In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [3]:
```
df = pd.read_csv('../data/DATA/cancer_classification.csv')
```

Exploratory Data Analysis

In [4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 31 columns):
 #   Column                   Non-Null Count  Dtype  
---  ------                   --------------  -----  
 0   mean radius              569 non-null    float64
 1   mean texture             569 non-null    float64
 2   mean perimeter           569 non-null    float64
 3   mean area                569 non-null    float64
 4   mean smoothness          569 non-null    float64
 5   mean compactness         569 non-null    float64
 6   mean concavity           569 non-null    float64
 7   mean concave points      569 non-null    float64
 8   mean symmetry            569 non-null    float64
 9   mean fractal dimension   569 non-null    float64
 10  radius error             569 non-null    float64
 11  texture error            569 non-null    float64
 12  perimeter error          569 non-null    float64
 13  area error               569 non-null    float64
 14  smoothness error         569 non-null    float64
 15  compactness error        569 non-null    float64
 16  concavity error          569 non-null    float64
 17  concave points error     569 non-null    float64
 18  symmetry error           569 non-null    float64
 19  fractal dimension error  569 non-null    float64
 20  worst radius             569 non-null    float64
 21  worst texture            569 non-null    float64
 22  worst perimeter          569 non-null    float64
 23  worst area               569 non-null    float64
 24  worst smoothness         569 non-null    float64
 25  worst compactness        569 non-null    float64
 26  worst concavity          569 non-null    float64
 27  worst concave points     569 non-null    float64
 28  worst symmetry           569 non-null    float64
 29  worst fractal dimension  569 non-null    float64
 30  benign_0__mal_1          569 non-null    int64  
dtypes: float64(30), int64(1)
memory usage: 137.9 KB
```

In [6]:
```
df.describe().transpose()
```

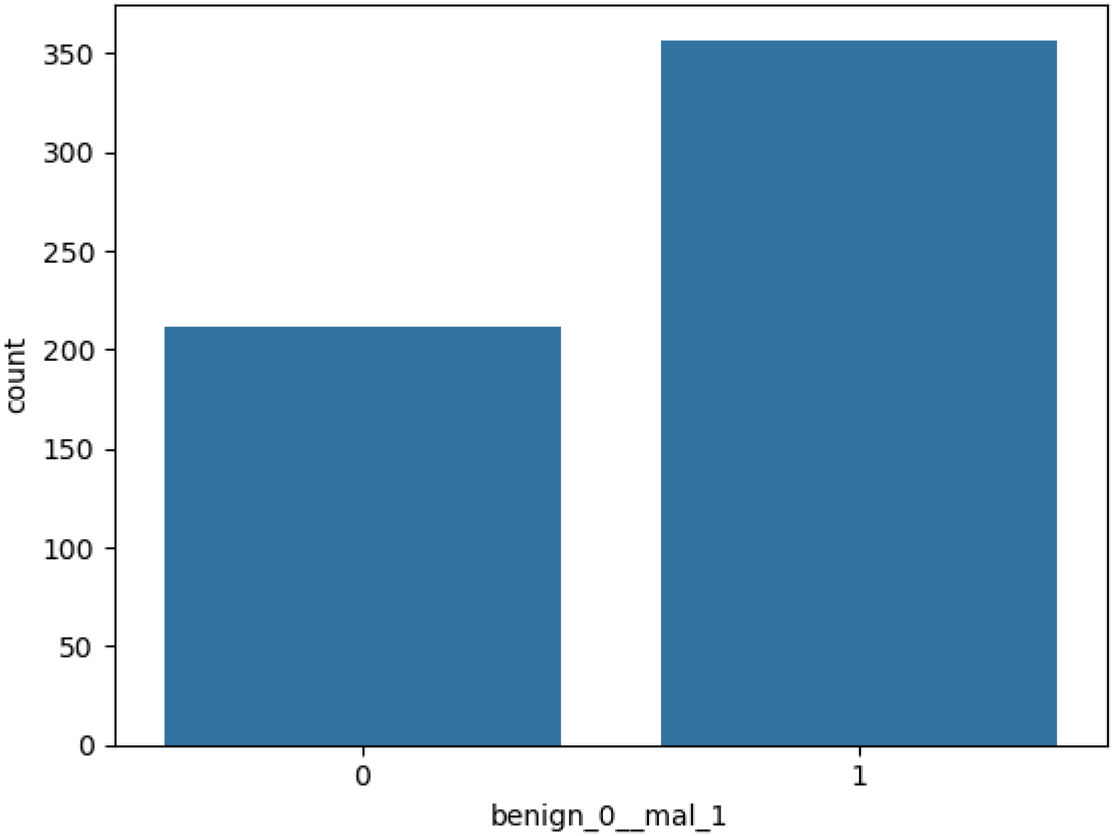
Out[6]:

	count	mean	std	min	25%	50%	
mean radius	569.0	14.127292	3.524049	6.981000	11.700000	13.370000	
mean texture	569.0	19.289649	4.301036	9.710000	16.170000	18.840000	
mean perimeter	569.0	91.969033	24.298981	43.790000	75.170000	86.240000	1
mean area	569.0	654.889104	351.914129	143.500000	420.300000	551.100000	7
mean smoothness	569.0	0.096360	0.014064	0.052630	0.086370	0.095870	
mean compactness	569.0	0.104341	0.052813	0.019380	0.064920	0.092630	
mean concavity	569.0	0.088799	0.079720	0.000000	0.029560	0.061540	
mean concave points	569.0	0.048919	0.038803	0.000000	0.020310	0.033500	
mean symmetry	569.0	0.181162	0.027414	0.106000	0.161900	0.179200	
mean fractal dimension	569.0	0.062798	0.007060	0.049960	0.057700	0.061540	
radius error	569.0	0.405172	0.277313	0.111500	0.232400	0.324200	
texture error	569.0	1.216853	0.551648	0.360200	0.833900	1.108000	
perimeter error	569.0	2.866059	2.021855	0.757000	1.606000	2.287000	
area error	569.0	40.337079	45.491006	6.802000	17.850000	24.530000	
smoothness error	569.0	0.007041	0.003003	0.001713	0.005169	0.006380	
compactness error	569.0	0.025478	0.017908	0.002252	0.013080	0.020450	
concavity error	569.0	0.031894	0.030186	0.000000	0.015090	0.025890	
concave points error	569.0	0.011796	0.006170	0.000000	0.007638	0.010930	
symmetry error	569.0	0.020542	0.008266	0.007882	0.015160	0.018730	
fractal dimension error	569.0	0.003795	0.002646	0.000895	0.002248	0.003187	
worst radius	569.0	16.269190	4.833242	7.930000	13.010000	14.970000	
worst texture	569.0	25.677223	6.146258	12.020000	21.080000	25.410000	
worst perimeter	569.0	107.261213	33.602542	50.410000	84.110000	97.660000	1
worst area	569.0	880.583128	569.356993	185.200000	515.300000	686.500000	10
worst smoothness	569.0	0.132369	0.022832	0.071170	0.116600	0.131300	
worst compactness	569.0	0.254265	0.157336	0.027290	0.147200	0.211900	
worst concavity	569.0	0.272188	0.208624	0.000000	0.114500	0.226700	

	count	mean	std	min	25%	50%
worst concave points	569.0	0.114606	0.065732	0.000000	0.064930	0.099930
worst symmetry	569.0	0.290076	0.061867	0.156500	0.250400	0.282200
worst fractal dimension	569.0	0.083946	0.018061	0.055040	0.071460	0.080040
benign_0__mal_1	569.0	0.627417	0.483918	0.000000	0.000000	1.000000

In [7]:
```
sns.countplot(x='benign_0__mal_1', data=df)
```

Out[7]: <Axes: xlabel='benign_0__mal_1', ylabel='count'>



In [8]:
```
df.corr()['']
```

Out[8]:

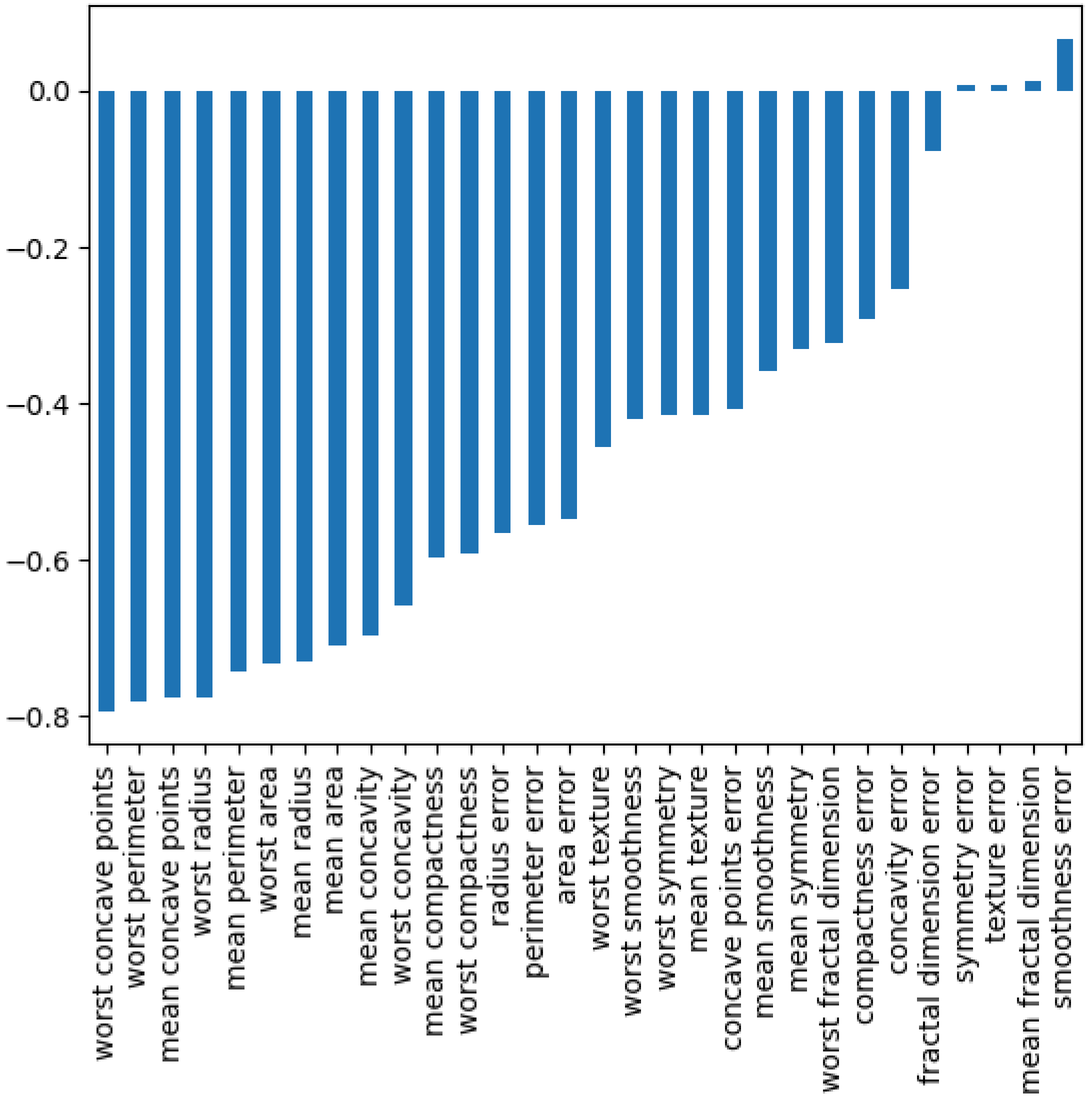
	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness
mean radius	1.000000	0.323782	0.997855	0.987357	0.170581	0.506124
mean texture	0.323782	1.000000	0.329533	0.321086	-0.023389	0.236702
mean perimeter	0.997855	0.329533	1.000000	0.986507	0.207278	0.556936
mean area	0.987357	0.321086	0.986507	1.000000	0.177028	0.498502
mean smoothness	0.170581	-0.023389	0.207278	0.177028	1.000000	0.659123
mean compactness	0.506124	0.236702	0.556936	0.498502	0.659123	1.000000
mean concavity	0.676764	0.302418	0.716136	0.685983	0.521984	0.883121
mean concave points	0.822529	0.293464	0.850977	0.823269	0.553695	0.831135
mean symmetry	0.147741	0.071401	0.183027	0.151293	0.557775	0.602641
mean fractal dimension	-0.311631	-0.076437	-0.261477	-0.283110	0.584792	0.565369
radius error	0.679090	0.275869	0.691765	0.732562	0.301467	0.497473
texture error	-0.097317	0.386358	-0.086761	-0.066280	0.068406	0.046205
perimeter error	0.674172	0.281673	0.693135	0.726628	0.296092	0.548905
area error	0.735864	0.259845	0.744983	0.800086	0.246552	0.455653
smoothness error	-0.222600	0.006614	-0.202694	-0.166777	0.332375	0.135299
compactness error	0.206000	0.191975	0.250744	0.212583	0.318943	0.738722
concavity error	0.194204	0.143293	0.228082	0.207660	0.248396	0.570517
concave points error	0.376169	0.163851	0.407217	0.372320	0.380676	0.642262
symmetry error	-0.104321	0.009127	-0.081629	-0.072497	0.200774	0.229977
fractal dimension error	-0.042641	0.054458	-0.005523	-0.019887	0.283607	0.507318
worst radius	0.969539	0.352573	0.969476	0.962746	0.213120	0.535315
worst texture	0.297008	0.912045	0.303038	0.287489	0.036072	0.248133
worst perimeter	0.965137	0.358040	0.970387	0.959120	0.238853	0.590210
worst area	0.941082	0.343546	0.941550	0.959213	0.206718	0.509604
worst smoothness	0.119616	0.077503	0.150549	0.123523	0.805324	0.565541
worst compactness	0.413463	0.277830	0.455774	0.390410	0.472468	0.865809

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness
worst concavity	0.526911	0.301025	0.563879	0.512606	0.434926	0.816275
worst concave points	0.744214	0.295316	0.771241	0.722017	0.503053	0.815573
worst symmetry	0.163953	0.105008	0.189115	0.143570	0.394309	0.510223
worst fractal dimension	0.007066	0.119205	0.051019	0.003738	0.499316	0.687382
benign_0__mal_1	-0.730029	-0.415185	-0.742636	-0.708984	-0.358560	-0.596534

31 rows × 31 columns

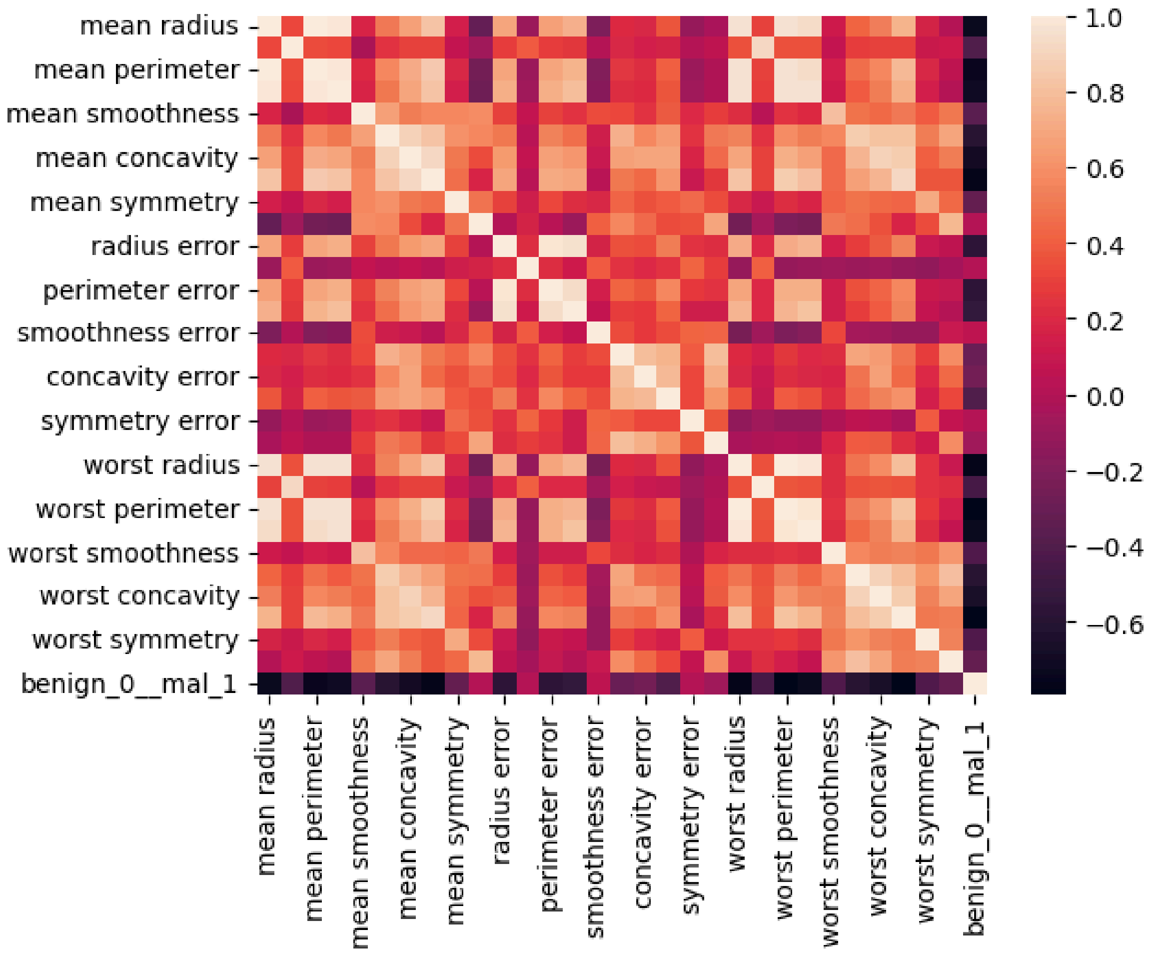
In [14]:
```
df.corr()['benign_0__mal_1'][:-1].sort_values().plot(kind='bar')
```

Out[14]: <Axes: >



In [15]:
```
sns.heatmap(df.corr())
```

Out[15]: <Axes: >



In [17]:
```
X= df.drop('benign_0__mal_1', axis=1).values
```

In [18]:
```
y= df['benign_0__mal_1'].values
```

In [19]:
```
from sklearn.model_selection import train_test_split
```

In [20]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random
```

In [21]:
```
from sklearn.preprocessing import MinMaxScaler
```

In [22]:
```
scaler = MinMaxScaler()
```

In [23]:
```
X_train = scaler.fit_transform(X_train)
X_test = scaler.fit_transform(X_test)
```

In [26]:
```
X_test.max()
```

Out[26]: 1.0000000000000002

In [28]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
```

In [29]:
```
X_train.shape
```

Out[29]: (426, 30)

In [30]:
```
model = Sequential()
```

In [31]:
```
model.add(Dense(30, activation='relu'))
model.add(Dense(15, activation='relu'))
# BINARY CLASSIFICATION PROBLEM we will use sigmoid
model.add(Dense(1, activation='sigmoid'))
model.compile(loss='binary_crossentropy', optimizer='adam')
```

In [32]:
```
model.fit(x=X_train, y=y_train, epochs=600, validation_data=(X_test, y_test))
```

```
Epoch 1/600
14/14 [==============================] - 2s 57ms/step - loss: 0.6836 - val_loss:
0.6472
Epoch 2/600
14/14 [==============================] - 0s 11ms/step - loss: 0.6431 - val_loss:
0.6111
Epoch 3/600
14/14 [==============================] - 0s 10ms/step - loss: 0.6062 - val_loss:
0.5727
Epoch 4/600
14/14 [==============================] - 0s 8ms/step - loss: 0.5704 - val_loss:
0.5328
Epoch 5/600
14/14 [==============================] - 0s 10ms/step - loss: 0.5310 - val_loss:
0.4923
Epoch 6/600
14/14 [==============================] - 0s 11ms/step - loss: 0.4870 - val_loss:
0.4441
Epoch 7/600
14/14 [==============================] - 0s 11ms/step - loss: 0.4416 - val_loss:
0.4000
Epoch 8/600
14/14 [==============================] - 0s 11ms/step - loss: 0.4002 - val_loss:
0.3606
Epoch 9/600
14/14 [==============================] - 0s 12ms/step - loss: 0.3566 - val_loss:
0.3178
Epoch 10/600
14/14 [==============================] - 0s 10ms/step - loss: 0.3229 - val_loss:
0.2910
Epoch 11/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2913 - val_loss:
0.2662
Epoch 12/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2659 - val_loss:
0.2465
Epoch 13/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2442 - val_loss:
0.2237
Epoch 14/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2286 - val_loss:
0.2167
Epoch 15/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2121 - val_loss:
0.1979
Epoch 16/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2008 - val_loss:
0.1990
Epoch 17/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1901 - val_loss:
0.1865
Epoch 18/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1844 - val_loss:
0.1907
Epoch 19/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1716 - val_loss:
0.1817
Epoch 20/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1598 - val_loss:
0.1636
```

```
Epoch 21/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1524 - val_loss: 
0.1735
Epoch 22/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1460 - val_loss: 
0.1632
Epoch 23/600
14/14 [==============================] - 0s 11ms/step - loss: 0.1390 - val_loss: 
0.1654
Epoch 24/600
14/14 [==============================] - 0s 12ms/step - loss: 0.1305 - val_loss: 
0.1563
Epoch 25/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1242 - val_loss: 
0.1534
Epoch 26/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1192 - val_loss: 
0.1620
Epoch 27/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1140 - val_loss: 
0.1664
Epoch 28/600
14/14 [==============================] - 0s 10ms/step - loss: 0.1079 - val_loss: 
0.1548
Epoch 29/600
14/14 [==============================] - 0s 5ms/step - loss: 0.1037 - val_loss: 
0.1607
Epoch 30/600
14/14 [==============================] - 0s 5ms/step - loss: 0.1007 - val_loss: 
0.1678
Epoch 31/600
14/14 [==============================] - 0s 5ms/step - loss: 0.0960 - val_loss: 
0.1589
Epoch 32/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0921 - val_loss: 
0.1472
Epoch 33/600
14/14 [==============================] - 0s 5ms/step - loss: 0.0920 - val_loss: 
0.1700
Epoch 34/600
14/14 [==============================] - 0s 5ms/step - loss: 0.0884 - val_loss: 
0.1518
Epoch 35/600
14/14 [==============================] - 0s 5ms/step - loss: 0.0835 - val_loss: 
0.1657
Epoch 36/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0815 - val_loss: 
0.1655
Epoch 37/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0797 - val_loss: 
0.1626
Epoch 38/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0788 - val_loss: 
0.1789
Epoch 39/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0766 - val_loss: 
0.1629
Epoch 40/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0743 - val_loss: 
0.1652
```

```
Epoch 41/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0721 - val_loss:
0.1654
Epoch 42/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0709 - val_loss:
0.1781
Epoch 43/600
14/14 [==============================] - 0s 23ms/step - loss: 0.0692 - val_loss:
0.1629
Epoch 44/600
14/14 [==============================] - 0s 19ms/step - loss: 0.0728 - val_loss:
0.1991
Epoch 45/600
14/14 [==============================] - 0s 16ms/step - loss: 0.0712 - val_loss:
0.1647
Epoch 46/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0680 - val_loss:
0.1825
Epoch 47/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0659 - val_loss:
0.1893
Epoch 48/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0664 - val_loss:
0.1779
Epoch 49/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0690 - val_loss:
0.1805
Epoch 50/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0631 - val_loss:
0.1969
Epoch 51/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0615 - val_loss:
0.1780
Epoch 52/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0627 - val_loss:
0.2110
Epoch 53/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0615 - val_loss:
0.1894
Epoch 54/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0621 - val_loss:
0.2036
Epoch 55/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0654 - val_loss:
0.1721
Epoch 56/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0627 - val_loss:
0.2127
Epoch 57/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0603 - val_loss:
0.1920
Epoch 58/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0573 - val_loss:
0.2120
Epoch 59/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0588 - val_loss:
0.1946
Epoch 60/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0571 - val_loss:
0.1916
```

```
Epoch 61/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0568 - val_loss:
0.2044
Epoch 62/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0579 - val_loss:
0.1908
Epoch 63/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0561 - val_loss:
0.2252
Epoch 64/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0570 - val_loss:
0.1913
Epoch 65/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0632 - val_loss:
0.2479
Epoch 66/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0546 - val_loss:
0.1872
Epoch 67/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0566 - val_loss:
0.2047
Epoch 68/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0540 - val_loss:
0.2151
Epoch 69/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0531 - val_loss:
0.2137
Epoch 70/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0542 - val_loss:
0.2195
Epoch 71/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0542 - val_loss:
0.2191
Epoch 72/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0535 - val_loss:
0.2311
Epoch 73/600
14/14 [==============================] - 0s 22ms/step - loss: 0.0532 - val_loss:
0.1844
Epoch 74/600
14/14 [==============================] - 0s 20ms/step - loss: 0.0520 - val_loss:
0.2446
Epoch 75/600
14/14 [==============================] - 0s 22ms/step - loss: 0.0521 - val_loss:
0.2163
Epoch 76/600
14/14 [==============================] - 0s 20ms/step - loss: 0.0549 - val_loss:
0.2148
Epoch 77/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0596 - val_loss:
0.2457
Epoch 78/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0572 - val_loss:
0.2246
Epoch 79/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0590 - val_loss:
0.2418
Epoch 80/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0510 - val_loss:
0.2246
```

```
Epoch 81/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0512 - val_loss:
0.2343
Epoch 82/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0510 - val_loss:
0.2081
Epoch 83/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0508 - val_loss:
0.2482
Epoch 84/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0497 - val_loss:
0.2103
Epoch 85/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0501 - val_loss:
0.2420
Epoch 86/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0490 - val_loss:
0.2234
Epoch 87/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0512 - val_loss:
0.2523
Epoch 88/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0538 - val_loss:
0.2282
Epoch 89/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0495 - val_loss:
0.2465
Epoch 90/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0479 - val_loss:
0.2200
Epoch 91/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0491 - val_loss:
0.2456
Epoch 92/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0498 - val_loss:
0.2396
Epoch 93/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0479 - val_loss:
0.2424
Epoch 94/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0485 - val_loss:
0.2334
Epoch 95/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0512 - val_loss:
0.2584
Epoch 96/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0542 - val_loss:
0.2286
Epoch 97/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0472 - val_loss:
0.2872
Epoch 98/600
14/14 [==============================] - 0s 16ms/step - loss: 0.0500 - val_loss:
0.2121
Epoch 99/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0486 - val_loss:
0.2671
Epoch 100/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0471 - val_loss:
0.2390
```

```
Epoch 101/600
14/14 [==============================] - 1s 38ms/step - loss: 0.0476 - val_loss:
0.2454
Epoch 102/600
14/14 [==============================] - 0s 34ms/step - loss: 0.0481 - val_loss:
0.2631
Epoch 103/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0466 - val_loss:
0.2297
Epoch 104/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0494 - val_loss:
0.2853
Epoch 105/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0479 - val_loss:
0.2510
Epoch 106/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0514 - val_loss:
0.2824
Epoch 107/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0515 - val_loss:
0.2424
Epoch 108/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0518 - val_loss:
0.2802
Epoch 109/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0450 - val_loss:
0.2370
Epoch 110/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0467 - val_loss:
0.2962
Epoch 111/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0464 - val_loss:
0.2670
Epoch 112/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0440 - val_loss:
0.2832
Epoch 113/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0445 - val_loss:
0.2773
Epoch 114/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0465 - val_loss:
0.2399
Epoch 115/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0498 - val_loss:
0.3305
Epoch 116/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0467 - val_loss:
0.2564
Epoch 117/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0436 - val_loss:
0.2907
Epoch 118/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0448 - val_loss:
0.2887
Epoch 119/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0459 - val_loss:
0.3029
Epoch 120/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0510 - val_loss:
0.2943
```

```
Epoch 121/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0459 - val_loss:
0.2651
Epoch 122/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0439 - val_loss:
0.2982
Epoch 123/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0426 - val_loss:
0.2724
Epoch 124/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0431 - val_loss:
0.2709
Epoch 125/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0451 - val_loss:
0.2729
Epoch 126/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0505 - val_loss:
0.3522
Epoch 127/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0421 - val_loss:
0.2578
Epoch 128/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0445 - val_loss:
0.2991
Epoch 129/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0455 - val_loss:
0.2945
Epoch 130/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0426 - val_loss:
0.3227
Epoch 131/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0452 - val_loss:
0.3078
Epoch 132/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0421 - val_loss:
0.2869
Epoch 133/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0422 - val_loss:
0.2819
Epoch 134/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0410 - val_loss:
0.3191
Epoch 135/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0424 - val_loss:
0.3004
Epoch 136/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0440 - val_loss:
0.3274
Epoch 137/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0398 - val_loss:
0.2523
Epoch 138/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0424 - val_loss:
0.3150
Epoch 139/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0405 - val_loss:
0.2988
Epoch 140/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0408 - val_loss:
0.3088
```

```
Epoch 141/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0410 - val_loss: 
0.3082
Epoch 142/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0402 - val_loss: 
0.3298
Epoch 143/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0417 - val_loss: 
0.3041
Epoch 144/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0421 - val_loss: 
0.3163
Epoch 145/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0400 - val_loss: 
0.3386
Epoch 146/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0413 - val_loss: 
0.3334
Epoch 147/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0400 - val_loss: 
0.3410
Epoch 148/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0395 - val_loss: 
0.3358
Epoch 149/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0393 - val_loss: 
0.3421
Epoch 150/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0408 - val_loss: 
0.3293
Epoch 151/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0385 - val_loss: 
0.3481
Epoch 152/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0391 - val_loss: 
0.3093
Epoch 153/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0388 - val_loss: 
0.3368
Epoch 154/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0382 - val_loss: 
0.3442
Epoch 155/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0382 - val_loss: 
0.3178
Epoch 156/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0380 - val_loss: 
0.3460
Epoch 157/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0384 - val_loss: 
0.3462
Epoch 158/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0380 - val_loss: 
0.3580
Epoch 159/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0398 - val_loss: 
0.3348
Epoch 160/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0378 - val_loss: 
0.3701
```

```
Epoch 161/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0371 - val_loss:
0.3250
Epoch 162/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0373 - val_loss:
0.3593
Epoch 163/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0384 - val_loss:
0.3615
Epoch 164/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0378 - val_loss:
0.3366
Epoch 165/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0386 - val_loss:
0.3611
Epoch 166/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0385 - val_loss:
0.3851
Epoch 167/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0371 - val_loss:
0.3310
Epoch 168/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0379 - val_loss:
0.3687
Epoch 169/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0364 - val_loss:
0.3561
Epoch 170/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0381 - val_loss:
0.3361
Epoch 171/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0424 - val_loss:
0.4062
Epoch 172/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0400 - val_loss:
0.3237
Epoch 173/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0408 - val_loss:
0.4132
Epoch 174/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0378 - val_loss:
0.3431
Epoch 175/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0378 - val_loss:
0.4007
Epoch 176/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0358 - val_loss:
0.3699
Epoch 177/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0367 - val_loss:
0.3846
Epoch 178/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0388 - val_loss:
0.3846
Epoch 179/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0391 - val_loss:
0.3651
Epoch 180/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0387 - val_loss:
0.4069
```

```
Epoch 181/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0353 - val_loss:
0.3954
Epoch 182/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0351 - val_loss:
0.4018
Epoch 183/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0343 - val_loss:
0.3613
Epoch 184/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0345 - val_loss:
0.4002
Epoch 185/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0359 - val_loss:
0.4121
Epoch 186/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0332 - val_loss:
0.3555
Epoch 187/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0338 - val_loss:
0.4182
Epoch 188/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0352 - val_loss:
0.3426
Epoch 189/600
14/14 [==============================] - 0s 18ms/step - loss: 0.0357 - val_loss:
0.4212
Epoch 190/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0346 - val_loss:
0.4054
Epoch 191/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0337 - val_loss:
0.4109
Epoch 192/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0369 - val_loss:
0.4268
Epoch 193/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0397 - val_loss:
0.3600
Epoch 194/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0350 - val_loss:
0.3862
Epoch 195/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0336 - val_loss:
0.4147
Epoch 196/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0329 - val_loss:
0.4215
Epoch 197/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0328 - val_loss:
0.3835
Epoch 198/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0411 - val_loss:
0.4209
Epoch 199/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0327 - val_loss:
0.4196
Epoch 200/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0323 - val_loss:
0.3967
```

```
Epoch 201/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0362 - val_loss:
0.4741
Epoch 202/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0399 - val_loss:
0.3921
Epoch 203/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0365 - val_loss:
0.4672
Epoch 204/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0313 - val_loss:
0.3689
Epoch 205/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0332 - val_loss:
0.4731
Epoch 206/600
14/14 [==============================] - 0s 18ms/step - loss: 0.0353 - val_loss:
0.4624
Epoch 207/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0333 - val_loss:
0.3995
Epoch 208/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0347 - val_loss:
0.4454
Epoch 209/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0327 - val_loss:
0.4236
Epoch 210/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0419 - val_loss:
0.4080
Epoch 211/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0338 - val_loss:
0.4253
Epoch 212/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0343 - val_loss:
0.4379
Epoch 213/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0310 - val_loss:
0.3990
Epoch 214/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0309 - val_loss:
0.4538
Epoch 215/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0312 - val_loss:
0.4309
Epoch 216/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0329 - val_loss:
0.4600
Epoch 217/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0307 - val_loss:
0.4735
Epoch 218/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0315 - val_loss:
0.4407
Epoch 219/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0316 - val_loss:
0.4506
Epoch 220/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0333 - val_loss:
0.4736
```

```
Epoch 221/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0311 - val_loss:
0.4631
Epoch 222/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0323 - val_loss:
0.4850
Epoch 223/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0376 - val_loss:
0.3830
Epoch 224/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0356 - val_loss:
0.5299
Epoch 225/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0339 - val_loss:
0.4288
Epoch 226/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0308 - val_loss:
0.4516
Epoch 227/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0336 - val_loss:
0.4371
Epoch 228/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0302 - val_loss:
0.4757
Epoch 229/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0309 - val_loss:
0.5046
Epoch 230/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0379 - val_loss:
0.3778
Epoch 231/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0409 - val_loss:
0.5399
Epoch 232/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0389 - val_loss:
0.4033
Epoch 233/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0304 - val_loss:
0.5143
Epoch 234/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0297 - val_loss:
0.4466
Epoch 235/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0285 - val_loss:
0.5351
Epoch 236/600
14/14 [==============================] - 0s 16ms/step - loss: 0.0362 - val_loss:
0.4416
Epoch 237/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0318 - val_loss:
0.4522
Epoch 238/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0311 - val_loss:
0.5549
Epoch 239/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0309 - val_loss:
0.5128
Epoch 240/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0289 - val_loss:
0.4587
```

```
Epoch 241/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0281 - val_loss:
0.5027
Epoch 242/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0288 - val_loss:
0.4713
Epoch 243/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0324 - val_loss:
0.5557
Epoch 244/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0298 - val_loss:
0.4492
Epoch 245/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0321 - val_loss:
0.4990
Epoch 246/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0281 - val_loss:
0.4473
Epoch 247/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0331 - val_loss:
0.5551
Epoch 248/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0264 - val_loss:
0.4195
Epoch 249/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0377 - val_loss:
0.5709
Epoch 250/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0278 - val_loss:
0.4240
Epoch 251/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0269 - val_loss:
0.5389
Epoch 252/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0266 - val_loss:
0.4723
Epoch 253/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0273 - val_loss:
0.4881
Epoch 254/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0267 - val_loss:
0.4964
Epoch 255/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0297 - val_loss:
0.4471
Epoch 256/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0367 - val_loss:
0.4737
Epoch 257/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0283 - val_loss:
0.4775
Epoch 258/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0307 - val_loss:
0.4881
Epoch 259/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0276 - val_loss:
0.5289
Epoch 260/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0270 - val_loss:
0.5374
```

```
Epoch 261/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0281 - val_loss:
0.5184
Epoch 262/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0269 - val_loss:
0.5029
Epoch 263/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0279 - val_loss:
0.5334
Epoch 264/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0265 - val_loss:
0.5156
Epoch 265/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0265 - val_loss:
0.5038
Epoch 266/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0256 - val_loss:
0.5577
Epoch 267/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0262 - val_loss:
0.5192
Epoch 268/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0269 - val_loss:
0.5352
Epoch 269/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0265 - val_loss:
0.5065
Epoch 270/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0271 - val_loss:
0.6129
Epoch 271/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0329 - val_loss:
0.5702
Epoch 272/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0286 - val_loss:
0.4735
Epoch 273/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0278 - val_loss:
0.6440
Epoch 274/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0295 - val_loss:
0.4936
Epoch 275/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0252 - val_loss:
0.5618
Epoch 276/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0241 - val_loss:
0.4999
Epoch 277/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0270 - val_loss:
0.5478
Epoch 278/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0258 - val_loss:
0.5308
Epoch 279/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0245 - val_loss:
0.5575
Epoch 280/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0243 - val_loss:
0.5400
```

```
Epoch 281/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0244 - val_loss:
0.5615
Epoch 282/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0249 - val_loss:
0.5527
Epoch 283/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0235 - val_loss:
0.5365
Epoch 284/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0249 - val_loss:
0.5941
Epoch 285/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0262 - val_loss:
0.5330
Epoch 286/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0246 - val_loss:
0.5384
Epoch 287/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0247 - val_loss:
0.5566
Epoch 288/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0236 - val_loss:
0.5414
Epoch 289/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0254 - val_loss:
0.6256
Epoch 290/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0266 - val_loss:
0.5706
Epoch 291/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0240 - val_loss:
0.5372
Epoch 292/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0246 - val_loss:
0.6186
Epoch 293/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0235 - val_loss:
0.5473
Epoch 294/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0232 - val_loss:
0.5904
Epoch 295/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0256 - val_loss:
0.5950
Epoch 296/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0302 - val_loss:
0.5479
Epoch 297/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0221 - val_loss:
0.5987
Epoch 298/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0227 - val_loss:
0.5737
Epoch 299/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0222 - val_loss:
0.5772
Epoch 300/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0227 - val_loss:
0.6287
```

```
Epoch 301/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0235 - val_loss:
0.5486
Epoch 302/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0251 - val_loss:
0.5746
Epoch 303/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0270 - val_loss:
0.6323
Epoch 304/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0277 - val_loss:
0.4709
Epoch 305/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0284 - val_loss:
0.6556
Epoch 306/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0222 - val_loss:
0.4915
Epoch 307/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0260 - val_loss:
0.6993
Epoch 308/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0246 - val_loss:
0.5529
Epoch 309/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0225 - val_loss:
0.6148
Epoch 310/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0222 - val_loss:
0.6164
Epoch 311/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0215 - val_loss:
0.6004
Epoch 312/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0218 - val_loss:
0.5975
Epoch 313/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0224 - val_loss:
0.6089
Epoch 314/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0225 - val_loss:
0.6420
Epoch 315/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0265 - val_loss:
0.5337
Epoch 316/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0267 - val_loss:
0.6899
Epoch 317/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0306 - val_loss:
0.4977
Epoch 318/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0249 - val_loss:
0.7055
Epoch 319/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0248 - val_loss:
0.5971
Epoch 320/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0232 - val_loss:
0.6404
```

```
Epoch 321/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0220 - val_loss:
0.6124
Epoch 322/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0219 - val_loss:
0.5983
Epoch 323/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0203 - val_loss:
0.6348
Epoch 324/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0207 - val_loss:
0.6123
Epoch 325/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0219 - val_loss:
0.6042
Epoch 326/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0220 - val_loss:
0.6287
Epoch 327/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0202 - val_loss:
0.5891
Epoch 328/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0261 - val_loss:
0.6933
Epoch 329/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0215 - val_loss:
0.6206
Epoch 330/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0201 - val_loss:
0.6086
Epoch 331/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0252 - val_loss:
0.7147
Epoch 332/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0251 - val_loss:
0.6291
Epoch 333/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0198 - val_loss:
0.6358
Epoch 334/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0209 - val_loss:
0.6485
Epoch 335/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0189 - val_loss:
0.5829
Epoch 336/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0205 - val_loss:
0.6559
Epoch 337/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0213 - val_loss:
0.7180
Epoch 338/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0236 - val_loss:
0.6350
Epoch 339/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0202 - val_loss:
0.6526
Epoch 340/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0201 - val_loss:
0.7106
```

```
Epoch 341/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0190 - val_loss:
0.6220
Epoch 342/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0203 - val_loss:
0.6882
Epoch 343/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0187 - val_loss:
0.5947
Epoch 344/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0234 - val_loss:
0.7651
Epoch 345/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0223 - val_loss:
0.6023
Epoch 346/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0202 - val_loss:
0.6619
Epoch 347/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0197 - val_loss:
0.6856
Epoch 348/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0210 - val_loss:
0.6682
Epoch 349/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0215 - val_loss:
0.7046
Epoch 350/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0190 - val_loss:
0.6609
Epoch 351/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0196 - val_loss:
0.6420
Epoch 352/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0321 - val_loss:
0.7941
Epoch 353/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0206 - val_loss:
0.6502
Epoch 354/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0175 - val_loss:
0.7181
Epoch 355/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0190 - val_loss:
0.6598
Epoch 356/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0189 - val_loss:
0.6494
Epoch 357/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0195 - val_loss:
0.7212
Epoch 358/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0229 - val_loss:
0.6253
Epoch 359/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0226 - val_loss:
0.7475
Epoch 360/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0213 - val_loss:
0.6385
```

```
Epoch 361/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0192 - val_loss: 
0.6777
Epoch 362/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0185 - val_loss: 
0.7115
Epoch 363/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0192 - val_loss: 
0.6412
Epoch 364/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0178 - val_loss: 
0.7938
Epoch 365/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0213 - val_loss: 
0.6853
Epoch 366/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0178 - val_loss: 
0.7444
Epoch 367/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0187 - val_loss: 
0.7233
Epoch 368/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0171 - val_loss: 
0.7178
Epoch 369/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0169 - val_loss: 
0.7052
Epoch 370/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0164 - val_loss: 
0.6809
Epoch 371/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0176 - val_loss: 
0.7052
Epoch 372/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0181 - val_loss: 
0.7079
Epoch 373/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0178 - val_loss: 
0.7682
Epoch 374/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0176 - val_loss: 
0.6350
Epoch 375/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0180 - val_loss: 
0.7183
Epoch 376/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0158 - val_loss: 
0.7547
Epoch 377/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0177 - val_loss: 
0.6839
Epoch 378/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0160 - val_loss: 
0.7488
Epoch 379/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0167 - val_loss: 
0.6462
Epoch 380/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0216 - val_loss: 
0.7829
```

```
Epoch 381/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0164 - val_loss:
0.7216
Epoch 382/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0157 - val_loss:
0.7178
Epoch 383/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0181 - val_loss:
0.7496
Epoch 384/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0153 - val_loss:
0.7298
Epoch 385/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0157 - val_loss:
0.7151
Epoch 386/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0153 - val_loss:
0.7430
Epoch 387/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0169 - val_loss:
0.7199
Epoch 388/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0154 - val_loss:
0.7667
Epoch 389/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0163 - val_loss:
0.7838
Epoch 390/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0165 - val_loss:
0.7403
Epoch 391/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0171 - val_loss:
0.7264
Epoch 392/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0180 - val_loss:
0.8047
Epoch 393/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0177 - val_loss:
0.6865
Epoch 394/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0195 - val_loss:
0.7188
Epoch 395/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0190 - val_loss:
0.8610
Epoch 396/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0191 - val_loss:
0.7246
Epoch 397/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0183 - val_loss:
0.7807
Epoch 398/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0160 - val_loss:
0.7659
Epoch 399/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0173 - val_loss:
0.7092
Epoch 400/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0177 - val_loss:
0.7720
```

```
Epoch 401/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0227 - val_loss:
0.7059
Epoch 402/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0168 - val_loss:
0.8668
Epoch 403/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0224 - val_loss:
0.6528
Epoch 404/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0211 - val_loss:
0.8091
Epoch 405/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0153 - val_loss:
0.7248
Epoch 406/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0148 - val_loss:
0.7957
Epoch 407/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0161 - val_loss:
0.7061
Epoch 408/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0154 - val_loss:
0.7960
Epoch 409/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0143 - val_loss:
0.7794
Epoch 410/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0146 - val_loss:
0.7824
Epoch 411/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0146 - val_loss:
0.7381
Epoch 412/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0153 - val_loss:
0.8760
Epoch 413/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0160 - val_loss:
0.7805
Epoch 414/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0138 - val_loss:
0.7375
Epoch 415/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0137 - val_loss:
0.8726
Epoch 416/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0146 - val_loss:
0.7268
Epoch 417/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0141 - val_loss:
0.8547
Epoch 418/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0163 - val_loss:
0.7738
Epoch 419/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0181 - val_loss:
0.7800
Epoch 420/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0202 - val_loss:
0.8329
```

```
Epoch 421/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0143 - val_loss:
0.8371
Epoch 422/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0156 - val_loss:
0.7446
Epoch 423/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0147 - val_loss:
0.8768
Epoch 424/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0141 - val_loss:
0.7953
Epoch 425/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0131 - val_loss:
0.7685
Epoch 426/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0127 - val_loss:
0.8417
Epoch 427/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0168 - val_loss:
0.7407
Epoch 428/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0151 - val_loss:
0.8837
Epoch 429/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0124 - val_loss:
0.7923
Epoch 430/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0127 - val_loss:
0.8404
Epoch 431/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0134 - val_loss:
0.8256
Epoch 432/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0129 - val_loss:
0.7938
Epoch 433/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0124 - val_loss:
0.8441
Epoch 434/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0127 - val_loss:
0.8204
Epoch 435/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0128 - val_loss:
0.8194
Epoch 436/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0120 - val_loss:
0.8545
Epoch 437/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0124 - val_loss:
0.7966
Epoch 438/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0134 - val_loss:
0.9156
Epoch 439/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0162 - val_loss:
0.7992
Epoch 440/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0137 - val_loss:
0.8150
```

```
Epoch 441/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0119 - val_loss:
0.8896
Epoch 442/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0119 - val_loss:
0.8014
Epoch 443/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0120 - val_loss:
0.8638
Epoch 444/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0138 - val_loss:
0.7688
Epoch 445/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0145 - val_loss:
0.8649
Epoch 446/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0127 - val_loss:
0.9176
Epoch 447/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0134 - val_loss:
0.8331
Epoch 448/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0140 - val_loss:
0.8409
Epoch 449/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0140 - val_loss:
0.9333
Epoch 450/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0118 - val_loss:
0.8129
Epoch 451/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0116 - val_loss:
0.9340
Epoch 452/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0118 - val_loss:
0.8558
Epoch 453/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0111 - val_loss:
0.8966
Epoch 454/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0108 - val_loss:
0.8681
Epoch 455/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0136 - val_loss:
1.0131
Epoch 456/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0146 - val_loss:
0.8447
Epoch 457/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0112 - val_loss:
0.9416
Epoch 458/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0129 - val_loss:
0.8640
Epoch 459/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0143 - val_loss:
0.8050
Epoch 460/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0143 - val_loss:
0.9466
```

```
Epoch 461/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0109 - val_loss:
0.8800
Epoch 462/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0108 - val_loss:
0.9128
Epoch 463/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0102 - val_loss:
0.8962
Epoch 464/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0106 - val_loss:
0.9462
Epoch 465/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0124 - val_loss:
0.8547
Epoch 466/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0132 - val_loss:
0.9464
Epoch 467/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0111 - val_loss:
0.9583
Epoch 468/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0112 - val_loss:
0.9088
Epoch 469/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0099 - val_loss:
0.9809
Epoch 470/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0111 - val_loss:
0.9123
Epoch 471/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0121 - val_loss:
0.9062
Epoch 472/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0145 - val_loss:
0.8450
Epoch 473/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0149 - val_loss:
0.9884
Epoch 474/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0136 - val_loss:
0.9687
Epoch 475/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0114 - val_loss:
0.9490
Epoch 476/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0155 - val_loss:
0.8567
Epoch 477/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0128 - val_loss:
0.9853
Epoch 478/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0108 - val_loss:
0.8444
Epoch 479/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0106 - val_loss:
1.0295
Epoch 480/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0099 - val_loss:
0.9058
```

```
Epoch 481/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0100 - val_loss:
0.9618
Epoch 482/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0098 - val_loss:
0.9898
Epoch 483/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0104 - val_loss:
0.9010
Epoch 484/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0118 - val_loss:
0.9754
Epoch 485/600
14/14 [==============================] - 0s 16ms/step - loss: 0.0104 - val_loss:
0.9676
Epoch 486/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0096 - val_loss:
0.9609
Epoch 487/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0096 - val_loss:
0.9707
Epoch 488/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0097 - val_loss:
0.9688
Epoch 489/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0097 - val_loss:
0.9110
Epoch 490/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0100 - val_loss:
0.9773
Epoch 491/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0091 - val_loss:
0.9313
Epoch 492/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0091 - val_loss:
0.9501
Epoch 493/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0108 - val_loss:
0.9935
Epoch 494/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0090 - val_loss:
0.9212
Epoch 495/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0101 - val_loss:
0.9851
Epoch 496/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0111 - val_loss:
1.0460
Epoch 497/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0111 - val_loss:
0.9548
Epoch 498/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0089 - val_loss:
1.0392
Epoch 499/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0084 - val_loss:
0.9115
Epoch 500/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0113 - val_loss:
0.9304
```

```
Epoch 501/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0112 - val_loss:
1.0480
Epoch 502/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0086 - val_loss:
0.9765
Epoch 503/600
14/14 [==============================] - 0s 16ms/step - loss: 0.0093 - val_loss:
0.9213
Epoch 504/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0103 - val_loss:
1.1067
Epoch 505/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0118 - val_loss:
0.9269
Epoch 506/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0098 - val_loss:
1.0733
Epoch 507/600
14/14 [==============================] - 0s 14ms/step - loss: 0.0125 - val_loss:
1.0584
Epoch 508/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0130 - val_loss:
0.9522
Epoch 509/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0107 - val_loss:
0.9668
Epoch 510/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0104 - val_loss:
1.0044
Epoch 511/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0086 - val_loss:
0.9919
Epoch 512/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0084 - val_loss:
1.0550
Epoch 513/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0090 - val_loss:
0.9761
Epoch 514/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0083 - val_loss:
1.0286
Epoch 515/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0078 - val_loss:
0.9960
Epoch 516/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0076 - val_loss:
1.0070
Epoch 517/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0082 - val_loss:
1.0653
Epoch 518/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0084 - val_loss:
0.9949
Epoch 519/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0086 - val_loss:
1.0336
Epoch 520/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0077 - val_loss:
0.9505
```

```
Epoch 521/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0083 - val_loss:
1.1282
Epoch 522/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0080 - val_loss:
0.9612
Epoch 523/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0085 - val_loss:
1.0952
Epoch 524/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0088 - val_loss:
1.0342
Epoch 525/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0077 - val_loss:
1.0480
Epoch 526/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0072 - val_loss:
0.9697
Epoch 527/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0090 - val_loss:
1.0843
Epoch 528/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0087 - val_loss:
1.0964
Epoch 529/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0112 - val_loss:
1.0532
Epoch 530/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0121 - val_loss:
0.8690
Epoch 531/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0189 - val_loss:
1.1023
Epoch 532/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0162 - val_loss:
1.2006
Epoch 533/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0189 - val_loss:
0.9232
Epoch 534/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0076 - val_loss:
1.1752
Epoch 535/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0088 - val_loss:
1.0410
Epoch 536/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0106 - val_loss:
0.9476
Epoch 537/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0113 - val_loss:
1.1062
Epoch 538/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0070 - val_loss:
1.0358
Epoch 539/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0070 - val_loss:
1.1123
Epoch 540/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0077 - val_loss:
1.0074
```

```
Epoch 541/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0075 - val_loss:
1.0556
Epoch 542/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0071 - val_loss:
1.0903
Epoch 543/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0070 - val_loss:
1.0560
Epoch 544/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0064 - val_loss:
1.1002
Epoch 545/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0094 - val_loss:
0.9488
Epoch 546/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0097 - val_loss:
1.2166
Epoch 547/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0156 - val_loss:
0.8844
Epoch 548/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0150 - val_loss:
1.3800
Epoch 549/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0243 - val_loss:
0.7983
Epoch 550/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0222 - val_loss:
1.2114
Epoch 551/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0144 - val_loss:
1.1410
Epoch 552/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0103 - val_loss:
1.0955
Epoch 553/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0074 - val_loss:
1.0812
Epoch 554/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0071 - val_loss:
1.0899
Epoch 555/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0065 - val_loss:
1.0906
Epoch 556/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0071 - val_loss:
1.0459
Epoch 557/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0065 - val_loss:
1.1298
Epoch 558/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0063 - val_loss:
1.0269
Epoch 559/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0068 - val_loss:
1.1490
Epoch 560/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0073 - val_loss:
1.0760
```

```
Epoch 561/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0059 - val_loss:
1.1285
Epoch 562/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0066 - val_loss:
1.1069
Epoch 563/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0061 - val_loss:
1.0957
Epoch 564/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0063 - val_loss:
1.1100
Epoch 565/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0062 - val_loss:
1.1206
Epoch 566/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0059 - val_loss:
1.0785
Epoch 567/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0072 - val_loss:
1.1418
Epoch 568/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0069 - val_loss:
1.0690
Epoch 569/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0068 - val_loss:
1.1201
Epoch 570/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0065 - val_loss:
1.1450
Epoch 571/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0061 - val_loss:
1.0656
Epoch 572/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0057 - val_loss:
1.1547
Epoch 573/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0062 - val_loss:
1.0828
Epoch 574/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0075 - val_loss:
1.1890
Epoch 575/600
14/14 [==============================] - 0s 9ms/step - loss: 0.0078 - val_loss:
1.1241
Epoch 576/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0065 - val_loss:
1.0944
Epoch 577/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0059 - val_loss:
1.1563
Epoch 578/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0057 - val_loss:
1.1732
Epoch 579/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0061 - val_loss:
1.0641
Epoch 580/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0055 - val_loss:
1.2347
```

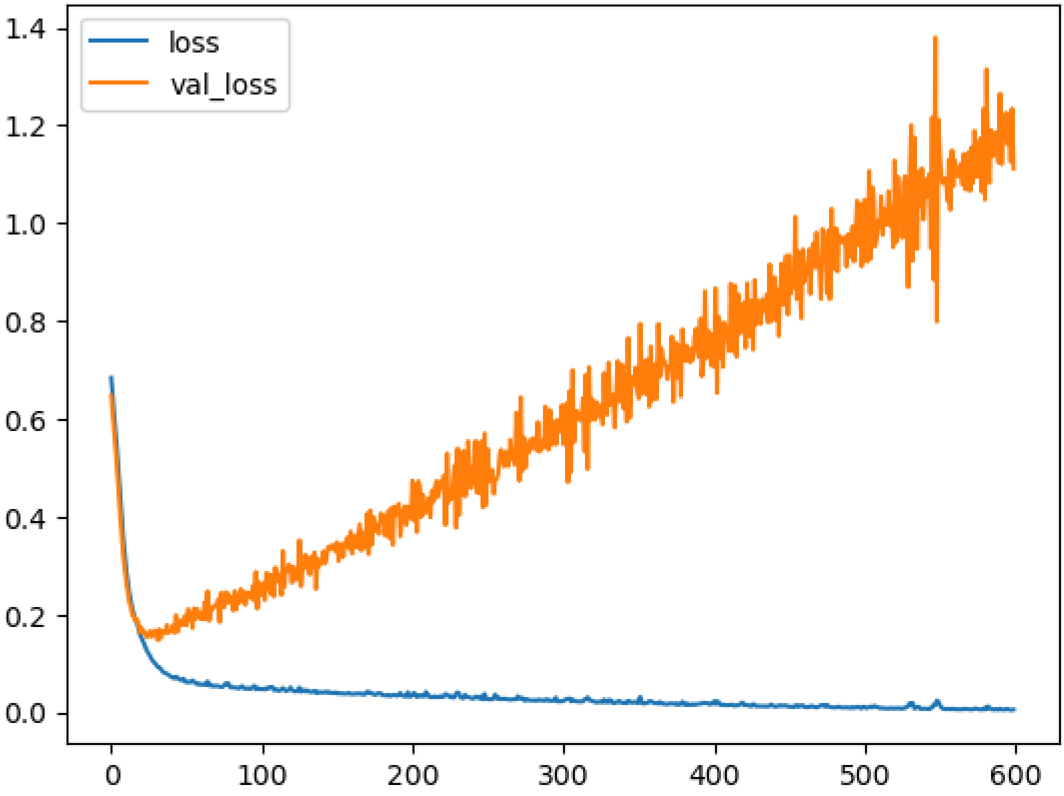
```
Epoch 581/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0094 - val_loss:
1.0477
Epoch 582/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0059 - val_loss:
1.3149
Epoch 583/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0121 - val_loss:
1.1223
Epoch 584/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0091 - val_loss:
1.0827
Epoch 585/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0071 - val_loss:
1.1905
Epoch 586/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0057 - val_loss:
1.1365
Epoch 587/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0054 - val_loss:
1.1415
Epoch 588/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0071 - val_loss:
1.1859
Epoch 589/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0057 - val_loss:
1.1559
Epoch 590/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0053 - val_loss:
1.1236
Epoch 591/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0074 - val_loss:
1.2649
Epoch 592/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0056 - val_loss:
1.1206
Epoch 593/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0053 - val_loss:
1.1901
Epoch 594/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0053 - val_loss:
1.1732
Epoch 595/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0067 - val_loss:
1.2259
Epoch 596/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0068 - val_loss:
1.1611
Epoch 597/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0056 - val_loss:
1.1861
Epoch 598/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0048 - val_loss:
1.1255
Epoch 599/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0051 - val_loss:
1.2346
Epoch 600/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0055 - val_loss:
1.1116
```

Out[32]: <keras.callbacks.History at 0x1f1d246e5b0>

In [34]:
```
losses = pd.DataFrame(model.history.history)
```

In [35]:
```
losses.plot()
```

Out[35]: <Axes: >



In [36]:
```
# This is the perfect example of overfitting, during the first few epochs both l
```

In [37]:
```
#however at certain point our loss is decreasing vs val_loss is increasing; this
```

In [39]:
```
# we need to try early stopping
```

In [43]:
```
model_v1 = Sequential()
model_v1.add(Dense(30, activation='relu'))
model_v1.add(Dense(15, activation='relu'))
# BINARY CLASSIFICATION PROBLEM we will use sigmoid
model_v1.add(Dense(1, activation='sigmoid'))
model_v1.compile(loss='binary_crossentropy', optimizer='adam')
```

In [44]:
```
from tensorflow.keras.callbacks import EarlyStopping
```

In [45]:
```
earlyStop = EarlyStopping(monitor='val_loss', mode='min', verbose=1, patience=25
```

In [46]:
```
model_v1.fit(x=X_train, y=y_train, epochs=600, validation_data=(X_test, y_test),
```

```
Epoch 1/600
14/14 [==============================] - 1s 20ms/step - loss: 0.6898 - val_loss:
0.6509
Epoch 2/600
14/14 [==============================] - 0s 7ms/step - loss: 0.6453 - val_loss:
0.6105
Epoch 3/600
14/14 [==============================] - 0s 7ms/step - loss: 0.6064 - val_loss:
0.5755
Epoch 4/600
14/14 [==============================] - 0s 8ms/step - loss: 0.5694 - val_loss:
0.5338
Epoch 5/600
14/14 [==============================] - 0s 7ms/step - loss: 0.5305 - val_loss:
0.4925
Epoch 6/600
14/14 [==============================] - 0s 9ms/step - loss: 0.4917 - val_loss:
0.4498
Epoch 7/600
14/14 [==============================] - 0s 9ms/step - loss: 0.4516 - val_loss:
0.4100
Epoch 8/600
14/14 [==============================] - 0s 12ms/step - loss: 0.4148 - val_loss:
0.3738
Epoch 9/600
14/14 [==============================] - 0s 5ms/step - loss: 0.3787 - val_loss:
0.3395
Epoch 10/600
14/14 [==============================] - 0s 5ms/step - loss: 0.3464 - val_loss:
0.3082
Epoch 11/600
14/14 [==============================] - 0s 5ms/step - loss: 0.3190 - val_loss:
0.2837
Epoch 12/600
14/14 [==============================] - 0s 5ms/step - loss: 0.2916 - val_loss:
0.2601
Epoch 13/600
14/14 [==============================] - 0s 5ms/step - loss: 0.2707 - val_loss:
0.2426
Epoch 14/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2520 - val_loss:
0.2264
Epoch 15/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2368 - val_loss:
0.2146
Epoch 16/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2210 - val_loss:
0.2071
Epoch 17/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2088 - val_loss:
0.1951
Epoch 18/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1975 - val_loss:
0.1870
Epoch 19/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1870 - val_loss:
0.1814
Epoch 20/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1770 - val_loss:
0.1781
```

```
Epoch 21/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1688 - val_loss:
0.1801
Epoch 22/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1608 - val_loss:
0.1671
Epoch 23/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1533 - val_loss:
0.1595
Epoch 24/600
14/14 [==============================] - 0s 11ms/step - loss: 0.1455 - val_loss:
0.1669
Epoch 25/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1378 - val_loss:
0.1571
Epoch 26/600
14/14 [==============================] - 0s 8ms/step - loss: 0.1332 - val_loss:
0.1530
Epoch 27/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1281 - val_loss:
0.1502
Epoch 28/600
14/14 [==============================] - 0s 6ms/step - loss: 0.1237 - val_loss:
0.1739
Epoch 29/600
14/14 [==============================] - 0s 5ms/step - loss: 0.1190 - val_loss:
0.1508
Epoch 30/600
14/14 [==============================] - 0s 8ms/step - loss: 0.1131 - val_loss:
0.1648
Epoch 31/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1111 - val_loss:
0.1615
Epoch 32/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1061 - val_loss:
0.1603
Epoch 33/600
14/14 [==============================] - 0s 12ms/step - loss: 0.1019 - val_loss:
0.1610
Epoch 34/600
14/14 [==============================] - 0s 11ms/step - loss: 0.0983 - val_loss:
0.1617
Epoch 35/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0970 - val_loss:
0.1597
Epoch 36/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0962 - val_loss:
0.1621
Epoch 37/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0942 - val_loss:
0.1626
Epoch 38/600
14/14 [==============================] - 0s 10ms/step - loss: 0.0876 - val_loss:
0.1679
Epoch 39/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0863 - val_loss:
0.1557
Epoch 40/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1019 - val_loss:
0.1548
```

```
Epoch 41/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0880 - val_loss:
0.1615
Epoch 42/600
14/14 [==============================] - 0s 7ms/step - loss: 0.0804 - val_loss:
0.1767
Epoch 43/600
14/14 [==============================] - 0s 6ms/step - loss: 0.0788 - val_loss:
0.1666
Epoch 44/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0769 - val_loss:
0.1599
Epoch 45/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0757 - val_loss:
0.1758
Epoch 46/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0750 - val_loss:
0.1622
Epoch 47/600
14/14 [==============================] - 0s 8ms/step - loss: 0.0773 - val_loss:
0.1690
Epoch 48/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0787 - val_loss:
0.1760
Epoch 49/600
14/14 [==============================] - 0s 15ms/step - loss: 0.0724 - val_loss:
0.1804
Epoch 50/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0701 - val_loss:
0.1767
Epoch 51/600
14/14 [==============================] - 0s 13ms/step - loss: 0.0770 - val_loss:
0.2098
Epoch 52/600
14/14 [==============================] - 0s 12ms/step - loss: 0.0724 - val_loss:
0.1715
Epoch 52: early stopping
```

Out[46]: `<keras.callbacks.History at 0x1f1d6e62c40>`

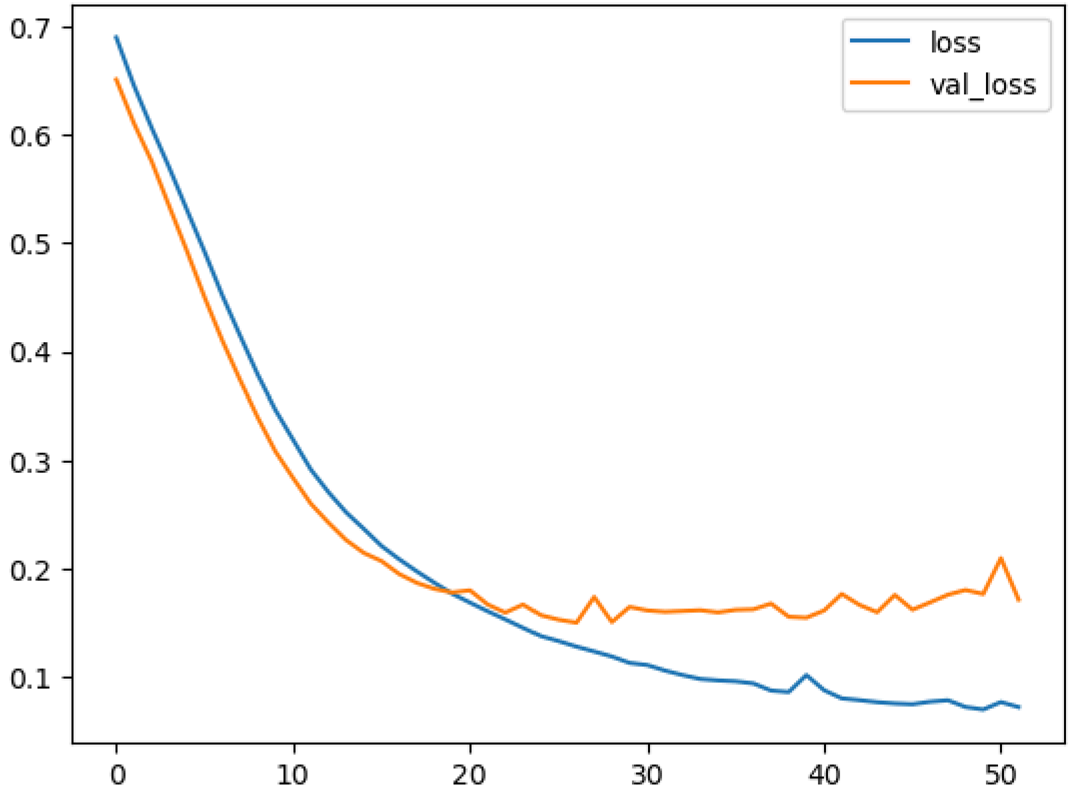
In [47]:

```
model_v1_loss = pd.DataFrame(model_v1.history.history)
```

In [48]:

```
model_v1_loss.plot()
```

Out[48]: `<Axes: >`



In [49]:
```
# Let's try Dropout Layers ; this will drop percentage of neurons randomly
```

In [78]:
```
model_v2 = Sequential()
model_v2.add(Dense(30, activation='relu'))
model_v2.add(Dropout(0.5))
model_v2.add(Dense(15, activation='relu'))
model_v2.add(Dropout(0.5))
# BINARY CLASSIFICATION PROBLEM we will use sigmoid
model_v2.add(Dense(1, activation='sigmoid'))
model_v2.compile(loss='binary_crossentropy', optimizer='adam')
```

In [79]:
```
model_v2.fit(x=X_train, y=y_train, epochs=600, validation_data=(X_test, y_test),
```

```
Epoch 1/600
14/14 [==============================] - 2s 29ms/step - loss: 0.7089 - val_loss: 
0.6833
Epoch 2/600
14/14 [==============================] - 0s 6ms/step - loss: 0.6815 - val_loss: 
0.6679
Epoch 3/600
14/14 [==============================] - 0s 7ms/step - loss: 0.6551 - val_loss: 
0.6537
Epoch 4/600
14/14 [==============================] - 0s 7ms/step - loss: 0.6526 - val_loss: 
0.6374
Epoch 5/600
14/14 [==============================] - 0s 9ms/step - loss: 0.6401 - val_loss: 
0.6184
Epoch 6/600
14/14 [==============================] - 0s 8ms/step - loss: 0.6263 - val_loss: 
0.5951
Epoch 7/600
14/14 [==============================] - 0s 10ms/step - loss: 0.6096 - val_loss: 
0.5719
Epoch 8/600
14/14 [==============================] - 0s 6ms/step - loss: 0.5818 - val_loss: 
0.5393
Epoch 9/600
14/14 [==============================] - 0s 8ms/step - loss: 0.5603 - val_loss: 
0.5075
Epoch 10/600
14/14 [==============================] - 0s 9ms/step - loss: 0.5469 - val_loss: 
0.4809
Epoch 11/600
14/14 [==============================] - 0s 9ms/step - loss: 0.5089 - val_loss: 
0.4537
Epoch 12/600
14/14 [==============================] - 0s 8ms/step - loss: 0.4930 - val_loss: 
0.4245
Epoch 13/600
14/14 [==============================] - 0s 9ms/step - loss: 0.4569 - val_loss: 
0.3885
Epoch 14/600
14/14 [==============================] - 0s 7ms/step - loss: 0.4330 - val_loss: 
0.3604
Epoch 15/600
14/14 [==============================] - 0s 7ms/step - loss: 0.4341 - val_loss: 
0.3346
Epoch 16/600
14/14 [==============================] - 0s 8ms/step - loss: 0.3978 - val_loss: 
0.3098
Epoch 17/600
14/14 [==============================] - 0s 8ms/step - loss: 0.3835 - val_loss: 
0.3030
Epoch 18/600
14/14 [==============================] - 0s 8ms/step - loss: 0.3613 - val_loss: 
0.2845
Epoch 19/600
14/14 [==============================] - 0s 10ms/step - loss: 0.3738 - val_loss: 
0.2673
Epoch 20/600
14/14 [==============================] - 0s 7ms/step - loss: 0.3515 - val_loss: 
0.2575
```

```
Epoch 21/600
14/14 [==============================] - 0s 7ms/step - loss: 0.3385 - val_loss:
0.2493
Epoch 22/600
14/14 [==============================] - 0s 7ms/step - loss: 0.3004 - val_loss:
0.2363
Epoch 23/600
14/14 [==============================] - 0s 9ms/step - loss: 0.3292 - val_loss:
0.2228
Epoch 24/600
14/14 [==============================] - 0s 10ms/step - loss: 0.2978 - val_loss:
0.2241
Epoch 25/600
14/14 [==============================] - 0s 9ms/step - loss: 0.3041 - val_loss:
0.2030
Epoch 26/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2887 - val_loss:
0.1949
Epoch 27/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2838 - val_loss:
0.1890
Epoch 28/600
14/14 [==============================] - 0s 5ms/step - loss: 0.2748 - val_loss:
0.1820
Epoch 29/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2715 - val_loss:
0.1830
Epoch 30/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2490 - val_loss:
0.1906
Epoch 31/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2300 - val_loss:
0.1634
Epoch 32/600
14/14 [==============================] - 0s 7ms/step - loss: 0.2685 - val_loss:
0.1789
Epoch 33/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2602 - val_loss:
0.1701
Epoch 34/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2694 - val_loss:
0.1679
Epoch 35/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2504 - val_loss:
0.1672
Epoch 36/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2230 - val_loss:
0.1822
Epoch 37/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2133 - val_loss:
0.1575
Epoch 38/600
14/14 [==============================] - 0s 6ms/step - loss: 0.2352 - val_loss:
0.1628
Epoch 39/600
14/14 [==============================] - 0s 8ms/step - loss: 0.1963 - val_loss:
0.1644
Epoch 40/600
14/14 [==============================] - 0s 12ms/step - loss: 0.2123 - val_loss:
0.1684
```

```
Epoch 41/600
14/14 [==============================] - 0s 11ms/step - loss: 0.2209 - val_loss:
0.1469
Epoch 42/600
14/14 [==============================] - 0s 11ms/step - loss: 0.2101 - val_loss:
0.1586
Epoch 43/600
14/14 [==============================] - 0s 8ms/step - loss: 0.2141 - val_loss:
0.1571
Epoch 44/600
14/14 [==============================] - 0s 9ms/step - loss: 0.2159 - val_loss:
0.1402
Epoch 45/600
14/14 [==============================] - 0s 11ms/step - loss: 0.1873 - val_loss:
0.1437
Epoch 46/600
14/14 [==============================] - 0s 13ms/step - loss: 0.1686 - val_loss:
0.1692
Epoch 47/600
14/14 [==============================] - 0s 14ms/step - loss: 0.1940 - val_loss:
0.1524
Epoch 48/600
14/14 [==============================] - 0s 12ms/step - loss: 0.1849 - val_loss:
0.1545
Epoch 49/600
14/14 [==============================] - 0s 11ms/step - loss: 0.1913 - val_loss:
0.1617
Epoch 50/600
14/14 [==============================] - 0s 15ms/step - loss: 0.1842 - val_loss:
0.1565
Epoch 51/600
14/14 [==============================] - 0s 17ms/step - loss: 0.1740 - val_loss:
0.1442
Epoch 52/600
14/14 [==============================] - 0s 16ms/step - loss: 0.1588 - val_loss:
0.1497
Epoch 53/600
14/14 [==============================] - 0s 15ms/step - loss: 0.1792 - val_loss:
0.2009
Epoch 54/600
14/14 [==============================] - 0s 13ms/step - loss: 0.1621 - val_loss:
0.1525
Epoch 55/600
14/14 [==============================] - 0s 15ms/step - loss: 0.1766 - val_loss:
0.1424
Epoch 56/600
14/14 [==============================] - 0s 15ms/step - loss: 0.1453 - val_loss:
0.1340
Epoch 57/600
14/14 [==============================] - 0s 14ms/step - loss: 0.1646 - val_loss:
0.1648
Epoch 58/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1411 - val_loss:
0.1423
Epoch 59/600
14/14 [==============================] - 0s 8ms/step - loss: 0.1502 - val_loss:
0.1603
Epoch 60/600
14/14 [==============================] - 0s 7ms/step - loss: 0.1500 - val_loss:
0.1398
```

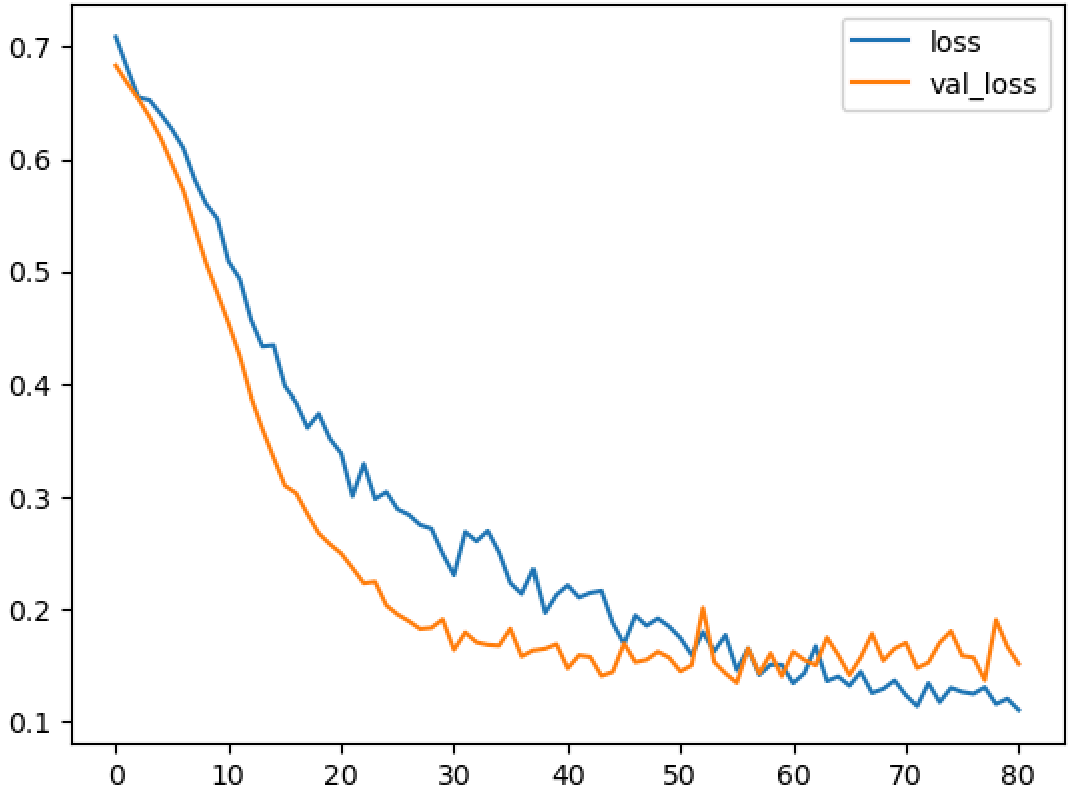
```
Epoch 61/600
14/14 [==============================] - 0s 8ms/step - loss: 0.1337 - val_loss:
0.1616
Epoch 62/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1425 - val_loss:
0.1544
Epoch 63/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1668 - val_loss:
0.1497
Epoch 64/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1356 - val_loss:
0.1744
Epoch 65/600
14/14 [==============================] - 0s 16ms/step - loss: 0.1396 - val_loss:
0.1588
Epoch 66/600
14/14 [==============================] - 0s 25ms/step - loss: 0.1314 - val_loss:
0.1409
Epoch 67/600
14/14 [==============================] - 0s 18ms/step - loss: 0.1438 - val_loss:
0.1568
Epoch 68/600
14/14 [==============================] - 0s 15ms/step - loss: 0.1250 - val_loss:
0.1778
Epoch 69/600
14/14 [==============================] - 0s 14ms/step - loss: 0.1286 - val_loss:
0.1538
Epoch 70/600
14/14 [==============================] - 0s 14ms/step - loss: 0.1361 - val_loss:
0.1645
Epoch 71/600
14/14 [==============================] - 0s 15ms/step - loss: 0.1230 - val_loss:
0.1696
Epoch 72/600
14/14 [==============================] - 0s 13ms/step - loss: 0.1132 - val_loss:
0.1472
Epoch 73/600
14/14 [==============================] - 0s 14ms/step - loss: 0.1337 - val_loss:
0.1521
Epoch 74/600
14/14 [==============================] - 0s 13ms/step - loss: 0.1167 - val_loss:
0.1698
Epoch 75/600
14/14 [==============================] - 0s 10ms/step - loss: 0.1295 - val_loss:
0.1801
Epoch 76/600
14/14 [==============================] - 0s 8ms/step - loss: 0.1259 - val_loss:
0.1582
Epoch 77/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1242 - val_loss:
0.1565
Epoch 78/600
14/14 [==============================] - 0s 10ms/step - loss: 0.1300 - val_loss:
0.1363
Epoch 79/600
14/14 [==============================] - 0s 9ms/step - loss: 0.1151 - val_loss:
0.1902
Epoch 80/600
14/14 [==============================] - 0s 10ms/step - loss: 0.1198 - val_loss:
0.1663
```

```
Epoch 81/600
14/14 [==============================] - 0s 10ms/step - loss: 0.1098 - val_loss:
0.1509
Epoch 81: early stopping
```

Out[79]: <keras.callbacks.History at 0x1f1d2da1220>

In [82]:
```
losses = pd.DataFrame(model_v2.history.history)
losses.plot()
```

Out[82]: <Axes: >



In [56]:
```
# Notice that the training los and val loss both are quickly going down in same
```

In [90]:
```
predicted_classes = model_v2.predict(X_test)
predicted_classes = (predicted_classes > 0.5).astype(int)
```

```
5/5 [==============================] - 0s 3ms/step
```

In [91]:
```
from sklearn.metrics import classification_report, confusion_matrix
```

In [92]:
```
print(classification_report(y_test, predicted_classes))
```

```
              precision    recall  f1-score   support

           0       0.84      0.98      0.91        55
           1       0.99      0.89      0.93        88

    accuracy                           0.92       143
   macro avg       0.92      0.93      0.92       143
weighted avg       0.93      0.92      0.92       143
```

In [93]:
```
print(confusion_matrix(y_test, predicted_classes))
```

```
[[54  1]
 [10 78]]
```

In [94]:
```
# Overall we should got performance precision and recall
```

In [ ]: