1. **Import Libraries**

In [142]:

```
import torch
import torch.nn as nn
import torch.optim as optim
from torchvision import datasets, transforms
from matplotlib import pyplot as plt
```

1. **Basic Settings**

In [143]:

```
batch_size = 20
learning_rate = .01
epochs = 50
```

1. **Prepare the Data**

In [144]:

```
train_loader = torch.utils.data.DataLoader(datasets.CIFAR10('../data', train = True, downl
oad = True, transform = transforms.Compose([transforms.ToTensor(),transforms.Normalize((.5
,.5,.5),(.5,.5,.5))])), batch_size = batch_size, shuffle = True)

test_loader = torch.utils.data.DataLoader(datasets.CIFAR10('../data', train = False, trans
form = transforms.Compose([transforms.ToTensor(),transforms.Normalize((.5,.5,.5),(.5,.5,.5
))])), batch_size = batch_size, shuffle = False)
```

```
Files already downloaded and verified
```

1. **Define the Module**

In [145]:

```
class MLP(nn.Module):

    def __init__(self):
        super(MLP, self).__init__()

        self.model = nn.Sequential(
            nn.Linear(3072,6000),
            nn.ReLU(inplace=True),
            nn.Linear(6000,6000),
            nn.ReLU(inplace=True),
            nn.Linear(6000,6000),
            nn.ReLU(inplace=True),
            nn.Linear(6000,6000),
            nn.ReLU(inplace=True),
            nn.Linear(6000,6000),
            nn.ReLU(inplace=True),
            nn.Linear(6000,6000),
            nn.ReLU(inplace=True),
            nn.Linear(6000, 10),
        )

    def forward(self, x):
        x = self.model(x)

        return x
```

1. **Cuda, Optimizer, Loss Function**

In [148]:

```
device = torch.device('cuda:0')
net = MLP().to(device)
optimizer = optim.SGD(net.parameters(), lr=learning_rate)
criteon = nn.CrossEntropyLoss().to(device)
```

1. **Start Training**

In [149]:

```
for epoch in range(epochs):
  train_loss = 0
  train_acc = 0

  for data, target in train_loader:
    data = data.view(-1, 32*32*3)
    data, target = data.to(device), target.to(device)
    logits = net(data)
    loss = criteon(logits, target)
    optimizer.zero_grad()
    loss.backward()
    optimizer.step()

    _,pred = logits.max(1)
    num_correct = (pred==target).sum().item()
    acc = num_correct/data.shape[0]
    train_acc += acc

    train_loss += loss.data

  print('Train Epoch: {} Loss: {:.6f} Training Accuracy: {:.6f}'.format(epoch+1, train_los
s/len(train_loader), train_acc/len(train_loader)))
```

```
Train Epoch: 1 Loss: 2.246491 Training Accuracy: 0.168020
Train Epoch: 2 Loss: 1.861921 Training Accuracy: 0.303680
Train Epoch: 3 Loss: 1.607362 Training Accuracy: 0.413580
Train Epoch: 4 Loss: 1.447467 Training Accuracy: 0.477280
Train Epoch: 5 Loss: 1.326011 Training Accuracy: 0.521420
Train Epoch: 6 Loss: 1.221435 Training Accuracy: 0.559900
Train Epoch: 7 Loss: 1.126308 Training Accuracy: 0.593960
Train Epoch: 8 Loss: 1.028003 Training Accuracy: 0.633300
Train Epoch: 9 Loss: 0.934547 Training Accuracy: 0.663760
Train Epoch: 10 Loss: 0.835291 Training Accuracy: 0.699140
Train Epoch: 11 Loss: 0.738954 Training Accuracy: 0.733500
Train Epoch: 12 Loss: 0.650593 Training Accuracy: 0.768420
Train Epoch: 13 Loss: 0.563912 Training Accuracy: 0.797780
Train Epoch: 14 Loss: 0.487000 Training Accuracy: 0.825580
Train Epoch: 15 Loss: 0.418204 Training Accuracy: 0.850980
Train Epoch: 16 Loss: 0.356919 Training Accuracy: 0.873760
Train Epoch: 17 Loss: 0.300846 Training Accuracy: 0.893800
Train Epoch: 18 Loss: 0.265264 Training Accuracy: 0.906880
Train Epoch: 19 Loss: 0.226921 Training Accuracy: 0.918920
Train Epoch: 20 Loss: 0.193748 Training Accuracy: 0.932980
Train Epoch: 21 Loss: 0.186749 Training Accuracy: 0.935320
Train Epoch: 22 Loss: 0.146558 Training Accuracy: 0.949020
Train Epoch: 23 Loss: 0.132519 Training Accuracy: 0.955240
Train Epoch: 24 Loss: 0.119683 Training Accuracy: 0.958940
Train Epoch: 25 Loss: 0.107644 Training Accuracy: 0.962640
Train Epoch: 26 Loss: 0.088223 Training Accuracy: 0.970040
Train Epoch: 27 Loss: 0.085317 Training Accuracy: 0.970820
Train Epoch: 28 Loss: 0.083620 Training Accuracy: 0.971540
Train Epoch: 29 Loss: 0.072746 Training Accuracy: 0.975580
Train Epoch: 30 Loss: 0.067181 Training Accuracy: 0.977040
Train Epoch: 31 Loss: 0.057029 Training Accuracy: 0.981000
Train Epoch: 32 Loss: 0.059055 Training Accuracy: 0.980640
Train Epoch: 33 Loss: 0.049335 Training Accuracy: 0.983560
Train Epoch: 34 Loss: 0.050138 Training Accuracy: 0.983720
Train Epoch: 35 Loss: 0.035821 Training Accuracy: 0.988560
Train Epoch: 36 Loss: 0.040724 Training Accuracy: 0.986380
Train Epoch: 37 Loss: 0.036546 Training Accuracy: 0.988260
```

```
Train Epoch: 38 Loss: 0.039892 Training Accuracy: 0.986860
Train Epoch: 39 Loss: 0.040126 Training Accuracy: 0.986740
Train Epoch: 40 Loss: 0.020161 Training Accuracy: 0.993620
Train Epoch: 41 Loss: 0.025165 Training Accuracy: 0.992280
Train Epoch: 42 Loss: 0.014221 Training Accuracy: 0.995540
Train Epoch: 43 Loss: 0.005151 Training Accuracy: 0.998480
Train Epoch: 44 Loss: 0.004949 Training Accuracy: 0.998660
Train Epoch: 45 Loss: 0.001692 Training Accuracy: 0.999580
Train Epoch: 46 Loss: 0.001409 Training Accuracy: 0.999540
Train Epoch: 47 Loss: 0.001348 Training Accuracy: 0.999520
Train Epoch: 48 Loss: 0.000501 Training Accuracy: 0.999840
Train Epoch: 49 Loss: 0.002131 Training Accuracy: 0.999240
Train Epoch: 50 Loss: 0.000647 Training Accuracy: 0.999860
```

1. **Evaluate the Model**

In [150]:

```
correct = 0
for data, target in test_loader:
    data = data.view(-1, 32*32*3)
    data, target = data.to(device), target.cuda()
    logits = net(data)

    pred = logits.argmax(dim=1)
    correct += pred.eq(target).float().sum().item()

total_num = len(test_loader.dataset)
acc = correct / total_num
print('test accuracy:', acc)
```

```
test accuracy: 0.5878
```

1. **Make Predictions**

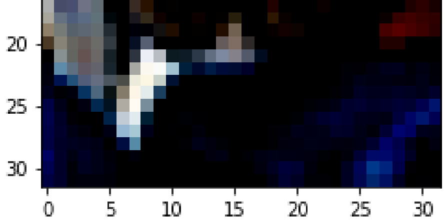
In [151]:

```
def plot_image(img, prediction, label):

  fig = plt.figure()
  for i in range(6):
    plt.imshow(img[i])
    plt.title("Prediction = {} Label = {}".format(prediction[i].item(),label[i].item()))
    plt.show()
```

In [153]:

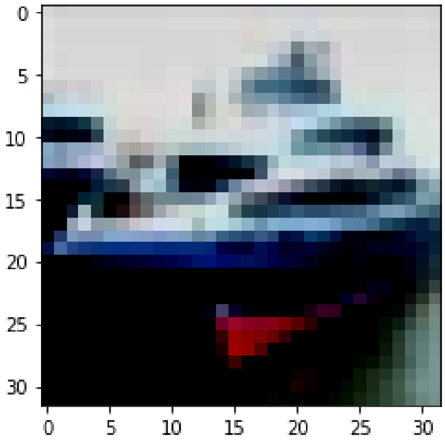
```
import numpy as np

x, y = next(iter(test_loader))


x = x.view(-1, 32*32*3)
x, y = x.to(device), y.cuda()
out = net(x)
pred = out.argmax(dim = 1)
x = x.detach().cpu().reshape((20,3,32,32)).permute(0,2,3,1).numpy()
plot_image(x, pred, y)
```

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..2
55] for integers).
```



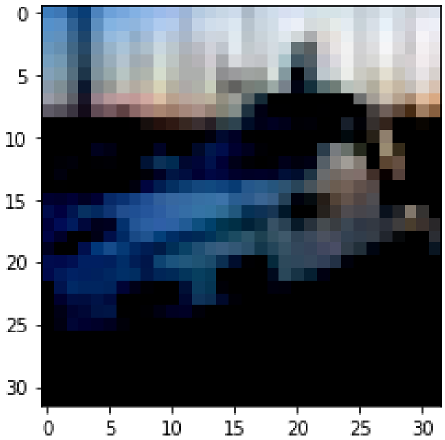

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..2
55] for integers).
```

Prediction = 8 Label = 8



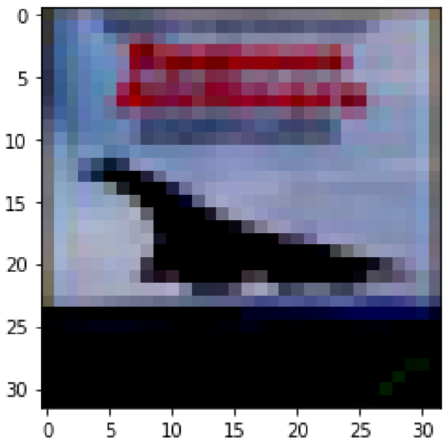

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..2
55] for integers).
```

Prediction = 8 Label = 8



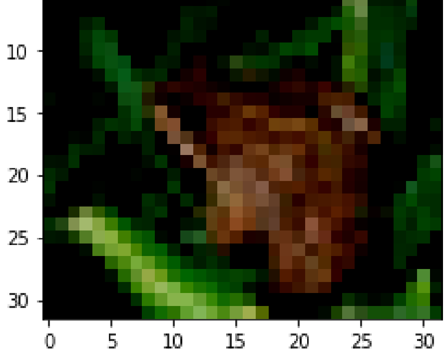

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..2
55] for integers).
```

Prediction = 0 Label = 0




```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..2
55] for integers).
```

Prediction = 4 Label = 6



```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..2
55] for integers).
```