AlexNet

April 16, 2019

0.1 Loading Files from drive

The command below is to load files from drive

```
In [0]: from google.colab import drive
        drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/co
```

0.2 Importing Libraries

Numpy, Pandas, Torch, PIL, Torchvision, matplotlib and os libraries are imported

```
In [0]: import numpy as np
        import pandas as pd
        import os
        import torch
        import torchvision
        from PIL import Image
        import matplotlib.pyplot as plt
        from torch.utils.data import Dataset
        from torchvision import datasets, models, transforms
```

0.3 Dataset loading

The dataset class is inherited and customized as per the dataset given. RandomResizedCrop, RandomHorizontalFlip are used as data augmentation techniques. The dataset is also normalized to obtain better results.

```
In [0]: class DataSet(Dataset):
            def __init__(self, root_dir, total_no, csv_file, transform=None):
                self.root_dir = root_dir
                self.transform = transform
                self.total_no = total_no
                self.csv_file = np.array(pd.read_csv(csv_file, header=None))[0]

            def __len__(self):
                return self.total_no
```

```
        def __getitem__(self, image_no):
            img_name = os.path.join(self.root_dir, str(image_no+1)+".jpg")
            image = Image.open(img_name)
            sample = {'image': image, 'category': self.csv_file[image_no]-1}
            if self.transform:
                sample['image'] = self.transform(sample['image'])
            return sample

    trainDataset = DataSet('/content/drive/My Drive/HW3_data/train/',
                           1888,
                           '/content/drive/My Drive/HW3_data/train_labels.csv',
                           transforms.Compose([
            transforms.RandomResizedCrop(224),
            transforms.RandomHorizontalFlip(),
            transforms.ToTensor(),
            transforms.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])
        ]))
    testDataset = DataSet('/content/drive/My Drive/HW3_data/test/', 800,
                          '/content/drive/My Drive/HW3_data/test_labels.csv',
                          transforms.Compose([
            transforms.Resize(256),
            transforms.CenterCrop(224),
            transforms.ToTensor(),
            transforms.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])
        ]))
```

0.4 Dataloaders for loading the datasets defined

Train and test dataloaders are defined with batch size 4, number of workers 4 and shuffling while loading data has been enabled.

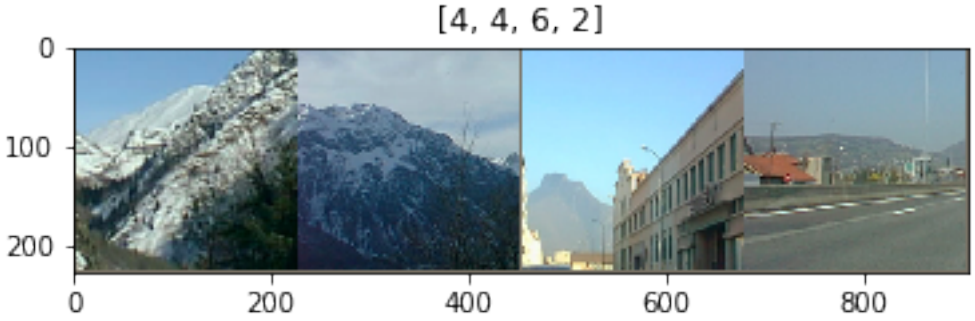
```
In [0]: trainDataloader = torch.utils.data.DataLoader(trainDataset, batch_size=4,
                                                     shuffle=True, num_workers=4)
        testDataloader = torch.utils.data.DataLoader(testDataset, batch_size=4,
                                                    shuffle=True, num_workers=4)
        device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
```

0.5 Displaying the images

The images are displayed along with their classes after loading data

```
In [0]: def imshow(inp, title=None):
            inp = inp.numpy().transpose((1, 2, 0))
            mean = np.array([0.485, 0.456, 0.406])
            std = np.array([0.229, 0.224, 0.225])
            inp = std * inp + mean
            inp = np.clip(inp, 0, 1)
```

```
    plt.imshow(inp)
    if title is not None:
        plt.title(title)
inputs = next(iter(trainDataloader))
out = torchvision.utils.make_grid(inputs['image'])
imshow(out, title=[int(x) for x in inputs['category']])
```



0.6 Loading pretrained Alexnet model

```
In [0]: alexnet = torchvision.models.alexnet(pretrained=True)

Downloading: "https://download.pytorch.org/models/alexnet-owt-4df8aa71.pth" to /root/.torch/mo
244418560it [00:08, 27452845.75it/s]
```

0.7 Transfer Learning and Fine-tuning

All the layers are freezed except the final layer and the number of outputs in final layer is changed to 8.

```
In [0]: for param in alexnet.parameters():
          param.requires_grad=False
        alexnet.classifier[6] = torch.nn.Linear(alexnet.classifier[6].in_features, 8)
```

0.8 Final Alexnet model

```
In [0]: alexnet.to(device)

Out[0]: AlexNet(
          (features): Sequential(
            (0): Conv2d(3, 64, kernel_size=(11, 11), stride=(4, 4), padding=(2, 2))
            (1): ReLU(inplace)
            (2): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
            (3): Conv2d(64, 192, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
            (4): ReLU(inplace)
```

```
    (5): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (6): Conv2d(192, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): ReLU(inplace)
    (8): Conv2d(384, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (9): ReLU(inplace)
    (10): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (11): ReLU(inplace)
    (12): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
  )
  (avgpool): AdaptiveAvgPool2d(output_size=(6, 6))
  (classifier): Sequential(
    (0): Dropout(p=0.5)
    (1): Linear(in_features=9216, out_features=4096, bias=True)
    (2): ReLU(inplace)
    (3): Dropout(p=0.5)
    (4): Linear(in_features=4096, out_features=4096, bias=True)
    (5): ReLU(inplace)
    (6): Linear(in_features=4096, out_features=8, bias=True)
  )
)
```

0.9 Defining Optimizer, Loss functions and Learning rate scheduler

The optimizer function, loss function and the learning rate scheduler are defined in the following segment of code.

```
In [0]: Loss = torch.nn.CrossEntropyLoss()
        Optimizer = torch.optim.Adam(alexnet.parameters(), lr=0.001)
        exp_lr_scheduler = torch.optim.lr_scheduler.StepLR(Optimizer, step_size=7, gamma=0.1)
```

0.10 Function for running the defined model

The function is defined for loading the data for each epoch, outputing the output for the batch and performing backpropagation using the defined optimizer.

```
In [0]: def run_model(model, epochs, loss, optimizer, trainDataloader, testDataloader):
          model.to(device)
          for epoch in range(epochs):
            current_loss = 0.0
            exp_lr_scheduler.step()
            for i, data in enumerate(trainDataloader, 0):
              images, labels = data['image'], data['category']
              images, labels = images.to(device), labels.to(device)
              optimizer.zero_grad()
              obtained_outputs = model(images)
              obtained_loss = loss(obtained_outputs, labels)
              obtained_loss.backward()
              optimizer.step()
```

```
            current_loss += obtained_loss.item()
            if(i%100 == 99):
              print("EPOCH:", epoch+1)
              print("BATCH:", i+1)
              print("LOSS:", current_loss/100)
              print("----------------------------")
              current_loss = 0.0
        print("Training Done!!!")
        model.to(device)
        correct = 0
        total = 0
        with torch.no_grad():
          for data in testDataloader:
            images, labels = data['image'], data['category']
            images, labels = images.to(device), labels.to(device)
            outputs = model(images)
            predicted_output = torch.argmax(outputs, 1)
            correct += (predicted_output == labels).sum().item()
            total += labels.size(0)
        print("Accuracy:", correct*100/total, "%")
```

0.11 Running the model

Resnet model is run for 200 epochs with the defined Cross Entropy Loss and Adam Optimizer.

```
In [0]: run_model(alexnet, 200, Loss, Optimizer, trainDataloader, testDataloader)
```

0.12 Training Accuracy

The trained model is run on the train dataset. Accuracy of 93.432% is obtained.

```
In [0]: correct = 0
        total = 0
        with torch.no_grad():
          for data in trainDataloader:
            images, labels = data['image'], data['category']
            images, labels = images.to(device), labels.to(device)
            outputs = alexnet(images)
            predicted_output = torch.argmax(outputs, 1)
            correct += (predicted_output == labels).sum().item()
            total += labels.size(0)
        print("Training Accuracy:", correct*100/total, "%")
```

```
Training Accuracy: 93.4322033898305 %
```

0.13 Testing Accuracy

The trained model is run on the test dataset. Accuracy of 93.25% is obtained.

```
In [0]: alexnet.to(device)
        correct = 0
        total = 0
        with torch.no_grad():
            for data in testDataloader:
              images, labels = data['image'], data['category']
              images, labels = images.to(device), labels.to(device)
              outputs = alexnet(images)
              predicted_output = torch.argmax(outputs, 1)
              correct += (predicted_output == labels).sum().item()
              total += labels.size(0)
            print("Test Accuracy:", correct*100/total, "%")
```

```
Test Accuracy: 93.25 %
```

```
In [0]:
```