In [1]:
```python
# Import our dependencies
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler,OneHotEncoder, MinMaxScaler
import pandas as pd
import tensorflow as tf
import numpy as np

# Import our input dataset
df = pd.read_csv('../neural-network/pitcher_salaries_cleaned.csv')
df.head()
```

Out[1]:

	Year	Full Name	Age	Salary	ERA	Hits	Earned Runs	Strike Outs	Home Runs	Wins	Losses	Outs Pitched	Batters Faced by Pitcher	Games Finished	Weight	
0	1990	AbbottJim	23	185000	4.51	246	106	105	16	10	14	635	925	0	200	
1	1990	AbbottPaul	23	100000	5.97	37	23	25	0	0	5	104	162	0	185	
2	1990	AldredScott	22	100000	3.77	13	6	7	0	1	2	43	63	0	195	
3	1990	AndersonAllan	26	300000	4.53	214	95	82	20	7	18	566	797	0	178	
4	1990	AppierKevin	23	100000	2.76	179	57	127	13	12	8	557	784	1	180	

In [2]:
```python
# create log transformed column for salary
df['sal-log']=np.log10(df['Salary'])
df
```

Out[2]:

	Year	Full Name	Age	Salary	ERA	Hits	Earned Runs	Strike Outs	Home Runs	Wins	Losses	Outs Pitched	Batters Faced by Pitcher	Games Finished
0	1990	AbbottJim	23	185000	4.51	246	106	105	16	10	14	635	925	0
1	1990	AbbottPaul	23	100000	5.97	37	23	25	0	0	5	104	162	0
2	1990	AldredScott	22	100000	3.77	13	6	7	0	1	2	43	63	0
3	1990	AndersonAllan	26	300000	4.53	214	95	82	20	7	18	566	797	0
4	1990	AppierKevin	23	100000	2.76	179	57	127	13	12	8	557	784	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4932	2016	WorleyVance	29	2600000	3.53	84	34	56	11	2	2	260	365	13
4933	2016	WrightMike	26	510500	5.79	81	48	50	12	3	4	224	328	5
4934	2016	WrightSteven	32	514500	3.33	138	58	127	12	13	6	470	656	0
4935	2016	YoungChris	37	4250000	6.19	104	61	94	28	3	9	266	406	7
4936	2016	ZimmermannJordan	30	18000000	4.87	118	57	66	14	9	7	316	450	1

4937 rows × 20 columns

Reduce down to top features

In [3]:
```python
df= df.drop(["Full Name","Team","League","Age","Earned Runs","Home Runs","Wins","Losses","Weight","Height
df.head()
```

C:\Users\alyss\anaconda3\envs\mlenv\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: In a future

Out[3]:

	ERA	Hits	Strike Outs	Outs Pitched	Batters Faced by Pitcher	Games Finished	Games Started	sal-log
0	4.51	246	105	635	925	0	33	5.267172
1	5.97	37	25	104	162	0	7	5.000000
2	3.77	13	7	43	63	0	3	5.000000
3	4.53	214	82	566	797	0	31	5.477121
4	2.76	179	127	557	784	1	24	5.000000

Split Features/Target & Training/Testing Sets

Split into features and target

- **y variable**: Our target variable, `Salary`
- **X variable**: Our features; just drop `Salary` and `Full Name`

In [4]:
```python
# Split our preprocessed data into our features and target arrays
y = df["sal-log"].values
X = df.drop(["sal-log"],1).values

# Split the preprocessed data into a training and testing dataset
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=1)
```

Build and Instantiate `StandardScaler` object, then standardize numerical features

In [5]:
```python
# Create a StandardScaler instance
scaler = MinMaxScaler()

# Fit the StandardScaler
X_scaler = scaler.fit(X_train)

# Scale the data
X_train_scaled = X_scaler.transform(X_train)
X_test_scaled = X_scaler.transform(X_test)
```

In [ ]:
```python
# see if data scaled properly
scaled_data=pd.DataFrame(X_train_scaled)
scaled_data.head()
```

In [ ]:
```python
# see if data scaled properly
scaled_y=pd.DataFrame(y_train_scaled)
scaled_y.head()
```

Build Neural Net Framework

In [21]:
```python
# Define the model - deep neural net
number_input_features = len(X_train[0])
```

```python
hidden_nodes_layer1 = 100
hidden_nodes_layer2 = 70
hidden_nodes_layer3 = 50
hidden_nodes_layer4 = 30

nn = tf.keras.models.Sequential()

# First hidden layer
nn.add(
    tf.keras.layers.Dense(units=hidden_nodes_layer1, input_dim=number_input_features, activation="relu")
)

# Second hidden layer
nn.add(tf.keras.layers.Dense(units=hidden_nodes_layer2, activation="relu"))

# Third hidden layer
nn.add(tf.keras.layers.Dense(units=hidden_nodes_layer2, activation="relu"))

# Fourth hidden layer
nn.add(tf.keras.layers.Dense(units=hidden_nodes_layer2, activation="relu"))

# Output layer
nn.add(tf.keras.layers.Dense(units=10, activation="relu"))

# Check the structure of the model
nn.summary()
```

```
Model: "sequential_3"
_____
 Layer (type)                Output Shape              Param #
=================================================================
 dense_15 (Dense)            (None, 100)               800

 dense_16 (Dense)            (None, 70)                7070

 dense_17 (Dense)            (None, 70)                4970

 dense_18 (Dense)            (None, 70)                4970

 dense_19 (Dense)            (None, 10)                710

=================================================================
Total params: 18,520
Trainable params: 18,520
Non-trainable params: 0
_____
```

Compile the Model

In [22]:
```python
# Compile the model
nn.compile(loss="mean_squared_error", optimizer="adam", metrics=["accuracy"])
```

Train the model

In [23]:
```python
# Train the model
fit_model = nn.fit(X_train,y_train,epochs=500)
```

```
Epoch 1/500
116/116 [==============================] - 1s 1ms/step - loss: 32.3460 - accuracy: 0.0030
Epoch 2/500
116/116 [==============================] - 0s 1ms/step - loss: 30.3291 - accuracy: 0.0041
Epoch 3/500
116/116 [==============================] - 0s 1ms/step - loss: 30.1364 - accuracy: 0.0024
Epoch 4/500
116/116 [==============================] - 0s 1ms/step - loss: 29.6275 - accuracy: 0.0038
Epoch 5/500
```

```
116/116 [==============================] - 0s 1ms/step - loss: 26.6922 - accuracy: 0.0019
Epoch 6/500
116/116 [==============================] - 0s 1ms/step - loss: 24.3139 - accuracy: 0.0041
Epoch 7/500
116/116 [==============================] - 0s 1ms/step - loss: 19.4088 - accuracy: 0.0027
Epoch 8/500
116/116 [==============================] - 0s 1ms/step - loss: 18.9586 - accuracy: 0.0019
Epoch 9/500
116/116 [==============================] - 0s 1ms/step - loss: 15.6305 - accuracy: 0.0016
Epoch 10/500
116/116 [==============================] - 0s 1ms/step - loss: 12.1871 - accuracy: 0.0014
Epoch 11/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6950 - accuracy: 0.0022
Epoch 12/500
116/116 [==============================] - 0s 2ms/step - loss: 11.7523 - accuracy: 0.0035
Epoch 13/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6695 - accuracy: 0.0016
Epoch 14/500
116/116 [==============================] - 0s 1ms/step - loss: 11.7284 - accuracy: 0.0011
Epoch 15/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6663 - accuracy: 5.4025e-04
Epoch 16/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6293 - accuracy: 0.0022
Epoch 17/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6065 - accuracy: 8.1037e-04
Epoch 18/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6213 - accuracy: 0.0016
Epoch 19/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5621 - accuracy: 8.1037e-04
Epoch 20/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6802 - accuracy: 0.0011
Epoch 21/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6155 - accuracy: 0.0019
Epoch 22/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5237 - accuracy: 0.0014
Epoch 23/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5333 - accuracy: 0.0011
Epoch 24/500
116/116 [==============================] - 0s 1ms/step - loss: 11.6940 - accuracy: 5.4025e-04
Epoch 25/500
116/116 [==============================] - 0s 2ms/step - loss: 11.5736 - accuracy: 8.1037e-04
Epoch 26/500
116/116 [==============================] - 0s 2ms/step - loss: 11.5096 - accuracy: 8.1037e-04
Epoch 27/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5313 - accuracy: 0.0011
Epoch 28/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5207 - accuracy: 0.0011
Epoch 29/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5268 - accuracy: 0.0016
Epoch 30/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5135 - accuracy: 0.0011
Epoch 31/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5136 - accuracy: 8.1037e-04
Epoch 32/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4957 - accuracy: 5.4025e-04
Epoch 33/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4817 - accuracy: 5.4025e-04
Epoch 34/500
116/116 [==============================] - 0s 904us/step - loss: 11.4753 - accuracy: 0.0011
Epoch 35/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4865 - accuracy: 0.0014
Epoch 36/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5058 - accuracy: 8.1037e-04
Epoch 37/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4771 - accuracy: 8.1037e-04
Epoch 38/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5112 - accuracy: 0.0022
Epoch 39/500
116/116 [==============================] - 0s 1ms/step - loss: 11.5117 - accuracy: 0.0014
Epoch 40/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4864 - accuracy: 0.0019
Epoch 41/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4793 - accuracy: 0.0014
Epoch 42/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4568 - accuracy: 0.0014
Epoch 43/500
```

```
116/116 [==============================] - 0s 1ms/step - loss: 11.4975 - accuracy: 0.0016
Epoch 44/500
116/116 [==============================] - 0s 1ms/step - loss: 11.4687 - accuracy: 0.0019
Epoch 45/500
116/116 [==============================] - 0s 2ms/step - loss: 10.1994 - accuracy: 2.7012e-04
Epoch 46/500
116/116 [==============================] - 0s 2ms/step - loss: 7.8294 - accuracy: 0.0016
Epoch 47/500
116/116 [==============================] - 0s 1ms/step - loss: 7.8194 - accuracy: 0.0019
Epoch 48/500
116/116 [==============================] - 0s 1ms/step - loss: 7.8217 - accuracy: 0.0011
Epoch 49/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7909 - accuracy: 0.0016
Epoch 50/500
116/116 [==============================] - 0s 1ms/step - loss: 7.8282 - accuracy: 0.0016
Epoch 51/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7801 - accuracy: 5.4025e-04
Epoch 52/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7655 - accuracy: 0.0019
Epoch 53/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7720 - accuracy: 0.0016
Epoch 54/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7640 - accuracy: 0.0016
Epoch 55/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7612 - accuracy: 8.1037e-04
Epoch 56/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7562 - accuracy: 0.0016
Epoch 57/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7575 - accuracy: 2.7012e-04
Epoch 58/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7448 - accuracy: 0.0022
Epoch 59/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7440 - accuracy: 0.0016
Epoch 60/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7324 - accuracy: 2.7012e-04
Epoch 61/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7580 - accuracy: 5.4025e-04
Epoch 62/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7284 - accuracy: 0.0016
Epoch 63/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7460 - accuracy: 0.0011
Epoch 64/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7440 - accuracy: 0.0011
Epoch 65/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7306 - accuracy: 0.0019
Epoch 66/500
116/116 [==============================] - 0s 835us/step - loss: 7.7425 - accuracy: 8.1037e-04
Epoch 67/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7499 - accuracy: 0.0011
Epoch 68/500
116/116 [==============================] - 0s 974us/step - loss: 7.7286 - accuracy: 8.1037e-04
Epoch 69/500
116/116 [==============================] - 0s 922us/step - loss: 7.7143 - accuracy: 0.0011
Epoch 70/500
116/116 [==============================] - 0s 965us/step - loss: 7.7241 - accuracy: 0.0011
Epoch 71/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7274 - accuracy: 8.1037e-04
Epoch 72/500
116/116 [==============================] - 0s 948us/step - loss: 7.7101 - accuracy: 0.0016
Epoch 73/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7177 - accuracy: 0.0016
Epoch 74/500
116/116 [==============================] - 0s 861us/step - loss: 7.7244 - accuracy: 5.4025e-04
Epoch 75/500
116/116 [==============================] - 0s 939us/step - loss: 7.7193 - accuracy: 0.0011
Epoch 76/500
116/116 [==============================] - 0s 870us/step - loss: 7.7178 - accuracy: 5.4025e-04
Epoch 77/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7134 - accuracy: 0.0011
Epoch 78/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7130 - accuracy: 5.4025e-04
Epoch 79/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7143 - accuracy: 8.1037e-04
Epoch 80/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7105 - accuracy: 0.0022
Epoch 81/500
```

```
116/116 [==============================] - 0s 1ms/step - loss: 7.7093 - accuracy: 0.0016
Epoch 82/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7063 - accuracy: 0.0019
Epoch 83/500
116/116 [==============================] - 0s 948us/step - loss: 7.7101 - accuracy: 0.0016
Epoch 84/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7089 - accuracy: 0.0016
Epoch 85/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7070 - accuracy: 0.0016
Epoch 86/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7082 - accuracy: 0.0014
Epoch 87/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7030 - accuracy: 5.4025e-04
Epoch 88/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7032 - accuracy: 8.1037e-04
Epoch 89/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7057 - accuracy: 0.0011
Epoch 90/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7005 - accuracy: 8.1037e-04
Epoch 91/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7072 - accuracy: 0.0014
Epoch 92/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7005 - accuracy: 8.1037e-04
Epoch 93/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6980 - accuracy: 0.0011
Epoch 94/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7130 - accuracy: 5.4025e-04
Epoch 95/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7050 - accuracy: 5.4025e-04
Epoch 96/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7000 - accuracy: 8.1037e-04
Epoch 97/500
116/116 [==============================] - 0s 809us/step - loss: 7.7079 - accuracy: 5.4025e-04
Epoch 98/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7008 - accuracy: 0.0011
Epoch 99/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7110 - accuracy: 5.4025e-04
Epoch 100/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7045 - accuracy: 2.7012e-04
Epoch 101/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7029 - accuracy: 8.1037e-04
Epoch 102/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6997 - accuracy: 0.0011
Epoch 103/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6989 - accuracy: 0.0014
Epoch 104/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7039 - accuracy: 5.4025e-04
Epoch 105/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7134 - accuracy: 8.1037e-04
Epoch 106/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7040 - accuracy: 5.4025e-04
Epoch 107/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7002 - accuracy: 2.7012e-04
Epoch 108/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7030 - accuracy: 0.0016
Epoch 109/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7076 - accuracy: 0.0000e+00
Epoch 110/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7005 - accuracy: 8.1037e-04
Epoch 111/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6989 - accuracy: 0.0019
Epoch 112/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7016 - accuracy: 0.0019
Epoch 113/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7086 - accuracy: 0.0016
Epoch 114/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7013 - accuracy: 8.1037e-04
Epoch 115/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6990 - accuracy: 2.7012e-04
Epoch 116/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7051 - accuracy: 0.0011
Epoch 117/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7050 - accuracy: 8.1037e-04
Epoch 118/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7076 - accuracy: 0.0014
Epoch 119/500
```

```
116/116 [==============================] - 0s 1ms/step - loss: 7.6982 - accuracy: 0.0019
Epoch 120/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7013 - accuracy: 0.0011
Epoch 121/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6993 - accuracy: 8.1037e-04
Epoch 122/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7089 - accuracy: 0.0014
Epoch 123/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7097 - accuracy: 0.0014
Epoch 124/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6956 - accuracy: 0.0014
Epoch 125/500
116/116 [==============================] - 0s 983us/step - loss: 7.7044 - accuracy: 0.0011
Epoch 126/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7023 - accuracy: 0.0014
Epoch 127/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6987 - accuracy: 0.0011
Epoch 128/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6982 - accuracy: 0.0011
Epoch 129/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6988 - accuracy: 0.0016
Epoch 130/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7018 - accuracy: 8.1037e-04
Epoch 131/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6961 - accuracy: 0.0016
Epoch 132/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6983 - accuracy: 0.0022
Epoch 133/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7015 - accuracy: 0.0016
Epoch 134/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6988 - accuracy: 0.0022
Epoch 135/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6983 - accuracy: 0.0022
Epoch 136/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6954 - accuracy: 0.0014
Epoch 137/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6993 - accuracy: 0.0024
Epoch 138/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6998 - accuracy: 0.0011
Epoch 139/500
116/116 [==============================] - 0s 3ms/step - loss: 7.7012 - accuracy: 0.0019
Epoch 140/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6965 - accuracy: 0.0024
Epoch 141/500
116/116 [==============================] - 0s 3ms/step - loss: 7.7088 - accuracy: 0.0019
Epoch 142/500
116/116 [==============================] - 0s 3ms/step - loss: 7.7050 - accuracy: 0.0019
Epoch 143/500
116/116 [==============================] - 0s 3ms/step - loss: 7.7120 - accuracy: 0.0011
Epoch 144/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6995 - accuracy: 0.0022
Epoch 145/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6976 - accuracy: 8.1037e-04
Epoch 146/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6971 - accuracy: 0.0035
Epoch 147/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6975 - accuracy: 0.0022
Epoch 148/500
116/116 [==============================] - 0s 3ms/step - loss: 7.7018 - accuracy: 0.0011
Epoch 149/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7043 - accuracy: 0.0038
Epoch 150/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6969 - accuracy: 0.0035
Epoch 151/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6975 - accuracy: 0.0024
Epoch 152/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7025 - accuracy: 0.0019
Epoch 153/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6975 - accuracy: 0.0014
Epoch 154/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7053 - accuracy: 0.0014
Epoch 155/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6966 - accuracy: 0.0022
Epoch 156/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7008 - accuracy: 0.0019
Epoch 157/500
```

```
116/116 [==============================] - 0s 2ms/step - loss: 7.6998 - accuracy: 0.0019
Epoch 158/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7023 - accuracy: 0.0030
Epoch 159/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6987 - accuracy: 0.0024
Epoch 160/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6963 - accuracy: 0.0041
Epoch 161/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7036 - accuracy: 0.0030
Epoch 162/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7008 - accuracy: 0.0022
Epoch 163/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7001 - accuracy: 0.0032
Epoch 164/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6977 - accuracy: 0.0043
Epoch 165/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6956 - accuracy: 0.0030
Epoch 166/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6999 - accuracy: 0.0030
Epoch 167/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6970 - accuracy: 0.0032
Epoch 168/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6998 - accuracy: 0.0027
Epoch 169/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6982 - accuracy: 0.0038
Epoch 170/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7005 - accuracy: 0.0038
Epoch 171/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7044 - accuracy: 0.0030
Epoch 172/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6961 - accuracy: 0.0032
Epoch 173/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6962 - accuracy: 0.0022
Epoch 174/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6998 - accuracy: 0.0022
Epoch 175/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6955 - accuracy: 0.0024
Epoch 176/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6950 - accuracy: 0.0030
Epoch 177/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6975 - accuracy: 0.0041
Epoch 178/500
116/116 [==============================] - 0s 948us/step - loss: 7.6981 - accuracy: 0.0027
Epoch 179/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6967 - accuracy: 0.0027
Epoch 180/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6987 - accuracy: 8.1037e-04
Epoch 181/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7001 - accuracy: 0.0035
Epoch 182/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6952 - accuracy: 0.0027
Epoch 183/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6969 - accuracy: 0.0024
Epoch 184/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7006 - accuracy: 0.0032
Epoch 185/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6961 - accuracy: 0.0019
Epoch 186/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6983 - accuracy: 5.4025e-04
Epoch 187/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6940 - accuracy: 0.0035
Epoch 188/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6979 - accuracy: 0.0038
Epoch 189/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6959 - accuracy: 0.0024
Epoch 190/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6973 - accuracy: 0.0027
Epoch 191/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6945 - accuracy: 0.0016
Epoch 192/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6940 - accuracy: 0.0016
Epoch 193/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6950 - accuracy: 0.0022
Epoch 194/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7002 - accuracy: 0.0024
Epoch 195/500
```

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116/116 [==============================] - 0s 852us/step - loss: 7.6976 - accuracy: 0.0014
Epoch 196/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6961 - accuracy: 0.0011
Epoch 197/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6965 - accuracy: 0.0016
Epoch 198/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6948 - accuracy: 0.0014
Epoch 199/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7007 - accuracy: 0.0022
Epoch 200/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6992 - accuracy: 0.0011
Epoch 201/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7026 - accuracy: 8.1037e-04
Epoch 202/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6998 - accuracy: 0.0019
Epoch 203/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6981 - accuracy: 0.0019
Epoch 204/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7003 - accuracy: 8.1037e-04
Epoch 205/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7001 - accuracy: 0.0011
Epoch 206/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6964 - accuracy: 0.0016
Epoch 207/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7021 - accuracy: 0.0024
Epoch 208/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6971 - accuracy: 0.0030
Epoch 209/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6996 - accuracy: 0.0024
Epoch 210/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6972 - accuracy: 0.0024
Epoch 211/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6958 - accuracy: 0.0030
Epoch 212/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7001 - accuracy: 8.1037e-04
Epoch 213/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6944 - accuracy: 0.0016
Epoch 214/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6949 - accuracy: 0.0011
Epoch 215/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6937 - accuracy: 0.0016
Epoch 216/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7020 - accuracy: 8.1037e-04
Epoch 217/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7036 - accuracy: 0.0000e+00
Epoch 218/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6966 - accuracy: 0.0014
Epoch 219/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6979 - accuracy: 2.7012e-04
Epoch 220/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7044 - accuracy: 0.0043
Epoch 221/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6969 - accuracy: 0.0011
Epoch 222/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6992 - accuracy: 0.0011
Epoch 223/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6970 - accuracy: 0.0038
Epoch 224/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6977 - accuracy: 0.0051
Epoch 225/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6943 - accuracy: 0.0068
Epoch 226/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6986 - accuracy: 0.0024
Epoch 227/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6967 - accuracy: 0.0011
Epoch 228/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7002 - accuracy: 0.0016
Epoch 229/500
116/116 [==============================] - 0s 2ms/step - loss: 7.7011 - accuracy: 0.0027
Epoch 230/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6962 - accuracy: 0.0016
Epoch 231/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7013 - accuracy: 0.0022
Epoch 232/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6990 - accuracy: 0.0016
Epoch 233/500
```

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116/116 [==============================] - 0s 1ms/step - loss: 7.6957 - accuracy: 0.0019
Epoch 234/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6987 - accuracy: 0.0027
Epoch 235/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6969 - accuracy: 8.1037e-04
Epoch 236/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6987 - accuracy: 0.0016
Epoch 237/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6967 - accuracy: 5.4025e-04
Epoch 238/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6947 - accuracy: 5.4025e-04
Epoch 239/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6954 - accuracy: 5.4025e-04
Epoch 240/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6973 - accuracy: 0.0000e+00
Epoch 241/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6950 - accuracy: 5.4025e-04
Epoch 242/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6973 - accuracy: 2.7012e-04
Epoch 243/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6940 - accuracy: 0.0014
Epoch 244/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6985 - accuracy: 5.4025e-04
Epoch 245/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6993 - accuracy: 0.0016
Epoch 246/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6966 - accuracy: 0.0019
Epoch 247/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6957 - accuracy: 0.0022
Epoch 248/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6946 - accuracy: 0.0027
Epoch 249/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6949 - accuracy: 0.0032
Epoch 250/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6957 - accuracy: 0.0046
Epoch 251/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6938 - accuracy: 0.0027
Epoch 252/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6942 - accuracy: 0.0030
Epoch 253/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6949 - accuracy: 0.0027
Epoch 254/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6912 - accuracy: 5.4025e-04
Epoch 255/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6980 - accuracy: 8.1037e-04
Epoch 256/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6939 - accuracy: 0.0019
Epoch 257/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6950 - accuracy: 0.0019
Epoch 258/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6949 - accuracy: 0.0027
Epoch 259/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6955 - accuracy: 0.0019
Epoch 260/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6933 - accuracy: 0.0019
Epoch 261/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6931 - accuracy: 0.0030
Epoch 262/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6948 - accuracy: 0.0027
Epoch 263/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6953 - accuracy: 0.0032
Epoch 264/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6935 - accuracy: 0.0038
Epoch 265/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6973 - accuracy: 0.0019
Epoch 266/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6945 - accuracy: 0.0024
Epoch 267/500
116/116 [==============================] - 0s 930us/step - loss: 7.6980 - accuracy: 0.0016
Epoch 268/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6944 - accuracy: 0.0019
Epoch 269/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6931 - accuracy: 0.0014
Epoch 270/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6952 - accuracy: 0.0016
Epoch 271/500
```

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116/116 [==============================] - 0s 2ms/step - loss: 7.6951 - accuracy: 0.0022
Epoch 272/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6935 - accuracy: 0.0062
Epoch 273/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6933 - accuracy: 0.0027
Epoch 274/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6972 - accuracy: 0.0019
Epoch 275/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6982 - accuracy: 0.0016
Epoch 276/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6983 - accuracy: 0.0019
Epoch 277/500
116/116 [==============================] - 0s 1ms/step - loss: 7.7004 - accuracy: 0.0014
Epoch 278/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6965 - accuracy: 0.0016
Epoch 279/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6955 - accuracy: 0.0014
Epoch 280/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6942 - accuracy: 0.0016
Epoch 281/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6918 - accuracy: 0.0014
Epoch 282/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6952 - accuracy: 8.1037e-04
Epoch 283/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6986 - accuracy: 0.0019
Epoch 284/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6909 - accuracy: 5.4025e-04
Epoch 285/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6927 - accuracy: 0.0011
Epoch 286/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6932 - accuracy: 0.0014
Epoch 287/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6928 - accuracy: 0.0011
Epoch 288/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6936 - accuracy: 8.1037e-04
Epoch 289/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6948 - accuracy: 2.7012e-04
Epoch 290/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6963 - accuracy: 0.0016
Epoch 291/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6924 - accuracy: 0.0016
Epoch 292/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6948 - accuracy: 0.0016
Epoch 293/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6916 - accuracy: 5.4025e-04
Epoch 294/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6925 - accuracy: 0.0027
Epoch 295/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6918 - accuracy: 0.0019
Epoch 296/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6934 - accuracy: 0.0030
Epoch 297/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6904 - accuracy: 0.0022
Epoch 298/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6910 - accuracy: 0.0030
Epoch 299/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6933 - accuracy: 0.0041
Epoch 300/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6935 - accuracy: 0.0022
Epoch 301/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6923 - accuracy: 0.0019
Epoch 302/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6939 - accuracy: 0.0032
Epoch 303/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6919 - accuracy: 0.0019
Epoch 304/500
116/116 [==============================] - 0s 1000us/step - loss: 7.6906 - accuracy: 0.0027
Epoch 305/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6907 - accuracy: 0.0030
Epoch 306/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6923 - accuracy: 0.0016
Epoch 307/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6907 - accuracy: 0.0019
Epoch 308/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6964 - accuracy: 0.0016
Epoch 309/500
```

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116/116 [==============================] - 0s 1ms/step - loss: 7.6906 - accuracy: 0.0019
Epoch 310/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6932 - accuracy: 0.0019
Epoch 311/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6904 - accuracy: 0.0014
Epoch 312/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6914 - accuracy: 0.0016
Epoch 313/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6917 - accuracy: 0.0024
Epoch 314/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6913 - accuracy: 0.0022
Epoch 315/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6929 - accuracy: 0.0011
Epoch 316/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6891 - accuracy: 0.0035
Epoch 317/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6895 - accuracy: 0.0024
Epoch 318/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6912 - accuracy: 0.0024
Epoch 319/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6903 - accuracy: 0.0014
Epoch 320/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6937 - accuracy: 0.0011
Epoch 321/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6915 - accuracy: 0.0027
Epoch 322/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6923 - accuracy: 0.0027
Epoch 323/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6935 - accuracy: 0.0024
Epoch 324/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6898 - accuracy: 0.0024
Epoch 325/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6889 - accuracy: 8.1037e-04
Epoch 326/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6903 - accuracy: 8.1037e-04
Epoch 327/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6879 - accuracy: 0.0027
Epoch 328/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6884 - accuracy: 0.0041
Epoch 329/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6881 - accuracy: 0.0030
Epoch 330/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6882 - accuracy: 0.0011
Epoch 331/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6872 - accuracy: 0.0035
Epoch 332/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6909 - accuracy: 0.0016
Epoch 333/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6883 - accuracy: 0.0032
Epoch 334/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6865 - accuracy: 0.0022
Epoch 335/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6868 - accuracy: 0.0030
Epoch 336/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6887 - accuracy: 0.0024
Epoch 337/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6903 - accuracy: 0.0024
Epoch 338/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6886 - accuracy: 0.0024
Epoch 339/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6930 - accuracy: 0.0014
Epoch 340/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6903 - accuracy: 0.0024
Epoch 341/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6896 - accuracy: 0.0027
Epoch 342/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6880 - accuracy: 0.0035
Epoch 343/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6889 - accuracy: 0.0041
Epoch 344/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6895 - accuracy: 0.0035
Epoch 345/500
116/116 [==============================] - 0s 983us/step - loss: 7.6907 - accuracy: 0.0022
Epoch 346/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6907 - accuracy: 0.0019
Epoch 347/500
```

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116/116 [==============================] - 0s 2ms/step - loss: 7.6894 - accuracy: 0.0041
Epoch 348/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6861 - accuracy: 0.0032
Epoch 349/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6859 - accuracy: 0.0068
Epoch 350/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6903 - accuracy: 0.0019
Epoch 351/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6881 - accuracy: 0.0019
Epoch 352/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6891 - accuracy: 0.0024
Epoch 353/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6890 - accuracy: 0.0027
Epoch 354/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6871 - accuracy: 0.0030
Epoch 355/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6888 - accuracy: 0.0011
Epoch 356/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6890 - accuracy: 0.0011
Epoch 357/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6888 - accuracy: 5.4025e-04
Epoch 358/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6865 - accuracy: 8.1037e-04
Epoch 359/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6901 - accuracy: 8.1037e-04
Epoch 360/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6896 - accuracy: 0.0000e+00
Epoch 361/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6898 - accuracy: 2.7012e-04
Epoch 362/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6875 - accuracy: 5.4025e-04
Epoch 363/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6882 - accuracy: 0.0011
Epoch 364/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6872 - accuracy: 8.1037e-04
Epoch 365/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6921 - accuracy: 0.0019
Epoch 366/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6873 - accuracy: 0.0019
Epoch 367/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6890 - accuracy: 0.0014
Epoch 368/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6869 - accuracy: 0.0022
Epoch 369/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6908 - accuracy: 0.0030
Epoch 370/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6896 - accuracy: 8.1037e-04
Epoch 371/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6869 - accuracy: 0.0016
Epoch 372/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6865 - accuracy: 0.0014
Epoch 373/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6909 - accuracy: 0.0024
Epoch 374/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6848 - accuracy: 0.0014
Epoch 375/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6875 - accuracy: 0.0011
Epoch 376/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6884 - accuracy: 0.0022
Epoch 377/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6866 - accuracy: 0.0024
Epoch 378/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6862 - accuracy: 8.1037e-04
Epoch 379/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6851 - accuracy: 0.0019
Epoch 380/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6890 - accuracy: 0.0014
Epoch 381/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6861 - accuracy: 0.0022
Epoch 382/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6869 - accuracy: 0.0027
Epoch 383/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6912 - accuracy: 0.0011
Epoch 384/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6895 - accuracy: 0.0019
Epoch 385/500
```

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116/116 [==============================] - 0s 1ms/step - loss: 7.6915 - accuracy: 0.0019
Epoch 386/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6860 - accuracy: 0.0019
Epoch 387/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6887 - accuracy: 0.0032
Epoch 388/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6850 - accuracy: 0.0032
Epoch 389/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6862 - accuracy: 0.0030
Epoch 390/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6871 - accuracy: 0.0035
Epoch 391/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6856 - accuracy: 0.0022
Epoch 392/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6870 - accuracy: 0.0022
Epoch 393/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6873 - accuracy: 0.0016
Epoch 394/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6862 - accuracy: 0.0030
Epoch 395/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6875 - accuracy: 0.0024
Epoch 396/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6887 - accuracy: 0.0014
Epoch 397/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6891 - accuracy: 0.0014
Epoch 398/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6855 - accuracy: 0.0016
Epoch 399/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6865 - accuracy: 0.0011
Epoch 400/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6856 - accuracy: 0.0014
Epoch 401/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6872 - accuracy: 0.0016
Epoch 402/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6846 - accuracy: 0.0022
Epoch 403/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6839 - accuracy: 0.0016
Epoch 404/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6872 - accuracy: 0.0016
Epoch 405/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6864 - accuracy: 8.1037e-04
Epoch 406/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6904 - accuracy: 0.0014
Epoch 407/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6843 - accuracy: 0.0027
Epoch 408/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6878 - accuracy: 0.0011
Epoch 409/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6865 - accuracy: 0.0014
Epoch 410/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6855 - accuracy: 0.0019
Epoch 411/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6854 - accuracy: 0.0014
Epoch 412/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6858 - accuracy: 8.1037e-04
Epoch 413/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6849 - accuracy: 0.0011
Epoch 414/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6879 - accuracy: 0.0019
Epoch 415/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6850 - accuracy: 0.0032
Epoch 416/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6884 - accuracy: 0.0016
Epoch 417/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6853 - accuracy: 0.0011
Epoch 418/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6845 - accuracy: 0.0014
Epoch 419/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6848 - accuracy: 0.0011
Epoch 420/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6865 - accuracy: 0.0016
Epoch 421/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6855 - accuracy: 0.0022
Epoch 422/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6835 - accuracy: 8.1037e-04
Epoch 423/500
```

```
116/116 [==============================] - 0s 2ms/step - loss: 7.6889 - accuracy: 0.0011
Epoch 424/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6897 - accuracy: 0.0030
Epoch 425/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6844 - accuracy: 0.0014
Epoch 426/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6912 - accuracy: 0.0019
Epoch 427/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6869 - accuracy: 0.0024
Epoch 428/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6856 - accuracy: 0.0014
Epoch 429/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6847 - accuracy: 0.0022
Epoch 430/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6834 - accuracy: 0.0014
Epoch 431/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6860 - accuracy: 0.0027
Epoch 432/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6880 - accuracy: 0.0022
Epoch 433/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6865 - accuracy: 5.4025e-04
Epoch 434/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6840 - accuracy: 0.0019
Epoch 435/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6867 - accuracy: 0.0011
Epoch 436/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6854 - accuracy: 0.0022
Epoch 437/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6878 - accuracy: 0.0016
Epoch 438/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6870 - accuracy: 0.0024
Epoch 439/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6855 - accuracy: 0.0019
Epoch 440/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6845 - accuracy: 0.0014
Epoch 441/500
116/116 [==============================] - 0s 3ms/step - loss: 7.6858 - accuracy: 0.0016
Epoch 442/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6839 - accuracy: 0.0027
Epoch 443/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6854 - accuracy: 0.0024
Epoch 444/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6872 - accuracy: 0.0030
Epoch 445/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6836 - accuracy: 0.0030
Epoch 446/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6856 - accuracy: 5.4025e-04
Epoch 447/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6887 - accuracy: 0.0011
Epoch 448/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6860 - accuracy: 0.0030
Epoch 449/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6867 - accuracy: 0.0022
Epoch 450/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6823 - accuracy: 0.0022
Epoch 451/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6875 - accuracy: 0.0011
Epoch 452/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6857 - accuracy: 0.0016
Epoch 453/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6836 - accuracy: 0.0019
Epoch 454/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6851 - accuracy: 0.0016
Epoch 455/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6876 - accuracy: 0.0027
Epoch 456/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6888 - accuracy: 0.0011
Epoch 457/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6847 - accuracy: 0.0022
Epoch 458/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6830 - accuracy: 8.1037e-04
Epoch 459/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6842 - accuracy: 8.1037e-04
Epoch 460/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6845 - accuracy: 0.0014
Epoch 461/500
```

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116/116 [==============================] - 0s 2ms/step - loss: 7.6842 - accuracy: 0.0016
Epoch 462/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6827 - accuracy: 0.0016
Epoch 463/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6838 - accuracy: 0.0016
Epoch 464/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6879 - accuracy: 0.0016
Epoch 465/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6902 - accuracy: 0.0024
Epoch 466/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6837 - accuracy: 0.0027
Epoch 467/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6834 - accuracy: 0.0027
Epoch 468/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6841 - accuracy: 0.0022
Epoch 469/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6837 - accuracy: 0.0022
Epoch 470/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6855 - accuracy: 0.0043
Epoch 471/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6848 - accuracy: 5.4025e-04
Epoch 472/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6820 - accuracy: 0.0011
Epoch 473/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6823 - accuracy: 0.0027
Epoch 474/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6823 - accuracy: 0.0022
Epoch 475/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6832 - accuracy: 0.0027
Epoch 476/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6821 - accuracy: 0.0014
Epoch 477/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6851 - accuracy: 0.0019
Epoch 478/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6855 - accuracy: 0.0011
Epoch 479/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6836 - accuracy: 0.0027
Epoch 480/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6826 - accuracy: 0.0014
Epoch 481/500
116/116 [==============================] - 0s 1000us/step - loss: 7.6855 - accuracy: 0.0014
Epoch 482/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6850 - accuracy: 0.0030
Epoch 483/500
116/116 [==============================] - 0s 1ms/step - loss: 7.6859 - accuracy: 0.0014
Epoch 484/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6849 - accuracy: 5.4025e-04
Epoch 485/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6835 - accuracy: 0.0022
Epoch 486/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6844 - accuracy: 0.0019
Epoch 487/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6846 - accuracy: 5.4025e-04
Epoch 488/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6832 - accuracy: 0.0016
Epoch 489/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6837 - accuracy: 0.0014
Epoch 490/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6822 - accuracy: 0.0022
Epoch 491/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6809 - accuracy: 0.0019
Epoch 492/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6860 - accuracy: 0.0022
Epoch 493/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6871 - accuracy: 0.0014
Epoch 494/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6861 - accuracy: 0.0022
Epoch 495/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6832 - accuracy: 0.0011
Epoch 496/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6828 - accuracy: 0.0019
Epoch 497/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6820 - accuracy: 0.0024
Epoch 498/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6839 - accuracy: 5.4025e-04
Epoch 499/500
```

```
116/116 [==============================] - 0s 2ms/step - loss: 7.6836 - accuracy: 0.0022
Epoch 500/500
116/116 [==============================] - 0s 2ms/step - loss: 7.6867 - accuracy: 0.0011
```

In [24]:
```python
# Evaluate the model using the test data
model_loss, model_accuracy = nn.evaluate(X_test_scaled,y_test,verbose=2)
print(f"Loss: {model_loss}, Accuracy: {model_accuracy}")
```
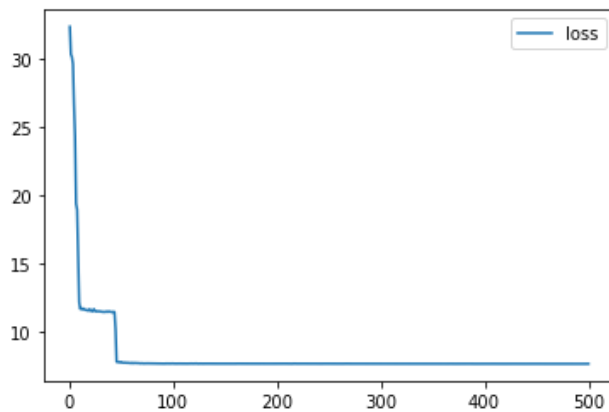
```
39/39 - 0s - loss: 9.2384 - accuracy: 0.0000e+00 - 179ms/epoch - 5ms/step
Loss: 9.23840618133545, Accuracy: 0.0
```

In [25]:
```python
# Create a DataFrame containing training history
history_df = pd.DataFrame(fit_model.history, index=range(1,len(fit_model.history["loss"])+1))

# Plot the loss
history_df.plot(y="loss")
```

Out[25]: <AxesSubplot:>

In [26]:
```python
# Plot the accuracy
history_df.plot(y="accuracy")
```
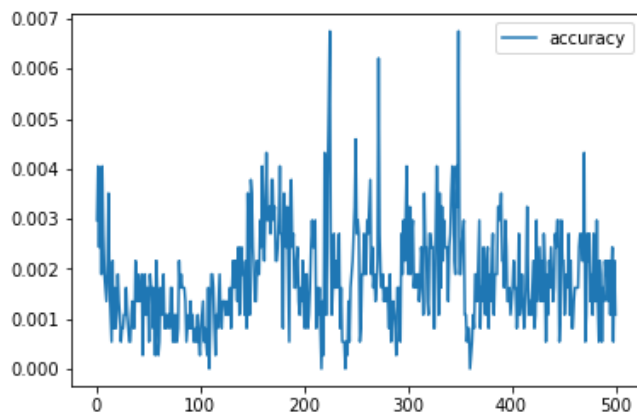
Out[26]: <AxesSubplot:>

In [ ]: