

```
In [3]: import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

```
In [4]: df = pd.read_csv('avocado.csv')
```

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

```
Out[5]:
```

	Unnamed: 0	Date	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags	Large Bags	XLarge Bags
0	0	2015-12-27	1.33	64236.62	1036.74	54454.85	48.16	8696.87	8603.62	93.25	
1	1	2015-12-20	1.35	54876.98	674.28	44638.81	58.33	9505.56	9408.07	97.49	
2	2	2015-12-13	0.93	118220.22	794.70	109149.67	130.50	8145.35	8042.21	103.14	
3	3	2015-12-06	1.08	78992.15	1132.00	71976.41	72.58	5811.16	5677.40	133.76	
4	4	2015-11-29	1.28	51039.60	941.48	43838.39	75.78	6183.95	5986.26	197.69	

```
In [6]: df.info()
```

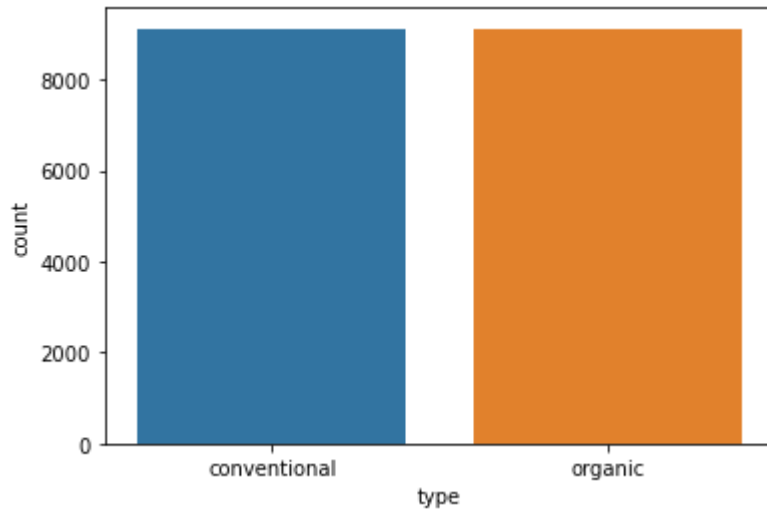
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 18249 entries, 0 to 18248
Data columns (total 14 columns):
 #   Column          Non-Null Count  Dtype
---  -
 0   Unnamed: 0      18249 non-null  int64
 1   Date            18249 non-null  object
 2   AveragePrice    18249 non-null  float64
 3   Total Volume    18249 non-null  float64
 4   4046            18249 non-null  float64
 5   4225            18249 non-null  float64
 6   4770            18249 non-null  float64
 7   Total Bags      18249 non-null  float64
 8   Small Bags      18249 non-null  float64
 9   Large Bags      18249 non-null  float64
10  XLarge Bags     18249 non-null  float64
11  type            18249 non-null  object
12  year            18249 non-null  int64
13  region          18249 non-null  object
dtypes: float64(9), int64(2), object(3)
memory usage: 1.9+ MB
```

```
In [7]: df.columns
```

```
Out[7]: Index(['Unnamed: 0', 'Date', 'AveragePrice', 'Total Volume', '4046', '4225',
              '4770', 'Total Bags', 'Small Bags', 'Large Bags', 'XLarge Bags', 'type',
              'year', 'region'],
              dtype='object')
```

```
In [8]: sns.countplot(x='type',data=df)
```

```
Out[8]: <AxesSubplot:xlabel='type', ylabel='count'>
```

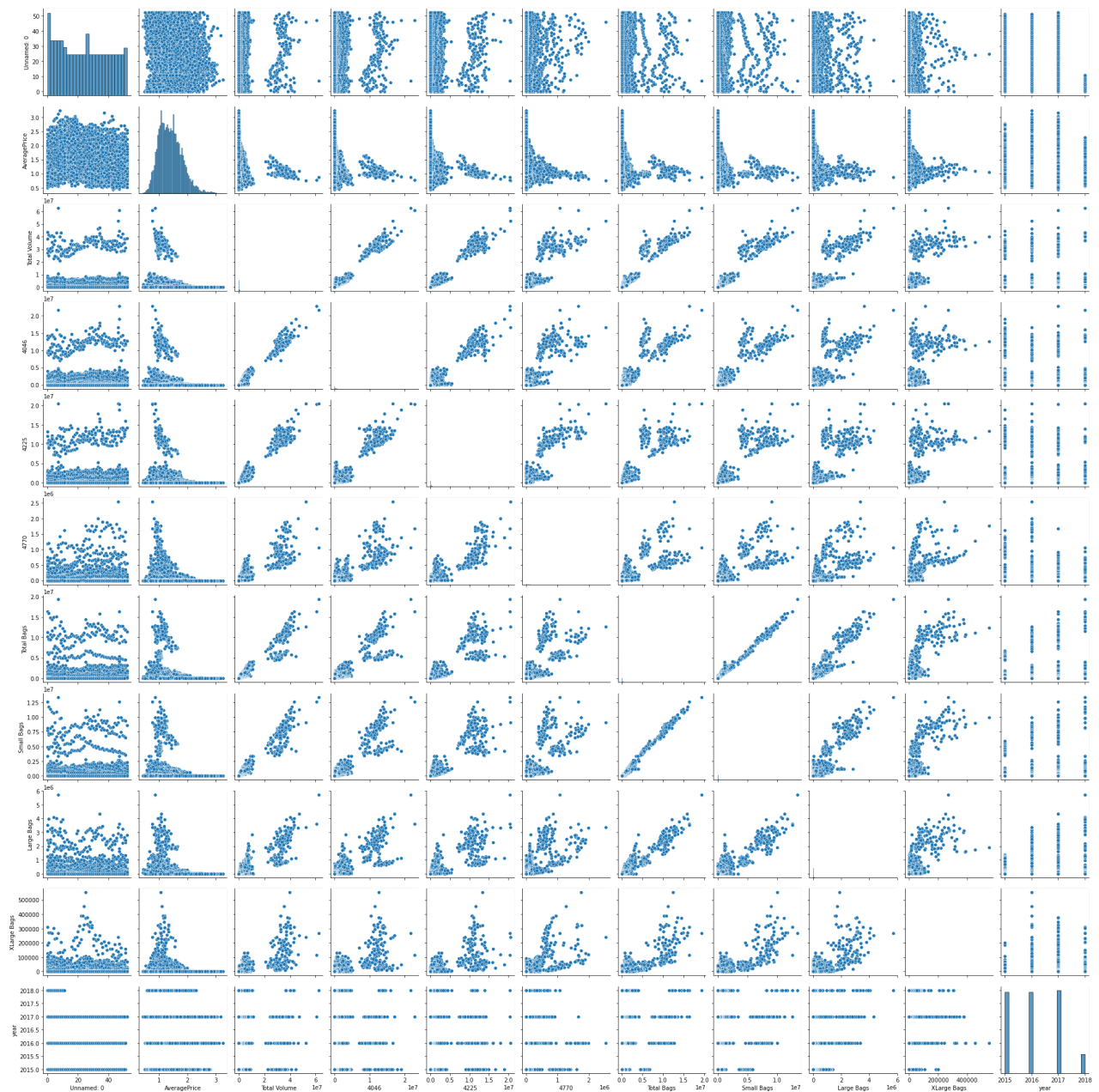


```
In [9]: df['type'].value_counts()
```

```
Out[9]: conventional    9126  
        organic        9123  
        Name: type, dtype: int64
```

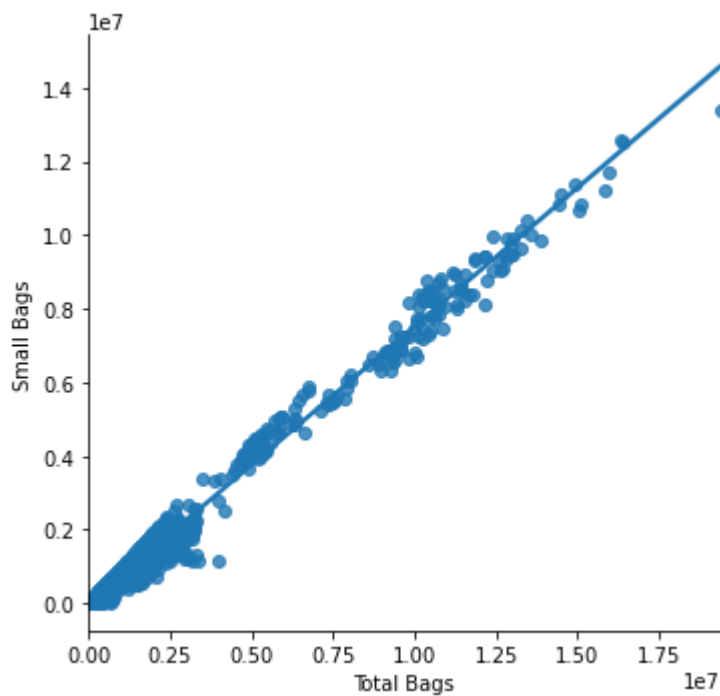
```
In [10]: sns.pairplot(df)
```

```
Out[10]: <seaborn.axisgrid.PairGrid at 0x287594d3d90>
```



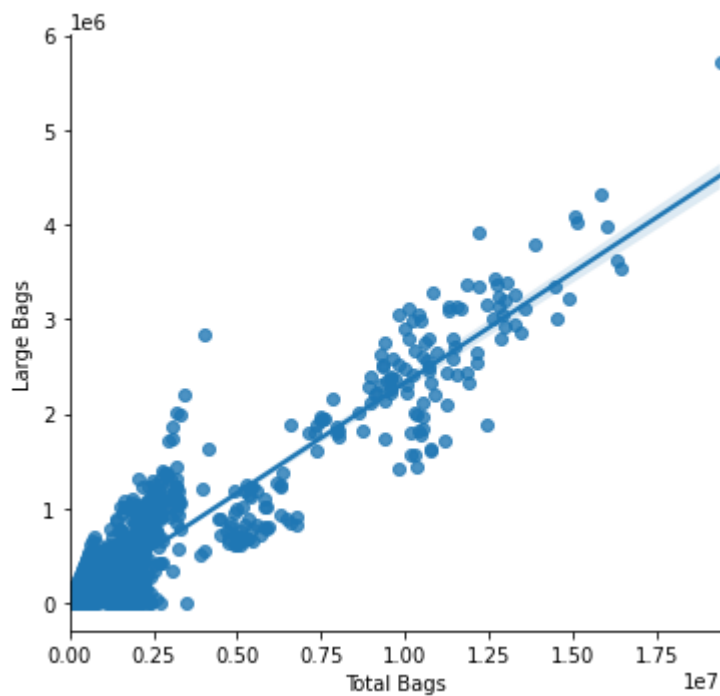
```
In [11]: sns.lmplot(x='Total Bags',y='Small Bags',data=df)
```

```
Out[11]: <seaborn.axisgrid.FacetGrid at 0x2871cea0a90>
```



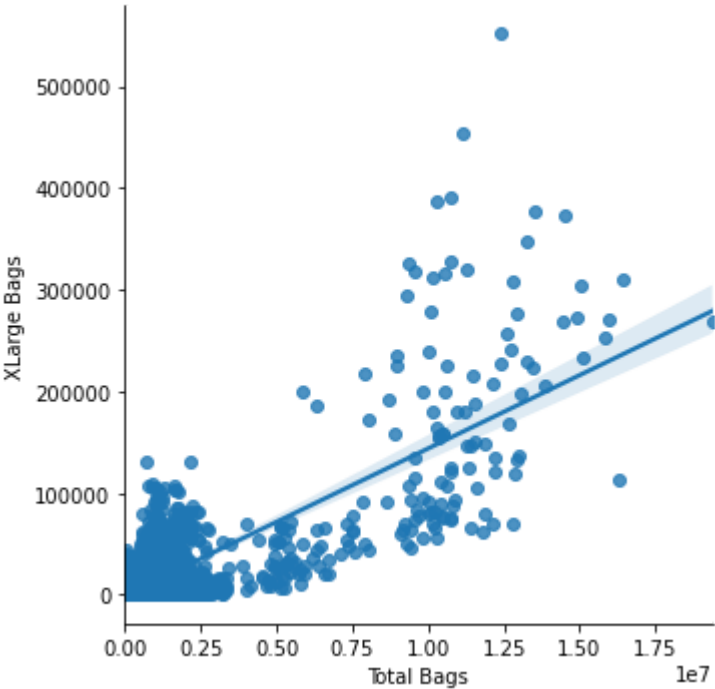
```
In [12]: sns.lmplot(x='Total Bags',y='Large Bags',data=df)
```

```
Out[12]: <seaborn.axisgrid.FacetGrid at 0x2875eacc610>
```



```
In [13]: sns.lmplot(x='Total Bags',y='XLarge Bags',data=df)
```

```
Out[13]: <seaborn.axisgrid.FacetGrid at 0x2875f0d6280>
```



In [14]:

#There is a better correlation between small bags and total bags, hinting that small ba

In [15]:

#Convert types into binary numbers (conventional and organic)

In [16]:

df.head()

Out[16]:

	Unnamed: 0	Date	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags	Large Bags	XLa B
0	0	2015-12-27	1.33	64236.62	1036.74	54454.85	48.16	8696.87	8603.62	93.25	
1	1	2015-12-20	1.35	54876.98	674.28	44638.81	58.33	9505.56	9408.07	97.49	
2	2	2015-12-13	0.93	118220.22	794.70	109149.67	130.50	8145.35	8042.21	103.14	
3	3	2015-12-06	1.08	78992.15	1132.00	71976.41	72.58	5811.16	5677.40	133.76	
4	4	2015-11-29	1.28	51039.60	941.48	43838.39	75.78	6183.95	5986.26	197.69	

In [22]:

df1 = pd.get_dummies(df, columns=['type', 'region'],drop_first=True)

In [23]:

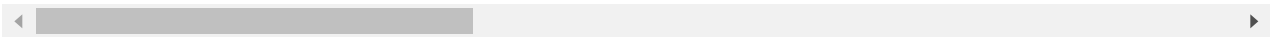
df1.head()

Out[23]:

	Unnamed: 0	Date	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags	Large Bags	...
0	0	2015-12-27	1.33	64236.62	1036.74	54454.85	48.16	8696.87	8603.62	93.25	...

	Unnamed: 0	Date	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags	Large Bags	...
1	1	2015-12-20	1.35	54876.98	674.28	44638.81	58.33	9505.56	9408.07	97.49	...
2	2	2015-12-13	0.93	118220.22	794.70	109149.67	130.50	8145.35	8042.21	103.14	...
3	3	2015-12-06	1.08	78992.15	1132.00	71976.41	72.58	5811.16	5677.40	133.76	...
4	4	2015-11-29	1.28	51039.60	941.48	43838.39	75.78	6183.95	5986.26	197.69	...

5 rows × 66 columns



```
In [26]: df1.columns
```

```
Out[26]: Index(['Unnamed: 0', 'Date', 'AveragePrice', 'Total Volume', '4046', '4225', '4770', 'Total Bags', 'Small Bags', 'Large Bags', 'XLarge Bags', 'year', 'type_organic', 'region_Atlanta', 'region_BaltimoreWashington', 'region_Boise', 'region_Boston', 'region_BuffaloRochester', 'region_California', 'region_Charlotte', 'region_Chicago', 'region_CincinnatiDayton', 'region_Columbus', 'region_DallasFtWorth', 'region_Denver', 'region_Detroit', 'region_GrandRapids', 'region_GreatLakes', 'region_HarrisburgScranton', 'region_HartfordSpringfield', 'region_Houston', 'region_Indianapolis', 'region_Jacksonville', 'region_LasVegas', 'region_LosAngeles', 'region_Louisville', 'region_MiamiFtLauderdale', 'region_Midsouth', 'region_Nashville', 'region_NewOrleansMobile', 'region_NewYork', 'region_Northeast', 'region_NorthernNewEngland', 'region_Orlando', 'region_Philadelphia', 'region_PhoenixTucson', 'region_Pittsburgh', 'region_Plains', 'region_Portland', 'region_RaleighGreensboro', 'region_RichmondNorfolk', 'region_Roanoke', 'region_Sacramento', 'region_SanDiego', 'region_SanFrancisco', 'region_Seattle', 'region_SouthCarolina', 'region_SouthCentral', 'region_Southeast', 'region_Spokane', 'region_StLouis', 'region_Syracuse', 'region_Tampa', 'region_TotalUS', 'region_West', 'region_WestTexNewMexico'], dtype='object')
```

```
In [94]: corrtype = df.corr()
corrtype
```

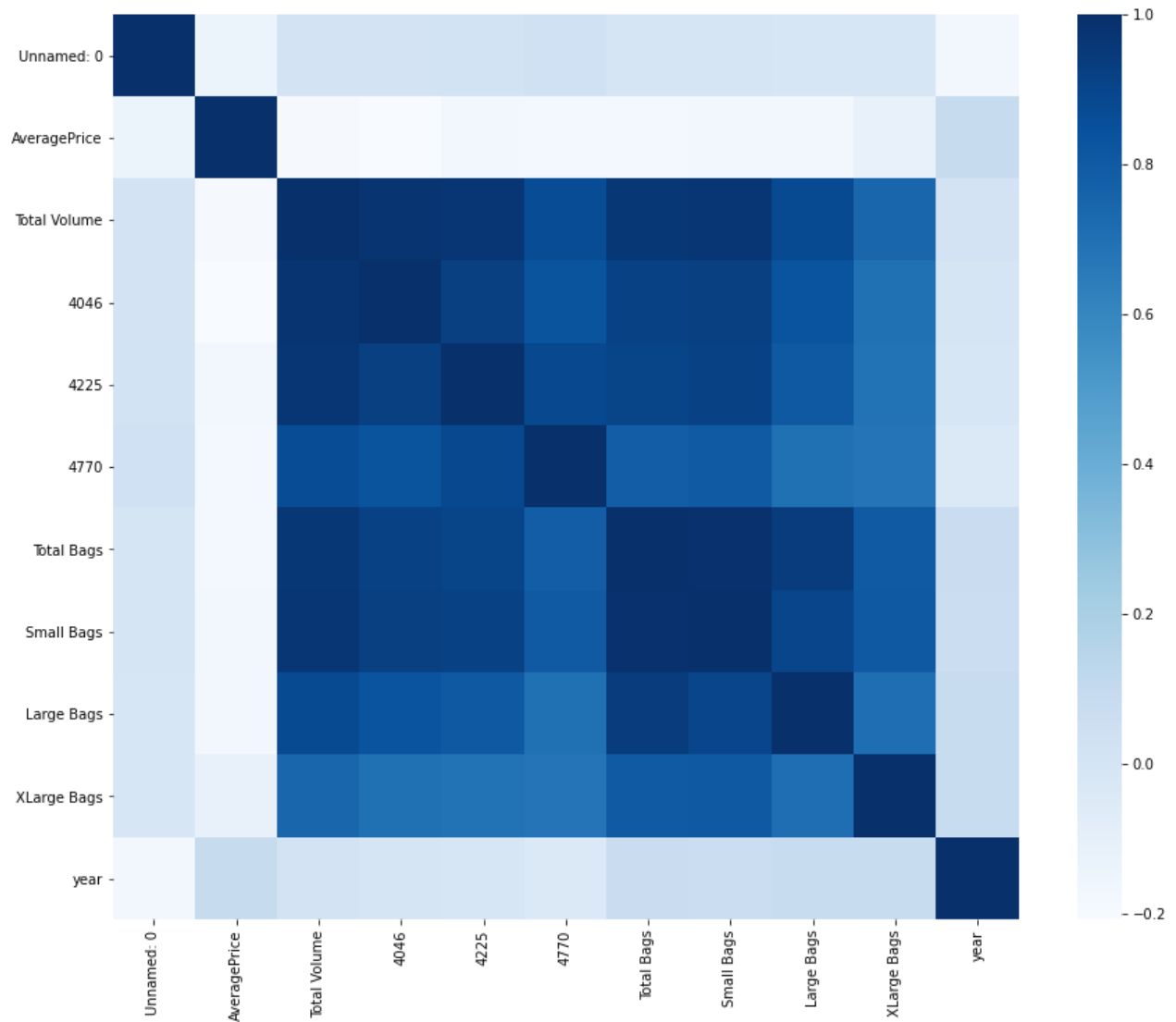
	Unnamed: 0	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags
Unnamed: 0	1.000000	-0.133008	0.014035	0.017628	0.019829	0.041752	-0.002219	0.000347
AveragePrice	-0.133008	1.000000	-0.192752	-0.208317	-0.172928	-0.179446	-0.177088	-0.174730
Total Volume	0.014035	-0.192752	1.000000	0.977863	0.974181	0.872202	0.963047	0.967238
4046	0.017628	-0.208317	0.977863	1.000000	0.926110	0.833389	0.920057	0.925280
4225	0.019829	-0.172928	0.974181	0.926110	1.000000	0.887855	0.905787	0.916031
4770	0.041752	-0.179446	0.872202	0.833389	0.887855	1.000000	0.792314	0.802733
Total Bags	-0.002219	-0.177088	0.963047	0.920057	0.905787	0.792314	1.000000	0.994335
Small Bags	0.000347	-0.174730	0.967238	0.925280	0.916031	0.802733	0.994335	1.000000

	Unnamed: 0	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags
Large Bags	-0.009196	-0.172940	0.880640	0.838645	0.810015	0.698471	0.943009	0.902589
XLarge Bags	-0.011546	-0.117592	0.747157	0.699377	0.688809	0.679861	0.804233	0.806845
year	-0.171667	0.093197	0.017193	0.003353	-0.009559	-0.036531	0.071552	0.063915



```
In [95]: plt.subplots(figsize=(15,12))
sns.heatmap(corrtype, cmap='Blues',square=True)
```

Out[95]: <AxesSubplot:>



```
In [56]: X = df1.drop('type_organic',axis=1).values
y = df1['type_organic'].values
```

```
In [57]: from sklearn.model_selection import train_test_split
```

```
In [58]: X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.3, random_state=101)
```

```
In [59]: from sklearn.preprocessing import MinMaxScaler
```

```
In [60]: scaler = MinMaxScaler()
```

```
In [49]: df1.drop('Date',axis=1,inplace=True)
```

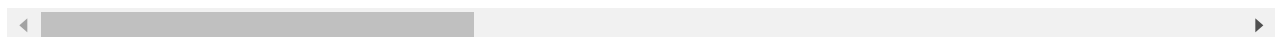
```
In [53]: df1.drop('Unnamed: 0',axis=1,inplace=True)
```

```
In [54]: df1
```

```
Out[54]:
```

	AveragePrice	Total Volume	4046	4225	4770	Total Bags	Small Bags	Large Bags	XLarge Bags	year
0	1.33	64236.62	1036.74	54454.85	48.16	8696.87	8603.62	93.25	0.0	2015
1	1.35	54876.98	674.28	44638.81	58.33	9505.56	9408.07	97.49	0.0	2015
2	0.93	118220.22	794.70	109149.67	130.50	8145.35	8042.21	103.14	0.0	2015
3	1.08	78992.15	1132.00	71976.41	72.58	5811.16	5677.40	133.76	0.0	2015
4	1.28	51039.60	941.48	43838.39	75.78	6183.95	5986.26	197.69	0.0	2015
...
18244	1.63	17074.83	2046.96	1529.20	0.00	13498.67	13066.82	431.85	0.0	2018
18245	1.71	13888.04	1191.70	3431.50	0.00	9264.84	8940.04	324.80	0.0	2018
18246	1.87	13766.76	1191.92	2452.79	727.94	9394.11	9351.80	42.31	0.0	2018
18247	1.93	16205.22	1527.63	2981.04	727.01	10969.54	10919.54	50.00	0.0	2018
18248	1.62	17489.58	2894.77	2356.13	224.53	12014.15	11988.14	26.01	0.0	2018

18249 rows × 64 columns



```
In [61]: X_train = scaler.fit_transform(X_train)
```

```
In [62]: X_test = scaler.transform(X_test)
```

```
In [63]: from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
```

```
In [64]: X_train.shape
```

```
Out[64]: (12774, 63)
```

```
In [67]: model = Sequential()

model.add(Dense(63,activation='relu'))
model.add(Dense(47,activation='relu'))
model.add(Dense(31,activation='relu'))
model.add(Dense(15,activation='relu'))

model.add(Dense(1,activation='sigmoid'))
```



```
model.compile(optimizer='adam',loss='mse')
```

```
In [68]: model.fit(x=X_train,y=y_train,
                  validation_data=(X_test,y_test),
                  batch_size=128,epochs=400)
```

```
Epoch 1/400
100/100 [=====] - 1s 4ms/step - loss: 0.2155 - val_loss: 0.1264
Epoch 2/400
100/100 [=====] - 0s 3ms/step - loss: 0.0932 - val_loss: 0.0883
Epoch 3/400
100/100 [=====] - 0s 3ms/step - loss: 0.0757 - val_loss: 0.0795
Epoch 4/400
100/100 [=====] - 0s 2ms/step - loss: 0.0673 - val_loss: 0.0703
Epoch 5/400
100/100 [=====] - 0s 3ms/step - loss: 0.0586 - val_loss: 0.0596
Epoch 6/400
100/100 [=====] - 0s 3ms/step - loss: 0.0521 - val_loss: 0.0532
Epoch 7/400
100/100 [=====] - 0s 3ms/step - loss: 0.0424 - val_loss: 0.0428
Epoch 8/400
100/100 [=====] - 0s 3ms/step - loss: 0.0323 - val_loss: 0.0333
Epoch 9/400
100/100 [=====] - 0s 2ms/step - loss: 0.0254 - val_loss: 0.0233
Epoch 10/400
100/100 [=====] - 0s 2ms/step - loss: 0.0173 - val_loss: 0.0159
Epoch 11/400
100/100 [=====] - 0s 2ms/step - loss: 0.0115 - val_loss: 0.0110
Epoch 12/400
100/100 [=====] - 0s 2ms/step - loss: 0.0086 - val_loss: 0.0087
Epoch 13/400
100/100 [=====] - 0s 2ms/step - loss: 0.0076 - val_loss: 0.0069
Epoch 14/400
100/100 [=====] - 0s 2ms/step - loss: 0.0051 - val_loss: 0.0053
Epoch 15/400
100/100 [=====] - 0s 2ms/step - loss: 0.0029 - val_loss: 0.0048
Epoch 16/400
100/100 [=====] - 0s 2ms/step - loss: 0.0037 - val_loss: 0.0043
Epoch 17/400
100/100 [=====] - 0s 2ms/step - loss: 0.0025 - val_loss: 0.0025
Epoch 18/400
100/100 [=====] - 0s 2ms/step - loss: 0.0026 - val_loss: 0.0027
Epoch 19/400
100/100 [=====] - 0s 2ms/step - loss: 0.0024 - val_loss: 0.0069
Epoch 20/400
100/100 [=====] - 0s 3ms/step - loss: 0.0024 - val_loss: 0.0016
Epoch 21/400
100/100 [=====] - 0s 3ms/step - loss: 0.0016 - val_loss: 0.0017
Epoch 22/400
100/100 [=====] - 0s 3ms/step - loss: 0.0021 - val_loss: 0.0083
Epoch 23/400
100/100 [=====] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0027
Epoch 24/400
100/100 [=====] - 0s 3ms/step - loss: 0.0017 - val_loss: 0.0016
Epoch 25/400
100/100 [=====] - 0s 3ms/step - loss: 0.0012 - val_loss: 0.0010
Epoch 26/400
100/100 [=====] - 0s 3ms/step - loss: 0.0017 - val_loss: 9.4496
e-04
Epoch 27/400
100/100 [=====] - 0s 3ms/step - loss: 7.1566e-04 - val_loss: 0.
0010
Epoch 28/400
```

```
100/100 [=====] - 0s 3ms/step - loss: 4.6730e-04 - val_loss: 0.0020
Epoch 29/400
100/100 [=====] - 0s 3ms/step - loss: 4.1806e-04 - val_loss: 0.0010
Epoch 30/400
100/100 [=====] - 0s 3ms/step - loss: 3.4695e-04 - val_loss: 9.7480e-04
Epoch 31/400
100/100 [=====] - 0s 3ms/step - loss: 8.2447e-04 - val_loss: 0.0011
Epoch 32/400
100/100 [=====] - 0s 3ms/step - loss: 0.0014 - val_loss: 8.5105e-04
Epoch 33/400
100/100 [=====] - 0s 3ms/step - loss: 0.0028 - val_loss: 0.0052
Epoch 34/400
100/100 [=====] - ETA: 0s - loss: 0.001 - 0s 3ms/step - loss: 0.0014 - val_loss: 8.4818e-04
Epoch 35/400
100/100 [=====] - 0s 3ms/step - loss: 6.3110e-04 - val_loss: 0.0013
Epoch 36/400
100/100 [=====] - 0s 3ms/step - loss: 4.5011e-04 - val_loss: 5.6430e-04
Epoch 37/400
100/100 [=====] - 0s 3ms/step - loss: 4.5272e-04 - val_loss: 0.0013
Epoch 38/400
100/100 [=====] - 0s 3ms/step - loss: 0.0020 - val_loss: 0.0036
Epoch 39/400
100/100 [=====] - 0s 3ms/step - loss: 6.1405e-04 - val_loss: 9.1763e-04
Epoch 40/400
100/100 [=====] - 0s 3ms/step - loss: 4.6570e-04 - val_loss: 0.0049
Epoch 41/400
100/100 [=====] - 0s 3ms/step - loss: 0.0016 - val_loss: 0.0016
Epoch 42/400
100/100 [=====] - 0s 3ms/step - loss: 3.1465e-04 - val_loss: 7.0099e-04
Epoch 43/400
100/100 [=====] - 0s 3ms/step - loss: 4.4832e-05 - val_loss: 6.9683e-04
Epoch 44/400
100/100 [=====] - 0s 3ms/step - loss: 2.5523e-05 - val_loss: 7.0435e-04
Epoch 45/400
100/100 [=====] - 0s 3ms/step - loss: 2.4460e-04 - val_loss: 0.0023
Epoch 46/400
100/100 [=====] - 0s 3ms/step - loss: 0.0073 - val_loss: 0.0135
Epoch 47/400
100/100 [=====] - 0s 3ms/step - loss: 0.0131 - val_loss: 0.0031
Epoch 48/400
100/100 [=====] - 0s 2ms/step - loss: 0.0041 - val_loss: 0.0023
Epoch 49/400
100/100 [=====] - 0s 2ms/step - loss: 3.3093e-04 - val_loss: 9.3909e-04
Epoch 50/400
100/100 [=====] - 0s 2ms/step - loss: 7.4217e-04 - val_loss: 0.0026
Epoch 51/400
100/100 [=====] - ETA: 0s - loss: 0.001 - 0s 2ms/step - loss: 7.7015e-04 - val_loss: 6.8822e-04
```

```
Epoch 52/400
100/100 [=====] - 0s 2ms/step - loss: 1.6237e-04 - val_loss: 6.
2931e-04
Epoch 53/400
100/100 [=====] - 0s 2ms/step - loss: 1.1440e-05 - val_loss: 6.
0569e-04
Epoch 54/400
100/100 [=====] - 0s 2ms/step - loss: 1.2144e-05 - val_loss: 5.
8346e-04
Epoch 55/400
100/100 [=====] - 0s 3ms/step - loss: 1.1864e-05 - val_loss: 6.
0142e-04
Epoch 56/400
100/100 [=====] - 0s 2ms/step - loss: 1.2065e-05 - val_loss: 5.
8717e-04
Epoch 57/400
100/100 [=====] - 0s 2ms/step - loss: 8.5260e-06 - val_loss: 5.
9009e-04
Epoch 58/400
100/100 [=====] - 0s 2ms/step - loss: 7.3052e-06 - val_loss: 5.
9604e-04
Epoch 59/400
100/100 [=====] - 0s 2ms/step - loss: 1.1912e-05 - val_loss: 5.
8895e-04
Epoch 60/400
100/100 [=====] - 0s 2ms/step - loss: 7.5729e-06 - val_loss: 5.
7584e-04
Epoch 61/400
100/100 [=====] - 0s 2ms/step - loss: 6.7196e-06 - val_loss: 5.
7729e-04
Epoch 62/400
100/100 [=====] - 0s 2ms/step - loss: 6.7800e-06 - val_loss: 5.
8144e-04
Epoch 63/400
100/100 [=====] - 0s 2ms/step - loss: 8.5173e-06 - val_loss: 5.
8299e-04
Epoch 64/400
100/100 [=====] - 0s 2ms/step - loss: 6.7622e-06 - val_loss: 5.
8591e-04
Epoch 65/400
100/100 [=====] - 0s 2ms/step - loss: 5.4508e-06 - val_loss: 5.
7464e-04
Epoch 66/400
100/100 [=====] - 0s 3ms/step - loss: 1.1923e-05 - val_loss: 6.
8328e-04
Epoch 67/400
100/100 [=====] - 0s 2ms/step - loss: 7.0532e-06 - val_loss: 5.
7411e-04
Epoch 68/400
100/100 [=====] - 0s 3ms/step - loss: 0.0088 - val_loss: 0.0260
Epoch 69/400
100/100 [=====] - 0s 3ms/step - loss: 0.0279 - val_loss: 0.0223
Epoch 70/400
100/100 [=====] - 0s 3ms/step - loss: 0.0201 - val_loss: 0.0208
Epoch 71/400
100/100 [=====] - 0s 3ms/step - loss: 0.0195 - val_loss: 0.0203
Epoch 72/400
100/100 [=====] - 0s 3ms/step - loss: 0.0184 - val_loss: 0.0196
Epoch 73/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 74/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 75/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 76/400
```

```
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 77/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 78/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 79/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 80/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 81/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 82/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 83/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 84/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 85/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 86/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 87/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 88/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 89/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 90/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 91/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 92/400
100/100 [=====] - 0s 4ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 93/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 94/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 95/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 96/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 97/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 98/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 99/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 100/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 101/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 102/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 103/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 104/400
100/100 [=====] - 0s 3ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 105/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0195
Epoch 106/400
100/100 [=====] - 0s 2ms/step - loss: 0.0183 - val_loss: 0.0196
Epoch 107/400
100/100 [=====] - 0s 2ms/step - loss: 0.0211 - val_loss: 0.0194
Epoch 108/400
100/100 [=====] - 0s 2ms/step - loss: 0.0150 - val_loss: 0.0126
```

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Epoch 109/400
100/100 [=====] - 0s 3ms/step - loss: 0.0095 - val_loss: 0.0054
Epoch 110/400
100/100 [=====] - 0s 3ms/step - loss: 0.0023 - val_loss: 0.0015
Epoch 111/400
100/100 [=====] - 0s 3ms/step - loss: 4.5956e-04 - val_loss: 8.
9261e-04
Epoch 112/400
100/100 [=====] - 0s 2ms/step - loss: 6.6280e-05 - val_loss: 4.
2187e-04
Epoch 113/400
100/100 [=====] - 0s 2ms/step - loss: 2.3725e-05 - val_loss: 3.
9352e-04
Epoch 114/400
100/100 [=====] - 0s 3ms/step - loss: 2.0784e-05 - val_loss: 3.
6688e-04
Epoch 115/400
100/100 [=====] - 0s 3ms/step - loss: 1.6208e-05 - val_loss: 3.
5635e-04
Epoch 116/400
100/100 [=====] - 0s 3ms/step - loss: 1.1163e-05 - val_loss: 3.
5229e-04
Epoch 117/400
100/100 [=====] - 0s 3ms/step - loss: 9.2332e-06 - val_loss: 3.
4782e-04
Epoch 118/400
100/100 [=====] - 0s 3ms/step - loss: 7.3485e-06 - val_loss: 3.
4847e-04
Epoch 119/400
100/100 [=====] - 0s 2ms/step - loss: 6.3582e-06 - val_loss: 3.
4767e-04
Epoch 120/400
100/100 [=====] - 0s 2ms/step - loss: 5.9314e-06 - val_loss: 3.
4903e-04
Epoch 121/400
100/100 [=====] - 0s 2ms/step - loss: 4.9509e-06 - val_loss: 3.
4590e-04
Epoch 122/400
100/100 [=====] - 0s 2ms/step - loss: 4.1949e-06 - val_loss: 3.
4302e-04
Epoch 123/400
100/100 [=====] - 0s 2ms/step - loss: 3.9766e-06 - val_loss: 3.
4064e-04
Epoch 124/400
100/100 [=====] - 0s 2ms/step - loss: 3.5646e-06 - val_loss: 3.
3864e-04
Epoch 125/400
100/100 [=====] - 0s 2ms/step - loss: 2.9872e-06 - val_loss: 3.
3866e-04
Epoch 126/400
100/100 [=====] - 0s 3ms/step - loss: 2.7082e-06 - val_loss: 3.
4362e-04
Epoch 127/400
100/100 [=====] - 0s 2ms/step - loss: 2.6583e-06 - val_loss: 3.
3797e-04
Epoch 128/400
100/100 [=====] - 0s 2ms/step - loss: 2.3066e-06 - val_loss: 3.
3689e-04
Epoch 129/400
100/100 [=====] - 0s 3ms/step - loss: 2.1418e-06 - val_loss: 3.
3583e-04
Epoch 130/400
100/100 [=====] - 0s 3ms/step - loss: 1.9219e-06 - val_loss: 3.
3485e-04
Epoch 131/400
```

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100/100 [=====] - 0s 3ms/step - loss: 1.8439e-06 - val_loss: 3.3604e-04
Epoch 132/400
100/100 [=====] - 0s 3ms/step - loss: 1.7662e-06 - val_loss: 3.3367e-04
Epoch 133/400
100/100 [=====] - 0s 3ms/step - loss: 1.6033e-06 - val_loss: 3.3302e-04
Epoch 134/400
100/100 [=====] - 0s 3ms/step - loss: 1.5001e-06 - val_loss: 3.3341e-04
Epoch 135/400
100/100 [=====] - 0s 3ms/step - loss: 1.4039e-06 - val_loss: 3.3099e-04
Epoch 136/400
100/100 [=====] - 0s 3ms/step - loss: 1.4173e-06 - val_loss: 3.4093e-04
Epoch 137/400
100/100 [=====] - 0s 3ms/step - loss: 1.2734e-06 - val_loss: 3.3782e-04
Epoch 138/400
100/100 [=====] - 0s 3ms/step - loss: 1.1393e-06 - val_loss: 3.3445e-04
Epoch 139/400
100/100 [=====] - 0s 3ms/step - loss: 1.0860e-06 - val_loss: 3.3425e-04
Epoch 140/400
100/100 [=====] - 0s 3ms/step - loss: 9.8429e-07 - val_loss: 3.3130e-04
Epoch 141/400
100/100 [=====] - 0s 3ms/step - loss: 1.0309e-06 - val_loss: 3.3277e-04
Epoch 142/400
100/100 [=====] - 0s 3ms/step - loss: 8.9856e-07 - val_loss: 3.3369e-04
Epoch 143/400
100/100 [=====] - 0s 3ms/step - loss: 8.6999e-07 - val_loss: 3.3481e-04
Epoch 144/400
100/100 [=====] - 0s 3ms/step - loss: 7.7210e-07 - val_loss: 3.3137e-04
Epoch 145/400
100/100 [=====] - 0s 3ms/step - loss: 7.6558e-07 - val_loss: 3.3498e-04
Epoch 146/400
100/100 [=====] - 0s 3ms/step - loss: 8.3150e-07 - val_loss: 3.3476e-04
Epoch 147/400
100/100 [=====] - 0s 3ms/step - loss: 6.6157e-07 - val_loss: 3.3633e-04
Epoch 148/400
100/100 [=====] - 0s 3ms/step - loss: 6.4485e-07 - val_loss: 3.2998e-04
Epoch 149/400
100/100 [=====] - 0s 3ms/step - loss: 6.1087e-07 - val_loss: 3.3058e-04
Epoch 150/400
100/100 [=====] - 0s 3ms/step - loss: 5.7209e-07 - val_loss: 3.3705e-04
Epoch 151/400
100/100 [=====] - 0s 3ms/step - loss: 5.7901e-07 - val_loss: 3.3523e-04
Epoch 152/400
100/100 [=====] - 0s 3ms/step - loss: 4.9363e-07 - val_loss: 3.4011e-04
```

Epoch 153/400
100/100 [=====] - 0s 2ms/step - loss: 4.8078e-07 - val_loss: 3.3878e-04
Epoch 154/400
100/100 [=====] - 0s 2ms/step - loss: 4.9578e-07 - val_loss: 3.3724e-04
Epoch 155/400
100/100 [=====] - 0s 2ms/step - loss: 4.2703e-07 - val_loss: 3.3106e-04
Epoch 156/400
100/100 [=====] - 0s 3ms/step - loss: 4.6386e-07 - val_loss: 3.3957e-04
Epoch 157/400
100/100 [=====] - 0s 3ms/step - loss: 4.0737e-07 - val_loss: 3.3422e-04
Epoch 158/400
100/100 [=====] - 0s 3ms/step - loss: 4.2214e-07 - val_loss: 3.3752e-04
Epoch 159/400
100/100 [=====] - 0s 3ms/step - loss: 3.4917e-07 - val_loss: 3.3313e-04
Epoch 160/400
100/100 [=====] - 0s 3ms/step - loss: 3.6755e-07 - val_loss: 3.3503e-04
Epoch 161/400
100/100 [=====] - 0s 3ms/step - loss: 3.1654e-07 - val_loss: 3.3931e-04
Epoch 162/400
100/100 [=====] - 0s 2ms/step - loss: 3.1223e-07 - val_loss: 3.3751e-04
Epoch 163/400
100/100 [=====] - 0s 2ms/step - loss: 3.6792e-07 - val_loss: 3.3751e-04
Epoch 164/400
100/100 [=====] - 0s 2ms/step - loss: 2.8378e-07 - val_loss: 3.3876e-04
Epoch 165/400
100/100 [=====] - 0s 3ms/step - loss: 3.5227e-07 - val_loss: 3.3990e-04
Epoch 166/400
100/100 [=====] - 0s 3ms/step - loss: 2.3372e-07 - val_loss: 3.3004e-04
Epoch 167/400
100/100 [=====] - 0s 3ms/step - loss: 2.5453e-07 - val_loss: 3.3819e-04
Epoch 168/400
100/100 [=====] - 0s 3ms/step - loss: 2.5799e-07 - val_loss: 3.4426e-04
Epoch 169/400
100/100 [=====] - 0s 3ms/step - loss: 2.1617e-07 - val_loss: 3.3479e-04
Epoch 170/400
100/100 [=====] - 0s 3ms/step - loss: 2.3680e-07 - val_loss: 3.4280e-04
Epoch 171/400
100/100 [=====] - 0s 4ms/step - loss: 2.8232e-07 - val_loss: 3.4202e-04
Epoch 172/400
100/100 [=====] - 0s 3ms/step - loss: 1.8398e-07 - val_loss: 3.2672e-04
Epoch 173/400
100/100 [=====] - 0s 3ms/step - loss: 2.9815e-07 - val_loss: 3.3701e-04
Epoch 174/400
100/100 [=====] - 0s 3ms/step - loss: 1.8980e-07 - val_loss: 3.

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3394e-04
Epoch 175/400
100/100 [=====] - 0s 2ms/step - loss: 2.8447e-07 - val_loss: 3.
4800e-04
Epoch 176/400
100/100 [=====] - 0s 2ms/step - loss: 0.0146 - val_loss: 0.0244
Epoch 177/400
100/100 [=====] - 0s 2ms/step - loss: 0.0088 - val_loss: 0.0183
Epoch 178/400
100/100 [=====] - 0s 2ms/step - loss: 0.0038 - val_loss: 0.0014
Epoch 179/400
100/100 [=====] - 0s 2ms/step - loss: 0.0011 - val_loss: 5.9054
e-04
Epoch 180/400
100/100 [=====] - 0s 2ms/step - loss: 3.5092e-05 - val_loss: 5.
2305e-04
Epoch 181/400
100/100 [=====] - 0s 2ms/step - loss: 7.9868e-06 - val_loss: 5.
3255e-04
Epoch 182/400
100/100 [=====] - 0s 2ms/step - loss: 6.0476e-06 - val_loss: 5.
1910e-04
Epoch 183/400
100/100 [=====] - 0s 2ms/step - loss: 5.3813e-06 - val_loss: 5.
1677e-04
Epoch 184/400
100/100 [=====] - 0s 2ms/step - loss: 4.8879e-06 - val_loss: 4.
9908e-04
Epoch 185/400
100/100 [=====] - 0s 2ms/step - loss: 4.3665e-06 - val_loss: 4.
9999e-04
Epoch 186/400
100/100 [=====] - 0s 2ms/step - loss: 3.9880e-06 - val_loss: 4.
8275e-04
Epoch 187/400
100/100 [=====] - 0s 2ms/step - loss: 3.8404e-06 - val_loss: 4.
8373e-04
Epoch 188/400
100/100 [=====] - 0s 2ms/step - loss: 3.3414e-06 - val_loss: 4.
8393e-04
Epoch 189/400
100/100 [=====] - 0s 2ms/step - loss: 3.0185e-06 - val_loss: 4.
7865e-04
Epoch 190/400
100/100 [=====] - 0s 2ms/step - loss: 2.9102e-06 - val_loss: 4.
7487e-04
Epoch 191/400
100/100 [=====] - 0s 2ms/step - loss: 2.6254e-06 - val_loss: 4.
6327e-04
Epoch 192/400
100/100 [=====] - 0s 3ms/step - loss: 2.3612e-06 - val_loss: 4.
7567e-04
Epoch 193/400
100/100 [=====] - 0s 3ms/step - loss: 2.2339e-06 - val_loss: 4.
8339e-04
Epoch 194/400
100/100 [=====] - 0s 2ms/step - loss: 2.0714e-06 - val_loss: 4.
6786e-04
Epoch 195/400
100/100 [=====] - 0s 2ms/step - loss: 1.8945e-06 - val_loss: 4.
5815e-04
Epoch 196/400
100/100 [=====] - 0s 2ms/step - loss: 1.7660e-06 - val_loss: 4.
5698e-04
Epoch 197/400
```



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100/100 [=====] - 0s 2ms/step - loss: 1.6337e-06 - val_loss: 4.5506e-04
Epoch 198/400
100/100 [=====] - 0s 2ms/step - loss: 1.5400e-06 - val_loss: 4.5248e-04
Epoch 199/400
100/100 [=====] - 0s 3ms/step - loss: 1.4721e-06 - val_loss: 4.5655e-04
Epoch 200/400
100/100 [=====] - 0s 2ms/step - loss: 1.3134e-06 - val_loss: 4.5335e-04
Epoch 201/400
100/100 [=====] - 0s 2ms/step - loss: 1.2110e-06 - val_loss: 4.4412e-04
Epoch 202/400
100/100 [=====] - 0s 2ms/step - loss: 1.1878e-06 - val_loss: 4.4612e-04
Epoch 203/400
100/100 [=====] - 0s 3ms/step - loss: 1.0741e-06 - val_loss: 4.4726e-04
Epoch 204/400
100/100 [=====] - 0s 3ms/step - loss: 1.0029e-06 - val_loss: 4.5065e-04
Epoch 205/400
100/100 [=====] - 0s 3ms/step - loss: 9.2463e-07 - val_loss: 4.4500e-04
Epoch 206/400
100/100 [=====] - 0s 3ms/step - loss: 8.7125e-07 - val_loss: 4.4248e-04
Epoch 207/400
100/100 [=====] - 0s 3ms/step - loss: 8.0808e-07 - val_loss: 4.5295e-04
Epoch 208/400
100/100 [=====] - 0s 3ms/step - loss: 7.7843e-07 - val_loss: 4.4538e-04
Epoch 209/400
100/100 [=====] - 0s 3ms/step - loss: 7.0635e-07 - val_loss: 4.3119e-04
Epoch 210/400
100/100 [=====] - 0s 3ms/step - loss: 6.6850e-07 - val_loss: 4.4348e-04
Epoch 211/400
100/100 [=====] - 0s 3ms/step - loss: 6.3289e-07 - val_loss: 4.2955e-04
Epoch 212/400
100/100 [=====] - 0s 3ms/step - loss: 6.1565e-07 - val_loss: 4.3215e-04
Epoch 213/400
100/100 [=====] - 0s 3ms/step - loss: 5.4141e-07 - val_loss: 4.2992e-04
Epoch 214/400
100/100 [=====] - 0s 3ms/step - loss: 5.1645e-07 - val_loss: 4.2066e-04
Epoch 215/400
100/100 [=====] - 0s 4ms/step - loss: 4.8808e-07 - val_loss: 4.2783e-04
Epoch 216/400
100/100 [=====] - 0s 3ms/step - loss: 4.7065e-07 - val_loss: 4.2726e-04
Epoch 217/400
100/100 [=====] - 0s 3ms/step - loss: 4.4257e-07 - val_loss: 4.2415e-04
Epoch 218/400
100/100 [=====] - 0s 3ms/step - loss: 4.0941e-07 - val_loss: 4.1727e-04
```

Epoch 219/400
100/100 [=====] - 0s 3ms/step - loss: 3.9260e-07 - val_loss: 4.1921e-04
Epoch 220/400
100/100 [=====] - 0s 3ms/step - loss: 3.6177e-07 - val_loss: 4.2399e-04
Epoch 221/400
100/100 [=====] - 0s 3ms/step - loss: 3.4069e-07 - val_loss: 4.1721e-04
Epoch 222/400
100/100 [=====] - 0s 3ms/step - loss: 3.2661e-07 - val_loss: 4.1976e-04
Epoch 223/400
100/100 [=====] - 0s 3ms/step - loss: 3.0484e-07 - val_loss: 4.1776e-04
Epoch 224/400
100/100 [=====] - 0s 3ms/step - loss: 2.8612e-07 - val_loss: 4.1437e-04
Epoch 225/400
100/100 [=====] - 0s 3ms/step - loss: 2.7044e-07 - val_loss: 4.1773e-04
Epoch 226/400
100/100 [=====] - 0s 3ms/step - loss: 2.5575e-07 - val_loss: 4.1114e-04
Epoch 227/400
100/100 [=====] - 0s 3ms/step - loss: 2.5110e-07 - val_loss: 4.1472e-04
Epoch 228/400
100/100 [=====] - 0s 3ms/step - loss: 2.2824e-07 - val_loss: 4.0951e-04
Epoch 229/400
100/100 [=====] - 0s 3ms/step - loss: 2.2033e-07 - val_loss: 4.0294e-04
Epoch 230/400
100/100 [=====] - 0s 3ms/step - loss: 2.0583e-07 - val_loss: 4.0203e-04
Epoch 231/400
100/100 [=====] - 0s 3ms/step - loss: 2.0181e-07 - val_loss: 4.0545e-04
Epoch 232/400
100/100 [=====] - 0s 3ms/step - loss: 1.8687e-07 - val_loss: 4.0685e-04
Epoch 233/400
100/100 [=====] - 0s 2ms/step - loss: 1.7391e-07 - val_loss: 4.0200e-04
Epoch 234/400
100/100 [=====] - 0s 2ms/step - loss: 1.6958e-07 - val_loss: 4.0303e-04
Epoch 235/400
100/100 [=====] - 0s 2ms/step - loss: 1.6102e-07 - val_loss: 4.0507e-04
Epoch 236/400
100/100 [=====] - 0s 2ms/step - loss: 1.4897e-07 - val_loss: 3.9688e-04
Epoch 237/400
100/100 [=====] - 0s 1ms/step - loss: 1.4215e-07 - val_loss: 4.1268e-04
Epoch 238/400
100/100 [=====] - 0s 2ms/step - loss: 1.3765e-07 - val_loss: 3.9745e-04
Epoch 239/400
100/100 [=====] - 0s 1ms/step - loss: 1.3472e-07 - val_loss: 4.0517e-04
Epoch 240/400
100/100 [=====] - 0s 1ms/step - loss: 1.3124e-07 - val_loss: 4.

```
0202e-04
Epoch 241/400
100/100 [=====] - 0s 2ms/step - loss: 1.1946e-07 - val_loss: 4.
0709e-04
Epoch 242/400
100/100 [=====] - 0s 1ms/step - loss: 1.1047e-07 - val_loss: 3.
9268e-04
Epoch 243/400
100/100 [=====] - 0s 1ms/step - loss: 1.0730e-07 - val_loss: 3.
9981e-04
Epoch 244/400
100/100 [=====] - 0s 2ms/step - loss: 1.0225e-07 - val_loss: 3.
9408e-04
Epoch 245/400
100/100 [=====] - 0s 1ms/step - loss: 9.8306e-08 - val_loss: 3.
9382e-04
Epoch 246/400
100/100 [=====] - 0s 2ms/step - loss: 9.1467e-08 - val_loss: 4.
0594e-04
Epoch 247/400
100/100 [=====] - 0s 1ms/step - loss: 9.0265e-08 - val_loss: 3.
9842e-04
Epoch 248/400
100/100 [=====] - 0s 1ms/step - loss: 8.9901e-08 - val_loss: 3.
9497e-04
Epoch 249/400
100/100 [=====] - 0s 1ms/step - loss: 8.1510e-08 - val_loss: 3.
9193e-04
Epoch 250/400
100/100 [=====] - 0s 2ms/step - loss: 7.7669e-08 - val_loss: 3.
9235e-04
Epoch 251/400
100/100 [=====] - 0s 2ms/step - loss: 7.7025e-08 - val_loss: 3.
9140e-04
Epoch 252/400
100/100 [=====] - 0s 2ms/step - loss: 6.7062e-08 - val_loss: 3.
8711e-04
Epoch 253/400
100/100 [=====] - 0s 2ms/step - loss: 6.6762e-08 - val_loss: 4.
0132e-04
Epoch 254/400
100/100 [=====] - 0s 2ms/step - loss: 6.8533e-08 - val_loss: 3.
9928e-04
Epoch 255/400
100/100 [=====] - 0s 2ms/step - loss: 6.2734e-08 - val_loss: 3.
9070e-04
Epoch 256/400
100/100 [=====] - 0s 2ms/step - loss: 6.0041e-08 - val_loss: 3.
9859e-04
Epoch 257/400
100/100 [=====] - 0s 2ms/step - loss: 5.5033e-08 - val_loss: 3.
9645e-04
Epoch 258/400
100/100 [=====] - 0s 2ms/step - loss: 5.3088e-08 - val_loss: 3.
9896e-04
Epoch 259/400
100/100 [=====] - 0s 3ms/step - loss: 5.1411e-08 - val_loss: 3.
9615e-04
Epoch 260/400
100/100 [=====] - 0s 2ms/step - loss: 4.8585e-08 - val_loss: 3.
9641e-04
Epoch 261/400
100/100 [=====] - 0s 2ms/step - loss: 4.7567e-08 - val_loss: 3.
9350e-04
Epoch 262/400
```

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100/100 [=====] - 0s 2ms/step - loss: 4.2922e-08 - val_loss: 3.8336e-04
Epoch 263/400
100/100 [=====] - 0s 2ms/step - loss: 4.0959e-08 - val_loss: 3.8959e-04
Epoch 264/400
100/100 [=====] - 0s 2ms/step - loss: 3.8861e-08 - val_loss: 3.8694e-04
Epoch 265/400
100/100 [=====] - 0s 2ms/step - loss: 3.7202e-08 - val_loss: 3.8689e-04
Epoch 266/400
100/100 [=====] - 0s 3ms/step - loss: 3.5381e-08 - val_loss: 3.8256e-04
Epoch 267/400
100/100 [=====] - 0s 3ms/step - loss: 3.8543e-08 - val_loss: 3.7916e-04
Epoch 268/400
100/100 [=====] - 0s 3ms/step - loss: 3.2347e-08 - val_loss: 3.9393e-04
Epoch 269/400
100/100 [=====] - 0s 3ms/step - loss: 3.1960e-08 - val_loss: 3.8768e-04
Epoch 270/400
100/100 [=====] - 0s 3ms/step - loss: 2.9730e-08 - val_loss: 3.9014e-04
Epoch 271/400
100/100 [=====] - 0s 3ms/step - loss: 3.1430e-08 - val_loss: 3.8723e-04
Epoch 272/400
100/100 [=====] - 0s 3ms/step - loss: 2.8141e-08 - val_loss: 3.9248e-04
Epoch 273/400
100/100 [=====] - 0s 3ms/step - loss: 3.2788e-08 - val_loss: 3.9513e-04
Epoch 274/400
100/100 [=====] - 0s 3ms/step - loss: 2.7194e-08 - val_loss: 3.9184e-04
Epoch 275/400
100/100 [=====] - 0s 3ms/step - loss: 2.4864e-08 - val_loss: 3.7845e-04
Epoch 276/400
100/100 [=====] - 0s 3ms/step - loss: 2.3135e-08 - val_loss: 3.8241e-04
Epoch 277/400
100/100 [=====] - 0s 3ms/step - loss: 2.3540e-08 - val_loss: 3.8517e-04
Epoch 278/400
100/100 [=====] - 0s 3ms/step - loss: 2.2689e-08 - val_loss: 3.8384e-04
Epoch 279/400
100/100 [=====] - 0s 2ms/step - loss: 2.0432e-08 - val_loss: 3.8852e-04
Epoch 280/400
100/100 [=====] - 0s 2ms/step - loss: 1.9629e-08 - val_loss: 3.8879e-04
Epoch 281/400
100/100 [=====] - 0s 2ms/step - loss: 1.8577e-08 - val_loss: 3.9266e-04
Epoch 282/400
100/100 [=====] - 0s 3ms/step - loss: 1.7233e-08 - val_loss: 3.7833e-04
Epoch 283/400
100/100 [=====] - 0s 3ms/step - loss: 1.9430e-08 - val_loss: 3.8309e-04
```

Epoch 284/400
100/100 [=====] - 0s 3ms/step - loss: 1.5532e-08 - val_loss: 3.7629e-04
Epoch 285/400
100/100 [=====] - 0s 3ms/step - loss: 2.2215e-08 - val_loss: 3.8785e-04
Epoch 286/400
100/100 [=====] - 0s 3ms/step - loss: 1.5361e-08 - val_loss: 3.7930e-04
Epoch 287/400
100/100 [=====] - 0s 3ms/step - loss: 1.6851e-08 - val_loss: 3.8424e-04
Epoch 288/400
100/100 [=====] - 0s 3ms/step - loss: 2.2881e-08 - val_loss: 3.7418e-04
Epoch 289/400
100/100 [=====] - 0s 3ms/step - loss: 1.4585e-08 - val_loss: 3.8720e-04
Epoch 290/400
100/100 [=====] - 0s 3ms/step - loss: 1.2385e-08 - val_loss: 3.9677e-04
Epoch 291/400
100/100 [=====] - 0s 3ms/step - loss: 1.1877e-08 - val_loss: 3.8486e-04
Epoch 292/400
100/100 [=====] - 0s 3ms/step - loss: 1.2844e-08 - val_loss: 3.8365e-04
Epoch 293/400
100/100 [=====] - 0s 2ms/step - loss: 0.0313 - val_loss: 0.0403
Epoch 294/400
100/100 [=====] - 0s 2ms/step - loss: 0.0277 - val_loss: 0.0256
Epoch 295/400
100/100 [=====] - 0s 2ms/step - loss: 0.0194 - val_loss: 0.0231
Epoch 296/400
100/100 [=====] - 0s 2ms/step - loss: 0.0179 - val_loss: 0.0218
Epoch 297/400
100/100 [=====] - 0s 2ms/step - loss: 0.0175 - val_loss: 0.0217
Epoch 298/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 299/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
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Epoch 311/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217

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Epoch 312/400
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Epoch 313/400
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Epoch 314/400
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Epoch 343/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 344/400
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100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 345/400
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Epoch 363/400
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100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 371/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 372/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 373/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 374/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 375/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 376/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
```

```

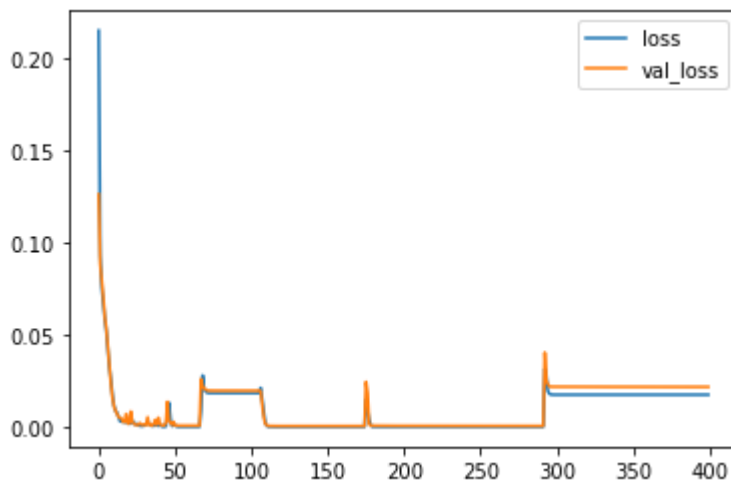
Epoch 377/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 378/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 379/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 380/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 381/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 382/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 383/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 384/400
100/100 [=====] - 0s 2ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 385/400
100/100 [=====] - 0s 2ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 386/400
100/100 [=====] - 0s 2ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 387/400
100/100 [=====] - 0s 2ms/step - loss: 0.0174 - val_loss: 0.0217
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100/100 [=====] - 0s 2ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 389/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 390/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 391/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 392/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 393/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 394/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 395/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 396/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 397/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 398/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 399/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 400/400
100/100 [=====] - 0s 3ms/step - loss: 0.0174 - val_loss: 0.0216

```

Out[68]: <keras.callbacks.History at 0x2872d93d220>

```
In [69]: model_loss = pd.DataFrame(model.history.history)
         model_loss.plot()
```

Out[69]: <AxesSubplot:>



```
In [70]: from tensorflow.keras.callbacks import EarlyStopping
```

```
In [71]: early_stop = EarlyStopping(monitor='val_loss',mode='min',
    verbose=1,patience=25)
```

```
In [72]: model.fit(x=X_train,y=y_train,epochs=400,validation_data=(X_test,y_test),
    callbacks=[early_stop])
```

```
Epoch 1/400
400/400 [=====] - 1s 2ms/step - loss: 0.0174 - val_loss: 0.0217
Epoch 2/400
400/400 [=====] - 1s 2ms/step - loss: 0.0503 - val_loss: 0.0445
Epoch 3/400
400/400 [=====] - 1s 2ms/step - loss: 0.0234 - val_loss: 0.0106
Epoch 4/400
400/400 [=====] - 1s 2ms/step - loss: 0.0100 - val_loss: 0.0103
Epoch 5/400
400/400 [=====] - 1s 2ms/step - loss: 0.0107 - val_loss: 0.0145
Epoch 6/400
400/400 [=====] - 1s 2ms/step - loss: 0.0167 - val_loss: 0.0110
Epoch 7/400
400/400 [=====] - 1s 2ms/step - loss: 0.0105 - val_loss: 0.0090
Epoch 8/400
400/400 [=====] - 1s 2ms/step - loss: 0.0104 - val_loss: 0.0097
Epoch 9/400
400/400 [=====] - 1s 2ms/step - loss: 0.0150 - val_loss: 0.0095
Epoch 10/400
400/400 [=====] - 1s 2ms/step - loss: 0.0102 - val_loss: 0.0088
Epoch 11/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 12/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 13/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 14/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 15/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 16/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 17/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 18/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 19/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
```

```
Epoch 20/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 21/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 22/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 23/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 24/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 25/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 26/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 27/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 28/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 29/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 30/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 31/400
400/400 [=====] - 1s 3ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 32/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 33/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 34/400
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Epoch 35/400
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Epoch 36/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 37/400
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Epoch 38/400
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Epoch 39/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 40/400
400/400 [=====] - 1s 2ms/step - loss: 0.0096 - val_loss: 0.0088
Epoch 41/400
400/400 [=====] - 1s 2ms/step - loss: 0.0311 - val_loss: 0.0352
Epoch 42/400
400/400 [=====] - 1s 2ms/step - loss: 0.0152 - val_loss: 9.9823
e-04
Epoch 43/400
400/400 [=====] - 1s 3ms/step - loss: 6.9747e-04 - val_loss: 3.
5312e-04
Epoch 44/400
400/400 [=====] - 1s 2ms/step - loss: 3.2136e-05 - val_loss: 3.
3227e-04
Epoch 45/400
400/400 [=====] - 1s 2ms/step - loss: 4.2066e-06 - val_loss: 3.
0644e-04
Epoch 46/400
400/400 [=====] - 1s 3ms/step - loss: 1.0494e-06 - val_loss: 3.
1392e-04
Epoch 47/400
400/400 [=====] - 1s 3ms/step - loss: 4.6051e-07 - val_loss: 3.
0867e-04
Epoch 48/400
400/400 [=====] - 1s 3ms/step - loss: 2.7386e-07 - val_loss: 3.
0686e-04
```

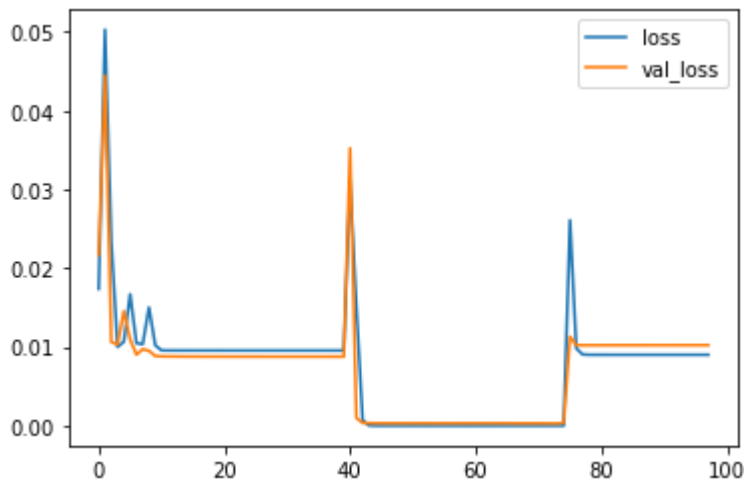
```
Epoch 49/400
400/400 [=====] - 1s 3ms/step - loss: 1.8898e-07 - val_loss: 3.0299e-04
Epoch 50/400
400/400 [=====] - 1s 3ms/step - loss: 1.5049e-07 - val_loss: 3.0680e-04
Epoch 51/400
400/400 [=====] - 1s 3ms/step - loss: 1.1499e-07 - val_loss: 3.1375e-04
Epoch 52/400
400/400 [=====] - 1s 3ms/step - loss: 9.3453e-08 - val_loss: 3.0438e-04
Epoch 53/400
400/400 [=====] - 1s 3ms/step - loss: 8.3383e-08 - val_loss: 3.1184e-04
Epoch 54/400
400/400 [=====] - 1s 2ms/step - loss: 6.0949e-08 - val_loss: 3.0064e-04
Epoch 55/400
400/400 [=====] - 1s 2ms/step - loss: 4.9849e-08 - val_loss: 3.0140e-04
Epoch 56/400
400/400 [=====] - 1s 2ms/step - loss: 4.5504e-08 - val_loss: 3.0692e-04
Epoch 57/400
400/400 [=====] - 1s 2ms/step - loss: 3.1444e-08 - val_loss: 3.0140e-04
Epoch 58/400
400/400 [=====] - 1s 2ms/step - loss: 3.0704e-08 - val_loss: 3.0890e-04
Epoch 59/400
400/400 [=====] - 1s 2ms/step - loss: 2.4423e-08 - val_loss: 3.0521e-04
Epoch 60/400
400/400 [=====] - 1s 2ms/step - loss: 2.3847e-08 - val_loss: 3.1268e-04
Epoch 61/400
400/400 [=====] - 1s 2ms/step - loss: 1.9114e-08 - val_loss: 3.0368e-04
Epoch 62/400
400/400 [=====] - 1s 3ms/step - loss: 1.6322e-08 - val_loss: 3.0607e-04
Epoch 63/400
400/400 [=====] - 1s 3ms/step - loss: 1.3365e-08 - val_loss: 3.1449e-04
Epoch 64/400
400/400 [=====] - 1s 3ms/step - loss: 1.1139e-08 - val_loss: 3.0676e-04
Epoch 65/400
400/400 [=====] - 1s 2ms/step - loss: 1.0556e-08 - val_loss: 3.0924e-04
Epoch 66/400
400/400 [=====] - 1s 2ms/step - loss: 9.2955e-09 - val_loss: 3.0247e-04
Epoch 67/400
400/400 [=====] - 1s 2ms/step - loss: 8.3164e-09 - val_loss: 3.0251e-04
Epoch 68/400
400/400 [=====] - 1s 2ms/step - loss: 6.6939e-09 - val_loss: 2.9127e-04
Epoch 69/400
400/400 [=====] - 1s 2ms/step - loss: 6.8521e-09 - val_loss: 2.9999e-04
Epoch 70/400
400/400 [=====] - 1s 2ms/step - loss: 5.1736e-09 - val_loss: 2.
```

```
9130e-04
Epoch 71/400
400/400 [=====] - 1s 3ms/step - loss: 4.8427e-09 - val_loss: 3.
0437e-04
Epoch 72/400
400/400 [=====] - 1s 2ms/step - loss: 4.6056e-09 - val_loss: 2.
9183e-04
Epoch 73/400
400/400 [=====] - 1s 2ms/step - loss: 3.6746e-09 - val_loss: 2.
8668e-04
Epoch 74/400
400/400 [=====] - 1s 3ms/step - loss: 4.6099e-09 - val_loss: 2.
8745e-04
Epoch 75/400
400/400 [=====] - 1s 2ms/step - loss: 8.3305e-09 - val_loss: 3.
5985e-04
Epoch 76/400
400/400 [=====] - 1s 2ms/step - loss: 0.0261 - val_loss: 0.0113
Epoch 77/400
400/400 [=====] - 1s 2ms/step - loss: 0.0098 - val_loss: 0.0102
Epoch 78/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 79/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 80/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 81/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 82/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 83/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 84/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 85/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 86/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 87/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 88/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 89/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 90/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 91/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 92/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 93/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 94/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 95/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 96/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 97/400
400/400 [=====] - 1s 2ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 98/400
400/400 [=====] - 1s 3ms/step - loss: 0.0090 - val_loss: 0.0102
Epoch 00098: early stopping
```

Out[72]: <keras.callbacks.History at 0x2872dd7d6a0>

```
In [73]: model_loss = pd.DataFrame(model.history.history)
         model_loss.plot()
```

Out[73]: <AxesSubplot:>



```
In [74]: #Early stopping did not do well in this scenario.
         #Try dropouts
```

```
In [82]: from tensorflow.keras.layers import Dropout
```

```
In [83]: model = Sequential()

         model.add(Dense(63,activation='relu'))
         model.add(Dropout(0.5))

         model.add(Dense(47,activation='relu'))
         model.add(Dropout(0.5))

         model.add(Dense(31,activation='relu'))
         model.add(Dropout(0.5))

         model.add(Dense(15,activation='relu'))
         model.add(Dropout(0.5))

         model.add(Dense(1,activation='sigmoid'))

         model.compile(loss='binary_crossentropy',optimizer='adam')
```

```
In [84]: model.fit(x=X_train,y=y_train,epochs=600,validation_data=(X_test,y_test),
                  callbacks=[early_stop])
```

```
Epoch 1/600
400/400 [=====] - 2s 3ms/step - loss: 0.6908 - val_loss: 0.6572
Epoch 2/600
400/400 [=====] - 1s 2ms/step - loss: 0.5632 - val_loss: 0.3238
Epoch 3/600
400/400 [=====] - 1s 2ms/step - loss: 0.3676 - val_loss: 0.2351
Epoch 4/600
400/400 [=====] - 1s 2ms/step - loss: 0.2829 - val_loss: 0.2001
Epoch 5/600
400/400 [=====] - 1s 2ms/step - loss: 0.2416 - val_loss: 0.1826
Epoch 6/600
400/400 [=====] - 1s 2ms/step - loss: 0.2154 - val_loss: 0.1550
Epoch 7/600
```

```
400/400 [=====] - 1s 2ms/step - loss: 0.1875 - val_loss: 0.1335
Epoch 8/600
400/400 [=====] - 1s 2ms/step - loss: 0.1606 - val_loss: 0.1193
Epoch 9/600
400/400 [=====] - 1s 2ms/step - loss: 0.1456 - val_loss: 0.0932
Epoch 10/600
400/400 [=====] - 1s 2ms/step - loss: 0.1276 - val_loss: 0.0908
Epoch 11/600
400/400 [=====] - 1s 2ms/step - loss: 0.1089 - val_loss: 0.0552
Epoch 12/600
400/400 [=====] - 1s 2ms/step - loss: 0.1001 - val_loss: 0.0544
Epoch 13/600
400/400 [=====] - 1s 3ms/step - loss: 0.0862 - val_loss: 0.0471
Epoch 14/600
400/400 [=====] - 1s 2ms/step - loss: 0.0812 - val_loss: 0.0436
Epoch 15/600
400/400 [=====] - 1s 2ms/step - loss: 0.0772 - val_loss: 0.0402
Epoch 16/600
400/400 [=====] - 1s 2ms/step - loss: 0.0696 - val_loss: 0.0280
Epoch 17/600
400/400 [=====] - 1s 2ms/step - loss: 0.0684 - val_loss: 0.0217
Epoch 18/600
400/400 [=====] - 1s 2ms/step - loss: 0.0600 - val_loss: 0.0176
Epoch 19/600
400/400 [=====] - 1s 3ms/step - loss: 0.0587 - val_loss: 0.0169
Epoch 20/600
400/400 [=====] - 1s 2ms/step - loss: 0.0547 - val_loss: 0.0191
Epoch 21/600
400/400 [=====] - 1s 2ms/step - loss: 0.0505 - val_loss: 0.0160
Epoch 22/600
400/400 [=====] - 1s 2ms/step - loss: 0.0494 - val_loss: 0.0150
Epoch 23/600
400/400 [=====] - 1s 2ms/step - loss: 0.0477 - val_loss: 0.0149
Epoch 24/600
400/400 [=====] - 1s 2ms/step - loss: 0.0463 - val_loss: 0.0147
Epoch 25/600
400/400 [=====] - 1s 2ms/step - loss: 0.0437 - val_loss: 0.0182
Epoch 26/600
400/400 [=====] - 1s 2ms/step - loss: 0.0414 - val_loss: 0.0162
Epoch 27/600
400/400 [=====] - 1s 2ms/step - loss: 0.0455 - val_loss: 0.0125
Epoch 28/600
400/400 [=====] - 1s 2ms/step - loss: 0.0378 - val_loss: 0.0062
Epoch 29/600
400/400 [=====] - 1s 2ms/step - loss: 0.0393 - val_loss: 0.0088
Epoch 30/600
400/400 [=====] - 1s 3ms/step - loss: 0.0426 - val_loss: 0.0120
Epoch 31/600
400/400 [=====] - 1s 2ms/step - loss: 0.0341 - val_loss: 0.0154
Epoch 32/600
400/400 [=====] - 1s 2ms/step - loss: 0.0345 - val_loss: 0.0105
Epoch 33/600
400/400 [=====] - 1s 2ms/step - loss: 0.0359 - val_loss: 0.0121
Epoch 34/600
400/400 [=====] - 1s 2ms/step - loss: 0.0337 - val_loss: 0.0033
Epoch 35/600
400/400 [=====] - 1s 2ms/step - loss: 0.0359 - val_loss: 0.0050
Epoch 36/600
400/400 [=====] - 1s 2ms/step - loss: 0.0317 - val_loss: 0.0044
Epoch 37/600
400/400 [=====] - 1s 2ms/step - loss: 0.0336 - val_loss: 0.0046
Epoch 38/600
400/400 [=====] - 1s 2ms/step - loss: 0.0305 - val_loss: 0.0085
Epoch 39/600
400/400 [=====] - 1s 2ms/step - loss: 0.0380 - val_loss: 0.0097
```

```
Epoch 40/600
400/400 [=====] - 1s 2ms/step - loss: 0.0354 - val_loss: 0.0075
Epoch 41/600
400/400 [=====] - 1s 2ms/step - loss: 0.0325 - val_loss: 0.0058
Epoch 42/600
400/400 [=====] - 1s 2ms/step - loss: 0.0378 - val_loss: 0.0053
Epoch 43/600
400/400 [=====] - 1s 2ms/step - loss: 0.0296 - val_loss: 0.0076
Epoch 44/600
400/400 [=====] - 1s 2ms/step - loss: 0.0308 - val_loss: 0.0082
Epoch 45/600
400/400 [=====] - 1s 2ms/step - loss: 0.0294 - val_loss: 0.0053
Epoch 46/600
400/400 [=====] - 1s 2ms/step - loss: 0.0315 - val_loss: 0.0074
Epoch 47/600
400/400 [=====] - 1s 3ms/step - loss: 0.0302 - val_loss: 0.0076
Epoch 48/600
400/400 [=====] - 1s 2ms/step - loss: 0.0312 - val_loss: 0.0032
Epoch 49/600
400/400 [=====] - 1s 2ms/step - loss: 0.0255 - val_loss: 0.0013
Epoch 50/600
400/400 [=====] - 1s 2ms/step - loss: 0.0285 - val_loss: 0.0048
Epoch 51/600
400/400 [=====] - 1s 2ms/step - loss: 0.0262 - val_loss: 0.0052
Epoch 52/600
400/400 [=====] - 1s 3ms/step - loss: 0.0328 - val_loss: 0.0154
Epoch 53/600
400/400 [=====] - 1s 2ms/step - loss: 0.0274 - val_loss: 0.0021
Epoch 54/600
400/400 [=====] - 1s 2ms/step - loss: 0.0334 - val_loss: 0.0031
Epoch 55/600
400/400 [=====] - 1s 2ms/step - loss: 0.0267 - val_loss: 0.0034
Epoch 56/600
400/400 [=====] - 1s 2ms/step - loss: 0.0262 - val_loss: 0.0034
Epoch 57/600
400/400 [=====] - 1s 2ms/step - loss: 0.0289 - val_loss: 0.0056
Epoch 58/600
400/400 [=====] - 1s 2ms/step - loss: 0.0220 - val_loss: 0.0022
Epoch 59/600
400/400 [=====] - 1s 2ms/step - loss: 0.0249 - val_loss: 0.0023
Epoch 60/600
400/400 [=====] - 1s 2ms/step - loss: 0.0266 - val_loss: 0.0151
Epoch 61/600
400/400 [=====] - 1s 2ms/step - loss: 0.0292 - val_loss: 0.0012
Epoch 62/600
400/400 [=====] - 1s 2ms/step - loss: 0.0261 - val_loss: 0.0056
Epoch 63/600
400/400 [=====] - 1s 2ms/step - loss: 0.0269 - val_loss: 0.0038
Epoch 64/600
400/400 [=====] - 1s 2ms/step - loss: 0.0242 - val_loss: 0.0061
Epoch 65/600
400/400 [=====] - 1s 2ms/step - loss: 0.0273 - val_loss: 0.0051
Epoch 66/600
400/400 [=====] - 1s 2ms/step - loss: 0.0238 - val_loss: 0.0047
Epoch 67/600
400/400 [=====] - 1s 2ms/step - loss: 0.0232 - val_loss: 0.0122
Epoch 68/600
400/400 [=====] - 1s 3ms/step - loss: 0.0277 - val_loss: 0.0040
Epoch 69/600
400/400 [=====] - 1s 3ms/step - loss: 0.0264 - val_loss: 0.0045
Epoch 70/600
400/400 [=====] - 1s 2ms/step - loss: 0.0205 - val_loss: 0.0026
Epoch 71/600
400/400 [=====] - 1s 2ms/step - loss: 0.0187 - val_loss: 0.0044
Epoch 72/600
```

```

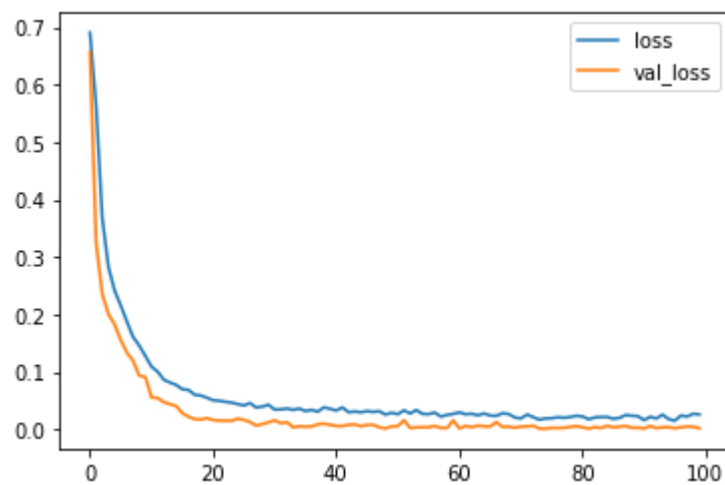
400/400 [=====] - 1s 2ms/step - loss: 0.0255 - val_loss: 0.0050
Epoch 73/600
400/400 [=====] - 1s 2ms/step - loss: 0.0210 - val_loss: 0.0060
Epoch 74/600
400/400 [=====] - 1s 2ms/step - loss: 0.0166 - val_loss: 0.0011
Epoch 75/600
400/400 [=====] - 1s 2ms/step - loss: 0.0187 - val_loss: 8.9013
e-04
Epoch 76/600
400/400 [=====] - 1s 2ms/step - loss: 0.0192 - val_loss: 0.0023
Epoch 77/600
400/400 [=====] - 1s 2ms/step - loss: 0.0208 - val_loss: 0.0021
Epoch 78/600
400/400 [=====] - 1s 2ms/step - loss: 0.0199 - val_loss: 0.0023
Epoch 79/600
400/400 [=====] - 1s 2ms/step - loss: 0.0212 - val_loss: 0.0039
Epoch 80/600
400/400 [=====] - 1s 2ms/step - loss: 0.0233 - val_loss: 0.0055
Epoch 81/600
400/400 [=====] - 1s 2ms/step - loss: 0.0221 - val_loss: 0.0032
Epoch 82/600
400/400 [=====] - 1s 2ms/step - loss: 0.0173 - val_loss: 0.0011
Epoch 83/600
400/400 [=====] - 1s 2ms/step - loss: 0.0204 - val_loss: 0.0036
Epoch 84/600
400/400 [=====] - 1s 2ms/step - loss: 0.0212 - val_loss: 0.0022
Epoch 85/600
400/400 [=====] - 1s 2ms/step - loss: 0.0213 - val_loss: 0.0058
Epoch 86/600
400/400 [=====] - 1s 2ms/step - loss: 0.0182 - val_loss: 0.0032
Epoch 87/600
400/400 [=====] - 1s 2ms/step - loss: 0.0197 - val_loss: 0.0043
Epoch 88/600
400/400 [=====] - 1s 3ms/step - loss: 0.0246 - val_loss: 0.0056
Epoch 89/600
400/400 [=====] - 1s 2ms/step - loss: 0.0235 - val_loss: 0.0025
Epoch 90/600
400/400 [=====] - 1s 2ms/step - loss: 0.0227 - val_loss: 0.0026
Epoch 91/600
400/400 [=====] - 1s 2ms/step - loss: 0.0157 - val_loss: 0.0013
Epoch 92/600
400/400 [=====] - 1s 2ms/step - loss: 0.0215 - val_loss: 0.0055
Epoch 93/600
400/400 [=====] - 1s 2ms/step - loss: 0.0187 - val_loss: 0.0019
Epoch 94/600
400/400 [=====] - 1s 2ms/step - loss: 0.0253 - val_loss: 0.0032
Epoch 95/600
400/400 [=====] - 1s 3ms/step - loss: 0.0175 - val_loss: 0.0035
Epoch 96/600
400/400 [=====] - 1s 2ms/step - loss: 0.0148 - val_loss: 0.0017
Epoch 97/600
400/400 [=====] - 1s 2ms/step - loss: 0.0238 - val_loss: 0.0034
Epoch 98/600
400/400 [=====] - 1s 2ms/step - loss: 0.0220 - val_loss: 0.0046
Epoch 99/600
400/400 [=====] - 1s 3ms/step - loss: 0.0268 - val_loss: 0.0041
Epoch 100/600
400/400 [=====] - 1s 2ms/step - loss: 0.0257 - val_loss: 0.0016
Epoch 00100: early stopping

```

Out[84]: <keras.callbacks.History at 0x2873043ca30>

```
In [85]: model_loss = pd.DataFrame(model.history.history)
         model_loss.plot()
```


Out[85]: <AxesSubplot:>

In [79]: *#Model performed much better after dropouts were added!*

In []: