**Face Emotion Recognition**

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**1.Exploring the data:**

This first section contains the utility functions to load the dataset to be used for our model training.

The dataset used for this project is the one published in the "Challenges in Representation Learning: Facial Expression Recognition Challenge" by Kaggle.

**2.Data description:**

The data consists of 48x48 pixel grayscale images of faces. The faces have been automatically registered so that the face is more or less centered and occupies about the same amount of space in each image. The task is to categorize each face based on the emotion shown in the facial expression in to one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral).

The csv file contains two main columns, "emotion" and "pixels". The "emotion" column contains a numeric code ranging from 0 to 6, inclusive, for the emotion that is present in the image. The "pixels" column contains a string surrounded in quotes for each image. The contents of this string a space-separated pixel values in row major order. test.csv contains only the "pixels" column and your task is to predict the emotion column.

This dataset was prepared by Pierre-Luc Carrier and Aaron Courville, as part of an ongoing research project. They have graciously provided the workshop organizers with a preliminary version of their dataset to use for this contest.



**3. Creating our Deep Learning model:**

Now the interesting part comes to us. Let's build a custom DL model.

* **Model architecture:**

After some research in the state of the art for Facial Expression Recognition, found that a simple convolutional architecture based on LeNet-5 would achieve nice results.

Anyway, more recent proposals have achieved more accurate results, and even if Tensorflow already includes prebuilt models (such as MobileNet, which is one of the best model architectures for portable devices), I came up with my own implementation based on a neetwrk architecture which is supposed to be a deep-lightweight accurate model for the FER problem: "[Extended deep neural network for facial emotion recognition (EDNN)]

they assure through some tests that their EDNN gives better results in classification tasks for Facial Expression Recognition, and by the architecture metrics this network turns out to be a more lightweight model compared with others.

In any case, I proceeded to use Tensorflow 2.0 to build my own EDNN implementation with the Keras module.

The implementation will come from two functions:

One to build the Residual Block

The second one to build the rest of the model

The residual block architecture is as follows:



**ednn.summary():**

In this summary you can see how we creted the layers

Model: "model"

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) [(None, 48, 48, 1)] 0

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conv2d (Conv2D) (None, 22, 22, 32) 832 input\_1[0][0]

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max\_pooling2d (MaxPooling2D) (None, 11, 11, 32) 0 conv2d[0][0]

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conv2d\_1 (Conv2D) (None, 9, 9, 64) 18496 max\_pooling2d[0][0]

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conv2d\_2 (Conv2D) (None, 9, 9, 64) 4160 conv2d\_1[0][0]

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conv2d\_3 (Conv2D) (None, 9, 9, 64) 36928 conv2d\_2[0][0]

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concatenate (Concatenate) (None, 9, 9, 128) 0 conv2d\_2[0][0]

conv2d\_3[0][0]

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conv2d\_4 (Conv2D) (None, 9, 9, 128) 147584 concatenate[0][0]

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conv2d\_5 (Conv2D) (None, 9, 9, 256) 33024 conv2d\_4[0][0]

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concatenate\_1 (Concatenate) (None, 9, 9, 320) 0 conv2d\_5[0][0]

conv2d\_1[0][0]

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conv2d\_6 (Conv2D) (None, 9, 9, 128) 368768 concatenate\_1[0][0]

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max\_pooling2d\_1 (MaxPooling2D) (None, 4, 4, 128) 0 conv2d\_6[0][0]

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conv2d\_7 (Conv2D) (None, 2, 2, 128) 147584 max\_pooling2d\_1[0][0]

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conv2d\_8 (Conv2D) (None, 2, 2, 64) 8256 conv2d\_7[0][0]

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conv2d\_9 (Conv2D) (None, 2, 2, 64) 36928 conv2d\_8[0][0]

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concatenate\_2 (Concatenate) (None, 2, 2, 128) 0 conv2d\_8[0][0]

conv2d\_9[0][0]

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conv2d\_10 (Conv2D) (None, 2, 2, 128) 147584 concatenate\_2[0][0]

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conv2d\_11 (Conv2D) (None, 2, 2, 256) 33024 conv2d\_10[0][0]

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concatenate\_3 (Concatenate) (None, 2, 2, 384) 0 conv2d\_11[0][0]

conv2d\_7[0][0]

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conv2d\_12 (Conv2D) (None, 2, 2, 256) 884992 concatenate\_3[0][0]

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max\_pooling2d\_2 (MaxPooling2D) (None, 1, 1, 256) 0 conv2d\_12[0][0]

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conv2d\_13 (Conv2D) (None, 1, 1, 512) 1180160 max\_pooling2d\_2[0][0]

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flatten (Flatten) (None, 512) 0 conv2d\_13[0][0]

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dense (Dense) (None, 1024) 525312 flatten[0][0]

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dropout (Dropout) (None, 1024) 0 dense[0][0]

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dense\_1 (Dense) (None, 512) 524800 dropout[0][0]

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dropout\_1 (Dropout) (None, 512) 0 dense\_1[0][0]

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dense\_2 (Dense) (None, 7) 3591 dropout\_1[0][0]

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Total params: 4,102,023

Trainable params: 4,102,023

Non-trainable params: 0

* **Model training:**

So far we have created out model and we already have loaded the datset. But beofr, let's create our media folder

We can now proceed to train the model.

Train on 28709 samples, validate on 7178 samples

28709/28709 [==============================] - 508s 18ms/sample - loss: 1.8201 - accuracy: 0.2817 - val\_loss: 1.6472 - val\_accuracy: 0.3576

**4. Testing the model in Real-time using OpenCV and WebCam:**

Now we will test the model that we build for emotion detection in real-time using OpenCV and webcam. To do so we will write a python script. We will use the Jupyter notebook in our local system to make use of a webcam. You can use other IDEs as well. First, we will install a few libraries that are required. Use the below code to import those all.

After importing all the required libraries we will load the model weights that we saved earlier after training. Use the below code to load your saved model. After importing the model weights we have imported a haar cascade file that is designed by open cv to detect the frontal face.

After importing the haar cascade file we will have written a code to detect faces and classify the desired emotions. We have assigned the labels that will be different emotions like angry, happy, sad, surprise, neutral. As soon as you run the code a new window will pop up and your webcam will turn on. It will then detect the face of the person, draw a bounding box over the detected person, and then convert the RGB image into grayscale & classify it in real-time. Please refer to the below code for the same and sample outputs that are shown in the images. To stop the code you need to press ‘q’.

**5. Conclusion:**

That's it! We reached the end of our exercise.

* This first section contains the utility functions to load the dataset to be used for our model training.
* The dataset used for this project is the one published in the "Challenges in Representation Learning: Facial Expression Recognition Challenge"
* The csv file contains two main columns, "emotion" and "pixels". The "emotion" column contains a numeric code ranging from 0 to 6, inclusive, for the emotion that is present in the image.
* We created our deep learning model in which we created model architecture in which we created layers and in model training we fit the model
* We tested the model in real time using opencv and python
* After importing all the required libraries we will load the model weights that we saved earlier after training.
* we have imported a haar cascade file that is designed by open cv to detect the frontal face.
* After importing the haar cascade file we will have written a code to detect faces and classify the desired emotions.