0.348	0.750	0.417	0.536	0.911	0.688	0.122
Resnet_2L_lr_0001.h5	0.038	0.040	0.043	0.077	0.910	0.568	0.173
Resnet_2L_lr_00001.h5	0.0	0.0	0.0	0.0	0.869	0.454	0.169
InceptionV3_2L_lr_00001.h5	0.487	0.687	0.588	0.634	0.907	0.654	0.115

Best models

Model Name	Accuracy	Precision	Recall	F1	ROC AUC	PR AUC	Hamming Loss
DenseNet121_2L_lr_00001.h5	0.494	0.770	0.572	0.656	0.918	0.681	0.101
MobileNet_2L_lr_0001.h5	0.551	0.743	0.663	0.700	0.929	0.756	0.095
InceptionV3_2L_lr_00001.h5	0.487	0.687	0.588	0.634	0.907	0.654	0.115
Resnet50_lr_0001_Batch32.h5	0.436	0.673	0.497	0.572	0.904	0.563	0.125

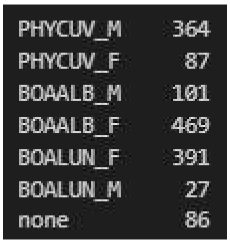
Best Model: MobileNet_2L_lr_0001.h5

Smaller learning rates give the best results

F1 - Score selected models

Model Name	**PHYCUV _M**	**PHYCUV _F**	**BOAALB _M**	**BOAALB _F**	**BOALUN _F**	**BOALUN _M**	**NONE**
DenseNet121_2L_lr_00001.h5	0	0	0.4	0.703	0.685	0	0
MobileNet_2L_lr_0001.h5	0	0	0	0.707	0.777	0	0
InceptionV3_2L_lr_00001.h5	0	0	0	0.662	0.667	0	0
Resnet50_lr_0001_Batch32.h5	0	0	0	0.636	0.578	0	0

Data augmentation
Time



```
PHYCUV_M    364
PHYCUV_F     87
BOAALB_M    101
BOAALB_F    469
BOALUN_F    391
BOALUN_M     27
none         86
```

3 etiquetas

F1 - Score selected models

Model Name	PHYCUV	BOAALB	BOALUN
DenseNet121_2L_lr_00001.h5	0	0.703	0
MobileNet_2L_lr_0001.h5	0	0.707	0
InceptionV3_2L_lr_00001.h5	0	0.662	0
Resnet50_lr_0001_Batch32.h5	0	0.636	0

Temas a tratar en próxima reunión con Director de tesis y Codirector:

- Trabajar con cross validation k fold = 5
- Conj entrenamiento y test 70 30
- usar time masking
- usar 3 labels
- borrador estructura tesis que compartió Ulloa
- Documentando bien pruebas
- formulación de hipotesis
- plan de pruebas para hacer check
- intentar frecuency masking
- intentar time stretching
- Viernes a las 10 nuevo horario

3LABELS - New Beggining

EVALUATION PLAN

To create a testing plan for these models, we need to consider the following steps:

Data preprocessing: First, we need to preprocess the data in the same way for all the models. We will resize the images to a fixed size (224x224) and normalize the pixel values.

Data augmentation techniques for testing: Time masking, Frequency masking, Time stretching

Step 1

Splitting the data with no augmentation: We need to split the dataset into training, validation. We will use 70% of the data for training, 30% for validation.

Splitting the data with augmentation: We need to split the dataset in 70% 30% and then include to the 70% part the augmented data, then train with that 70%

Step 2

Model selection: We will train and test four models: MobileNet, Inception-V3, DenseNet-121, and ResNet50. All the models will be pretrained on the ImageNet dataset and fine-tuned on the target dataset. We will use binary cross-entropy loss and sigmoid activation function for multi-label classification.

- MobileNet
- Inception-V3
- DenseNet-121
- ResNet50

Hyperparameter tuning: We will perform hyperparameter tuning to find the best learning rate, and the number of epochs for each model. We will use the validation set for this purpose.
Learning Rate: 0.00001 due to previous results
Epochs: because of an implemented early stop function used to avoid over-fitting, the number of epochs will vary depending on the model, architecture, dataset, and hyperparameters selected.
Regularization: L2 selected as preferred to avoid overfitting or none

Architecture
1 fully connected layer 256, act relu and reg L2
2 fully connected layer 128 & 256, act relu and reg L2

Evaluation: Finally, we will evaluate the performance of each model on the testing set. We will use the following evaluation metrics: accuracy, precision, recall, F1-score, and ROC AUC, Hamming Loss. We will compare the performance of the models and select the one with the best performance(F1 score).

Here is the detailed testing plan for the models:

Data preprocessing:
Resize the images to a fixed size of (224, 224).
Normalize the pixel values to the range [0, 1].

Train models with selected parameters and architecture and corresponding dataset
Resulting on 48 models

Mobile Net

- ☑ ~~**Augmented - Frequency Masking**~~
    - ☑ ~~One fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~
    - ☑ ~~Two fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~
- ☑ ~~**Augmented - Time Masking**~~
    - ☑ ~~One fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☐ CrossValidation-5folds
            - ☑ ~~Normal Training~~
    - ☑ ~~Two fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~
- ☑ ~~**Not Augmented**~~
    - ☑ ~~One fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~
    - ☑ ~~Two fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~

DensNet121

- ☐ **Augmented - Frequency Masking**
  - ☐ One fully connected Layer
    - ☐ Regularization L2
      - ☐ CrossValidation-5folds
      - ☑ ~~Normal Training~~
  - ☐ Two fully connected Layer
    - ☐ Regularization L2
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
- ☑ ~~**Augmented - Time Masking**~~
  - ☑ ~~One fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
  - ☑ ~~Two fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
- ☑ ~~**Not Augmented**~~
  - ☑ ~~One fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☐ Normal Training
  - ☑ ~~Two fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☐ Normal Training

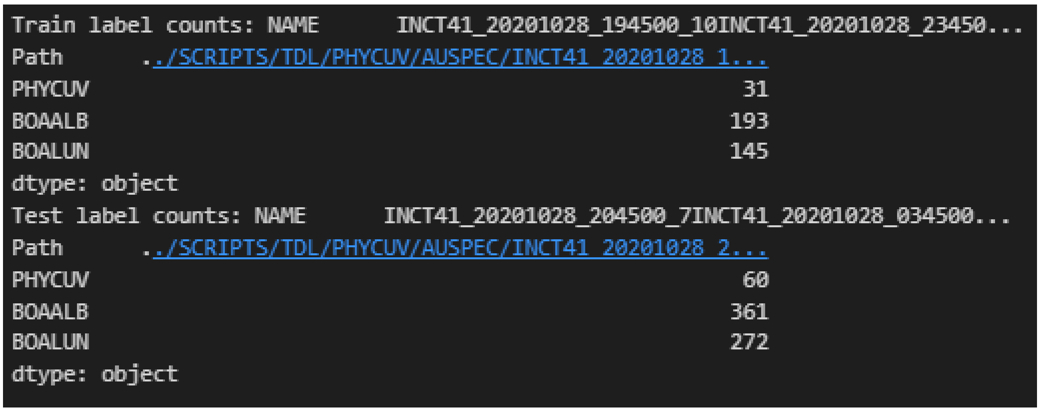
Resnet50

- ☐ **Augmented - Frequency Masking**
    - ☐ One fully connected Layer
        - ☐ Regularization L2
            - ☐ CrossValidation-5folds
            - ☐ Normal Training
    - ☐ Two fully connected Layer
        - ☐ Regularization L2
            - ☐ CrossValidation-5folds
            - ☐ Normal Training
- ☑ ~~**Augmented - Time Masking**~~
    - ☑ ~~One fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~
    - ☑ ~~Two fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☑ ~~CrossValidation-5folds~~
            - ☑ ~~Normal Training~~
- ☑ ~~**Not Augmented**~~
    - ☑ ~~One fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☐ CrossValidation-5folds
            - ☐ Normal Training
    - ☑ ~~Two fully connected Layer~~
        - ☑ ~~Regularization L2~~
            - ☐ CrossValidation-5folds
            - ☐ Normal Training

InceptionV3

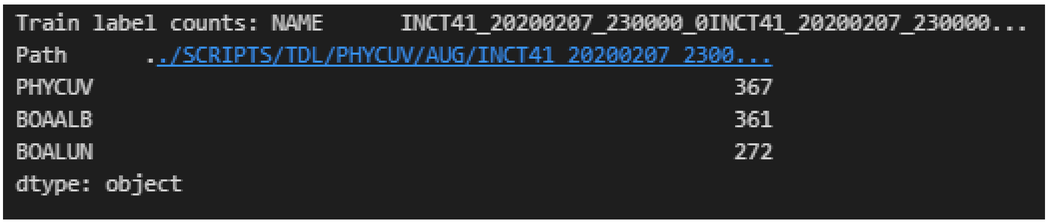
- ☑ **~~Augmented - Frequency Masking~~**
  - ☑ ~~One fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
  - ☑ ~~Two fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
- ☑ **~~Augmented - Time Masking~~**
  - ☑ ~~One fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
  - ☑ ~~Two fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☑ ~~CrossValidation-5folds~~
      - ☑ ~~Normal Training~~
- ☑ **~~Not Augmented~~**
  - ☑ ~~One fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☐ CrossValidation-5folds
      - ☐ Normal Training
  - ☑ ~~Two fully connected Layer~~
    - ☑ ~~Regularization L2~~
      - ☐ CrossValidation-5folds
      - ☐ Normal Training

Distribución 65% - 35% de dataset original para entrenamientos con data aumentada



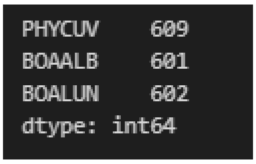
```
Train label counts: NAME      INCT41_20201028_194500_10INCT41_20201028_23450...
Path      ../SCRIPTS/TDL/PHYCUV/AUSPEC/INCT41_20201028_1...
PHYCUV                                                   31
BOALB                                                   193
BOALUN                                                  145
dtype: object
Test label counts: NAME      INCT41_20201028_204500_7INCT41_20201028_034500...
Path      ../SCRIPTS/TDL/PHYCUV/AUSPEC/INCT41_20201028_2...
PHYCUV                                                   60
BOAALB                                                  361
BOALUN                                                  272
dtype: object
```

cantidad de datos por label una vez la data aumentada por time masking se adicionó al conjunto de 65%



```
Train label counts: NAME      INCT41_20200207_230000_0INCT41_20200207_230000...
Path      ../SCRIPTS/TDL/PHYCUV/AUG/INCT41_20200207_2300...
PHYCUV                                                  367
BOAALB                                                  361
BOALUN                                                  272
dtype: object
```

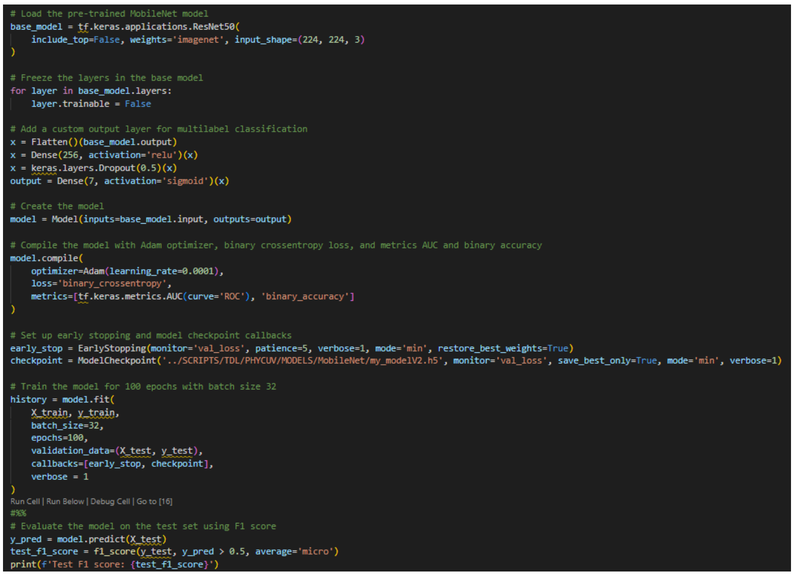
Cantidad de datos una vez la data aumentada por Frequency Masking junto al conjunto de 65%



```
PHYCUV    609
BOAALB    601
BOALUN    602
dtype: int64
```

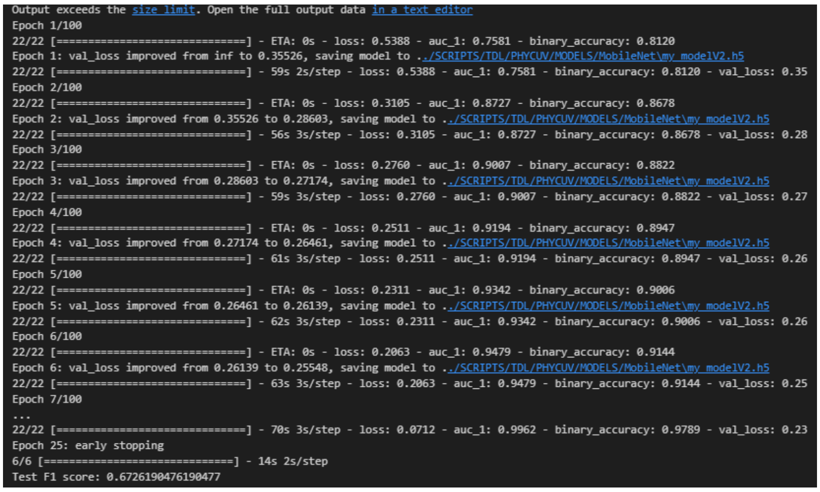
Detail & Screenshots of Results

DenseNet:



```
# Load the pre-trained MobileNet model
base_model = tf.keras.applications.ResNet50(
    include_top=False, weights='imagenet', input_shape=(224, 224, 3)
)

# Freeze the layers in the base model
for layer in base_model.layers:
    layer.trainable = False

# Add a custom output layer for multilabel classification
x = Flatten()(base_model.output)
x = Dense(256, activation='relu')(x)
x = keras.layers.Dropout(0.5)(x)
output = Dense(7, activation='sigmoid')(x)

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

# Compile the model with Adam optimizer, binary crossentropy loss, and metrics AUC and binary accuracy
model.compile(
    optimizer=Adam(learning_rate=0.0001),
    loss='binary_crossentropy',
    metrics=[tf.keras.metrics.AUC(curve='ROC'), 'binary_accuracy']
)

# Set up early stopping and model checkpoint callbacks
early_stop = EarlyStopping(monitor='val_loss', patience=5, verbose=1, mode='min', restore_best_weights=True)
checkpoint = ModelCheckpoint('../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet/my_modelV2.h5', monitor='val_loss', save_best_only=True, mode='min', verbose=1)

# Train the model for 100 epochs with batch size 32
history = model.fit(
    X_train, y_train,
    batch_size=32,
    epochs=100,
    validation_data=(X_test, y_test),
    callbacks=[early_stop, checkpoint],
    verbose = 1
)
Run Cell | Run Below | Debug Cell | Go to [16]
#%%
# Evaluate the model on the test set using F1 score
y_pred = model.predict(X_test)
test_f1_score = f1_score(y_test, y_pred > 0.5, average='micro')
print(f'Test F1 score: {test_f1_score}')
```

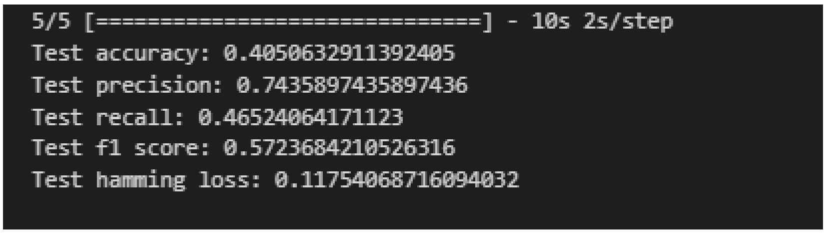
PRUEBA #1:



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.5388 - auc_1: 0.7581 - binary_accuracy: 0.8120
Epoch 1: val_loss improved from inf to 0.35526, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 59s 2s/step - loss: 0.5388 - auc_1: 0.7581 - binary_accuracy: 0.8120 - val_loss: 0.35
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.3105 - auc_1: 0.8727 - binary_accuracy: 0.8678
Epoch 2: val_loss improved from 0.35526 to 0.28603, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 56s 3s/step - loss: 0.3105 - auc_1: 0.8727 - binary_accuracy: 0.8678 - val_loss: 0.28
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.2760 - auc_1: 0.9007 - binary_accuracy: 0.8822
Epoch 3: val_loss improved from 0.28603 to 0.27174, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 59s 3s/step - loss: 0.2760 - auc_1: 0.9007 - binary_accuracy: 0.8822 - val_loss: 0.27
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.2511 - auc_1: 0.9194 - binary_accuracy: 0.8947
Epoch 4: val_loss improved from 0.27174 to 0.26461, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 61s 3s/step - loss: 0.2511 - auc_1: 0.9194 - binary_accuracy: 0.8947 - val_loss: 0.26
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.2311 - auc_1: 0.9342 - binary_accuracy: 0.9006
Epoch 5: val_loss improved from 0.26461 to 0.26139, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 62s 3s/step - loss: 0.2311 - auc_1: 0.9342 - binary_accuracy: 0.9006 - val_loss: 0.26
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.2063 - auc_1: 0.9479 - binary_accuracy: 0.9144
Epoch 6: val_loss improved from 0.26139 to 0.25548, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 63s 3s/step - loss: 0.2063 - auc_1: 0.9479 - binary_accuracy: 0.9144 - val_loss: 0.25
Epoch 7/100
...
22/22 [==============================] - 70s 3s/step - loss: 0.0712 - auc_1: 0.9962 - binary_accuracy: 0.9789 - val_loss: 0.23
Epoch 25: early stopping
6/6 [==============================] - 14s 2s/step
Test F1 score: 0.6726190476190477
```

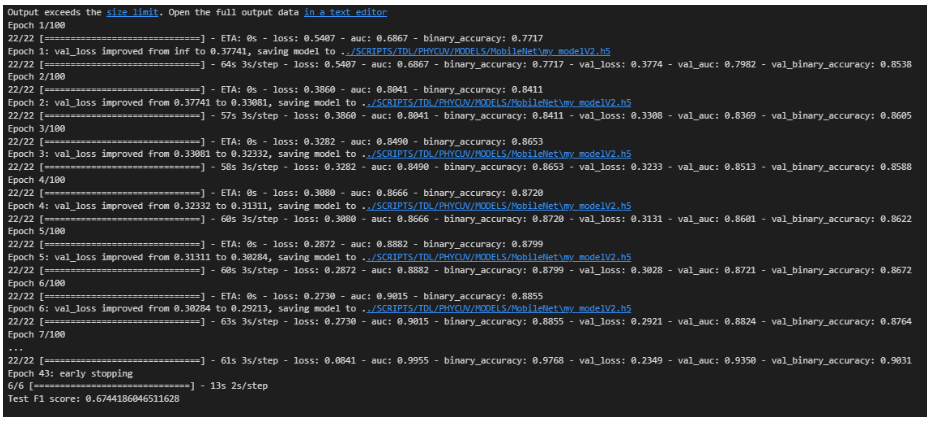
Model name: DenseNet121_lr_0001_epoch_25_batch_32.h5

Test:



```
5/5 [==============================] - 10s 2s/step
Test accuracy: 0.4050632911392405
Test precision: 0.7435897435897436
Test recall: 0.46524064171123
Test f1 score: 0.5723684210526316
Test hamming loss: 0.11754068716094032
```

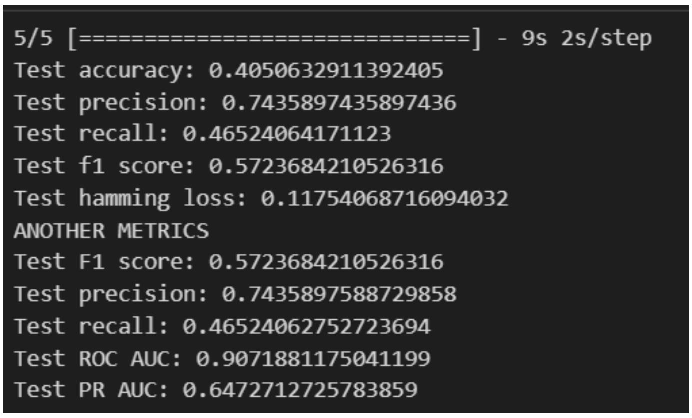
PRUEBA#2



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.5407 - auc: 0.6867 - binary_accuracy: 0.7717
Epoch 1: val_loss improved from inf to 0.37741, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 64s 3s/step - loss: 0.5407 - auc: 0.6867 - binary_accuracy: 0.7717 - val_loss: 0.3774 - val_auc: 0.7982 - val_binary_accuracy: 0.8538
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.3860 - auc: 0.8041 - binary_accuracy: 0.8411
Epoch 2: val_loss improved from 0.37741 to 0.33081, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 57s 3s/step - loss: 0.3860 - auc: 0.8041 - binary_accuracy: 0.8411 - val_loss: 0.3308 - val_auc: 0.8369 - val_binary_accuracy: 0.8605
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3282 - auc: 0.8490 - binary_accuracy: 0.8653
Epoch 3: val_loss improved from 0.33081 to 0.32332, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 58s 3s/step - loss: 0.3282 - auc: 0.8490 - binary_accuracy: 0.8653 - val_loss: 0.3233 - val_auc: 0.8513 - val_binary_accuracy: 0.8588
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.3080 - auc: 0.8666 - binary_accuracy: 0.8720
Epoch 4: val_loss improved from 0.32332 to 0.31311, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 60s 3s/step - loss: 0.3080 - auc: 0.8666 - binary_accuracy: 0.8720 - val_loss: 0.3131 - val_auc: 0.8601 - val_binary_accuracy: 0.8622
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.2872 - auc: 0.8882 - binary_accuracy: 0.8799
Epoch 5: val_loss improved from 0.31311 to 0.30284, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 60s 3s/step - loss: 0.2872 - auc: 0.8882 - binary_accuracy: 0.8799 - val_loss: 0.3028 - val_auc: 0.8721 - val_binary_accuracy: 0.8672
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.2730 - auc: 0.9015 - binary_accuracy: 0.8855
Epoch 6: val_loss improved from 0.30284 to 0.29213, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\my_modelV2.h5
22/22 [==============================] - 63s 3s/step - loss: 0.2730 - auc: 0.9015 - binary_accuracy: 0.8855 - val_loss: 0.2921 - val_auc: 0.8824 - val_binary_accuracy: 0.8764
Epoch 7/100
...
22/22 [==============================] - 61s 3s/step - loss: 0.0841 - auc: 0.9955 - binary_accuracy: 0.9768 - val_loss: 0.2349 - val_auc: 0.9350 - val_binary_accuracy: 0.9031
Epoch 43: early stopping
6/6 [==============================] - 13s 2s/step
Test F1 score: 0.6744186046511628
```

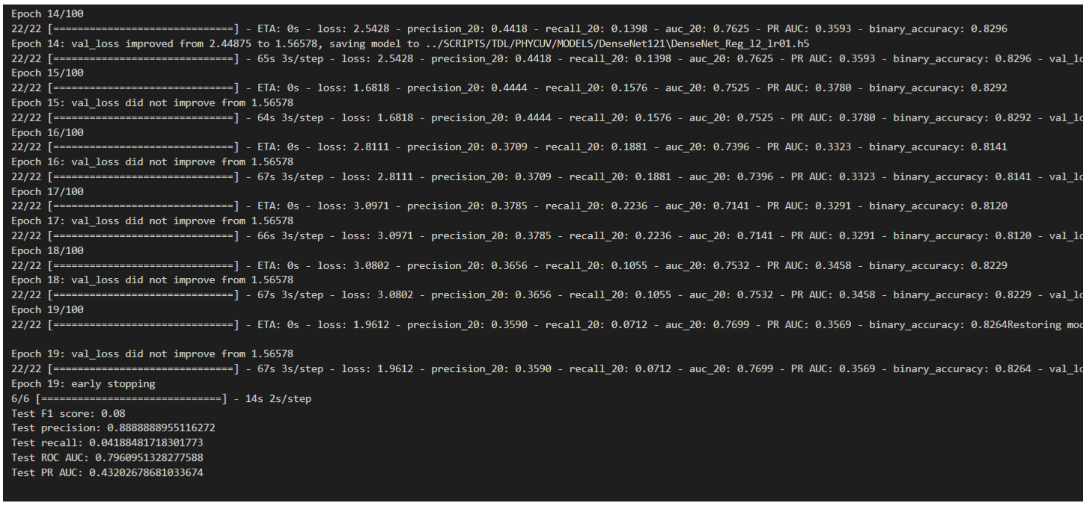
Model Name: DenseNet121_lr_0001_epoch_25_batch_32.h5

Test:



```
5/5 [==============================] - 9s 2s/step
Test accuracy: 0.4050632911392405
Test precision: 0.7435897435897436
Test recall: 0.46524064171123
Test f1 score: 0.5723684210526316
Test hamming loss: 0.11754068716094032
ANOTHER METRICS
Test F1 score: 0.5723684210526316
Test precision: 0.7435897588729858
Test recall: 0.46524062752723694
Test ROC AUC: 0.9071881175041199
Test PR AUC: 0.6472712725783859
```

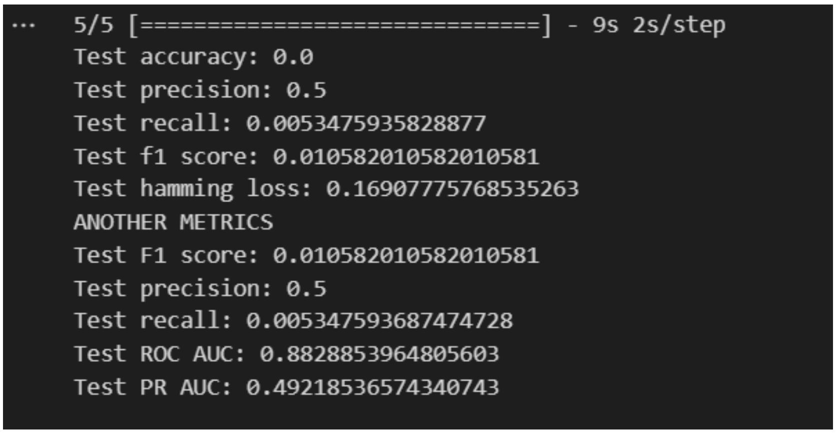
PRUEBA #3:



```
Epoch 14/100
22/22 [==============================] - ETA: 0s - loss: 2.5428 - precision_20: 0.4418 - recall_20: 0.1398 - auc_20: 0.7625 - PR AUC: 0.3593 - binary_accuracy: 0.8296
Epoch 14: val_loss improved from 2.44875 to 1.56578, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr01.h5
22/22 [==============================] - 65s 3s/step - loss: 2.5428 - precision_20: 0.4418 - recall_20: 0.1398 - auc_20: 0.7625 - PR AUC: 0.3593 - binary_accuracy: 0.8296 - val_lo
Epoch 15/100
22/22 [==============================] - ETA: 0s - loss: 1.6818 - precision_20: 0.4444 - recall_20: 0.1576 - auc_20: 0.7525 - PR AUC: 0.3780 - binary_accuracy: 0.8292
Epoch 15: val_loss did not improve from 1.56578
22/22 [==============================] - 64s 3s/step - loss: 1.6818 - precision_20: 0.4444 - recall_20: 0.1576 - auc_20: 0.7525 - PR AUC: 0.3780 - binary_accuracy: 0.8292 - val_lo
Epoch 16/100
22/22 [==============================] - ETA: 0s - loss: 2.8111 - precision_20: 0.3709 - recall_20: 0.1881 - auc_20: 0.7396 - PR AUC: 0.3323 - binary_accuracy: 0.8141
Epoch 16: val_loss did not improve from 1.56578
22/22 [==============================] - 67s 3s/step - loss: 2.8111 - precision_20: 0.3709 - recall_20: 0.1881 - auc_20: 0.7396 - PR AUC: 0.3323 - binary_accuracy: 0.8141 - val_lo
Epoch 17/100
22/22 [==============================] - ETA: 0s - loss: 3.0971 - precision_20: 0.3785 - recall_20: 0.2236 - auc_20: 0.7141 - PR AUC: 0.3291 - binary_accuracy: 0.8120
Epoch 17: val_loss did not improve from 1.56578
22/22 [==============================] - 66s 3s/step - loss: 3.0971 - precision_20: 0.3785 - recall_20: 0.2236 - auc_20: 0.7141 - PR AUC: 0.3291 - binary_accuracy: 0.8120 - val_lo
Epoch 18/100
22/22 [==============================] - ETA: 0s - loss: 3.0802 - precision_20: 0.3656 - recall_20: 0.1055 - auc_20: 0.7532 - PR AUC: 0.3458 - binary_accuracy: 0.8229
Epoch 18: val_loss did not improve from 1.56578
22/22 [==============================] - 67s 3s/step - loss: 3.0802 - precision_20: 0.3656 - recall_20: 0.1055 - auc_20: 0.7532 - PR AUC: 0.3458 - binary_accuracy: 0.8229 - val_lo
Epoch 19/100
22/22 [==============================] - ETA: 0s - loss: 1.9612 - precision_20: 0.3590 - recall_20: 0.0712 - auc_20: 0.7699 - PR AUC: 0.3569 - binary_accuracy: 0.8264Restoring mod

Epoch 19: val_loss did not improve from 1.56578
22/22 [==============================] - 67s 3s/step - loss: 1.9612 - precision_20: 0.3590 - recall_20: 0.0712 - auc_20: 0.7699 - PR AUC: 0.3569 - binary_accuracy: 0.8264 - val_lo
Epoch 19: early stopping
6/6 [==============================] - 14s 2s/step
Test F1 score: 0.08
Test precision: 0.8888888955116272
Test recall: 0.04188481718301773
Test ROC AUC: 0.7960951328277588
Test PR AUC: 0.43202678681033674
```

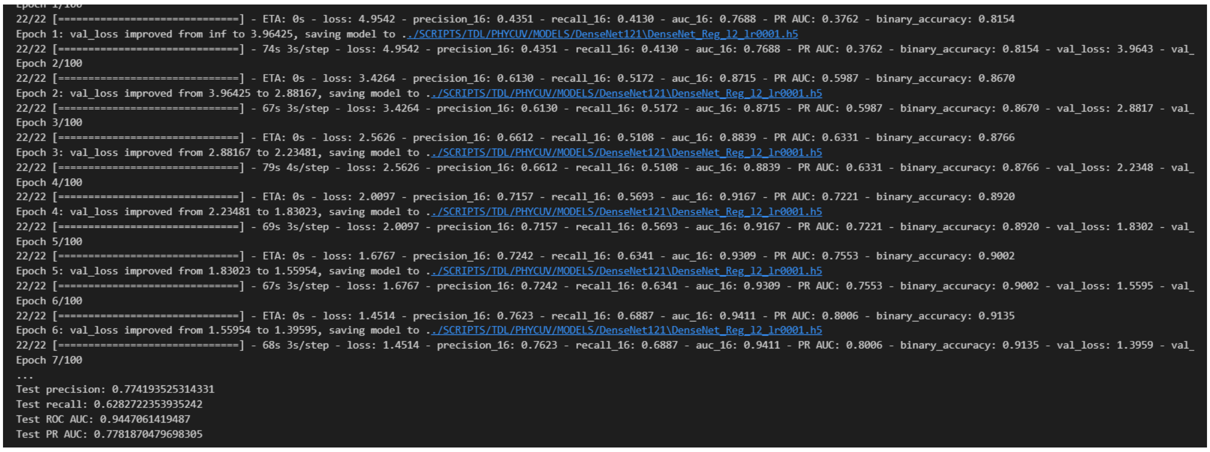
Model Name:DenseNet_Reg_l2_lr01.h5

Test:



```
...   5/5 [==============================] - 9s 2s/step
      Test accuracy: 0.0
      Test precision: 0.5
      Test recall: 0.0053475935828877
      Test f1 score: 0.010582010582010581
      Test hamming loss: 0.16907775768535263
      ANOTHER METRICS
      Test F1 score: 0.010582010582010581
      Test precision: 0.5
      Test recall: 0.005347593687474728
      Test ROC AUC: 0.8828853964805603
      Test PR AUC: 0.49218536574340743
```

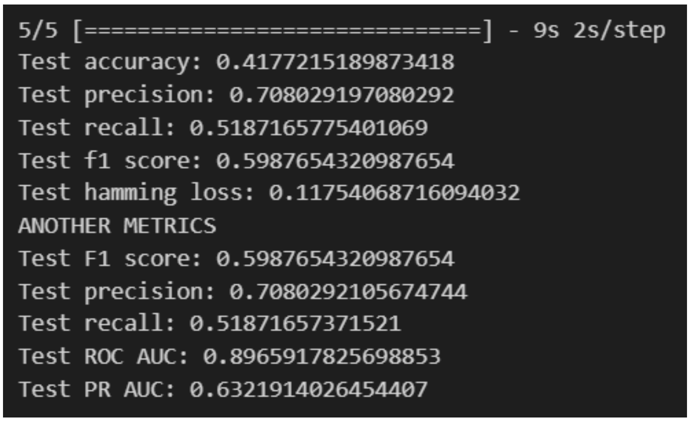
PRUEBA #4



```
22/22 [==============================] - ETA: 0s - loss: 4.9542 - precision_16: 0.4351 - recall_16: 0.4130 - auc_16: 0.7688 - PR AUC: 0.3762 - binary_accuracy: 0.8154
Epoch 1: val_loss improved from inf to 3.96425, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr0001.h5
22/22 [==============================] - 74s 3s/step - loss: 4.9542 - precision_16: 0.4351 - recall_16: 0.4130 - auc_16: 0.7688 - PR AUC: 0.3762 - binary_accuracy: 0.8154 - val_loss: 3.9643 - val_
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 3.4264 - precision_16: 0.6130 - recall_16: 0.5172 - auc_16: 0.8715 - PR AUC: 0.5987 - binary_accuracy: 0.8670
Epoch 2: val_loss improved from 3.96425 to 2.88167, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr0001.h5
22/22 [==============================] - 67s 3s/step - loss: 3.4264 - precision_16: 0.6130 - recall_16: 0.5172 - auc_16: 0.8715 - PR AUC: 0.5987 - binary_accuracy: 0.8670 - val_loss: 2.8817 - val_
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 2.5626 - precision_16: 0.6612 - recall_16: 0.5108 - auc_16: 0.8839 - PR AUC: 0.6331 - binary_accuracy: 0.8766
Epoch 3: val_loss improved from 2.88167 to 2.23481, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr0001.h5
22/22 [==============================] - 79s 4s/step - loss: 2.5626 - precision_16: 0.6612 - recall_16: 0.5108 - auc_16: 0.8839 - PR AUC: 0.6331 - binary_accuracy: 0.8766 - val_loss: 2.2348 - val_
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 2.0097 - precision_16: 0.7157 - recall_16: 0.5693 - auc_16: 0.9167 - PR AUC: 0.7221 - binary_accuracy: 0.8920
Epoch 4: val_loss improved from 2.23481 to 1.83023, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr0001.h5
22/22 [==============================] - 69s 3s/step - loss: 2.0097 - precision_16: 0.7157 - recall_16: 0.5693 - auc_16: 0.9167 - PR AUC: 0.7221 - binary_accuracy: 0.8920 - val_loss: 1.8302 - val_
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 1.6767 - precision_16: 0.7242 - recall_16: 0.6341 - auc_16: 0.9309 - PR AUC: 0.7553 - binary_accuracy: 0.9002
Epoch 5: val_loss improved from 1.83023 to 1.55954, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr0001.h5
22/22 [==============================] - 67s 3s/step - loss: 1.6767 - precision_16: 0.7242 - recall_16: 0.6341 - auc_16: 0.9309 - PR AUC: 0.7553 - binary_accuracy: 0.9002 - val_loss: 1.5595 - val_
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 1.4514 - precision_16: 0.7623 - recall_16: 0.6887 - auc_16: 0.9411 - PR AUC: 0.8006 - binary_accuracy: 0.9135
Epoch 6: val_loss improved from 1.55954 to 1.39595, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr0001.h5
22/22 [==============================] - 68s 3s/step - loss: 1.4514 - precision_16: 0.7623 - recall_16: 0.6887 - auc_16: 0.9411 - PR AUC: 0.8006 - binary_accuracy: 0.9135 - val_loss: 1.3959 - val_
Epoch 7/100
...
Test precision: 0.774193525314331
Test recall: 0.6282722353935242
Test ROC AUC: 0.9447061419487
Test PR AUC: 0.7781870479698305
```

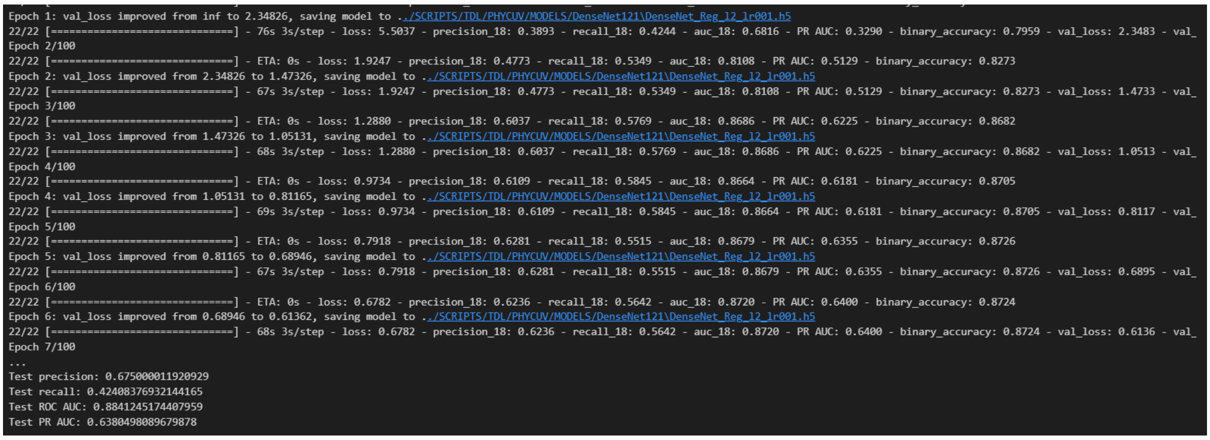
Model Name:DenseNet_Reg_l2_lr0001.h5

Test:



```
5/5 [==============================] - 9s 2s/step
Test accuracy: 0.4177215189873418
Test precision: 0.708029197080292
Test recall: 0.5187165775401069
Test f1 score: 0.5987654320987654
Test hamming loss: 0.11754068716094032
ANOTHER METRICS
Test F1 score: 0.5987654320987654
Test precision: 0.7080292105674744
Test recall: 0.51871657371521
Test ROC AUC: 0.8965917825698853
Test PR AUC: 0.6321914026454407
```

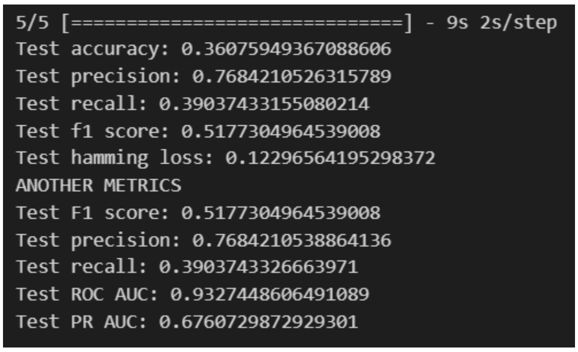
PRUEBA #5



```
Epoch 1: val_loss improved from inf to 2.34826, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr001.h5
22/22 [==============================] - 76s 3s/step - loss: 5.5037 - precision_18: 0.3893 - recall_18: 0.4244 - auc_18: 0.6816 - PR AUC: 0.3290 - binary_accuracy: 0.7959 - val_loss: 2.3483 - val_
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 1.9247 - precision_18: 0.4773 - recall_18: 0.5349 - auc_18: 0.8108 - PR AUC: 0.5129 - binary_accuracy: 0.8273
Epoch 2: val_loss improved from 2.34826 to 1.47326, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr001.h5
22/22 [==============================] - 67s 3s/step - loss: 1.9247 - precision_18: 0.4773 - recall_18: 0.5349 - auc_18: 0.8108 - PR AUC: 0.5129 - binary_accuracy: 0.8273 - val_loss: 1.4733 - val_
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 1.2880 - precision_18: 0.6037 - recall_18: 0.5769 - auc_18: 0.8686 - PR AUC: 0.6225 - binary_accuracy: 0.8682
Epoch 3: val_loss improved from 1.47326 to 1.05131, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr001.h5
22/22 [==============================] - 68s 3s/step - loss: 1.2880 - precision_18: 0.6037 - recall_18: 0.5769 - auc_18: 0.8686 - PR AUC: 0.6225 - binary_accuracy: 0.8682 - val_loss: 1.0513 - val_
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.9734 - precision_18: 0.6109 - recall_18: 0.5845 - auc_18: 0.8664 - PR AUC: 0.6181 - binary_accuracy: 0.8705
Epoch 4: val_loss improved from 1.05131 to 0.81165, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr001.h5
22/22 [==============================] - 69s 3s/step - loss: 0.9734 - precision_18: 0.6109 - recall_18: 0.5845 - auc_18: 0.8664 - PR AUC: 0.6181 - binary_accuracy: 0.8705 - val_loss: 0.8117 - val_
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.7918 - precision_18: 0.6281 - recall_18: 0.5515 - auc_18: 0.8679 - PR AUC: 0.6355 - binary_accuracy: 0.8726
Epoch 5: val_loss improved from 0.81165 to 0.68946, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr001.h5
22/22 [==============================] - 67s 3s/step - loss: 0.7918 - precision_18: 0.6281 - recall_18: 0.5515 - auc_18: 0.8679 - PR AUC: 0.6355 - binary_accuracy: 0.8726 - val_loss: 0.6895 - val_
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.6782 - precision_18: 0.6236 - recall_18: 0.5642 - auc_18: 0.8720 - PR AUC: 0.6400 - binary_accuracy: 0.8724
Epoch 6: val_loss improved from 0.68946 to 0.61362, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr001.h5
22/22 [==============================] - 68s 3s/step - loss: 0.6782 - precision_18: 0.6236 - recall_18: 0.5642 - auc_18: 0.8720 - PR AUC: 0.6400 - binary_accuracy: 0.8724 - val_loss: 0.6136 - val_
Epoch 7/100
...
Test precision: 0.675000011920929
Test recall: 0.42408376932144165
Test ROC AUC: 0.8841245174407959
Test PR AUC: 0.6380498089679878
```

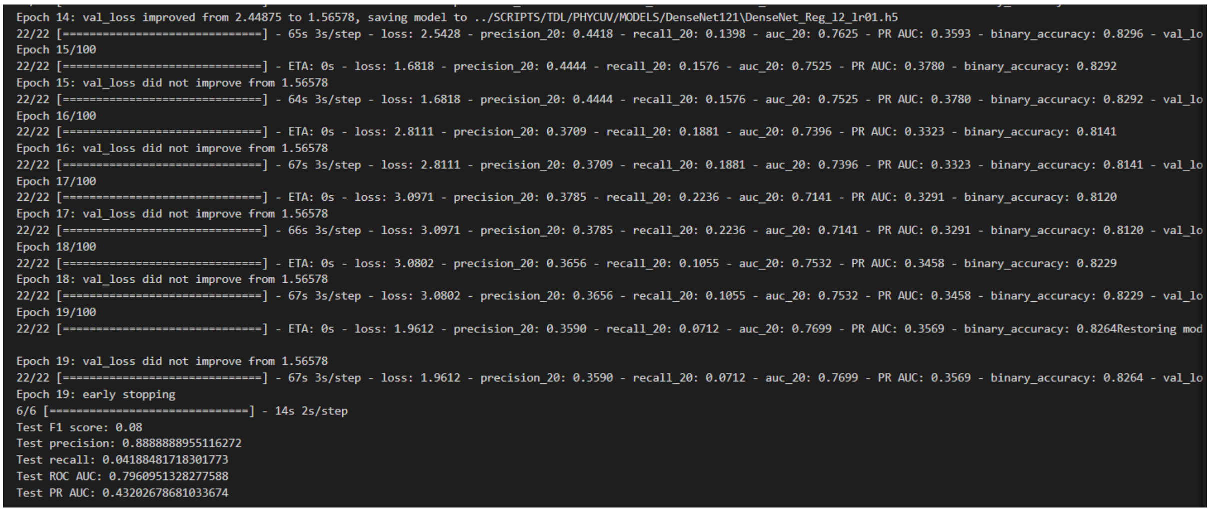
Model Name: DenseNet_Reg_l2_lr001.h5

Test:



```
5/5 [==============================] - 9s 2s/step
Test accuracy: 0.36075949367088606
Test precision: 0.7684210526315789
Test recall: 0.39037433155080214
Test f1 score: 0.5177304964539008
Test hamming loss: 0.12296564195298372
ANOTHER METRICS
Test F1 score: 0.5177304964539008
Test precision: 0.7684210538864136
Test recall: 0.3903743326663971
Test ROC AUC: 0.9327448606491089
Test PR AUC: 0.6760729872929301
```

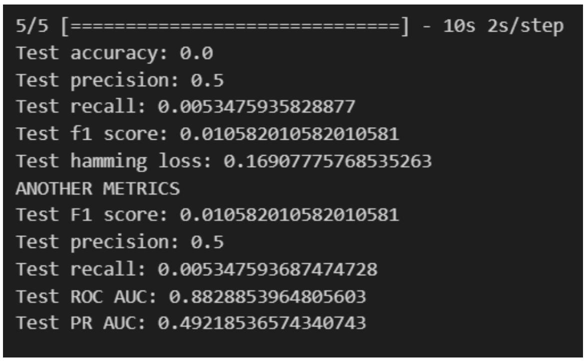
PRUEBA #6



```
Epoch 14: val_loss improved from 2.44875 to 1.56578, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/DenseNet121\DenseNet_Reg_l2_lr01.h5
22/22 [==============================] - 65s 3s/step - loss: 2.5428 - precision_20: 0.4418 - recall_20: 0.1398 - auc_20: 0.7625 - PR AUC: 0.3593 - binary_accuracy: 0.8296 - val_lo
Epoch 15/100
22/22 [==============================] - ETA: 0s - loss: 1.6818 - precision_20: 0.4444 - recall_20: 0.1576 - auc_20: 0.7525 - PR AUC: 0.3780 - binary_accuracy: 0.8292
Epoch 15: val_loss did not improve from 1.56578
22/22 [==============================] - 64s 3s/step - loss: 1.6818 - precision_20: 0.4444 - recall_20: 0.1576 - auc_20: 0.7525 - PR AUC: 0.3780 - binary_accuracy: 0.8292 - val_lo
Epoch 16/100
22/22 [==============================] - ETA: 0s - loss: 2.8111 - precision_20: 0.3709 - recall_20: 0.1881 - auc_20: 0.7396 - PR AUC: 0.3323 - binary_accuracy: 0.8141
Epoch 16: val_loss did not improve from 1.56578
22/22 [==============================] - 67s 3s/step - loss: 2.8111 - precision_20: 0.3709 - recall_20: 0.1881 - auc_20: 0.7396 - PR AUC: 0.3323 - binary_accuracy: 0.8141 - val_lo
Epoch 17/100
22/22 [==============================] - ETA: 0s - loss: 3.0971 - precision_20: 0.3785 - recall_20: 0.2236 - auc_20: 0.7141 - PR AUC: 0.3291 - binary_accuracy: 0.8120
Epoch 17: val_loss did not improve from 1.56578
22/22 [==============================] - 66s 3s/step - loss: 3.0971 - precision_20: 0.3785 - recall_20: 0.2236 - auc_20: 0.7141 - PR AUC: 0.3291 - binary_accuracy: 0.8120 - val_lo
Epoch 18/100
22/22 [==============================] - ETA: 0s - loss: 3.0802 - precision_20: 0.3656 - recall_20: 0.1055 - auc_20: 0.7532 - PR AUC: 0.3458 - binary_accuracy: 0.8229
Epoch 18: val_loss did not improve from 1.56578
22/22 [==============================] - 67s 3s/step - loss: 3.0802 - precision_20: 0.3656 - recall_20: 0.1055 - auc_20: 0.7532 - PR AUC: 0.3458 - binary_accuracy: 0.8229 - val_lo
Epoch 19/100
22/22 [==============================] - ETA: 0s - loss: 1.9612 - precision_20: 0.3590 - recall_20: 0.0712 - auc_20: 0.7699 - PR AUC: 0.3569 - binary_accuracy: 0.8264Restoring mod

Epoch 19: val_loss did not improve from 1.56578
22/22 [==============================] - 67s 3s/step - loss: 1.9612 - precision_20: 0.3590 - recall_20: 0.0712 - auc_20: 0.7699 - PR AUC: 0.3569 - binary_accuracy: 0.8264 - val_lo
Epoch 19: early stopping
6/6 [==============================] - 14s 2s/step
Test F1 score: 0.08
Test precision: 0.8888888955116272
Test recall: 0.041884817183017 73
Test ROC AUC: 0.7960951328277588
Test PR AUC: 0.43202678681033674
```

Model name: DenseNet_Reg_l2_lr01.h5

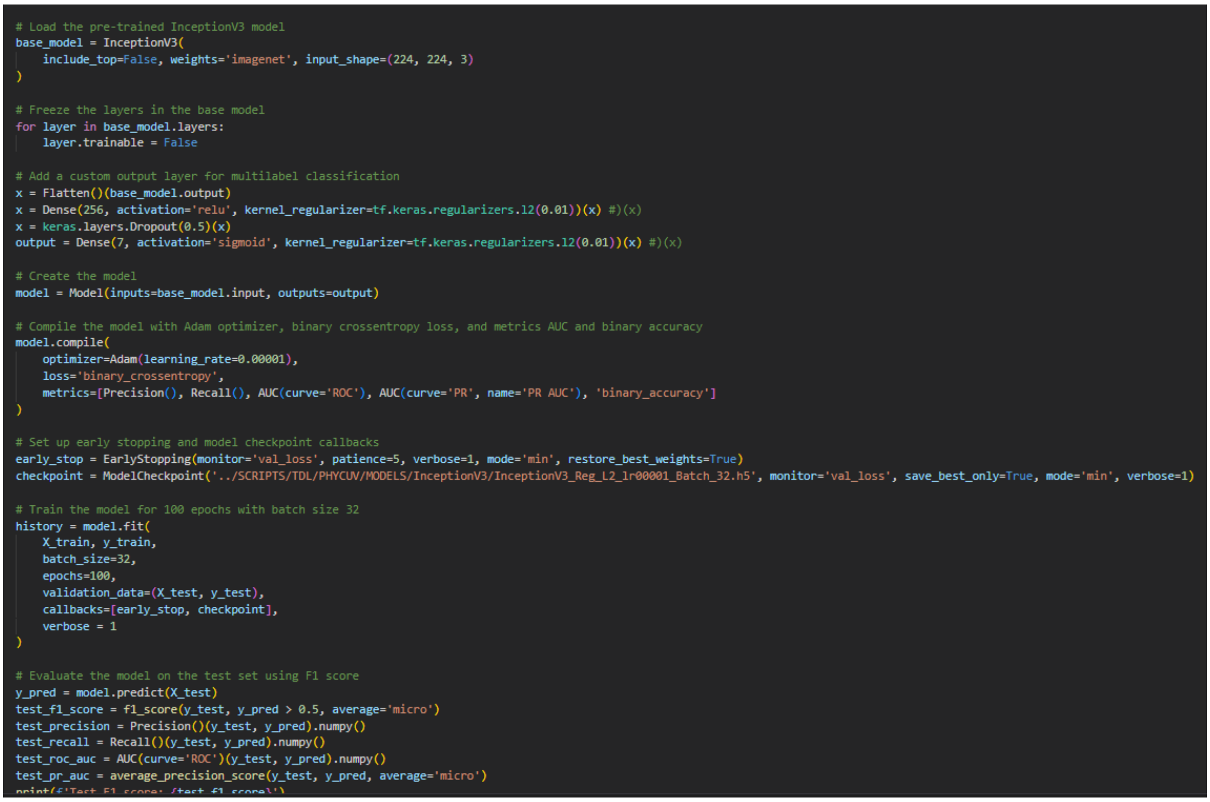
Test:



```
5/5 [==============================] - 10s 2s/step
Test accuracy: 0.0
Test precision: 0.5
Test recall: 0.0053475935828877
Test f1 score: 0.010582010582010581
Test hamming loss: 0.16907775768535263
ANOTHER METRICS
Test F1 score: 0.010582010582010581
Test precision: 0.5
Test recall: 0.005347593687474728
Test ROC AUC: 0.8828853964805603
Test PR AUC: 0.49218536574340743
```

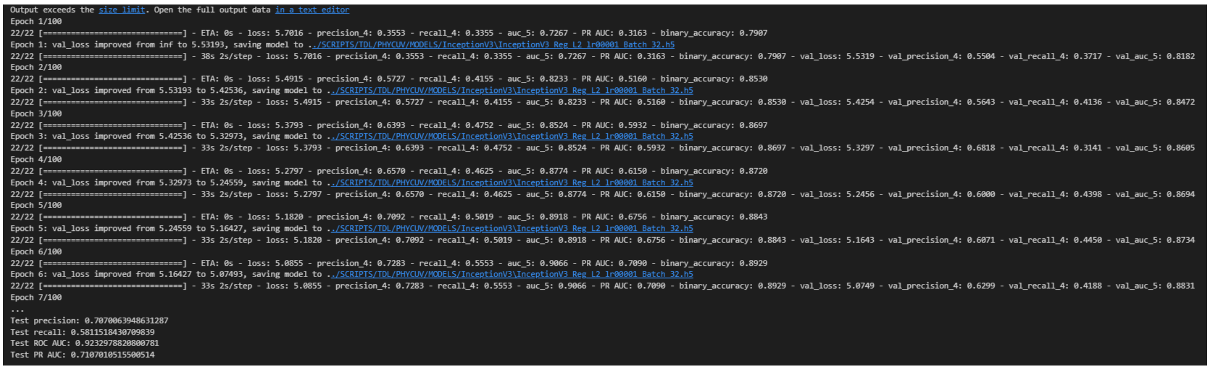
INCEPTIONV3:

Prueba con Regularizaciòn:



```
# Load the pre-trained InceptionV3 model
base_model = InceptionV3(
    include_top=False, weights='imagenet', input_shape=(224, 224, 3)
)

# Freeze the layers in the base model
for layer in base_model.layers:
    layer.trainable = False

# Add a custom output layer for multilabel classification
x = Flatten()(base_model.output)
x = Dense(256, activation='relu', kernel_regularizer=tf.keras.regularizers.l2(0.01))(x) #)(x)
x = keras.layers.Dropout(0.5)(x)
output = Dense(7, activation='sigmoid', kernel_regularizer=tf.keras.regularizers.l2(0.01))(x) #)(x)

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

# Compile the model with Adam optimizer, binary crossentropy loss, and metrics AUC and binary accuracy
model.compile(
    optimizer=Adam(learning_rate=0.00001),
    loss='binary_crossentropy',
    metrics=[Precision(), Recall(), AUC(curve='ROC'), AUC(curve='PR', name='PR AUC'), 'binary_accuracy']
)

# Set up early stopping and model checkpoint callbacks
early_stop = EarlyStopping(monitor='val_loss', patience=5, verbose=1, mode='min', restore_best_weights=True)
checkpoint = ModelCheckpoint('../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3/InceptionV3_Reg_L2_lr00001_Batch_32.h5', monitor='val_loss', save_best_only=True, mode='min', verbose=1)

# Train the model for 100 epochs with batch size 32
history = model.fit(
    X_train, y_train,
    batch_size=32,
    epochs=100,
    validation_data=(X_test, y_test),
    callbacks=[early_stop, checkpoint],
    verbose = 1
)

# Evaluate the model on the test set using F1 score
y_pred = model.predict(X_test)
test_f1_score = f1_score(y_test, y_pred > 0.5, average='micro')
test_precision = Precision()(y_test, y_pred).numpy()
test_recall = Recall()(y_test, y_pred).numpy()
test_roc_auc = AUC(curve='ROC')(y_test, y_pred).numpy()
test_pr_auc = average_precision_score(y_test, y_pred, average='micro')
print(f'Test F1 score: {test_f1_score}')
```

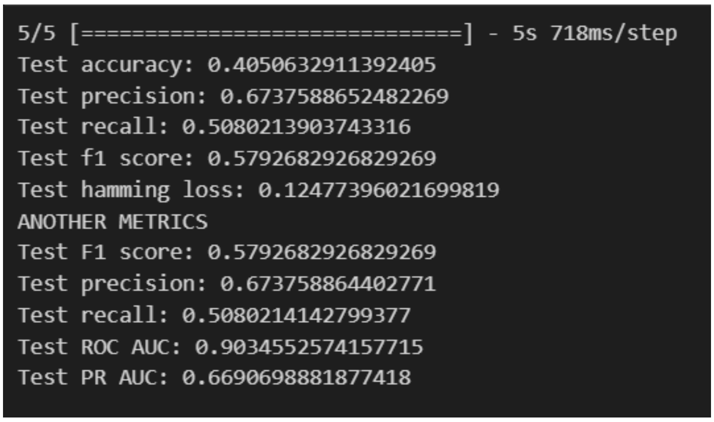
PRUEBA #1:



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 5.7016 - precision_4: 0.3553 - recall_4: 0.3355 - auc_5: 0.7267 - PR AUC: 0.3163 - binary_accuracy: 0.7907
Epoch 1: val_loss improved from inf to 5.53193, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr00001_Batch_32.h5
22/22 [==============================] - 38s 2s/step - loss: 5.7016 - precision_4: 0.3553 - recall_4: 0.3355 - auc_5: 0.7267 - PR AUC: 0.3163 - binary_accuracy: 0.7907 - val_loss: 5.5319 - val_precision_4: 0.5504 - val_recall_4: 0.3717 - val_auc_5: 0.8182
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 5.4915 - precision_4: 0.5727 - recall_4: 0.4155 - auc_5: 0.8233 - PR AUC: 0.5160 - binary_accuracy: 0.8530
Epoch 2: val_loss improved from 5.53193 to 5.42536, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr00001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 5.4915 - precision_4: 0.5727 - recall_4: 0.4155 - auc_5: 0.8233 - PR AUC: 0.5160 - binary_accuracy: 0.8530 - val_loss: 5.4254 - val_precision_4: 0.5643 - val_recall_4: 0.4136 - val_auc_5: 0.8472
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 5.3793 - precision_4: 0.6393 - recall_4: 0.4752 - auc_5: 0.8524 - PR AUC: 0.5932 - binary_accuracy: 0.8697
Epoch 3: val_loss improved from 5.42536 to 5.32973, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr00001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 5.3793 - precision_4: 0.6393 - recall_4: 0.4752 - auc_5: 0.8524 - PR AUC: 0.5932 - binary_accuracy: 0.8697 - val_loss: 5.3297 - val_precision_4: 0.6818 - val_recall_4: 0.3141 - val_auc_5: 0.8605
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 5.2797 - precision_4: 0.6570 - recall_4: 0.4625 - auc_5: 0.8774 - PR AUC: 0.6150 - binary_accuracy: 0.8720
Epoch 4: val_loss improved from 5.32973 to 5.24559, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr00001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 5.2797 - precision_4: 0.6570 - recall_4: 0.4625 - auc_5: 0.8774 - PR AUC: 0.6150 - binary_accuracy: 0.8720 - val_loss: 5.2456 - val_precision_4: 0.6000 - val_recall_4: 0.4398 - val_auc_5: 0.8694
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 5.1820 - precision_4: 0.7092 - recall_4: 0.5019 - auc_5: 0.8918 - PR AUC: 0.6756 - binary_accuracy: 0.8843
Epoch 5: val_loss improved from 5.24559 to 5.16427, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr00001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 5.1820 - precision_4: 0.7092 - recall_4: 0.5019 - auc_5: 0.8918 - PR AUC: 0.6756 - binary_accuracy: 0.8843 - val_loss: 5.1643 - val_precision_4: 0.6071 - val_recall_4: 0.4450 - val_auc_5: 0.8734
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 5.0855 - precision_4: 0.7283 - recall_4: 0.5553 - auc_5: 0.9066 - PR AUC: 0.7090 - binary_accuracy: 0.8929
Epoch 6: val_loss improved from 5.16427 to 5.07493, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr00001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 5.0855 - precision_4: 0.7283 - recall_4: 0.5553 - auc_5: 0.9066 - PR AUC: 0.7090 - binary_accuracy: 0.8929 - val_loss: 5.0749 - val_precision_4: 0.6299 - val_recall_4: 0.4188 - val_auc_5: 0.8831
Epoch 7/100
...
Test precision: 0.7070063948631287
Test recall: 0.5811518430709839
Test ROC AUC: 0.9232978820800781
Test PR AUC: 0.7107010515500514
```

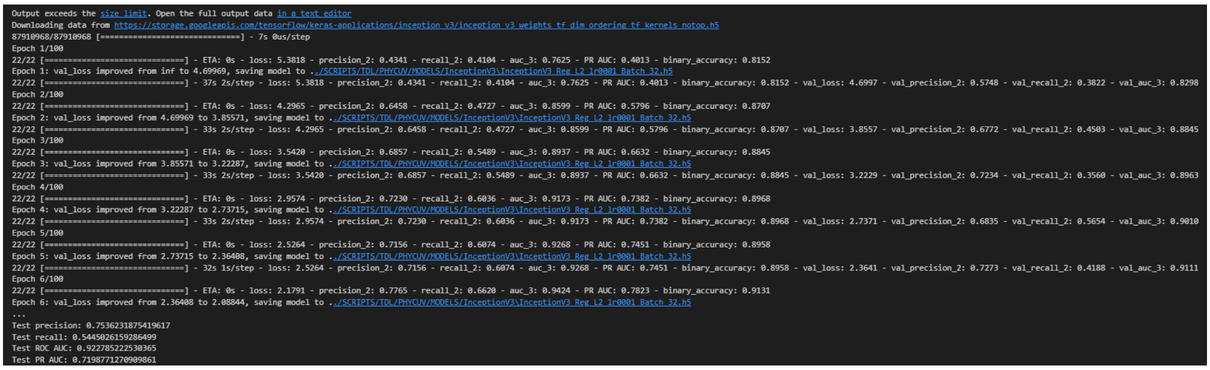
Model Name: [InceptionV3_Reg_L2_lr00001_Batch_32.h5]

test:



```
5/5 [==============================] - 5s 718ms/step
Test accuracy: 0.4050632911392405
Test precision: 0.6737588652482269
Test recall: 0.5080213903743316
Test f1 score: 0.5792682926829269
Test hamming loss: 0.12477396021699819
ANOTHER METRICS
Test F1 score: 0.5792682926829269
Test precision: 0.673758864402771
Test recall: 0.5080214142799377
Test ROC AUC: 0.9034552574157715
Test PR AUC: 0.6690698881877418
```

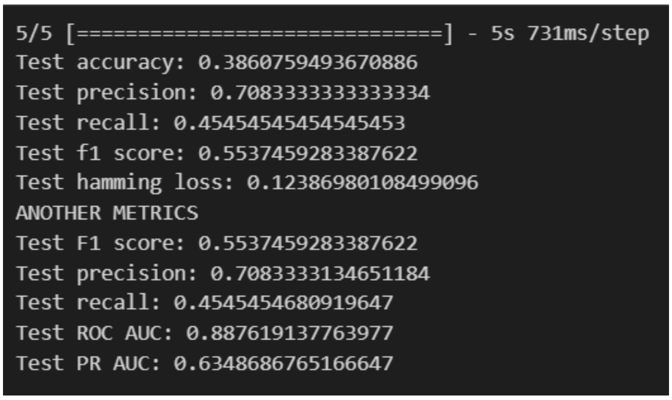
PRUEBA#2



```
Output exceeds the size limit. Open the full output data in a text editor
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/inception_v3/inception_v3_weights_tf_dim_ordering_tf_kernels_notop.h5
87910968/87910968 [==============================] - 7s 0us/step
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 5.3818 - precision_2: 0.4341 - recall_2: 0.4104 - auc_3: 0.7625 - PR AUC: 0.4013 - binary_accuracy: 0.8152
Epoch 1: val_loss improved from inf to 4.69969, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr0001_Batch_32.h5
22/22 [==============================] - 37s 2s/step - loss: 5.3818 - precision_2: 0.4341 - recall_2: 0.4104 - auc_3: 0.7625 - PR AUC: 0.4013 - binary_accuracy: 0.8152 - val_loss: 4.6997 - val_precision_2: 0.5748 - val_recall_2: 0.3822 - val_auc_3: 0.8298
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 4.2965 - precision_2: 0.6458 - recall_2: 0.4727 - auc_3: 0.8599 - PR AUC: 0.5796 - binary_accuracy: 0.8707
Epoch 2: val_loss improved from 4.69969 to 3.85571, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr0001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 4.2965 - precision_2: 0.6458 - recall_2: 0.4727 - auc_3: 0.8599 - PR AUC: 0.5796 - binary_accuracy: 0.8707 - val_loss: 3.8557 - val_precision_2: 0.6772 - val_recall_2: 0.4503 - val_auc_3: 0.8845
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 3.5420 - precision_2: 0.6857 - recall_2: 0.5489 - auc_3: 0.8937 - PR AUC: 0.6632 - binary_accuracy: 0.8845
Epoch 3: val_loss improved from 3.85571 to 3.22287, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr0001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 3.5420 - precision_2: 0.6857 - recall_2: 0.5489 - auc_3: 0.8937 - PR AUC: 0.6632 - binary_accuracy: 0.8845 - val_loss: 3.2229 - val_precision_2: 0.7234 - val_recall_2: 0.3560 - val_auc_3: 0.8963
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 2.9574 - precision_2: 0.7230 - recall_2: 0.6036 - auc_3: 0.9173 - PR AUC: 0.7382 - binary_accuracy: 0.8968
Epoch 4: val_loss improved from 3.22287 to 2.73715, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr0001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 2.9574 - precision_2: 0.7230 - recall_2: 0.6036 - auc_3: 0.9173 - PR AUC: 0.7382 - binary_accuracy: 0.8968 - val_loss: 2.7371 - val_precision_2: 0.6835 - val_recall_2: 0.5654 - val_auc_3: 0.9010
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 2.5264 - precision_2: 0.7156 - recall_2: 0.6074 - auc_3: 0.9268 - PR AUC: 0.7451 - binary_accuracy: 0.8958
Epoch 5: val_loss improved from 2.73715 to 2.36408, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr0001_Batch_32.h5
22/22 [==============================] - 32s 1s/step - loss: 2.5264 - precision_2: 0.7156 - recall_2: 0.6074 - auc_3: 0.9268 - PR AUC: 0.7451 - binary_accuracy: 0.8958 - val_loss: 2.3641 - val_precision_2: 0.7273 - val_recall_2: 0.4188 - val_auc_3: 0.9111
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 2.1791 - precision_2: 0.7765 - recall_2: 0.6620 - auc_3: 0.9424 - PR AUC: 0.7823 - binary_accuracy: 0.9131
Epoch 6: val_loss improved from 2.36408 to 2.08844, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_Reg_L2_lr0001_Batch_32.h5
...
Test precision: 0.7536231875419617
Test recall: 0.5445026159286499
Test ROC AUC: 0.9227852225303650
Test PR AUC: 0.7198771270909861
```

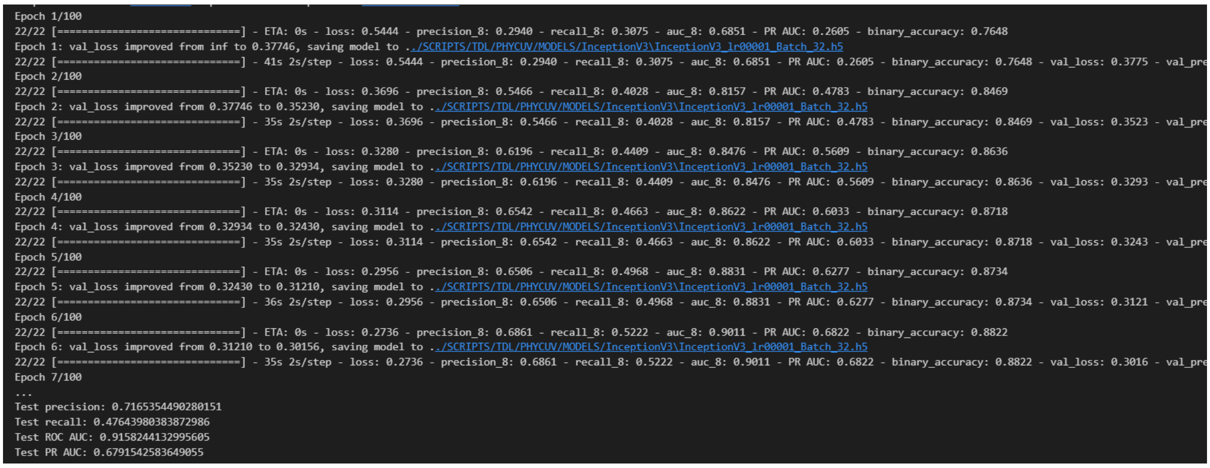
Model Name:InceptionV3_Reg_L2_lr0001_Batch_32.h5

Test:



```
5/5 [==============================] - 5s 731ms/step
Test accuracy: 0.3860759493670886
Test precision: 0.7083333333333334
Test recall: 0.45454545454545453
Test f1 score: 0.5537459283387622
Test hamming loss: 0.12386980108499096
ANOTHER METRICS
Test F1 score: 0.5537459283387622
Test precision: 0.7083333134651184
Test recall: 0.4545454680919647
Test ROC AUC: 0.887619137763977
Test PR AUC: 0.6348686765166647
```

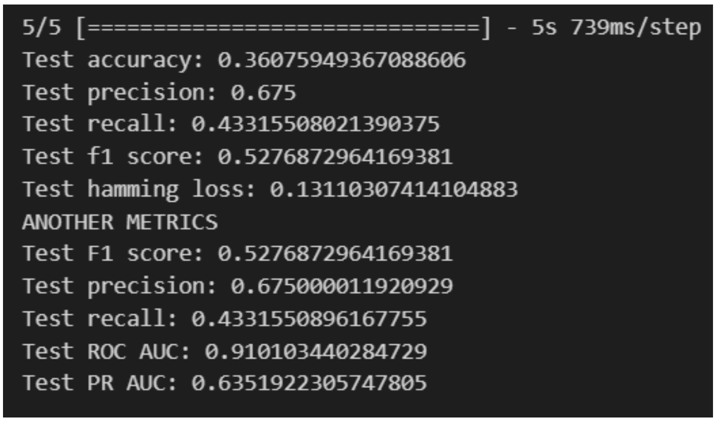
PRUEBA #3



```
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.5444 - precision_8: 0.2940 - recall_8: 0.3075 - auc_8: 0.6851 - PR AUC: 0.2605 - binary_accuracy: 0.7648
Epoch 1: val_loss improved from inf to 0.37746, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr00001_Batch_32.h5
22/22 [==============================] - 41s 2s/step - loss: 0.5444 - precision_8: 0.2940 - recall_8: 0.3075 - auc_8: 0.6851 - PR AUC: 0.2605 - binary_accuracy: 0.7648 - val_loss: 0.3775 - val_pre
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.3696 - precision_8: 0.5466 - recall_8: 0.4028 - auc_8: 0.8157 - PR AUC: 0.4783 - binary_accuracy: 0.8469
Epoch 2: val_loss improved from 0.37746 to 0.35230, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr00001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.3696 - precision_8: 0.5466 - recall_8: 0.4028 - auc_8: 0.8157 - PR AUC: 0.4783 - binary_accuracy: 0.8469 - val_loss: 0.3523 - val_pre
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3280 - precision_8: 0.6196 - recall_8: 0.4409 - auc_8: 0.8476 - PR AUC: 0.5609 - binary_accuracy: 0.8636
Epoch 3: val_loss improved from 0.35230 to 0.32934, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr00001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.3280 - precision_8: 0.6196 - recall_8: 0.4409 - auc_8: 0.8476 - PR AUC: 0.5609 - binary_accuracy: 0.8636 - val_loss: 0.3293 - val_pre
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.3114 - precision_8: 0.6542 - recall_8: 0.4663 - auc_8: 0.8622 - PR AUC: 0.6033 - binary_accuracy: 0.8718
Epoch 4: val_loss improved from 0.32934 to 0.32430, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr00001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.3114 - precision_8: 0.6542 - recall_8: 0.4663 - auc_8: 0.8622 - PR AUC: 0.6033 - binary_accuracy: 0.8718 - val_loss: 0.3243 - val_pre
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.2956 - precision_8: 0.6506 - recall_8: 0.4968 - auc_8: 0.8831 - PR AUC: 0.6277 - binary_accuracy: 0.8734
Epoch 5: val_loss improved from 0.32430 to 0.31210, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr00001_Batch_32.h5
22/22 [==============================] - 36s 2s/step - loss: 0.2956 - precision_8: 0.6506 - recall_8: 0.4968 - auc_8: 0.8831 - PR AUC: 0.6277 - binary_accuracy: 0.8734 - val_loss: 0.3121 - val_pre
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.2736 - precision_8: 0.6861 - recall_8: 0.5222 - auc_8: 0.9011 - PR AUC: 0.6822 - binary_accuracy: 0.8822
Epoch 6: val_loss improved from 0.31210 to 0.30156, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr00001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.2736 - precision_8: 0.6861 - recall_8: 0.5222 - auc_8: 0.9011 - PR AUC: 0.6822 - binary_accuracy: 0.8822 - val_loss: 0.3016 - val_pre
Epoch 7/100
...
Test precision: 0.7165354490280151
Test recall: 0.47643980383872986
Test ROC AUC: 0.9158244132995605
Test PR AUC: 0.6791542583649055
```

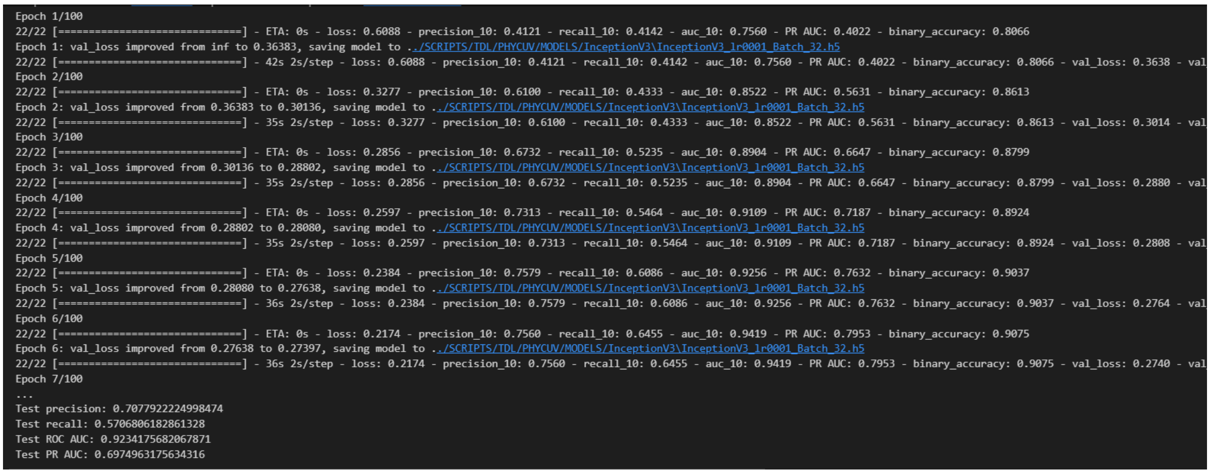
Model name:InceptionV3_lr00001_Batch_32.h5

Test:



```
5/5 [==============================] - 5s 739ms/step
Test accuracy: 0.36075949367088606
Test precision: 0.675
Test recall: 0.43315508021390375
Test f1 score: 0.5276872964169381
Test hamming loss: 0.13110307414104883
ANOTHER METRICS
Test F1 score: 0.5276872964169381
Test precision: 0.675000011920929
Test recall: 0.4331550896167755
Test ROC AUC: 0.910103440284729
Test PR AUC: 0.6351922305747805
```

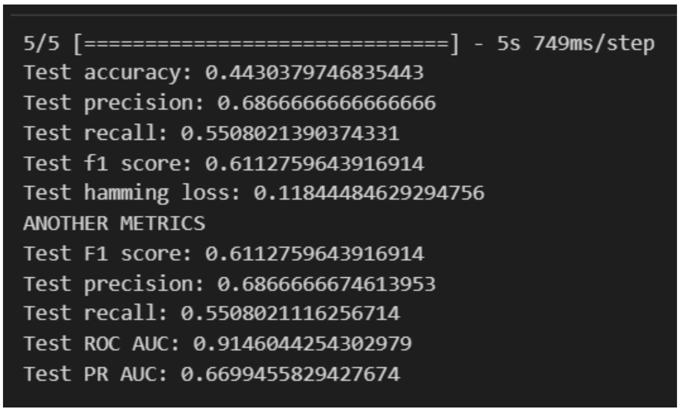
PRUEBA #4



```
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.6088 - precision_10: 0.4121 - recall_10: 0.4142 - auc_10: 0.7560 - PR AUC: 0.4022 - binary_accuracy: 0.8066
Epoch 1: val_loss improved from inf to 0.36383, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr0001_Batch_32.h5
22/22 [==============================] - 42s 2s/step - loss: 0.6088 - precision_10: 0.4121 - recall_10: 0.4142 - auc_10: 0.7560 - PR AUC: 0.4022 - binary_accuracy: 0.8066 - val_loss: 0.3638 - val
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.3277 - precision_10: 0.6100 - recall_10: 0.4333 - auc_10: 0.8522 - PR AUC: 0.5631 - binary_accuracy: 0.8613
Epoch 2: val_loss improved from 0.36383 to 0.30136, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr0001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.3277 - precision_10: 0.6100 - recall_10: 0.4333 - auc_10: 0.8522 - PR AUC: 0.5631 - binary_accuracy: 0.8613 - val_loss: 0.3014 - val
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.2856 - precision_10: 0.6732 - recall_10: 0.5235 - auc_10: 0.8904 - PR AUC: 0.6647 - binary_accuracy: 0.8799
Epoch 3: val_loss improved from 0.30136 to 0.28802, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr0001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.2856 - precision_10: 0.6732 - recall_10: 0.5235 - auc_10: 0.8904 - PR AUC: 0.6647 - binary_accuracy: 0.8799 - val_loss: 0.2880 - val
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.2597 - precision_10: 0.7313 - recall_10: 0.5464 - auc_10: 0.9109 - PR AUC: 0.7187 - binary_accuracy: 0.8924
Epoch 4: val_loss improved from 0.28802 to 0.28080, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr0001_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.2597 - precision_10: 0.7313 - recall_10: 0.5464 - auc_10: 0.9109 - PR AUC: 0.7187 - binary_accuracy: 0.8924 - val_loss: 0.2808 - val
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.2384 - precision_10: 0.7579 - recall_10: 0.6086 - auc_10: 0.9256 - PR AUC: 0.7632 - binary_accuracy: 0.9037
Epoch 5: val_loss improved from 0.28080 to 0.27638, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr0001_Batch_32.h5
22/22 [==============================] - 36s 2s/step - loss: 0.2384 - precision_10: 0.7579 - recall_10: 0.6086 - auc_10: 0.9256 - PR AUC: 0.7632 - binary_accuracy: 0.9037 - val_loss: 0.2764 - val
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.2174 - precision_10: 0.7560 - recall_10: 0.6455 - auc_10: 0.9419 - PR AUC: 0.7953 - binary_accuracy: 0.9075
Epoch 6: val_loss improved from 0.27638 to 0.27397, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr0001_Batch_32.h5
22/22 [==============================] - 36s 2s/step - loss: 0.2174 - precision_10: 0.7560 - recall_10: 0.6455 - auc_10: 0.9419 - PR AUC: 0.7953 - binary_accuracy: 0.9075 - val_loss: 0.2740 - val
Epoch 7/100
...
Test precision: 0.7077922224998474
Test recall: 0.5706806182861328
Test ROC AUC: 0.9234175682067871
Test PR AUC: 0.6974963175634316
```

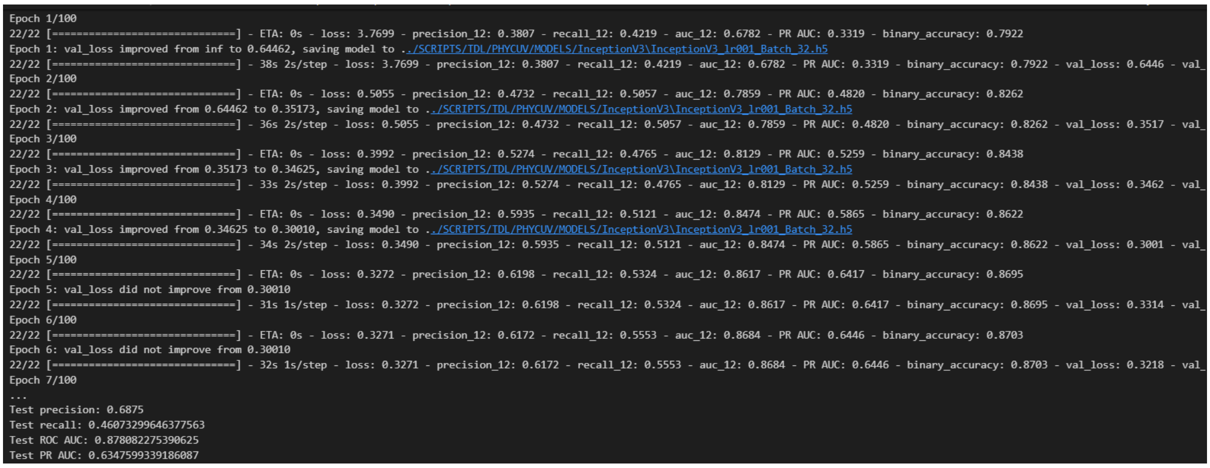
Model name:InceptionV3_lr0001_Batch_32.h5

Test:



```
5/5 [==============================] - 5s 749ms/step
Test accuracy: 0.4430379746835443
Test precision: 0.6866666666666666
Test recall: 0.5508021390374331
Test f1 score: 0.6112759643916914
Test hamming loss: 0.11844484629294756
ANOTHER METRICS
Test F1 score: 0.6112759643916914
Test precision: 0.6866666674613953
Test recall: 0.5508021116256714
Test ROC AUC: 0.9146044254302979
Test PR AUC: 0.6699455829427674
```

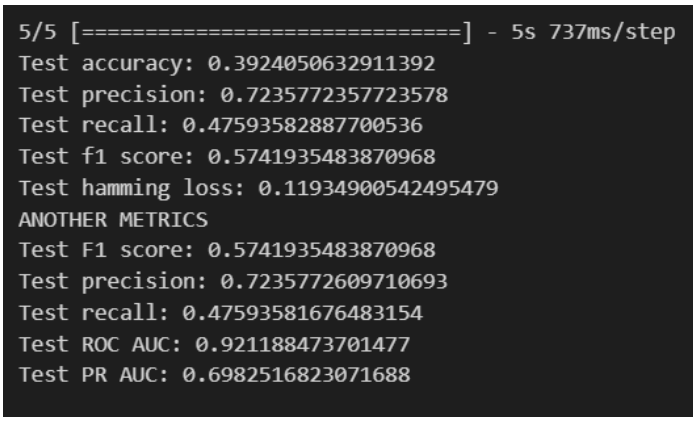
PRUEBA #5



```
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 3.7699 - precision_12: 0.3807 - recall_12: 0.4219 - auc_12: 0.6782 - PR AUC: 0.3319 - binary_accuracy: 0.7922
Epoch 1: val_loss improved from inf to 0.64462, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr001_Batch_32.h5
22/22 [==============================] - 38s 2s/step - loss: 3.7699 - precision_12: 0.3807 - recall_12: 0.4219 - auc_12: 0.6782 - PR AUC: 0.3319 - binary_accuracy: 0.7922 - val_loss: 0.6446 - val_
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.5055 - precision_12: 0.4732 - recall_12: 0.5057 - auc_12: 0.7859 - PR AUC: 0.4820 - binary_accuracy: 0.8262
Epoch 2: val_loss improved from 0.64462 to 0.35173, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr001_Batch_32.h5
22/22 [==============================] - 36s 2s/step - loss: 0.5055 - precision_12: 0.4732 - recall_12: 0.5057 - auc_12: 0.7859 - PR AUC: 0.4820 - binary_accuracy: 0.8262 - val_loss: 0.3517 - val_
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3992 - precision_12: 0.5274 - recall_12: 0.4765 - auc_12: 0.8129 - PR AUC: 0.5259 - binary_accuracy: 0.8438
Epoch 3: val_loss improved from 0.35173 to 0.34625, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr001_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 0.3992 - precision_12: 0.5274 - recall_12: 0.4765 - auc_12: 0.8129 - PR AUC: 0.5259 - binary_accuracy: 0.8438 - val_loss: 0.3462 - val_
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.3490 - precision_12: 0.5935 - recall_12: 0.5121 - auc_12: 0.8474 - PR AUC: 0.5865 - binary_accuracy: 0.8622
Epoch 4: val_loss improved from 0.34625 to 0.30010, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr001_Batch_32.h5
22/22 [==============================] - 34s 2s/step - loss: 0.3490 - precision_12: 0.5935 - recall_12: 0.5121 - auc_12: 0.8474 - PR AUC: 0.5865 - binary_accuracy: 0.8622 - val_loss: 0.3001 - val_
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.3272 - precision_12: 0.6198 - recall_12: 0.5324 - auc_12: 0.8617 - PR AUC: 0.6417 - binary_accuracy: 0.8695
Epoch 5: val_loss did not improve from 0.30010
22/22 [==============================] - 31s 1s/step - loss: 0.3272 - precision_12: 0.6198 - recall_12: 0.5324 - auc_12: 0.8617 - PR AUC: 0.6417 - binary_accuracy: 0.8695 - val_loss: 0.3314 - val_
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.3271 - precision_12: 0.6172 - recall_12: 0.5553 - auc_12: 0.8684 - PR AUC: 0.6446 - binary_accuracy: 0.8703
Epoch 6: val_loss did not improve from 0.30010
22/22 [==============================] - 32s 1s/step - loss: 0.3271 - precision_12: 0.6172 - recall_12: 0.5553 - auc_12: 0.8684 - PR AUC: 0.6446 - binary_accuracy: 0.8703 - val_loss: 0.3218 - val_
Epoch 7/100
...
Test precision: 0.6875
Test recall: 0.46073299646377563
Test ROC AUC: 0.878082275390625
Test PR AUC: 0.6347599339186087
```

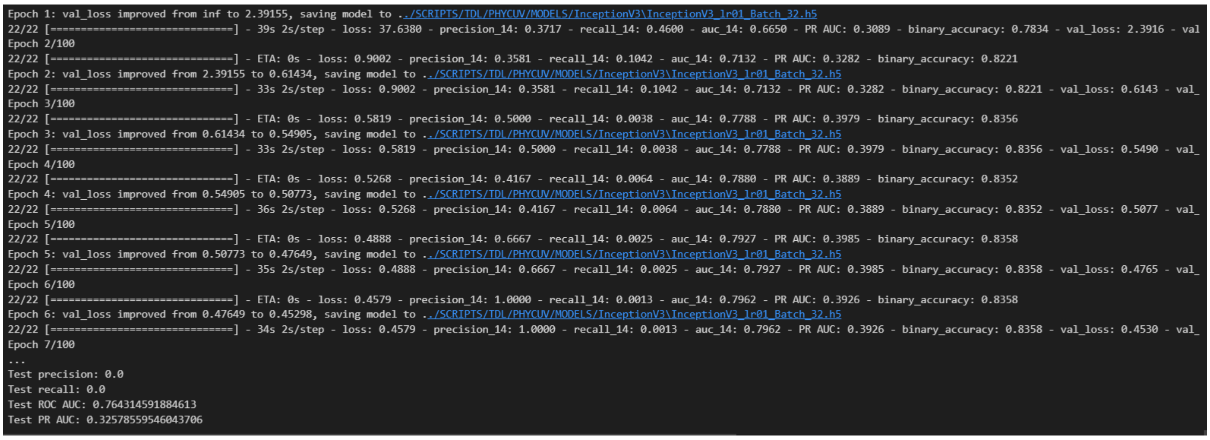
Model Name: InceptionV3_lr001_Batch_32.h5

test:



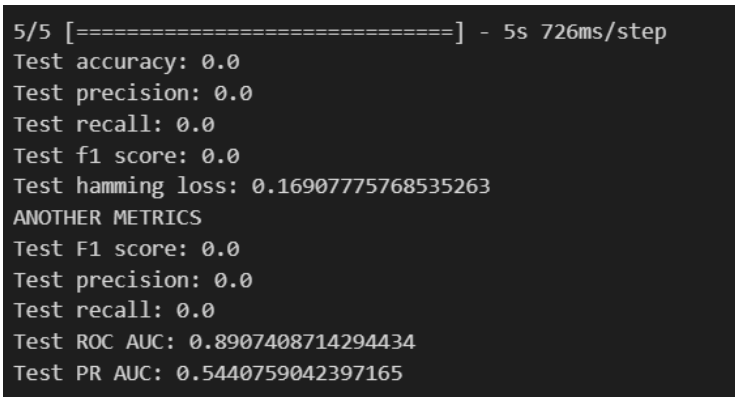
```
5/5 [==============================] - 5s 737ms/step
Test accuracy: 0.3924050632911392
Test precision: 0.7235772357723578
Test recall: 0.47593582887700536
Test f1 score: 0.5741935483870968
Test hamming loss: 0.11934900542495479
ANOTHER METRICS
Test F1 score: 0.5741935483870968
Test precision: 0.7235772609710693
Test recall: 0.47593581676483154
Test ROC AUC: 0.921188473701477
Test PR AUC: 0.6982516823071688
```

PRUEBA#6



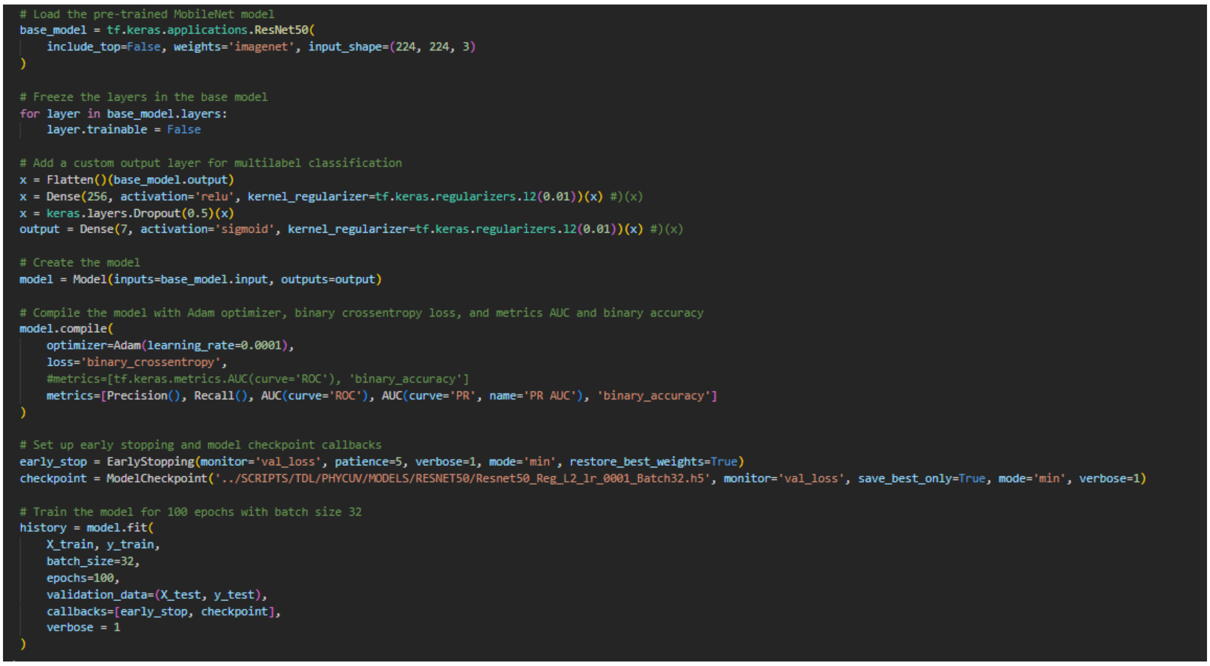
```
Epoch 1: val_loss improved from inf to 2.39155, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr01_Batch_32.h5
22/22 [==============================] - 39s 2s/step - loss: 37.6380 - precision_14: 0.3717 - recall_14: 0.4600 - auc_14: 0.6650 - PR AUC: 0.3089 - binary_accuracy: 0.7834 - val_loss: 2.3916 - val
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.9002 - precision_14: 0.3581 - recall_14: 0.1042 - auc_14: 0.7132 - PR AUC: 0.3282 - binary_accuracy: 0.8221
Epoch 2: val_loss improved from 2.39155 to 0.61434, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr01_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 0.9002 - precision_14: 0.3581 - recall_14: 0.1042 - auc_14: 0.7132 - PR AUC: 0.3282 - binary_accuracy: 0.8221 - val_loss: 0.6143 - val_
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.5819 - precision_14: 0.5000 - recall_14: 0.0038 - auc_14: 0.7788 - PR AUC: 0.3979 - binary_accuracy: 0.8356
Epoch 3: val_loss improved from 0.61434 to 0.54905, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr01_Batch_32.h5
22/22 [==============================] - 33s 2s/step - loss: 0.5819 - precision_14: 0.5000 - recall_14: 0.0038 - auc_14: 0.7788 - PR AUC: 0.3979 - binary_accuracy: 0.8356 - val_loss: 0.5490 - val_
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.5268 - precision_14: 0.4167 - recall_14: 0.0064 - auc_14: 0.7880 - PR AUC: 0.3889 - binary_accuracy: 0.8352
Epoch 4: val_loss improved from 0.54905 to 0.50773, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr01_Batch_32.h5
22/22 [==============================] - 36s 2s/step - loss: 0.5268 - precision_14: 0.4167 - recall_14: 0.0064 - auc_14: 0.7880 - PR AUC: 0.3889 - binary_accuracy: 0.8352 - val_loss: 0.5077 - val_
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.4888 - precision_14: 0.6667 - recall_14: 0.0025 - auc_14: 0.7927 - PR AUC: 0.3985 - binary_accuracy: 0.8358
Epoch 5: val_loss improved from 0.50773 to 0.47649, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr01_Batch_32.h5
22/22 [==============================] - 35s 2s/step - loss: 0.4888 - precision_14: 0.6667 - recall_14: 0.0025 - auc_14: 0.7927 - PR AUC: 0.3985 - binary_accuracy: 0.8358 - val_loss: 0.4765 - val_
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.4579 - precision_14: 1.0000 - recall_14: 0.0013 - auc_14: 0.7962 - PR AUC: 0.3926 - binary_accuracy: 0.8358
Epoch 6: val_loss improved from 0.47649 to 0.45298, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/InceptionV3\InceptionV3_lr01_Batch_32.h5
22/22 [==============================] - 34s 2s/step - loss: 0.4579 - precision_14: 1.0000 - recall_14: 0.0013 - auc_14: 0.7962 - PR AUC: 0.3926 - binary_accuracy: 0.8358 - val_loss: 0.4530 - val_
Epoch 7/100
...
Test precision: 0.0
Test recall: 0.0
Test ROC AUC: 0.764314591884613
Test PR AUC: 0.32578559546043706
```

Model name:InceptionV3_lr01_Batch_32.h5



```
5/5 [==============================] - 5s 726ms/step
Test accuracy: 0.0
Test precision: 0.0
Test recall: 0.0
Test f1 score: 0.0
Test hamming loss: 0.16907775768535263
ANOTHER METRICS
Test F1 score: 0.0
Test precision: 0.0
Test recall: 0.0
Test ROC AUC: 0.8907408714294434
Test PR AUC: 0.5440759042397165
```

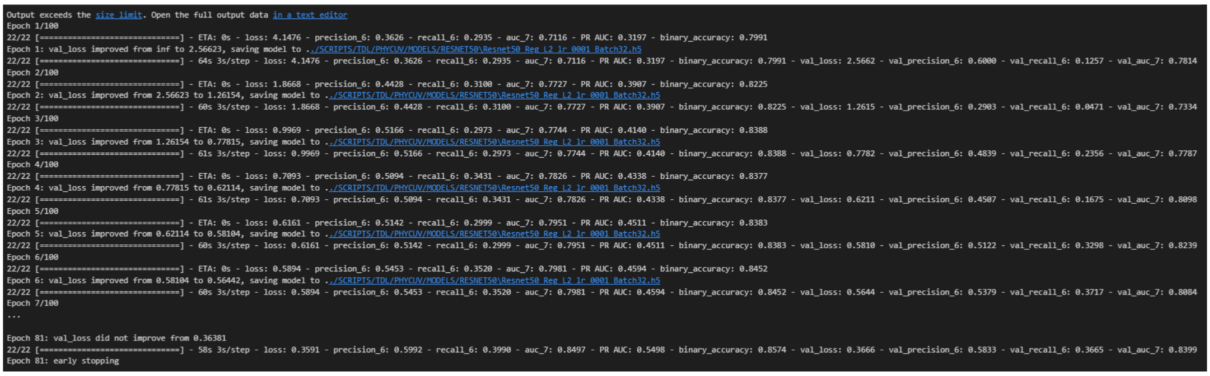
Resnet50:



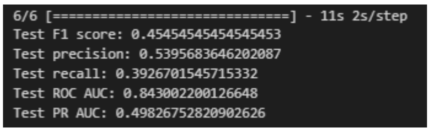
```python
# Load the pre-trained MobileNet model
base_model = tf.keras.applications.ResNet50(
    include_top=False, weights='imagenet', input_shape=(224, 224, 3)
)

# Freeze the layers in the base model
for layer in base_model.layers:
    layer.trainable = False

# Add a custom output layer for multilabel classification
x = Flatten()(base_model.output)
x = Dense(256, activation='relu', kernel_regularizer=tf.keras.regularizers.l2(0.01))(x) #)(x)
x = keras.layers.Dropout(0.5)(x)
output = Dense(7, activation='sigmoid', kernel_regularizer=tf.keras.regularizers.l2(0.01))(x) #)(x)

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

# Compile the model with Adam optimizer, binary crossentropy loss, and metrics AUC and binary accuracy
model.compile(
    optimizer=Adam(learning_rate=0.0001),
    loss='binary_crossentropy',
    #metrics=[tf.keras.metrics.AUC(curve='ROC'), 'binary_accuracy']
    metrics=[Precision(), Recall(), AUC(curve='ROC'), AUC(curve='PR', name='PR AUC'), 'binary_accuracy']
)

# Set up early stopping and model checkpoint callbacks
early_stop = EarlyStopping(monitor='val_loss', patience=5, verbose=1, mode='min', restore_best_weights=True)
checkpoint = ModelCheckpoint('../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50/Resnet50_Reg_L2_lr_0001_Batch32.h5', monitor='val_loss', save_best_only=True, mode='min', verbose=1)

# Train the model for 100 epochs with batch size 32
history = model.fit(
    X_train, y_train,
    batch_size=32,
    epochs=100,
    validation_data=(X_test, y_test),
    callbacks=[early_stop, checkpoint],
    verbose = 1
)
```

Con Regularizacion

PRUEBA #1:



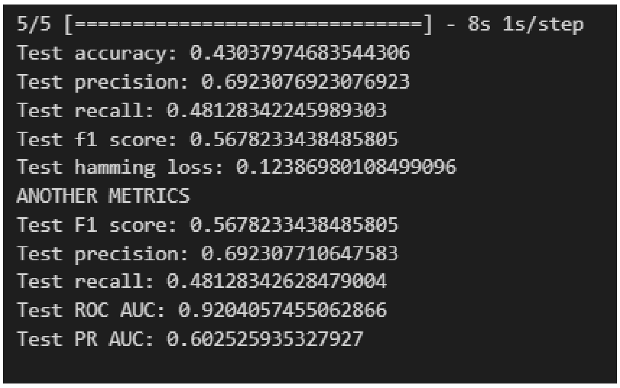
```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 4.1476 - precision_6: 0.3626 - recall_6: 0.2935 - auc_7: 0.7116 - PR AUC: 0.3197 - binary_accuracy: 0.7991
Epoch 1: val_loss improved from inf to 2.56623, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_0001_Batch32.h5
22/22 [==============================] - 64s 3s/step - loss: 4.1476 - precision_6: 0.3626 - recall_6: 0.2935 - auc_7: 0.7116 - PR AUC: 0.3197 - binary_accuracy: 0.7991 - val_loss: 2.5662 - val_precision_6: 0.6000 - val_recall_6: 0.1257 - val_auc_7: 0.7814
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 1.8668 - precision_6: 0.4428 - recall_6: 0.3100 - auc_7: 0.7727 - PR AUC: 0.3907 - binary_accuracy: 0.8225
Epoch 2: val_loss improved from 2.56623 to 1.26154, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_0001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 1.8668 - precision_6: 0.4428 - recall_6: 0.3100 - auc_7: 0.7727 - PR AUC: 0.3907 - binary_accuracy: 0.8225 - val_loss: 1.2615 - val_precision_6: 0.2903 - val_recall_6: 0.0471 - val_auc_7: 0.7334
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.9969 - precision_6: 0.5166 - recall_6: 0.2973 - auc_7: 0.7744 - PR AUC: 0.4140 - binary_accuracy: 0.8388
Epoch 3: val_loss improved from 1.26154 to 0.77815, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_0001_Batch32.h5
22/22 [==============================] - 61s 3s/step - loss: 0.9969 - precision_6: 0.5166 - recall_6: 0.2973 - auc_7: 0.7744 - PR AUC: 0.4140 - binary_accuracy: 0.8388 - val_loss: 0.7782 - val_precision_6: 0.4839 - val_recall_6: 0.2356 - val_auc_7: 0.7787
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.7093 - precision_6: 0.5094 - recall_6: 0.3431 - auc_7: 0.7826 - PR AUC: 0.4338 - binary_accuracy: 0.8377
Epoch 4: val_loss improved from 0.77815 to 0.62114, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_0001_Batch32.h5
22/22 [==============================] - 61s 3s/step - loss: 0.7093 - precision_6: 0.5094 - recall_6: 0.3431 - auc_7: 0.7826 - PR AUC: 0.4338 - binary_accuracy: 0.8377 - val_loss: 0.6211 - val_precision_6: 0.4507 - val_recall_6: 0.1675 - val_auc_7: 0.8098
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.6161 - precision_6: 0.5142 - recall_6: 0.2999 - auc_7: 0.7951 - PR AUC: 0.4511 - binary_accuracy: 0.8383
Epoch 5: val_loss improved from 0.62114 to 0.58104, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_0001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 0.6161 - precision_6: 0.5142 - recall_6: 0.2999 - auc_7: 0.7951 - PR AUC: 0.4511 - binary_accuracy: 0.8383 - val_loss: 0.5810 - val_precision_6: 0.5122 - val_recall_6: 0.3298 - val_auc_7: 0.8239
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.5894 - precision_6: 0.5453 - recall_6: 0.3520 - auc_7: 0.7981 - PR AUC: 0.4594 - binary_accuracy: 0.8452
Epoch 6: val_loss improved from 0.58104 to 0.56442, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_0001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 0.5894 - precision_6: 0.5453 - recall_6: 0.3520 - auc_7: 0.7981 - PR AUC: 0.4594 - binary_accuracy: 0.8452 - val_loss: 0.5644 - val_precision_6: 0.5379 - val_recall_6: 0.3717 - val_auc_7: 0.8084
Epoch 7/100
...

Epoch 81: val_loss did not improve from 0.36381
22/22 [==============================] - 58s 3s/step - loss: 0.3591 - precision_6: 0.5992 - recall_6: 0.3990 - auc_7: 0.8497 - PR AUC: 0.5498 - binary_accuracy: 0.8574 - val_loss: 0.3666 - val_precision_6: 0.5833 - val_recall_6: 0.3665 - val_auc_7: 0.8399
Epoch 81: early stopping
```



```
6/6 [==============================] - 11s 2s/step
Test F1 score: 0.4545454545454545453
Test precision: 0.5395683646202087
Test recall: 0.3926701545715332
Test ROC AUC: 0.843002200126648
Test PR AUC: 0.49826752820902626
```

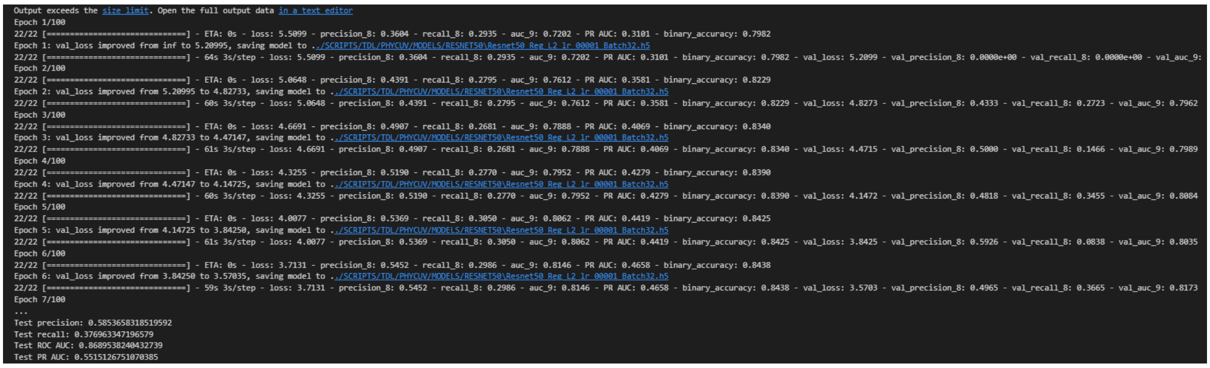
Model name:Resnet50_Reg_L2_lr_0001_Batch32.h5

test:



```
5/5 [==============================] - 8s 1s/step
Test accuracy: 0.43037974683544306
Test precision: 0.6923076923076923
Test recall: 0.48128342245989303
Test f1 score: 0.5678233438485805
Test hamming loss: 0.12386980108499096
ANOTHER METRICS
Test F1 score: 0.5678233438485805
Test precision: 0.692307710647583
Test recall: 0.48128342628479004
Test ROC AUC: 0.9204057455062866
Test PR AUC: 0.602525935327927
```

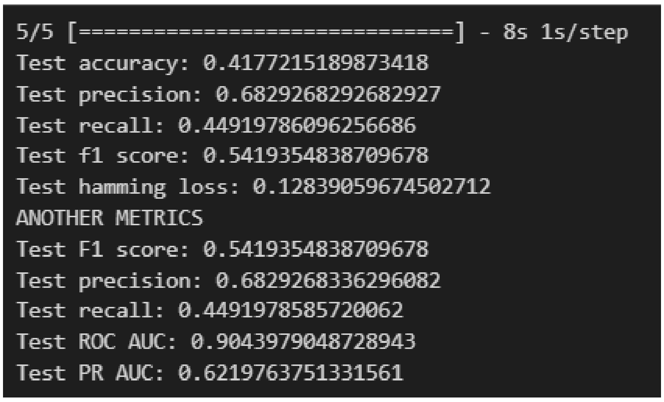
PRUEBA #2:



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 5.5099 - precision_8: 0.3604 - recall_8: 0.2935 - auc_9: 0.7202 - PR AUC: 0.3101 - binary_accuracy: 0.7982
Epoch 1: val_loss improved from inf to 5.20995, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_00001_Batch32.h5
22/22 [==============================] - 64s 3s/step - loss: 5.5099 - precision_8: 0.3604 - recall_8: 0.2935 - auc_9: 0.7202 - PR AUC: 0.3101 - binary_accuracy: 0.7982 - val_loss: 5.2099 - val_precision_8: 0.0000e+00 - val_recall_8: 0.0000e+00 - val_auc_9:
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 5.0648 - precision_8: 0.4391 - recall_8: 0.2795 - auc_9: 0.7612 - PR AUC: 0.3581 - binary_accuracy: 0.8229
Epoch 2: val_loss improved from 5.20995 to 4.82733, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_00001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 5.0648 - precision_8: 0.4391 - recall_8: 0.2795 - auc_9: 0.7612 - PR AUC: 0.3581 - binary_accuracy: 0.8229 - val_loss: 4.8273 - val_precision_8: 0.4333 - val_recall_8: 0.2723 - val_auc_9: 0.7962
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 4.6691 - precision_8: 0.4907 - recall_8: 0.2681 - auc_9: 0.7888 - PR AUC: 0.4069 - binary_accuracy: 0.8340
Epoch 3: val_loss improved from 4.82733 to 4.47147, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_00001_Batch32.h5
22/22 [==============================] - 61s 3s/step - loss: 4.6691 - precision_8: 0.4907 - recall_8: 0.2681 - auc_9: 0.7888 - PR AUC: 0.4069 - binary_accuracy: 0.8340 - val_loss: 4.4715 - val_precision_8: 0.5000 - val_recall_8: 0.1466 - val_auc_9: 0.7989
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 4.3255 - precision_8: 0.5190 - recall_8: 0.2770 - auc_9: 0.7952 - PR AUC: 0.4279 - binary_accuracy: 0.8390
Epoch 4: val_loss improved from 4.47147 to 4.14725, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_00001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 4.3255 - precision_8: 0.5190 - recall_8: 0.2770 - auc_9: 0.7952 - PR AUC: 0.4279 - binary_accuracy: 0.8390 - val_loss: 4.1472 - val_precision_8: 0.4818 - val_recall_8: 0.3455 - val_auc_9: 0.8084
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 4.0077 - precision_8: 0.5369 - recall_8: 0.3050 - auc_9: 0.8062 - PR AUC: 0.4419 - binary_accuracy: 0.8425
Epoch 5: val_loss improved from 4.14725 to 3.84250, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_00001_Batch32.h5
22/22 [==============================] - 61s 3s/step - loss: 4.0077 - precision_8: 0.5369 - recall_8: 0.3050 - auc_9: 0.8062 - PR AUC: 0.4419 - binary_accuracy: 0.8425 - val_loss: 3.8425 - val_precision_8: 0.5926 - val_recall_8: 0.0838 - val_auc_9: 0.8035
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 3.7131 - precision_8: 0.5452 - recall_8: 0.2986 - auc_9: 0.8146 - PR AUC: 0.4658 - binary_accuracy: 0.8438
Epoch 6: val_loss improved from 3.84250 to 3.57035, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_Reg_L2_lr_00001_Batch32.h5
22/22 [==============================] - 59s 3s/step - loss: 3.7131 - precision_8: 0.5452 - recall_8: 0.2986 - auc_9: 0.8146 - PR AUC: 0.4658 - binary_accuracy: 0.8438 - val_loss: 3.5703 - val_precision_8: 0.4965 - val_recall_8: 0.3665 - val_auc_9: 0.8173
Epoch 7/100
...
Test precision: 0.5853658318519592
Test recall: 0.376963347196579
Test ROC AUC: 0.8689538240432739
Test PR AUC: 0.5515126751070385
```

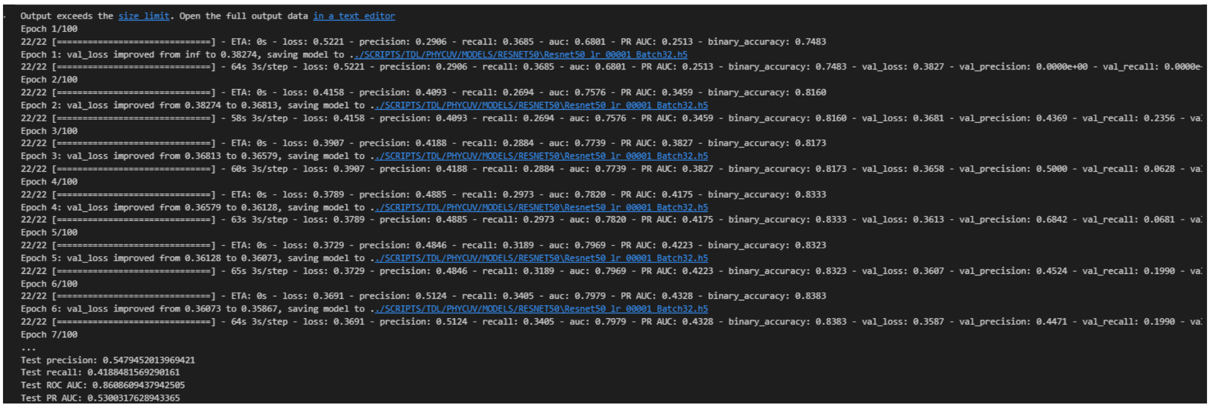
Model name: Resnet50_Reg_L2_lr_00001_Batch32.h5

test:



```
5/5 [==============================] - 8s 1s/step
Test accuracy: 0.4177215189873418
Test precision: 0.6829268292682927
Test recall: 0.44919786096256686
Test f1 score: 0.5419354838709678
Test hamming loss: 0.12839059674502712
ANOTHER METRICS
Test F1 score: 0.5419354838709678
Test precision: 0.6829268336296082
Test recall: 0.4491978585720062
Test ROC AUC: 0.9043979048728943
Test PR AUC: 0.6219763751331561
```

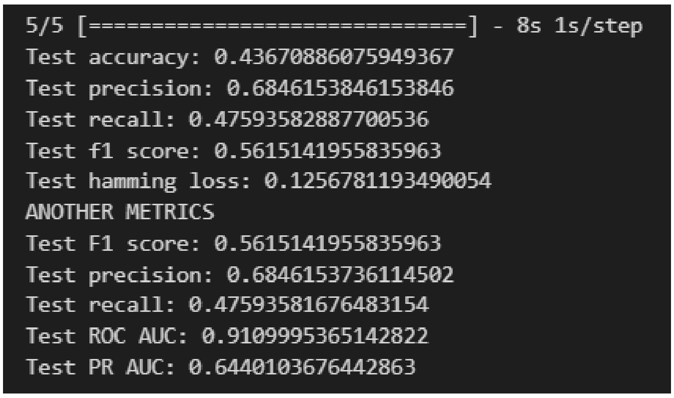
PRUEBA #3



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.5221 - precision: 0.2906 - recall: 0.3685 - auc: 0.6801 - PR AUC: 0.2513 - binary_accuracy: 0.7483
Epoch 1: val_loss improved from inf to 0.38274, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_00001_Batch32.h5
22/22 [==============================] - 64s 3s/step - loss: 0.5221 - precision: 0.2906 - recall: 0.3685 - auc: 0.6801 - PR AUC: 0.2513 - binary_accuracy: 0.7483 - val_loss: 0.3827 - val_precision: 0.0000e+00 - val_recall: 0.0000e-
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.4158 - precision: 0.4093 - recall: 0.2694 - auc: 0.7576 - PR AUC: 0.3459 - binary_accuracy: 0.8160
Epoch 2: val_loss improved from 0.38274 to 0.36813, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_00001_Batch32.h5
22/22 [==============================] - 58s 3s/step - loss: 0.4158 - precision: 0.4093 - recall: 0.2694 - auc: 0.7576 - PR AUC: 0.3459 - binary_accuracy: 0.8160 - val_loss: 0.3681 - val_precision: 0.4369 - val_recall: 0.2356 - va
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3907 - precision: 0.4188 - recall: 0.2884 - auc: 0.7739 - PR AUC: 0.3827 - binary_accuracy: 0.8173
Epoch 3: val_loss improved from 0.36813 to 0.36579, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_00001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 0.3907 - precision: 0.4188 - recall: 0.2884 - auc: 0.7739 - PR AUC: 0.3827 - binary_accuracy: 0.8173 - val_loss: 0.3658 - val_precision: 0.5000 - val_recall: 0.0628 - va
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.3789 - precision: 0.4885 - recall: 0.2973 - auc: 0.7820 - PR AUC: 0.4175 - binary_accuracy: 0.8333
Epoch 4: val_loss improved from 0.36579 to 0.36128, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_00001_Batch32.h5
22/22 [==============================] - 63s 3s/step - loss: 0.3789 - precision: 0.4885 - recall: 0.2973 - auc: 0.7820 - PR AUC: 0.4175 - binary_accuracy: 0.8333 - val_loss: 0.3613 - val_precision: 0.6842 - val_recall: 0.0681 - va
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.3729 - precision: 0.4846 - recall: 0.3189 - auc: 0.7969 - PR AUC: 0.4223 - binary_accuracy: 0.8323
Epoch 5: val_loss improved from 0.36128 to 0.36073, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_00001_Batch32.h5
22/22 [==============================] - 65s 3s/step - loss: 0.3729 - precision: 0.4846 - recall: 0.3189 - auc: 0.7969 - PR AUC: 0.4223 - binary_accuracy: 0.8323 - val_loss: 0.3607 - val_precision: 0.4524 - val_recall: 0.1990 - va
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.3691 - precision: 0.5124 - recall: 0.3405 - auc: 0.7979 - PR AUC: 0.4328 - binary_accuracy: 0.8383
Epoch 6: val_loss improved from 0.36073 to 0.35867, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_00001_Batch32.h5
22/22 [==============================] - 64s 3s/step - loss: 0.3691 - precision: 0.5124 - recall: 0.3405 - auc: 0.7979 - PR AUC: 0.4328 - binary_accuracy: 0.8383 - val_loss: 0.3587 - val_precision: 0.4471 - val_recall: 0.1990 - va
Epoch 7/100
...
Test precision: 0.5479452013969421
Test recall: 0.4188481569290161
Test ROC AUC: 0.8608609437942505
Test PR AUC: 0.5300317628943365
```

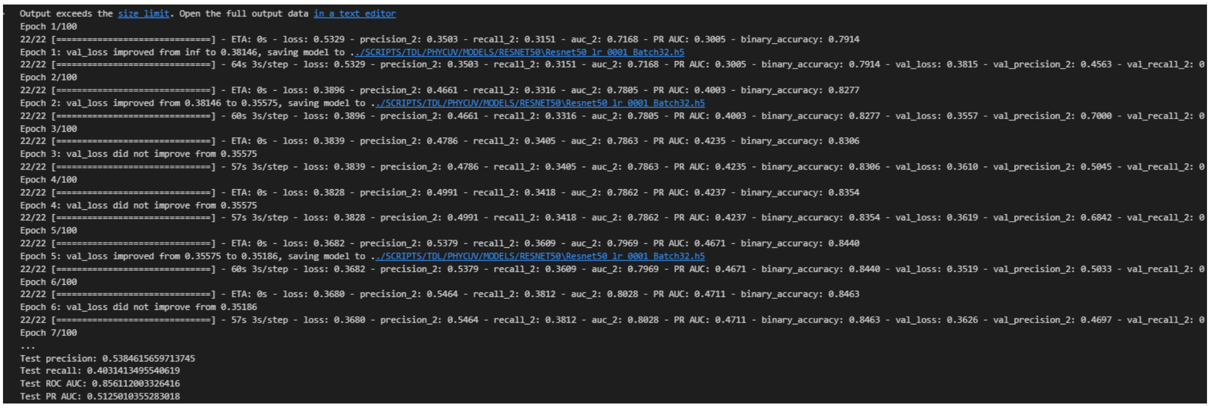
Model Name: Resnet50_lr_00001_Batch32.h5

test:



```
5/5 [==============================] - 8s 1s/step
Test accuracy: 0.43670886075949367
Test precision: 0.6846153846153846
Test recall: 0.47593582887700536
Test f1 score: 0.5615141955835963
Test hamming loss: 0.1256781193490054
ANOTHER METRICS
Test F1 score: 0.5615141955835963
Test precision: 0.6846153736114502
Test recall: 0.47593581676483154
Test ROC AUC: 0.9109995365142822
Test PR AUC: 0.6440103676442863
```

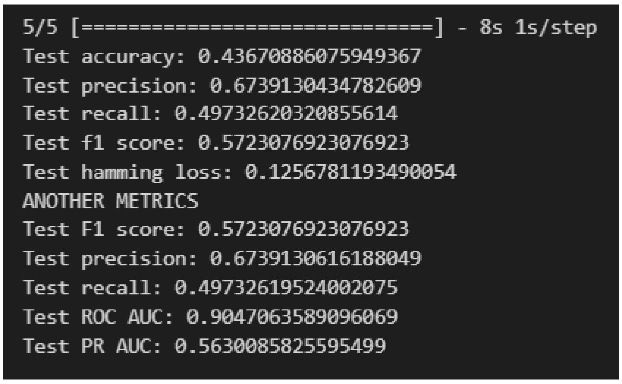
PRUEBA #4



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.5329 - precision_2: 0.3503 - recall_2: 0.3151 - auc_2: 0.7168 - PR AUC: 0.3005 - binary_accuracy: 0.7914
Epoch 1: val_loss improved from inf to 0.38146, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_0001_Batch32.h5
22/22 [==============================] - 64s 3s/step - loss: 0.5329 - precision_2: 0.3503 - recall_2: 0.3151 - auc_2: 0.7168 - PR AUC: 0.3005 - binary_accuracy: 0.7914 - val_loss: 0.3815 - val_precision_2: 0.4563 - val_recall_2: 0
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.3896 - precision_2: 0.4661 - recall_2: 0.3316 - auc_2: 0.7805 - PR AUC: 0.4003 - binary_accuracy: 0.8277
Epoch 2: val_loss improved from 0.38146 to 0.35575, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_0001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 0.3896 - precision_2: 0.4661 - recall_2: 0.3316 - auc_2: 0.7805 - PR AUC: 0.4003 - binary_accuracy: 0.8277 - val_loss: 0.3557 - val_precision_2: 0.7000 - val_recall_2: 0
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3839 - precision_2: 0.4786 - recall_2: 0.3405 - auc_2: 0.7863 - PR AUC: 0.4235 - binary_accuracy: 0.8306
Epoch 3: val_loss did not improve from 0.35575
22/22 [==============================] - 57s 3s/step - loss: 0.3839 - precision_2: 0.4786 - recall_2: 0.3405 - auc_2: 0.7863 - PR AUC: 0.4235 - binary_accuracy: 0.8306 - val_loss: 0.3610 - val_precision_2: 0.5045 - val_recall_2: 0
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.3828 - precision_2: 0.4991 - recall_2: 0.3418 - auc_2: 0.7862 - PR AUC: 0.4237 - binary_accuracy: 0.8354
Epoch 4: val_loss did not improve from 0.35575
22/22 [==============================] - 57s 3s/step - loss: 0.3828 - precision_2: 0.4991 - recall_2: 0.3418 - auc_2: 0.7862 - PR AUC: 0.4237 - binary_accuracy: 0.8354 - val_loss: 0.3619 - val_precision_2: 0.6842 - val_recall_2: 0
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.3682 - precision_2: 0.5379 - recall_2: 0.3609 - auc_2: 0.7969 - PR AUC: 0.4671 - binary_accuracy: 0.8440
Epoch 5: val_loss improved from 0.35575 to 0.35186, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_0001_Batch32.h5
22/22 [==============================] - 60s 3s/step - loss: 0.3682 - precision_2: 0.5379 - recall_2: 0.3609 - auc_2: 0.7969 - PR AUC: 0.4671 - binary_accuracy: 0.8440 - val_loss: 0.3519 - val_precision_2: 0.5033 - val_recall_2: 0
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.3680 - precision_2: 0.5464 - recall_2: 0.3812 - auc_2: 0.8028 - PR AUC: 0.4711 - binary_accuracy: 0.8463
Epoch 6: val_loss did not improve from 0.35186
22/22 [==============================] - 57s 3s/step - loss: 0.3680 - precision_2: 0.5464 - recall_2: 0.3812 - auc_2: 0.8028 - PR AUC: 0.4711 - binary_accuracy: 0.8463 - val_loss: 0.3626 - val_precision_2: 0.4697 - val_recall_2: 0
Epoch 7/100
...
Test precision: 0.5384615659713745
Test recall: 0.4031413495540619
Test ROC AUC: 0.856112003326416
Test PR AUC: 0.5125010355283018
```

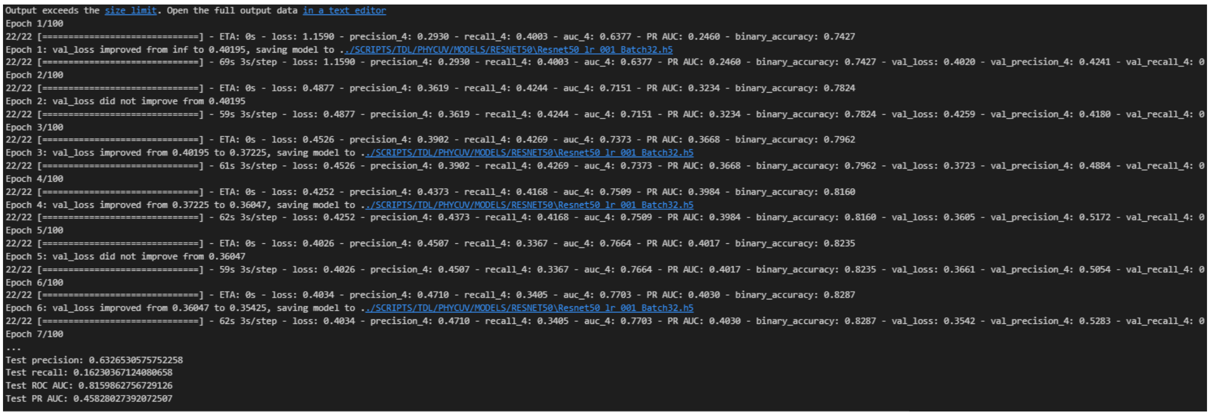
Model name:Resnet50_lr_0001_Batch32.h5

Test:



```
5/5 [==============================] - 8s 1s/step
Test accuracy: 0.43670886075949367
Test precision: 0.6739130434782609
Test recall: 0.49732620320855614
Test f1 score: 0.5723076923076923
Test hamming loss: 0.1256781193490054
ANOTHER METRICS
Test F1 score: 0.5723076923076923
Test precision: 0.6739130616188049
Test recall: 0.49732619524002075
Test ROC AUC: 0.9047063589096069
Test PR AUC: 0.5630085825595499
```

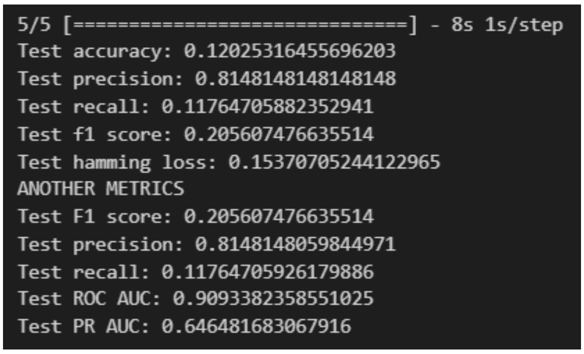
PRUEBA #5



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 1.1590 - precision_4: 0.2930 - recall_4: 0.4003 - auc_4: 0.6377 - PR AUC: 0.2460 - binary_accuracy: 0.7427
Epoch 1: val_loss improved from inf to 0.40195, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_001_Batch32.h5
22/22 [==============================] - 69s 3s/step - loss: 1.1590 - precision_4: 0.2930 - recall_4: 0.4003 - auc_4: 0.6377 - PR AUC: 0.2460 - binary_accuracy: 0.7427 - val_loss: 0.4020 - val_precision_4: 0.4241 - val_recall_4: 0
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.4877 - precision_4: 0.3619 - recall_4: 0.4244 - auc_4: 0.7151 - PR AUC: 0.3234 - binary_accuracy: 0.7824
Epoch 2: val_loss did not improve from 0.40195
22/22 [==============================] - 59s 3s/step - loss: 0.4877 - precision_4: 0.3619 - recall_4: 0.4244 - auc_4: 0.7151 - PR AUC: 0.3234 - binary_accuracy: 0.7824 - val_loss: 0.4259 - val_precision_4: 0.4180 - val_recall_4: 0
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.4526 - precision_4: 0.3902 - recall_4: 0.4269 - auc_4: 0.7373 - PR AUC: 0.3668 - binary_accuracy: 0.7962
Epoch 3: val_loss improved from 0.40195 to 0.37225, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_001_Batch32.h5
22/22 [==============================] - 61s 3s/step - loss: 0.4526 - precision_4: 0.3902 - recall_4: 0.4269 - auc_4: 0.7373 - PR AUC: 0.3668 - binary_accuracy: 0.7962 - val_loss: 0.3723 - val_precision_4: 0.4884 - val_recall_4: 0
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.4252 - precision_4: 0.4373 - recall_4: 0.4168 - auc_4: 0.7509 - PR AUC: 0.3984 - binary_accuracy: 0.8160
Epoch 4: val_loss improved from 0.37225 to 0.36047, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_001_Batch32.h5
22/22 [==============================] - 62s 3s/step - loss: 0.4252 - precision_4: 0.4373 - recall_4: 0.4168 - auc_4: 0.7509 - PR AUC: 0.3984 - binary_accuracy: 0.8160 - val_loss: 0.3605 - val_precision_4: 0.5172 - val_recall_4: 0
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.4026 - precision_4: 0.4507 - recall_4: 0.3367 - auc_4: 0.7664 - PR AUC: 0.4017 - binary_accuracy: 0.8235
Epoch 5: val_loss did not improve from 0.36047
22/22 [==============================] - 59s 3s/step - loss: 0.4026 - precision_4: 0.4507 - recall_4: 0.3367 - auc_4: 0.7664 - PR AUC: 0.4017 - binary_accuracy: 0.8235 - val_loss: 0.3661 - val_precision_4: 0.5054 - val_recall_4: 0
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.4034 - precision_4: 0.4710 - recall_4: 0.3405 - auc_4: 0.7703 - PR AUC: 0.4030 - binary_accuracy: 0.8287
Epoch 6: val_loss improved from 0.36047 to 0.35425, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_001_Batch32.h5
22/22 [==============================] - 62s 3s/step - loss: 0.4034 - precision_4: 0.4710 - recall_4: 0.3405 - auc_4: 0.7703 - PR AUC: 0.4030 - binary_accuracy: 0.8287 - val_loss: 0.3542 - val_precision_4: 0.5283 - val_recall_4: 0
Epoch 7/100
...
Test precision: 0.6326530575752258
Test recall: 0.16230367124080658
Test ROC AUC: 0.8159862756729126
Test PR AUC: 0.45828027392072507
```

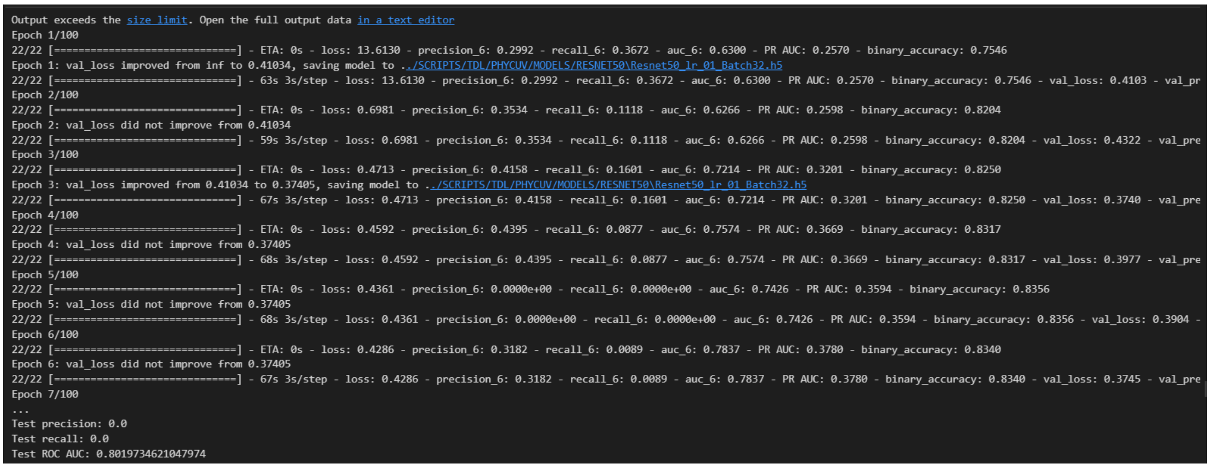
Model Name: Resnet50_lr_001_Batch32.h5

Test:



```
5/5 [==============================] - 8s 1s/step
Test accuracy: 0.12025316455696203
Test precision: 0.8148148148148148
Test recall: 0.11764705882352941
Test f1 score: 0.205607476635514
Test hamming loss: 0.15370705244122965
ANOTHER METRICS
Test F1 score: 0.205607476635514
Test precision: 0.8148148059844971
Test recall: 0.11764705926179886
Test ROC AUC: 0.9093382358551025
Test PR AUC: 0.646481683067916
```

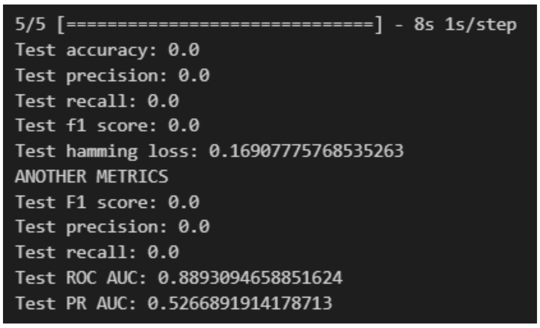
PRUEBA #6



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 13.6130 - precision_6: 0.2992 - recall_6: 0.3672 - auc_6: 0.6300 - PR AUC: 0.2570 - binary_accuracy: 0.7546
Epoch 1: val_loss improved from inf to 0.41034, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_01_Batch32.h5
22/22 [==============================] - 63s 3s/step - loss: 13.6130 - precision_6: 0.2992 - recall_6: 0.3672 - auc_6: 0.6300 - PR AUC: 0.2570 - binary_accuracy: 0.7546 - val_loss: 0.4103 - val_pr
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.6981 - precision_6: 0.3534 - recall_6: 0.1118 - auc_6: 0.6266 - PR AUC: 0.2598 - binary_accuracy: 0.8204
Epoch 2: val_loss did not improve from 0.41034
22/22 [==============================] - 59s 3s/step - loss: 0.6981 - precision_6: 0.3534 - recall_6: 0.1118 - auc_6: 0.6266 - PR AUC: 0.2598 - binary_accuracy: 0.8204 - val_loss: 0.4322 - val_pre
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.4713 - precision_6: 0.4158 - recall_6: 0.1601 - auc_6: 0.7214 - PR AUC: 0.3201 - binary_accuracy: 0.8250
Epoch 3: val_loss improved from 0.41034 to 0.37405, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/RESNET50\Resnet50_lr_01_Batch32.h5
22/22 [==============================] - 67s 3s/step - loss: 0.4713 - precision_6: 0.4158 - recall_6: 0.1601 - auc_6: 0.7214 - PR AUC: 0.3201 - binary_accuracy: 0.8250 - val_loss: 0.3740 - val_pre
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.4592 - precision_6: 0.4395 - recall_6: 0.0877 - auc_6: 0.7574 - PR AUC: 0.3669 - binary_accuracy: 0.8317
Epoch 4: val_loss did not improve from 0.37405
22/22 [==============================] - 68s 3s/step - loss: 0.4592 - precision_6: 0.4395 - recall_6: 0.0877 - auc_6: 0.7574 - PR AUC: 0.3669 - binary_accuracy: 0.8317 - val_loss: 0.3977 - val_pre
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.4361 - precision_6: 0.0000e+00 - recall_6: 0.0000e+00 - auc_6: 0.7426 - PR AUC: 0.3594 - binary_accuracy: 0.8356
Epoch 5: val_loss did not improve from 0.37405
22/22 [==============================] - 68s 3s/step - loss: 0.4361 - precision_6: 0.0000e+00 - recall_6: 0.0000e+00 - auc_6: 0.7426 - PR AUC: 0.3594 - binary_accuracy: 0.8356 - val_loss: 0.3904 -
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.4286 - precision_6: 0.3182 - recall_6: 0.0089 - auc_6: 0.7837 - PR AUC: 0.3780 - binary_accuracy: 0.8340
Epoch 6: val_loss did not improve from 0.37405
22/22 [==============================] - 67s 3s/step - loss: 0.4286 - precision_6: 0.3182 - recall_6: 0.0089 - auc_6: 0.7837 - PR AUC: 0.3780 - binary_accuracy: 0.8340 - val_loss: 0.3745 - val_pre
Epoch 7/100
...
Test precision: 0.0
Test recall: 0.0
Test ROC AUC: 0.8019734621047974
```

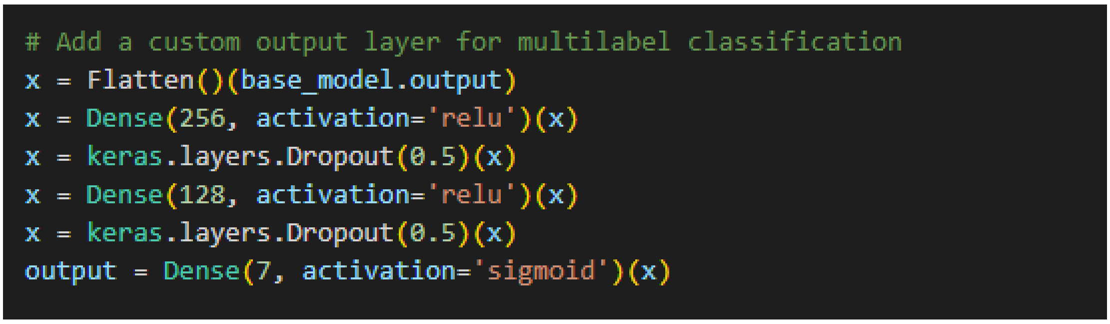
model name:Resnet50_lr_01_Batch32.h5

Test:



```
5/5 [==============================] - 8s 1s/step
Test accuracy: 0.0
Test precision: 0.0
Test recall: 0.0
Test f1 score: 0.0
Test hamming loss: 0.16907775768535263
ANOTHER METRICS
Test F1 score: 0.0
Test precision: 0.0
Test recall: 0.0
Test ROC AUC: 0.8893094658851624
Test PR AUC: 0.5266891914178713
```

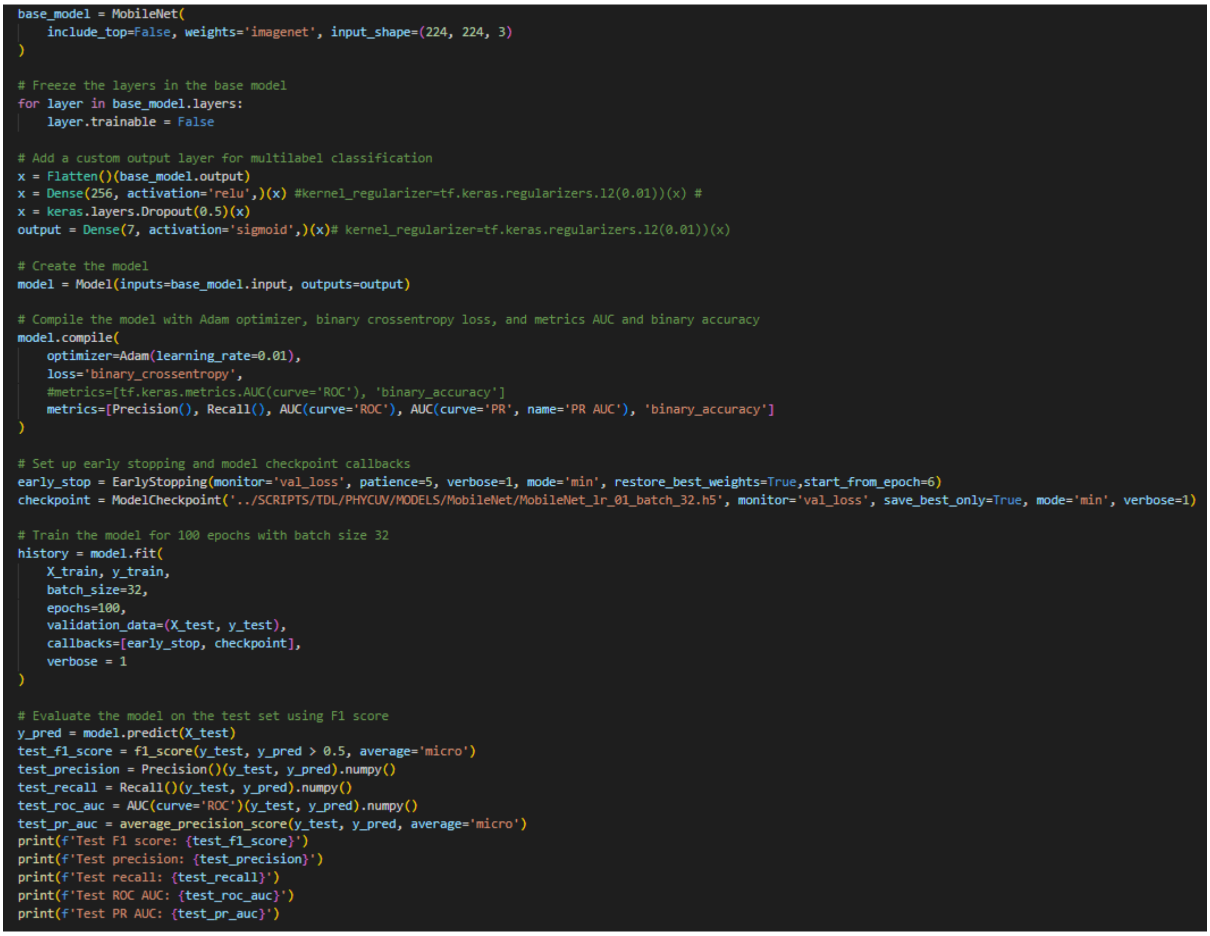
PRUEBAs con layer 256 and 128



```
# Add a custom output layer for multilabel classification
x = Flatten()(base_model.output)
x = Dense(256, activation='relu')(x)
x = keras.layers.Dropout(0.5)(x)
x = Dense(128, activation='relu')(x)
x = keras.layers.Dropout(0.5)(x)
output = Dense(7, activation='sigmoid')(x)
```

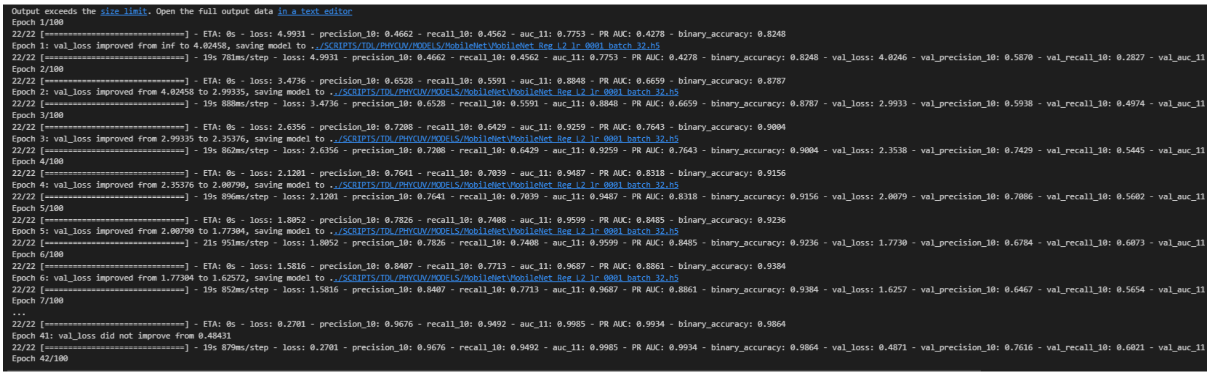
MOBILENET:

code:



```python
base_model = MobileNet(
    include_top=False, weights='imagenet', input_shape=(224, 224, 3)
)

# Freeze the layers in the base model
for layer in base_model.layers:
    layer.trainable = False

# Add a custom output layer for multilabel classification
x = Flatten()(base_model.output)
x = Dense(256, activation='relu',)(x) #kernel_regularizer=tf.keras.regularizers.l2(0.01))(x) #
x = keras.layers.Dropout(0.5)(x)
output = Dense(7, activation='sigmoid',)(x)# kernel_regularizer=tf.keras.regularizers.l2(0.01))(x)

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

# Compile the model with Adam optimizer, binary crossentropy loss, and metrics AUC and binary accuracy
model.compile(
    optimizer=Adam(learning_rate=0.01),
    loss='binary_crossentropy',
    #metrics=[tf.keras.metrics.AUC(curve='ROC'), 'binary_accuracy']
    metrics=[Precision(), Recall(), AUC(curve='ROC'), AUC(curve='PR', name='PR AUC'), 'binary_accuracy']
)

# Set up early stopping and model checkpoint callbacks
early_stop = EarlyStopping(monitor='val_loss', patience=5, verbose=1, mode='min', restore_best_weights=True,start_from_epoch=6)
checkpoint = ModelCheckpoint('../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet/MobileNet_lr_01_batch_32.h5', monitor='val_loss', save_best_only=True, mode='min', verbose=1)

# Train the model for 100 epochs with batch size 32
history = model.fit(
    X_train, y_train,
    batch_size=32,
    epochs=100,
    validation_data=(X_test, y_test),
    callbacks=[early_stop, checkpoint],
    verbose = 1
)

# Evaluate the model on the test set using F1 score
y_pred = model.predict(X_test)
test_f1_score = f1_score(y_test, y_pred > 0.5, average='micro')
test_precision = Precision()(y_test, y_pred).numpy()
test_recall = Recall()(y_test, y_pred).numpy()
test_roc_auc = AUC(curve='ROC')(y_test, y_pred).numpy()
test_pr_auc = average_precision_score(y_test, y_pred, average='micro')
print(f'Test F1 score: {test_f1_score}')
print(f'Test precision: {test_precision}')
print(f'Test recall: {test_recall}')
print(f'Test ROC AUC: {test_roc_auc}')
print(f'Test PR AUC: {test_pr_auc}')
```

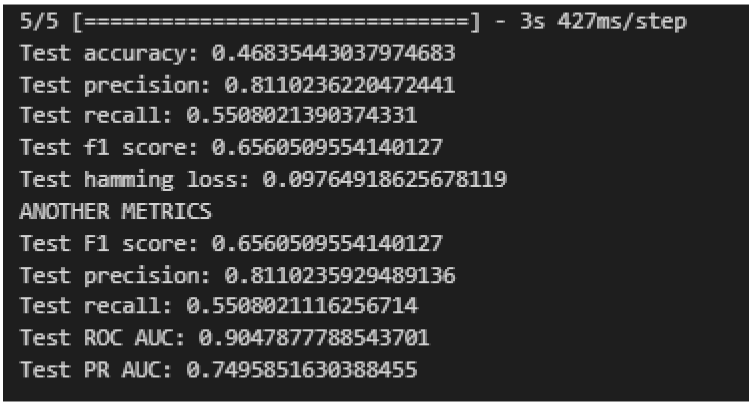
PRUEBA#1:



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 4.9931 - precision_10: 0.4662 - recall_10: 0.4562 - auc_11: 0.7753 - PR AUC: 0.4278 - binary_accuracy: 0.8248
Epoch 1: val_loss improved from inf to 4.02458, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_0001_batch_32.h5
22/22 [==============================] - 19s 781ms/step - loss: 4.9931 - precision_10: 0.4662 - recall_10: 0.4562 - auc_11: 0.7753 - PR AUC: 0.4278 - binary_accuracy: 0.8248 - val_loss: 4.0246 - val_precision_10: 0.5870 - val_recall_10: 0.2827 - val_auc_11
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 3.4736 - precision_10: 0.6528 - recall_10: 0.5591 - auc_11: 0.8848 - PR AUC: 0.6659 - binary_accuracy: 0.8787
Epoch 2: val_loss improved from 4.02458 to 2.99335, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_0001_batch_32.h5
22/22 [==============================] - 19s 888ms/step - loss: 3.4736 - precision_10: 0.6528 - recall_10: 0.5591 - auc_11: 0.8848 - PR AUC: 0.6659 - binary_accuracy: 0.8787 - val_loss: 2.9933 - val_precision_10: 0.5938 - val_recall_10: 0.4974 - val_auc_11
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 2.6356 - precision_10: 0.7208 - recall_10: 0.6429 - auc_11: 0.9259 - PR AUC: 0.7643 - binary_accuracy: 0.9004
Epoch 3: val_loss improved from 2.99335 to 2.35376, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_0001_batch_32.h5
22/22 [==============================] - 19s 862ms/step - loss: 2.6356 - precision_10: 0.7208 - recall_10: 0.6429 - auc_11: 0.9259 - PR AUC: 0.7643 - binary_accuracy: 0.9004 - val_loss: 2.3538 - val_precision_10: 0.7429 - val_recall_10: 0.5445 - val_auc_11
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 2.1201 - precision_10: 0.7641 - recall_10: 0.7039 - auc_11: 0.9487 - PR AUC: 0.8318 - binary_accuracy: 0.9156
Epoch 4: val_loss improved from 2.35376 to 2.00790, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_0001_batch_32.h5
22/22 [==============================] - 19s 896ms/step - loss: 2.1201 - precision_10: 0.7641 - recall_10: 0.7039 - auc_11: 0.9487 - PR AUC: 0.8318 - binary_accuracy: 0.9156 - val_loss: 2.0079 - val_precision_10: 0.7086 - val_recall_10: 0.5602 - val_auc_11
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 1.8052 - precision_10: 0.7826 - recall_10: 0.7408 - auc_11: 0.9599 - PR AUC: 0.8485 - binary_accuracy: 0.9236
Epoch 5: val_loss improved from 2.00790 to 1.77304, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_0001_batch_32.h5
22/22 [==============================] - 21s 951ms/step - loss: 1.8052 - precision_10: 0.7826 - recall_10: 0.7408 - auc_11: 0.9599 - PR AUC: 0.8485 - binary_accuracy: 0.9236 - val_loss: 1.7730 - val_precision_10: 0.6784 - val_recall_10: 0.6073 - val_auc_11
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 1.5816 - precision_10: 0.8407 - recall_10: 0.7713 - auc_11: 0.9687 - PR AUC: 0.8861 - binary_accuracy: 0.9384
Epoch 6: val_loss improved from 1.77304 to 1.62572, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_0001_batch_32.h5
22/22 [==============================] - 19s 852ms/step - loss: 1.5816 - precision_10: 0.8407 - recall_10: 0.7713 - auc_11: 0.9687 - PR AUC: 0.8861 - binary_accuracy: 0.9384 - val_loss: 1.6257 - val_precision_10: 0.6467 - val_recall_10: 0.5654 - val_auc_11
Epoch 7/100
...
22/22 [==============================] - ETA: 0s - loss: 0.2701 - precision_10: 0.9676 - recall_10: 0.9492 - auc_11: 0.9985 - PR AUC: 0.9934 - binary_accuracy: 0.9864
Epoch 41: val_loss did not improve from 0.48431
22/22 [==============================] - 19s 879ms/step - loss: 0.2701 - precision_10: 0.9676 - recall_10: 0.9492 - auc_11: 0.9985 - PR AUC: 0.9934 - binary_accuracy: 0.9864 - val_loss: 0.4871 - val_precision_10: 0.7616 - val_recall_10: 0.6021 - val_auc_11
Epoch 42/100
```

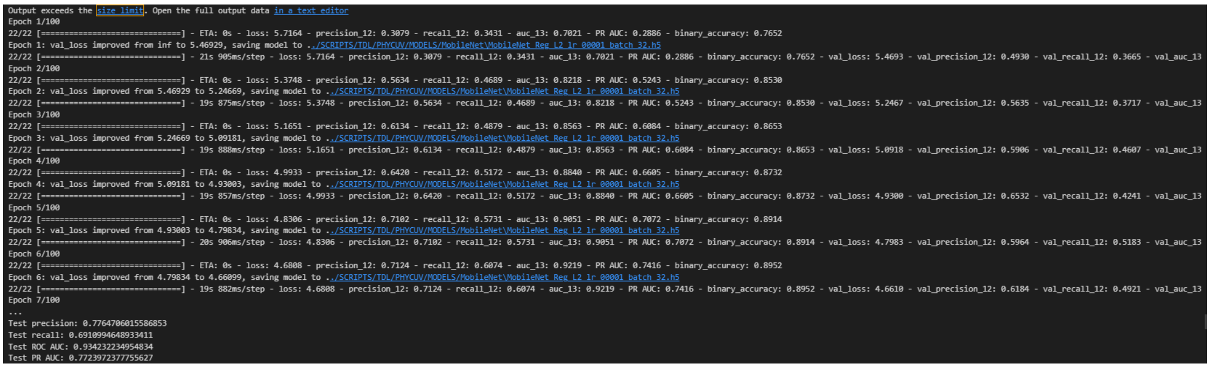
model name:MobileNet_Reg_L2_lr_0001_batch_32.h5

Test



```
5/5 [==============================] - 3s 427ms/step
Test accuracy: 0.46835443037974683
Test precision: 0.8110236220472441
Test recall: 0.5508021390374331
Test f1 score: 0.6560509554140127
Test hamming loss: 0.09764918625678119
ANOTHER METRICS
Test F1 score: 0.6560509554140127
Test precision: 0.8110235929489136
Test recall: 0.5508021116256714
Test ROC AUC: 0.9047877788543701
Test PR AUC: 0.7495851630388455
```

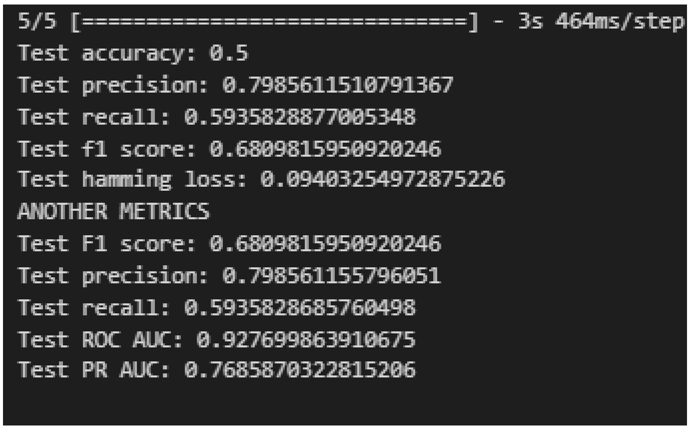
PRUEBA#2



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 5.7164 - precision_12: 0.3079 - recall_12: 0.3431 - auc_13: 0.7021 - PR AUC: 0.2886 - binary_accuracy: 0.7652
Epoch 1: val_loss improved from inf to 5.46929, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_00001_batch_32.h5
22/22 [==============================] - 21s 905ms/step - loss: 5.7164 - precision_12: 0.3079 - recall_12: 0.3431 - auc_13: 0.7021 - PR AUC: 0.2886 - binary_accuracy: 0.7652 - val_loss: 5.4693 - val_precision_12: 0.4930 - val_recall_12: 0.3665 - val_auc_13
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 5.3748 - precision_12: 0.5634 - recall_12: 0.4689 - auc_13: 0.8218 - PR AUC: 0.5243 - binary_accuracy: 0.8530
Epoch 2: val_loss improved from 5.46929 to 5.24669, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_00001_batch_32.h5
22/22 [==============================] - 19s 875ms/step - loss: 5.3748 - precision_12: 0.5634 - recall_12: 0.4689 - auc_13: 0.8218 - PR AUC: 0.5243 - binary_accuracy: 0.8530 - val_loss: 5.2467 - val_precision_12: 0.5635 - val_recall_12: 0.3717 - val_auc_13
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 5.1651 - precision_12: 0.6134 - recall_12: 0.4879 - auc_13: 0.8563 - PR AUC: 0.6084 - binary_accuracy: 0.8653
Epoch 3: val_loss improved from 5.24669 to 5.09181, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_00001_batch_32.h5
22/22 [==============================] - 19s 888ms/step - loss: 5.1651 - precision_12: 0.6134 - recall_12: 0.4879 - auc_13: 0.8563 - PR AUC: 0.6084 - binary_accuracy: 0.8653 - val_loss: 5.0918 - val_precision_12: 0.5906 - val_recall_12: 0.4607 - val_auc_13
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 4.9933 - precision_12: 0.6420 - recall_12: 0.5172 - auc_13: 0.8840 - PR AUC: 0.6605 - binary_accuracy: 0.8732
Epoch 4: val_loss improved from 5.09181 to 4.93003, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_00001_batch_32.h5
22/22 [==============================] - 19s 857ms/step - loss: 4.9933 - precision_12: 0.6420 - recall_12: 0.5172 - auc_13: 0.8840 - PR AUC: 0.6605 - binary_accuracy: 0.8732 - val_loss: 4.9300 - val_precision_12: 0.6532 - val_recall_12: 0.4241 - val_auc_13
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 4.8306 - precision_12: 0.7102 - recall_12: 0.5731 - auc_13: 0.9051 - PR AUC: 0.7072 - binary_accuracy: 0.8914
Epoch 5: val_loss improved from 4.93003 to 4.79834, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_00001_batch_32.h5
22/22 [==============================] - 20s 906ms/step - loss: 4.8306 - precision_12: 0.7102 - recall_12: 0.5731 - auc_13: 0.9051 - PR AUC: 0.7072 - binary_accuracy: 0.8914 - val_loss: 4.7983 - val_precision_12: 0.5964 - val_recall_12: 0.5183 - val_auc_13
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 4.6808 - precision_12: 0.7124 - recall_12: 0.6074 - auc_13: 0.9219 - PR AUC: 0.7416 - binary_accuracy: 0.8952
Epoch 6: val_loss improved from 4.79834 to 4.66099, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_Reg_L2_lr_00001_batch_32.h5
22/22 [==============================] - 19s 882ms/step - loss: 4.6808 - precision_12: 0.7124 - recall_12: 0.6074 - auc_13: 0.9219 - PR AUC: 0.7416 - binary_accuracy: 0.8952 - val_loss: 4.6610 - val_precision_12: 0.6184 - val_recall_12: 0.4921 - val_auc_13
Epoch 7/100
...
Test precision: 0.7764706015586853
Test recall: 0.6910994648933411
Test ROC AUC: 0.934232234954834
Test PR AUC: 0.7723972377755627
```

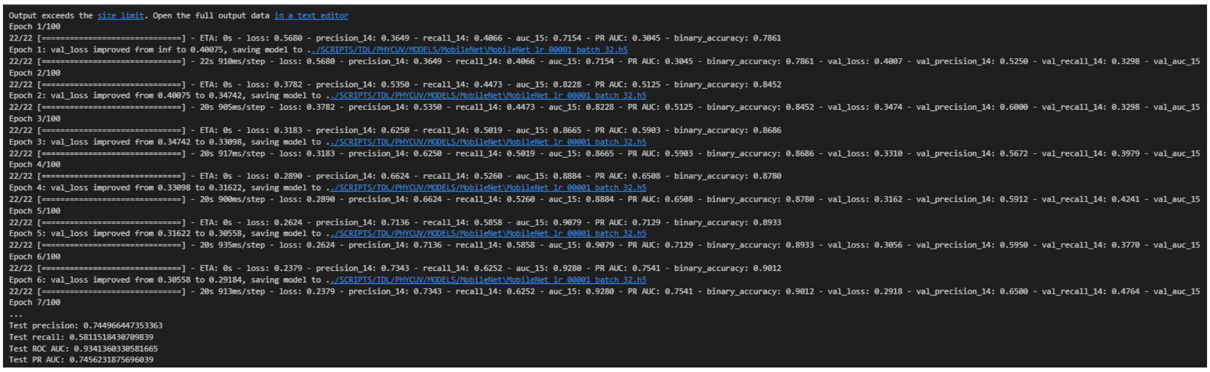
model name:MobileNet_Reg_L2_lr_00001_batch_32.h5

Test



```
5/5 [==============================] - 3s 464ms/step
Test accuracy: 0.5
Test precision: 0.7985611510791367
Test recall: 0.5935828877005348
Test f1 score: 0.6809815950920246
Test hamming loss: 0.09403254972875226
ANOTHER METRICS
Test F1 score: 0.6809815950920246
Test precision: 0.798561155796051
Test recall: 0.5935828685760498
Test ROC AUC: 0.927699863910675
Test PR AUC: 0.7685870322815206
```

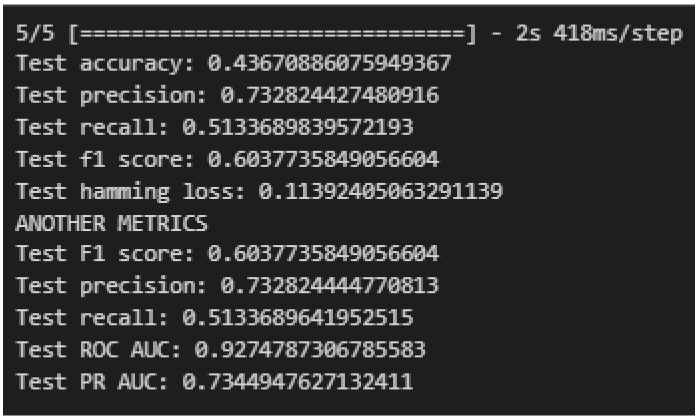
PRUEBA #3



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.5680 - precision_14: 0.3649 - recall_14: 0.4066 - auc_15: 0.7154 - PR AUC: 0.3045 - binary_accuracy: 0.7861
Epoch 1: val_loss improved from inf to 0.40075, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_00001_batch_32.h5
22/22 [==============================] - 22s 910ms/step - loss: 0.5680 - precision_14: 0.3649 - recall_14: 0.4066 - auc_15: 0.7154 - PR AUC: 0.3045 - binary_accuracy: 0.7861 - val_loss: 0.4007 - val_precision_14: 0.5250 - val_recall_14: 0.3298 - val_auc_15
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.3782 - precision_14: 0.5350 - recall_14: 0.4473 - auc_15: 0.8228 - PR AUC: 0.5125 - binary_accuracy: 0.8452
Epoch 2: val_loss improved from 0.40075 to 0.34742, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_00001_batch_32.h5
22/22 [==============================] - 20s 905ms/step - loss: 0.3782 - precision_14: 0.5350 - recall_14: 0.4473 - auc_15: 0.8228 - PR AUC: 0.5125 - binary_accuracy: 0.8452 - val_loss: 0.3474 - val_precision_14: 0.6000 - val_recall_14: 0.3298 - val_auc_15
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3183 - precision_14: 0.6250 - recall_14: 0.5019 - auc_15: 0.8665 - PR AUC: 0.5903 - binary_accuracy: 0.8686
Epoch 3: val_loss improved from 0.34742 to 0.33098, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_00001_batch_32.h5
22/22 [==============================] - 20s 917ms/step - loss: 0.3183 - precision_14: 0.6250 - recall_14: 0.5019 - auc_15: 0.8665 - PR AUC: 0.5903 - binary_accuracy: 0.8686 - val_loss: 0.3310 - val_precision_14: 0.5672 - val_recall_14: 0.3979 - val_auc_15
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.2890 - precision_14: 0.6624 - recall_14: 0.5260 - auc_15: 0.8884 - PR AUC: 0.6508 - binary_accuracy: 0.8780
Epoch 4: val_loss improved from 0.33098 to 0.31622, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_00001_batch_32.h5
22/22 [==============================] - 20s 900ms/step - loss: 0.2890 - precision_14: 0.6624 - recall_14: 0.5260 - auc_15: 0.8884 - PR AUC: 0.6508 - binary_accuracy: 0.8780 - val_loss: 0.3162 - val_precision_14: 0.5912 - val_recall_14: 0.4241 - val_auc_15
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.2624 - precision_14: 0.7136 - recall_14: 0.5858 - auc_15: 0.9079 - PR AUC: 0.7129 - binary_accuracy: 0.8933
Epoch 5: val_loss improved from 0.31622 to 0.30558, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_00001_batch_32.h5
22/22 [==============================] - 20s 935ms/step - loss: 0.2624 - precision_14: 0.7136 - recall_14: 0.5858 - auc_15: 0.9079 - PR AUC: 0.7129 - binary_accuracy: 0.8933 - val_loss: 0.3056 - val_precision_14: 0.5950 - val_recall_14: 0.3770 - val_auc_15
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.2379 - precision_14: 0.7343 - recall_14: 0.6252 - auc_15: 0.9280 - PR AUC: 0.7541 - binary_accuracy: 0.9012
Epoch 6: val_loss improved from 0.30558 to 0.29184, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_00001_batch_32.h5
22/22 [==============================] - 20s 913ms/step - loss: 0.2379 - precision_14: 0.7343 - recall_14: 0.6252 - auc_15: 0.9280 - PR AUC: 0.7541 - binary_accuracy: 0.9012 - val_loss: 0.2918 - val_precision_14: 0.6500 - val_recall_14: 0.4764 - val_auc_15
Epoch 7/100
...
Test precision: 0.744966447353363
Test recall: 0.5811518430709839
Test ROC AUC: 0.9341360330581665
Test PR AUC: 0.7456231875696039
```

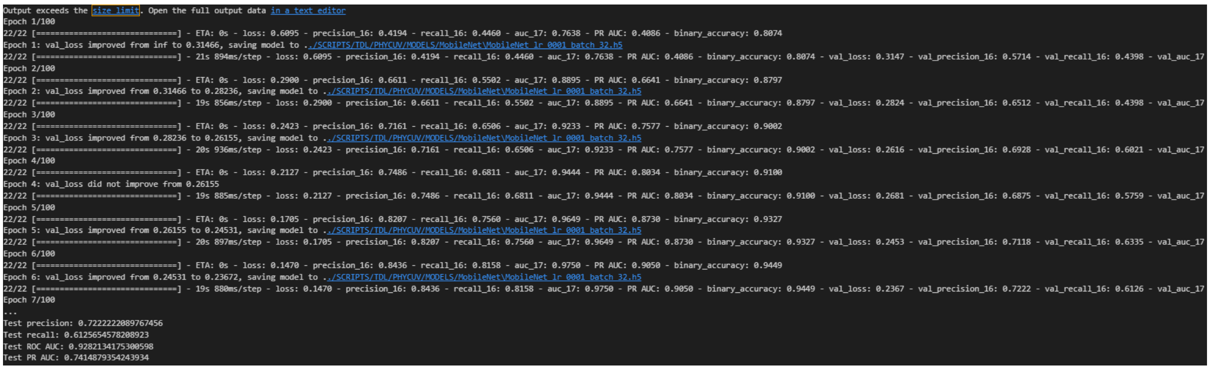
Model name:MobileNet_lr_00001_batch_32.h5

Test



```
5/5 [==============================] - 2s 418ms/step
Test accuracy: 0.43670886075949367
Test precision: 0.732824427480916
Test recall: 0.5133689839572193
Test f1 score: 0.6037735849056604
Test hamming loss: 0.11392405063291139
ANOTHER METRICS
Test F1 score: 0.6037735849056604
Test precision: 0.732824444770813
Test recall: 0.5133689641952515
Test ROC AUC: 0.9274787306785583
Test PR AUC: 0.7344947627132411
```

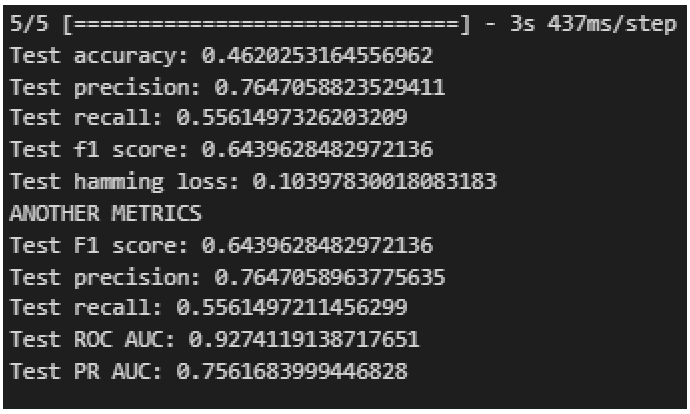
PRUEBA#4



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 0.6095 - precision_16: 0.4194 - recall_16: 0.4460 - auc_17: 0.7638 - PR AUC: 0.4086 - binary_accuracy: 0.8074
Epoch 1: val_loss improved from inf to 0.31466, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_0001_batch_32.h5
22/22 [==============================] - 21s 894ms/step - loss: 0.6095 - precision_16: 0.4194 - recall_16: 0.4460 - auc_17: 0.7638 - PR AUC: 0.4086 - binary_accuracy: 0.8074 - val_loss: 0.3147 - val_precision_16: 0.5714 - val_recall_16: 0.4398 - val_auc_17
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.2900 - precision_16: 0.6611 - recall_16: 0.5502 - auc_17: 0.8895 - PR AUC: 0.6641 - binary_accuracy: 0.8797
Epoch 2: val_loss improved from 0.31466 to 0.28236, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_0001_batch_32.h5
22/22 [==============================] - 19s 856ms/step - loss: 0.2900 - precision_16: 0.6611 - recall_16: 0.5502 - auc_17: 0.8895 - PR AUC: 0.6641 - binary_accuracy: 0.8797 - val_loss: 0.2824 - val_precision_16: 0.6512 - val_recall_16: 0.4398 - val_auc_17
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.2423 - precision_16: 0.7161 - recall_16: 0.6506 - auc_17: 0.9233 - PR AUC: 0.7577 - binary_accuracy: 0.9002
Epoch 3: val_loss improved from 0.28236 to 0.26155, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_0001_batch_32.h5
22/22 [==============================] - 20s 936ms/step - loss: 0.2423 - precision_16: 0.7161 - recall_16: 0.6506 - auc_17: 0.9233 - PR AUC: 0.7577 - binary_accuracy: 0.9002 - val_loss: 0.2616 - val_precision_16: 0.6928 - val_recall_16: 0.6021 - val_auc_17
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.2127 - precision_16: 0.7486 - recall_16: 0.6811 - auc_17: 0.9444 - PR AUC: 0.8034 - binary_accuracy: 0.9100
Epoch 4: val_loss did not improve from 0.26155
22/22 [==============================] - 19s 885ms/step - loss: 0.2127 - precision_16: 0.7486 - recall_16: 0.6811 - auc_17: 0.9444 - PR AUC: 0.8034 - binary_accuracy: 0.9100 - val_loss: 0.2681 - val_precision_16: 0.6875 - val_recall_16: 0.5759 - val_auc_17
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.1705 - precision_16: 0.8207 - recall_16: 0.7560 - auc_17: 0.9649 - PR AUC: 0.8730 - binary_accuracy: 0.9327
Epoch 5: val_loss improved from 0.26155 to 0.24531, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_0001_batch_32.h5
22/22 [==============================] - 20s 897ms/step - loss: 0.1705 - precision_16: 0.8207 - recall_16: 0.7560 - auc_17: 0.9649 - PR AUC: 0.8730 - binary_accuracy: 0.9327 - val_loss: 0.2453 - val_precision_16: 0.7118 - val_recall_16: 0.6335 - val_auc_17
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.1470 - precision_16: 0.8436 - recall_16: 0.8158 - auc_17: 0.9750 - PR AUC: 0.9050 - binary_accuracy: 0.9449
Epoch 6: val_loss improved from 0.24531 to 0.23672, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_0001_batch_32.h5
22/22 [==============================] - 19s 880ms/step - loss: 0.1470 - precision_16: 0.8436 - recall_16: 0.8158 - auc_17: 0.9750 - PR AUC: 0.9050 - binary_accuracy: 0.9449 - val_loss: 0.2367 - val_precision_16: 0.7222 - val_recall_16: 0.6126 - val_auc_17
Epoch 7/100
...
Test precision: 0.7222222089767456
Test recall: 0.6125654578208923
Test ROC AUC: 0.9282134175300598
Test PR AUC: 0.7414879354243934
```

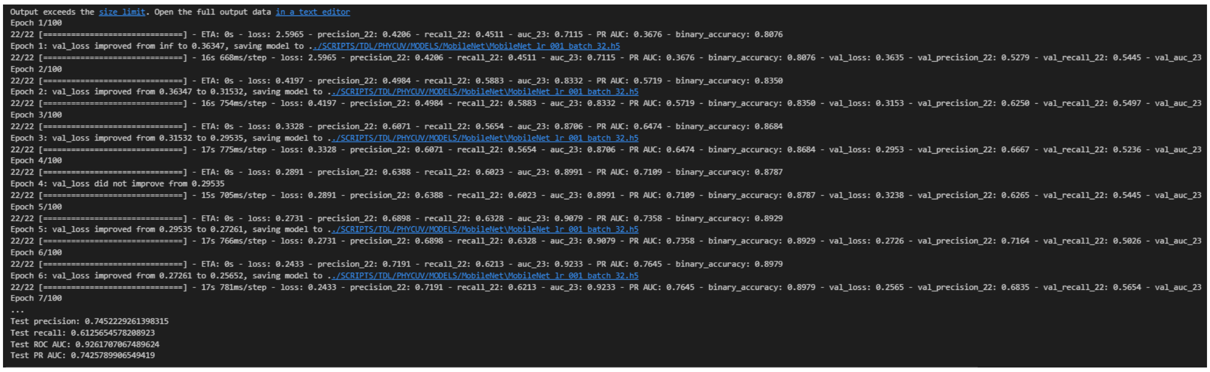
model name:MobileNet_lr_0001_batch_32.h5

test



```
5/5 [==============================] - 3s 437ms/step
Test accuracy: 0.4620253164556962
Test precision: 0.7647058823529411
Test recall: 0.5561497326203209
Test f1 score: 0.6439628482972136
Test hamming loss: 0.10397830018083183
ANOTHER METRICS
Test F1 score: 0.6439628482972136
Test precision: 0.7647058963775635
Test recall: 0.5561497211456299
Test ROC AUC: 0.9274119138717651
Test PR AUC: 0.7561683999446828
```

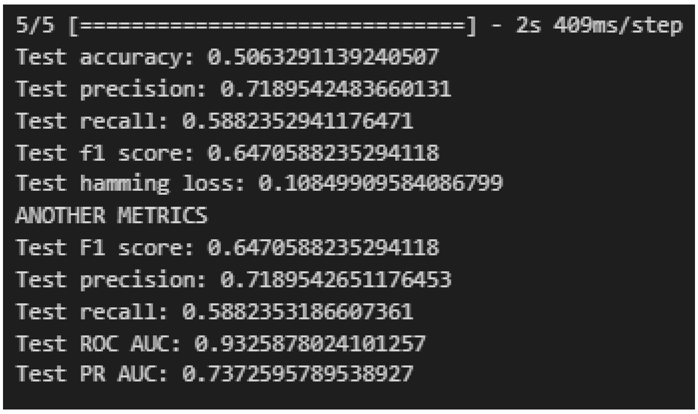
PRUEBA#5



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 2.5965 - precision_22: 0.4206 - recall_22: 0.4511 - auc_23: 0.7115 - PR AUC: 0.3676 - binary_accuracy: 0.8076
Epoch 1: val_loss improved from inf to 0.36347, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_001_batch_32.h5
22/22 [==============================] - 16s 668ms/step - loss: 2.5965 - precision_22: 0.4206 - recall_22: 0.4511 - auc_23: 0.7115 - PR AUC: 0.3676 - binary_accuracy: 0.8076 - val_loss: 0.3635 - val_precision_22: 0.5279 - val_recall_22: 0.5445 - val_auc_23
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 0.4197 - precision_22: 0.4984 - recall_22: 0.5883 - auc_23: 0.8332 - PR AUC: 0.5719 - binary_accuracy: 0.8350
Epoch 2: val_loss improved from 0.36347 to 0.31532, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_001_batch_32.h5
22/22 [==============================] - 16s 754ms/step - loss: 0.4197 - precision_22: 0.4984 - recall_22: 0.5883 - auc_23: 0.8332 - PR AUC: 0.5719 - binary_accuracy: 0.8350 - val_loss: 0.3153 - val_precision_22: 0.6250 - val_recall_22: 0.5497 - val_auc_23
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.3328 - precision_22: 0.6071 - recall_22: 0.5654 - auc_23: 0.8706 - PR AUC: 0.6474 - binary_accuracy: 0.8684
Epoch 3: val_loss improved from 0.31532 to 0.29535, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_001_batch_32.h5
22/22 [==============================] - 17s 775ms/step - loss: 0.3328 - precision_22: 0.6071 - recall_22: 0.5654 - auc_23: 0.8706 - PR AUC: 0.6474 - binary_accuracy: 0.8684 - val_loss: 0.2953 - val_precision_22: 0.6667 - val_recall_22: 0.5236 - val_auc_23
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.2891 - precision_22: 0.6388 - recall_22: 0.6023 - auc_23: 0.8991 - PR AUC: 0.7109 - binary_accuracy: 0.8787
Epoch 4: val_loss did not improve from 0.29535
22/22 [==============================] - 15s 705ms/step - loss: 0.2891 - precision_22: 0.6388 - recall_22: 0.6023 - auc_23: 0.8991 - PR AUC: 0.7109 - binary_accuracy: 0.8787 - val_loss: 0.3238 - val_precision_22: 0.6265 - val_recall_22: 0.5445 - val_auc_23
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.2731 - precision_22: 0.6898 - recall_22: 0.6328 - auc_23: 0.9079 - PR AUC: 0.7358 - binary_accuracy: 0.8929
Epoch 5: val_loss improved from 0.29535 to 0.27261, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_001_batch_32.h5
22/22 [==============================] - 17s 766ms/step - loss: 0.2731 - precision_22: 0.6898 - recall_22: 0.6328 - auc_23: 0.9079 - PR AUC: 0.7358 - binary_accuracy: 0.8929 - val_loss: 0.2726 - val_precision_22: 0.7164 - val_recall_22: 0.5026 - val_auc_23
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.2433 - precision_22: 0.7191 - recall_22: 0.6213 - auc_23: 0.9233 - PR AUC: 0.7645 - binary_accuracy: 0.8979
Epoch 6: val_loss improved from 0.27261 to 0.25652, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_001_batch_32.h5
22/22 [==============================] - 17s 781ms/step - loss: 0.2433 - precision_22: 0.7191 - recall_22: 0.6213 - auc_23: 0.9233 - PR AUC: 0.7645 - binary_accuracy: 0.8979 - val_loss: 0.2565 - val_precision_22: 0.6835 - val_recall_22: 0.5654 - val_auc_23
Epoch 7/100
...
Test precision: 0.7452229261398315
Test recall: 0.6125654578208923
Test ROC AUC: 0.9261707067489624
Test PR AUC: 0.7425789906549419
```

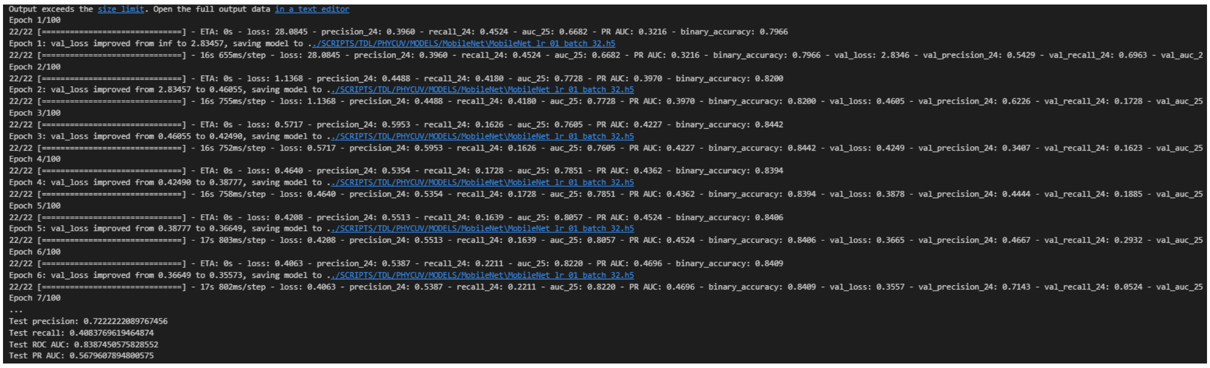
model name: [MobileNet_lr_001_batch_32.h5]

Test



```
5/5 [==============================] - 2s 409ms/step
Test accuracy: 0.5063291139240507
Test precision: 0.7189542483660131
Test recall: 0.5882352941176471
Test f1 score: 0.6470588235294118
Test hamming loss: 0.10849909584086799
ANOTHER METRICS
Test F1 score: 0.6470588235294118
Test precision: 0.7189542651176453
Test recall: 0.5882353186607361
Test ROC AUC: 0.9325878024101257
Test PR AUC: 0.7372595789538927
```

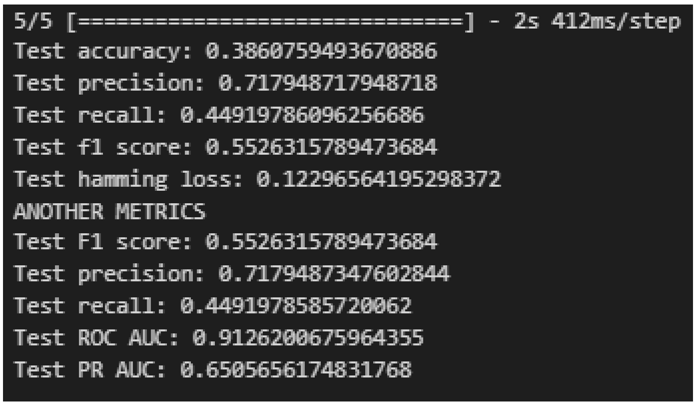
PRUEBA#6



```
Output exceeds the size limit. Open the full output data in a text editor
Epoch 1/100
22/22 [==============================] - ETA: 0s - loss: 28.0845 - precision_24: 0.3960 - recall_24: 0.4524 - auc_25: 0.6682 - PR AUC: 0.3216 - binary_accuracy: 0.7966
Epoch 1: val_loss improved from inf to 2.83457, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_01_batch_32.h5
22/22 [==============================] - 16s 655ms/step - loss: 28.0845 - precision_24: 0.3960 - recall_24: 0.4524 - auc_25: 0.6682 - PR AUC: 0.3216 - binary_accuracy: 0.7966 - val_loss: 2.8346 - val_precision_24: 0.5429 - val_recall_24: 0.6963 - val_auc_2
Epoch 2/100
22/22 [==============================] - ETA: 0s - loss: 1.1368 - precision_24: 0.4488 - recall_24: 0.4180 - auc_25: 0.7728 - PR AUC: 0.3970 - binary_accuracy: 0.8200
Epoch 2: val_loss improved from 2.83457 to 0.46055, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_01_batch_32.h5
22/22 [==============================] - 16s 755ms/step - loss: 1.1368 - precision_24: 0.4488 - recall_24: 0.4180 - auc_25: 0.7728 - PR AUC: 0.3970 - binary_accuracy: 0.8200 - val_loss: 0.4605 - val_precision_24: 0.6226 - val_recall_24: 0.1728 - val_auc_25
Epoch 3/100
22/22 [==============================] - ETA: 0s - loss: 0.5717 - precision_24: 0.5953 - recall_24: 0.1626 - auc_25: 0.7605 - PR AUC: 0.4227 - binary_accuracy: 0.8442
Epoch 3: val_loss improved from 0.46055 to 0.42490, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_01_batch_32.h5
22/22 [==============================] - 16s 752ms/step - loss: 0.5717 - precision_24: 0.5953 - recall_24: 0.1626 - auc_25: 0.7605 - PR AUC: 0.4227 - binary_accuracy: 0.8442 - val_loss: 0.4249 - val_precision_24: 0.3407 - val_recall_24: 0.1623 - val_auc_25
Epoch 4/100
22/22 [==============================] - ETA: 0s - loss: 0.4640 - precision_24: 0.5354 - recall_24: 0.1728 - auc_25: 0.7851 - PR AUC: 0.4362 - binary_accuracy: 0.8394
Epoch 4: val_loss improved from 0.42490 to 0.38777, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_01_batch_32.h5
22/22 [==============================] - 16s 758ms/step - loss: 0.4640 - precision_24: 0.5354 - recall_24: 0.1728 - auc_25: 0.7851 - PR AUC: 0.4362 - binary_accuracy: 0.8394 - val_loss: 0.3878 - val_precision_24: 0.4444 - val_recall_24: 0.1885 - val_auc_25
Epoch 5/100
22/22 [==============================] - ETA: 0s - loss: 0.4208 - precision_24: 0.5513 - recall_24: 0.1639 - auc_25: 0.8057 - PR AUC: 0.4524 - binary_accuracy: 0.8406
Epoch 5: val_loss improved from 0.38777 to 0.36649, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_01_batch_32.h5
22/22 [==============================] - 17s 803ms/step - loss: 0.4208 - precision_24: 0.5513 - recall_24: 0.1639 - auc_25: 0.8057 - PR AUC: 0.4524 - binary_accuracy: 0.8406 - val_loss: 0.3665 - val_precision_24: 0.4667 - val_recall_24: 0.2932 - val_auc_25
Epoch 6/100
22/22 [==============================] - ETA: 0s - loss: 0.4063 - precision_24: 0.5387 - recall_24: 0.2211 - auc_25: 0.8220 - PR AUC: 0.4696 - binary_accuracy: 0.8409
Epoch 6: val_loss improved from 0.36649 to 0.35573, saving model to ../SCRIPTS/TDL/PHYCUV/MODELS/MobileNet\MobileNet_lr_01_batch_32.h5
22/22 [==============================] - 17s 802ms/step - loss: 0.4063 - precision_24: 0.5387 - recall_24: 0.2211 - auc_25: 0.8220 - PR AUC: 0.4696 - binary_accuracy: 0.8409 - val_loss: 0.3557 - val_precision_24: 0.7143 - val_recall_24: 0.0524 - val_auc_25
Epoch 7/100
...
Test precision: 0.7222222089767456
Test recall: 0.4083769619464874
Test ROC AUC: 0.8387450575828552
Test PR AUC: 0.5679607894800575
```

Model name: MobileNet_lr_01_batch_32.h5

Test



```
5/5 [==============================] - 2s 412ms/step
Test accuracy: 0.3860759493670886
Test precision: 0.717948717948718
Test recall: 0.44919786096256686
Test f1 score: 0.5526315789473684
Test hamming loss: 0.12296564195298372
ANOTHER METRICS
Test F1 score: 0.5526315789473684
Test precision: 0.7179487347602844
Test recall: 0.4491978585720062
Test ROC AUC: 0.9126200675964355
Test PR AUC: 0.6505656174831768
```

```
 Layer (type)                Output Shape              Param #
=================================================================
 input_2 (InputLayer)        [(None, 224, 224, 3)]     0

 conv1 (Conv2D)              (None, 112, 112, 32)      864

 conv1_bn (BatchNormalizatio  (None, 112, 112, 32)     128
 n)

 conv1_relu (ReLU)           (None, 112, 112, 32)      0

 conv_dw_1 (DepthwiseConv2D)  (None, 112, 112, 32)     288

 conv_dw_1_bn (BatchNormaliz  (None, 112, 112, 32)     128
 ation)

                             .
                             .
                             .
                             .
                             .

 conv_pw_13_relu (ReLU)      (None, 7, 7, 1024)        0

 flatten_1 (Flatten)         (None, 50176)             0

 dense_2 (Dense)             (None, 256)               12845312

 dropout_1 (Dropout)         (None, 256)               0

 dense_3 (Dense)             (None, 3)                 771

=================================================================
Total params: 16,074,947
Trainable params: 12,846,083
Non-trainable params: 3,228,864
```