Import Libraries

```
import torch
import torch.nn as nn
import torch.optim as optim
import torchvision
from torchvision import datasets, models, transforms
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from tqdm.auto import tqdm
import os
```

For Google Colab Users

This cell is for mounting your Google Drive to the Colab Notebook. If you are not using Google Colab, you can skip this cell

RUN THIS BLOCK WITHOUT ANY CHANGE to download the data

```
from google.colab import drive
drive.mount("/content/drive", force_remount=True)
#@title RUN THIS BLOCK WITHOUT ANY CHANGE to download the data
```

```
    Mounted at /content/drive
```

```
# Check for GPU
device = "cuda" if torch.cuda.is_available() else "cpu"

# Check for GPU in mac
# device = "mps" if torch.backends.mps.is_available() else "cpu"

device
```

```
    'cuda'
```

Data

Transforming Data

```
data_transforms = {

    'Training' : transforms.Compose([
        transforms.Resize((224, 224)),
        # transforms.RandomHorizontalFlip(),
        transforms.ToTensor()
    ]),
    'Testing': transforms.Compose([
        transforms.Resize((224, 224)),
        transforms.ToTensor()

    ])
}
```

Loading Data

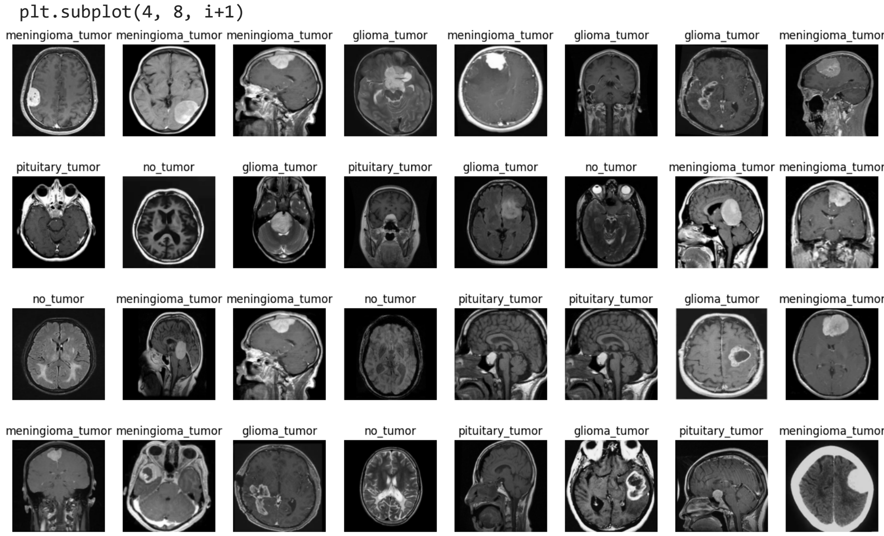
```
# directory: where training and testing data are
base_path = os.getcwd()
data_dir = "/content/drive/MyDrive/Dataset"

### START CODE HERE

# datasets.ImageFolder: (https://pytorch.org/vision/main/generated/torchvision.datasets.ImageFolder.html)
# torch.utils.data.DataLoader: (https://pytorch.org/docs/stable/data.html#torch.utils.data.DataLoader)

# image_datasets are dictionary of (type of dataset, dataloader)
# type of dataset are training and testing
image_datasets = {x: datasets.ImageFolder(os.path.join(data_dir, x), data_transforms[x]) for x in data_transforms}

# DataLoader helps us for better performance and experience in data loading
dataloaders = {x: torch.utils.data.DataLoader(image_datasets[x], batch_size=64, shuffle=True) for x in data_transforms}
### END CODE HERE

dataset_sizes = {x: len(image_datasets[x]) for x in data_transforms}
class_names = image_datasets['Training'].classes

dataset_sizes, class_names
```

```
({'Training': 2770, 'Testing': 394},
 ['glioma_tumor', 'meningioma_tumor', 'no_tumor', 'pituitary_tumor'])
```

Samples of data

```
samples, labels = next(iter(dataloaders['Testing']))
plt.figure(figsize=(17, 10))
plt.axis('off')
for i in range(32):
    plt.subplot(4, 8, i+1)
    plt.imshow(samples[i].permute(1, 2, 0))
    plt.title(class_names[labels[i]])
    plt.axis('off')
```

```
<ipython-input-32-b6ce09419233>:5: MatplotlibDeprecationWarning: Auto-removal of overla
  plt.subplot(4, 8, i+1)
```



Model

Loading Model

```
# Loading are pretrained model in this task our model is resnet50 (https://www.youtube.com/watch?v=mGMpHyiN5lk)
### START CODE HERE

# Loading pretrained model
model = models.resnet50(weights=torchvision.models.ResNet50_Weights.DEFAULT)
for param in model.parameters():
    param.requires_grad = False
### END CODE HERE
model
```

```
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
          (relu): ReLU(inplace=True)
        )
        (4): Bottleneck(
          (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
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        )
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        (0): Bottleneck(
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          (relu): ReLU(inplace=True)
          (downsample): Sequential(
            (0): Conv2d(1024, 2048, kernel_size=(1, 1), stride=(2, 2), bias=False)
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        (2): Bottleneck(
          (conv1): Conv2d(2048, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
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          (relu): ReLU(inplace=True)
        )
      )
      (avgpool): AdaptiveAvgPool2d(output_size=(1, 1))
      (fc): Linear(in_features=2048, out_features=1000, bias=True)
    )
```

Preparing Model

```
### START CODE HERE
```

```
# You have to change the (fc) layer of the model to compatible with your data
model.fc = nn.Linear(model.fc.in_features, 4)

### END CODE HERE
model = model.to(device)
model
```

```
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
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          )
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        (1): Bottleneck(
          (conv1): Conv2d(2048, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
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          (relu): ReLU(inplace=True)
        )
      )
      (avgpool): AdaptiveAvgPool2d(output_size=(1, 1))
      (fc): Linear(in_features=2048, out_features=4, bias=True)
    )
```

Training

Loss function

```
criterion = nn.CrossEntropyLoss()
```

Optimizer

```
# you have to change it for better performance
optimizer = optim.Adam(model.parameters(), lr=0.001)
```

Others

```
# you can have other thongs like learning rate scheduler and ...
```

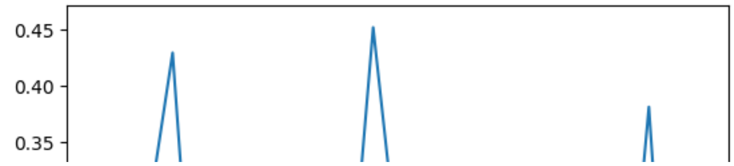
Train

```
### START CODE HERE

losses = []
EPOCH = 25

# for training part you have to set model to train mode
model.train()

# loop on epochs
for e in tqdm(range(EPOCH)):
  # loop on batches
  for inputs, labels in dataloaders["Training"]:
    inputs = inputs.to(device)
    labels = labels.to(device)

    # set the grad to zero
    optimizer.zero_grad()

    # forward part
    # hint: using of pytorch max method (https://pytorch.org/docs/stable/generated/torch.max.html)
    outputs = model(inputs)
    _, predictions = torch.max(outputs, dim=1)

    #  compute loss
    loss = criterion(outputs, labels)

    # backward part
    loss.backward()

    # update parameters
    optimizer.step()

  # you have to append loss for each epoch
  losses.append(float(loss))
### END CODE HERE
```

```
100%                                    25/25 [06:55<00:00, 16.47s/it]
```

Plot loss function

```
# you have to calculate losses arrayin Train part
plt.plot(list(range(len(losses))), losses)
plt.show()
```



Evaluate model


```
### START CODE HERE

def calc_accuracy(data, model):
  corrects = 0

  # for testing part you have to set model to eval mode
  model.eval()
  for inputs, labels in tqdm(dataloaders[data]):
      inputs = inputs.to(device)
      labels = labels.to(device)

      with torch.no_grad():
        outputs = torch.max(model(inputs), 1)
        _, preds = outputs
        corrects += torch.sum(preds == labels.data)
  return corrects.double() / dataset_sizes[data]

### END CODE HERE
```

```
# accuracy of training data
calc_accuracy("Training", model)
```

100% 44/44 [00:22<00:00, 2.14it/s]

```
tensor(0.9816, device='cuda:0', dtype=torch.float64)
```

```
# accuracy of testing data
calc_accuracy("Testing", model)
```

100% 7/7 [00:02<00:00, 3.35it/s]

```
tensor(0.7640, device='cuda:0', dtype=torch.float64)
```

Saving Model

```
PATH = os.path.join(base_path, 'model.ci')
torch.save(model, PATH)
```

Loading and eval Model

```
### START CODE HERE

model_for_eval = torch.load(PATH)
model_for_eval.to(device)

### END CODE HERE
```

```
        (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
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    (avgpool): AdaptiveAvgPool2d(output_size=(1, 1))
    (fc): Linear(in_features=2048, out_features=4, bias=True)
  )
```

```
model_for_eval
```

```
      (1): Bottleneck(
        (conv1): Conv2d(2048, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
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        (relu): ReLU(inplace=True)
      )
    )
    (avgpool): AdaptiveAvgPool2d(output_size=(1, 1))
    (fc): Linear(in_features=2048, out_features=4, bias=True)
  )
```

```
# accuracy of training data by loadded model
calc_accuracy("Trainig",model_for_eval )
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
<ipython-input-52-ed1de7bc48b6> in <cell line: 2>()
      1 # accuracy of training data by loadded model
----> 2 calc_accuracy("Trainig",model_for_eval )

<ipython-input-14-45ba085c8017> in calc_accuracy(data, model)
      6   # for testing part you have to set model to eval mode
      7   model.eval()
----> 8   for inputs, labels in tqdm(dataloaders[data]):
      9       inputs = inputs.to(device)
     10       labels = labels.to(device)

KeyError: 'Trainig'
```

SEARCH STACK OVERFLOW

```
# accuracy of testing data by loadded model
calc_accuracy("Testing", model_for_eval)
```

100% 7/7 [00:02<00:00, 3.40it/s]

```
tensor(0.7640, device='cuda:0', dtype=torch.float64)
```