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	I
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
```

```
version of pandas all arguments of DataFrame.drop except for the argument 'labels' will be keyword-only
  """Entry point for launching an IPython kernel.
```

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 [5]:

```
# 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)
```

```
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 [6]:

```
# 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 [ ]:

```
# see if data scaled properly
scaled_data=pd.DataFrame(X_train_scaled)
scaled_data.head()
```

In [ ]:

```
# see if data scaled properly
scaled_y=pd.DataFrame(y_train_scaled)
scaled_y.head()
```

Build Neural Net Framework

In [19]:

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

```
hidden_nodes_layer1 = 50
hidden_nodes_layer2 = 30
hidden_nodes_layer3 = 20
hidden_nodes_layer4 = 10



nn = tf.keras.models.Sequential()

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

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

# Third hidden layer
nn.add(tf.keras.layers.Dense(units=hidden_nodes_layer3, activation="elu"))

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



# Output layer
nn.add(tf.keras.layers.Dense(units=5, activation="elu"))

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

```
Model: "sequential_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_15 (Dense)            (None, 50)                400

 dense_16 (Dense)            (None, 30)                1530

 dense_17 (Dense)            (None, 20)                620

 dense_18 (Dense)            (None, 10)                210

 dense_19 (Dense)            (None, 5)                 55

=================================================================
Total params: 2,815
Trainable params: 2,815
Non-trainable params: 0
_________________________________________________________________
```

Compile the Model

In [20]:

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

Train the model

In [21]:

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

```
Epoch 1/200
116/116 [==============================] - 1s 1ms/step - loss: 8.5833 - accuracy: 0.0000e+00
Epoch 2/200
116/116 [==============================] - 0s 948us/step - loss: 0.4447 - accuracy: 0.0000e+00
Epoch 3/200
```

```
116/116 [==============================] - 0s 826us/step - loss: 0.4257 - accuracy: 0.0000e+00
Epoch 4/200
116/116 [==============================] - 0s 809us/step - loss: 0.4208 - accuracy: 0.0000e+00
Epoch 5/200
116/116 [==============================] - 0s 765us/step - loss: 0.4278 - accuracy: 0.0000e+00
Epoch 6/200
116/116 [==============================] - 0s 774us/step - loss: 0.4062 - accuracy: 0.0000e+00
Epoch 7/200
116/116 [==============================] - 0s 843us/step - loss: 0.3967 - accuracy: 0.0000e+00
Epoch 8/200
116/116 [==============================] - 0s 748us/step - loss: 0.3888 - accuracy: 0.0000e+00
Epoch 9/200
116/116 [==============================] - 0s 843us/step - loss: 0.3802 - accuracy: 0.0000e+00
Epoch 10/200
116/116 [==============================] - 0s 756us/step - loss: 0.3750 - accuracy: 0.0000e+00
Epoch 11/200
116/116 [==============================] - 0s 887us/step - loss: 0.3766 - accuracy: 0.0000e+00
Epoch 12/200
116/116 [==============================] - 0s 757us/step - loss: 0.3784 - accuracy: 0.0000e+00
Epoch 13/200
116/116 [==============================] - 0s 791us/step - loss: 0.3867 - accuracy: 0.0000e+00
Epoch 14/200
116/116 [==============================] - 0s 739us/step - loss: 0.3844 - accuracy: 0.0000e+00
Epoch 15/200
116/116 [==============================] - 0s 739us/step - loss: 0.3732 - accuracy: 0.0000e+00
Epoch 16/200
116/116 [==============================] - 0s 774us/step - loss: 0.3896 - accuracy: 0.0000e+00
Epoch 17/200
116/116 [==============================] - 0s 791us/step - loss: 0.3852 - accuracy: 0.0000e+00
Epoch 18/200
116/116 [==============================] - 0s 783us/step - loss: 0.3882 - accuracy: 0.0000e+00
Epoch 19/200
116/116 [==============================] - 0s 774us/step - loss: 0.3772 - accuracy: 0.0000e+00
Epoch 20/200
116/116 [==============================] - 0s 809us/step - loss: 0.3784 - accuracy: 0.0000e+00
Epoch 21/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3778 - accuracy: 0.0000e+00
Epoch 22/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3835 - accuracy: 0.0000e+00
Epoch 23/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3783 - accuracy: 0.0000e+00
Epoch 24/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3803 - accuracy: 0.0000e+00
Epoch 25/200
116/116 [==============================] - 0s 809us/step - loss: 0.3731 - accuracy: 0.0000e+00
Epoch 26/200
116/116 [==============================] - 0s 730us/step - loss: 0.3746 - accuracy: 0.0000e+00
Epoch 27/200
116/116 [==============================] - 0s 774us/step - loss: 0.3750 - accuracy: 0.0000e+00
Epoch 28/200
116/116 [==============================] - 0s 757us/step - loss: 0.3694 - accuracy: 0.0000e+00
Epoch 29/200
116/116 [==============================] - 0s 765us/step - loss: 0.3734 - accuracy: 0.0000e+00
Epoch 30/200
116/116 [==============================] - 0s 913us/step - loss: 0.3777 - accuracy: 0.0000e+00
Epoch 31/200
116/116 [==============================] - 0s 748us/step - loss: 0.3699 - accuracy: 0.0000e+00
Epoch 32/200
116/116 [==============================] - 0s 817us/step - loss: 0.3735 - accuracy: 0.0000e+00
Epoch 33/200
116/116 [==============================] - 0s 739us/step - loss: 0.3789 - accuracy: 0.0000e+00
Epoch 34/200
116/116 [==============================] - 0s 739us/step - loss: 0.3737 - accuracy: 0.0000e+00
Epoch 35/200
116/116 [==============================] - 0s 826us/step - loss: 0.3789 - accuracy: 0.0000e+00
Epoch 36/200
116/116 [==============================] - 0s 843us/step - loss: 0.3754 - accuracy: 0.0000e+00
Epoch 37/200
116/116 [==============================] - 0s 835us/step - loss: 0.3941 - accuracy: 0.0000e+00
Epoch 38/200
116/116 [==============================] - 0s 757us/step - loss: 0.3973 - accuracy: 0.0000e+00
Epoch 39/200
116/116 [==============================] - 0s 826us/step - loss: 0.3963 - accuracy: 0.0000e+00
Epoch 40/200
116/116 [==============================] - 0s 791us/step - loss: 0.4025 - accuracy: 0.0000e+00
Epoch 41/200
```

```
116/116 [==============================] - 0s 843us/step - loss: 0.3776 - accuracy: 0.0000e+00
Epoch 42/200
116/116 [==============================] - 0s 913us/step - loss: 0.3645 - accuracy: 0.0000e+00
Epoch 43/200
116/116 [==============================] - 0s 835us/step - loss: 0.3651 - accuracy: 0.0000e+00
Epoch 44/200
116/116 [==============================] - 0s 774us/step - loss: 0.3632 - accuracy: 0.0000e+00
Epoch 45/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3695 - accuracy: 0.0000e+00
Epoch 46/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3709 - accuracy: 0.0000e+00
Epoch 47/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3666 - accuracy: 0.0000e+00
Epoch 48/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3715 - accuracy: 0.0000e+00
Epoch 49/200
116/116 [==============================] - 0s 765us/step - loss: 0.3770 - accuracy: 0.0000e+00
Epoch 50/200
116/116 [==============================] - 0s 730us/step - loss: 0.3586 - accuracy: 0.0000e+00
Epoch 51/200
116/116 [==============================] - 0s 748us/step - loss: 0.3632 - accuracy: 0.0000e+00
Epoch 52/200
116/116 [==============================] - 0s 774us/step - loss: 0.3672 - accuracy: 0.0000e+00
Epoch 53/200
116/116 [==============================] - 0s 748us/step - loss: 0.3550 - accuracy: 0.0000e+00
Epoch 54/200
116/116 [==============================] - 0s 765us/step - loss: 0.3564 - accuracy: 0.0000e+00
Epoch 55/200
116/116 [==============================] - 0s 800us/step - loss: 0.3664 - accuracy: 0.0000e+00
Epoch 56/200
116/116 [==============================] - 0s 774us/step - loss: 0.3576 - accuracy: 0.0000e+00
Epoch 57/200
116/116 [==============================] - 0s 739us/step - loss: 0.3671 - accuracy: 0.0000e+00
Epoch 58/200
116/116 [==============================] - 0s 843us/step - loss: 0.3677 - accuracy: 0.0000e+00
Epoch 59/200
116/116 [==============================] - 0s 861us/step - loss: 0.3737 - accuracy: 0.0000e+00
Epoch 60/200
116/116 [==============================] - 0s 791us/step - loss: 0.3744 - accuracy: 0.0000e+00
Epoch 61/200
116/116 [==============================] - 0s 730us/step - loss: 0.3692 - accuracy: 0.0000e+00
Epoch 62/200
116/116 [==============================] - 0s 765us/step - loss: 0.3669 - accuracy: 0.0000e+00
Epoch 63/200
116/116 [==============================] - 0s 817us/step - loss: 0.3721 - accuracy: 0.0000e+00
Epoch 64/200
116/116 [==============================] - 0s 757us/step - loss: 0.3730 - accuracy: 0.0000e+00
Epoch 65/200
116/116 [==============================] - 0s 861us/step - loss: 0.3659 - accuracy: 0.0000e+00
Epoch 66/200
116/116 [==============================] - 0s 783us/step - loss: 0.3712 - accuracy: 0.0000e+00
Epoch 67/200
116/116 [==============================] - 0s 748us/step - loss: 0.3738 - accuracy: 0.0000e+00
Epoch 68/200
116/116 [==============================] - 0s 809us/step - loss: 0.3682 - accuracy: 0.0000e+00
Epoch 69/200
116/116 [==============================] - 0s 974us/step - loss: 0.3732 - accuracy: 0.0000e+00
Epoch 70/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3707 - accuracy: 0.0000e+00
Epoch 71/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3694 - accuracy: 0.0000e+00
Epoch 72/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3691 - accuracy: 0.0000e+00
Epoch 73/200
116/116 [==============================] - 0s 800us/step - loss: 0.3656 - accuracy: 0.0000e+00
Epoch 74/200
116/116 [==============================] - 0s 783us/step - loss: 0.3701 - accuracy: 0.0000e+00
Epoch 75/200
116/116 [==============================] - 0s 731us/step - loss: 0.3790 - accuracy: 0.0000e+00
Epoch 76/200
116/116 [==============================] - 0s 809us/step - loss: 0.3731 - accuracy: 0.0000e+00
Epoch 77/200
116/116 [==============================] - 0s 809us/step - loss: 0.3677 - accuracy: 0.0000e+00
Epoch 78/200
116/116 [==============================] - 0s 939us/step - loss: 0.3719 - accuracy: 0.0000e+00
Epoch 79/200
```

```
116/116 [==============================] - 0s 739us/step - loss: 0.3682 - accuracy: 0.0000e+00
Epoch 80/200
116/116 [==============================] - 0s 800us/step - loss: 0.3676 - accuracy: 0.0000e+00
Epoch 81/200
116/116 [==============================] - 0s 757us/step - loss: 0.3659 - accuracy: 0.0000e+00
Epoch 82/200
116/116 [==============================] - 0s 748us/step - loss: 0.3665 - accuracy: 0.0000e+00
Epoch 83/200
116/116 [==============================] - 0s 756us/step - loss: 0.3724 - accuracy: 0.0000e+00
Epoch 84/200
116/116 [==============================] - 0s 757us/step - loss: 0.3665 - accuracy: 0.0000e+00
Epoch 85/200
116/116 [==============================] - 0s 791us/step - loss: 0.3663 - accuracy: 0.0000e+00
Epoch 86/200
116/116 [==============================] - 0s 800us/step - loss: 0.3638 - accuracy: 0.0000e+00
Epoch 87/200
116/116 [==============================] - 0s 722us/step - loss: 0.3742 - accuracy: 0.0000e+00
Epoch 88/200
116/116 [==============================] - 0s 791us/step - loss: 0.3606 - accuracy: 0.0000e+00
Epoch 89/200
116/116 [==============================] - 0s 852us/step - loss: 0.3698 - accuracy: 0.0000e+00
Epoch 90/200
116/116 [==============================] - 0s 765us/step - loss: 0.3721 - accuracy: 0.0000e+00
Epoch 91/200
116/116 [==============================] - 0s 922us/step - loss: 0.3674 - accuracy: 0.0000e+00
Epoch 92/200
116/116 [==============================] - 0s 800us/step - loss: 0.3623 - accuracy: 0.0000e+00
Epoch 93/200
116/116 [==============================] - 0s 1000us/step - loss: 0.3578 - accuracy: 0.0000e+00
Epoch 94/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3664 - accuracy: 0.0000e+00
Epoch 95/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3667 - accuracy: 0.0000e+00
Epoch 96/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3633 - accuracy: 0.0000e+00
Epoch 97/200
116/116 [==============================] - 0s 800us/step - loss: 0.3711 - accuracy: 0.0000e+00
Epoch 98/200
116/116 [==============================] - 0s 774us/step - loss: 0.3692 - accuracy: 0.0000e+00
Epoch 99/200
116/116 [==============================] - 0s 783us/step - loss: 0.3704 - accuracy: 0.0000e+00
Epoch 100/200
116/116 [==============================] - 0s 930us/step - loss: 0.3597 - accuracy: 0.0000e+00
Epoch 101/200
116/116 [==============================] - 0s 748us/step - loss: 0.3730 - accuracy: 0.0000e+00
Epoch 102/200
116/116 [==============================] - 0s 748us/step - loss: 0.3679 - accuracy: 0.0000e+00
Epoch 103/200
116/116 [==============================] - 0s 835us/step - loss: 0.3626 - accuracy: 0.0000e+00
Epoch 104/200
116/116 [==============================] - 0s 791us/step - loss: 0.3582 - accuracy: 0.0000e+00
Epoch 105/200
116/116 [==============================] - 0s 896us/step - loss: 0.3667 - accuracy: 0.0000e+00
Epoch 106/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3611 - accuracy: 0.0000e+00
Epoch 107/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3667 - accuracy: 0.0000e+00
Epoch 108/200
116/116 [==============================] - 0s 904us/step - loss: 0.3661 - accuracy: 0.0000e+00
Epoch 109/200
116/116 [==============================] - 0s 826us/step - loss: 0.3635 - accuracy: 0.0000e+00
Epoch 110/200
116/116 [==============================] - 0s 904us/step - loss: 0.3596 - accuracy: 0.0000e+00
Epoch 111/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3669 - accuracy: 0.0000e+00
Epoch 112/200
116/116 [==============================] - 0s 904us/step - loss: 0.3648 - accuracy: 0.0000e+00
Epoch 113/200
116/116 [==============================] - 0s 835us/step - loss: 0.3676 - accuracy: 0.0000e+00
Epoch 114/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3691 - accuracy: 0.0000e+00
Epoch 115/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3614 - accuracy: 0.0000e+00
Epoch 116/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3575 - accuracy: 0.0000e+00
Epoch 117/200
```

```
116/116 [==============================] - 0s 1ms/step - loss: 0.3597 - accuracy: 0.0000e+00
Epoch 118/200
116/116 [==============================] - 0s 965us/step - loss: 0.3586 - accuracy: 0.0000e+00
Epoch 119/200
116/116 [==============================] - 0s 861us/step - loss: 0.3589 - accuracy: 0.0000e+00
Epoch 120/200
116/116 [==============================] - 0s 826us/step - loss: 0.3585 - accuracy: 0.0000e+00
Epoch 121/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3572 - accuracy: 0.0000e+00
Epoch 122/200
116/116 [==============================] - 0s 826us/step - loss: 0.3645 - accuracy: 0.0000e+00
Epoch 123/200
116/116 [==============================] - 0s 930us/step - loss: 0.3628 - accuracy: 0.0000e+00
Epoch 124/200
116/116 [==============================] - 0s 887us/step - loss: 0.3634 - accuracy: 0.0000e+00
Epoch 125/200
116/116 [==============================] - 0s 913us/step - loss: 0.3685 - accuracy: 0.0000e+00
Epoch 126/200
116/116 [==============================] - 0s 991us/step - loss: 0.3664 - accuracy: 0.0000e+00
Epoch 127/200
116/116 [==============================] - 0s 913us/step - loss: 0.3623 - accuracy: 0.0000e+00
Epoch 128/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3644 - accuracy: 0.0000e+00
Epoch 129/200
116/116 [==============================] - 0s 922us/step - loss: 0.3604 - accuracy: 0.0000e+00
Epoch 130/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3594 - accuracy: 0.0000e+00
Epoch 131/200
116/116 [==============================] - 0s 904us/step - loss: 0.3613 - accuracy: 0.0000e+00
Epoch 132/200
116/116 [==============================] - 0s 826us/step - loss: 0.3621 - accuracy: 0.0000e+00
Epoch 133/200
116/116 [==============================] - 0s 991us/step - loss: 0.3585 - accuracy: 0.0000e+00
Epoch 134/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3636 - accuracy: 0.0000e+00
Epoch 135/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3659 - accuracy: 0.0000e+00
Epoch 136/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3603 - accuracy: 0.0000e+00
Epoch 137/200
116/116 [==============================] - 0s 922us/step - loss: 0.3598 - accuracy: 0.0000e+00
Epoch 138/200
116/116 [==============================] - 0s 861us/step - loss: 0.3621 - accuracy: 0.0000e+00
Epoch 139/200
116/116 [==============================] - 0s 930us/step - loss: 0.3604 - accuracy: 0.0000e+00
Epoch 140/200
116/116 [==============================] - 0s 826us/step - loss: 0.3591 - accuracy: 0.0000e+00
Epoch 141/200
116/116 [==============================] - 0s 809us/step - loss: 0.3612 - accuracy: 0.0000e+00
Epoch 142/200
116/116 [==============================] - 0s 852us/step - loss: 0.3640 - accuracy: 0.0000e+00
Epoch 143/200
116/116 [==============================] - 0s 913us/step - loss: 0.3580 - accuracy: 0.0000e+00
Epoch 144/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3572 - accuracy: 0.0000e+00
Epoch 145/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3597 - accuracy: 0.0000e+00
Epoch 146/200
116/116 [==============================] - 0s 896us/step - loss: 0.3555 - accuracy: 0.0000e+00
Epoch 147/200
116/116 [==============================] - 0s 800us/step - loss: 0.3560 - accuracy: 0.0000e+00
Epoch 148/200
116/116 [==============================] - 0s 930us/step - loss: 0.3709 - accuracy: 0.0000e+00
Epoch 149/200
116/116 [==============================] - 0s 887us/step - loss: 0.3681 - accuracy: 0.0000e+00
Epoch 150/200
116/116 [==============================] - 0s 800us/step - loss: 0.3649 - accuracy: 0.0000e+00
Epoch 151/200
116/116 [==============================] - 0s 904us/step - loss: 0.3656 - accuracy: 0.0000e+00
Epoch 152/200
116/116 [==============================] - 0s 896us/step - loss: 0.3663 - accuracy: 0.0000e+00
Epoch 153/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3659 - accuracy: 0.0000e+00
Epoch 154/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3650 - accuracy: 0.0000e+00
Epoch 155/200
```

```
116/116 [==============================] - 0s 1ms/step - loss: 0.3714 - accuracy: 0.0000e+00
Epoch 156/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3686 - accuracy: 0.0000e+00
Epoch 157/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3645 - accuracy: 0.0000e+00
Epoch 158/200
116/116 [==============================] - 0s 939us/step - loss: 0.3768 - accuracy: 0.0000e+00
Epoch 159/200
116/116 [==============================] - 0s 939us/step - loss: 0.3622 - accuracy: 0.0000e+00
Epoch 160/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3638 - accuracy: 0.0000e+00
Epoch 161/200
116/116 [==============================] - 0s 930us/step - loss: 0.3591 - accuracy: 0.0000e+00
Epoch 162/200
116/116 [==============================] - 0s 913us/step - loss: 0.3601 - accuracy: 0.0000e+00
Epoch 163/200
116/116 [==============================] - 0s 843us/step - loss: 0.3637 - accuracy: 0.0000e+00
Epoch 164/200
116/116 [==============================] - 0s 852us/step - loss: 0.3615 - accuracy: 0.0000e+00
Epoch 165/200
116/116 [==============================] - 0s 843us/step - loss: 0.3575 - accuracy: 0.0000e+00
Epoch 166/200
116/116 [==============================] - 0s 817us/step - loss: 0.3587 - accuracy: 0.0000e+00
Epoch 167/200
116/116 [==============================] - 0s 896us/step - loss: 0.3592 - accuracy: 0.0000e+00
Epoch 168/200
116/116 [==============================] - 0s 913us/step - loss: 0.3546 - accuracy: 0.0000e+00
Epoch 169/200
116/116 [==============================] - 0s 948us/step - loss: 0.3557 - accuracy: 0.0000e+00
Epoch 170/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3569 - accuracy: 0.0000e+00
Epoch 171/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3623 - accuracy: 0.0000e+00
Epoch 172/200
116/116 [==============================] - 0s 991us/step - loss: 0.3609 - accuracy: 0.0000e+00
Epoch 173/200
116/116 [==============================] - 0s 809us/step - loss: 0.3582 - accuracy: 0.0000e+00
Epoch 174/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3581 - accuracy: 0.0000e+00
Epoch 175/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3555 - accuracy: 0.0000e+00
Epoch 176/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3576 - accuracy: 0.0000e+00
Epoch 177/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3528 - accuracy: 0.0000e+00
Epoch 178/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3572 - accuracy: 0.0000e+00
Epoch 179/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3561 - accuracy: 0.0000e+00
Epoch 180/200
116/116 [==============================] - 0s 904us/step - loss: 0.3554 - accuracy: 0.0000e+00
Epoch 181/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3541 - accuracy: 0.0000e+00
Epoch 182/200
116/116 [==============================] - 0s 852us/step - loss: 0.3535 - accuracy: 0.0000e+00
Epoch 183/200
116/116 [==============================] - 0s 965us/step - loss: 0.3538 - accuracy: 0.0000e+00
Epoch 184/200
116/116 [==============================] - 0s 913us/step - loss: 0.3588 - accuracy: 0.0000e+00
Epoch 185/200
116/116 [==============================] - 0s 948us/step - loss: 0.3579 - accuracy: 0.0000e+00
Epoch 186/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3539 - accuracy: 0.0000e+00
Epoch 187/200
116/116 [==============================] - 0s 965us/step - loss: 0.3555 - accuracy: 0.0000e+00
Epoch 188/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3624 - accuracy: 0.0000e+00
Epoch 189/200
116/116 [==============================] - 0s 1ms/step - loss: 0.3547 - accuracy: 0.0000e+00
Epoch 190/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3603 - accuracy: 0.0000e+00
Epoch 191/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3593 - accuracy: 0.0000e+00
Epoch 192/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3573 - accuracy: 0.0000e+00
Epoch 193/200
```

```
116/116 [==============================] - 0s 2ms/step - loss: 0.3644 - accuracy: 0.0000e+00
Epoch 194/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3604 - accuracy: 0.0000e+00
Epoch 195/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3589 - accuracy: 0.0000e+00
Epoch 196/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3600 - accuracy: 0.0000e+00
Epoch 197/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3532 - accuracy: 0.0000e+00
Epoch 198/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3568 - accuracy: 0.0000e+00
Epoch 199/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3569 - accuracy: 0.0000e+00
Epoch 200/200
116/116 [==============================] - 0s 2ms/step - loss: 0.3554 - accuracy: 0.0000e+00
```

In [22]:

```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}")
```

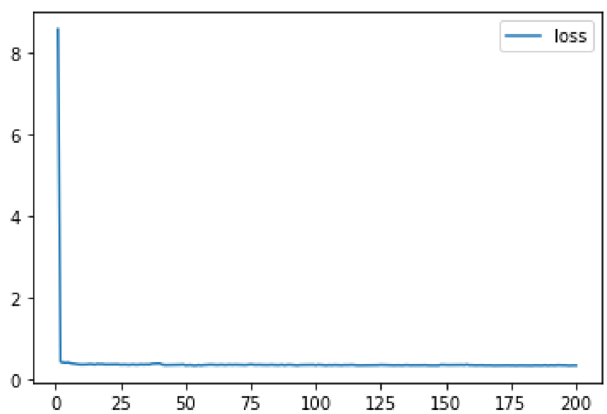
```
39/39 - 0s - loss: 10.6428 - accuracy: 0.0000e+00 - 121ms/epoch - 3ms/step
Loss: 10.642814636230469, Accuracy: 0.0
```

In [23]:

```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")
```

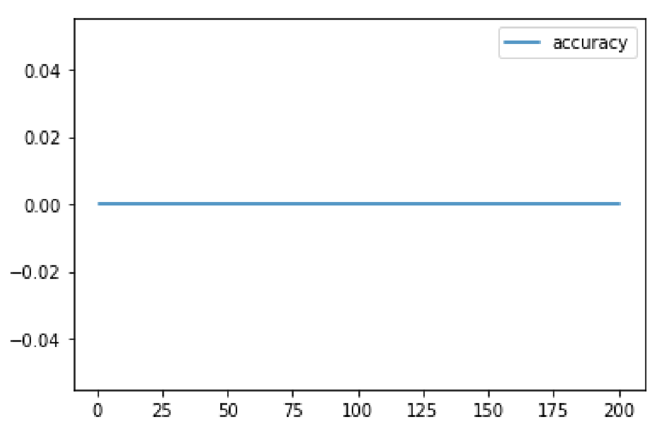
Out[23]: <AxesSubplot:>



In [24]:

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

Out[24]: <AxesSubplot:>



In [ ]: