Computer Vision HW2 Report

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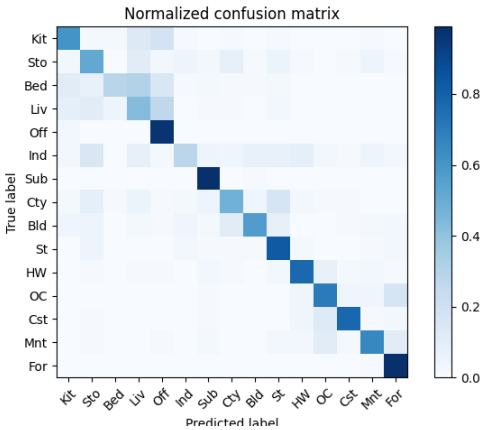
Part 1. (10%)

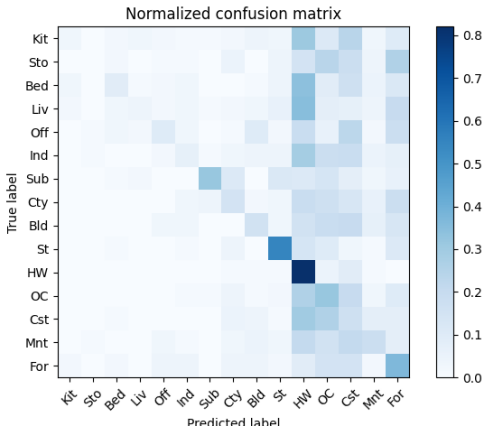
• Plot confusion matrix of two settings. (i.e. Bag of sift and tiny image) (5%)

Ans:

Bag of sift



Tiny image



• Compare the results/accuracy of both settings and explain the result. (5%)

Ans:

The accuracy of Bag of sift is 65.8% and Tiny image is 22.4%. The reason Tiny image has worse result is that it gets feature by simply resizing the image. From the above plot we can see that for Bag of sift, the true label and predicted label have better matches than Tiny image.

Part 2. (25%)

• Report accuracy of both models on the validation set. (2%)

Ans:

	Accuracy
MyNet	59.2%
ResNet18	87.9%

• Print the network architecture & number of parameters of both models. What is the main difference between ResNet and other CNN architectures? (5%)

Ans:

The main difference between the two architecture is the number of layers and parameters. ResNet18 has 18 layers and about 11M parameters, MyNet has only two layers and 128k parameters.

ResNet18: (Total params: 11,173,962)

```
ResNet18(
  (resnet): 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)
    (relu): ReLU(inplace=True)
    (maxpool): Identity()
    (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)
        (relu): ReLU(inplace=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)
      )
      (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)
        (relu): ReLU(inplace=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)
      )
    )
    (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)
        (relu): ReLU(inplace=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)
        (downsample): 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)
        (relu): ReLU(inplace=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)
      )
    )
```

```
    (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)
        (relu): ReLU(inplace=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)
        (downsample): 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)
        (relu): ReLU(inplace=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)
      )
    )
    (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)
        (relu): ReLU(inplace=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)
        (downsample): 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)
        (relu): ReLU(inplace=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)
      )
    )
    (avgpool): AdaptiveAvgPool2d(output_size=(1, 1))
    (fc): Linear(in_features=512, out_features=10, bias=True)
  )
)
Total params: 11173962
```

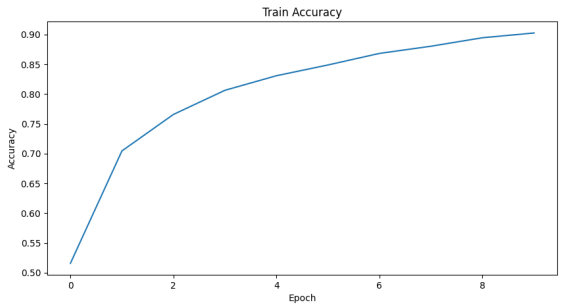
MyNet: (Total params: 128,050)

```
MyNet(
  (conv1): Conv2d(3, 8, kernel_size=(3, 3), stride=(1, 1))
  (bn1): BatchNorm2d(8, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
  (relu1): ReLU(inplace=True)
  (pool1): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
  (conv2): Conv2d(8, 24, kernel_size=(3, 3), stride=(1, 1))
  (bn2): BatchNorm2d(24, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
  (relu2): ReLU(inplace=True)
  (pool2): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
  (fc1): Linear(in_features=864, out_features=144, bias=True)
  (fc2): Linear(in_features=144, out_features=10, bias=True)
)
Total params: 128050
```

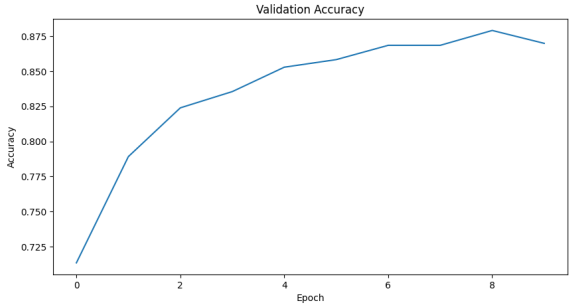
• Plot four learning curves (loss & accuracy) of the training process (train/validation) for both models. Total 8 plots. (8%)
Ans:

ResNet18

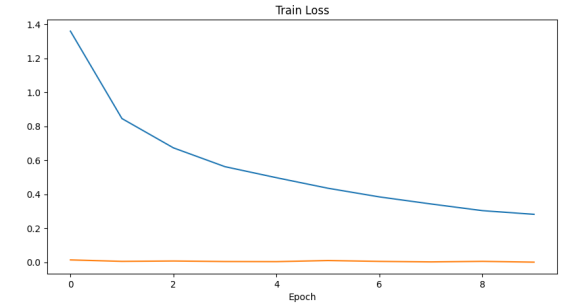
Train Accuracy



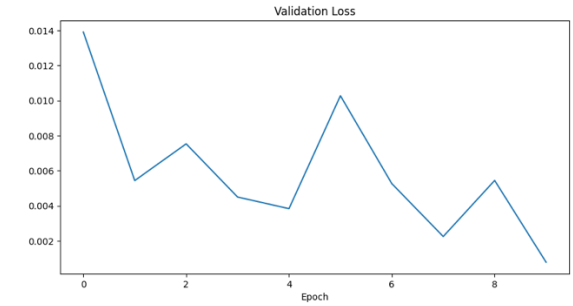
Validation Accuracy



Train Loss (ignore the yellow line)

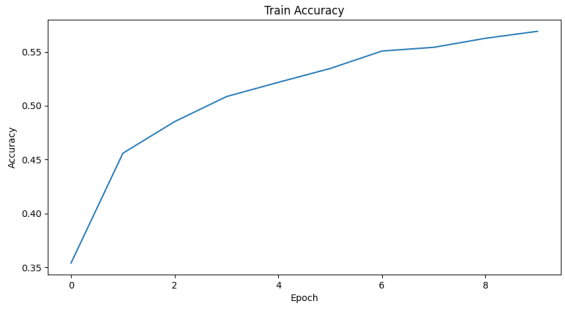


Validation Loss

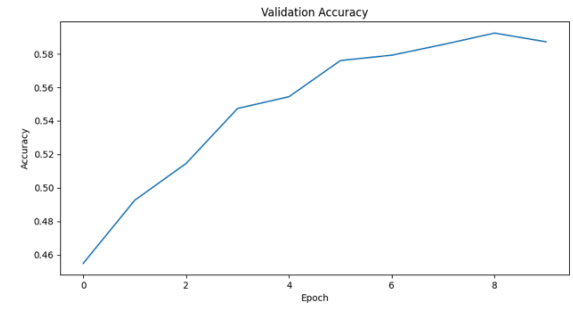


MyNet

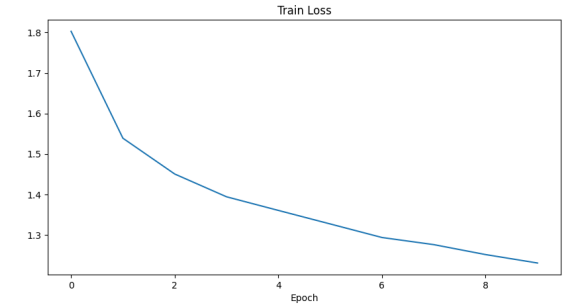
Train Accuracy



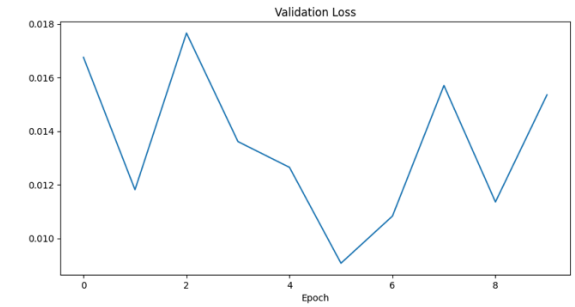
Validation Accuracy



Train Loss



Validation Loss



• Briefly describe what method do you apply on your best model? (e.g. data augmentation, model architecture, loss function, etc) (10%)

Ans:

1. **Data Augmentation:**
    a. **Random Horizontal Flip with prob=0.5**
    b. **Random Rotation within 15 degrees**
    c. **Color Jitter with brightness=0.2, contrast=0.2, saturation=0.2 and hue=0.1**

```
##### TODO: Data Augmentation Begin #####
transforms.RandomHorizontalFlip(p=0.5),
transforms.RandomRotation(degrees=15),
transforms.ColorJitter(brightness=0.2, contrast=0.2, saturation=0.2, hue=0.1),

##### TODO: Data Augmentation End #####
```

2. **Model Architecture**
    a. **Reduce the kernel size of first convolution layer from 7 to 3, and modify the stride and padding to 1.**
    b. **Remove the maxpool layer and replace with Identity().**

```
self.resnet.conv1 = nn.Conv2d(3, 64, kernel_size=3, stride=1, padding=1, bias=False)
self.resnet.maxpool = nn.Identity()
```