Final Project - Stock Price Prediction

Kyle Lee 2018/12/10

1. EDA and Data Preparation

In [1]:

```
import numpy as np
import pandas as pd
from datetime import datetime
from sklearn.preprocessing import StandardScaler
from matplotlib.pyplot import figure
from sklearn import metrics
import matplotlib.pyplot as plt
```

In [2]:

```
#import data
data=pd.read_csv("stock.csv")
data.head()
```

Out[2]:

	Start Date	1/1/1960	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unr
0	End Date	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2	NaN	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Com
3	NaN	Last Price	Last Price	Last Price	Last Price	Last Price	Last Price	Last
4	Dates	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_

In [3]:

```
#Delete first row, since it's all NaNs
data=data.iloc[2:,]
data.head()
```

Out[3]:

	Start Date	1/1/1960	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unn
2	NaN	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Com
3	NaN	Last Price	Last Price	Last Price	Last Price	Last Price	Last Price	Last
4	Dates	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_
5	1/1/1960	NaN	NaN	NaN	NaN	NaN	NaN	NaN
6	1/4/1960	59.91	NaN	NaN	NaN	NaN	NaN	NaN

In [4]:

```
#Set the first column as the index, and delete it
data.index=data.iloc[:,0]
data=data.drop(data.columns[0],axis=1)
data.head()
```

Out[4]:

	1/1/1960	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unn
Start Date							
NaN	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Cor
NaN	Last Price	Last Price	Last Price	Last Price	Last Price	Last Price	Las
Dates	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_LAST	PX_
1/1/1960	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1/4/1960	59.91	NaN	NaN	NaN	NaN	NaN	NaN

In [5]:

```
#set the first row as the column names,and delete them
data.columns=data.iloc[0]
data=data[4:]
data.head()
```

Out[5]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	USURTO Inde
Start Date								
1/4/1960	59.91	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1/5/1960	60.39	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1/6/1960	60.13	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1/7/1960	59.69	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1/8/1960	59.5	NaN	NaN	NaN	NaN	NaN	NaN	NaN

In [6]:

```
dates=[]
for i in enumerate(data.index):
    dates=np.append(dates,datetime.strptime(i[1],'%m/%d/%Y'))
data.index=dates
```

In [7]:

```
for i in range(9):
    print(data.columns[i],"has ",len(data.iloc[:,i].dropna()),"data points")
```

```
SPX Index has  14833 data points
VIX Index has  7286 data points
USGG10YR Index has  14497 data points
USGG2YR Index has  10901 data points
USGG5YR Index has  14473 data points
XAU Curncy has  11435 data points
CL1 Comdty has  8941 data points
USURTOT Index has  504 data points
GDP CQOQ Index has  0 data points
```

In [8]:

```
data.describe()
```

Out[8]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	USURTO Inde
count	14833	7286	14497	10901	14473	11435	8941	504
unique	12470	2369	7823	7359	7771	7272	4832	68
top	102.09	12.42	4.202	0.25	4.154	384.5	20.48	5.4
freq	7	15	77	18	57	17	13	23

We can see the USURTOT Index and the GDP CQOQ Index has too little data, since they are unemployment and GDP, where they are mostly measured quarterly or yearly, so I decided to drop them

In [9]:

```
#dropping the last two columns
data2=data.iloc[:,0:7]
data2.head()
```

Out[9]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty
1960-01-04	59.91	NaN	NaN	NaN	NaN	NaN	NaN
1960-01-05	60.39	NaN	NaN	NaN	NaN	NaN	NaN
1960-01-06	60.13	NaN	NaN	NaN	NaN	NaN	NaN
1960-01-07	59.69	NaN	NaN	NaN	NaN	NaN	NaN
1960-01-08	59.5	NaN	NaN	NaN	NaN	NaN	NaN

In [10]:

```
#I used dropna instead of fillna()
data2=data2.dropna()
data2.head()
```

Out[10]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty
1990-01-02	359.69	17.24	7.93	7.875	7.847	399	22.89
1990-01-03	358.76	18.19	7.974	7.927	7.911	395	23.68
1990-01-04	355.67	19.22	7.972	7.91	7.9	396.5	23.41
1990-01-05	352.2	20.11	7.984	7.885	7.896	405	23.08
1990-01-08	353.79	20.26	8.012	7.893	7.907	404.6	21.62

In [11]:

```
#Creating the y for models, since we are predicting the next day's stock price,
#the target value for this day should be the next day's price
data2['target']=data2["SPX Index"].shift(-1)
data2.head()
```

Out[11]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	target
1990-01-02	359.69	17.24	7.93	7.875	7.847	399	22.89	358.76
1990-01-03	358.76	18.19	7.974	7.927	7.911	395	23.68	355.67
1990-01-04	355.67	19.22	7.972	7.91	7.9	396.5	23.41	352.2
1990-01-05	352.2	20.11	7.984	7.885	7.896	405	23.08	353.79
1990-01-08	353.79	20.26	8.012	7.893	7.907	404.6	21.62	349.62

In [12]:

```
#making sure there's no na values
data2=data2.dropna()
```

In [13]:

```
data2
```

Out[13]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	target
1990-01-02	359.69	17.24	7.93	7.875	7.847	399	22.89	358.76
1990-01-03	358.76	18.19	7.974	7.927	7.911	395	23.68	355.67
1990-01-04	355.67	19.22	7.972	7.91	7.9	396.5	23.41	352.2
1990-01-05	352.2	20.11	7.984	7.885	7.896	405	23.08	353.79
1990-01-08	353.79	20.26	8.012	7.893	7.907	404.6	21.62	349.62
1990-01-09	349.62	22.2	8.009	7.893	7.903	403.45	22.07	347.31
1990-01-10	347.31	22.44	8.014	7.876	7.907	409.1	22.9	348.53
1990-01-11	348.53	20.05	8.044	7.92	7.949	412.1	23.14	339.93
1990-01-12	339.93	24.64	8.096	7.938	7.983	416.25	23.13	337
1990-01-15	337	26.34	8.113	7.947	7.995	415.6	22.36	340.75
1990-01-16	340.75	24.18	8.196	8.098	8.106	412.75	22.78	337.4
1990-01-17	337.4	24.16	8.191	8.054	8.095	410.4	22.1	338.19
1990-01-18	338.19	24.34	8.303	8.232	8.233	413.4	22.76	339.15
1990-01-19	339.15	22.5	8.232	8.162	8.164	408.65	23.67	330.38
1990-01-22	330.38	26.7	8.27	8.136	8.164	406	22.55	331.61
1990-01-23	331.61	24.72	8.349	8.235	8.254	408.25	21.6	330.26
1990-01-24	330.26	25.39	8.366	8.235	8.269	420.75	21.59	326.08
1990-01-25	326.08	25.63	8.413	8.246	8.305	415.65	22.24	325.8
1990-01-26	325.8	26.28	8.464	8.263	8.348	418	22.56	325.2

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	target
1990-01-29	325.2	26.44	8.535	8.324	8.431	418.75	22.8	322.98
1990-01-30	322.98	27.25	8.501	8.28	8.388	418.15	22.46	329.08
1990-01-31	329.08	25.36	8.418	8.254	8.318	415.05	22.68	328.79
1990-02-01	328.79	24.87	8.413	8.28	8.333	415.8	22.7	330.92
1990-02-02	330.92	24.32	8.494	8.341	8.409	417.95	23.02	331.85
1990-02-05	331.85	24.54	8.519	8.359	8.421	423	22.39	329.66
1990-02-06	329.66	24.69	8.58	8.402	8.484	421.05	22.51	333.75
1990-02-07	333.75	24.29	8.536	8.385	8.441	423.75	22.32	332.96
1990-02-08	332.96	23.77	8.429	8.315	8.378	418	22.09	333.62
1990-02-09	333.62	23.69	8.29	8.218	8.261	415.5	21.74	330.08
1990-02-12	330.08	24.38	8.385	8.28	8.348	418.85	22.03	331.02
...	...	...	...	...	...	...	...	...
2018-10-19	2767.78	19.89	3.1921	2.9038	3.0463	1226.49	69.12	2755.88
2018-10-22	2755.88	19.64	3.1978	2.9082	3.0498	1222.1	69.17	2740.69
2018-10-23	2740.69	20.71	3.1676	2.879	3.012	1230.3	66.43	2656.1
2018-10-24	2656.1	25.23	3.1035	2.8305	2.9398	1233.79	66.82	2705.57
2018-10-25	2705.57	24.22	3.1167	2.8467	2.9596	1232.17	67.33	2658.69
2018-10-26	2658.69	24.16	3.0755	2.8062	2.9071	1233.53	67.59	2641.25
2018-10-29	2641.25	24.7	3.0849	2.8164	2.919	1229.42	67.04	2682.63
2018-10-30	2682.63	23.35	3.1227	2.8507	2.9562	1222.93	66.18	2711.74

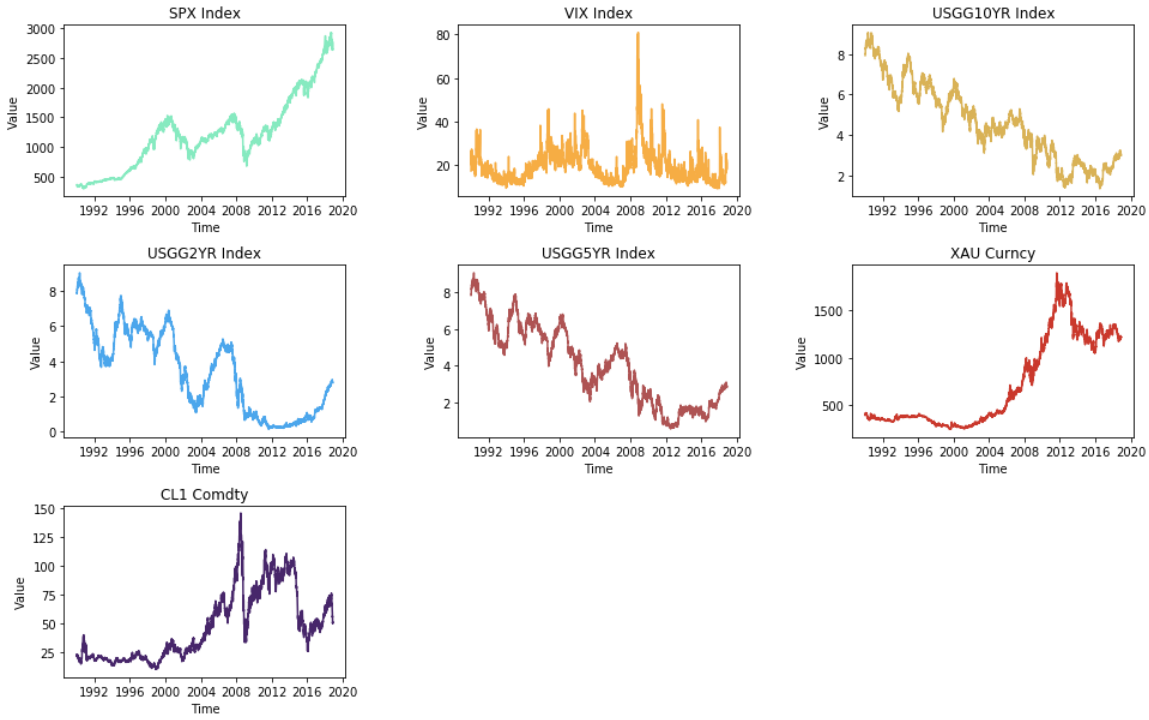
nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	target
2018-10-31	2711.74	21.23	3.1435	2.8669	2.9749	1214.76	65.31	2740.37
2018-11-01	2740.37	19.34	3.1303	2.8445	2.9563	1233.43	63.69	2723.06
2018-11-02	2723.06	19.51	3.2121	2.9034	3.033	1232.89	63.14	2738.31
2018-11-05	2738.31	19.96	3.2008	2.9075	3.028	1231.49	63.1	2755.45
2018-11-06	2755.45	19.91	3.2276	2.9279	3.0554	1227.19	62.21	2813.89
2018-11-07	2813.89	16.36	3.2355	2.9567	3.0795	1226.49	61.67	2806.83
2018-11-08	2806.83	16.72	3.2373	2.965	3.0916	1224	60.67	2781.01
2018-11-09	2781.01	17.36	3.1819	2.9241	3.0353	1209.65	60.19	2726.22
2018-11-12	2726.22	20.45	3.1819	2.9241	3.0353	1200.37	59.93	2722.18
2018-11-13	2722.18	20.02	3.1397	2.8911	2.984	1202.23	55.69	2701.58
2018-11-14	2701.58	21.25	3.125	2.8663	2.9567	1210.88	56.25	2730.2
2018-11-15	2730.2	19.98	3.1103	2.8539	2.9379	1213.36	56.46	2736.27
2018-11-16	2736.27	18.14	3.0628	2.7998	2.8782	1223.36	56.46	2690.73
2018-11-19	2690.73	20.1	3.0628	2.7893	2.8697	1224.17	56.76	2641.89
2018-11-20	2641.89	22.48	3.0628	2.8037	2.8867	1221.66	53.43	2649.93
2018-11-21	2649.93	20.8	3.0627	2.8139	2.8901	1226.04	54.63	2632.56
2018-11-23	2632.56	21.52	3.039	2.8094	2.8662	1223.05	50.42	2673.45
2018-11-26	2673.45	18.9	3.0535	2.8302	2.885	1222.4	51.63	2682.17
2018-11-27	2682.17	19.02	3.0572	2.8329	2.8901	1215.05	51.56	2743.79
2018-11-28	2743.79	18.49	3.059	2.8086	2.8649	1221.23	50.29	2737.76

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	target
2018-11-29	2737.76	18.79	3.0298	2.8086	2.8463	1224.21	51.45	2760.17
2018-11-30	2760.17	18.07	2.9879	2.7865	2.8125	1220.52	50.93	2789.64

7228 rows × 8 columns

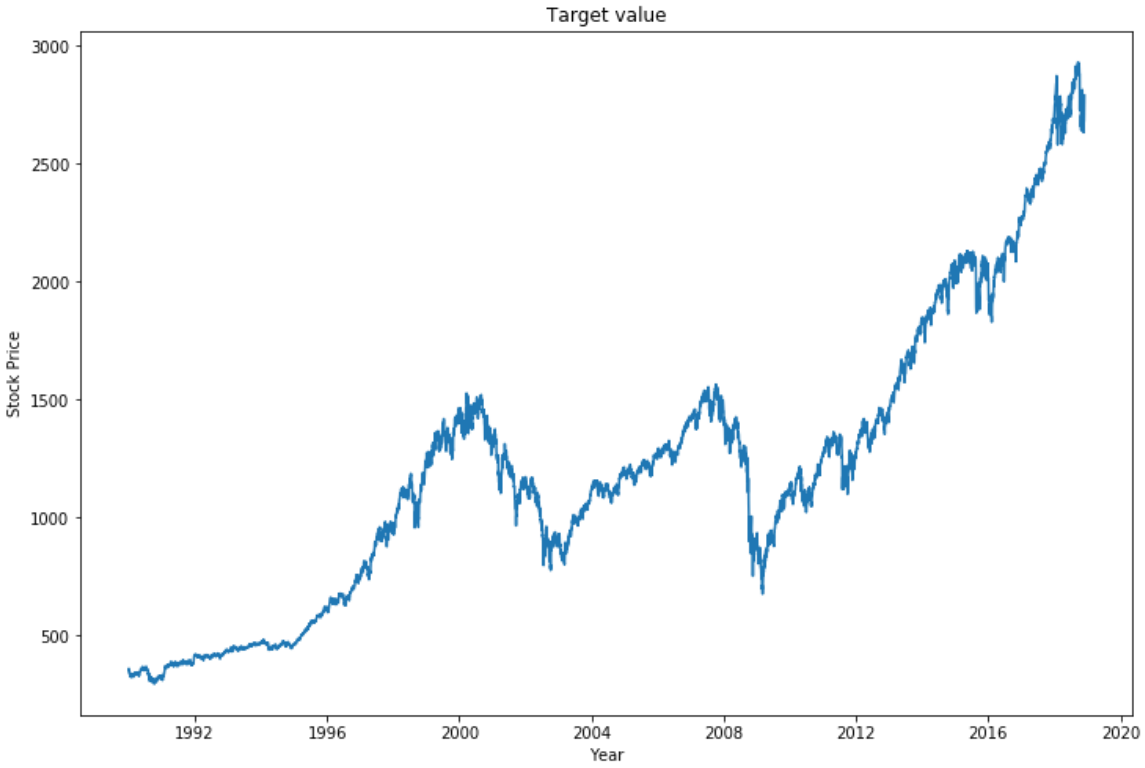
In [14]:

```
fig = plt.figure(figsize=(16,10))
fig.subplots_adjust(hspace=0.4, wspace=0.4)
for j in range(7):
    ax= fig.add_subplot(3,3,j+1)
    y=np.array(data2[data2.columns[j]])
    y=[float(i) for i in y]
    x=data2[data2.columns[j]].index
    ax.plot(x,y,c=np.random.rand(3))
    ax.set_title(data2.columns[j])
    ax.set_ylabel('Value')
    ax.set_xlabel('Time')
plt.show()
```



In [15]:

```
#briefly plot the data for SPY
y=np.array(data2['target'])
y=[float(i) for i in y]
x=data2['target'].index
figure(figsize=(12,8))
plt.plot(x,y)
plt.title('Target value')
plt.xlabel('Year')
plt.ylabel('Stock Price')
plt.show()
```



2. Prepare X, y for training

Get the X and y ready for implementing machine learning models Also I decided to try out both regression and classification

In [16]:

```
X_data=np.array(data2.drop(['SPX Index', 'target'],axis=1))
# X_data=[float(i) for i in X_data]
X_data=X_data.astype(float)
print("Shape of X_data is: ", X_data.shape,'\nSneak peek on first five elements: \n', X
_data[0:5])
```

```
Shape of X_data is:  (7228, 6)
Sneak peek on first five elements:
 [[ 17.24    7.93    7.875   7.847 399.     22.89 ]
 [ 18.19    7.974   7.927   7.911 395.     23.68 ]
 [ 19.22    7.972   7.91    7.9   396.5    23.41 ]
 [ 20.11    7.984   7.885   7.896 405.     23.08 ]
 [ 20.26    8.012   7.893   7.907 404.6    21.62 ]]
```

In [17]:

```
y_data=np.array(data2.target)
y_data=[float(i) for i in y_data]
print("Length of y_data is :", len(y_data),'\nSneak peek on first five elements: \n', y
_data[0:5])
```

```
Length of y_data is : 7228
Sneak peek on first five elements:
 [358.76, 355.67, 352.2, 353.79, 349.62]
```

In [18]:

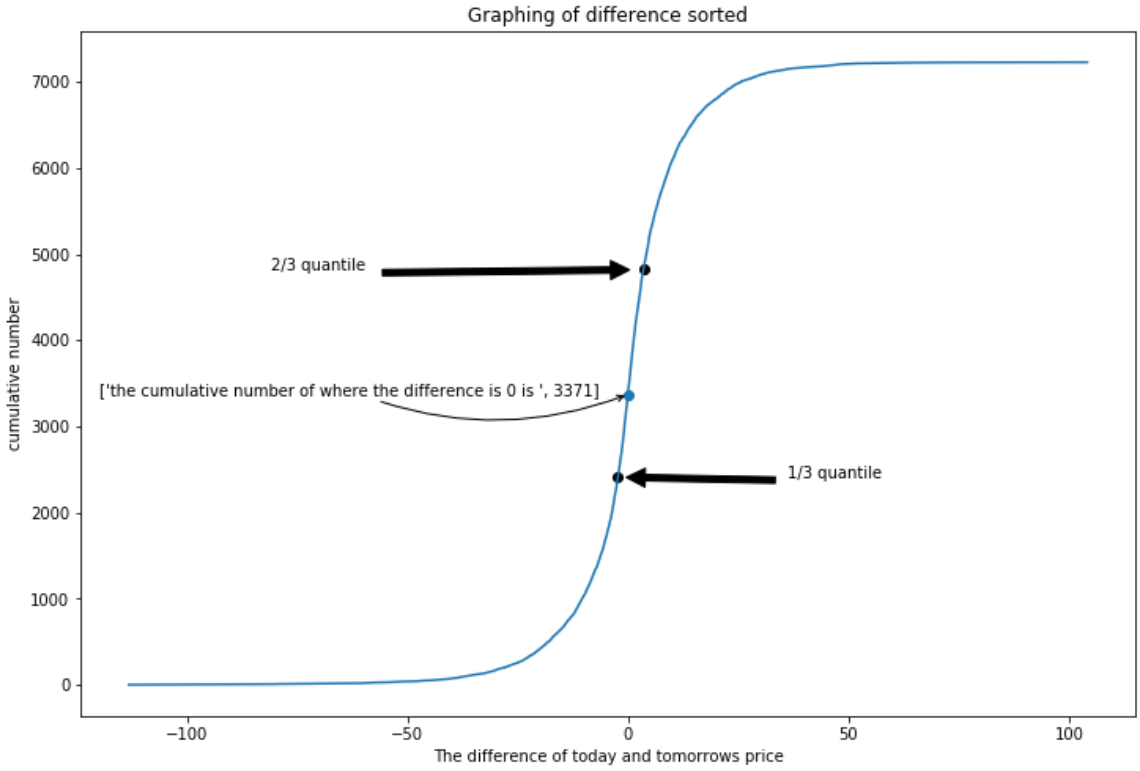
```
#Turning it into classification
data_f=data2.astype(float)
data_f.head()
```

Out[18]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	target
1990-01-02	359.69	17.24	7.930	7.875	7.847	399.0	22.89	358.76
1990-01-03	358.76	18.19	7.974	7.927	7.911	395.0	23.68	355.67
1990-01-04	355.67	19.22	7.972	7.910	7.900	396.5	23.41	352.20
1990-01-05	352.20	20.11	7.984	7.885	7.896	405.0	23.08	353.79
1990-01-08	353.79	20.26	8.012	7.893	7.907	404.6	21.62	349.62

In [19]:

```
data_f['diff']=data_f['target']-data_f['SPX Index']
sorted_diff=np.sort(data_f['diff'])
leng=len(data_f['diff'])
figure(figsize=(12,8))
plt.plot(sorted_diff,range(leng))
plt.scatter(sorted_diff[int(leng/3)],int(leng/3),c='black')
plt.scatter(sorted_diff[int(leng*2/3)],int(leng*2/3),c='black')
plt.scatter(sorted_diff[sorted_diff>0][0],np.argwhere(sorted_diff>0)[0])
plt.annotate(['the cumulative number of where the difference is 0 is ',int(np.argwhere(
sorted_diff>0)[0])],
             xy=(sorted_diff[sorted_diff>0][0],np.argwhere(sorted_diff>0)[0]),
            xytext=(-120,np.argwhere(sorted_diff>0)[0]),arrowprops=dict(arrowstyle='->'
,connectionstyle="arc3,rad=.2"))
plt.annotate('1/3 quantile',xy=(sorted_diff[int(leng/3)],int(leng/3)),
             xytext=(36,int(leng/3)),arrowprops=dict(facecolor='black',shrink=0.05))
plt.annotate('2/3 quantile',xy=(sorted_diff[int(leng*(2/3))],int(leng*(2/3))),
             xytext=(-81,int(leng*2/3)),arrowprops=dict(facecolor='black',shrink=0.05))
plt.xlabel('The difference of today and tomorrows price')
plt.ylabel('cumulative number')
plt.title('Graphing of difference sorted')
plt.show()
```



Creating classification

In [20]:

```
data_f['classify']=1
data_f['classify'].loc[((data_f['diff']>data_f['diff'].quantile(2/3)) & (data_f['diff']
>0))]=2
data_f['classify'].loc[((data_f['diff']<data_f['diff'].quantile(1/3)) & (data_f['diff']
<0))]=0
data_f
```

```
C:\Users\kyle1\Anaconda3\lib\site-packages\pandas\core\indexing.py:189: Se
ttingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-doc
s/stable/indexing.html#indexing-view-versus-copy
  self._setitem_with_indexer(indexer, value)
```

Out[20]:

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	targ
1990-01-02	359.69	17.24	7.9300	7.8750	7.8470	399.00	22.89	358.76
1990-01-03	358.76	18.19	7.9740	7.9270	7.9110	395.00	23.68	355.67
1990-01-04	355.67	19.22	7.9720	7.9100	7.9000	396.50	23.41	352.20
1990-01-05	352.20	20.11	7.9840	7.8850	7.8960	405.00	23.08	353.79
1990-01-08	353.79	20.26	8.0120	7.8930	7.9070	404.60	21.62	349.62
1990-01-09	349.62	22.20	8.0090	7.8930	7.9030	403.45	22.07	347.31
1990-01-10	347.31	22.44	8.0140	7.8760	7.9070	409.10	22.90	348.53
1990-01-11	348.53	20.05	8.0440	7.9200	7.9490	412.10	23.14	339.93
1990-01-12	339.93	24.64	8.0960	7.9380	7.9830	416.25	23.13	337.00
1990-01-15	337.00	26.34	8.1130	7.9470	7.9950	415.60	22.36	340.75
1990-01-16	340.75	24.18	8.1960	8.0980	8.1060	412.75	22.78	337.40
1990-01-17	337.40	24.16	8.1910	8.0540	8.0950	410.40	22.10	338.19
1990-01-18	338.19	24.34	8.3030	8.2320	8.2330	413.40	22.76	339.15
1990-01-19	339.15	22.50	8.2320	8.1620	8.1640	408.65	23.67	330.38
1990-01-22	330.38	26.70	8.2700	8.1360	8.1640	406.00	22.55	331.61
1990-01-23	331.61	24.72	8.3490	8.2350	8.2540	408.25	21.60	330.26
1990-01-24	330.26	25.39	8.3660	8.2350	8.2690	420.75	21.59	326.08
1990-01-25	326.08	25.63	8.4130	8.2460	8.3050	415.65	22.24	325.80
1990-01-26	325.80	26.28	8.4640	8.2630	8.3480	418.00	22.56	325.20

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	targ
1990-01-29	325.20	26.44	8.5350	8.3240	8.4310	418.75	22.80	322.98
1990-01-30	322.98	27.25	8.5010	8.2800	8.3880	418.15	22.46	329.08
1990-01-31	329.08	25.36	8.4180	8.2540	8.3180	415.05	22.68	328.79
1990-02-01	328.79	24.87	8.4130	8.2800	8.3330	415.80	22.70	330.92
1990-02-02	330.92	24.32	8.4940	8.3410	8.4090	417.95	23.02	331.85
1990-02-05	331.85	24.54	8.5190	8.3590	8.4210	423.00	22.39	329.66
1990-02-06	329.66	24.69	8.5800	8.4020	8.4840	421.05	22.51	333.75
1990-02-07	333.75	24.29	8.5360	8.3850	8.4410	423.75	22.32	332.96
1990-02-08	332.96	23.77	8.4290	8.3150	8.3780	418.00	22.09	333.62
1990-02-09	333.62	23.69	8.2900	8.2180	8.2610	415.50	21.74	330.08
1990-02-12	330.08	24.38	8.3850	8.2800	8.3480	418.85	22.03	331.02
...	...	...	...	...	...	...	...	...
2018-10-19	2767.78	19.89	3.1921	2.9038	3.0463	1226.49	69.12	2755.8
2018-10-22	2755.88	19.64	3.1978	2.9082	3.0498	1222.10	69.17	2740.6
2018-10-23	2740.69	20.71	3.1676	2.8790	3.0120	1230.30	66.43	2656.1
2018-10-24	2656.10	25.23	3.1035	2.8305	2.9398	1233.79	66.82	2705.5
2018-10-25	2705.57	24.22	3.1167	2.8467	2.9596	1232.17	67.33	2658.6
2018-10-26	2658.69	24.16	3.0755	2.8062	2.9071	1233.53	67.59	2641.2
2018-10-29	2641.25	24.70	3.0849	2.8164	2.9190	1229.42	67.04	2682.6
2018-10-30	2682.63	23.35	3.1227	2.8507	2.9562	1222.93	66.18	2711.7

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	targ
2018-10-31	2711.74	21.23	3.1435	2.8669	2.9749	1214.76	65.31	2740.3
2018-11-01	2740.37	19.34	3.1303	2.8445	2.9563	1233.43	63.69	2723.0
2018-11-02	2723.06	19.51	3.2121	2.9034	3.0330	1232.89	63.14	2738.3
2018-11-05	2738.31	19.96	3.2008	2.9075	3.0280	1231.49	63.10	2755.4
2018-11-06	2755.45	19.91	3.2276	2.9279	3.0554	1227.19	62.21	2813.8
2018-11-07	2813.89	16.36	3.2355	2.9567	3.0795	1226.49	61.67	2806.8
2018-11-08	2806.83	16.72	3.2373	2.9650	3.0916	1224.00	60.67	2781.0
2018-11-09	2781.01	17.36	3.1819	2.9241	3.0353	1209.65	60.19	2726.2
2018-11-12	2726.22	20.45	3.1819	2.9241	3.0353	1200.37	59.93	2722.1
2018-11-13	2722.18	20.02	3.1397	2.8911	2.9840	1202.23	55.69	2701.5
2018-11-14	2701.58	21.25	3.1250	2.8663	2.9567	1210.88	56.25	2730.2
2018-11-15	2730.20	19.98	3.1103	2.8539	2.9379	1213.36	56.46	2736.2
2018-11-16	2736.27	18.14	3.0628	2.7998	2.8782	1223.36	56.46	2690.7
2018-11-19	2690.73	20.10	3.0628	2.7893	2.8697	1224.17	56.76	2641.8
2018-11-20	2641.89	22.48	3.0628	2.8037	2.8867	1221.66	53.43	2649.9
2018-11-21	2649.93	20.80	3.0627	2.8139	2.8901	1226.04	54.63	2632.5
2018-11-23	2632.56	21.52	3.0390	2.8094	2.8662	1223.05	50.42	2673.4
2018-11-26	2673.45	18.90	3.0535	2.8302	2.8850	1222.40	51.63	2682.1
2018-11-27	2682.17	19.02	3.0572	2.8329	2.8901	1215.05	51.56	2743.7
2018-11-28	2743.79	18.49	3.0590	2.8086	2.8649	1221.23	50.29	2737.7

nan	SPX Index	VIX Index	USGG10YR Index	USGG2YR Index	USGG5YR Index	XAU Curncy	CL1 Comdty	targ
2018-11-29	2737.76	18.79	3.0298	2.8086	2.8463	1224.21	51.45	2760.1
2018-11-30	2760.17	18.07	2.9879	2.7865	2.8125	1220.52	50.93	2789.6

7228 rows × 10 columns

In [21]:

```
text=['The trend is going down: ','The trend is staying the same: ','The trend is going
 up : ']
for i in range(3):
    print(text[i],sum(data_f['classify']==i))
```

```
The trend is going down:  2408
The trend is staying the same:  2411
The trend is going up :  2409
```

X_data remains the same for classifier, but y_data would be the 'classify' in the last column of the dataframe

In [22]:

```
y_data_class=np.array(data_f.classify)
print("Length of y_data is :", len(y_data_class),'\nSneak peek on first five elements:
\n', y_data_class[0:5])
```

```
Length of y_data is : 7228
Sneak peek on first five elements:
 [1 0 0 1 0]
```

Standardize data and split into train test data

In [23]:

```
X_train=np.array(X_data[0:int(0.8*len(X_data))])
y_train=np.array(y_data[0:int(0.8*len(y_data))])
y_train_class=np.array(y_data_class[0:int(0.8*len(y_data_class))])
X_test=np.array(X_data[int(0.8*len(X_data)):])
y_test=np.array(y_data[int(0.8*len(y_data)):])
y_test_class=np.array(y_data_class[int(0.8*len(y_data_class)):])
```

In [24]:

```
#Data Scaling
sc=StandardScaler()
sc2=StandardScaler()
X_train=sc.fit_transform(X_train)
X_test=sc.transform(X_test)
y_train=sc2.fit_transform(y_train.reshape(-1,1))
y_test=sc2.transform(y_test.reshape(-1,1))
X_data_sc=sc.fit_transform(X_data)
y_data_sc=sc.fit_transform(np.array(y_data).reshape(-1,1))
```

3. Machine Learning methods

Linear Regression

In [25]:

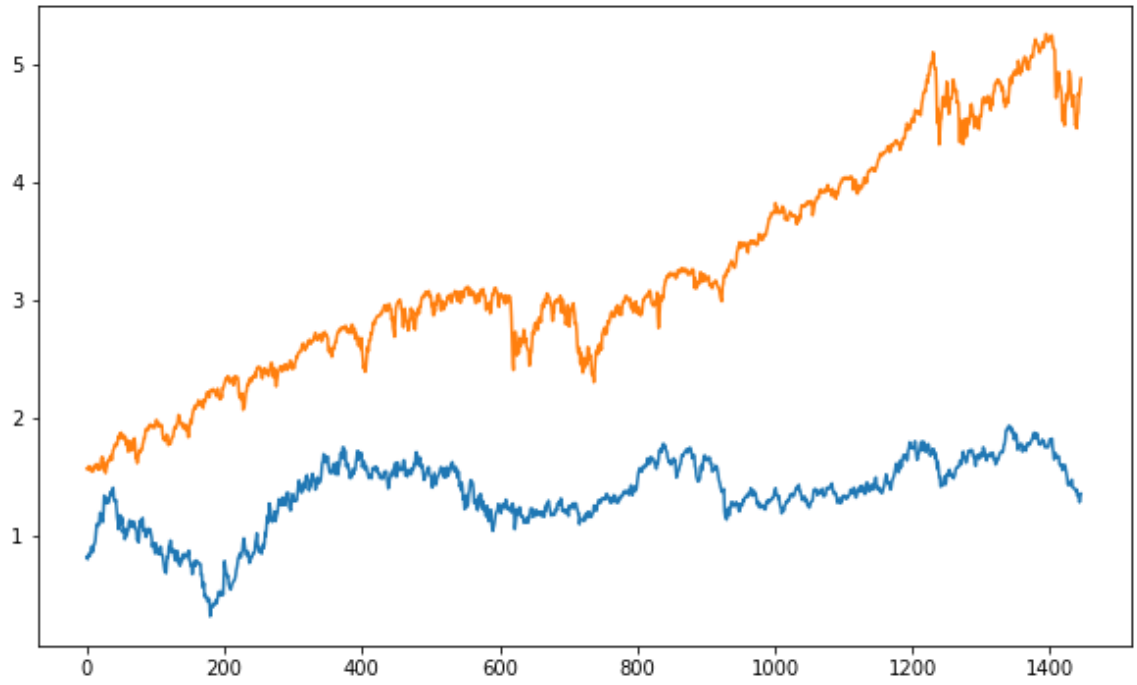
```
from sklearn import linear_model
model=linear_model.LinearRegression()
model.fit(X_train,y_train)
```

Out[25]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=1, normalize=Fals
e)
```

In [26]:

```
#fit data to model and graph results
y_pred=model.predict(X_test)
figure(figsize=(10,6))
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
```



In [27]:

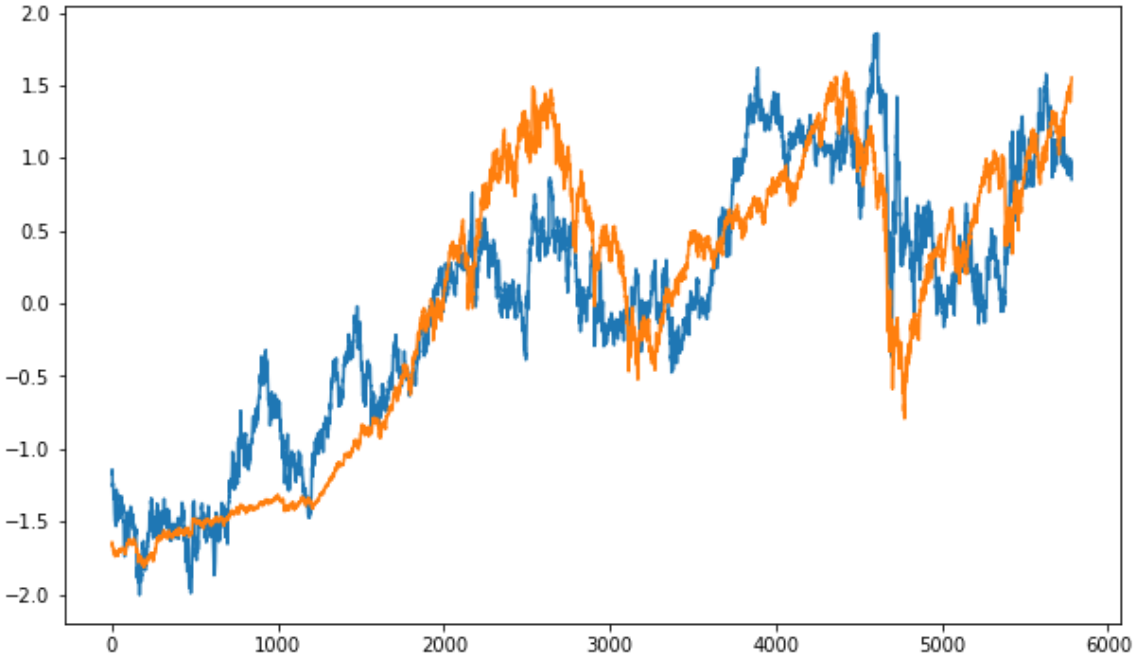
```
print("RMSE of test set: ",np.sqrt(metrics.mean_squared_error(y_test,y_pred)))
```

```
RMSE of test set:  2.01655443941397
```

Since it looks completely off, I wanted to check train data

In [28]:

```
predictions=model.predict(X_train)
figure(figsize=(10,6))
plt.plot(predictions)
plt.plot(y_train)
plt.show()
```



In [29]:

```
print("RMSE of train set: ",np.sqrt(metrics.mean_squared_error(y_train,predictions)))
```

```
RMSE of train set:  0.47315506396143053
```

Which actually looks decent.

Lasso Regression

In [30]:

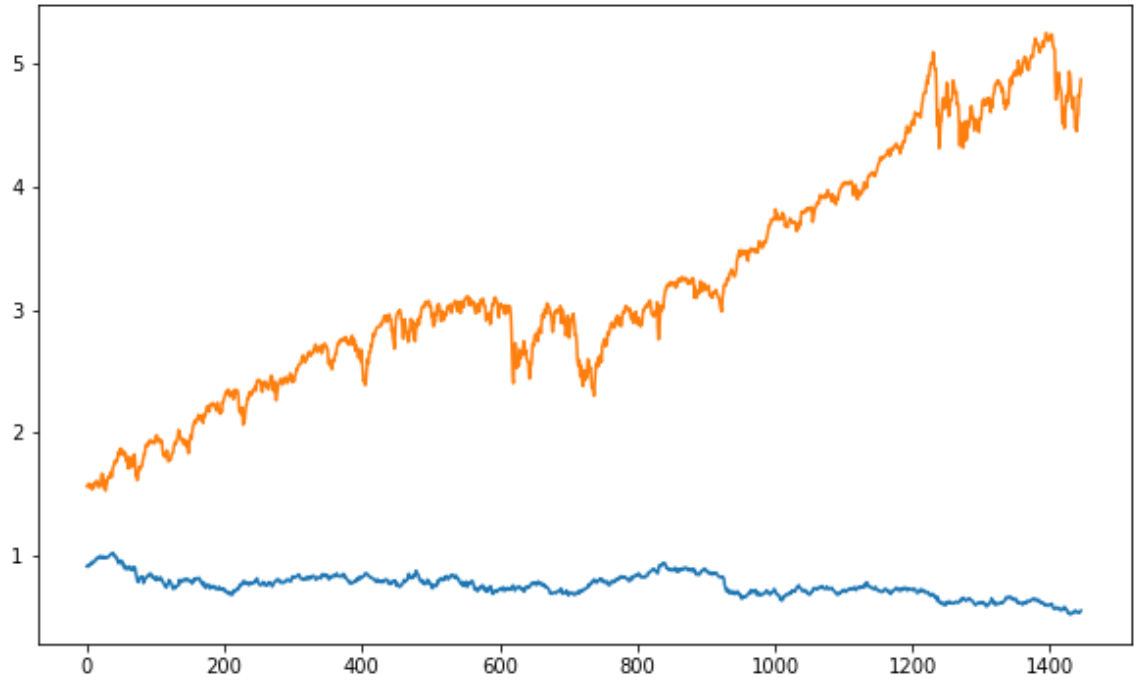
```
clf = linear_model.Lasso(alpha=0.2)
clf.fit(X_train,y_train)
```

Out[30]:

```
Lasso(alpha=0.2, copy_X=True, fit_intercept=True, max_iter=1000,
   normalize=False, positive=False, precompute=False, random_state=None,
   selection='cyclic', tol=0.0001, warm_start=False)
```

In [31]:

```
#fit data to model and graph results
y_pred=clf.predict(X_test)
figure(figsize=(10,6))
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
print("RMSE of LASSO on test set: ",np.sqrt(metrics.mean_squared_error(y_test,y_pred)))
```




```
RMSE of LASSO on test set:  2.659531397249428
```

We can see that using LASSO gives us a higher RMSE, since LASSO performs variable selection, thus lowering the explanitory power(also if we change the alpha to 1, the prediction drops flat)

Logistic Regression

In [32]:

```
lr=linear_model.LogisticRegression(multi_class='multinomial',solver='newton-cg')
lr.fit(X_train,y_train_class)
```

Out[32]:

```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=Tru
e,
          intercept_scaling=1, max_iter=100, multi_class='multinomial',
          n_jobs=1, penalty='l2', random_state=None, solver='newton-cg',
          tol=0.0001, verbose=0, warm_start=False)
```

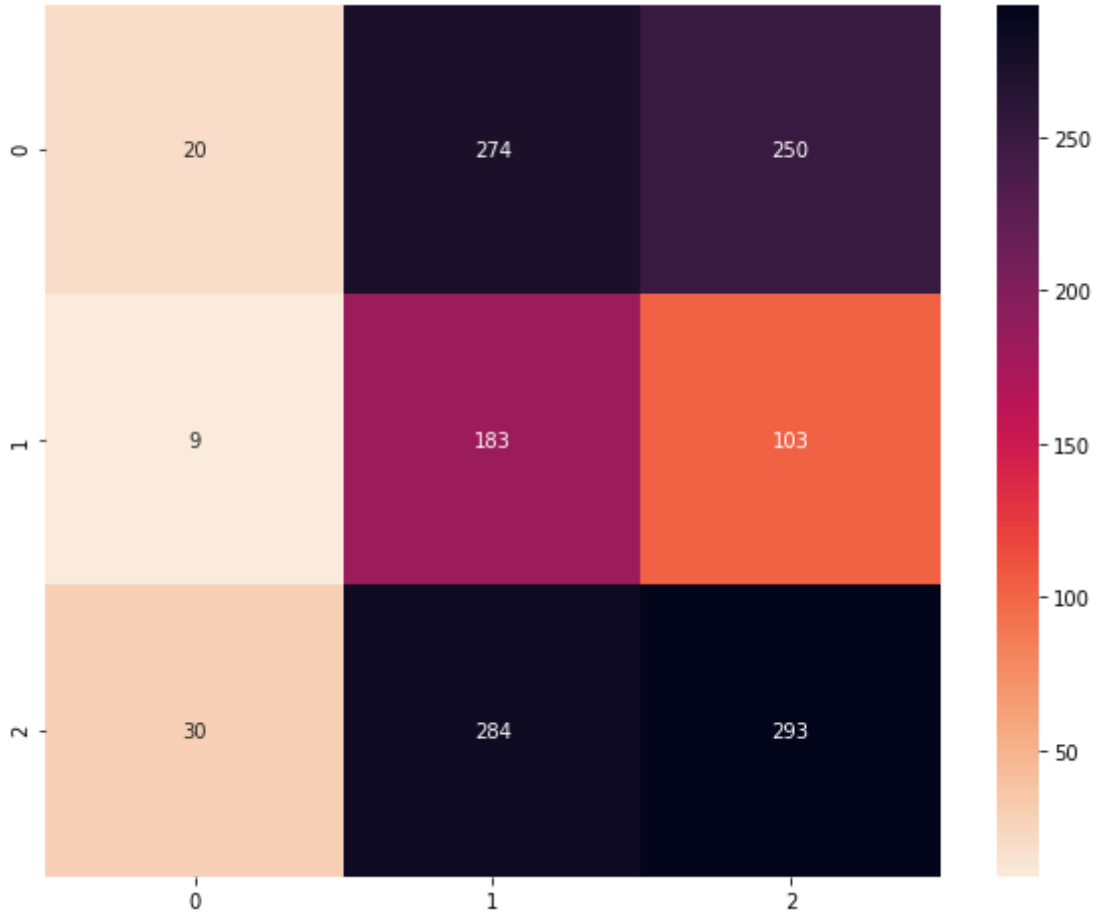
In [33]:

```
y_pred=lr.predict(X_test)
```

In [34]:

```
cm=metrics.confusion_matrix(y_test_class,y_pred)
print(cm)
import seaborn as sn
cmap = sn.cm.rocket_r
plt.figure(figsize=(10,8))
sn.heatmap(cm, annot=True,cmap=cmap,fmt='g')
plt.show()
```

```
[[ 20 274 250]
 [  9 183 103]
 [ 30 284 293]]
```



In [35]:

```
from sklearn.metrics import classification_report
print(classification_report(y_test_class, y_pred))
```

```
             precision    recall  f1-score   support

          0       0.34      0.04      0.07       544
          1       0.25      0.62      0.35       295
          2       0.45      0.48      0.47       607

avg / total       0.37      0.34      0.29      1446
```

We can see that the prediction for the [2] is the best, but it doensn't predict price decrease well. Also all three scores are low. So I tried gridsearch to find better parameters

In [36]:

```
from sklearn.model_selection import GridSearchCV
params={'C': [100,10,1,.01,.001]}
y_pred=lr.predict(X_test)
```

In [37]:

```
gs = GridSearchCV(lr, params, n_jobs=-1)
gs.fit(X_train, y_train_class)
```

Out[37]:

```
GridSearchCV(cv=None, error_score='raise',
       estimator=LogisticRegression(C=1.0, class_weight=None, dual=False,
fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='multinomial',
          n_jobs=1, penalty='l2', random_state=None, solver='newton-cg',
          tol=0.0001, verbose=0, warm_start=False),
       fit_params=None, iid=True, n_jobs=-1,
       param_grid={'C': [100, 10, 1, 0.01, 0.001]},
       pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
       scoring=None, verbose=0)
```

In [38]:

```
gs.best_params_
```

Out[38]:

```
{'C': 0.001}
```

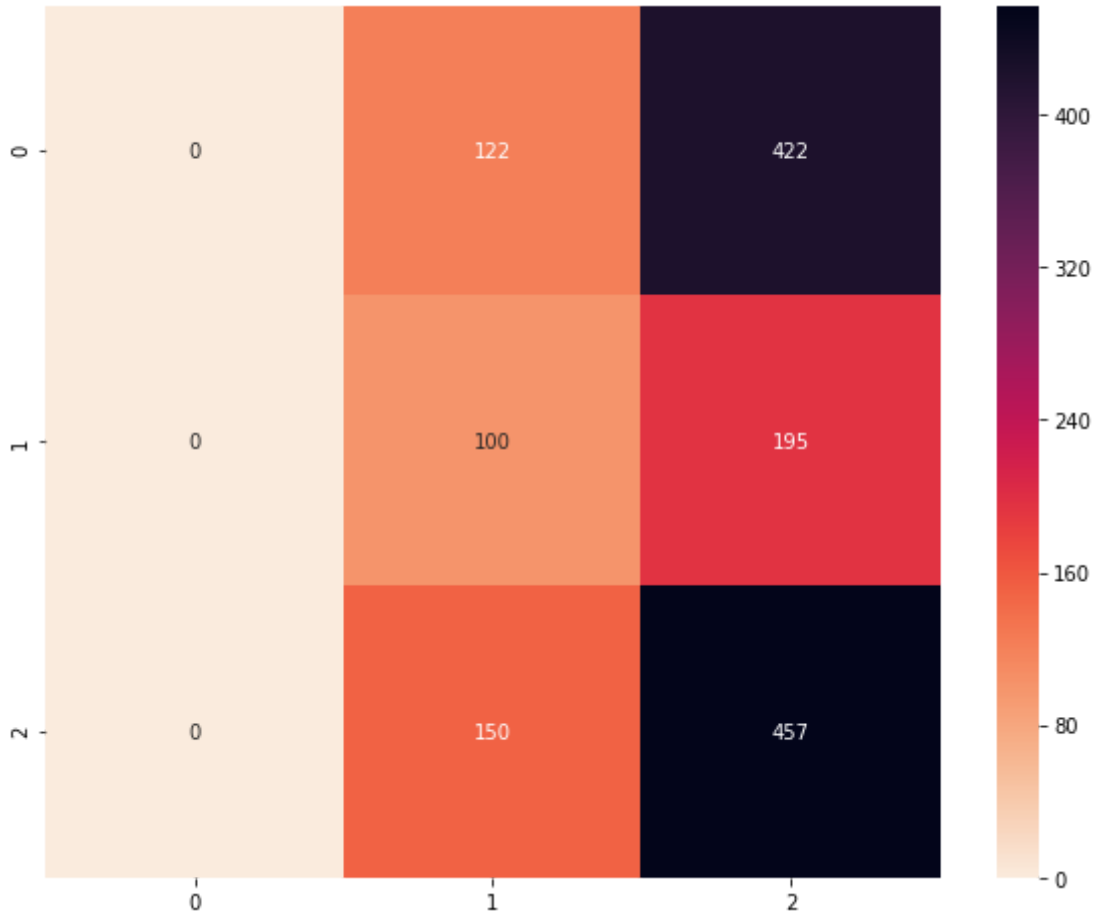
In [39]:

```
y_pred = gs.predict(X_test)
```

In [40]:

```
cm=metrics.confusion_matrix(y_test_class,y_pred)
print(cm)
import seaborn as sn
cmap = sn.cm.rocket_r
plt.figure(figsize=(10,8))
sn.heatmap(cm, annot=True,cmap=cmap,fmt='g')
plt.show()
```

```
[[  0 122 422]
 [  0 100 195]
 [  0 150 457]]
```



In [41]:

```
from sklearn.metrics import classification_report
print(classification_report(y_test_class, y_pred))
```

```
             precision    recall  f1-score   support

          0       0.00      0.00      0.00       544
          1       0.27      0.34      0.30       295
          2       0.43      0.75      0.54       607

avg / total       0.23      0.39      0.29      1446


C:\Users\kyle1\Anaconda3\lib\site-packages\sklearn\metrics\classification.
py:1135: UndefinedMetricWarning: Precision and F-score are ill-defined and
being set to 0.0 in labels with no predicted samples.
  'precision', 'predicted', average, warn_for)
```

We can see the predictions for [2] went up even more, but the precision and f1 score lowered.

SVM

In [42]:

```
from sklearn.svm import SVR
svr=SVR(kernel='rbf', C=1000, gamma=0.1)
svr.fit(X_train,y_train.ravel())
```

Out[42]:

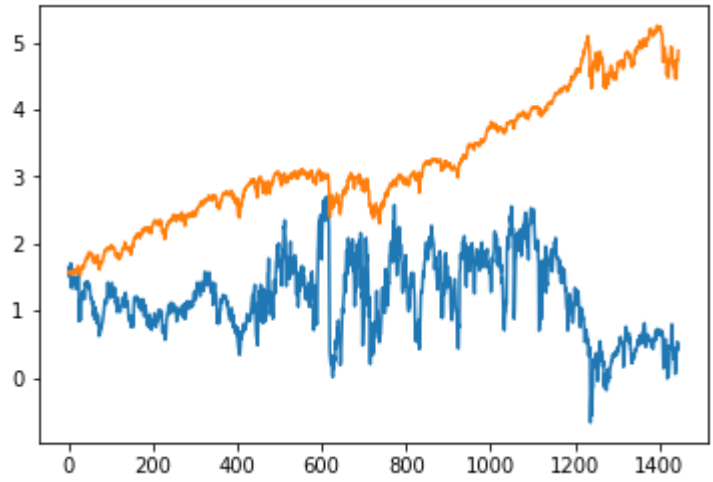
```
SVR(C=1000, cache_size=200, coef0=0.0, degree=3, epsilon=0.1, gamma=0.1,
  kernel='rbf', max_iter=-1, shrinking=True, tol=0.001, verbose=False)
```

In [43]:

```
y_pred=svr.predict(X_test)
```

In [44]:

```
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
print("RMSE of SVR on test set: ",np.sqrt(metrics.mean_squared_error(y_test,y_pred)))
```




```
RMSE of SVR on test set:  2.3378401543996925
```

SVC

In [45]:

```
from sklearn.svm import SVC
svc=SVC(kernel='linear',C=1000)
svc.fit(X_train,y_train_class.ravel())
```

Out[45]:

```
SVC(C=1000, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma='auto', kernel='linear',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
```

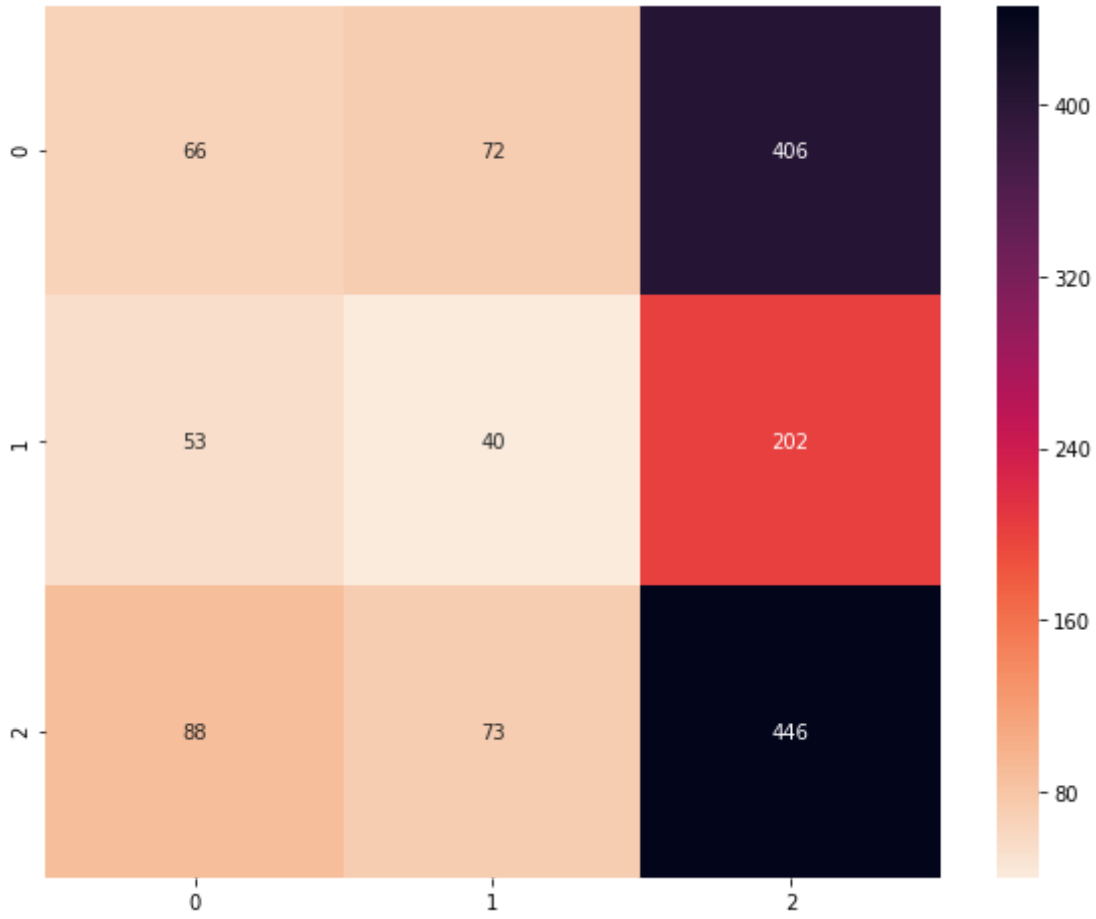
In [46]:

```
y_pred=svc.predict(X_test)
```

In [47]:

```
cm=metrics.confusion_matrix(y_test_class,y_pred)
print(cm)
import seaborn as sn
cmap = sn.cm.rocket_r
plt.figure(figsize=(10,8))
sn.heatmap(cm, annot=True,cmap=cmap,fmt='g')
plt.show()
```

```
[[ 66  72 406]
 [ 53  40 202]
 [ 88  73 446]]
```



In [48]:

```
from sklearn.metrics import classification_report
print(classification_report(y_test_class, y_pred))
```

```
             precision    recall  f1-score   support

          0       0.32      0.12      0.18       544
          1       0.22      0.14      0.17       295
          2       0.42      0.73      0.54       607

avg / total       0.34      0.38      0.33      1446
```

Again we can see that SVC mostly predicts 2 instead of 0 and 1.

RandomForestClassifier

In [49]:

```
from sklearn.ensemble import RandomForestRegressor, RandomForestClassifier
```

In [50]:

```
rfr=RandomForestRegressor(n_estimators=1000,random_state=42, max_features='sqrt',max_de
pth=150,oob_score=True)
rfr.fit(X_train,y_train.ravel())
```

Out[50]:

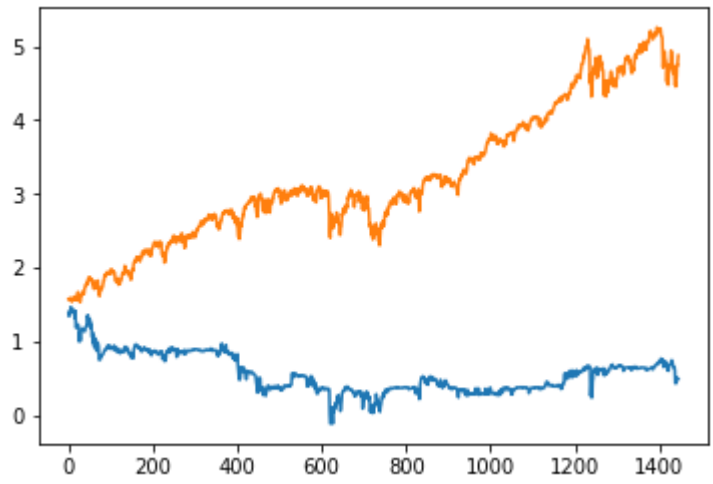
```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=150,
           max_features='sqrt', max_leaf_nodes=None,
           min_impurity_decrease=0.0, min_impurity_split=None,
           min_samples_leaf=1, min_samples_split=2,
           min_weight_fraction_leaf=0.0, n_estimators=1000, n_jobs=1,
           oob_score=True, random_state=42, verbose=0, warm_start=False)
```

In [51]:

```
y_pred=rfr.predict(X_test)
```

In [52]:

```
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
```



In [53]:

```
print("RMSE of randomforest on test set: ",np.sqrt(metrics.mean_squared_error(y_test,y_
pred)))
```

```
RMSE of randomforest on test set:  2.855658265912516
```

In [54]:

```
rfc=RandomForestClassifier(n_estimators=1000,random_state=42, max_features='sqrt',max_d
epth=50)
rfc.fit(X_train,y_train_class.ravel())
```

Out[54]:

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gin
i',
            max_depth=50, max_features='sqrt', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=1000, n_jobs=1,
            oob_score=False, random_state=42, verbose=0, warm_start=False)
```

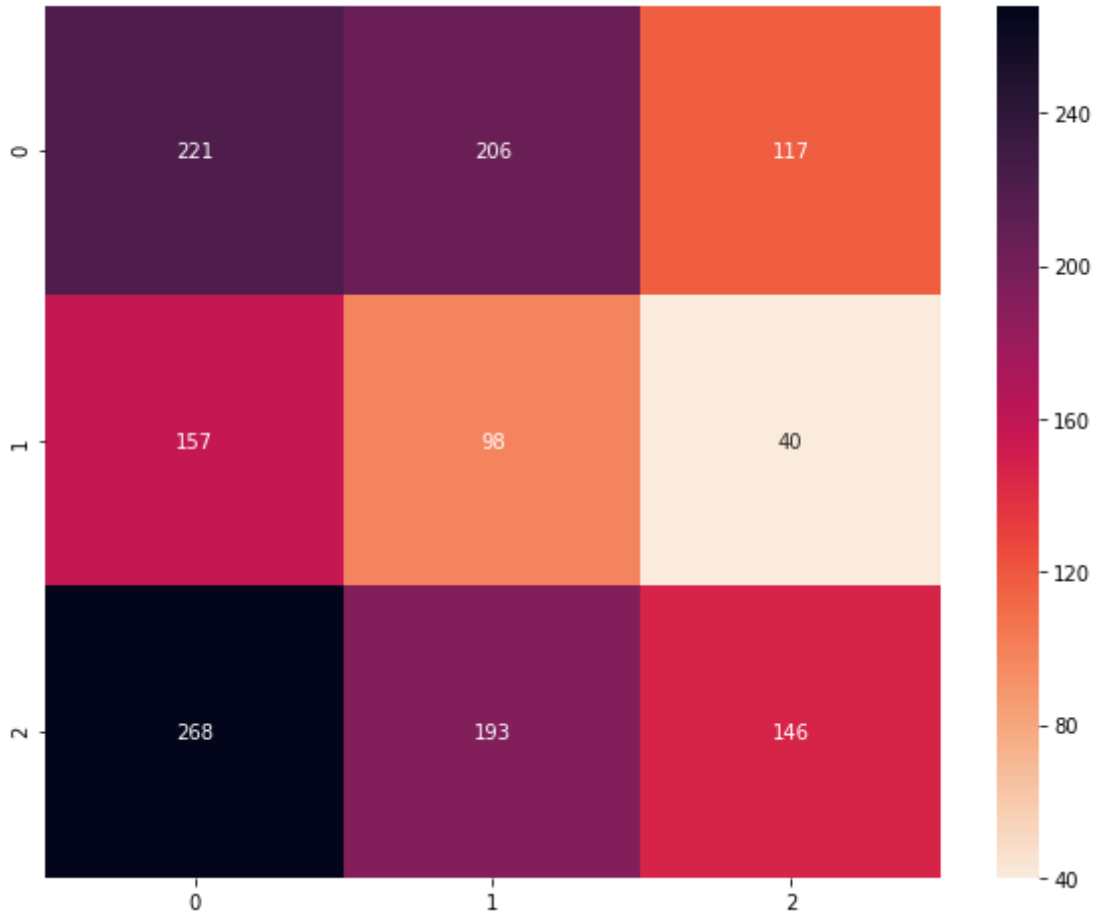
In [55]:

```
y_pred=rfc.predict(X_test)
```

In [56]:

```
cm=metrics.confusion_matrix(y_test_class,y_pred)
print(cm)
import seaborn as sn
cmap = sn.cm.rocket_r
plt.figure(figsize=(10,8))
sn.heatmap(cm, annot=True,cmap=cmap,fmt='g')
plt.show()
```

```
[[221 206 117]
 [157  98  40]
 [268 193 146]]
```



In [57]:

```
from sklearn.metrics import classification_report
print(classification_report(y_test_class, y_pred))
```

```
             precision    recall  f1-score   support

          0       0.34      0.41      0.37       544
          1       0.20      0.33      0.25       295
          2       0.48      0.24      0.32       607

avg / total       0.37      0.32      0.32      1446
```

LightGbm

In [58]:

```
import lightgbm as lgb
```

In [59]:

```
d_train=lgb.Dataset(X_train, label=y_train.ravel())

params={}
params['learning_rate']=0.1
params['boosting_type']='gbdt'
params['objective']='regression'
params['sub_feature']=0.5
params['num_leaves']=1024
params['min_data']=50
params['max_depth']=10
params['verbose']=2
```

In [60]:

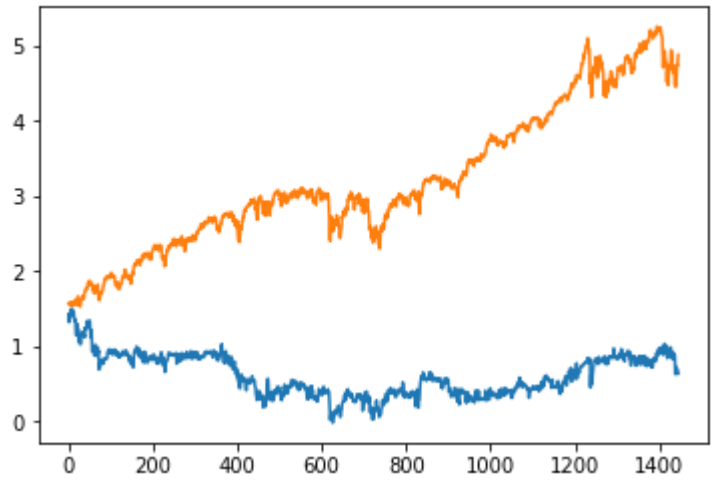
```
clf=lgb.train(params, d_train,1000)
```

In [61]:

```
y_pred=clf.predict(X_test)
```

In [62]:

```
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
```



LightGBM classifier

In [63]:

```
d_train=lgb.Dataset(X_train, label=y_train_class.ravel())

params={}
params['learning_rate']=0.01
params['boosting_type']='gbdt'
params['objective']='multiclass'
params['sub_feature']=0.5
params['num_leaves']=1024
params['min_data']=50
params['max_depth']=10
params['num_class']=3
```

In [64]:

```
clf=lgb.train(params, d_train,1000)
```

In [65]:

```
y_pred=clf.predict(X_test)
```

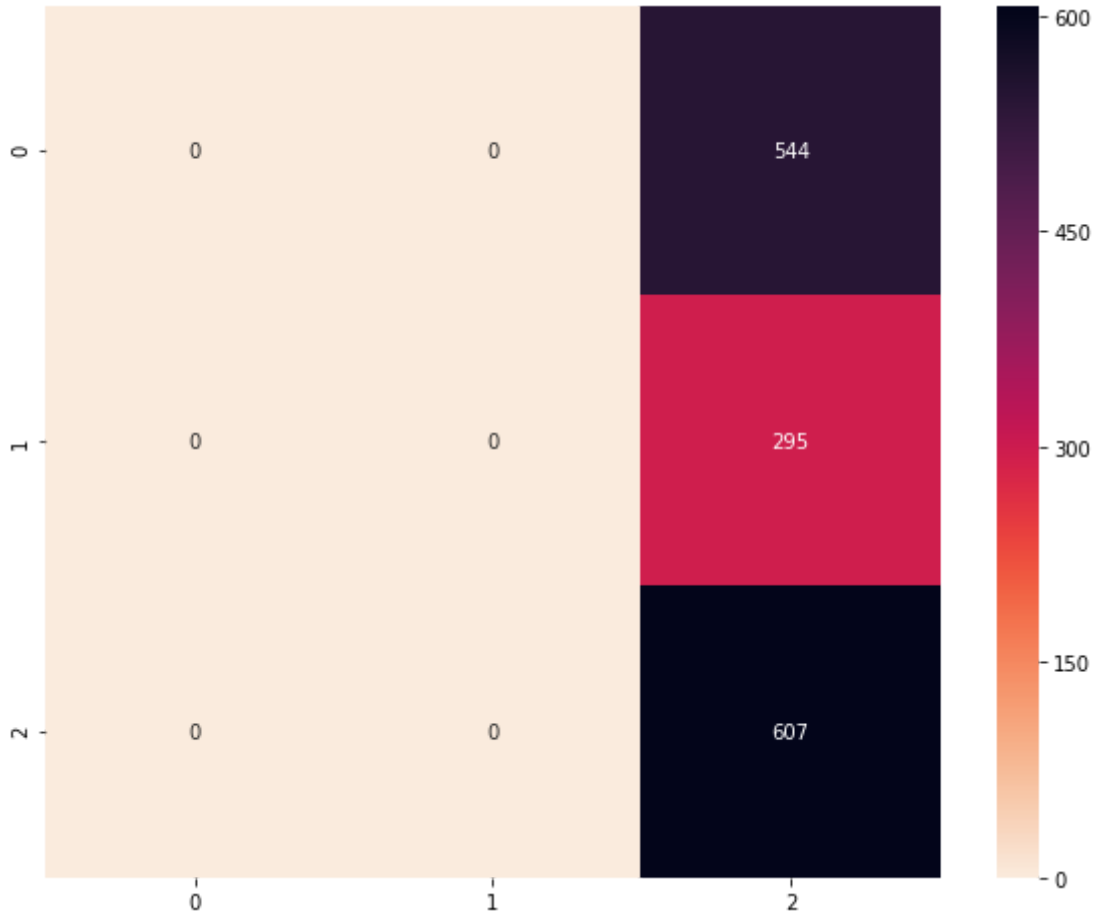
In [66]:

```
temp=[]
for i in y_pred:
    temp=np.append(temp,np.argmax(y_pred[0]))
y_pred=np.array(temp)
```

In [67]:

```
cm=metrics.confusion_matrix(y_test_class,y_pred)
print(cm)
import seaborn as sn
cmap = sn.cm.rocket_r
plt.figure(figsize=(10,8))
sn.heatmap(cm, annot=True,cmap=cmap,fmt='g')
plt.show()
```

```
[[  0   0 544]
 [  0   0 295]
 [  0   0 607]]
```



In [68]:

```
print(classification_report(y_test_class, y_pred))
```

```
             precision    recall  f1-score   support

          0       0.00      0.00      0.00       544
          1       0.00      0.00      0.00       295
          2       0.42      1.00      0.59       607

avg / total       0.18      0.42      0.25      1446


C:\Users\kyle1\Anaconda3\lib\site-packages\sklearn\metrics\classification.
py:1135: UndefinedMetricWarning: Precision and F-score are ill-defined and
being set to 0.0 in labels with no predicted samples.
  'precision', 'predicted', average, warn_for)
```

Deep learning

1. prepare data

In [69]:

```
def cut_time(data,stepsize,steplen):
    temp=[]
    times=int((len(data)-steplen)/stepsize)
    for i in range(times):
        temp.append(np.array(data[i*stepsize:i*stepsize+steplen]))
    return np.array(temp)
def cut_time_y(data,stepsize,steplen):
    temp=[]
    times=int((len(data)-steplen)/stepsize)
    for i in range(times):
        temp.append(np.array(data[i*stepsize+steplen]))
    return np.array(temp)
```

In [70]:

```
sc = StandardScaler()
X_data=sc.fit_transform(X_data)
y_data=sc.fit_transform(np.array(y_data).reshape(-1,1))
features=len(X_data[0])
stepsize=5
steplen=5

X_data2=cut_time(X_data,stepsize,steplen)
X_data2=X_data2.reshape(X_data2.shape[0],steplen,features)
y_data2=cut_time_y(y_data,stepsize,steplen)
y_data2_class=cut_time_y(y_data_class,stepsize,steplen)

X_train=X_data2[0:int(0.6*len(X_data2))]
y_train=y_data2[0:int(0.6*len(y_data2))]
y_train_class=y_data2_class[0:int(0.6*len(y_data2_class))]

X_val=X_data2[int(0.6*len(X_data2)):int(0.8*len(X_data2))]
y_val=y_data2[int(0.6*len(y_data2)):int(0.8*len(y_data2))]
y_val_class=y_data2_class[int(0.6*len(y_data2_class)):int(0.8*len(y_data2_class))]

X_test=X_data2[int(0.8*len(X_data2)):]
y_test=y_data2[int(0.8*len(y_data2)):]
y_test_class=y_data2_class[int(0.8*len(y_data2_class)):]

X_train
```

Out[70]:

```
array([[[-0.25896952,  1.76397678,  1.9168328 ,  1.79011164,
         -0.69458277, -0.830246  ],
        [-0.13760766,  1.78707541,  1.93892621,  1.81995062,
         -0.70326133, -0.80374729],
        [-0.00602585,  1.78602547,  1.93170337,  1.81482205,
         -0.70000687, -0.81280381],
        [ 0.10767105,  1.79232509,  1.92108153,  1.81295711,
         -0.68156493, -0.8238729 ],
        [ 0.12683345,  1.80702422,  1.92448052,  1.81808569,
         -0.68243279, -0.8728452 ]],

       [[ 0.37466714,  1.80544932,  1.92448052,  1.81622075,
         -0.68492788, -0.857751  ],
        [ 0.40532698,  1.80807416,  1.91725767,  1.81808569,
         -0.67266941, -0.82991058],
        [ 0.10000609,  1.82382323,  1.9359521 ,  1.83766752,
         -0.6661605 , -0.82186034],
        [ 0.6863755 ,  1.85112161,  1.94359982,  1.85351949,
         -0.65715649, -0.82219576],
        [ 0.90354936,  1.86004608,  1.94742368,  1.8591143 ,
         -0.65856676, -0.84802362]],

       [[ 0.62761081,  1.90361849,  2.01157955,  1.91086629,
         -0.66475023, -0.8339357 ],
        [ 0.62505583,  1.90099365,  1.99288512,  1.90573772,
         -0.66984888, -0.85674472],
        [ 0.64805071,  1.95979016,  2.06851257,  1.97007804,
         -0.66333996, -0.83460655],
        [ 0.41299194,  1.92251737,  2.03877144,  1.93790788,
         -0.67364575, -0.80408272],
        [ 0.94953912,  1.94246619,  2.02772473,  1.93790788,
         -0.67939529, -0.84165051]],

       ...,

       [[-0.72397707,  0.03572678,  0.55745063,  0.2509793 ,
         -0.11604845,  0.47523493],
        [-0.80701414,  0.05347073,  0.56841237,  0.26925568,
         -0.10476632,  0.49401883],
        [-0.67798732,  0.06496755,  0.57928912,  0.28086491,
         -0.10715293,  0.49703767],
        [-0.67159985,  0.0691673 ,  0.57941658,  0.2842218 ,
         -0.10216276,  0.52085297],
        [-0.73675201,  0.07336705,  0.57950156,  0.28757868,
         -0.12364219,  0.50005651]],

       [[-0.73547451,  0.09546824,  0.60129756,  0.31098364,
         -0.13340556,  0.57754009],
        [-0.83128651,  0.12087673,  0.61621061,  0.33452847,
         -0.12451004,  0.5802235 ],
        [-0.76230187,  0.1113748 ,  0.60907274,  0.32786132,
         -0.12125558,  0.62483526],
        [-0.79296171,  0.13368597,  0.62377336,  0.34809588,
         -0.12993414,  0.58122978],
        [-0.76996683,  0.14539278,  0.62394331,  0.35485628,
         -0.12429308,  0.60806392]],

       [[-0.6626574 ,  0.14114053,  0.62411326,  0.3549029 ,
         -0.13991448,  0.55473107],
```

```
        [-0.7571919 ,  0.15085245,  0.63214336,  0.36697837,
         -0.13698547,  0.5889446 ],
        [-0.73291953,  0.16376669,  0.65092276,  0.38404254,
         -0.13514127,  0.52018211],
        [-0.82234406,  0.15625963,  0.64221286,  0.38063903,
         -0.14251805,  0.53158662],
        [-0.7942392 ,  0.166969  ,  0.65627617,  0.39094281,
         -0.12722209,  0.54902882]]])
```

In [71]:

```
# one hot encode
from keras.utils import to_categorical
y_train_class = to_categorical(np.array(y_train_class))
y_val_class = to_categorical(np.array(y_val_class))
```

```
C:\Users\kyle1\Anaconda3\lib\site-packages\h5py\__init__.py:34: FutureWarn
ing: Conversion of the second argument of issubdtype from `float` to `np.f
loating` is deprecated. In future, it will be treated as `np.float64 == n
p.dtype(float).type`.
  from ._conv import register_converters as _register_converters
Using TensorFlow backend.
```

In [72]:

```
y_test_class
```

Out[72]:

```
array([1, 2, 0, 2, 0, 0, 2, 0, 2, 2, 2, 1, 2, 1, 2, 0, 2, 2, 0, 0, 1, 0,
       2, 2, 0, 2, 2, 2, 0, 1, 1, 2, 0, 0, 2, 2, 0, 2, 0, 0, 1, 1, 0, 0,
       2, 2, 2, 2, 0, 1, 1, 1, 0, 0, 2, 2, 2, 1, 1, 0, 0, 2, 2, 2, 2, 1,
       2, 0, 2, 0, 1, 2, 2, 2, 2, 1, 0, 2, 0, 0, 0, 1, 2, 2, 0, 1, 2, 0,
       2, 0, 2, 1, 1, 0, 2, 2, 2, 0, 1, 2, 0, 0, 0, 0, 0, 2, 2, 2, 0, 0,
       1, 1, 0, 0, 2, 2, 0, 1, 2, 1, 0, 0, 0, 2, 0, 1, 0, 0, 2, 0, 2, 1,
       1, 0, 2, 0, 2, 0, 2, 0, 2, 2, 0, 0, 2, 2, 2, 0, 2, 2, 0, 1, 0, 1,
       2, 0, 2, 2, 2, 0, 2, 0, 2, 1, 2, 0, 0, 2, 1, 2, 0, 1, 1, 2, 2, 0,
       1, 0, 0, 0, 2, 0, 1, 1, 0, 0, 0, 0, 0, 2, 0, 2, 2, 2, 2, 0, 1, 1,
       2, 1, 2, 1, 2, 0, 1, 0, 1, 2, 2, 2, 1, 2, 2, 0, 0, 2, 0, 0, 2, 2,
       2, 1, 1, 1, 1, 0, 2, 1, 0, 0, 1, 2, 0, 1, 1, 1, 0, 2, 2, 0, 2, 2,
       1, 2, 2, 2, 1, 1, 0, 2, 1, 0, 2, 1, 0, 2, 0, 0, 0, 1, 2, 2, 0, 0,
       2, 1, 0, 0, 2, 2, 2, 2, 2, 2, 2, 2, 1, 0, 1, 2, 0, 1, 0, 1, 0, 2,
       2, 0, 2], dtype=int64)
```

In [73]:

```
import tensorflow as tf
```

In [74]:

```
import keras
from keras.layers import Dense, Flatten, BatchNormalization,Dropout, Input, merge, conc
atenate,add
from keras.layers import Conv1D, MaxPooling1D, Conv2D, MaxPooling2D, LSTM
from keras.layers import Activation
from keras.models import Sequential
from keras.optimizers import Adam, rmsprop, sgd
from keras import backend as K
from keras.layers.advanced_activations import LeakyReLU, PReLU, ReLU
from keras.callbacks import ReduceLROnPlateau,EarlyStopping
from keras.models import Model
```

In [75]:

```
X_train.shape
```

Out[75]:

```
(866, 5, 6)
```

CNN 1D

In [76]:

```
inputs=Input(X_train.shape[1:])
x=Dense(32)(inputs)
x=Conv1D(16,kernel_size=3,strides=1)(x)
x=BatchNormalization()(x)
# x=ReLU()(x)

# x1=Conv1D(16,4)(x)
# x=LeakyReLU(alpha=0.1)(x1)

# x2=MaxPooling1D(pool_size=1)(x)
# x=concatenate([x1,x2])
x=Flatten()(x)
# x=Dense(32,name='my16')(x)

predictions=Dense(3, activation='softmax')(x)
model=Model(inputs=inputs, outputs=predictions)
model.compile(optimizer=Adam(lr=0.0001), loss='categorical_crossentropy', metrics=['acc
uracy'])
model.summary()
history=model.fit(X_train,y_train_class, batch_size=256, epochs=1000, verbose=1,
                  validation_data=(X_val,y_val_class))
#                   callbacks=[ReduceLROnPlateau(monitor='acc',factor=0.2, patience=5, m
in_lr= 0.00001),EarlyStopping(monitor='acc',patience=7)])
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         (None, 5, 6)              0
_________________________________________________________________
dense_1 (Dense)              (None, 5, 32)             224
_________________________________________________________________
conv1d_1 (Conv1D)            (None, 3, 16)             1552
_________________________________________________________________
batch_normalization_1 (Batch (None, 3, 16)             64
_________________________________________________________________
flatten_1 (Flatten)          (None, 48)                0
_________________________________________________________________
dense_2 (Dense)              (None, 3)                 147
=================================================================
Total params: 1,987
Trainable params: 1,955
Non-trainable params: 32
_________________________________________________________________
Train on 866 samples, validate on 289 samples
Epoch 1/1000
866/866 [==============================] - 0s 539us/step - loss: 1.1072 -
acc: 0.4238 - val_loss: 3.3779 - val_acc: 0.2837
Epoch 2/1000
866/866 [==============================] - 0s 17us/step - loss: 1.0898 - a
cc: 0.4319 - val_loss: 3.2280 - val_acc: 0.2837
Epoch 3/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0763 - a
cc: 0.4249 - val_loss: 3.0887 - val_acc: 0.2837
Epoch 4/1000
866/866 [==============================] - 0s 17us/step - loss: 1.0618 - a
cc: 0.4376 - val_loss: 2.9540 - val_acc: 0.2803
Epoch 5/1000
866/866 [==============================] - 0s 20us/step - loss: 1.0520 - a
cc: 0.4423 - val_loss: 2.8275 - val_acc: 0.2837
Epoch 6/1000
866/866 [==============================] - 0s 17us/step - loss: 1.0442 - a
cc: 0.4469 - val_loss: 2.7331 - val_acc: 0.2872
Epoch 7/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0361 - a
cc: 0.4573 - val_loss: 2.6216 - val_acc: 0.2872
Epoch 8/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0283 - a
cc: 0.4688 - val_loss: 2.4905 - val_acc: 0.2907
Epoch 9/1000
866/866 [==============================] - 0s 15us/step - loss: 1.0250 - a
cc: 0.4711 - val_loss: 2.3876 - val_acc: 0.3045
Epoch 10/1000
866/866 [==============================] - 0s 15us/step - loss: 1.0182 - a
cc: 0.4792 - val_loss: 2.2878 - val_acc: 0.3149
Epoch 11/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0184 - a
cc: 0.4758 - val_loss: 2.2153 - val_acc: 0.3183
Epoch 12/1000
866/866 [==============================] - 0s 17us/step - loss: 1.0118 - a
cc: 0.4769 - val_loss: 2.1378 - val_acc: 0.3218
Epoch 13/1000
866/866 [==============================] - 0s 18us/step - loss: 1.0117 - a
cc: 0.4734 - val_loss: 2.0787 - val_acc: 0.3218
Epoch 14/1000
866/866 [==============================] - 0s 22us/step - loss: 1.0095 - a
```

```
cc: 0.4677 - val_loss: 2.0217 - val_acc: 0.3356
Epoch 15/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0068 - a
cc: 0.4815 - val_loss: 1.9802 - val_acc: 0.3426
Epoch 16/1000
866/866 [==============================] - 0s 15us/step - loss: 1.0055 - a
cc: 0.4723 - val_loss: 1.9415 - val_acc: 0.3426
Epoch 17/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0053 - a
cc: 0.4792 - val_loss: 1.9180 - val_acc: 0.3391
Epoch 18/1000
866/866 [==============================] - 0s 22us/step - loss: 1.0033 - a
cc: 0.4781 - val_loss: 1.9098 - val_acc: 0.3356
Epoch 19/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9999 - a
cc: 0.4815 - val_loss: 1.8756 - val_acc: 0.3356
Epoch 20/1000
866/866 [==============================] - 0s 16us/step - loss: 1.0012 - a
cc: 0.4688 - val_loss: 1.8264 - val_acc: 0.3426
Epoch 21/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9979 - a
cc: 0.4758 - val_loss: 1.7856 - val_acc: 0.3495
Epoch 22/1000
866/866 [==============================] - 0s 17us/step - loss: 1.0007 - a
cc: 0.4792 - val_loss: 1.7593 - val_acc: 0.3495
Epoch 23/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9974 - a
cc: 0.4815 - val_loss: 1.7443 - val_acc: 0.3495
Epoch 24/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9958 - a
cc: 0.4792 - val_loss: 1.7357 - val_acc: 0.3460
Epoch 25/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9969 - a
cc: 0.4769 - val_loss: 1.7420 - val_acc: 0.3460
Epoch 26/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9959 - a
cc: 0.4815 - val_loss: 1.7290 - val_acc: 0.3460
Epoch 27/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9969 - a
cc: 0.4746 - val_loss: 1.7120 - val_acc: 0.3460
Epoch 28/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9938 - a
cc: 0.4861 - val_loss: 1.6837 - val_acc: 0.3460
Epoch 29/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9949 - a
cc: 0.4838 - val_loss: 1.6557 - val_acc: 0.3426
Epoch 30/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9920 - a
cc: 0.4711 - val_loss: 1.6229 - val_acc: 0.3495
Epoch 31/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9923 - a
cc: 0.4665 - val_loss: 1.6098 - val_acc: 0.3495
Epoch 32/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9932 - a
cc: 0.4769 - val_loss: 1.6099 - val_acc: 0.3495
Epoch 33/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9919 - a
cc: 0.4873 - val_loss: 1.6021 - val_acc: 0.3460
Epoch 34/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9901 - a
cc: 0.4781 - val_loss: 1.5790 - val_acc: 0.3529
```

```
Epoch 35/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9910 - a
cc: 0.4781 - val_loss: 1.5451 - val_acc: 0.3564
Epoch 36/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9917 - a
cc: 0.4642 - val_loss: 1.5226 - val_acc: 0.3564
Epoch 37/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9896 - a
cc: 0.4792 - val_loss: 1.5170 - val_acc: 0.3564
Epoch 38/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9914 - a
cc: 0.4758 - val_loss: 1.5205 - val_acc: 0.3564
Epoch 39/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9903 - a
cc: 0.4711 - val_loss: 1.5262 - val_acc: 0.3564
Epoch 40/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9897 - a
cc: 0.4723 - val_loss: 1.5292 - val_acc: 0.3529
Epoch 41/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9880 - a
cc: 0.4792 - val_loss: 1.5146 - val_acc: 0.3564
Epoch 42/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9886 - a
cc: 0.4769 - val_loss: 1.4999 - val_acc: 0.3564
Epoch 43/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9882 - a
cc: 0.4792 - val_loss: 1.4834 - val_acc: 0.3633
Epoch 44/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9897 - a
cc: 0.4781 - val_loss: 1.4760 - val_acc: 0.3599
Epoch 45/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9882 - a
cc: 0.4723 - val_loss: 1.4582 - val_acc: 0.3564
Epoch 46/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9875 - a
cc: 0.4792 - val_loss: 1.4420 - val_acc: 0.3599
Epoch 47/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9891 - a
cc: 0.4746 - val_loss: 1.4328 - val_acc: 0.3564
Epoch 48/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9853 - a
cc: 0.4838 - val_loss: 1.4353 - val_acc: 0.3564
Epoch 49/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9870 - a
cc: 0.4792 - val_loss: 1.4403 - val_acc: 0.3599
Epoch 50/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9862 - a
cc: 0.4734 - val_loss: 1.4534 - val_acc: 0.3564
Epoch 51/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9861 - a
cc: 0.4896 - val_loss: 1.4665 - val_acc: 0.3564
Epoch 52/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9867 - a
cc: 0.4827 - val_loss: 1.4649 - val_acc: 0.3529
Epoch 53/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9868 - a
cc: 0.4873 - val_loss: 1.4623 - val_acc: 0.3495
Epoch 54/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9844 - a
cc: 0.4919 - val_loss: 1.4570 - val_acc: 0.3495
Epoch 55/1000
```

```
866/866 [==============================] - 0s 15us/step - loss: 0.9865 - a
cc: 0.4815 - val_loss: 1.4469 - val_acc: 0.3495
Epoch 56/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9858 - a
cc: 0.4850 - val_loss: 1.4380 - val_acc: 0.3529
Epoch 57/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9865 - a
cc: 0.4873 - val_loss: 1.4239 - val_acc: 0.3564
Epoch 58/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9864 - a
cc: 0.4838 - val_loss: 1.4169 - val_acc: 0.3529
Epoch 59/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9860 - a
cc: 0.4746 - val_loss: 1.4096 - val_acc: 0.3529
Epoch 60/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9871 - a
cc: 0.4815 - val_loss: 1.3941 - val_acc: 0.3564
Epoch 61/1000
866/866 [==============================] - 0s 14us/step - loss: 0.9844 - a
cc: 0.4919 - val_loss: 1.3819 - val_acc: 0.3564
Epoch 62/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9848 - a
cc: 0.4942 - val_loss: 1.3999 - val_acc: 0.3564
Epoch 63/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9838 - a
cc: 0.4919 - val_loss: 1.4198 - val_acc: 0.3564
Epoch 64/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9839 - a
cc: 0.4908 - val_loss: 1.4332 - val_acc: 0.3564
Epoch 65/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9846 - a
cc: 0.4861 - val_loss: 1.4311 - val_acc: 0.3564
Epoch 66/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9863 - a
cc: 0.5046 - val_loss: 1.4140 - val_acc: 0.3564
Epoch 67/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9837 - a
cc: 0.4873 - val_loss: 1.4118 - val_acc: 0.3599
Epoch 68/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9847 - a
cc: 0.4919 - val_loss: 1.4132 - val_acc: 0.3599
Epoch 69/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9844 - a
cc: 0.4885 - val_loss: 1.4120 - val_acc: 0.3599
Epoch 70/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9823 - a
cc: 0.4954 - val_loss: 1.3991 - val_acc: 0.3599
Epoch 71/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9826 - a
cc: 0.4977 - val_loss: 1.3939 - val_acc: 0.3633
Epoch 72/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9836 - a
cc: 0.5046 - val_loss: 1.3971 - val_acc: 0.3564
Epoch 73/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9837 - a
cc: 0.4908 - val_loss: 1.4030 - val_acc: 0.3564
Epoch 74/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9839 - a
cc: 0.4919 - val_loss: 1.4083 - val_acc: 0.3599
Epoch 75/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9843 - a
```

```
cc: 0.4931 - val_loss: 1.3929 - val_acc: 0.3633
Epoch 76/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9863 - a
cc: 0.4896 - val_loss: 1.3826 - val_acc: 0.3702
Epoch 77/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9831 - a
cc: 0.4965 - val_loss: 1.3725 - val_acc: 0.3702
Epoch 78/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9842 - a
cc: 0.4942 - val_loss: 1.3637 - val_acc: 0.3702
Epoch 79/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9799 - a
cc: 0.5023 - val_loss: 1.3668 - val_acc: 0.3737
Epoch 80/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9807 - a
cc: 0.5069 - val_loss: 1.3870 - val_acc: 0.3702
Epoch 81/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9819 - a
cc: 0.5035 - val_loss: 1.3981 - val_acc: 0.3668
Epoch 82/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9829 - a
cc: 0.4977 - val_loss: 1.4029 - val_acc: 0.3668
Epoch 83/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9816 - a
cc: 0.4954 - val_loss: 1.4136 - val_acc: 0.3668
Epoch 84/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9805 - a
cc: 0.4977 - val_loss: 1.4098 - val_acc: 0.3668
Epoch 85/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9836 - a
cc: 0.4896 - val_loss: 1.3874 - val_acc: 0.3702
Epoch 86/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9812 - a
cc: 0.5023 - val_loss: 1.3690 - val_acc: 0.3702
Epoch 87/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9809 - a
cc: 0.4988 - val_loss: 1.3624 - val_acc: 0.3668
Epoch 88/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9846 - a
cc: 0.4954 - val_loss: 1.3764 - val_acc: 0.3668
Epoch 89/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9805 - a
cc: 0.5081 - val_loss: 1.3919 - val_acc: 0.3668
Epoch 90/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9831 - a
cc: 0.4977 - val_loss: 1.3915 - val_acc: 0.3668
Epoch 91/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9820 - a
cc: 0.4931 - val_loss: 1.3749 - val_acc: 0.3668
Epoch 92/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9811 - a
cc: 0.4954 - val_loss: 1.3809 - val_acc: 0.3668
Epoch 93/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9807 - a
cc: 0.5035 - val_loss: 1.3850 - val_acc: 0.3668
Epoch 94/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9808 - a
cc: 0.5058 - val_loss: 1.3819 - val_acc: 0.3668
Epoch 95/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9796 - a
cc: 0.5035 - val_loss: 1.3772 - val_acc: 0.3668
```

```
Epoch 96/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9816 - a
cc: 0.4965 - val_loss: 1.3776 - val_acc: 0.3668
Epoch 97/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9809 - a
cc: 0.5023 - val_loss: 1.3785 - val_acc: 0.3702
Epoch 98/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9801 - a
cc: 0.5012 - val_loss: 1.3844 - val_acc: 0.3702
Epoch 99/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9823 - a
cc: 0.5081 - val_loss: 1.3817 - val_acc: 0.3668
Epoch 100/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9808 - a
cc: 0.5058 - val_loss: 1.3807 - val_acc: 0.3668
Epoch 101/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9804 - a
cc: 0.5012 - val_loss: 1.3809 - val_acc: 0.3668
Epoch 102/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9831 - a
cc: 0.5023 - val_loss: 1.3852 - val_acc: 0.3668
Epoch 103/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9778 - a
cc: 0.5058 - val_loss: 1.3887 - val_acc: 0.3668
Epoch 104/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9794 - a
cc: 0.4965 - val_loss: 1.3928 - val_acc: 0.3668
Epoch 105/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9797 - a
cc: 0.5035 - val_loss: 1.3937 - val_acc: 0.3668
Epoch 106/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9794 - a
cc: 0.5023 - val_loss: 1.4105 - val_acc: 0.3668
Epoch 107/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9807 - a
cc: 0.5000 - val_loss: 1.4132 - val_acc: 0.3668
Epoch 108/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9798 - a
cc: 0.5162 - val_loss: 1.4073 - val_acc: 0.3668
Epoch 109/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9818 - a
cc: 0.5058 - val_loss: 1.3889 - val_acc: 0.3668
Epoch 110/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9762 - a
cc: 0.4965 - val_loss: 1.3778 - val_acc: 0.3737
Epoch 111/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9782 - a
cc: 0.5023 - val_loss: 1.3767 - val_acc: 0.3772
Epoch 112/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9797 - a
cc: 0.4965 - val_loss: 1.3738 - val_acc: 0.3772
Epoch 113/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9816 - a
cc: 0.5000 - val_loss: 1.3746 - val_acc: 0.3772
Epoch 114/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9795 - a
cc: 0.5046 - val_loss: 1.3926 - val_acc: 0.3737
Epoch 115/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9767 - a
cc: 0.5115 - val_loss: 1.3982 - val_acc: 0.3737
Epoch 116/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9759 - a
cc: 0.5023 - val_loss: 1.3946 - val_acc: 0.3772
Epoch 117/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9779 - a
cc: 0.5023 - val_loss: 1.3859 - val_acc: 0.3772
Epoch 118/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9784 - a
cc: 0.4965 - val_loss: 1.3834 - val_acc: 0.3772
Epoch 119/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9785 - a
cc: 0.5058 - val_loss: 1.3836 - val_acc: 0.3772
Epoch 120/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9774 - a
cc: 0.4965 - val_loss: 1.3912 - val_acc: 0.3772
Epoch 121/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9777 - a
cc: 0.5058 - val_loss: 1.3958 - val_acc: 0.3772
Epoch 122/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9762 - a
cc: 0.4977 - val_loss: 1.4096 - val_acc: 0.3806
Epoch 123/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9768 - a
cc: 0.5058 - val_loss: 1.4279 - val_acc: 0.3668
Epoch 124/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9760 - a
cc: 0.5092 - val_loss: 1.4398 - val_acc: 0.3668
Epoch 125/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9793 - a
cc: 0.5046 - val_loss: 1.4382 - val_acc: 0.3668
Epoch 126/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9792 - a
cc: 0.5069 - val_loss: 1.4350 - val_acc: 0.3702
Epoch 127/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9780 - a
cc: 0.4965 - val_loss: 1.4271 - val_acc: 0.3737
Epoch 128/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9758 - a
cc: 0.5081 - val_loss: 1.4216 - val_acc: 0.3737
Epoch 129/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9759 - a
cc: 0.4988 - val_loss: 1.4096 - val_acc: 0.3737
Epoch 130/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9797 - a
cc: 0.4885 - val_loss: 1.3989 - val_acc: 0.3737
Epoch 131/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9756 - a
cc: 0.5012 - val_loss: 1.4055 - val_acc: 0.3737
Epoch 132/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9782 - a
cc: 0.5069 - val_loss: 1.4324 - val_acc: 0.3737
Epoch 133/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9771 - a
cc: 0.5069 - val_loss: 1.4552 - val_acc: 0.3668
Epoch 134/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9772 - a
cc: 0.5104 - val_loss: 1.4547 - val_acc: 0.3702
Epoch 135/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9797 - a
cc: 0.5000 - val_loss: 1.4448 - val_acc: 0.3737
Epoch 136/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9779 - a
```

```
cc: 0.5023 - val_loss: 1.4343 - val_acc: 0.3737
Epoch 137/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9777 - a
cc: 0.5046 - val_loss: 1.4214 - val_acc: 0.3737
Epoch 138/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9754 - a
cc: 0.5058 - val_loss: 1.4094 - val_acc: 0.3772
Epoch 139/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9770 - a
cc: 0.5104 - val_loss: 1.4061 - val_acc: 0.3772
Epoch 140/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9774 - a
cc: 0.4977 - val_loss: 1.4184 - val_acc: 0.3772
Epoch 141/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9764 - a
cc: 0.5115 - val_loss: 1.4214 - val_acc: 0.3772
Epoch 142/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9768 - a
cc: 0.4931 - val_loss: 1.4232 - val_acc: 0.3772
Epoch 143/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9763 - a
cc: 0.5104 - val_loss: 1.4161 - val_acc: 0.3772
Epoch 144/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9766 - a
cc: 0.5104 - val_loss: 1.4120 - val_acc: 0.3772
Epoch 145/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9765 - a
cc: 0.5058 - val_loss: 1.4156 - val_acc: 0.3772
Epoch 146/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9747 - a
cc: 0.5058 - val_loss: 1.4179 - val_acc: 0.3772
Epoch 147/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9761 - a
cc: 0.5104 - val_loss: 1.4210 - val_acc: 0.3772
Epoch 148/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9755 - a
cc: 0.5092 - val_loss: 1.4138 - val_acc: 0.3772
Epoch 149/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9768 - a
cc: 0.5046 - val_loss: 1.4091 - val_acc: 0.3772
Epoch 150/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9766 - a
cc: 0.5023 - val_loss: 1.4144 - val_acc: 0.3772
Epoch 151/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9763 - a
cc: 0.4988 - val_loss: 1.4156 - val_acc: 0.3772
Epoch 152/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9763 - a
cc: 0.5081 - val_loss: 1.4184 - val_acc: 0.3772
Epoch 153/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9752 - a
cc: 0.5012 - val_loss: 1.4213 - val_acc: 0.3772
Epoch 154/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9755 - a
cc: 0.5127 - val_loss: 1.4234 - val_acc: 0.3772
Epoch 155/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9758 - a
cc: 0.5115 - val_loss: 1.4208 - val_acc: 0.3806
Epoch 156/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9756 - a
cc: 0.5115 - val_loss: 1.4288 - val_acc: 0.3806
```

```
Epoch 157/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9768 - a
cc: 0.5139 - val_loss: 1.4349 - val_acc: 0.3806
Epoch 158/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9774 - a
cc: 0.5069 - val_loss: 1.4405 - val_acc: 0.3772
Epoch 159/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9753 - a
cc: 0.5150 - val_loss: 1.4481 - val_acc: 0.3772
Epoch 160/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9755 - a
cc: 0.5185 - val_loss: 1.4530 - val_acc: 0.3772
Epoch 161/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9738 - a
cc: 0.5115 - val_loss: 1.4377 - val_acc: 0.3772
Epoch 162/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9759 - a
cc: 0.5092 - val_loss: 1.4312 - val_acc: 0.3806
Epoch 163/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9745 - a
cc: 0.5139 - val_loss: 1.4253 - val_acc: 0.3772
Epoch 164/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9764 - a
cc: 0.5081 - val_loss: 1.4228 - val_acc: 0.3737
Epoch 165/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9750 - a
cc: 0.5081 - val_loss: 1.4242 - val_acc: 0.3806
Epoch 166/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9754 - a
cc: 0.5069 - val_loss: 1.4310 - val_acc: 0.3806
Epoch 167/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9772 - a
cc: 0.5081 - val_loss: 1.4356 - val_acc: 0.3737
Epoch 168/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9751 - a
cc: 0.5104 - val_loss: 1.4339 - val_acc: 0.3737
Epoch 169/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9755 - a
cc: 0.5092 - val_loss: 1.4343 - val_acc: 0.3806
Epoch 170/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9753 - a
cc: 0.5081 - val_loss: 1.4362 - val_acc: 0.3806
Epoch 171/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9749 - a
cc: 0.5127 - val_loss: 1.4423 - val_acc: 0.3772
Epoch 172/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9729 - a
cc: 0.5139 - val_loss: 1.4506 - val_acc: 0.3772
Epoch 173/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9732 - a
cc: 0.5046 - val_loss: 1.4504 - val_acc: 0.3806
Epoch 174/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9748 - a
cc: 0.5150 - val_loss: 1.4545 - val_acc: 0.3806
Epoch 175/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9781 - a
cc: 0.5104 - val_loss: 1.4574 - val_acc: 0.3841
Epoch 176/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9753 - a
cc: 0.5139 - val_loss: 1.4612 - val_acc: 0.3875
Epoch 177/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9776 - a
cc: 0.5139 - val_loss: 1.4750 - val_acc: 0.3806
Epoch 178/1000
866/866 [==============================] - 0s 26us/step - loss: 0.9751 - a
cc: 0.5150 - val_loss: 1.4831 - val_acc: 0.3806
Epoch 179/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9743 - a
cc: 0.5127 - val_loss: 1.4829 - val_acc: 0.3910
Epoch 180/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9764 - a
cc: 0.5150 - val_loss: 1.4767 - val_acc: 0.3910
Epoch 181/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9767 - a
cc: 0.5185 - val_loss: 1.4769 - val_acc: 0.3945
Epoch 182/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9711 - a
cc: 0.5196 - val_loss: 1.4775 - val_acc: 0.3910
Epoch 183/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9735 - a
cc: 0.5139 - val_loss: 1.4837 - val_acc: 0.3910
Epoch 184/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9742 - a
cc: 0.5196 - val_loss: 1.4868 - val_acc: 0.3875
Epoch 185/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9746 - a
cc: 0.5058 - val_loss: 1.4788 - val_acc: 0.4014
Epoch 186/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9739 - a
cc: 0.5127 - val_loss: 1.4802 - val_acc: 0.4014
Epoch 187/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9748 - a
cc: 0.5081 - val_loss: 1.4777 - val_acc: 0.4014
Epoch 188/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9750 - a
cc: 0.5162 - val_loss: 1.4658 - val_acc: 0.4014
Epoch 189/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9745 - a
cc: 0.5058 - val_loss: 1.4568 - val_acc: 0.4048
Epoch 190/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9741 - a
cc: 0.5081 - val_loss: 1.4454 - val_acc: 0.4118
Epoch 191/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9786 - a
cc: 0.5035 - val_loss: 1.4487 - val_acc: 0.4083
Epoch 192/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9743 - a
cc: 0.5058 - val_loss: 1.4555 - val_acc: 0.4048
Epoch 193/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9745 - a
cc: 0.5150 - val_loss: 1.4551 - val_acc: 0.4048
Epoch 194/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9760 - a
cc: 0.5173 - val_loss: 1.4552 - val_acc: 0.4014
Epoch 195/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9734 - a
cc: 0.5115 - val_loss: 1.4546 - val_acc: 0.4014
Epoch 196/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9739 - a
cc: 0.5127 - val_loss: 1.4648 - val_acc: 0.4014
Epoch 197/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9742 - a
```

```
cc: 0.5069 - val_loss: 1.4691 - val_acc: 0.4014
Epoch 198/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9740 - a
cc: 0.5150 - val_loss: 1.4664 - val_acc: 0.4014
Epoch 199/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9729 - a
cc: 0.5081 - val_loss: 1.4636 - val_acc: 0.4118
Epoch 200/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9733 - a
cc: 0.5104 - val_loss: 1.4605 - val_acc: 0.4118
Epoch 201/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9747 - a
cc: 0.5035 - val_loss: 1.4667 - val_acc: 0.4118
Epoch 202/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9744 - a
cc: 0.4988 - val_loss: 1.4652 - val_acc: 0.4083
Epoch 203/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9746 - a
cc: 0.5023 - val_loss: 1.4766 - val_acc: 0.4048
Epoch 204/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9737 - a
cc: 0.5150 - val_loss: 1.4838 - val_acc: 0.4014
Epoch 205/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9716 - a
cc: 0.5092 - val_loss: 1.4854 - val_acc: 0.4014
Epoch 206/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9710 - a
cc: 0.5127 - val_loss: 1.4901 - val_acc: 0.4014
Epoch 207/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9717 - a
cc: 0.5127 - val_loss: 1.4962 - val_acc: 0.3979
Epoch 208/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9745 - a
cc: 0.5104 - val_loss: 1.5058 - val_acc: 0.3875
Epoch 209/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9742 - a
cc: 0.5023 - val_loss: 1.5127 - val_acc: 0.3875
Epoch 210/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9748 - a
cc: 0.5139 - val_loss: 1.5155 - val_acc: 0.3875
Epoch 211/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9738 - a
cc: 0.5139 - val_loss: 1.5063 - val_acc: 0.3979
Epoch 212/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9717 - a
cc: 0.5150 - val_loss: 1.4871 - val_acc: 0.4048
Epoch 213/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9730 - a
cc: 0.5104 - val_loss: 1.4809 - val_acc: 0.4083
Epoch 214/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9752 - a
cc: 0.5139 - val_loss: 1.4856 - val_acc: 0.4048
Epoch 215/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9733 - a
cc: 0.5023 - val_loss: 1.4870 - val_acc: 0.4048
Epoch 216/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9744 - a
cc: 0.5150 - val_loss: 1.5055 - val_acc: 0.4048
Epoch 217/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9706 - a
cc: 0.5092 - val_loss: 1.5100 - val_acc: 0.4048
```

```
Epoch 218/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9721 - a
cc: 0.5127 - val_loss: 1.5041 - val_acc: 0.4048
Epoch 219/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9731 - a
cc: 0.5127 - val_loss: 1.5036 - val_acc: 0.4118
Epoch 220/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9728 - a
cc: 0.5150 - val_loss: 1.5042 - val_acc: 0.4083
Epoch 221/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9710 - a
cc: 0.5035 - val_loss: 1.5031 - val_acc: 0.4118
Epoch 222/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9743 - a
cc: 0.5115 - val_loss: 1.5052 - val_acc: 0.4118
Epoch 223/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9730 - a
cc: 0.5208 - val_loss: 1.5134 - val_acc: 0.4118
Epoch 224/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9747 - a
cc: 0.5150 - val_loss: 1.5150 - val_acc: 0.4118
Epoch 225/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9710 - a
cc: 0.5115 - val_loss: 1.5229 - val_acc: 0.4118
Epoch 226/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9733 - a
cc: 0.5058 - val_loss: 1.5278 - val_acc: 0.4118
Epoch 227/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9731 - a
cc: 0.5127 - val_loss: 1.5345 - val_acc: 0.4048
Epoch 228/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9723 - a
cc: 0.5139 - val_loss: 1.5415 - val_acc: 0.4014
Epoch 229/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9728 - a
cc: 0.5185 - val_loss: 1.5520 - val_acc: 0.4014
Epoch 230/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9727 - a
cc: 0.5081 - val_loss: 1.5530 - val_acc: 0.4014
Epoch 231/1000
866/866 [==============================] - 0s 25us/step - loss: 0.9754 - a
cc: 0.5208 - val_loss: 1.5355 - val_acc: 0.4048
Epoch 232/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9759 - a
cc: 0.5162 - val_loss: 1.5316 - val_acc: 0.4083
Epoch 233/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9727 - a
cc: 0.5150 - val_loss: 1.5297 - val_acc: 0.4152
Epoch 234/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9722 - a
cc: 0.5139 - val_loss: 1.5375 - val_acc: 0.4083
Epoch 235/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9721 - a
cc: 0.5081 - val_loss: 1.5464 - val_acc: 0.4083
Epoch 236/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9730 - a
cc: 0.5035 - val_loss: 1.5434 - val_acc: 0.4083
Epoch 237/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9727 - a
cc: 0.5092 - val_loss: 1.5316 - val_acc: 0.4118
Epoch 238/1000
```

```
866/866 [==============================] - 0s 18us/step - loss: 0.9734 - a
cc: 0.5115 - val_loss: 1.5285 - val_acc: 0.4152
Epoch 239/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9719 - a
cc: 0.5104 - val_loss: 1.5315 - val_acc: 0.4118
Epoch 240/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9730 - a
cc: 0.5058 - val_loss: 1.5330 - val_acc: 0.4152
Epoch 241/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9721 - a
cc: 0.5139 - val_loss: 1.5409 - val_acc: 0.4083
Epoch 242/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9741 - a
cc: 0.5139 - val_loss: 1.5434 - val_acc: 0.4048
Epoch 243/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9734 - a
cc: 0.5046 - val_loss: 1.5484 - val_acc: 0.4048
Epoch 244/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9733 - a
cc: 0.5150 - val_loss: 1.5591 - val_acc: 0.4083
Epoch 245/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9741 - a
cc: 0.5115 - val_loss: 1.5711 - val_acc: 0.4083
Epoch 246/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9724 - a
cc: 0.5092 - val_loss: 1.5757 - val_acc: 0.4083
Epoch 247/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9730 - a
cc: 0.5023 - val_loss: 1.5752 - val_acc: 0.3979
Epoch 248/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9724 - a
cc: 0.5104 - val_loss: 1.5713 - val_acc: 0.4048
Epoch 249/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9732 - a
cc: 0.5104 - val_loss: 1.5652 - val_acc: 0.4083
Epoch 250/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9731 - a
cc: 0.5058 - val_loss: 1.5634 - val_acc: 0.4152
Epoch 251/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9719 - a
cc: 0.5219 - val_loss: 1.5639 - val_acc: 0.4118
Epoch 252/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9732 - a
cc: 0.5046 - val_loss: 1.5672 - val_acc: 0.4118
Epoch 253/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9703 - a
cc: 0.5185 - val_loss: 1.5711 - val_acc: 0.4118
Epoch 254/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9711 - a
cc: 0.5162 - val_loss: 1.5761 - val_acc: 0.4118
Epoch 255/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9718 - a
cc: 0.5104 - val_loss: 1.5776 - val_acc: 0.4118
Epoch 256/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9704 - a
cc: 0.5185 - val_loss: 1.5720 - val_acc: 0.4152
Epoch 257/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9726 - a
cc: 0.5219 - val_loss: 1.5665 - val_acc: 0.4152
Epoch 258/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9718 - a
```

```
cc: 0.5242 - val_loss: 1.5629 - val_acc: 0.4187
Epoch 259/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9728 - a
cc: 0.5115 - val_loss: 1.5571 - val_acc: 0.4256
Epoch 260/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9729 - a
cc: 0.5127 - val_loss: 1.5546 - val_acc: 0.4221
Epoch 261/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9717 - a
cc: 0.5139 - val_loss: 1.5616 - val_acc: 0.4152
Epoch 262/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9743 - a
cc: 0.5139 - val_loss: 1.5626 - val_acc: 0.4048
Epoch 263/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9728 - a
cc: 0.5162 - val_loss: 1.5753 - val_acc: 0.4048
Epoch 264/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9719 - a
cc: 0.5127 - val_loss: 1.5843 - val_acc: 0.4048
Epoch 265/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9709 - a
cc: 0.5162 - val_loss: 1.5854 - val_acc: 0.4083
Epoch 266/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9709 - a
cc: 0.5208 - val_loss: 1.5879 - val_acc: 0.4187
Epoch 267/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9716 - a
cc: 0.5058 - val_loss: 1.5827 - val_acc: 0.4187
Epoch 268/1000
866/866 [==============================] - 0s 29us/step - loss: 0.9725 - a
cc: 0.5150 - val_loss: 1.5772 - val_acc: 0.4256
Epoch 269/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9716 - a
cc: 0.5185 - val_loss: 1.5812 - val_acc: 0.4221
Epoch 270/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9728 - a
cc: 0.5139 - val_loss: 1.5915 - val_acc: 0.4256
Epoch 271/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9712 - a
cc: 0.5150 - val_loss: 1.5877 - val_acc: 0.4256
Epoch 272/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9698 - a
cc: 0.5162 - val_loss: 1.5899 - val_acc: 0.4152
Epoch 273/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9696 - a
cc: 0.5115 - val_loss: 1.5901 - val_acc: 0.4152
Epoch 274/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9721 - a
cc: 0.5150 - val_loss: 1.5891 - val_acc: 0.4083
Epoch 275/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9719 - a
cc: 0.5185 - val_loss: 1.5874 - val_acc: 0.4083
Epoch 276/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9737 - a
cc: 0.5219 - val_loss: 1.5837 - val_acc: 0.4187
Epoch 277/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9701 - a
cc: 0.5196 - val_loss: 1.5726 - val_acc: 0.4152
Epoch 278/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9712 - a
cc: 0.5162 - val_loss: 1.5746 - val_acc: 0.4221
```

```
Epoch 279/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9715 - a
cc: 0.5139 - val_loss: 1.5767 - val_acc: 0.4187
Epoch 280/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9727 - a
cc: 0.5173 - val_loss: 1.5782 - val_acc: 0.4221
Epoch 281/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9713 - a
cc: 0.5115 - val_loss: 1.5827 - val_acc: 0.4152
Epoch 282/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9713 - a
cc: 0.5115 - val_loss: 1.5853 - val_acc: 0.4221
Epoch 283/1000
866/866 [==============================] - 0s 26us/step - loss: 0.9713 - a
cc: 0.5104 - val_loss: 1.5932 - val_acc: 0.4256
Epoch 284/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9705 - a
cc: 0.5115 - val_loss: 1.6022 - val_acc: 0.4187
Epoch 285/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9704 - a
cc: 0.5139 - val_loss: 1.6144 - val_acc: 0.4152
Epoch 286/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9721 - a
cc: 0.5115 - val_loss: 1.6173 - val_acc: 0.4152
Epoch 287/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9704 - a
cc: 0.5196 - val_loss: 1.6200 - val_acc: 0.4221
Epoch 288/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9731 - a
cc: 0.5081 - val_loss: 1.6179 - val_acc: 0.4187
Epoch 289/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9722 - a
cc: 0.5139 - val_loss: 1.6126 - val_acc: 0.4221
Epoch 290/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9728 - a
cc: 0.5023 - val_loss: 1.6079 - val_acc: 0.4187
Epoch 291/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9726 - a
cc: 0.5023 - val_loss: 1.6044 - val_acc: 0.4187
Epoch 292/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9699 - a
cc: 0.5092 - val_loss: 1.5918 - val_acc: 0.4291
Epoch 293/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9731 - a
cc: 0.5092 - val_loss: 1.5863 - val_acc: 0.4291
Epoch 294/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9714 - a
cc: 0.5069 - val_loss: 1.5840 - val_acc: 0.4256
Epoch 295/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9707 - a
cc: 0.5104 - val_loss: 1.5903 - val_acc: 0.4221
Epoch 296/1000
866/866 [==============================] - 0s 30us/step - loss: 0.9704 - a
cc: 0.5127 - val_loss: 1.6003 - val_acc: 0.4256
Epoch 297/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9733 - a
cc: 0.4977 - val_loss: 1.6054 - val_acc: 0.4325
Epoch 298/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9708 - a
cc: 0.5173 - val_loss: 1.6045 - val_acc: 0.4360
Epoch 299/1000
```

```
866/866 [==============================] - 0s 18us/step - loss: 0.9704 - a
cc: 0.5115 - val_loss: 1.6133 - val_acc: 0.4291
Epoch 300/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9714 - a
cc: 0.5139 - val_loss: 1.6244 - val_acc: 0.4152
Epoch 301/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9715 - a
cc: 0.5173 - val_loss: 1.6246 - val_acc: 0.4221
Epoch 302/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9719 - a
cc: 0.5115 - val_loss: 1.6169 - val_acc: 0.4394
Epoch 303/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9704 - a
cc: 0.5162 - val_loss: 1.6101 - val_acc: 0.4360
Epoch 304/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9718 - a
cc: 0.5139 - val_loss: 1.6059 - val_acc: 0.4394
Epoch 305/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9716 - a
cc: 0.5058 - val_loss: 1.5973 - val_acc: 0.4360
Epoch 306/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9708 - a
cc: 0.5150 - val_loss: 1.5991 - val_acc: 0.4394
Epoch 307/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9717 - a
cc: 0.5023 - val_loss: 1.6026 - val_acc: 0.4325
Epoch 308/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9702 - a
cc: 0.5139 - val_loss: 1.5993 - val_acc: 0.4325
Epoch 309/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9729 - a
cc: 0.5058 - val_loss: 1.5994 - val_acc: 0.4291
Epoch 310/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9713 - a
cc: 0.5069 - val_loss: 1.6025 - val_acc: 0.4187
Epoch 311/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9708 - a
cc: 0.5104 - val_loss: 1.6061 - val_acc: 0.4187
Epoch 312/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9704 - a
cc: 0.5115 - val_loss: 1.5992 - val_acc: 0.4325
Epoch 313/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9716 - a
cc: 0.5092 - val_loss: 1.5973 - val_acc: 0.4291
Epoch 314/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9722 - a
cc: 0.5115 - val_loss: 1.5926 - val_acc: 0.4325
Epoch 315/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9714 - a
cc: 0.5092 - val_loss: 1.5910 - val_acc: 0.4360
Epoch 316/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9719 - a
cc: 0.5104 - val_loss: 1.5926 - val_acc: 0.4325
Epoch 317/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9703 - a
cc: 0.5150 - val_loss: 1.5952 - val_acc: 0.4291
Epoch 318/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9706 - a
cc: 0.5127 - val_loss: 1.5962 - val_acc: 0.4325
Epoch 319/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9709 - a
```

```
cc: 0.5139 - val_loss: 1.6018 - val_acc: 0.4360
Epoch 320/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9723 - a
cc: 0.5058 - val_loss: 1.6107 - val_acc: 0.4360
Epoch 321/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9720 - a
cc: 0.5173 - val_loss: 1.6256 - val_acc: 0.4360
Epoch 322/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9722 - a
cc: 0.5035 - val_loss: 1.6384 - val_acc: 0.4360
Epoch 323/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9721 - a
cc: 0.5173 - val_loss: 1.6430 - val_acc: 0.4394
Epoch 324/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9711 - a
cc: 0.5104 - val_loss: 1.6499 - val_acc: 0.4394
Epoch 325/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9718 - a
cc: 0.5185 - val_loss: 1.6547 - val_acc: 0.4291
Epoch 326/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9706 - a
cc: 0.5092 - val_loss: 1.6546 - val_acc: 0.4187
Epoch 327/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9714 - a
cc: 0.5058 - val_loss: 1.6426 - val_acc: 0.4221
Epoch 328/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9706 - a
cc: 0.5081 - val_loss: 1.6324 - val_acc: 0.4325
Epoch 329/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9712 - a
cc: 0.5104 - val_loss: 1.6239 - val_acc: 0.4360
Epoch 330/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9714 - a
cc: 0.5092 - val_loss: 1.6232 - val_acc: 0.4291
Epoch 331/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9718 - a
cc: 0.5035 - val_loss: 1.6322 - val_acc: 0.4360
Epoch 332/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9697 - a
cc: 0.5127 - val_loss: 1.6387 - val_acc: 0.4325
Epoch 333/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9697 - a
cc: 0.5127 - val_loss: 1.6487 - val_acc: 0.4394
Epoch 334/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9716 - a
cc: 0.5127 - val_loss: 1.6499 - val_acc: 0.4394
Epoch 335/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9691 - a
cc: 0.5092 - val_loss: 1.6436 - val_acc: 0.4360
Epoch 336/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9691 - a
cc: 0.5150 - val_loss: 1.6492 - val_acc: 0.4325
Epoch 337/1000
866/866 [==============================] - 0s 25us/step - loss: 0.9724 - a
cc: 0.5000 - val_loss: 1.6509 - val_acc: 0.4325
Epoch 338/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9732 - a
cc: 0.5035 - val_loss: 1.6507 - val_acc: 0.4325
Epoch 339/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5150 - val_loss: 1.6501 - val_acc: 0.4360
```

```
Epoch 340/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9705 - a
cc: 0.5092 - val_loss: 1.6506 - val_acc: 0.4360
Epoch 341/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9683 - a
cc: 0.5150 - val_loss: 1.6496 - val_acc: 0.4394
Epoch 342/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9686 - a
cc: 0.5139 - val_loss: 1.6439 - val_acc: 0.4394
Epoch 343/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9691 - a
cc: 0.5115 - val_loss: 1.6399 - val_acc: 0.4360
Epoch 344/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9718 - a
cc: 0.5127 - val_loss: 1.6423 - val_acc: 0.4360
Epoch 345/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9713 - a
cc: 0.5115 - val_loss: 1.6505 - val_acc: 0.4394
Epoch 346/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9696 - a
cc: 0.5104 - val_loss: 1.6550 - val_acc: 0.4360
Epoch 347/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9698 - a
cc: 0.5104 - val_loss: 1.6583 - val_acc: 0.4360
Epoch 348/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9723 - a
cc: 0.5104 - val_loss: 1.6644 - val_acc: 0.4360
Epoch 349/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9702 - a
cc: 0.5185 - val_loss: 1.6726 - val_acc: 0.4394
Epoch 350/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9696 - a
cc: 0.5069 - val_loss: 1.6681 - val_acc: 0.4394
Epoch 351/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9719 - a
cc: 0.5162 - val_loss: 1.6638 - val_acc: 0.4360
Epoch 352/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9685 - a
cc: 0.5208 - val_loss: 1.6591 - val_acc: 0.4360
Epoch 353/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9713 - a
cc: 0.5115 - val_loss: 1.6481 - val_acc: 0.4394
Epoch 354/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9700 - a
cc: 0.5115 - val_loss: 1.6460 - val_acc: 0.4325
Epoch 355/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9699 - a
cc: 0.5104 - val_loss: 1.6491 - val_acc: 0.4325
Epoch 356/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9723 - a
cc: 0.5139 - val_loss: 1.6570 - val_acc: 0.4394
Epoch 357/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9696 - a
cc: 0.5219 - val_loss: 1.6625 - val_acc: 0.4429
Epoch 358/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9713 - a
cc: 0.5115 - val_loss: 1.6589 - val_acc: 0.4429
Epoch 359/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9696 - a
cc: 0.5162 - val_loss: 1.6509 - val_acc: 0.4429
Epoch 360/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9696 - a
cc: 0.5092 - val_loss: 1.6435 - val_acc: 0.4429
Epoch 361/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9694 - a
cc: 0.5185 - val_loss: 1.6370 - val_acc: 0.4394
Epoch 362/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9706 - a
cc: 0.5081 - val_loss: 1.6304 - val_acc: 0.4325
Epoch 363/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9695 - a
cc: 0.5104 - val_loss: 1.6314 - val_acc: 0.4360
Epoch 364/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9691 - a
cc: 0.5139 - val_loss: 1.6365 - val_acc: 0.4360
Epoch 365/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9698 - a
cc: 0.5115 - val_loss: 1.6409 - val_acc: 0.4360
Epoch 366/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9738 - a
cc: 0.5208 - val_loss: 1.6396 - val_acc: 0.4360
Epoch 367/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9693 - a
cc: 0.5046 - val_loss: 1.6372 - val_acc: 0.4429
Epoch 368/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9717 - a
cc: 0.5104 - val_loss: 1.6369 - val_acc: 0.4394
Epoch 369/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9707 - a
cc: 0.5139 - val_loss: 1.6394 - val_acc: 0.4394
Epoch 370/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9702 - a
cc: 0.5208 - val_loss: 1.6380 - val_acc: 0.4360
Epoch 371/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9696 - a
cc: 0.5104 - val_loss: 1.6332 - val_acc: 0.4394
Epoch 372/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9703 - a
cc: 0.5162 - val_loss: 1.6372 - val_acc: 0.4256
Epoch 373/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9707 - a
cc: 0.5127 - val_loss: 1.6432 - val_acc: 0.4118
Epoch 374/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9696 - a
cc: 0.5162 - val_loss: 1.6463 - val_acc: 0.4360
Epoch 375/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9698 - a
cc: 0.5150 - val_loss: 1.6487 - val_acc: 0.4360
Epoch 376/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9703 - a
cc: 0.5081 - val_loss: 1.6457 - val_acc: 0.4360
Epoch 377/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9705 - a
cc: 0.5115 - val_loss: 1.6402 - val_acc: 0.4360
Epoch 378/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9697 - a
cc: 0.5092 - val_loss: 1.6360 - val_acc: 0.4291
Epoch 379/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9735 - a
cc: 0.5081 - val_loss: 1.6320 - val_acc: 0.4429
Epoch 380/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9697 - a
```

```
cc: 0.5069 - val_loss: 1.6252 - val_acc: 0.4429
Epoch 381/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9728 - a
cc: 0.5139 - val_loss: 1.6244 - val_acc: 0.4464
Epoch 382/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9686 - a
cc: 0.5115 - val_loss: 1.6284 - val_acc: 0.4360
Epoch 383/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9724 - a
cc: 0.5023 - val_loss: 1.6282 - val_acc: 0.4291
Epoch 384/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9707 - a
cc: 0.5081 - val_loss: 1.6326 - val_acc: 0.4325
Epoch 385/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9695 - a
cc: 0.5104 - val_loss: 1.6376 - val_acc: 0.4325
Epoch 386/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9695 - a
cc: 0.5139 - val_loss: 1.6435 - val_acc: 0.4325
Epoch 387/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9697 - a
cc: 0.5208 - val_loss: 1.6457 - val_acc: 0.4325
Epoch 388/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9683 - a
cc: 0.5150 - val_loss: 1.6435 - val_acc: 0.4325
Epoch 389/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9686 - a
cc: 0.5219 - val_loss: 1.6377 - val_acc: 0.4394
Epoch 390/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9691 - a
cc: 0.5185 - val_loss: 1.6363 - val_acc: 0.4429
Epoch 391/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9714 - a
cc: 0.5254 - val_loss: 1.6354 - val_acc: 0.4394
Epoch 392/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9694 - a
cc: 0.5254 - val_loss: 1.6340 - val_acc: 0.4429
Epoch 393/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9716 - a
cc: 0.5139 - val_loss: 1.6332 - val_acc: 0.4325
Epoch 394/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9683 - a
cc: 0.5162 - val_loss: 1.6244 - val_acc: 0.4291
Epoch 395/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9723 - a
cc: 0.5127 - val_loss: 1.6099 - val_acc: 0.4394
Epoch 396/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9697 - a
cc: 0.5069 - val_loss: 1.5982 - val_acc: 0.4291
Epoch 397/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9714 - a
cc: 0.5115 - val_loss: 1.5924 - val_acc: 0.4360
Epoch 398/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9716 - a
cc: 0.5081 - val_loss: 1.5996 - val_acc: 0.4360
Epoch 399/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9689 - a
cc: 0.5127 - val_loss: 1.6112 - val_acc: 0.4325
Epoch 400/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9704 - a
cc: 0.5162 - val_loss: 1.6160 - val_acc: 0.4291
```

```
Epoch 401/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9687 - a
cc: 0.5150 - val_loss: 1.6217 - val_acc: 0.4325
Epoch 402/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9716 - a
cc: 0.5162 - val_loss: 1.6373 - val_acc: 0.4360
Epoch 403/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5150 - val_loss: 1.6429 - val_acc: 0.4360
Epoch 404/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9685 - a
cc: 0.5208 - val_loss: 1.6433 - val_acc: 0.4360
Epoch 405/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9711 - a
cc: 0.5139 - val_loss: 1.6476 - val_acc: 0.4325
Epoch 406/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9682 - a
cc: 0.5127 - val_loss: 1.6416 - val_acc: 0.4360
Epoch 407/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9700 - a
cc: 0.5185 - val_loss: 1.6381 - val_acc: 0.4325
Epoch 408/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9702 - a
cc: 0.5185 - val_loss: 1.6449 - val_acc: 0.4464
Epoch 409/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9709 - a
cc: 0.5127 - val_loss: 1.6437 - val_acc: 0.4464
Epoch 410/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9684 - a
cc: 0.5104 - val_loss: 1.6472 - val_acc: 0.4325
Epoch 411/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5058 - val_loss: 1.6418 - val_acc: 0.4394
Epoch 412/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9695 - a
cc: 0.5092 - val_loss: 1.6410 - val_acc: 0.4187
Epoch 413/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9689 - a
cc: 0.5115 - val_loss: 1.6381 - val_acc: 0.4048
Epoch 414/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9684 - a
cc: 0.5115 - val_loss: 1.6338 - val_acc: 0.4048
Epoch 415/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9675 - a
cc: 0.5081 - val_loss: 1.6268 - val_acc: 0.4187
Epoch 416/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9694 - a
cc: 0.5104 - val_loss: 1.6201 - val_acc: 0.4187
Epoch 417/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9695 - a
cc: 0.5150 - val_loss: 1.6218 - val_acc: 0.4394
Epoch 418/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9672 - a
cc: 0.5127 - val_loss: 1.6205 - val_acc: 0.4394
Epoch 419/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9689 - a
cc: 0.5173 - val_loss: 1.6219 - val_acc: 0.4325
Epoch 420/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9693 - a
cc: 0.5069 - val_loss: 1.6226 - val_acc: 0.4429
Epoch 421/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9692 - a
cc: 0.5196 - val_loss: 1.6274 - val_acc: 0.4394
Epoch 422/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9688 - a
cc: 0.5162 - val_loss: 1.6349 - val_acc: 0.4429
Epoch 423/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9700 - a
cc: 0.5196 - val_loss: 1.6352 - val_acc: 0.4394
Epoch 424/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9706 - a
cc: 0.5058 - val_loss: 1.6360 - val_acc: 0.4256
Epoch 425/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9702 - a
cc: 0.5115 - val_loss: 1.6398 - val_acc: 0.4187
Epoch 426/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9695 - a
cc: 0.5162 - val_loss: 1.6365 - val_acc: 0.4187
Epoch 427/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9693 - a
cc: 0.5150 - val_loss: 1.6396 - val_acc: 0.4325
Epoch 428/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9712 - a
cc: 0.5150 - val_loss: 1.6354 - val_acc: 0.4394
Epoch 429/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9696 - a
cc: 0.5208 - val_loss: 1.6288 - val_acc: 0.4325
Epoch 430/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9698 - a
cc: 0.5219 - val_loss: 1.6232 - val_acc: 0.4394
Epoch 431/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9696 - a
cc: 0.5185 - val_loss: 1.6167 - val_acc: 0.4187
Epoch 432/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9700 - a
cc: 0.5104 - val_loss: 1.6178 - val_acc: 0.4083
Epoch 433/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9698 - a
cc: 0.5046 - val_loss: 1.6265 - val_acc: 0.4083
Epoch 434/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9668 - a
cc: 0.5231 - val_loss: 1.6307 - val_acc: 0.4048
Epoch 435/1000
866/866 [==============================] - 0s 26us/step - loss: 0.9676 - a
cc: 0.5058 - val_loss: 1.6324 - val_acc: 0.4083
Epoch 436/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9697 - a
cc: 0.5127 - val_loss: 1.6298 - val_acc: 0.4256
Epoch 437/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9698 - a
cc: 0.5150 - val_loss: 1.6358 - val_acc: 0.4360
Epoch 438/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9688 - a
cc: 0.5185 - val_loss: 1.6411 - val_acc: 0.4429
Epoch 439/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9700 - a
cc: 0.5173 - val_loss: 1.6422 - val_acc: 0.4325
Epoch 440/1000
866/866 [==============================] - ETA: 0s - loss: 0.9590 - acc:
0.492 - 0s 20us/step - loss: 0.9694 - acc: 0.5115 - val_loss: 1.6410 - val
_acc: 0.4429
Epoch 441/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9694 - a
cc: 0.5127 - val_loss: 1.6451 - val_acc: 0.4187
Epoch 442/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9691 - a
cc: 0.5058 - val_loss: 1.6483 - val_acc: 0.4083
Epoch 443/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9692 - a
cc: 0.5208 - val_loss: 1.6503 - val_acc: 0.4048
Epoch 444/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9700 - a
cc: 0.5104 - val_loss: 1.6484 - val_acc: 0.4014
Epoch 445/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9701 - a
cc: 0.5150 - val_loss: 1.6543 - val_acc: 0.4014
Epoch 446/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9686 - a
cc: 0.5185 - val_loss: 1.6579 - val_acc: 0.4014
Epoch 447/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5150 - val_loss: 1.6530 - val_acc: 0.4014
Epoch 448/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9697 - a
cc: 0.5127 - val_loss: 1.6471 - val_acc: 0.4048
Epoch 449/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9744 - a
cc: 0.5150 - val_loss: 1.6467 - val_acc: 0.4083
Epoch 450/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9674 - a
cc: 0.5150 - val_loss: 1.6460 - val_acc: 0.4083
Epoch 451/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9704 - a
cc: 0.5092 - val_loss: 1.6427 - val_acc: 0.4048
Epoch 452/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9687 - a
cc: 0.5069 - val_loss: 1.6431 - val_acc: 0.4048
Epoch 453/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9699 - a
cc: 0.5058 - val_loss: 1.6465 - val_acc: 0.4083
Epoch 454/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9678 - a
cc: 0.5115 - val_loss: 1.6510 - val_acc: 0.4048
Epoch 455/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9708 - a
cc: 0.5092 - val_loss: 1.6518 - val_acc: 0.4083
Epoch 456/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9704 - a
cc: 0.5127 - val_loss: 1.6464 - val_acc: 0.4048
Epoch 457/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9680 - a
cc: 0.5092 - val_loss: 1.6430 - val_acc: 0.4118
Epoch 458/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9706 - a
cc: 0.5185 - val_loss: 1.6500 - val_acc: 0.4187
Epoch 459/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9692 - a
cc: 0.5069 - val_loss: 1.6517 - val_acc: 0.4325
Epoch 460/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9687 - a
cc: 0.5115 - val_loss: 1.6592 - val_acc: 0.4429
Epoch 461/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9693 - a
```

```
cc: 0.5115 - val_loss: 1.6531 - val_acc: 0.4360
Epoch 462/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9699 - a
cc: 0.5139 - val_loss: 1.6482 - val_acc: 0.4325
Epoch 463/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9691 - a
cc: 0.5185 - val_loss: 1.6365 - val_acc: 0.4429
Epoch 464/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9689 - a
cc: 0.5104 - val_loss: 1.6259 - val_acc: 0.4360
Epoch 465/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9708 - a
cc: 0.5162 - val_loss: 1.6230 - val_acc: 0.4325
Epoch 466/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9676 - a
cc: 0.5058 - val_loss: 1.6246 - val_acc: 0.4187
Epoch 467/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9700 - a
cc: 0.5069 - val_loss: 1.6238 - val_acc: 0.4083
Epoch 468/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9690 - a
cc: 0.5150 - val_loss: 1.6293 - val_acc: 0.4118
Epoch 469/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9714 - a
cc: 0.5173 - val_loss: 1.6377 - val_acc: 0.4221
Epoch 470/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9688 - a
cc: 0.5127 - val_loss: 1.6445 - val_acc: 0.4256
Epoch 471/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9693 - a
cc: 0.5127 - val_loss: 1.6465 - val_acc: 0.4325
Epoch 472/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9700 - a
cc: 0.5127 - val_loss: 1.6435 - val_acc: 0.4291
Epoch 473/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9709 - a
cc: 0.5185 - val_loss: 1.6383 - val_acc: 0.4221
Epoch 474/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9714 - a
cc: 0.5092 - val_loss: 1.6450 - val_acc: 0.4118
Epoch 475/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9676 - a
cc: 0.5173 - val_loss: 1.6484 - val_acc: 0.4083
Epoch 476/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9691 - a
cc: 0.5162 - val_loss: 1.6442 - val_acc: 0.4048
Epoch 477/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9687 - a
cc: 0.5092 - val_loss: 1.6376 - val_acc: 0.4083
Epoch 478/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9712 - a
cc: 0.5162 - val_loss: 1.6319 - val_acc: 0.4083
Epoch 479/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9687 - a
cc: 0.5139 - val_loss: 1.6227 - val_acc: 0.4152
Epoch 480/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9680 - a
cc: 0.5173 - val_loss: 1.6217 - val_acc: 0.4291
Epoch 481/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9696 - a
cc: 0.5115 - val_loss: 1.6177 - val_acc: 0.4360
```

```
Epoch 482/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9686 - a
cc: 0.5173 - val_loss: 1.6167 - val_acc: 0.4360
Epoch 483/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9725 - a
cc: 0.5173 - val_loss: 1.6173 - val_acc: 0.4325
Epoch 484/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9676 - a
cc: 0.5196 - val_loss: 1.6160 - val_acc: 0.4152
Epoch 485/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9683 - a
cc: 0.5208 - val_loss: 1.6173 - val_acc: 0.4118
Epoch 486/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9678 - a
cc: 0.5162 - val_loss: 1.6119 - val_acc: 0.4118
Epoch 487/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9696 - a
cc: 0.5104 - val_loss: 1.6085 - val_acc: 0.4083
Epoch 488/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5127 - val_loss: 1.6004 - val_acc: 0.4083
Epoch 489/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9668 - a
cc: 0.5185 - val_loss: 1.6039 - val_acc: 0.4083
Epoch 490/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9696 - a
cc: 0.5139 - val_loss: 1.6032 - val_acc: 0.4083
Epoch 491/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9700 - a
cc: 0.5150 - val_loss: 1.6125 - val_acc: 0.4152
Epoch 492/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9673 - a
cc: 0.5139 - val_loss: 1.6128 - val_acc: 0.4118
Epoch 493/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9690 - a
cc: 0.5196 - val_loss: 1.6143 - val_acc: 0.4118
Epoch 494/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5058 - val_loss: 1.6080 - val_acc: 0.4118
Epoch 495/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9700 - a
cc: 0.5185 - val_loss: 1.6074 - val_acc: 0.4118
Epoch 496/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9689 - a
cc: 0.5104 - val_loss: 1.6142 - val_acc: 0.4118
Epoch 497/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9651 - a
cc: 0.5185 - val_loss: 1.6242 - val_acc: 0.4118
Epoch 498/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9679 - a
cc: 0.5208 - val_loss: 1.6409 - val_acc: 0.4118
Epoch 499/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9714 - a
cc: 0.5266 - val_loss: 1.6501 - val_acc: 0.4118
Epoch 500/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9688 - a
cc: 0.5127 - val_loss: 1.6499 - val_acc: 0.4118
Epoch 501/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9680 - a
cc: 0.5185 - val_loss: 1.6468 - val_acc: 0.4118
Epoch 502/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9682 - a
cc: 0.5127 - val_loss: 1.6473 - val_acc: 0.4118
Epoch 503/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9717 - a
cc: 0.5127 - val_loss: 1.6393 - val_acc: 0.4083
Epoch 504/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9700 - a
cc: 0.5196 - val_loss: 1.6380 - val_acc: 0.4118
Epoch 505/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9673 - a
cc: 0.5127 - val_loss: 1.6285 - val_acc: 0.4118
Epoch 506/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9678 - a
cc: 0.5173 - val_loss: 1.6207 - val_acc: 0.4187
Epoch 507/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5115 - val_loss: 1.6130 - val_acc: 0.4118
Epoch 508/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9681 - a
cc: 0.5127 - val_loss: 1.6074 - val_acc: 0.4118
Epoch 509/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9683 - a
cc: 0.5173 - val_loss: 1.6016 - val_acc: 0.4187
Epoch 510/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9709 - a
cc: 0.5208 - val_loss: 1.6062 - val_acc: 0.4152
Epoch 511/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9675 - a
cc: 0.5081 - val_loss: 1.6119 - val_acc: 0.4187
Epoch 512/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9660 - a
cc: 0.5196 - val_loss: 1.6219 - val_acc: 0.4221
Epoch 513/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9683 - a
cc: 0.5162 - val_loss: 1.6307 - val_acc: 0.4221
Epoch 514/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9679 - a
cc: 0.5081 - val_loss: 1.6416 - val_acc: 0.4152
Epoch 515/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9696 - a
cc: 0.5092 - val_loss: 1.6503 - val_acc: 0.4221
Epoch 516/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9686 - a
cc: 0.5162 - val_loss: 1.6566 - val_acc: 0.4152
Epoch 517/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9668 - a
cc: 0.5185 - val_loss: 1.6553 - val_acc: 0.4118
Epoch 518/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9683 - a
cc: 0.5081 - val_loss: 1.6468 - val_acc: 0.4118
Epoch 519/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9704 - a
cc: 0.5115 - val_loss: 1.6425 - val_acc: 0.4118
Epoch 520/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9679 - a
cc: 0.5081 - val_loss: 1.6359 - val_acc: 0.4152
Epoch 521/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9676 - a
cc: 0.5231 - val_loss: 1.6189 - val_acc: 0.4221
Epoch 522/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
```

```
cc: 0.5104 - val_loss: 1.6017 - val_acc: 0.4221
Epoch 523/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9680 - a
cc: 0.5115 - val_loss: 1.5851 - val_acc: 0.4152
Epoch 524/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9704 - a
cc: 0.5081 - val_loss: 1.5811 - val_acc: 0.4152
Epoch 525/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9683 - a
cc: 0.5104 - val_loss: 1.5812 - val_acc: 0.4152
Epoch 526/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9656 - a
cc: 0.5150 - val_loss: 1.5794 - val_acc: 0.4187
Epoch 527/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9692 - a
cc: 0.5185 - val_loss: 1.5725 - val_acc: 0.4118
Epoch 528/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9683 - a
cc: 0.5069 - val_loss: 1.5718 - val_acc: 0.4118
Epoch 529/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9692 - a
cc: 0.5173 - val_loss: 1.5712 - val_acc: 0.4118
Epoch 530/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9704 - a
cc: 0.5150 - val_loss: 1.5722 - val_acc: 0.4187
Epoch 531/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9697 - a
cc: 0.5162 - val_loss: 1.5795 - val_acc: 0.4187
Epoch 532/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9683 - a
cc: 0.5196 - val_loss: 1.5826 - val_acc: 0.4187
Epoch 533/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9677 - a
cc: 0.5173 - val_loss: 1.5883 - val_acc: 0.4221
Epoch 534/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9673 - a
cc: 0.5139 - val_loss: 1.6000 - val_acc: 0.4083
Epoch 535/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9693 - a
cc: 0.5069 - val_loss: 1.6156 - val_acc: 0.4118
Epoch 536/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9689 - a
cc: 0.5185 - val_loss: 1.6128 - val_acc: 0.4118
Epoch 537/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9668 - a
cc: 0.5185 - val_loss: 1.6031 - val_acc: 0.4118
Epoch 538/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9676 - a
cc: 0.5173 - val_loss: 1.5974 - val_acc: 0.4152
Epoch 539/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9673 - a
cc: 0.5150 - val_loss: 1.5843 - val_acc: 0.4152
Epoch 540/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9697 - a
cc: 0.5046 - val_loss: 1.5809 - val_acc: 0.4118
Epoch 541/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9683 - a
cc: 0.5196 - val_loss: 1.5843 - val_acc: 0.4256
Epoch 542/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9670 - a
cc: 0.5139 - val_loss: 1.5878 - val_acc: 0.4256
```

```
Epoch 543/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9695 - a
cc: 0.5046 - val_loss: 1.5946 - val_acc: 0.4187
Epoch 544/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9698 - a
cc: 0.5219 - val_loss: 1.5994 - val_acc: 0.4187
Epoch 545/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5196 - val_loss: 1.5982 - val_acc: 0.4187
Epoch 546/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9701 - a
cc: 0.5185 - val_loss: 1.6003 - val_acc: 0.4152
Epoch 547/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9682 - a
cc: 0.5150 - val_loss: 1.5973 - val_acc: 0.4083
Epoch 548/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9678 - a
cc: 0.5162 - val_loss: 1.6052 - val_acc: 0.4118
Epoch 549/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9681 - a
cc: 0.5196 - val_loss: 1.6059 - val_acc: 0.4118
Epoch 550/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9688 - a
cc: 0.5092 - val_loss: 1.6167 - val_acc: 0.4118
Epoch 551/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9671 - a
cc: 0.5127 - val_loss: 1.6181 - val_acc: 0.4152
Epoch 552/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9698 - a
cc: 0.5127 - val_loss: 1.6252 - val_acc: 0.4187
Epoch 553/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9683 - a
cc: 0.5254 - val_loss: 1.6442 - val_acc: 0.4221
Epoch 554/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9692 - a
cc: 0.5150 - val_loss: 1.6461 - val_acc: 0.4360
Epoch 555/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9663 - a
cc: 0.5196 - val_loss: 1.6420 - val_acc: 0.4256
Epoch 556/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9676 - a
cc: 0.5139 - val_loss: 1.6390 - val_acc: 0.4152
Epoch 557/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9700 - a
cc: 0.5115 - val_loss: 1.6407 - val_acc: 0.4083
Epoch 558/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9684 - a
cc: 0.5150 - val_loss: 1.6454 - val_acc: 0.4152
Epoch 559/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9670 - a
cc: 0.5139 - val_loss: 1.6411 - val_acc: 0.4118
Epoch 560/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9696 - a
cc: 0.5139 - val_loss: 1.6429 - val_acc: 0.4256
Epoch 561/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5173 - val_loss: 1.6364 - val_acc: 0.4325
Epoch 562/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9702 - a
cc: 0.5173 - val_loss: 1.6348 - val_acc: 0.4221
Epoch 563/1000
```

```
866/866 [==============================] - 0s 17us/step - loss: 0.9674 - a
cc: 0.5185 - val_loss: 1.6354 - val_acc: 0.4152
Epoch 564/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9680 - a
cc: 0.5162 - val_loss: 1.6315 - val_acc: 0.4152
Epoch 565/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9675 - a
cc: 0.5219 - val_loss: 1.6337 - val_acc: 0.4118
Epoch 566/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9687 - a
cc: 0.5139 - val_loss: 1.6412 - val_acc: 0.4083
Epoch 567/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9695 - a
cc: 0.5150 - val_loss: 1.6424 - val_acc: 0.4118
Epoch 568/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9734 - a
cc: 0.5069 - val_loss: 1.6396 - val_acc: 0.4083
Epoch 569/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9686 - a
cc: 0.5139 - val_loss: 1.6382 - val_acc: 0.4152
Epoch 570/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9685 - a
cc: 0.5127 - val_loss: 1.6332 - val_acc: 0.4083
Epoch 571/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9695 - a
cc: 0.5081 - val_loss: 1.6318 - val_acc: 0.4118
Epoch 572/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9682 - a
cc: 0.5150 - val_loss: 1.6360 - val_acc: 0.4118
Epoch 573/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9694 - a
cc: 0.5139 - val_loss: 1.6384 - val_acc: 0.4048
Epoch 574/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9687 - a
cc: 0.5127 - val_loss: 1.6431 - val_acc: 0.4118
Epoch 575/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5058 - val_loss: 1.6424 - val_acc: 0.4118
Epoch 576/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9673 - a
cc: 0.5092 - val_loss: 1.6409 - val_acc: 0.4083
Epoch 577/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9689 - a
cc: 0.5127 - val_loss: 1.6311 - val_acc: 0.4083
Epoch 578/1000
866/866 [==============================] - ETA: 0s - loss: 0.9313 - acc:
 0.554 - 0s 15us/step - loss: 0.9677 - acc: 0.5127 - val_loss: 1.6354 - va
l_acc: 0.4152
Epoch 579/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9676 - a
cc: 0.5162 - val_loss: 1.6402 - val_acc: 0.4152
Epoch 580/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9674 - a
cc: 0.5092 - val_loss: 1.6420 - val_acc: 0.4187
Epoch 581/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9672 - a
cc: 0.5162 - val_loss: 1.6393 - val_acc: 0.4221
Epoch 582/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9685 - a
cc: 0.5219 - val_loss: 1.6400 - val_acc: 0.4256
Epoch 583/1000
```

```
866/866 [==============================] - 0s 17us/step - loss: 0.9691 - a
cc: 0.5185 - val_loss: 1.6455 - val_acc: 0.4221
Epoch 584/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9693 - a
cc: 0.5115 - val_loss: 1.6540 - val_acc: 0.4256
Epoch 585/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9663 - a
cc: 0.5092 - val_loss: 1.6562 - val_acc: 0.4221
Epoch 586/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9668 - a
cc: 0.5104 - val_loss: 1.6473 - val_acc: 0.4256
Epoch 587/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9657 - a
cc: 0.5150 - val_loss: 1.6395 - val_acc: 0.4256
Epoch 588/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9679 - a
cc: 0.5150 - val_loss: 1.6304 - val_acc: 0.4256
Epoch 589/1000
866/866 [==============================] - ETA: 0s - loss: 0.9868 - acc:
 0.511 - 0s 15us/step - loss: 0.9676 - acc: 0.5127 - val_loss: 1.6311 - va
l_acc: 0.4256
Epoch 590/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9742 - a
cc: 0.5127 - val_loss: 1.6316 - val_acc: 0.4256
Epoch 591/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9677 - a
cc: 0.5139 - val_loss: 1.6324 - val_acc: 0.4221
Epoch 592/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9678 - a
cc: 0.5139 - val_loss: 1.6283 - val_acc: 0.4221
Epoch 593/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9700 - a
cc: 0.5150 - val_loss: 1.6231 - val_acc: 0.4187
Epoch 594/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9669 - a
cc: 0.5173 - val_loss: 1.6249 - val_acc: 0.4187
Epoch 595/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9700 - a
cc: 0.5127 - val_loss: 1.6254 - val_acc: 0.4256
Epoch 596/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5196 - val_loss: 1.6241 - val_acc: 0.4221
Epoch 597/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9707 - a
cc: 0.5092 - val_loss: 1.6318 - val_acc: 0.4187
Epoch 598/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9700 - a
cc: 0.5150 - val_loss: 1.6348 - val_acc: 0.4187
Epoch 599/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9693 - a
cc: 0.5092 - val_loss: 1.6417 - val_acc: 0.4221
Epoch 600/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9678 - a
cc: 0.5127 - val_loss: 1.6476 - val_acc: 0.4187
Epoch 601/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9680 - a
cc: 0.5150 - val_loss: 1.6586 - val_acc: 0.4256
Epoch 602/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9676 - a
cc: 0.5081 - val_loss: 1.6612 - val_acc: 0.4291
Epoch 603/1000
```

```
866/866 [==============================] - 0s 18us/step - loss: 0.9657 - a
cc: 0.5196 - val_loss: 1.6609 - val_acc: 0.4291
Epoch 604/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9689 - a
cc: 0.5115 - val_loss: 1.6553 - val_acc: 0.4221
Epoch 605/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9652 - a
cc: 0.5104 - val_loss: 1.6580 - val_acc: 0.4187
Epoch 606/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9665 - a
cc: 0.5127 - val_loss: 1.6601 - val_acc: 0.4187
Epoch 607/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9685 - a
cc: 0.5150 - val_loss: 1.6642 - val_acc: 0.4187
Epoch 608/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9672 - a
cc: 0.5139 - val_loss: 1.6656 - val_acc: 0.4256
Epoch 609/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9669 - a
cc: 0.5127 - val_loss: 1.6617 - val_acc: 0.4221
Epoch 610/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9669 - a
cc: 0.5104 - val_loss: 1.6600 - val_acc: 0.4256
Epoch 611/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9673 - a
cc: 0.5242 - val_loss: 1.6573 - val_acc: 0.4256
Epoch 612/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9677 - a
cc: 0.5242 - val_loss: 1.6659 - val_acc: 0.4221
Epoch 613/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9678 - a
cc: 0.5173 - val_loss: 1.6667 - val_acc: 0.4221
Epoch 614/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9666 - a
cc: 0.5173 - val_loss: 1.6628 - val_acc: 0.4221
Epoch 615/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9679 - a
cc: 0.5150 - val_loss: 1.6566 - val_acc: 0.4221
Epoch 616/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9696 - a
cc: 0.5162 - val_loss: 1.6620 - val_acc: 0.4256
Epoch 617/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9673 - a
cc: 0.5173 - val_loss: 1.6712 - val_acc: 0.4221
Epoch 618/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9676 - a
cc: 0.5115 - val_loss: 1.6751 - val_acc: 0.4256
Epoch 619/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9685 - a
cc: 0.5115 - val_loss: 1.6792 - val_acc: 0.4187
Epoch 620/1000
866/866 [==============================] - 0s 30us/step - loss: 0.9669 - a
cc: 0.5173 - val_loss: 1.6774 - val_acc: 0.4256
Epoch 621/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9675 - a
cc: 0.5150 - val_loss: 1.6708 - val_acc: 0.4291
Epoch 622/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9687 - a
cc: 0.5150 - val_loss: 1.6681 - val_acc: 0.4360
Epoch 623/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9704 - a
```

```
cc: 0.5115 - val_loss: 1.6661 - val_acc: 0.4360
Epoch 624/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9662 - a
cc: 0.5127 - val_loss: 1.6562 - val_acc: 0.4256
Epoch 625/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9673 - a
cc: 0.5173 - val_loss: 1.6552 - val_acc: 0.4221
Epoch 626/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9665 - a
cc: 0.5208 - val_loss: 1.6577 - val_acc: 0.4187
Epoch 627/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9659 - a
cc: 0.5162 - val_loss: 1.6558 - val_acc: 0.4221
Epoch 628/1000
866/866 [==============================] - 0s 14us/step - loss: 0.9691 - a
cc: 0.5208 - val_loss: 1.6491 - val_acc: 0.4256
Epoch 629/1000
866/866 [==============================] - 0s 14us/step - loss: 0.9678 - a
cc: 0.5254 - val_loss: 1.6462 - val_acc: 0.4256
Epoch 630/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9682 - a
cc: 0.5162 - val_loss: 1.6409 - val_acc: 0.4221
Epoch 631/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9665 - a
cc: 0.5208 - val_loss: 1.6333 - val_acc: 0.4221
Epoch 632/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9685 - a
cc: 0.5139 - val_loss: 1.6328 - val_acc: 0.4256
Epoch 633/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9682 - a
cc: 0.5081 - val_loss: 1.6281 - val_acc: 0.4256
Epoch 634/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9698 - a
cc: 0.5173 - val_loss: 1.6299 - val_acc: 0.4256
Epoch 635/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9673 - a
cc: 0.5173 - val_loss: 1.6242 - val_acc: 0.4221
Epoch 636/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9682 - a
cc: 0.5173 - val_loss: 1.6245 - val_acc: 0.4256
Epoch 637/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9691 - a
cc: 0.5127 - val_loss: 1.6296 - val_acc: 0.4256
Epoch 638/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9680 - a
cc: 0.5150 - val_loss: 1.6282 - val_acc: 0.4256
Epoch 639/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9683 - a
cc: 0.5115 - val_loss: 1.6298 - val_acc: 0.4256
Epoch 640/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9664 - a
cc: 0.5127 - val_loss: 1.6327 - val_acc: 0.4256
Epoch 641/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9696 - a
cc: 0.5173 - val_loss: 1.6331 - val_acc: 0.4291
Epoch 642/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9658 - a
cc: 0.5162 - val_loss: 1.6342 - val_acc: 0.4256
Epoch 643/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9688 - a
cc: 0.5208 - val_loss: 1.6375 - val_acc: 0.4256
```

```
Epoch 644/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9657 - a
cc: 0.5277 - val_loss: 1.6438 - val_acc: 0.4187
Epoch 645/1000
866/866 [==============================] - 0s 25us/step - loss: 0.9677 - a
cc: 0.5208 - val_loss: 1.6482 - val_acc: 0.4118
Epoch 646/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9666 - a
cc: 0.5219 - val_loss: 1.6571 - val_acc: 0.4187
Epoch 647/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9674 - a
cc: 0.5162 - val_loss: 1.6504 - val_acc: 0.4221
Epoch 648/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9682 - a
cc: 0.5104 - val_loss: 1.6472 - val_acc: 0.4256
Epoch 649/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9674 - a
cc: 0.5208 - val_loss: 1.6452 - val_acc: 0.4256
Epoch 650/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9692 - a
cc: 0.5104 - val_loss: 1.6466 - val_acc: 0.4221
Epoch 651/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5069 - val_loss: 1.6406 - val_acc: 0.4187
Epoch 652/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9685 - a
cc: 0.5081 - val_loss: 1.6238 - val_acc: 0.4187
Epoch 653/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9690 - a
cc: 0.5069 - val_loss: 1.6187 - val_acc: 0.4256
Epoch 654/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9685 - a
cc: 0.5150 - val_loss: 1.6192 - val_acc: 0.4256
Epoch 655/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9668 - a
cc: 0.5139 - val_loss: 1.6141 - val_acc: 0.4256
Epoch 656/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9661 - a
cc: 0.5127 - val_loss: 1.6175 - val_acc: 0.4152
Epoch 657/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9682 - a
cc: 0.5115 - val_loss: 1.6189 - val_acc: 0.4152
Epoch 658/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9686 - a
cc: 0.5058 - val_loss: 1.6183 - val_acc: 0.4118
Epoch 659/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9659 - a
cc: 0.5185 - val_loss: 1.6160 - val_acc: 0.4152
Epoch 660/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9671 - a
cc: 0.5162 - val_loss: 1.6154 - val_acc: 0.4221
Epoch 661/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9663 - a
cc: 0.5185 - val_loss: 1.6149 - val_acc: 0.4118
Epoch 662/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9663 - a
cc: 0.5127 - val_loss: 1.6120 - val_acc: 0.4118
Epoch 663/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9670 - a
cc: 0.5139 - val_loss: 1.6118 - val_acc: 0.4118
Epoch 664/1000
```

```
866/866 [==============================] - 0s 18us/step - loss: 0.9676 - a
cc: 0.5081 - val_loss: 1.6127 - val_acc: 0.4256
Epoch 665/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9661 - a
cc: 0.5219 - val_loss: 1.6150 - val_acc: 0.4291
Epoch 666/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9660 - a
cc: 0.5104 - val_loss: 1.6161 - val_acc: 0.4291
Epoch 667/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9662 - a
cc: 0.5196 - val_loss: 1.6148 - val_acc: 0.4256
Epoch 668/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9671 - a
cc: 0.5127 - val_loss: 1.6090 - val_acc: 0.4256
Epoch 669/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9662 - a
cc: 0.5127 - val_loss: 1.5998 - val_acc: 0.4256
Epoch 670/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
cc: 0.5173 - val_loss: 1.5970 - val_acc: 0.4291
Epoch 671/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9667 - a
cc: 0.5173 - val_loss: 1.5962 - val_acc: 0.4291
Epoch 672/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9670 - a
cc: 0.5139 - val_loss: 1.5937 - val_acc: 0.4325
Epoch 673/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9654 - a
cc: 0.5219 - val_loss: 1.5902 - val_acc: 0.4291
Epoch 674/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9664 - a
cc: 0.5231 - val_loss: 1.5885 - val_acc: 0.4325
Epoch 675/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9671 - a
cc: 0.5162 - val_loss: 1.5935 - val_acc: 0.4325
Epoch 676/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9680 - a
cc: 0.5127 - val_loss: 1.5981 - val_acc: 0.4221
Epoch 677/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9699 - a
cc: 0.5127 - val_loss: 1.6068 - val_acc: 0.4221
Epoch 678/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9670 - a
cc: 0.5139 - val_loss: 1.6074 - val_acc: 0.4325
Epoch 679/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9691 - a
cc: 0.5069 - val_loss: 1.6104 - val_acc: 0.4256
Epoch 680/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9663 - a
cc: 0.5185 - val_loss: 1.6141 - val_acc: 0.4256
Epoch 681/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9664 - a
cc: 0.5173 - val_loss: 1.6198 - val_acc: 0.4187
Epoch 682/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9673 - a
cc: 0.5173 - val_loss: 1.6223 - val_acc: 0.4187
Epoch 683/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9666 - a
cc: 0.5173 - val_loss: 1.6255 - val_acc: 0.4187
Epoch 684/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9683 - a
```

```
cc: 0.5185 - val_loss: 1.6371 - val_acc: 0.4256
Epoch 685/1000
866/866 [==============================] - 0s 14us/step - loss: 0.9662 - a
cc: 0.5219 - val_loss: 1.6464 - val_acc: 0.4256
Epoch 686/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9670 - a
cc: 0.5104 - val_loss: 1.6456 - val_acc: 0.4221
Epoch 687/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9685 - a
cc: 0.5139 - val_loss: 1.6450 - val_acc: 0.4221
Epoch 688/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9665 - a
cc: 0.5219 - val_loss: 1.6417 - val_acc: 0.4256
Epoch 689/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9663 - a
cc: 0.5092 - val_loss: 1.6327 - val_acc: 0.4221
Epoch 690/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9675 - a
cc: 0.5173 - val_loss: 1.6254 - val_acc: 0.4221
Epoch 691/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9670 - a
cc: 0.5254 - val_loss: 1.6202 - val_acc: 0.4291
Epoch 692/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9680 - a
cc: 0.5104 - val_loss: 1.6070 - val_acc: 0.4221
Epoch 693/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
cc: 0.5173 - val_loss: 1.6053 - val_acc: 0.4394
Epoch 694/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9705 - a
cc: 0.5104 - val_loss: 1.5991 - val_acc: 0.4291
Epoch 695/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9664 - a
cc: 0.5092 - val_loss: 1.5930 - val_acc: 0.4256
Epoch 696/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9678 - a
cc: 0.5173 - val_loss: 1.5913 - val_acc: 0.4291
Epoch 697/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9694 - a
cc: 0.5173 - val_loss: 1.6006 - val_acc: 0.4256
Epoch 698/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9685 - a
cc: 0.5115 - val_loss: 1.6071 - val_acc: 0.4256
Epoch 699/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9655 - a
cc: 0.5173 - val_loss: 1.6108 - val_acc: 0.4291
Epoch 700/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9660 - a
cc: 0.5208 - val_loss: 1.6121 - val_acc: 0.4256
Epoch 701/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9691 - a
cc: 0.5150 - val_loss: 1.6098 - val_acc: 0.4256
Epoch 702/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9669 - a
cc: 0.5150 - val_loss: 1.6119 - val_acc: 0.4256
Epoch 703/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9666 - a
cc: 0.5196 - val_loss: 1.6178 - val_acc: 0.4118
Epoch 704/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9667 - a
cc: 0.5173 - val_loss: 1.6247 - val_acc: 0.4083
```

```
Epoch 705/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9699 - a
cc: 0.5185 - val_loss: 1.6294 - val_acc: 0.4083
Epoch 706/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9676 - a
cc: 0.5104 - val_loss: 1.6337 - val_acc: 0.4187
Epoch 707/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9659 - a
cc: 0.5173 - val_loss: 1.6326 - val_acc: 0.4256
Epoch 708/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9683 - a
cc: 0.5173 - val_loss: 1.6328 - val_acc: 0.4394
Epoch 709/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9682 - a
cc: 0.5127 - val_loss: 1.6315 - val_acc: 0.4360
Epoch 710/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9676 - a
cc: 0.5173 - val_loss: 1.6201 - val_acc: 0.4325
Epoch 711/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9682 - a
cc: 0.5115 - val_loss: 1.6116 - val_acc: 0.4291
Epoch 712/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9678 - a
cc: 0.5173 - val_loss: 1.6025 - val_acc: 0.4325
Epoch 713/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9682 - a
cc: 0.5058 - val_loss: 1.5995 - val_acc: 0.4256
Epoch 714/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9667 - a
cc: 0.5185 - val_loss: 1.6100 - val_acc: 0.4291
Epoch 715/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9628 - a
cc: 0.5219 - val_loss: 1.6181 - val_acc: 0.4291
Epoch 716/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9685 - a
cc: 0.5150 - val_loss: 1.6220 - val_acc: 0.4291
Epoch 717/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9685 - a
cc: 0.5150 - val_loss: 1.6338 - val_acc: 0.4256
Epoch 718/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9703 - a
cc: 0.5208 - val_loss: 1.6394 - val_acc: 0.4187
Epoch 719/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9672 - a
cc: 0.5115 - val_loss: 1.6407 - val_acc: 0.4256
Epoch 720/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9664 - a
cc: 0.5104 - val_loss: 1.6451 - val_acc: 0.4221
Epoch 721/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9664 - a
cc: 0.5219 - val_loss: 1.6496 - val_acc: 0.4221
Epoch 722/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9697 - a
cc: 0.5139 - val_loss: 1.6557 - val_acc: 0.4221
Epoch 723/1000
866/866 [==============================] - 0s 25us/step - loss: 0.9667 - a
cc: 0.5092 - val_loss: 1.6614 - val_acc: 0.4256
Epoch 724/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9667 - a
cc: 0.5139 - val_loss: 1.6660 - val_acc: 0.4256
Epoch 725/1000
```

```
866/866 [==============================] - 0s 22us/step - loss: 0.9673 - a
cc: 0.5208 - val_loss: 1.6664 - val_acc: 0.4256
Epoch 726/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9660 - a
cc: 0.5173 - val_loss: 1.6607 - val_acc: 0.4291
Epoch 727/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9684 - a
cc: 0.5185 - val_loss: 1.6598 - val_acc: 0.4291
Epoch 728/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9668 - a
cc: 0.5162 - val_loss: 1.6556 - val_acc: 0.4221
Epoch 729/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9678 - a
cc: 0.5254 - val_loss: 1.6570 - val_acc: 0.4256
Epoch 730/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9663 - a
cc: 0.5173 - val_loss: 1.6564 - val_acc: 0.4256
Epoch 731/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9678 - a
cc: 0.5115 - val_loss: 1.6543 - val_acc: 0.4325
Epoch 732/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9664 - a
cc: 0.5081 - val_loss: 1.6533 - val_acc: 0.4256
Epoch 733/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9660 - a
cc: 0.5035 - val_loss: 1.6513 - val_acc: 0.4221
Epoch 734/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9692 - a
cc: 0.5196 - val_loss: 1.6414 - val_acc: 0.4221
Epoch 735/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9666 - a
cc: 0.5092 - val_loss: 1.6473 - val_acc: 0.4187
Epoch 736/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9666 - a
cc: 0.5150 - val_loss: 1.6507 - val_acc: 0.4187
Epoch 737/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9665 - a
cc: 0.5150 - val_loss: 1.6480 - val_acc: 0.4256
Epoch 738/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9678 - a
cc: 0.5208 - val_loss: 1.6475 - val_acc: 0.4291
Epoch 739/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9670 - a
cc: 0.5208 - val_loss: 1.6464 - val_acc: 0.4325
Epoch 740/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9667 - a
cc: 0.5173 - val_loss: 1.6507 - val_acc: 0.4291
Epoch 741/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9677 - a
cc: 0.5219 - val_loss: 1.6532 - val_acc: 0.4256
Epoch 742/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9683 - a
cc: 0.5092 - val_loss: 1.6534 - val_acc: 0.4291
Epoch 743/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9656 - a
cc: 0.5139 - val_loss: 1.6546 - val_acc: 0.4256
Epoch 744/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9656 - a
cc: 0.5115 - val_loss: 1.6581 - val_acc: 0.4152
Epoch 745/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9697 - a
```

```
cc: 0.5115 - val_loss: 1.6575 - val_acc: 0.4152
Epoch 746/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9682 - a
cc: 0.5127 - val_loss: 1.6446 - val_acc: 0.4221
Epoch 747/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9699 - a
cc: 0.5127 - val_loss: 1.6333 - val_acc: 0.4221
Epoch 748/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9657 - a
cc: 0.5208 - val_loss: 1.6232 - val_acc: 0.4221
Epoch 749/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9656 - a
cc: 0.5173 - val_loss: 1.6254 - val_acc: 0.4187
Epoch 750/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9676 - a
cc: 0.5139 - val_loss: 1.6316 - val_acc: 0.4256
Epoch 751/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9669 - a
cc: 0.5150 - val_loss: 1.6329 - val_acc: 0.4256
Epoch 752/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9681 - a
cc: 0.5196 - val_loss: 1.6402 - val_acc: 0.4256
Epoch 753/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9656 - a
cc: 0.5162 - val_loss: 1.6358 - val_acc: 0.4256
Epoch 754/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9666 - a
cc: 0.5242 - val_loss: 1.6399 - val_acc: 0.4256
Epoch 755/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9673 - a
cc: 0.5208 - val_loss: 1.6427 - val_acc: 0.4291
Epoch 756/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9672 - a
cc: 0.5173 - val_loss: 1.6487 - val_acc: 0.4291
Epoch 757/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9679 - a
cc: 0.5150 - val_loss: 1.6481 - val_acc: 0.4187
Epoch 758/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9673 - a
cc: 0.5104 - val_loss: 1.6428 - val_acc: 0.4083
Epoch 759/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9676 - a
cc: 0.5162 - val_loss: 1.6367 - val_acc: 0.4187
Epoch 760/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9688 - a
cc: 0.5139 - val_loss: 1.6391 - val_acc: 0.4256
Epoch 761/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9673 - a
cc: 0.5196 - val_loss: 1.6425 - val_acc: 0.4256
Epoch 762/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9675 - a
cc: 0.5185 - val_loss: 1.6456 - val_acc: 0.4256
Epoch 763/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9704 - a
cc: 0.5104 - val_loss: 1.6459 - val_acc: 0.4187
Epoch 764/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9677 - a
cc: 0.5115 - val_loss: 1.6479 - val_acc: 0.4152
Epoch 765/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9671 - a
cc: 0.5185 - val_loss: 1.6497 - val_acc: 0.4118
```

```
Epoch 766/1000
866/866 [==============================] - ETA: 0s - loss: 0.9913 - acc:
 0.511 - 0s 16us/step - loss: 0.9678 - acc: 0.5115 - val_loss: 1.6473 - va
l_acc: 0.4187
Epoch 767/1000
866/866 [==============================] - 0s 14us/step - loss: 0.9681 - a
cc: 0.5150 - val_loss: 1.6463 - val_acc: 0.4187
Epoch 768/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9663 - a
cc: 0.5104 - val_loss: 1.6432 - val_acc: 0.4187
Epoch 769/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9669 - a
cc: 0.5035 - val_loss: 1.6434 - val_acc: 0.4291
Epoch 770/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9683 - a
cc: 0.5069 - val_loss: 1.6482 - val_acc: 0.4291
Epoch 771/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9673 - a
cc: 0.5092 - val_loss: 1.6438 - val_acc: 0.4325
Epoch 772/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9674 - a
cc: 0.5173 - val_loss: 1.6334 - val_acc: 0.4325
Epoch 773/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9687 - a
cc: 0.5058 - val_loss: 1.6231 - val_acc: 0.4256
Epoch 774/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9662 - a
cc: 0.5139 - val_loss: 1.6211 - val_acc: 0.4291
Epoch 775/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9666 - a
cc: 0.5081 - val_loss: 1.6183 - val_acc: 0.4187
Epoch 776/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9667 - a
cc: 0.5196 - val_loss: 1.6206 - val_acc: 0.4221
Epoch 777/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9652 - a
cc: 0.5208 - val_loss: 1.6176 - val_acc: 0.4187
Epoch 778/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9677 - a
cc: 0.5219 - val_loss: 1.6165 - val_acc: 0.4221
Epoch 779/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9684 - a
cc: 0.5139 - val_loss: 1.6137 - val_acc: 0.4256
Epoch 780/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9684 - a
cc: 0.5162 - val_loss: 1.6140 - val_acc: 0.4221
Epoch 781/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9656 - a
cc: 0.5185 - val_loss: 1.6137 - val_acc: 0.4118
Epoch 782/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9681 - a
cc: 0.5104 - val_loss: 1.6167 - val_acc: 0.4118
Epoch 783/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9672 - a
cc: 0.5173 - val_loss: 1.6264 - val_acc: 0.4291
Epoch 784/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9700 - a
cc: 0.5127 - val_loss: 1.6300 - val_acc: 0.4291
Epoch 785/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9664 - a
cc: 0.5208 - val_loss: 1.6371 - val_acc: 0.4291
```

```
Epoch 786/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9683 - a
cc: 0.5127 - val_loss: 1.6456 - val_acc: 0.4221
Epoch 787/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9681 - a
cc: 0.5115 - val_loss: 1.6520 - val_acc: 0.4187
Epoch 788/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9672 - a
cc: 0.5162 - val_loss: 1.6601 - val_acc: 0.4256
Epoch 789/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9672 - a
cc: 0.5104 - val_loss: 1.6605 - val_acc: 0.4325
Epoch 790/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9670 - a
cc: 0.5115 - val_loss: 1.6574 - val_acc: 0.4256
Epoch 791/1000
866/866 [==============================] - ETA: 0s - loss: 0.9706 - acc:
 0.511 - 0s 17us/step - loss: 0.9661 - acc: 0.5104 - val_loss: 1.6476 - va
l_acc: 0.4221
Epoch 792/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9660 - a
cc: 0.5150 - val_loss: 1.6363 - val_acc: 0.4187
Epoch 793/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9676 - a
cc: 0.5219 - val_loss: 1.6276 - val_acc: 0.4152
Epoch 794/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9668 - a
cc: 0.5139 - val_loss: 1.6222 - val_acc: 0.4152
Epoch 795/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9680 - a
cc: 0.5104 - val_loss: 1.6268 - val_acc: 0.4187
Epoch 796/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9652 - a
cc: 0.5150 - val_loss: 1.6330 - val_acc: 0.4256
Epoch 797/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9664 - a
cc: 0.5162 - val_loss: 1.6437 - val_acc: 0.4291
Epoch 798/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9674 - a
cc: 0.5196 - val_loss: 1.6537 - val_acc: 0.4394
Epoch 799/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9691 - a
cc: 0.5104 - val_loss: 1.6525 - val_acc: 0.4360
Epoch 800/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9683 - a
cc: 0.5023 - val_loss: 1.6521 - val_acc: 0.4256
Epoch 801/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9659 - a
cc: 0.5208 - val_loss: 1.6441 - val_acc: 0.4291
Epoch 802/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9678 - a
cc: 0.5139 - val_loss: 1.6402 - val_acc: 0.4325
Epoch 803/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9677 - a
cc: 0.5092 - val_loss: 1.6390 - val_acc: 0.4291
Epoch 804/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9642 - a
cc: 0.5150 - val_loss: 1.6272 - val_acc: 0.4291
Epoch 805/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9643 - a
cc: 0.5069 - val_loss: 1.6189 - val_acc: 0.4291
```

```
Epoch 806/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9668 - a
cc: 0.5104 - val_loss: 1.6149 - val_acc: 0.4221
Epoch 807/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9672 - a
cc: 0.5127 - val_loss: 1.6161 - val_acc: 0.4187
Epoch 808/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9647 - a
cc: 0.5185 - val_loss: 1.6157 - val_acc: 0.4187
Epoch 809/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9662 - a
cc: 0.5162 - val_loss: 1.6199 - val_acc: 0.4187
Epoch 810/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9688 - a
cc: 0.5139 - val_loss: 1.6236 - val_acc: 0.4291
Epoch 811/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9676 - a
cc: 0.5173 - val_loss: 1.6145 - val_acc: 0.4291
Epoch 812/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9651 - a
cc: 0.5162 - val_loss: 1.6112 - val_acc: 0.4291
Epoch 813/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9676 - a
cc: 0.5115 - val_loss: 1.6165 - val_acc: 0.4325
Epoch 814/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9654 - a
cc: 0.5104 - val_loss: 1.6250 - val_acc: 0.4187
Epoch 815/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9668 - a
cc: 0.5139 - val_loss: 1.6331 - val_acc: 0.4187
Epoch 816/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9669 - a
cc: 0.5127 - val_loss: 1.6396 - val_acc: 0.4187
Epoch 817/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9666 - a
cc: 0.5196 - val_loss: 1.6405 - val_acc: 0.4325
Epoch 818/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9669 - a
cc: 0.5115 - val_loss: 1.6416 - val_acc: 0.4291
Epoch 819/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9675 - a
cc: 0.5081 - val_loss: 1.6424 - val_acc: 0.4291
Epoch 820/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9657 - a
cc: 0.5208 - val_loss: 1.6342 - val_acc: 0.4187
Epoch 821/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9655 - a
cc: 0.5173 - val_loss: 1.6242 - val_acc: 0.4187
Epoch 822/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9669 - a
cc: 0.5115 - val_loss: 1.6237 - val_acc: 0.4256
Epoch 823/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9678 - a
cc: 0.5127 - val_loss: 1.6247 - val_acc: 0.4291
Epoch 824/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9655 - a
cc: 0.5173 - val_loss: 1.6140 - val_acc: 0.4291
Epoch 825/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9690 - a
cc: 0.5173 - val_loss: 1.6097 - val_acc: 0.4291
Epoch 826/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9684 - a
cc: 0.5104 - val_loss: 1.6055 - val_acc: 0.4291
Epoch 827/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9669 - a
cc: 0.5115 - val_loss: 1.6036 - val_acc: 0.4187
Epoch 828/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9665 - a
cc: 0.5173 - val_loss: 1.6066 - val_acc: 0.4187
Epoch 829/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
cc: 0.5127 - val_loss: 1.6136 - val_acc: 0.4187
Epoch 830/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9666 - a
cc: 0.5115 - val_loss: 1.6211 - val_acc: 0.4187
Epoch 831/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9672 - a
cc: 0.5185 - val_loss: 1.6250 - val_acc: 0.4187
Epoch 832/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9687 - a
cc: 0.5104 - val_loss: 1.6279 - val_acc: 0.4187
Epoch 833/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9668 - a
cc: 0.5162 - val_loss: 1.6308 - val_acc: 0.4187
Epoch 834/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9671 - a
cc: 0.5139 - val_loss: 1.6371 - val_acc: 0.4187
Epoch 835/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9684 - a
cc: 0.5139 - val_loss: 1.6478 - val_acc: 0.4187
Epoch 836/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9675 - a
cc: 0.5208 - val_loss: 1.6516 - val_acc: 0.4291
Epoch 837/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9671 - a
cc: 0.5150 - val_loss: 1.6525 - val_acc: 0.4187
Epoch 838/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9667 - a
cc: 0.5162 - val_loss: 1.6571 - val_acc: 0.4187
Epoch 839/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9656 - a
cc: 0.5185 - val_loss: 1.6567 - val_acc: 0.4152
Epoch 840/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9681 - a
cc: 0.5104 - val_loss: 1.6489 - val_acc: 0.4152
Epoch 841/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9675 - a
cc: 0.5081 - val_loss: 1.6408 - val_acc: 0.4118
Epoch 842/1000
866/866 [==============================] - ETA: 0s - loss: 0.9697 - acc:
 0.535 - 0s 18us/step - loss: 0.9691 - acc: 0.5173 - val_loss: 1.6385 - va
l_acc: 0.4118
Epoch 843/1000
866/866 [==============================] - ETA: 0s - loss: 0.9762 - acc:
 0.484 - 0s 18us/step - loss: 0.9660 - acc: 0.5069 - val_loss: 1.6397 - va
l_acc: 0.4187
Epoch 844/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9670 - a
cc: 0.5208 - val_loss: 1.6355 - val_acc: 0.4291
Epoch 845/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9649 - a
cc: 0.5127 - val_loss: 1.6300 - val_acc: 0.4291
```

```
Epoch 846/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9654 - a
cc: 0.5208 - val_loss: 1.6223 - val_acc: 0.4325
Epoch 847/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9664 - a
cc: 0.5219 - val_loss: 1.6231 - val_acc: 0.4291
Epoch 848/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9663 - a
cc: 0.5173 - val_loss: 1.6197 - val_acc: 0.4291
Epoch 849/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9667 - a
cc: 0.5219 - val_loss: 1.6177 - val_acc: 0.4256
Epoch 850/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9691 - a
cc: 0.5127 - val_loss: 1.6073 - val_acc: 0.4325
Epoch 851/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9657 - a
cc: 0.5115 - val_loss: 1.6062 - val_acc: 0.4187
Epoch 852/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9649 - a
cc: 0.5139 - val_loss: 1.6115 - val_acc: 0.4221
Epoch 853/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9671 - a
cc: 0.5196 - val_loss: 1.6195 - val_acc: 0.4221
Epoch 854/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9666 - a
cc: 0.5208 - val_loss: 1.6311 - val_acc: 0.4152
Epoch 855/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9650 - a
cc: 0.5115 - val_loss: 1.6508 - val_acc: 0.4118
Epoch 856/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9671 - a
cc: 0.5150 - val_loss: 1.6696 - val_acc: 0.4118
Epoch 857/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9666 - a
cc: 0.5219 - val_loss: 1.6854 - val_acc: 0.4083
Epoch 858/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9657 - a
cc: 0.5139 - val_loss: 1.6875 - val_acc: 0.4118
Epoch 859/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9685 - a
cc: 0.5139 - val_loss: 1.6803 - val_acc: 0.4152
Epoch 860/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9690 - a
cc: 0.5127 - val_loss: 1.6637 - val_acc: 0.4083
Epoch 861/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9661 - a
cc: 0.5139 - val_loss: 1.6551 - val_acc: 0.4152
Epoch 862/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9680 - a
cc: 0.5185 - val_loss: 1.6486 - val_acc: 0.4152
Epoch 863/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9678 - a
cc: 0.5208 - val_loss: 1.6473 - val_acc: 0.4221
Epoch 864/1000
866/866 [==============================] - 0s 26us/step - loss: 0.9681 - a
cc: 0.5150 - val_loss: 1.6390 - val_acc: 0.4118
Epoch 865/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9683 - a
cc: 0.5115 - val_loss: 1.6309 - val_acc: 0.4118
Epoch 866/1000
```

```
866/866 [==============================] - 0s 21us/step - loss: 0.9687 - a
cc: 0.5092 - val_loss: 1.6231 - val_acc: 0.4118
Epoch 867/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9681 - a
cc: 0.5127 - val_loss: 1.6234 - val_acc: 0.4221
Epoch 868/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9683 - a
cc: 0.5115 - val_loss: 1.6201 - val_acc: 0.4291
Epoch 869/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9684 - a
cc: 0.5185 - val_loss: 1.6194 - val_acc: 0.4325
Epoch 870/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9666 - a
cc: 0.5115 - val_loss: 1.6180 - val_acc: 0.4152
Epoch 871/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9670 - a
cc: 0.5127 - val_loss: 1.6260 - val_acc: 0.4118
Epoch 872/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9672 - a
cc: 0.5104 - val_loss: 1.6353 - val_acc: 0.4152
Epoch 873/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9678 - a
cc: 0.5104 - val_loss: 1.6351 - val_acc: 0.4118
Epoch 874/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9656 - a
cc: 0.5081 - val_loss: 1.6291 - val_acc: 0.4152
Epoch 875/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9650 - a
cc: 0.5185 - val_loss: 1.6217 - val_acc: 0.4152
Epoch 876/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9691 - a
cc: 0.5173 - val_loss: 1.6209 - val_acc: 0.4187
Epoch 877/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9665 - a
cc: 0.5173 - val_loss: 1.6177 - val_acc: 0.4187
Epoch 878/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9668 - a
cc: 0.5127 - val_loss: 1.6184 - val_acc: 0.4187
Epoch 879/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9674 - a
cc: 0.5150 - val_loss: 1.6233 - val_acc: 0.4152
Epoch 880/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9640 - a
cc: 0.5150 - val_loss: 1.6234 - val_acc: 0.4152
Epoch 881/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9651 - a
cc: 0.5162 - val_loss: 1.6218 - val_acc: 0.4118
Epoch 882/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9667 - a
cc: 0.5104 - val_loss: 1.6245 - val_acc: 0.4152
Epoch 883/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9664 - a
cc: 0.5196 - val_loss: 1.6222 - val_acc: 0.4152
Epoch 884/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9661 - a
cc: 0.5150 - val_loss: 1.6158 - val_acc: 0.4152
Epoch 885/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9695 - a
cc: 0.5127 - val_loss: 1.6026 - val_acc: 0.4221
Epoch 886/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9675 - a
```

```
cc: 0.5127 - val_loss: 1.6075 - val_acc: 0.4187
Epoch 887/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9679 - a
cc: 0.5139 - val_loss: 1.6084 - val_acc: 0.4187
Epoch 888/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9682 - a
cc: 0.5046 - val_loss: 1.6143 - val_acc: 0.4152
Epoch 889/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9685 - a
cc: 0.5081 - val_loss: 1.6252 - val_acc: 0.4152
Epoch 890/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9693 - a
cc: 0.5035 - val_loss: 1.6275 - val_acc: 0.4152
Epoch 891/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9655 - a
cc: 0.5150 - val_loss: 1.6249 - val_acc: 0.4152
Epoch 892/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9653 - a
cc: 0.5104 - val_loss: 1.6209 - val_acc: 0.4152
Epoch 893/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9653 - a
cc: 0.5139 - val_loss: 1.6183 - val_acc: 0.4221
Epoch 894/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9674 - a
cc: 0.5046 - val_loss: 1.6157 - val_acc: 0.4291
Epoch 895/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9662 - a
cc: 0.5127 - val_loss: 1.6088 - val_acc: 0.4325
Epoch 896/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9649 - a
cc: 0.5173 - val_loss: 1.6136 - val_acc: 0.4256
Epoch 897/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9658 - a
cc: 0.5081 - val_loss: 1.6186 - val_acc: 0.4256
Epoch 898/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9665 - a
cc: 0.5173 - val_loss: 1.6291 - val_acc: 0.4256
Epoch 899/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9666 - a
cc: 0.5127 - val_loss: 1.6434 - val_acc: 0.4291
Epoch 900/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9685 - a
cc: 0.5046 - val_loss: 1.6512 - val_acc: 0.4291
Epoch 901/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9661 - a
cc: 0.5092 - val_loss: 1.6476 - val_acc: 0.4325
Epoch 902/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9667 - a
cc: 0.5104 - val_loss: 1.6455 - val_acc: 0.4291
Epoch 903/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9682 - a
cc: 0.5115 - val_loss: 1.6370 - val_acc: 0.4325
Epoch 904/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9668 - a
cc: 0.5219 - val_loss: 1.6221 - val_acc: 0.4291
Epoch 905/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9656 - a
cc: 0.5092 - val_loss: 1.6152 - val_acc: 0.4291
Epoch 906/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9663 - a
cc: 0.5185 - val_loss: 1.6140 - val_acc: 0.4221
```

```
Epoch 907/1000
866/866 [==============================] - 0s 25us/step - loss: 0.9650 - a
cc: 0.5150 - val_loss: 1.6115 - val_acc: 0.4187
Epoch 908/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9671 - a
cc: 0.5139 - val_loss: 1.6168 - val_acc: 0.4152
Epoch 909/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9678 - a
cc: 0.5208 - val_loss: 1.6251 - val_acc: 0.4152
Epoch 910/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9661 - a
cc: 0.5173 - val_loss: 1.6289 - val_acc: 0.4152
Epoch 911/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9657 - a
cc: 0.5139 - val_loss: 1.6372 - val_acc: 0.4221
Epoch 912/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9657 - a
cc: 0.5115 - val_loss: 1.6413 - val_acc: 0.4221
Epoch 913/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9681 - a
cc: 0.5104 - val_loss: 1.6466 - val_acc: 0.4152
Epoch 914/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9680 - a
cc: 0.5127 - val_loss: 1.6408 - val_acc: 0.4221
Epoch 915/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9665 - a
cc: 0.5196 - val_loss: 1.6378 - val_acc: 0.4256
Epoch 916/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9689 - a
cc: 0.5185 - val_loss: 1.6354 - val_acc: 0.4152
Epoch 917/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9668 - a
cc: 0.5196 - val_loss: 1.6386 - val_acc: 0.4118
Epoch 918/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9701 - a
cc: 0.5139 - val_loss: 1.6426 - val_acc: 0.4187
Epoch 919/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9650 - a
cc: 0.5104 - val_loss: 1.6493 - val_acc: 0.4187
Epoch 920/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9669 - a
cc: 0.5115 - val_loss: 1.6486 - val_acc: 0.4187
Epoch 921/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9671 - a
cc: 0.5092 - val_loss: 1.6442 - val_acc: 0.4187
Epoch 922/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9662 - a
cc: 0.5219 - val_loss: 1.6404 - val_acc: 0.4221
Epoch 923/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9674 - a
cc: 0.5139 - val_loss: 1.6451 - val_acc: 0.4221
Epoch 924/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9659 - a
cc: 0.5162 - val_loss: 1.6573 - val_acc: 0.4325
Epoch 925/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9661 - a
cc: 0.5162 - val_loss: 1.6722 - val_acc: 0.4325
Epoch 926/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9657 - a
cc: 0.5150 - val_loss: 1.6809 - val_acc: 0.4291
Epoch 927/1000
```

```
866/866 [==============================] - 0s 16us/step - loss: 0.9656 - a
cc: 0.5173 - val_loss: 1.6791 - val_acc: 0.4256
Epoch 928/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9659 - a
cc: 0.5115 - val_loss: 1.6782 - val_acc: 0.4187
Epoch 929/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9689 - a
cc: 0.5104 - val_loss: 1.6773 - val_acc: 0.4152
Epoch 930/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9660 - a
cc: 0.5231 - val_loss: 1.6730 - val_acc: 0.4083
Epoch 931/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9677 - a
cc: 0.5162 - val_loss: 1.6654 - val_acc: 0.4118
Epoch 932/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9658 - a
cc: 0.5139 - val_loss: 1.6560 - val_acc: 0.4118
Epoch 933/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9657 - a
cc: 0.5104 - val_loss: 1.6543 - val_acc: 0.4187
Epoch 934/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
cc: 0.5139 - val_loss: 1.6588 - val_acc: 0.4291
Epoch 935/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9666 - a
cc: 0.5115 - val_loss: 1.6499 - val_acc: 0.4187
Epoch 936/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9688 - a
cc: 0.5127 - val_loss: 1.6436 - val_acc: 0.4221
Epoch 937/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9669 - a
cc: 0.5150 - val_loss: 1.6405 - val_acc: 0.4221
Epoch 938/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9669 - a
cc: 0.5162 - val_loss: 1.6375 - val_acc: 0.4187
Epoch 939/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9664 - a
cc: 0.5173 - val_loss: 1.6385 - val_acc: 0.4221
Epoch 940/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9674 - a
cc: 0.5104 - val_loss: 1.6368 - val_acc: 0.4221
Epoch 941/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9668 - a
cc: 0.5115 - val_loss: 1.6271 - val_acc: 0.4221
Epoch 942/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9659 - a
cc: 0.5162 - val_loss: 1.6246 - val_acc: 0.4187
Epoch 943/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9688 - a
cc: 0.5196 - val_loss: 1.6258 - val_acc: 0.4221
Epoch 944/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9657 - a
cc: 0.5162 - val_loss: 1.6261 - val_acc: 0.4152
Epoch 945/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9665 - a
cc: 0.5162 - val_loss: 1.6275 - val_acc: 0.4187
Epoch 946/1000
866/866 [==============================] - 0s 24us/step - loss: 0.9660 - a
cc: 0.5219 - val_loss: 1.6290 - val_acc: 0.4221
Epoch 947/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9693 - a
```

```
cc: 0.5046 - val_loss: 1.6300 - val_acc: 0.4152
Epoch 948/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9655 - a
cc: 0.5173 - val_loss: 1.6304 - val_acc: 0.4152
Epoch 949/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9655 - a
cc: 0.5162 - val_loss: 1.6320 - val_acc: 0.4152
Epoch 950/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9657 - a
cc: 0.5185 - val_loss: 1.6363 - val_acc: 0.4187
Epoch 951/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9678 - a
cc: 0.5173 - val_loss: 1.6392 - val_acc: 0.4221
Epoch 952/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9644 - a
cc: 0.5104 - val_loss: 1.6433 - val_acc: 0.4187
Epoch 953/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9652 - a
cc: 0.5185 - val_loss: 1.6497 - val_acc: 0.4221
Epoch 954/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9655 - a
cc: 0.5139 - val_loss: 1.6519 - val_acc: 0.4187
Epoch 955/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9653 - a
cc: 0.5127 - val_loss: 1.6422 - val_acc: 0.4152
Epoch 956/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9657 - a
cc: 0.5162 - val_loss: 1.6395 - val_acc: 0.4152
Epoch 957/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9668 - a
cc: 0.5069 - val_loss: 1.6402 - val_acc: 0.4221
Epoch 958/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9668 - a
cc: 0.5162 - val_loss: 1.6311 - val_acc: 0.4152
Epoch 959/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9666 - a
cc: 0.5139 - val_loss: 1.6253 - val_acc: 0.4221
Epoch 960/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9665 - a
cc: 0.5139 - val_loss: 1.6213 - val_acc: 0.4187
Epoch 961/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9666 - a
cc: 0.5219 - val_loss: 1.6165 - val_acc: 0.4152
Epoch 962/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9700 - a
cc: 0.5289 - val_loss: 1.6177 - val_acc: 0.4152
Epoch 963/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9650 - a
cc: 0.5173 - val_loss: 1.6241 - val_acc: 0.4187
Epoch 964/1000
866/866 [==============================] - 0s 23us/step - loss: 0.9679 - a
cc: 0.5208 - val_loss: 1.6331 - val_acc: 0.4187
Epoch 965/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9667 - a
cc: 0.5150 - val_loss: 1.6401 - val_acc: 0.4221
Epoch 966/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9674 - a
cc: 0.5196 - val_loss: 1.6452 - val_acc: 0.4118
Epoch 967/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9664 - a
cc: 0.5196 - val_loss: 1.6425 - val_acc: 0.4187
```

```
Epoch 968/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9655 - a
cc: 0.5127 - val_loss: 1.6402 - val_acc: 0.4221
Epoch 969/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9679 - a
cc: 0.5173 - val_loss: 1.6390 - val_acc: 0.4221
Epoch 970/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9675 - a
cc: 0.5173 - val_loss: 1.6430 - val_acc: 0.4187
Epoch 971/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9694 - a
cc: 0.5104 - val_loss: 1.6426 - val_acc: 0.4221
Epoch 972/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9659 - a
cc: 0.5173 - val_loss: 1.6447 - val_acc: 0.4221
Epoch 973/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9668 - a
cc: 0.5069 - val_loss: 1.6532 - val_acc: 0.4152
Epoch 974/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9659 - a
cc: 0.5139 - val_loss: 1.6480 - val_acc: 0.4152
Epoch 975/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9694 - a
cc: 0.5115 - val_loss: 1.6423 - val_acc: 0.4152
Epoch 976/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9692 - a
cc: 0.5081 - val_loss: 1.6281 - val_acc: 0.4187
Epoch 977/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9673 - a
cc: 0.5092 - val_loss: 1.6227 - val_acc: 0.4221
Epoch 978/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9668 - a
cc: 0.5150 - val_loss: 1.6177 - val_acc: 0.4291
Epoch 979/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9683 - a
cc: 0.5127 - val_loss: 1.6224 - val_acc: 0.4221
Epoch 980/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9680 - a
cc: 0.5242 - val_loss: 1.6155 - val_acc: 0.4187
Epoch 981/1000
866/866 [==============================] - 0s 20us/step - loss: 0.9675 - a
cc: 0.5092 - val_loss: 1.6187 - val_acc: 0.4118
Epoch 982/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9652 - a
cc: 0.5196 - val_loss: 1.6304 - val_acc: 0.4118
Epoch 983/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9665 - a
cc: 0.5173 - val_loss: 1.6411 - val_acc: 0.4152
Epoch 984/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
cc: 0.5185 - val_loss: 1.6462 - val_acc: 0.4152
Epoch 985/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9658 - a
cc: 0.5185 - val_loss: 1.6523 - val_acc: 0.4152
Epoch 986/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9661 - a
cc: 0.5196 - val_loss: 1.6510 - val_acc: 0.4221
Epoch 987/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9669 - a
cc: 0.5104 - val_loss: 1.6502 - val_acc: 0.4187
Epoch 988/1000
```

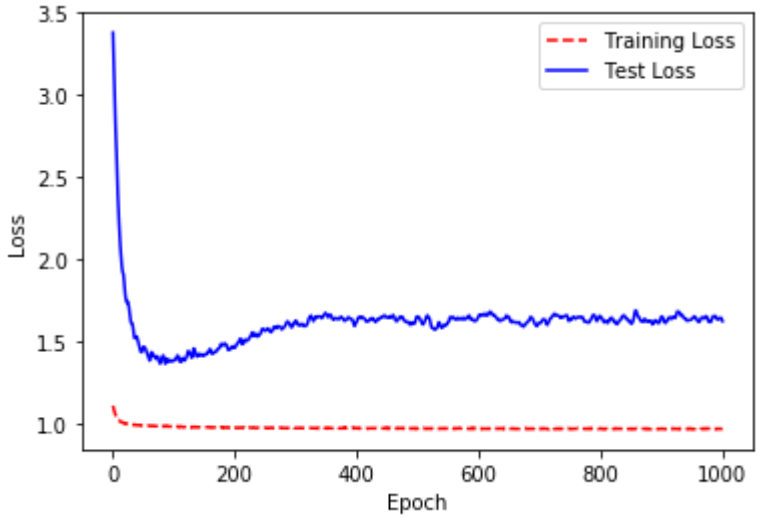
```
866/866 [==============================] - 0s 17us/step - loss: 0.9682 - a
cc: 0.5196 - val_loss: 1.6530 - val_acc: 0.4118
Epoch 989/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9631 - a
cc: 0.5173 - val_loss: 1.6517 - val_acc: 0.4083
Epoch 990/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9653 - a
cc: 0.5150 - val_loss: 1.6409 - val_acc: 0.4152
Epoch 991/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9673 - a
cc: 0.5104 - val_loss: 1.6339 - val_acc: 0.4221
Epoch 992/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9665 - a
cc: 0.5162 - val_loss: 1.6316 - val_acc: 0.4187
Epoch 993/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9679 - a
cc: 0.5150 - val_loss: 1.6342 - val_acc: 0.4187
Epoch 994/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9667 - a
cc: 0.5069 - val_loss: 1.6370 - val_acc: 0.4118
Epoch 995/1000
866/866 [==============================] - 0s 18us/step - loss: 0.9670 - a
cc: 0.5139 - val_loss: 1.6383 - val_acc: 0.4118
Epoch 996/1000
866/866 [==============================] - 0s 16us/step - loss: 0.9677 - a
cc: 0.5092 - val_loss: 1.6399 - val_acc: 0.4152
Epoch 997/1000
866/866 [==============================] - 0s 21us/step - loss: 0.9655 - a
cc: 0.5115 - val_loss: 1.6434 - val_acc: 0.4256
Epoch 998/1000
866/866 [==============================] - 0s 17us/step - loss: 0.9658 - a
cc: 0.5173 - val_loss: 1.6379 - val_acc: 0.4256
Epoch 999/1000
866/866 [==============================] - 0s 15us/step - loss: 0.9672 - a
cc: 0.5173 - val_loss: 1.6315 - val_acc: 0.4291
Epoch 1000/1000
866/866 [==============================] - 0s 22us/step - loss: 0.9675 - a
cc: 0.5046 - val_loss: 1.6223 - val_acc: 0.4221
```

In [77]:

```
# Get training and test loss histories
training_loss = history.history['loss']
test_loss = history.history['val_loss']

# Create count of the number of epochs
epoch_count = range(1, len(training_loss) + 1)

# Visualize loss history
plt.plot(epoch_count, training_loss, 'r--')
plt.plot(epoch_count, test_loss, 'b-')
plt.legend(['Training Loss', 'Test Loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.show();
```



In [78]:

```
y_pred=model.predict(X_test)
```

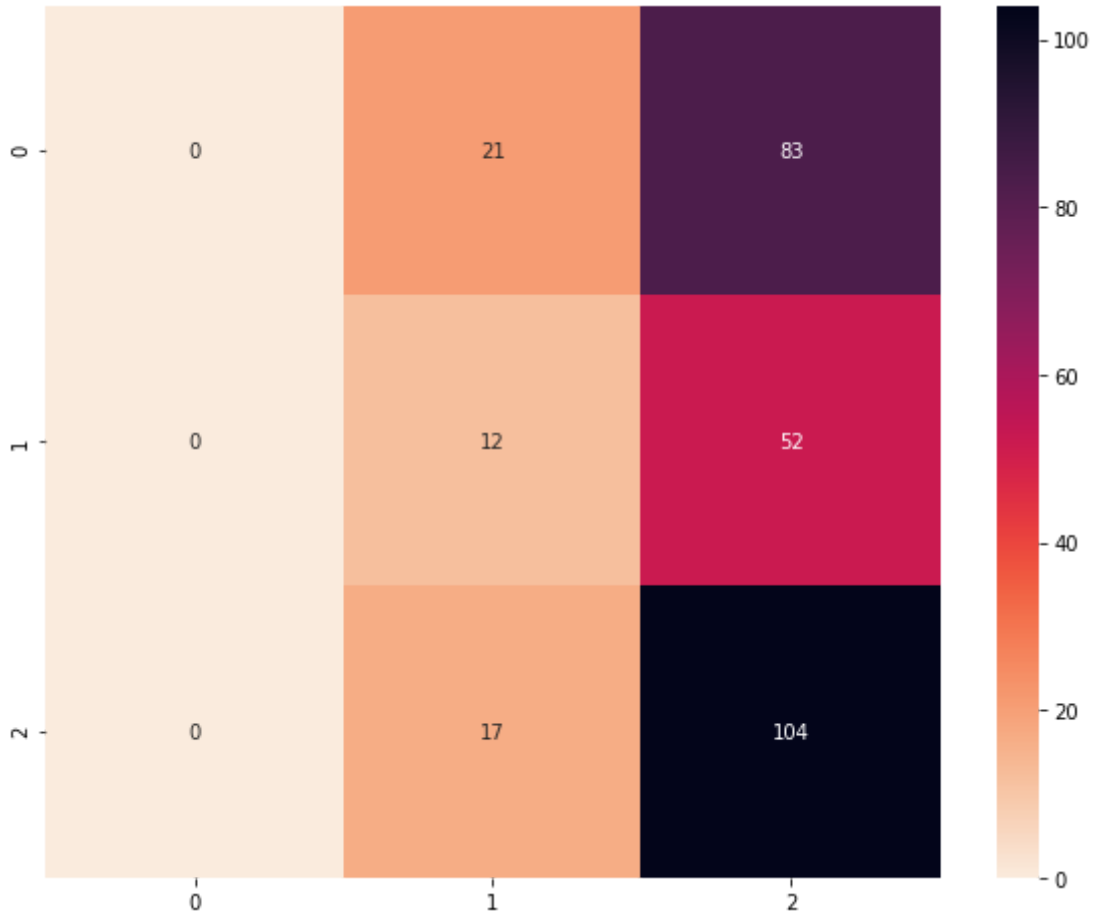
In [79]:

```
#since it's the probability, need to change it to the index
y_pred = [ np.argmax(t) for t in y_pred ]
```

In [80]:

```
cm=metrics.confusion_matrix(y_test_class,y_pred)
print(cm)
import seaborn as sn
cmap = sn.cm.rocket_r
plt.figure(figsize=(10,8))
sn.heatmap(cm, annot=True,cmap=cmap,fmt='g')
plt.show()
```

```
[[  0  21  83]
 [  0  12  52]
 [  0  17 104]]
```



In [81]:

```
print(classification_report(y_test_class, y_pred))
```

```
             precision    recall  f1-score   support

          0       0.00      0.00      0.00       104
          1       0.24      0.19      0.21        64
          2       0.44      0.86      0.58       121

avg / total       0.24      0.40      0.29       289


C:\Users\kyle1\Anaconda3\lib\site-packages\sklearn\metrics\classification.
py:1135: UndefinedMetricWarning: Precision and F-score are ill-defined and
being set to 0.0 in labels with no predicted samples.
  'precision', 'predicted', average, warn_for)
```

In [82]:

```
#if you want to keep training
# history=model.fit(X_train,y_train_class, batch_size=256, epochs=1000, verbose=1, vali
dation_data=(X_val,y_val_class))
```

Regression CNN 1D

In [83]:

```
inputs=Input(X_train.shape[1:])
x=Dense(32)(inputs)
x=Conv1D(16,kernel_size=3,strides=1)(x)
x=BatchNormalization()(x)
# x=ReLU()(x)

# x1=Conv1D(16,4)(x)
# x=LeakyReLU(alpha=0.1)(x1)

# x2=MaxPooling1D(pool_size=1)(x)
# x=concatenate([x1,x2])
x=Flatten()(x)
# x=Dense(32,name='my16')(x)

predictions=Dense(1, activation='sigmoid')(x)
model=Model(inputs=inputs, outputs=predictions)
model.compile(optimizer=Adam(lr=0.0001), loss='mean_squared_error', metrics=['mse'])
model.summary()
history=model.fit(X_train,y_train, batch_size=256, epochs=500, verbose=1,validation_dat
a=(X_val,y_val))
#                   callbacks=[ReduceLROnPlateau(monitor='acc',factor=0.2, patience=5, m
in_lr= 0.00001),EarlyStopping(monitor='acc',patience=7)])
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         (None, 5, 6)              0
_________________________________________________________________
dense_3 (Dense)              (None, 5, 32)             224
_________________________________________________________________
conv1d_2 (Conv1D)            (None, 3, 16)             1552
_________________________________________________________________
batch_normalization_2 (Batch (None, 3, 16)             64
_________________________________________________________________
flatten_2 (Flatten)          (None, 48)                0
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 49
=================================================================
Total params: 1,889
Trainable params: 1,857
Non-trainable params: 32
_________________________________________________________________
Train on 866 samples, validate on 289 samples
Epoch 1/500
866/866 [==============================] - 0s 575us/step - loss: 1.4824 -
mean_squared_error: 1.4824 - val_loss: 0.6525 - val_mean_squared_error: 0.
6525
Epoch 2/500
866/866 [==============================] - 0s 15us/step - loss: 1.4600 - m
ean_squared_error: 1.4600 - val_loss: 0.6880 - val_mean_squared_error: 0.6
880
Epoch 3/500
866/866 [==============================] - 0s 16us/step - loss: 1.4336 - m
ean_squared_error: 1.4336 - val_loss: 0.7296 - val_mean_squared_error: 0.7
296
Epoch 4/500
866/866 [==============================] - 0s 15us/step - loss: 1.4138 - m
ean_squared_error: 1.4138 - val_loss: 0.7672 - val_mean_squared_error: 0.7
672
Epoch 5/500
866/866 [==============================] - 0s 15us/step - loss: 1.3928 - m
ean_squared_error: 1.3928 - val_loss: 0.8012 - val_mean_squared_error: 0.8
012
Epoch 6/500
866/866 [==============================] - 0s 18us/step - loss: 1.3740 - m
ean_squared_error: 1.3740 - val_loss: 0.8312 - val_mean_squared_error: 0.8
312
Epoch 7/500
866/866 [==============================] - 0s 18us/step - loss: 1.3567 - m
ean_squared_error: 1.3567 - val_loss: 0.8581 - val_mean_squared_error: 0.8
581
Epoch 8/500
866/866 [==============================] - 0s 16us/step - loss: 1.3428 - m
ean_squared_error: 1.3428 - val_loss: 0.8812 - val_mean_squared_error: 0.8
812
Epoch 9/500
866/866 [==============================] - 0s 16us/step - loss: 1.3299 - m
ean_squared_error: 1.3299 - val_loss: 0.9017 - val_mean_squared_error: 0.9
017
Epoch 10/500
866/866 [==============================] - 0s 18us/step - loss: 1.3186 - m
ean_squared_error: 1.3186 - val_loss: 0.9198 - val_mean_squared_error: 0.9
198
Epoch 11/500
```

```
866/866 [==============================] - 0s 17us/step - loss: 1.3062 - m
ean_squared_error: 1.3062 - val_loss: 0.9340 - val_mean_squared_error: 0.9
340
Epoch 12/500
866/866 [==============================] - 0s 15us/step - loss: 1.2967 - m
ean_squared_error: 1.2967 - val_loss: 0.9464 - val_mean_squared_error: 0.9
464
Epoch 13/500
866/866 [==============================] - 0s 15us/step - loss: 1.2865 - m
ean_squared_error: 1.2865 - val_loss: 0.9565 - val_mean_squared_error: 0.9
565
Epoch 14/500
866/866 [==============================] - 0s 16us/step - loss: 1.2793 - m
ean_squared_error: 1.2793 - val_loss: 0.9652 - val_mean_squared_error: 0.9
652
Epoch 15/500
866/866 [==============================] - 0s 24us/step - loss: 1.2723 - m
ean_squared_error: 1.2723 - val_loss: 0.9731 - val_mean_squared_error: 0.9
731
Epoch 16/500
866/866 [==============================] - 0s 16us/step - loss: 1.2640 - m
ean_squared_error: 1.2640 - val_loss: 0.9798 - val_mean_squared_error: 0.9
798
Epoch 17/500
866/866 [==============================] - 0s 15us/step - loss: 1.2596 - m
ean_squared_error: 1.2596 - val_loss: 0.9856 - val_mean_squared_error: 0.9
856
Epoch 18/500
866/866 [==============================] - 0s 14us/step - loss: 1.2550 - m
ean_squared_error: 1.2550 - val_loss: 0.9910 - val_mean_squared_error: 0.9
910
Epoch 19/500
866/866 [==============================] - 0s 17us/step - loss: 1.2526 - m
ean_squared_error: 1.2526 - val_loss: 0.9957 - val_mean_squared_error: 0.9
957
Epoch 20/500
866/866 [==============================] - 0s 16us/step - loss: 1.2458 - m
ean_squared_error: 1.2458 - val_loss: 0.9996 - val_mean_squared_error: 0.9
996
Epoch 21/500
866/866 [==============================] - 0s 18us/step - loss: 1.2426 - m
ean_squared_error: 1.2426 - val_loss: 1.0030 - val_mean_squared_error: 1.0
030
Epoch 22/500
866/866 [==============================] - 0s 16us/step - loss: 1.2395 - m
ean_squared_error: 1.2395 - val_loss: 1.0059 - val_mean_squared_error: 1.0
059
Epoch 23/500
866/866 [==============================] - 0s 15us/step - loss: 1.2387 - m
ean_squared_error: 1.2387 - val_loss: 1.0085 - val_mean_squared_error: 1.0
085
Epoch 24/500
866/866 [==============================] - 0s 21us/step - loss: 1.2344 - m
ean_squared_error: 1.2344 - val_loss: 1.0108 - val_mean_squared_error: 1.0
108
Epoch 25/500
866/866 [==============================] - 0s 17us/step - loss: 1.2328 - m
ean_squared_error: 1.2328 - val_loss: 1.0129 - val_mean_squared_error: 1.0
129
Epoch 26/500
866/866 [==============================] - 0s 17us/step - loss: 1.2323 - m
```

```
ean_squared_error: 1.2323 - val_loss: 1.0147 - val_mean_squared_error: 1.0
147
Epoch 27/500
866/866 [==============================] - 0s 16us/step - loss: 1.2282 - m
ean_squared_error: 1.2282 - val_loss: 1.0163 - val_mean_squared_error: 1.0
163
Epoch 28/500
866/866 [==============================] - 0s 15us/step - loss: 1.2249 - m
ean_squared_error: 1.2249 - val_loss: 1.0177 - val_mean_squared_error: 1.0
177
Epoch 29/500
866/866 [==============================] - 0s 16us/step - loss: 1.2230 - m
ean_squared_error: 1.2230 - val_loss: 1.0189 - val_mean_squared_error: 1.0
189
Epoch 30/500
866/866 [==============================] - 0s 15us/step - loss: 1.2225 - m
ean_squared_error: 1.2225 - val_loss: 1.0200 - val_mean_squared_error: 1.0
200
Epoch 31/500
866/866 [==============================] - 0s 16us/step - loss: 1.2225 - m
ean_squared_error: 1.2225 - val_loss: 1.0210 - val_mean_squared_error: 1.0
210
Epoch 32/500
866/866 [==============================] - 0s 22us/step - loss: 1.2201 - m
ean_squared_error: 1.2201 - val_loss: 1.0220 - val_mean_squared_error: 1.0
220
Epoch 33/500
866/866 [==============================] - 0s 23us/step - loss: 1.2196 - m
ean_squared_error: 1.2196 - val_loss: 1.0229 - val_mean_squared_error: 1.0
229
Epoch 34/500
866/866 [==============================] - 0s 16us/step - loss: 1.2190 - m
ean_squared_error: 1.2190 - val_loss: 1.0237 - val_mean_squared_error: 1.0
237
Epoch 35/500
866/866 [==============================] - 0s 16us/step - loss: 1.2159 - m
ean_squared_error: 1.2159 - val_loss: 1.0243 - val_mean_squared_error: 1.0
243
Epoch 36/500
866/866 [==============================] - 0s 16us/step - loss: 1.2144 - m
ean_squared_error: 1.2144 - val_loss: 1.0249 - val_mean_squared_error: 1.0
249
Epoch 37/500
866/866 [==============================] - 0s 15us/step - loss: 1.2147 - m
ean_squared_error: 1.2147 - val_loss: 1.0254 - val_mean_squared_error: 1.0
254
Epoch 38/500
866/866 [==============================] - 0s 24us/step - loss: 1.2121 - m
ean_squared_error: 1.2121 - val_loss: 1.0259 - val_mean_squared_error: 1.0
259
Epoch 39/500
866/866 [==============================] - 0s 18us/step - loss: 1.2138 - m
ean_squared_error: 1.2138 - val_loss: 1.0263 - val_mean_squared_error: 1.0
263
Epoch 40/500
866/866 [==============================] - 0s 15us/step - loss: 1.2103 - m
ean_squared_error: 1.2103 - val_loss: 1.0267 - val_mean_squared_error: 1.0
267
Epoch 41/500
866/866 [==============================] - 0s 16us/step - loss: 1.2119 - m
ean_squared_error: 1.2119 - val_loss: 1.0271 - val_mean_squared_error: 1.0
```

```
271
Epoch 42/500
866/866 [==============================] - 0s 17us/step - loss: 1.2096 - m
ean_squared_error: 1.2096 - val_loss: 1.0274 - val_mean_squared_error: 1.0
274
Epoch 43/500
866/866 [==============================] - 0s 16us/step - loss: 1.2079 - m
ean_squared_error: 1.2079 - val_loss: 1.0277 - val_mean_squared_error: 1.0
277
Epoch 44/500
866/866 [==============================] - 0s 18us/step - loss: 1.2072 - m
ean_squared_error: 1.2072 - val_loss: 1.0279 - val_mean_squared_error: 1.0
279
Epoch 45/500
866/866 [==============================] - 0s 15us/step - loss: 1.2075 - m
ean_squared_error: 1.2075 - val_loss: 1.0282 - val_mean_squared_error: 1.0
282
Epoch 46/500
866/866 [==============================] - 0s 15us/step - loss: 1.2065 - m
ean_squared_error: 1.2065 - val_loss: 1.0284 - val_mean_squared_error: 1.0
284
Epoch 47/500
866/866 [==============================] - 0s 14us/step - loss: 1.2066 - m
ean_squared_error: 1.2066 - val_loss: 1.0285 - val_mean_squared_error: 1.0
285
Epoch 48/500
866/866 [==============================] - 0s 15us/step - loss: 1.2040 - m
ean_squared_error: 1.2040 - val_loss: 1.0288 - val_mean_squared_error: 1.0
288
Epoch 49/500
866/866 [==============================] - 0s 21us/step - loss: 1.2044 - m
ean_squared_error: 1.2044 - val_loss: 1.0289 - val_mean_squared_error: 1.0
289
Epoch 50/500
866/866 [==============================] - 0s 15us/step - loss: 1.2032 - m
ean_squared_error: 1.2032 - val_loss: 1.0291 - val_mean_squared_error: 1.0
291
Epoch 51/500
866/866 [==============================] - 0s 16us/step - loss: 1.2023 - m
ean_squared_error: 1.2023 - val_loss: 1.0292 - val_mean_squared_error: 1.0
292
Epoch 52/500
866/866 [==============================] - 0s 15us/step - loss: 1.2031 - m
ean_squared_error: 1.2031 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 53/500
866/866 [==============================] - 0s 15us/step - loss: 1.2019 - m
ean_squared_error: 1.2019 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 54/500
866/866 [==============================] - 0s 16us/step - loss: 1.2001 - m
ean_squared_error: 1.2001 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 55/500
866/866 [==============================] - 0s 23us/step - loss: 1.2003 - m
ean_squared_error: 1.2003 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 56/500
866/866 [==============================] - 0s 16us/step - loss: 1.1992 - m
ean_squared_error: 1.1992 - val_loss: 1.0298 - val_mean_squared_error: 1.0
298
```

```
Epoch 57/500
866/866 [==============================] - 0s 17us/step - loss: 1.1979 - m
ean_squared_error: 1.1979 - val_loss: 1.0298 - val_mean_squared_error: 1.0
298
Epoch 58/500
866/866 [==============================] - 0s 15us/step - loss: 1.1976 - m
ean_squared_error: 1.1976 - val_loss: 1.0299 - val_mean_squared_error: 1.0
299
Epoch 59/500
866/866 [==============================] - 0s 16us/step - loss: 1.1983 - m
ean_squared_error: 1.1983 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 60/500
866/866 [==============================] - 0s 18us/step - loss: 1.1967 - m
ean_squared_error: 1.1967 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 61/500
866/866 [==============================] - 0s 18us/step - loss: 1.1966 - m
ean_squared_error: 1.1966 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 62/500
866/866 [==============================] - 0s 17us/step - loss: 1.1955 - m
ean_squared_error: 1.1955 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 63/500
866/866 [==============================] - 0s 18us/step - loss: 1.1957 - m
ean_squared_error: 1.1957 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 64/500
866/866 [==============================] - 0s 20us/step - loss: 1.1940 - m
ean_squared_error: 1.1940 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 65/500
866/866 [==============================] - 0s 16us/step - loss: 1.1935 - m
ean_squared_error: 1.1935 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 66/500
866/866 [==============================] - ETA: 0s - loss: 1.1673 - mean_s
quared_error: 1.16 - 0s 16us/step - loss: 1.1958 - mean_squared_error: 1.1
958 - val_loss: 1.0301 - val_mean_squared_error: 1.0301
Epoch 67/500
866/866 [==============================] - 0s 16us/step - loss: 1.1933 - m
ean_squared_error: 1.1933 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 68/500
866/866 [==============================] - 0s 20us/step - loss: 1.1978 - m
ean_squared_error: 1.1978 - val_loss: 1.0302 - val_mean_squared_error: 1.0
302
Epoch 69/500
866/866 [==============================] - 0s 23us/step - loss: 1.1930 - m
ean_squared_error: 1.1930 - val_loss: 1.0302 - val_mean_squared_error: 1.0
302
Epoch 70/500
866/866 [==============================] - 0s 18us/step - loss: 1.1914 - m
ean_squared_error: 1.1914 - val_loss: 1.0303 - val_mean_squared_error: 1.0
303
Epoch 71/500
866/866 [==============================] - 0s 15us/step - loss: 1.1917 - m
ean_squared_error: 1.1917 - val_loss: 1.0304 - val_mean_squared_error: 1.0
304
Epoch 72/500
```

```
866/866 [==============================] - 0s 15us/step - loss: 1.1902 - m
ean_squared_error: 1.1902 - val_loss: 1.0304 - val_mean_squared_error: 1.0
304
Epoch 73/500
866/866 [==============================] - 0s 17us/step - loss: 1.1889 - m
ean_squared_error: 1.1889 - val_loss: 1.0304 - val_mean_squared_error: 1.0
304
Epoch 74/500
866/866 [==============================] - 0s 17us/step - loss: 1.1888 - m
ean_squared_error: 1.1888 - val_loss: 1.0304 - val_mean_squared_error: 1.0
304
Epoch 75/500
866/866 [==============================] - 0s 18us/step - loss: 1.1878 - m
ean_squared_error: 1.1878 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 76/500
866/866 [==============================] - 0s 17us/step - loss: 1.1881 - m
ean_squared_error: 1.1881 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 77/500
866/866 [==============================] - 0s 16us/step - loss: 1.1887 - m
ean_squared_error: 1.1887 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 78/500
866/866 [==============================] - 0s 16us/step - loss: 1.1870 - m
ean_squared_error: 1.1870 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 79/500
866/866 [==============================] - 0s 21us/step - loss: 1.1877 - m
ean_squared_error: 1.1877 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 80/500
866/866 [==============================] - 0s 20us/step - loss: 1.1865 - m
ean_squared_error: 1.1865 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 81/500
866/866 [==============================] - 0s 16us/step - loss: 1.1868 - m
ean_squared_error: 1.1868 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 82/500
866/866 [==============================] - 0s 16us/step - loss: 1.1851 - m
ean_squared_error: 1.1851 - val_loss: 1.0307 - val_mean_squared_error: 1.0
307
Epoch 83/500
866/866 [==============================] - 0s 20us/step - loss: 1.1859 - m
ean_squared_error: 1.1859 - val_loss: 1.0307 - val_mean_squared_error: 1.0
307
Epoch 84/500
866/866 [==============================] - 0s 18us/step - loss: 1.1851 - m
ean_squared_error: 1.1851 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 85/500
866/866 [==============================] - 0s 16us/step - loss: 1.1824 - m
ean_squared_error: 1.1824 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 86/500
866/866 [==============================] - 0s 16us/step - loss: 1.1841 - m
ean_squared_error: 1.1841 - val_loss: 1.0307 - val_mean_squared_error: 1.0
307
Epoch 87/500
866/866 [==============================] - 0s 16us/step - loss: 1.1832 - m
```

```
ean_squared_error: 1.1832 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 88/500
866/866 [==============================] - 0s 15us/step - loss: 1.1831 - m
ean_squared_error: 1.1831 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 89/500
866/866 [==============================] - 0s 15us/step - loss: 1.1838 - m
ean_squared_error: 1.1838 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 90/500
866/866 [==============================] - 0s 25us/step - loss: 1.1823 - m
ean_squared_error: 1.1823 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 91/500
866/866 [==============================] - 0s 17us/step - loss: 1.1835 - m
ean_squared_error: 1.1835 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 92/500
866/866 [==============================] - 0s 18us/step - loss: 1.1841 - m
ean_squared_error: 1.1841 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 93/500
866/866 [==============================] - 0s 17us/step - loss: 1.1805 - m
ean_squared_error: 1.1805 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 94/500
866/866 [==============================] - 0s 16us/step - loss: 1.1837 - m
ean_squared_error: 1.1837 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 95/500
866/866 [==============================] - 0s 15us/step - loss: 1.1824 - m
ean_squared_error: 1.1824 - val_loss: 1.0307 - val_mean_squared_error: 1.0
307
Epoch 96/500
866/866 [==============================] - 0s 15us/step - loss: 1.1799 - m
ean_squared_error: 1.1799 - val_loss: 1.0306 - val_mean_squared_error: 1.0
306
Epoch 97/500
866/866 [==============================] - 0s 15us/step - loss: 1.1801 - m
ean_squared_error: 1.1801 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 98/500
866/866 [==============================] - 0s 15us/step - loss: 1.1795 - m
ean_squared_error: 1.1795 - val_loss: 1.0305 - val_mean_squared_error: 1.0
305
Epoch 99/500
866/866 [==============================] - 0s 14us/step - loss: 1.1783 - m
ean_squared_error: 1.1783 - val_loss: 1.0304 - val_mean_squared_error: 1.0
304
Epoch 100/500
866/866 [==============================] - 0s 21us/step - loss: 1.1776 - m
ean_squared_error: 1.1776 - val_loss: 1.0303 - val_mean_squared_error: 1.0
303
Epoch 101/500
866/866 [==============================] - 0s 22us/step - loss: 1.1770 - m
ean_squared_error: 1.1770 - val_loss: 1.0302 - val_mean_squared_error: 1.0
302
Epoch 102/500
866/866 [==============================] - 0s 16us/step - loss: 1.1768 - m
ean_squared_error: 1.1768 - val_loss: 1.0301 - val_mean_squared_error: 1.0
```

```
301
Epoch 103/500
866/866 [==============================] - 0s 16us/step - loss: 1.1774 - m
ean_squared_error: 1.1774 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 104/500
866/866 [==============================] - 0s 15us/step - loss: 1.1757 - m
ean_squared_error: 1.1757 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 105/500
866/866 [==============================] - 0s 15us/step - loss: 1.1759 - m
ean_squared_error: 1.1759 - val_loss: 1.0301 - val_mean_squared_error: 1.0
301
Epoch 106/500
866/866 [==============================] - 0s 17us/step - loss: 1.1773 - m
ean_squared_error: 1.1773 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 107/500
866/866 [==============================] - 0s 21us/step - loss: 1.1755 - m
ean_squared_error: 1.1755 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 108/500
866/866 [==============================] - 0s 15us/step - loss: 1.1749 - m
ean_squared_error: 1.1749 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 109/500
866/866 [==============================] - 0s 18us/step - loss: 1.1752 - m
ean_squared_error: 1.1752 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 110/500
866/866 [==============================] - 0s 21us/step - loss: 1.1744 - m
ean_squared_error: 1.1744 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 111/500
866/866 [==============================] - 0s 18us/step - loss: 1.1744 - m
ean_squared_error: 1.1744 - val_loss: 1.0299 - val_mean_squared_error: 1.0
299
Epoch 112/500
866/866 [==============================] - 0s 17us/step - loss: 1.1725 - m
ean_squared_error: 1.1725 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 113/500
866/866 [==============================] - 0s 21us/step - loss: 1.1713 - m
ean_squared_error: 1.1713 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 114/500
866/866 [==============================] - 0s 22us/step - loss: 1.1722 - m
ean_squared_error: 1.1722 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 115/500
866/866 [==============================] - 0s 18us/step - loss: 1.1726 - m
ean_squared_error: 1.1726 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 116/500
866/866 [==============================] - 0s 18us/step - loss: 1.1702 - m
ean_squared_error: 1.1702 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 117/500
866/866 [==============================] - 0s 23us/step - loss: 1.1718 - m
ean_squared_error: 1.1718 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
```

```
Epoch 118/500
866/866 [==============================] - 0s 18us/step - loss: 1.1698 - m
ean_squared_error: 1.1698 - val_loss: 1.0300 - val_mean_squared_error: 1.0
300
Epoch 119/500
866/866 [==============================] - 0s 17us/step - loss: 1.1702 - m
ean_squared_error: 1.1702 - val_loss: 1.0299 - val_mean_squared_error: 1.0
299
Epoch 120/500
866/866 [==============================] - 0s 20us/step - loss: 1.1708 - m
ean_squared_error: 1.1708 - val_loss: 1.0298 - val_mean_squared_error: 1.0
298
Epoch 121/500
866/866 [==============================] - 0s 17us/step - loss: 1.1700 - m
ean_squared_error: 1.1700 - val_loss: 1.0297 - val_mean_squared_error: 1.0
297
Epoch 122/500
866/866 [==============================] - 0s 16us/step - loss: 1.1706 - m
ean_squared_error: 1.1706 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 123/500
866/866 [==============================] - 0s 17us/step - loss: 1.1695 - m
ean_squared_error: 1.1695 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 124/500
866/866 [==============================] - 0s 17us/step - loss: 1.1715 - m
ean_squared_error: 1.1715 - val_loss: 1.0295 - val_mean_squared_error: 1.0
295
Epoch 125/500
866/866 [==============================] - 0s 17us/step - loss: 1.1715 - m
ean_squared_error: 1.1715 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 126/500
866/866 [==============================] - 0s 15us/step - loss: 1.1689 - m
ean_squared_error: 1.1689 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 127/500
866/866 [==============================] - 0s 20us/step - loss: 1.1691 - m
ean_squared_error: 1.1691 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 128/500
866/866 [==============================] - 0s 28us/step - loss: 1.1685 - m
ean_squared_error: 1.1685 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 129/500
866/866 [==============================] - 0s 18us/step - loss: 1.1669 - m
ean_squared_error: 1.1669 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 130/500
866/866 [==============================] - 0s 20us/step - loss: 1.1662 - m
ean_squared_error: 1.1662 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 131/500
866/866 [==============================] - 0s 17us/step - loss: 1.1680 - m
ean_squared_error: 1.1680 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 132/500
866/866 [==============================] - 0s 16us/step - loss: 1.1659 - m
ean_squared_error: 1.1659 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 133/500
```

```
866/866 [==============================] - 0s 17us/step - loss: 1.1666 - m
ean_squared_error: 1.1666 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 134/500
866/866 [==============================] - 0s 17us/step - loss: 1.1660 - m
ean_squared_error: 1.1660 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 135/500
866/866 [==============================] - 0s 16us/step - loss: 1.1717 - m
ean_squared_error: 1.1717 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 136/500
866/866 [==============================] - 0s 16us/step - loss: 1.1685 - m
ean_squared_error: 1.1685 - val_loss: 1.0295 - val_mean_squared_error: 1.0
295
Epoch 137/500
866/866 [==============================] - 0s 16us/step - loss: 1.1623 - m
ean_squared_error: 1.1623 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 138/500
866/866 [==============================] - 0s 16us/step - loss: 1.1653 - m
ean_squared_error: 1.1653 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 139/500
866/866 [==============================] - 0s 20us/step - loss: 1.1629 - m
ean_squared_error: 1.1629 - val_loss: 1.0296 - val_mean_squared_error: 1.0
296
Epoch 140/500
866/866 [==============================] - 0s 20us/step - loss: 1.1660 - m
ean_squared_error: 1.1660 - val_loss: 1.0295 - val_mean_squared_error: 1.0
295
Epoch 141/500
866/866 [==============================] - 0s 18us/step - loss: 1.1647 - m
ean_squared_error: 1.1647 - val_loss: 1.0295 - val_mean_squared_error: 1.0
295
Epoch 142/500
866/866 [==============================] - 0s 17us/step - loss: 1.1615 - m
ean_squared_error: 1.1615 - val_loss: 1.0295 - val_mean_squared_error: 1.0
295
Epoch 143/500
866/866 [==============================] - 0s 23us/step - loss: 1.1657 - m
ean_squared_error: 1.1657 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 144/500
866/866 [==============================] - 0s 16us/step - loss: 1.1601 - m
ean_squared_error: 1.1601 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 145/500
866/866 [==============================] - 0s 16us/step - loss: 1.1613 - m
ean_squared_error: 1.1613 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 146/500
866/866 [==============================] - 0s 15us/step - loss: 1.1612 - m
ean_squared_error: 1.1612 - val_loss: 1.0294 - val_mean_squared_error: 1.0
294
Epoch 147/500
866/866 [==============================] - 0s 16us/step - loss: 1.1602 - m
ean_squared_error: 1.1602 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 148/500
866/866 [==============================] - 0s 16us/step - loss: 1.1603 - m
```

```
ean_squared_error: 1.1603 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 149/500
866/866 [==============================] - 0s 21us/step - loss: 1.1622 - m
ean_squared_error: 1.1622 - val_loss: 1.0293 - val_mean_squared_error: 1.0
293
Epoch 150/500
866/866 [==============================] - 0s 22us/step - loss: 1.1613 - m
ean_squared_error: 1.1613 - val_loss: 1.0292 - val_mean_squared_error: 1.0
292
Epoch 151/500
866/866 [==============================] - 0s 18us/step - loss: 1.1589 - m
ean_squared_error: 1.1589 - val_loss: 1.0291 - val_mean_squared_error: 1.0
291
Epoch 152/500
866/866 [==============================] - 0s 22us/step - loss: 1.1586 - m
ean_squared_error: 1.1586 - val_loss: 1.0290 - val_mean_squared_error: 1.0
290
Epoch 153/500
866/866 [==============================] - 0s 18us/step - loss: 1.1585 - m
ean_squared_error: 1.1585 - val_loss: 1.0287 - val_mean_squared_error: 1.0
287
Epoch 154/500
866/866 [==============================] - 0s 20us/step - loss: 1.1584 - m
ean_squared_error: 1.1584 - val_loss: 1.0284 - val_mean_squared_error: 1.0
284
Epoch 155/500
866/866 [==============================] - 0s 17us/step - loss: 1.1574 - m
ean_squared_error: 1.1574 - val_loss: 1.0283 - val_mean_squared_error: 1.0
283
Epoch 156/500
866/866 [==============================] - 0s 16us/step - loss: 1.1617 - m
ean_squared_error: 1.1617 - val_loss: 1.0283 - val_mean_squared_error: 1.0
283
Epoch 157/500
866/866 [==============================] - 0s 17us/step - loss: 1.1580 - m
ean_squared_error: 1.1580 - val_loss: 1.0283 - val_mean_squared_error: 1.0
283
Epoch 158/500
866/866 [==============================] - 0s 16us/step - loss: 1.1556 - m
ean_squared_error: 1.1556 - val_loss: 1.0283 - val_mean_squared_error: 1.0
283
Epoch 159/500
866/866 [==============================] - 0s 16us/step - loss: 1.1553 - m
ean_squared_error: 1.1553 - val_loss: 1.0284 - val_mean_squared_error: 1.0
284
Epoch 160/500
866/866 [==============================] - 0s 21us/step - loss: 1.1578 - m
ean_squared_error: 1.1578 - val_loss: 1.0284 - val_mean_squared_error: 1.0
284
Epoch 161/500
866/866 [==============================] - 0s 21us/step - loss: 1.1545 - m
ean_squared_error: 1.1545 - val_loss: 1.0283 - val_mean_squared_error: 1.0
283
Epoch 162/500
866/866 [==============================] - 0s 24us/step - loss: 1.1537 - m
ean_squared_error: 1.1537 - val_loss: 1.0283 - val_mean_squared_error: 1.0
283
Epoch 163/500
866/866 [==============================] - 0s 17us/step - loss: 1.1552 - m
ean_squared_error: 1.1552 - val_loss: 1.0282 - val_mean_squared_error: 1.0
```

```
282
Epoch 164/500
866/866 [==============================] - 0s 17us/step - loss: 1.1540 - m
ean_squared_error: 1.1540 - val_loss: 1.0281 - val_mean_squared_error: 1.0
281
Epoch 165/500
866/866 [==============================] - 0s 22us/step - loss: 1.1537 - m
ean_squared_error: 1.1537 - val_loss: 1.0280 - val_mean_squared_error: 1.0
280
Epoch 166/500
866/866 [==============================] - 0s 22us/step - loss: 1.1525 - m
ean_squared_error: 1.1525 - val_loss: 1.0279 - val_mean_squared_error: 1.0
279
Epoch 167/500
866/866 [==============================] - 0s 18us/step - loss: 1.1522 - m
ean_squared_error: 1.1522 - val_loss: 1.0278 - val_mean_squared_error: 1.0
278
Epoch 168/500
866/866 [==============================] - 0s 23us/step - loss: 1.1515 - m
ean_squared_error: 1.1515 - val_loss: 1.0277 - val_mean_squared_error: 1.0
277
Epoch 169/500
866/866 [==============================] - 0s 18us/step - loss: 1.1521 - m
ean_squared_error: 1.1521 - val_loss: 1.0276 - val_mean_squared_error: 1.0
276
Epoch 170/500
866/866 [==============================] - 0s 17us/step - loss: 1.1523 - m
ean_squared_error: 1.1523 - val_loss: 1.0275 - val_mean_squared_error: 1.0
275
Epoch 171/500
866/866 [==============================] - 0s 17us/step - loss: 1.1507 - m
ean_squared_error: 1.1507 - val_loss: 1.0274 - val_mean_squared_error: 1.0
274
Epoch 172/500
866/866 [==============================] - 0s 16us/step - loss: 1.1510 - m
ean_squared_error: 1.1510 - val_loss: 1.0275 - val_mean_squared_error: 1.0
275
Epoch 173/500
866/866 [==============================] - 0s 22us/step - loss: 1.1505 - m
ean_squared_error: 1.1505 - val_loss: 1.0275 - val_mean_squared_error: 1.0
275
Epoch 174/500
866/866 [==============================] - 0s 20us/step - loss: 1.1502 - m
ean_squared_error: 1.1502 - val_loss: 1.0275 - val_mean_squared_error: 1.0
275
Epoch 175/500
866/866 [==============================] - 0s 17us/step - loss: 1.1488 - m
ean_squared_error: 1.1488 - val_loss: 1.0274 - val_mean_squared_error: 1.0
274
Epoch 176/500
866/866 [==============================] - 0s 21us/step - loss: 1.1520 - m
ean_squared_error: 1.1520 - val_loss: 1.0273 - val_mean_squared_error: 1.0
273
Epoch 177/500
866/866 [==============================] - 0s 17us/step - loss: 1.1484 - m
ean_squared_error: 1.1484 - val_loss: 1.0271 - val_mean_squared_error: 1.0
271
Epoch 178/500
866/866 [==============================] - 0s 16us/step - loss: 1.1481 - m
ean_squared_error: 1.1481 - val_loss: 1.0269 - val_mean_squared_error: 1.0
269
```

```
Epoch 179/500
866/866 [==============================] - 0s 17us/step - loss: 1.1470 - m
ean_squared_error: 1.1470 - val_loss: 1.0266 - val_mean_squared_error: 1.0
266
Epoch 180/500
866/866 [==============================] - 0s 17us/step - loss: 1.1471 - m
ean_squared_error: 1.1471 - val_loss: 1.0265 - val_mean_squared_error: 1.0
265
Epoch 181/500
866/866 [==============================] - 0s 28us/step - loss: 1.1471 - m
ean_squared_error: 1.1471 - val_loss: 1.0263 - val_mean_squared_error: 1.0
263
Epoch 182/500
866/866 [==============================] - 0s 17us/step - loss: 1.1473 - m
ean_squared_error: 1.1473 - val_loss: 1.0264 - val_mean_squared_error: 1.0
264
Epoch 183/500
866/866 [==============================] - 0s 16us/step - loss: 1.1462 - m
ean_squared_error: 1.1462 - val_loss: 1.0265 - val_mean_squared_error: 1.0
265
Epoch 184/500
866/866 [==============================] - 0s 16us/step - loss: 1.1472 - m
ean_squared_error: 1.1472 - val_loss: 1.0266 - val_mean_squared_error: 1.0
266
Epoch 185/500
866/866 [==============================] - 0s 16us/step - loss: 1.1452 - m
ean_squared_error: 1.1452 - val_loss: 1.0267 - val_mean_squared_error: 1.0
267
Epoch 186/500
866/866 [==============================] - 0s 16us/step - loss: 1.1449 - m
ean_squared_error: 1.1449 - val_loss: 1.0267 - val_mean_squared_error: 1.0
267
Epoch 187/500
866/866 [==============================] - 0s 16us/step - loss: 1.1445 - m
ean_squared_error: 1.1445 - val_loss: 1.0266 - val_mean_squared_error: 1.0
266
Epoch 188/500
866/866 [==============================] - 0s 16us/step - loss: 1.1448 - m
ean_squared_error: 1.1448 - val_loss: 1.0265 - val_mean_squared_error: 1.0
265
Epoch 189/500
866/866 [==============================] - 0s 17us/step - loss: 1.1451 - m
ean_squared_error: 1.1451 - val_loss: 1.0264 - val_mean_squared_error: 1.0
264
Epoch 190/500
866/866 [==============================] - 0s 17us/step - loss: 1.1429 - m
ean_squared_error: 1.1429 - val_loss: 1.0262 - val_mean_squared_error: 1.0
262
Epoch 191/500
866/866 [==============================] - 0s 18us/step - loss: 1.1416 - m
ean_squared_error: 1.1416 - val_loss: 1.0258 - val_mean_squared_error: 1.0
258
Epoch 192/500
866/866 [==============================] - 0s 26us/step - loss: 1.1436 - m
ean_squared_error: 1.1436 - val_loss: 1.0255 - val_mean_squared_error: 1.0
255
Epoch 193/500
866/866 [==============================] - 0s 16us/step - loss: 1.1428 - m
ean_squared_error: 1.1428 - val_loss: 1.0255 - val_mean_squared_error: 1.0
255
Epoch 194/500
```

```
866/866 [==============================] - 0s 16us/step - loss: 1.1424 - m
ean_squared_error: 1.1424 - val_loss: 1.0254 - val_mean_squared_error: 1.0
254
Epoch 195/500
866/866 [==============================] - 0s 17us/step - loss: 1.1448 - m
ean_squared_error: 1.1448 - val_loss: 1.0254 - val_mean_squared_error: 1.0
254
Epoch 196/500
866/866 [==============================] - 0s 16us/step - loss: 1.1402 - m
ean_squared_error: 1.1402 - val_loss: 1.0253 - val_mean_squared_error: 1.0
253
Epoch 197/500
866/866 [==============================] - ETA: 0s - loss: 1.1620 - mean_s
quared_error: 1.16 - 0s 17us/step - loss: 1.1419 - mean_squared_error: 1.1
419 - val_loss: 1.0251 - val_mean_squared_error: 1.0251
Epoch 198/500
866/866 [==============================] - 0s 23us/step - loss: 1.1412 - m
ean_squared_error: 1.1412 - val_loss: 1.0250 - val_mean_squared_error: 1.0
250
Epoch 199/500
866/866 [==============================] - 0s 20us/step - loss: 1.1397 - m
ean_squared_error: 1.1397 - val_loss: 1.0251 - val_mean_squared_error: 1.0
251
Epoch 200/500
866/866 [==============================] - 0s 20us/step - loss: 1.1411 - m
ean_squared_error: 1.1411 - val_loss: 1.0252 - val_mean_squared_error: 1.0
252
Epoch 201/500
866/866 [==============================] - 0s 17us/step - loss: 1.1404 - m
ean_squared_error: 1.1404 - val_loss: 1.0252 - val_mean_squared_error: 1.0
252
Epoch 202/500
866/866 [==============================] - 0s 21us/step - loss: 1.1392 - m
ean_squared_error: 1.1392 - val_loss: 1.0253 - val_mean_squared_error: 1.0
253
Epoch 203/500
866/866 [==============================] - 0s 17us/step - loss: 1.1388 - m
ean_squared_error: 1.1388 - val_loss: 1.0250 - val_mean_squared_error: 1.0
250
Epoch 204/500
866/866 [==============================] - 0s 18us/step - loss: 1.1397 - m
ean_squared_error: 1.1397 - val_loss: 1.0247 - val_mean_squared_error: 1.0
247
Epoch 205/500
866/866 [==============================] - 0s 28us/step - loss: 1.1363 - m
ean_squared_error: 1.1363 - val_loss: 1.0247 - val_mean_squared_error: 1.0
247
Epoch 206/500
866/866 [==============================] - 0s 23us/step - loss: 1.1363 - m
ean_squared_error: 1.1363 - val_loss: 1.0247 - val_mean_squared_error: 1.0
247
Epoch 207/500
866/866 [==============================] - 0s 20us/step - loss: 1.1355 - m
ean_squared_error: 1.1355 - val_loss: 1.0245 - val_mean_squared_error: 1.0
245
Epoch 208/500
866/866 [==============================] - 0s 17us/step - loss: 1.1354 - m
ean_squared_error: 1.1354 - val_loss: 1.0244 - val_mean_squared_error: 1.0
244
Epoch 209/500
866/866 [==============================] - 0s 22us/step - loss: 1.1370 - m
```

```
ean_squared_error: 1.1370 - val_loss: 1.0243 - val_mean_squared_error: 1.0
243
Epoch 210/500
866/866 [==============================] - 0s 21us/step - loss: 1.1350 - m
ean_squared_error: 1.1350 - val_loss: 1.0241 - val_mean_squared_error: 1.0
241
Epoch 211/500
866/866 [==============================] - 0s 20us/step - loss: 1.1336 - m
ean_squared_error: 1.1336 - val_loss: 1.0238 - val_mean_squared_error: 1.0
238
Epoch 212/500
866/866 [==============================] - 0s 16us/step - loss: 1.1352 - m
ean_squared_error: 1.1352 - val_loss: 1.0236 - val_mean_squared_error: 1.0
236
Epoch 213/500
866/866 [==============================] - 0s 16us/step - loss: 1.1398 - m
ean_squared_error: 1.1398 - val_loss: 1.0235 - val_mean_squared_error: 1.0
235
Epoch 214/500
866/866 [==============================] - 0s 15us/step - loss: 1.1332 - m
ean_squared_error: 1.1332 - val_loss: 1.0236 - val_mean_squared_error: 1.0
236
Epoch 215/500
866/866 [==============================] - 0s 14us/step - loss: 1.1321 - m
ean_squared_error: 1.1321 - val_loss: 1.0234 - val_mean_squared_error: 1.0
234
Epoch 216/500
866/866 [==============================] - 0s 16us/step - loss: 1.1333 - m
ean_squared_error: 1.1333 - val_loss: 1.0231 - val_mean_squared_error: 1.0
231
Epoch 217/500
866/866 [==============================] - 0s 18us/step - loss: 1.1310 - m
ean_squared_error: 1.1310 - val_loss: 1.0229 - val_mean_squared_error: 1.0
229
Epoch 218/500
866/866 [==============================] - 0s 16us/step - loss: 1.1352 - m
ean_squared_error: 1.1352 - val_loss: 1.0229 - val_mean_squared_error: 1.0
229
Epoch 219/500
866/866 [==============================] - 0s 21us/step - loss: 1.1303 - m
ean_squared_error: 1.1303 - val_loss: 1.0229 - val_mean_squared_error: 1.0
229
Epoch 220/500
866/866 [==============================] - 0s 18us/step - loss: 1.1357 - m
ean_squared_error: 1.1357 - val_loss: 1.0230 - val_mean_squared_error: 1.0
230
Epoch 221/500
866/866 [==============================] - 0s 15us/step - loss: 1.1303 - m
ean_squared_error: 1.1303 - val_loss: 1.0234 - val_mean_squared_error: 1.0
234
Epoch 222/500
866/866 [==============================] - 0s 20us/step - loss: 1.1273 - m
ean_squared_error: 1.1273 - val_loss: 1.0234 - val_mean_squared_error: 1.0
234
Epoch 223/500
866/866 [==============================] - 0s 22us/step - loss: 1.1282 - m
ean_squared_error: 1.1282 - val_loss: 1.0234 - val_mean_squared_error: 1.0
234
Epoch 224/500
866/866 [==============================] - 0s 17us/step - loss: 1.1255 - m
ean_squared_error: 1.1255 - val_loss: 1.0231 - val_mean_squared_error: 1.0
```

```
231
Epoch 225/500
866/866 [==============================] - 0s 16us/step - loss: 1.1291 - m
ean_squared_error: 1.1291 - val_loss: 1.0230 - val_mean_squared_error: 1.0
230
Epoch 226/500
866/866 [==============================] - 0s 22us/step - loss: 1.1255 - m
ean_squared_error: 1.1255 - val_loss: 1.0228 - val_mean_squared_error: 1.0
228
Epoch 227/500
866/866 [==============================] - 0s 16us/step - loss: 1.1289 - m
ean_squared_error: 1.1289 - val_loss: 1.0228 - val_mean_squared_error: 1.0
228
Epoch 228/500
866/866 [==============================] - 0s 15us/step - loss: 1.1264 - m
ean_squared_error: 1.1264 - val_loss: 1.0224 - val_mean_squared_error: 1.0
224
Epoch 229/500
866/866 [==============================] - 0s 15us/step - loss: 1.1225 - m
ean_squared_error: 1.1225 - val_loss: 1.0224 - val_mean_squared_error: 1.0
224
Epoch 230/500
866/866 [==============================] - 0s 16us/step - loss: 1.1243 - m
ean_squared_error: 1.1243 - val_loss: 1.0228 - val_mean_squared_error: 1.0
228
Epoch 231/500
866/866 [==============================] - 0s 17us/step - loss: 1.1229 - m
ean_squared_error: 1.1229 - val_loss: 1.0230 - val_mean_squared_error: 1.0
230
Epoch 232/500
866/866 [==============================] - 0s 20us/step - loss: 1.1227 - m
ean_squared_error: 1.1227 - val_loss: 1.0231 - val_mean_squared_error: 1.0
231
Epoch 233/500
866/866 [==============================] - 0s 16us/step - loss: 1.1222 - m
ean_squared_error: 1.1222 - val_loss: 1.0233 - val_mean_squared_error: 1.0
233
Epoch 234/500
866/866 [==============================] - 0s 15us/step - loss: 1.1214 - m
ean_squared_error: 1.1214 - val_loss: 1.0231 - val_mean_squared_error: 1.0
231
Epoch 235/500
866/866 [==============================] - 0s 16us/step - loss: 1.1206 - m
ean_squared_error: 1.1206 - val_loss: 1.0226 - val_mean_squared_error: 1.0
226
Epoch 236/500
866/866 [==============================] - 0s 15us/step - loss: 1.1201 - m
ean_squared_error: 1.1201 - val_loss: 1.0223 - val_mean_squared_error: 1.0
223
Epoch 237/500
866/866 [==============================] - 0s 18us/step - loss: 1.1185 - m
ean_squared_error: 1.1185 - val_loss: 1.0221 - val_mean_squared_error: 1.0
221
Epoch 238/500
866/866 [==============================] - 0s 18us/step - loss: 1.1204 - m
ean_squared_error: 1.1204 - val_loss: 1.0222 - val_mean_squared_error: 1.0
222
Epoch 239/500
866/866 [==============================] - 0s 16us/step - loss: 1.1179 - m
ean_squared_error: 1.1179 - val_loss: 1.0219 - val_mean_squared_error: 1.0
219
```

```
Epoch 240/500
866/866 [==============================] - 0s 14us/step - loss: 1.1168 - m
ean_squared_error: 1.1168 - val_loss: 1.0219 - val_mean_squared_error: 1.0
219
Epoch 241/500
866/866 [==============================] - 0s 21us/step - loss: 1.1220 - m
ean_squared_error: 1.1220 - val_loss: 1.0218 - val_mean_squared_error: 1.0
218
Epoch 242/500
866/866 [==============================] - 0s 16us/step - loss: 1.1152 - m
ean_squared_error: 1.1152 - val_loss: 1.0216 - val_mean_squared_error: 1.0
216
Epoch 243/500
866/866 [==============================] - 0s 15us/step - loss: 1.1144 - m
ean_squared_error: 1.1144 - val_loss: 1.0216 - val_mean_squared_error: 1.0
216
Epoch 244/500
866/866 [==============================] - ETA: 0s - loss: 1.1606 - mean_s
quared_error: 1.16 - 0s 16us/step - loss: 1.1139 - mean_squared_error: 1.1
139 - val_loss: 1.0214 - val_mean_squared_error: 1.0214
Epoch 245/500
866/866 [==============================] - 0s 15us/step - loss: 1.1138 - m
ean_squared_error: 1.1138 - val_loss: 1.0212 - val_mean_squared_error: 1.0
212
Epoch 246/500
866/866 [==============================] - 0s 17us/step - loss: 1.1123 - m
ean_squared_error: 1.1123 - val_loss: 1.0210 - val_mean_squared_error: 1.0
210
Epoch 247/500
866/866 [==============================] - 0s 16us/step - loss: 1.1109 - m
ean_squared_error: 1.1109 - val_loss: 1.0205 - val_mean_squared_error: 1.0
205
Epoch 248/500
866/866 [==============================] - 0s 15us/step - loss: 1.1117 - m
ean_squared_error: 1.1117 - val_loss: 1.0202 - val_mean_squared_error: 1.0
202
Epoch 249/500
866/866 [==============================] - 0s 15us/step - loss: 1.1093 - m
ean_squared_error: 1.1093 - val_loss: 1.0206 - val_mean_squared_error: 1.0
206
Epoch 250/500
866/866 [==============================] - 0s 15us/step - loss: 1.1089 - m
ean_squared_error: 1.1089 - val_loss: 1.0213 - val_mean_squared_error: 1.0
213
Epoch 251/500
866/866 [==============================] - 0s 21us/step - loss: 1.1093 - m
ean_squared_error: 1.1093 - val_loss: 1.0217 - val_mean_squared_error: 1.0
217
Epoch 252/500
866/866 [==============================] - 0s 18us/step - loss: 1.1075 - m
ean_squared_error: 1.1075 - val_loss: 1.0217 - val_mean_squared_error: 1.0
217
Epoch 253/500
866/866 [==============================] - 0s 22us/step - loss: 1.1058 - m
ean_squared_error: 1.1058 - val_loss: 1.0213 - val_mean_squared_error: 1.0
213
Epoch 254/500
866/866 [==============================] - 0s 16us/step - loss: 1.1069 - m
ean_squared_error: 1.1069 - val_loss: 1.0209 - val_mean_squared_error: 1.0
209
Epoch 255/500
```

```
866/866 [==============================] - 0s 18us/step - loss: 1.1043 - m
ean_squared_error: 1.1043 - val_loss: 1.0201 - val_mean_squared_error: 1.0
201
Epoch 256/500
866/866 [==============================] - 0s 18us/step - loss: 1.1034 - m
ean_squared_error: 1.1034 - val_loss: 1.0198 - val_mean_squared_error: 1.0
198
Epoch 257/500
866/866 [==============================] - 0s 17us/step - loss: 1.1016 - m
ean_squared_error: 1.1016 - val_loss: 1.0197 - val_mean_squared_error: 1.0
197
Epoch 258/500
866/866 [==============================] - 0s 15us/step - loss: 1.1031 - m
ean_squared_error: 1.1031 - val_loss: 1.0199 - val_mean_squared_error: 1.0
199
Epoch 259/500
866/866 [==============================] - 0s 21us/step - loss: 1.0994 - m
ean_squared_error: 1.0994 - val_loss: 1.0202 - val_mean_squared_error: 1.0
202
Epoch 260/500
866/866 [==============================] - 0s 21us/step - loss: 1.0972 - m
ean_squared_error: 1.0972 - val_loss: 1.0204 - val_mean_squared_error: 1.0
204
Epoch 261/500
866/866 [==============================] - 0s 17us/step - loss: 1.0973 - m
ean_squared_error: 1.0973 - val_loss: 1.0204 - val_mean_squared_error: 1.0
204
Epoch 262/500
866/866 [==============================] - 0s 23us/step - loss: 1.0951 - m
ean_squared_error: 1.0951 - val_loss: 1.0201 - val_mean_squared_error: 1.0
201
Epoch 263/500
866/866 [==============================] - 0s 16us/step - loss: 1.0941 - m
ean_squared_error: 1.0941 - val_loss: 1.0192 - val_mean_squared_error: 1.0
192
Epoch 264/500
866/866 [==============================] - 0s 15us/step - loss: 1.0902 - m
ean_squared_error: 1.0902 - val_loss: 1.0185 - val_mean_squared_error: 1.0
185
Epoch 265/500
866/866 [==============================] - 0s 15us/step - loss: 1.0893 - m
ean_squared_error: 1.0893 - val_loss: 1.0181 - val_mean_squared_error: 1.0
181
Epoch 266/500
866/866 [==============================] - 0s 15us/step - loss: 1.0874 - m
ean_squared_error: 1.0874 - val_loss: 1.0179 - val_mean_squared_error: 1.0
179
Epoch 267/500
866/866 [==============================] - 0s 18us/step - loss: 1.0898 - m
ean_squared_error: 1.0898 - val_loss: 1.0179 - val_mean_squared_error: 1.0
179
Epoch 268/500
866/866 [==============================] - 0s 17us/step - loss: 1.0840 - m
ean_squared_error: 1.0840 - val_loss: 1.0183 - val_mean_squared_error: 1.0
183
Epoch 269/500
866/866 [==============================] - 0s 18us/step - loss: 1.0806 - m
ean_squared_error: 1.0806 - val_loss: 1.0185 - val_mean_squared_error: 1.0
185
Epoch 270/500
866/866 [==============================] - 0s 16us/step - loss: 1.0783 - m
```

```
ean_squared_error: 1.0783 - val_loss: 1.0179 - val_mean_squared_error: 1.0
179
Epoch 271/500
866/866 [==============================] - 0s 16us/step - loss: 1.0749 - m
ean_squared_error: 1.0749 - val_loss: 1.0166 - val_mean_squared_error: 1.0
166
Epoch 272/500
866/866 [==============================] - 0s 20us/step - loss: 1.0712 - m
ean_squared_error: 1.0712 - val_loss: 1.0152 - val_mean_squared_error: 1.0
152
Epoch 273/500
866/866 [==============================] - 0s 17us/step - loss: 1.0664 - m
ean_squared_error: 1.0664 - val_loss: 1.0136 - val_mean_squared_error: 1.0
136
Epoch 274/500
866/866 [==============================] - 0s 15us/step - loss: 1.0623 - m
ean_squared_error: 1.0623 - val_loss: 1.0116 - val_mean_squared_error: 1.0
116
Epoch 275/500
866/866 [==============================] - 0s 15us/step - loss: 1.0573 - m
ean_squared_error: 1.0573 - val_loss: 1.0093 - val_mean_squared_error: 1.0
093
Epoch 276/500
866/866 [==============================] - 0s 15us/step - loss: 1.0506 - m
ean_squared_error: 1.0506 - val_loss: 1.0064 - val_mean_squared_error: 1.0
064
Epoch 277/500
866/866 [==============================] - 0s 16us/step - loss: 1.0441 - m
ean_squared_error: 1.0441 - val_loss: 1.0012 - val_mean_squared_error: 1.0
012
Epoch 278/500
866/866 [==============================] - 0s 22us/step - loss: 1.0334 - m
ean_squared_error: 1.0334 - val_loss: 0.9913 - val_mean_squared_error: 0.9
913
Epoch 279/500
866/866 [==============================] - 0s 16us/step - loss: 1.0256 - m
ean_squared_error: 1.0256 - val_loss: 0.9765 - val_mean_squared_error: 0.9
765
Epoch 280/500
866/866 [==============================] - 0s 15us/step - loss: 1.0171 - m
ean_squared_error: 1.0171 - val_loss: 0.9607 - val_mean_squared_error: 0.9
607
Epoch 281/500
866/866 [==============================] - 0s 16us/step - loss: 1.0085 - m
ean_squared_error: 1.0085 - val_loss: 0.9497 - val_mean_squared_error: 0.9
497
Epoch 282/500
866/866 [==============================] - 0s 15us/step - loss: 1.0010 - m
ean_squared_error: 1.0010 - val_loss: 0.9449 - val_mean_squared_error: 0.9
449
Epoch 283/500
866/866 [==============================] - 0s 15us/step - loss: 0.9952 - m
ean_squared_error: 0.9952 - val_loss: 0.9445 - val_mean_squared_error: 0.9
445
Epoch 284/500
866/866 [==============================] - 0s 16us/step - loss: 0.9842 - m
ean_squared_error: 0.9842 - val_loss: 0.9493 - val_mean_squared_error: 0.9
493
Epoch 285/500
866/866 [==============================] - 0s 17us/step - loss: 0.9768 - m
ean_squared_error: 0.9768 - val_loss: 0.9534 - val_mean_squared_error: 0.9
```

```
534
Epoch 286/500
866/866 [==============================] - 0s 18us/step - loss: 0.9706 - m
ean_squared_error: 0.9706 - val_loss: 0.9555 - val_mean_squared_error: 0.9
555
Epoch 287/500
866/866 [==============================] - 0s 16us/step - loss: 0.9625 - m
ean_squared_error: 0.9625 - val_loss: 0.9569 - val_mean_squared_error: 0.9
569
Epoch 288/500
866/866 [==============================] - 0s 22us/step - loss: 0.9585 - m
ean_squared_error: 0.9585 - val_loss: 0.9546 - val_mean_squared_error: 0.9
546
Epoch 289/500
866/866 [==============================] - 0s 16us/step - loss: 0.9525 - m
ean_squared_error: 0.9525 - val_loss: 0.9476 - val_mean_squared_error: 0.9
476
Epoch 290/500
866/866 [==============================] - 0s 15us/step - loss: 0.9484 - m
ean_squared_error: 0.9484 - val_loss: 0.9406 - val_mean_squared_error: 0.9
406
Epoch 291/500
866/866 [==============================] - 0s 15us/step - loss: 0.9444 - m
ean_squared_error: 0.9444 - val_loss: 0.9368 - val_mean_squared_error: 0.9
368
Epoch 292/500
866/866 [==============================] - 0s 14us/step - loss: 0.9417 - m
ean_squared_error: 0.9417 - val_loss: 0.9356 - val_mean_squared_error: 0.9
356
Epoch 293/500
866/866 [==============================] - 0s 16us/step - loss: 0.9411 - m
ean_squared_error: 0.9411 - val_loss: 0.9352 - val_mean_squared_error: 0.9
352
Epoch 294/500
866/866 [==============================] - 0s 14us/step - loss: 0.9347 - m
ean_squared_error: 0.9347 - val_loss: 0.9337 - val_mean_squared_error: 0.9
337
Epoch 295/500
866/866 [==============================] - 0s 18us/step - loss: 0.9304 - m
ean_squared_error: 0.9304 - val_loss: 0.9330 - val_mean_squared_error: 0.9
330
Epoch 296/500
866/866 [==============================] - 0s 17us/step - loss: 0.9279 - m
ean_squared_error: 0.9279 - val_loss: 0.9331 - val_mean_squared_error: 0.9
331
Epoch 297/500
866/866 [==============================] - 0s 20us/step - loss: 0.9313 - m
ean_squared_error: 0.9313 - val_loss: 0.9339 - val_mean_squared_error: 0.9
339
Epoch 298/500
866/866 [==============================] - 0s 20us/step - loss: 0.9233 - m
ean_squared_error: 0.9233 - val_loss: 0.9338 - val_mean_squared_error: 0.9
338
Epoch 299/500
866/866 [==============================] - 0s 17us/step - loss: 0.9203 - m
ean_squared_error: 0.9203 - val_loss: 0.9332 - val_mean_squared_error: 0.9
332
Epoch 300/500
866/866 [==============================] - 0s 17us/step - loss: 0.9194 - m
ean_squared_error: 0.9194 - val_loss: 0.9339 - val_mean_squared_error: 0.9
339
```

```
Epoch 301/500
866/866 [==============================] - 0s 17us/step - loss: 0.9163 - m
ean_squared_error: 0.9163 - val_loss: 0.9329 - val_mean_squared_error: 0.9
329
Epoch 302/500
866/866 [==============================] - 0s 16us/step - loss: 0.9179 - m
ean_squared_error: 0.9179 - val_loss: 0.9340 - val_mean_squared_error: 0.9
340
Epoch 303/500
866/866 [==============================] - 0s 15us/step - loss: 0.9117 - m
ean_squared_error: 0.9117 - val_loss: 0.9380 - val_mean_squared_error: 0.9
380
Epoch 304/500
866/866 [==============================] - 0s 20us/step - loss: 0.9100 - m
ean_squared_error: 0.9100 - val_loss: 0.9384 - val_mean_squared_error: 0.9
384
Epoch 305/500
866/866 [==============================] - 0s 22us/step - loss: 0.9087 - m
ean_squared_error: 0.9087 - val_loss: 0.9405 - val_mean_squared_error: 0.9
405
Epoch 306/500
866/866 [==============================] - 0s 15us/step - loss: 0.9093 - m
ean_squared_error: 0.9093 - val_loss: 0.9385 - val_mean_squared_error: 0.9
385
Epoch 307/500
866/866 [==============================] - 0s 18us/step - loss: 0.9053 - m
ean_squared_error: 0.9053 - val_loss: 0.9358 - val_mean_squared_error: 0.9
358
Epoch 308/500
866/866 [==============================] - 0s 17us/step - loss: 0.9031 - m
ean_squared_error: 0.9031 - val_loss: 0.9367 - val_mean_squared_error: 0.9
367
Epoch 309/500
866/866 [==============================] - 0s 17us/step - loss: 0.9025 - m
ean_squared_error: 0.9025 - val_loss: 0.9372 - val_mean_squared_error: 0.9
372
Epoch 310/500
866/866 [==============================] - 0s 15us/step - loss: 0.9010 - m
ean_squared_error: 0.9010 - val_loss: 0.9387 - val_mean_squared_error: 0.9
387
Epoch 311/500
866/866 [==============================] - 0s 15us/step - loss: 0.9018 - m
ean_squared_error: 0.9018 - val_loss: 0.9399 - val_mean_squared_error: 0.9
399
Epoch 312/500
866/866 [==============================] - 0s 16us/step - loss: 0.8995 - m
ean_squared_error: 0.8995 - val_loss: 0.9417 - val_mean_squared_error: 0.9
417
Epoch 313/500
866/866 [==============================] - 0s 16us/step - loss: 0.8993 - m
ean_squared_error: 0.8993 - val_loss: 0.9422 - val_mean_squared_error: 0.9
422
Epoch 314/500
866/866 [==============================] - 0s 14us/step - loss: 0.9024 - m
ean_squared_error: 0.9024 - val_loss: 0.9418 - val_mean_squared_error: 0.9
418
Epoch 315/500
866/866 [==============================] - 0s 16us/step - loss: 0.8967 - m
ean_squared_error: 0.8967 - val_loss: 0.9445 - val_mean_squared_error: 0.9
445
Epoch 316/500
```

```
866/866 [==============================] - 0s 20us/step - loss: 0.8958 - m
ean_squared_error: 0.8958 - val_loss: 0.9454 - val_mean_squared_error: 0.9
454
Epoch 317/500
866/866 [==============================] - 0s 15us/step - loss: 0.8925 - m
ean_squared_error: 0.8925 - val_loss: 0.9444 - val_mean_squared_error: 0.9
444
Epoch 318/500
866/866 [==============================] - 0s 23us/step - loss: 0.8921 - m
ean_squared_error: 0.8921 - val_loss: 0.9462 - val_mean_squared_error: 0.9
462
Epoch 319/500
866/866 [==============================] - 0s 15us/step - loss: 0.8935 - m
ean_squared_error: 0.8935 - val_loss: 0.9483 - val_mean_squared_error: 0.9
483
Epoch 320/500
866/866 [==============================] - 0s 14us/step - loss: 0.8910 - m
ean_squared_error: 0.8910 - val_loss: 0.9507 - val_mean_squared_error: 0.9
507
Epoch 321/500
866/866 [==============================] - 0s 23us/step - loss: 0.8929 - m
ean_squared_error: 0.8929 - val_loss: 0.9543 - val_mean_squared_error: 0.9
543
Epoch 322/500
866/866 [==============================] - 0s 20us/step - loss: 0.8916 - m
ean_squared_error: 0.8916 - val_loss: 0.9560 - val_mean_squared_error: 0.9
560
Epoch 323/500
866/866 [==============================] - 0s 16us/step - loss: 0.8879 - m
ean_squared_error: 0.8879 - val_loss: 0.9539 - val_mean_squared_error: 0.9
539
Epoch 324/500
866/866 [==============================] - 0s 16us/step - loss: 0.8871 - m
ean_squared_error: 0.8871 - val_loss: 0.9498 - val_mean_squared_error: 0.9
498
Epoch 325/500
866/866 [==============================] - 0s 16us/step - loss: 0.8884 - m
ean_squared_error: 0.8884 - val_loss: 0.9506 - val_mean_squared_error: 0.9
506
Epoch 326/500
866/866 [==============================] - 0s 21us/step - loss: 0.8884 - m
ean_squared_error: 0.8884 - val_loss: 0.9541 - val_mean_squared_error: 0.9
541
Epoch 327/500
866/866 [==============================] - 0s 16us/step - loss: 0.8857 - m
ean_squared_error: 0.8857 - val_loss: 0.9561 - val_mean_squared_error: 0.9
561
Epoch 328/500
866/866 [==============================] - 0s 14us/step - loss: 0.8856 - m
ean_squared_error: 0.8856 - val_loss: 0.9607 - val_mean_squared_error: 0.9
607
Epoch 329/500
866/866 [==============================] - 0s 16us/step - loss: 0.8838 - m
ean_squared_error: 0.8838 - val_loss: 0.9631 - val_mean_squared_error: 0.9
631
Epoch 330/500
866/866 [==============================] - 0s 14us/step - loss: 0.8855 - m
ean_squared_error: 0.8855 - val_loss: 0.9610 - val_mean_squared_error: 0.9
610
Epoch 331/500
866/866 [==============================] - 0s 18us/step - loss: 0.8821 - m
```

```
ean_squared_error: 0.8821 - val_loss: 0.9603 - val_mean_squared_error: 0.9
603
Epoch 332/500
866/866 [==============================] - 0s 17us/step - loss: 0.8817 - m
ean_squared_error: 0.8817 - val_loss: 0.9592 - val_mean_squared_error: 0.9
592
Epoch 333/500
866/866 [==============================] - 0s 17us/step - loss: 0.8811 - m
ean_squared_error: 0.8811 - val_loss: 0.9604 - val_mean_squared_error: 0.9
604
Epoch 334/500
866/866 [==============================] - 0s 17us/step - loss: 0.8825 - m
ean_squared_error: 0.8825 - val_loss: 0.9613 - val_mean_squared_error: 0.9
613
Epoch 335/500
866/866 [==============================] - 0s 15us/step - loss: 0.8828 - m
ean_squared_error: 0.8828 - val_loss: 0.9644 - val_mean_squared_error: 0.9
644
Epoch 336/500
866/866 [==============================] - 0s 17us/step - loss: 0.8804 - m
ean_squared_error: 0.8804 - val_loss: 0.9673 - val_mean_squared_error: 0.9
673
Epoch 337/500
866/866 [==============================] - 0s 16us/step - loss: 0.8788 - m
ean_squared_error: 0.8788 - val_loss: 0.9683 - val_mean_squared_error: 0.9
683
Epoch 338/500
866/866 [==============================] - 0s 16us/step - loss: 0.8794 - m
ean_squared_error: 0.8794 - val_loss: 0.9674 - val_mean_squared_error: 0.9
674
Epoch 339/500
866/866 [==============================] - 0s 16us/step - loss: 0.8798 - m
ean_squared_error: 0.8798 - val_loss: 0.9682 - val_mean_squared_error: 0.9
682
Epoch 340/500
866/866 [==============================] - 0s 15us/step - loss: 0.8792 - m
ean_squared_error: 0.8792 - val_loss: 0.9703 - val_mean_squared_error: 0.9
703
Epoch 341/500
866/866 [==============================] - 0s 16us/step - loss: 0.8762 - m
ean_squared_error: 0.8762 - val_loss: 0.9704 - val_mean_squared_error: 0.9
704
Epoch 342/500
866/866 [==============================] - 0s 23us/step - loss: 0.8810 - m
ean_squared_error: 0.8810 - val_loss: 0.9722 - val_mean_squared_error: 0.9
722
Epoch 343/500
866/866 [==============================] - 0s 16us/step - loss: 0.8749 - m
ean_squared_error: 0.8749 - val_loss: 0.9756 - val_mean_squared_error: 0.9
756
Epoch 344/500
866/866 [==============================] - 0s 16us/step - loss: 0.8753 - m
ean_squared_error: 0.8753 - val_loss: 0.9768 - val_mean_squared_error: 0.9
768
Epoch 345/500
866/866 [==============================] - 0s 15us/step - loss: 0.8752 - m
ean_squared_error: 0.8752 - val_loss: 0.9772 - val_mean_squared_error: 0.9
772
Epoch 346/500
866/866 [==============================] - 0s 15us/step - loss: 0.8791 - m
ean_squared_error: 0.8791 - val_loss: 0.9760 - val_mean_squared_error: 0.9
```

```
760
Epoch 347/500
866/866 [==============================] - 0s 15us/step - loss: 0.8747 - m
ean_squared_error: 0.8747 - val_loss: 0.9753 - val_mean_squared_error: 0.9
753
Epoch 348/500
866/866 [==============================] - 0s 14us/step - loss: 0.8768 - m
ean_squared_error: 0.8768 - val_loss: 0.9769 - val_mean_squared_error: 0.9
769
Epoch 349/500
866/866 [==============================] - 0s 15us/step - loss: 0.8744 - m
ean_squared_error: 0.8744 - val_loss: 0.9785 - val_mean_squared_error: 0.9
785
Epoch 350/500
866/866 [==============================] - 0s 17us/step - loss: 0.8753 - m
ean_squared_error: 0.8753 - val_loss: 0.9788 - val_mean_squared_error: 0.9
788
Epoch 351/500
866/866 [==============================] - 0s 18us/step - loss: 0.8741 - m
ean_squared_error: 0.8741 - val_loss: 0.9800 - val_mean_squared_error: 0.9
800
Epoch 352/500
866/866 [==============================] - 0s 17us/step - loss: 0.8736 - m
ean_squared_error: 0.8736 - val_loss: 0.9830 - val_mean_squared_error: 0.9
830
Epoch 353/500
866/866 [==============================] - 0s 21us/step - loss: 0.8708 - m
ean_squared_error: 0.8708 - val_loss: 0.9862 - val_mean_squared_error: 0.9
862
Epoch 354/500
866/866 [==============================] - 0s 20us/step - loss: 0.8803 - m
ean_squared_error: 0.8803 - val_loss: 0.9862 - val_mean_squared_error: 0.9
862
Epoch 355/500
866/866 [==============================] - 0s 17us/step - loss: 0.8703 - m
ean_squared_error: 0.8703 - val_loss: 0.9829 - val_mean_squared_error: 0.9
829
Epoch 356/500
866/866 [==============================] - 0s 17us/step - loss: 0.8715 - m
ean_squared_error: 0.8715 - val_loss: 0.9807 - val_mean_squared_error: 0.9
807
Epoch 357/500
866/866 [==============================] - 0s 17us/step - loss: 0.8715 - m
ean_squared_error: 0.8715 - val_loss: 0.9815 - val_mean_squared_error: 0.9
815
Epoch 358/500
866/866 [==============================] - 0s 17us/step - loss: 0.8749 - m
ean_squared_error: 0.8749 - val_loss: 0.9826 - val_mean_squared_error: 0.9
826
Epoch 359/500
866/866 [==============================] - 0s 17us/step - loss: 0.8687 - m
ean_squared_error: 0.8687 - val_loss: 0.9837 - val_mean_squared_error: 0.9
837
Epoch 360/500
866/866 [==============================] - 0s 15us/step - loss: 0.8693 - m
ean_squared_error: 0.8693 - val_loss: 0.9831 - val_mean_squared_error: 0.9
831
Epoch 361/500
866/866 [==============================] - 0s 15us/step - loss: 0.8707 - m
ean_squared_error: 0.8707 - val_loss: 0.9817 - val_mean_squared_error: 0.9
817
```

```
Epoch 362/500
866/866 [==============================] - 0s 15us/step - loss: 0.8688 - m
ean_squared_error: 0.8688 - val_loss: 0.9813 - val_mean_squared_error: 0.9
813
Epoch 363/500
866/866 [==============================] - 0s 20us/step - loss: 0.8704 - m
ean_squared_error: 0.8704 - val_loss: 0.9830 - val_mean_squared_error: 0.9
830
Epoch 364/500
866/866 [==============================] - 0s 21us/step - loss: 0.8689 - m
ean_squared_error: 0.8689 - val_loss: 0.9860 - val_mean_squared_error: 0.9
860
Epoch 365/500
866/866 [==============================] - 0s 18us/step - loss: 0.8692 - m
ean_squared_error: 0.8692 - val_loss: 0.9878 - val_mean_squared_error: 0.9
878
Epoch 366/500
866/866 [==============================] - 0s 16us/step - loss: 0.8697 - m
ean_squared_error: 0.8697 - val_loss: 0.9911 - val_mean_squared_error: 0.9
911
Epoch 367/500
866/866 [==============================] - 0s 18us/step - loss: 0.8662 - m
ean_squared_error: 0.8662 - val_loss: 0.9939 - val_mean_squared_error: 0.9
939
Epoch 368/500
866/866 [==============================] - 0s 16us/step - loss: 0.8663 - m
ean_squared_error: 0.8663 - val_loss: 0.9949 - val_mean_squared_error: 0.9
949
Epoch 369/500
866/866 [==============================] - 0s 14us/step - loss: 0.8678 - m
ean_squared_error: 0.8678 - val_loss: 0.9957 - val_mean_squared_error: 0.9
957
Epoch 370/500
866/866 [==============================] - 0s 16us/step - loss: 0.8671 - m
ean_squared_error: 0.8671 - val_loss: 0.9974 - val_mean_squared_error: 0.9
974
Epoch 371/500
866/866 [==============================] - 0s 17us/step - loss: 0.8650 - m
ean_squared_error: 0.8650 - val_loss: 0.9978 - val_mean_squared_error: 0.9
978
Epoch 372/500
866/866 [==============================] - 0s 25us/step - loss: 0.8666 - m
ean_squared_error: 0.8666 - val_loss: 0.9982 - val_mean_squared_error: 0.9
982
Epoch 373/500
866/866 [==============================] - 0s 15us/step - loss: 0.8670 - m
ean_squared_error: 0.8670 - val_loss: 0.9967 - val_mean_squared_error: 0.9
967
Epoch 374/500
866/866 [==============================] - 0s 15us/step - loss: 0.8682 - m
ean_squared_error: 0.8682 - val_loss: 0.9978 - val_mean_squared_error: 0.9
978
Epoch 375/500
866/866 [==============================] - 0s 15us/step - loss: 0.8643 - m
ean_squared_error: 0.8643 - val_loss: 0.9990 - val_mean_squared_error: 0.9
990
Epoch 376/500
866/866 [==============================] - 0s 16us/step - loss: 0.8640 - m
ean_squared_error: 0.8640 - val_loss: 1.0017 - val_mean_squared_error: 1.0
017
Epoch 377/500
```

```
866/866 [==============================] - 0s 20us/step - loss: 0.8674 - m
ean_squared_error: 0.8674 - val_loss: 1.0045 - val_mean_squared_error: 1.0
045
Epoch 378/500
866/866 [==============================] - 0s 18us/step - loss: 0.8634 - m
ean_squared_error: 0.8634 - val_loss: 1.0058 - val_mean_squared_error: 1.0
058
Epoch 379/500
866/866 [==============================] - 0s 16us/step - loss: 0.8636 - m
ean_squared_error: 0.8636 - val_loss: 1.0059 - val_mean_squared_error: 1.0
059
Epoch 380/500
866/866 [==============================] - 0s 15us/step - loss: 0.8632 - m
ean_squared_error: 0.8632 - val_loss: 1.0048 - val_mean_squared_error: 1.0
048
Epoch 381/500
866/866 [==============================] - 0s 15us/step - loss: 0.8677 - m
ean_squared_error: 0.8677 - val_loss: 1.0030 - val_mean_squared_error: 1.0
030
Epoch 382/500
866/866 [==============================] - 0s 16us/step - loss: 0.8617 - m
ean_squared_error: 0.8617 - val_loss: 1.0008 - val_mean_squared_error: 1.0
008
Epoch 383/500
866/866 [==============================] - 0s 15us/step - loss: 0.8621 - m
ean_squared_error: 0.8621 - val_loss: 1.0015 - val_mean_squared_error: 1.0
015
Epoch 384/500
866/866 [==============================] - 0s 18us/step - loss: 0.8635 - m
ean_squared_error: 0.8635 - val_loss: 1.0054 - val_mean_squared_error: 1.0
054
Epoch 385/500
866/866 [==============================] - 0s 17us/step - loss: 0.8629 - m
ean_squared_error: 0.8629 - val_loss: 1.0100 - val_mean_squared_error: 1.0
100
Epoch 386/500
866/866 [==============================] - 0s 21us/step - loss: 0.8610 - m
ean_squared_error: 0.8610 - val_loss: 1.0132 - val_mean_squared_error: 1.0
132
Epoch 387/500
866/866 [==============================] - 0s 18us/step - loss: 0.8652 - m
ean_squared_error: 0.8652 - val_loss: 1.0145 - val_mean_squared_error: 1.0
145
Epoch 388/500
866/866 [==============================] - 0s 15us/step - loss: 0.8603 - m
ean_squared_error: 0.8603 - val_loss: 1.0144 - val_mean_squared_error: 1.0
144
Epoch 389/500
866/866 [==============================] - 0s 15us/step - loss: 0.8623 - m
ean_squared_error: 0.8623 - val_loss: 1.0134 - val_mean_squared_error: 1.0
134
Epoch 390/500
866/866 [==============================] - 0s 20us/step - loss: 0.8605 - m
ean_squared_error: 0.8605 - val_loss: 1.0120 - val_mean_squared_error: 1.0
120
Epoch 391/500
866/866 [==============================] - 0s 18us/step - loss: 0.8616 - m
ean_squared_error: 0.8616 - val_loss: 1.0111 - val_mean_squared_error: 1.0
111
Epoch 392/500
866/866 [==============================] - 0s 16us/step - loss: 0.8636 - m
```

```
ean_squared_error: 0.8636 - val_loss: 1.0149 - val_mean_squared_error: 1.0
149
Epoch 393/500
866/866 [==============================] - 0s 16us/step - loss: 0.8648 - m
ean_squared_error: 0.8648 - val_loss: 1.0187 - val_mean_squared_error: 1.0
187
Epoch 394/500
866/866 [==============================] - 0s 14us/step - loss: 0.8628 - m
ean_squared_error: 0.8628 - val_loss: 1.0210 - val_mean_squared_error: 1.0
210
Epoch 395/500
866/866 [==============================] - 0s 18us/step - loss: 0.8595 - m
ean_squared_error: 0.8595 - val_loss: 1.0205 - val_mean_squared_error: 1.0
205
Epoch 396/500
866/866 [==============================] - 0s 21us/step - loss: 0.8662 - m
ean_squared_error: 0.8662 - val_loss: 1.0194 - val_mean_squared_error: 1.0
194
Epoch 397/500
866/866 [==============================] - 0s 16us/step - loss: 0.8588 - m
ean_squared_error: 0.8588 - val_loss: 1.0177 - val_mean_squared_error: 1.0
177
Epoch 398/500
866/866 [==============================] - 0s 15us/step - loss: 0.8574 - m
ean_squared_error: 0.8574 - val_loss: 1.0172 - val_mean_squared_error: 1.0
172
Epoch 399/500
866/866 [==============================] - 0s 17us/step - loss: 0.8581 - m
ean_squared_error: 0.8581 - val_loss: 1.0177 - val_mean_squared_error: 1.0
177
Epoch 400/500
866/866 [==============================] - 0s 23us/step - loss: 0.8597 - m
ean_squared_error: 0.8597 - val_loss: 1.0192 - val_mean_squared_error: 1.0
192
Epoch 401/500
866/866 [==============================] - 0s 16us/step - loss: 0.8578 - m
ean_squared_error: 0.8578 - val_loss: 1.0208 - val_mean_squared_error: 1.0
208
Epoch 402/500
866/866 [==============================] - 0s 21us/step - loss: 0.8620 - m
ean_squared_error: 0.8620 - val_loss: 1.0213 - val_mean_squared_error: 1.0
213
Epoch 403/500
866/866 [==============================] - 0s 18us/step - loss: 0.8583 - m
ean_squared_error: 0.8583 - val_loss: 1.0227 - val_mean_squared_error: 1.0
227
Epoch 404/500
866/866 [==============================] - 0s 16us/step - loss: 0.8583 - m
ean_squared_error: 0.8583 - val_loss: 1.0246 - val_mean_squared_error: 1.0
246
Epoch 405/500
866/866 [==============================] - 0s 16us/step - loss: 0.8617 - m
ean_squared_error: 0.8617 - val_loss: 1.0241 - val_mean_squared_error: 1.0
241
Epoch 406/500
866/866 [==============================] - 0s 21us/step - loss: 0.8644 - m
ean_squared_error: 0.8644 - val_loss: 1.0245 - val_mean_squared_error: 1.0
245
Epoch 407/500
866/866 [==============================] - 0s 16us/step - loss: 0.8579 - m
ean_squared_error: 0.8579 - val_loss: 1.0266 - val_mean_squared_error: 1.0
```

```
266
Epoch 408/500
866/866 [==============================] - 0s 15us/step - loss: 0.8573 - m
ean_squared_error: 0.8573 - val_loss: 1.0263 - val_mean_squared_error: 1.0
263
Epoch 409/500
866/866 [==============================] - 0s 16us/step - loss: 0.8575 - m
ean_squared_error: 0.8575 - val_loss: 1.0250 - val_mean_squared_error: 1.0
250
Epoch 410/500
866/866 [==============================] - 0s 16us/step - loss: 0.8567 - m
ean_squared_error: 0.8567 - val_loss: 1.0246 - val_mean_squared_error: 1.0
246
Epoch 411/500
866/866 [==============================] - 0s 15us/step - loss: 0.8577 - m
ean_squared_error: 0.8577 - val_loss: 1.0245 - val_mean_squared_error: 1.0
245
Epoch 412/500
866/866 [==============================] - 0s 16us/step - loss: 0.8569 - m
ean_squared_error: 0.8569 - val_loss: 1.0243 - val_mean_squared_error: 1.0
243
Epoch 413/500
866/866 [==============================] - 0s 15us/step - loss: 0.8652 - m
ean_squared_error: 0.8652 - val_loss: 1.0245 - val_mean_squared_error: 1.0
245
Epoch 414/500
866/866 [==============================] - 0s 15us/step - loss: 0.8569 - m
ean_squared_error: 0.8569 - val_loss: 1.0244 - val_mean_squared_error: 1.0
244
Epoch 415/500
866/866 [==============================] - 0s 18us/step - loss: 0.8561 - m
ean_squared_error: 0.8561 - val_loss: 1.0252 - val_mean_squared_error: 1.0
252
Epoch 416/500
866/866 [==============================] - 0s 20us/step - loss: 0.8568 - m
ean_squared_error: 0.8568 - val_loss: 1.0267 - val_mean_squared_error: 1.0
267
Epoch 417/500
866/866 [==============================] - 0s 22us/step - loss: 0.8543 - m
ean_squared_error: 0.8543 - val_loss: 1.0285 - val_mean_squared_error: 1.0
285
Epoch 418/500
866/866 [==============================] - 0s 15us/step - loss: 0.8600 - m
ean_squared_error: 0.8600 - val_loss: 1.0302 - val_mean_squared_error: 1.0
302
Epoch 419/500
866/866 [==============================] - 0s 15us/step - loss: 0.8546 - m
ean_squared_error: 0.8546 - val_loss: 1.0310 - val_mean_squared_error: 1.0
310
Epoch 420/500
866/866 [==============================] - 0s 17us/step - loss: 0.8569 - m
ean_squared_error: 0.8569 - val_loss: 1.0314 - val_mean_squared_error: 1.0
314
Epoch 421/500
866/866 [==============================] - 0s 17us/step - loss: 0.8550 - m
ean_squared_error: 0.8550 - val_loss: 1.0320 - val_mean_squared_error: 1.0
320
Epoch 422/500
866/866 [==============================] - 0s 18us/step - loss: 0.8556 - m
ean_squared_error: 0.8556 - val_loss: 1.0325 - val_mean_squared_error: 1.0
325
```

```
Epoch 423/500
866/866 [==============================] - 0s 17us/step - loss: 0.8542 - m
ean_squared_error: 0.8542 - val_loss: 1.0327 - val_mean_squared_error: 1.0
327
Epoch 424/500
866/866 [==============================] - 0s 15us/step - loss: 0.8565 - m
ean_squared_error: 0.8565 - val_loss: 1.0331 - val_mean_squared_error: 1.0
331
Epoch 425/500
866/866 [==============================] - 0s 15us/step - loss: 0.8541 - m
ean_squared_error: 0.8541 - val_loss: 1.0332 - val_mean_squared_error: 1.0
332
Epoch 426/500
866/866 [==============================] - 0s 15us/step - loss: 0.8579 - m
ean_squared_error: 0.8579 - val_loss: 1.0327 - val_mean_squared_error: 1.0
327
Epoch 427/500
866/866 [==============================] - 0s 21us/step - loss: 0.8567 - m
ean_squared_error: 0.8567 - val_loss: 1.0326 - val_mean_squared_error: 1.0
326
Epoch 428/500
866/866 [==============================] - 0s 17us/step - loss: 0.8530 - m
ean_squared_error: 0.8530 - val_loss: 1.0332 - val_mean_squared_error: 1.0
332
Epoch 429/500
866/866 [==============================] - 0s 16us/step - loss: 0.8519 - m
ean_squared_error: 0.8519 - val_loss: 1.0333 - val_mean_squared_error: 1.0
333
Epoch 430/500
866/866 [==============================] - 0s 15us/step - loss: 0.8552 - m
ean_squared_error: 0.8552 - val_loss: 1.0343 - val_mean_squared_error: 1.0
343
Epoch 431/500
866/866 [==============================] - 0s 18us/step - loss: 0.8593 - m
ean_squared_error: 0.8593 - val_loss: 1.0360 - val_mean_squared_error: 1.0
360
Epoch 432/500
866/866 [==============================] - 0s 21us/step - loss: 0.8554 - m
ean_squared_error: 0.8554 - val_loss: 1.0365 - val_mean_squared_error: 1.0
365
Epoch 433/500
866/866 [==============================] - 0s 17us/step - loss: 0.8554 - m
ean_squared_error: 0.8554 - val_loss: 1.0364 - val_mean_squared_error: 1.0
364
Epoch 434/500
866/866 [==============================] - 0s 17us/step - loss: 0.8559 - m
ean_squared_error: 0.8559 - val_loss: 1.0362 - val_mean_squared_error: 1.0
362
Epoch 435/500
866/866 [==============================] - 0s 17us/step - loss: 0.8516 - m
ean_squared_error: 0.8516 - val_loss: 1.0361 - val_mean_squared_error: 1.0
361
Epoch 436/500
866/866 [==============================] - 0s 17us/step - loss: 0.8519 - m
ean_squared_error: 0.8519 - val_loss: 1.0361 - val_mean_squared_error: 1.0
361
Epoch 437/500
866/866 [==============================] - 0s 16us/step - loss: 0.8523 - m
ean_squared_error: 0.8523 - val_loss: 1.0368 - val_mean_squared_error: 1.0
368
Epoch 438/500
```

```
866/866 [==============================] - 0s 15us/step - loss: 0.8507 - m
ean_squared_error: 0.8507 - val_loss: 1.0377 - val_mean_squared_error: 1.0
377
Epoch 439/500
866/866 [==============================] - 0s 16us/step - loss: 0.8523 - m
ean_squared_error: 0.8523 - val_loss: 1.0376 - val_mean_squared_error: 1.0
376
Epoch 440/500
866/866 [==============================] - 0s 15us/step - loss: 0.8528 - m
ean_squared_error: 0.8528 - val_loss: 1.0379 - val_mean_squared_error: 1.0
379
Epoch 441/500
866/866 [==============================] - 0s 15us/step - loss: 0.8514 - m
ean_squared_error: 0.8514 - val_loss: 1.0382 - val_mean_squared_error: 1.0
382
Epoch 442/500
866/866 [==============================] - 0s 17us/step - loss: 0.8531 - m
ean_squared_error: 0.8531 - val_loss: 1.0383 - val_mean_squared_error: 1.0
383
Epoch 443/500
866/866 [==============================] - 0s 17us/step - loss: 0.8509 - m
ean_squared_error: 0.8509 - val_loss: 1.0390 - val_mean_squared_error: 1.0
390
Epoch 444/500
866/866 [==============================] - 0s 17us/step - loss: 0.8522 - m
ean_squared_error: 0.8522 - val_loss: 1.0392 - val_mean_squared_error: 1.0
392
Epoch 445/500
866/866 [==============================] - 0s 16us/step - loss: 0.8501 - m
ean_squared_error: 0.8501 - val_loss: 1.0391 - val_mean_squared_error: 1.0
391
Epoch 446/500
866/866 [==============================] - 0s 16us/step - loss: 0.8511 - m
ean_squared_error: 0.8511 - val_loss: 1.0392 - val_mean_squared_error: 1.0
392
Epoch 447/500
866/866 [==============================] - 0s 15us/step - loss: 0.8517 - m
ean_squared_error: 0.8517 - val_loss: 1.0388 - val_mean_squared_error: 1.0
388
Epoch 448/500
866/866 [==============================] - 0s 16us/step - loss: 0.8493 - m
ean_squared_error: 0.8493 - val_loss: 1.0384 - val_mean_squared_error: 1.0
384
Epoch 449/500
866/866 [==============================] - 0s 16us/step - loss: 0.8490 - m
ean_squared_error: 0.8490 - val_loss: 1.0384 - val_mean_squared_error: 1.0
384
Epoch 450/500
866/866 [==============================] - 0s 20us/step - loss: 0.8499 - m
ean_squared_error: 0.8499 - val_loss: 1.0387 - val_mean_squared_error: 1.0
387
Epoch 451/500
866/866 [==============================] - 0s 20us/step - loss: 0.8509 - m
ean_squared_error: 0.8509 - val_loss: 1.0391 - val_mean_squared_error: 1.0
391
Epoch 452/500
866/866 [==============================] - 0s 18us/step - loss: 0.8512 - m
ean_squared_error: 0.8512 - val_loss: 1.0395 - val_mean_squared_error: 1.0
395
Epoch 453/500
866/866 [==============================] - 0s 15us/step - loss: 0.8513 - m
```

```
ean_squared_error: 0.8513 - val_loss: 1.0395 - val_mean_squared_error: 1.0
395
Epoch 454/500
866/866 [==============================] - 0s 18us/step - loss: 0.8492 - m
ean_squared_error: 0.8492 - val_loss: 1.0397 - val_mean_squared_error: 1.0
397
Epoch 455/500
866/866 [==============================] - 0s 21us/step - loss: 0.8491 - m
ean_squared_error: 0.8491 - val_loss: 1.0399 - val_mean_squared_error: 1.0
399
Epoch 456/500
866/866 [==============================] - 0s 17us/step - loss: 0.8565 - m
ean_squared_error: 0.8565 - val_loss: 1.0404 - val_mean_squared_error: 1.0
404
Epoch 457/500
866/866 [==============================] - 0s 20us/step - loss: 0.8521 - m
ean_squared_error: 0.8521 - val_loss: 1.0406 - val_mean_squared_error: 1.0
406
Epoch 458/500
866/866 [==============================] - 0s 18us/step - loss: 0.8484 - m
ean_squared_error: 0.8484 - val_loss: 1.0410 - val_mean_squared_error: 1.0
410
Epoch 459/500
866/866 [==============================] - 0s 17us/step - loss: 0.8479 - m
ean_squared_error: 0.8479 - val_loss: 1.0412 - val_mean_squared_error: 1.0
412
Epoch 460/500
866/866 [==============================] - 0s 18us/step - loss: 0.8496 - m
ean_squared_error: 0.8496 - val_loss: 1.0413 - val_mean_squared_error: 1.0
413
Epoch 461/500
866/866 [==============================] - 0s 17us/step - loss: 0.8534 - m
ean_squared_error: 0.8534 - val_loss: 1.0415 - val_mean_squared_error: 1.0
415
Epoch 462/500
866/866 [==============================] - 0s 15us/step - loss: 0.8506 - m
ean_squared_error: 0.8506 - val_loss: 1.0415 - val_mean_squared_error: 1.0
415
Epoch 463/500
866/866 [==============================] - 0s 15us/step - loss: 0.8476 - m
ean_squared_error: 0.8476 - val_loss: 1.0414 - val_mean_squared_error: 1.0
414
Epoch 464/500
866/866 [==============================] - 0s 15us/step - loss: 0.8479 - m
ean_squared_error: 0.8479 - val_loss: 1.0413 - val_mean_squared_error: 1.0
413
Epoch 465/500
866/866 [==============================] - 0s 20us/step - loss: 0.8468 - m
ean_squared_error: 0.8468 - val_loss: 1.0412 - val_mean_squared_error: 1.0
412
Epoch 466/500
866/866 [==============================] - 0s 15us/step - loss: 0.8481 - m
ean_squared_error: 0.8481 - val_loss: 1.0410 - val_mean_squared_error: 1.0
410
Epoch 467/500
866/866 [==============================] - 0s 16us/step - loss: 0.8466 - m
ean_squared_error: 0.8466 - val_loss: 1.0410 - val_mean_squared_error: 1.0
410
Epoch 468/500
866/866 [==============================] - 0s 16us/step - loss: 0.8499 - m
ean_squared_error: 0.8499 - val_loss: 1.0412 - val_mean_squared_error: 1.0
```

```
412
Epoch 469/500
866/866 [==============================] - 0s 15us/step - loss: 0.8478 - m
ean_squared_error: 0.8478 - val_loss: 1.0416 - val_mean_squared_error: 1.0
416
Epoch 470/500
866/866 [==============================] - 0s 23us/step - loss: 0.8462 - m
ean_squared_error: 0.8462 - val_loss: 1.0419 - val_mean_squared_error: 1.0
419
Epoch 471/500
866/866 [==============================] - 0s 17us/step - loss: 0.8469 - m
ean_squared_error: 0.8469 - val_loss: 1.0421 - val_mean_squared_error: 1.0
421
Epoch 472/500
866/866 [==============================] - 0s 16us/step - loss: 0.8488 - m
ean_squared_error: 0.8488 - val_loss: 1.0420 - val_mean_squared_error: 1.0
420
Epoch 473/500
866/866 [==============================] - 0s 20us/step - loss: 0.8472 - m
ean_squared_error: 0.8472 - val_loss: 1.0420 - val_mean_squared_error: 1.0
420
Epoch 474/500
866/866 [==============================] - 0s 16us/step - loss: 0.8453 - m
ean_squared_error: 0.8453 - val_loss: 1.0421 - val_mean_squared_error: 1.0
421
Epoch 475/500
866/866 [==============================] - 0s 15us/step - loss: 0.8468 - m
ean_squared_error: 0.8468 - val_loss: 1.0421 - val_mean_squared_error: 1.0
421
Epoch 476/500
866/866 [==============================] - 0s 16us/step - loss: 0.8478 - m
ean_squared_error: 0.8478 - val_loss: 1.0422 - val_mean_squared_error: 1.0
422
Epoch 477/500
866/866 [==============================] - 0s 16us/step - loss: 0.8472 - m
ean_squared_error: 0.8472 - val_loss: 1.0422 - val_mean_squared_error: 1.0
422
Epoch 478/500
866/866 [==============================] - 0s 15us/step - loss: 0.8469 - m
ean_squared_error: 0.8469 - val_loss: 1.0423 - val_mean_squared_error: 1.0
423
Epoch 479/500
866/866 [==============================] - 0s 14us/step - loss: 0.8464 - m
ean_squared_error: 0.8464 - val_loss: 1.0424 - val_mean_squared_error: 1.0
424
Epoch 480/500
866/866 [==============================] - 0s 15us/step - loss: 0.8507 - m
ean_squared_error: 0.8507 - val_loss: 1.0425 - val_mean_squared_error: 1.0
425
Epoch 481/500
866/866 [==============================] - 0s 18us/step - loss: 0.8467 - m
ean_squared_error: 0.8467 - val_loss: 1.0425 - val_mean_squared_error: 1.0
425
Epoch 482/500
866/866 [==============================] - 0s 23us/step - loss: 0.8456 - m
ean_squared_error: 0.8456 - val_loss: 1.0424 - val_mean_squared_error: 1.0
424
Epoch 483/500
866/866 [==============================] - 0s 16us/step - loss: 0.8472 - m
ean_squared_error: 0.8472 - val_loss: 1.0421 - val_mean_squared_error: 1.0
421
```

```
Epoch 484/500
866/866 [==============================] - 0s 16us/step - loss: 0.8456 - m
ean_squared_error: 0.8456 - val_loss: 1.0419 - val_mean_squared_error: 1.0
419
Epoch 485/500
866/866 [==============================] - 0s 15us/step - loss: 0.8447 - m
ean_squared_error: 0.8447 - val_loss: 1.0420 - val_mean_squared_error: 1.0
420
Epoch 486/500
866/866 [==============================] - 0s 15us/step - loss: 0.8465 - m
ean_squared_error: 0.8465 - val_loss: 1.0422 - val_mean_squared_error: 1.0
422
Epoch 487/500
866/866 [==============================] - 0s 18us/step - loss: 0.8442 - m
ean_squared_error: 0.8442 - val_loss: 1.0423 - val_mean_squared_error: 1.0
423
Epoch 488/500
866/866 [==============================] - 0s 18us/step - loss: 0.8440 - m
ean_squared_error: 0.8440 - val_loss: 1.0425 - val_mean_squared_error: 1.0
425
Epoch 489/500
866/866 [==============================] - 0s 16us/step - loss: 0.8453 - m
ean_squared_error: 0.8453 - val_loss: 1.0425 - val_mean_squared_error: 1.0
425
Epoch 490/500
866/866 [==============================] - 0s 15us/step - loss: 0.8450 - m
ean_squared_error: 0.8450 - val_loss: 1.0426 - val_mean_squared_error: 1.0
426
Epoch 491/500
866/866 [==============================] - 0s 15us/step - loss: 0.8431 - m
ean_squared_error: 0.8431 - val_loss: 1.0427 - val_mean_squared_error: 1.0
427
Epoch 492/500
866/866 [==============================] - 0s 15us/step - loss: 0.8456 - m
ean_squared_error: 0.8456 - val_loss: 1.0428 - val_mean_squared_error: 1.0
428
Epoch 493/500
866/866 [==============================] - 0s 16us/step - loss: 0.8433 - m
ean_squared_error: 0.8433 - val_loss: 1.0429 - val_mean_squared_error: 1.0
429
Epoch 494/500
866/866 [==============================] - 0s 17us/step - loss: 0.8445 - m
ean_squared_error: 0.8445 - val_loss: 1.0429 - val_mean_squared_error: 1.0
429
Epoch 495/500
866/866 [==============================] - 0s 17us/step - loss: 0.8429 - m
ean_squared_error: 0.8429 - val_loss: 1.0429 - val_mean_squared_error: 1.0
429
Epoch 496/500
866/866 [==============================] - 0s 17us/step - loss: 0.8451 - m
ean_squared_error: 0.8451 - val_loss: 1.0428 - val_mean_squared_error: 1.0
428
Epoch 497/500
866/866 [==============================] - 0s 16us/step - loss: 0.8436 - m
ean_squared_error: 0.8436 - val_loss: 1.0428 - val_mean_squared_error: 1.0
428
Epoch 498/500
866/866 [==============================] - 0s 17us/step - loss: 0.8443 - m
ean_squared_error: 0.8443 - val_loss: 1.0429 - val_mean_squared_error: 1.0
429
Epoch 499/500
```

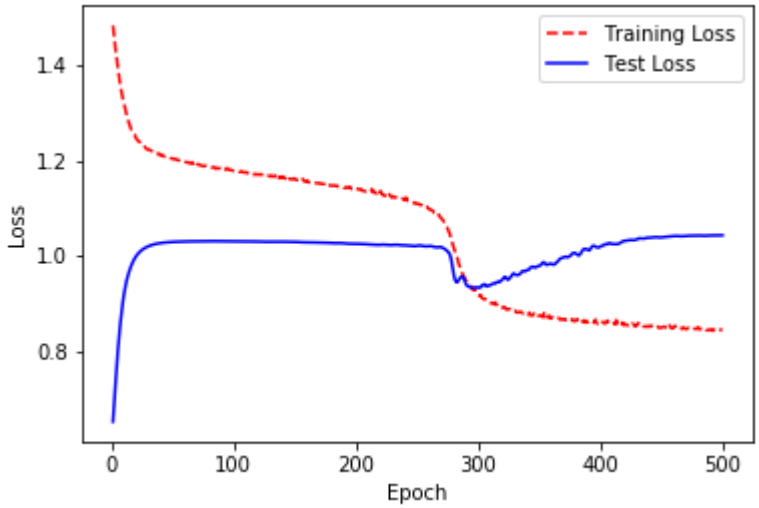
```
866/866 [==============================] - 0s 17us/step - loss: 0.8453 - m
ean_squared_error: 0.8453 - val_loss: 1.0429 - val_mean_squared_error: 1.0
429
Epoch 500/500
866/866 [==============================] - 0s 16us/step - loss: 0.8450 - m
ean_squared_error: 0.8450 - val_loss: 1.0429 - val_mean_squared_error: 1.0
429
```

In [84]:

```
# Get training and test loss histories
training_loss = history.history['loss']
test_loss = history.history['val_loss']

# Create count of the number of epochs
epoch_count = range(1, len(training_loss) + 1)

# Visualize loss history
plt.plot(epoch_count, training_loss, 'r--')
plt.plot(epoch_count, test_loss, 'b-')
plt.legend(['Training Loss', 'Test Loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.show();
```

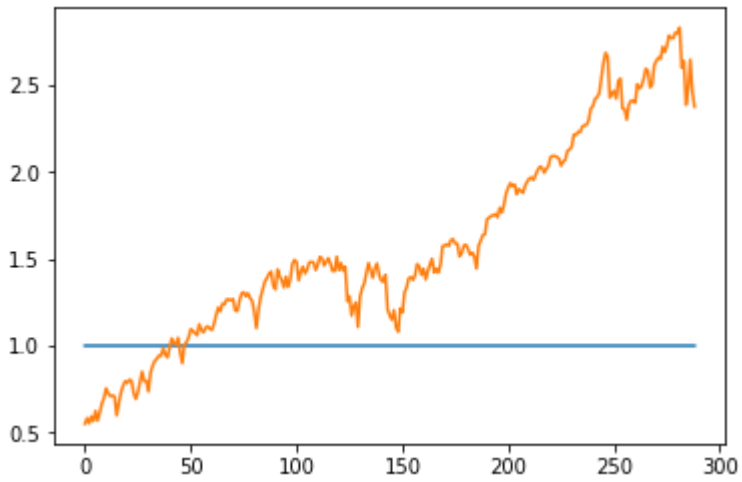


In [85]:

```
y_pred=model.predict(X_test)
```

In [86]:

```
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
```



In [87]:

```
print("RMSE of CNN on test set: ",np.sqrt(metrics.mean_squared_error(y_test,y_pred)))
```

```
RMSE of CNN on test set:  0.8224649537465623
```

LSTM

In [88]:

```
inputs=Input(X_train.shape[1:])

x=LSTM(64,dropout=0.5,recurrent_dropout=0.5)(inputs)
x=BatchNormalization()(x)
# x=LSTM(64)(x)
x=Dense(128,activation='relu')(x)
# x=Dense(32)(x)
x=LeakyReLU()(x)
predictions=Dense(1,activation='sigmoid')(x)

model= Model(inputs=inputs,outputs=predictions)
model.compile(optimizer=Adam(lr=0.001), loss='mean_squared_error')
model.summary()
history=model.fit(X_train, y_train, validation_data=(X_val,y_val),
          batch_size=256,
          epochs=100,
          verbose=1)
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_3 (InputLayer)         (None, 5, 6)              0
_________________________________________________________________
lstm_1 (LSTM)                (None, 64)                18176
_________________________________________________________________
batch_normalization_3 (Batch (None, 64)                256
_________________________________________________________________
dense_5 (Dense)              (None, 128)               8320
_________________________________________________________________
leaky_re_lu_1 (LeakyReLU)    (None, 128)               0
_________________________________________________________________
dense_6 (Dense)              (None, 1)                 129
=================================================================
Total params: 26,881
Trainable params: 26,753
Non-trainable params: 128
_________________________________________________________________
Train on 866 samples, validate on 289 samples
Epoch 1/100
866/866 [==============================] - 1s 1ms/step - loss: 1.5368 - va
l_loss: 0.5239
Epoch 2/100
866/866 [==============================] - 0s 91us/step - loss: 1.1734 - v
al_loss: 0.2100
Epoch 3/100
866/866 [==============================] - 0s 88us/step - loss: 0.9461 - v
al_loss: 0.0948
Epoch 4/100
866/866 [==============================] - 0s 88us/step - loss: 0.8212 - v
al_loss: 0.0936
Epoch 5/100
866/866 [==============================] - 0s 88us/step - loss: 0.7576 - v
al_loss: 0.0978
Epoch 6/100
866/866 [==============================] - 0s 85us/step - loss: 0.7328 - v
al_loss: 0.1003
Epoch 7/100
866/866 [==============================] - 0s 85us/step - loss: 0.7188 - v
al_loss: 0.1018
Epoch 8/100
866/866 [==============================] - 0s 85us/step - loss: 0.7089 - v
al_loss: 0.1027
Epoch 9/100
866/866 [==============================] - 0s 91us/step - loss: 0.7057 - v
al_loss: 0.1033
Epoch 10/100
866/866 [==============================] - 0s 105us/step - loss: 0.6964 -
val_loss: 0.1038
Epoch 11/100
866/866 [==============================] - 0s 93us/step - loss: 0.6978 - v
al_loss: 0.1041
Epoch 12/100
866/866 [==============================] - 0s 85us/step - loss: 0.6933 - v
al_loss: 0.1043
Epoch 13/100
866/866 [==============================] - 0s 90us/step - loss: 0.6914 - v
al_loss: 0.1045
Epoch 14/100
866/866 [==============================] - 0s 85us/step - loss: 0.6904 - v
```

```
al_loss: 0.1046
Epoch 15/100
866/866 [==============================] - 0s 94us/step - loss: 0.6891 - v
al_loss: 0.1047
Epoch 16/100
866/866 [==============================] - 0s 89us/step - loss: 0.6879 - v
al_loss: 0.1048
Epoch 17/100
866/866 [==============================] - 0s 85us/step - loss: 0.6881 - v
al_loss: 0.1048
Epoch 18/100
866/866 [==============================] - 0s 86us/step - loss: 0.6867 - v
al_loss: 0.1049
Epoch 19/100
866/866 [==============================] - 0s 85us/step - loss: 0.6868 - v
al_loss: 0.1049
Epoch 20/100
866/866 [==============================] - 0s 94us/step - loss: 0.6867 - v
al_loss: 0.1050
Epoch 21/100
866/866 [==============================] - 0s 89us/step - loss: 0.6858 - v
al_loss: 0.1050
Epoch 22/100
866/866 [==============================] - 0s 89us/step - loss: 0.6861 - v
al_loss: 0.1051
Epoch 23/100
866/866 [==============================] - 0s 107us/step - loss: 0.6853 -
val_loss: 0.1051
Epoch 24/100
866/866 [==============================] - 0s 92us/step - loss: 0.6839 - v
al_loss: 0.1051
Epoch 25/100
866/866 [==============================] - 0s 86us/step - loss: 0.6840 - v
al_loss: 0.1051
Epoch 26/100
866/866 [==============================] - 0s 90us/step - loss: 0.6844 - v
al_loss: 0.1052
Epoch 27/100
866/866 [==============================] - 0s 90us/step - loss: 0.6834 - v
al_loss: 0.1052
Epoch 28/100
866/866 [==============================] - 0s 89us/step - loss: 0.6843 - v
al_loss: 0.1052
Epoch 29/100
866/866 [==============================] - 0s 101us/step - loss: 0.6844 -
val_loss: 0.1052
Epoch 30/100
866/866 [==============================] - 0s 82us/step - loss: 0.6830 - v
al_loss: 0.1053
Epoch 31/100
866/866 [==============================] - 0s 91us/step - loss: 0.6828 - v
al_loss: 0.1053
Epoch 32/100
866/866 [==============================] - 0s 88us/step - loss: 0.6823 - v
al_loss: 0.1053
Epoch 33/100
866/866 [==============================] - 0s 82us/step - loss: 0.6826 - v
al_loss: 0.1053
Epoch 34/100
866/866 [==============================] - 0s 82us/step - loss: 0.6822 - v
al_loss: 0.1053
```

```
Epoch 35/100
866/866 [==============================] - 0s 89us/step - loss: 0.6829 - v
al_loss: 0.1053
Epoch 36/100
866/866 [==============================] - 0s 84us/step - loss: 0.6820 - v
al_loss: 0.1053
Epoch 37/100
866/866 [==============================] - 0s 83us/step - loss: 0.6817 - v
al_loss: 0.1054
Epoch 38/100
866/866 [==============================] - 0s 89us/step - loss: 0.6823 - v
al_loss: 0.1054
Epoch 39/100
866/866 [==============================] - 0s 101us/step - loss: 0.6819 -
val_loss: 0.1054
Epoch 40/100
866/866 [==============================] - 0s 83us/step - loss: 0.6823 - v
al_loss: 0.1054
Epoch 41/100
866/866 [==============================] - 0s 98us/step - loss: 0.6814 - v
al_loss: 0.1054
Epoch 42/100
866/866 [==============================] - 0s 82us/step - loss: 0.6818 - v
al_loss: 0.1054
Epoch 43/100
866/866 [==============================] - 0s 91us/step - loss: 0.6812 - v
al_loss: 0.1054
Epoch 44/100
866/866 [==============================] - 0s 97us/step - loss: 0.6818 - v
al_loss: 0.1054
Epoch 45/100
866/866 [==============================] - 0s 91us/step - loss: 0.6817 - v
al_loss: 0.1054
Epoch 46/100
866/866 [==============================] - 0s 84us/step - loss: 0.6814 - v
al_loss: 0.1054
Epoch 47/100
866/866 [==============================] - 0s 88us/step - loss: 0.6813 - v
al_loss: 0.1054
Epoch 48/100
866/866 [==============================] - 0s 84us/step - loss: 0.6813 - v
al_loss: 0.1054
Epoch 49/100
866/866 [==============================] - 0s 86us/step - loss: 0.6811 - v
al_loss: 0.1054
Epoch 50/100
866/866 [==============================] - 0s 94us/step - loss: 0.6811 - v
al_loss: 0.1055
Epoch 51/100
866/866 [==============================] - 0s 89us/step - loss: 0.6807 - v
al_loss: 0.1055
Epoch 52/100
866/866 [==============================] - 0s 90us/step - loss: 0.6809 - v
al_loss: 0.1055
Epoch 53/100
866/866 [==============================] - 0s 90us/step - loss: 0.6809 - v
al_loss: 0.1055
Epoch 54/100
866/866 [==============================] - 0s 82us/step - loss: 0.6811 - v
al_loss: 0.1055
Epoch 55/100
```

```
866/866 [==============================] - 0s 83us/step - loss: 0.6811 - v
al_loss: 0.1055
Epoch 56/100
866/866 [==============================] - 0s 98us/step - loss: 0.6810 - v
al_loss: 0.1055
Epoch 57/100
866/866 [==============================] - 0s 86us/step - loss: 0.6810 - v
al_loss: 0.1055
Epoch 58/100
866/866 [==============================] - 0s 88us/step - loss: 0.6805 - v
al_loss: 0.1055
Epoch 59/100
866/866 [==============================] - 0s 92us/step - loss: 0.6807 - v
al_loss: 0.1055
Epoch 60/100
866/866 [==============================] - 0s 92us/step - loss: 0.6808 - v
al_loss: 0.1055
Epoch 61/100
866/866 [==============================] - 0s 82us/step - loss: 0.6805 - v
al_loss: 0.1055
Epoch 62/100
866/866 [==============================] - 0s 83us/step - loss: 0.6807 - v
al_loss: 0.1055
Epoch 63/100
866/866 [==============================] - 0s 88us/step - loss: 0.6802 - v
al_loss: 0.1055
Epoch 64/100
866/866 [==============================] - 0s 91us/step - loss: 0.6807 - v
al_loss: 0.1055
Epoch 65/100
866/866 [==============================] - 0s 92us/step - loss: 0.6804 - v
al_loss: 0.1055
Epoch 66/100
866/866 [==============================] - 0s 91us/step - loss: 0.6806 - v
al_loss: 0.1055
Epoch 67/100
866/866 [==============================] - 0s 86us/step - loss: 0.6807 - v
al_loss: 0.1055
Epoch 68/100
866/866 [==============================] - 0s 86us/step - loss: 0.6802 - v
al_loss: 0.1055
Epoch 69/100
866/866 [==============================] - 0s 82us/step - loss: 0.6803 - v
al_loss: 0.1055
Epoch 70/100
866/866 [==============================] - 0s 92us/step - loss: 0.6804 - v
al_loss: 0.1055
Epoch 71/100
866/866 [==============================] - 0s 91us/step - loss: 0.6802 - v
al_loss: 0.1055
Epoch 72/100
866/866 [==============================] - 0s 90us/step - loss: 0.6803 - v
al_loss: 0.1055
Epoch 73/100
866/866 [==============================] - 0s 90us/step - loss: 0.6802 - v
al_loss: 0.1055
Epoch 74/100
866/866 [==============================] - 0s 83us/step - loss: 0.6803 - v
al_loss: 0.1055
Epoch 75/100
866/866 [==============================] - 0s 90us/step - loss: 0.6801 - v
```

```
al_loss: 0.1055
Epoch 76/100
866/866 [==============================] - 0s 84us/step - loss: 0.6803 - v
al_loss: 0.1055
Epoch 77/100
866/866 [==============================] - 0s 90us/step - loss: 0.6801 - v
al_loss: 0.1055
Epoch 78/100
866/866 [==============================] - 0s 91us/step - loss: 0.6801 - v
al_loss: 0.1056
Epoch 79/100
866/866 [==============================] - 0s 94us/step - loss: 0.6802 - v
al_loss: 0.1056
Epoch 80/100
866/866 [==============================] - 0s 89us/step - loss: 0.6801 - v
al_loss: 0.1056
Epoch 81/100
866/866 [==============================] - 0s 88us/step - loss: 0.6800 - v
al_loss: 0.1056
Epoch 82/100
866/866 [==============================] - 0s 82us/step - loss: 0.6801 - v
al_loss: 0.1056
Epoch 83/100
866/866 [==============================] - 0s 96us/step - loss: 0.6802 - v
al_loss: 0.1056
Epoch 84/100
866/866 [==============================] - 0s 86us/step - loss: 0.6799 - v
al_loss: 0.1056
Epoch 85/100
866/866 [==============================] - 0s 86us/step - loss: 0.6801 - v
al_loss: 0.1056
Epoch 86/100
866/866 [==============================] - 0s 97us/step - loss: 0.6800 - v
al_loss: 0.1056
Epoch 87/100
866/866 [==============================] - 0s 94us/step - loss: 0.6798 - v
al_loss: 0.1056
Epoch 88/100
866/866 [==============================] - 0s 89us/step - loss: 0.6800 - v
al_loss: 0.1056
Epoch 89/100
866/866 [==============================] - 0s 90us/step - loss: 0.6801 - v
al_loss: 0.1056
Epoch 90/100
866/866 [==============================] - 0s 105us/step - loss: 0.6799 -
val_loss: 0.1056
Epoch 91/100
866/866 [==============================] - 0s 113us/step - loss: 0.6799 -
val_loss: 0.1056
Epoch 92/100
866/866 [==============================] - 0s 98us/step - loss: 0.6798 - v
al_loss: 0.1056
Epoch 93/100
866/866 [==============================] - 0s 96us/step - loss: 0.6798 - v
al_loss: 0.1056
Epoch 94/100
866/866 [==============================] - 0s 89us/step - loss: 0.6799 - v
al_loss: 0.1056
Epoch 95/100
866/866 [==============================] - 0s 90us/step - loss: 0.6797 - v
al_loss: 0.1056
```

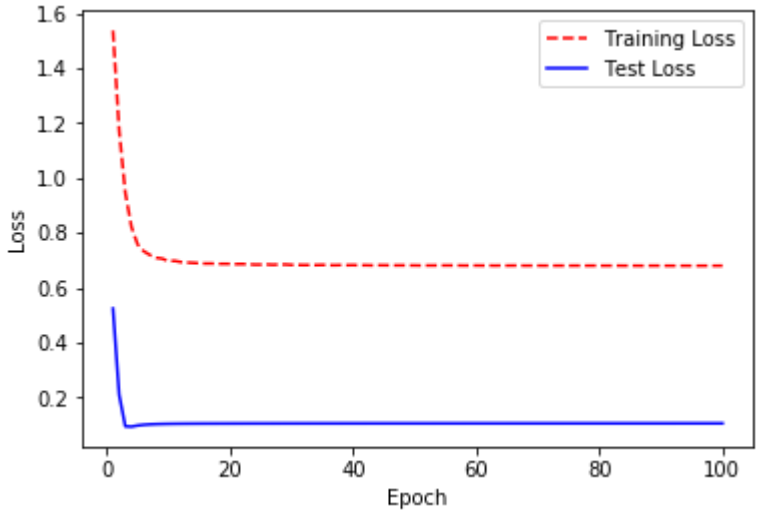
```
Epoch 96/100
866/866 [==============================] - 0s 102us/step - loss: 0.6798 -
val_loss: 0.1056
Epoch 97/100
866/866 [==============================] - 0s 100us/step - loss: 0.6799 -
val_loss: 0.1056
Epoch 98/100
866/866 [==============================] - 0s 93us/step - loss: 0.6798 - v
al_loss: 0.1056
Epoch 99/100
866/866 [==============================] - 0s 97us/step - loss: 0.6798 - v
al_loss: 0.1056
Epoch 100/100
866/866 [==============================] - 0s 97us/step - loss: 0.6800 - v
al_loss: 0.1056
```

In [89]:

```
# Get training and test loss histories
training_loss = history.history['loss']
test_loss = history.history['val_loss']

# Create count of the number of epochs
epoch_count = range(1, len(training_loss) + 1)

# Visualize loss history
plt.plot(epoch_count, training_loss, 'r--')
plt.plot(epoch_count, test_loss, 'b-')
plt.legend(['Training Loss', 'Test Loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.show();
```



In [90]:

```
y_pred=model.predict(X_test)
```

In [91]:

```
y_pred
```

Out[91]:

```
array([[3.55256111e-06],
       [4.41522161e-06],
       [4.24551081e-06],
       [3.97868189e-06],
       [3.78607592e-06],
       [3.58025022e-06],
       [2.70413830e-06],
       [2.86214322e-06],
       [3.01445198e-06],
       [3.44915338e-06],
       [3.67135203e-06],
       [3.56849341e-06],
       [3.78663935e-06],
       [3.52161533e-06],
       [3.68021711e-06],
       [3.54925237e-06],
       [3.99064083e-06],
       [4.58339036e-06],
       [5.51350286e-06],
       [5.39124085e-06],
       [5.93186587e-06],
       [6.07774973e-06],
       [5.82659504e-06],
       [6.57988903e-06],
       [6.91616424e-06],
       [6.12757367e-06],
       [7.50509435e-06],
       [7.36289576e-06],
       [6.26344490e-06],
       [5.11923281e-06],
       [4.42911323e-06],
       [4.64605864e-06],
       [5.30981924e-06],
       [5.16663113e-06],
       [5.23089466e-06],
       [5.47293439e-06],
       [5.44486329e-06],
       [5.34762785e-06],
       [4.94158667e-06],
       [5.50895629e-06],
       [5.02324519e-06],
       [6.74349667e-06],
       [6.99066595e-06],
       [7.24379061e-06],
       [6.82739937e-06],
       [5.72795307e-06],
       [4.47097864e-06],
       [4.40243139e-06],
       [5.81407267e-06],
       [5.83747396e-06],
       [5.58654847e-06],
       [6.40560893e-06],
       [5.48992830e-06],
       [6.36827053e-06],
       [6.61672539e-06],
       [6.76683703e-06],
       [5.57136400e-06],
       [6.87948432e-06],
       [6.95050039e-06],
```

```
       [6.59908119e-06],
       [6.80552512e-06],
       [6.17450769e-06],
       [6.57437522e-06],
       [6.84248289e-06],
       [7.98915062e-06],
       [8.17258660e-06],
       [8.57385658e-06],
       [8.53106212e-06],
       [8.03753937e-06],
       [7.07038407e-06],
       [7.46214437e-06],
       [6.53351117e-06],
       [5.14034264e-06],
       [5.93950199e-06],
       [6.34510707e-06],
       [6.64399749e-06],
       [6.62731645e-06],
       [6.83759072e-06],
       [7.33012121e-06],
       [5.96918380e-06],
       [5.10782684e-06],
       [4.03257809e-06],
       [3.27543694e-06],
       [3.97242229e-06],
       [4.76126934e-06],
       [5.26790018e-06],
       [5.67475581e-06],
       [5.59137243e-06],
       [5.48820663e-06],
       [6.65957077e-06],
       [5.37225060e-06],
       [6.56890415e-06],
       [7.92786341e-06],
       [6.60840806e-06],
       [6.08359460e-06],
       [6.13773818e-06],
       [5.98024326e-06],
       [5.20469075e-06],
       [6.72052602e-06],
       [7.29718704e-06],
       [7.35610956e-06],
       [8.14116811e-06],
       [8.21611502e-06],
       [7.91312596e-06],
       [6.49601634e-06],
       [5.91753724e-06],
       [6.07770289e-06],
       [5.09933352e-06],
       [5.34713854e-06],
       [5.92987499e-06],
       [6.42460509e-06],
       [6.58482259e-06],
       [6.71778344e-06],
       [6.34453272e-06],
       [7.75377794e-06],
       [7.64585911e-06],
       [7.55993233e-06],
       [6.85272244e-06],
       [6.68156872e-06],
       [8.59438023e-06],
```

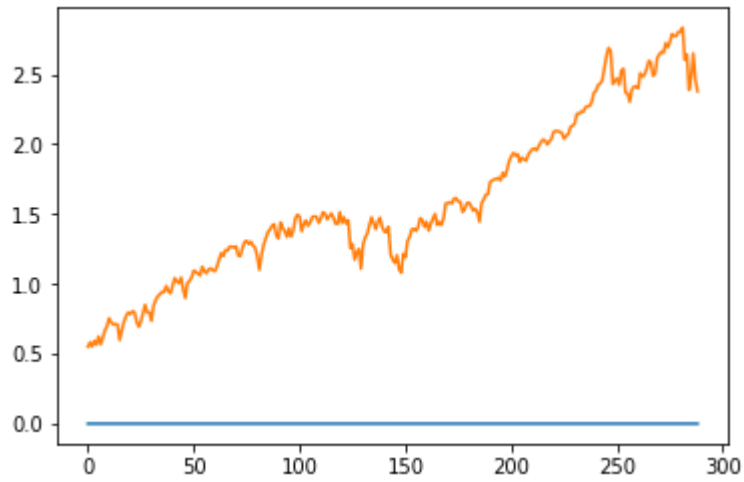
```
       [9.60130183e-06],
       [8.84212113e-06],
       [9.52164373e-06],
       [9.55327869e-06],
       [9.95386199e-06],
       [7.84441363e-06],
       [8.02397608e-06],
       [7.86781948e-06],
       [8.28951306e-06],
       [7.34712785e-06],
       [6.68611347e-06],
       [6.37828134e-06],
       [6.58715271e-06],
       [7.12870633e-06],
       [8.24064409e-06],
       [9.16658610e-06],
       [1.13960250e-05],
       [1.12964235e-05],
       [1.11785503e-05],
       [1.16821684e-05],
       [1.10187084e-05],
       [1.26503510e-05],
       [1.35440850e-05],
       [1.34538686e-05],
       [1.08462464e-05],
       [8.84538531e-06],
       [8.95878020e-06],
       [7.61123692e-06],
       [6.08023083e-06],
       [6.44637385e-06],
       [6.65813604e-06],
       [8.30613226e-06],
       [8.88814702e-06],
       [9.95116625e-06],
       [9.12438190e-06],
       [8.17361615e-06],
       [7.12691872e-06],
       [7.34408741e-06],
       [8.07348442e-06],
       [7.68539394e-06],
       [7.01949193e-06],
       [6.55332406e-06],
       [6.98734675e-06],
       [7.20480966e-06],
       [6.51444179e-06],
       [5.25527048e-06],
       [4.97892825e-06],
       [4.62401476e-06],
       [4.77695585e-06],
       [5.32136210e-06],
       [6.16815169e-06],
       [6.49439335e-06],
       [6.55138092e-06],
       [6.66344613e-06],
       [6.45799128e-06],
       [6.20818673e-06],
       [6.41074257e-06],
       [6.64944264e-06],
       [6.44682905e-06],
       [6.88897080e-06],
       [6.36500454e-06],
```

```
       [6.12166286e-06],
       [6.05951936e-06],
       [5.85073258e-06],
       [6.51040455e-06],
       [6.80693347e-06],
       [7.64055221e-06],
       [1.19452152e-05],
       [1.39480535e-05],
       [1.37886582e-05],
       [1.33116682e-05],
       [1.61282260e-05],
       [1.72750770e-05],
       [1.45343683e-05],
       [1.44095493e-05],
       [1.43148936e-05],
       [1.55147518e-05],
       [1.63510031e-05],
       [1.51535223e-05],
       [1.58350576e-05],
       [1.54862082e-05],
       [1.46417979e-05],
       [1.94625663e-05],
       [2.26362736e-05],
       [1.90140454e-05],
       [1.79068156e-05],
       [1.54892787e-05],
       [1.28005304e-05],
       [1.17920181e-05],
       [1.60002746e-05],
       [1.78427235e-05],
       [2.04477565e-05],
       [1.43658081e-05],
       [1.56684673e-05],
       [1.58960174e-05],
       [1.66322643e-05],
       [1.69079285e-05],
       [1.78751834e-05],
       [1.87749374e-05],
       [2.09358459e-05],
       [2.03600775e-05],
       [1.90423889e-05],
       [1.80288171e-05],
       [1.69711584e-05],
       [1.42373174e-05],
       [1.44520482e-05],
       [1.55703783e-05],
       [1.49882553e-05],
       [1.45289641e-05],
       [1.72566670e-05],
       [1.79244998e-05],
       [2.05488213e-05],
       [2.17723700e-05],
       [2.05046181e-05],
       [2.17013294e-05],
       [2.17221605e-05],
       [2.05903270e-05],
       [2.06369969e-05],
       [2.20998572e-05],
       [2.25657059e-05],
       [2.28423687e-05],
       [2.50997273e-05],
```

```
       [2.79045616e-05],
       [2.86419527e-05],
       [3.16271908e-05],
       [3.37089550e-05],
       [3.59928963e-05],
       [3.62153842e-05],
       [2.68768435e-05],
       [3.15865618e-05],
       [3.72562426e-05],
       [4.04745115e-05],
       [3.79728845e-05],
       [4.49742038e-05],
       [4.13588969e-05],
       [3.11501790e-05],
       [3.17929698e-05],
       [3.26958434e-05],
       [4.50411608e-05],
       [5.16014552e-05],
       [5.50742006e-05],
       [5.89364608e-05],
       [6.95154085e-05],
       [6.97808136e-05],
       [4.68439794e-05],
       [6.95707204e-05],
       [7.19598393e-05],
       [6.42632658e-05],
       [4.00361168e-05],
       [4.40289296e-05],
       [5.53821919e-05],
       [5.86878341e-05],
       [7.11083121e-05],
       [7.20649696e-05],
       [7.14138368e-05],
       [5.63268586e-05],
       [5.61743036e-05],
       [5.75597478e-05],
       [5.75797312e-05],
       [7.53599452e-05],
       [9.10357849e-05],
       [8.54000755e-05],
       [8.59835127e-05],
       [5.74203332e-05],
       [7.24619604e-05],
       [5.42321868e-05],
       [7.83459473e-05],
       [1.00967671e-04],
       [8.37260668e-05]], dtype=float32)
```

In [92]:

```
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
```



Final thoughts

I figured all the models weren't performing that well, which might mean my feature selection wasn't that good. So I thought of just using today's price to use as a feature to predict tomorrow's price, and it turned out pretty well with just linear regression.

In [93]:

```
X_data=np.array(data2.drop(['target'],axis=1))
# X_data=[float(i) for i in X_data]
X_data=X_data.astype(float)
print("Shape of X_data is: ", X_data.shape,'\nSneak peek on first five elements: \n', X
_data[0:5])
```

```
Shape of X_data is:  (7228, 7)
Sneak peek on first five elements:
 [[359.69   17.24    7.93    7.875   7.847 399.     22.89 ]
 [358.76   18.19    7.974   7.927   7.911 395.     23.68 ]
 [355.67   19.22    7.972   7.91    7.9   396.5    23.41 ]
 [352.2    20.11    7.984   7.885   7.896 405.     23.08 ]
 [353.79   20.26    8.012   7.893   7.907 404.6    21.62 ]]
```

In [94]:

```
y_data=np.array(data2.target)
y_data=[float(i) for i in y_data]
print("Length of y_data is :", len(y_data),'\nSneak peek on first five elements: \n', y
_data[0:5])
```

```
Length of y_data is : 7228
Sneak peek on first five elements:
 [358.76, 355.67, 352.2, 353.79, 349.62]
```

In [95]:

```
X_train=np.array(X_data[0:int(0.8*len(X_data))])
y_train=np.array(y_data[0:int(0.8*len(y_data))])
y_train_class=np.array(y_data_class[0:int(0.8*len(y_data_class))])
X_test=np.array(X_data[int(0.8*len(X_data)):])
y_test=np.array(y_data[int(0.8*len(y_data)):])
y_test_class=np.array(y_data_class[int(0.8*len(y_data_class)):])
```

In [96]:

```
#Data Scaling
sc=StandardScaler()
sc2=StandardScaler()
X_train=sc.fit_transform(X_train)
X_test=sc.transform(X_test)
y_train=sc2.fit_transform(y_train.reshape(-1,1))
y_test=sc2.transform(y_test.reshape(-1,1))
X_data_sc=sc.fit_transform(X_data)
y_data_sc=sc.fit_transform(np.array(y_data).reshape(-1,1))
```

In [97]:

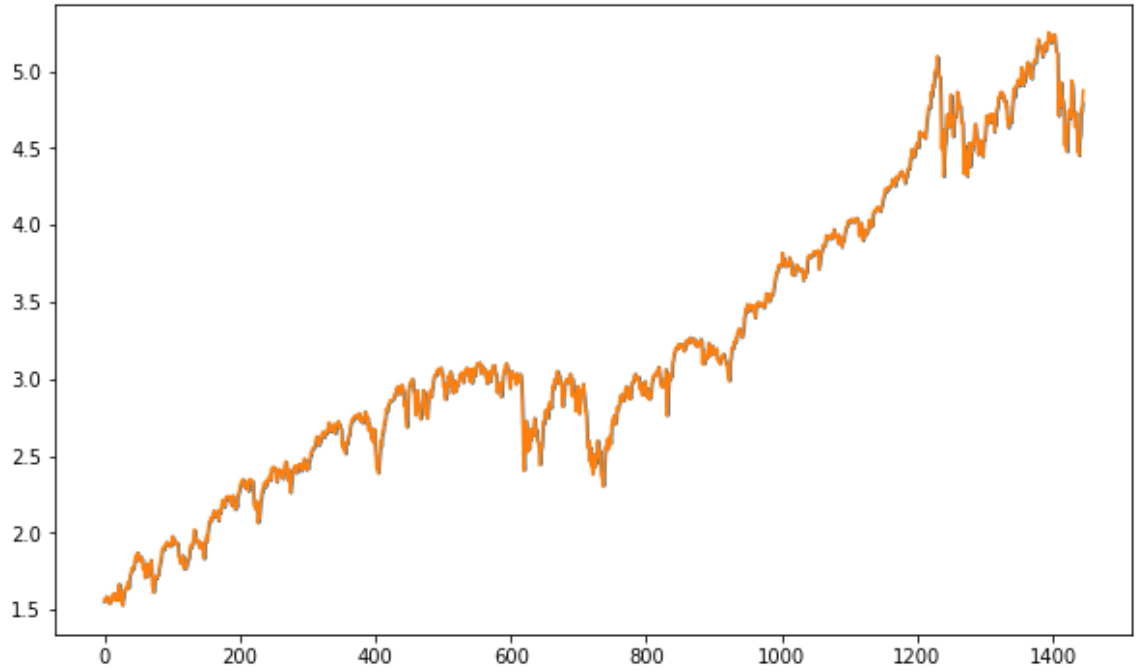
```
from sklearn import linear_model
model=linear_model.LinearRegression()
model.fit(X_train,y_train)
```

Out[97]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=1, normalize=Fals
e)
```

In [98]:

```
#fit data to model and graph results
y_pred=model.predict(X_test)
figure(figsize=(10,6))
plt.plot(y_pred)
plt.plot(y_test)
plt.show()
print("RMSE of test set: ",np.sqrt(metrics.mean_squared_error(y_test,y_pred)))
```




```
RMSE of test set:  0.046653871173250726
```

4. Conclusion

In conclusion, even though many models seems to be complicated, they have their pros and cons.
Complicated models doesn't directly imply that the results will be better.
More importantly is the feature selection and hyperparameter tunings for me, since in this ipynb we can see that just by adding 1 feature drastically improved the predictions and reduced the RMSE by a lot.

References: Codes in course by professor Purewal Cardiologist-Level Arrhythmia Detection with Convolutional Neural Networks, Andrew Ng.(https://arxiv.org/pdf/1707.01836.pdf (https://arxiv.org/pdf/1707.01836.pdf)) Time Series Prediction with LSTM Recurrent Neural Networks in Python with Keras, Jason Brownlee (https://machinelearningmastery.com/time-series-prediction-lstm-recurrent-neural-networks-python-keras/ (https://machinelearningmastery.com/time-series-prediction-lstm-recurrent-neural-networks-python-keras/)) What is LightGBM, How to implement it? How to fine tune the parameters?, Pushkar Mandot (https://medium.com/@pushkarmandot/https-medium-com-pushkarmandot-what-is-lightgbm-how-to-implement-it-how-to-fine-tune-the-parameters-60347819b7fc (https://medium.com/@pushkarmandot/https-medium-com-pushkarmandot-what-is-lightgbm-how-to-implement-it-how-to-fine-tune-the-parameters-60347819b7fc))