Libraries Used

In [1]:

```
from PIL import Image
import torch
import torchvision
from torchvision.transforms import ToTensor
import torchvision.transforms as transforms
import numpy as np
import matplotlib.pyplot as plt

import torch.nn as nn
import torch.optim as optim
import torch.nn.functional as F
import os
import pickle
```

Dataset Class

In [2]:

```
class Dataset():
    def __init__(self):
        self.labels,self.images = self.load_data()

    # To load images and labels for dataloader
    def load_data(self):
        labels={}
        images = {}
        count = 0
        # setting resize dimensions
        resize = transforms.Compose([transforms.Resize((256,256))])
        main_dir = os.listdir(os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\dataset",
        reference = {}
        # iterating through categories
        for i,dir in enumerate(main_dir):
            reference[dir]=i
            images_list = os.listdir(os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\da
            local_cnt = 0
            # iterating through images in a category
            for img in images_list:
                # 500 images from each category
                if local_cnt<500:
                    labels[count] = i
                    img_path = os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\dataset"
                    image = Image.open(img_path)
                    image = ToTensor()(image)
                    images[count] = resize(image)
                    count+=1
                    local_cnt+=1
                else:
                    break

        print(reference)
        return labels,images

    def __len__(self):
        return len(self.labels)


    # To return x,y values in each iteration over dataloader as batches.
    def __getitem__(self, idx):
        return (
            self.images[idx],
            self.labels[idx],
        )
```

Inherit from Dataset Class

In [3]:

```
class ValDataset(Dataset):

    def load_data(self):
          labels={}
          images = {}
          count = 0
          resize = transforms.Compose([transforms.Resize((256,256))])
          main_dir = os.listdir(os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\dataset
          for i,dir in enumerate(main_dir):
              print(i,dir)
              images_list = os.listdir(os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\
              local_cnt = 0
              for img in images_list:
                  if(local_cnt<100):
                      labels[count] = i
                      img_path = os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\datase
                      image = Image.open(img_path)
                      image = ToTensor()(image)
                      images[count] = resize(image)
                      count+=1
                      local_cnt+=1
                  else:
                      break

          return labels,images
```

Model Architecture

In [4]:

```
class Network(nn.Module):
    def __init__(self):
        super(Network,self).__init__()

        # CNNs for rgb images
        self.conv1= nn.Conv2d(in_channels=3,out_channels=6,kernel_size=5)
        self.conv2= nn.Conv2d(in_channels=6,out_channels=12,kernel_size=5)
        self.conv3= nn.Conv2d(in_channels=12,out_channels=24,kernel_size=5)
        self.conv4= nn.Conv2d(in_channels=24,out_channels=48,kernel_size=5)

        # Connecting CNN outputs with Fully Connected layers
        self.fc1 = nn.Linear(in_features=48*12*12,out_features=240)
        self.fc2 = nn.Linear(in_features=240,out_features=120)
        self.out = nn.Linear(in_features=120,out_features=17)


    def forward(self,t):
        t = t

        t=self.conv1(t)
        t=F.relu(t)
        t=F.max_pool2d(t,kernel_size = 2, stride = 2)


        t=self.conv2(t)
        t=F.relu(t)
        t=F.max_pool2d(t,kernel_size = 2, stride = 2)

        t=self.conv3(t)
        t=F.relu(t)
        t=F.max_pool2d(t,kernel_size = 2, stride = 2)

        t=self.conv4(t)
        t=F.relu(t)
        t=F.max_pool2d(t,kernel_size = 2, stride = 2)

        t=t.reshape(-1,48*12*12)
        t=self.fc1(t)
        t=F.relu(t)


        t=self.fc2(t)
        t=F.relu(t)

        t=self.out(t)


        return t
```

In [5]:

```
model = Network()
```

In [6]:

```
dataset = Dataset()
```

```
{'Cherry___healthy': 0, 'Cherry___Powdery_mildew': 1, 'Pepper___Bacterial_sp
ot': 2, 'Pepper___healthy': 3, 'Potato___Early_blight': 4, 'Potato___health
y': 5, 'Potato___Late_blight': 6, 'Tomato___Bacterial_spot': 7, 'Tomato___Ea
rly_blight': 8, 'Tomato___healthy': 9, 'Tomato___Late_blight': 10, 'Tomato__
_Leaf_Mold': 11, 'Tomato___Septoria_leaf_spot': 12, 'Tomato___Spider_mites T
wo-spotted_spider_mite': 13, 'Tomato___Target_Spot': 14, 'Tomato___Tomato_mo
saic_virus': 15, 'Tomato___Tomato_Yellow_Leaf_Curl_Virus': 16}
```

In [7]:

```
valdataset = ValDataset()
```

```
0 Cherry___healthy
1 Cherry___Powdery_mildew
2 Pepper___Bacterial_spot
3 Pepper___healthy
4 Potato___Early_blight
5 Potato___healthy
6 Potato___Late_blight
7 Tomato___Bacterial_spot
8 Tomato___Early_blight
9 Tomato___healthy
10 Tomato___Late_blight
11 Tomato___Leaf_Mold
12 Tomato___Septoria_leaf_spot
13 Tomato___Spider_mites Two-spotted_spider_mite
14 Tomato___Target_Spot
15 Tomato___Tomato_mosaic_virus
16 Tomato___Tomato_Yellow_Leaf_Curl_Virus
```

Function to return correct predictions in a batch

In [8]:

```
def get_num_correct(preds,labels):
    return preds.argmax(dim=1).eq(labels).sum().item()
```

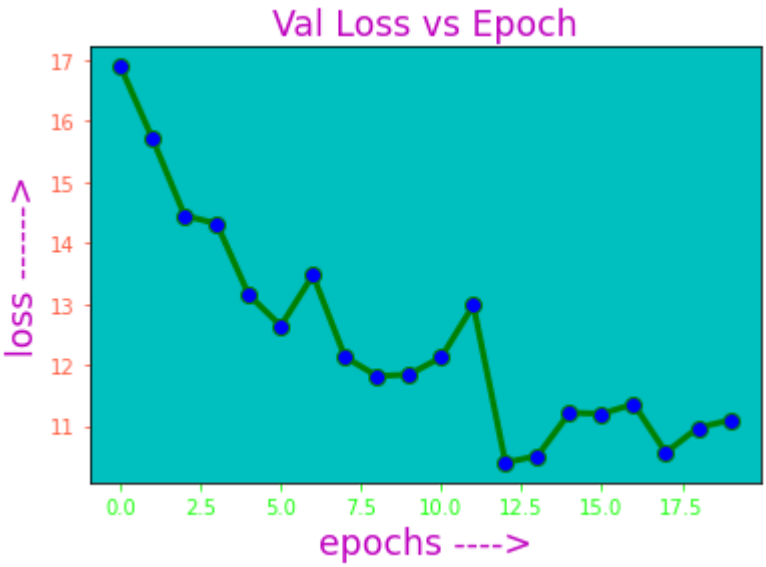
In [9]:

```
def train(dataset,valdataset, model):
    model.train()

    # dataloader in pytorch to load validation and train dataset
    dataloader = torch.utils.data.DataLoader(dataset, batch_size=64,shuffle=True)
    valdataloader = torch.utils.data.DataLoader(valdataset, batch_size=32,shuffle=True)

    # Defining the loss and optimizer
    criterion = nn.CrossEntropyLoss()
    optimizer = optim.Adam(model.parameters(), lr=0.001)
    num_of_epochs = 20
    epochs = []
    losses = []
    for epoch in range(num_of_epochs):
        cnt = 0
        tot_loss = 0
        tot_correct = 0
        for batch, (x, y) in enumerate(dataloader):
            # Sets the gradients of all optimized tensors to zero
            optimizer.zero_grad()
            y_pred = model(x)
            # Compute loss (here CrossEntropyLoss)
            loss = F.cross_entropy(y_pred,y)

            loss.backward()
            optimizer.step()

        for batch, (x, y) in enumerate(valdataloader):
            # Sets the gradients of all optimized tensors to zero
            optimizer.zero_grad()
            with torch.no_grad():
                y_pred = model(x)
                # Compute loss (here CrossEntropyLoss)
                loss = F.cross_entropy(y_pred,y)

            tot_loss+=loss.item()
            tot_correct +=get_num_correct(y_pred,y)
        epochs.append(epoch)
        losses.append(tot_loss)
        print("Epoch",epoch,"total_correct",tot_correct,"loss:",tot_loss)
        torch.save(model.state_dict(), "model002_ep"+str(epoch+1)+".pth")

    # Plot a Validation Loss vs Epochs graph
    plt.plot(epochs, losses, color='green', linewidth = 3,
         marker='o', markerfacecolor='blue', markersize=8)
    plt.xlabel('epochs ---->',color='m',fontsize='xx-large' )
    plt.ylabel('loss ------>',color='m',fontsize='xx-large')
    axes = plt.gca()        # 'gca' - get current axes
    axes.set_facecolor('c') #'c' - cyan
    axes.tick_params(axis='y', which='both', colors='tomato')
    axes.tick_params(axis='x', which='both', colors='#20ff14')
    plt.title("Val Loss vs Epoch",color='m',fontsize='xx-large')
```

In [10]:

```
train(dataset,valdataset, model)
```

```
Epoch 0 total_correct 11 loss: 16.890459775924683
Epoch 1 total_correct 34 loss: 15.705940961837769
Epoch 2 total_correct 31 loss: 14.44800353050232
Epoch 3 total_correct 46 loss: 14.314556956291199
Epoch 4 total_correct 48 loss: 13.146132707595825
Epoch 5 total_correct 50 loss: 12.63981831073761
Epoch 6 total_correct 43 loss: 13.4731684923172
Epoch 7 total_correct 67 loss: 12.127838969230652
Epoch 8 total_correct 54 loss: 11.816549062728882
Epoch 9 total_correct 66 loss: 11.841871619224548
Epoch 10 total_correct 67 loss: 12.124208450317383
Epoch 11 total_correct 51 loss: 12.97870934009552
Epoch 12 total_correct 73 loss: 10.396920800209045
Epoch 13 total_correct 73 loss: 10.508474588394165
Epoch 14 total_correct 65 loss: 11.215993285179138
Epoch 15 total_correct 81 loss: 11.196353554725647
Epoch 16 total_correct 74 loss: 11.35795783996582
Epoch 17 total_correct 79 loss: 10.563099980354309
Epoch 18 total_correct 85 loss: 10.968981981277466
Epoch 19 total_correct 81 loss: 11.093221068382263
```



Saving labels to label value as a json

In [11]:

```
main_dir = os.listdir(os.path.join(r"C:\Users\chahakgarg\OneDrive\Desktop\dataset\minidatas
reference = {}
for i,dir in enumerate(main_dir):
    reference[dir]=i
with open('labels.json', 'wb') as iw:
    pickle.dump(reference, iw)
```

Saving trained model

In [12]:

```
torch.save(model.state_dict(), "model.pth")
```

In [13]:

```
# prediction function to test
def predict(img_path):
    image = Image.open(img_path)
    image = ToTensor()(image)
    resize = transforms.Compose([transforms.Resize((256,256))])
    y_result = model(resize(image).unsqueeze(0))
    result_idx = y_result.argmax(dim=1)
    for key,value in reference.items():
        if(value==result_idx):
            print(key)
            break
```

In [15]:

```
predict(r"C:\Users\chahakgarg\OneDrive\Desktop\dataset\test\Potato.jpg")
```

```
Potato___Early_blight
```