Use case

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Image classification (via CNN)

Setup

- Classify image in **CIFAR 10** dataset with **CNN** model
- Use **GPU** for training
- **Input** : image in size (32, 32, 3)
- **Output** : 10 classes (0-9)
- Batch size is 32
- from 60,000 image splited into
    1. 40,000 of train
    2. 10,000 of validation
    3. 10,000 of test

Model arch.

1. Conv2D (`nn.Conv2d(3, 6, 5)`)
    - input_channel = 3
    - output_channel = 6
    - kernel_size = (5, 5)
    - **parameters** = (5x5)x3x6 + 6 = 456
2. ReLU (`nn.ReLU()`)
3. MaxPool2D (`nn.MaxPool2d(2, 2)`)
    - kernal_size = (2, 2)
    - stride = 2
4. Conv2D (`nn.Conv2d(6, 16, 5)`)

    - input_channel = 6
    - output_channel = 16
    - kernel_size = (5, 5)
    - **parameters** = (5x5)x6x16 + 16 = 2,416
5. ReLU
6. MaxPool2D
    - kernal_size = (2, 2)
    - stride = 2
7. Flatten (`torch.flatten()`)
8. Dense (`nn.Linear(400, 120)`)
    - input = 400 (16x5x5)
    - output = 120
    - **parameters** = 400x120 + 120 = 48,120
9. ReLU
10. Dense (`nn.Linear(120, 84)`)
    - input = 120
    - output = 84
    - **parameters** = 120x84 + 84 = 10,164
11. ReLU
12. Dense (`nn.Linear(84, 10)`)
    - input = 84
    - output = 10
    - **parameters** = 84x10 + 10 = 850
13. Softmax (`nn.Softmax()`)

Total parameters = 456 + 2,416 + 48,120 + 10,164 + 850 = 61,006

```
from torchinfo import summary
print(summary(model, input_size=(32, 3, 32, 32)))
```

Training

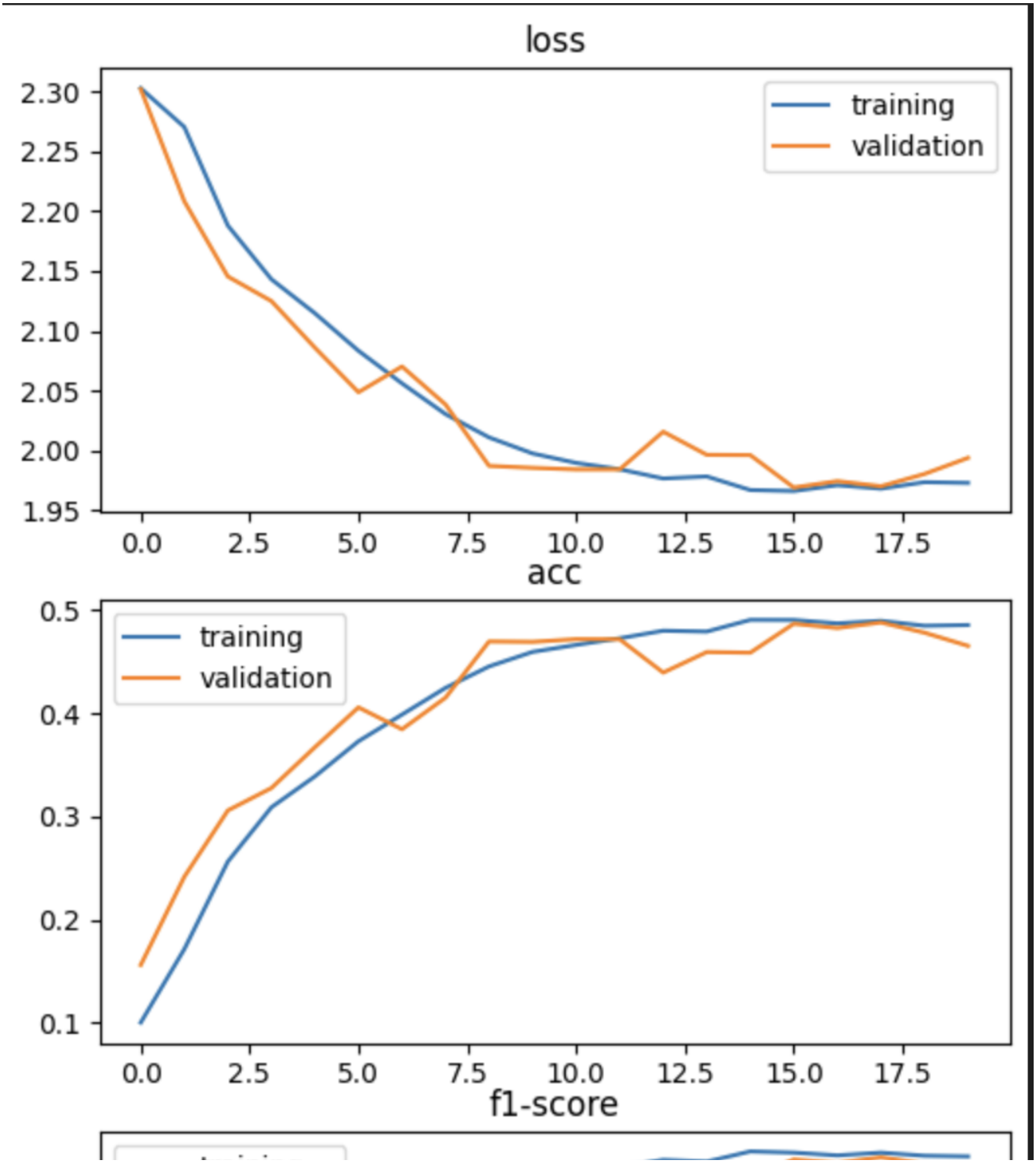
- Loss(criterion) : `nn.CrossEntropyLoss()`
- Optimizer : `torch.optim.SGD(model.parameters(), lr=1e-2, momentum=0.9)`
- train steps

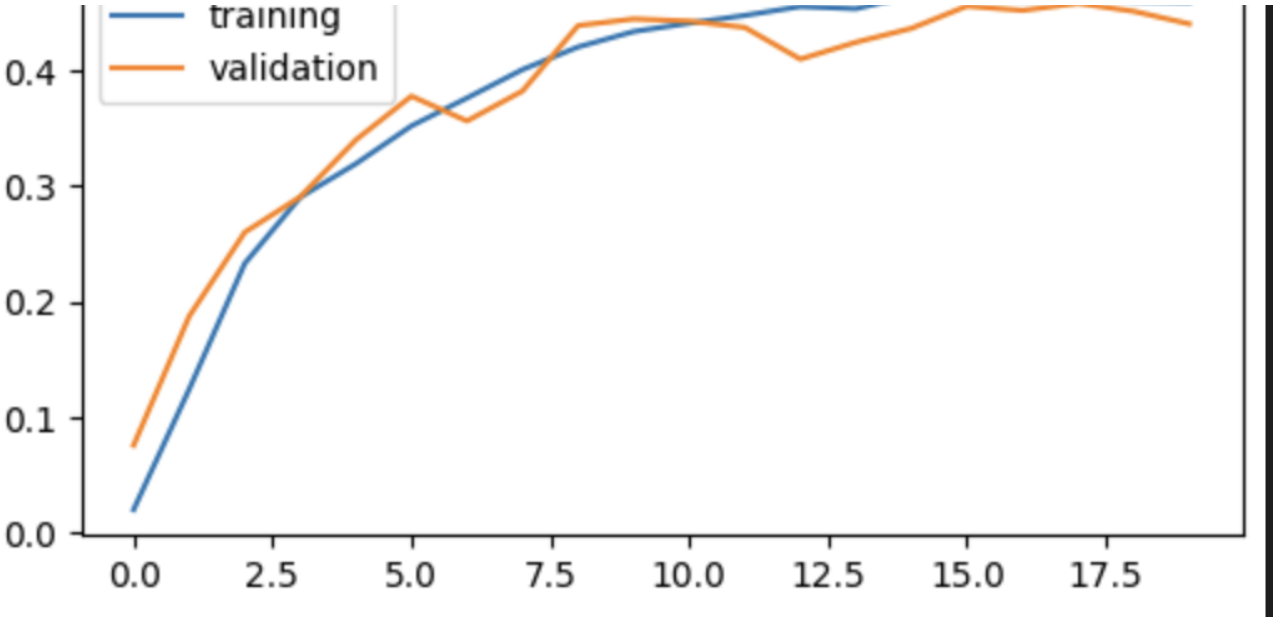
> Let's train!
> For an epoch in a range
> Call model dot train
> Do the forward pass
> Calculate the loss
> Optimizer zero grad
> Lossssss backward
> Optimizer step step step

> Test time!
> Call model dot eval
> With torch inference mode
> Do the forward pass
> Calculate the loss
>
> Print out what's happenin'
>
> Let's do it again 'gain 'gain

choose the model by **validation loss**

Training result





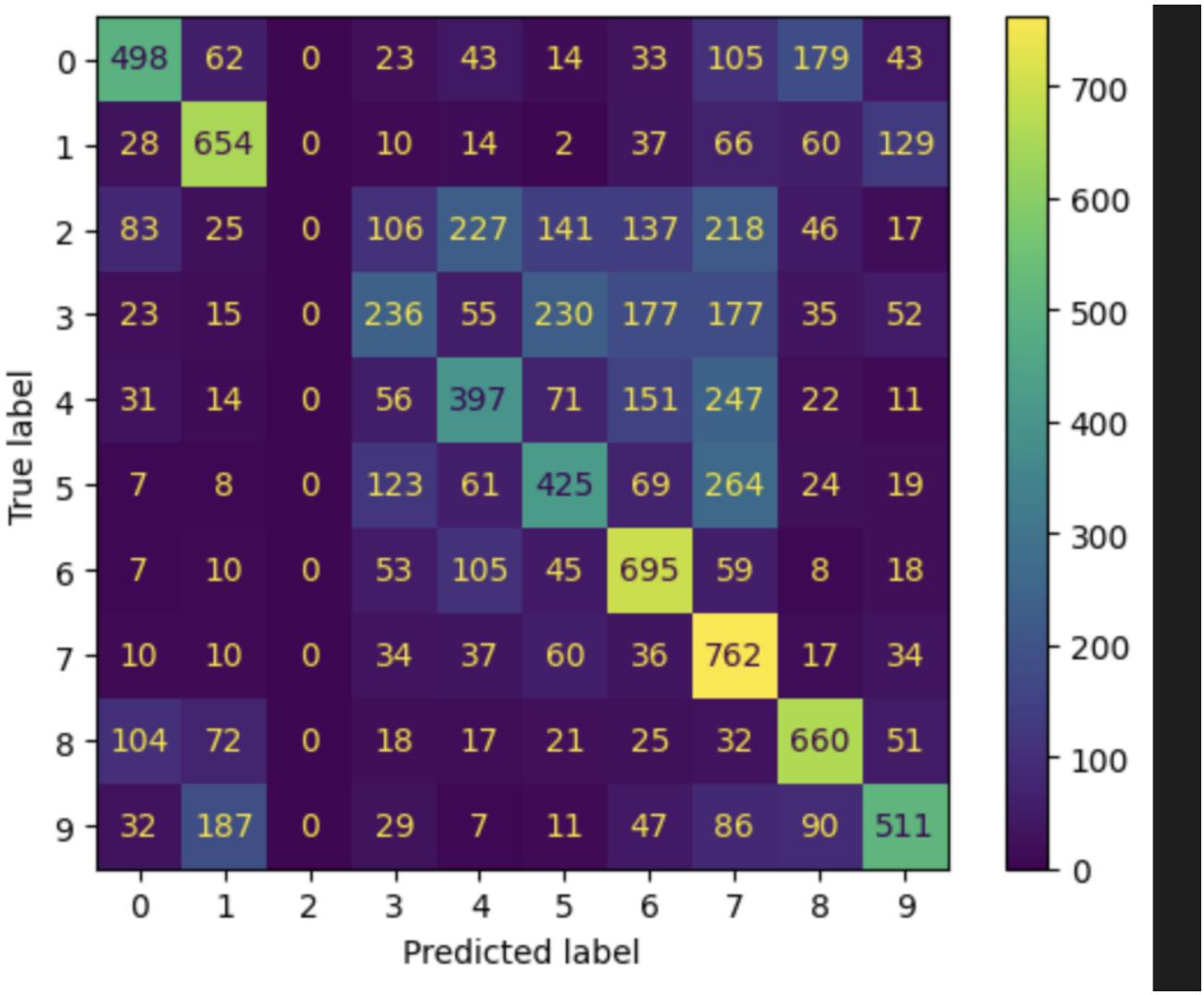
Metrics

```
report = classification_report(y_labels, y_pred)

acc = report['accuracy']
prec = report['weighted avg']['precision']
rec = report['weighted avg']['recall']
f1 = report['weighted avg']['f1-score']
```

- Accuracy
  - in **prediction**, how many **correct**
- Precision
  - in **prediction**, how many correct in **positive**
- Recall
  - in **positive**, how many correct in **prediction**
- F1
  - average of precision and recall

Evaluation (confusion matrix)

```
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay

M = confusion_matrix(y_labels, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=M)
```



Text classification (via EfficientNet V2 S)

Setup

- Classify 10 classes in Animal image dataset using EfficientNet V2 model
- Use GPU for training
- Input : image in size (224, 224, 3)
    - (230, 230) -> random rotation, clop, horizontal flip, vertical flip, nomralize -> train
    - normalize -> test
- Output : 10 classes (0-9)
- Batch size is 32
- from 2,000 image splited into
    1. 1,400 of train
    2. 300 of validation
    3. 300 of test

Model arch.

1. use pretrained weight from ImageNet-1000

```
import torchvision
pretrained_weight =
torchvision.models.EfficientNet_V2_S_Weights.IMAGENET1K_V1
```

2. use EfficientNet V2 size S

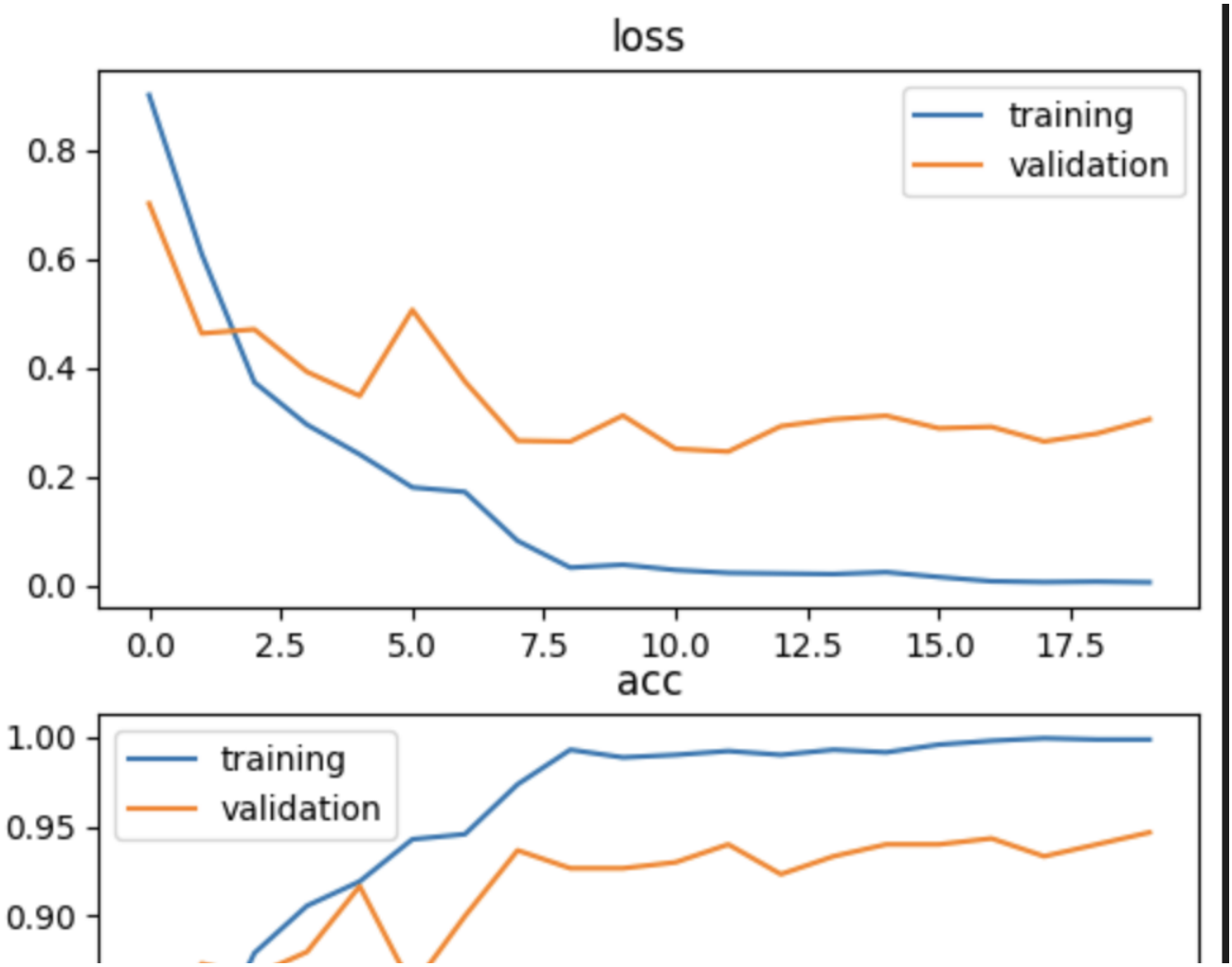
```
model = torchvision.models.efficientnet_v2_s(weights =
pretrained_weight)
model.classifier[1] = nn.Linear(1280, 10)
model.to(device)
```

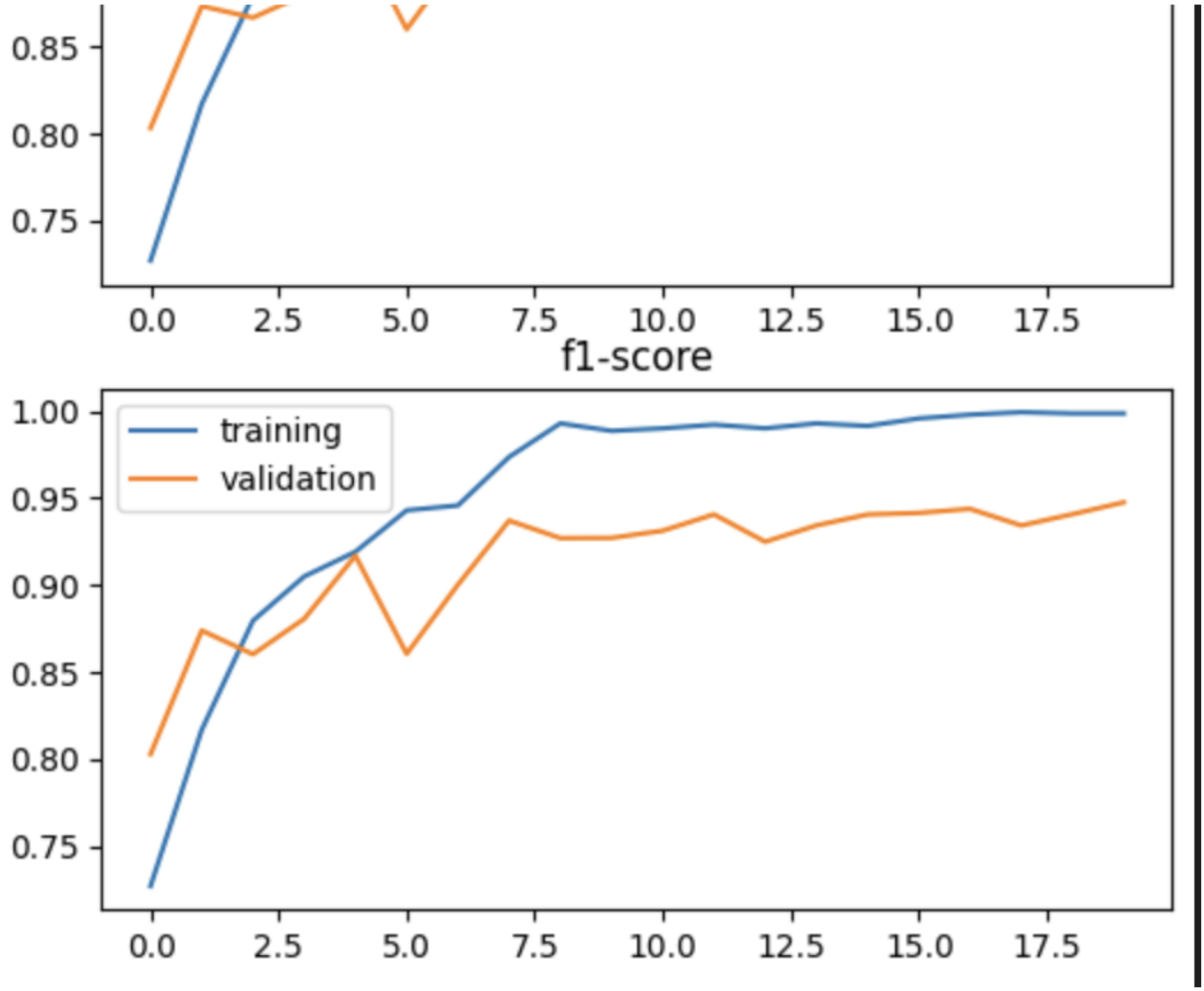
Total parameters = 20,190,298

Training

- criterion : `nn.CrossEntropyLoss()`
- optimizer : `torch.optim.SGD(model.parameters(), lr=1e-2, momentum=0.9)`
- scheduler : `torch.optim.lr_scheduler.StepLR(optimizer, step_size=7, gamma=0.5)`

Training result

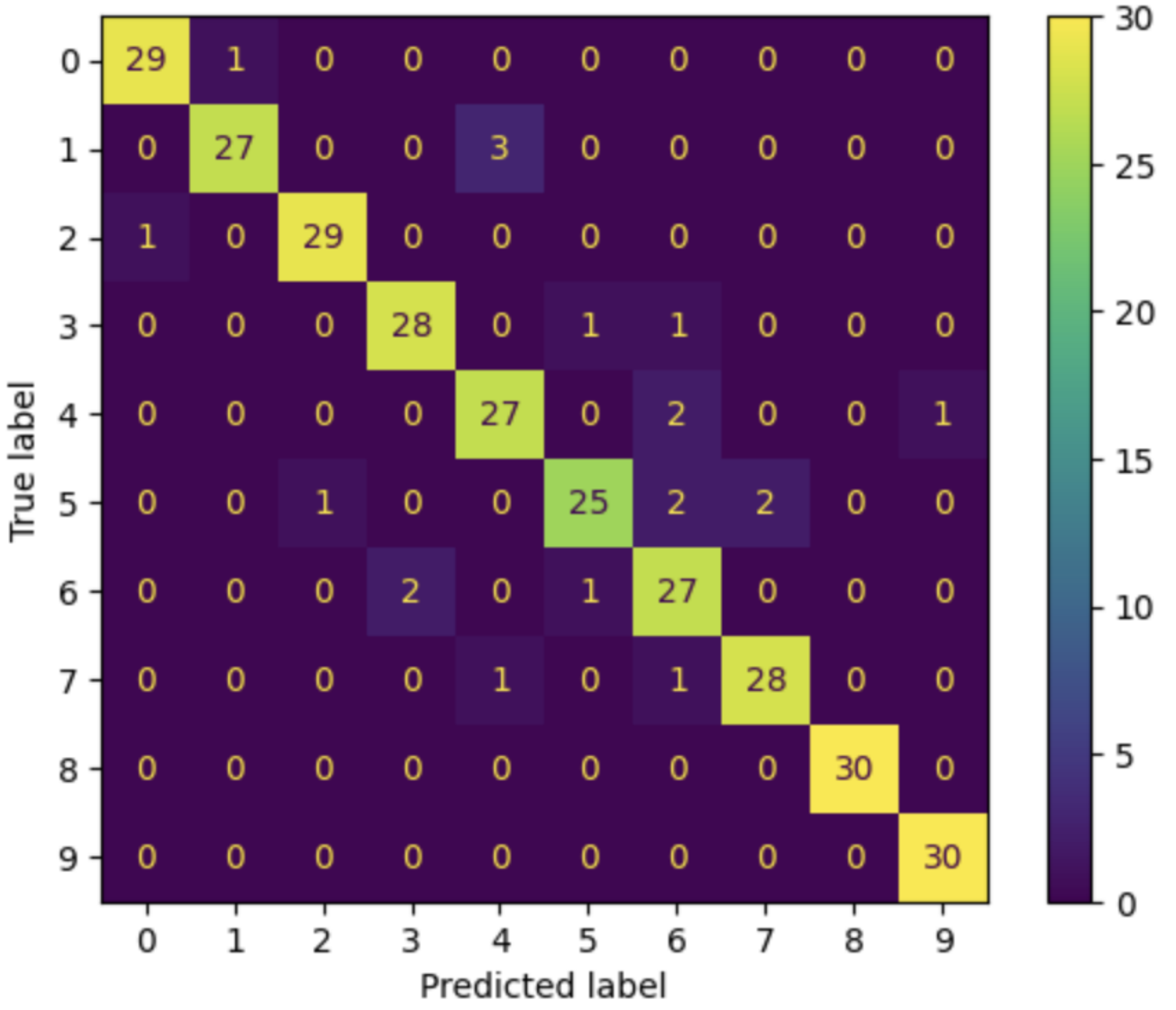




Metrics

- Accuracy
- Precision
- Recall
- F1

Evaluation (confusion matrix)


True label
Predicted label
0 29 1 0 0 0 0 0 0 0 0
1 0 27 0 0 3 0 0 0 0 0
2 1 0 29 0 0 0 0 0 0 0
3 0 0 0 28 0 1 1 0 0 0
4 0 0 0 0 27 0 2 0 0 1
5 0 0 1 0 0 25 2 2 0 0
6 0 0 0 2 0 1 27 0 0 0
7 0 0 0 0 1 0 1 28 0 0
8 0 0 0 0 0 0 0 0 30 0
9 0 0 0 0 0 0 0 0 0 30
0 1 2 3 4 5 6 7 8 9
30 25 20 15 10 5 0