쓰레기 분류 모델 보고서

빅데이터 7기

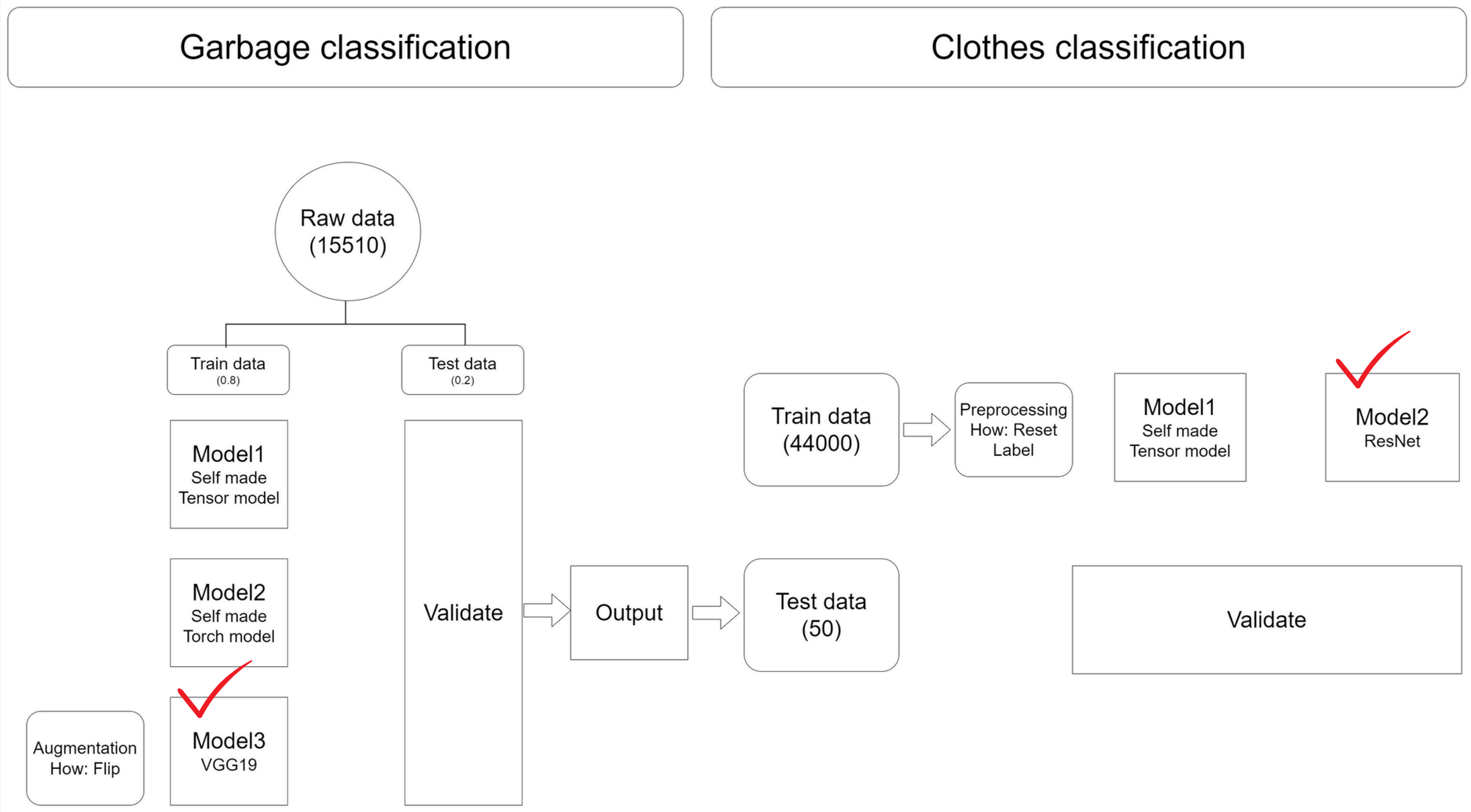
분리수거 잘해 조

김재경, 안필주, 이민아, 이주복

개요

재활용 선별장에서 재활용 쓰레기를 분류할 때, 중량을 이용하여 분류하는 현재 상황에 재활용 분류 모델을 사용하여 분류의 정확성을 높이고자 한다.

Process


Garbage classification
Clothes classification
Raw data
(15510)
Train data
(0.8)
Test data
(0.2)
Model1
Self made
Tensor model
Model2
Self made
Torch model
Model3
VGG19
Augmentation
How: Flip
Validate
Output
Test data
(50)
Train data
(44000)
Preprocessing
How: Reset
Label
Model1
Self made
Tensor model
Model2
ResNet
Validate

Garbage Classification

- Data

데이터 수: **15510**개

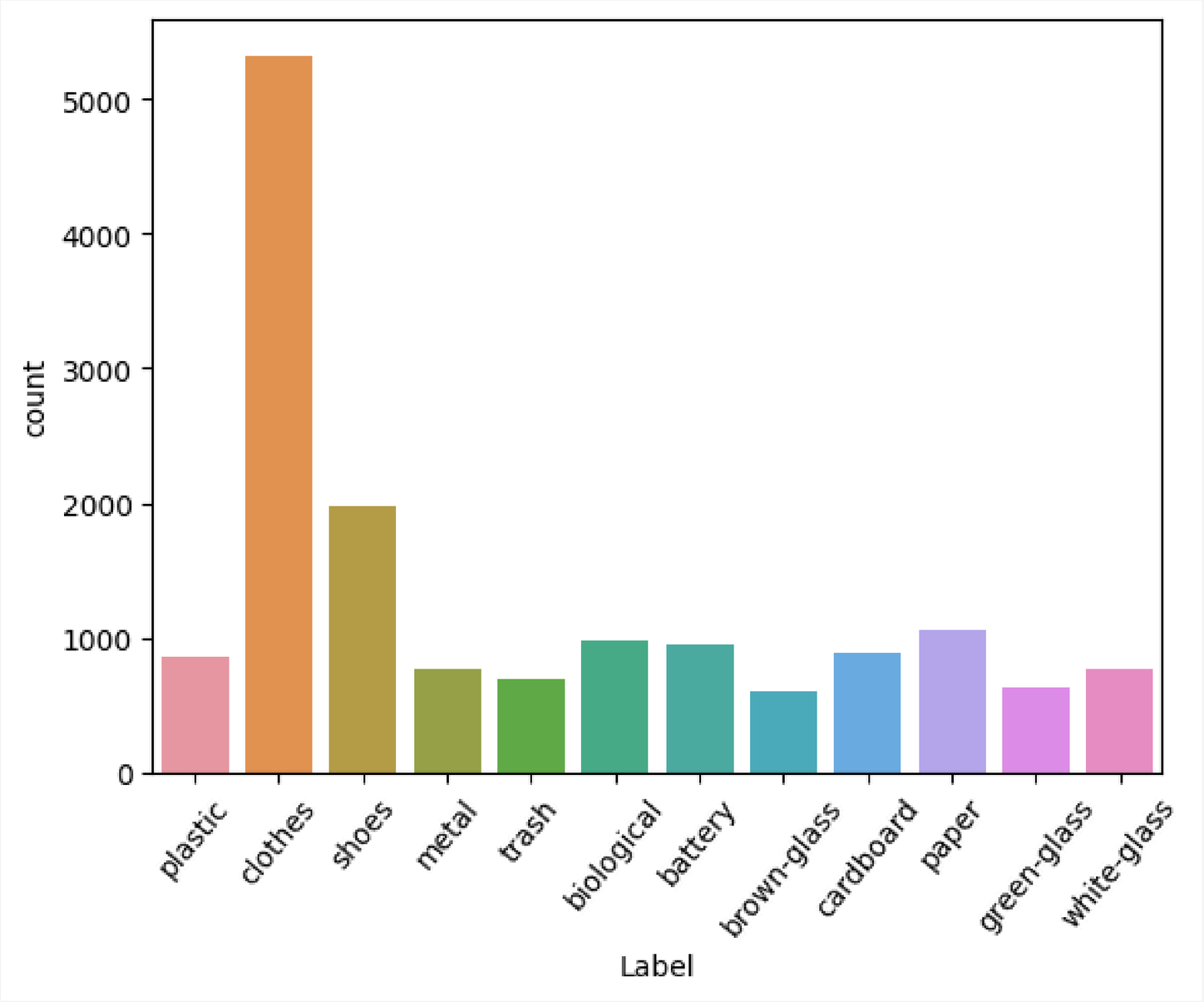
Label: 12개

배터리, 식품, 갈색 병, 판지, 의류, 녹색 병, 금속, 종이, 플라스틱, 생필품, 흰색 병

Garbage Classification

- Label

Label	
clothes	34.33%
shoes	12.75%
paper	6.77%
biological	6.35%
battery	6.06%
cardboard	5.74%
plastic	5.58%
white-glass	5.00%
metal	4.96%
trash	4.49%
green-glass	4.06%
brown-glass	3.91%



Garbage Classification

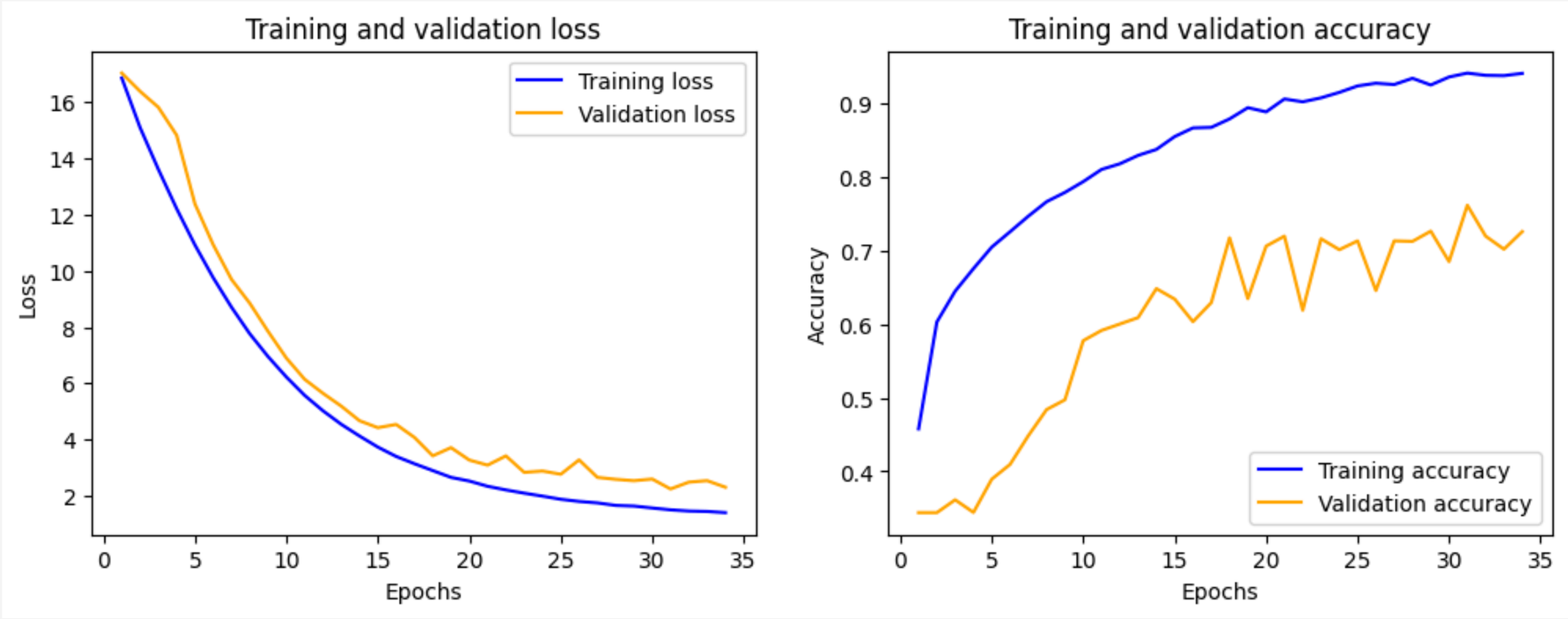
- Model1: Self made Tensor model

Convolution layer
- **Layer: 6**
- **Activation: Relu**
- **Padding: Same**
- **L2 regularizer**
- **Dropout: 0.2**

Pooling layer
- **Maxpooling**

Optimizer
- **Adam**
- **Learning rate: 0.0002**

Batch size: 128
Epoch: 100
Early Stopping



Epoch = 34	Loss	Accuracy
Train set	1.40	0.94
Valid set	2.31	0.72

Garbage Classification

- Model1: Self made Tensor model

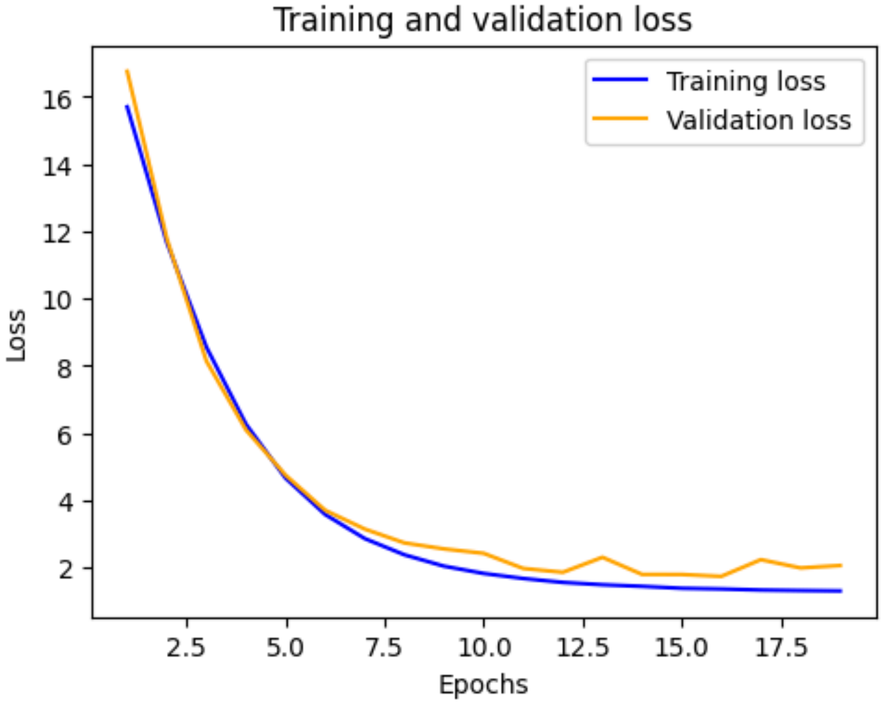
Parameter Tuning

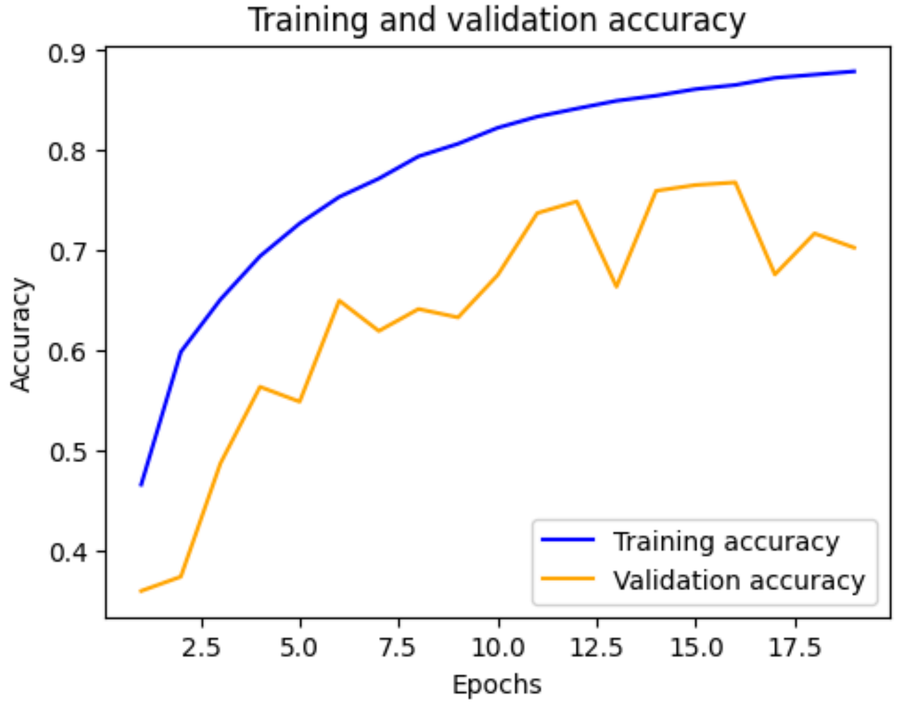
Dropout 변경
- Layer마다 다르게 적용

- **layer1,2: 0.2**
- **layer3~6: 0.4**

보완할 내용

1. **Learning rate 조절**
2. **L2 정규화 수치 변경**





Epoch = 18	Loss	Accuracy
Train set	1.32	0.87
Valid set	1.99	0.70

Garbage Classification

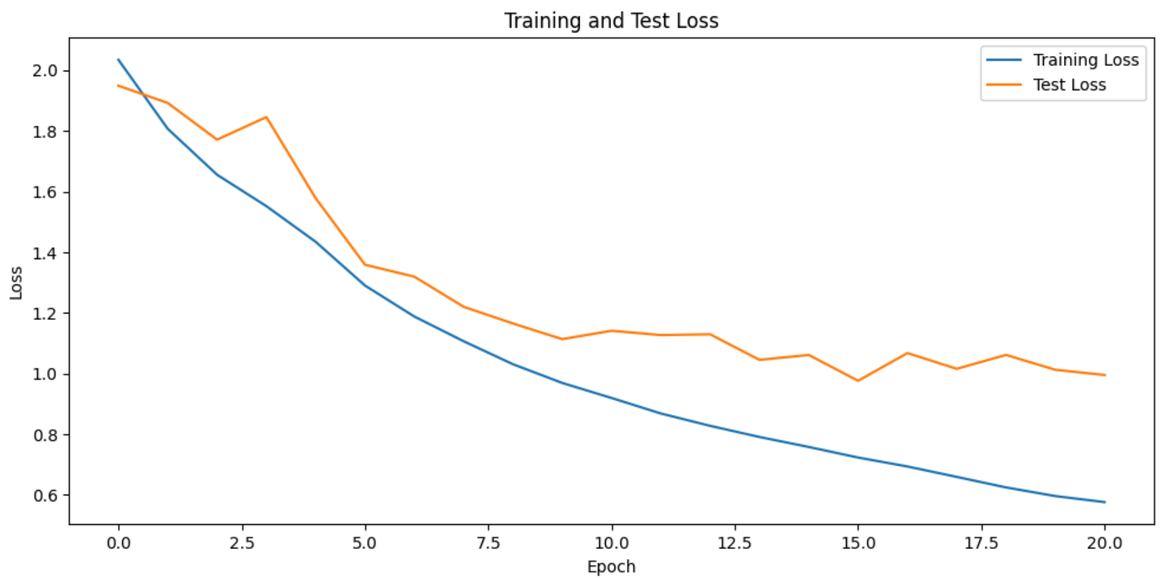
- Model2: Self made Torch model

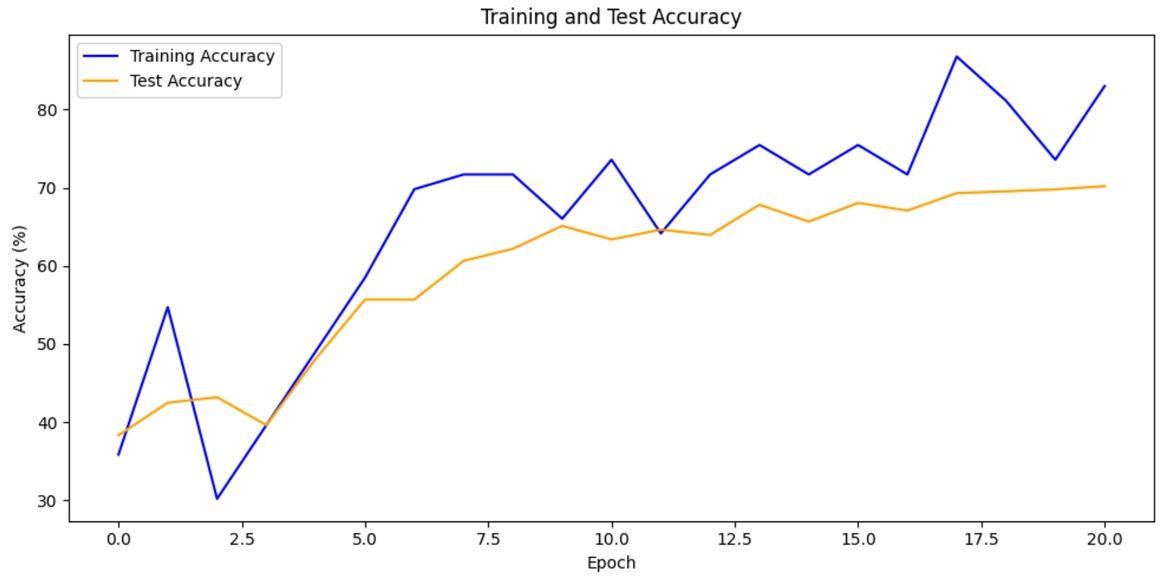
Convolution layer
- **Layer: 3**
- **Activation: Relu**
- **Padding: 2**

Pooling layer
- **Maxpooling**

Optimizer
- **SGD**
- **Learning rate: 0.01**
- **Momentum: 0.5**

Batch size: 64
Epoch: 50
Early Stopping





Epoch = 20	Loss	Accuracy
Train set	0.57	0.81
Valid set	1.03	0.70

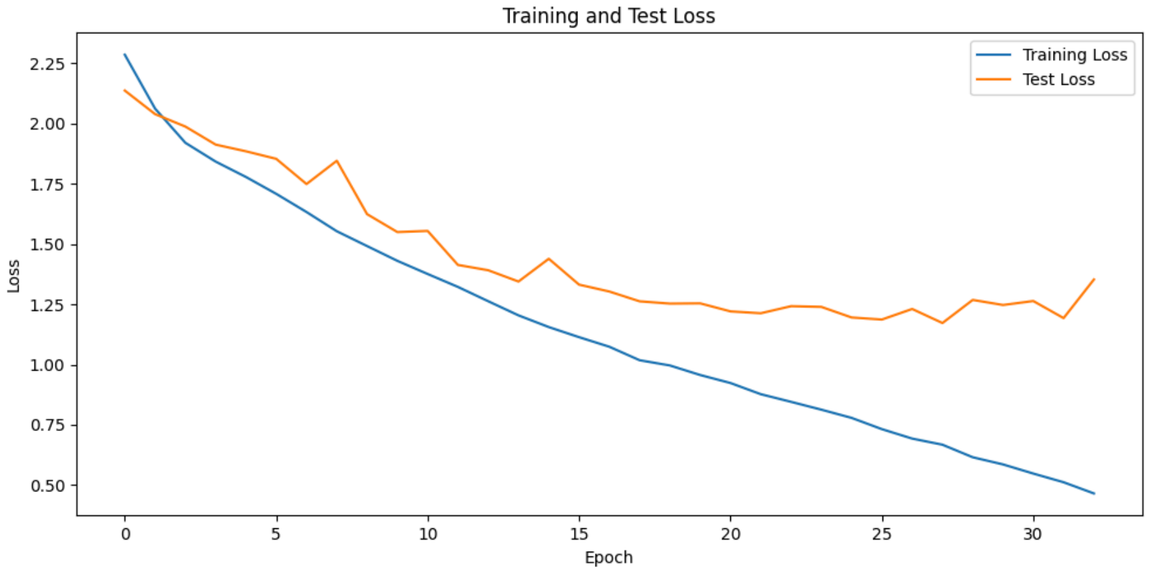
Garbage Classification

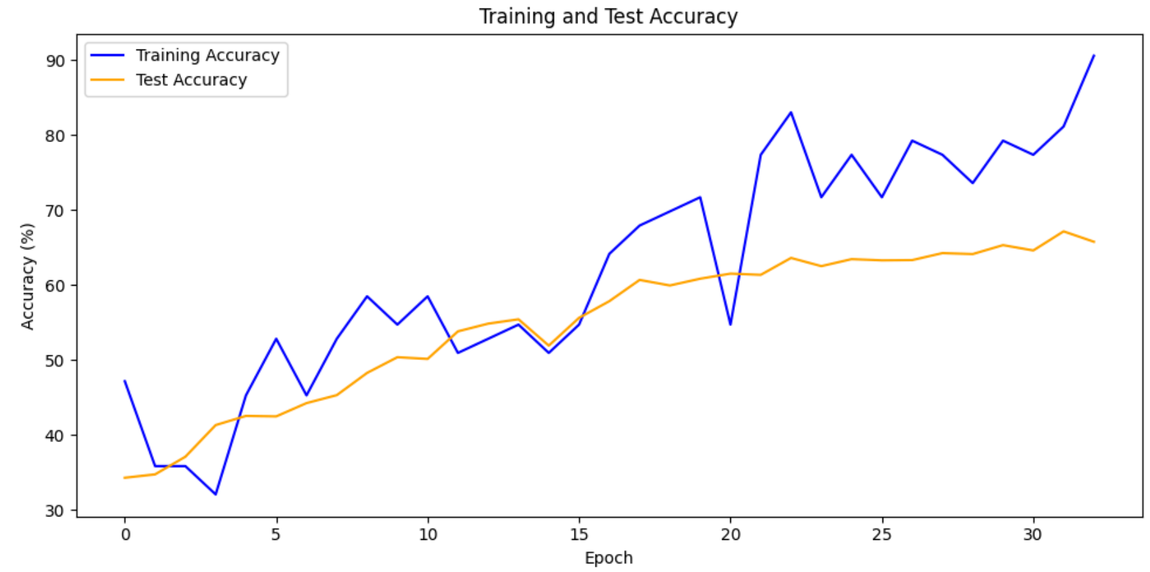
- Model2: Self made Torch model

Parameter Tuning

Layer 추가

- **layer: 3 -> 5**





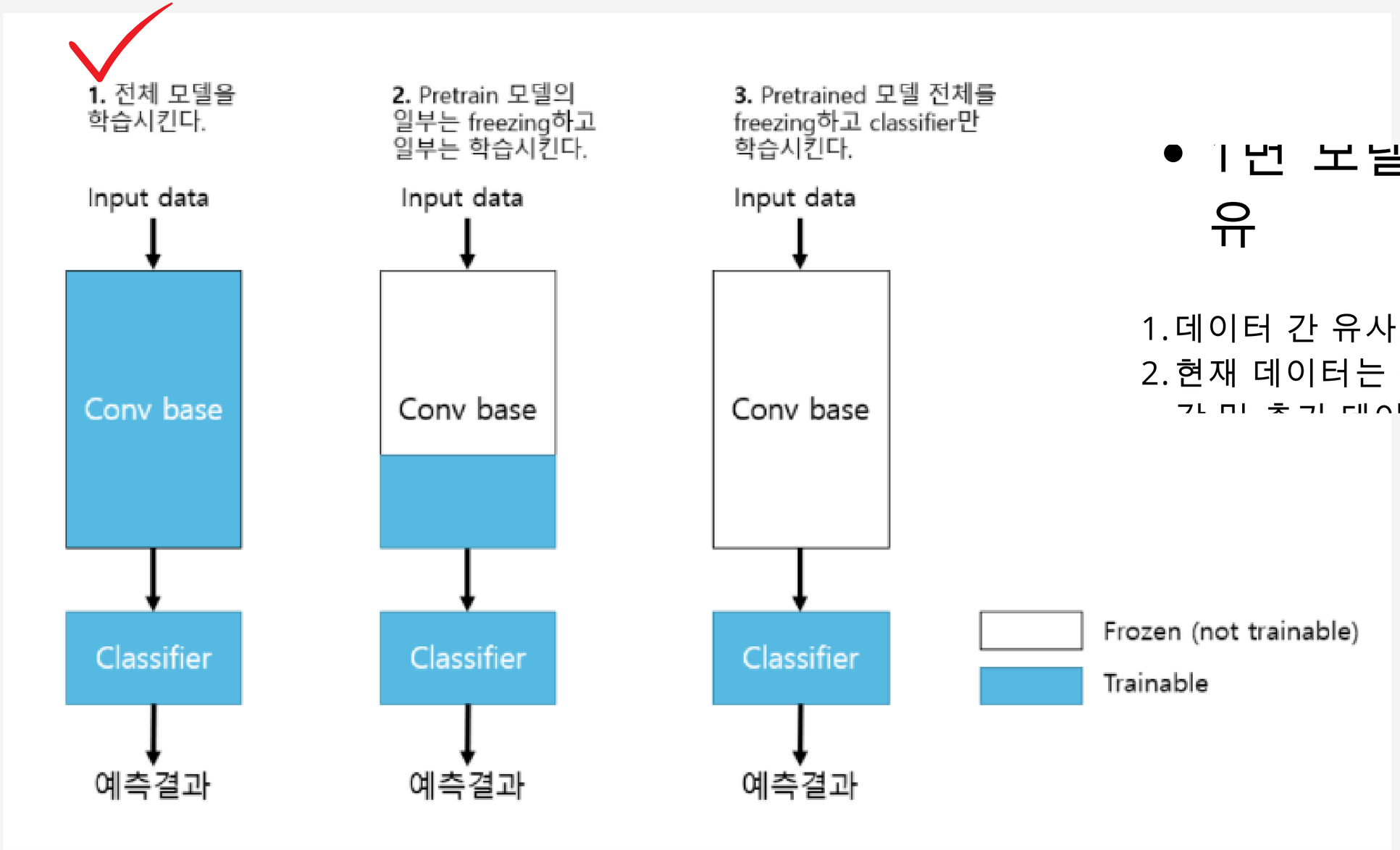
Epoch = 32	Loss	Accuracy
Train set	0.51	0.89
Valid set	1.19	0.67

보완할 내용

1. **Dropout 추가**
2. **L1 or L2 정규화 적용**
3. **Learning rate 조절**
4. **Batch size 조절**

Garbage Classification

- Model3: VGGNet



- 1번 모델 선정 이유

1. 데이터 간 유사도가 낮음
2. 현재 데이터는 적으나 데이터 증

Garbage Classification

- Model3: VGGNet

```
==========================================================================================
Layer (type:depth-idx)                   Output Shape              Param #
==========================================================================================
myVggNet                                 [1, 12]                   --
├─VGG: 1-1                               [1, 12]                   --
|    └─Sequential: 2-1                   [1, 512, 7, 7]            --
|    |    └─Conv2d: 3-1                  [1, 64, 224, 224]         1,792
|    |    └─ReLU: 3-2                    [1, 64, 224, 224]         --
|    |    └─Conv2d: 3-3                  [1, 64, 224, 224]         36,928
|    |    └─ReLU: 3-4                    [1, 64, 224, 224]         --
|    |    └─MaxPool2d: 3-5               [1, 64, 112, 112]         --
|    |    └─Conv2d: 3-6                  [1, 128, 112, 112]        73,856
|    |    └─ReLU: 3-7                    [1, 128, 112, 112]        --
|    |    └─Conv2d: 3-8                  [1, 128, 112, 112]        147,584
|    |    └─ReLU: 3-9                    [1, 128, 112, 112]        --
|    |    └─MaxPool2d: 3-10              [1, 128, 56, 56]          --
|    |    └─Conv2d: 3-11                 [1, 256, 56, 56]          295,168
|    |    └─ReLU: 3-12                   [1, 256, 56, 56]          --
|    |    └─Conv2d: 3-13                 [1, 256, 56, 56]          590,080
|    |    └─ReLU: 3-14                   [1, 256, 56, 56]          --
|    |    └─Conv2d: 3-15                 [1, 256, 56, 56]          590,080
|    |    └─ReLU: 3-16                   [1, 256, 56, 56]          --
|    |    └─Conv2d: 3-17                 [1, 256, 56, 56]          590,080
|    |    └─ReLU: 3-18                   [1, 256, 56, 56]          --
|    |    └─MaxPool2d: 3-19              [1, 256, 28, 28]          --
|    |    └─Conv2d: 3-20                 [1, 512, 28, 28]          1,180,160
|    |    └─ReLU: 3-21                   [1, 512, 28, 28]          --
|    |    └─Conv2d: 3-22                 [1, 512, 28, 28]          2,359,808
|    |    └─ReLU: 3-23                   [1, 512, 28, 28]          --
|    |    └─Conv2d: 3-24                 [1, 512, 28, 28]          2,359,808
|    |    └─ReLU: 3-25                   [1, 512, 28, 28]          --
|    |    └─Conv2d: 3-26                 [1, 512, 28, 28]          2,359,808
|    |    └─ReLU: 3-27                   [1, 512, 28, 28]          --
|    |    └─MaxPool2d: 3-28              [1, 512, 14, 14]          --
|    |    └─Conv2d: 3-29                 [1, 512, 14, 14]          2,359,808
|    |    └─ReLU: 3-30                   [1, 512, 14, 14]          --
|    |    └─Conv2d: 3-31                 [1, 512, 14, 14]          2,359,808
|    |    └─ReLU: 3-32                   [1, 512, 14, 14]          --
|    |    └─Conv2d: 3-33                 [1, 512, 14, 14]          2,359,808
|    |    └─ReLU: 3-34                   [1, 512, 14, 14]          --
|    |    └─Conv2d: 3-35                 [1, 512, 14, 14]          2,359,808
|    |    └─ReLU: 3-36                   [1, 512, 14, 14]          --
|    |    └─MaxPool2d: 3-37              [1, 512, 7, 7]            --
|    └─AdaptiveAvgPool2d: 2-2            [1, 512, 7, 7]            --
|    └─Sequential: 2-3                   [1, 12]                   --
|    |    └─Linear: 3-38                 [1, 4096]                 102,764,544
|    |    └─ReLU: 3-39                   [1, 4096]                 --
|    |    └─Dropout: 3-40                [1, 4096]                 --
|    |    └─Linear: 3-41                 [1, 4096]                 16,781,312
|    |    └─ReLU: 3-42                   [1, 4096]                 --
|    |    └─Dropout: 3-43                [1, 4096]                 --
|    |    └─Linear: 3-44                 [1, 12]                   49,164
==========================================================================================
Total params: 139,619,404
Trainable params: 139,619,404
Non-trainable params: 0
Total mult-adds (Units.GIGABYTES): 19.64
==========================================================================================
Input size (MB): 0.60
Forward/backward pass size (MB): 118.88
Params size (MB): 558.48
Estimated Total Size (MB): 677.96
==========================================================================================
```


```
|    └─Sequential: 2-3                   [1, 12]                   --
|    |    └─Linear: 3-38                 [1, 4096]                 102,764,544
|    |    └─ReLU: 3-39                   [1, 4096]                 --
|    |    └─Dropout: 3-40                [1, 4096]                 --
|    |    └─Linear: 3-41                 [1, 4096]                 16,781,312
|    |    └─ReLU: 3-42                   [1, 4096]                 --
|    |    └─Dropout: 3-43                [1, 4096]                 --
|    |    └─Linear: 3-44                 [1, 12]                   49,164
==========================================================================================
Total params: 139,619,404
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Total mult-adds (Units.GIGABYTES): 19.64
==========================================================================================
Input size (MB): 0.60
Forward/backward pass size (MB): 118.88
Params size (MB): 558.48
Estimated Total Size (MB): 677.96
==========================================================================================
```

Garbage Classification

- Model3: VGGNet

Optimizer
- **SGD**
- **Learning rate: 0.001**
- **Momentum: 0.5**

Batch size: 256
Epoch: 20

Epoch = 5	Loss	Accuracy
Train set	2.13	-
Valid set	1.97	0.40

Optimizer
- **Adam**
- **Learning rate: 0.0001**

Batch size: 256
Epoch: 20

Epoch = 20	Loss	Accuracy
Train set	0.98	-
Valid set	0.90	0.78

Garbage Classification

- Model3: VGGNet

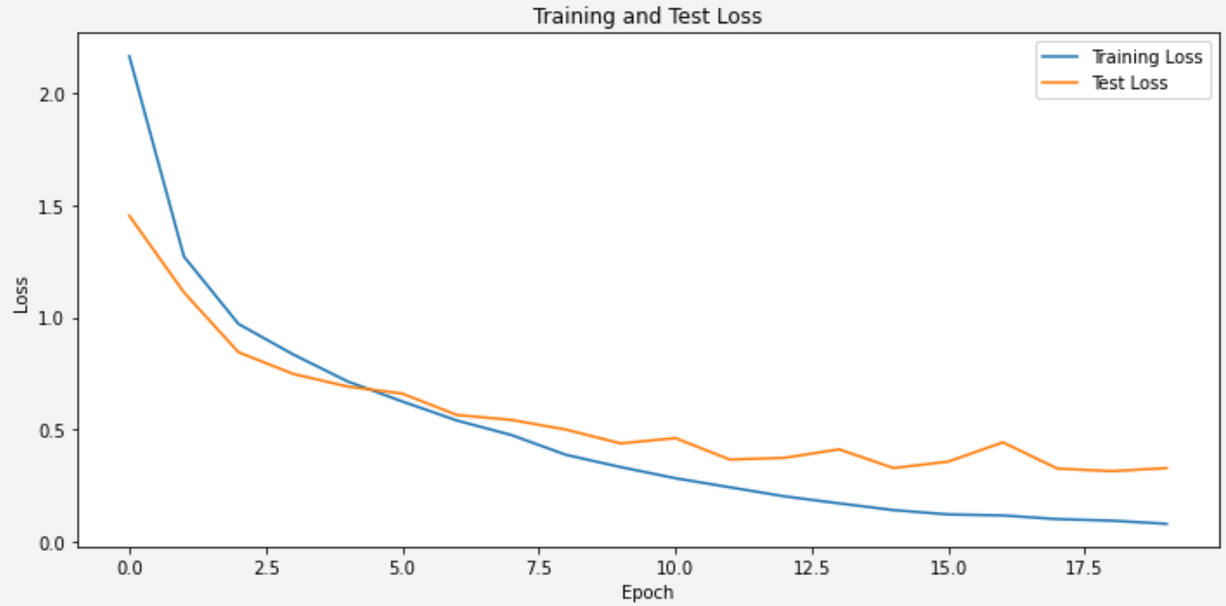
Data Augmentation, Parameter Tuning

Raw data * 3

- **상하, 좌우 반전 추가**

Dropout 추가

- **Dropout: 0.5**



Epoch = 20	Loss	Accuracy
Train set	0.07	0.95
Valid set	0.32	0.91

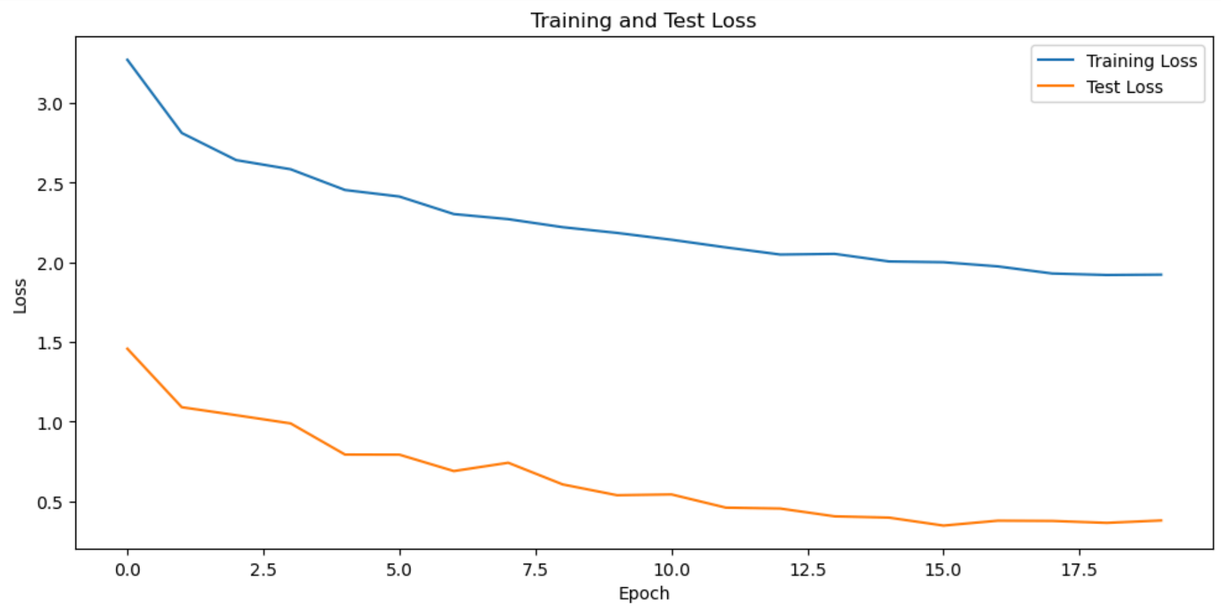
Garbage Classification

- Model3: VGGNet

Data Augmentation

Raw Data * 4

- 상하, 좌우, 상하좌우 반전 추가



Epoch = 20	Loss	Accuracy
Train set	2.12	0.72
Valid set	0.49	0.90

Garbage Classification

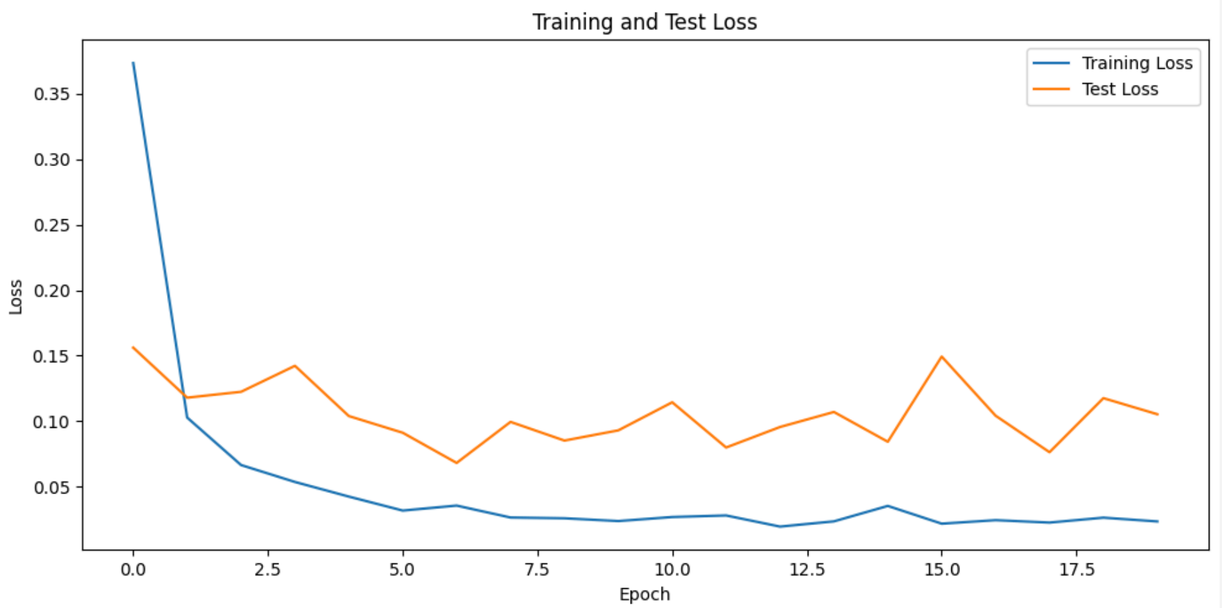
- Model3: VGGNet

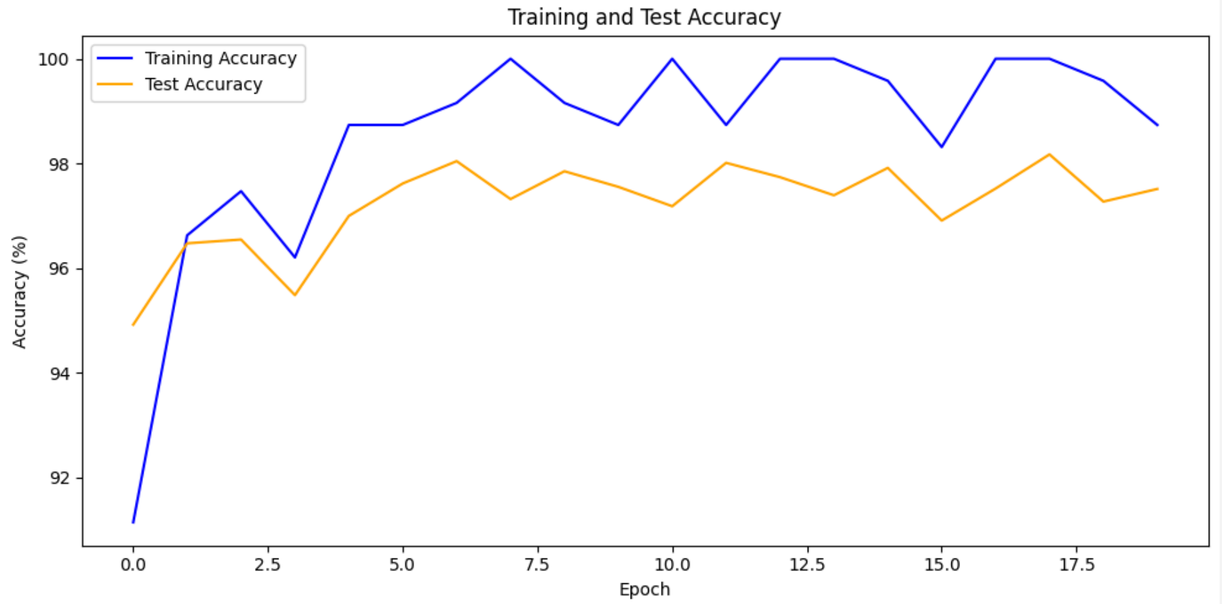
Sequential Tuning

VGG19의 Default
가중치 적용

Sequential Dropout
변경

- **Dropout: 0.5 -> 0.3**





Epoch = 20	Loss	Accuracy
Train set	0.02	0.98
Valid set	0.12	0.97

Clothes Classification

- Data

데이터 수: 44000개

Label: 9개

0: 가방
1: 밸트
2: 하의
3: 안경
4: 속옷
5: 신발
6: 상의
7: 지갑
8: 시계

Clothes Classification

- Preprocessing

Label(45개)

'Topwear', 'Bottomwear', 'Watches', 'Socks', 'Shoes', 'Belts', 'Flip Flops', 'Bags', 'Innerwear', 'Sandal', 'Shoe Accessories', 'Fragrance', 'Jewellery', 'Lips', 'Saree', 'Eyewear', 'Nails', 'Scarves', 'Dress', 'Loungewear and Nightwear', 'Wallets', 'Apparel Set', 'Headwear', 'Mufflers', 'Skin Care', 'Makeup', 'Free Gifts', 'Ties', 'Accessories', 'Skin', 'Beauty Accessories', 'Water Bottle', 'Eyes', 'Bath and Body', 'Gloves', 'Sports Accessories', 'Cufflinks', 'Sports Equipment', 'Stoles', 'Hair', 'Perfumes', 'Home Furnishing', 'Umbrellas', 'Wristbands', 'Vouchers'

의류를 제외한 품목 제거,
의류 하위 품목 상위 품목에 추가

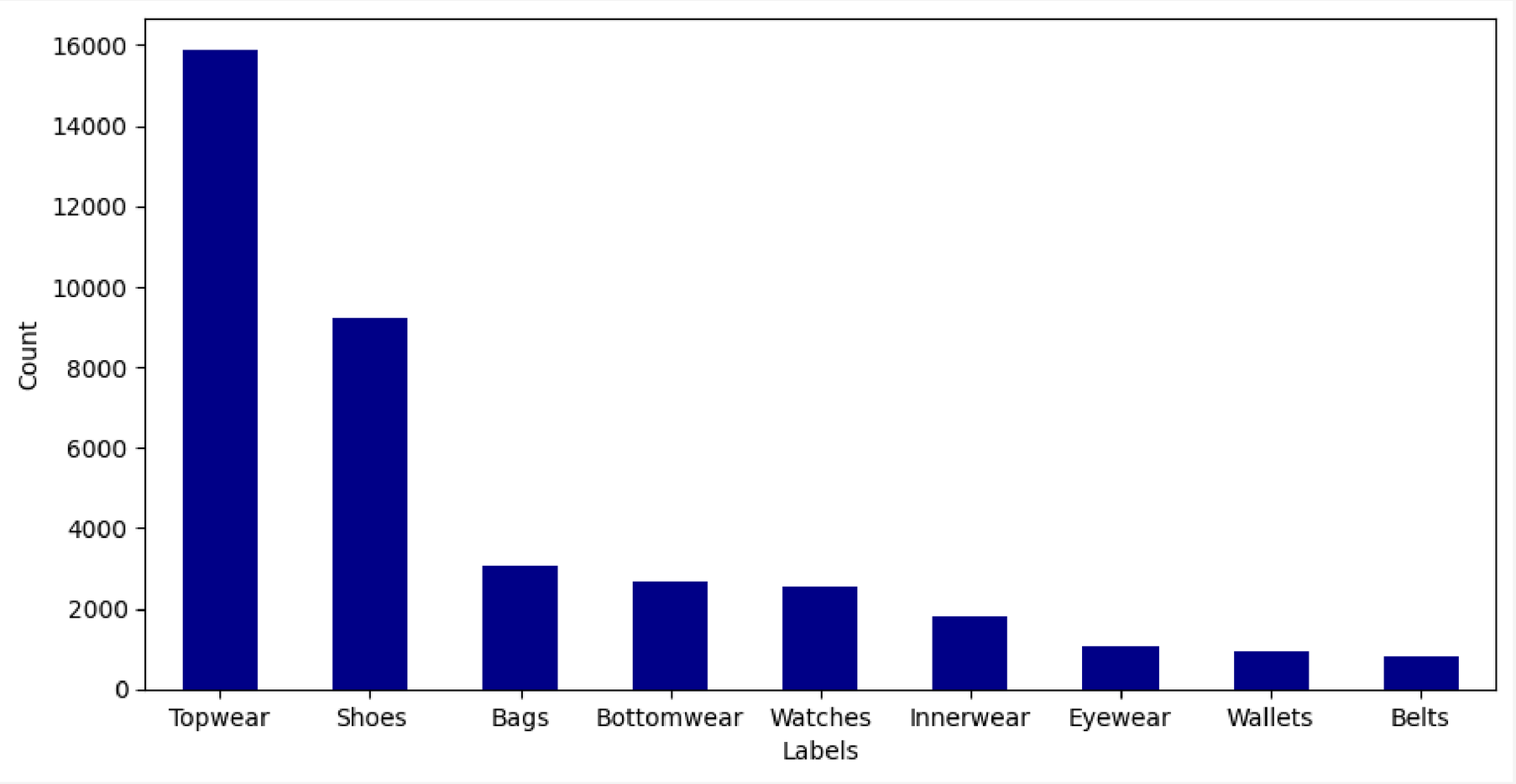
Reseted Label(9개)

'Topwear', 'Bottomwear' 'Watches', 'Shoes', 'Belts' 'Bags', 'Innerwear', 'Eyewear', 'Wallets'

Garbage Classification

- Label

label	
Topwear	41.77%
Shoes	24.26%
Bags	8.04%
Bottomwear	7.09%
Watches	6.69%
Innerwear	4.76%
Eyewear	2.82%
Wallets	2.45%
Belts	2.13%



Clothes Classification

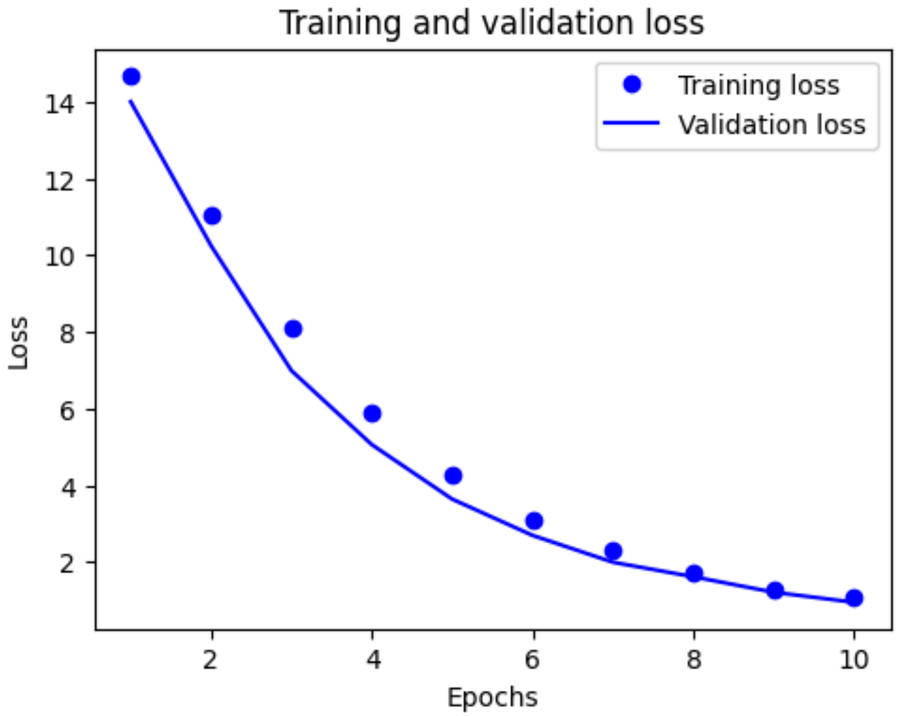
- Model1: Self made Tensor model

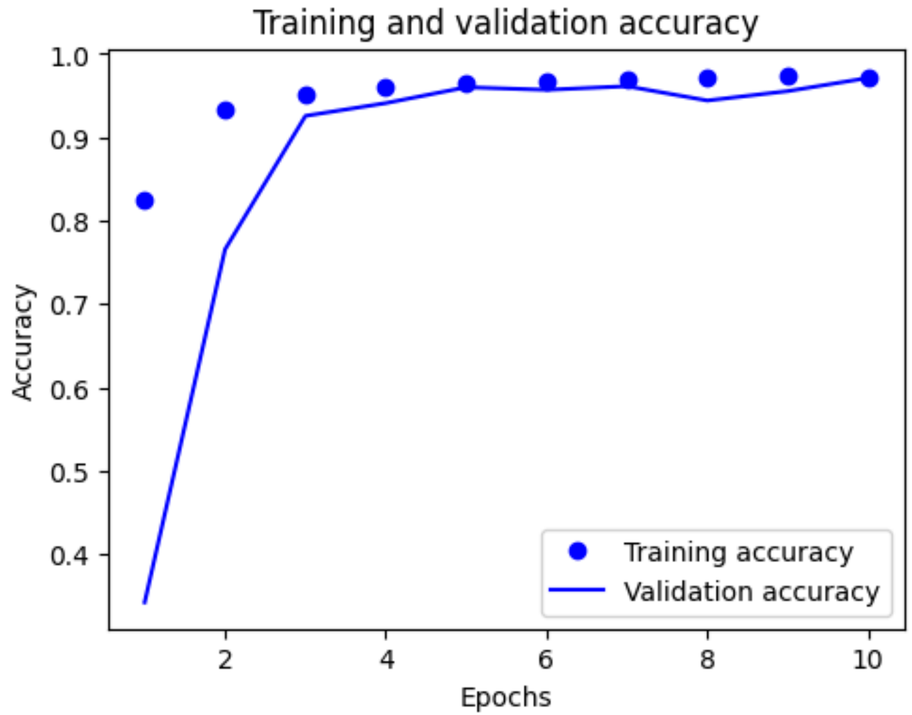
Convolution layer
- **Layer: 6**
- **Activation: Relu**
- **Padding: Same**
- **L2 regularizer**
- **Dropout: 0.2**

Pooling layer
- **Maxpooling**

Optimizer
- **Adam**
- **Learning rate: 0.0002**

Batch size: 128
Epoch: 10
Early Stopping





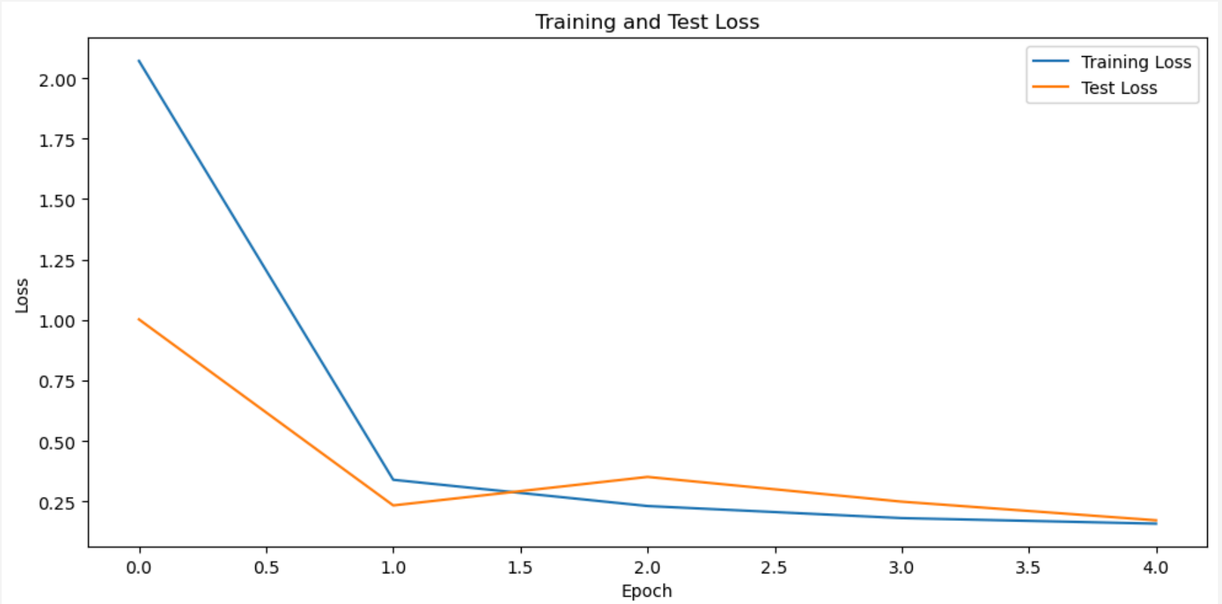
Epoch = 18	Loss	Accuracy
Train set	1.07	0.97
Valid set	0.95	0.97

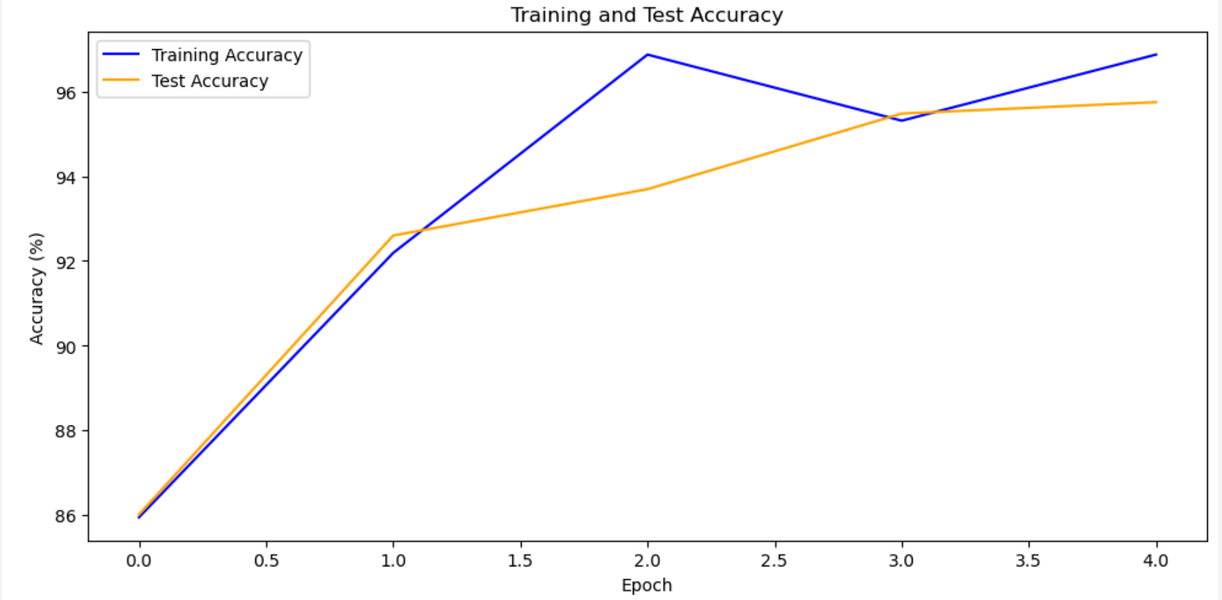
Clothes Classification

- Model2: ResNet

Optimizer
- **Adam**
- **Learning rate: 0.03**

Batch size: 128
Epoch: 5





Epoch = 5	Loss	Accuracy
Train set	0.15	0.97
Valid set	0.17	0.96

추가 내용

모델 보완할 사항

- openCV의 Rotation을 활용하여 데이터를 증강
- VGGNet 모델의 Convolution base frozen

추가 고려사항

- 의류 데이터에서 상의가 차지하는 비중이 크므로 데이터를 증강할 때, 상의 데이터를 제외한 나머지 데이터를 증강하여 데이터의 수를 비슷하게 맞추면 모델의 재현성이 좋아지지 않을까?
- 의류 분류 모델에 “의류가 아님“이라는 라벨을 추가하여 쓰레기 분류 모델에서 분류되지 않은 데이터를 의류 분류 모델에서 분류하는 것도 고려해보면 좋을 것 같다.