

```

# !pip install keras tensorflow -U

import math
import numpy as np
import pandas as pd
import tensorflow as tf
import matplotlib.pyplot as plt
from tensorflow.keras import Model
from tensorflow.keras import Sequential
from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import StandardScaler
from tensorflow.keras.layers import Dense, Dropout
from sklearn.model_selection import train_test_split
from tensorflow.keras.losses import MeanSquaredLogarithmicError

df =
np.loadtxt('https://raw.githubusercontent.com/jbrownlee/Datasets/master/pima-indians-diabetes.data.csv', delimiter=',')

df
array([[ 6.   , 148.   , 72.   , ..., 0.627, 50.   , 1.   ],
       [ 1.   , 85.   , 66.   , ..., 0.351, 31.   , 0.   ],
       [ 8.   , 183.   , 64.   , ..., 0.672, 32.   , 1.   ],
       ...,
       [ 5.   , 121.   , 72.   , ..., 0.245, 30.   , 0.   ],
       [ 1.   , 126.   , 60.   , ..., 0.349, 47.   , 1.   ],
       [ 1.   , 93.   , 70.   , ..., 0.315, 23.   , 0.   ]])

df.shape
(768, 9)

x = df[:, :8]
y = df[:, 8]

from sklearn.model_selection import train_test_split
X_train, X_temp, y_train, y_temp = train_test_split(x, y,
test_size=0.2, random_state=42)

X_test, X_val, y_test, y_val = train_test_split(X_temp, y_temp,
test_size=0.5, random_state=42)

print(f"x train shape {X_train.shape}")
print(f"y train shape {y_train.shape}")
print(f"x test shape {X_test.shape}")
print(f"y test shape {y_test.shape}")
print(f"x val shape {X_val.shape}")
print(f"y val shape {y_val.shape}")

```

```

x_train shape(614, 8)
y_train shape(614,)
x_test shape(77, 8)
y_test shape(77,)
x_val shape(77, 8)
y_val shape(77,)

from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
X_val = scaler.transform(X_val)

from collections import Counter
Counter(y)

Counter({1.0: 268, 0.0: 500})

import seaborn as sns
# sns.countplot(y)

from tensorflow.keras.models import Sequential
model = Sequential([

tf.keras.layers.InputLayer(8,),
Dense(50,activation='relu'),

Dense(50,activation='relu'),
Dense(50,activation='relu'),
Dense(50,activation='relu'),

Dense(1,activation='sigmoid')
])

2022-11-12 19:23:28.405404: I
tensorflow/core/common_runtime/process_util.cc:146] Creating new
thread pool with default inter op setting: 2. Tune using
inter_op_parallelism_threads for best performance.

```

```
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
dense (Dense)	(None, 50)	450
dense_1 (Dense)	(None, 50)	2550
dense_2 (Dense)	(None, 50)	2550

dense_3 (Dense)	(None, 50)	2550
dense_4 (Dense)	(None, 1)	51
=====		
Total params: 8,151		
Trainable params: 8,151		
Non-trainable params: 0		

```
opt = tf.keras.optimizers.Adam(learning_rate=0.0001)
model.compile(loss='binary_crossentropy', optimizer=opt,
metrics=['accuracy'])
```

```
history = model.fit(x=x,y=y,epochs=300,
batch_size=50,validation_data=(X_val,y_val))
```

```
2022-11-12 19:23:28.666100: I
tensorflow/compiler/mlir/mlir_graph_optimization_pass.cc:185] None of
the MLIR Optimization Passes are enabled (registered 2)
```

Epoch 1/300

```
16/16 [=====] - 1s 20ms/step - loss: 4.3687 -
accuracy: 0.6484 - val_loss: 0.7085 - val_accuracy: 0.3766
```

Epoch 2/300

```
16/16 [=====] - 0s 5ms/step - loss: 1.8559 -
accuracy: 0.5820 - val_loss: 0.7094 - val_accuracy: 0.4156
```

Epoch 3/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.9362 -
accuracy: 0.4987 - val_loss: 0.7087 - val_accuracy: 0.4286
```

Epoch 4/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.7237 -
accuracy: 0.6276 - val_loss: 0.7089 - val_accuracy: 0.4286
```

Epoch 5/300

```
16/16 [=====] - 0s 6ms/step - loss: 0.6846 -
accuracy: 0.6341 - val_loss: 0.7092 - val_accuracy: 0.4156
```

Epoch 6/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.6645 -
accuracy: 0.6406 - val_loss: 0.7088 - val_accuracy: 0.4156
```

Epoch 7/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.6514 -
accuracy: 0.6471 - val_loss: 0.7083 - val_accuracy: 0.4026
```

Epoch 8/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.6433 -
accuracy: 0.6562 - val_loss: 0.7080 - val_accuracy: 0.4156
```

Epoch 9/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.6350 -
accuracy: 0.6641 - val_loss: 0.7077 - val_accuracy: 0.4156
```

Epoch 10/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.6243 -
```

```
accuracy: 0.6706 - val_loss: 0.7072 - val_accuracy: 0.4156
Epoch 11/300
16/16 [=====] - 0s 5ms/step - loss: 0.6146 -
accuracy: 0.6667 - val_loss: 0.7070 - val_accuracy: 0.3896
Epoch 12/300
16/16 [=====] - 0s 5ms/step - loss: 0.6075 -
accuracy: 0.6849 - val_loss: 0.7066 - val_accuracy: 0.3896
Epoch 13/300
16/16 [=====] - 0s 5ms/step - loss: 0.6069 -
accuracy: 0.6823 - val_loss: 0.7061 - val_accuracy: 0.4026
Epoch 14/300
16/16 [=====] - 0s 5ms/step - loss: 0.5973 -
accuracy: 0.6888 - val_loss: 0.7054 - val_accuracy: 0.4026
Epoch 15/300
16/16 [=====] - 0s 5ms/step - loss: 0.5979 -
accuracy: 0.6823 - val_loss: 0.7049 - val_accuracy: 0.4156
Epoch 16/300
16/16 [=====] - 0s 5ms/step - loss: 0.6024 -
accuracy: 0.6901 - val_loss: 0.7043 - val_accuracy: 0.4156
Epoch 17/300
16/16 [=====] - 0s 6ms/step - loss: 0.5915 -
accuracy: 0.6927 - val_loss: 0.7039 - val_accuracy: 0.4156
Epoch 18/300
16/16 [=====] - 0s 6ms/step - loss: 0.6017 -
accuracy: 0.6797 - val_loss: 0.7033 - val_accuracy: 0.4416
Epoch 19/300
16/16 [=====] - 0s 5ms/step - loss: 0.5847 -
accuracy: 0.6888 - val_loss: 0.7029 - val_accuracy: 0.4416
Epoch 20/300
16/16 [=====] - 0s 5ms/step - loss: 0.5832 -
accuracy: 0.7044 - val_loss: 0.7021 - val_accuracy: 0.4675
Epoch 21/300
16/16 [=====] - 0s 5ms/step - loss: 0.5780 -
accuracy: 0.7070 - val_loss: 0.7018 - val_accuracy: 0.4675
Epoch 22/300
16/16 [=====] - 0s 5ms/step - loss: 0.5734 -
accuracy: 0.7044 - val_loss: 0.7014 - val_accuracy: 0.4545
Epoch 23/300
16/16 [=====] - 0s 5ms/step - loss: 0.5774 -
accuracy: 0.7109 - val_loss: 0.7009 - val_accuracy: 0.4675
Epoch 24/300
16/16 [=====] - 0s 5ms/step - loss: 0.5749 -
accuracy: 0.7096 - val_loss: 0.7004 - val_accuracy: 0.4805
Epoch 25/300
16/16 [=====] - 0s 6ms/step - loss: 0.5749 -
accuracy: 0.7122 - val_loss: 0.7001 - val_accuracy: 0.4935
Epoch 26/300
16/16 [=====] - 0s 6ms/step - loss: 0.5731 -
accuracy: 0.7135 - val_loss: 0.6995 - val_accuracy: 0.5325
```

Epoch 27/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5646 - accuracy: 0.7331 - val\_loss: 0.6993 - val\_accuracy: 0.5195  
Epoch 28/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5831 - accuracy: 0.6979 - val\_loss: 0.6987 - val\_accuracy: 0.5195  
Epoch 29/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5697 - accuracy: 0.7005 - val\_loss: 0.6983 - val\_accuracy: 0.5195  
Epoch 30/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5623 - accuracy: 0.7292 - val\_loss: 0.6980 - val\_accuracy: 0.5195  
Epoch 31/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5587 - accuracy: 0.7109 - val\_loss: 0.6975 - val\_accuracy: 0.5065  
Epoch 32/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5611 - accuracy: 0.7174 - val\_loss: 0.6971 - val\_accuracy: 0.5065  
Epoch 33/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5619 - accuracy: 0.7227 - val\_loss: 0.6967 - val\_accuracy: 0.4935  
Epoch 34/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5540 - accuracy: 0.7357 - val\_loss: 0.6963 - val\_accuracy: 0.5065  
Epoch 35/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5552 - accuracy: 0.7214 - val\_loss: 0.6960 - val\_accuracy: 0.4935  
Epoch 36/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5528 - accuracy: 0.7279 - val\_loss: 0.6955 - val\_accuracy: 0.5065  
Epoch 37/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5540 - accuracy: 0.7174 - val\_loss: 0.6952 - val\_accuracy: 0.5065  
Epoch 38/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5522 - accuracy: 0.7357 - val\_loss: 0.6950 - val\_accuracy: 0.4805  
Epoch 39/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5536 - accuracy: 0.7214 - val\_loss: 0.6945 - val\_accuracy: 0.4675  
Epoch 40/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5521 - accuracy: 0.7266 - val\_loss: 0.6941 - val\_accuracy: 0.4675  
Epoch 41/300  
16/16 [=====] - 0s 7ms/step - loss: 0.5580 - accuracy: 0.7201 - val\_loss: 0.6935 - val\_accuracy: 0.4675  
Epoch 42/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5480 - accuracy: 0.7331 - val\_loss: 0.6930 - val\_accuracy: 0.4675  
Epoch 43/300

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16/16 [=====] - 0s 5ms/step - loss: 0.5494 -  
accuracy: 0.7214 - val_loss: 0.6927 - val_accuracy: 0.5065  
Epoch 44/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5573 -  
accuracy: 0.7227 - val_loss: 0.6923 - val_accuracy: 0.4935  
Epoch 45/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5440 -  
accuracy: 0.7318 - val_loss: 0.6919 - val_accuracy: 0.5065  
Epoch 46/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5462 -  
accuracy: 0.7135 - val_loss: 0.6917 - val_accuracy: 0.5065  
Epoch 47/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5392 -  
accuracy: 0.7292 - val_loss: 0.6909 - val_accuracy: 0.5325  
Epoch 48/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5374 -  
accuracy: 0.7344 - val_loss: 0.6908 - val_accuracy: 0.5325  
Epoch 49/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5382 -  
accuracy: 0.7266 - val_loss: 0.6904 - val_accuracy: 0.5455  
Epoch 50/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5440 -  
accuracy: 0.7279 - val_loss: 0.6902 - val_accuracy: 0.5455  
Epoch 51/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5350 -  
accuracy: 0.7305 - val_loss: 0.6898 - val_accuracy: 0.5455  
Epoch 52/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5325 -  
accuracy: 0.7344 - val_loss: 0.6893 - val_accuracy: 0.5455  
Epoch 53/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5316 -  
accuracy: 0.7318 - val_loss: 0.6887 - val_accuracy: 0.5455  
Epoch 54/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5328 -  
accuracy: 0.7487 - val_loss: 0.6885 - val_accuracy: 0.5584  
Epoch 55/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5327 -  
accuracy: 0.7305 - val_loss: 0.6882 - val_accuracy: 0.5584  
Epoch 56/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5335 -  
accuracy: 0.7422 - val_loss: 0.6879 - val_accuracy: 0.5584  
Epoch 57/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5343 -  
accuracy: 0.7331 - val_loss: 0.6875 - val_accuracy: 0.5584  
Epoch 58/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5298 -  
accuracy: 0.7370 - val_loss: 0.6869 - val_accuracy: 0.5714  
Epoch 59/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5294 -
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accuracy: 0.7409 - val\_loss: 0.6862 - val\_accuracy: 0.5584  
Epoch 60/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5323 -  
accuracy: 0.7461 - val\_loss: 0.6859 - val\_accuracy: 0.5714  
Epoch 61/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5301 -  
accuracy: 0.7383 - val\_loss: 0.6855 - val\_accuracy: 0.5714  
Epoch 62/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5381 -  
accuracy: 0.7318 - val\_loss: 0.6852 - val\_accuracy: 0.5714  
Epoch 63/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5295 -  
accuracy: 0.7370 - val\_loss: 0.6850 - val\_accuracy: 0.5714  
Epoch 64/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5247 -  
accuracy: 0.7344 - val\_loss: 0.6847 - val\_accuracy: 0.5714  
Epoch 65/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5213 -  
accuracy: 0.7448 - val\_loss: 0.6844 - val\_accuracy: 0.5584  
Epoch 66/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5219 -  
accuracy: 0.7461 - val\_loss: 0.6840 - val\_accuracy: 0.5584  
Epoch 67/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5246 -  
accuracy: 0.7422 - val\_loss: 0.6836 - val\_accuracy: 0.5584  
Epoch 68/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5222 -  
accuracy: 0.7396 - val\_loss: 0.6832 - val\_accuracy: 0.5584  
Epoch 69/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5229 -  
accuracy: 0.7396 - val\_loss: 0.6830 - val\_accuracy: 0.5584  
Epoch 70/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5212 -  
accuracy: 0.7383 - val\_loss: 0.6825 - val\_accuracy: 0.5584  
Epoch 71/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5177 -  
accuracy: 0.7422 - val\_loss: 0.6824 - val\_accuracy: 0.5584  
Epoch 72/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5214 -  
accuracy: 0.7383 - val\_loss: 0.6822 - val\_accuracy: 0.5195  
Epoch 73/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5248 -  
accuracy: 0.7344 - val\_loss: 0.6817 - val\_accuracy: 0.5065  
Epoch 74/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5227 -  
accuracy: 0.7396 - val\_loss: 0.6814 - val\_accuracy: 0.5195  
Epoch 75/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5220 -  
accuracy: 0.7240 - val\_loss: 0.6810 - val\_accuracy: 0.5065

Epoch 76/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5191 - accuracy: 0.7383 - val\_loss: 0.6804 - val\_accuracy: 0.5325  
Epoch 77/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5221 - accuracy: 0.7318 - val\_loss: 0.6804 - val\_accuracy: 0.5325  
Epoch 78/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5211 - accuracy: 0.7344 - val\_loss: 0.6802 - val\_accuracy: 0.5325  
Epoch 79/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5251 - accuracy: 0.7279 - val\_loss: 0.6798 - val\_accuracy: 0.5325  
Epoch 80/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5234 - accuracy: 0.7344 - val\_loss: 0.6795 - val\_accuracy: 0.5325  
Epoch 81/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5118 - accuracy: 0.7526 - val\_loss: 0.6792 - val\_accuracy: 0.5584  
Epoch 82/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5099 - accuracy: 0.7565 - val\_loss: 0.6788 - val\_accuracy: 0.5584  
Epoch 83/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5155 - accuracy: 0.7344 - val\_loss: 0.6785 - val\_accuracy: 0.5584  
Epoch 84/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5088 - accuracy: 0.7448 - val\_loss: 0.6783 - val\_accuracy: 0.5714  
Epoch 85/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5140 - accuracy: 0.7448 - val\_loss: 0.6779 - val\_accuracy: 0.5844  
Epoch 86/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5303 - accuracy: 0.7227 - val\_loss: 0.6779 - val\_accuracy: 0.5844  
Epoch 87/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5261 - accuracy: 0.7370 - val\_loss: 0.6775 - val\_accuracy: 0.5844  
Epoch 88/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5108 - accuracy: 0.7357 - val\_loss: 0.6771 - val\_accuracy: 0.5844  
Epoch 89/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5140 - accuracy: 0.7422 - val\_loss: 0.6769 - val\_accuracy: 0.5844  
Epoch 90/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5082 - accuracy: 0.7357 - val\_loss: 0.6768 - val\_accuracy: 0.5844  
Epoch 91/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5083 - accuracy: 0.7552 - val\_loss: 0.6766 - val\_accuracy: 0.5844  
Epoch 92/300

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16/16 [=====] - 0s 5ms/step - loss: 0.5105 -  
accuracy: 0.7344 - val_loss: 0.6764 - val_accuracy: 0.5844  
Epoch 93/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5057 -  
accuracy: 0.7487 - val_loss: 0.6762 - val_accuracy: 0.5974  
Epoch 94/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5112 -  
accuracy: 0.7370 - val_loss: 0.6760 - val_accuracy: 0.5974  
Epoch 95/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5042 -  
accuracy: 0.7487 - val_loss: 0.6758 - val_accuracy: 0.5974  
Epoch 96/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5055 -  
accuracy: 0.7461 - val_loss: 0.6754 - val_accuracy: 0.5974  
Epoch 97/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5065 -  
accuracy: 0.7474 - val_loss: 0.6752 - val_accuracy: 0.5974  
Epoch 98/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5075 -  
accuracy: 0.7474 - val_loss: 0.6752 - val_accuracy: 0.5974  
Epoch 99/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5053 -  
accuracy: 0.7461 - val_loss: 0.6750 - val_accuracy: 0.5974  
Epoch 100/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5002 -  
accuracy: 0.7474 - val_loss: 0.6749 - val_accuracy: 0.5974  
Epoch 101/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5015 -  
accuracy: 0.7669 - val_loss: 0.6749 - val_accuracy: 0.6104  
Epoch 102/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5127 -  
accuracy: 0.7435 - val_loss: 0.6748 - val_accuracy: 0.6104  
Epoch 103/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5332 -  
accuracy: 0.7266 - val_loss: 0.6744 - val_accuracy: 0.6104  
Epoch 104/300  
16/16 [=====] - 0s 6ms/step - loss: 0.5029 -  
accuracy: 0.7578 - val_loss: 0.6742 - val_accuracy: 0.6104  
Epoch 105/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5004 -  
accuracy: 0.7695 - val_loss: 0.6742 - val_accuracy: 0.6104  
Epoch 106/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5040 -  
accuracy: 0.7461 - val_loss: 0.6738 - val_accuracy: 0.6104  
Epoch 107/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4965 -  
accuracy: 0.7604 - val_loss: 0.6737 - val_accuracy: 0.6104  
Epoch 108/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5004 -
```

accuracy: 0.7513 - val\_loss: 0.6737 - val\_accuracy: 0.6104  
Epoch 109/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5205 -  
accuracy: 0.7331 - val\_loss: 0.6735 - val\_accuracy: 0.6104  
Epoch 110/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5035 -  
accuracy: 0.7513 - val\_loss: 0.6731 - val\_accuracy: 0.6104  
Epoch 111/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5064 -  
accuracy: 0.7565 - val\_loss: 0.6735 - val\_accuracy: 0.6104  
Epoch 112/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5020 -  
accuracy: 0.7448 - val\_loss: 0.6737 - val\_accuracy: 0.6104  
Epoch 113/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5225 -  
accuracy: 0.7292 - val\_loss: 0.6727 - val\_accuracy: 0.6104  
Epoch 114/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5040 -  
accuracy: 0.7357 - val\_loss: 0.6725 - val\_accuracy: 0.6104  
Epoch 115/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4999 -  
accuracy: 0.7422 - val\_loss: 0.6728 - val\_accuracy: 0.6104  
Epoch 116/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4982 -  
accuracy: 0.7487 - val\_loss: 0.6727 - val\_accuracy: 0.6104  
Epoch 117/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5224 -  
accuracy: 0.7292 - val\_loss: 0.6725 - val\_accuracy: 0.6104  
Epoch 118/300  
16/16 [=====] - 0s 5ms/step - loss: 0.5021 -  
accuracy: 0.7474 - val\_loss: 0.6723 - val\_accuracy: 0.6104  
Epoch 119/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4913 -  
accuracy: 0.7643 - val\_loss: 0.6724 - val\_accuracy: 0.6104  
Epoch 120/300  
16/16 [=====] - 0s 7ms/step - loss: 0.4949 -  
accuracy: 0.7552 - val\_loss: 0.6719 - val\_accuracy: 0.6104  
Epoch 121/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4995 -  
accuracy: 0.7461 - val\_loss: 0.6718 - val\_accuracy: 0.6104  
Epoch 122/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4984 -  
accuracy: 0.7539 - val\_loss: 0.6721 - val\_accuracy: 0.6104  
Epoch 123/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4979 -  
accuracy: 0.7539 - val\_loss: 0.6720 - val\_accuracy: 0.6104  
Epoch 124/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4959 -  
accuracy: 0.7513 - val\_loss: 0.6719 - val\_accuracy: 0.6104

```
Epoch 125/300
16/16 [=====] - 0s 5ms/step - loss: 0.4918 -
accuracy: 0.7565 - val_loss: 0.6718 - val_accuracy: 0.6104
Epoch 126/300
16/16 [=====] - 0s 5ms/step - loss: 0.4905 -
accuracy: 0.7565 - val_loss: 0.6716 - val_accuracy: 0.6104
Epoch 127/300
16/16 [=====] - 0s 5ms/step - loss: 0.4877 -
accuracy: 0.7578 - val_loss: 0.6717 - val_accuracy: 0.6104
Epoch 128/300
16/16 [=====] - 0s 5ms/step - loss: 0.4849 -
accuracy: 0.7474 - val_loss: 0.6720 - val_accuracy: 0.6104
Epoch 129/300
16/16 [=====] - 0s 5ms/step - loss: 0.4938 -
accuracy: 0.7526 - val_loss: 0.6717 - val_accuracy: 0.6104
Epoch 130/300
16/16 [=====] - 0s 5ms/step - loss: 0.4926 -
accuracy: 0.7539 - val_loss: 0.6713 - val_accuracy: 0.6104
Epoch 131/300
16/16 [=====] - 0s 5ms/step - loss: 0.4905 -
accuracy: 0.7604 - val_loss: 0.6712 - val_accuracy: 0.6104
Epoch 132/300
16/16 [=====] - 0s 5ms/step - loss: 0.4948 -
accuracy: 0.7591 - val_loss: 0.6712 - val_accuracy: 0.6104
Epoch 133/300
16/16 [=====] - 0s 5ms/step - loss: 0.5104 -
accuracy: 0.7461 - val_loss: 0.6713 - val_accuracy: 0.6104
Epoch 134/300
16/16 [=====] - 0s 5ms/step - loss: 0.4953 -
accuracy: 0.7604 - val_loss: 0.6716 - val_accuracy: 0.6104
Epoch 135/300
16/16 [=====] - 0s 5ms/step - loss: 0.4909 -
accuracy: 0.7552 - val_loss: 0.6714 - val_accuracy: 0.6104
Epoch 136/300
16/16 [=====] - 0s 5ms/step - loss: 0.4898 -
accuracy: 0.7552 - val_loss: 0.6711 - val_accuracy: 0.6104
Epoch 137/300
16/16 [=====] - 0s 5ms/step - loss: 0.4850 -
accuracy: 0.7448 - val_loss: 0.6715 - val_accuracy: 0.6104
Epoch 138/300
16/16 [=====] - 0s 5ms/step - loss: 0.4857 -
accuracy: 0.7669 - val_loss: 0.6713 - val_accuracy: 0.6104
Epoch 139/300
16/16 [=====] - 0s 5ms/step - loss: 0.4868 -
accuracy: 0.7578 - val_loss: 0.6715 - val_accuracy: 0.6104
Epoch 140/300
16/16 [=====] - 0s 5ms/step - loss: 0.4922 -
accuracy: 0.7578 - val_loss: 0.6714 - val_accuracy: 0.6104
Epoch 141/300
```

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16/16 [=====] - 0s 5ms/step - loss: 0.5093 -  
accuracy: 0.7266 - val_loss: 0.6715 - val_accuracy: 0.6104  
Epoch 142/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4896 -  
accuracy: 0.7604 - val_loss: 0.6708 - val_accuracy: 0.6104  
Epoch 143/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4852 -  
accuracy: 0.7656 - val_loss: 0.6712 - val_accuracy: 0.6104  
Epoch 144/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4792 -  
accuracy: 0.7682 - val_loss: 0.6710 - val_accuracy: 0.6104  
Epoch 145/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4849 -  
accuracy: 0.7721 - val_loss: 0.6708 - val_accuracy: 0.6104  
Epoch 146/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4989 -  
accuracy: 0.7500 - val_loss: 0.6714 - val_accuracy: 0.6104  
Epoch 147/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4814 -  
accuracy: 0.7604 - val_loss: 0.6712 - val_accuracy: 0.6104  
Epoch 148/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4816 -  
accuracy: 0.7773 - val_loss: 0.6708 - val_accuracy: 0.6104  
Epoch 149/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4989 -  
accuracy: 0.7474 - val_loss: 0.6716 - val_accuracy: 0.6104  
Epoch 150/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4812 -  
accuracy: 0.7799 - val_loss: 0.6715 - val_accuracy: 0.6104  
Epoch 151/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4786 -  
accuracy: 0.7695 - val_loss: 0.6714 - val_accuracy: 0.6104  
Epoch 152/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4904 -  
accuracy: 0.7656 - val_loss: 0.6720 - val_accuracy: 0.6104  
Epoch 153/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4902 -  
accuracy: 0.7526 - val_loss: 0.6713 - val_accuracy: 0.6104  
Epoch 154/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4916 -  
accuracy: 0.7604 - val_loss: 0.6716 - val_accuracy: 0.6104  
Epoch 155/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4977 -  
accuracy: 0.7539 - val_loss: 0.6713 - val_accuracy: 0.6104  
Epoch 156/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4892 -  
accuracy: 0.7565 - val_loss: 0.6711 - val_accuracy: 0.6104  
Epoch 157/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4901 -
```

accuracy: 0.7487 - val\_loss: 0.6713 - val\_accuracy: 0.6104  
Epoch 158/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4845 -  
accuracy: 0.7552 - val\_loss: 0.6714 - val\_accuracy: 0.6104  
Epoch 159/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4788 -  
accuracy: 0.7630 - val\_loss: 0.6714 - val\_accuracy: 0.6104  
Epoch 160/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4835 -  
accuracy: 0.7630 - val\_loss: 0.6719 - val\_accuracy: 0.6104  
Epoch 161/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4739 -  
accuracy: 0.7747 - val\_loss: 0.6723 - val\_accuracy: 0.6104  
Epoch 162/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4763 -  
accuracy: 0.7773 - val\_loss: 0.6721 - val\_accuracy: 0.6104  
Epoch 163/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4768 -  
accuracy: 0.7760 - val\_loss: 0.6720 - val\_accuracy: 0.6104  
Epoch 164/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4856 -  
accuracy: 0.7409 - val\_loss: 0.6719 - val\_accuracy: 0.6104  
Epoch 165/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4732 -  
accuracy: 0.7799 - val\_loss: 0.6720 - val\_accuracy: 0.6104  
Epoch 166/300  
16/16 [=====] - 0s 7ms/step - loss: 0.4775 -  
accuracy: 0.7656 - val\_loss: 0.6721 - val\_accuracy: 0.6104  
Epoch 167/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4764 -  
accuracy: 0.7682 - val\_loss: 0.6729 - val\_accuracy: 0.6104  
Epoch 168/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4789 -  
accuracy: 0.7578 - val\_loss: 0.6719 - val\_accuracy: 0.6104  
Epoch 169/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4775 -  
accuracy: 0.7734 - val\_loss: 0.6726 - val\_accuracy: 0.6104  
Epoch 170/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4844 -  
accuracy: 0.7578 - val\_loss: 0.6730 - val\_accuracy: 0.6104  
Epoch 171/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4750 -  
accuracy: 0.7786 - val\_loss: 0.6728 - val\_accuracy: 0.6104  
Epoch 172/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4692 -  
accuracy: 0.7878 - val\_loss: 0.6727 - val\_accuracy: 0.6104  
Epoch 173/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4776 -  
accuracy: 0.7526 - val\_loss: 0.6728 - val\_accuracy: 0.6104  
Epoch 174/300

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16/16 [=====] - 0s 5ms/step - loss: 0.4720 -  
accuracy: 0.7812 - val_loss: 0.6736 - val_accuracy: 0.6104  
Epoch 175/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4859 -  
accuracy: 0.7721 - val_loss: 0.6734 - val_accuracy: 0.6104  
Epoch 176/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4762 -  
accuracy: 0.7591 - val_loss: 0.6730 - val_accuracy: 0.6104  
Epoch 177/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4756 -  
accuracy: 0.7682 - val_loss: 0.6730 - val_accuracy: 0.6104  
Epoch 178/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4699 -  
accuracy: 0.7799 - val_loss: 0.6738 - val_accuracy: 0.6104  
Epoch 179/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4687 -  
accuracy: 0.7721 - val_loss: 0.6737 - val_accuracy: 0.6104  
Epoch 180/300  
16/16 [=====] - 0s 9ms/step - loss: 0.4667 -  
accuracy: 0.7773 - val_loss: 0.6740 - val_accuracy: 0.6104  
Epoch 181/300  
16/16 [=====] - 0s 9ms/step - loss: 0.4745 -  
accuracy: 0.7799 - val_loss: 0.6742 - val_accuracy: 0.6104  
Epoch 182/300  
16/16 [=====] - 0s 7ms/step - loss: 0.4704 -  
accuracy: 0.7721 - val_loss: 0.6742 - val_accuracy: 0.6104  
Epoch 183/300  
16/16 [=====] - 0s 13ms/step - loss: 0.4688 -  
accuracy: 0.7839 - val_loss: 0.6747 - val_accuracy: 0.6104  
Epoch 184/300  
16/16 [=====] - 0s 10ms/step - loss: 0.4740 -  
accuracy: 0.7721 - val_loss: 0.6749 - val_accuracy: 0.6104  
Epoch 185/300  
16/16 [=====] - 0s 11ms/step - loss: 0.4693 -  
accuracy: 0.7643 - val_loss: 0.6750 - val_accuracy: 0.6104  
Epoch 186/300  
16/16 [=====] - 0s 8ms/step - loss: 0.4661 -  
accuracy: 0.7786 - val_loss: 0.6749 - val_accuracy: 0.6104  
Epoch 187/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4753 -  
accuracy: 0.7773 - val_loss: 0.6752 - val_accuracy: 0.6104  
Epoch 188/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4650 -  
accuracy: 0.7839 - val_loss: 0.6751 - val_accuracy: 0.6104  
Epoch 189/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4732 -  
accuracy: 0.7682 - val_loss: 0.6748 - val_accuracy: 0.6104  
Epoch 190/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4701 -
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accuracy: 0.7812 - val\_loss: 0.6753 - val\_accuracy: 0.6104  
Epoch 191/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4676 -  
accuracy: 0.7773 - val\_loss: 0.6754 - val\_accuracy: 0.6104  
Epoch 192/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4631 -  
accuracy: 0.7865 - val\_loss: 0.6756 - val\_accuracy: 0.6104  
Epoch 193/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4631 -  
accuracy: 0.7773 - val\_loss: 0.6761 - val\_accuracy: 0.6104  
Epoch 194/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4677 -  
accuracy: 0.7760 - val\_loss: 0.6765 - val\_accuracy: 0.6104  
Epoch 195/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4657 -  
accuracy: 0.7773 - val\_loss: 0.6766 - val\_accuracy: 0.6104  
Epoch 196/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4643 -  
accuracy: 0.7839 - val\_loss: 0.6761 - val\_accuracy: 0.6104  
Epoch 197/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4670 -  
accuracy: 0.7799 - val\_loss: 0.6765 - val\_accuracy: 0.6104  
Epoch 198/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4740 -  
accuracy: 0.7682 - val\_loss: 0.6771 - val\_accuracy: 0.6104  
Epoch 199/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4729 -  
accuracy: 0.7630 - val\_loss: 0.6774 - val\_accuracy: 0.6104  
Epoch 200/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4656 -  
accuracy: 0.7917 - val\_loss: 0.6779 - val\_accuracy: 0.6104  
Epoch 201/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4694 -  
accuracy: 0.7839 - val\_loss: 0.6778 - val\_accuracy: 0.6104  
Epoch 202/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4601 -  
accuracy: 0.7917 - val\_loss: 0.6774 - val\_accuracy: 0.6104  
Epoch 203/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4621 -  
accuracy: 0.7799 - val\_loss: 0.6773 - val\_accuracy: 0.6104  
Epoch 204/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4953 -  
accuracy: 0.7734 - val\_loss: 0.6789 - val\_accuracy: 0.6104  
Epoch 205/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4812 -  
accuracy: 0.7500 - val\_loss: 0.6793 - val\_accuracy: 0.6104  
Epoch 206/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4736 -  
accuracy: 0.7643 - val\_loss: 0.6792 - val\_accuracy: 0.6104

Epoch 207/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4730 - accuracy: 0.7578 - val\_loss: 0.6783 - val\_accuracy: 0.6104  
Epoch 208/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4666 - accuracy: 0.7734 - val\_loss: 0.6786 - val\_accuracy: 0.6104  
Epoch 209/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4659 - accuracy: 0.7773 - val\_loss: 0.6783 - val\_accuracy: 0.6104  
Epoch 210/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4854 - accuracy: 0.7734 - val\_loss: 0.6793 - val\_accuracy: 0.6104  
Epoch 211/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4732 - accuracy: 0.7669 - val\_loss: 0.6795 - val\_accuracy: 0.6104  
Epoch 212/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4569 - accuracy: 0.7852 - val\_loss: 0.6808 - val\_accuracy: 0.6104  
Epoch 213/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4636 - accuracy: 0.7682 - val\_loss: 0.6803 - val\_accuracy: 0.6104  
Epoch 214/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4551 - accuracy: 0.7878 - val\_loss: 0.6814 - val\_accuracy: 0.6104  
Epoch 215/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4691 - accuracy: 0.7630 - val\_loss: 0.6807 - val\_accuracy: 0.6104  
Epoch 216/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4593 - accuracy: 0.7891 - val\_loss: 0.6821 - val\_accuracy: 0.6104  
Epoch 217/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4693 - accuracy: 0.7708 - val\_loss: 0.6820 - val\_accuracy: 0.6104  
Epoch 218/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4620 - accuracy: 0.7812 - val\_loss: 0.6822 - val\_accuracy: 0.6104  
Epoch 219/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4572 - accuracy: 0.7917 - val\_loss: 0.6819 - val\_accuracy: 0.6104  
Epoch 220/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4532 - accuracy: 0.7839 - val\_loss: 0.6822 - val\_accuracy: 0.6104  
Epoch 221/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4633 - accuracy: 0.7760 - val\_loss: 0.6825 - val\_accuracy: 0.6104  
Epoch 222/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4660 - accuracy: 0.7656 - val\_loss: 0.6828 - val\_accuracy: 0.6104  
Epoch 223/300

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16/16 [=====] - 0s 5ms/step - loss: 0.4581 -  
accuracy: 0.7917 - val_loss: 0.6832 - val_accuracy: 0.6104  
Epoch 224/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4714 -  
accuracy: 0.7604 - val_loss: 0.6846 - val_accuracy: 0.6104  
Epoch 225/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4729 -  
accuracy: 0.7812 - val_loss: 0.6840 - val_accuracy: 0.6104  
Epoch 226/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4743 -  
accuracy: 0.7539 - val_loss: 0.6838 - val_accuracy: 0.6104  
Epoch 227/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4545 -  
accuracy: 0.7891 - val_loss: 0.6840 - val_accuracy: 0.6104  
Epoch 228/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4543 -  
accuracy: 0.7852 - val_loss: 0.6843 - val_accuracy: 0.6104  
Epoch 229/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4583 -  
accuracy: 0.7773 - val_loss: 0.6844 - val_accuracy: 0.6104  
Epoch 230/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4592 -  
accuracy: 0.7839 - val_loss: 0.6847 - val_accuracy: 0.6104  
Epoch 231/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4551 -  
accuracy: 0.7773 - val_loss: 0.6855 - val_accuracy: 0.6104  
Epoch 232/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4560 -  
accuracy: 0.7773 - val_loss: 0.6855 - val_accuracy: 0.6104  
Epoch 233/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4536 -  
accuracy: 0.7839 - val_loss: 0.6862 - val_accuracy: 0.6104  
Epoch 234/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4556 -  
accuracy: 0.7826 - val_loss: 0.6859 - val_accuracy: 0.6104  
Epoch 235/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4556 -  
accuracy: 0.7826 - val_loss: 0.6872 - val_accuracy: 0.6104  
Epoch 236/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4600 -  
accuracy: 0.7865 - val_loss: 0.6871 - val_accuracy: 0.6104  
Epoch 237/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4797 -  
accuracy: 0.7643 - val_loss: 0.6866 - val_accuracy: 0.6104  
Epoch 238/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4932 -  
accuracy: 0.7604 - val_loss: 0.6869 - val_accuracy: 0.6104  
Epoch 239/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4672 -
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accuracy: 0.7526 - val\_loss: 0.6863 - val\_accuracy: 0.6104  
Epoch 240/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4571 -  
accuracy: 0.7812 - val\_loss: 0.6872 - val\_accuracy: 0.6104  
Epoch 241/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4634 -  
accuracy: 0.7852 - val\_loss: 0.6871 - val\_accuracy: 0.6104  
Epoch 242/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4604 -  
accuracy: 0.7786 - val\_loss: 0.6880 - val\_accuracy: 0.6104  
Epoch 243/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4553 -  
accuracy: 0.7865 - val\_loss: 0.6890 - val\_accuracy: 0.6104  
Epoch 244/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4496 -  
accuracy: 0.7917 - val\_loss: 0.6888 - val\_accuracy: 0.6104  
Epoch 245/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4519 -  
accuracy: 0.7943 - val\_loss: 0.6892 - val\_accuracy: 0.6104  
Epoch 246/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4544 -  
accuracy: 0.7878 - val\_loss: 0.6896 - val\_accuracy: 0.6104  
Epoch 247/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4483 -  
accuracy: 0.7799 - val\_loss: 0.6896 - val\_accuracy: 0.6104  
Epoch 248/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4475 -  
accuracy: 0.7943 - val\_loss: 0.6904 - val\_accuracy: 0.6104  
Epoch 249/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4480 -  
accuracy: 0.7865 - val\_loss: 0.6902 - val\_accuracy: 0.6104  
Epoch 250/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4490 -  
accuracy: 0.7799 - val\_loss: 0.6917 - val\_accuracy: 0.6104  
Epoch 251/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4492 -  
accuracy: 0.7891 - val\_loss: 0.6909 - val\_accuracy: 0.6104  
Epoch 252/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4504 -  
accuracy: 0.7839 - val\_loss: 0.6914 - val\_accuracy: 0.6104  
Epoch 253/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4475 -  
accuracy: 0.7917 - val\_loss: 0.6918 - val\_accuracy: 0.6104  
Epoch 254/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4455 -  
accuracy: 0.7878 - val\_loss: 0.6923 - val\_accuracy: 0.6104  
Epoch 255/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4424 -  
accuracy: 0.7956 - val\_loss: 0.6928 - val\_accuracy: 0.6104

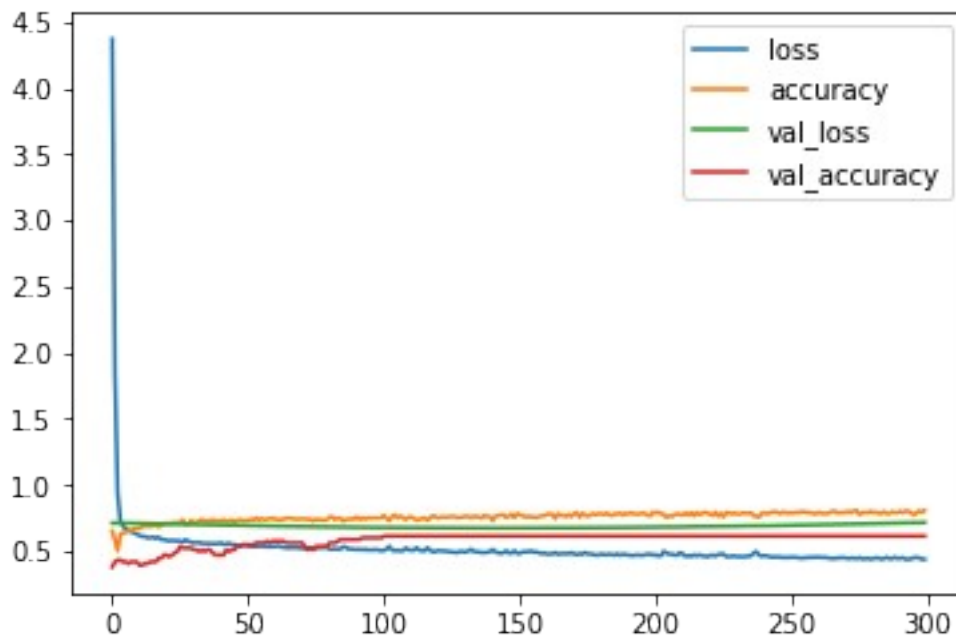
Epoch 256/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4460 - accuracy: 0.7917 - val\_loss: 0.6935 - val\_accuracy: 0.6104  
Epoch 257/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4498 - accuracy: 0.7891 - val\_loss: 0.6942 - val\_accuracy: 0.6104  
Epoch 258/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4475 - accuracy: 0.7865 - val\_loss: 0.6938 - val\_accuracy: 0.6104  
Epoch 259/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4502 - accuracy: 0.7826 - val\_loss: 0.6942 - val\_accuracy: 0.6104  
Epoch 260/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4509 - accuracy: 0.7773 - val\_loss: 0.6949 - val\_accuracy: 0.6104  
Epoch 261/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4492 - accuracy: 0.7904 - val\_loss: 0.6956 - val\_accuracy: 0.6104  
Epoch 262/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4499 - accuracy: 0.7826 - val\_loss: 0.6963 - val\_accuracy: 0.6104  
Epoch 263/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4478 - accuracy: 0.7799 - val\_loss: 0.6959 - val\_accuracy: 0.6104  
Epoch 264/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4477 - accuracy: 0.7799 - val\_loss: 0.6970 - val\_accuracy: 0.6104  
Epoch 265/300  
16/16 [=====] - 0s 6ms/step - loss: 0.4424 - accuracy: 0.7865 - val\_loss: 0.6968 - val\_accuracy: 0.6104  
Epoch 266/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4418 - accuracy: 0.7982 - val\_loss: 0.6969 - val\_accuracy: 0.6104  
Epoch 267/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4399 - accuracy: 0.7969 - val\_loss: 0.6972 - val\_accuracy: 0.6104  
Epoch 268/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4466 - accuracy: 0.7826 - val\_loss: 0.6974 - val\_accuracy: 0.6104  
Epoch 269/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4447 - accuracy: 0.7904 - val\_loss: 0.6990 - val\_accuracy: 0.6104  
Epoch 270/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4476 - accuracy: 0.7878 - val\_loss: 0.6991 - val\_accuracy: 0.6104  
Epoch 271/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4442 - accuracy: 0.7904 - val\_loss: 0.6997 - val\_accuracy: 0.6104  
Epoch 272/300

```
16/16 [=====] - 0s 5ms/step - loss: 0.4400 -  
accuracy: 0.7956 - val_loss: 0.6999 - val_accuracy: 0.6104  
Epoch 273/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4436 -  
accuracy: 0.7865 - val_loss: 0.7003 - val_accuracy: 0.6104  
Epoch 274/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4437 -  
accuracy: 0.8021 - val_loss: 0.7012 - val_accuracy: 0.6104  
Epoch 275/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4388 -  
accuracy: 0.8034 - val_loss: 0.7021 - val_accuracy: 0.6104  
Epoch 276/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4472 -  
accuracy: 0.7721 - val_loss: 0.7025 - val_accuracy: 0.6104  
Epoch 277/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4388 -  
accuracy: 0.7865 - val_loss: 0.7020 - val_accuracy: 0.6104  
Epoch 278/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4382 -  
accuracy: 0.7904 - val_loss: 0.7037 - val_accuracy: 0.6104  
Epoch 279/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4425 -  
accuracy: 0.7852 - val_loss: 0.7032 - val_accuracy: 0.6104  
Epoch 280/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4357 -  
accuracy: 0.7982 - val_loss: 0.7040 - val_accuracy: 0.6104  
Epoch 281/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4400 -  
accuracy: 0.7878 - val_loss: 0.7038 - val_accuracy: 0.6104  
Epoch 282/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4445 -  
accuracy: 0.7917 - val_loss: 0.7044 - val_accuracy: 0.6104  
Epoch 283/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4441 -  
accuracy: 0.7839 - val_loss: 0.7065 - val_accuracy: 0.6104  
Epoch 284/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4351 -  
accuracy: 0.7786 - val_loss: 0.7043 - val_accuracy: 0.6104  
Epoch 285/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4402 -  
accuracy: 0.7969 - val_loss: 0.7052 - val_accuracy: 0.6104  
Epoch 286/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4496 -  
accuracy: 0.7812 - val_loss: 0.7061 - val_accuracy: 0.6104  
Epoch 287/300  
16/16 [=====] - 0s 5ms/step - loss: 0.4395 -  
accuracy: 0.7799 - val_loss: 0.7075 - val_accuracy: 0.6104  
Epoch 288/300  
16/16 [=====] - 0s 7ms/step - loss: 0.4394 -
```

```
accuracy: 0.7930 - val_loss: 0.7064 - val_accuracy: 0.6104
Epoch 289/300
16/16 [=====] - 0s 7ms/step - loss: 0.4505 -
accuracy: 0.7891 - val_loss: 0.7066 - val_accuracy: 0.6104
Epoch 290/300
16/16 [=====] - 0s 5ms/step - loss: 0.4408 -
accuracy: 0.7865 - val_loss: 0.7081 - val_accuracy: 0.6104
Epoch 291/300
16/16 [=====] - 0s 5ms/step - loss: 0.4434 -
accuracy: 0.7969 - val_loss: 0.7075 - val_accuracy: 0.6104
Epoch 292/300
16/16 [=====] - 0s 5ms/step - loss: 0.4456 -
accuracy: 0.7865 - val_loss: 0.7088 - val_accuracy: 0.6104
Epoch 293/300
16/16 [=====] - 0s 5ms/step - loss: 0.4344 -
accuracy: 0.7995 - val_loss: 0.7098 - val_accuracy: 0.6104
Epoch 294/300
16/16 [=====] - 0s 5ms/step - loss: 0.4346 -
accuracy: 0.7995 - val_loss: 0.7106 - val_accuracy: 0.6104
Epoch 295/300
16/16 [=====] - 0s 5ms/step - loss: 0.4384 -
accuracy: 0.7865 - val_loss: 0.7120 - val_accuracy: 0.6104
Epoch 296/300
16/16 [=====] - 0s 5ms/step - loss: 0.4464 -
accuracy: 0.7695 - val_loss: 0.7113 - val_accuracy: 0.6104
Epoch 297/300
16/16 [=====] - 0s 5ms/step - loss: 0.4481 -
accuracy: 0.7852 - val_loss: 0.7110 - val_accuracy: 0.6104
Epoch 298/300
16/16 [=====] - 0s 5ms/step - loss: 0.4457 -
accuracy: 0.8021 - val_loss: 0.7113 - val_accuracy: 0.6104
Epoch 299/300
16/16 [=====] - 0s 5ms/step - loss: 0.4336 -
accuracy: 0.7891 - val_loss: 0.7128 - val_accuracy: 0.6104
Epoch 300/300
16/16 [=====] - 0s 5ms/step - loss: 0.4352 -
accuracy: 0.8034 - val_loss: 0.7133 - val_accuracy: 0.6104

losses = pd.DataFrame(model.history.history)
losses.plot()

<AxesSubplot:>
```



```
model.evaluate(x,y)
```

```
24/24 [=====] - 0s 2ms/step - loss: 0.4277 - accuracy: 0.8099
```

```
[0.42774689197540283, 0.8098958134651184]
```

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

```
y_pred
```

```
array([[0.29241186],
       [0.25659525],
       [0.2345556 ],
       [0.25635856],
       [0.2683779 ],
       [0.26534295],
       [0.24615443],
       [0.18696874],
       [0.23531413],
       [0.26499653],
       [0.25147843],
       [0.19693151],
       [0.2525043 ],
       [0.2924193 ],
       [0.24108097],
       [0.24926525],
       [0.24154398],
       [0.30027997],
       [0.26890767],
```

[0.18842933],  
[0.27719277],  
[0.23296693],  
[0.25262323],  
[0.23384169],  
[0.26180875],  
[0.2531795 ],  
[0.21080497],  
[0.2493422 ],  
[0.27968198],  
[0.22347766],  
[0.2744137 ],  
[0.22154438],  
[0.24633941],  
[0.26000386],  
[0.30314064],  
[0.1814619 ],  
[0.17811224],  
[0.22696063],  
[0.23095623],  
[0.24577609],  
[0.21299466],  
[0.25943238],  
[0.26748422],  
[0.28173897],  
[0.21895227],  
[0.25581098],  
[0.2772973 ],  
[0.26322144],  
[0.27639455],  
[0.2651384 ],  
[0.29406345],  
[0.19382304],  
[0.24121556],  
[0.2256059 ],  
[0.2787133 ],  
[0.28141072],  
[0.22622645],  
[0.30917984],  
[0.23824352],  
[0.25481486],  
[0.25906867],  
[0.2787506 ],  
[0.20846003],  
[0.2344867 ],  
[0.27582753],  
[0.24831259],  
[0.29489657],  
[0.26952785],

```
[0.26609173],  
[0.26449886],  
[0.3253206 ],  
[0.20729351],  
[0.27737445],  
[0.27037466],  
[0.2857654 ],  
[0.21922398],  
[0.2420043  ]], dtype=float32)
```

```
# !pip install ann_visualizer
```

```
# !pip install graphviz
```

```
# from ann_visualizer.visualize import ann_viz
```

```
# ann_viz(model, title="")
```

```
# !pip3 install keras
```

```
# !pip3 install ann_visualizer
```

```
# !pip install graphviz
```

```
# from ann_visualizer.visualize import ann_viz;
```

```
# ann_viz(model, title="My first neural network")
```

```
# python3 index.py
```