Laurea Magistrale in
DATASCIENCE

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

Alternative Methods to Detect COVID-19

A Digitial Signal and Image Management Project

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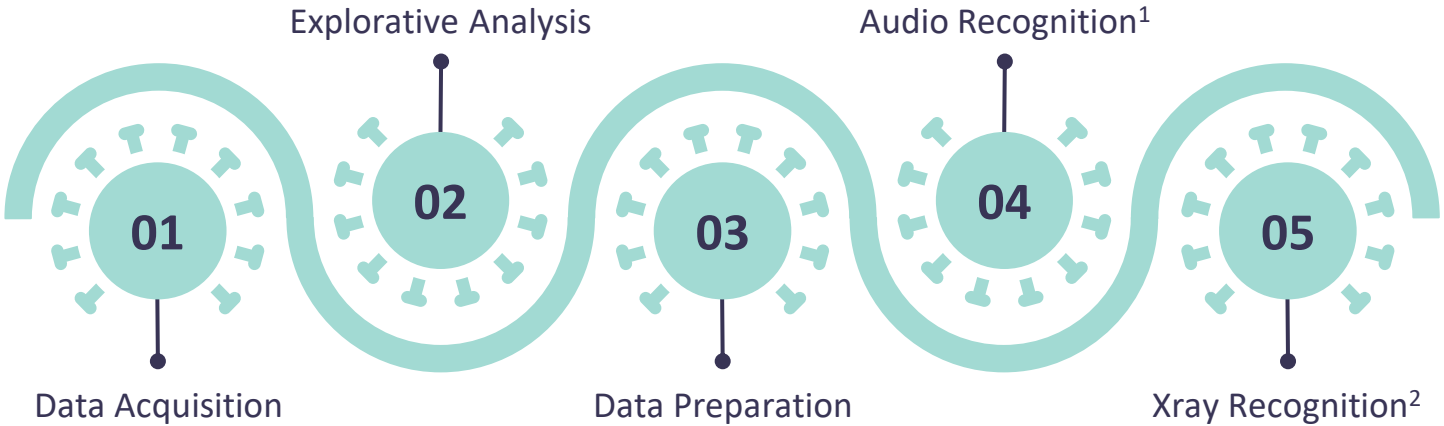
PIPELINE



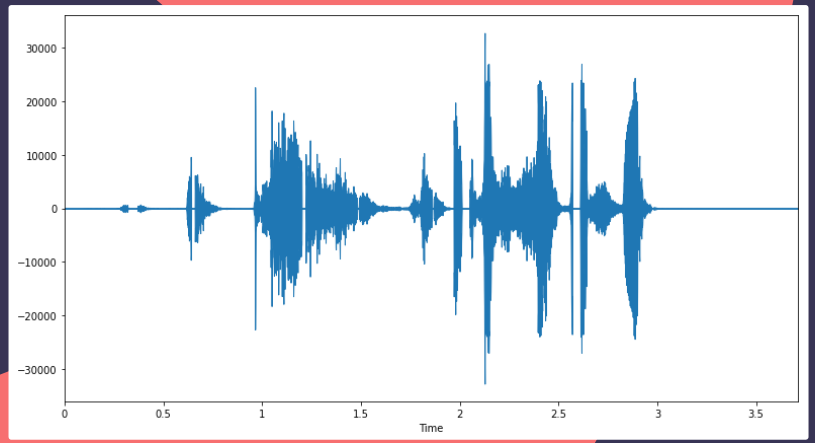
[1] COVID-19 Cough Recordings | Kaggle
[2] Deep Learning and Transfer Learning on COVID-19 | Kaggle

01

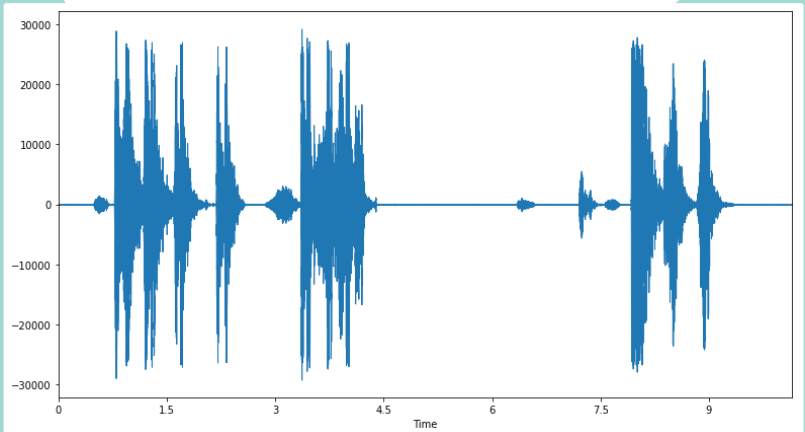
AUDIO

Audio Recognition

COVID



Not COVID

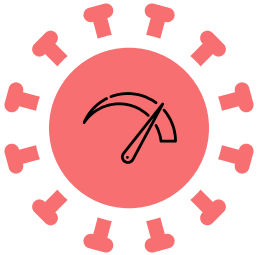


AUDIO AUGMENTATION

Only COVID-19 audio

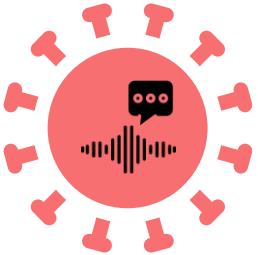
ADD NOISE

Simply add some random value into audio



CHANGE SPEED

Change speed of audio (randomly)

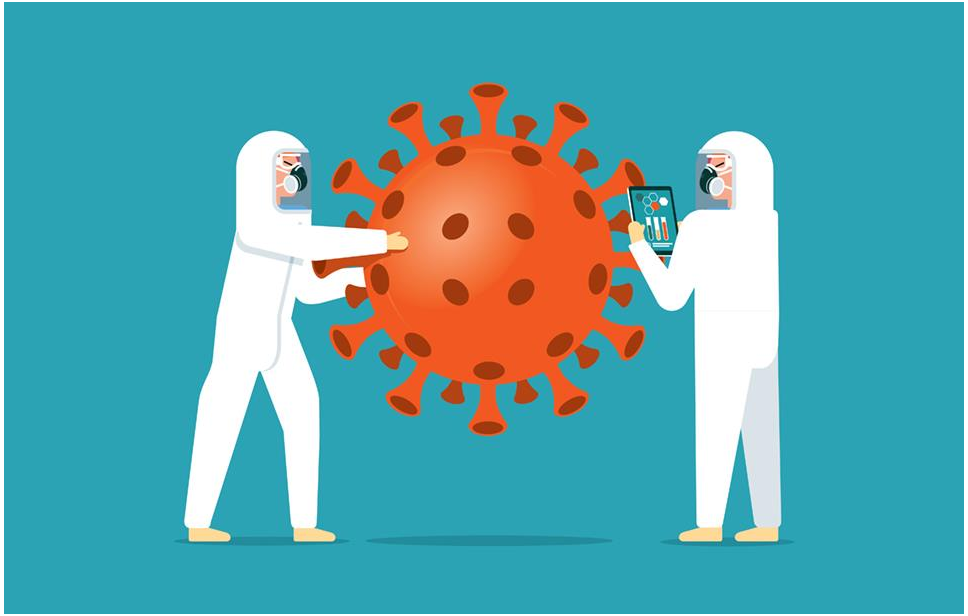


PITCH SHIFTING

Adjust the intonation of the voice (randomly)

FEATURE EXTRACTION

- Chroma STFT 1;
- Chroma STFT 6;
- Chroma STFT 12;
- Spectral Centroid;
- Spectral Bandwidth;
- Rolloff;
- Zero Crossing Rate;
- MFCC from 1 to 20.



MODELS

01

SVM

C: 10
Gamma: 0.0001

02

LOGISTIC REGRESSION

Solver: LibLinear
Balanced Weights

03

NEURAL NETWORK

6 Layers
Activation Function: ReLu

04

CNN

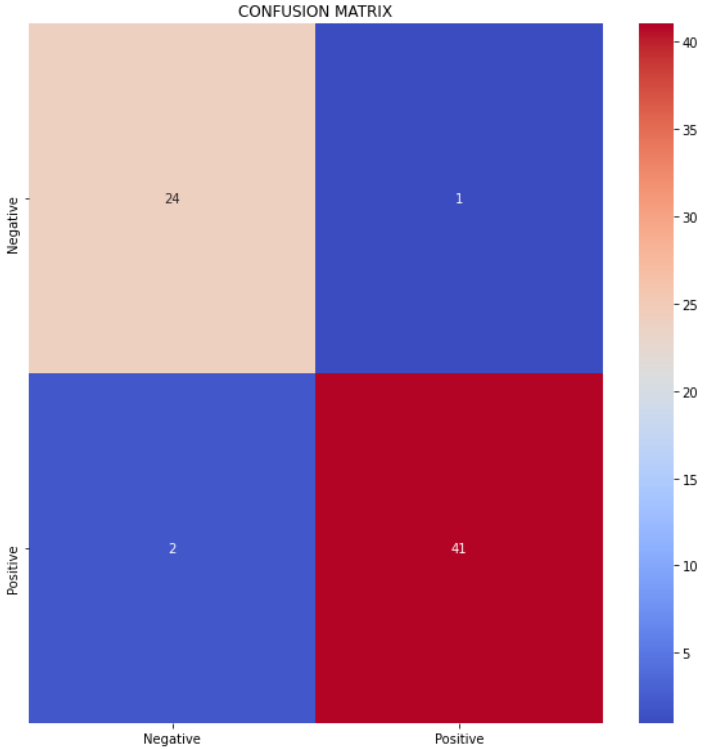
2 Models

BEST MODEL - LOGISTIC

Feature Importance:

- $Coeff_{MFCC_3} = -0.57758$
- $Coeff_{MFCC_7} = -0.32325$
- $Coeff_{MFCC_8} = 0.36815$
- $Coeff_{MFCC_{10}} = 0.40355$
- $Coeff_{MFCC_{12}} = 0.48419$
- $Coeff_{MFCC_{14}} = 0.45921$

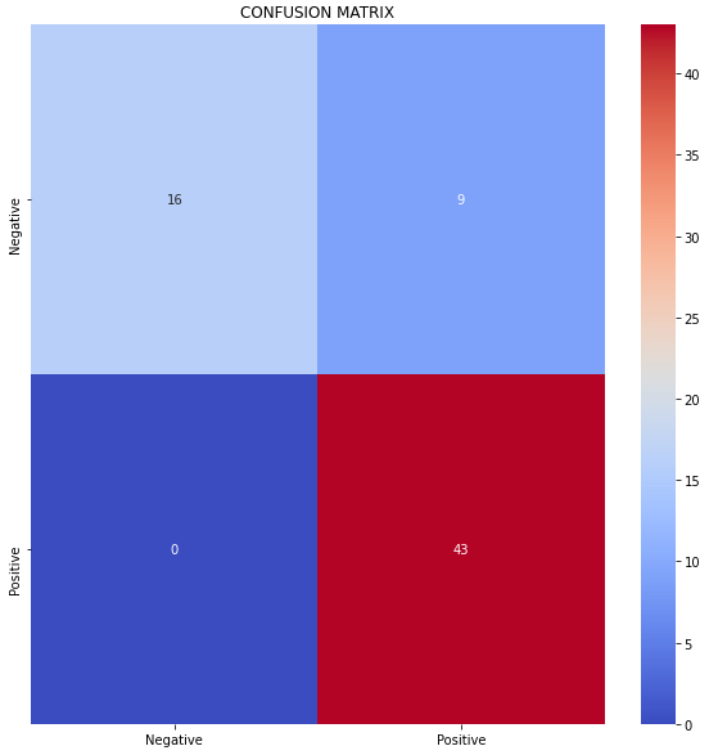
	Precision	Recall	F1-Score
Negative	0.92	0.96	0.94
Positive	0.98	0.95	0.96



BEST MODEL (NN)

- Sequential()
- Input(27, 1)
- Convolutional 1D (512, 10)
- Convolutional 1D (256, 10)
- MaxPooling()
- Dense(10)
- Flatten()
- Dense(2) with Softmax

	Precision	Recall	F1-Score
Negative	0.96	0.96	0.96
Positive	0.98	0.97	0.98



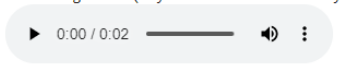
LIVE TUTORIAL

You can record your cough to see if you are Positive to COVID-19.

BUT remember, the Accuracy is 97% and it is not a swab!

```
[ ] signal, rate = librosa.load("audio.wav")
    ipd.Audio(signal, rate = rate)
```

```
/usr/local/lib/python3.6/dist-packages/librosa/core/audio.py:162: UserWarning: PySoundFile failed. Trying audioread instead.
  warnings.warn("PySoundFile failed. Trying audioread instead.")
```




```
def kwow_if_you_are_posivite(audio):
  signal, rate = librosa.load(audio)

  #-- Create DataFrame
  new_audio = pd.DataFrame()
  new_audio["filename"] = 0
  new_audio.loc[0] = audio

  #-- Add Features
  new_audio["chroma_stft_1"] = np.mean(librosa.feature.chroma_stft(y = signal, sr = rate)[0])
  new_audio["chroma_stft_6"] = np.mean(librosa.feature.chroma_stft(y = signal, sr = rate)[5])
  new_audio["chroma_stft_12"] = np.mean(librosa.feature.chroma_stft(y = signal, sr = rate)[11])
  new_audio["spectral_centroid"] = np.mean(librosa.feature.spectral_centroid(y = signal, sr = rate))
  new_audio["spectral_bandwidth"] = np.mean(librosa.feature.spectral_bandwidth(y = signal,  sr = rate))
  new_audio["rolloff"] = np.mean(librosa.feature.spectral_rolloff(y = signal, sr = rate))
  new_audio["zcr"] = np.mean(librosa.feature.zero_crossing_rate(y = signal))

  for i in range(0, 20):
    new_audio["mfcc_" + str(i)] = np.mean(librosa.feature.mfcc(y = signal, sr = rate)[i])

  y_pred = model.predict(new_audio[new_audio.columns[1:]], verbose=0)
  y_pred = np.argmax(y_pred, axis = 1)

  if y_pred == 1:
    print("Oh Man! You Are Positive to COVID-19! Stay Safe!")
  else:
    print("Lucky You! You are Negative to COVID-19. Wear your mask and Stay Safe!")

  return y_pred
```

```
[ ] kwow_if_you_are_posivite("audio.wav")
```

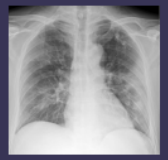
02

IMAGE

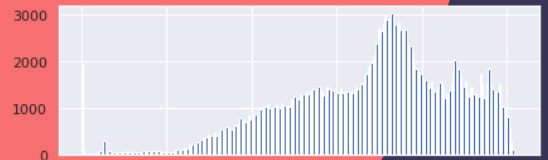
X-Ray Chest Recognition

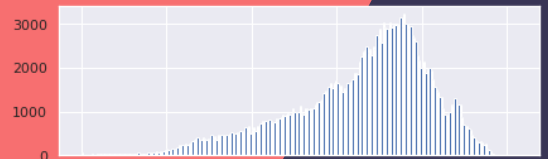
COVID

Images



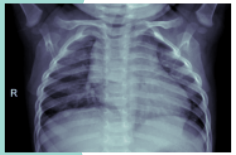
Histograms

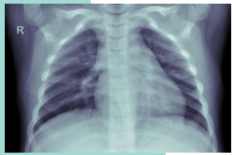




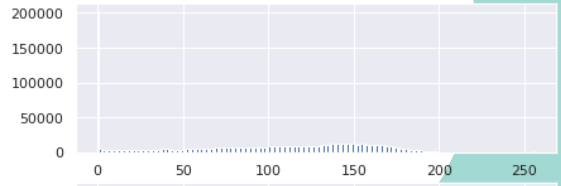
Not COVID

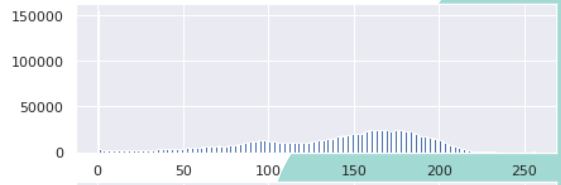
Images

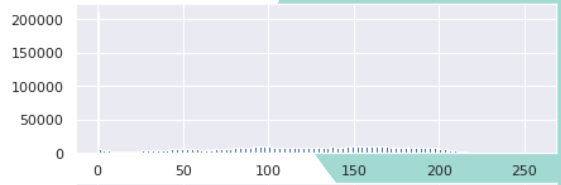


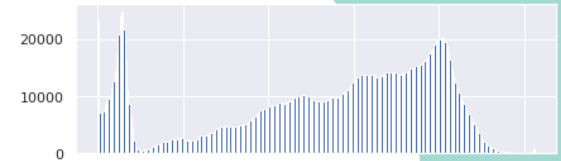


Histograms









AUGMENTATION

Zooming

From 0% to 20% of zooming

Shearing

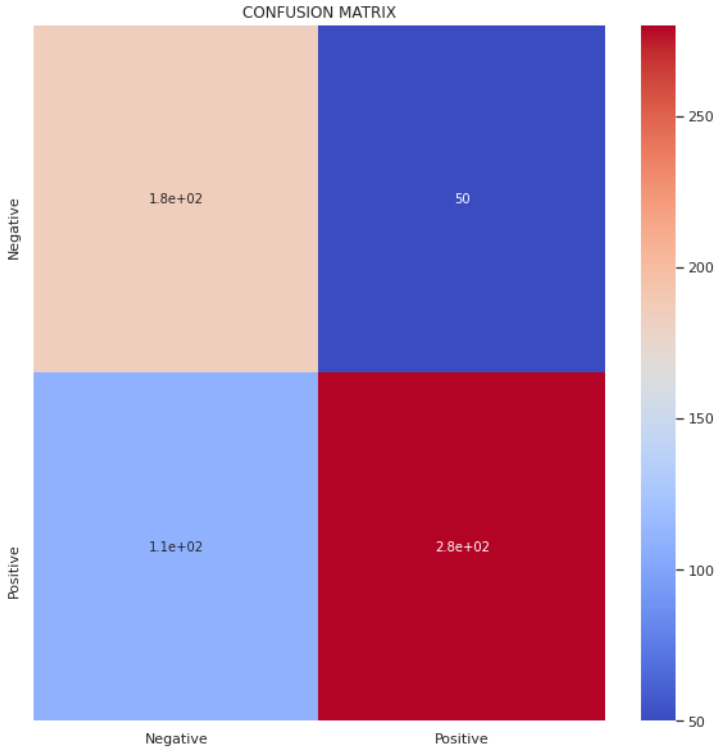
Shear angle in counter-clockwise direction in degrees

MODEL: ResNet - 50

Fine Tuning:

- GlobalAveragePooling2D()
- Dense() with 128 Neurons
- Dropout(0.2)
- Dense(1) with Sigmoid Activation

	Precision	Recall	F1-Score
Negative	0.63	0.79	0.70
Positive	0.85	0.72	0.78

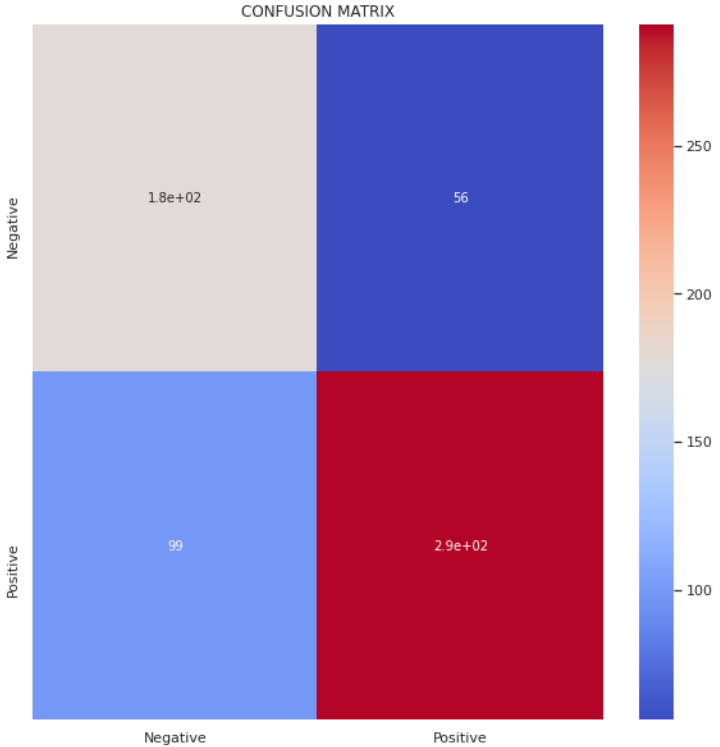


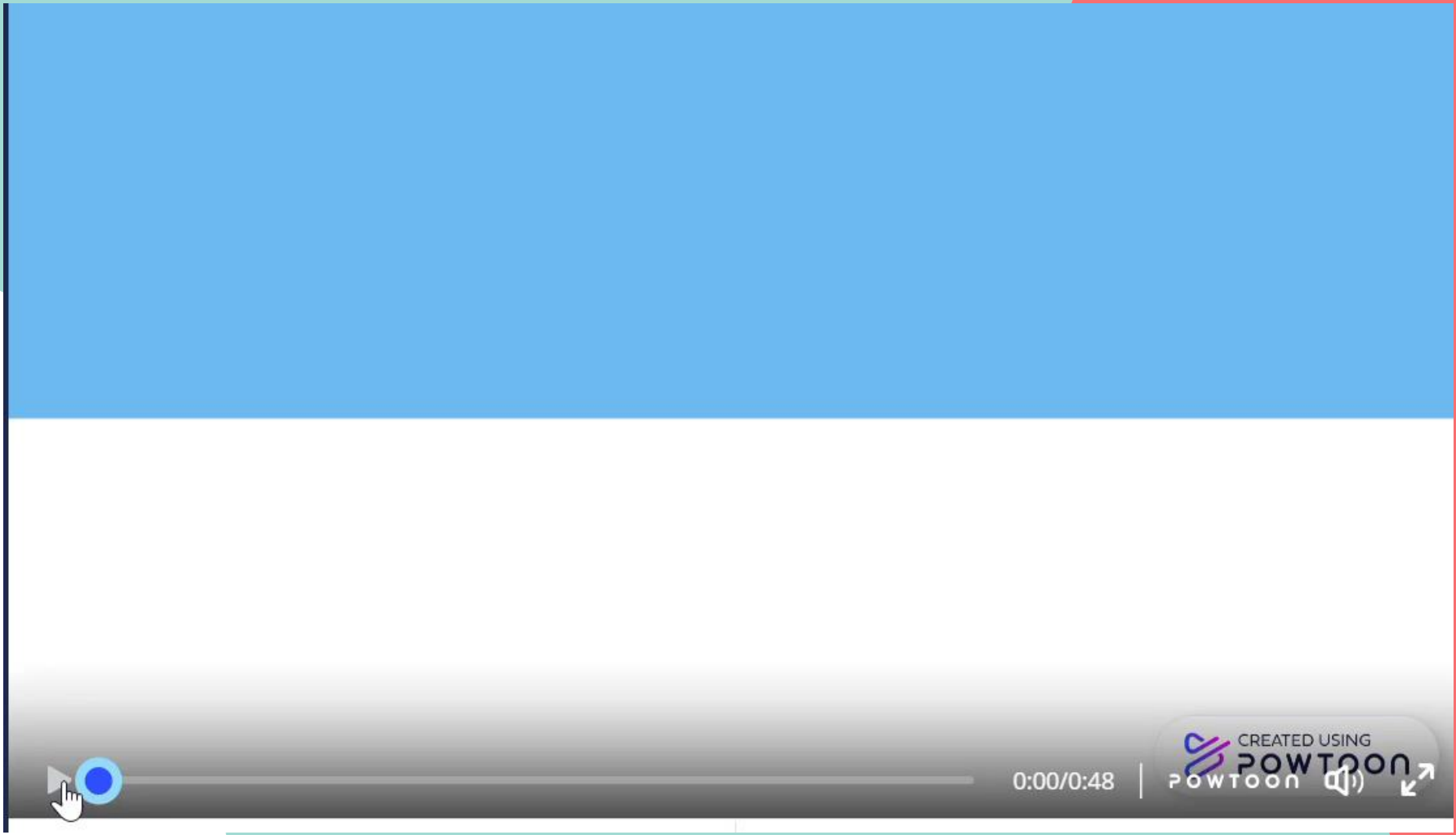
MODEL: EfficientNet – B7

Fine Tuning:

- GlobalAveragePooling2D()
- Dense() with 128 Neurons
- Dropout(0.2)
- Dense(1) with Sigmoid Activation

	Precision	Recall	F1-Score
Negative	0.64	0.76	0.70
Positive	0.84	0.75	0.79




0:00/0:48
CREATED USING
POWTOON
POWTOON

THANKS

Do you have any question?