MANE 4962 HW 1

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Problem 1:

In [1]:
```
import numpy as np

x1 = np.array([2, 3, 4, 8, 9])
x2 = np.array([2, -3, -4, 89])

features_x1 = len(x1)
features_x2 = len(x2)

print('features_x1=', features_x1)
print('features_x2=', features_x2)
```

```
features_x1= 5
features_x2= 4
```

In [2]:
```
norm1_x1 = np.linalg.norm(x1, 1)
norm2_x1 = np.linalg.norm(x1, 2)
norm_inf_x1 = np.linalg.norm(x1, np.inf)

norm1_x2 = np.linalg.norm(x2, 1)
norm2_x2 = np.linalg.norm(x2, 2)
norm_inf_x2 = np.linalg.norm(x2, np.inf)

print("norm1_x1:",norm1_x1)
print("norm2_x1:", norm2_x1)
print("norm_inf_x1:", norm_inf_x1)
print("norm1-x2:",norm1_x2)
print("norm2-x2:",norm2_x2)
print("norm_inf_x2:", norm_inf_x2)
```

```
norm1_x1: 26.0
norm2_x1: 13.19090595827292
norm_inf_x1: 9.0
norm1-x2: 98.0
norm2-x2: 89.16277250063504
norm_inf_x2: 89.0
```

Problem 2:

Assuming the input and output image are RGB, each has 3 channels.

In [3]:
```
feature_dimensions = (1024, 1024, 3)
output_dimensions = (64, 64, 3)
length_feature = np.prod(feature_dimensions)
length_output = np.prod(output_dimensions)
```

(a) The length of the feature vector

In [4]:
```
length_feature
```

Out[4]: 3145728

(b) The length of the output vector

In [5]:
```
length_output
```

Out[5]: 12288

(c) Number of elements in matrix W

In [6]:
```
W = 3145728 * 12288
```

In [7]:
```
W
```

Out[7]: 38654705664

Number of elements in matrix b

In [8]:
```
print('elements of b:', length_output)
```

```
elements of b: 12288
```

Problem 3:

In [9]:
```
matrix = np.array([[1, 2], [-1, 0]])
norm1 = np.linalg.norm(matrix, 1)
norm2 = np.linalg.norm(matrix, 2)
norm_inf = np.linalg.norm(matrix, np.inf)
frobenius_norm = np.linalg.norm(matrix, 'fro')
```

1-norm of W

In [10]:
```
norm1
```

Out[10]: 2.0

2-norm of W

In [11]:
```
norm2
```

Out[11]: 2.2882456112707366

infinite norm of W

In [12]:
```
norm_inf
```

Out[12]: 3.0

Frobenius norm of W

In [13]:
```
frobenius_norm
```

Out[13]:
```
2.449489742783178
```

Problem 4:

In [14]:
```
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn import svm
from sklearn.metrics import accuracy_score

iris = datasets.load_iris()

X = iris.data[:, :3] # only selecting first three features
y = iris.target

X_train, X_test, y_train, y_test=train_test_split(
    X,y,
    test_size=0.40,
    train_size=0.60,
    random_state=123,
    shuffle=True,
    stratify=y)

clf = svm.SVC()
clf.fit(X_train, y_train)

preds = clf.predict(X_test)

acc = accuracy_score(y_test,clf.predict(X_test) )
print('accuracy score :', acc)
```

```
accuracy score : 0.9333333333333333
```

Problem 5:

In [15]:
```
import tensorflow as tf
from numpy import loadtxt
from keras.models import Sequential
from keras.layers import Dense
from keras import optimizers
from tensorflow.python.keras.optimizers import *

#Load dataset
#split into input (X) and output (y)
X = np.array([[1], [5], [10], [15], [20], [40], [50], [65], [80], [100]])
X = X*1.0
y = np.array([[1**(1/7)], [5**(1/7)], [10**(1/7)], [15**(1/7)], [20**(1/7)], [40**(

y = y*1.0

#define keras model
model = Sequential()
```

```
model.add(Dense(6,input_dim=1,activation='relu'))
model.add(Dense(6,activation='relu'))
model.add(Dense(6,activation='relu'))
model.add(Dense(1))

#compile the keras model
opt = optimizers.Adam(learning_rate=0.001)
mse = tf.keras.losses.MeanSquaredError(
    reduction=tf.keras.losses.Reduction.SUM)
model.compile(loss=mse, optimizer=opt)



#fit the keras model on the dataset (CPU)
model.fit(X,y,epochs=2000,batch_size=10, verbose=0)
model.summary()

#make class predictions with the model
predictions = model.predict(X)

#summarize the first 10 cases
for i in range(10):
    print('%s => %.2f (expected %.2f)' % (X[i].tolist(), predictions[i][0], y[i][0]
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 6)                 12

 dense_1 (Dense)             (None, 6)                 42

 dense_2 (Dense)             (None, 6)                 42

 dense_3 (Dense)             (None, 1)                 7

=================================================================
Total params: 103
Trainable params: 103
Non-trainable params: 0
_________________________________________________________________
1/1 [==============================] - 0s 85ms/step
[1.0] => 1.04 (expected 1.00)
[5.0] => 1.24 (expected 1.26)
[10.0] => 1.46 (expected 1.39)
[15.0] => 1.49 (expected 1.47)
[20.0] => 1.52 (expected 1.53)
[40.0] => 1.64 (expected 1.69)
[50.0] => 1.70 (expected 1.75)
[65.0] => 1.78 (expected 1.82)
[80.0] => 1.87 (expected 1.87)
[100.0] => 1.99 (expected 1.93)
```

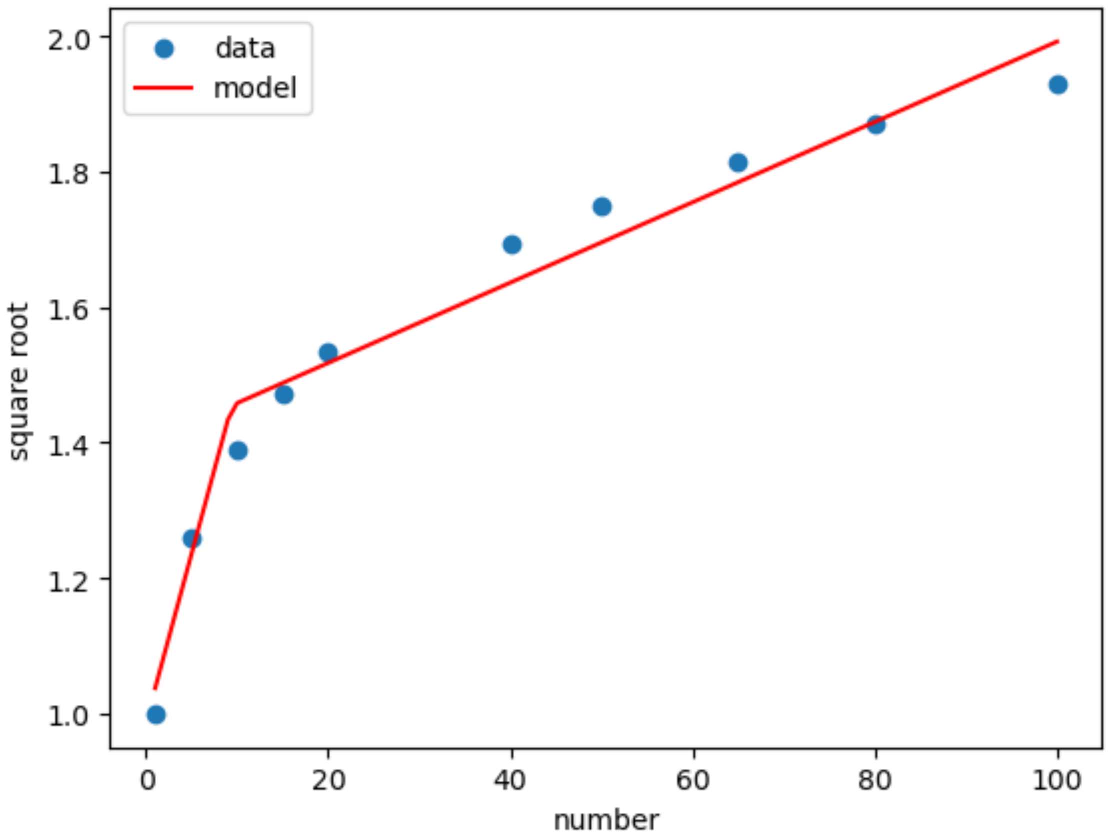
In [16]:

```
import matplotlib.pyplot as plt
number_grid = np.linspace(1, 100, 100)
```

```
plt.scatter(X,y, label='data')
plt.plot(number_grid,model.predict(np.expand_dims(number_grid,axis=1)) , color='red
plt.xlabel('number')
plt.ylabel('square root')
plt.legend()
```

```
4/4 [==============================] - 0s 2ms/step
```

Out[16]: <matplotlib.legend.Legend at 0x1f856aa9480>



Problem 6:

In [17]:
```
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn import svm
from sklearn.metrics import accuracy_score

iris = datasets.load_iris()

X = iris.data[:, :1] #only sepal length
y = iris.data[:,2:3] #only petal length

X_train, X_test, y_train, y_test=train_test_split(
    X,y,
    test_size=0.40,
    train_size=0.60,
    random_state=123,
    shuffle=True)
```

In [18]:
```
#define keras model
model = Sequential()
```

```
model.add(Dense(40,input_dim=1,activation='relu'))
model.add(Dense(40,activation='relu'))
model.add(Dense(40,activation='relu'))
model.add(Dense(1))

#compile the keras model
opt = optimizers.Adam(learning_rate=0.001)
mse = tf.keras.losses.MeanSquaredError(
    reduction=tf.keras.losses.Reduction.SUM)
model.compile(loss=mse, optimizer=opt)
print('tarining')
#fit the keras model on the dataset (CPU)
model.fit(X_train,y_train,epochs=2000,batch_size=10, verbose=0)
model.summary()

#make class predictions with the model
predictions = model.predict(X_test)

print('predictions')
for i in range(len(y_test)):
    print('%s => %.2f (expected %.2f)' % (X_test[i].tolist(), predictions[i][0], y_
```

```
tarining
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_4 (Dense)             (None, 40)                80

 dense_5 (Dense)             (None, 40)                1640

 dense_6 (Dense)             (None, 40)                1640

 dense_7 (Dense)             (None, 1)                 41

=================================================================
Total params: 3,401
Trainable params: 3,401
Non-trainable params: 0
_________________________________________________________________
2/2 [==============================] - 0s 4ms/step
predictions
[6.3] => 4.80 (expected 4.90)
[6.8] => 5.34 (expected 5.50)
[6.4] => 4.91 (expected 5.60)
[5.6] => 3.40 (expected 4.10)
[4.9] => 1.59 (expected 1.40)
[6.0] => 4.25 (expected 4.80)
[6.3] => 4.80 (expected 4.40)
[4.4] => 1.16 (expected 1.30)
[4.4] => 1.16 (expected 1.40)
[5.5] => 2.89 (expected 4.40)
[6.9] => 5.44 (expected 5.10)
[5.5] => 2.89 (expected 1.40)
[5.2] => 1.84 (expected 3.90)
[6.5] => 5.02 (expected 5.50)
[7.7] => 6.37 (expected 6.10)
[6.5] => 5.02 (expected 5.80)
[5.5] => 2.89 (expected 1.30)
[4.3] => 1.07 (expected 1.10)
[6.1] => 4.46 (expected 4.70)
[4.8] => 1.50 (expected 1.40)
[5.2] => 1.84 (expected 1.40)
[6.3] => 4.80 (expected 5.10)
[4.8] => 1.50 (expected 1.90)
[6.1] => 4.46 (expected 4.90)
[5.1] => 1.76 (expected 1.60)
[5.4] => 2.34 (expected 1.70)
[5.4] => 2.34 (expected 1.50)
[5.6] => 3.40 (expected 4.90)
[7.7] => 6.37 (expected 6.70)
[5.0] => 1.67 (expected 1.40)
[7.4] => 6.02 (expected 6.10)
[6.0] => 4.25 (expected 5.00)
[4.7] => 1.41 (expected 1.60)
[5.1] => 1.76 (expected 1.40)
[6.0] => 4.25 (expected 4.00)
[5.0] => 1.67 (expected 3.30)
```

```
[7.9] => 6.61 (expected 6.40)
[5.4] => 2.34 (expected 1.70)
[5.4] => 2.34 (expected 1.30)
[5.8] => 3.82 (expected 3.90)
[5.0] => 1.67 (expected 3.50)
[5.0] => 1.67 (expected 1.20)
[6.8] => 5.34 (expected 5.90)
[6.7] => 5.23 (expected 5.20)
[5.8] => 3.82 (expected 5.10)
[5.8] => 3.82 (expected 5.10)
[6.3] => 4.80 (expected 5.60)
[5.5] => 2.89 (expected 4.00)
[5.1] => 1.76 (expected 1.50)
[4.4] => 1.16 (expected 1.30)
[6.5] => 5.02 (expected 5.10)
[5.1] => 1.76 (expected 1.70)
[4.9] => 1.59 (expected 1.50)
[6.7] => 5.23 (expected 4.70)
[6.1] => 4.46 (expected 4.60)
[5.5] => 2.89 (expected 4.00)
[5.7] => 3.61 (expected 3.50)
[5.8] => 3.82 (expected 5.10)
[6.7] => 5.23 (expected 4.40)
[6.4] => 4.91 (expected 5.30)
```

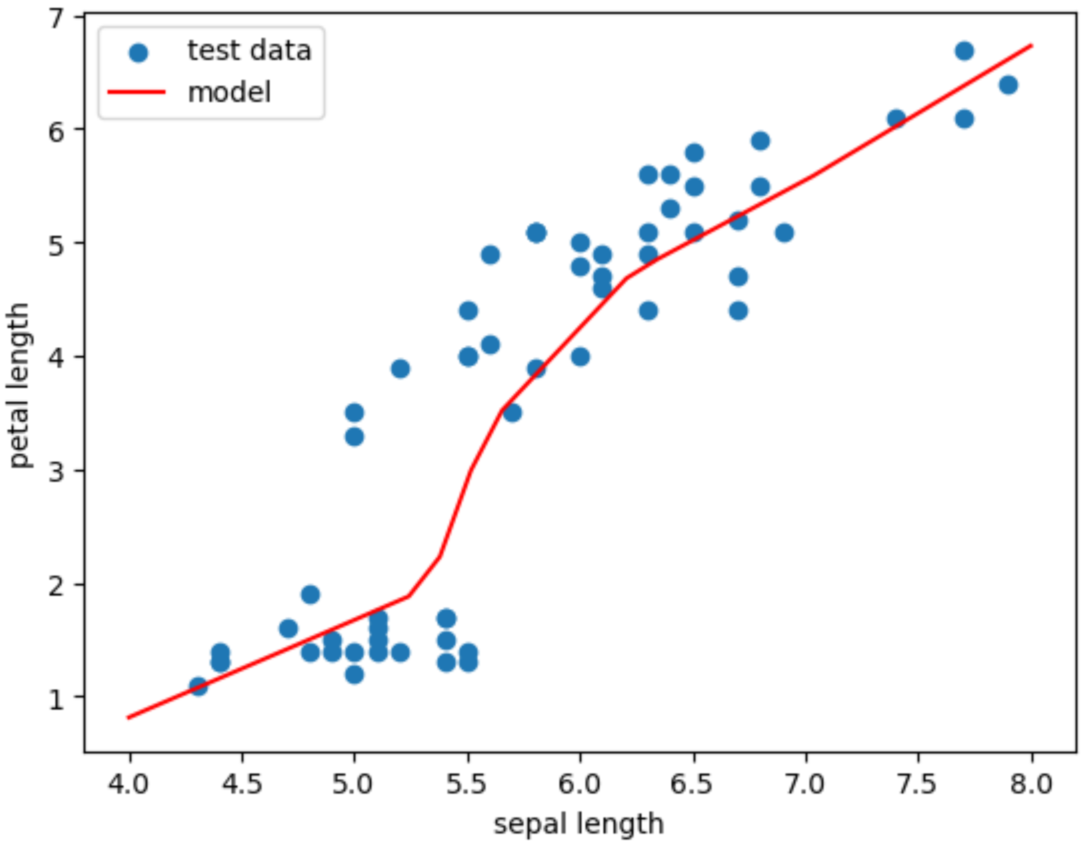
In [19]:

```
import matplotlib.pyplot as plt
number_grid = np.linspace(4, 8, 30)
plt.scatter(X_test,y_test, label='test data')
plt.plot(number_grid,model.predict(np.expand_dims(number_grid,axis=1)) , color='red
plt.xlabel('sepal length')
plt.ylabel('petal length')
plt.legend()
```

```
1/1 [==============================] - 0s 18ms/step
```

Out[19]:

```
<matplotlib.legend.Legend at 0x1f854c756f0>
```



test data
model
7
6
5
4
3
2
1
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
petal length
sepal length