성능비교

2. Classification

3) Model Info

▼ Code

```
# Hyper Parameter
BATCH_SIZE = 32
EPOCHS = 45

# learning rate decay(step) parameter
STEP_SIZE = 15
GAMMA = 0.1

''' 6. ResNet 모델 설계 ResNet 18 참고'''

class BasicBlock(nn.Module):
  def __init__(self, in_planes, planes, stride = 1):
    super(BasicBlock, self).__init__()
    self.conv1 = nn.Conv2d(in_planes, planes,
                           kernel_size = 3,
                           stride = stride,
                           padding = 1,
                           bias = False)
    self.bn1 = nn.BatchNorm2d(planes)
    self.conv2 = nn.Conv2d(planes, planes,
                           kernel_size = 3,
                           stride = 1,
                           padding = 1,
                           bias = False)
    self.bn2 = nn.BatchNorm2d(planes)

    # shortcut 정의
    self.shortcut = nn.Sequential()
    # 차원이 다른경우
    if stride != 1 or in_planes != planes:
      self.shortcut = nn.Sequential(
          nn.Conv2d(in_planes, planes,
                    kernel_size = 1,
                    stride = stride,
                    bias = False),
          nn.BatchNorm2d(planes)
      )

  def forward(self, x):
    out = F.relu(self.bn1(self.conv1(x)))
    out = self.bn2(self.conv2(out))
    # skip connection
    out += self.shortcut(x)
    out = F.relu(out)
    return out

class ResNet(nn.Module):
  def __init__(self, num_classes = 10):
    super(ResNet, self).__init__()
```

```
    self.in_planes = 64

    self.conv1 = nn.Conv2d(3, 64,
                           kernel_size = 3,
                           stride = 1,
                           padding = 1,
                           bias = False)
    self.bn1 = nn.BatchNorm2d(64)
    self.layer1 = self._make_layer(64, 2, stride = 1)
    self.layer2 = self._make_layer(128, 2, stride = 2)
    self.layer3 = self._make_layer(256, 2, stride = 2)
    self.layer4 = self._make_layer(512, 2, stride = 2)
    self.linear = nn.Linear(512, num_classes)

  def _make_layer(self, planes, num_blocks, stride):
    strides = [stride] + [1] * (num_blocks - 1)
    layers = []
    for stride in strides:
      layers.append(BasicBlock(self.in_planes, planes, stride))
      self.in_planes = planes
    return nn.Sequential(*layers)

  def forward(self, x):
    out = F.relu(self.bn1(self.conv1(x)))
    out = self.layer1(out)
    out = self.layer2(out)
    out = self.layer3(out)
    out = self.layer4(out)
    out = F.adaptive_avg_pool2d(out, 1)
    out = out.view(out.size(0), -1)
    out = self.linear(out)
    return out


''' 7. Optimizer, Objective Fucntion 설정 '''
model = ResNet().to(DEVICE)
# SGD(확률적 경사하강법) 적용, L2 Regularization 적용
optimizer = torch.optim.SGD(model.parameters(), lr=0.01, momentum=0.9)
# Step decay 적용
scheduler = torch.optim.lr_scheduler.StepLR(optimizer, step_size=STEP_SIZE, gamma=GAMMA)
criterion = nn.CrossEntropyLoss()
lrs = []
```

▼ Info

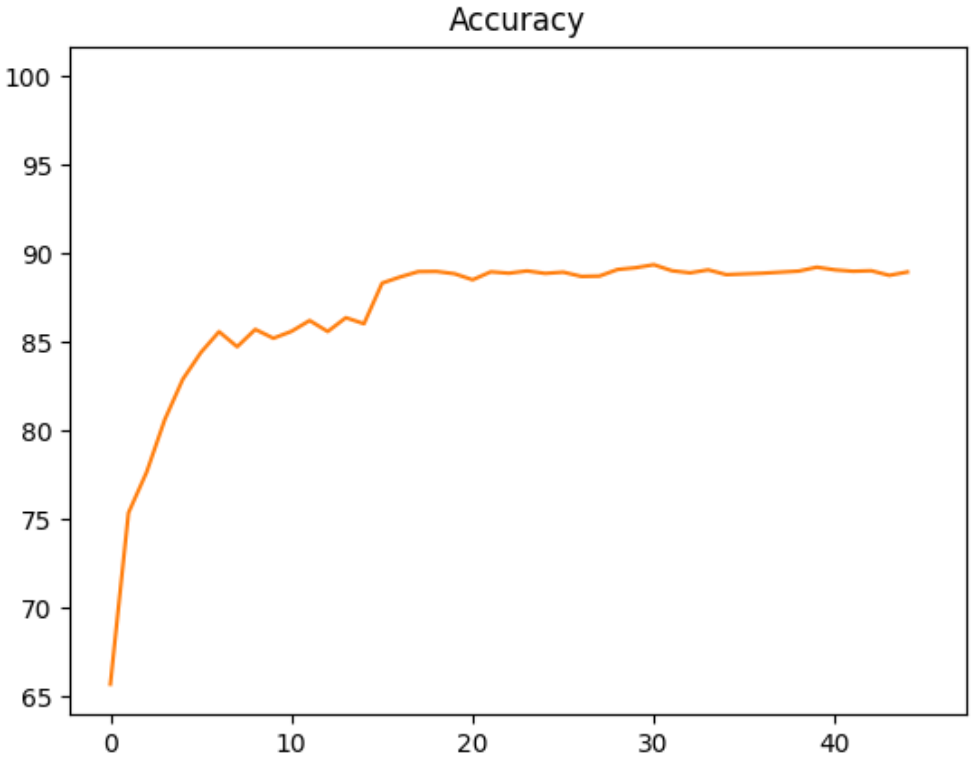
```
ResNet(
  (conv1): Conv2d(3, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
  (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
  (layer1): Sequential(
    (0): BasicBlock(
      (conv1): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential()
    )
    (1): BasicBlock(
      (conv1): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
```

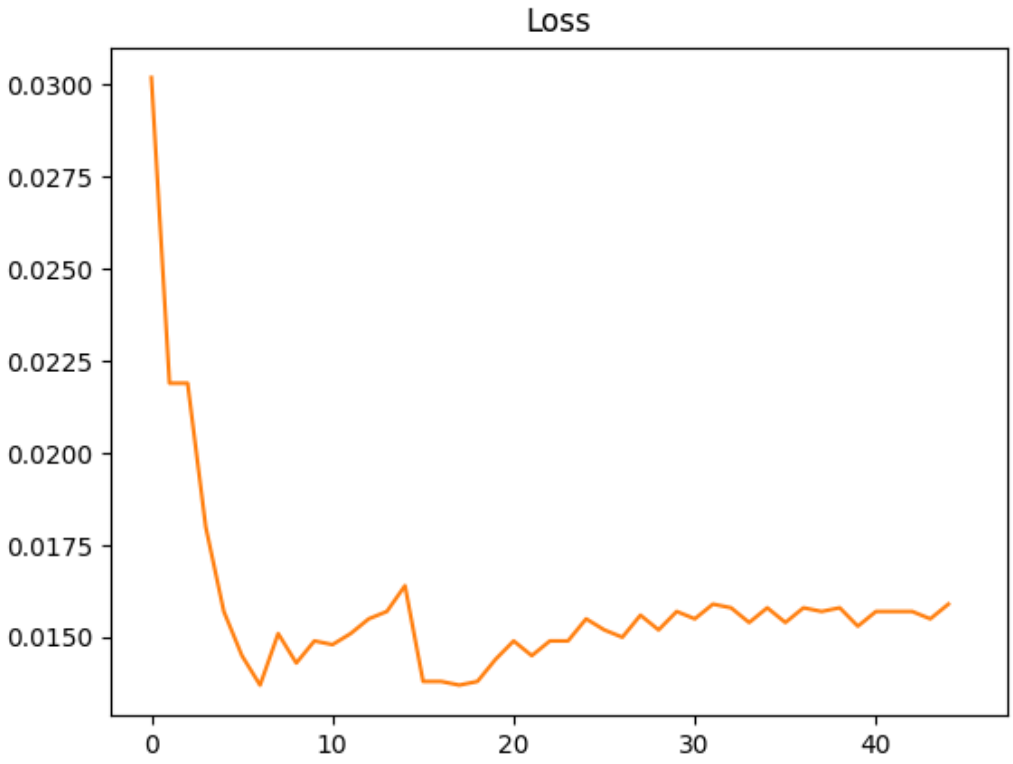
```
      (shortcut): Sequential()
    )
  )
  (layer2): Sequential(
    (0): BasicBlock(
      (conv1): Conv2d(64, 128, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential(
        (0): Conv2d(64, 128, kernel_size=(1, 1), stride=(2, 2), bias=False)
        (1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      )
    )
    (1): BasicBlock(
      (conv1): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential()
    )
  )
  (layer3): Sequential(
    (0): BasicBlock(
      (conv1): Conv2d(128, 256, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential(
        (0): Conv2d(128, 256, kernel_size=(1, 1), stride=(2, 2), bias=False)
        (1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      )
    )
    (1): BasicBlock(
      (conv1): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential()
    )
  )
  (layer4): Sequential(
    (0): BasicBlock(
      (conv1): Conv2d(256, 512, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(512, 512, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential(
        (0): Conv2d(256, 512, kernel_size=(1, 1), stride=(2, 2), bias=False)
        (1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      )
    )
    (1): BasicBlock(
      (conv1): Conv2d(512, 512, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (conv2): Conv2d(512, 512, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False)
      (bn2): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
      (shortcut): Sequential()
    )
  )
  (linear): Linear(in_features=512, out_features=10, bias=True)
)
```

- step decay 15epoch기준 gamma 0.1 적용
- SGD, momentum 0.9 적용
- Layer가 너무 얕고 필터가 적어 정확도가 떨어지는 문제점 보완

1) Original vs Resize_x2 vs SR_x2

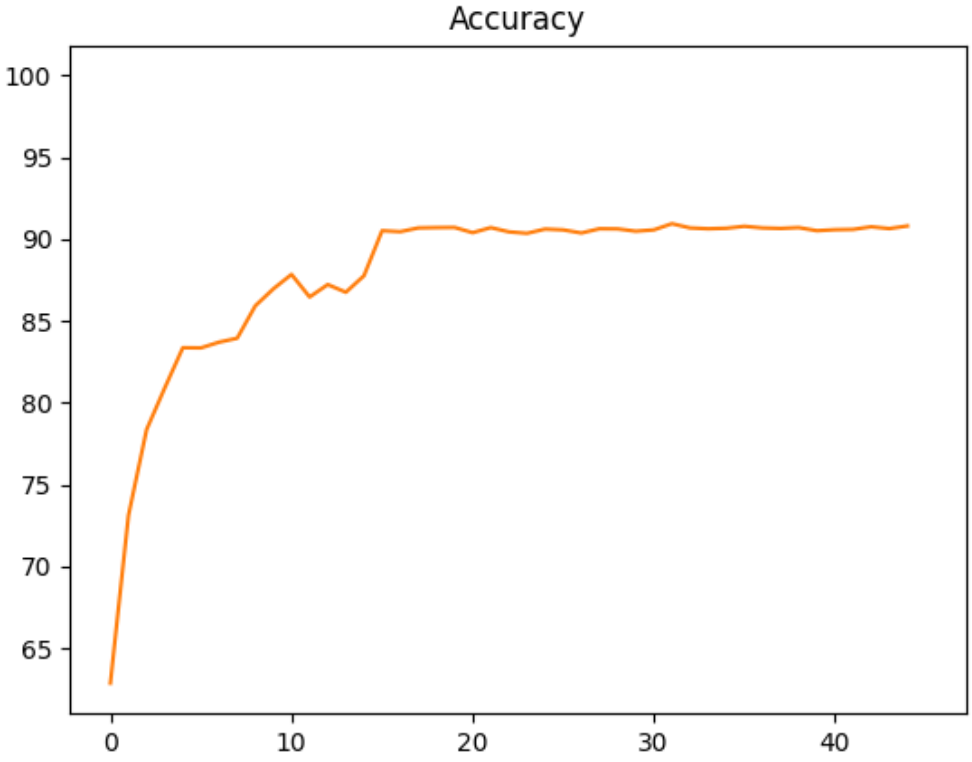
(1) Original

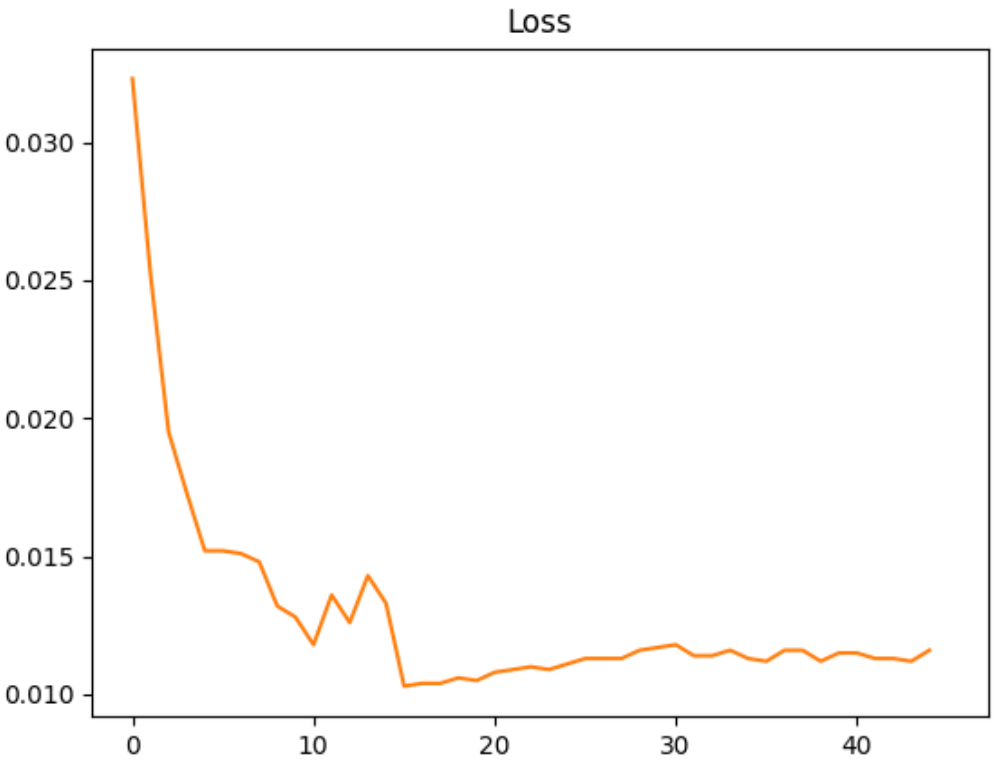




- max accuracy: **89.38%**
- top 5 average accuracy: **89.206%**

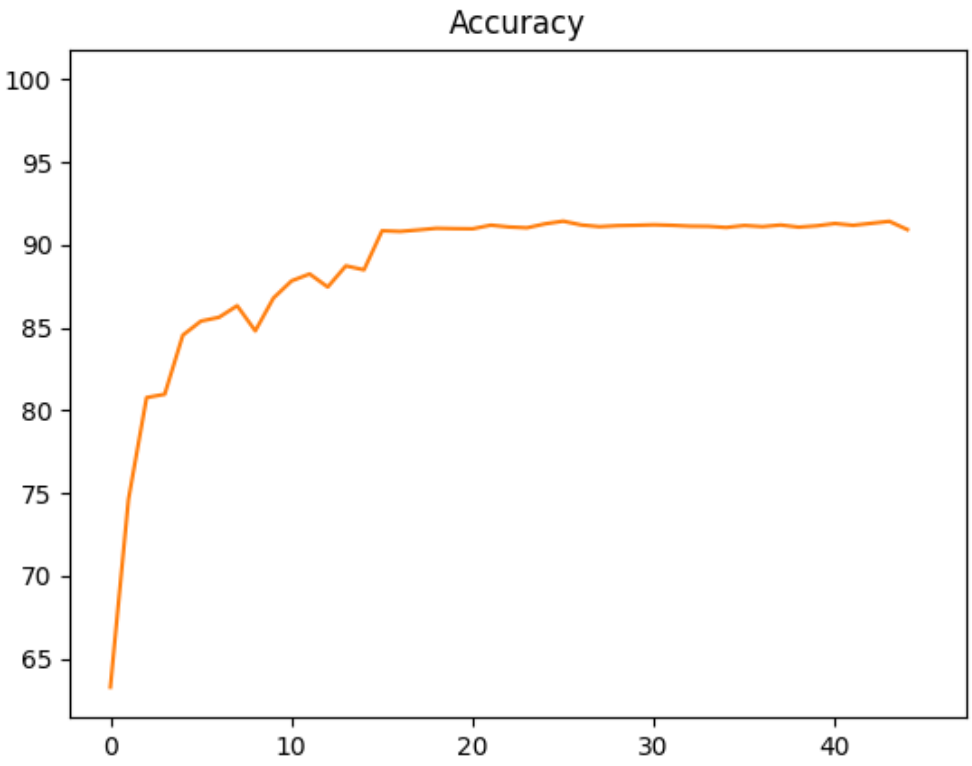
(2) Resize_x2


Accuracy
100
95
90
85
80
75
70
65
0
10
20
30
40

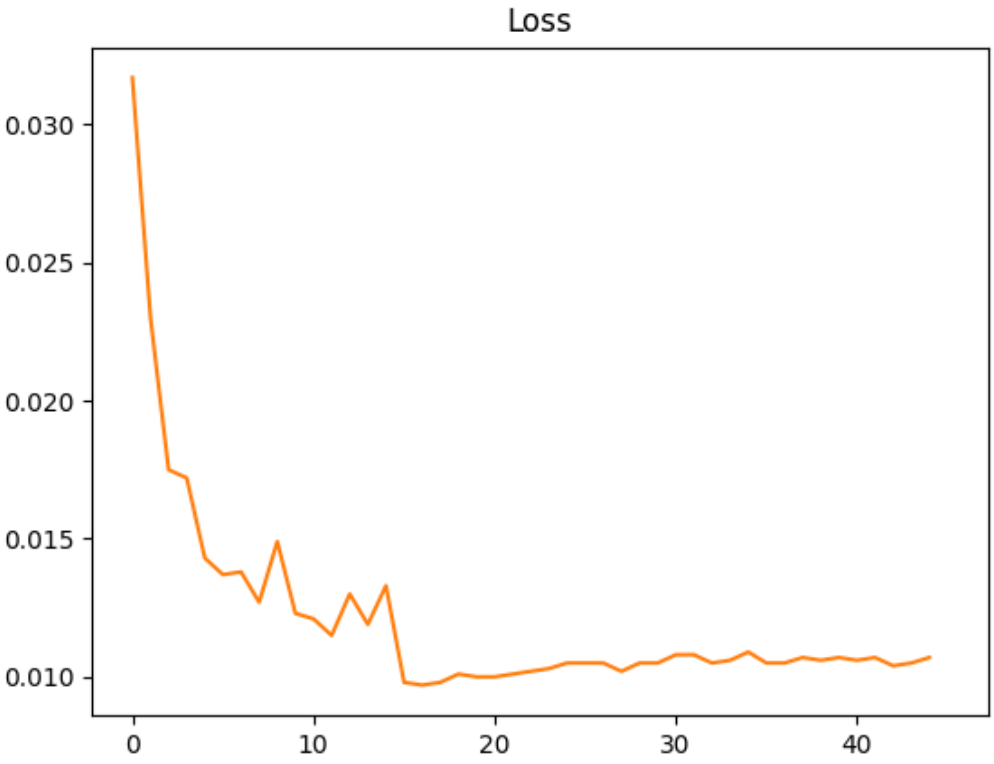

Loss
0.030
0.025
0.020
0.015
0.010
0
10
20
30
40

- max accuracy: **90.95%**
- top 5 average accuracy: **90.804%**

(3) SR_x2



- max accuracy: **91.44%**
- top 5 average accuracy: **91.352%**

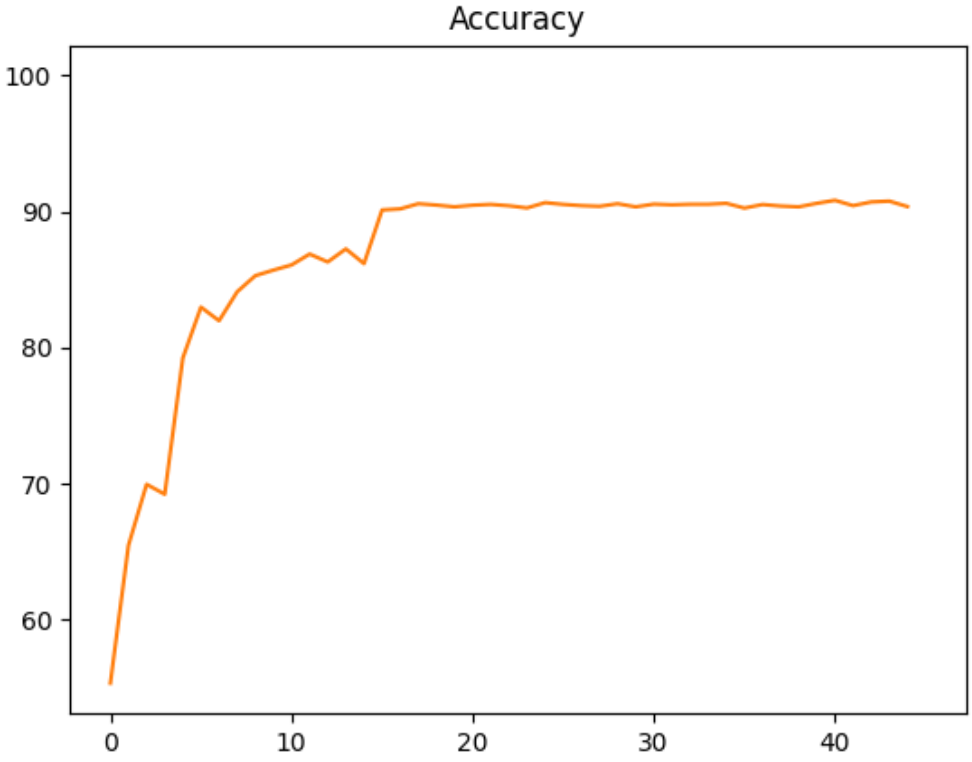


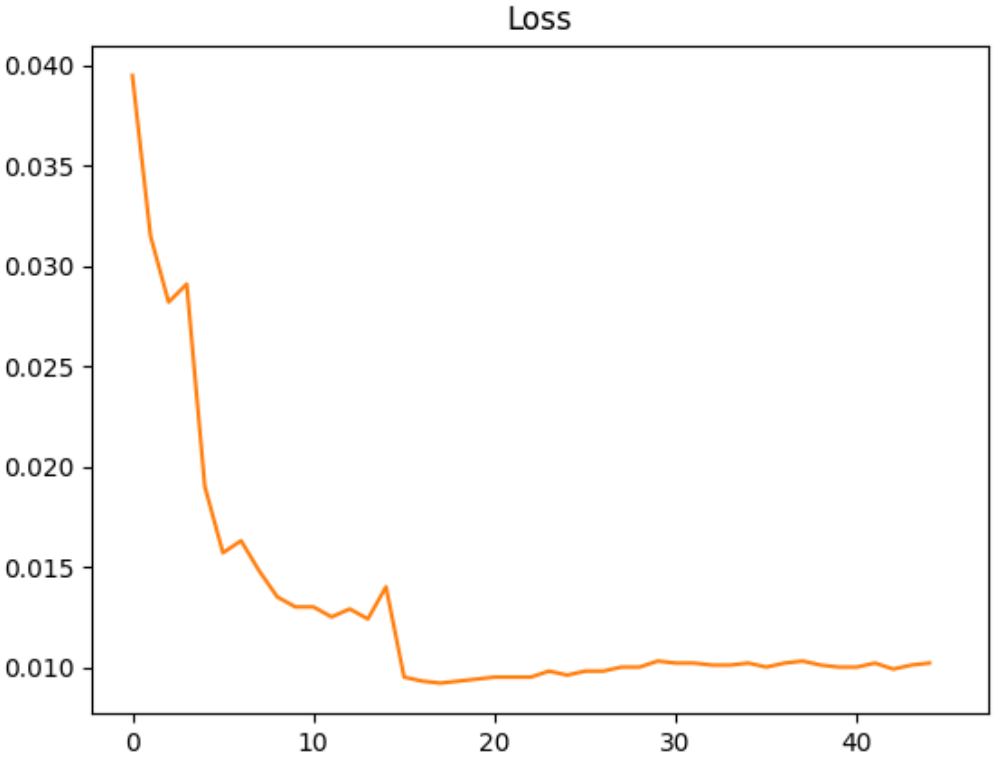
(4) 비교

- SR x2 vs resize x2 ⇒ top 5 accuracy 평균 **0.548%** 차이
- SR x2 vs original ⇒ top 5 accuracy 평균 **2.146%** 차이

2) Resize_x4 vs SR_x4

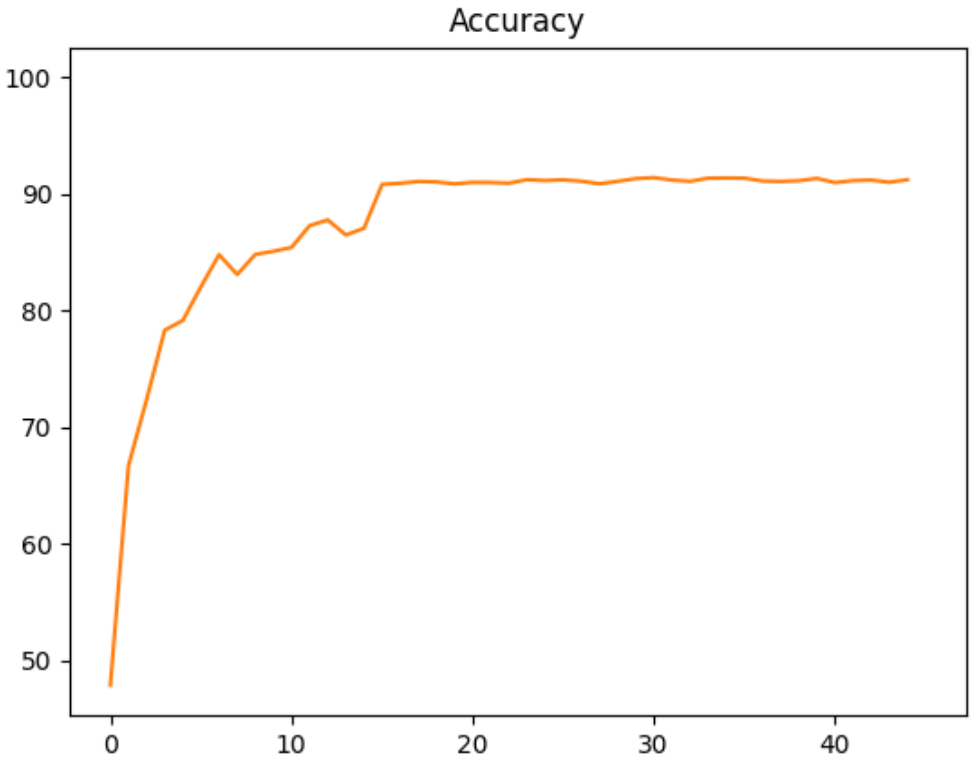
(1) Resize_x4

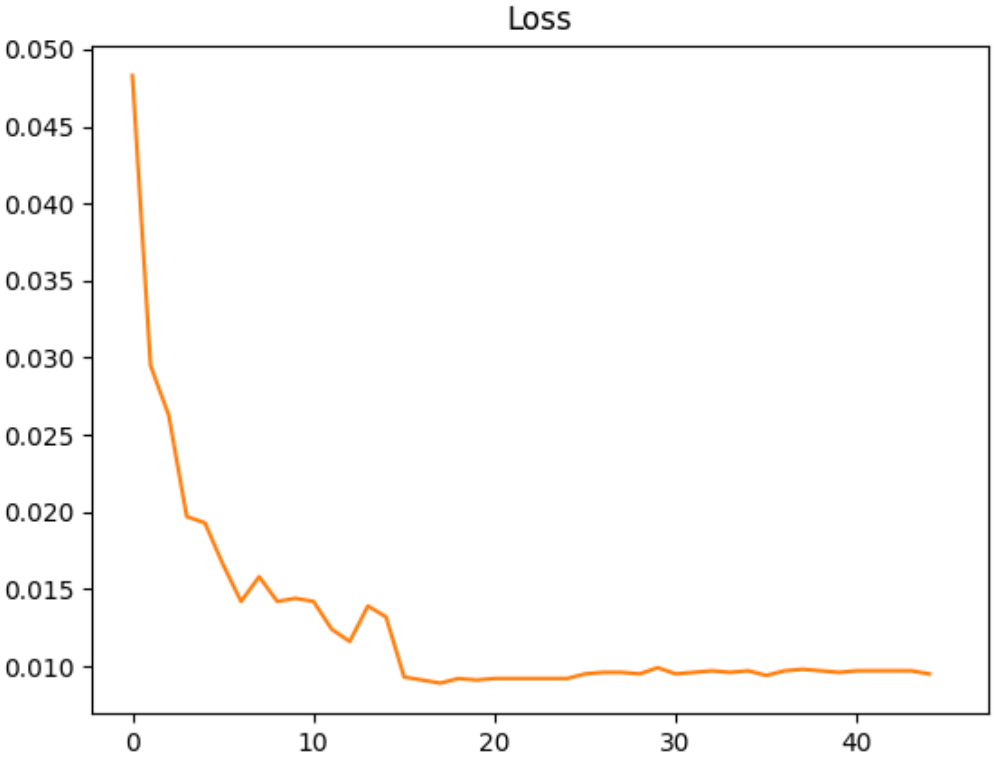

Accuracy
100
90
80
70
60
0
10
20
30
40


Loss
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0
10
20
30
40

- max accuracy: **90.83%**
- top 5 average accuracy: **90.72%**

(2) SR_x4





- max accuracy: **91.42%**
- top 5 average accuracy: **91.38%**

(3) 비교

- SR x4 vs resize x4 ⇒ top 5 accuracy 평균 **0.66%** 차이
- SR x4 vs original ⇒ top 5 accuracy 평균 **2.174%** 차이