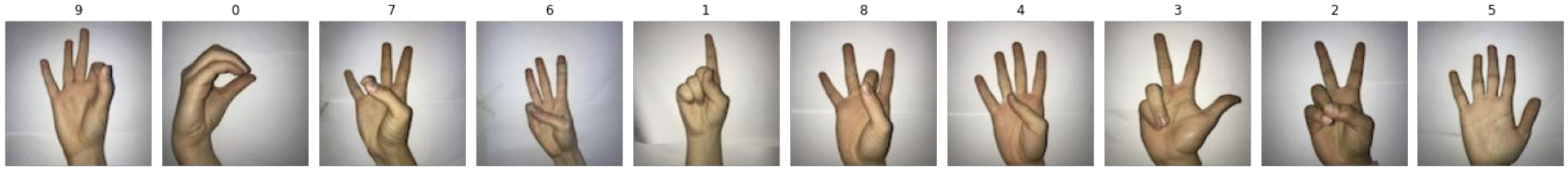
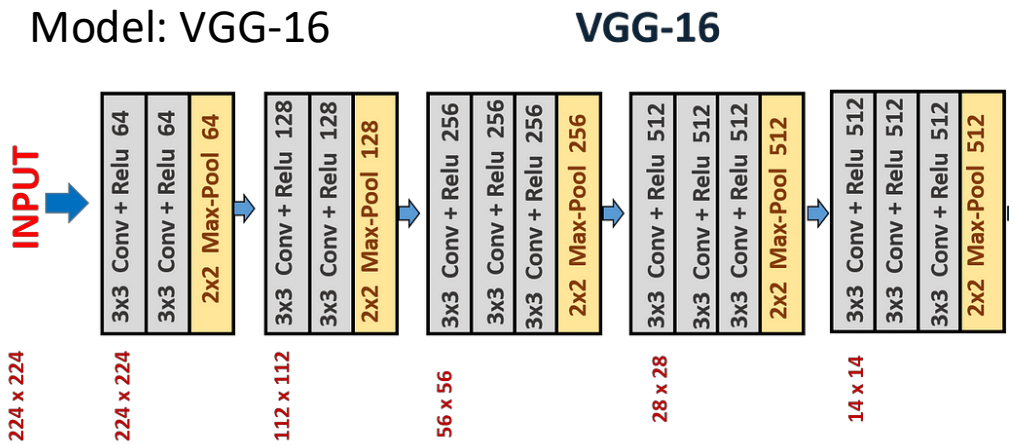
# Assignment #1: 10 sign languages representing 0 to 9




Model: VGG-16




```
# use “get_layer” method to save the last layer of the network
last_layer = base_model.get_layer('global_average_pooling2d')

# save the output of the last layer to be the input of the next layer
last_output = last_layer.output

# add our new softmax layer with 3 hidden units
x = Dense(10, activation='softmax', name='softmax')(last_output)
```

## Hyperparameter

| | |
|---|---|
| Epoch | 20 |
| Opimizer | Adam |
| Loss Function | **Categorical Cross Entropy** |
| Learning Rate | 0.0001 |
| Metrics | Accuracy |

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```
base_model = vgg16.VGG16(weights = "imagenet", include_top=False, input_shape = (224,224, 3), pooling='avg')
base_model.summary()
```

```
Total params: 14719818 (56.15 MB)
Trainable params: 12984330 (49.53 MB)
Non-trainable params: 1735488 (6.62 MB)
```

Freeze all layers except the last 10 layers

```
Total params: 14719818 (56.15 MB)
Trainable params: 7084554 (27.03 MB)
Non-trainable params: 7635264 (29.13 MB)
```

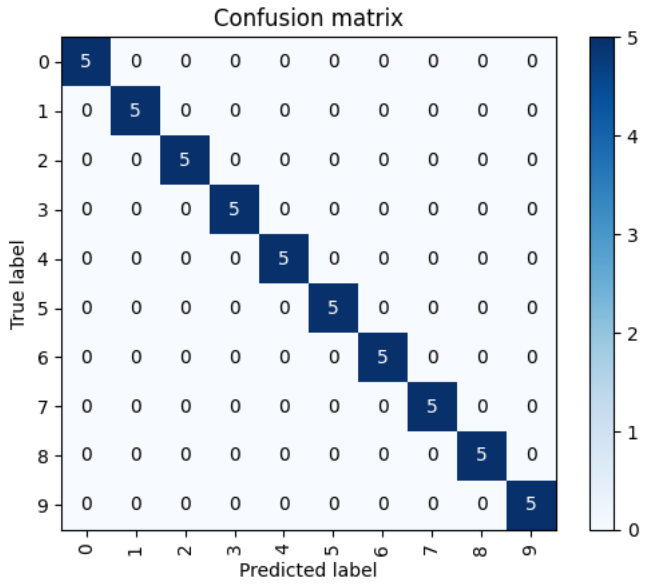
Freeze all layers except the last 5 layers

**The level 1 has more params than level 2 fine-tuning**

# Assignment #1: 10 sign languages representing 0 to 9

Model Comparation: freeze all layers except the last 5 layers vs last 10 layers

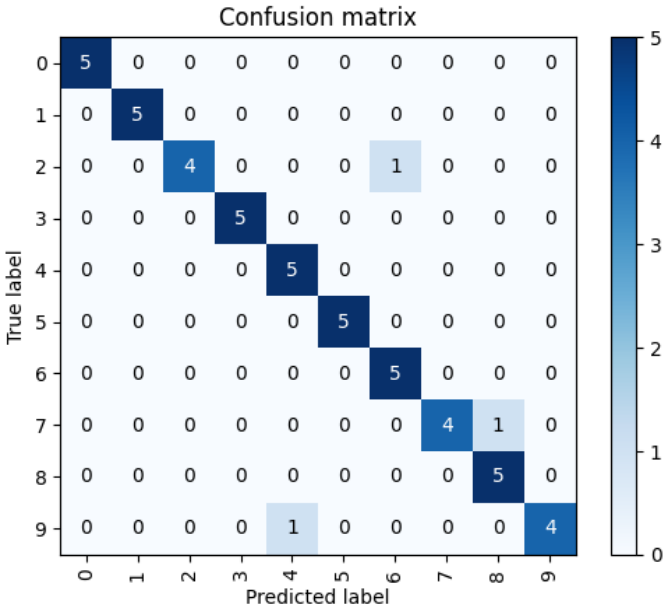
freeze all layers except the last 10 layers




- Testing loss: **0.0279**
- Testing accuracy: **1.0000**

**VS**

freeze all layers except the last 5 layers




- Testing loss: **0.1894**
- Testing accuracy: **0.9400**

**The level 1 (10 Layers) Fine Tuning is better than level 2 (5 layers) fine-tuning**

# Conclusion

- In the first project, which is centered around sign language classification, the VGG16 model was employed. Within this context, tuning Level 1 (freeze all layers except the last 10 layers) yielded better results than tuning Level 2 (freeze all layers except the last 5 layers).

- Conversely, in the second project focusing on traffic sign classification, the VGG19 model was used, and here, tuning Level 2 outperformed tuning Level 1.