Model Building

This phase includes:

1. Initialize The Model
2. Add The Convolution Layer
3. Add The Pooling Layer
4. Add The Flatten Layer
5. Adding The Dense Layers
6. Compile The Model
7. Fit And Save The Model

In [15]:
```
classes = 29
batch = 32
epochs = 15
learning_rate = 0.001
```

Model Creation

[28]:
```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```

[29]:
```
# Creating Model
model=Sequential()
```

```
2022-05-28 11:09:39.431060: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'lib
cuda.so.1'; dlerror: libcuda.so.1: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /opt/ibm/dsdrive
r/lib:/opt/oracle/lib:/opt/conda/envs/Python-3.9/lib/python3.9/site-packages/tensorflow
2022-05-28 11:09:39.431118: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR (303)
```

[30]:
```
# Adding Layers
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())

# Adding Hidden Layers
model.add(Dense(300,activation='relu'))
model.add(Dense(150,activation='relu'))

# Adding Output Layer
model.add(Dense(9,activation='softmax'))
```

[31]:
```
# Compiling the Model
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

[32]:
```
# Fitting the Model Generator
model.fit_generator(x_train,steps_per_epoch=len(x_train),epochs=10,validation_data=x_test,validation_steps=len(x_test))
```

Model Summary

In [18]:
```
adam = Adam(lr=learning_rate)
model.compile(optimizer=adam, loss='categorical_crossentropy', metrics=['accuracy'])
```

The summary of our CNN architecture can be seen below. Overall it contains 4,596,765 trainable parameters.

In [19]:
```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 32, 32, 64)        1792

 max_pooling2d (MaxPooling2D  (None, 16, 16, 64)       0
 )

 batch_normalization (BatchN  (None, 16, 16, 64)       256
 ormalization)

 conv2d_1 (Conv2D)           (None, 16, 16, 128)       73856

 max_pooling2d_1 (MaxPooling  (None, 8, 8, 128)        0
 2D)

 batch_normalization_1 (Batc  (None, 8, 8, 128)        512
 hNormalization)

 dropout (Dropout)           (None, 8, 8, 128)         0

 conv2d_2 (Conv2D)           (None, 8, 8, 256)         295168

 max_pooling2d_2 (MaxPooling  (None, 4, 4, 256)        0
 2D)

 batch_normalization_2 (Batc  (None, 4, 4, 256)        1024
 hNormalization)

 flatten (Flatten)           (None, 4096)              0

 dropout_1 (Dropout)         (None, 4096)              0

 dense (Dense)               (None, 1024)              4195328

 dense_1 (Dense)             (None, 29)                29725

=================================================================
Total params: 4,597,661
Trainable params: 4,596,765
Non-trainable params: 896
```

5. Train Model

In [20]:
```
history = model.fit(x_train, y_train, batch_size=batch, epochs=epochs, validation_split=0.2, shuffle = True, verbose=1)
```

```
Epoch 1/15
1958/1958 [==============================] - 259s 132ms/step - loss: 0.5975 - accuracy: 0.8204 - val_loss: 1.4899 - val_accurac
y: 0.6816
Epoch 2/15
1958/1958 [==============================] - 250s 128ms/step - loss: 0.1237 - accuracy: 0.9622 - val_loss: 0.8504 - val_accurac
y: 0.8234
Epoch 3/15
1958/1958 [==============================] - 245s 125ms/step - loss: 0.0887 - accuracy: 0.9740 - val_loss: 0.1775 - val_accurac
y: 0.9515
Epoch 4/15
1958/1958 [==============================] - 250s 128ms/step - loss: 0.0668 - accuracy: 0.9822 - val_loss: 0.1956 - val_accurac
y: 0.9558
Epoch 5/15
1958/1958 [==============================] - 252s 129ms/step - loss: 0.0672 - accuracy: 0.9833 - val_loss: 0.0750 - val_accurac
y: 0.9822
Epoch 6/15
1958/1958 [==============================] - 260s 133ms/step - loss: 0.0533 - accuracy: 0.9874 - val_loss: 0.0844 - val_accurac
y: 0.9748
Epoch 7/15
1958/1958 [==============================] - 260s 133ms/step - loss: 0.0451 - accuracy: 0.9893 - val_loss: 0.1199 - val_accurac
y: 0.9602
Epoch 8/15
1958/1958 [==============================] - 257s 131ms/step - loss: 0.0429 - accuracy: 0.9895 - val_loss: 0.0470 - val_accurac
y: 0.9855
Epoch 9/15
1958/1958 [==============================] - 256s 131ms/step - loss: 0.0416 - accuracy: 0.9905 - val_loss: 0.0256 - val_accurac
y: 0.9950
Epoch 10/15
1958/1958 [==============================] - 267s 136ms/step - loss: 0.0354 - accuracy: 0.9923 - val_loss: 0.0646 - val_accurac
y: 0.9890
Epoch 11/15
1958/1958 [==============================] - 263s 135ms/step - loss: 0.0322 - accuracy: 0.9920 - val_loss: 0.0218 - val_accurac
y: 0.9930
Epoch 12/15
1958/1958 [==============================] - 263s 134ms/step - loss: 0.0257 - accuracy: 0.9938 - val_loss: 0.0740 - val_accurac
y: 0.9877
Epoch 13/15
1958/1958 [==============================] - 256s 131ms/step - loss: 0.0271 - accuracy: 0.9941 - val_loss: 0.0582 - val_accurac
y: 0.9862
```

In [21]:
```
pwd
```

Out[21]:
```
'C:\\Users\\Cliff\\Desktop\\Real-Time-Communication-Specially-Abled-main\\Real-Time-Communication-Specially-Abled-main\\Project
Files'
```

In [22]:
```
#save model
model.save('aslmodel.h5')
```