ANN_keras

November 20, 2019

1 ANN using Keras

[1]:
```
# Importing the libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd


# Importing the dataset
dataset = pd.read_csv('C:/Users/kshitij/Desktop/Desktop/AML/CSV Files/iris.csv')
X = dataset.iloc[:, 1:5].values
y = dataset.iloc[:, 5].values

# Encoding categorical data
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
labelencoder_y = LabelEncoder()
y = labelencoder_y.fit_transform(y)


# Converting to categorical-three column form as output should be three neurons␣
 ↪[1 0 1]
from keras.utils import np_utils
new_y = np_utils.to_categorical(y)

# Splitting the dataset into the Training set and Test set
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, new_y, test_size = 0.25,␣
 ↪random_state = 1)

# Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Importing the Keras libraries and packages
import keras
```

```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import Dropout

# Initialising the ANN
classifier = Sequential()

# Adding the input layer and the first hidden layer
classifier.add(Dense(units = 10, kernel_initializer = 'uniform', activation =␣
↪'relu', input_shape = (4, )))
classifier.add(Dropout(0.2))

# Adding the second hidden layer
classifier.add(Dense(units = 10, kernel_initializer = 'uniform', activation =␣
↪'relu'))
classifier.add(Dropout(0.2))

# Adding the output layer
classifier.add(Dense(units = 3, kernel_initializer = 'uniform', activation =␣
↪'softmax'))

# Compiling the ANN
classifier.compile(optimizer = 'adam', loss = 'categorical_crossentropy',␣
↪metrics = ['accuracy'])

# Fitting the ANN to the Training set
classifier.fit(X_train, y_train, validation_split=0.4, batch_size = 20, epochs␣
↪= 500)

# Predicting the Test set results
y_pred = classifier.predict(X_test)
pred_bool = (y_pred > 0.5)

# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix, classification_report
cm = confusion_matrix(y_test.argmax(axis=1), pred_bool.argmax(axis=1))
print("Confusion Matrix : ")
print(cm)
print("Classification Report : ")
print(classification_report(y_test.argmax(axis=1), pred_bool.argmax(axis=1)))
```

```
Using TensorFlow backend.
```

```
WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:74: The name tf.get_default_graph
is deprecated. Please use tf.compat.v1.get_default_graph instead.
```

```
WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:517: The name tf.placeholder is
deprecated. Please use tf.compat.v1.placeholder instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:4138: The name tf.random_uniform is
deprecated. Please use tf.random.uniform instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:133: The name
tf.placeholder_with_default is deprecated. Please use
tf.compat.v1.placeholder_with_default instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:3445: calling dropout (from
tensorflow.python.ops.nn_ops) with keep_prob is deprecated and will be removed
in a future version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 -
keep_prob`.
WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\optimizers.py:790: The name tf.train.Optimizer is deprecated.
Please use tf.compat.v1.train.Optimizer instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:3295: The name tf.log is
deprecated. Please use tf.math.log instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\tensorflow_core\python\ops\math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future
version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:986: The name tf.assign_add is
deprecated. Please use tf.compat.v1.assign_add instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:973: The name tf.assign is
deprecated. Please use tf.compat.v1.assign instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:2741: The name tf.Session is
deprecated. Please use tf.compat.v1.Session instead.

Train on 67 samples, validate on 45 samples
Epoch 1/500
```

```
WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:174: The name
tf.get_default_session is deprecated. Please use
tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:181: The name tf.ConfigProto is
deprecated. Please use tf.compat.v1.ConfigProto instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:190: The name tf.global_variables
is deprecated. Please use tf.compat.v1.global_variables instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:199: The name
tf.is_variable_initialized is deprecated. Please use
tf.compat.v1.is_variable_initialized instead.

WARNING:tensorflow:From D:\Users\kshitij\Anaconda3\envs\tensorflow_env\lib\site-
packages\keras\backend\tensorflow_backend.py:206: The name
tf.variables_initializer is deprecated. Please use
tf.compat.v1.variables_initializer instead.

67/67 [==============================] - 3s 48ms/step - loss: 1.0986 - acc:
0.3433 - val_loss: 1.0987 - val_acc: 0.2889
Epoch 2/500
67/67 [==============================] - 0s 283us/step - loss: 1.0981 - acc:
0.4179 - val_loss: 1.0988 - val_acc: 0.2889
Epoch 3/500
67/67 [==============================] - 0s 310us/step - loss: 1.0976 - acc:
0.4179 - val_loss: 1.0989 - val_acc: 0.2889
Epoch 4/500
67/67 [==============================] - 0s 238us/step - loss: 1.0971 - acc:
0.4179 - val_loss: 1.0989 - val_acc: 0.2889
Epoch 5/500
67/67 [==============================] - 0s 298us/step - loss: 1.0965 - acc:
0.4179 - val_loss: 1.0988 - val_acc: 0.2889
Epoch 6/500
67/67 [==============================] - 0s 281us/step - loss: 1.0960 - acc:
0.4179 - val_loss: 1.0986 - val_acc: 0.2889
Epoch 7/500
67/67 [==============================] - 0s 253us/step - loss: 1.0951 - acc:
0.4179 - val_loss: 1.0981 - val_acc: 0.2889
Epoch 8/500
67/67 [==============================] - 0s 253us/step - loss: 1.0938 - acc:
0.4179 - val_loss: 1.0973 - val_acc: 0.2889
Epoch 9/500
67/67 [==============================] - 0s 312us/step - loss: 1.0920 - acc:
```

```
0.4179 - val_loss: 1.0962 - val_acc: 0.2889
Epoch 10/500
67/67 [==============================] - 0s 245us/step - loss: 1.0902 - acc:
0.4179 - val_loss: 1.0947 - val_acc: 0.2889
Epoch 11/500
67/67 [==============================] - 0s 328us/step - loss: 1.0883 - acc:
0.4179 - val_loss: 1.0926 - val_acc: 0.2889
Epoch 12/500
67/67 [==============================] - 0s 327us/step - loss: 1.0849 - acc:
0.4179 - val_loss: 1.0899 - val_acc: 0.2889
Epoch 13/500
67/67 [==============================] - 0s 238us/step - loss: 1.0807 - acc:
0.4179 - val_loss: 1.0867 - val_acc: 0.2889
Epoch 14/500
67/67 [==============================] - ETA: 0s - loss: 1.0771 - acc: 0.550 -
0s 267us/step - loss: 1.0754 - acc: 0.4776 - val_loss: 1.0826 - val_acc: 0.2889
Epoch 15/500
67/67 [==============================] - 0s 252us/step - loss: 1.0680 - acc:
0.4478 - val_loss: 1.0775 - val_acc: 0.4222
Epoch 16/500
67/67 [==============================] - 0s 267us/step - loss: 1.0634 - acc:
0.5821 - val_loss: 1.0714 - val_acc: 0.6667
Epoch 17/500
67/67 [==============================] - 0s 239us/step - loss: 1.0520 - acc:
0.6418 - val_loss: 1.0643 - val_acc: 0.6667
Epoch 18/500
67/67 [==============================] - 0s 249us/step - loss: 1.0436 - acc:
0.6567 - val_loss: 1.0560 - val_acc: 0.6667
Epoch 19/500
67/67 [==============================] - 0s 254us/step - loss: 1.0256 - acc:
0.6716 - val_loss: 1.0463 - val_acc: 0.6667
Epoch 20/500
67/67 [==============================] - 0s 238us/step - loss: 1.0160 - acc:
0.6866 - val_loss: 1.0353 - val_acc: 0.6667
Epoch 21/500
67/67 [==============================] - 0s 253us/step - loss: 1.0045 - acc:
0.6866 - val_loss: 1.0228 - val_acc: 0.6667
Epoch 22/500
67/67 [==============================] - 0s 253us/step - loss: 0.9916 - acc:
0.7164 - val_loss: 1.0094 - val_acc: 0.6667
Epoch 23/500
67/67 [==============================] - 0s 283us/step - loss: 0.9673 - acc:
0.7015 - val_loss: 0.9954 - val_acc: 0.6667
Epoch 24/500
67/67 [==============================] - 0s 282us/step - loss: 0.9377 - acc:
0.7015 - val_loss: 0.9800 - val_acc: 0.6667
Epoch 25/500
67/67 [==============================] - 0s 313us/step - loss: 0.9282 - acc:
```

```
0.7015 - val_loss: 0.9636 - val_acc: 0.6667
Epoch 26/500
67/67 [==============================] - 0s 283us/step - loss: 0.8963 - acc:
0.7164 - val_loss: 0.9462 - val_acc: 0.6667
Epoch 27/500
67/67 [==============================] - 0s 283us/step - loss: 0.8794 - acc:
0.7164 - val_loss: 0.9281 - val_acc: 0.6667
Epoch 28/500
67/67 [==============================] - 0s 402us/step - loss: 0.8796 - acc:
0.6866 - val_loss: 0.9106 - val_acc: 0.6667
Epoch 29/500
67/67 [==============================] - 0s 238us/step - loss: 0.8293 - acc:
0.7164 - val_loss: 0.8925 - val_acc: 0.6667
Epoch 30/500
67/67 [==============================] - 0s 264us/step - loss: 0.8171 - acc:
0.7164 - val_loss: 0.8738 - val_acc: 0.6667
Epoch 31/500
67/67 [==============================] - 0s 239us/step - loss: 0.7662 - acc:
0.7164 - val_loss: 0.8542 - val_acc: 0.6667
Epoch 32/500
67/67 [==============================] - 0s 238us/step - loss: 0.7559 - acc:
0.7164 - val_loss: 0.8354 - val_acc: 0.6667
Epoch 33/500
67/67 [==============================] - 0s 297us/step - loss: 0.7444 - acc:
0.7164 - val_loss: 0.8173 - val_acc: 0.6667
Epoch 34/500
67/67 [==============================] - 0s 223us/step - loss: 0.7233 - acc:
0.7015 - val_loss: 0.7999 - val_acc: 0.6667
Epoch 35/500
67/67 [==============================] - 0s 223us/step - loss: 0.7089 - acc:
0.7015 - val_loss: 0.7826 - val_acc: 0.6667
Epoch 36/500
67/67 [==============================] - 0s 223us/step - loss: 0.7247 - acc:
0.7015 - val_loss: 0.7652 - val_acc: 0.6667
Epoch 37/500
67/67 [==============================] - 0s 269us/step - loss: 0.6572 - acc:
0.7164 - val_loss: 0.7479 - val_acc: 0.6667
Epoch 38/500
67/67 [==============================] - 0s 238us/step - loss: 0.6448 - acc:
0.7164 - val_loss: 0.7311 - val_acc: 0.6667
Epoch 39/500
67/67 [==============================] - 0s 250us/step - loss: 0.6370 - acc:
0.7164 - val_loss: 0.7158 - val_acc: 0.6667
Epoch 40/500
67/67 [==============================] - 0s 372us/step - loss: 0.6467 - acc:
0.7164 - val_loss: 0.7007 - val_acc: 0.6667
Epoch 41/500
67/67 [==============================] - 0s 327us/step - loss: 0.6152 - acc:
```

```
0.7164 - val_loss: 0.6852 - val_acc: 0.6667
Epoch 42/500
67/67 [==============================] - 0s 323us/step - loss: 0.6241 - acc:
0.7164 - val_loss: 0.6703 - val_acc: 0.6667
Epoch 43/500
67/67 [==============================] - 0s 208us/step - loss: 0.5736 - acc:
0.7164 - val_loss: 0.6557 - val_acc: 0.6667
Epoch 44/500
67/67 [==============================] - 0s 238us/step - loss: 0.6046 - acc:
0.7164 - val_loss: 0.6422 - val_acc: 0.6667
Epoch 45/500
67/67 [==============================] - 0s 223us/step - loss: 0.5900 - acc:
0.7164 - val_loss: 0.6291 - val_acc: 0.6667
Epoch 46/500
67/67 [==============================] - 0s 237us/step - loss: 0.5758 - acc:
0.7164 - val_loss: 0.6173 - val_acc: 0.6667
Epoch 47/500
67/67 [==============================] - 0s 267us/step - loss: 0.5499 - acc:
0.7015 - val_loss: 0.6074 - val_acc: 0.6667
Epoch 48/500
67/67 [==============================] - 0s 236us/step - loss: 0.5610 - acc:
0.7164 - val_loss: 0.5980 - val_acc: 0.6667
Epoch 49/500
67/67 [==============================] - 0s 208us/step - loss: 0.5270 - acc:
0.7164 - val_loss: 0.5895 - val_acc: 0.6667
Epoch 50/500
67/67 [==============================] - 0s 224us/step - loss: 0.5350 - acc:
0.7164 - val_loss: 0.5818 - val_acc: 0.6667
Epoch 51/500
67/67 [==============================] - 0s 238us/step - loss: 0.5193 - acc:
0.7164 - val_loss: 0.5742 - val_acc: 0.6667
Epoch 52/500
67/67 [==============================] - 0s 238us/step - loss: 0.5194 - acc:
0.7164 - val_loss: 0.5671 - val_acc: 0.6667
Epoch 53/500
67/67 [==============================] - 0s 238us/step - loss: 0.4976 - acc:
0.7164 - val_loss: 0.5609 - val_acc: 0.6667
Epoch 54/500
67/67 [==============================] - 0s 223us/step - loss: 0.4898 - acc:
0.7164 - val_loss: 0.5544 - val_acc: 0.6667
Epoch 55/500
67/67 [==============================] - 0s 238us/step - loss: 0.5015 - acc:
0.7164 - val_loss: 0.5484 - val_acc: 0.6667
Epoch 56/500
67/67 [==============================] - 0s 238us/step - loss: 0.4791 - acc:
0.7164 - val_loss: 0.5428 - val_acc: 0.6667
Epoch 57/500
67/67 [==============================] - 0s 223us/step - loss: 0.5037 - acc:
```

```
0.7164 - val_loss: 0.5378 - val_acc: 0.6667
Epoch 58/500
67/67 [==============================] - 0s 233us/step - loss: 0.5142 - acc:
0.7164 - val_loss: 0.5321 - val_acc: 0.6667
Epoch 59/500
67/67 [==============================] - 0s 253us/step - loss: 0.4785 - acc:
0.7164 - val_loss: 0.5271 - val_acc: 0.6667
Epoch 60/500
67/67 [==============================] - 0s 237us/step - loss: 0.4769 - acc:
0.7164 - val_loss: 0.5228 - val_acc: 0.6667
Epoch 61/500
67/67 [==============================] - 0s 208us/step - loss: 0.4764 - acc:
0.7164 - val_loss: 0.5190 - val_acc: 0.6667
Epoch 62/500
67/67 [==============================] - 0s 210us/step - loss: 0.4690 - acc:
0.7164 - val_loss: 0.5160 - val_acc: 0.6667
Epoch 63/500
67/67 [==============================] - 0s 253us/step - loss: 0.4433 - acc:
0.7164 - val_loss: 0.5133 - val_acc: 0.6667
Epoch 64/500
67/67 [==============================] - 0s 239us/step - loss: 0.4623 - acc:
0.7164 - val_loss: 0.5104 - val_acc: 0.6667
Epoch 65/500
67/67 [==============================] - 0s 237us/step - loss: 0.4764 - acc:
0.7164 - val_loss: 0.5069 - val_acc: 0.6667
Epoch 66/500
67/67 [==============================] - 0s 284us/step - loss: 0.4686 - acc:
0.7164 - val_loss: 0.5029 - val_acc: 0.6667
Epoch 67/500
67/67 [==============================] - 0s 268us/step - loss: 0.4388 - acc:
0.7164 - val_loss: 0.5001 - val_acc: 0.6667
Epoch 68/500
67/67 [==============================] - 0s 298us/step - loss: 0.4523 - acc:
0.7015 - val_loss: 0.4976 - val_acc: 0.6667
Epoch 69/500
67/67 [==============================] - 0s 238us/step - loss: 0.4378 - acc:
0.7313 - val_loss: 0.4953 - val_acc: 0.6667
Epoch 70/500
67/67 [==============================] - 0s 268us/step - loss: 0.4554 - acc:
0.7164 - val_loss: 0.4931 - val_acc: 0.6889
Epoch 71/500
67/67 [==============================] - 0s 282us/step - loss: 0.4593 - acc:
0.7164 - val_loss: 0.4896 - val_acc: 0.7111
Epoch 72/500
67/67 [==============================] - 0s 239us/step - loss: 0.4433 - acc:
0.7313 - val_loss: 0.4871 - val_acc: 0.7111
Epoch 73/500
67/67 [==============================] - 0s 258us/step - loss: 0.4192 - acc:
```

```
0.7164 - val_loss: 0.4847 - val_acc: 0.7111
Epoch 74/500
67/67 [==============================] - 0s 243us/step - loss: 0.4452 - acc:
0.7164 - val_loss: 0.4831 - val_acc: 0.6889
Epoch 75/500
67/67 [==============================] - 0s 283us/step - loss: 0.4217 - acc:
0.7313 - val_loss: 0.4814 - val_acc: 0.6889
Epoch 76/500
67/67 [==============================] - 0s 252us/step - loss: 0.4431 - acc:
0.7463 - val_loss: 0.4796 - val_acc: 0.7111
Epoch 77/500
67/67 [==============================] - 0s 252us/step - loss: 0.4314 - acc:
0.7164 - val_loss: 0.4781 - val_acc: 0.7111
Epoch 78/500
67/67 [==============================] - 0s 269us/step - loss: 0.4242 - acc:
0.7164 - val_loss: 0.4762 - val_acc: 0.7111
Epoch 79/500
67/67 [==============================] - 0s 253us/step - loss: 0.4425 - acc:
0.7313 - val_loss: 0.4733 - val_acc: 0.7111
Epoch 80/500
67/67 [==============================] - 0s 254us/step - loss: 0.4142 - acc:
0.7164 - val_loss: 0.4702 - val_acc: 0.7111
Epoch 81/500
67/67 [==============================] - 0s 270us/step - loss: 0.4228 - acc:
0.7313 - val_loss: 0.4677 - val_acc: 0.7111
Epoch 82/500
67/67 [==============================] - 0s 298us/step - loss: 0.4437 - acc:
0.7313 - val_loss: 0.4649 - val_acc: 0.7111
Epoch 83/500
67/67 [==============================] - 0s 266us/step - loss: 0.4224 - acc:
0.7463 - val_loss: 0.4622 - val_acc: 0.7111
Epoch 84/500
67/67 [==============================] - 0s 251us/step - loss: 0.4139 - acc:
0.7612 - val_loss: 0.4600 - val_acc: 0.7333
Epoch 85/500
67/67 [==============================] - 0s 253us/step - loss: 0.4298 - acc:
0.7164 - val_loss: 0.4582 - val_acc: 0.7333
Epoch 86/500
67/67 [==============================] - 0s 341us/step - loss: 0.4093 - acc:
0.7463 - val_loss: 0.4564 - val_acc: 0.7333
Epoch 87/500
67/67 [==============================] - 0s 287us/step - loss: 0.4065 - acc:
0.7612 - val_loss: 0.4545 - val_acc: 0.7333
Epoch 88/500
67/67 [==============================] - 0s 270us/step - loss: 0.4607 - acc:
0.7463 - val_loss: 0.4534 - val_acc: 0.7333
Epoch 89/500
67/67 [==============================] - 0s 283us/step - loss: 0.3859 - acc:
```

```
0.7612 - val_loss: 0.4517 - val_acc: 0.7333
Epoch 90/500
67/67 [==============================] - 0s 297us/step - loss: 0.4365 - acc:
0.7612 - val_loss: 0.4501 - val_acc: 0.7333
Epoch 91/500
67/67 [==============================] - 0s 329us/step - loss: 0.4145 - acc:
0.7612 - val_loss: 0.4486 - val_acc: 0.7333
Epoch 92/500
67/67 [==============================] - 0s 198us/step - loss: 0.4177 - acc:
0.7463 - val_loss: 0.4475 - val_acc: 0.7333
Epoch 93/500
67/67 [==============================] - 0s 298us/step - loss: 0.4271 - acc:
0.7463 - val_loss: 0.4459 - val_acc: 0.7333
Epoch 94/500
67/67 [==============================] - 0s 238us/step - loss: 0.4264 - acc:
0.7612 - val_loss: 0.4449 - val_acc: 0.7333
Epoch 95/500
67/67 [==============================] - 0s 253us/step - loss: 0.4133 - acc:
0.7463 - val_loss: 0.4440 - val_acc: 0.7333
Epoch 96/500
67/67 [==============================] - 0s 269us/step - loss: 0.4070 - acc:
0.7910 - val_loss: 0.4433 - val_acc: 0.7333
Epoch 97/500
67/67 [==============================] - 0s 312us/step - loss: 0.4288 - acc:
0.7463 - val_loss: 0.4416 - val_acc: 0.7333
Epoch 98/500
67/67 [==============================] - 0s 269us/step - loss: 0.3799 - acc:
0.7612 - val_loss: 0.4402 - val_acc: 0.7333
Epoch 99/500
67/67 [==============================] - 0s 253us/step - loss: 0.4069 - acc:
0.7910 - val_loss: 0.4387 - val_acc: 0.7333
Epoch 100/500
67/67 [==============================] - 0s 252us/step - loss: 0.3827 - acc:
0.7761 - val_loss: 0.4362 - val_acc: 0.7333
Epoch 101/500
67/67 [==============================] - 0s 282us/step - loss: 0.3952 - acc:
0.7761 - val_loss: 0.4342 - val_acc: 0.7333
Epoch 102/500
67/67 [==============================] - 0s 238us/step - loss: 0.4052 - acc:
0.7761 - val_loss: 0.4330 - val_acc: 0.7333
Epoch 103/500
67/67 [==============================] - 0s 254us/step - loss: 0.4041 - acc:
0.8060 - val_loss: 0.4326 - val_acc: 0.7333
Epoch 104/500
67/67 [==============================] - 0s 432us/step - loss: 0.3800 - acc:
0.8060 - val_loss: 0.4315 - val_acc: 0.7333
Epoch 105/500
67/67 [==============================] - 0s 239us/step - loss: 0.3713 - acc:
```

```
0.8060 - val_loss: 0.4313 - val_acc: 0.7333
Epoch 106/500
67/67 [==============================] - 0s 238us/step - loss: 0.3745 - acc:
0.7761 - val_loss: 0.4303 - val_acc: 0.7333
Epoch 107/500
67/67 [==============================] - 0s 253us/step - loss: 0.3836 - acc:
0.8209 - val_loss: 0.4292 - val_acc: 0.7333
Epoch 108/500
67/67 [==============================] - 0s 268us/step - loss: 0.3547 - acc:
0.8060 - val_loss: 0.4277 - val_acc: 0.7333
Epoch 109/500
67/67 [==============================] - 0s 253us/step - loss: 0.3962 - acc:
0.7910 - val_loss: 0.4264 - val_acc: 0.7333
Epoch 110/500
67/67 [==============================] - 0s 388us/step - loss: 0.3749 - acc:
0.8060 - val_loss: 0.4256 - val_acc: 0.7333
Epoch 111/500
67/67 [==============================] - 0s 249us/step - loss: 0.3754 - acc:
0.8358 - val_loss: 0.4246 - val_acc: 0.7333
Epoch 112/500
67/67 [==============================] - 0s 297us/step - loss: 0.4055 - acc:
0.7910 - val_loss: 0.4240 - val_acc: 0.7333
Epoch 113/500
67/67 [==============================] - 0s 268us/step - loss: 0.3817 - acc:
0.8209 - val_loss: 0.4223 - val_acc: 0.7333
Epoch 114/500
67/67 [==============================] - 0s 313us/step - loss: 0.3659 - acc:
0.8060 - val_loss: 0.4208 - val_acc: 0.7333
Epoch 115/500
67/67 [==============================] - 0s 266us/step - loss: 0.3879 - acc:
0.7761 - val_loss: 0.4199 - val_acc: 0.7333
Epoch 116/500
67/67 [==============================] - 0s 297us/step - loss: 0.3501 - acc:
0.8657 - val_loss: 0.4186 - val_acc: 0.7333
Epoch 117/500
67/67 [==============================] - 0s 265us/step - loss: 0.3740 - acc:
0.8507 - val_loss: 0.4183 - val_acc: 0.7333
Epoch 118/500
67/67 [==============================] - 0s 223us/step - loss: 0.3753 - acc:
0.7910 - val_loss: 0.4187 - val_acc: 0.7333
Epoch 119/500
67/67 [==============================] - 0s 254us/step - loss: 0.3765 - acc:
0.8209 - val_loss: 0.4189 - val_acc: 0.7333
Epoch 120/500
67/67 [==============================] - 0s 223us/step - loss: 0.3525 - acc:
0.7910 - val_loss: 0.4184 - val_acc: 0.7333
Epoch 121/500
67/67 [==============================] - 0s 299us/step - loss: 0.3822 - acc:
```

```
0.8507 - val_loss: 0.4183 - val_acc: 0.7333
Epoch 122/500
67/67 [==============================] - 0s 208us/step - loss: 0.3562 - acc:
0.7910 - val_loss: 0.4168 - val_acc: 0.7333
Epoch 123/500
67/67 [==============================] - 0s 280us/step - loss: 0.3888 - acc:
0.8060 - val_loss: 0.4164 - val_acc: 0.7333
Epoch 124/500
67/67 [==============================] - 0s 252us/step - loss: 0.3438 - acc:
0.8358 - val_loss: 0.4159 - val_acc: 0.7556
Epoch 125/500
67/67 [==============================] - 0s 269us/step - loss: 0.3736 - acc:
0.8358 - val_loss: 0.4147 - val_acc: 0.7556
Epoch 126/500
67/67 [==============================] - 0s 241us/step - loss: 0.3926 - acc:
0.8358 - val_loss: 0.4130 - val_acc: 0.7556
Epoch 127/500
67/67 [==============================] - 0s 268us/step - loss: 0.3695 - acc:
0.8358 - val_loss: 0.4098 - val_acc: 0.7556
Epoch 128/500
67/67 [==============================] - 0s 253us/step - loss: 0.3386 - acc:
0.8507 - val_loss: 0.4083 - val_acc: 0.7556
Epoch 129/500
67/67 [==============================] - 0s 282us/step - loss: 0.3786 - acc:
0.7910 - val_loss: 0.4065 - val_acc: 0.7556
Epoch 130/500
67/67 [==============================] - 0s 251us/step - loss: 0.3356 - acc:
0.8507 - val_loss: 0.4055 - val_acc: 0.7556
Epoch 131/500
67/67 [==============================] - 0s 313us/step - loss: 0.3821 - acc:
0.8358 - val_loss: 0.4047 - val_acc: 0.7556
Epoch 132/500
67/67 [==============================] - 0s 238us/step - loss: 0.3491 - acc:
0.8209 - val_loss: 0.4032 - val_acc: 0.7556
Epoch 133/500
67/67 [==============================] - 0s 283us/step - loss: 0.4039 - acc:
0.8209 - val_loss: 0.4019 - val_acc: 0.7556
Epoch 134/500
67/67 [==============================] - 0s 223us/step - loss: 0.3483 - acc:
0.8209 - val_loss: 0.4000 - val_acc: 0.7778
Epoch 135/500
67/67 [==============================] - 0s 229us/step - loss: 0.3409 - acc:
0.8358 - val_loss: 0.3984 - val_acc: 0.7778
Epoch 136/500
67/67 [==============================] - 0s 270us/step - loss: 0.3590 - acc:
0.8806 - val_loss: 0.3965 - val_acc: 0.7778
Epoch 137/500
67/67 [==============================] - 0s 283us/step - loss: 0.3387 - acc:
```

```
0.8507 - val_loss: 0.3953 - val_acc: 0.7778
Epoch 138/500
67/67 [==============================] - 0s 302us/step - loss: 0.3225 - acc:
0.8657 - val_loss: 0.3944 - val_acc: 0.7778
Epoch 139/500
67/67 [==============================] - 0s 267us/step - loss: 0.3312 - acc:
0.8507 - val_loss: 0.3944 - val_acc: 0.7778
Epoch 140/500
67/67 [==============================] - 0s 327us/step - loss: 0.3591 - acc:
0.8657 - val_loss: 0.3929 - val_acc: 0.7778
Epoch 141/500
67/67 [==============================] - 0s 241us/step - loss: 0.3649 - acc:
0.8657 - val_loss: 0.3917 - val_acc: 0.7778
Epoch 142/500
67/67 [==============================] - 0s 253us/step - loss: 0.3484 - acc:
0.8358 - val_loss: 0.3910 - val_acc: 0.7778
Epoch 143/500
67/67 [==============================] - 0s 283us/step - loss: 0.3631 - acc:
0.8358 - val_loss: 0.3908 - val_acc: 0.7778
Epoch 144/500
67/67 [==============================] - 0s 283us/step - loss: 0.3428 - acc:
0.8358 - val_loss: 0.3907 - val_acc: 0.7778
Epoch 145/500
67/67 [==============================] - 0s 269us/step - loss: 0.3390 - acc:
0.8358 - val_loss: 0.3908 - val_acc: 0.7778
Epoch 146/500
67/67 [==============================] - 0s 268us/step - loss: 0.3767 - acc:
0.8209 - val_loss: 0.3898 - val_acc: 0.7778
Epoch 147/500
67/67 [==============================] - 0s 254us/step - loss: 0.3513 - acc:
0.8060 - val_loss: 0.3886 - val_acc: 0.7778
Epoch 148/500
67/67 [==============================] - 0s 223us/step - loss: 0.3339 - acc:
0.8507 - val_loss: 0.3875 - val_acc: 0.7778
Epoch 149/500
67/67 [==============================] - 0s 283us/step - loss: 0.3670 - acc:
0.8507 - val_loss: 0.3868 - val_acc: 0.8000
Epoch 150/500
67/67 [==============================] - 0s 250us/step - loss: 0.3575 - acc:
0.8358 - val_loss: 0.3859 - val_acc: 0.8000
Epoch 151/500
67/67 [==============================] - 0s 239us/step - loss: 0.3464 - acc:
0.8507 - val_loss: 0.3852 - val_acc: 0.8000
Epoch 152/500
67/67 [==============================] - 0s 298us/step - loss: 0.3276 - acc:
0.8806 - val_loss: 0.3843 - val_acc: 0.8000
Epoch 153/500
67/67 [==============================] - 0s 283us/step - loss: 0.3400 - acc:
```

```
0.8358 - val_loss: 0.3837 - val_acc: 0.8000
Epoch 154/500
67/67 [==============================] - 0s 432us/step - loss: 0.3194 - acc:
0.8657 - val_loss: 0.3821 - val_acc: 0.8000
Epoch 155/500
67/67 [==============================] - 0s 252us/step - loss: 0.3231 - acc:
0.8657 - val_loss: 0.3806 - val_acc: 0.8000
Epoch 156/500
67/67 [==============================] - 0s 283us/step - loss: 0.3276 - acc:
0.8507 - val_loss: 0.3793 - val_acc: 0.8000
Epoch 157/500
67/67 [==============================] - 0s 238us/step - loss: 0.3320 - acc:
0.8657 - val_loss: 0.3772 - val_acc: 0.8000
Epoch 158/500
67/67 [==============================] - 0s 268us/step - loss: 0.3620 - acc:
0.8657 - val_loss: 0.3752 - val_acc: 0.8222
Epoch 159/500
67/67 [==============================] - 0s 279us/step - loss: 0.3157 - acc:
0.8657 - val_loss: 0.3746 - val_acc: 0.8222
Epoch 160/500
67/67 [==============================] - 0s 264us/step - loss: 0.3271 - acc:
0.8657 - val_loss: 0.3752 - val_acc: 0.8222
Epoch 161/500
67/67 [==============================] - 0s 283us/step - loss: 0.3492 - acc:
0.8657 - val_loss: 0.3760 - val_acc: 0.8000
Epoch 162/500
67/67 [==============================] - 0s 253us/step - loss: 0.3218 - acc:
0.8507 - val_loss: 0.3767 - val_acc: 0.8000
Epoch 163/500
67/67 [==============================] - 0s 266us/step - loss: 0.3122 - acc:
0.8358 - val_loss: 0.3772 - val_acc: 0.8000
Epoch 164/500
67/67 [==============================] - 0s 268us/step - loss: 0.3261 - acc:
0.8507 - val_loss: 0.3764 - val_acc: 0.8000
Epoch 165/500
67/67 [==============================] - 0s 243us/step - loss: 0.3288 - acc:
0.8358 - val_loss: 0.3751 - val_acc: 0.8222
Epoch 166/500
67/67 [==============================] - 0s 283us/step - loss: 0.3074 - acc:
0.8507 - val_loss: 0.3731 - val_acc: 0.8222
Epoch 167/500
67/67 [==============================] - 0s 253us/step - loss: 0.3318 - acc:
0.8507 - val_loss: 0.3711 - val_acc: 0.8222
Epoch 168/500
67/67 [==============================] - 0s 266us/step - loss: 0.3454 - acc:
0.8507 - val_loss: 0.3685 - val_acc: 0.8222
Epoch 169/500
67/67 [==============================] - 0s 253us/step - loss: 0.3083 - acc:
```

```
0.8955 - val_loss: 0.3670 - val_acc: 0.8222
Epoch 170/500
67/67 [==============================] - 0s 283us/step - loss: 0.3069 - acc:
0.8806 - val_loss: 0.3649 - val_acc: 0.8222
Epoch 171/500
67/67 [==============================] - 0s 283us/step - loss: 0.3138 - acc:
0.8657 - val_loss: 0.3633 - val_acc: 0.8222
Epoch 172/500
67/67 [==============================] - 0s 297us/step - loss: 0.3383 - acc:
0.8657 - val_loss: 0.3623 - val_acc: 0.8222
Epoch 173/500
67/67 [==============================] - 0s 253us/step - loss: 0.3034 - acc:
0.8806 - val_loss: 0.3608 - val_acc: 0.8222
Epoch 174/500
67/67 [==============================] - 0s 313us/step - loss: 0.3090 - acc:
0.8657 - val_loss: 0.3587 - val_acc: 0.8222
Epoch 175/500
67/67 [==============================] - 0s 288us/step - loss: 0.3214 - acc:
0.8209 - val_loss: 0.3577 - val_acc: 0.8222
Epoch 176/500
67/67 [==============================] - 0s 253us/step - loss: 0.3194 - acc:
0.8955 - val_loss: 0.3568 - val_acc: 0.8222
Epoch 177/500
67/67 [==============================] - 0s 283us/step - loss: 0.3250 - acc:
0.9104 - val_loss: 0.3564 - val_acc: 0.8222
Epoch 178/500
67/67 [==============================] - 0s 253us/step - loss: 0.3214 - acc:
0.8507 - val_loss: 0.3555 - val_acc: 0.8222
Epoch 179/500
67/67 [==============================] - 0s 253us/step - loss: 0.3133 - acc:
0.8955 - val_loss: 0.3558 - val_acc: 0.8222
Epoch 180/500
67/67 [==============================] - 0s 268us/step - loss: 0.3070 - acc:
0.8955 - val_loss: 0.3562 - val_acc: 0.8222
Epoch 181/500
67/67 [==============================] - 0s 298us/step - loss: 0.3064 - acc:
0.8806 - val_loss: 0.3566 - val_acc: 0.8222
Epoch 182/500
67/67 [==============================] - 0s 238us/step - loss: 0.3658 - acc:
0.8060 - val_loss: 0.3565 - val_acc: 0.8222
Epoch 183/500
67/67 [==============================] - 0s 267us/step - loss: 0.3050 - acc:
0.8806 - val_loss: 0.3568 - val_acc: 0.8222
Epoch 184/500
67/67 [==============================] - 0s 283us/step - loss: 0.3099 - acc:
0.8358 - val_loss: 0.3575 - val_acc: 0.8222
Epoch 185/500
67/67 [==============================] - 0s 284us/step - loss: 0.2996 - acc:
```

```
0.8955 - val_loss: 0.3579 - val_acc: 0.8222
Epoch 186/500
67/67 [==============================] - 0s 283us/step - loss: 0.3077 - acc:
0.8806 - val_loss: 0.3580 - val_acc: 0.8222
Epoch 187/500
67/67 [==============================] - 0s 253us/step - loss: 0.3200 - acc:
0.8507 - val_loss: 0.3560 - val_acc: 0.8222
Epoch 188/500
67/67 [==============================] - 0s 223us/step - loss: 0.3177 - acc:
0.8507 - val_loss: 0.3545 - val_acc: 0.8222
Epoch 189/500
67/67 [==============================] - 0s 268us/step - loss: 0.3170 - acc:
0.8806 - val_loss: 0.3518 - val_acc: 0.8222
Epoch 190/500
67/67 [==============================] - 0s 327us/step - loss: 0.2988 - acc:
0.8806 - val_loss: 0.3499 - val_acc: 0.8222
Epoch 191/500
67/67 [==============================] - 0s 268us/step - loss: 0.2999 - acc:
0.8806 - val_loss: 0.3475 - val_acc: 0.8222
Epoch 192/500
67/67 [==============================] - 0s 269us/step - loss: 0.2861 - acc:
0.8955 - val_loss: 0.3453 - val_acc: 0.8222
Epoch 193/500
67/67 [==============================] - 0s 323us/step - loss: 0.3239 - acc:
0.8657 - val_loss: 0.3439 - val_acc: 0.8222
Epoch 194/500
67/67 [==============================] - 0s 343us/step - loss: 0.3168 - acc:
0.8955 - val_loss: 0.3426 - val_acc: 0.8222
Epoch 195/500
67/67 [==============================] - 0s 364us/step - loss: 0.2976 - acc:
0.9104 - val_loss: 0.3426 - val_acc: 0.8222
Epoch 196/500
67/67 [==============================] - 0s 569us/step - loss: 0.3141 - acc:
0.8507 - val_loss: 0.3428 - val_acc: 0.8222
Epoch 197/500
67/67 [==============================] - 0s 325us/step - loss: 0.3028 - acc:
0.9104 - val_loss: 0.3426 - val_acc: 0.8222
Epoch 198/500
67/67 [==============================] - 0s 343us/step - loss: 0.3175 - acc:
0.8806 - val_loss: 0.3411 - val_acc: 0.8222
Epoch 199/500
67/67 [==============================] - 0s 327us/step - loss: 0.2806 - acc:
0.8657 - val_loss: 0.3401 - val_acc: 0.8222
Epoch 200/500
67/67 [==============================] - 0s 387us/step - loss: 0.2752 - acc:
0.8955 - val_loss: 0.3392 - val_acc: 0.8222
Epoch 201/500
67/67 [==============================] - 0s 268us/step - loss: 0.2545 - acc:
```

```
0.9104 - val_loss: 0.3382 - val_acc: 0.8222
Epoch 202/500
67/67 [==============================] - 0s 327us/step - loss: 0.2708 - acc:
0.8657 - val_loss: 0.3372 - val_acc: 0.8222
Epoch 203/500
67/67 [==============================] - 0s 329us/step - loss: 0.2862 - acc:
0.8955 - val_loss: 0.3361 - val_acc: 0.8222
Epoch 204/500
67/67 [==============================] - 0s 341us/step - loss: 0.2951 - acc:
0.8806 - val_loss: 0.3349 - val_acc: 0.8222
Epoch 205/500
67/67 [==============================] - 0s 281us/step - loss: 0.2852 - acc:
0.8955 - val_loss: 0.3334 - val_acc: 0.8222
Epoch 206/500
67/67 [==============================] - 0s 342us/step - loss: 0.2860 - acc:
0.8806 - val_loss: 0.3326 - val_acc: 0.8222
Epoch 207/500
67/67 [==============================] - 0s 372us/step - loss: 0.2789 - acc:
0.9104 - val_loss: 0.3322 - val_acc: 0.8222
Epoch 208/500
67/67 [==============================] - 0s 328us/step - loss: 0.2837 - acc:
0.8806 - val_loss: 0.3319 - val_acc: 0.8222
Epoch 209/500
67/67 [==============================] - 0s 342us/step - loss: 0.2834 - acc:
0.9104 - val_loss: 0.3313 - val_acc: 0.8222
Epoch 210/500
67/67 [==============================] - 0s 372us/step - loss: 0.2946 - acc:
0.8806 - val_loss: 0.3317 - val_acc: 0.8222
Epoch 211/500
67/67 [==============================] - 0s 685us/step - loss: 0.2751 - acc:
0.9104 - val_loss: 0.3321 - val_acc: 0.8222
Epoch 212/500
67/67 [==============================] - 0s 313us/step - loss: 0.3036 - acc:
0.8955 - val_loss: 0.3311 - val_acc: 0.8222
Epoch 213/500
67/67 [==============================] - 0s 447us/step - loss: 0.2699 - acc:
0.8657 - val_loss: 0.3303 - val_acc: 0.8222
Epoch 214/500
67/67 [==============================] - 0s 283us/step - loss: 0.2797 - acc:
0.8806 - val_loss: 0.3295 - val_acc: 0.8222
Epoch 215/500
67/67 [==============================] - 0s 319us/step - loss: 0.2897 - acc:
0.9104 - val_loss: 0.3280 - val_acc: 0.8222
Epoch 216/500
67/67 [==============================] - 0s 372us/step - loss: 0.2525 - acc:
0.8806 - val_loss: 0.3266 - val_acc: 0.8222
Epoch 217/500
67/67 [==============================] - 0s 357us/step - loss: 0.2841 - acc:
```

```
0.8657 - val_loss: 0.3251 - val_acc: 0.8222
Epoch 218/500
67/67 [==============================] - 0s 305us/step - loss: 0.3124 - acc:
0.8657 - val_loss: 0.3218 - val_acc: 0.8222
Epoch 219/500
67/67 [==============================] - 0s 314us/step - loss: 0.3053 - acc:
0.8806 - val_loss: 0.3190 - val_acc: 0.8222
Epoch 220/500
67/67 [==============================] - 0s 355us/step - loss: 0.2529 - acc:
0.9552 - val_loss: 0.3183 - val_acc: 0.8222
Epoch 221/500
67/67 [==============================] - 0s 282us/step - loss: 0.2475 - acc:
0.9104 - val_loss: 0.3174 - val_acc: 0.8222
Epoch 222/500
67/67 [==============================] - 0s 417us/step - loss: 0.2596 - acc:
0.9104 - val_loss: 0.3168 - val_acc: 0.8222
Epoch 223/500
67/67 [==============================] - 0s 322us/step - loss: 0.2465 - acc:
0.9403 - val_loss: 0.3166 - val_acc: 0.8222
Epoch 224/500
67/67 [==============================] - 0s 308us/step - loss: 0.2573 - acc:
0.9403 - val_loss: 0.3161 - val_acc: 0.8222
Epoch 225/500
67/67 [==============================] - 0s 283us/step - loss: 0.3066 - acc:
0.8955 - val_loss: 0.3158 - val_acc: 0.8222
Epoch 226/500
67/67 [==============================] - 0s 343us/step - loss: 0.2590 - acc:
0.9254 - val_loss: 0.3153 - val_acc: 0.8222
Epoch 227/500
67/67 [==============================] - 0s 357us/step - loss: 0.2691 - acc:
0.9403 - val_loss: 0.3144 - val_acc: 0.8222
Epoch 228/500
67/67 [==============================] - 0s 365us/step - loss: 0.2777 - acc:
0.8806 - val_loss: 0.3142 - val_acc: 0.8222
Epoch 229/500
67/67 [==============================] - 0s 366us/step - loss: 0.2674 - acc:
0.9104 - val_loss: 0.3144 - val_acc: 0.8222
Epoch 230/500
67/67 [==============================] - 0s 342us/step - loss: 0.2353 - acc:
0.9254 - val_loss: 0.3135 - val_acc: 0.8222
Epoch 231/500
67/67 [==============================] - 0s 327us/step - loss: 0.2588 - acc:
0.8806 - val_loss: 0.3113 - val_acc: 0.8222
Epoch 232/500
67/67 [==============================] - 0s 342us/step - loss: 0.2592 - acc:
0.9254 - val_loss: 0.3105 - val_acc: 0.8222
Epoch 233/500
67/67 [==============================] - 0s 404us/step - loss: 0.2907 - acc:
```

```
0.8657 - val_loss: 0.3101 - val_acc: 0.8222
Epoch 234/500
67/67 [==============================] - 0s 402us/step - loss: 0.2710 - acc:
0.8955 - val_loss: 0.3087 - val_acc: 0.8222
Epoch 235/500
67/67 [==============================] - 0s 774us/step - loss: 0.2718 - acc:
0.9104 - val_loss: 0.3072 - val_acc: 0.8222
Epoch 236/500
67/67 [==============================] - 0s 343us/step - loss: 0.2607 - acc:
0.9104 - val_loss: 0.3046 - val_acc: 0.8222
Epoch 237/500
67/67 [==============================] - 0s 326us/step - loss: 0.2559 - acc:
0.8955 - val_loss: 0.3016 - val_acc: 0.8222
Epoch 238/500
67/67 [==============================] - 0s 595us/step - loss: 0.2757 - acc:
0.9254 - val_loss: 0.2986 - val_acc: 0.8222
Epoch 239/500
67/67 [==============================] - 0s 581us/step - loss: 0.2849 - acc:
0.9104 - val_loss: 0.2962 - val_acc: 0.8444
Epoch 240/500
67/67 [==============================] - 0s 342us/step - loss: 0.2526 - acc:
0.9403 - val_loss: 0.2943 - val_acc: 0.8444
Epoch 241/500
67/67 [==============================] - 0s 386us/step - loss: 0.2330 - acc:
0.9403 - val_loss: 0.2928 - val_acc: 0.8444
Epoch 242/500
67/67 [==============================] - 0s 372us/step - loss: 0.2443 - acc:
0.9104 - val_loss: 0.2925 - val_acc: 0.8444
Epoch 243/500
67/67 [==============================] - 0s 417us/step - loss: 0.2278 - acc:
0.9254 - val_loss: 0.2923 - val_acc: 0.8444
Epoch 244/500
67/67 [==============================] - 0s 393us/step - loss: 0.2814 - acc:
0.8955 - val_loss: 0.2916 - val_acc: 0.8444
Epoch 245/500
67/67 [==============================] - 0s 357us/step - loss: 0.2555 - acc:
0.9254 - val_loss: 0.2905 - val_acc: 0.8444
Epoch 246/500
67/67 [==============================] - 0s 5ms/step - loss: 0.2484 - acc:
0.9403 - val_loss: 0.2900 - val_acc: 0.8444
Epoch 247/500
67/67 [==============================] - 0s 342us/step - loss: 0.2366 - acc:
0.9701 - val_loss: 0.2898 - val_acc: 0.8444
Epoch 248/500
67/67 [==============================] - 0s 357us/step - loss: 0.2726 - acc:
0.9104 - val_loss: 0.2896 - val_acc: 0.8444
Epoch 249/500
67/67 [==============================] - 0s 373us/step - loss: 0.2302 - acc:
```

```
0.9552 - val_loss: 0.2879 - val_acc: 0.8444
Epoch 250/500
67/67 [==============================] - 0s 360us/step - loss: 0.2535 - acc:
0.9403 - val_loss: 0.2870 - val_acc: 0.8444
Epoch 251/500
67/67 [==============================] - 0s 343us/step - loss: 0.2450 - acc:
0.9552 - val_loss: 0.2868 - val_acc: 0.8444
Epoch 252/500
67/67 [==============================] - 0s 387us/step - loss: 0.2340 - acc:
0.9403 - val_loss: 0.2865 - val_acc: 0.8444
Epoch 253/500
67/67 [==============================] - 0s 655us/step - loss: 0.2299 - acc:
0.9254 - val_loss: 0.2863 - val_acc: 0.8444
Epoch 254/500
67/67 [==============================] - 0s 344us/step - loss: 0.2653 - acc:
0.9403 - val_loss: 0.2861 - val_acc: 0.8444
Epoch 255/500
67/67 [==============================] - 0s 313us/step - loss: 0.2595 - acc:
0.9254 - val_loss: 0.2860 - val_acc: 0.8444
Epoch 256/500
67/67 [==============================] - 0s 356us/step - loss: 0.2378 - acc:
0.9403 - val_loss: 0.2851 - val_acc: 0.8444
Epoch 257/500
67/67 [==============================] - 0s 401us/step - loss: 0.2238 - acc:
0.9254 - val_loss: 0.2841 - val_acc: 0.8444
Epoch 258/500
67/67 [==============================] - 0s 327us/step - loss: 0.2803 - acc:
0.9104 - val_loss: 0.2836 - val_acc: 0.8444
Epoch 259/500
67/67 [==============================] - 0s 384us/step - loss: 0.2480 - acc:
0.9552 - val_loss: 0.2815 - val_acc: 0.8444
Epoch 260/500
67/67 [==============================] - 0s 417us/step - loss: 0.2334 - acc:
0.9254 - val_loss: 0.2803 - val_acc: 0.8444
Epoch 261/500
67/67 [==============================] - 0s 337us/step - loss: 0.2332 - acc:
0.9104 - val_loss: 0.2799 - val_acc: 0.8444
Epoch 262/500
67/67 [==============================] - 0s 537us/step - loss: 0.2149 - acc:
0.9552 - val_loss: 0.2798 - val_acc: 0.8444
Epoch 263/500
67/67 [==============================] - 0s 342us/step - loss: 0.2576 - acc:
0.9254 - val_loss: 0.2791 - val_acc: 0.8444
Epoch 264/500
67/67 [==============================] - 0s 417us/step - loss: 0.2238 - acc:
0.9254 - val_loss: 0.2784 - val_acc: 0.8444
Epoch 265/500
67/67 [==============================] - 0s 387us/step - loss: 0.2565 - acc:
```

```
0.8955 - val_loss: 0.2768 - val_acc: 0.8444
Epoch 266/500
67/67 [==============================] - 0s 357us/step - loss: 0.2531 - acc:
0.9403 - val_loss: 0.2752 - val_acc: 0.8444
Epoch 267/500
67/67 [==============================] - 0s 373us/step - loss: 0.2115 - acc:
0.9701 - val_loss: 0.2747 - val_acc: 0.8444
Epoch 268/500
67/67 [==============================] - 0s 283us/step - loss: 0.2264 - acc:
0.9403 - val_loss: 0.2748 - val_acc: 0.8444
Epoch 269/500
67/67 [==============================] - 0s 283us/step - loss: 0.2273 - acc:
0.9254 - val_loss: 0.2738 - val_acc: 0.8444
Epoch 270/500
67/67 [==============================] - 0s 298us/step - loss: 0.2507 - acc:
0.9403 - val_loss: 0.2724 - val_acc: 0.8444
Epoch 271/500
67/67 [==============================] - 0s 341us/step - loss: 0.2252 - acc:
0.9552 - val_loss: 0.2696 - val_acc: 0.8667
Epoch 272/500
67/67 [==============================] - 0s 298us/step - loss: 0.2338 - acc:
0.9104 - val_loss: 0.2678 - val_acc: 0.8889
Epoch 273/500
67/67 [==============================] - 0s 313us/step - loss: 0.2350 - acc:
0.9254 - val_loss: 0.2662 - val_acc: 0.8889
Epoch 274/500
67/67 [==============================] - 0s 327us/step - loss: 0.2273 - acc:
0.9701 - val_loss: 0.2654 - val_acc: 0.8889
Epoch 275/500
67/67 [==============================] - 0s 313us/step - loss: 0.2159 - acc:
0.9701 - val_loss: 0.2653 - val_acc: 0.8889
Epoch 276/500
67/67 [==============================] - 0s 298us/step - loss: 0.2516 - acc:
0.9104 - val_loss: 0.2649 - val_acc: 0.8889
Epoch 277/500
67/67 [==============================] - 0s 461us/step - loss: 0.2613 - acc:
0.9254 - val_loss: 0.2640 - val_acc: 0.8889
Epoch 278/500
67/67 [==============================] - 0s 311us/step - loss: 0.2120 - acc:
0.9552 - val_loss: 0.2635 - val_acc: 0.8889
Epoch 279/500
67/67 [==============================] - 0s 298us/step - loss: 0.2376 - acc:
0.9403 - val_loss: 0.2625 - val_acc: 0.8889
Epoch 280/500
67/67 [==============================] - 0s 313us/step - loss: 0.2362 - acc:
0.9254 - val_loss: 0.2624 - val_acc: 0.8889
Epoch 281/500
67/67 [==============================] - 0s 403us/step - loss: 0.2428 - acc:
```

```
0.9254 - val_loss: 0.2629 - val_acc: 0.8889
Epoch 282/500
67/67 [==============================] - 0s 432us/step - loss: 0.2304 - acc:
0.9403 - val_loss: 0.2634 - val_acc: 0.8889
Epoch 283/500
67/67 [==============================] - 0s 299us/step - loss: 0.2243 - acc:
0.9552 - val_loss: 0.2620 - val_acc: 0.8889
Epoch 284/500
67/67 [==============================] - 0s 297us/step - loss: 0.2220 - acc:
0.9552 - val_loss: 0.2602 - val_acc: 0.8889
Epoch 285/500
67/67 [==============================] - 0s 327us/step - loss: 0.2075 - acc:
0.9701 - val_loss: 0.2594 - val_acc: 0.9111
Epoch 286/500
67/67 [==============================] - 0s 328us/step - loss: 0.2388 - acc:
0.9552 - val_loss: 0.2580 - val_acc: 0.9111
Epoch 287/500
67/67 [==============================] - 0s 327us/step - loss: 0.2295 - acc:
0.9701 - val_loss: 0.2562 - val_acc: 0.9111
Epoch 288/500
67/67 [==============================] - 0s 253us/step - loss: 0.1848 - acc:
0.9552 - val_loss: 0.2550 - val_acc: 0.9111
Epoch 289/500
67/67 [==============================] - 0s 340us/step - loss: 0.2433 - acc:
0.9403 - val_loss: 0.2542 - val_acc: 0.9111
Epoch 290/500
67/67 [==============================] - 0s 268us/step - loss: 0.2355 - acc:
0.9254 - val_loss: 0.2534 - val_acc: 0.9111
Epoch 291/500
67/67 [==============================] - ETA: 0s - loss: 0.2562 - acc: 0.900 -
0s 283us/step - loss: 0.2340 - acc: 0.9254 - val_loss: 0.2539 - val_acc: 0.9111
Epoch 292/500
67/67 [==============================] - 0s 276us/step - loss: 0.2689 - acc:
0.9104 - val_loss: 0.2555 - val_acc: 0.9111
Epoch 293/500
67/67 [==============================] - 0s 312us/step - loss: 0.2461 - acc:
0.9104 - val_loss: 0.2562 - val_acc: 0.9111
Epoch 294/500
67/67 [==============================] - 0s 283us/step - loss: 0.1997 - acc:
0.9552 - val_loss: 0.2560 - val_acc: 0.9111
Epoch 295/500
67/67 [==============================] - 0s 283us/step - loss: 0.2084 - acc:
0.9552 - val_loss: 0.2553 - val_acc: 0.9111
Epoch 296/500
67/67 [==============================] - 0s 313us/step - loss: 0.2195 - acc:
0.9403 - val_loss: 0.2548 - val_acc: 0.9111
Epoch 297/500
67/67 [==============================] - 0s 266us/step - loss: 0.2256 - acc:
```

```
0.9403 - val_loss: 0.2542 - val_acc: 0.9111
Epoch 298/500
67/67 [==============================] - 0s 238us/step - loss: 0.2147 - acc:
0.9552 - val_loss: 0.2541 - val_acc: 0.9111
Epoch 299/500
67/67 [==============================] - 0s 268us/step - loss: 0.2134 - acc:
0.9104 - val_loss: 0.2525 - val_acc: 0.9111
Epoch 300/500
67/67 [==============================] - 0s 267us/step - loss: 0.2051 - acc:
0.9552 - val_loss: 0.2517 - val_acc: 0.9111
Epoch 301/500
67/67 [==============================] - 0s 223us/step - loss: 0.1952 - acc:
0.9552 - val_loss: 0.2495 - val_acc: 0.9111
Epoch 302/500
67/67 [==============================] - 0s 327us/step - loss: 0.2136 - acc:
0.9104 - val_loss: 0.2485 - val_acc: 0.9111
Epoch 303/500
67/67 [==============================] - 0s 253us/step - loss: 0.1639 - acc:
0.9851 - val_loss: 0.2475 - val_acc: 0.9111
Epoch 304/500
67/67 [==============================] - 0s 238us/step - loss: 0.2129 - acc:
0.9403 - val_loss: 0.2464 - val_acc: 0.9111
Epoch 305/500
67/67 [==============================] - 0s 256us/step - loss: 0.2284 - acc:
0.9552 - val_loss: 0.2451 - val_acc: 0.9111
Epoch 306/500
67/67 [==============================] - 0s 284us/step - loss: 0.1974 - acc:
0.9701 - val_loss: 0.2449 - val_acc: 0.9111
Epoch 307/500
67/67 [==============================] - 0s 232us/step - loss: 0.2474 - acc:
0.9104 - val_loss: 0.2439 - val_acc: 0.9111
Epoch 308/500
67/67 [==============================] - 0s 269us/step - loss: 0.2137 - acc:
0.9552 - val_loss: 0.2430 - val_acc: 0.9111
Epoch 309/500
67/67 [==============================] - 0s 253us/step - loss: 0.1903 - acc:
0.9851 - val_loss: 0.2410 - val_acc: 0.9111
Epoch 310/500
67/67 [==============================] - 0s 267us/step - loss: 0.2163 - acc:
0.9403 - val_loss: 0.2408 - val_acc: 0.9111
Epoch 311/500
67/67 [==============================] - 0s 357us/step - loss: 0.2089 - acc:
0.9403 - val_loss: 0.2406 - val_acc: 0.9111
Epoch 312/500
67/67 [==============================] - 0s 283us/step - loss: 0.2001 - acc:
0.9552 - val_loss: 0.2404 - val_acc: 0.9111
Epoch 313/500
67/67 [==============================] - 0s 358us/step - loss: 0.2070 - acc:
```

```
0.9403 - val_loss: 0.2399 - val_acc: 0.9111
Epoch 314/500
67/67 [==============================] - 0s 283us/step - loss: 0.2078 - acc:
0.9552 - val_loss: 0.2388 - val_acc: 0.9111
Epoch 315/500
67/67 [==============================] - 0s 284us/step - loss: 0.1791 - acc:
0.9701 - val_loss: 0.2379 - val_acc: 0.9111
Epoch 316/500
67/67 [==============================] - 0s 313us/step - loss: 0.2179 - acc:
0.9254 - val_loss: 0.2370 - val_acc: 0.9111
Epoch 317/500
67/67 [==============================] - 0s 242us/step - loss: 0.2539 - acc:
0.9104 - val_loss: 0.2365 - val_acc: 0.9111
Epoch 318/500
67/67 [==============================] - 0s 252us/step - loss: 0.1960 - acc:
0.9701 - val_loss: 0.2364 - val_acc: 0.9111
Epoch 319/500
67/67 [==============================] - 0s 253us/step - loss: 0.2532 - acc:
0.9552 - val_loss: 0.2356 - val_acc: 0.9333
Epoch 320/500
67/67 [==============================] - 0s 223us/step - loss: 0.1572 - acc:
0.9552 - val_loss: 0.2347 - val_acc: 0.9333
Epoch 321/500
67/67 [==============================] - 0s 279us/step - loss: 0.2309 - acc:
0.9552 - val_loss: 0.2338 - val_acc: 0.9333
Epoch 322/500
67/67 [==============================] - 0s 284us/step - loss: 0.1719 - acc:
0.9701 - val_loss: 0.2332 - val_acc: 0.9333
Epoch 323/500
67/67 [==============================] - 0s 237us/step - loss: 0.2182 - acc:
0.9552 - val_loss: 0.2333 - val_acc: 0.9333
Epoch 324/500
67/67 [==============================] - 0s 268us/step - loss: 0.1886 - acc:
0.9552 - val_loss: 0.2343 - val_acc: 0.9111
Epoch 325/500
67/67 [==============================] - 0s 341us/step - loss: 0.1985 - acc:
0.9552 - val_loss: 0.2348 - val_acc: 0.9111
Epoch 326/500
67/67 [==============================] - 0s 298us/step - loss: 0.1882 - acc:
0.9552 - val_loss: 0.2358 - val_acc: 0.9111
Epoch 327/500
67/67 [==============================] - 0s 268us/step - loss: 0.1671 - acc:
0.9851 - val_loss: 0.2359 - val_acc: 0.9111
Epoch 328/500
67/67 [==============================] - 0s 326us/step - loss: 0.2200 - acc:
0.8955 - val_loss: 0.2358 - val_acc: 0.9111
Epoch 329/500
67/67 [==============================] - 0s 252us/step - loss: 0.1739 - acc:
```

```
0.9403 - val_loss: 0.2354 - val_acc: 0.9111
Epoch 330/500
67/67 [==============================] - 0s 238us/step - loss: 0.2059 - acc:
0.9403 - val_loss: 0.2342 - val_acc: 0.9111
Epoch 331/500
67/67 [==============================] - 0s 299us/step - loss: 0.1955 - acc:
0.9403 - val_loss: 0.2329 - val_acc: 0.9111
Epoch 332/500
67/67 [==============================] - 0s 313us/step - loss: 0.2119 - acc:
0.9104 - val_loss: 0.2315 - val_acc: 0.9333
Epoch 333/500
67/67 [==============================] - 0s 252us/step - loss: 0.2067 - acc:
0.9403 - val_loss: 0.2292 - val_acc: 0.9333
Epoch 334/500
67/67 [==============================] - 0s 237us/step - loss: 0.2213 - acc:
0.9701 - val_loss: 0.2273 - val_acc: 0.9333
Epoch 335/500
67/67 [==============================] - 0s 298us/step - loss: 0.2259 - acc:
0.9254 - val_loss: 0.2260 - val_acc: 0.9333
Epoch 336/500
67/67 [==============================] - 0s 253us/step - loss: 0.2052 - acc:
0.9104 - val_loss: 0.2246 - val_acc: 0.9333
Epoch 337/500
67/67 [==============================] - 0s 268us/step - loss: 0.1845 - acc:
0.9552 - val_loss: 0.2239 - val_acc: 0.9333
Epoch 338/500
67/67 [==============================] - 0s 298us/step - loss: 0.1773 - acc:
0.9851 - val_loss: 0.2229 - val_acc: 0.9333
Epoch 339/500
67/67 [==============================] - 0s 253us/step - loss: 0.1933 - acc:
0.9552 - val_loss: 0.2229 - val_acc: 0.9333
Epoch 340/500
67/67 [==============================] - 0s 325us/step - loss: 0.1964 - acc:
0.9552 - val_loss: 0.2220 - val_acc: 0.9333
Epoch 341/500
67/67 [==============================] - 0s 372us/step - loss: 0.1840 - acc:
0.9552 - val_loss: 0.2213 - val_acc: 0.9333
Epoch 342/500
67/67 [==============================] - 0s 327us/step - loss: 0.1925 - acc:
0.9552 - val_loss: 0.2204 - val_acc: 0.9556
Epoch 343/500
67/67 [==============================] - 0s 432us/step - loss: 0.1684 - acc:
0.9701 - val_loss: 0.2199 - val_acc: 0.9556
Epoch 344/500
67/67 [==============================] - 0s 417us/step - loss: 0.2046 - acc:
0.9403 - val_loss: 0.2199 - val_acc: 0.9556
Epoch 345/500
67/67 [==============================] - 0s 462us/step - loss: 0.1922 - acc:
```

```
0.9552 - val_loss: 0.2198 - val_acc: 0.9333
Epoch 346/500
67/67 [==============================] - 0s 402us/step - loss: 0.1980 - acc:
0.9403 - val_loss: 0.2188 - val_acc: 0.9556
Epoch 347/500
67/67 [==============================] - 0s 327us/step - loss: 0.1846 - acc:
0.9552 - val_loss: 0.2181 - val_acc: 0.9556
Epoch 348/500
67/67 [==============================] - 0s 342us/step - loss: 0.1637 - acc:
0.9552 - val_loss: 0.2175 - val_acc: 0.9556
Epoch 349/500
67/67 [==============================] - 0s 460us/step - loss: 0.1615 - acc:
0.9701 - val_loss: 0.2166 - val_acc: 0.9556
Epoch 350/500
67/67 [==============================] - 0s 434us/step - loss: 0.1662 - acc:
0.9701 - val_loss: 0.2163 - val_acc: 0.9556
Epoch 351/500
67/67 [==============================] - 0s 411us/step - loss: 0.1701 - acc:
0.9403 - val_loss: 0.2165 - val_acc: 0.9333
Epoch 352/500
67/67 [==============================] - 0s 357us/step - loss: 0.1855 - acc:
0.9552 - val_loss: 0.2160 - val_acc: 0.9333
Epoch 353/500
67/67 [==============================] - 0s 373us/step - loss: 0.1662 - acc:
0.9701 - val_loss: 0.2159 - val_acc: 0.9333
Epoch 354/500
67/67 [==============================] - 0s 313us/step - loss: 0.1714 - acc:
0.9701 - val_loss: 0.2164 - val_acc: 0.9333
Epoch 355/500
67/67 [==============================] - 0s 313us/step - loss: 0.1772 - acc:
0.9552 - val_loss: 0.2170 - val_acc: 0.9333
Epoch 356/500
67/67 [==============================] - 0s 386us/step - loss: 0.1742 - acc:
0.9552 - val_loss: 0.2172 - val_acc: 0.9333
Epoch 357/500
67/67 [==============================] - 0s 355us/step - loss: 0.1815 - acc:
0.9552 - val_loss: 0.2175 - val_acc: 0.9333
Epoch 358/500
67/67 [==============================] - 0s 313us/step - loss: 0.1663 - acc:
0.9851 - val_loss: 0.2180 - val_acc: 0.9333
Epoch 359/500
67/67 [==============================] - 0s 284us/step - loss: 0.1748 - acc:
0.9701 - val_loss: 0.2177 - val_acc: 0.9333
Epoch 360/500
67/67 [==============================] - 0s 372us/step - loss: 0.1848 - acc:
0.9701 - val_loss: 0.2170 - val_acc: 0.9333
Epoch 361/500
67/67 [==============================] - 0s 329us/step - loss: 0.1677 - acc:
```

```
0.9552 - val_loss: 0.2165 - val_acc: 0.9333
Epoch 362/500
67/67 [==============================] - 0s 339us/step - loss: 0.1694 - acc:
0.9701 - val_loss: 0.2155 - val_acc: 0.9333
Epoch 363/500
67/67 [==============================] - 0s 313us/step - loss: 0.1669 - acc:
0.9552 - val_loss: 0.2149 - val_acc: 0.9333
Epoch 364/500
67/67 [==============================] - 0s 327us/step - loss: 0.1711 - acc:
0.9701 - val_loss: 0.2144 - val_acc: 0.9333
Epoch 365/500
67/67 [==============================] - 0s 357us/step - loss: 0.1678 - acc:
0.9701 - val_loss: 0.2147 - val_acc: 0.9333
Epoch 366/500
67/67 [==============================] - 0s 298us/step - loss: 0.1737 - acc:
0.9552 - val_loss: 0.2146 - val_acc: 0.9333
Epoch 367/500
67/67 [==============================] - 0s 342us/step - loss: 0.2078 - acc:
0.9403 - val_loss: 0.2138 - val_acc: 0.9333
Epoch 368/500
67/67 [==============================] - 0s 298us/step - loss: 0.1599 - acc:
0.9701 - val_loss: 0.2132 - val_acc: 0.9333
Epoch 369/500
67/67 [==============================] - 0s 238us/step - loss: 0.1601 - acc:
0.9701 - val_loss: 0.2120 - val_acc: 0.9333
Epoch 370/500
67/67 [==============================] - 0s 252us/step - loss: 0.1513 - acc:
0.9701 - val_loss: 0.2113 - val_acc: 0.9333
Epoch 371/500
67/67 [==============================] - 0s 298us/step - loss: 0.1545 - acc:
0.9701 - val_loss: 0.2103 - val_acc: 0.9333
Epoch 372/500
67/67 [==============================] - 0s 269us/step - loss: 0.1576 - acc:
0.9851 - val_loss: 0.2095 - val_acc: 0.9333
Epoch 373/500
67/67 [==============================] - 0s 282us/step - loss: 0.1604 - acc:
0.9701 - val_loss: 0.2083 - val_acc: 0.9333
Epoch 374/500
67/67 [==============================] - 0s 269us/step - loss: 0.1890 - acc:
0.9254 - val_loss: 0.2080 - val_acc: 0.9333
Epoch 375/500
67/67 [==============================] - 0s 281us/step - loss: 0.1865 - acc:
0.9552 - val_loss: 0.2071 - val_acc: 0.9333
Epoch 376/500
67/67 [==============================] - 0s 282us/step - loss: 0.2024 - acc:
0.9403 - val_loss: 0.2065 - val_acc: 0.9333
Epoch 377/500
67/67 [==============================] - 0s 302us/step - loss: 0.1719 - acc:
```

```
0.9552 - val_loss: 0.2059 - val_acc: 0.9333
Epoch 378/500
67/67 [==============================] - 0s 297us/step - loss: 0.1697 - acc:
0.9701 - val_loss: 0.2061 - val_acc: 0.9333
Epoch 379/500
67/67 [==============================] - 0s 283us/step - loss: 0.1339 - acc:
0.9851 - val_loss: 0.2056 - val_acc: 0.9333
Epoch 380/500
67/67 [==============================] - 0s 298us/step - loss: 0.1547 - acc:
0.9701 - val_loss: 0.2053 - val_acc: 0.9333
Epoch 381/500
67/67 [==============================] - 0s 371us/step - loss: 0.1718 - acc:
0.9552 - val_loss: 0.2048 - val_acc: 0.9333
Epoch 382/500
67/67 [==============================] - 0s 551us/step - loss: 0.1591 - acc:
0.9851 - val_loss: 0.2035 - val_acc: 0.9333
Epoch 383/500
67/67 [==============================] - 0s 342us/step - loss: 0.1524 - acc:
0.9552 - val_loss: 0.2021 - val_acc: 0.9333
Epoch 384/500
67/67 [==============================] - 0s 327us/step - loss: 0.1960 - acc:
0.9104 - val_loss: 0.2009 - val_acc: 0.9333
Epoch 385/500
67/67 [==============================] - 0s 347us/step - loss: 0.1499 - acc:
0.9701 - val_loss: 0.2001 - val_acc: 0.9333
Epoch 386/500
67/67 [==============================] - 0s 354us/step - loss: 0.1573 - acc:
0.9552 - val_loss: 0.1999 - val_acc: 0.9333
Epoch 387/500
67/67 [==============================] - 0s 372us/step - loss: 0.1420 - acc:
0.9851 - val_loss: 0.1996 - val_acc: 0.9333
Epoch 388/500
67/67 [==============================] - 0s 283us/step - loss: 0.1664 - acc:
0.9701 - val_loss: 0.1995 - val_acc: 0.9333
Epoch 389/500
67/67 [==============================] - 0s 268us/step - loss: 0.1705 - acc:
0.9552 - val_loss: 0.1991 - val_acc: 0.9333
Epoch 390/500
67/67 [==============================] - 0s 298us/step - loss: 0.1518 - acc:
0.9552 - val_loss: 0.1994 - val_acc: 0.9333
Epoch 391/500
67/67 [==============================] - 0s 274us/step - loss: 0.1452 - acc:
0.9701 - val_loss: 0.1990 - val_acc: 0.9333
Epoch 392/500
67/67 [==============================] - 0s 268us/step - loss: 0.1777 - acc:
0.9552 - val_loss: 0.1993 - val_acc: 0.9333
Epoch 393/500
67/67 [==============================] - 0s 251us/step - loss: 0.1413 - acc:
```

```
0.9701 - val_loss: 0.2002 - val_acc: 0.9333
Epoch 394/500
67/67 [==============================] - 0s 223us/step - loss: 0.1403 - acc:
0.9701 - val_loss: 0.2007 - val_acc: 0.9333
Epoch 395/500
67/67 [==============================] - 0s 268us/step - loss: 0.1607 - acc:
0.9701 - val_loss: 0.2012 - val_acc: 0.9333
Epoch 396/500
67/67 [==============================] - 0s 253us/step - loss: 0.1266 - acc:
0.9701 - val_loss: 0.2014 - val_acc: 0.9333
Epoch 397/500
67/67 [==============================] - 0s 266us/step - loss: 0.1813 - acc:
0.9403 - val_loss: 0.2001 - val_acc: 0.9333
Epoch 398/500
67/67 [==============================] - 0s 342us/step - loss: 0.1390 - acc:
0.9701 - val_loss: 0.1976 - val_acc: 0.9333
Epoch 399/500
67/67 [==============================] - 0s 313us/step - loss: 0.1451 - acc:
0.9701 - val_loss: 0.1964 - val_acc: 0.9333
Epoch 400/500
67/67 [==============================] - 0s 266us/step - loss: 0.1517 - acc:
0.9851 - val_loss: 0.1960 - val_acc: 0.9333
Epoch 401/500
67/67 [==============================] - 0s 268us/step - loss: 0.1807 - acc:
0.9403 - val_loss: 0.1945 - val_acc: 0.9333
Epoch 402/500
67/67 [==============================] - 0s 268us/step - loss: 0.2040 - acc:
0.9403 - val_loss: 0.1934 - val_acc: 0.9333
Epoch 403/500
67/67 [==============================] - 0s 253us/step - loss: 0.1515 - acc:
0.9701 - val_loss: 0.1923 - val_acc: 0.9333
Epoch 404/500
67/67 [==============================] - 0s 323us/step - loss: 0.1834 - acc:
0.9552 - val_loss: 0.1913 - val_acc: 0.9333
Epoch 405/500
67/67 [==============================] - 0s 268us/step - loss: 0.1492 - acc:
0.9701 - val_loss: 0.1913 - val_acc: 0.9333
Epoch 406/500
67/67 [==============================] - 0s 326us/step - loss: 0.1702 - acc:
0.9552 - val_loss: 0.1913 - val_acc: 0.9333
Epoch 407/500
67/67 [==============================] - 0s 239us/step - loss: 0.1781 - acc:
0.9701 - val_loss: 0.1912 - val_acc: 0.9333
Epoch 408/500
67/67 [==============================] - 0s 284us/step - loss: 0.1372 - acc:
0.9851 - val_loss: 0.1908 - val_acc: 0.9333
Epoch 409/500
67/67 [==============================] - 0s 342us/step - loss: 0.1993 - acc:
```

```
0.9552 - val_loss: 0.1893 - val_acc: 0.9333
Epoch 410/500
67/67 [==============================] - 0s 357us/step - loss: 0.1239 - acc:
0.9851 - val_loss: 0.1883 - val_acc: 0.9556
Epoch 411/500
67/67 [==============================] - 0s 298us/step - loss: 0.1701 - acc:
0.9552 - val_loss: 0.1878 - val_acc: 0.9556
Epoch 412/500
67/67 [==============================] - 0s 371us/step - loss: 0.1405 - acc:
0.9701 - val_loss: 0.1878 - val_acc: 0.9333
Epoch 413/500
67/67 [==============================] - 0s 313us/step - loss: 0.1564 - acc:
0.9552 - val_loss: 0.1878 - val_acc: 0.9333
Epoch 414/500
67/67 [==============================] - 0s 342us/step - loss: 0.1453 - acc:
0.9701 - val_loss: 0.1879 - val_acc: 0.9333
Epoch 415/500
67/67 [==============================] - 0s 313us/step - loss: 0.1704 - acc:
0.9701 - val_loss: 0.1878 - val_acc: 0.9333
Epoch 416/500
67/67 [==============================] - 0s 414us/step - loss: 0.1767 - acc:
0.9552 - val_loss: 0.1875 - val_acc: 0.9333
Epoch 417/500
67/67 [==============================] - ETA: 0s - loss: 0.1178 - acc: 1.000 -
0s 313us/step - loss: 0.1344 - acc: 0.9701 - val_loss: 0.1874 - val_acc: 0.9333
Epoch 418/500
67/67 [==============================] - 0s 342us/step - loss: 0.1452 - acc:
0.9851 - val_loss: 0.1872 - val_acc: 0.9333
Epoch 419/500
67/67 [==============================] - 0s 432us/step - loss: 0.1526 - acc:
0.9403 - val_loss: 0.1870 - val_acc: 0.9333
Epoch 420/500
67/67 [==============================] - 0s 415us/step - loss: 0.1348 - acc:
0.9851 - val_loss: 0.1874 - val_acc: 0.9333
Epoch 421/500
67/67 [==============================] - 0s 343us/step - loss: 0.1389 - acc:
0.9701 - val_loss: 0.1876 - val_acc: 0.9333
Epoch 422/500
67/67 [==============================] - 0s 301us/step - loss: 0.1375 - acc:
0.9851 - val_loss: 0.1877 - val_acc: 0.9333
Epoch 423/500
67/67 [==============================] - 0s 461us/step - loss: 0.1695 - acc:
0.9851 - val_loss: 0.1860 - val_acc: 0.9333
Epoch 424/500
67/67 [==============================] - 0s 327us/step - loss: 0.1401 - acc:
0.9701 - val_loss: 0.1850 - val_acc: 0.9333
Epoch 425/500
67/67 [==============================] - 0s 388us/step - loss: 0.1377 - acc:
```

```
0.9851 - val_loss: 0.1840 - val_acc: 0.9333
Epoch 426/500
67/67 [==============================] - 0s 373us/step - loss: 0.1763 - acc:
0.9403 - val_loss: 0.1833 - val_acc: 0.9333
Epoch 427/500
67/67 [==============================] - 0s 462us/step - loss: 0.1310 - acc:
0.9701 - val_loss: 0.1832 - val_acc: 0.9333
Epoch 428/500
67/67 [==============================] - 0s 432us/step - loss: 0.1556 - acc:
0.9552 - val_loss: 0.1830 - val_acc: 0.9333
Epoch 429/500
67/67 [==============================] - 0s 432us/step - loss: 0.1667 - acc:
0.9701 - val_loss: 0.1821 - val_acc: 0.9556
Epoch 430/500
67/67 [==============================] - 0s 357us/step - loss: 0.1526 - acc:
0.9701 - val_loss: 0.1819 - val_acc: 0.9556
Epoch 431/500
67/67 [==============================] - 0s 372us/step - loss: 0.1452 - acc:
0.9701 - val_loss: 0.1824 - val_acc: 0.9333
Epoch 432/500
67/67 [==============================] - 0s 357us/step - loss: 0.1362 - acc:
0.9552 - val_loss: 0.1825 - val_acc: 0.9333
Epoch 433/500
67/67 [==============================] - 0s 385us/step - loss: 0.1631 - acc:
0.9701 - val_loss: 0.1820 - val_acc: 0.9333
Epoch 434/500
67/67 [==============================] - 0s 298us/step - loss: 0.1769 - acc:
0.9552 - val_loss: 0.1821 - val_acc: 0.9333
Epoch 435/500
67/67 [==============================] - 0s 326us/step - loss: 0.1657 - acc:
0.9403 - val_loss: 0.1820 - val_acc: 0.9556
Epoch 436/500
67/67 [==============================] - 0s 292us/step - loss: 0.1349 - acc:
0.9851 - val_loss: 0.1824 - val_acc: 0.9333
Epoch 437/500
67/67 [==============================] - 0s 368us/step - loss: 0.1142 - acc:
0.9851 - val_loss: 0.1835 - val_acc: 0.9333
Epoch 438/500
67/67 [==============================] - 0s 265us/step - loss: 0.1182 - acc:
0.9851 - val_loss: 0.1844 - val_acc: 0.9333
Epoch 439/500
67/67 [==============================] - 0s 268us/step - loss: 0.1876 - acc:
0.9552 - val_loss: 0.1847 - val_acc: 0.9333
Epoch 440/500
67/67 [==============================] - 0s 237us/step - loss: 0.1397 - acc:
0.9851 - val_loss: 0.1853 - val_acc: 0.9333
Epoch 441/500
67/67 [==============================] - 0s 299us/step - loss: 0.1841 - acc:
```

```
0.9552 - val_loss: 0.1854 - val_acc: 0.9333
Epoch 442/500
67/67 [==============================] - ETA: 0s - loss: 0.1168 - acc: 1.000 -
0s 298us/step - loss: 0.1288 - acc: 0.9851 - val_loss: 0.1849 - val_acc: 0.9333
Epoch 443/500
67/67 [==============================] - 0s 268us/step - loss: 0.1634 - acc:
0.9851 - val_loss: 0.1845 - val_acc: 0.9333
Epoch 444/500
67/67 [==============================] - 0s 260us/step - loss: 0.1242 - acc:
0.9701 - val_loss: 0.1848 - val_acc: 0.9333
Epoch 445/500
67/67 [==============================] - 0s 357us/step - loss: 0.1309 - acc:
0.9701 - val_loss: 0.1849 - val_acc: 0.9333
Epoch 446/500
67/67 [==============================] - 0s 264us/step - loss: 0.1618 - acc:
0.9552 - val_loss: 0.1838 - val_acc: 0.9333
Epoch 447/500
67/67 [==============================] - 0s 267us/step - loss: 0.1458 - acc:
0.9851 - val_loss: 0.1842 - val_acc: 0.9333
Epoch 448/500
67/67 [==============================] - 0s 339us/step - loss: 0.1249 - acc:
0.9701 - val_loss: 0.1844 - val_acc: 0.9333
Epoch 449/500
67/67 [==============================] - 0s 268us/step - loss: 0.1194 - acc:
0.9701 - val_loss: 0.1847 - val_acc: 0.9333
Epoch 450/500
67/67 [==============================] - 0s 266us/step - loss: 0.1261 - acc:
0.9552 - val_loss: 0.1846 - val_acc: 0.9333
Epoch 451/500
67/67 [==============================] - 0s 253us/step - loss: 0.1126 - acc:
0.9851 - val_loss: 0.1843 - val_acc: 0.9333
Epoch 452/500
67/67 [==============================] - 0s 327us/step - loss: 0.1249 - acc:
0.9701 - val_loss: 0.1846 - val_acc: 0.9333
Epoch 453/500
67/67 [==============================] - 0s 298us/step - loss: 0.1211 - acc:
0.9851 - val_loss: 0.1841 - val_acc: 0.9333
Epoch 454/500
67/67 [==============================] - 0s 372us/step - loss: 0.1672 - acc:
0.9701 - val_loss: 0.1824 - val_acc: 0.9333
Epoch 455/500
67/67 [==============================] - 0s 238us/step - loss: 0.1422 - acc:
0.9701 - val_loss: 0.1811 - val_acc: 0.9333
Epoch 456/500
67/67 [==============================] - 0s 313us/step - loss: 0.1102 - acc:
0.9851 - val_loss: 0.1793 - val_acc: 0.9333
Epoch 457/500
67/67 [==============================] - 0s 268us/step - loss: 0.1033 - acc:
```

```
0.9851 - val_loss: 0.1787 - val_acc: 0.9333
Epoch 458/500
67/67 [==============================] - 0s 298us/step - loss: 0.1364 - acc:
0.9851 - val_loss: 0.1785 - val_acc: 0.9333
Epoch 459/500
67/67 [==============================] - 0s 298us/step - loss: 0.1120 - acc:
0.9701 - val_loss: 0.1779 - val_acc: 0.9333
Epoch 460/500
67/67 [==============================] - 0s 298us/step - loss: 0.1822 - acc:
0.9403 - val_loss: 0.1774 - val_acc: 0.9333
Epoch 461/500
67/67 [==============================] - 0s 268us/step - loss: 0.1509 - acc:
0.9701 - val_loss: 0.1774 - val_acc: 0.9333
Epoch 462/500
67/67 [==============================] - 0s 268us/step - loss: 0.1270 - acc:
0.9552 - val_loss: 0.1784 - val_acc: 0.9333
Epoch 463/500
67/67 [==============================] - 0s 268us/step - loss: 0.1269 - acc:
0.9851 - val_loss: 0.1792 - val_acc: 0.9333
Epoch 464/500
67/67 [==============================] - 0s 238us/step - loss: 0.1123 - acc:
0.9701 - val_loss: 0.1796 - val_acc: 0.9333
Epoch 465/500
67/67 [==============================] - 0s 489us/step - loss: 0.1039 - acc:
0.9851 - val_loss: 0.1789 - val_acc: 0.9333
Epoch 466/500
67/67 [==============================] - 0s 283us/step - loss: 0.1603 - acc:
0.9552 - val_loss: 0.1784 - val_acc: 0.9333
Epoch 467/500
67/67 [==============================] - 0s 342us/step - loss: 0.1448 - acc:
0.9701 - val_loss: 0.1785 - val_acc: 0.9333
Epoch 468/500
67/67 [==============================] - 0s 372us/step - loss: 0.1507 - acc:
0.9701 - val_loss: 0.1780 - val_acc: 0.9333
Epoch 469/500
67/67 [==============================] - 0s 342us/step - loss: 0.1501 - acc:
0.9254 - val_loss: 0.1784 - val_acc: 0.9333
Epoch 470/500
67/67 [==============================] - 0s 372us/step - loss: 0.0949 - acc:
1.0000 - val_loss: 0.1794 - val_acc: 0.9333
Epoch 471/500
67/67 [==============================] - 0s 342us/step - loss: 0.1147 - acc:
0.9851 - val_loss: 0.1801 - val_acc: 0.9333
Epoch 472/500
67/67 [==============================] - 0s 342us/step - loss: 0.1389 - acc:
0.9701 - val_loss: 0.1806 - val_acc: 0.9333
Epoch 473/500
67/67 [==============================] - 0s 342us/step - loss: 0.1115 - acc:
```

```
0.9851 - val_loss: 0.1807 - val_acc: 0.9333
Epoch 474/500
67/67 [==============================] - 0s 403us/step - loss: 0.1186 - acc:
0.9701 - val_loss: 0.1805 - val_acc: 0.9333
Epoch 475/500
67/67 [==============================] - 0s 268us/step - loss: 0.1587 - acc:
0.9701 - val_loss: 0.1798 - val_acc: 0.9333
Epoch 476/500
67/67 [==============================] - 0s 341us/step - loss: 0.1448 - acc:
0.9701 - val_loss: 0.1777 - val_acc: 0.9333
Epoch 477/500
67/67 [==============================] - 0s 326us/step - loss: 0.1116 - acc:
0.9851 - val_loss: 0.1757 - val_acc: 0.9333
Epoch 478/500
67/67 [==============================] - 0s 268us/step - loss: 0.1724 - acc:
0.9701 - val_loss: 0.1743 - val_acc: 0.9333
Epoch 479/500
67/67 [==============================] - 0s 253us/step - loss: 0.1441 - acc:
0.9701 - val_loss: 0.1730 - val_acc: 0.9333
Epoch 480/500
67/67 [==============================] - 0s 268us/step - loss: 0.1078 - acc:
0.9851 - val_loss: 0.1723 - val_acc: 0.9333
Epoch 481/500
67/67 [==============================] - 0s 285us/step - loss: 0.1341 - acc:
0.9851 - val_loss: 0.1721 - val_acc: 0.9333
Epoch 482/500
67/67 [==============================] - 0s 241us/step - loss: 0.1289 - acc:
0.9701 - val_loss: 0.1723 - val_acc: 0.9333
Epoch 483/500
67/67 [==============================] - 0s 281us/step - loss: 0.1231 - acc:
0.9701 - val_loss: 0.1725 - val_acc: 0.9333
Epoch 484/500
67/67 [==============================] - 0s 313us/step - loss: 0.1457 - acc:
0.9701 - val_loss: 0.1727 - val_acc: 0.9333
Epoch 485/500
67/67 [==============================] - 0s 254us/step - loss: 0.1699 - acc:
0.9552 - val_loss: 0.1731 - val_acc: 0.9333
Epoch 486/500
67/67 [==============================] - 0s 283us/step - loss: 0.1043 - acc:
0.9851 - val_loss: 0.1732 - val_acc: 0.9333
Epoch 487/500
67/67 [==============================] - 0s 327us/step - loss: 0.1230 - acc:
0.9701 - val_loss: 0.1733 - val_acc: 0.9333
Epoch 488/500
67/67 [==============================] - 0s 268us/step - loss: 0.1235 - acc:
0.9851 - val_loss: 0.1726 - val_acc: 0.9333
Epoch 489/500
67/67 [==============================] - 0s 265us/step - loss: 0.1131 - acc:
```

```
0.9851 - val_loss: 0.1701 - val_acc: 0.9556
Epoch 490/500
67/67 [==============================] - 0s 343us/step - loss: 0.1360 - acc:
0.9701 - val_loss: 0.1689 - val_acc: 0.9556
Epoch 491/500
67/67 [==============================] - 0s 327us/step - loss: 0.0923 - acc:
0.9851 - val_loss: 0.1681 - val_acc: 0.9556
Epoch 492/500
67/67 [==============================] - 0s 386us/step - loss: 0.1136 - acc:
0.9851 - val_loss: 0.1679 - val_acc: 0.9556
Epoch 493/500
67/67 [==============================] - 0s 327us/step - loss: 0.0955 - acc:
0.9851 - val_loss: 0.1677 - val_acc: 0.9556
Epoch 494/500
67/67 [==============================] - 0s 342us/step - loss: 0.1364 - acc:
0.9701 - val_loss: 0.1679 - val_acc: 0.9556
Epoch 495/500
67/67 [==============================] - 0s 371us/step - loss: 0.0994 - acc:
0.9701 - val_loss: 0.1681 - val_acc: 0.9556
Epoch 496/500
67/67 [==============================] - 0s 670us/step - loss: 0.1992 - acc:
0.9254 - val_loss: 0.1687 - val_acc: 0.9556
Epoch 497/500
67/67 [==============================] - 0s 372us/step - loss: 0.1158 - acc:
0.9701 - val_loss: 0.1694 - val_acc: 0.9556
Epoch 498/500
67/67 [==============================] - 0s 355us/step - loss: 0.1105 - acc:
0.9851 - val_loss: 0.1698 - val_acc: 0.9556
Epoch 499/500
67/67 [==============================] - ETA: 0s - loss: 0.0700 - acc: 1.000 -
0s 417us/step - loss: 0.1448 - acc: 0.9851 - val_loss: 0.1692 - val_acc: 0.9556
Epoch 500/500
67/67 [==============================] - 0s 342us/step - loss: 0.0992 - acc:
0.9851 - val_loss: 0.1689 - val_acc: 0.9556
Confusion Matrix :
[[13  0  0]
 [ 0 15  1]
 [ 0  0  9]]
Classification Report :
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        13
           1       1.00      0.94      0.97        16
           2       0.90      1.00      0.95         9

    accuracy                           0.97        38
   macro avg       0.97      0.98      0.97        38
weighted avg       0.98      0.97      0.97        38
```

1.1 Analysis

1.1.1 Keras is a simple tool for constructing a neural network. It is a high-level framework based on tensorflow, theano or cntk backends.First we encode categorical data and then obtain train and test set.After applying feature scaling we initialize the neural network.Sequential specifies to keras that we are creating model sequentially and the output of each layer we add is input to the next layer we specify.Then we add input layer,hidden layers and output layer.We then fit the ANN to the training set and predict results.