HEALTHCARE ANALYTICS

ASSIGNMENT – II

DETECTING COVID-19 WITH CHEST X RAY

Github Link : https://github.com/Pabintha/HEALTHCARE-ANALYTICS

AIM:

To perform image classification using the Chest X-Ray dataset, utilizing the ResNet-18 model in PyTorch for training and evaluation.

IMPLEMENTATION:

#Importing Libraries

```
%matplotlib inline
import os
import shutil
import random
import torch
import torchvision
import numpy as np
from PIL import Image
from matplotlib import pyplot as plt
torch.manual_seed(0)
print('Using PyTorch version', torch.__version__)
```

```
Using PyTorch version 2.0.1+cu118
```

#Preparing Training and Test Sets

```
class_names = ['normal', 'viral', 'covid']
root_dir = 'COVID-19 Radiography Database'
source_dirs = ['NORMAL', 'Viral Pneumonia', 'COVID-19']


if os.path.isdir(os.path.join(root_dir, source_dirs[1])):
    os.mkdir(os.path.join(root_dir, 'test'))


    for i, d in enumerate(source_dirs):
        os.rename(os.path.join(root_dir, d), os.path.join(root_dir, class_names[i]))


    for c in class_names:
        os.mkdir(os.path.join(root_dir, 'test', c))


    for c in class_names:
        images = [x for x in os.listdir(os.path.join(root_dir, c)) if x.lower().endswith('png')]
        selected_images = random.sample(images, 30)
        for image in selected_images:
            source_path = os.path.join(root_dir, c, image)
            target_path = os.path.join(root_dir, 'test', c, image)
```

```
            shutil.move(source_path, target_path)
```

#Creating Custom Dataset

```
class ChestXRayDataset(torch.utils.data.Dataset):
   def __init__(self, image_dirs, transform):
      def get_images(class_name):
         images = [x for x in os.listdir(image_dirs[class_name]) if x[-3:].lower().endswith('png')]
         print(f'Found {len(images)} {class_name} examples')
         return images


      self.images = {}
      self.class_names = ['normal', 'viral', 'covid']


      for class_name in self.class_names:
         self.images[class_name] = get_images(class_name)


      self.image_dirs = image_dirs
      self.transform = transform


   def __len__(self):
      return sum([len(self.images[class_name]) for class_name in self.class_names])


   def __getitem__(self, index):
      class_name = random.choice(self.class_names)
      index = index % len(self.images[class_name])
      image_name = self.images[class_name][index]
      image_path = os.path.join(self.image_dirs[class_name], image_name)
      image = Image.open(image_path).convert('RGB')
      return self.transform(image), self.class_names.index(class_name)
```

#Image Transformations

```
train_transform = torchvision.transforms.Compose([
   torchvision.transforms.Resize(size=(224, 224)),
   torchvision.transforms.RandomHorizontalFlip(),
   torchvision.transforms.ToTensor(),
   torchvision.transforms.Normalize(mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225])
])

test_transform = torchvision.transforms.Compose([
   torchvision.transforms.Resize(size=(224, 224)),
   torchvision.transforms.ToTensor(),
    torchvision.transforms.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])
])
```

#Prepare Data Loader

```
train_dirs = {
   'normal': '/content/drive/MyDrive/NORMAL',
   'viral': '/content/drive/MyDrive/NORMAL',
   'covid': '/content/drive/MyDrive/COVID-19'
}
train_dataset = ChestXRayDataset(train_dirs, train_transform)
```

```
Found 1342 normal examples
Found 1342 viral examples
Found 1143 covid examples
```

```
test_dirs = {
   'normal': '/content/drive/MyDrive/NORMAL',
   'viral': '/content/drive/MyDrive/NORMAL',
   'covid': '/content/drive/MyDrive/COVID-19'
}
test_dataset = ChestXRayDataset(test_dirs, test_transform)
```

```
Found 1342 normal examples
Found 1342 viral examples
Found 1143 covid examples
```

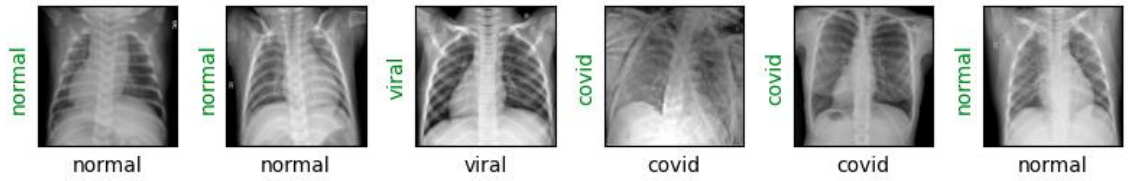
```
batch_size = 6

dl_train = torch.utils.data.DataLoader(train_dataset, batch_size=batch_size, shuffle=True)
dl_test = torch.utils.data.DataLoader(test_dataset, batch_size=batch_size, shuffle=True)

print('Number of training batches', len(dl_train))
print('Number of test batches', len(dl_test))
```

```
Number of training batches 638
Number of test batches 638
```

#Data Visualization

```
class_names = train_dataset.class_names

def show_images(images, labels, preds):
   plt.figure(figsize=(8, 4))
   for i, image in enumerate(images):
      plt.subplot(1, 6, i + 1, xticks=[], yticks=[])
      image = image.numpy().transpose((1, 2, 0))
      mean = np.array([0.485, 0.456, 0.406])
      std = np.array([0.229, 0.224, 0.225])
      image = image * std + mean
       image = np.clip(image, 0., 1.)
      plt.imshow(image)
      col = 'green'
```

```
 if preds[i] != labels[i]:
            col = 'red'

        plt.xlabel(f'{class_names[int(labels[i].numpy())]}')
        plt.ylabel(f'{class_names[int(preds[i].numpy())]}', color=col)
    plt.tight_layout()
    plt.show()
images, labels = next(iter(dl_train))
show_images(images, labels, labels)
```



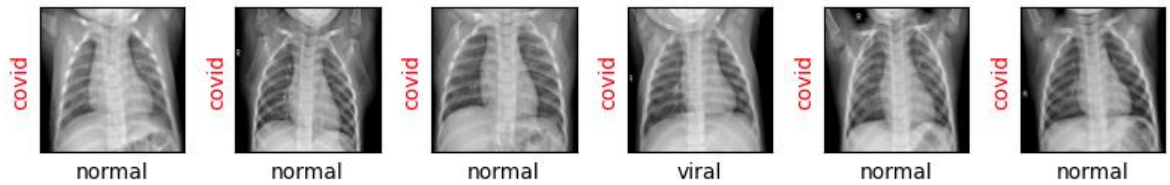

```
images, labels = next(iter(dl_test))
show_images(images, labels, labels)
```

#Creating the Model

```
resnet18 = torchvision.models.resnet18(pretrained=True)

print(resnet18)
```

```
/usr/local/lib/python3.10/dist-packages/torchvision/models/_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated since 0.13 and may be
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/torchvision/models/_utils.py:223: UserWarning: Arguments other than a weight enum or `None` for 'weights' are
  warnings.warn(msg)
Downloading: "https://download.pytorch.org/models/resnet18-f37072fd.pth" to /root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
100%|██████████| 44.7M/44.7M [00:00<00:00, 279MB/s]
ResNet(
  (conv1): Conv2d(3, 64, kernel_size=(7, 7), stride=(2, 2), padding=(3, 3), bias=False)
  (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
  (relu): ReLU(inplace=True)
  (maxpool): MaxPool2d(kernel_size=3, stride=2, padding=1, dilation=1, ceil_mode=False)
  (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)
    )
```

```
resnet18.fc = torch.nn.Linear(in_features=512, out_features=3)
loss_fn = torch.nn.CrossEntropyLoss()
optimizer = torch.optim.Adam(resnet18.parameters(), lr=3e-5)


def show_preds():
  resnet18.eval() # set to evaluation mode
  images, labels = next(iter(dl_test))
  outputs = resnet18(images)
  _, preds = torch.max(outputs, 1)
  show_images(images, labels, preds)

show_preds()
```

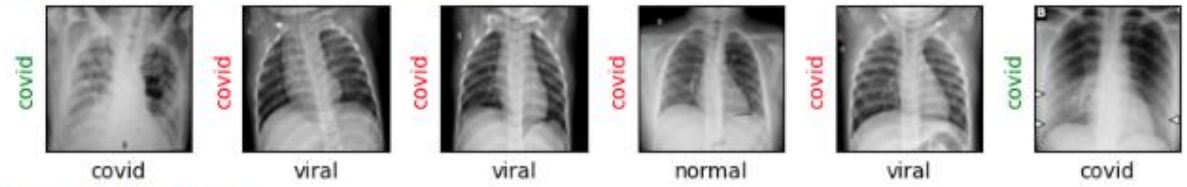


#Training the Model

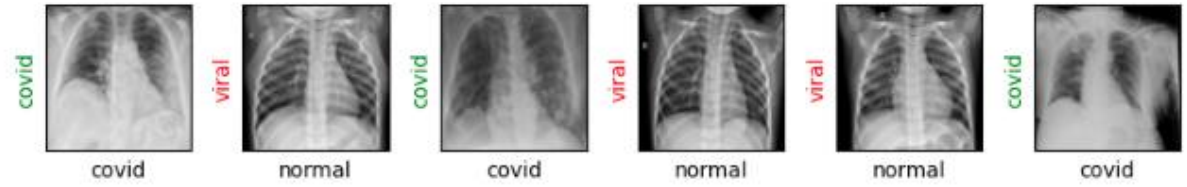
```
def train(epochs):
  print('Starting training..')
  for e in range(0, epochs):
    print('='*20)
    print(f'Starting epoch {e + 1}/{epochs}')
    print('='*20)

    train_loss = 0.
    val_loss = 0.

    resnet18.train() # set model to training phase

    for train_step, (images, labels) in enumerate(dl_train):
      optimizer.zero_grad()
      outputs = resnet18(images)
      loss = loss_fn(outputs, labels)
      loss.backward()
      optimizer.step()
      train_loss += loss.item()
      if train_step % 20 == 0:
        print('Evaluating at step', train_step)

        accuracy = 0

        resnet18.eval() # set model to eval phase
```

```
 for val_step, (images, labels) in enumerate(dl_test):
                outputs = resnet18(images)
                loss = loss_fn(outputs, labels)
                val_loss += loss.item()

                _, preds = torch.max(outputs, 1)
                accuracy += sum((preds == labels).numpy())

            val_loss /= (val_step + 1)
            accuracy = accuracy/len(test_dataset)
            print(f'Validation Loss: {val_loss:.4f}, Accuracy: {accuracy:.4f}')

            show_preds()

            resnet18.train()

            if accuracy >= 0.95:
                print('Performance condition satisfied, stopping..')
                return

        train_loss /= (train_step + 1)

        print(f'Training Loss: {train_loss:.4f}')
    print('Training complete..')

%%time
train(epochs=1)
```

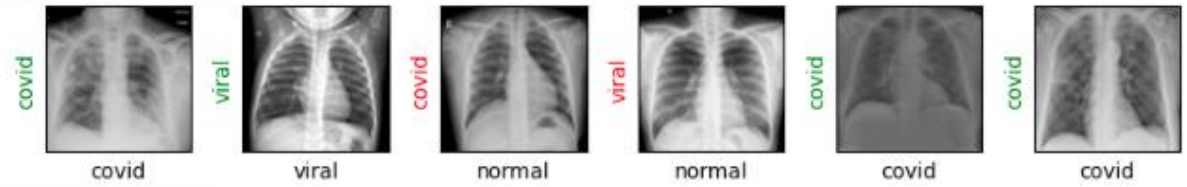
```
Starting training..
====================
Starting epoch 1/1
====================
Evaluating at step 0
Validation Loss: 1.3609, Accuracy: 0.3240
```



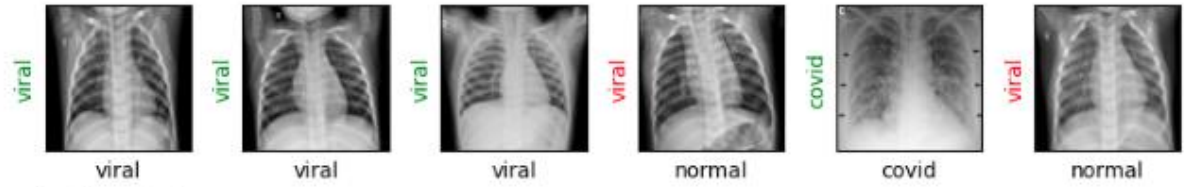

```
Evaluating at step 20
Validation Loss: 0.7271, Accuracy: 0.6399
```



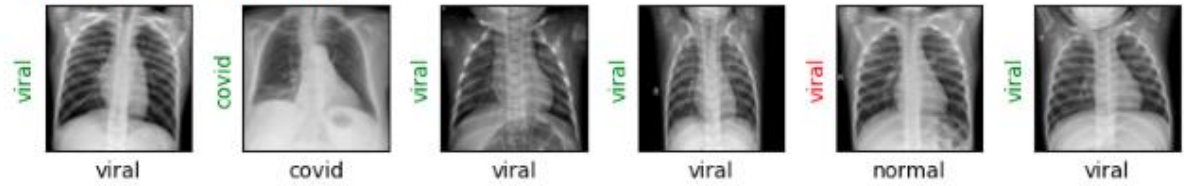

```
Evaluating at step 40
Validation Loss: 0.6264, Accuracy: 0.6577
```




```
Evaluating at step 60
Validation Loss: 0.5791, Accuracy: 0.6783
```



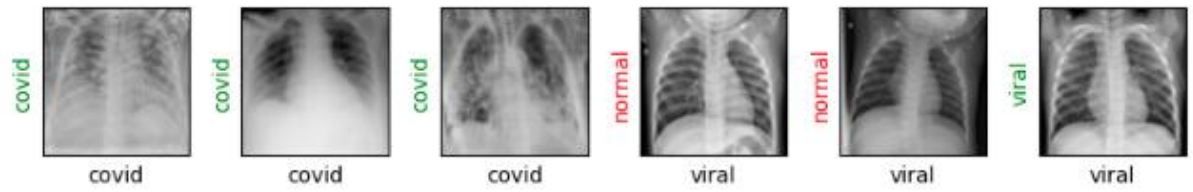

```
Evaluating at step 80
Validation Loss: 0.5852, Accuracy: 0.6653
```




```
Training Loss: 0.6001
Training complete..
CPU times: user 2h 35min 38s, sys: 1min 56s, total: 2h 37min 35s
Wall time: 2h 53min 4s
```

#Final Predictions

show_preds()



RESULT:

Thus the code is designed to train a ResNet-18 model using the Chest X-Ray dataset for classifying chest X-ray images into three categories (normal, viral pneumonia, and COVID-19) and the model's predictions, along with performance metrics such as loss and accuracy are measured.