In [1]:
```python
%matplotlib inline
from __future__ import print_function
import argparse
import torch
import torch.nn as nn
import torch.nn.functional as F
import torch.optim as optim
import torchvision
from torch.utils.data import Dataset
from torchvision import datasets, transforms
from torch.autograd import Variable

import matplotlib as mpl
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
import seaborn as sns
import pandas as pd
from tqdm import tnrange, tqdm_notebook,tqdm
import math
import random
from PIL import Image
import os
from collections import OrderedDict
```

Preprocess

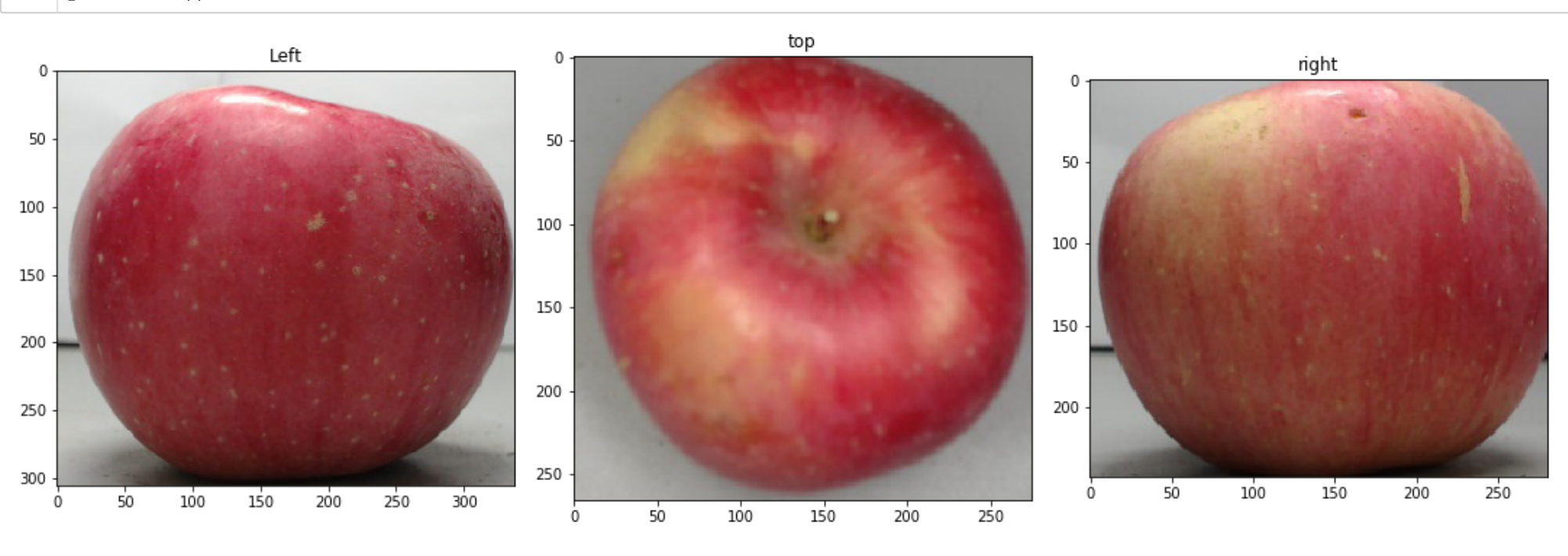
In [2]:
```python
DataDir = './'
SAPARATELINE = '-' * 100
SAPARATE = lambda: print(SAPARATELINE)
data = pd.read_csv('train.csv')

print("The shape of 'train.csv': ",data.shape)
SAPARATE()
print("The head of 'train.csv':\n",data.head())
```

```
The shape of 'train.csv':  (5711, 9)
----------------------------------------------------------------------------------------------------
The head of 'train.csv':
    Unnamed: 0  id                         left                         right  \
0           0   0  Data/01.90+/00000_left.jpg  Data/01.90+/00000_right.jpg
1           1   1  Data/01.90+/00001_left.jpg  Data/01.90+/00001_right.jpg
2           2   2  Data/01.90+/00002_left.jpg  Data/01.90+/00002_right.jpg
3           3   3  Data/01.90+/00003_left.jpg  Data/01.90+/00003_right.jpg
4           6   6  Data/01.90+/00006_left.jpg  Data/01.90+/00006_right.jpg

                         top label                      left_box  \
0  Data/01.90+/00000_top.jpg   90+  ['142', '37', '563', '431']
1  Data/01.90+/00001_top.jpg   90+   ['93', '35', '555', '442']
2  Data/01.90+/00002_top.jpg   90+  ['100', '59', '548', '437']
3  Data/01.90+/00003_top.jpg   90+   ['89', '67', '520', '433']
4  Data/01.90+/00006_top.jpg   90+  ['116', '77', '520', '426']

                     right_box                      top_box
0  ['104', '22', '567', '442']   ['125', '76', '499', '408']
1  ['120', '45', '522', '420']  ['174', '101', '533', '427']
2  ['119', '70', '546', '426']   ['167', '94', '498', '441']
3  ['142', '66', '535', '428']  ['173', '108', '526', '456']
4  ['118', '19', '589', '445']   ['105', '95', '496', '444']
```

In [3]:
```python
random_index = np.random.randint(0,data.index.size)
# print('Label:\t',data['label'][random_index])

random_apple_info = data.loc[random_index]
img_left_pos = random_apple_info['left_box'][2:-2].split("', '")
img_top_pos = random_apple_info['top_box'][2:-2].split("', '")
img_right_pos = random_apple_info['right_box'][2:-2].split("', '")

print('Label:\t',data['label'][random_index])
print('Left:\t{:30}\tPos: ({:3},{:3}),({:3},{:3})'
      .format(random_apple_info.at['left'],img_left_pos[0],img_left_pos[1],img_left_pos[2],img_left_pos[3]))
print('Top:\t{:30}\tPos: ({:3},{:3}),({:3},{:3})'
      .format(random_apple_info.at['top'],img_top_pos[0],img_top_pos[1],img_top_pos[2],img_top_pos[3]))
print('Right:\t{:30}\tPos: ({:3},{:3}),({:3},{:3})'
      .format(random_apple_info.at['right'],img_right_pos[0],img_right_pos[1],img_right_pos[2],img_right_pos[
```

```
Label:   80+
Left:    Data/02.80+/00583_left.jpg      Pos: (118,60 ),(456,366)
Top:     Data/02.80+/00583_top.jpg       Pos: (215,153),(490,419)
Right:   Data/02.80+/00583_right.jpg     Pos: (169,138),(450,381)
```

In [4]:
```python
pil_img_left = Image.open(os.path.join(DataDir, random_apple_info.at['left'])).crop((int(img_left_pos[0]),
                                                                                    int(img_left_pos[1]),
                                                                                    int(img_left_pos[2]),
                                                                                    int(img_left_pos[3])))
pil_img_right = Image.open(os.path.join(DataDir, random_apple_info.at['right'])).crop((int(img_right_pos[0]),
                                                                                      int(img_right_pos[1]),
                                                                                      int(img_right_pos[2]),
                                                                                      int(img_right_pos[3]))
pil_img_top = Image.open(os.path.join(DataDir, random_apple_info.at['top'])).crop((int(img_top_pos[0]),
                                                                                  int(img_top_pos[1]),
                                                                                  int(img_top_pos[2]),
                                                                                  int(img_top_pos[3])))
# pil_im = Image.open('1.jpg').convert('L') #灰度操作

plt.figure(figsize=(5 * 3 , 5))

ax1 = plt.subplot('131')
plt.imshow(pil_img_left)
ax1.set_title("Left")

ax2 = plt.subplot(132)
plt.imshow(pil_img_top)
ax2.set_title("top")

ax3 = plt.subplot(133)
plt.imshow(pil_img_right)
ax3.set_title("right")

plt.tight_layout()
plt.show()
```



In [5]:
```python
print('Labels: ', sorted(set(data['label'])))
```

```
Labels:  ['80+', '80-', '90+', 'bad']
```

In [6]:
```python
# data[["id", "label"]].groupby(['label'], as_index=False)
print("Count the amount of each label:")
pd.value_counts(data["label"])
```

```
Count the amount of each label:
```

Out[6]:
```
90+    2907
80+    1967
80-     441
bad     396
Name: label, dtype: int64
```

Get mean and std of every channal

This is only a example, just show how to get mean and std from one picture.

Notice: In training phase, your mean and std must calculate from the whole training set.

In [7]:
```python
pic = np.array(pil_img_left)
print("pic.shape:",pic.shape)

pic_mean = np.mean(pic/255, axis = (0,1),keepdims = True)
print("pic_mean:",pic_mean)

pic_mean = pic_mean.reshape(3,)
print("pic_mean:", pic_mean)

pic_std = np.std(pic,axis = (0,1),keepdims = True)
print("pic_std:",pic_std)

pic_std = pic_std.reshape(3,)
print("pic_std:",pic_std)
```

```
pic.shape: (306, 338, 3)
pic_mean: [[[0.59334833 0.34683197 0.36197992]]]
pic_mean: [0.59334833 0.34683197 0.36197992]
pic_std: [[[47.27379549 68.99296688 66.41355196]]]
pic_std: [47.27379549 68.99296688 66.41355196]
```

start

In [8]:
```python
class AppleSet(Dataset):

    def __init__(self, root, train = True, transform = None, ):
        self.train = train
        self.root = root
        self.transform = transform
#         classes = ['90+','80+','80-','bad']
        if self.train:
            self.data = pd.read_csv(os.path.join(self.root, 'train.csv' ))
            print(pd.value_counts(self.data["label"]))
        else:
            self.data = pd.read_csv(os.path.join(self.root, 'test.csv' ))
            print(pd.value_counts(self.data["label"]))

    def __len__(self):
        return self.data.index.size

    def __getitem__(self, index):
        self.classes = ['90+','80+','80-','bad']

        data_item          = self.data.iloc[index]
        apple_item_path    = data_item['left']
        apple_item_img     = Image.open(os.path.join(self.root, apple_item_path))
        apple_img_box_list = data_item['left_box'][2:-2].split("', '")
        apple_item_img     = apple_item_img.crop((int(apple_img_box_list[0]),int(apple_img_box_list[1]),int(a

        if self.transform:
            apple_item_img = self.transform(apple_item_img)
        target = data_item['label']

        return apple_item_img, self.classes.index(target),data_item['id'],data_item['label']
```

In [9]:
```python
N_CLASSES  = 4
IMAGE_SIZE = 227
BATCH_SIZE = 16

use_cuda = torch.cuda.is_available()
if (use_cuda):
    print("Great, you have a GPU!")
else:
    print("Life is short -- consider a GPU!")
device = torch.device("cuda:2" if use_cuda else "cpu")
print('Your device will be: ', device)
```

```
Great, you have a GPU!
Your device will be:  cuda:2
```

In [10]:
```python
transform = transforms.Compose([
#     transforms.CenterCrop(480), #???
    transforms.Resize((IMAGE_SIZE, IMAGE_SIZE)),
    transforms.RandomHorizontalFlip(), #???
    transforms.ToTensor(),
    transforms.Normalize((0.5, 0.5, 0.5), (0.5, 0.5, 0.5)),
])

train_data = AppleSet(root = DataDir, train = True, transform = transform)
test_data = AppleSet(root = DataDir, train = False, transform = transform)
print(len(train_data))
print(len(test_data))
```

```
90+    2907
80+    1967
80-     441
bad     396
Name: label, dtype: int64
90+    738
80+    497
80-    118
bad     75
Name: label, dtype: int64
5711
1428
```

In [11]:
```python
print('Train Size: ', train_data.data.size)
```

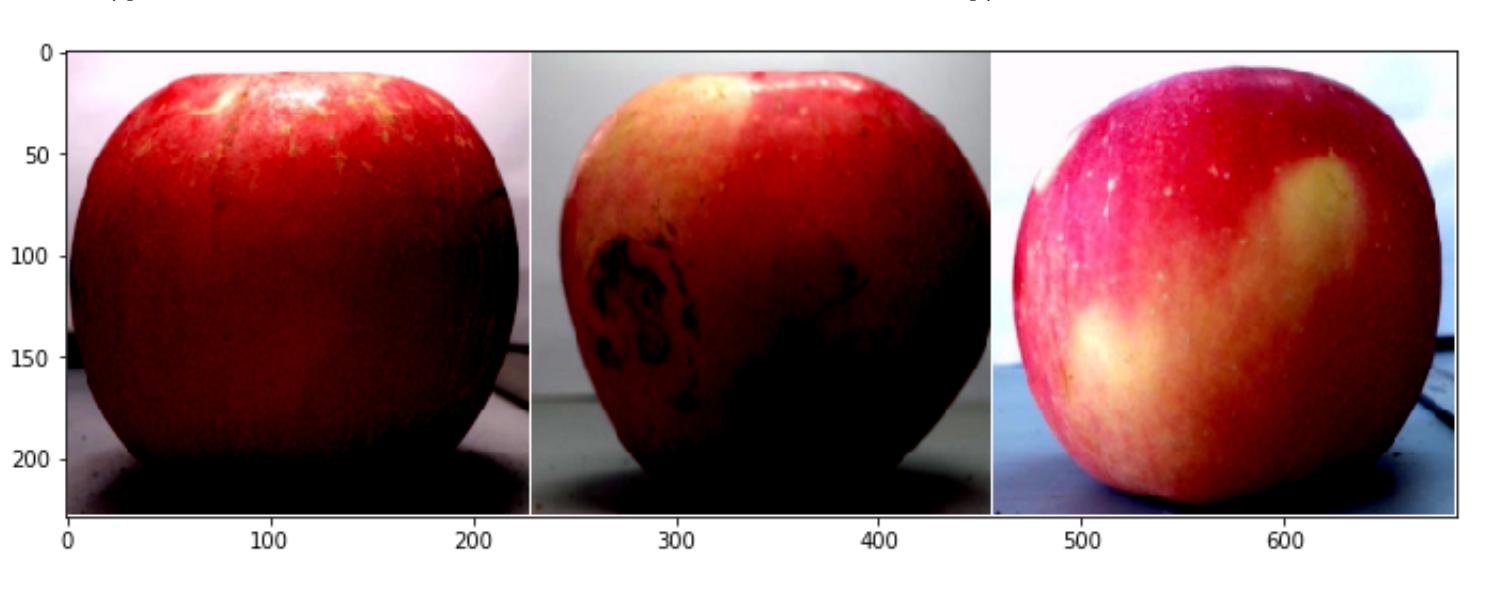
```
Train Size:  51399
```

In [12]:
```python
# train_data.data
```

In [13]:
```python
train_loader = torch.utils.data.DataLoader(dataset = train_data,
                                           batch_size = BATCH_SIZE,
                                           shuffle = True)
test_loader = torch.utils.data.DataLoader(dataset = test_data,
                                          batch_size = BATCH_SIZE)
```

In [14]:
```python
def imshow(batch, class_names=None, num_images=4):
    plt.figure(figsize=(4 * num_images, 4))
    img, classes,ids,labels = batch
    print(classes)
    img_num = min(num_images, img.shape[0])

    grid = torchvision.utils.make_grid(img[:img_num],
                                       nrow=img_num,
                                       padding = 1,
                                      pad_value = 1)
    grid = grid.cpu().numpy().transpose((1, 2, 0))
#     mean = np.array([0.485, 0.456, 0.406])
#     std = np.array([0.229, 0.224, 0.225])
#     grid = std * grid + mean
    grid = np.clip(grid, 0, 1)

    plt.imshow(grid)
#     if class_names:
#         titles = [class_names[x] for x in classes[:img_num]]
#         plt.axis('off')
#         plt.title(titles)
    plt.pause(0.001)

imshow(next(iter(train_loader)),num_images = 3)
```

```
tensor([0, 3, 0, 0, 1, 1, 0, 0, 0, 1, 0, 2, 1, 0, 0, 0])
```



In [15]:
```python
torch.manual_seed(117)
```

Out[15]: <torch._C.Generator at 0x2af8c5a19a70>

Create Model

In [16]:
```python
class Net(nn.Module):
    def __init__(self, num_classes = 4, init_weights = True, pretrained = True):
        super(Net, self).__init__()
        self.conv = torch.nn.Sequential(OrderedDict([
            ('Conv2d_1',nn.Conv2d(3, 64, 11, 4, 2)),
            ('ReLU_1',nn.ReLU(inplace = True)),
            ('MaxPool2d_1',nn.MaxPool2d(3, 2, 0)),
            ('Conv2d_2',nn.Conv2d(64, 192, 5, 1, 2)),
            ('ReLU_2',nn.ReLU(inplace=True)),
            ('MaxPool2d_2',nn.MaxPool2d(3, 2, 0)),
            ('Conv2d_3',nn.Conv2d(192, 384, 3, 1, 1)),
            ('ReLU_3',nn.ReLU(inplace = True)),
            ('Conv2d_4',nn.Conv2d(384, 256, 3, 1, 1)),
            ('ReLU_4',nn.ReLU(inplace=True)),
            ('Conv2d_5',nn.Conv2d(256,256 ,3, 1, 1)),
            ('ReLU_5',nn.ReLU(inplace=True)),
            ('MaxPool2d_3',nn.MaxPool2d(3, 2, 0))
        ]))

        self.dense = torch.nn.Sequential(OrderedDict([
            ('Dropout_1',nn.Dropout()),
            ('Linear_1',nn.Linear(9216, 4096)),
            ('ReLU_1',nn.ReLU(inplace=True)),
            ('Dropout_2',nn.Dropout()),
            ('Linear_2',nn.Linear(4096, 4096)),
            ('ReLU_2',nn.ReLU(inplace=True)),
            ('Linear_3',nn.Linear(4096, num_classes))
          ]))

        if init_weights:
            self._initialize_weights()

    def forward(self, x):
        x = self.conv(x)
        x = x.view(x.size(0), -1)
        x = self.dense(x)
        return x

    def _initialize_weights(self):
        for m in self.modules():
            if isinstance(m, nn.Conv2d):
                n = m.kernel_size[0] * m.kernel_size[1] * m.out_channels
                m.weight.data.normal_(0, math.sqrt(2. / n))
                if m.bias is not None:
                    m.bias.data.zero_()
            elif isinstance(m, nn.Linear):
                m.weight.data.normal_(0, 0.01)
                m.bias.data.zero_()
```

Create a function to return a pre-trained model

In [17]:
```python
def AppleModel(pretrained = False, **kwargs):
    model = Net(**kwargs)
    if pretrained:
        print("Try to use pre-trained model")
        filePath = os.path.join(DataDir, 'AppleModel.pth')
        if os.path.isfile(filePath):
            print("Loading...")
            model = torch.load(filePath)
            print("Success!")
        else:
            print("Failed! Create a new model instead.")
    return model
```

Create Train Function

In [46]:
```python
def train(model, device, train_loader, optimizer, epoch):
    SAPARATE()
    print("Start training...")
    print('epoch: {}, Learning rate: {}'.format(epoch,optimizer.param_groups[0]['lr']))
    model.train()

    correct = 0
    total_loss = 0
    total_acc = 0
    train_list = {'loss':[],'acc':[],'idx':[]}

    for batch_idx, (inputs, targets,ids,labels) in enumerate(tqdm_notebook(train_loader,total=len(train_loade
        indx_target = targets.clone() # clone labels
        inputs, targets = Variable(inputs), Variable(targets)
        if use_cuda:
            inputs, targets = inputs.to(device), targets.to(device)

        optimizer.zero_grad()   # Clears the gradients of all optimized
        outputs = model(inputs) # output will be batch_size * class_size

        loss = F.cross_entropy(outputs, targets) # calculate loss
        loss.backward()
        optimizer.step()

        total_loss += loss.data.item() # add loss to total_loss

        pred = outputs.data.max(1)[1]  # get the index of the max log-probability
        correct = pred.cpu().eq(indx_target).sum()
        total_acc += correct # the amount of corrent items

        if batch_idx % 5 == 0 and batch_idx >= 0:
                acc = float(correct) * 1.0 / len(inputs) * 100
                train_list['loss'].append(loss.data.item())
                train_list['acc'].append(acc)
                train_list['idx'].append(batch_idx)
#                 print('Train Epoch: {} [{:5}/{:5}] Loss: {:.6f} Acc: {:.4f} lr: {:.2e}'.format(
#                     epoch,
#                     batch_idx * len(inputs),
#                     len(train_loader.dataset),
#                     loss.data.item(),
#                     acc,
#                     optimizer.param_groups[0]['lr']))
    print("Train Info: Loss: {:.6f}, Acc: {:.6f}, lr: {:.2e}".format(total_loss,
                                                                      100 * float(total_acc)/len(train_loader.da
                                                                      optimizer.param_groups[0]['lr']))

    # losss pic
    plt.plot(train_list['idx'],
             train_list['loss'],
             "b",linewidth=1,
             label = "epoch_" + str(epoch))    #在当前绘图对象绘图（X轴，Y轴，蓝色虚线，线宽度）
    plt.xlabel("iterations")                   #X轴标签
    plt.ylabel("loss")                         #Y轴标签
    plt.title("Lost Analysis")                 #图标题
    plt.show()

    #acc pic
    plt.plot(train_list['idx'],
             train_list['acc'],
             "r",linewidth=1,
             label = "epoch_" + str(epoch))    #在当前绘图对象绘图（X轴，Y轴，蓝色虚线，线宽度）
    plt.xlabel("iterations")                   #X轴标签
    plt.ylabel("acc")                          #Y轴标签
    plt.title("Accuracy Analysis")             #图标题
    plt.show()
```

Create Test Function

In [30]:
```python
def test(model, device, test_loader, optimizer, epoch):
    model.eval()

    test_loss = 0
    correct = 0
    global best_acc
    global lr
    global patience

    for batch_idx, (inputs, target,ids,labels) in enumerate(tqdm_notebook(test_loader,total=len(test_loader))
        indx_target = target.clone()

        target = Variable(target)
        with torch.no_grad():
            inputs = Variable(inputs)

        if use_cuda:
            inputs, target = inputs.to(device), target.to(device)

        output = model(inputs)
        test_loss += F.cross_entropy(output, target).data.item()
        pred = output.data.max(1)[1]  # get the index of the max log-probability
        correct += pred.cpu().eq(indx_target).sum()
        test_loss_percent = test_loss / len(test_loader) # average over number of mini-batch
        acc = 100. * float(correct) / len(test_loader.dataset)


    print('Test set: Average loss: {:.4f}, Accuracy: {}/{} ({:.2f}%)'.format(
        test_loss * 100 / len(test_loader),
        correct,
        len(test_loader.dataset),
        acc))

    if acc > best_acc:
        save_file = True # config. If need to save model

        patience = patience + 1 # if the acc of the model better than older one weo times, than update it.
        print("Best acc is {},lower than current acc {}. Patience set to {}.".format(best_acc,acc,patience))

        if patience == 2:
            patience = 0
            print("Patience already to 2,set to 0.")
            lr = lr/10
            print("Leaning Rate set to {}.".format(lr))

            if save_file: # model save
                new_file = os.path.join(DataDir, 'AppleModel.pth')
                torch.save(model, new_file)
                print("Save a new model to {}.".format(new_file))
            best_acc = acc
```

Create model

In [20]:
```python
model = AppleModel(pretrained = True, num_classes = N_CLASSES, init_weights = True)
if use_cuda:
    model.to(device)
print(model)
```

```
Try to use pre-trained model
Loading...
Success!
Net(
  (conv): Sequential(
    (Conv2d_1): Conv2d(3, 64, kernel_size=(11, 11), stride=(4, 4), padding=(2, 2))
    (ReLU_1): ReLU(inplace)
    (MaxPool2d_1): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (Conv2d_2): Conv2d(64, 192, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
    (ReLU_2): ReLU(inplace)
    (MaxPool2d_2): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (Conv2d_3): Conv2d(192, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (ReLU_3): ReLU(inplace)
    (Conv2d_4): Conv2d(384, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (ReLU_4): ReLU(inplace)
    (Conv2d_5): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (ReLU_5): ReLU(inplace)
    (MaxPool2d_3): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
  )
  (dense): Sequential(
    (Dropout_1): Dropout(p=0.5)
    (Linear_1): Linear(in_features=9216, out_features=4096, bias=True)
    (ReLU_1): ReLU(inplace)
    (Dropout_2): Dropout(p=0.5)
    (Linear_2): Linear(in_features=4096, out_features=4096, bias=True)
    (ReLU_2): ReLU(inplace)
    (Linear_3): Linear(in_features=4096, out_features=4, bias=True)
  )
)
```

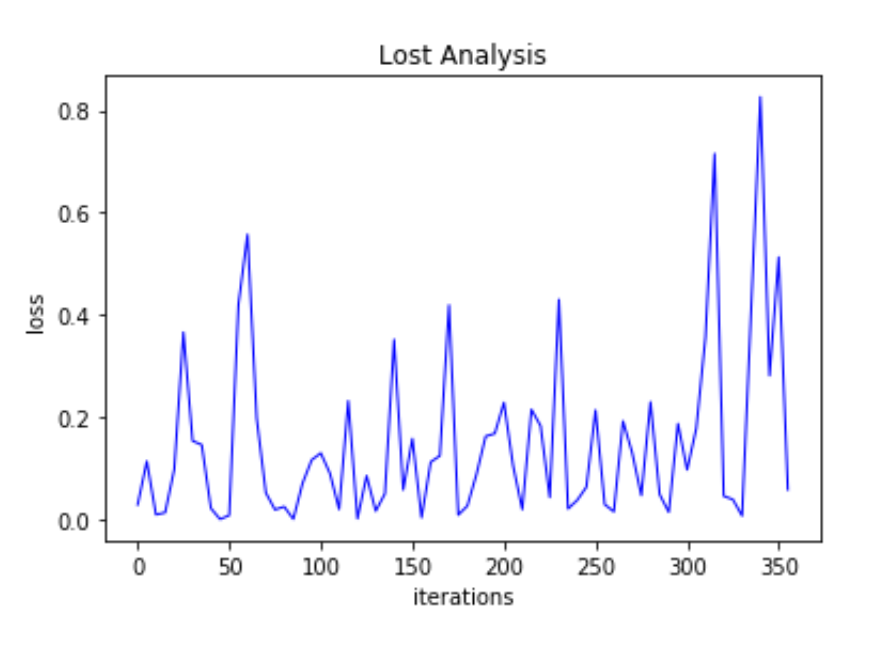
Strart Train model

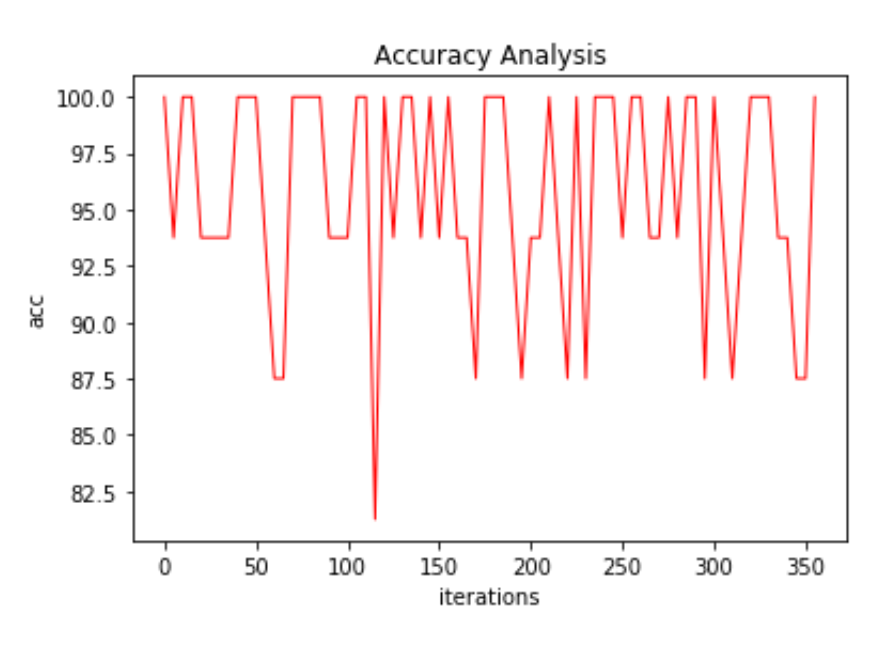
In [48]:
```python
best_acc = 0
lr = 0
patience = 0

try:
    epoch_size = 30
    for epoch in range(epoch_size):
        if epoch == 0:
            lr = 0.001 # init learning rate
            print("Leaning Rate set to {}".format(lr))
        optimizer = optim.Adam(model.parameters(), lr = lr, weight_decay=5e-4)

        train(model,device,train_loader,optimizer,epoch)
        test(model,device,test_loader,optimizer,epoch)

        torch.cuda.empty_cache()
except Exception as e:
    import traceback
    traceback.print_exc()
finally:
    print("Best Result: {:.3f}%".format(best_acc))
```

```
Leaning Rate set to 0.001
----------------------------------------------------------------------------------------------------
Start training...
epoch: 0, Learning rate: 0.001
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 51.653300, Acc: 95.675013, lr: 1.00e-03
```



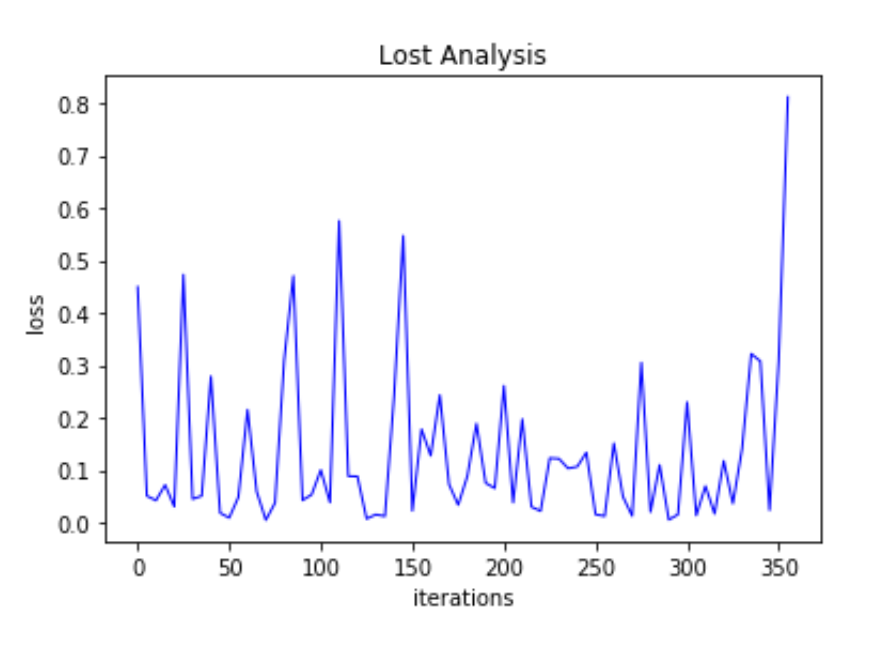


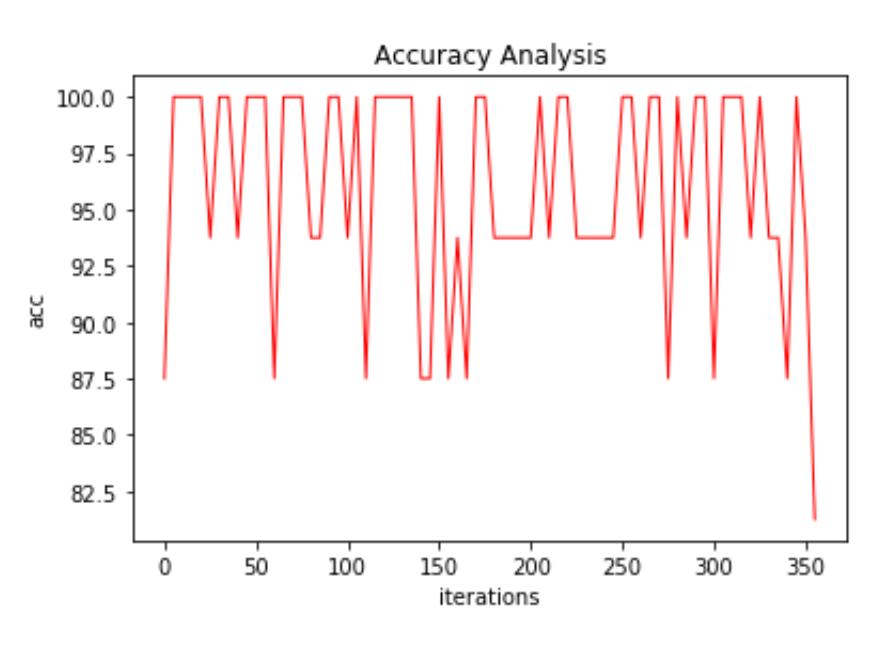
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 13.2349, Accuracy: 1376/1428 (96.36%)
Best acc is 0,lower than current acc 96.35854341736695.Patience set to 1.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 1, Learning rate: 0.001
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 51.350275, Acc: 96.025214, lr: 1.00e-03
```



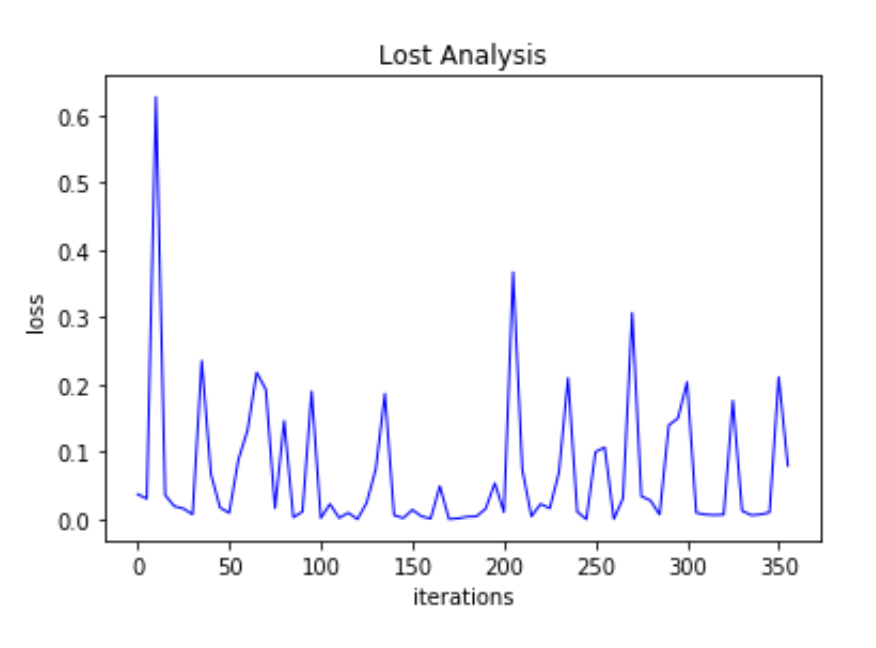


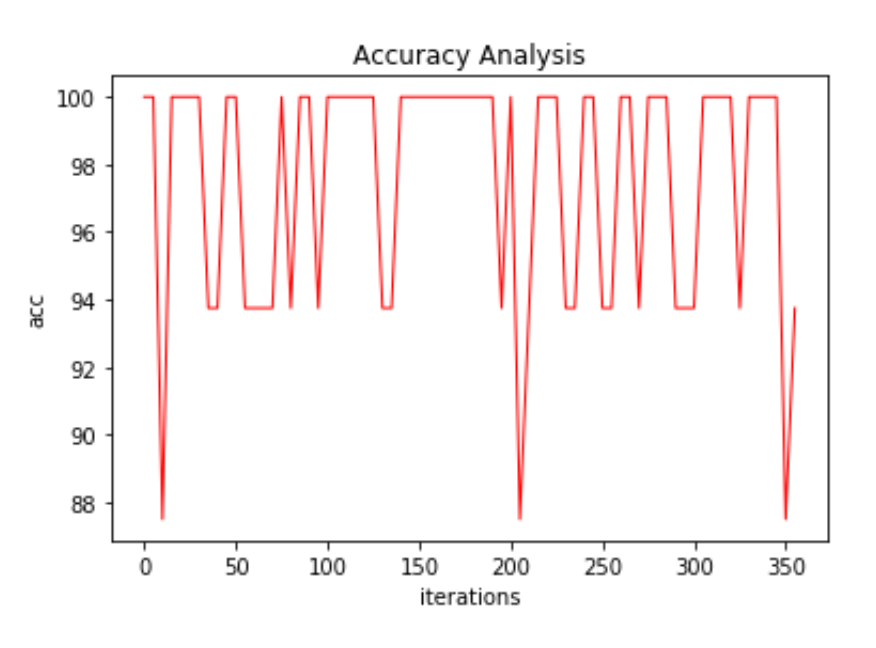
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 20.2029, Accuracy: 1357/1428 (95.03%)
Best acc is 0,lower than current acc 95.0280112044818.Patience set to 2.
Patience already to 2,set to 0.
Leaning Rate set to 0.0001.

/lustre/wangdan/anaconda2/envs/py3/lib/python3.7/site-packages/torch/serialization.py:250: UserWarning: Couldn
't retrieve source code for container of type Net. It won't be checked for correctness upon loading.
  "type " + obj.__name__ + ". It won't be checked "

Save a new model to ./AppleModel.pth.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 2, Learning rate: 0.0001
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 22.816076, Acc: 98.108913, lr: 1.00e-04
```



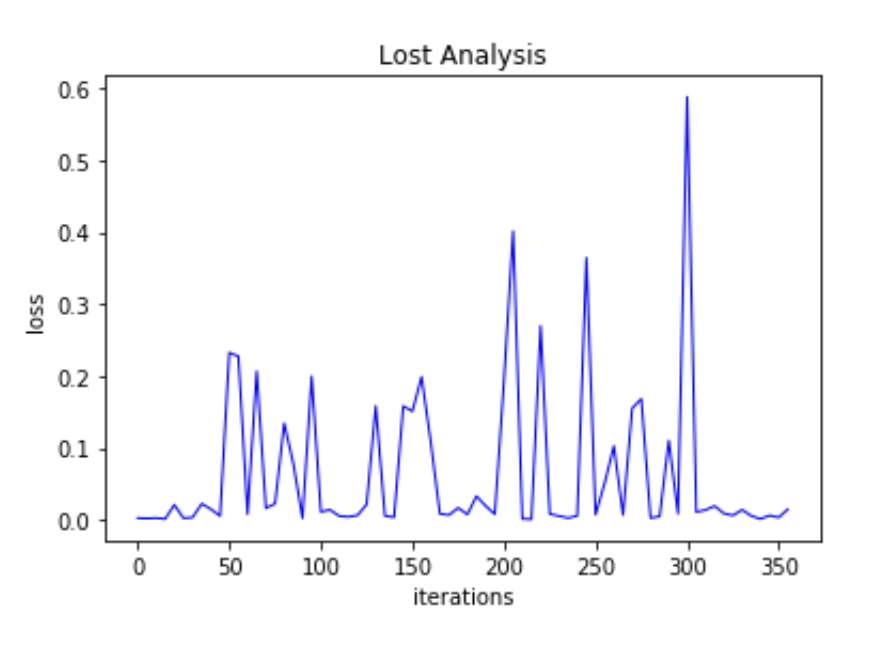


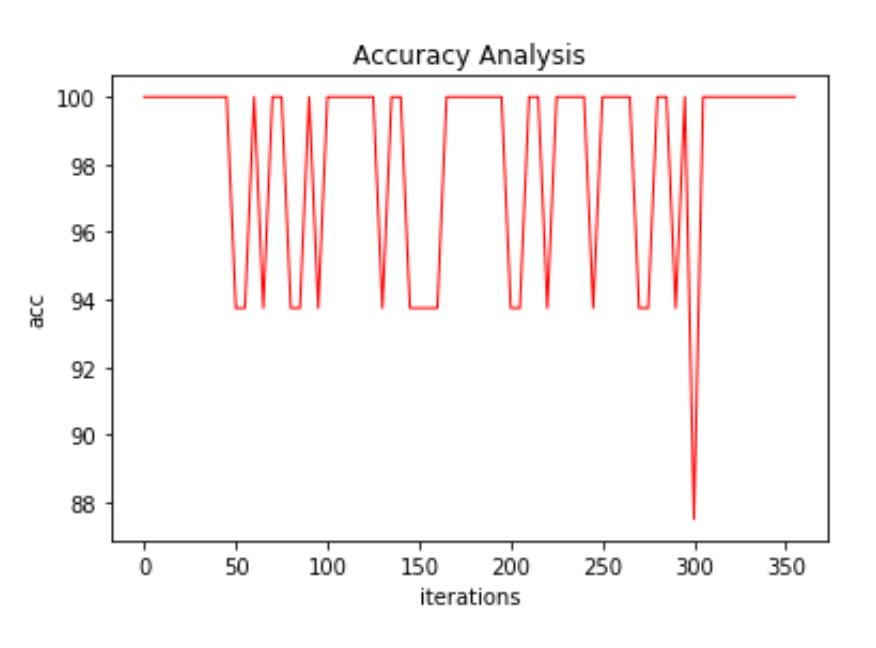
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.4776, Accuracy: 1393/1428 (97.55%)
Best acc is 95.0280112044818,lower than current acc 97.54901960784314.Patience set to 1.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 3, Learning rate: 0.0001
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 17.771070, Acc: 98.494134, lr: 1.00e-04
```



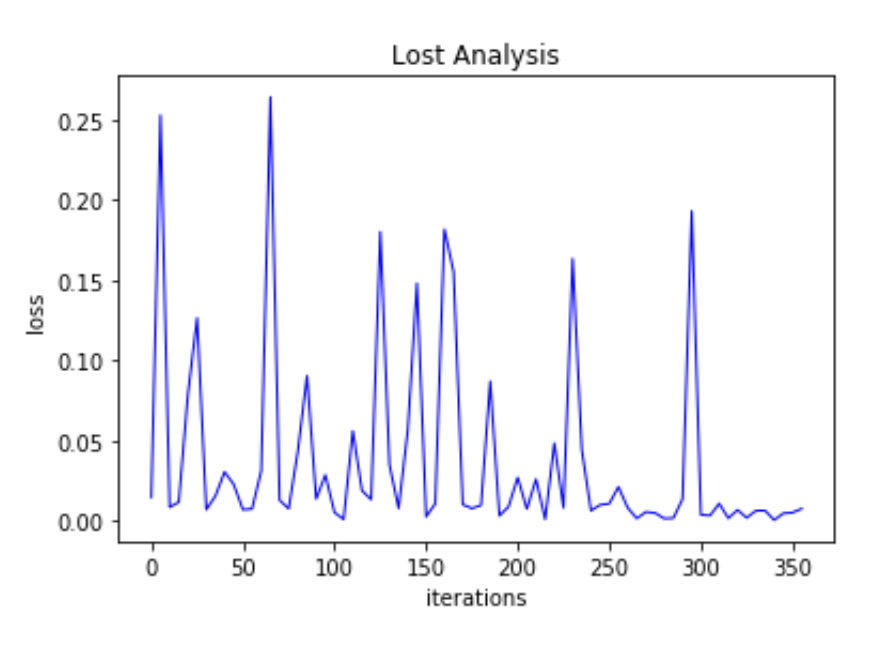


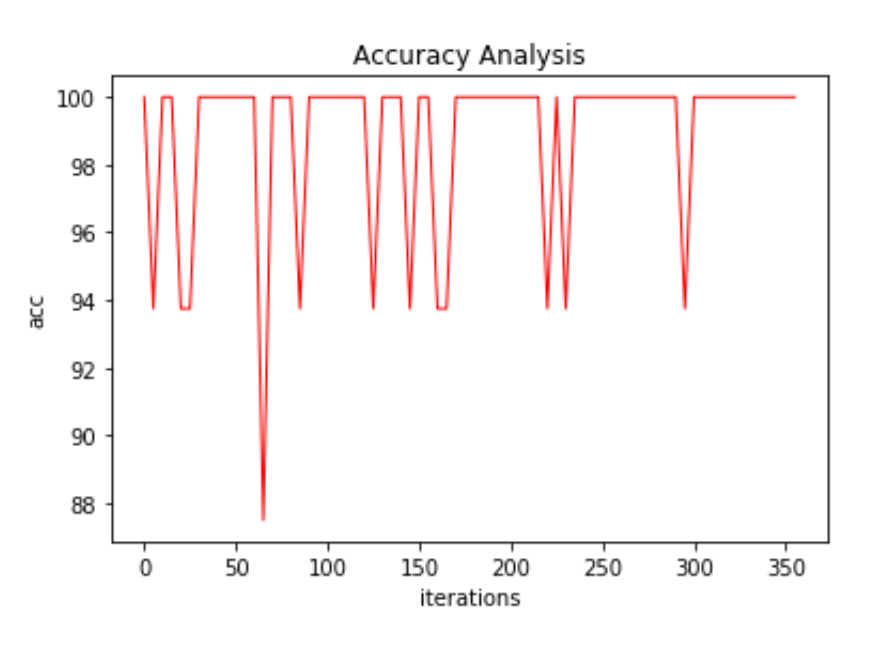
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 14.0206, Accuracy: 1390/1428 (97.34%)
Best acc is 95.0280112044818,lower than current acc 97.3389355742297.Patience set to 2.
Patience already to 2,set to 0.
Leaning Rate set to 1e-05.

/lustre/wangdan/anaconda2/envs/py3/lib/python3.7/site-packages/torch/serialization.py:250: UserWarning: Couldn
't retrieve source code for container of type Net. It won't be checked for correctness upon loading.
  "type " + obj.__name__ + ". It won't be checked "

Save a new model to ./AppleModel.pth.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 4, Learning rate: 1e-05
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 13.951571, Acc: 98.914376, lr: 1.00e-05
```



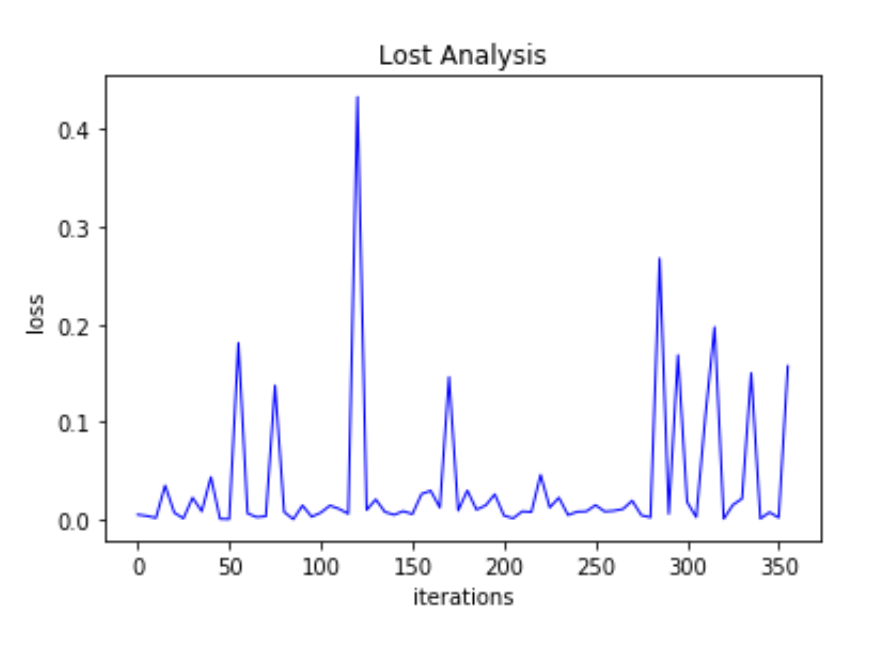


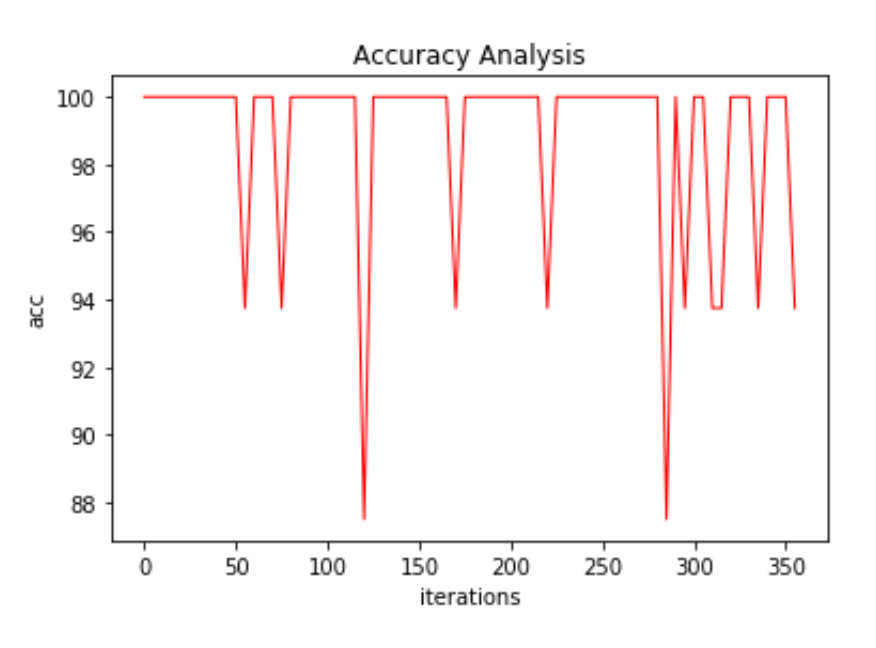
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.2197, Accuracy: 1392/1428 (97.48%)
Best acc is 97.3389355742297,lower than current acc 97.47899159663865.Patience set to 1.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 5, Learning rate: 1e-05
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.621754, Acc: 98.826825, lr: 1.00e-05
```



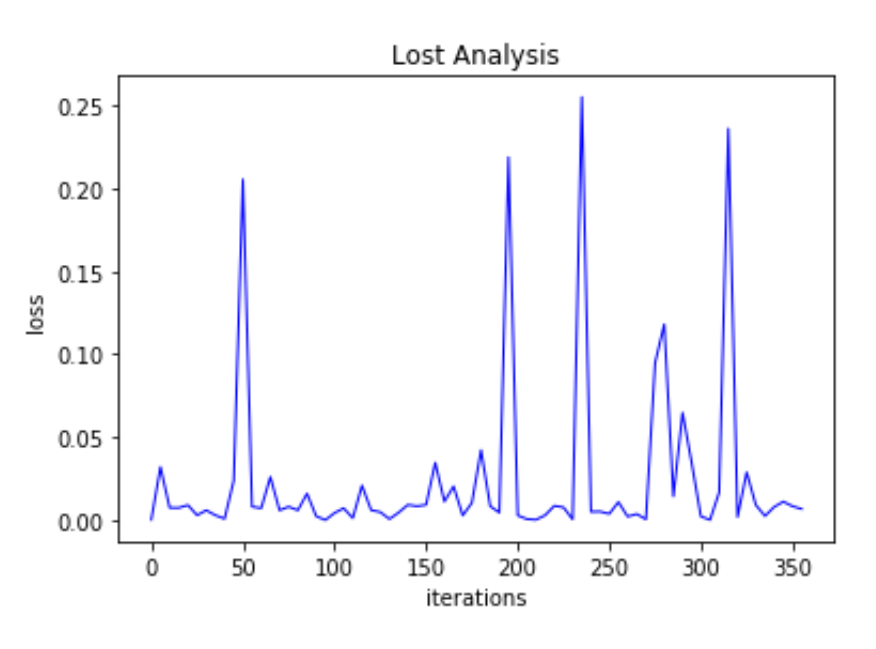


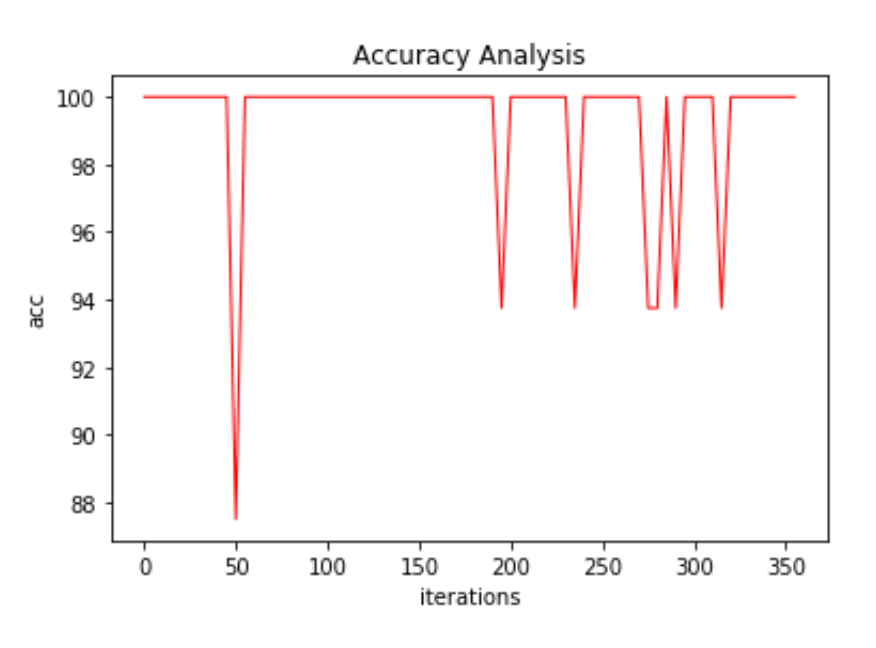
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 12.3555, Accuracy: 1391/1428 (97.41%)
Best acc is 97.3389355742297,lower than current acc 97.40896358543418.Patience set to 2.
Patience already to 2,set to 0.
Leaning Rate set to 1.0000000000000002e-06.

/lustre/wangdan/anaconda2/envs/py3/lib/python3.7/site-packages/torch/serialization.py:250: UserWarning: Couldn
't retrieve source code for container of type Net. It won't be checked for correctness upon loading.
  "type " + obj.__name__ + ". It won't be checked "

Save a new model to ./AppleModel.pth.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 6, Learning rate: 1.0000000000000002e-06
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 13.265477, Acc: 98.844335, lr: 1.00e-06
```



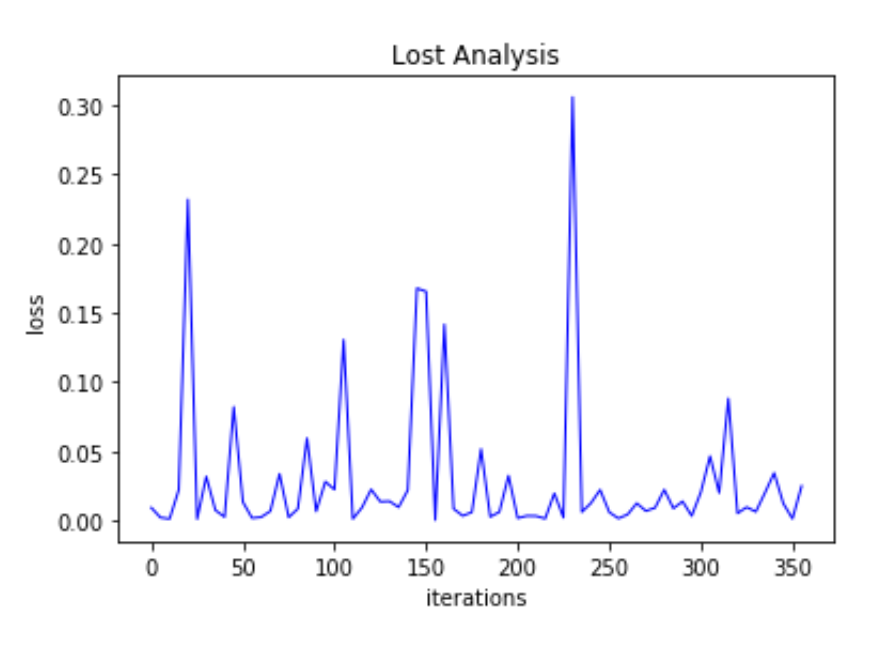


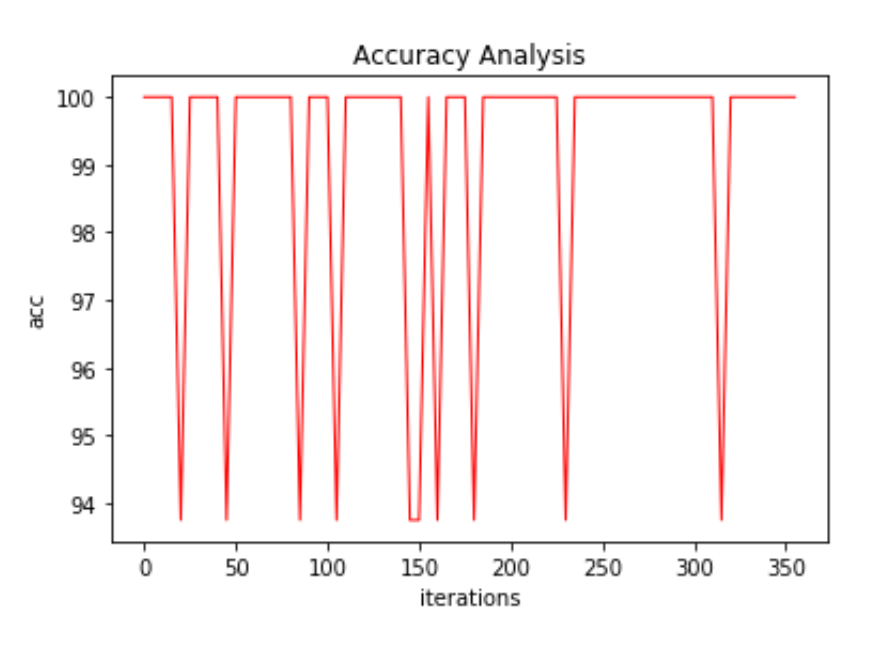
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.3345, Accuracy: 1392/1428 (97.48%)
Best acc is 97.40896358543418,lower than current acc 97.47899159663865.Patience set to 1.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 7, Learning rate: 1.0000000000000002e-06
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.233430, Acc: 98.984416, lr: 1.00e-06
```



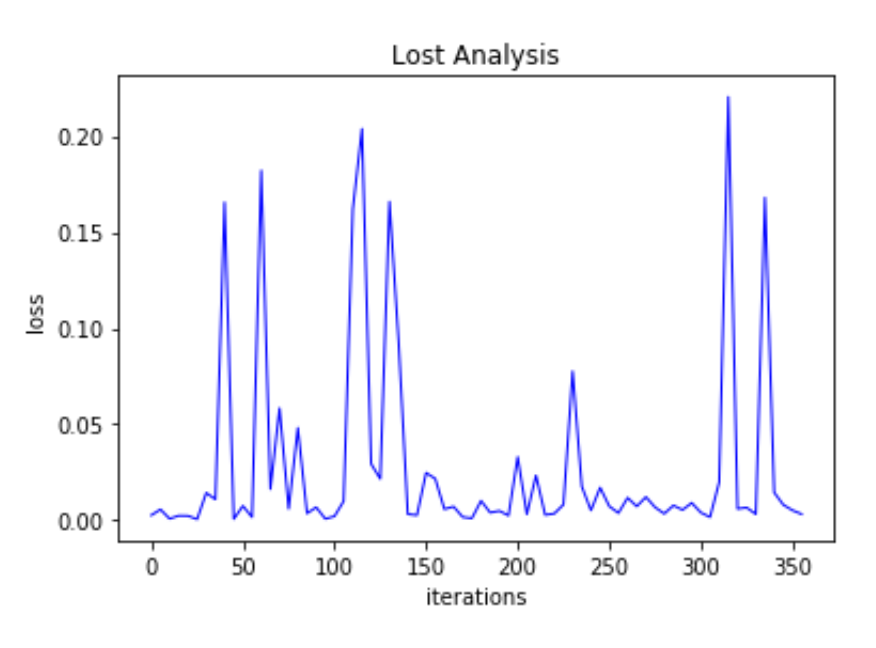


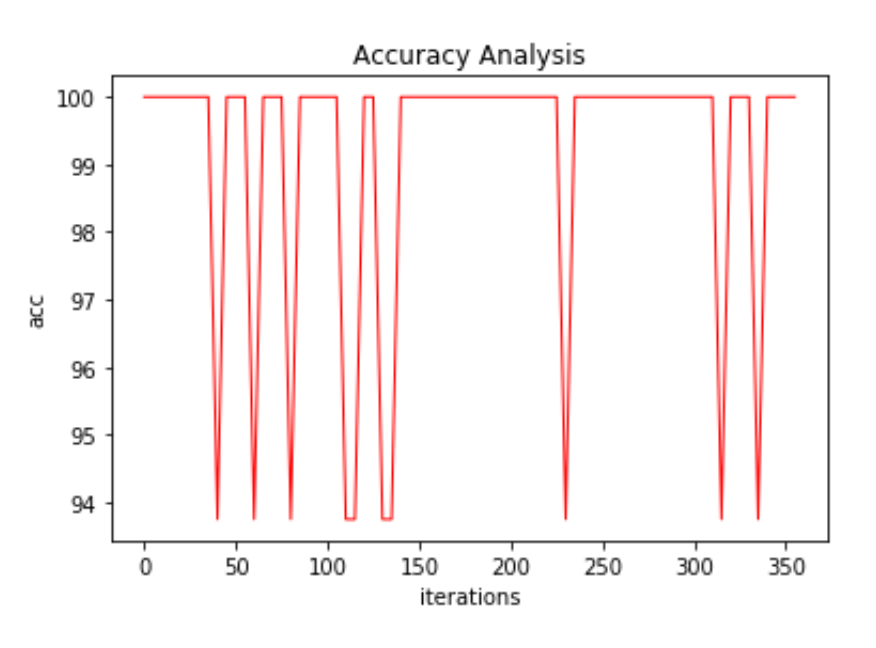
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 9.2953, Accuracy: 1393/1428 (97.55%)
Best acc is 97.40896358543418,lower than current acc 97.54901960784314.Patience set to 2.
Patience already to 2,set to 0.
Leaning Rate set to 1.0000000000000002e-07.

/lustre/wangdan/anaconda2/envs/py3/lib/python3.7/site-packages/torch/serialization.py:250: UserWarning: Couldn
't retrieve source code for container of type Net. It won't be checked for correctness upon loading.
  "type " + obj.__name__ + ". It won't be checked "

Save a new model to ./AppleModel.pth.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 8, Learning rate: 1.0000000000000002e-07
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 13.250331, Acc: 98.879356, lr: 1.00e-07
```



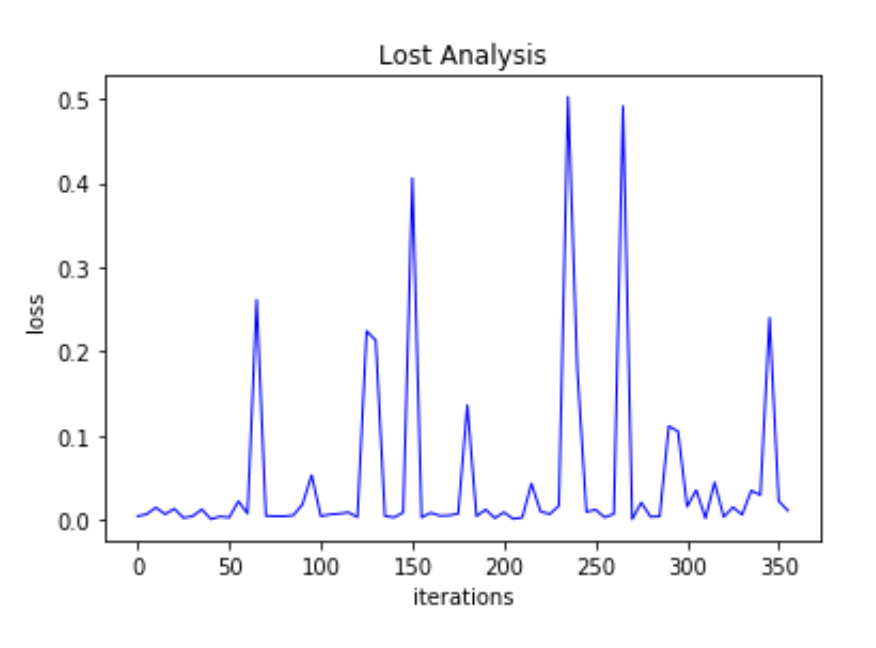


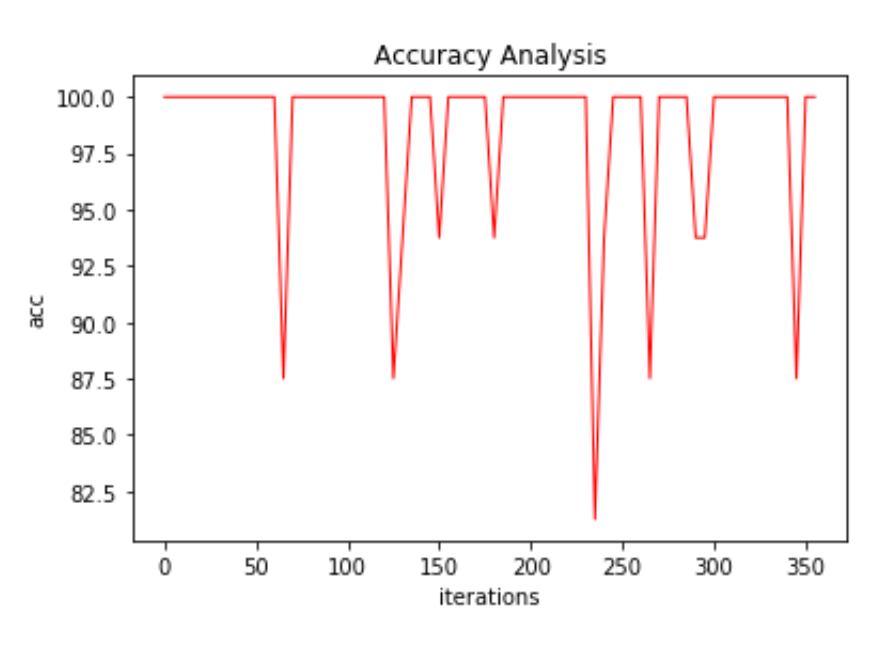
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.3457, Accuracy: 1396/1428 (97.76%)
Best acc is 97.54901960784314,lower than current acc 97.75910364145658.Patience set to 1.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 9, Learning rate: 1.0000000000000002e-07
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.549227, Acc: 98.914376, lr: 1.00e-07
```



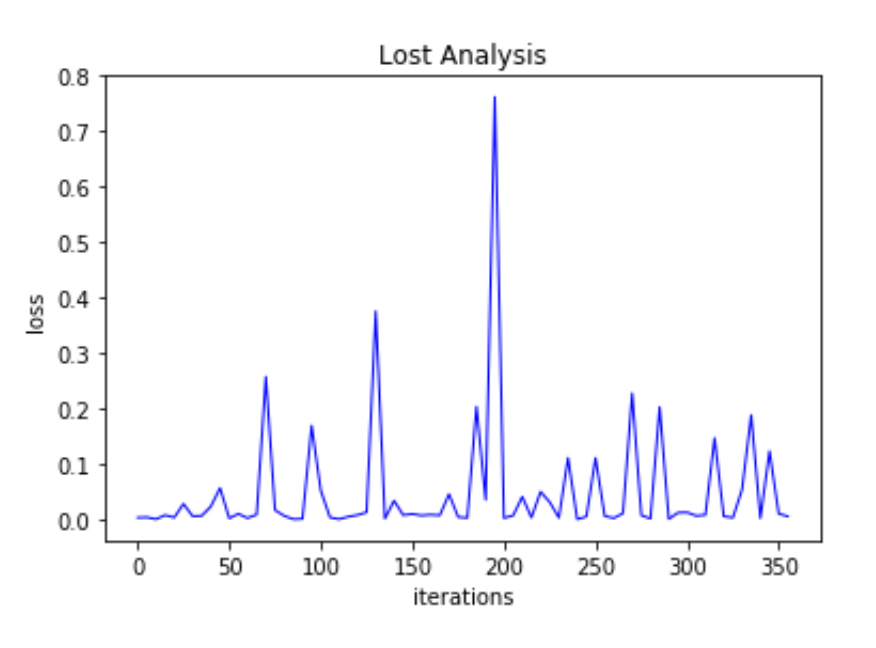


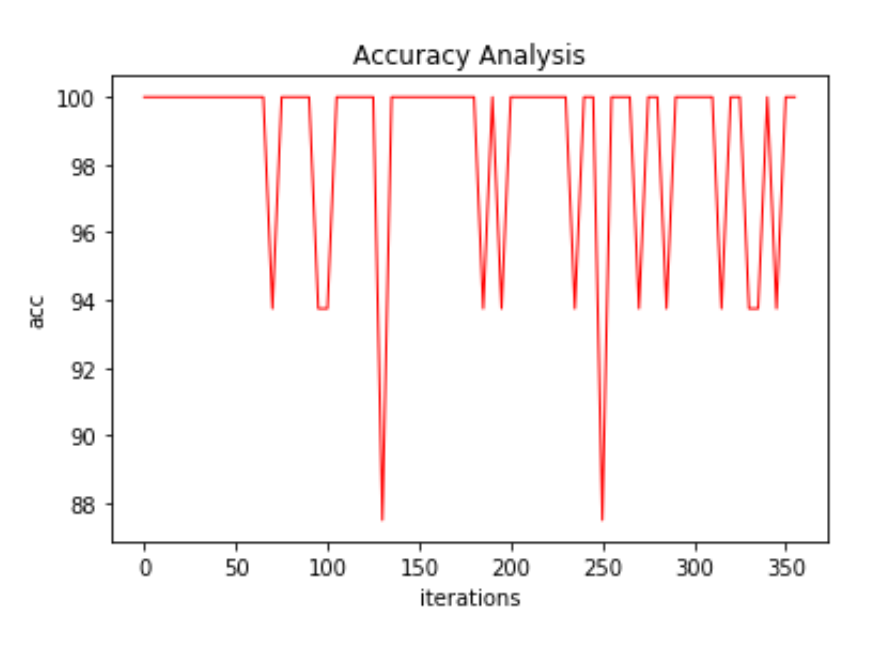
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.3057, Accuracy: 1395/1428 (97.69%)
Best acc is 97.54901960784314,lower than current acc 97.6890756302521.Patience set to 2.
Patience already to 2,set to 0.
Leaning Rate set to 1.0000000000000002e-08.

/lustre/wangdan/anaconda2/envs/py3/lib/python3.7/site-packages/torch/serialization.py:250: UserWarning: Couldn
't retrieve source code for container of type Net. It won't be checked for correctness upon loading.
  "type " + obj.__name__ + ". It won't be checked "

Save a new model to ./AppleModel.pth.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 10, Learning rate: 1.0000000000000002e-08
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.463104, Acc: 99.124497, lr: 1.00e-08
```



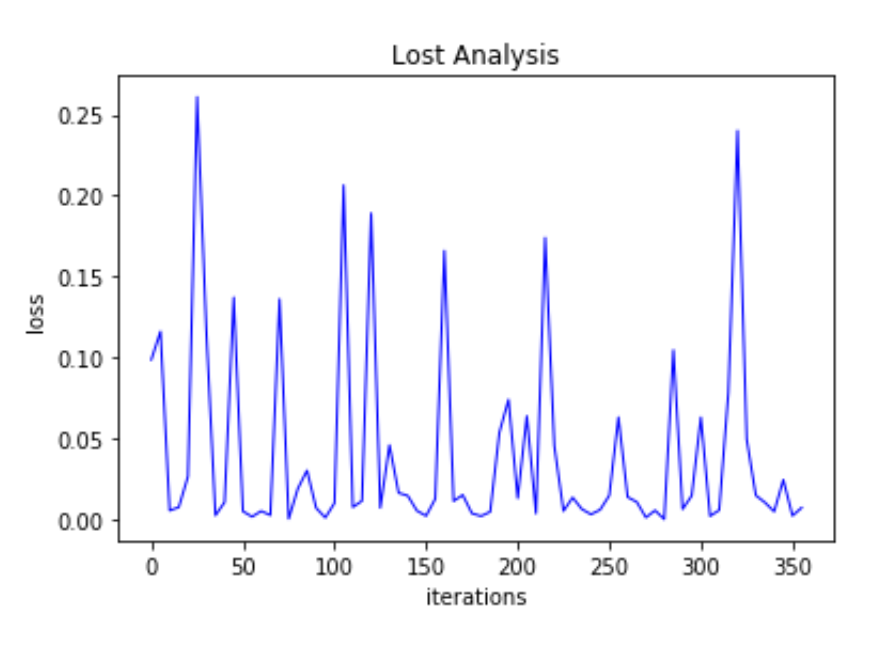


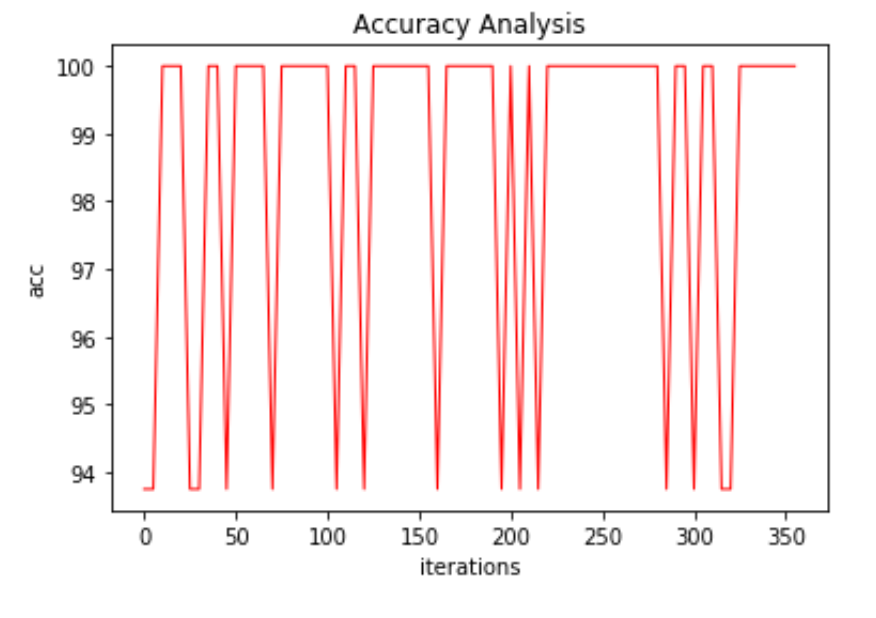
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.7639, Accuracy: 1393/1428 (97.55%)
----------------------------------------------------------------------------------------------------
Start training...
epoch: 11, Learning rate: 1.0000000000000002e-08
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.100294, Acc: 99.001926, lr: 1.00e-08
```



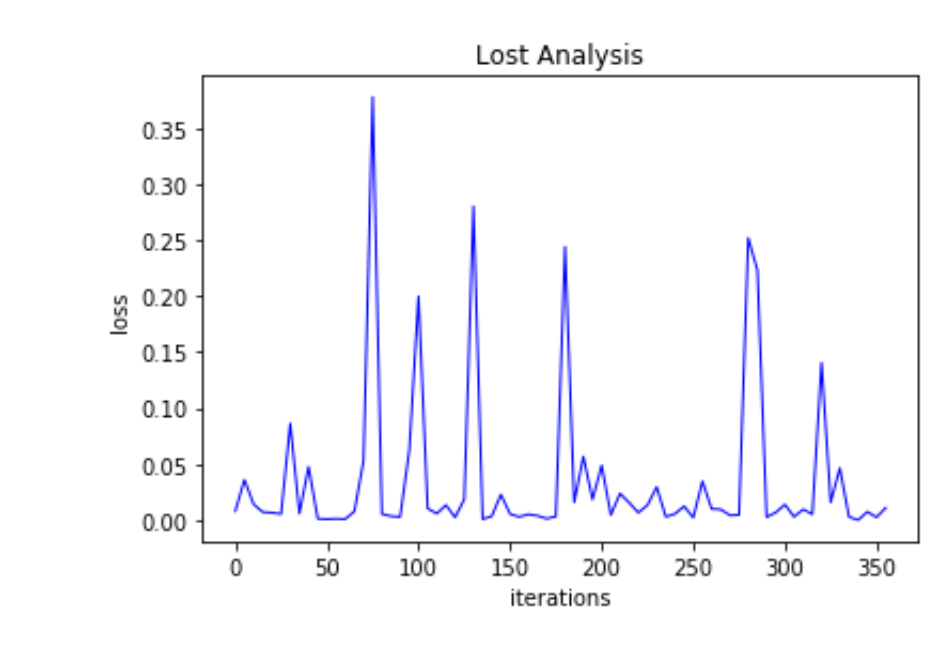


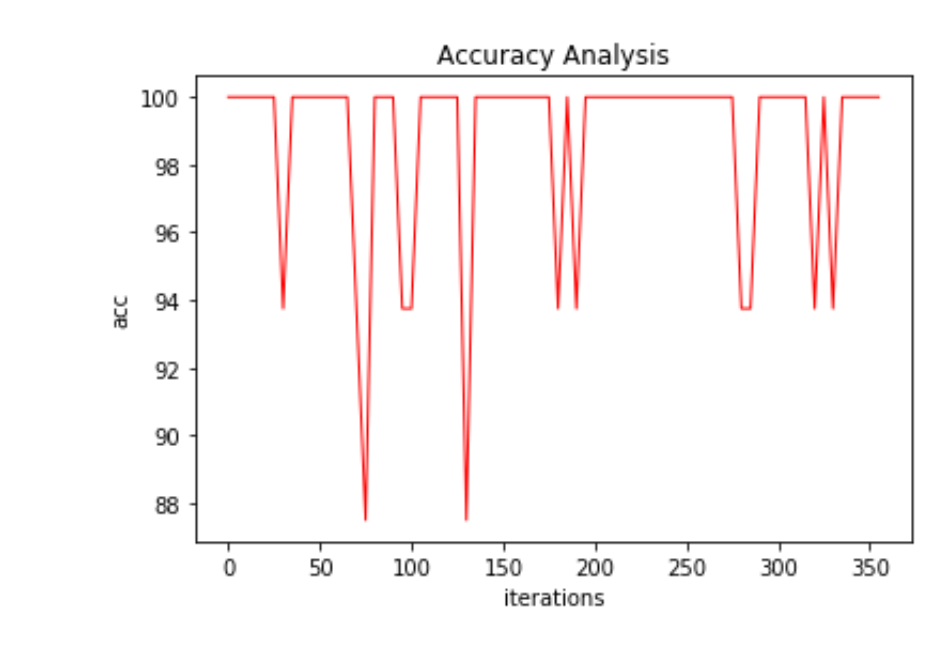
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.1554, Accuracy: 1396/1428 (97.76%)
Best acc is 97.6890756302521,lower than current acc 97.75910364145658.Patience set to 1.
----------------------------------------------------------------------------------------------------
Start training...
epoch: 12, Learning rate: 1.0000000000000002e-08
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.120740, Acc: 98.984416, lr: 1.00e-08
```



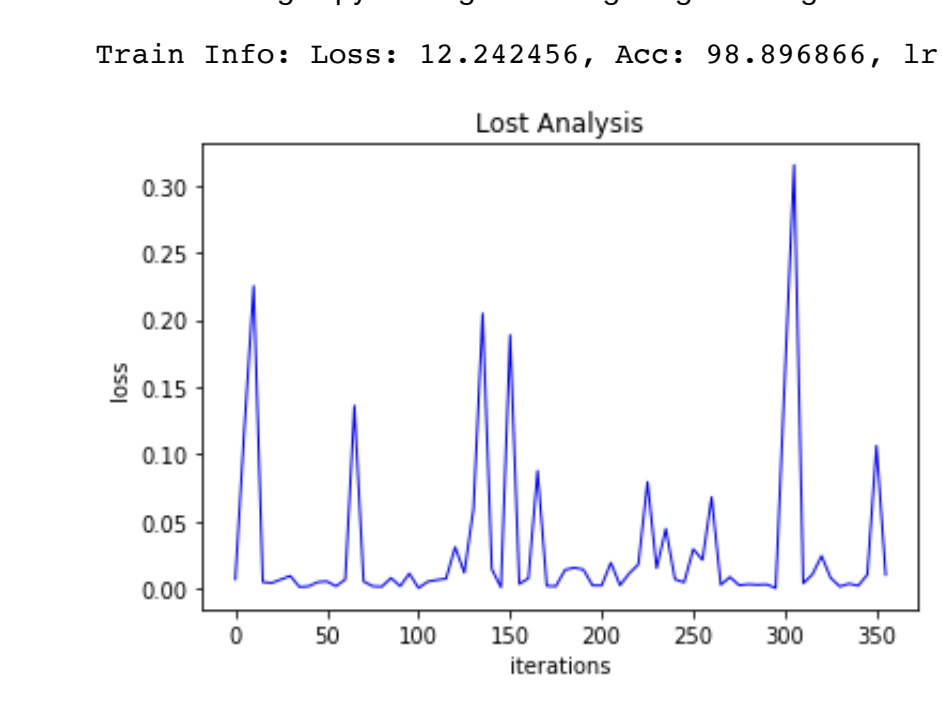


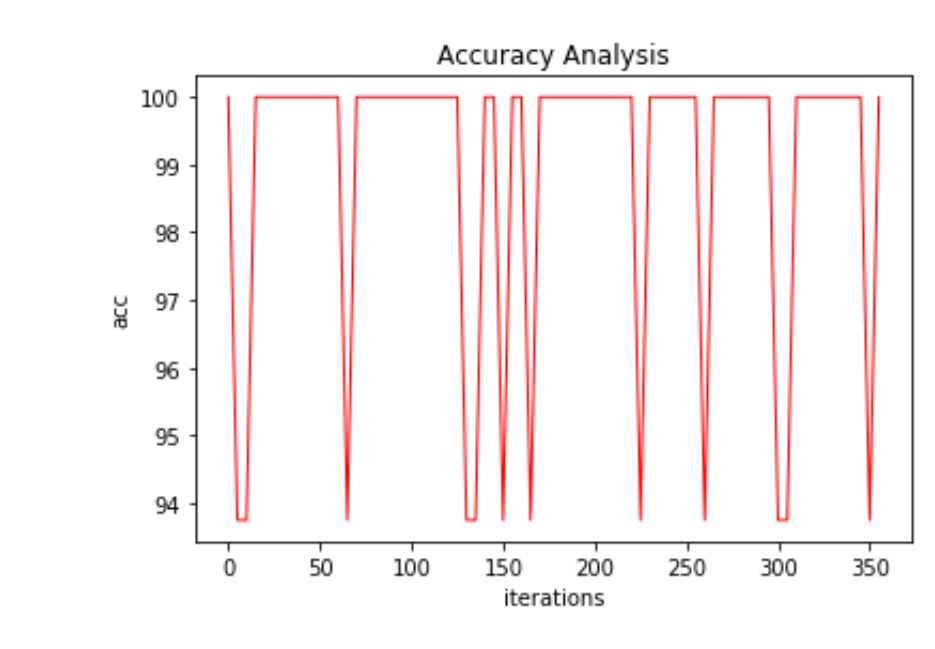
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.2170, Accuracy: 1394/1428 (97.62%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 13, Learning rate: 1.0000000000000002e-08
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.242456, Acc: 98.896866, lr: 1.00e-08
```



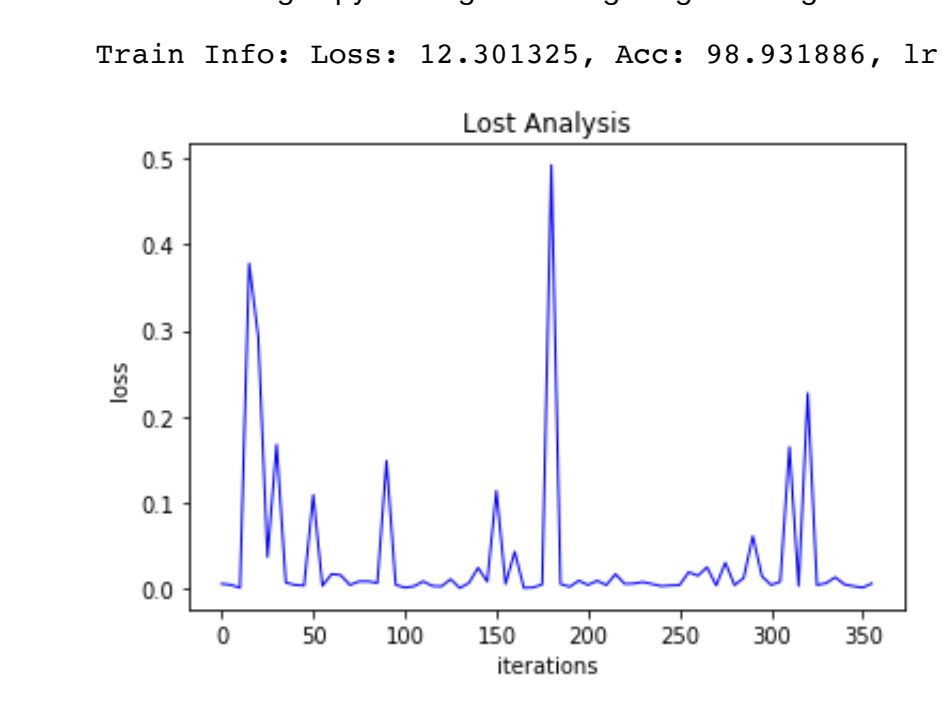


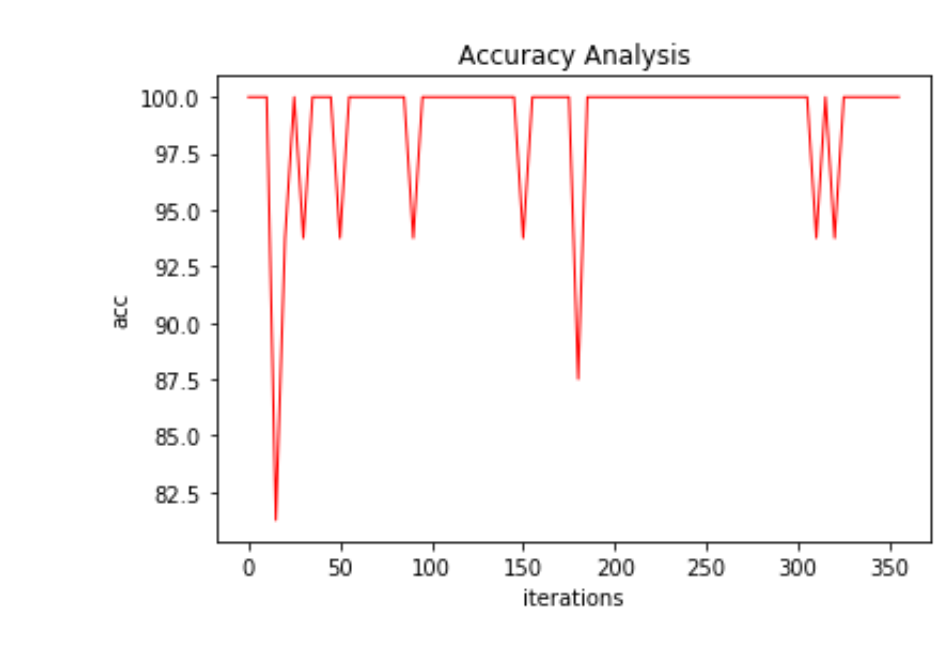
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 12.2138, Accuracy: 1391/1428 (97.41%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 14, Learning rate: 1.0000000000000002e-08
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.301325, Acc: 98.931886, lr: 1.00e-08
```



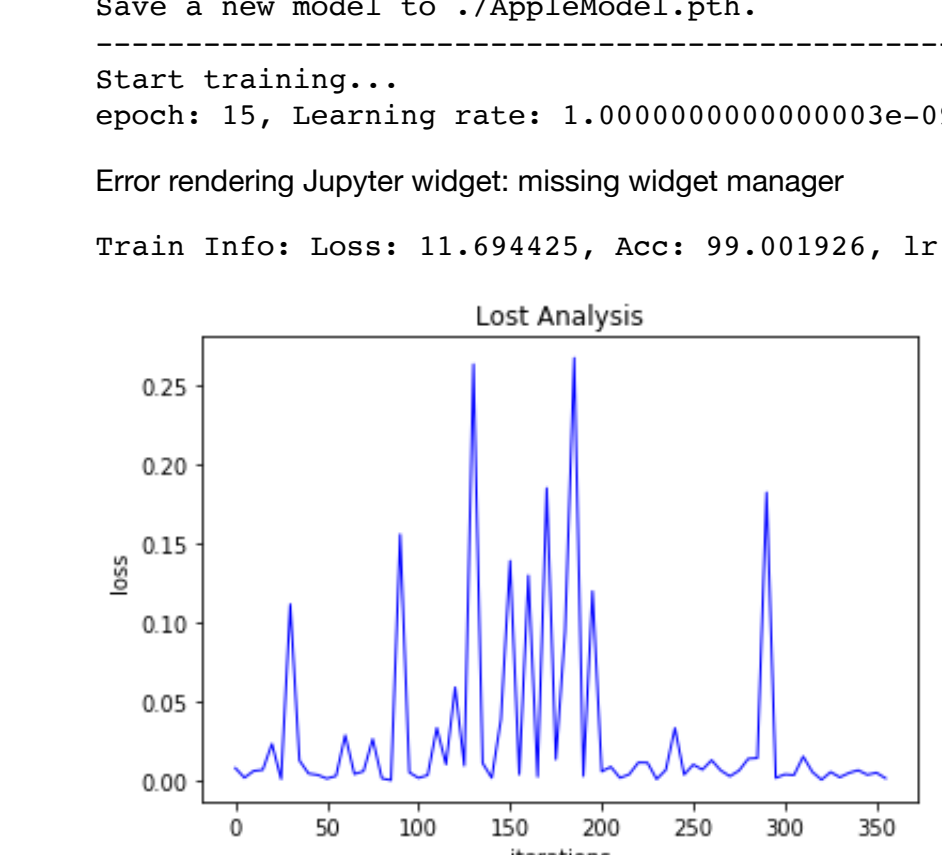


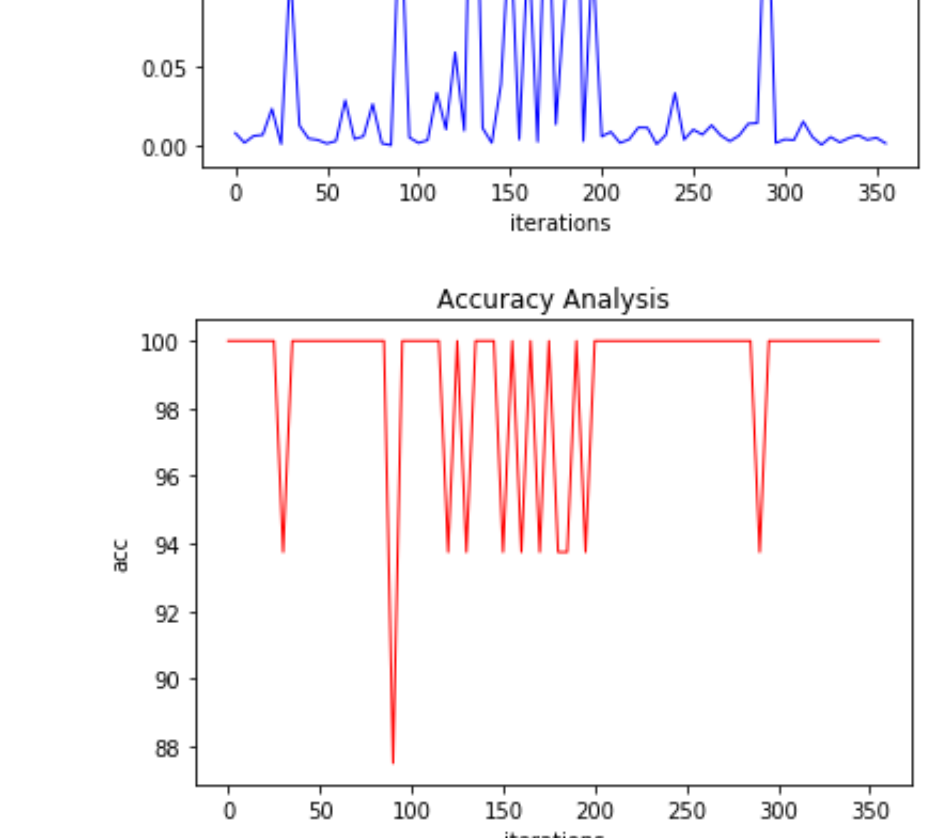
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.5185, Accuracy: 1397/1428 (97.83%)
Best acc is 97.6890756302521,lower than current acc 97.82913165266106.Patience set to 2.
Patience already to 2,set to 0.
Leaning Rate set to 1.0000000000000003e-09.

/lustre/wangdan/anaconda2/envs/py3/lib/python3.7/site-packages/torch/serialization.py:250: UserWarning: Couldn
't retrieve source code for container of type Net. It won't be checked for correctness upon loading.
  "type " + obj.__name__ + ". It won't be checked "

Save a new model to ./AppleModel.pth.
--------------------------------------------------------------------------------------------------
Start training...
epoch: 15, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.694425, Acc: 99.001926, lr: 1.00e-09
```



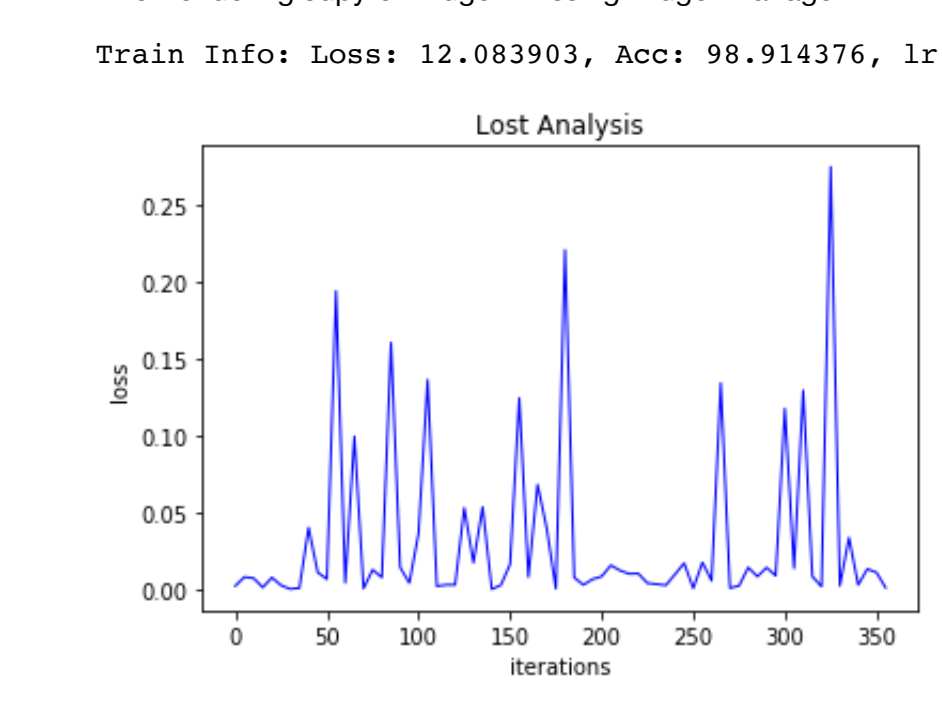


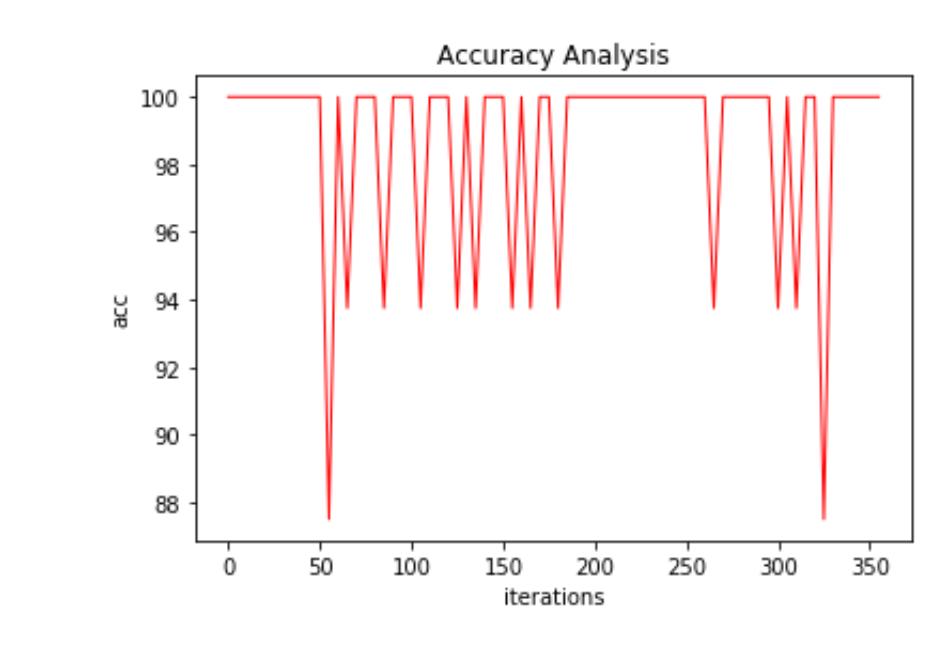
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.4531, Accuracy: 1396/1428 (97.76%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 16, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.083903, Acc: 98.914376, lr: 1.00e-09
```



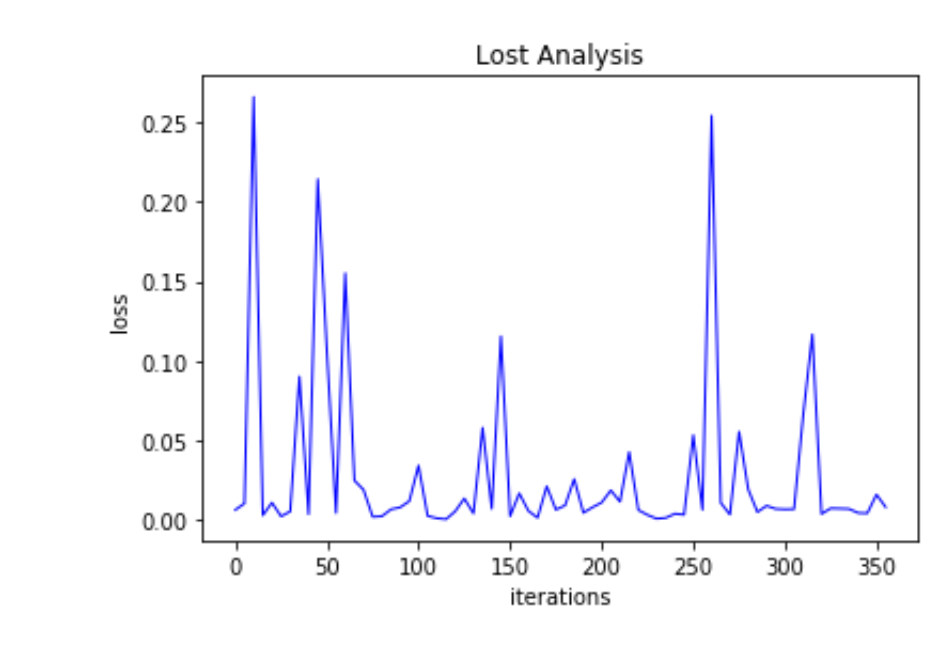


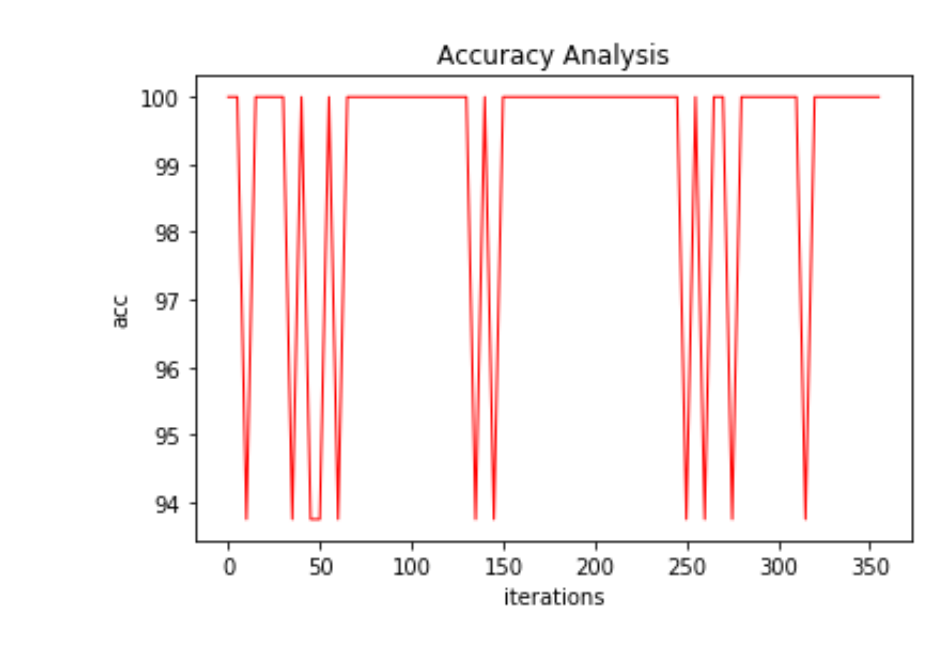
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 12.0778, Accuracy: 1391/1428 (97.41%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 17, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.707259, Acc: 98.914376, lr: 1.00e-09
```



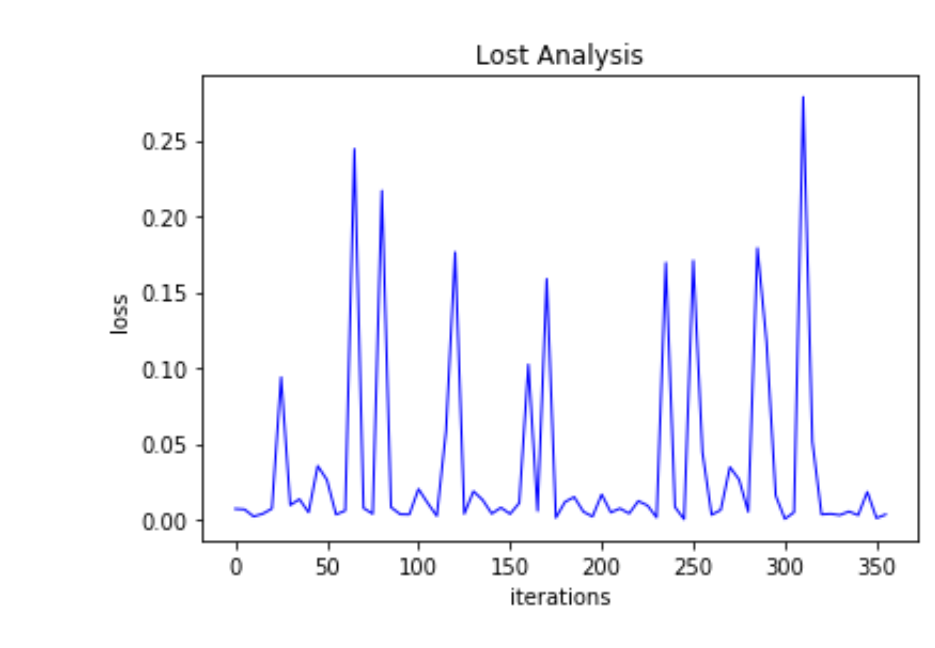


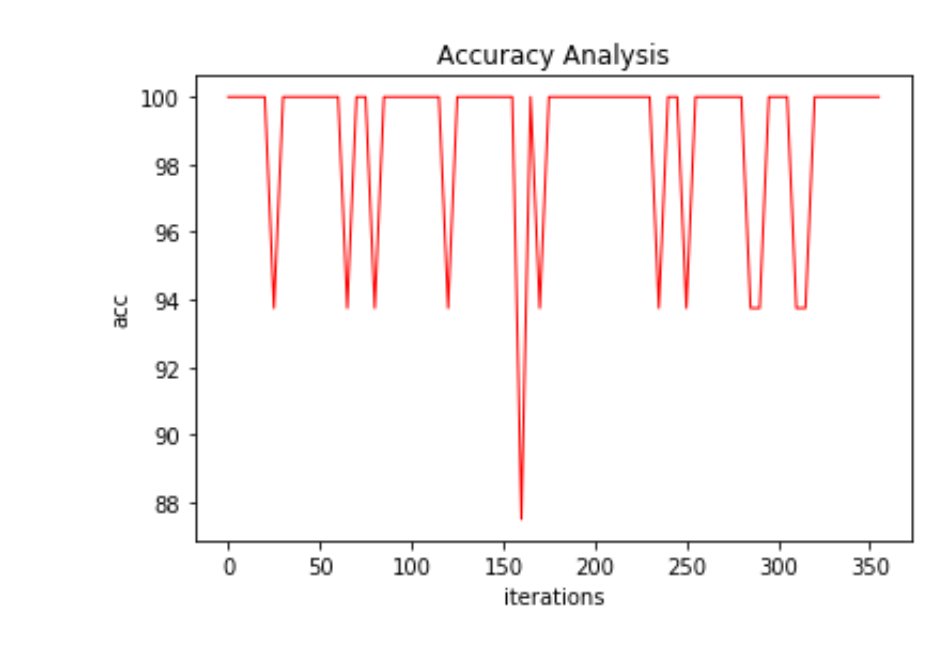
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.2145, Accuracy: 1396/1428 (97.76%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 18, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.732817, Acc: 98.949396, lr: 1.00e-09
```



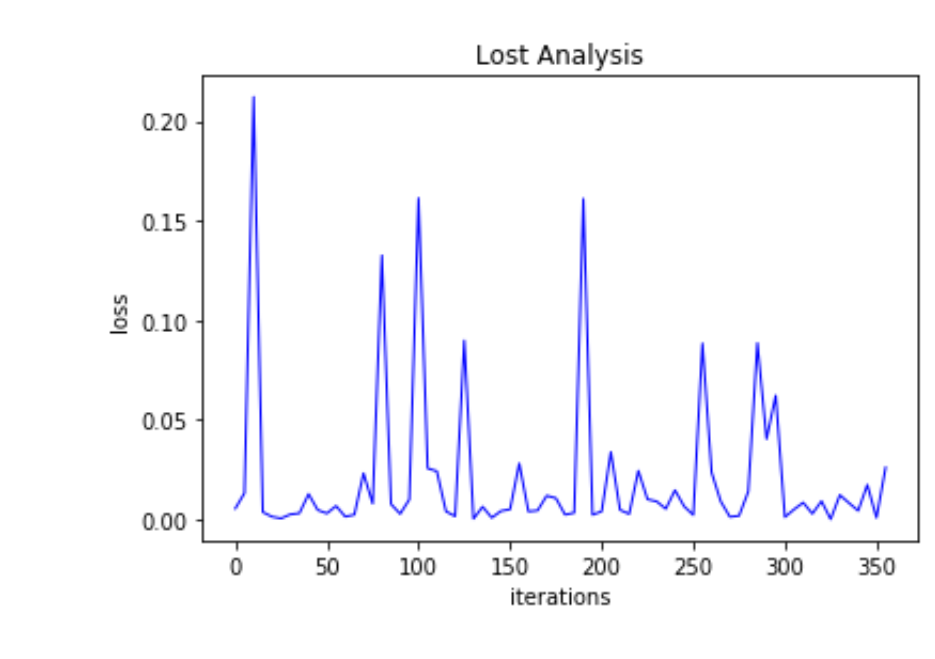


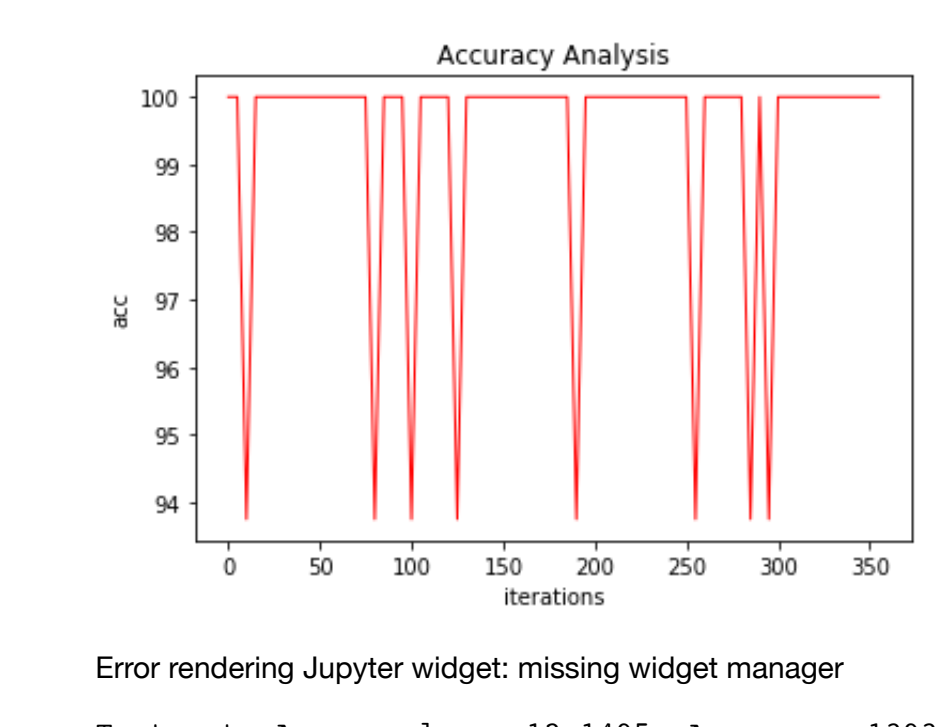
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.6883, Accuracy: 1395/1428 (97.69%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 19, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.701669, Acc: 99.019436, lr: 1.00e-09
```



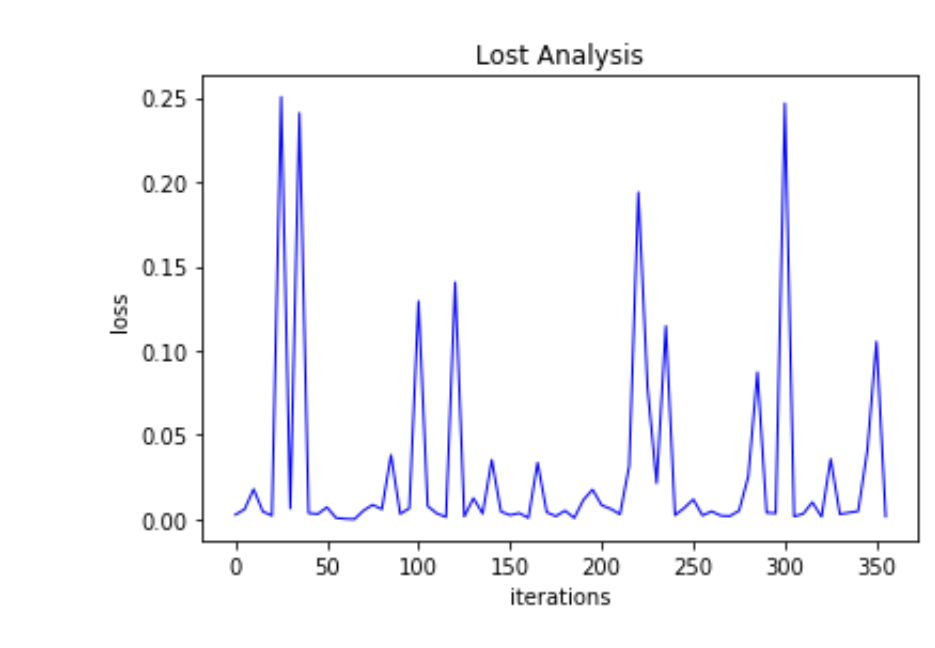


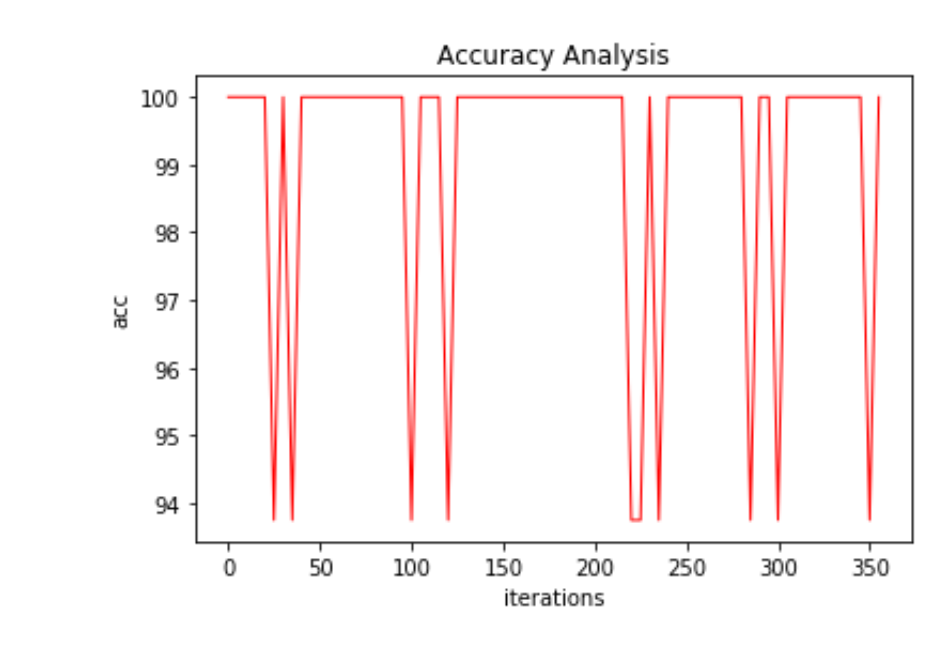
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 12.1495, Accuracy: 1393/1428 (97.55%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 20, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.307194, Acc: 98.984416, lr: 1.00e-09
```



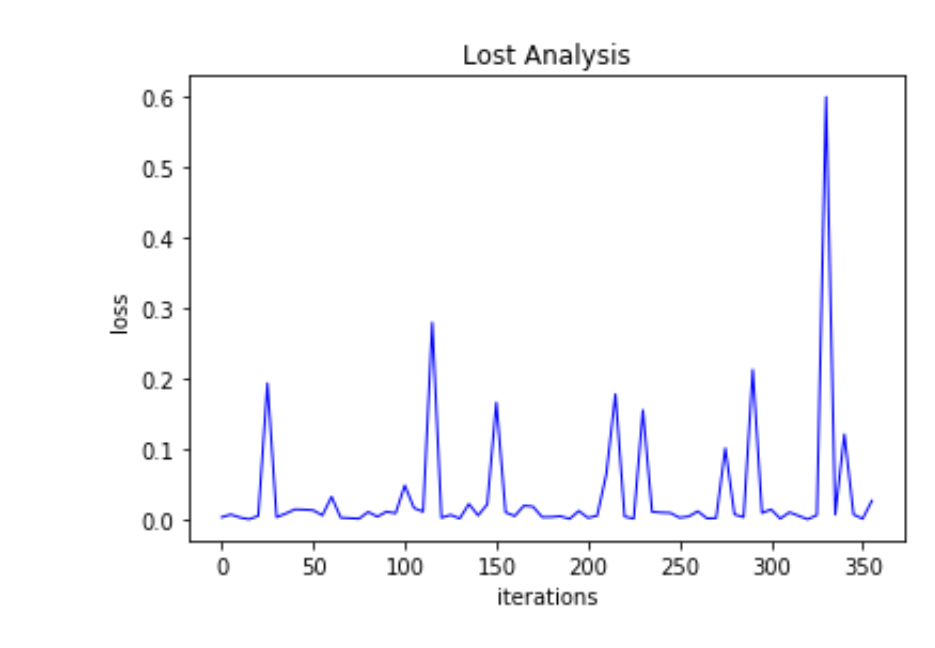


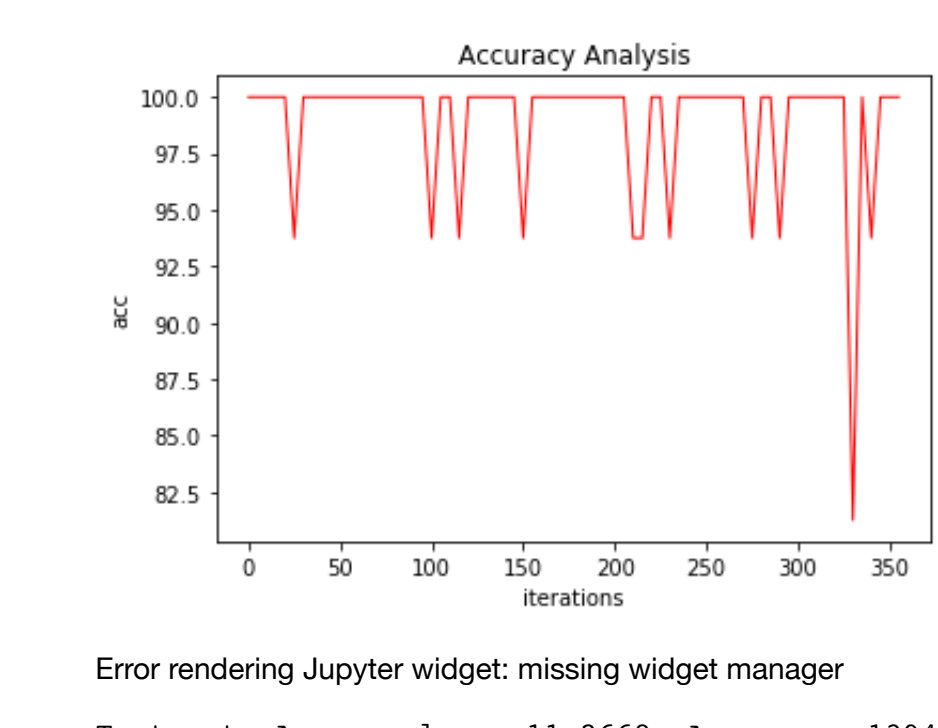
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.7376, Accuracy: 1395/1428 (97.69%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 21, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 13.106361, Acc: 98.844335, lr: 1.00e-09
```



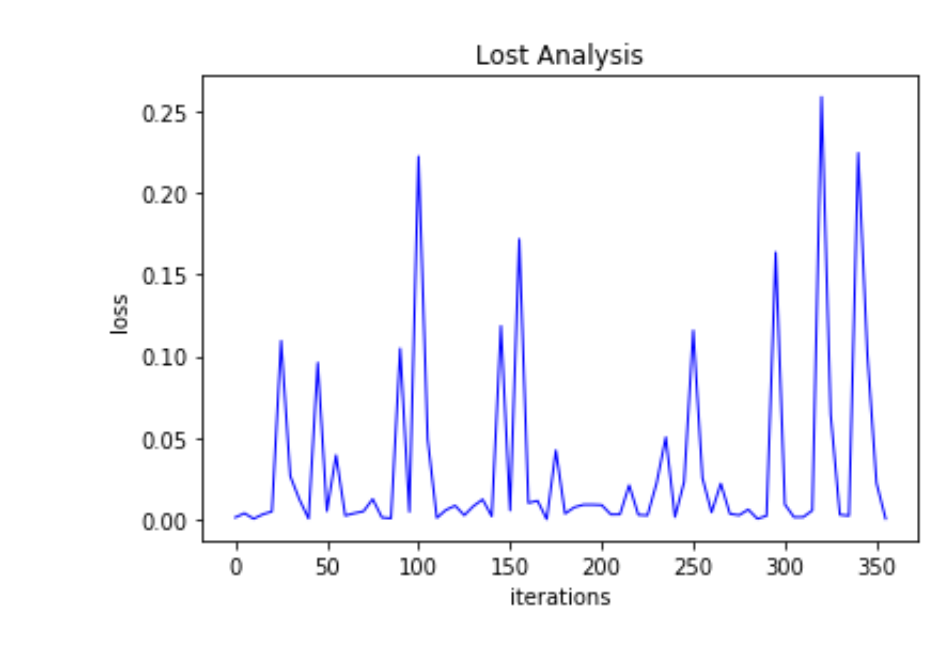


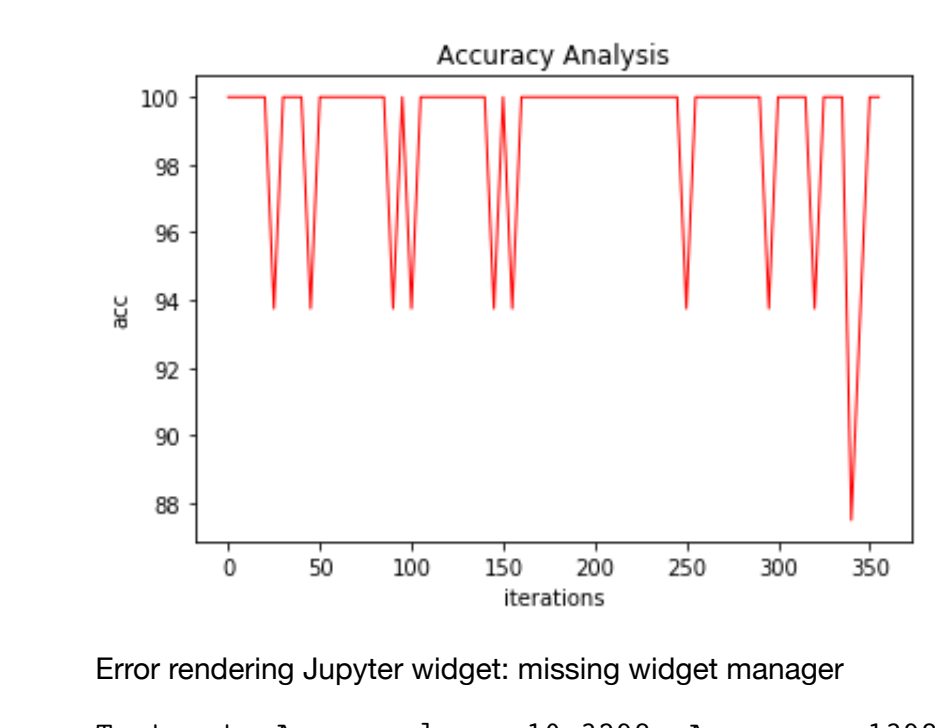
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.2668, Accuracy: 1394/1428 (97.62%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 22, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.581755, Acc: 99.036946, lr: 1.00e-09
```



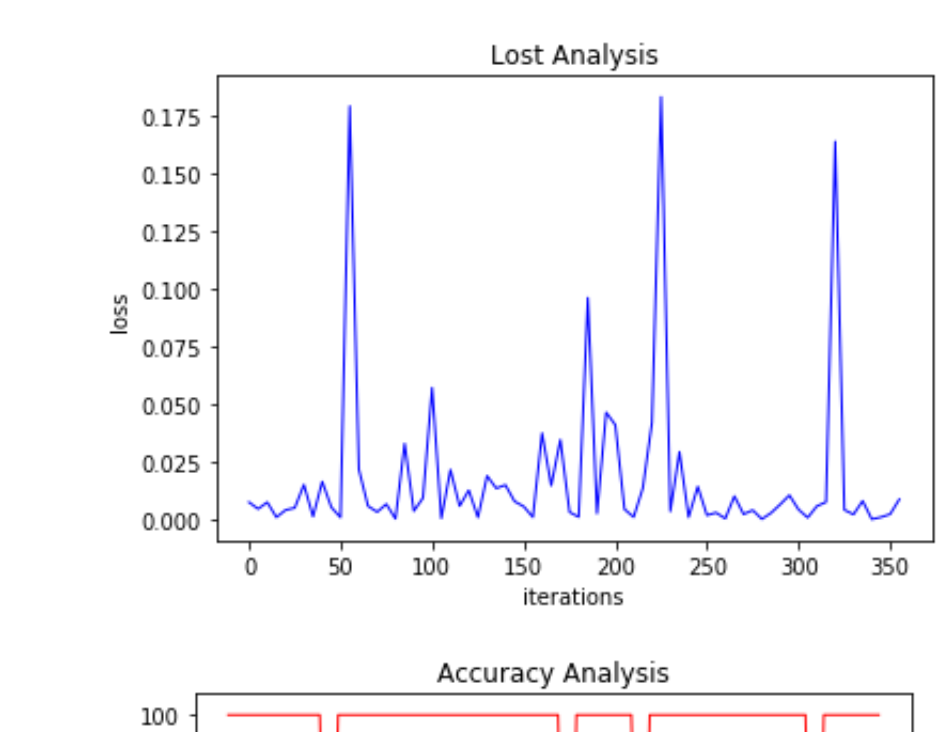


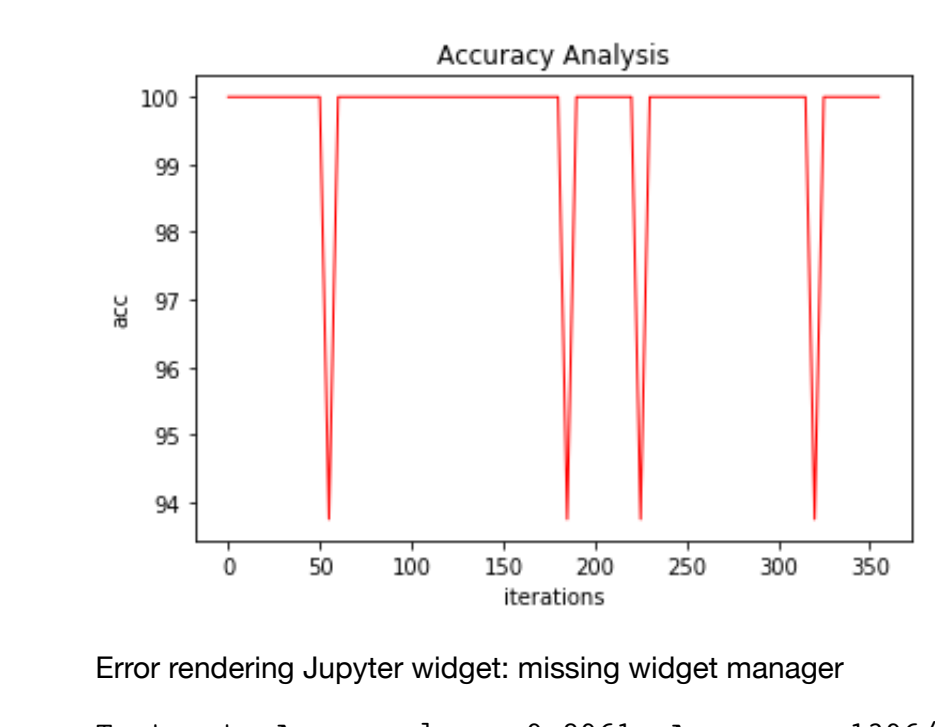
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.3298, Accuracy: 1398/1428 (97.90%)
Best acc is 97.82913165266106,lower than current acc 97.89915966386555.Patience set to 1.
--------------------------------------------------------------------------------------------------
Start training...
epoch: 23, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.764241, Acc: 98.966906, lr: 1.00e-09
```



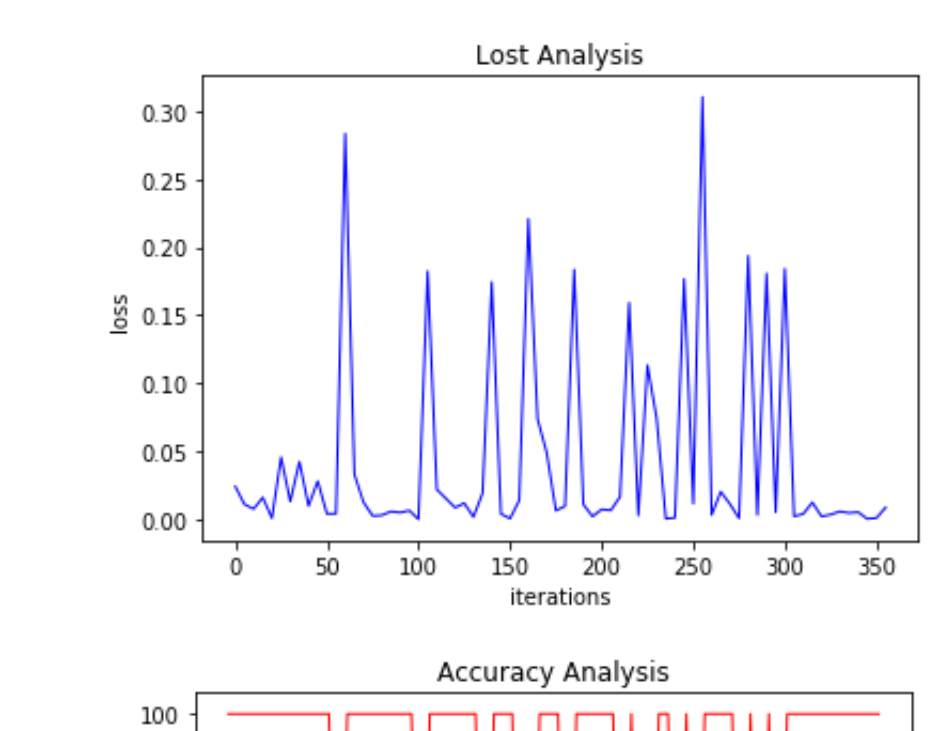


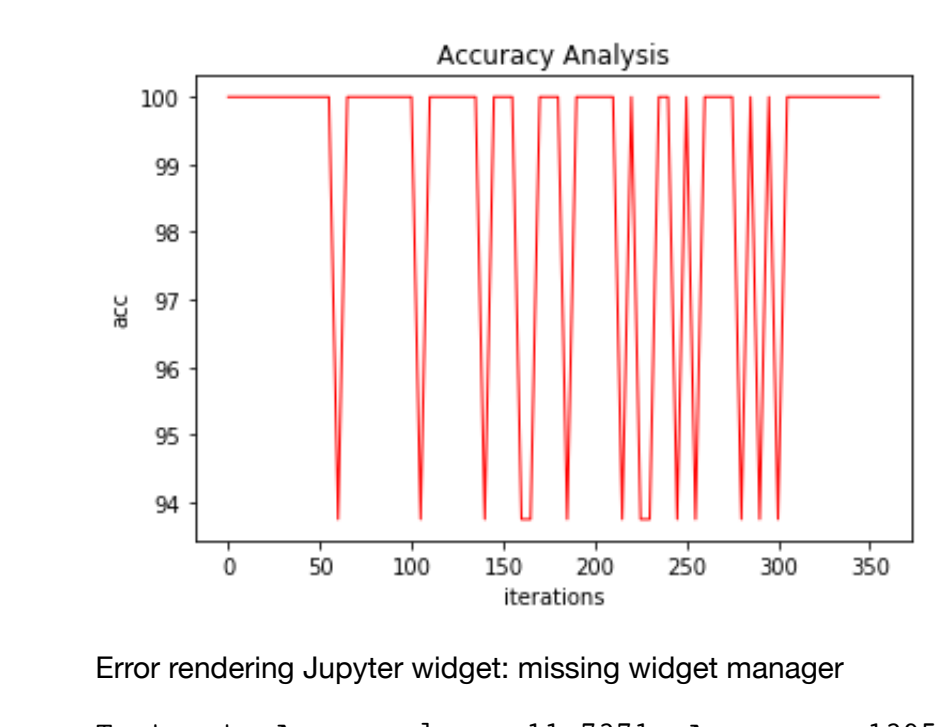
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 9.8961, Accuracy: 1396/1428 (97.76%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 24, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 13.287110, Acc: 98.984416, lr: 1.00e-09
```





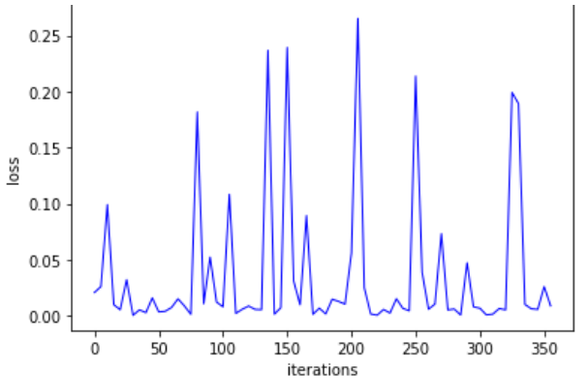
Error rendering Jupyter widget: missing widget manager

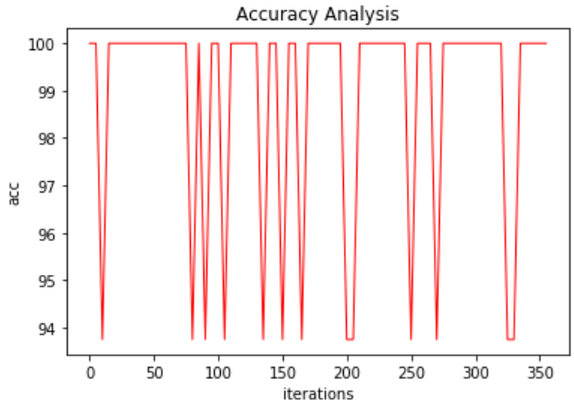
```
Test set: Average loss: 11.7371, Accuracy: 1395/1428 (97.69%)
--------------------------------------------------------------------------------------------------
Start training...
epoch: 25, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.550140, Acc: 98.966906, lr: 1.00e-09
```

Lost Analysis



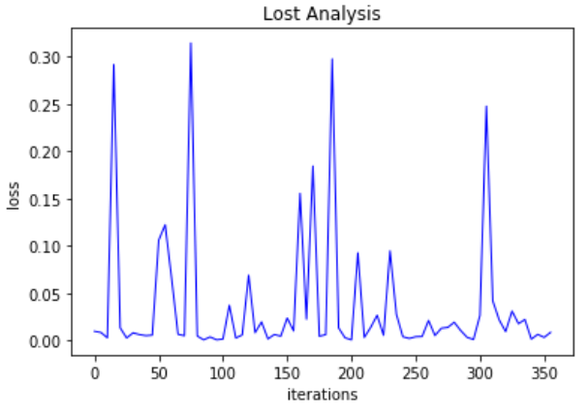


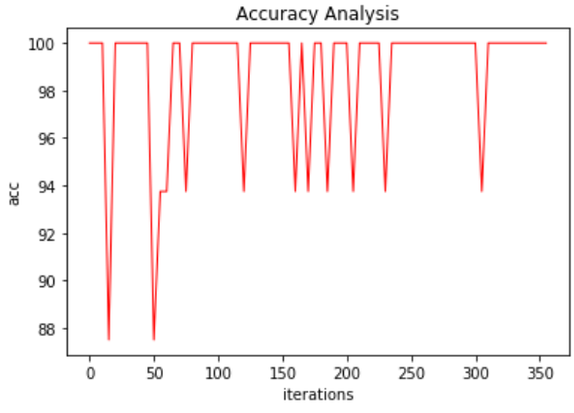
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.6293, Accuracy: 1396/1428 (97.76%)
----------------------------------------------------------------------------------------------------
Start training...
epoch: 26, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.616555, Acc: 99.019436, lr: 1.00e-09
```



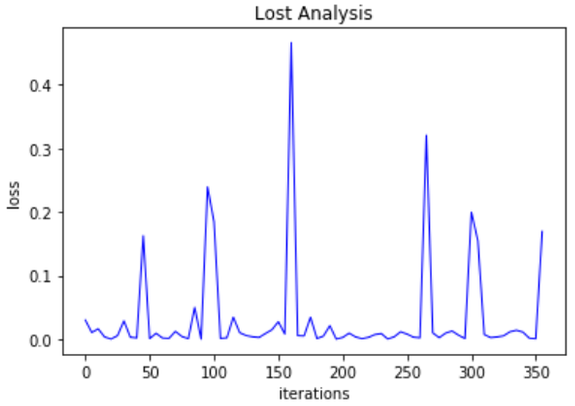


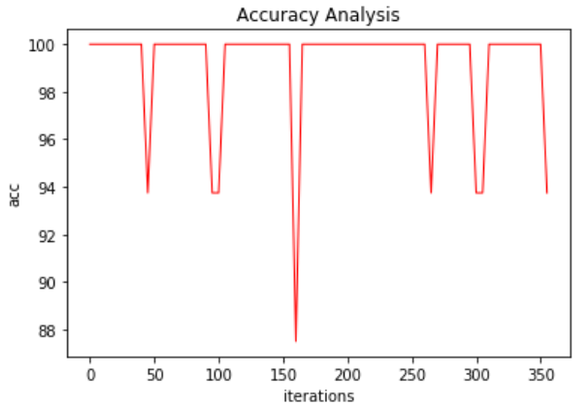
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.8890, Accuracy: 1394/1428 (97.62%)
----------------------------------------------------------------------------------------------------
Start training...
epoch: 27, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.734734, Acc: 98.914376, lr: 1.00e-09
```



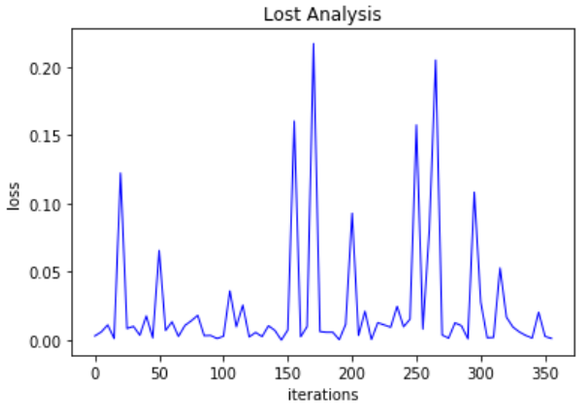


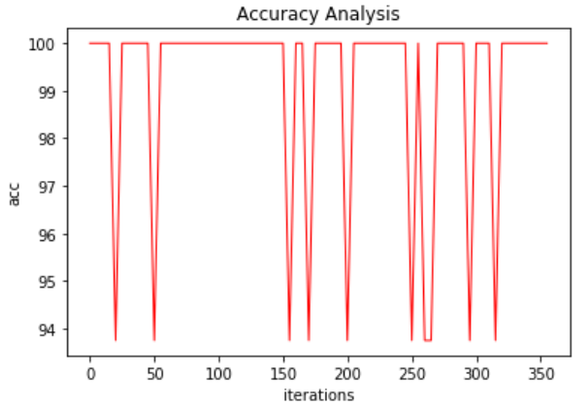
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 11.5396, Accuracy: 1392/1428 (97.48%)
--------------------------------------------------------------------------------------------------------------
Start training...
epoch: 28, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 11.844354, Acc: 98.879356, lr: 1.00e-09
```



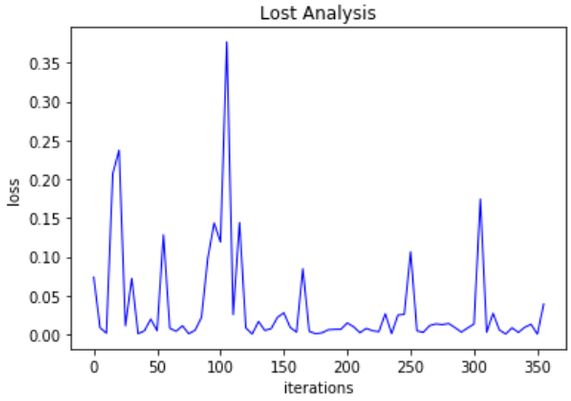


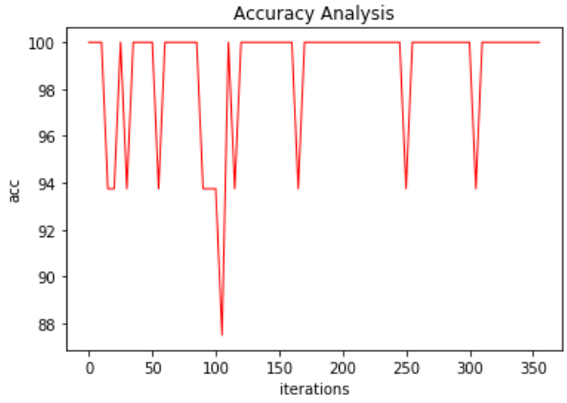
Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 10.5531, Accuracy: 1396/1428 (97.76%)
--------------------------------------------------------------------------------------------------------------
Start training...
epoch: 29, Learning rate: 1.0000000000000003e-09
```

Error rendering Jupyter widget: missing widget manager

```
Train Info: Loss: 12.547759, Acc: 98.896866, lr: 1.00e-09
```





Error rendering Jupyter widget: missing widget manager

```
Test set: Average loss: 12.7612, Accuracy: 1394/1428 (97.62%)
Best Result: 97.829%
```

In [ ]:

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