# ASSGN_7_Ridge

April 7, 2022

[1]:
```
# MLFA ASSIGNMENT 7
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# 20CS30066
```

[2]:
```
# importing required modules
import numpy as np
import pandas as pd
from tqdm import tqdm
import matplotlib.pyplot as plt
from sklearn.metrics import mean_squared_error
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
```

[3]:
```
# reading the data csv
df = pd.read_csv('data.csv')
```

[4]:
```
# inserting a column with value 1 for vectorisation later
df.insert(0, 'Constant', 1)
```

[5]:
```
df = df[['Constant', 'age', 'sex', 'cp', 'trestbps', 'chol', 'fbs', 'restecg',
       'thalach', 'exang', 'oldpeak', 'num       ']]
```

[6]:
```
df.head(5)
```

[6]:

| | Constant | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | num |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 28 | 1 | 2 | 130 | 132 | 0 | 2 | 185 | 0 | 0.0 | 0 |
| 1 | 1 | 29 | 1 | 2 | 120 | 243 | 0 | 0 | 160 | 0 | 0.0 | 0 |
| 2 | 1 | 29 | 1 | 2 | 140 | ? | 0 | 0 | 170 | 0 | 0.0 | 0 |
| 3 | 1 | 30 | 0 | 1 | 170 | 237 | 0 | 1 | 170 | 0 | 0.0 | 0 |
| 4 | 1 | 31 | 0 | 2 | 100 | 219 | 0 | 1 | 150 | 0 | 0.0 | 0 |

[7]:
```
# removing rows with missing values
df = df[df[df.columns]!='?']
df = df.dropna()
df = df.astype(float)
```

```
/home/tfjuror/anaconda3/lib/python3.7/site-
packages/pandas/core/ops/array_ops.py:253: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perform elementwise
comparison
  res_values = method(rvalues)
```

[8]:
```
# all missing values have been dealt with
np.sum(df.isna())
```

[8]:
```
Constant      0
age           0
sex           0
cp            0
trestbps      0
chol          0
fbs           0
restecg       0
thalach       0
exang         0
oldpeak       0
num           0
dtype: int64
```

[9]:
```
df.columns
```

[9]:
```
Index(['Constant', 'age', 'sex', 'cp', 'trestbps', 'chol', 'fbs', 'restecg',
       'thalach', 'exang', 'oldpeak', 'num       '],
      dtype='object')
```

[10]:
```
X_columns = ['Constant','age', 'sex', 'cp', 'trestbps', 'chol', 'fbs',␣
↪'restecg','thalach',
       'exang', 'oldpeak']
Y_column = 'num       '
```

[11]:
```
X = df[X_columns]
Y = df[Y_column]

print(X.shape)
print(Y.shape)
```

```
(261, 11)
(261,)
```

[12]:
```
# creating the train test split
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size = 0.
↪2,random_state=43)
```

[13]:
```
print(X_train.shape)
print(Y_train.shape)

print(X_test.shape)
print(Y_test.shape)
```

```
(208, 11)
(208,)
(53, 11)
(53,)
```

[14]:
```
# weights randomly initialised
W = np.random.rand(X_train.shape[1],1)
```

[15]:
```
# initial weights
print(W)
```

```
[[0.71587184]
 [0.65261946]
 [0.66175051]
 [0.60994618]
 [0.64712878]
 [0.85694772]
 [0.23806433]
 [0.08423133]
 [0.91081032]
 [0.48259467]
 [0.22691205]]
```

[16]:
```
# hyperparameters defined here
epochs = 10000
lr = 1e-4
ridge_param = 0.5
loss_array=[]
```

[17]:
```
# training loop with inbuilt updates via gradient descent
for epoch in tqdm(range(epochs),position=0, leave=True):
    if(epoch%2000 == 0):
        lr/=10
    L = 0
    del_L = np.zeros((X_train.shape[1],))
    for i in range(len(X_train)):
        row = np.array(X_train.iloc[i,:])
```

```
        row = np.reshape(row,(row.shape[0],1))
        H = (row.T.astype(float) @ W.astype(float))
        L += (H - float(Y_train.iloc[i]))**2
        for j in range(len(del_L)):
            del_L[j]+=(H - float(Y_train.iloc[i]))*row[j]
    L /= 2*len(X_train)
    L += np.sum(np.square(W))*ridge_param
    del_L /= len(X_train)
    del_L += 2*np.sum(W)*ridge_param
    loss_array.append(L.item())
    for j in range(len(del_L)):
        W[j] = W[j] - lr* del_L[j]
```

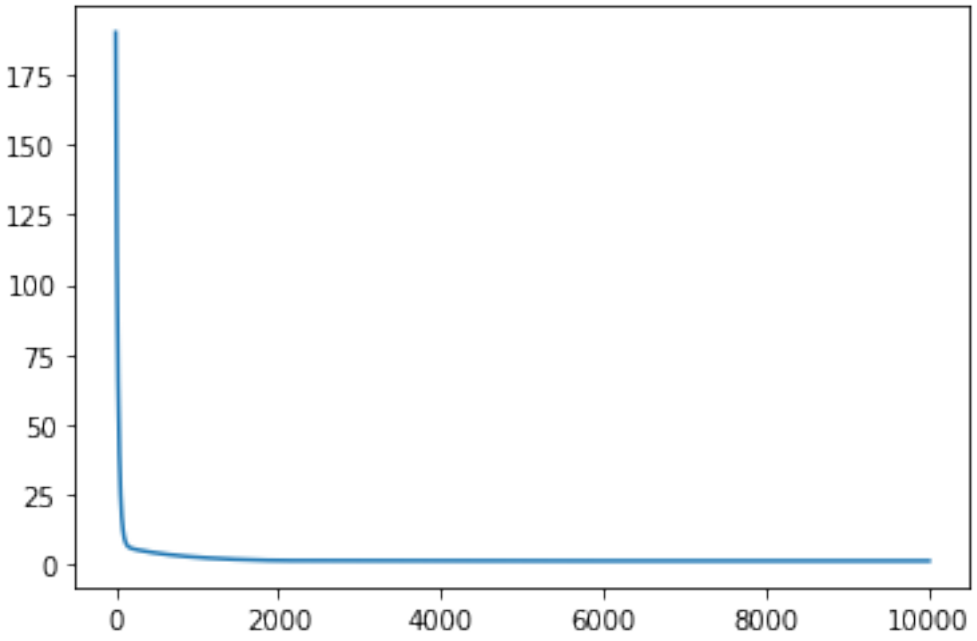
```
100%|      | 10000/10000 [16:18<00:00, 10.22it/s]
```

[18]:
```
# finetuned weights after training
print(W)
```

```
[[ 6.45384361e-01]
 [ 5.66043067e-02]
 [ 5.91355351e-01]
 [ 5.16760155e-01]
 [-3.52368878e-02]
 [-2.00723505e-03]
 [ 1.73881720e-01]
 [ 1.87755931e-02]
 [-5.59100913e-04]
 [ 4.14779546e-01]
 [ 1.57467924e-01]]
```

[19]:
```
# decreasing losses visualised
# first couple losses are removed from plotting to avoid skew due to random␣
 ↪initialisation
plt.plot(loss_array[2:])
```

[19]:
```
[<matplotlib.lines.Line2D at 0x7efd937b39d0>]
```




[20]:
```
# utility function to generate predictions
def gen_preds(W,X):
    preds = []
    for i in range(len(X)):
        row = np.array(X.iloc[i,:])
        row = np.reshape(row,(row.shape[0],1))
        H = (row.T.astype(float) @ W.astype(float))
        threshed = 1 if H.item()>0.5 else 0
        preds.append(threshed)
    return np.array(preds)
```

[21]:
```
preds_train = gen_preds(W,X_train)
preds_test = gen_preds(W,X_test)
```

[22]:
```
print('RMSE on train set',mean_squared_error(Y_train,np.array(preds_train)))
print('RMSE on test set',mean_squared_error(Y_test,np.array(preds_test)))
```

```
RMSE on train set 0.25961538461538464
RMSE on test set 0.24528301886792453
```

[23]:
```
print('Accuracy on train set',accuracy_score(Y_train,np.array(preds_train)))
print('Accuracy on test set',accuracy_score(Y_test,np.array(preds_test)))
```

```
Accuracy on train set 0.7403846153846154
Accuracy on test set 0.7547169811320755
```

[ ]: