Sprint-2
Model Buliding

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Project Name	Classification of Arrhythmia by Using Deep Learning with 2-D ECG Spectral Image Representation

Task

1. Model Building

We are ready with the augmented and pre-processed image data,we will begin our build our model by following the below steps:

Import The Libraries:

Import the Libraries:

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Convolution2D
from tensorflow.keras.layers import MaxPooling2D
from tensorflow.keras.layers import Flatten
```

Initializing The Model:

Keras has 2 ways to define a neural network:

- Sequential
- Function API

The Sequential class is used to define linear initializations of network layers which then, collectively, constitute a model.

In our example below, we will use the Sequential constructor to create a model, which will then have layers added to it using the add () method. Now, will initialize our model

Adding CNN Layer:

We are adding a convolution layer with an activation function as “relu” and with a small filter size (3,3) and a number of filters as (32) followed by a max-pooling layer.

The Max pool layer is used to downsample the input. The flatten layer flattens the input.

Adding CNN Layers:

```
model = Sequential()
```

```
model.add(Convolution2D(32,(3,3),input_shape = (64,64,3),activation = "relu"))
```

```
model.add(MaxPooling2D(pool_size = (2,2)))
```

```
model.add(Convolution2D(32,(3,3),activation='relu'))
```

```
model.add(MaxPooling2D(pool_size=(2,2)))
```

```
model.add(Flatten()) # ANN Input...
```

Adding Dense Layer:

Dense layer is deeply connected neural network layer. It is most common and frequently used layer.

Adding Dense Layers:

```
model.add(Dense(units = 128,kernel_initializer = "random_uniform",activation = "relu"))
```

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```

Adding Output Layer:

Adding Output Layer:

```
[ ]  model.add(Dense(units = 6,kernel_initializer = "random_uniform",activation = "softmax"))
```

Understanding the model is very important phase to properly use it for training and prediction purposes . keras provides a simple method, summary to get the full information about the model and its layers

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 62, 62, 32)        896

max_pooling2d (MaxPooling2D  (None, 31, 31, 32)        0
)

conv2d_1 (Conv2D)            (None, 29, 29, 32)        9248

max_pooling2d_1 (MaxPooling  (None, 14, 14, 32)        0
2D)

flatten (Flatten)            (None, 6272)              0

dense (Dense)                (None, 128)               802944

dense_1 (Dense)              (None, 128)               16512

dense_2 (Dense)              (None, 128)               16512

dense_3 (Dense)              (None, 128)               16512

dense_4 (Dense)              (None, 128)               16512
```

Configure The Learning Process:

The compilation is the final step in creating a model. Once the compilation is done, we can move on to the training phase. The loss function is used to find error or deviation in the learning process. Keras requires loss function during the model compilation proceses

Optimization is an important process that optimizes the input weights by comparing the prediction and the loss function. Here we are using adam optimizer

Metrics is used to evaluate the performance of your model. It is similar to loss function, but not used in the training process.

```
[ ]  model.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])
```

Train The Model:

We will train our model with our image dataset. fit_generator functions used to train a deep learning neural network.

Train the model:

```
model.fit_generator(generator=x_train,steps_per_epoch = len(x_train), epochs=9, validation_data=x_test,validation_steps = len(x_test))

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`,
  """Entry point for launching an IPython kernel.
Epoch 1/9
480/480 [==============================] - 41s 66ms/step - loss: 1.3631 - accuracy: 0.5007 - val_loss: 1.6149 - val_accuracy: 0.4544
Epoch 2/9
480/480 [==============================] - 31s 65ms/step - loss: 0.7976 - accuracy: 0.6908 - val_loss: 0.9267 - val_accuracy: 0.6988
Epoch 3/9
480/480 [==============================] - 34s 71ms/step - loss: 0.3399 - accuracy: 0.8819 - val_loss: 0.6958 - val_accuracy: 0.7965
Epoch 4/9
480/480 [==============================] - 30s 63ms/step - loss: 0.2286 - accuracy: 0.9223 - val_loss: 0.5724 - val_accuracy: 0.8095
Epoch 5/9
480/480 [==============================] - 30s 63ms/step - loss: 0.1798 - accuracy: 0.9439 - val_loss: 0.4829 - val_accuracy: 0.8488
Epoch 6/9
480/480 [==============================] - 30s 63ms/step - loss: 0.1416 - accuracy: 0.9555 - val_loss: 0.5124 - val_accuracy: 0.8549
Epoch 7/9
480/480 [==============================] - 30s 62ms/step - loss: 0.1068 - accuracy: 0.9662 - val_loss: 0.5708 - val_accuracy: 0.8585
Epoch 8/9
480/480 [==============================] - 30s 63ms/step - loss: 0.0917 - accuracy: 0.9710 - val_loss: 0.4615 - val_accuracy: 0.8714
Epoch 9/9
480/480 [==============================] - 30s 62ms/step - loss: 0.0796 - accuracy: 0.9750 - val_loss: 0.7387 - val_accuracy: 0.8535
<keras.callbacks.History at 0x7f85e00f6410>
```

Save The Model:

The model is saved with .h5 extension as follows.

An H5 file is a data file saved in the Hierarchical Data Format (HDF). It contains multidimensional arrays of scientific data.

Save the model:

```
[ ]  #Saving Model.
     model.save('ECG.h5')
```

Test The Model:

Load necessary libraries and load the saved model using load_model Taking an image as input and checking the results

The target size should for the image that is should be the same as the target size that you have used for training

Testing the model:

```
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
```

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

```
[30] img=image.load_img("/content/fig_44.png",target_size=(64,64))
```

```
[31] x=image.img_to_array(img)
```

```
[32] img
```

```
[33] import numpy as np
```

```
[34] x=np.expand_dims(x,axis=0)
```

```
[35] pred = model.predict(x)
```