y = df['totalvotes'].values

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 5344)              14284512
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 5345
=================================================================
Total params: 14,289,857
Trainable params: 14,289,857
Non-trainable params: 0
_________________________________________________________________
None
Train on 2721 samples
Epoch 1/100
2721/2721 [==============================] - 10s 4ms/sample - loss: 9381745978502.3516 - mse: 9381748932608.0000
Epoch 2/100
2721/2721 [==============================] - 9s 3ms/sample - loss: 9378059751868.0723 - mse: 9378063187968.0000
Epoch 3/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 9369342295058.4414 - mse: 9369342181376.0000
Epoch 4/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 9355608455385.5195 - mse: 9355607932928.0000
Epoch 5/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 9338035377987.0820 - mse: 9338035896320.0000
Epoch 95/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 3701527765344.2471 - mse: 3701528330240.0000
Epoch 96/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 3675185211342.7236 - mse: 3675185479680.0000
Epoch 97/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 3649374098189.2661 - mse: 3649372946432.0000
Epoch 98/100
2721/2721 [==============================] - 9s 3ms/sample - loss: 3623577882863.3477 - mse: 3623577976832.0000
Epoch 99/100
2721/2721 [==============================] - 9s 3ms/sample - loss: 3599386996906.1021 - mse: 3599386542080.0000
Epoch 100/100
2721/2721 [==============================] - 8s 3ms/sample - loss: 3575027308213.6743 - mse: 3575027597312.0000
r2_score of y_train: 0.1872076104671837
r2_score of y_test: 0.18492524187504644
neural network model with 1 hidden layer is done!
```

Training the model with 1 hidden layer
Total Time: 15 mins

y = df['totalvotes'].values

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_2 (Dense)              (None, 5344)              14284512
_________________________________________________________________
dense_3 (Dense)              (None, 5344)              28563680
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 5345
=================================================================
Total params: 42,853,537
Trainable params: 42,853,537
Non-trainable params: 0
_________________________________________________________________
None
Train on 2721 samples
Epoch 1/100
2721/2721 [==============================] - 25s 9ms/sample - loss: 9183323850049.3867 - mse: 9183323750400.0000
Epoch 2/100
2721/2721 [==============================] - 25s 9ms/sample - loss: 6133273795376.6406 - mse: 6133274640384.0000
Epoch 3/100
2721/2721 [==============================] - 25s 9ms/sample - loss: 3453539358362.4844 - mse: 3453539581952.0000
Epoch 4/100
2721/2721 [==============================] - 25s 9ms/sample - loss: 2582551219638.4268 - mse: 2582551199744.0000
Epoch 5/100
Epoch 95/100
2721/2721 [==============================] - 29s 11ms/sample - loss: 8880102119.6090 - mse: 8880103424.0000
Epoch 96/100
2721/2721 [==============================] - 29s 11ms/sample - loss: 8369913704.3381 - mse: 8369913856.0000
Epoch 97/100
2721/2721 [==============================] - 29s 11ms/sample - loss: 8420966648.1793 - mse: 8420965376.0000
Epoch 98/100
2721/2721 [==============================] - 29s 11ms/sample - loss: 7633665933.8773 - mse: 7633666560.0000
Epoch 99/100
2721/2721 [==============================] - 30s 11ms/sample - loss: 7245674765.5362 - mse: 7245673472.0000
Epoch 100/100
2721/2721 [==============================] - 30s 11ms/sample - loss: 7042875558.2683 - mse: 7042875392.0000
r2_score of y_train: 0.998542961527269
r2_score of y_test: 0.986836137393499
neural network model with 2 hidden layers is done!
```

Training the model with 2 hidden layers
Total Time: 45 mins

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 9665)              93421890
_________________________________________________________________
dense_1 (Dense)              (None, 9665)              93421890
_________________________________________________________________
dense_2 (Dense)              (None, 1)                 9666
=================================================================
Total params: 186,853,446
Trainable params: 186,853,446
Non-trainable params: 0
_________________________________________________________________
```

[18]

```
# train the model for 100 epochs
model = nn.fit(X_train_scaled, y_train, epochs=50)
```

```
Epoch 36/50
30032/30032 [==============================] - 2663s 89ms/sample - loss: 69013763941.7944 - mse: 69013782528.0000
Epoch 37/50
30032/30032 [==============================] - 2996s 100ms/sample - loss: 27105227519.1055 - mse: 27105234944.0000
Epoch 38/50
30032/30032 [==============================] - 4423s 147ms/sample - loss: 70524384642.1082 - mse: 70524387328.0000
Epoch 39/50
30032/30032 [==============================] - 2772s 92ms/sample - loss: 34133394901.8860 - mse: 34133399552.0000
Epoch 40/50
30032/30032 [==============================] - 2771s 92ms/sample - loss: 40945962369.1734 - mse: 40945971200.0000
Epoch 41/50
30032/30032 [==============================] - 2766s 92ms/sample - loss: 31298373064.5173 - mse: 31298387968.0000
Epoch 42/50
30032/30032 [==============================] - 2780s 93ms/sample - loss: 27320213137.5509 - mse: 27320238080.0000
Epoch 43/50
30032/30032 [==============================] - 2759s 92ms/sample - loss: 46198547755.1031 - mse: 46198554624.0000
Epoch 44/50
30032/30032 [==============================] - 2761s 92ms/sample - loss: 48161741135.9622 - mse: 48161751040.0000
Epoch 45/50
30032/30032 [==============================] - 3713s 124ms/sample - loss: 38139335662.2384 - mse: 38139387904.0000
Epoch 46/50
30032/30032 [==============================] - 3621s 121ms/sample - loss: 32038363352.3756 - mse: 32038371328.0000
Epoch 47/50
30032/30032 [==============================] - 3863s 129ms/sample - loss: 30613974870.4190 - mse: 30613972992.0000
Epoch 48/50
30032/30032 [==============================] - 2746s 91ms/sample - loss: 57388354544.3636 - mse: 57388351488.0000
Epoch 49/50
30032/30032 [==============================] - 2637s 88ms/sample - loss: 22141545709.2789 - mse: 22141538304.0000
Epoch 50/50
30032/30032 [==============================] - 2627s 87ms/sample - loss: 27240833076.6209 - mse: 27240806400.0000
```

[19]

```
# predict values for the train and test sets
y_train_pred = nn.predict(X_train_scaled)
y_test_pred = nn.predict(X_test_scaled)
```

[20]

```
# score the training predictions with r2_score()
r2_score(y_train, y_train_pred)
```

```
0.9991990876693556
```

y = df['expenditure_amount'].values
Total time: 2 days

[21]

```
# score the test predictions with r2_score()
r2_score(y_test, y_test_pred)
```

```
0.8145582287092288
```