In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import sklearn.svm as svm
from sklearn.metrics import accuracy_score as score
%matplotlib inline
```

In [2]:
```
#inputs are the training data, the labels and the number of training datapoints to
def data_partition(data,labels,n_validation):
    rows = np.linspace(0,len(labels)-1,len(labels),dtype=int)
    np.random.shuffle(rows)

    n_training = len(data) - n_validation

    train_data = data[rows[:n_training]]
    train_labels = labels[rows[:n_training]]

    val_data = data[rows[n_training:]]
    val_labels = labels[rows[n_training:]]

    return train_data,train_labels,val_data,val_labels
```

a) Partitioning MNIST dataset

In [3]:
```
mnist = np.load('data/mnist-data.npz')
```

In [4]:
```
mnist.files
```

Out[4]:
```
['training_data', 'test_data', 'training_labels']
```

In [5]:
```
mnist['training_data'].shape
```

Out[5]:
```
(60000, 1, 28, 28)
```

In [6]:
```
#Need to reshape the data to have the images be row vectors
mnist_data=mnist['training_data'].reshape(60000,784)
```

In [7]:
```
mnist_t_data,mnist_t_labels,mnist_v_data,mnist_v_labels = data_partition(mnist_data
                                                                         mnist['tra
```

In [8]:
```
#check that training and validation sizes are correct
print('training/input : ',len(mnist_t_data))
print('validation/input : ',len(mnist_v_data))
```

```
training/input :  50000
validation/input :  10000
```

b) Partitioning spam dataset

In [9]:
```
spam = np.load('data/spam-data.npz')
```

In [10]:
```
spam.files
```

Out[10]:
```
['training_data', 'training_labels', 'test_data']
```

In [11]:
```
spam_t_data,spam_t_labels,spam_v_data,spam_v_labels = data_partition(spam['training
                                                                          round(0.2*len(
```

In [12]:
```
#check that training and validation sizes are correct
print('training/input : ',len(spam_t_data)/len(spam['training_data']))
print('validation/input : ',len(spam_v_data)/len(spam['training_data']))
```

```
training/input :  0.8000958772770853
validation/input :  0.19990412272291466
```

c) Partitioning CIFAR-10 dataset

In [13]:
```
cifar = np.load('data/cifar10-data.npz')
```

In [14]:
```
cifar.files
```

Out[14]:
```
['training_data', 'test_data', 'training_labels']
```

In [15]:
```
cifar_t_data, cifar_t_labels, cifar_v_data, cifar_v_labels = data_partition(cifar['
                                                                            cifar['
```

In [16]:
```
#check that training and validation sizes are correct
print('training data length: ',len(cifar_t_data))
print('validation data length: ',len(cifar_v_data))
```

```
training data length:  45000
validation data length:  5000
```

Q3

In [17]:
```
# This function is for the SVC model; kernel can be selected. Takes in traing and v
# scores for both
def sk_svm(t_data, t_labels,v_data,v_labels, batch_sizes, c=1,kernel='linear',degre

    t_scores = []
    v_scores = []
    for n in batch_sizes:
        clf=svm.SVC(C=c, kernel=kernel)
        clf.fit(t_data[:n], t_labels[:n])
        t_scores += [score(clf.predict(t_data),t_labels)]
        v_scores += [score(clf.predict(v_data),v_labels)]
    return t_scores, v_scores
```

In [18]:
```
#This function is just for the plots for Q3
def accuracy_plot(batch, t_scores, v_scores, dataset):
```

```
    plt.figure(figsize=(6,5))
    plt.plot(batch, t_scores,label='Training')
    plt.plot(batch, v_scores,label='Validation')
    plt.title('SVM Accuracy for {}'.format(dataset))
    plt.xlabel('Training batch size')
    plt.ylabel('Accuracy')
    plt.legend()
    plt.savefig('Q3_{}_plot'.format(dataset), dpi=300)
```

a)

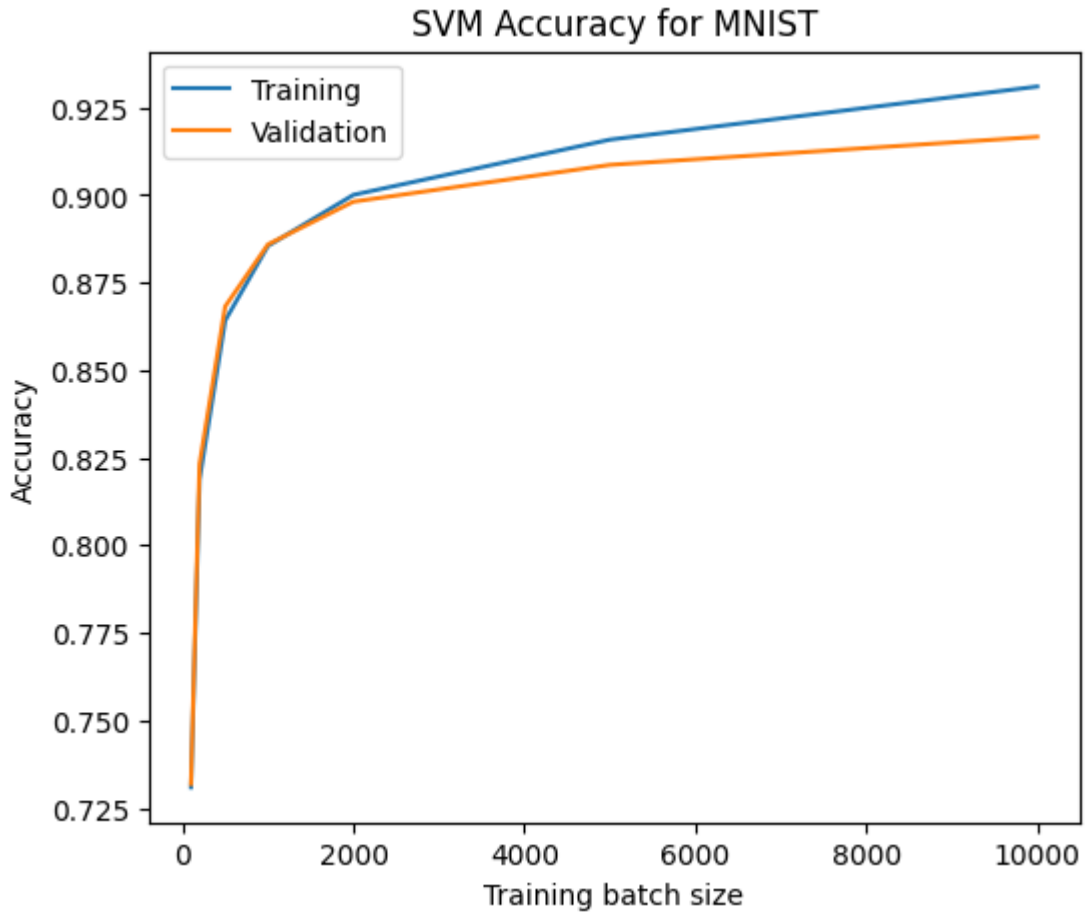
In [19]:
```
batch = [100,200,500,1000,2000,5000,10000]
```

In [20]:
```
mnist_t_scores, mnist_v_scores = sk_svm(mnist_t_data,mnist_t_labels, mnist_v_data,
```

In [21]:
```
mnist_t_scores
```

Out[21]:
```
[0.7482, 0.79746, 0.8582, 0.8761, 0.89758, 0.91316, 0.93018]
```

In [51]:
```
accuracy_plot(batch,mnist_t_scores,mnist_v_scores, 'MNIST')
```



b)

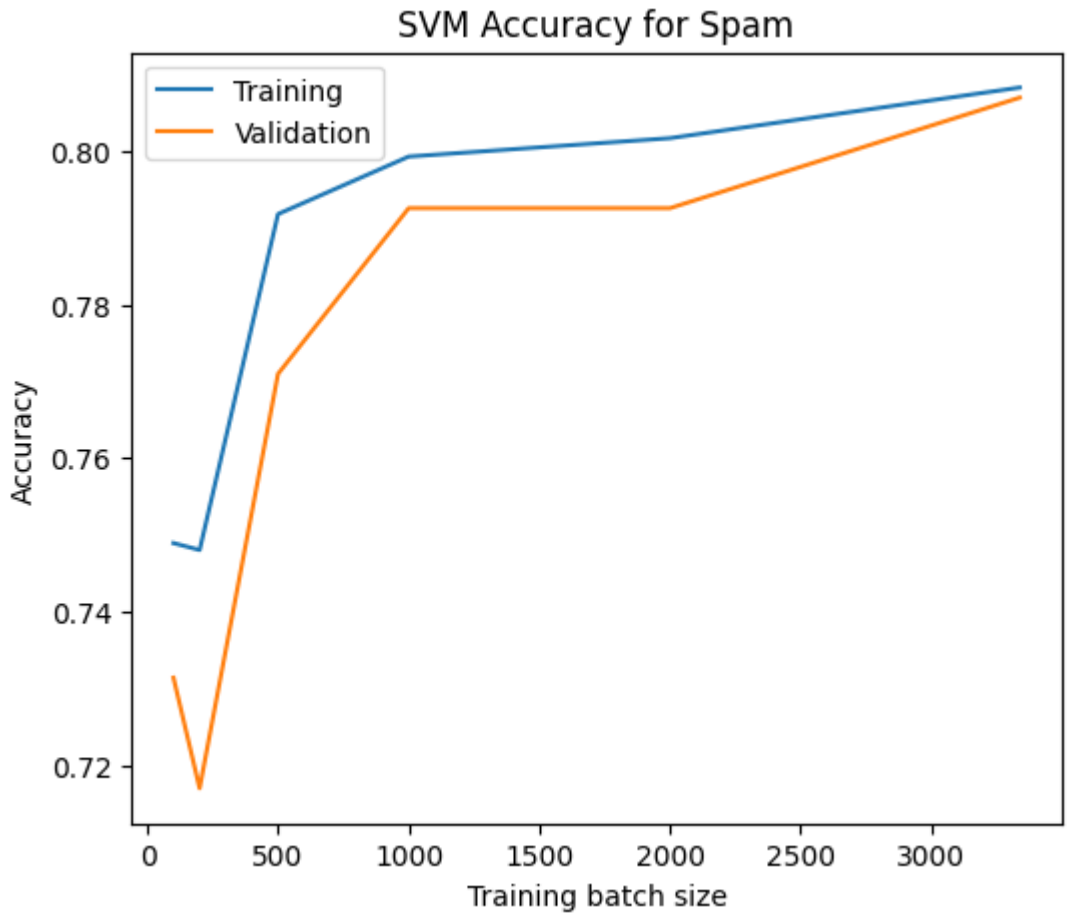
In [86]:
```
batch=[100,200,500,1000,2000,len(spam_t_data)]
```

In [65]:
```
spam_t_scores, spam_v_scores = sk_svm(spam_t_data,spam_t_labels,spam_v_data,spam_v_
```

In [66]:
```
spam_v_scores
```

Out[66]:
```
[0.7314148681055156,
 0.7170263788968825,
 0.7709832134292566,
 0.7925659472422062,
 0.7925659472422062,
 0.8069544364508393]
```

In [67]:
```
accuracy_plot(batch,spam_t_scores,spam_v_scores, 'Spam')
```

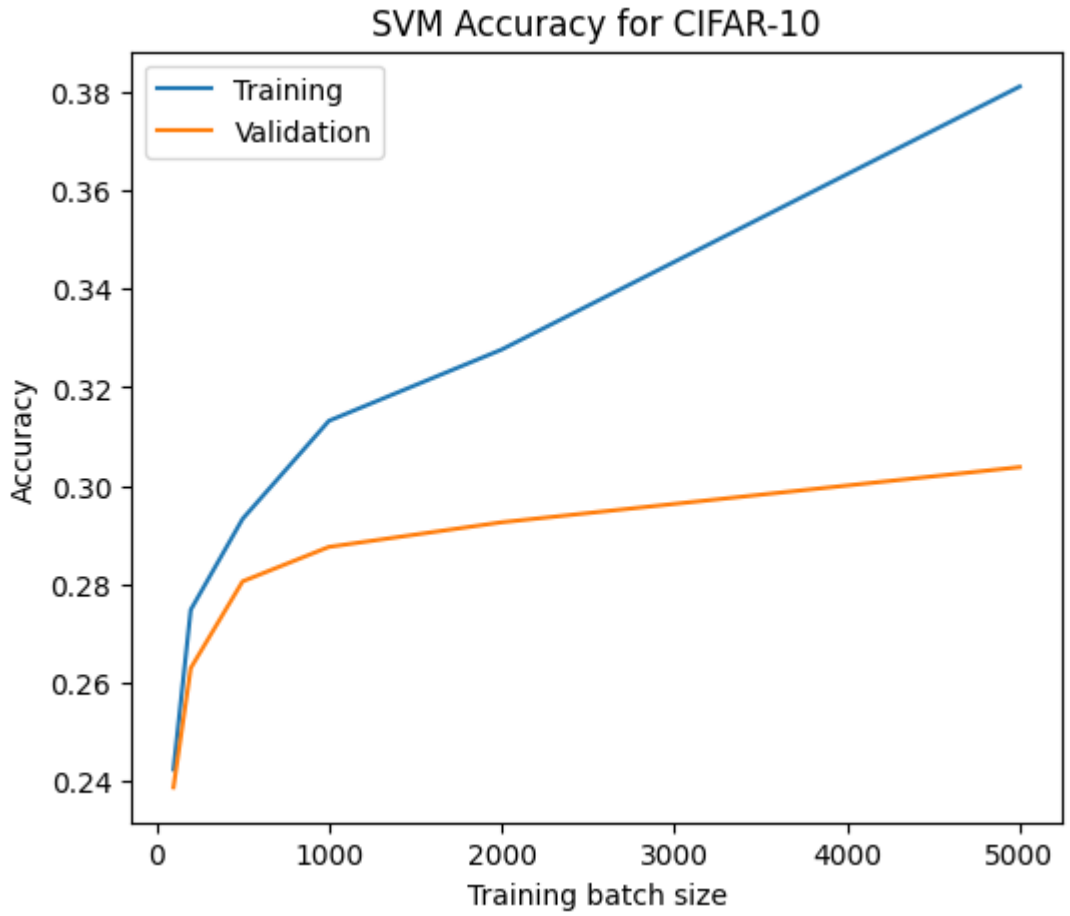


c)

In [72]:
```
batch=[100,200,500,1000,2000,5000]
```

In [73]:
```
cifar_t_scores, cifar_v_scores = sk_svm(cifar_t_data, cifar_t_labels, cifar_v_data,
```

In [74]:
```
accuracy_plot(batch,cifar_t_scores,cifar_v_scores, 'CIFAR-10')
```



Q4 Hyperparameter tuning

In [91]:
```
C=[10**n for n in np.linspace(-4,4,9)]
```

In [96]:
```
def linear_svm(t_data, t_labels,v_data,v_labels, c=1):

    clf=svm.LinearSVC(dual=False, C=c)
    clf.fit(t_data, t_labels)

    return score(clf.predict(v_data),v_labels)
```

In [97]:
```
len(mnist_t_data)
```

Out[97]:
```
50000
```

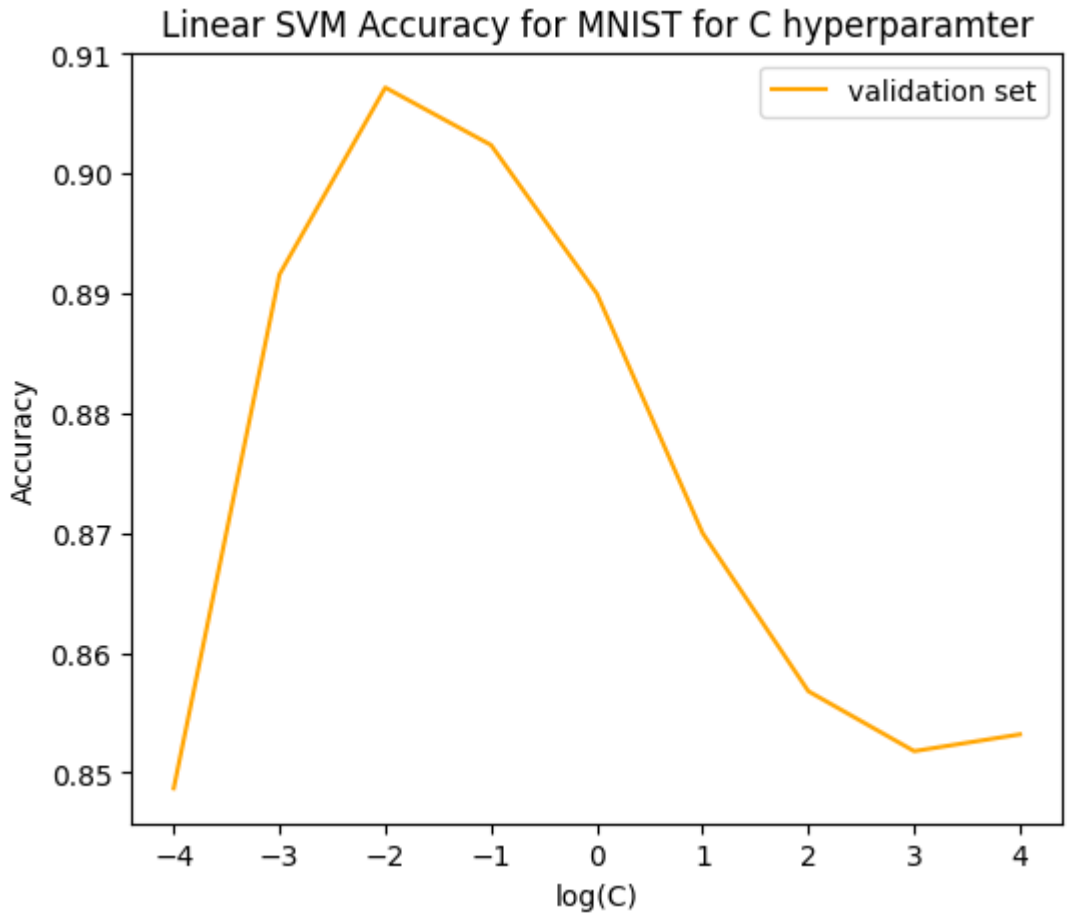
In [98]:
```
accuracies = []
for c in C:
    accuracies+=[linear_svm(mnist_t_data[:10000], mnist_t_labels[:10000],mnist_v_da
```

```
C:\Users\Colin\Anaconda3\envs\python38\lib\site-packages\sklearn\svm\_base.py:124
4: ConvergenceWarning: Liblinear failed to converge, increase the number of iterat
ions.
  warnings.warn(
C:\Users\Colin\Anaconda3\envs\python38\lib\site-packages\sklearn\svm\_base.py:124
4: ConvergenceWarning: Liblinear failed to converge, increase the number of iterat
ions.
  warnings.warn(
```

In [104…
```python
from math import log10
```

In [105…
```python
log_C=[log10(c) for c in C]
```

In [114…
```python
plt.figure(figsize=(6,5))
plt.plot(log_C, accuracies,c='orange', label = 'validation set')
plt.title('Linear SVM Accuracy for MNIST for C hyperparamter')
plt.xlabel('log(C)')
plt.ylabel('Accuracy')
plt.legend()
plt.savefig('Q4_tuning_plot', dpi=300)
```



Q5

In [22]:
```python
# This function takes in a dataset with labels, shuffles them both randomly, then p
# It returns a list of k tuples containing training data and its corresponding labe
```

```
def kfold_partition(data,labels,k_fold):
    rows = np.linspace(0,len(labels)-1,len(labels),dtype=int)
    np.random.shuffle(rows)

    data_partition = np.array_split(data[rows],k_fold)
    label_partition = np.array_split(labels[rows],k_fold)

    partitions = []

    for i in range(k_fold):
        partitions+=[(list(data_partition[i]),list(label_partition[i]))]

    return partitions
```

In [132…
```
partitions = kfold_partition(spam['training_data'],spam['training_labels'],5)
```

In [227…
```
# This function takes in partitioned data and returns an average accuracy score.
# The CV number depends on the number of partitions of the passed-in data

def kfold_cv(data,c):

    cv_accuracy=[]


    for i in range(len(data)):
        # generate the validation set; each set is the validation set once
        v_data = np.array(data[i][0])
        v_labels = np.array(data[i][1])

        # initialize a list for the training sets
        t_data=[]
        t_labels=[]

        # combined the partitions from the passed-in data, so long as the partition
        for j in range(len(data)):
            t_data += [x for x in data[j][0] if j != i]
            t_labels += [y for y in data[j][1] if j!= i]

        # train an svm and predict on the validation set; get the accuracy
        cv_accuracy+=[linear_svm(t_data, t_labels,v_data,v_labels, c=c)]

    return sum(cv_accuracy)/len(cv_accuracy)
```

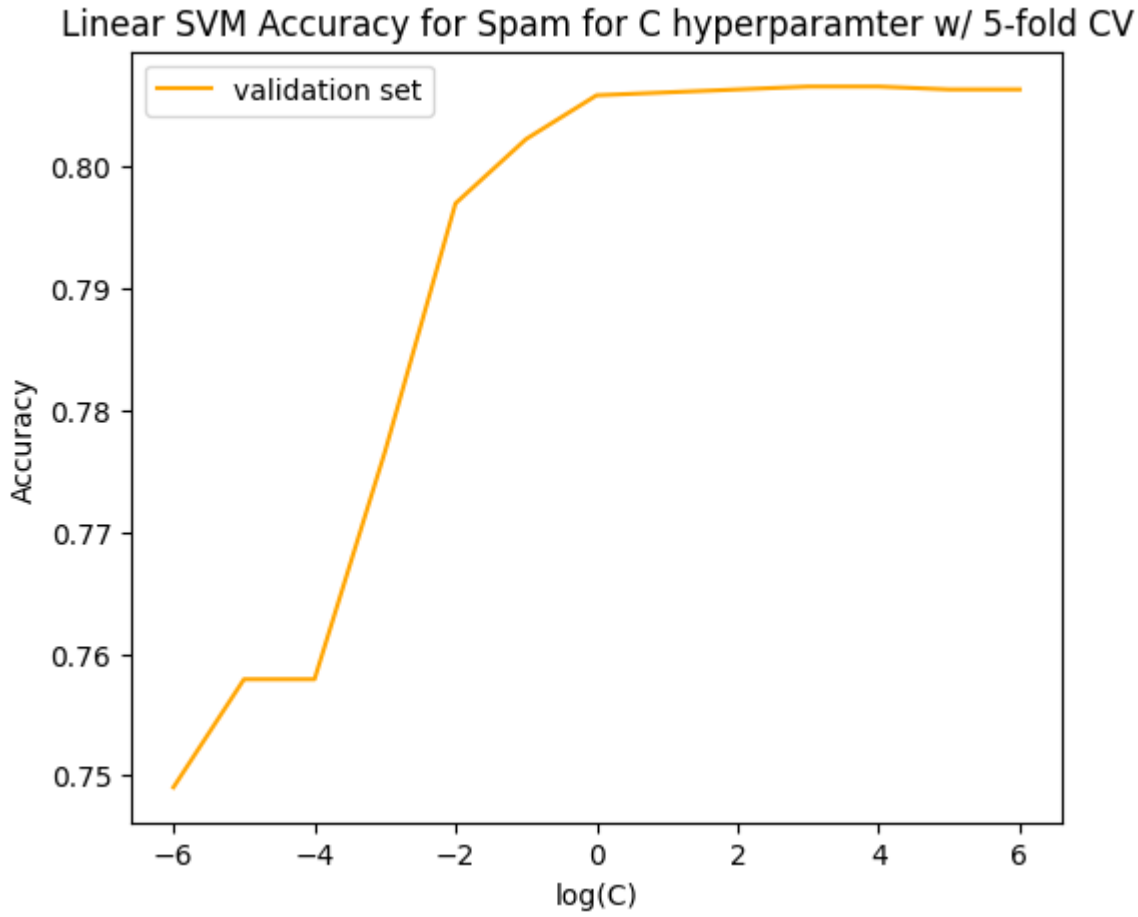
In [228…
```
#generate 12 possible values for the C hyperparamater
C=[10**n for n in np.linspace(-6,6,13)]

#get the logs of the Cs for plotting
log_C=[log10(c) for c in C]
```

In [229…
```
# get the CV accuracies for each of the C values
accuracies=[]
```

```
for c in C:
    accuracies+=[kfold_cv(partitions,c=c)]
```

In [230…
```
plt.figure(figsize=(6,5))
plt.plot(log_C, accuracies,c='orange', label = 'validation set')
plt.title('Linear SVM Accuracy for Spam for C hyperparamter w/ 5-fold CV')
plt.xlabel('log(C)')
plt.ylabel('Accuracy')
plt.legend()
plt.savefig('Q5_k-fold_tuning_plot', dpi=300)
```



Q6

MNIST

In [352…
```
mnist_t_data,mnist_t_labels,mnist_v_data,mnist_v_labels = data_partition(mnist_data
                                                                         mnist['tra
```

In [373…
```
predictor,mnist_t_scores, mnist_v_scores = sk_svm(mnist_t_data,mnist_t_labels, mnis
```

In [374…
```
mnist_v_scores
```

Out[374]:
```
[0.8186]
```

In [309…
```
mnist_v_scores
```

Out[309]:
```
[0.9829]
```

Got an accuracy of 0.9829 training on 50,000 samples. For the final model for Kaggle will train on the entire training set

In [313…
```
len(mnist_data)
```

Out[313]:
```
60000
```

In [375…
```
predictor=svm.SVC(C=1000, kernel='rbf')
predictor.fit(mnist_data, mnist['training_labels'])
```

Out[375]:
```
SVC(C=1000)
```

In [320…
```
mnist['test_data'].shape
```

Out[320]:
```
(10000, 1, 28, 28)
```

In [322…
```
#Need to reshape the test data to have the images be row vectors
mnist_test_data=mnist['test_data'].reshape(10000,784)
```

In [376…
```
test_preds = predictor.predict(mnist_test_data)
```

In [378…
```
df = pd.DataFrame({'Id': np.linspace(1,10000,10000,dtype=int), 'Category': test_pre
```

In [379…
```
df.to_csv('mnist_preds2.csv',index=False)
```

In [10]:
```
def add_features(data):

    means=[]

    for i in range(len(data)):
        means+=[data[i].mean()]

    means = np.array(means)
    means=means.reshape(len(data),1)

    mod_data = np.append(data,means,1)
#     mod_data = np.append(mod_data,zeros,1)
#     mod_data = np.append(mod_data,variances,1)

    return mod_data
```

In [475…
```
# add the row averages as a new feature
mnist_mod = add_features(mnist_data)
```

In [439…
```
mnist_t_data,mnist_t_labels,mnist_v_data,mnist_v_labels = data_partition(mnist_mod,
                                                                         mnist['tra
```

In [446…
```
mnist_t_scores, mnist_v_scores = sk_svm(mnist_t_data,mnist_t_labels, mnist_v_data,
```

In [447…
```
mnist_v_scores
```

Out[447]:
```
[0.9844]
```

Adding the average pixel value for a datapoint yields an improvement; let's retrain a model on the entire training data with this added feature then get predictions on the test data to submit to Kaggle

In [449…
```
predictor=svm.SVC(C=100, kernel='rbf')
predictor.fit(mnist_mod, mnist['training_labels'])
```

Out[449]:
```
SVC
SVC(C=100)
```

In [451…
```
#Need to reshape the test data to have the images be row vectors
mnist_test_data=mnist['test_data'].reshape(10000,784)

# add the row averages as a new feature
mnist_test_mod = add_features(mnist_test_data)
```

In [452…
```
test_preds = predictor.predict(mnist_test_mod)
```

In [453…
```
df = pd.DataFrame({'Id': np.linspace(1,10000,10000,dtype=int), 'Category': test_pre
df.to_csv('mnist_mod_preds.csv',index=False)
```

Let's also try flipping the images and adding those columns as new features

In [464…
```
mnist_mod.shape
```

Out[464]:
```
(60000, 785)
```

In [457…
```
mnist_flipped=np.fliplr(mnist_data)
```

In [465…
```
mnist_mod = np.append(mnist_mod,mnist_flipped,1)
```

In [476…
```
mnist_t_data,mnist_t_labels,mnist_v_data,mnist_v_labels = data_partition(mnist_mod,
                                                                         mnist['tra
```

In [539…
```
mnist_t_scores, mnist_v_scores = sk_svm(mnist_t_data,mnist_t_labels, mnist_v_data,
```

In [540…
```
mnist_v_scores
```

Out[540]: [0.981]

Flipping the images doesn't improve the score. Let's try adding Gaussian Noise

In [751…
```
mnist_t_data,mnist_t_labels,mnist_v_data,mnist_v_labels = data_partition(mnist_data
                                                                         mnist['tra
```

In [752…
```
mnist_t_data = add_features(mnist_t_data,add_noise=True)
mnist_v_data = add_features(mnist_v_data,add_noise=False)
```

In [753…
```
mnist_t_scores, mnist_v_scores = sk_svm(mnist_t_data,mnist_t_labels, mnist_v_data,
```

In [754…
```
mnist_v_scores
```

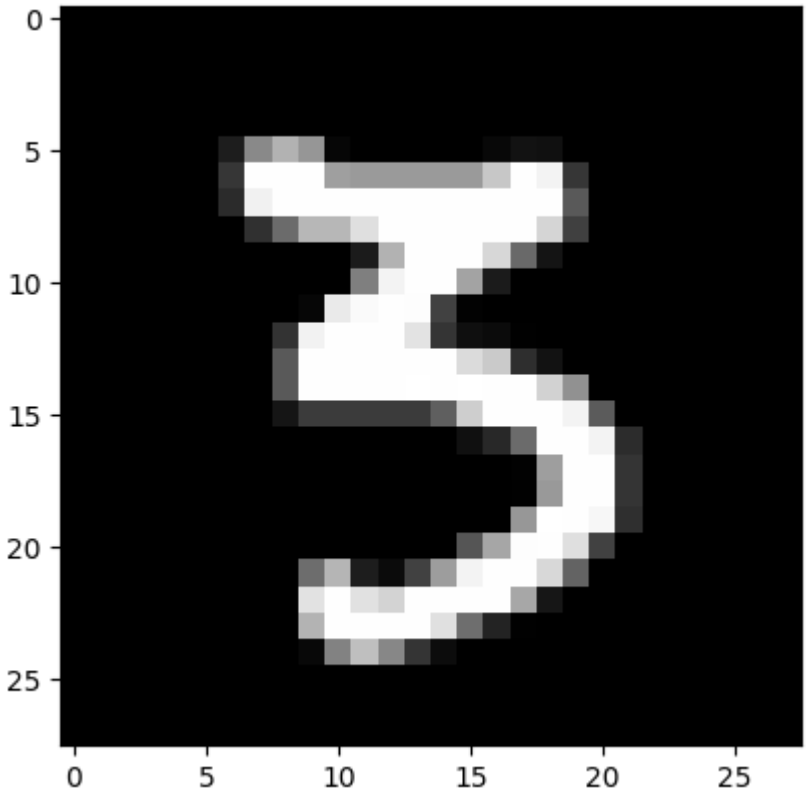
Out[754]: [0.826]

Let's try the Canny edge detector

In [14]:
```
import cv2 as cv
```

In [15]:
```
plt.imshow(mnist['training_data'][8][0],cmap='gray')
```

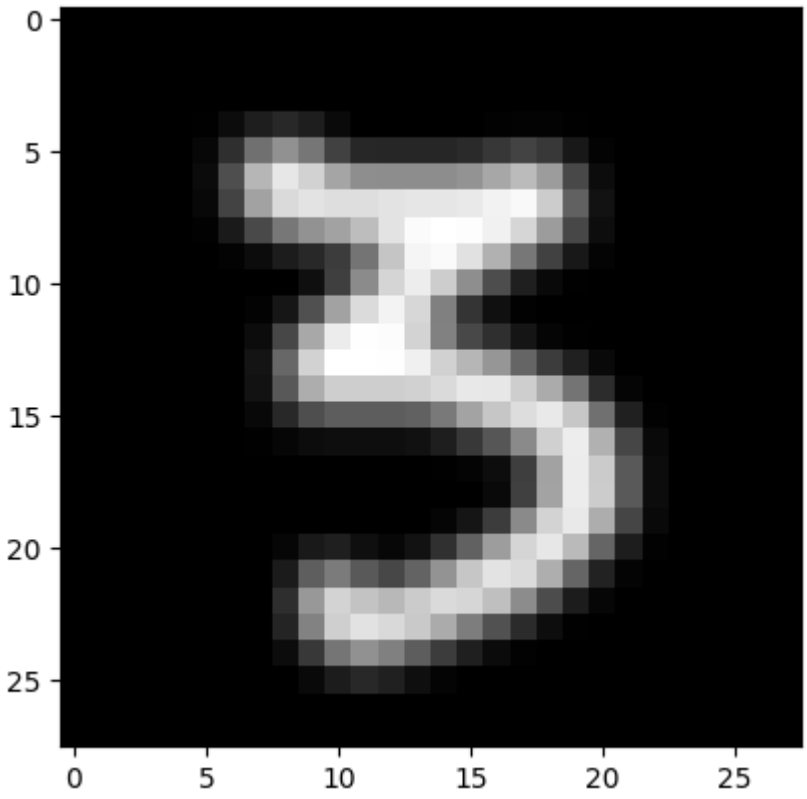
Out[15]: <matplotlib.image.AxesImage at 0x12d2768c9d0>



In [16]:
```
img = 255*mnist['training_data'][8][0]
img_blur = cv.GaussianBlur(img, (3,3), 0)
```

In [17]:
```
plt.imshow(img_blur,cmap='gray')
```

Out[17]:
```
<matplotlib.image.AxesImage at 0x12d276bfb80>
```



In [18]:
```
edge = cv.Canny(np.uint8(img_blur),90,200)
```

In [19]:
```
(1/255*edge).sum()/784
```

Out[19]:
```
0.11224489795918367
```

Adding the Canny output as features did not work so well. Let's instead create "new" data by adding Gaussian blur to the existing data and adding it onto the existing data.

In [20]:
```
#make a copy of the data to modify
blurry_mnist=mnist['training_data']
```

In [21]:
```
# for each image/data point, add blur and re-write the blurred image to that positi
for i in range(len(blurry_mnist)):
    #scale the pixel values back to the 0-255 range becasue it seems to work better
    img = 255*blurry_mnist[i][0]
    blurry_mnist[i][0]=cv.GaussianBlur(img, (1,1), 0)
blurry_mnist=1/255*blurry_mnist
```

In [22]:
```
blurry_mnist=blurry_mnist.reshape(60000,784)
```

In [23]:
```
big_mnist=np.vstack((mnist_data,blurry_mnist))
```

In [24]:
```
big_mnist.shape
```

Out[24]:
```
(120000, 784)
```

In [25]:
```
big_labels = np.hstack((mnist['training_labels'],mnist['training_labels']))
```

In [26]:
```
mnist['training_labels']
```

Out[26]:
```
array([8, 9, 6, ..., 7, 1, 1], dtype=int64)
```

In [27]:
```
big_labels.shape
```

Out[27]:
```
(120000,)
```

In [28]:
```
mnist_mod = add_features(big_mnist)
```

In [29]:
```
mnist_t_data,mnist_t_labels,mnist_v_data,mnist_v_labels = data_partition(mnist_mod,
                                                                         big_labels
```

In [30]:
```
mnist_t_scores, mnist_v_scores = sk_svm(mnist_t_data,mnist_t_labels, mnist_v_data,
```

In [31]:
```
mnist_v_scores
```

Out[31]:
```
[0.9908]
```

This is for the Kaggle submission

In [33]:
```
predictor=svm.SVC(C=10, kernel='rbf')
predictor.fit(mnist_mod, big_labels)
```

Out[33]:
```
SVC
SVC(C=10)
```

In [34]:
```
raw_test = mnist['test_data']
```

In [36]:
```
raw_test = raw_test.reshape(10000,784)
```

In [38]:
```
mod_test = add_features(raw_test)
```

In [40]:
```
preds = predictor.predict(mod_test)
```

In [42]:
```
df = pd.DataFrame({'Id': np.linspace(1,10000,10000,dtype=int), 'Category': preds},d
df.to_csv('big_mnist_preds.csv',index=False)
```

This is just troubleshooting

In [45]:
```
#lets compare these to the mnist_mod_preds since they are the current high score
df1=pd.read_csv('mnist_mod_preds.csv')
df['current high'] = df1['Category']
```

In [49]:
```
df.loc[df['Category'] != df['current high']]
```

Out[49]:

	Id	Category	current high
98	99	7	1
6489	6490	1	7

The following was an unsuccessful attempt to get more accuracy by adding the sum of edge pixels in an image as a feature.

In [152…
```
edges=[]
for i in range(len(raw_test)):
    img = 255*raw_test[i][0]
    img_blur = cv.GaussianBlur(img, (11,11), 0)
    edge = cv.Canny(np.uint8(img_blur),120,180)
    edges+=[(1/255*edge).sum()/784]
```

In [152…
```
#Need to reshape the test data to have the images be row vectors
mnist_test_data=mnist['test_data'].reshape(10000,784)

# add the row averages as a new feature
mnist_test_mod = add_features(mnist_test_data)
```

In [152…
```
edges=np.array(edges).reshape(len(mnist_test_data),1)
```

In [152…
```
mnist_test_mod = np.append(mnist_test_mod,edges,1)
```

In [152…
```
test_preds = predictor.predict(mnist_test_mod)
```

In [152…
```
df = pd.DataFrame({'Id': np.linspace(1,10000,10000,dtype=int), 'Category': test_pre
df.to_csv('mnist_edgemod_preds.csv',index=False)
```

In [152…
```
df1=pd.read_csv('mnist_preds.csv')
```

In [153…
```
df1['cat 2'] = df['Category']
```

There were no updates to the predictions so this additional feature was unhelpful

Spam

In [198…
```
import os
```

In [260…
```
def get_freqs(path):

    files = os.listdir(path)
    word_freqs = {}

    for file in files:
        with open('{}/{}'.format(path,file), encoding='utf8', errors='ignore') as f
            try:
                lines = f.readlines() # Read in text from file
            except Exception as e:
                    # skip files we have trouble reading.
                continue

        for i in range(len(lines)):
            words=lines[i].split()

            for word in words:
                if word not in word_freqs.keys():
                    word_freqs[word] = 1
                elif word in word_freqs.keys():
                    word_freqs[word] += 1

    word_freqs = sorted(word_freqs.items(), key=lambda x:x[1],reverse=True)
    return word_freqs
```

In [287…
```
spam_freqs=get_freqs('data/spam')
```

In [288…
```
ham_freqs=get_freqs('data/ham')
```

In [289…
```
spam_words=[spam_freqs[:200][i][0] for i in range(200)]
spam_freqs=[spam_freqs[:200][i][1] for i in range(200)]
```

In [290…
```
ham_words=[ham_freqs[:200][i][0] for i in range(200)]
ham_freqs=[ham_freqs[:200][i][1] for i in range(200)]
```

In [291…
```
# add these all as features
additions=list(set(spam_words)^set(ham_words))
```

In [282…
```
spam = np.load('data/spam-data.npz')
```

In [283…
```
spam_t_data,spam_t_labels,spam_v_data,spam_v_labels = data_partition(spam['training
                                                                    round(0.2*len(
```

In [284…
```
spam_t_data.shape
```

Out[284]:
```
(3338, 218)
```

In [285…
```
spam_t_scores, spam_v_scores = sk_svm(spam_t_data,spam_t_labels,spam_v_data,spam_v_
                                      c= 4000,kernel='rbf')
```

In [286…
```
spam_v_scores
```

Out[286]:
```
[0.9448441247002398]
```

In [296…
```
spam['training_data']
```

Out[296]:
```
4172
```

This is for the Kaggle Submission

In [299…
```
predictor=svm.SVC(C=4000, kernel='rbf')
predictor.fit(spam['training_data'], spam['training_labels'])
```

Out[299]:
```
SVC(C=4000)
```

In [301…
```
spam_preds = predictor.predict(spam['test_data'])
```

In [303…
```
df = pd.DataFrame({'Id': np.linspace(1,len(spam_preds),len(spam_preds),dtype=int),
df.to_csv('spam_preds.csv',index=False)
```

CIFAR

In [40]:
```
from skimage.io import imread
from skimage.transform import resize
from skimage.feature import hog
from skimage import exposure
```

In [62]:
```
def make_hog(data):

    fds = np.empty((0,70308),dtype=None)
    # hog_img=np.array(131072,dtype=None)

    for i in range(data.shape[0]):
        img=cifar['training_data'][3].reshape(3,32,32)
        img = img.transpose(1,2,0)

        resized = resize(img,(128*4,64*4))
        fd, hog_image = hog(resized, orientations=9, pixels_per_cell=(8, 8),
                    cells_per_block=(2, 2), visualize=True, multichannel=True)
        fds = np.r_[fds,[fd]]

    return fds
```

In [63]:
```
import warnings

def fxn():
    warnings.warn("deprecated", DeprecationWarning)
```

```
with warnings.catch_warnings():
    warnings.simplefilter("ignore")
    fxn()
```

In [ ]:
```
hogged_cifar=make_hog(cifar['training_data'])
```

```
C:\Users\Colin\AppData\Local\Temp\ipykernel_9516\3630791607.py:11: FutureWarning:
`multichannel` is a deprecated argument name for `hog`. It will be removed in vers
ion 1.0. Please use `channel_axis` instead.
  fd, hog_image = hog(resized, orientations=9, pixels_per_cell=(8, 8),
```

In [68]:
```
test.shape
```

Out[68]:
```
(100, 70308)
```

In [35]:
```
fd, hog_image = hog(resized, orientations=9, pixels_per_cell=(8, 8),
                    cells_per_block=(2, 2), visualize=True, multichannel=True)
plt.axis("off")
plt.imshow(hog_image, cmap="gray")
plt.show()
```

```
C:\Users\Colin\AppData\Local\Temp\ipykernel_9516\2838016178.py:1: FutureWarning: `
multichannel` is a deprecated argument name for `hog`. It will be removed in versi
on 1.0. Please use `channel_axis` instead.
  fd, hog_image = hog(resized, orientations=9, pixels_per_cell=(8, 8),
```

In [45]:
```
fd.shape
```

Out[45]:
```
(70308,)
```

In [566…

```
#This function takes in an array of shape (n,3072), sharpens the color image and co
#returns a new array with shape (n,1024)

def sharpen(data):

    from PIL import Image

    arr = np.empty(1024, dtype=None)
    kernel = np.array([[0, -1, 0],
                       [-1, 5,-1],
                       [0, -1, 0]])

    for i in range(data.shape[0]):
        img=data[i].reshape(3,32,32)
        img = img.transpose(1,2,0)

        img = cv.filter2D(src=img, ddepth=-1, kernel=kernel)

        gray=Image.fromarray(img).convert('L')
        arr = np.vstack((arr,np.array(gray).reshape(1024).astype(int))).astype(int)

    return arr
```

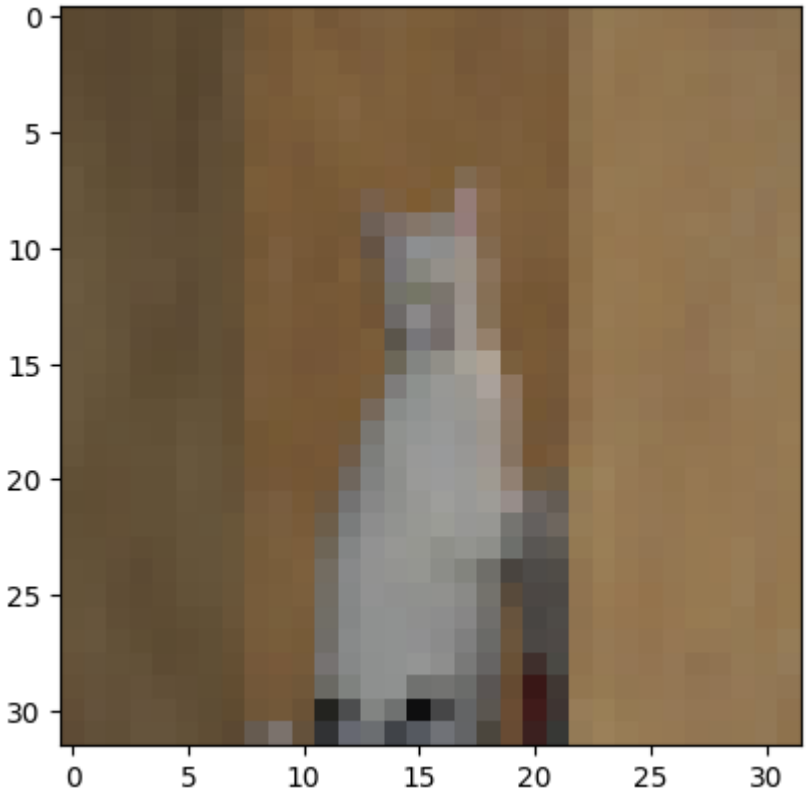
let's take a look at the data

In [534…

```
img=cifar['training_data'][2].reshape(3,32,32)
img = img.transpose(1,2,0)
plt.imshow(img)
```

Out[534]:

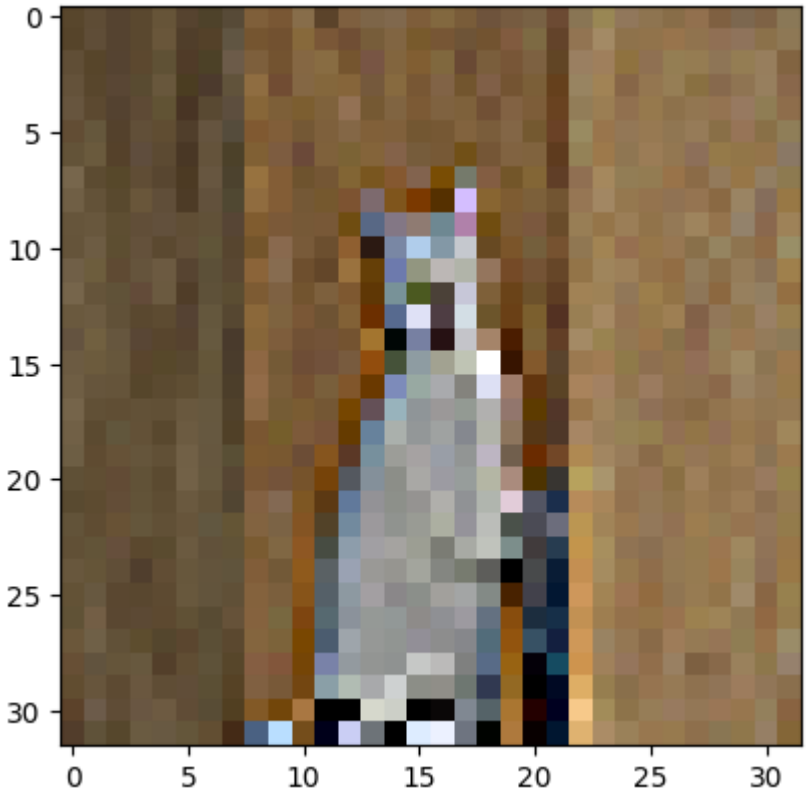
```
<matplotlib.image.AxesImage at 0x12dd9c621c0>
```



In [535…
```
kernel = np.array([[0, -1, 0],
                   [-1, 5,-1],
                   [0, -1, 0]])
img = cv.filter2D(src=img, ddepth=-1, kernel=kernel)
```

In [537…
```
plt.imshow(img)
```

Out[537]:
```
<matplotlib.image.AxesImage at 0x12dd9cd2730>
```



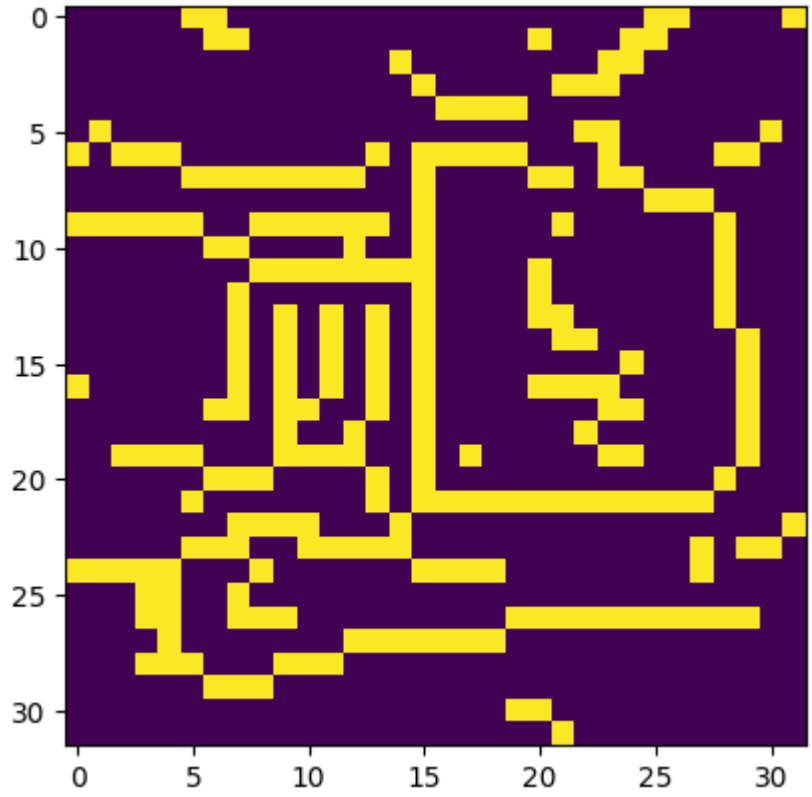
In [439…
```
# image_sharp.reshape(3072)
```

Out[439]:
```
array([ 82, 102, 141, ...,  96, 108, 103], dtype=uint8)
```

In [448…
```
edge = cv.Canny(np.uint8(img),248,255)
```

In [445…
```
plt.imshow(edge)
```

Out[445]:
```
<matplotlib.image.AxesImage at 0x12dd8b939a0>
```



In [405…
```
from PIL import Image
```

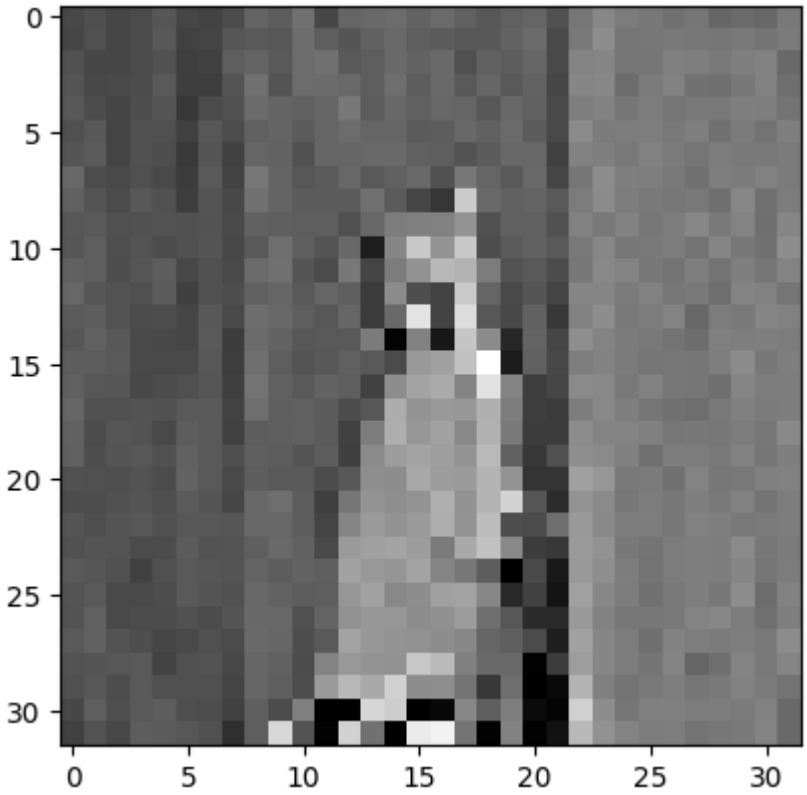
In [538…
```
gray=Image.fromarray(img).convert('L')
```

In [503…
```
gray
```

Out[503]:


In [539…
```
plt.imshow(gray,cmap='gray')
```

Out[539]:
```
<matplotlib.image.AxesImage at 0x12dd9d3bd00>
```



In [ ]:
```
# new=sharpen(cifar['training_data'])
```

In [18]:
```
cifar = np.load('data/cifar10-data.npz')
```

In [19]:
```
cifar_t_data, cifar_t_labels, cifar_v_data, cifar_v_labels = data_partition(cifar['
                                                                            cifar['
```

In [ ]:
```
cifar_t_scores, cifar_v_scores = sk_svm(cifar_t_data,cifar_t_labels,cifar_v_data,ci
                                        c= 100,kernel='rbf')
```

In [36]:
```
cifar_v_scores
```

Out[36]:
```
[0.3548]
```

This is for the Kaggle submission

In [25]:
```
predictor=svm.SVC(C=100, kernel='rbf')
predictor.fit(cifar['training_data'][:25000], cifar['training_labels'][:25000])
```

Out[25]:
```
SVC
SVC(C=100)
```

In [26]:
```
preds = predictor.predict(cifar['test_data'])
```

In [27]:
```
df = pd.DataFrame({'Id': np.linspace(1,len(preds),len(preds),dtype=int), 'Category'
df.to_csv('cifar25k_test_preds.csv',index=False)
```