In [1]:

```
# 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('encoded_binned_df.csv')
df.head()
```

Out[1]:

	ERA	Hits	Earned Runs	Strike Outs	Home Runs	Wins	Losses	Outs Pitched	Batters Faced by Pitcher	Games Finished	Weight	Height	Games Started	salBin_low	salBin_
0	4.51	246	106	105	16	10	14	635	925	0	200	75	33	1	
1	5.97	37	23	25	0	0	5	104	162	0	185	75	7	1	
2	3.77	13	6	7	0	1	2	43	63	0	195	76	3	1	
3	4.53	214	95	82	20	7	18	566	797	0	178	71	31	1	
4	2.76	179	57	127	13	12	8	557	784	1	180	74	24	1	

In [3]:

```
### Drop unnecessary columns
df= df.filter(['Batters Faced by Pitcher','Outs Pitched','ERA','Strike Outs',"salBin_low","salBin_mid","sa
df.head()
```

Out[3]:

	Batters Faced by Pitcher	Outs Pitched	ERA	Strike Outs	salBin_low	salBin_mid	salBin_high	salBin_top
0	925	635	4.51	105	1	0	0	0
1	162	104	5.97	25	1	0	0	0
2	63	43	3.77	7	1	0	0	0
3	797	566	4.53	82	1	0	0	0
4	784	557	2.76	127	1	0	0	0

Split Features/Target & Training/Testing Sets

Split into features and target

- **y variable**: Our target variables, `Salary-Bin_low` , `Salary-Bin_mid` , `Salary-Bin_high` , `Salary-Bin_top`
- **X variable**: Our features

In [4]:

```
# Split our preprocessed data into our features and target arrays
y = df[["salBin_low","salBin_mid","salBin_high","salBin_top"]].values
X = df.drop(["salBin_low","salBin_mid","salBin_high","salBin_top"],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)
```

```
C:\Users\alyss\anaconda3\envs\mlenv\lib\site-packages\ipykernel_launcher.py:3: FutureWarning: In a future
version of pandas all arguments of DataFrame.drop except for the argument 'labels' will be keyword-only
  This is separate from the ipykernel package so we can avoid doing imports until
```

Build and Instantiate `StandardScaler` object, then standardize numerical

features

In [5]:

```
# Create a StandardScaler instance
scaler = StandardScaler()

# 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)
```

Build Neural Net Framework

In [9]:

```
# Define the model - deep neural net
number_input_features = len(X_train[0])
hidden_nodes_layer1 = 144
hidden_nodes_layer2 = 144
hidden_nodes_layer3 = 32
hidden_nodes_layer4 = 32


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_layer3, activation="relu"))

# Third hidden layer
nn.add(tf.keras.layers.Dense(units=hidden_nodes_layer4, activation="relu"))

# Output layer
nn.add(tf.keras.layers.Dense(units=4, activation="softmax"))

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

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_5 (Dense)             (None, 144)               720

 dense_6 (Dense)             (None, 144)               20880

 dense_7 (Dense)             (None, 32)                4640

 dense_8 (Dense)             (None, 32)                1056

 dense_9 (Dense)             (None, 4)                 132

=================================================================
Total params: 27,428
Trainable params: 27,428
Non-trainable params: 0
_________________________________________________________________
```

Compile the Model

In [10]:

```
# Compile the model
nn.compile(loss="CategoricalCrossentropy", optimizer="adam", metrics=["accuracy"])
```

Train the model

In [11]:

```
# Train the model
fit_model = nn.fit(X_train,y_train,epochs=200)
```

```
Epoch 1/200
116/116 [==============================] - 0s 730us/step - loss: 3.0569 - accuracy: 0.3976
Epoch 2/200
116/116 [==============================] - 0s 722us/step - loss: 1.4584 - accuracy: 0.4103
Epoch 3/200
116/116 [==============================] - 0s 730us/step - loss: 1.4333 - accuracy: 0.4246
Epoch 4/200
116/116 [==============================] - 0s 748us/step - loss: 1.4084 - accuracy: 0.4238
Epoch 5/200
116/116 [==============================] - 0s 748us/step - loss: 1.3056 - accuracy: 0.4298
Epoch 6/200
116/116 [==============================] - 0s 748us/step - loss: 1.2501 - accuracy: 0.4308
Epoch 7/200
116/116 [==============================] - 0s 739us/step - loss: 1.2307 - accuracy: 0.4363
Epoch 8/200
116/116 [==============================] - 0s 722us/step - loss: 1.2129 - accuracy: 0.4441
Epoch 9/200
116/116 [==============================] - 0s 739us/step - loss: 1.2749 - accuracy: 0.4236
Epoch 10/200
116/116 [==============================] - 0s 730us/step - loss: 1.2182 - accuracy: 0.4465
Epoch 11/200
116/116 [==============================] - 0s 713us/step - loss: 1.2506 - accuracy: 0.4435
Epoch 12/200
116/116 [==============================] - 0s 765us/step - loss: 1.2255 - accuracy: 0.4600
Epoch 13/200
116/116 [==============================] - 0s 757us/step - loss: 1.2153 - accuracy: 0.4460
Epoch 14/200
116/116 [==============================] - 0s 774us/step - loss: 1.1746 - accuracy: 0.4611
Epoch 15/200
116/116 [==============================] - 0s 791us/step - loss: 1.1815 - accuracy: 0.4562
Epoch 16/200
116/116 [==============================] - 0s 722us/step - loss: 1.1756 - accuracy: 0.4592
Epoch 17/200
116/116 [==============================] - 0s 722us/step - loss: 1.2096 - accuracy: 0.4500
Epoch 18/200
116/116 [==============================] - 0s 757us/step - loss: 1.1823 - accuracy: 0.4576
Epoch 19/200
116/116 [==============================] - 0s 730us/step - loss: 1.1783 - accuracy: 0.4657
Epoch 20/200
116/116 [==============================] - 0s 722us/step - loss: 1.1640 - accuracy: 0.4751
Epoch 21/200
116/116 [==============================] - 0s 730us/step - loss: 1.1830 - accuracy: 0.4608
Epoch 22/200
116/116 [==============================] - 0s 722us/step - loss: 1.1767 - accuracy: 0.4581
Epoch 23/200
116/116 [==============================] - 0s 730us/step - loss: 1.1964 - accuracy: 0.4611
Epoch 24/200
116/116 [==============================] - 0s 739us/step - loss: 1.1915 - accuracy: 0.4530
Epoch 25/200
116/116 [==============================] - 0s 833us/step - loss: 1.2864 - accuracy: 0.4211
Epoch 26/200
116/116 [==============================] - 0s 774us/step - loss: 1.1969 - accuracy: 0.4592
Epoch 27/200
116/116 [==============================] - 0s 800us/step - loss: 1.1739 - accuracy: 0.4676
Epoch 28/200
116/116 [==============================] - 0s 765us/step - loss: 1.1732 - accuracy: 0.4500
Epoch 29/200
116/116 [==============================] - 0s 730us/step - loss: 1.1566 - accuracy: 0.4724
Epoch 30/200
116/116 [==============================] - 0s 713us/step - loss: 1.1516 - accuracy: 0.4770
Epoch 31/200
116/116 [==============================] - 0s 739us/step - loss: 1.1646 - accuracy: 0.4662
Epoch 32/200
```

```
116/116 [==============================] - 0s 730us/step - loss: 1.1580 - accuracy: 0.4611
Epoch 33/200
116/116 [==============================] - 0s 739us/step - loss: 1.1508 - accuracy: 0.4738
Epoch 34/200
116/116 [==============================] - 0s 765us/step - loss: 1.1551 - accuracy: 0.4627
Epoch 35/200
116/116 [==============================] - 0s 974us/step - loss: 1.1517 - accuracy: 0.4806
Epoch 36/200
116/116 [==============================] - 0s 730us/step - loss: 1.1704 - accuracy: 0.4600
Epoch 37/200
116/116 [==============================] - 0s 722us/step - loss: 1.1528 - accuracy: 0.4641
Epoch 38/200
116/116 [==============================] - 0s 713us/step - loss: 1.1560 - accuracy: 0.4668
Epoch 39/200
116/116 [==============================] - 0s 722us/step - loss: 1.1538 - accuracy: 0.4703
Epoch 40/200
116/116 [==============================] - 0s 730us/step - loss: 1.1596 - accuracy: 0.4619
Epoch 41/200
116/116 [==============================] - 0s 739us/step - loss: 1.1845 - accuracy: 0.4335
Epoch 42/200
116/116 [==============================] - 0s 730us/step - loss: 1.1604 - accuracy: 0.4646
Epoch 43/200
116/116 [==============================] - 0s 730us/step - loss: 1.1568 - accuracy: 0.4622
Epoch 44/200
116/116 [==============================] - 0s 713us/step - loss: 1.1520 - accuracy: 0.4695
Epoch 45/200
116/116 [==============================] - 0s 722us/step - loss: 1.1524 - accuracy: 0.4670
Epoch 46/200
116/116 [==============================] - 0s 730us/step - loss: 1.1633 - accuracy: 0.4543
Epoch 47/200
116/116 [==============================] - 0s 739us/step - loss: 1.1597 - accuracy: 0.4565
Epoch 48/200
116/116 [==============================] - 0s 730us/step - loss: 1.1537 - accuracy: 0.4641
Epoch 49/200
116/116 [==============================] - 0s 739us/step - loss: 1.1624 - accuracy: 0.4573
Epoch 50/200
116/116 [==============================] - 0s 713us/step - loss: 1.1543 - accuracy: 0.4498
Epoch 51/200
116/116 [==============================] - 0s 730us/step - loss: 1.1582 - accuracy: 0.4649
Epoch 52/200
116/116 [==============================] - 0s 730us/step - loss: 1.1544 - accuracy: 0.4668
Epoch 53/200
116/116 [==============================] - 0s 722us/step - loss: 1.1586 - accuracy: 0.4560
Epoch 54/200
116/116 [==============================] - 0s 739us/step - loss: 1.1607 - accuracy: 0.4665
Epoch 55/200
116/116 [==============================] - 0s 757us/step - loss: 1.1545 - accuracy: 0.4665
Epoch 56/200
116/116 [==============================] - 0s 730us/step - loss: 1.1501 - accuracy: 0.4679
Epoch 57/200
116/116 [==============================] - 0s 774us/step - loss: 1.1582 - accuracy: 0.4670
Epoch 58/200
116/116 [==============================] - 0s 783us/step - loss: 1.1515 - accuracy: 0.4673
Epoch 59/200
116/116 [==============================] - 0s 757us/step - loss: 1.1557 - accuracy: 0.4598
Epoch 60/200
116/116 [==============================] - 0s 730us/step - loss: 1.1576 - accuracy: 0.4687
Epoch 61/200
116/116 [==============================] - 0s 739us/step - loss: 1.1510 - accuracy: 0.4738
Epoch 62/200
116/116 [==============================] - 0s 730us/step - loss: 1.1619 - accuracy: 0.4560
Epoch 63/200
116/116 [==============================] - 0s 757us/step - loss: 1.1608 - accuracy: 0.4633
Epoch 64/200
116/116 [==============================] - 0s 730us/step - loss: 1.1497 - accuracy: 0.4727
Epoch 65/200
116/116 [==============================] - 0s 713us/step - loss: 1.1586 - accuracy: 0.4641
Epoch 66/200
116/116 [==============================] - 0s 757us/step - loss: 1.1531 - accuracy: 0.4665
Epoch 67/200
116/116 [==============================] - 0s 757us/step - loss: 1.1535 - accuracy: 0.4692
Epoch 68/200
116/116 [==============================] - 0s 730us/step - loss: 1.1530 - accuracy: 0.4654
Epoch 69/200
116/116 [==============================] - 0s 748us/step - loss: 1.1499 - accuracy: 0.4679
Epoch 70/200
```

```
116/116 [==============================] - 0s 722us/step - loss: 1.1540 - accuracy: 0.4684
Epoch 71/200
116/116 [==============================] - 0s 739us/step - loss: 1.1491 - accuracy: 0.4652
Epoch 72/200
116/116 [==============================] - 0s 722us/step - loss: 1.1509 - accuracy: 0.4743
Epoch 73/200
116/116 [==============================] - 0s 722us/step - loss: 1.1472 - accuracy: 0.4781
Epoch 74/200
116/116 [==============================] - 0s 757us/step - loss: 1.1498 - accuracy: 0.4754
Epoch 75/200
116/116 [==============================] - 0s 713us/step - loss: 1.1523 - accuracy: 0.4614
Epoch 76/200
116/116 [==============================] - 0s 730us/step - loss: 1.1597 - accuracy: 0.4668
Epoch 77/200
116/116 [==============================] - 0s 739us/step - loss: 1.1655 - accuracy: 0.4571
Epoch 78/200
116/116 [==============================] - 0s 722us/step - loss: 1.1499 - accuracy: 0.4668
Epoch 79/200
116/116 [==============================] - 0s 739us/step - loss: 1.1457 - accuracy: 0.4660
Epoch 80/200
116/116 [==============================] - 0s 739us/step - loss: 1.1471 - accuracy: 0.4681
Epoch 81/200
116/116 [==============================] - 0s 739us/step - loss: 1.1488 - accuracy: 0.4679
Epoch 82/200
116/116 [==============================] - 0s 730us/step - loss: 1.1479 - accuracy: 0.4670
Epoch 83/200
116/116 [==============================] - 0s 722us/step - loss: 1.1503 - accuracy: 0.4751
Epoch 84/200
116/116 [==============================] - 0s 722us/step - loss: 1.1478 - accuracy: 0.4633
Epoch 85/200
116/116 [==============================] - 0s 730us/step - loss: 1.1483 - accuracy: 0.4754
Epoch 86/200
116/116 [==============================] - 0s 739us/step - loss: 1.1446 - accuracy: 0.4727
Epoch 87/200
116/116 [==============================] - 0s 739us/step - loss: 1.1499 - accuracy: 0.4714
Epoch 88/200
116/116 [==============================] - 0s 843us/step - loss: 1.1477 - accuracy: 0.4733
Epoch 89/200
116/116 [==============================] - 0s 722us/step - loss: 1.1494 - accuracy: 0.4641
Epoch 90/200
116/116 [==============================] - 0s 722us/step - loss: 1.1450 - accuracy: 0.4762
Epoch 91/200
116/116 [==============================] - 0s 722us/step - loss: 1.1455 - accuracy: 0.4697
Epoch 92/200
116/116 [==============================] - 0s 730us/step - loss: 1.1447 - accuracy: 0.4706
Epoch 93/200
116/116 [==============================] - 0s 739us/step - loss: 1.1428 - accuracy: 0.4757
Epoch 94/200
116/116 [==============================] - 0s 730us/step - loss: 1.1453 - accuracy: 0.4708
Epoch 95/200
116/116 [==============================] - 0s 739us/step - loss: 1.1460 - accuracy: 0.4743
Epoch 96/200
116/116 [==============================] - 0s 739us/step - loss: 1.1473 - accuracy: 0.4733
Epoch 97/200
116/116 [==============================] - 0s 739us/step - loss: 1.1462 - accuracy: 0.4784
Epoch 98/200
116/116 [==============================] - 0s 739us/step - loss: 1.1465 - accuracy: 0.4751
Epoch 99/200
116/116 [==============================] - 0s 739us/step - loss: 1.1463 - accuracy: 0.4743
Epoch 100/200
116/116 [==============================] - 0s 722us/step - loss: 1.1433 - accuracy: 0.4760
Epoch 101/200
116/116 [==============================] - 0s 748us/step - loss: 1.1429 - accuracy: 0.4735
Epoch 102/200
116/116 [==============================] - 0s 748us/step - loss: 1.1474 - accuracy: 0.4727
Epoch 103/200
116/116 [==============================] - 0s 739us/step - loss: 1.1440 - accuracy: 0.4760
Epoch 104/200
116/116 [==============================] - 0s 739us/step - loss: 1.1428 - accuracy: 0.4703
Epoch 105/200
116/116 [==============================] - 0s 722us/step - loss: 1.1440 - accuracy: 0.4765
Epoch 106/200
116/116 [==============================] - 0s 722us/step - loss: 1.1422 - accuracy: 0.4738
Epoch 107/200
116/116 [==============================] - 0s 739us/step - loss: 1.1419 - accuracy: 0.4776
Epoch 108/200
```

```
116/116 [==============================] - 0s 722us/step - loss: 1.1432 - accuracy: 0.4792
Epoch 109/200
116/116 [==============================] - 0s 739us/step - loss: 1.1417 - accuracy: 0.4808
Epoch 110/200
116/116 [==============================] - 0s 739us/step - loss: 1.1423 - accuracy: 0.4754
Epoch 111/200
116/116 [==============================] - 0s 739us/step - loss: 1.1444 - accuracy: 0.4789
Epoch 112/200
116/116 [==============================] - 0s 739us/step - loss: 1.1404 - accuracy: 0.4757
Epoch 113/200
116/116 [==============================] - 0s 731us/step - loss: 1.1428 - accuracy: 0.4781
Epoch 114/200
116/116 [==============================] - 0s 739us/step - loss: 1.1441 - accuracy: 0.4757
Epoch 115/200
116/116 [==============================] - 0s 739us/step - loss: 1.1437 - accuracy: 0.4784
Epoch 116/200
116/116 [==============================] - 0s 739us/step - loss: 1.1429 - accuracy: 0.4795
Epoch 117/200
116/116 [==============================] - 0s 739us/step - loss: 1.1414 - accuracy: 0.4816
Epoch 118/200
116/116 [==============================] - 0s 826us/step - loss: 1.1403 - accuracy: 0.4822
Epoch 119/200
116/116 [==============================] - 0s 783us/step - loss: 1.1397 - accuracy: 0.4806
Epoch 120/200
116/116 [==============================] - 0s 791us/step - loss: 1.1411 - accuracy: 0.4762
Epoch 121/200
116/116 [==============================] - 0s 748us/step - loss: 1.1410 - accuracy: 0.4800
Epoch 122/200
116/116 [==============================] - 0s 739us/step - loss: 1.1403 - accuracy: 0.4770
Epoch 123/200
116/116 [==============================] - 0s 739us/step - loss: 1.1452 - accuracy: 0.4716
Epoch 124/200
116/116 [==============================] - 0s 765us/step - loss: 1.1408 - accuracy: 0.4773
Epoch 125/200
116/116 [==============================] - 0s 809us/step - loss: 1.1410 - accuracy: 0.4743
Epoch 126/200
116/116 [==============================] - 0s 791us/step - loss: 1.1400 - accuracy: 0.4722
Epoch 127/200
116/116 [==============================] - 0s 774us/step - loss: 1.1406 - accuracy: 0.4816
Epoch 128/200
116/116 [==============================] - 0s 765us/step - loss: 1.1397 - accuracy: 0.4824
Epoch 129/200
116/116 [==============================] - 0s 774us/step - loss: 1.1405 - accuracy: 0.4776
Epoch 130/200
116/116 [==============================] - 0s 843us/step - loss: 1.1408 - accuracy: 0.4849
Epoch 131/200
116/116 [==============================] - 0s 1ms/step - loss: 1.1407 - accuracy: 0.4808
Epoch 132/200
116/116 [==============================] - 0s 852us/step - loss: 1.1393 - accuracy: 0.4789
Epoch 133/200
116/116 [==============================] - 0s 749us/step - loss: 1.1422 - accuracy: 0.4754
Epoch 134/200
116/116 [==============================] - 0s 738us/step - loss: 1.1421 - accuracy: 0.4787
Epoch 135/200
116/116 [==============================] - 0s 739us/step - loss: 1.1392 - accuracy: 0.4770
Epoch 136/200
116/116 [==============================] - 0s 765us/step - loss: 1.1412 - accuracy: 0.4765
Epoch 137/200
116/116 [==============================] - 0s 739us/step - loss: 1.1417 - accuracy: 0.4806
Epoch 138/200
116/116 [==============================] - 0s 730us/step - loss: 1.1387 - accuracy: 0.4770
Epoch 139/200
116/116 [==============================] - 0s 730us/step - loss: 1.1393 - accuracy: 0.4816
Epoch 140/200
116/116 [==============================] - 0s 730us/step - loss: 1.1434 - accuracy: 0.4746
Epoch 141/200
116/116 [==============================] - 0s 730us/step - loss: 1.1372 - accuracy: 0.4757
Epoch 142/200
116/116 [==============================] - 0s 757us/step - loss: 1.1388 - accuracy: 0.4819
Epoch 143/200
116/116 [==============================] - 0s 765us/step - loss: 1.1378 - accuracy: 0.4800
Epoch 144/200
116/116 [==============================] - 0s 748us/step - loss: 1.1385 - accuracy: 0.4738
Epoch 145/200
116/116 [==============================] - 0s 730us/step - loss: 1.1404 - accuracy: 0.4746
Epoch 146/200
```

```
116/116 [==============================] - 0s 733us/step - loss: 1.1377 - accuracy: 0.4822
Epoch 147/200
116/116 [==============================] - 0s 748us/step - loss: 1.1379 - accuracy: 0.4773
Epoch 148/200
116/116 [==============================] - 0s 765us/step - loss: 1.1376 - accuracy: 0.4760
Epoch 149/200
116/116 [==============================] - 0s 843us/step - loss: 1.1420 - accuracy: 0.4716
Epoch 150/200
116/116 [==============================] - 0s 843us/step - loss: 1.1381 - accuracy: 0.4822
Epoch 151/200
116/116 [==============================] - 0s 774us/step - loss: 1.1354 - accuracy: 0.4843
Epoch 152/200
116/116 [==============================] - 0s 739us/step - loss: 1.1371 - accuracy: 0.4778
Epoch 153/200
116/116 [==============================] - 0s 731us/step - loss: 1.1351 - accuracy: 0.4800
Epoch 154/200
116/116 [==============================] - 0s 853us/step - loss: 1.1387 - accuracy: 0.4762
Epoch 155/200
116/116 [==============================] - 0s 765us/step - loss: 1.1359 - accuracy: 0.4830
Epoch 156/200
116/116 [==============================] - 0s 765us/step - loss: 1.1351 - accuracy: 0.4806
Epoch 157/200
116/116 [==============================] - 0s 748us/step - loss: 1.1394 - accuracy: 0.4849
Epoch 158/200
116/116 [==============================] - 0s 741us/step - loss: 1.1377 - accuracy: 0.4781
Epoch 159/200
116/116 [==============================] - 0s 739us/step - loss: 1.1373 - accuracy: 0.4751
Epoch 160/200
116/116 [==============================] - 0s 750us/step - loss: 1.1328 - accuracy: 0.4816
Epoch 161/200
116/116 [==============================] - 0s 758us/step - loss: 1.1362 - accuracy: 0.4778
Epoch 162/200
116/116 [==============================] - 0s 739us/step - loss: 1.1340 - accuracy: 0.4765
Epoch 163/200
116/116 [==============================] - 0s 730us/step - loss: 1.1362 - accuracy: 0.4770
Epoch 164/200
116/116 [==============================] - 0s 739us/step - loss: 1.1356 - accuracy: 0.4781
Epoch 165/200
116/116 [==============================] - 0s 722us/step - loss: 1.1328 - accuracy: 0.4816
Epoch 166/200
116/116 [==============================] - 0s 722us/step - loss: 1.1324 - accuracy: 0.4765
Epoch 167/200
116/116 [==============================] - 0s 757us/step - loss: 1.1347 - accuracy: 0.4841
Epoch 168/200
116/116 [==============================] - 0s 739us/step - loss: 1.1315 - accuracy: 0.4800
Epoch 169/200
116/116 [==============================] - 0s 748us/step - loss: 1.1352 - accuracy: 0.4854
Epoch 170/200
116/116 [==============================] - 0s 730us/step - loss: 1.1362 - accuracy: 0.4778
Epoch 171/200
116/116 [==============================] - 0s 731us/step - loss: 1.1327 - accuracy: 0.4778
Epoch 172/200
116/116 [==============================] - 0s 730us/step - loss: 1.1334 - accuracy: 0.4873
Epoch 173/200
116/116 [==============================] - 0s 757us/step - loss: 1.1326 - accuracy: 0.4776
Epoch 174/200
116/116 [==============================] - 0s 736us/step - loss: 1.1295 - accuracy: 0.4827
Epoch 175/200
116/116 [==============================] - 0s 722us/step - loss: 1.1289 - accuracy: 0.4803
Epoch 176/200
116/116 [==============================] - 0s 795us/step - loss: 1.1336 - accuracy: 0.4816
Epoch 177/200
116/116 [==============================] - 0s 835us/step - loss: 1.1294 - accuracy: 0.4789
Epoch 178/200
116/116 [==============================] - 0s 930us/step - loss: 1.1318 - accuracy: 0.4795
Epoch 179/200
116/116 [==============================] - 0s 757us/step - loss: 1.1324 - accuracy: 0.4808
Epoch 180/200
116/116 [==============================] - 0s 785us/step - loss: 1.1297 - accuracy: 0.4803
Epoch 181/200
116/116 [==============================] - 0s 783us/step - loss: 1.1290 - accuracy: 0.4860
Epoch 182/200
116/116 [==============================] - 0s 730us/step - loss: 1.1301 - accuracy: 0.4854
Epoch 183/200
116/116 [==============================] - 0s 748us/step - loss: 1.1281 - accuracy: 0.4841
Epoch 184/200
```

```
116/116 [==============================] - 0s 776us/step - loss: 1.1285 - accuracy: 0.4895
Epoch 185/200
116/116 [==============================] - 0s 783us/step - loss: 1.1304 - accuracy: 0.4795
Epoch 186/200
116/116 [==============================] - 0s 748us/step - loss: 1.1297 - accuracy: 0.4816
Epoch 187/200
116/116 [==============================] - 0s 748us/step - loss: 1.1304 - accuracy: 0.4824
Epoch 188/200
116/116 [==============================] - 0s 730us/step - loss: 1.1309 - accuracy: 0.4760
Epoch 189/200
116/116 [==============================] - 0s 826us/step - loss: 1.1295 - accuracy: 0.4803
Epoch 190/200
116/116 [==============================] - 0s 783us/step - loss: 1.1294 - accuracy: 0.4808
Epoch 191/200
116/116 [==============================] - 0s 730us/step - loss: 1.1272 - accuracy: 0.4843
Epoch 192/200
116/116 [==============================] - 0s 739us/step - loss: 1.1302 - accuracy: 0.4816
Epoch 193/200
116/116 [==============================] - 0s 799us/step - loss: 1.1268 - accuracy: 0.4827
Epoch 194/200
116/116 [==============================] - 0s 791us/step - loss: 1.1284 - accuracy: 0.4795
Epoch 195/200
116/116 [==============================] - 0s 757us/step - loss: 1.1281 - accuracy: 0.4824
Epoch 196/200
116/116 [==============================] - 0s 748us/step - loss: 1.1252 - accuracy: 0.4830
Epoch 197/200
116/116 [==============================] - 0s 780us/step - loss: 1.1284 - accuracy: 0.4849
Epoch 198/200
116/116 [==============================] - 0s 791us/step - loss: 1.1273 - accuracy: 0.4800
Epoch 199/200
116/116 [==============================] - 0s 739us/step - loss: 1.1267 - accuracy: 0.4833
Epoch 200/200
116/116 [==============================] - 0s 878us/step - loss: 1.1247 - accuracy: 0.4830
```

In [12]:

```
# 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*100:.2f}%, Accuracy: {model_accuracy*100:.2f}%")
```

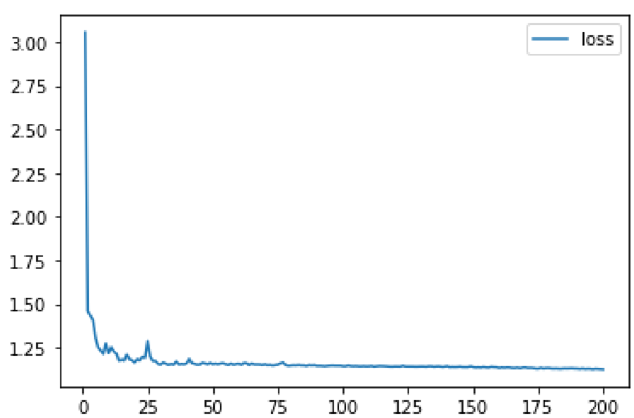
```
39/39 - 0s - loss: 1.2985 - accuracy: 0.3887 - 107ms/epoch - 3ms/step
Loss: 129.85%, Accuracy: 38.87%
```

In [13]:

```
# 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")
```

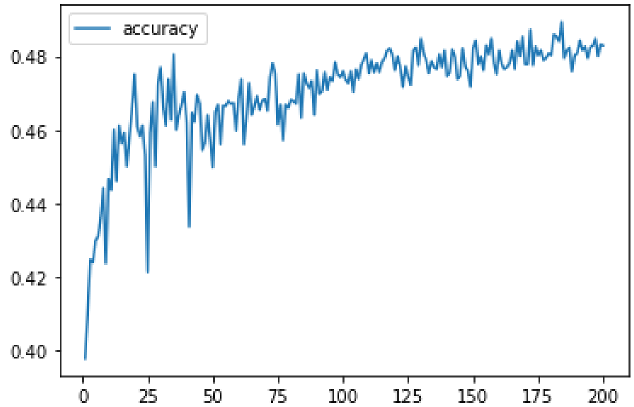
Out[13]: <AxesSubplot:>



In [14]:

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

Out[14]: <AxesSubplot:>



In [ ]: