Part A Question 2

In [ ]:
```
import time
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import tensorflow as tf
import shap
shap.initjs()


import IPython.display as ipd

from scipy.io import wavfile as wav

from sklearn import preprocessing
from sklearn.model_selection import KFold
from sklearn.model_selection import train_test_split
from sklearn.metrics import f1_score, precision_score, recall_score, confusion_matrix


import tensorflow.keras as keras
from tensorflow.keras import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import *
from tensorflow.keras.regularizers import l2
from tensorflow.keras.callbacks import ReduceLROnPlateau,EarlyStopping,ModelCheckpoint,
from sklearn import datasets
from sklearn.model_selection import KFold
```

```
c:\Users\JoeTe\AppData\Local\Programs\Python\Python310\lib\site-packages\tqdm\auto.py:2
2: TqdmWarning: IProgress not found. Please update jupyter and ipywidgets. See https://
ipywidgets.readthedocs.io/en/stable/user_install.html
  from .autonotebook import tqdm as notebook_tqdm
```

In [ ]:
```
SEED = 42
import os
os.environ['TF_CUDNN_DETERMINISTIC'] = '1'

import random
random.seed(SEED)

import numpy as np
np.random.seed(SEED)

import tensorflow as tf
tf.random.set_seed(SEED)
```

In [ ]:
```
df = pd.read_csv('./full.csv')
df.head()
```

Out[ ]:

	filename	tempo	total_beats	average_beats	chroma_stft_mean	chroma
0	app_3001_4001_phnd_neg_0000.wav	184.570312	623	69.222222	0.515281	
1	app_3001_4001_phnd_neg_0001.wav	151.999081	521	74.428571	0.487201	
2	app_3001_4001_phnd_neg_0002.wav	112.347147	1614	146.727273	0.444244	
3	app_3001_4001_phnd_neg_0003.wav	107.666016	2060	158.461538	0.454156	
4	app_3001_4001_phnd_neg_0004.wav	75.999540	66	33.000000	0.478780	

5 rows × 78 columns

In [ ]:
```
df['label'] = df['filename'].str.split('_').str[-2]
df['label'].value_counts()
```

Out[ ]:
```
pos    92826
neg    89428
Name: label, dtype: int64
```

In [ ]:
```
columns_to_drop = ['label','filename']

def split_dataset(df, columns_to_drop, test_size, random_state):
  label_encoder = preprocessing.LabelEncoder()

  df['label'] = label_encoder.fit_transform(df['label'])

  df_train, df_test = train_test_split(df, test_size=test_size, random_state=random_sta

  df_train2 = df_train.drop(columns_to_drop,axis=1)
  y_train2 = df_train['label'].to_numpy()

  df_test2 = df_test.drop(columns_to_drop,axis=1)
  y_test2 = df_test['label'].to_numpy()

  return df_train2, y_train2, df_test2, y_test2

def preprocess_dataset(df_train, df_test):

  standard_scaler = preprocessing.StandardScaler()
  df_train_scaled = standard_scaler.fit_transform(df_train)

  df_test_scaled = standard_scaler.transform(df_test)

  return df_train_scaled, df_test_scaled

X_train, y_train, X_test, y_test = split_dataset(df, columns_to_drop, test_size=0.3, ra

X_train_scaled, X_test_scaled = preprocess_dataset(X_train, X_test)
```

In [ ]:
```
num_neurons = 128
learning_rate = 0.001
batch_size = 256
no_epochs = 100
```

Timing callback for every epoch

In [ ]:
```
# TimingCallBack class for Q2b

class TimingCallback(keras.callbacks.Callback):
    def on_train_begin(self, logs={}):
        self.times = []

    def on_epoch_begin(self, epoch, logs={}):
        self.epoch_time_start = time.time()

    def on_epoch_end(self, epoch, logs={}):
        self.times.append(time.time() - self.epoch_time_start)
```

Callback for early stopping

In [ ]:
```
callback = tf.keras.callbacks.EarlyStopping(monitor='val_accuracy', patience=3)
```

Number of folds and batch sizes

In [ ]:
```
no_folds = 5
batch_size_list = [128, 256, 512, 1024]
cv = KFold(n_splits=no_folds, shuffle=True, random_state=0)
```

In [ ]:
```
Q2_X, Q2_Y = X_train, y_train
```

In [ ]:
```
model_acc = {}
model_train_acc = {}
model_loss = {}
Q2_history = {}
time_taken_dict = {}
batch_idx = 0

model_list = ["model_128", "model_256", "model_512", "model_1024"]
model_fold = ["_0", "_1", "_2", "_3" ,"_4"]

for models in model_list:
    fold = 0
    train_acc = []
    val_acc = []
    val_loss = []
    time_taken_list = []
    for train_idx, test_idx in cv.split(Q2_X, Q2_Y):
        cb = TimingCallback()
        Q2_X_train, Q2_y_train  = Q2_X.iloc[train_idx], Q2_Y[train_idx]
        Q2_X_test, Q2_y_test = Q2_X.iloc[test_idx], Q2_Y[test_idx]

        # Rescale the data, so we do the scaling after splitting
        Q2_X_train, Q2_X_test = preprocess_dataset(Q2_X_train, Q2_X_test)


        Q2_model = Sequential([Dense(num_neurons, activation='relu'),
                               Dropout(0.2), Dense(num_neurons, activation ='relu'),
                               Dropout(0.2), Dense(num_neurons, activation='relu'),
                               Dropout(0.2), Dense(1, activation='sigmoid')])

        Q2_model.compile(optimizer='adam',
                         loss='binary_crossentropy',
                         metrics=['accuracy'])
```

```
        Q2_history[models + model_fold[fold]] = Q2_model.fit(Q2_X_train, Q2_y_train,
                        batch_size = batch_size_list[batch_idx],
                        epochs=no_epochs,
                        verbose=1,
                        use_multiprocessing=True,
                        validation_data=(Q2_X_test, Q2_y_test), callbacks=[callback, cb

        #Time taken of final epoch for each fold
        time_taken_list.append(cb.times[-1])
        #print("Time Taken for final epoch " + models + model_fold[fold] + " : {}".forma

        #Validation Accuracy of final epoch of each fold
        val_acc.append(Q2_history[models + model_fold[fold]].history['val_accuracy'][-1

        #Training Accuracy of final epoch of each fold
        train_acc.append(Q2_history[models + model_fold[fold]].history['accuracy'][-1])

        #Val loss of final epoch of each fold
        val_loss.append(Q2_history[models + model_fold[fold]].history['val_loss'][-1])

        #print(models +' fold %d test accuracy %g'%(fold, val_acc[fold]))
        fold += 1

    batch_idx +=1
    model_acc[models] = val_acc
    model_train_acc[models] = train_acc
    model_loss[models] = val_loss
    time_taken_dict[models]= time_taken_list
    #print(models + '* mean accuracy = %g *'% np.mean(val_acc))
```

```
Epoch 1/100
798/798 [==============================] - 6s 5ms/step - loss: 0.6900 - accuracy: 0.535
4 - val_loss: 0.6831 - val_accuracy: 0.5505
Epoch 2/100
798/798 [==============================] - 5s 6ms/step - loss: 0.6836 - accuracy: 0.551
2 - val_loss: 0.6814 - val_accuracy: 0.5601
Epoch 3/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6808 - accuracy: 0.558
7 - val_loss: 0.6789 - val_accuracy: 0.5662
Epoch 4/100
798/798 [==============================] - 5s 6ms/step - loss: 0.6782 - accuracy: 0.564
4 - val_loss: 0.6762 - val_accuracy: 0.5702
Epoch 5/100
798/798 [==============================] - 5s 6ms/step - loss: 0.6749 - accuracy: 0.571
5 - val_loss: 0.6745 - val_accuracy: 0.5725
Epoch 6/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6716 - accuracy: 0.577
1 - val_loss: 0.6725 - val_accuracy: 0.5796
Epoch 7/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6681 - accuracy: 0.583
4 - val_loss: 0.6696 - val_accuracy: 0.5792
Epoch 8/100
798/798 [==============================] - 5s 6ms/step - loss: 0.6642 - accuracy: 0.589
0 - val_loss: 0.6656 - val_accuracy: 0.5894
Epoch 9/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6609 - accuracy: 0.591
6 - val_loss: 0.6639 - val_accuracy: 0.5927
Epoch 10/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6574 - accuracy: 0.599
2 - val_loss: 0.6595 - val_accuracy: 0.5972
Epoch 11/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6538 - accuracy: 0.605
5 - val_loss: 0.6588 - val_accuracy: 0.5986
Epoch 12/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6497 - accuracy: 0.608
4 - val_loss: 0.6531 - val_accuracy: 0.6082
Epoch 13/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6465 - accuracy: 0.615
4 - val_loss: 0.6517 - val_accuracy: 0.6050
Epoch 14/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6441 - accuracy: 0.618
1 - val_loss: 0.6523 - val_accuracy: 0.6042
Epoch 15/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6404 - accuracy: 0.621
7 - val_loss: 0.6469 - val_accuracy: 0.6127
Epoch 16/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6374 - accuracy: 0.627
3 - val_loss: 0.6463 - val_accuracy: 0.6122
Epoch 17/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6342 - accuracy: 0.628
8 - val_loss: 0.6437 - val_accuracy: 0.6177
Epoch 18/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6318 - accuracy: 0.630
4 - val_loss: 0.6417 - val_accuracy: 0.6185
Epoch 19/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6318 - accuracy: 0.630
5 - val_loss: 0.6413 - val_accuracy: 0.6215
Epoch 20/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6280 - accuracy: 0.635
3 - val_loss: 0.6386 - val_accuracy: 0.6238
```

```
Epoch 21/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6262 - accuracy: 0.636
8 - val_loss: 0.6358 - val_accuracy: 0.6264
Epoch 22/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6238 - accuracy: 0.640
6 - val_loss: 0.6342 - val_accuracy: 0.6300
Epoch 23/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6210 - accuracy: 0.642
7 - val_loss: 0.6337 - val_accuracy: 0.6305
Epoch 24/100
798/798 [==============================] - 4s 6ms/step - loss: 0.6198 - accuracy: 0.644
9 - val_loss: 0.6316 - val_accuracy: 0.6347
Epoch 25/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6180 - accuracy: 0.645
2 - val_loss: 0.6319 - val_accuracy: 0.6314
Epoch 26/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6156 - accuracy: 0.647
9 - val_loss: 0.6296 - val_accuracy: 0.6338
Epoch 27/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6149 - accuracy: 0.648
8 - val_loss: 0.6291 - val_accuracy: 0.6346
Epoch 1/100
798/798 [==============================] - 5s 5ms/step - loss: 0.6911 - accuracy: 0.532
9 - val_loss: 0.6842 - val_accuracy: 0.5506
Epoch 2/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6836 - accuracy: 0.552
6 - val_loss: 0.6814 - val_accuracy: 0.5576
Epoch 3/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6806 - accuracy: 0.559
4 - val_loss: 0.6796 - val_accuracy: 0.5616
Epoch 4/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6778 - accuracy: 0.566
9 - val_loss: 0.6778 - val_accuracy: 0.5653
Epoch 5/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6747 - accuracy: 0.569
8 - val_loss: 0.6760 - val_accuracy: 0.5711
Epoch 6/100
798/798 [==============================] - 5s 6ms/step - loss: 0.6712 - accuracy: 0.576
7 - val_loss: 0.6720 - val_accuracy: 0.5790
Epoch 7/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6679 - accuracy: 0.582
8 - val_loss: 0.6698 - val_accuracy: 0.5760
Epoch 8/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6645 - accuracy: 0.588
3 - val_loss: 0.6661 - val_accuracy: 0.5842
Epoch 9/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6607 - accuracy: 0.594
5 - val_loss: 0.6626 - val_accuracy: 0.5921
Epoch 10/100
798/798 [==============================] - 4s 6ms/step - loss: 0.6569 - accuracy: 0.599
9 - val_loss: 0.6607 - val_accuracy: 0.5954
Epoch 11/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6524 - accuracy: 0.606
0 - val_loss: 0.6592 - val_accuracy: 0.5943
Epoch 12/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6490 - accuracy: 0.610
4 - val_loss: 0.6561 - val_accuracy: 0.5985
Epoch 13/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6450 - accuracy: 0.616
4 - val_loss: 0.6531 - val_accuracy: 0.6026
```

```
Epoch 14/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6417 - accuracy: 0.619
4 - val_loss: 0.6502 - val_accuracy: 0.6049
Epoch 15/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6393 - accuracy: 0.622
6 - val_loss: 0.6458 - val_accuracy: 0.6142
Epoch 16/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6350 - accuracy: 0.627
2 - val_loss: 0.6463 - val_accuracy: 0.6126
Epoch 17/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6339 - accuracy: 0.627
7 - val_loss: 0.6442 - val_accuracy: 0.6172
Epoch 18/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6309 - accuracy: 0.630
9 - val_loss: 0.6422 - val_accuracy: 0.6193
Epoch 19/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6294 - accuracy: 0.631
9 - val_loss: 0.6424 - val_accuracy: 0.6207
Epoch 20/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6255 - accuracy: 0.637
7 - val_loss: 0.6399 - val_accuracy: 0.6206
Epoch 21/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6241 - accuracy: 0.637
2 - val_loss: 0.6376 - val_accuracy: 0.6261
Epoch 22/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6223 - accuracy: 0.641
7 - val_loss: 0.6357 - val_accuracy: 0.6265
Epoch 23/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6186 - accuracy: 0.644
2 - val_loss: 0.6347 - val_accuracy: 0.6290
Epoch 24/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6164 - accuracy: 0.646
0 - val_loss: 0.6337 - val_accuracy: 0.6285
Epoch 25/100
798/798 [==============================] - 5s 6ms/step - loss: 0.6146 - accuracy: 0.647
9 - val_loss: 0.6314 - val_accuracy: 0.6338
Epoch 26/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6141 - accuracy: 0.647
5 - val_loss: 0.6319 - val_accuracy: 0.6363
Epoch 27/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6117 - accuracy: 0.652
0 - val_loss: 0.6296 - val_accuracy: 0.6341
Epoch 28/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6106 - accuracy: 0.651
3 - val_loss: 0.6290 - val_accuracy: 0.6348
Epoch 29/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6083 - accuracy: 0.654
0 - val_loss: 0.6280 - val_accuracy: 0.6381
Epoch 30/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6074 - accuracy: 0.655
7 - val_loss: 0.6255 - val_accuracy: 0.6386
Epoch 31/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6047 - accuracy: 0.657
5 - val_loss: 0.6257 - val_accuracy: 0.6418
Epoch 32/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6050 - accuracy: 0.658
9 - val_loss: 0.6229 - val_accuracy: 0.6400
Epoch 33/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6032 - accuracy: 0.659
1 - val_loss: 0.6249 - val_accuracy: 0.6409
```

```
Epoch 34/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6018 - accuracy: 0.662
1 - val_loss: 0.6218 - val_accuracy: 0.6439
Epoch 35/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5996 - accuracy: 0.662
6 - val_loss: 0.6209 - val_accuracy: 0.6428
Epoch 36/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5984 - accuracy: 0.664
7 - val_loss: 0.6203 - val_accuracy: 0.6442
Epoch 37/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5972 - accuracy: 0.665
8 - val_loss: 0.6192 - val_accuracy: 0.6467
Epoch 38/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5965 - accuracy: 0.664
8 - val_loss: 0.6187 - val_accuracy: 0.6427
Epoch 39/100
798/798 [==============================] - 4s 5ms/step - loss: 0.5969 - accuracy: 0.666
2 - val_loss: 0.6199 - val_accuracy: 0.6444
Epoch 40/100
798/798 [==============================] - 4s 5ms/step - loss: 0.5942 - accuracy: 0.669
3 - val_loss: 0.6179 - val_accuracy: 0.6435
Epoch 1/100
798/798 [==============================] - 4s 5ms/step - loss: 0.6901 - accuracy: 0.533
2 - val_loss: 0.6837 - val_accuracy: 0.5483
Epoch 2/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6841 - accuracy: 0.549
9 - val_loss: 0.6832 - val_accuracy: 0.5583
Epoch 3/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6813 - accuracy: 0.556
4 - val_loss: 0.6791 - val_accuracy: 0.5606
Epoch 4/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6790 - accuracy: 0.564
2 - val_loss: 0.6789 - val_accuracy: 0.5621
Epoch 5/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6754 - accuracy: 0.569
2 - val_loss: 0.6748 - val_accuracy: 0.5665
Epoch 6/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6721 - accuracy: 0.575
2 - val_loss: 0.6721 - val_accuracy: 0.5707
Epoch 7/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6688 - accuracy: 0.582
7 - val_loss: 0.6691 - val_accuracy: 0.5811
Epoch 8/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6654 - accuracy: 0.588
3 - val_loss: 0.6666 - val_accuracy: 0.5838
Epoch 9/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6608 - accuracy: 0.593
6 - val_loss: 0.6635 - val_accuracy: 0.5861
Epoch 10/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6582 - accuracy: 0.596
7 - val_loss: 0.6597 - val_accuracy: 0.5935
Epoch 11/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6547 - accuracy: 0.601
9 - val_loss: 0.6596 - val_accuracy: 0.5991
Epoch 12/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6504 - accuracy: 0.606
5 - val_loss: 0.6546 - val_accuracy: 0.5994
Epoch 13/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6476 - accuracy: 0.609
2 - val_loss: 0.6520 - val_accuracy: 0.6070
```

```
Epoch 14/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6448 - accuracy: 0.616
2 - val_loss: 0.6515 - val_accuracy: 0.6039
Epoch 15/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6420 - accuracy: 0.619
5 - val_loss: 0.6485 - val_accuracy: 0.6102
Epoch 16/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6369 - accuracy: 0.624
3 - val_loss: 0.6466 - val_accuracy: 0.6105
Epoch 17/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6362 - accuracy: 0.624
6 - val_loss: 0.6444 - val_accuracy: 0.6141
Epoch 18/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6334 - accuracy: 0.626
5 - val_loss: 0.6403 - val_accuracy: 0.6216
Epoch 19/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6296 - accuracy: 0.634
5 - val_loss: 0.6392 - val_accuracy: 0.6218
Epoch 20/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6279 - accuracy: 0.632
3 - val_loss: 0.6390 - val_accuracy: 0.6238
Epoch 21/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6249 - accuracy: 0.639
6 - val_loss: 0.6365 - val_accuracy: 0.6262
Epoch 22/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6228 - accuracy: 0.640
6 - val_loss: 0.6355 - val_accuracy: 0.6275
Epoch 23/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6213 - accuracy: 0.643
3 - val_loss: 0.6331 - val_accuracy: 0.6297
Epoch 24/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6192 - accuracy: 0.644
9 - val_loss: 0.6315 - val_accuracy: 0.6335
Epoch 25/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6190 - accuracy: 0.643
7 - val_loss: 0.6307 - val_accuracy: 0.6321
Epoch 26/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6158 - accuracy: 0.649
7 - val_loss: 0.6301 - val_accuracy: 0.6376
Epoch 27/100
798/798 [==============================] - 3s 3ms/step - loss: 0.6143 - accuracy: 0.650
6 - val_loss: 0.6282 - val_accuracy: 0.6356
Epoch 28/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6124 - accuracy: 0.650
5 - val_loss: 0.6279 - val_accuracy: 0.6376
Epoch 29/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6108 - accuracy: 0.653
5 - val_loss: 0.6263 - val_accuracy: 0.6387
Epoch 30/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6088 - accuracy: 0.656
3 - val_loss: 0.6273 - val_accuracy: 0.6337
Epoch 31/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6096 - accuracy: 0.654
5 - val_loss: 0.6248 - val_accuracy: 0.6430
Epoch 32/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6061 - accuracy: 0.658
5 - val_loss: 0.6228 - val_accuracy: 0.6416
Epoch 33/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6065 - accuracy: 0.657
6 - val_loss: 0.6220 - val_accuracy: 0.6428
```

```
Epoch 34/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6040 - accuracy: 0.657
9 - val_loss: 0.6231 - val_accuracy: 0.6392
Epoch 1/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6900 - accuracy: 0.536
6 - val_loss: 0.6838 - val_accuracy: 0.5552
Epoch 2/100
798/798 [==============================] - 3s 3ms/step - loss: 0.6833 - accuracy: 0.553
6 - val_loss: 0.6819 - val_accuracy: 0.5555
Epoch 3/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6803 - accuracy: 0.558
8 - val_loss: 0.6786 - val_accuracy: 0.5638
Epoch 4/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6773 - accuracy: 0.567
9 - val_loss: 0.6771 - val_accuracy: 0.5671
Epoch 5/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6734 - accuracy: 0.574
2 - val_loss: 0.6746 - val_accuracy: 0.5716
Epoch 6/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6705 - accuracy: 0.580
0 - val_loss: 0.6704 - val_accuracy: 0.5774
Epoch 7/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6664 - accuracy: 0.586
2 - val_loss: 0.6682 - val_accuracy: 0.5857
Epoch 8/100
798/798 [==============================] - 3s 3ms/step - loss: 0.6634 - accuracy: 0.593
1 - val_loss: 0.6654 - val_accuracy: 0.5888
Epoch 9/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6592 - accuracy: 0.597
8 - val_loss: 0.6634 - val_accuracy: 0.5956
Epoch 10/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6557 - accuracy: 0.601
6 - val_loss: 0.6623 - val_accuracy: 0.5935
Epoch 11/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6525 - accuracy: 0.607
5 - val_loss: 0.6591 - val_accuracy: 0.6000
Epoch 12/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6484 - accuracy: 0.611
9 - val_loss: 0.6534 - val_accuracy: 0.6085
Epoch 13/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6448 - accuracy: 0.617
7 - val_loss: 0.6518 - val_accuracy: 0.6108
Epoch 14/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6414 - accuracy: 0.619
3 - val_loss: 0.6510 - val_accuracy: 0.6121
Epoch 15/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6391 - accuracy: 0.623
5 - val_loss: 0.6484 - val_accuracy: 0.6128
Epoch 16/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6357 - accuracy: 0.627
1 - val_loss: 0.6478 - val_accuracy: 0.6136
Epoch 17/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6337 - accuracy: 0.629
0 - val_loss: 0.6453 - val_accuracy: 0.6188
Epoch 18/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6308 - accuracy: 0.631
9 - val_loss: 0.6453 - val_accuracy: 0.6166
Epoch 19/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6295 - accuracy: 0.633
2 - val_loss: 0.6424 - val_accuracy: 0.6227
```

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Epoch 20/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6262 - accuracy: 0.637
4 - val_loss: 0.6402 - val_accuracy: 0.6218
Epoch 21/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6236 - accuracy: 0.638
8 - val_loss: 0.6393 - val_accuracy: 0.6234
Epoch 22/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6201 - accuracy: 0.642
0 - val_loss: 0.6373 - val_accuracy: 0.6288
Epoch 23/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6187 - accuracy: 0.643
4 - val_loss: 0.6350 - val_accuracy: 0.6298
Epoch 24/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6163 - accuracy: 0.647
8 - val_loss: 0.6352 - val_accuracy: 0.6299
Epoch 25/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6161 - accuracy: 0.648
0 - val_loss: 0.6339 - val_accuracy: 0.6319
Epoch 26/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6139 - accuracy: 0.651
8 - val_loss: 0.6322 - val_accuracy: 0.6360
Epoch 27/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6125 - accuracy: 0.652
4 - val_loss: 0.6288 - val_accuracy: 0.6326
Epoch 28/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6107 - accuracy: 0.653
0 - val_loss: 0.6280 - val_accuracy: 0.6373
Epoch 29/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6090 - accuracy: 0.655
0 - val_loss: 0.6283 - val_accuracy: 0.6320
Epoch 30/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6075 - accuracy: 0.657
0 - val_loss: 0.6265 - val_accuracy: 0.6356
Epoch 31/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6062 - accuracy: 0.656
1 - val_loss: 0.6260 - val_accuracy: 0.6376
Epoch 32/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6037 - accuracy: 0.660
8 - val_loss: 0.6264 - val_accuracy: 0.6379
Epoch 33/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6032 - accuracy: 0.659
3 - val_loss: 0.6232 - val_accuracy: 0.6381
Epoch 34/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6015 - accuracy: 0.661
6 - val_loss: 0.6223 - val_accuracy: 0.6396
Epoch 35/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6000 - accuracy: 0.663
5 - val_loss: 0.6221 - val_accuracy: 0.6400
Epoch 36/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5989 - accuracy: 0.664
5 - val_loss: 0.6223 - val_accuracy: 0.6398
Epoch 37/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5977 - accuracy: 0.666
8 - val_loss: 0.6200 - val_accuracy: 0.6444
Epoch 38/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5972 - accuracy: 0.666
0 - val_loss: 0.6209 - val_accuracy: 0.6438
Epoch 39/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5971 - accuracy: 0.667
3 - val_loss: 0.6209 - val_accuracy: 0.6435
```

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Epoch 40/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5950 - accuracy: 0.666
7 - val_loss: 0.6204 - val_accuracy: 0.6424
Epoch 1/100
798/798 [==============================] - 4s 4ms/step - loss: 0.6901 - accuracy: 0.535
9 - val_loss: 0.6837 - val_accuracy: 0.5476
Epoch 2/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6837 - accuracy: 0.550
8 - val_loss: 0.6818 - val_accuracy: 0.5536
Epoch 3/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6807 - accuracy: 0.559
2 - val_loss: 0.6798 - val_accuracy: 0.5585
Epoch 4/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6775 - accuracy: 0.565
8 - val_loss: 0.6764 - val_accuracy: 0.5634
Epoch 5/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6742 - accuracy: 0.573
1 - val_loss: 0.6739 - val_accuracy: 0.5682
Epoch 6/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6712 - accuracy: 0.576
8 - val_loss: 0.6716 - val_accuracy: 0.5755
Epoch 7/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6673 - accuracy: 0.582
7 - val_loss: 0.6683 - val_accuracy: 0.5828
Epoch 8/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6638 - accuracy: 0.589
1 - val_loss: 0.6652 - val_accuracy: 0.5866
Epoch 9/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6602 - accuracy: 0.595
6 - val_loss: 0.6658 - val_accuracy: 0.5876
Epoch 10/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6575 - accuracy: 0.600
2 - val_loss: 0.6604 - val_accuracy: 0.5943
Epoch 11/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6533 - accuracy: 0.603
8 - val_loss: 0.6601 - val_accuracy: 0.5953
Epoch 12/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6506 - accuracy: 0.606
9 - val_loss: 0.6556 - val_accuracy: 0.6016
Epoch 13/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6477 - accuracy: 0.613
2 - val_loss: 0.6559 - val_accuracy: 0.6016
Epoch 14/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6442 - accuracy: 0.614
6 - val_loss: 0.6543 - val_accuracy: 0.6033
Epoch 15/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6412 - accuracy: 0.620
1 - val_loss: 0.6480 - val_accuracy: 0.6101
Epoch 16/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6383 - accuracy: 0.622
7 - val_loss: 0.6498 - val_accuracy: 0.6094
Epoch 17/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6348 - accuracy: 0.626
2 - val_loss: 0.6470 - val_accuracy: 0.6145
Epoch 18/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6344 - accuracy: 0.628
9 - val_loss: 0.6452 - val_accuracy: 0.6147
Epoch 19/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6310 - accuracy: 0.632
0 - val_loss: 0.6447 - val_accuracy: 0.6149
```

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Epoch 20/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6287 - accuracy: 0.634
3 - val_loss: 0.6427 - val_accuracy: 0.6199
Epoch 21/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6267 - accuracy: 0.637
1 - val_loss: 0.6409 - val_accuracy: 0.6212
Epoch 22/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6245 - accuracy: 0.640
1 - val_loss: 0.6394 - val_accuracy: 0.6264
Epoch 23/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6221 - accuracy: 0.643
1 - val_loss: 0.6370 - val_accuracy: 0.6252
Epoch 24/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6202 - accuracy: 0.641
2 - val_loss: 0.6343 - val_accuracy: 0.6312
Epoch 25/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6177 - accuracy: 0.647
6 - val_loss: 0.6335 - val_accuracy: 0.6306
Epoch 26/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6163 - accuracy: 0.649
6 - val_loss: 0.6319 - val_accuracy: 0.6301
Epoch 27/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6150 - accuracy: 0.650
2 - val_loss: 0.6316 - val_accuracy: 0.6312
Epoch 28/100
798/798 [==============================] - 3s 3ms/step - loss: 0.6121 - accuracy: 0.652
4 - val_loss: 0.6295 - val_accuracy: 0.6311
Epoch 29/100
798/798 [==============================] - 3s 3ms/step - loss: 0.6106 - accuracy: 0.655
1 - val_loss: 0.6301 - val_accuracy: 0.6335
Epoch 30/100
798/798 [==============================] - 3s 3ms/step - loss: 0.6095 - accuracy: 0.655
5 - val_loss: 0.6292 - val_accuracy: 0.6348
Epoch 31/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6071 - accuracy: 0.657
5 - val_loss: 0.6264 - val_accuracy: 0.6358
Epoch 32/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6061 - accuracy: 0.658
1 - val_loss: 0.6260 - val_accuracy: 0.6370
Epoch 33/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6042 - accuracy: 0.660
3 - val_loss: 0.6246 - val_accuracy: 0.6384
Epoch 34/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6020 - accuracy: 0.662
3 - val_loss: 0.6248 - val_accuracy: 0.6397
Epoch 35/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6018 - accuracy: 0.662
7 - val_loss: 0.6237 - val_accuracy: 0.6403
Epoch 36/100
798/798 [==============================] - 3s 4ms/step - loss: 0.6008 - accuracy: 0.664
4 - val_loss: 0.6215 - val_accuracy: 0.6466
Epoch 37/100
798/798 [==============================] - 3s 4ms/step - loss: 0.5995 - accuracy: 0.663
9 - val_loss: 0.6207 - val_accuracy: 0.6426
Epoch 38/100
798/798 [==============================] - 4s 4ms/step - loss: 0.5983 - accuracy: 0.665
4 - val_loss: 0.6209 - val_accuracy: 0.6462
Epoch 39/100
798/798 [==============================] - 4s 4ms/step - loss: 0.5976 - accuracy: 0.667
2 - val_loss: 0.6207 - val_accuracy: 0.6441
```

```
Epoch 1/100
399/399 [==============================] - 3s 5ms/step - loss: 0.6918 - accuracy: 0.534
1 - val_loss: 0.6837 - val_accuracy: 0.5524
Epoch 2/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6848 - accuracy: 0.549
1 - val_loss: 0.6810 - val_accuracy: 0.5577
Epoch 3/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6815 - accuracy: 0.557
3 - val_loss: 0.6795 - val_accuracy: 0.5596
Epoch 4/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6788 - accuracy: 0.565
2 - val_loss: 0.6773 - val_accuracy: 0.5670
Epoch 5/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6761 - accuracy: 0.569
9 - val_loss: 0.6739 - val_accuracy: 0.5711
Epoch 6/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6730 - accuracy: 0.575
7 - val_loss: 0.6735 - val_accuracy: 0.5725
Epoch 7/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6698 - accuracy: 0.581
9 - val_loss: 0.6707 - val_accuracy: 0.5793
Epoch 8/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6667 - accuracy: 0.586
4 - val_loss: 0.6684 - val_accuracy: 0.5854
Epoch 9/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6629 - accuracy: 0.590
6 - val_loss: 0.6646 - val_accuracy: 0.5915
Epoch 10/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6598 - accuracy: 0.597
0 - val_loss: 0.6623 - val_accuracy: 0.5952
Epoch 11/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6564 - accuracy: 0.602
1 - val_loss: 0.6597 - val_accuracy: 0.5998
Epoch 12/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6531 - accuracy: 0.604
9 - val_loss: 0.6568 - val_accuracy: 0.6022
Epoch 13/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6509 - accuracy: 0.609
2 - val_loss: 0.6547 - val_accuracy: 0.6052
Epoch 14/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6477 - accuracy: 0.614
1 - val_loss: 0.6533 - val_accuracy: 0.6083
Epoch 15/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6450 - accuracy: 0.617
8 - val_loss: 0.6522 - val_accuracy: 0.6104
Epoch 16/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6402 - accuracy: 0.623
5 - val_loss: 0.6493 - val_accuracy: 0.6099
Epoch 17/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6378 - accuracy: 0.627
2 - val_loss: 0.6475 - val_accuracy: 0.6169
Epoch 18/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6357 - accuracy: 0.627
4 - val_loss: 0.6451 - val_accuracy: 0.6162
Epoch 19/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6323 - accuracy: 0.631
7 - val_loss: 0.6416 - val_accuracy: 0.6238
Epoch 20/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6326 - accuracy: 0.631
6 - val_loss: 0.6401 - val_accuracy: 0.6246
```

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Epoch 21/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6288 - accuracy: 0.637
8 - val_loss: 0.6390 - val_accuracy: 0.6260
Epoch 22/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6264 - accuracy: 0.637
9 - val_loss: 0.6382 - val_accuracy: 0.6283
Epoch 23/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6231 - accuracy: 0.643
4 - val_loss: 0.6383 - val_accuracy: 0.6266
Epoch 24/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6221 - accuracy: 0.644
1 - val_loss: 0.6347 - val_accuracy: 0.6315
Epoch 25/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6204 - accuracy: 0.645
3 - val_loss: 0.6338 - val_accuracy: 0.6311
Epoch 26/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6187 - accuracy: 0.647
6 - val_loss: 0.6335 - val_accuracy: 0.6325
Epoch 27/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6164 - accuracy: 0.649
8 - val_loss: 0.6329 - val_accuracy: 0.6307
Epoch 28/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6155 - accuracy: 0.650
0 - val_loss: 0.6292 - val_accuracy: 0.6359
Epoch 29/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6120 - accuracy: 0.653
3 - val_loss: 0.6272 - val_accuracy: 0.6401
Epoch 30/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6107 - accuracy: 0.655
8 - val_loss: 0.6299 - val_accuracy: 0.6343
Epoch 31/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6095 - accuracy: 0.657
0 - val_loss: 0.6274 - val_accuracy: 0.6393
Epoch 32/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6090 - accuracy: 0.656
4 - val_loss: 0.6276 - val_accuracy: 0.6411
Epoch 33/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6066 - accuracy: 0.659
4 - val_loss: 0.6256 - val_accuracy: 0.6404
Epoch 34/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6050 - accuracy: 0.662
0 - val_loss: 0.6245 - val_accuracy: 0.6417
Epoch 35/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6030 - accuracy: 0.662
6 - val_loss: 0.6211 - val_accuracy: 0.6447
Epoch 36/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6025 - accuracy: 0.662
6 - val_loss: 0.6215 - val_accuracy: 0.6433
Epoch 37/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6021 - accuracy: 0.663
8 - val_loss: 0.6213 - val_accuracy: 0.6446
Epoch 38/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6008 - accuracy: 0.666
1 - val_loss: 0.6212 - val_accuracy: 0.6424
Epoch 1/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6903 - accuracy: 0.534
4 - val_loss: 0.6842 - val_accuracy: 0.5509
Epoch 2/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6844 - accuracy: 0.549
1 - val_loss: 0.6817 - val_accuracy: 0.5596
```

```
Epoch 3/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6818 - accuracy: 0.557
0 - val_loss: 0.6799 - val_accuracy: 0.5620
Epoch 4/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6786 - accuracy: 0.563
4 - val_loss: 0.6796 - val_accuracy: 0.5634
Epoch 5/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6767 - accuracy: 0.567
8 - val_loss: 0.6781 - val_accuracy: 0.5643
Epoch 6/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6733 - accuracy: 0.575
5 - val_loss: 0.6732 - val_accuracy: 0.5745
Epoch 7/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6702 - accuracy: 0.578
4 - val_loss: 0.6710 - val_accuracy: 0.5759
Epoch 8/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6666 - accuracy: 0.587
6 - val_loss: 0.6688 - val_accuracy: 0.5822
Epoch 9/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6632 - accuracy: 0.589
8 - val_loss: 0.6652 - val_accuracy: 0.5890
Epoch 10/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6597 - accuracy: 0.597
4 - val_loss: 0.6636 - val_accuracy: 0.5874
Epoch 11/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6566 - accuracy: 0.600
1 - val_loss: 0.6605 - val_accuracy: 0.5970
Epoch 12/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6531 - accuracy: 0.605
2 - val_loss: 0.6609 - val_accuracy: 0.5947
Epoch 13/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6499 - accuracy: 0.609
1 - val_loss: 0.6564 - val_accuracy: 0.6006
Epoch 14/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6470 - accuracy: 0.612
9 - val_loss: 0.6545 - val_accuracy: 0.6029
Epoch 15/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6424 - accuracy: 0.619
5 - val_loss: 0.6511 - val_accuracy: 0.6079
Epoch 16/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6411 - accuracy: 0.621
5 - val_loss: 0.6489 - val_accuracy: 0.6095
Epoch 17/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6379 - accuracy: 0.625
5 - val_loss: 0.6495 - val_accuracy: 0.6106
Epoch 18/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6354 - accuracy: 0.628
7 - val_loss: 0.6451 - val_accuracy: 0.6197
Epoch 19/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6328 - accuracy: 0.629
9 - val_loss: 0.6434 - val_accuracy: 0.6184
Epoch 20/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6295 - accuracy: 0.634
8 - val_loss: 0.6427 - val_accuracy: 0.6227
Epoch 21/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6281 - accuracy: 0.636
5 - val_loss: 0.6413 - val_accuracy: 0.6229
Epoch 22/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6261 - accuracy: 0.636
1 - val_loss: 0.6388 - val_accuracy: 0.6250
```

```
Epoch 23/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6232 - accuracy: 0.641
3 - val_loss: 0.6379 - val_accuracy: 0.6247
Epoch 24/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6219 - accuracy: 0.642
5 - val_loss: 0.6360 - val_accuracy: 0.6271
Epoch 25/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6198 - accuracy: 0.645
0 - val_loss: 0.6368 - val_accuracy: 0.6257
Epoch 26/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6172 - accuracy: 0.648
2 - val_loss: 0.6347 - val_accuracy: 0.6313
Epoch 27/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6166 - accuracy: 0.648
3 - val_loss: 0.6343 - val_accuracy: 0.6329
Epoch 28/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6158 - accuracy: 0.647
5 - val_loss: 0.6325 - val_accuracy: 0.6327
Epoch 29/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6140 - accuracy: 0.649
1 - val_loss: 0.6321 - val_accuracy: 0.6352
Epoch 30/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6113 - accuracy: 0.654
8 - val_loss: 0.6311 - val_accuracy: 0.6316
Epoch 31/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6100 - accuracy: 0.654
3 - val_loss: 0.6313 - val_accuracy: 0.6360
Epoch 32/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6081 - accuracy: 0.656
7 - val_loss: 0.6287 - val_accuracy: 0.6388
Epoch 33/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6075 - accuracy: 0.658
1 - val_loss: 0.6288 - val_accuracy: 0.6403
Epoch 34/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6048 - accuracy: 0.659
3 - val_loss: 0.6280 - val_accuracy: 0.6381
Epoch 35/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6054 - accuracy: 0.659
1 - val_loss: 0.6266 - val_accuracy: 0.6396
Epoch 36/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6018 - accuracy: 0.661
7 - val_loss: 0.6246 - val_accuracy: 0.6415
Epoch 37/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6014 - accuracy: 0.665
2 - val_loss: 0.6242 - val_accuracy: 0.6443
Epoch 38/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6002 - accuracy: 0.664
5 - val_loss: 0.6252 - val_accuracy: 0.6409
Epoch 39/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5992 - accuracy: 0.665
3 - val_loss: 0.6237 - val_accuracy: 0.6434
Epoch 40/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6002 - accuracy: 0.665
6 - val_loss: 0.6223 - val_accuracy: 0.6456
Epoch 41/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5964 - accuracy: 0.665
8 - val_loss: 0.6220 - val_accuracy: 0.6428
Epoch 42/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5945 - accuracy: 0.669
5 - val_loss: 0.6198 - val_accuracy: 0.6447
```

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Epoch 43/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5961 - accuracy: 0.667
7 - val_loss: 0.6193 - val_accuracy: 0.6483
Epoch 44/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5928 - accuracy: 0.673
6 - val_loss: 0.6191 - val_accuracy: 0.6497
Epoch 45/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5945 - accuracy: 0.669
6 - val_loss: 0.6209 - val_accuracy: 0.6455
Epoch 46/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5929 - accuracy: 0.670
2 - val_loss: 0.6181 - val_accuracy: 0.6487
Epoch 47/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5912 - accuracy: 0.672
0 - val_loss: 0.6202 - val_accuracy: 0.6462
Epoch 1/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6903 - accuracy: 0.533
2 - val_loss: 0.6841 - val_accuracy: 0.5465
Epoch 2/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6842 - accuracy: 0.551
6 - val_loss: 0.6832 - val_accuracy: 0.5579
Epoch 3/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6809 - accuracy: 0.559
0 - val_loss: 0.6792 - val_accuracy: 0.5616
Epoch 4/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6786 - accuracy: 0.563
5 - val_loss: 0.6772 - val_accuracy: 0.5672
Epoch 5/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6759 - accuracy: 0.570
0 - val_loss: 0.6743 - val_accuracy: 0.5723
Epoch 6/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6730 - accuracy: 0.574
1 - val_loss: 0.6722 - val_accuracy: 0.5798
Epoch 7/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6699 - accuracy: 0.579
3 - val_loss: 0.6693 - val_accuracy: 0.5839
Epoch 8/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6670 - accuracy: 0.585
8 - val_loss: 0.6675 - val_accuracy: 0.5866
Epoch 9/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6630 - accuracy: 0.591
6 - val_loss: 0.6656 - val_accuracy: 0.5917
Epoch 10/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6597 - accuracy: 0.594
9 - val_loss: 0.6611 - val_accuracy: 0.5967
Epoch 11/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6568 - accuracy: 0.600
8 - val_loss: 0.6593 - val_accuracy: 0.6013
Epoch 12/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6527 - accuracy: 0.607
7 - val_loss: 0.6556 - val_accuracy: 0.6075
Epoch 13/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6502 - accuracy: 0.609
7 - val_loss: 0.6523 - val_accuracy: 0.6105
Epoch 14/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6467 - accuracy: 0.611
9 - val_loss: 0.6500 - val_accuracy: 0.6124
Epoch 15/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6436 - accuracy: 0.619
1 - val_loss: 0.6490 - val_accuracy: 0.6134
```

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Epoch 16/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6406 - accuracy: 0.622
2 - val_loss: 0.6464 - val_accuracy: 0.6161
Epoch 17/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6373 - accuracy: 0.624
7 - val_loss: 0.6435 - val_accuracy: 0.6212
Epoch 18/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6351 - accuracy: 0.628
6 - val_loss: 0.6447 - val_accuracy: 0.6185
Epoch 19/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6328 - accuracy: 0.631
2 - val_loss: 0.6424 - val_accuracy: 0.6187
Epoch 20/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6300 - accuracy: 0.633
4 - val_loss: 0.6397 - val_accuracy: 0.6256
Epoch 21/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6276 - accuracy: 0.636
2 - val_loss: 0.6370 - val_accuracy: 0.6277
Epoch 22/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6249 - accuracy: 0.637
6 - val_loss: 0.6347 - val_accuracy: 0.6284
Epoch 23/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6229 - accuracy: 0.641
1 - val_loss: 0.6342 - val_accuracy: 0.6289
Epoch 24/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6218 - accuracy: 0.644
9 - val_loss: 0.6326 - val_accuracy: 0.6307
Epoch 25/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6192 - accuracy: 0.646
0 - val_loss: 0.6313 - val_accuracy: 0.6349
Epoch 26/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6180 - accuracy: 0.647
6 - val_loss: 0.6302 - val_accuracy: 0.6348
Epoch 27/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6161 - accuracy: 0.649
0 - val_loss: 0.6282 - val_accuracy: 0.6349
Epoch 28/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6136 - accuracy: 0.651
2 - val_loss: 0.6290 - val_accuracy: 0.6363
Epoch 29/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6120 - accuracy: 0.653
6 - val_loss: 0.6266 - val_accuracy: 0.6372
Epoch 30/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6110 - accuracy: 0.656
4 - val_loss: 0.6239 - val_accuracy: 0.6390
Epoch 31/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6091 - accuracy: 0.655
4 - val_loss: 0.6241 - val_accuracy: 0.6397
Epoch 32/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6088 - accuracy: 0.656
6 - val_loss: 0.6220 - val_accuracy: 0.6413
Epoch 33/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6064 - accuracy: 0.658
8 - val_loss: 0.6230 - val_accuracy: 0.6421
Epoch 34/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6043 - accuracy: 0.659
4 - val_loss: 0.6206 - val_accuracy: 0.6437
Epoch 35/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6021 - accuracy: 0.663
9 - val_loss: 0.6194 - val_accuracy: 0.6460
```

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Epoch 36/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6041 - accuracy: 0.662
3 - val_loss: 0.6195 - val_accuracy: 0.6424
Epoch 37/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6002 - accuracy: 0.665
3 - val_loss: 0.6192 - val_accuracy: 0.6463
Epoch 38/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5996 - accuracy: 0.664
6 - val_loss: 0.6174 - val_accuracy: 0.6488
Epoch 39/100
399/399 [==============================] - 1s 4ms/step - loss: 0.5978 - accuracy: 0.668
1 - val_loss: 0.6171 - val_accuracy: 0.6493
Epoch 40/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5995 - accuracy: 0.666
6 - val_loss: 0.6174 - val_accuracy: 0.6487
Epoch 41/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5966 - accuracy: 0.669
4 - val_loss: 0.6155 - val_accuracy: 0.6519
Epoch 42/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5962 - accuracy: 0.669
1 - val_loss: 0.6146 - val_accuracy: 0.6488
Epoch 43/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5959 - accuracy: 0.669
0 - val_loss: 0.6167 - val_accuracy: 0.6481
Epoch 44/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5940 - accuracy: 0.671
7 - val_loss: 0.6138 - val_accuracy: 0.6535
Epoch 45/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5937 - accuracy: 0.670
5 - val_loss: 0.6126 - val_accuracy: 0.6530
Epoch 46/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5926 - accuracy: 0.671
9 - val_loss: 0.6140 - val_accuracy: 0.6529
Epoch 47/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5900 - accuracy: 0.674
4 - val_loss: 0.6115 - val_accuracy: 0.6546
Epoch 48/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5903 - accuracy: 0.672
8 - val_loss: 0.6119 - val_accuracy: 0.6565
Epoch 49/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5881 - accuracy: 0.675
6 - val_loss: 0.6099 - val_accuracy: 0.6571
Epoch 50/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5887 - accuracy: 0.675
6 - val_loss: 0.6106 - val_accuracy: 0.6562
Epoch 51/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5874 - accuracy: 0.677
7 - val_loss: 0.6098 - val_accuracy: 0.6563
Epoch 52/100
399/399 [==============================] - 1s 4ms/step - loss: 0.5861 - accuracy: 0.678
0 - val_loss: 0.6077 - val_accuracy: 0.6608
Epoch 53/100
399/399 [==============================] - 1s 4ms/step - loss: 0.5853 - accuracy: 0.679
2 - val_loss: 0.6110 - val_accuracy: 0.6534
Epoch 54/100
399/399 [==============================] - 1s 4ms/step - loss: 0.5854 - accuracy: 0.679
7 - val_loss: 0.6082 - val_accuracy: 0.6548
Epoch 55/100
399/399 [==============================] - 1s 4ms/step - loss: 0.5845 - accuracy: 0.679
3 - val_loss: 0.6100 - val_accuracy: 0.6572
```

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Epoch 1/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6917 - accuracy: 0.533
8 - val_loss: 0.6838 - val_accuracy: 0.5540
Epoch 2/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6844 - accuracy: 0.547
5 - val_loss: 0.6820 - val_accuracy: 0.5581
Epoch 3/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6812 - accuracy: 0.558
4 - val_loss: 0.6799 - val_accuracy: 0.5614
Epoch 4/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6788 - accuracy: 0.559
7 - val_loss: 0.6782 - val_accuracy: 0.5653
Epoch 5/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6763 - accuracy: 0.567
9 - val_loss: 0.6765 - val_accuracy: 0.5716
Epoch 6/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6732 - accuracy: 0.573
7 - val_loss: 0.6725 - val_accuracy: 0.5784
Epoch 7/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6703 - accuracy: 0.577
2 - val_loss: 0.6702 - val_accuracy: 0.5817
Epoch 8/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6668 - accuracy: 0.584
3 - val_loss: 0.6674 - val_accuracy: 0.5855
Epoch 9/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6641 - accuracy: 0.587
8 - val_loss: 0.6647 - val_accuracy: 0.5918
Epoch 10/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6597 - accuracy: 0.596
1 - val_loss: 0.6629 - val_accuracy: 0.5905
Epoch 11/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6566 - accuracy: 0.600
5 - val_loss: 0.6619 - val_accuracy: 0.5953
Epoch 12/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6528 - accuracy: 0.605
9 - val_loss: 0.6576 - val_accuracy: 0.6013
Epoch 13/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6496 - accuracy: 0.608
5 - val_loss: 0.6570 - val_accuracy: 0.6059
Epoch 14/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6465 - accuracy: 0.611
6 - val_loss: 0.6538 - val_accuracy: 0.6075
Epoch 15/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6432 - accuracy: 0.616
8 - val_loss: 0.6509 - val_accuracy: 0.6118
Epoch 16/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6403 - accuracy: 0.620
0 - val_loss: 0.6493 - val_accuracy: 0.6136
Epoch 17/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6370 - accuracy: 0.624
4 - val_loss: 0.6484 - val_accuracy: 0.6136
Epoch 18/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6350 - accuracy: 0.627
4 - val_loss: 0.6445 - val_accuracy: 0.6154
Epoch 19/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6321 - accuracy: 0.629
1 - val_loss: 0.6438 - val_accuracy: 0.6217
Epoch 20/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6310 - accuracy: 0.631
5 - val_loss: 0.6411 - val_accuracy: 0.6227
```

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Epoch 21/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6283 - accuracy: 0.634
7 - val_loss: 0.6411 - val_accuracy: 0.6248
Epoch 22/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6258 - accuracy: 0.637
7 - val_loss: 0.6406 - val_accuracy: 0.6247
Epoch 23/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6230 - accuracy: 0.640
3 - val_loss: 0.6396 - val_accuracy: 0.6242
Epoch 24/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6202 - accuracy: 0.642
0 - val_loss: 0.6366 - val_accuracy: 0.6266
Epoch 25/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6190 - accuracy: 0.644
5 - val_loss: 0.6362 - val_accuracy: 0.6283
Epoch 26/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6167 - accuracy: 0.646
6 - val_loss: 0.6339 - val_accuracy: 0.6284
Epoch 27/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6146 - accuracy: 0.648
7 - val_loss: 0.6332 - val_accuracy: 0.6293
Epoch 28/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6147 - accuracy: 0.648
4 - val_loss: 0.6320 - val_accuracy: 0.6317
Epoch 29/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6127 - accuracy: 0.650
1 - val_loss: 0.6301 - val_accuracy: 0.6312
Epoch 30/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6119 - accuracy: 0.652
8 - val_loss: 0.6292 - val_accuracy: 0.6340
Epoch 31/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6080 - accuracy: 0.654
1 - val_loss: 0.6282 - val_accuracy: 0.6353
Epoch 32/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6080 - accuracy: 0.656
9 - val_loss: 0.6263 - val_accuracy: 0.6372
Epoch 33/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6068 - accuracy: 0.656
6 - val_loss: 0.6284 - val_accuracy: 0.6385
Epoch 34/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6037 - accuracy: 0.659
8 - val_loss: 0.6257 - val_accuracy: 0.6402
Epoch 35/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6045 - accuracy: 0.657
7 - val_loss: 0.6265 - val_accuracy: 0.6385
Epoch 36/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6017 - accuracy: 0.660
3 - val_loss: 0.6248 - val_accuracy: 0.6414
Epoch 37/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6003 - accuracy: 0.663
5 - val_loss: 0.6241 - val_accuracy: 0.6403
Epoch 38/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5978 - accuracy: 0.664
5 - val_loss: 0.6223 - val_accuracy: 0.6412
Epoch 39/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5981 - accuracy: 0.665
9 - val_loss: 0.6228 - val_accuracy: 0.6452
Epoch 40/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5971 - accuracy: 0.666
6 - val_loss: 0.6214 - val_accuracy: 0.6440
```

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Epoch 41/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5962 - accuracy: 0.667
5 - val_loss: 0.6219 - val_accuracy: 0.6403
Epoch 42/100
399/399 [==============================] - 2s 4ms/step - loss: 0.5949 - accuracy: 0.668
3 - val_loss: 0.6195 - val_accuracy: 0.6428
Epoch 1/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6913 - accuracy: 0.533
2 - val_loss: 0.6847 - val_accuracy: 0.5496
Epoch 2/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6838 - accuracy: 0.553
2 - val_loss: 0.6812 - val_accuracy: 0.5586
Epoch 3/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6814 - accuracy: 0.556
4 - val_loss: 0.6798 - val_accuracy: 0.5570
Epoch 4/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6785 - accuracy: 0.565
1 - val_loss: 0.6769 - val_accuracy: 0.5655
Epoch 5/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6759 - accuracy: 0.570
2 - val_loss: 0.6753 - val_accuracy: 0.5710
Epoch 6/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6719 - accuracy: 0.576
3 - val_loss: 0.6738 - val_accuracy: 0.5771
Epoch 7/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6695 - accuracy: 0.581
0 - val_loss: 0.6706 - val_accuracy: 0.5799
Epoch 8/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6659 - accuracy: 0.587
1 - val_loss: 0.6685 - val_accuracy: 0.5772
Epoch 9/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6614 - accuracy: 0.592
9 - val_loss: 0.6651 - val_accuracy: 0.5879
Epoch 10/100
399/399 [==============================] - 2s 5ms/step - loss: 0.6585 - accuracy: 0.597
4 - val_loss: 0.6619 - val_accuracy: 0.5885
Epoch 11/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6550 - accuracy: 0.602
3 - val_loss: 0.6599 - val_accuracy: 0.5979
Epoch 12/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6522 - accuracy: 0.608
1 - val_loss: 0.6563 - val_accuracy: 0.6013
Epoch 13/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6488 - accuracy: 0.611
6 - val_loss: 0.6549 - val_accuracy: 0.6036
Epoch 14/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6455 - accuracy: 0.615
6 - val_loss: 0.6543 - val_accuracy: 0.6024
Epoch 15/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6429 - accuracy: 0.617
8 - val_loss: 0.6506 - val_accuracy: 0.6087
Epoch 16/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6411 - accuracy: 0.619
4 - val_loss: 0.6471 - val_accuracy: 0.6138
Epoch 17/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6380 - accuracy: 0.625
0 - val_loss: 0.6471 - val_accuracy: 0.6142
Epoch 18/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6353 - accuracy: 0.626
5 - val_loss: 0.6451 - val_accuracy: 0.6161
```

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Epoch 19/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6324 - accuracy: 0.630
9 - val_loss: 0.6438 - val_accuracy: 0.6203
Epoch 20/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6296 - accuracy: 0.632
6 - val_loss: 0.6395 - val_accuracy: 0.6252
Epoch 21/100
399/399 [==============================] - 1s 4ms/step - loss: 0.6283 - accuracy: 0.635
8 - val_loss: 0.6401 - val_accuracy: 0.6217
Epoch 22/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6267 - accuracy: 0.637
0 - val_loss: 0.6395 - val_accuracy: 0.6233
Epoch 23/100
399/399 [==============================] - 2s 4ms/step - loss: 0.6236 - accuracy: 0.641
2 - val_loss: 0.6377 - val_accuracy: 0.6226
Epoch 1/100
200/200 [==============================] - 2s 6ms/step - loss: 0.6915 - accuracy: 0.533
2 - val_loss: 0.6848 - val_accuracy: 0.5520
Epoch 2/100
200/200 [==============================] - 1s 6ms/step - loss: 0.6853 - accuracy: 0.547
4 - val_loss: 0.6821 - val_accuracy: 0.5569
Epoch 3/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6821 - accuracy: 0.554
1 - val_loss: 0.6803 - val_accuracy: 0.5594
Epoch 4/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6802 - accuracy: 0.559
2 - val_loss: 0.6789 - val_accuracy: 0.5640
Epoch 5/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6779 - accuracy: 0.565
5 - val_loss: 0.6768 - val_accuracy: 0.5686
Epoch 6/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6758 - accuracy: 0.570
1 - val_loss: 0.6753 - val_accuracy: 0.5705
Epoch 7/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6736 - accuracy: 0.573
4 - val_loss: 0.6727 - val_accuracy: 0.5749
Epoch 8/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6714 - accuracy: 0.577
7 - val_loss: 0.6715 - val_accuracy: 0.5770
Epoch 9/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6684 - accuracy: 0.583
5 - val_loss: 0.6685 - val_accuracy: 0.5816
Epoch 10/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6648 - accuracy: 0.587
9 - val_loss: 0.6662 - val_accuracy: 0.5878
Epoch 11/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6617 - accuracy: 0.592
5 - val_loss: 0.6629 - val_accuracy: 0.5911
Epoch 12/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6589 - accuracy: 0.597
3 - val_loss: 0.6622 - val_accuracy: 0.5912
Epoch 13/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6565 - accuracy: 0.601
6 - val_loss: 0.6598 - val_accuracy: 0.5970
Epoch 14/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6525 - accuracy: 0.605
7 - val_loss: 0.6560 - val_accuracy: 0.5991
Epoch 15/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6501 - accuracy: 0.609
9 - val_loss: 0.6545 - val_accuracy: 0.6039
```

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Epoch 16/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6475 - accuracy: 0.611
0 - val_loss: 0.6514 - val_accuracy: 0.6091
Epoch 17/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6446 - accuracy: 0.616
5 - val_loss: 0.6509 - val_accuracy: 0.6123
Epoch 18/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6416 - accuracy: 0.620
3 - val_loss: 0.6496 - val_accuracy: 0.6101
Epoch 19/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6407 - accuracy: 0.622
6 - val_loss: 0.6481 - val_accuracy: 0.6149
Epoch 20/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6378 - accuracy: 0.625
3 - val_loss: 0.6437 - val_accuracy: 0.6200
Epoch 21/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6347 - accuracy: 0.627
4 - val_loss: 0.6425 - val_accuracy: 0.6192
Epoch 22/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6332 - accuracy: 0.628
0 - val_loss: 0.6417 - val_accuracy: 0.6182
Epoch 23/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6309 - accuracy: 0.634
6 - val_loss: 0.6404 - val_accuracy: 0.6219
Epoch 24/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6295 - accuracy: 0.633
1 - val_loss: 0.6388 - val_accuracy: 0.6258
Epoch 25/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6269 - accuracy: 0.636
1 - val_loss: 0.6387 - val_accuracy: 0.6265
Epoch 26/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6242 - accuracy: 0.640
8 - val_loss: 0.6351 - val_accuracy: 0.6271
Epoch 27/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6223 - accuracy: 0.641
8 - val_loss: 0.6354 - val_accuracy: 0.6285
Epoch 28/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6219 - accuracy: 0.642
2 - val_loss: 0.6349 - val_accuracy: 0.6322
Epoch 29/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6187 - accuracy: 0.644
9 - val_loss: 0.6312 - val_accuracy: 0.6296
Epoch 30/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6175 - accuracy: 0.646
8 - val_loss: 0.6329 - val_accuracy: 0.6297
Epoch 31/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6165 - accuracy: 0.648
9 - val_loss: 0.6301 - val_accuracy: 0.6349
Epoch 32/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6149 - accuracy: 0.648
5 - val_loss: 0.6311 - val_accuracy: 0.6320
Epoch 33/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6131 - accuracy: 0.652
2 - val_loss: 0.6286 - val_accuracy: 0.6341
Epoch 34/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6117 - accuracy: 0.655
1 - val_loss: 0.6276 - val_accuracy: 0.6377
Epoch 35/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6106 - accuracy: 0.656
0 - val_loss: 0.6257 - val_accuracy: 0.6396
```

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Epoch 36/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6088 - accuracy: 0.655
4 - val_loss: 0.6248 - val_accuracy: 0.6392
Epoch 37/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6066 - accuracy: 0.658
2 - val_loss: 0.6256 - val_accuracy: 0.6368
Epoch 38/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6066 - accuracy: 0.658
0 - val_loss: 0.6245 - val_accuracy: 0.6401
Epoch 39/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6066 - accuracy: 0.659
7 - val_loss: 0.6248 - val_accuracy: 0.6410
Epoch 40/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6039 - accuracy: 0.662
0 - val_loss: 0.6224 - val_accuracy: 0.6381
Epoch 41/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6027 - accuracy: 0.661
2 - val_loss: 0.6214 - val_accuracy: 0.6421
Epoch 42/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6035 - accuracy: 0.660
7 - val_loss: 0.6219 - val_accuracy: 0.6401
Epoch 43/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5997 - accuracy: 0.666
9 - val_loss: 0.6198 - val_accuracy: 0.6455
Epoch 44/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5995 - accuracy: 0.663
4 - val_loss: 0.6199 - val_accuracy: 0.6446
Epoch 45/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5990 - accuracy: 0.664
2 - val_loss: 0.6189 - val_accuracy: 0.6460
Epoch 46/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5954 - accuracy: 0.668
4 - val_loss: 0.6179 - val_accuracy: 0.6466
Epoch 47/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5976 - accuracy: 0.666
9 - val_loss: 0.6187 - val_accuracy: 0.6470
Epoch 48/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5952 - accuracy: 0.667
7 - val_loss: 0.6179 - val_accuracy: 0.6500
Epoch 49/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5946 - accuracy: 0.669
3 - val_loss: 0.6169 - val_accuracy: 0.6467
Epoch 50/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5944 - accuracy: 0.670
2 - val_loss: 0.6166 - val_accuracy: 0.6478
Epoch 51/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5924 - accuracy: 0.671
5 - val_loss: 0.6170 - val_accuracy: 0.6475
Epoch 1/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6915 - accuracy: 0.531
5 - val_loss: 0.6848 - val_accuracy: 0.5521
Epoch 2/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6855 - accuracy: 0.546
3 - val_loss: 0.6829 - val_accuracy: 0.5560
Epoch 3/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6822 - accuracy: 0.554
5 - val_loss: 0.6809 - val_accuracy: 0.5580
Epoch 4/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6797 - accuracy: 0.561
0 - val_loss: 0.6805 - val_accuracy: 0.5649
```

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Epoch 5/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6776 - accuracy: 0.566
2 - val_loss: 0.6777 - val_accuracy: 0.5683
Epoch 6/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6752 - accuracy: 0.569
2 - val_loss: 0.6759 - val_accuracy: 0.5678
Epoch 7/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6721 - accuracy: 0.576
4 - val_loss: 0.6733 - val_accuracy: 0.5742
Epoch 8/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6698 - accuracy: 0.579
6 - val_loss: 0.6713 - val_accuracy: 0.5781
Epoch 9/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6666 - accuracy: 0.586
5 - val_loss: 0.6678 - val_accuracy: 0.5872
Epoch 10/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6639 - accuracy: 0.591
1 - val_loss: 0.6667 - val_accuracy: 0.5875
Epoch 11/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6616 - accuracy: 0.594
5 - val_loss: 0.6639 - val_accuracy: 0.5918
Epoch 12/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6578 - accuracy: 0.598
1 - val_loss: 0.6618 - val_accuracy: 0.5925
Epoch 13/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6553 - accuracy: 0.603
1 - val_loss: 0.6596 - val_accuracy: 0.5997
Epoch 14/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6529 - accuracy: 0.606
6 - val_loss: 0.6576 - val_accuracy: 0.6002
Epoch 15/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6500 - accuracy: 0.610
0 - val_loss: 0.6541 - val_accuracy: 0.6039
Epoch 16/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6472 - accuracy: 0.613
2 - val_loss: 0.6520 - val_accuracy: 0.6084
Epoch 17/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6449 - accuracy: 0.616
2 - val_loss: 0.6520 - val_accuracy: 0.6086
Epoch 18/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6422 - accuracy: 0.617
1 - val_loss: 0.6490 - val_accuracy: 0.6139
Epoch 19/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6399 - accuracy: 0.622
5 - val_loss: 0.6477 - val_accuracy: 0.6139
Epoch 20/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6379 - accuracy: 0.624
6 - val_loss: 0.6463 - val_accuracy: 0.6162
Epoch 21/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6353 - accuracy: 0.626
4 - val_loss: 0.6462 - val_accuracy: 0.6195
Epoch 22/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6326 - accuracy: 0.631
6 - val_loss: 0.6434 - val_accuracy: 0.6214
Epoch 23/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6313 - accuracy: 0.630
5 - val_loss: 0.6411 - val_accuracy: 0.6249
Epoch 24/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6300 - accuracy: 0.633
1 - val_loss: 0.6405 - val_accuracy: 0.6242
```

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Epoch 25/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6277 - accuracy: 0.634
6 - val_loss: 0.6419 - val_accuracy: 0.6222
Epoch 26/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6251 - accuracy: 0.637
6 - val_loss: 0.6398 - val_accuracy: 0.6250
Epoch 27/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6235 - accuracy: 0.639
1 - val_loss: 0.6388 - val_accuracy: 0.6265
Epoch 28/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6229 - accuracy: 0.641
9 - val_loss: 0.6372 - val_accuracy: 0.6284
Epoch 29/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6191 - accuracy: 0.644
8 - val_loss: 0.6353 - val_accuracy: 0.6284
Epoch 30/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6178 - accuracy: 0.645
9 - val_loss: 0.6339 - val_accuracy: 0.6313
Epoch 31/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6169 - accuracy: 0.647
7 - val_loss: 0.6324 - val_accuracy: 0.6333
Epoch 32/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6166 - accuracy: 0.646
4 - val_loss: 0.6328 - val_accuracy: 0.6318
Epoch 33/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6123 - accuracy: 0.652
2 - val_loss: 0.6316 - val_accuracy: 0.6352
Epoch 34/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6114 - accuracy: 0.654
0 - val_loss: 0.6302 - val_accuracy: 0.6352
Epoch 35/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6109 - accuracy: 0.653
7 - val_loss: 0.6297 - val_accuracy: 0.6372
Epoch 36/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6093 - accuracy: 0.653
4 - val_loss: 0.6278 - val_accuracy: 0.6380
Epoch 37/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6077 - accuracy: 0.655
3 - val_loss: 0.6281 - val_accuracy: 0.6381
Epoch 38/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6070 - accuracy: 0.656
9 - val_loss: 0.6272 - val_accuracy: 0.6381
Epoch 39/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6050 - accuracy: 0.658
8 - val_loss: 0.6266 - val_accuracy: 0.6382
Epoch 40/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6043 - accuracy: 0.660
3 - val_loss: 0.6245 - val_accuracy: 0.6435
Epoch 41/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6036 - accuracy: 0.659
8 - val_loss: 0.6235 - val_accuracy: 0.6450
Epoch 42/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6019 - accuracy: 0.662
7 - val_loss: 0.6238 - val_accuracy: 0.6430
Epoch 43/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6019 - accuracy: 0.662
2 - val_loss: 0.6235 - val_accuracy: 0.6443
Epoch 44/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6008 - accuracy: 0.663
1 - val_loss: 0.6223 - val_accuracy: 0.6474
```

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Epoch 45/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5991 - accuracy: 0.664
6 - val_loss: 0.6202 - val_accuracy: 0.6495
Epoch 46/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5995 - accuracy: 0.663
0 - val_loss: 0.6215 - val_accuracy: 0.6476
Epoch 47/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5973 - accuracy: 0.665
8 - val_loss: 0.6212 - val_accuracy: 0.6477
Epoch 48/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5970 - accuracy: 0.666
0 - val_loss: 0.6200 - val_accuracy: 0.6472
Epoch 1/100
200/200 [==============================] - 1s 5ms/step - loss: 0.6906 - accuracy: 0.535
6 - val_loss: 0.6847 - val_accuracy: 0.5476
Epoch 2/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6846 - accuracy: 0.552
1 - val_loss: 0.6828 - val_accuracy: 0.5585
Epoch 3/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6822 - accuracy: 0.556
1 - val_loss: 0.6800 - val_accuracy: 0.5631
Epoch 4/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6795 - accuracy: 0.561
4 - val_loss: 0.6779 - val_accuracy: 0.5664
Epoch 5/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6773 - accuracy: 0.565
8 - val_loss: 0.6758 - val_accuracy: 0.5693
Epoch 6/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6746 - accuracy: 0.571
7 - val_loss: 0.6741 - val_accuracy: 0.5751
Epoch 7/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6723 - accuracy: 0.575
9 - val_loss: 0.6712 - val_accuracy: 0.5788
Epoch 8/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6691 - accuracy: 0.583
2 - val_loss: 0.6694 - val_accuracy: 0.5863
Epoch 9/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6670 - accuracy: 0.585
8 - val_loss: 0.6679 - val_accuracy: 0.5861
Epoch 10/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6637 - accuracy: 0.591
0 - val_loss: 0.6650 - val_accuracy: 0.5888
Epoch 11/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6611 - accuracy: 0.595
0 - val_loss: 0.6636 - val_accuracy: 0.5926
Epoch 12/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6585 - accuracy: 0.601
3 - val_loss: 0.6600 - val_accuracy: 0.6001
Epoch 13/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6543 - accuracy: 0.605
6 - val_loss: 0.6590 - val_accuracy: 0.6008
Epoch 14/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6520 - accuracy: 0.609
6 - val_loss: 0.6551 - val_accuracy: 0.6041
Epoch 15/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6496 - accuracy: 0.613
2 - val_loss: 0.6546 - val_accuracy: 0.6067
Epoch 16/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6460 - accuracy: 0.618
7 - val_loss: 0.6513 - val_accuracy: 0.6091
```

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Epoch 17/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6447 - accuracy: 0.618
2 - val_loss: 0.6498 - val_accuracy: 0.6138
Epoch 18/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6408 - accuracy: 0.621
9 - val_loss: 0.6483 - val_accuracy: 0.6143
Epoch 19/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6382 - accuracy: 0.625
1 - val_loss: 0.6445 - val_accuracy: 0.6212
Epoch 20/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6370 - accuracy: 0.625
3 - val_loss: 0.6438 - val_accuracy: 0.6194
Epoch 21/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6343 - accuracy: 0.630
6 - val_loss: 0.6418 - val_accuracy: 0.6217
Epoch 22/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6313 - accuracy: 0.632
4 - val_loss: 0.6401 - val_accuracy: 0.6221
Epoch 23/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6292 - accuracy: 0.635
8 - val_loss: 0.6398 - val_accuracy: 0.6224
Epoch 24/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6278 - accuracy: 0.636
6 - val_loss: 0.6375 - val_accuracy: 0.6281
Epoch 25/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6252 - accuracy: 0.639
6 - val_loss: 0.6363 - val_accuracy: 0.6310
Epoch 26/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6239 - accuracy: 0.641
2 - val_loss: 0.6350 - val_accuracy: 0.6333
Epoch 27/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6202 - accuracy: 0.645
1 - val_loss: 0.6352 - val_accuracy: 0.6311
Epoch 28/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6192 - accuracy: 0.646
8 - val_loss: 0.6320 - val_accuracy: 0.6358
Epoch 29/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6180 - accuracy: 0.648
1 - val_loss: 0.6322 - val_accuracy: 0.6330
Epoch 30/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6163 - accuracy: 0.650
4 - val_loss: 0.6304 - val_accuracy: 0.6386
Epoch 31/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6150 - accuracy: 0.650
5 - val_loss: 0.6282 - val_accuracy: 0.6379
Epoch 32/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6134 - accuracy: 0.651
2 - val_loss: 0.6289 - val_accuracy: 0.6385
Epoch 33/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6122 - accuracy: 0.655
2 - val_loss: 0.6280 - val_accuracy: 0.6391
Epoch 34/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6099 - accuracy: 0.655
7 - val_loss: 0.6266 - val_accuracy: 0.6394
Epoch 35/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6073 - accuracy: 0.658
9 - val_loss: 0.6261 - val_accuracy: 0.6399
Epoch 36/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6086 - accuracy: 0.659
5 - val_loss: 0.6247 - val_accuracy: 0.6414
```

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Epoch 37/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6055 - accuracy: 0.661
8 - val_loss: 0.6238 - val_accuracy: 0.6447
Epoch 38/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6036 - accuracy: 0.662
9 - val_loss: 0.6211 - val_accuracy: 0.6425
Epoch 39/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6042 - accuracy: 0.661
2 - val_loss: 0.6219 - val_accuracy: 0.6457
Epoch 40/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6024 - accuracy: 0.664
4 - val_loss: 0.6215 - val_accuracy: 0.6464
Epoch 41/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6006 - accuracy: 0.667
9 - val_loss: 0.6200 - val_accuracy: 0.6480
Epoch 42/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6013 - accuracy: 0.665
4 - val_loss: 0.6202 - val_accuracy: 0.6457
Epoch 43/100
200/200 [==============================] - 1s 3ms/step - loss: 0.5997 - accuracy: 0.666
5 - val_loss: 0.6187 - val_accuracy: 0.6481
Epoch 44/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5986 - accuracy: 0.667
8 - val_loss: 0.6184 - val_accuracy: 0.6466
Epoch 45/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5984 - accuracy: 0.667
0 - val_loss: 0.6199 - val_accuracy: 0.6473
Epoch 46/100
200/200 [==============================] - 1s 4ms/step - loss: 0.5948 - accuracy: 0.671
8 - val_loss: 0.6180 - val_accuracy: 0.6458
Epoch 1/100
200/200 [==============================] - 2s 5ms/step - loss: 0.6930 - accuracy: 0.530
1 - val_loss: 0.6852 - val_accuracy: 0.5489
Epoch 2/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6849 - accuracy: 0.548
5 - val_loss: 0.6826 - val_accuracy: 0.5559
Epoch 3/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6825 - accuracy: 0.555
1 - val_loss: 0.6804 - val_accuracy: 0.5624
Epoch 4/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6800 - accuracy: 0.558
9 - val_loss: 0.6787 - val_accuracy: 0.5701
Epoch 5/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6775 - accuracy: 0.566
1 - val_loss: 0.6775 - val_accuracy: 0.5695
Epoch 6/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6749 - accuracy: 0.570
8 - val_loss: 0.6746 - val_accuracy: 0.5764
Epoch 7/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6724 - accuracy: 0.576
4 - val_loss: 0.6741 - val_accuracy: 0.5764
Epoch 8/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6702 - accuracy: 0.579
8 - val_loss: 0.6706 - val_accuracy: 0.5829
Epoch 9/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6672 - accuracy: 0.586
6 - val_loss: 0.6670 - val_accuracy: 0.5866
Epoch 10/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6642 - accuracy: 0.590
4 - val_loss: 0.6640 - val_accuracy: 0.5904
```

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Epoch 11/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6604 - accuracy: 0.595
6 - val_loss: 0.6639 - val_accuracy: 0.5894
Epoch 12/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6571 - accuracy: 0.601
3 - val_loss: 0.6600 - val_accuracy: 0.5985
Epoch 13/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6534 - accuracy: 0.605
3 - val_loss: 0.6578 - val_accuracy: 0.6016
Epoch 14/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6518 - accuracy: 0.605
8 - val_loss: 0.6568 - val_accuracy: 0.6001
Epoch 15/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6491 - accuracy: 0.613
4 - val_loss: 0.6544 - val_accuracy: 0.6015
Epoch 16/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6464 - accuracy: 0.616
1 - val_loss: 0.6515 - val_accuracy: 0.6078
Epoch 17/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6435 - accuracy: 0.619
5 - val_loss: 0.6510 - val_accuracy: 0.6111
Epoch 18/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6402 - accuracy: 0.620
9 - val_loss: 0.6481 - val_accuracy: 0.6130
Epoch 19/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6376 - accuracy: 0.626
2 - val_loss: 0.6475 - val_accuracy: 0.6175
Epoch 20/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6347 - accuracy: 0.629
1 - val_loss: 0.6457 - val_accuracy: 0.6173
Epoch 21/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6335 - accuracy: 0.632
7 - val_loss: 0.6439 - val_accuracy: 0.6181
Epoch 22/100
200/200 [==============================] - 1s 3ms/step - loss: 0.6309 - accuracy: 0.635
1 - val_loss: 0.6423 - val_accuracy: 0.6212
Epoch 23/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6282 - accuracy: 0.635
9 - val_loss: 0.6408 - val_accuracy: 0.6248
Epoch 24/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6270 - accuracy: 0.637
9 - val_loss: 0.6406 - val_accuracy: 0.6228
Epoch 25/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6231 - accuracy: 0.643
7 - val_loss: 0.6407 - val_accuracy: 0.6223
Epoch 26/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6233 - accuracy: 0.641
3 - val_loss: 0.6366 - val_accuracy: 0.6295
Epoch 27/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6204 - accuracy: 0.644
0 - val_loss: 0.6362 - val_accuracy: 0.6317
Epoch 28/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6193 - accuracy: 0.645
9 - val_loss: 0.6357 - val_accuracy: 0.6313
Epoch 29/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6165 - accuracy: 0.649
1 - val_loss: 0.6336 - val_accuracy: 0.6310
Epoch 30/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6162 - accuracy: 0.651
1 - val_loss: 0.6320 - val_accuracy: 0.6339
```

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Epoch 31/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6145 - accuracy: 0.650
1 - val_loss: 0.6332 - val_accuracy: 0.6319
Epoch 32/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6107 - accuracy: 0.654
0 - val_loss: 0.6317 - val_accuracy: 0.6368
Epoch 33/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6108 - accuracy: 0.655
6 - val_loss: 0.6295 - val_accuracy: 0.6381
Epoch 34/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6099 - accuracy: 0.656
6 - val_loss: 0.6274 - val_accuracy: 0.6361
Epoch 35/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6083 - accuracy: 0.657
6 - val_loss: 0.6269 - val_accuracy: 0.6379
Epoch 36/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6063 - accuracy: 0.660
0 - val_loss: 0.6265 - val_accuracy: 0.6381
Epoch 1/100
200/200 [==============================] - 2s 5ms/step - loss: 0.6930 - accuracy: 0.532
3 - val_loss: 0.6860 - val_accuracy: 0.5455
Epoch 2/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6851 - accuracy: 0.549
1 - val_loss: 0.6830 - val_accuracy: 0.5546
Epoch 3/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6822 - accuracy: 0.557
1 - val_loss: 0.6808 - val_accuracy: 0.5565
Epoch 4/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6800 - accuracy: 0.562
6 - val_loss: 0.6783 - val_accuracy: 0.5634
Epoch 5/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6771 - accuracy: 0.566
6 - val_loss: 0.6766 - val_accuracy: 0.5649
Epoch 6/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6747 - accuracy: 0.572
4 - val_loss: 0.6745 - val_accuracy: 0.5721
Epoch 7/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6719 - accuracy: 0.577
8 - val_loss: 0.6734 - val_accuracy: 0.5740
Epoch 8/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6694 - accuracy: 0.581
0 - val_loss: 0.6711 - val_accuracy: 0.5758
Epoch 9/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6664 - accuracy: 0.586
0 - val_loss: 0.6682 - val_accuracy: 0.5796
Epoch 10/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6632 - accuracy: 0.590
9 - val_loss: 0.6648 - val_accuracy: 0.5883
Epoch 11/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6606 - accuracy: 0.598
2 - val_loss: 0.6638 - val_accuracy: 0.5922
Epoch 12/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6570 - accuracy: 0.601
5 - val_loss: 0.6607 - val_accuracy: 0.5949
Epoch 13/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6537 - accuracy: 0.606
3 - val_loss: 0.6594 - val_accuracy: 0.5974
Epoch 14/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6520 - accuracy: 0.607
8 - val_loss: 0.6562 - val_accuracy: 0.6020
```

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Epoch 15/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6495 - accuracy: 0.611
4 - val_loss: 0.6541 - val_accuracy: 0.6060
Epoch 16/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6455 - accuracy: 0.615
8 - val_loss: 0.6530 - val_accuracy: 0.6075
Epoch 17/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6442 - accuracy: 0.616
4 - val_loss: 0.6508 - val_accuracy: 0.6121
Epoch 18/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6397 - accuracy: 0.622
8 - val_loss: 0.6489 - val_accuracy: 0.6127
Epoch 19/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6386 - accuracy: 0.625
6 - val_loss: 0.6465 - val_accuracy: 0.6197
Epoch 20/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6361 - accuracy: 0.629
1 - val_loss: 0.6436 - val_accuracy: 0.6232
Epoch 21/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6332 - accuracy: 0.630
7 - val_loss: 0.6441 - val_accuracy: 0.6207
Epoch 22/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6313 - accuracy: 0.635
5 - val_loss: 0.6430 - val_accuracy: 0.6198
Epoch 23/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6282 - accuracy: 0.634
9 - val_loss: 0.6416 - val_accuracy: 0.6234
Epoch 24/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6253 - accuracy: 0.638
9 - val_loss: 0.6376 - val_accuracy: 0.6267
Epoch 25/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6255 - accuracy: 0.640
8 - val_loss: 0.6369 - val_accuracy: 0.6306
Epoch 26/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6223 - accuracy: 0.642
4 - val_loss: 0.6365 - val_accuracy: 0.6311
Epoch 27/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6212 - accuracy: 0.643
5 - val_loss: 0.6350 - val_accuracy: 0.6273
Epoch 28/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6191 - accuracy: 0.645
4 - val_loss: 0.6336 - val_accuracy: 0.6321
Epoch 29/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6178 - accuracy: 0.647
4 - val_loss: 0.6340 - val_accuracy: 0.6297
Epoch 30/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6148 - accuracy: 0.653
5 - val_loss: 0.6327 - val_accuracy: 0.6332
Epoch 31/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6139 - accuracy: 0.651
4 - val_loss: 0.6301 - val_accuracy: 0.6378
Epoch 32/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6112 - accuracy: 0.652
8 - val_loss: 0.6296 - val_accuracy: 0.6363
Epoch 33/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6103 - accuracy: 0.654
7 - val_loss: 0.6278 - val_accuracy: 0.6364
Epoch 34/100
200/200 [==============================] - 1s 4ms/step - loss: 0.6106 - accuracy: 0.655
6 - val_loss: 0.6286 - val_accuracy: 0.6365
```

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Epoch 1/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6941 - accuracy: 0.529
1 - val_loss: 0.6850 - val_accuracy: 0.5468
Epoch 2/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6872 - accuracy: 0.543
6 - val_loss: 0.6835 - val_accuracy: 0.5535
Epoch 3/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6836 - accuracy: 0.551
4 - val_loss: 0.6806 - val_accuracy: 0.5625
Epoch 4/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6818 - accuracy: 0.557
8 - val_loss: 0.6794 - val_accuracy: 0.5656
Epoch 5/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6796 - accuracy: 0.561
9 - val_loss: 0.6782 - val_accuracy: 0.5647
Epoch 6/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6776 - accuracy: 0.567
8 - val_loss: 0.6767 - val_accuracy: 0.5667
Epoch 7/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6752 - accuracy: 0.572
3 - val_loss: 0.6738 - val_accuracy: 0.5736
Epoch 8/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6733 - accuracy: 0.574
2 - val_loss: 0.6727 - val_accuracy: 0.5789
Epoch 9/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6713 - accuracy: 0.577
3 - val_loss: 0.6704 - val_accuracy: 0.5837
Epoch 10/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6688 - accuracy: 0.583
2 - val_loss: 0.6685 - val_accuracy: 0.5878
Epoch 11/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6669 - accuracy: 0.583
7 - val_loss: 0.6664 - val_accuracy: 0.5903
Epoch 12/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6644 - accuracy: 0.589
1 - val_loss: 0.6659 - val_accuracy: 0.5922
Epoch 13/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6624 - accuracy: 0.594
3 - val_loss: 0.6631 - val_accuracy: 0.5957
Epoch 14/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6593 - accuracy: 0.596
5 - val_loss: 0.6616 - val_accuracy: 0.5950
Epoch 15/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6576 - accuracy: 0.600
9 - val_loss: 0.6608 - val_accuracy: 0.5974
Epoch 16/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6558 - accuracy: 0.603
4 - val_loss: 0.6590 - val_accuracy: 0.6011
Epoch 17/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6525 - accuracy: 0.606
6 - val_loss: 0.6571 - val_accuracy: 0.6060
Epoch 18/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6503 - accuracy: 0.610
3 - val_loss: 0.6560 - val_accuracy: 0.6024
Epoch 19/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6480 - accuracy: 0.613
1 - val_loss: 0.6529 - val_accuracy: 0.6054
Epoch 20/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6459 - accuracy: 0.615
5 - val_loss: 0.6512 - val_accuracy: 0.6100
```

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Epoch 21/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6421 - accuracy: 0.620
7 - val_loss: 0.6482 - val_accuracy: 0.6144
Epoch 22/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6404 - accuracy: 0.622
2 - val_loss: 0.6485 - val_accuracy: 0.6131
Epoch 23/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6388 - accuracy: 0.624
6 - val_loss: 0.6471 - val_accuracy: 0.6166
Epoch 24/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6379 - accuracy: 0.626
0 - val_loss: 0.6431 - val_accuracy: 0.6165
Epoch 25/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6352 - accuracy: 0.627
6 - val_loss: 0.6446 - val_accuracy: 0.6206
Epoch 26/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6329 - accuracy: 0.630
9 - val_loss: 0.6408 - val_accuracy: 0.6233
Epoch 27/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6317 - accuracy: 0.632
3 - val_loss: 0.6410 - val_accuracy: 0.6217
Epoch 28/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6297 - accuracy: 0.635
5 - val_loss: 0.6402 - val_accuracy: 0.6206
Epoch 29/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6260 - accuracy: 0.638
6 - val_loss: 0.6377 - val_accuracy: 0.6265
Epoch 30/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6263 - accuracy: 0.637
9 - val_loss: 0.6374 - val_accuracy: 0.6291
Epoch 31/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6246 - accuracy: 0.639
8 - val_loss: 0.6359 - val_accuracy: 0.6264
Epoch 32/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6229 - accuracy: 0.643
9 - val_loss: 0.6346 - val_accuracy: 0.6316
Epoch 33/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6226 - accuracy: 0.642
1 - val_loss: 0.6321 - val_accuracy: 0.6346
Epoch 34/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6189 - accuracy: 0.647
5 - val_loss: 0.6322 - val_accuracy: 0.6333
Epoch 35/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6179 - accuracy: 0.647
0 - val_loss: 0.6301 - val_accuracy: 0.6371
Epoch 36/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6171 - accuracy: 0.649
5 - val_loss: 0.6309 - val_accuracy: 0.6336
Epoch 37/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6156 - accuracy: 0.648
0 - val_loss: 0.6298 - val_accuracy: 0.6371
Epoch 38/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6144 - accuracy: 0.653
2 - val_loss: 0.6300 - val_accuracy: 0.6356
Epoch 1/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6933 - accuracy: 0.530
8 - val_loss: 0.6851 - val_accuracy: 0.5515
Epoch 2/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6858 - accuracy: 0.546
9 - val_loss: 0.6828 - val_accuracy: 0.5577
```

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Epoch 3/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6831 - accuracy: 0.555
0 - val_loss: 0.6812 - val_accuracy: 0.5583
Epoch 4/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6804 - accuracy: 0.562
5 - val_loss: 0.6802 - val_accuracy: 0.5645
Epoch 5/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6790 - accuracy: 0.562
7 - val_loss: 0.6784 - val_accuracy: 0.5647
Epoch 6/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6763 - accuracy: 0.568
8 - val_loss: 0.6767 - val_accuracy: 0.5677
Epoch 7/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6748 - accuracy: 0.572
9 - val_loss: 0.6754 - val_accuracy: 0.5704
Epoch 8/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6724 - accuracy: 0.577
5 - val_loss: 0.6736 - val_accuracy: 0.5740
Epoch 9/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6710 - accuracy: 0.579
8 - val_loss: 0.6722 - val_accuracy: 0.5790
Epoch 10/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6684 - accuracy: 0.585
1 - val_loss: 0.6694 - val_accuracy: 0.5796
Epoch 11/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6663 - accuracy: 0.587
7 - val_loss: 0.6680 - val_accuracy: 0.5818
Epoch 12/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6633 - accuracy: 0.590
8 - val_loss: 0.6664 - val_accuracy: 0.5873
Epoch 13/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6614 - accuracy: 0.594
7 - val_loss: 0.6652 - val_accuracy: 0.5876
Epoch 14/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6599 - accuracy: 0.596
6 - val_loss: 0.6639 - val_accuracy: 0.5925
Epoch 15/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6570 - accuracy: 0.602
2 - val_loss: 0.6607 - val_accuracy: 0.5966
Epoch 16/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6545 - accuracy: 0.607
3 - val_loss: 0.6592 - val_accuracy: 0.6012
Epoch 17/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6525 - accuracy: 0.607
3 - val_loss: 0.6586 - val_accuracy: 0.5990
Epoch 18/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6497 - accuracy: 0.612
7 - val_loss: 0.6543 - val_accuracy: 0.6059
Epoch 19/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6476 - accuracy: 0.613
9 - val_loss: 0.6536 - val_accuracy: 0.6054
Epoch 20/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6444 - accuracy: 0.617
1 - val_loss: 0.6521 - val_accuracy: 0.6080
Epoch 21/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6431 - accuracy: 0.619
1 - val_loss: 0.6510 - val_accuracy: 0.6118
Epoch 22/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6413 - accuracy: 0.619
4 - val_loss: 0.6499 - val_accuracy: 0.6126
```

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Epoch 23/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6393 - accuracy: 0.623
1 - val_loss: 0.6478 - val_accuracy: 0.6155
Epoch 24/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6369 - accuracy: 0.627
4 - val_loss: 0.6468 - val_accuracy: 0.6173
Epoch 25/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6352 - accuracy: 0.629
1 - val_loss: 0.6455 - val_accuracy: 0.6157
Epoch 26/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6323 - accuracy: 0.633
8 - val_loss: 0.6450 - val_accuracy: 0.6211
Epoch 27/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6308 - accuracy: 0.633
9 - val_loss: 0.6426 - val_accuracy: 0.6202
Epoch 28/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6294 - accuracy: 0.635
4 - val_loss: 0.6405 - val_accuracy: 0.6265
Epoch 29/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6273 - accuracy: 0.639
2 - val_loss: 0.6396 - val_accuracy: 0.6242
Epoch 30/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6247 - accuracy: 0.641
2 - val_loss: 0.6384 - val_accuracy: 0.6256
Epoch 31/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6250 - accuracy: 0.641
0 - val_loss: 0.6361 - val_accuracy: 0.6294
Epoch 32/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6222 - accuracy: 0.644
6 - val_loss: 0.6368 - val_accuracy: 0.6270
Epoch 33/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6204 - accuracy: 0.646
0 - val_loss: 0.6330 - val_accuracy: 0.6309
Epoch 34/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6199 - accuracy: 0.647
0 - val_loss: 0.6344 - val_accuracy: 0.6293
Epoch 35/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6181 - accuracy: 0.648
1 - val_loss: 0.6318 - val_accuracy: 0.6352
Epoch 36/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6169 - accuracy: 0.649
9 - val_loss: 0.6322 - val_accuracy: 0.6330
Epoch 37/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6140 - accuracy: 0.653
3 - val_loss: 0.6306 - val_accuracy: 0.6363
Epoch 38/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6141 - accuracy: 0.653
5 - val_loss: 0.6312 - val_accuracy: 0.6365
Epoch 39/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6119 - accuracy: 0.654
8 - val_loss: 0.6284 - val_accuracy: 0.6386
Epoch 40/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6117 - accuracy: 0.655
4 - val_loss: 0.6287 - val_accuracy: 0.6364
Epoch 41/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6102 - accuracy: 0.657
5 - val_loss: 0.6282 - val_accuracy: 0.6401
Epoch 42/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6111 - accuracy: 0.656
5 - val_loss: 0.6260 - val_accuracy: 0.6375
```

```
Epoch 43/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6074 - accuracy: 0.660
1 - val_loss: 0.6256 - val_accuracy: 0.6374
Epoch 44/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6064 - accuracy: 0.660
1 - val_loss: 0.6257 - val_accuracy: 0.6374
Epoch 1/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6942 - accuracy: 0.527
9 - val_loss: 0.6864 - val_accuracy: 0.5409
Epoch 2/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6860 - accuracy: 0.545
7 - val_loss: 0.6839 - val_accuracy: 0.5515
Epoch 3/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6838 - accuracy: 0.551
7 - val_loss: 0.6817 - val_accuracy: 0.5565
Epoch 4/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6810 - accuracy: 0.558
5 - val_loss: 0.6796 - val_accuracy: 0.5610
Epoch 5/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6794 - accuracy: 0.562
9 - val_loss: 0.6782 - val_accuracy: 0.5641
Epoch 6/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6774 - accuracy: 0.565
0 - val_loss: 0.6768 - val_accuracy: 0.5673
Epoch 7/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6748 - accuracy: 0.571
0 - val_loss: 0.6760 - val_accuracy: 0.5711
Epoch 8/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6732 - accuracy: 0.573
9 - val_loss: 0.6754 - val_accuracy: 0.5730
Epoch 9/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6711 - accuracy: 0.578
3 - val_loss: 0.6742 - val_accuracy: 0.5715
Epoch 10/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6687 - accuracy: 0.584
7 - val_loss: 0.6707 - val_accuracy: 0.5760
Epoch 11/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6666 - accuracy: 0.589
0 - val_loss: 0.6694 - val_accuracy: 0.5795
Epoch 12/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6640 - accuracy: 0.592
7 - val_loss: 0.6657 - val_accuracy: 0.5866
Epoch 13/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6613 - accuracy: 0.595
6 - val_loss: 0.6653 - val_accuracy: 0.5875
Epoch 14/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6587 - accuracy: 0.600
8 - val_loss: 0.6623 - val_accuracy: 0.5917
Epoch 15/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6567 - accuracy: 0.602
8 - val_loss: 0.6609 - val_accuracy: 0.5967
Epoch 16/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6536 - accuracy: 0.607
2 - val_loss: 0.6580 - val_accuracy: 0.6024
Epoch 17/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6510 - accuracy: 0.612
5 - val_loss: 0.6567 - val_accuracy: 0.6059
Epoch 18/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6493 - accuracy: 0.612
5 - val_loss: 0.6558 - val_accuracy: 0.6046
```

```
Epoch 19/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6467 - accuracy: 0.616
8 - val_loss: 0.6526 - val_accuracy: 0.6105
Epoch 20/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6442 - accuracy: 0.619
6 - val_loss: 0.6523 - val_accuracy: 0.6145
Epoch 21/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6423 - accuracy: 0.621
1 - val_loss: 0.6497 - val_accuracy: 0.6150
Epoch 22/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6404 - accuracy: 0.623
5 - val_loss: 0.6507 - val_accuracy: 0.6094
Epoch 23/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6379 - accuracy: 0.627
6 - val_loss: 0.6482 - val_accuracy: 0.6134
Epoch 24/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6371 - accuracy: 0.627
7 - val_loss: 0.6464 - val_accuracy: 0.6181
Epoch 25/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6345 - accuracy: 0.630
2 - val_loss: 0.6448 - val_accuracy: 0.6214
Epoch 26/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6321 - accuracy: 0.635
0 - val_loss: 0.6441 - val_accuracy: 0.6230
Epoch 27/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6307 - accuracy: 0.636
8 - val_loss: 0.6424 - val_accuracy: 0.6238
Epoch 28/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6281 - accuracy: 0.637
6 - val_loss: 0.6408 - val_accuracy: 0.6268
Epoch 29/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6267 - accuracy: 0.640
6 - val_loss: 0.6395 - val_accuracy: 0.6284
Epoch 30/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6234 - accuracy: 0.643
1 - val_loss: 0.6381 - val_accuracy: 0.6261
Epoch 31/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6231 - accuracy: 0.643
5 - val_loss: 0.6391 - val_accuracy: 0.6261
Epoch 32/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6228 - accuracy: 0.644
2 - val_loss: 0.6362 - val_accuracy: 0.6270
Epoch 1/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6935 - accuracy: 0.528
3 - val_loss: 0.6852 - val_accuracy: 0.5524
Epoch 2/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6862 - accuracy: 0.545
1 - val_loss: 0.6836 - val_accuracy: 0.5570
Epoch 3/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6835 - accuracy: 0.551
8 - val_loss: 0.6816 - val_accuracy: 0.5620
Epoch 4/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6812 - accuracy: 0.558
9 - val_loss: 0.6796 - val_accuracy: 0.5657
Epoch 5/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6795 - accuracy: 0.561
2 - val_loss: 0.6788 - val_accuracy: 0.5680
Epoch 6/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6780 - accuracy: 0.566
2 - val_loss: 0.6762 - val_accuracy: 0.5721
```

```
Epoch 7/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6758 - accuracy: 0.569
5 - val_loss: 0.6749 - val_accuracy: 0.5790
Epoch 8/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6731 - accuracy: 0.575
0 - val_loss: 0.6726 - val_accuracy: 0.5795
Epoch 9/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6713 - accuracy: 0.578
4 - val_loss: 0.6710 - val_accuracy: 0.5817
Epoch 10/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6683 - accuracy: 0.582
6 - val_loss: 0.6688 - val_accuracy: 0.5890
Epoch 11/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6660 - accuracy: 0.585
8 - val_loss: 0.6667 - val_accuracy: 0.5928
Epoch 12/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6628 - accuracy: 0.594
9 - val_loss: 0.6646 - val_accuracy: 0.5967
Epoch 13/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6620 - accuracy: 0.593
8 - val_loss: 0.6623 - val_accuracy: 0.5969
Epoch 14/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6584 - accuracy: 0.599
8 - val_loss: 0.6610 - val_accuracy: 0.5972
Epoch 15/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6558 - accuracy: 0.603
0 - val_loss: 0.6582 - val_accuracy: 0.6065
Epoch 16/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6527 - accuracy: 0.609
4 - val_loss: 0.6564 - val_accuracy: 0.6045
Epoch 17/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6506 - accuracy: 0.610
0 - val_loss: 0.6561 - val_accuracy: 0.6060
Epoch 18/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6484 - accuracy: 0.613
7 - val_loss: 0.6533 - val_accuracy: 0.6107
Epoch 19/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6463 - accuracy: 0.616
1 - val_loss: 0.6519 - val_accuracy: 0.6138
Epoch 20/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6445 - accuracy: 0.619
8 - val_loss: 0.6500 - val_accuracy: 0.6150
Epoch 21/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6425 - accuracy: 0.620
6 - val_loss: 0.6486 - val_accuracy: 0.6180
Epoch 22/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6394 - accuracy: 0.625
1 - val_loss: 0.6466 - val_accuracy: 0.6196
Epoch 23/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6368 - accuracy: 0.628
5 - val_loss: 0.6445 - val_accuracy: 0.6215
Epoch 24/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6338 - accuracy: 0.632
9 - val_loss: 0.6425 - val_accuracy: 0.6248
Epoch 25/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6330 - accuracy: 0.632
8 - val_loss: 0.6415 - val_accuracy: 0.6253
Epoch 26/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6324 - accuracy: 0.633
8 - val_loss: 0.6396 - val_accuracy: 0.6263
```

```
Epoch 27/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6295 - accuracy: 0.638
4 - val_loss: 0.6395 - val_accuracy: 0.6273
Epoch 28/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6282 - accuracy: 0.639
8 - val_loss: 0.6372 - val_accuracy: 0.6292
Epoch 29/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6263 - accuracy: 0.641
2 - val_loss: 0.6358 - val_accuracy: 0.6339
Epoch 30/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6237 - accuracy: 0.643
7 - val_loss: 0.6342 - val_accuracy: 0.6314
Epoch 31/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6229 - accuracy: 0.644
3 - val_loss: 0.6334 - val_accuracy: 0.6332
Epoch 32/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6200 - accuracy: 0.648
9 - val_loss: 0.6315 - val_accuracy: 0.6337
Epoch 1/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6935 - accuracy: 0.529
3 - val_loss: 0.6858 - val_accuracy: 0.5443
Epoch 2/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6862 - accuracy: 0.545
3 - val_loss: 0.6842 - val_accuracy: 0.5556
Epoch 3/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6833 - accuracy: 0.552
6 - val_loss: 0.6814 - val_accuracy: 0.5569
Epoch 4/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6812 - accuracy: 0.557
8 - val_loss: 0.6796 - val_accuracy: 0.5578
Epoch 5/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6786 - accuracy: 0.564
2 - val_loss: 0.6787 - val_accuracy: 0.5658
Epoch 6/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6764 - accuracy: 0.570
4 - val_loss: 0.6766 - val_accuracy: 0.5653
Epoch 7/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6743 - accuracy: 0.573
7 - val_loss: 0.6745 - val_accuracy: 0.5703
Epoch 8/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6716 - accuracy: 0.578
1 - val_loss: 0.6732 - val_accuracy: 0.5723
Epoch 9/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6703 - accuracy: 0.579
8 - val_loss: 0.6713 - val_accuracy: 0.5797
Epoch 10/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6672 - accuracy: 0.584
0 - val_loss: 0.6687 - val_accuracy: 0.5808
Epoch 11/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6652 - accuracy: 0.588
0 - val_loss: 0.6671 - val_accuracy: 0.5863
Epoch 12/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6622 - accuracy: 0.594
3 - val_loss: 0.6654 - val_accuracy: 0.5881
Epoch 13/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6599 - accuracy: 0.596
7 - val_loss: 0.6636 - val_accuracy: 0.5884
Epoch 14/100
100/100 [==============================] - 1s 7ms/step - loss: 0.6574 - accuracy: 0.601
9 - val_loss: 0.6614 - val_accuracy: 0.5973
```

```
Epoch 15/100
100/100 [==============================] - 1s 8ms/step - loss: 0.6551 - accuracy: 0.602
7 - val_loss: 0.6599 - val_accuracy: 0.5972
Epoch 16/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6521 - accuracy: 0.608
4 - val_loss: 0.6576 - val_accuracy: 0.6008
Epoch 17/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6502 - accuracy: 0.611
9 - val_loss: 0.6552 - val_accuracy: 0.6047
Epoch 18/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6487 - accuracy: 0.612
7 - val_loss: 0.6547 - val_accuracy: 0.6047
Epoch 19/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6456 - accuracy: 0.617
3 - val_loss: 0.6523 - val_accuracy: 0.6081
Epoch 20/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6429 - accuracy: 0.619
9 - val_loss: 0.6510 - val_accuracy: 0.6108
Epoch 21/100
100/100 [==============================] - 1s 7ms/step - loss: 0.6420 - accuracy: 0.622
0 - val_loss: 0.6499 - val_accuracy: 0.6105
Epoch 22/100
100/100 [==============================] - 1s 6ms/step - loss: 0.6400 - accuracy: 0.624
5 - val_loss: 0.6479 - val_accuracy: 0.6135
Epoch 23/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6381 - accuracy: 0.627
6 - val_loss: 0.6467 - val_accuracy: 0.6152
Epoch 24/100
100/100 [==============================] - 1s 5ms/step - loss: 0.6354 - accuracy: 0.630
7 - val_loss: 0.6453 - val_accuracy: 0.6169
Epoch 25/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6339 - accuracy: 0.632
1 - val_loss: 0.6432 - val_accuracy: 0.6173
Epoch 26/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6317 - accuracy: 0.633
4 - val_loss: 0.6424 - val_accuracy: 0.6221
Epoch 27/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6292 - accuracy: 0.637
9 - val_loss: 0.6408 - val_accuracy: 0.6219
Epoch 28/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6279 - accuracy: 0.637
8 - val_loss: 0.6387 - val_accuracy: 0.6224
Epoch 29/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6257 - accuracy: 0.642
6 - val_loss: 0.6383 - val_accuracy: 0.6247
Epoch 30/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6241 - accuracy: 0.641
7 - val_loss: 0.6387 - val_accuracy: 0.6252
Epoch 31/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6224 - accuracy: 0.643
4 - val_loss: 0.6374 - val_accuracy: 0.6263
Epoch 32/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6216 - accuracy: 0.644
8 - val_loss: 0.6357 - val_accuracy: 0.6258
Epoch 33/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6194 - accuracy: 0.647
2 - val_loss: 0.6344 - val_accuracy: 0.6269
Epoch 34/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6180 - accuracy: 0.647
8 - val_loss: 0.6341 - val_accuracy: 0.6299
```

```
Epoch 35/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6171 - accuracy: 0.649
9 - val_loss: 0.6327 - val_accuracy: 0.6316
Epoch 36/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6152 - accuracy: 0.650
9 - val_loss: 0.6334 - val_accuracy: 0.6275
Epoch 37/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6140 - accuracy: 0.653
1 - val_loss: 0.6314 - val_accuracy: 0.6335
Epoch 38/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6125 - accuracy: 0.654
0 - val_loss: 0.6297 - val_accuracy: 0.6357
Epoch 39/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6118 - accuracy: 0.655
3 - val_loss: 0.6302 - val_accuracy: 0.6329
Epoch 40/100
100/100 [==============================] - 0s 4ms/step - loss: 0.6094 - accuracy: 0.657
7 - val_loss: 0.6291 - val_accuracy: 0.6338
Epoch 41/100
100/100 [==============================] - 0s 5ms/step - loss: 0.6090 - accuracy: 0.658
2 - val_loss: 0.6289 - val_accuracy: 0.6352
```

Question 2A

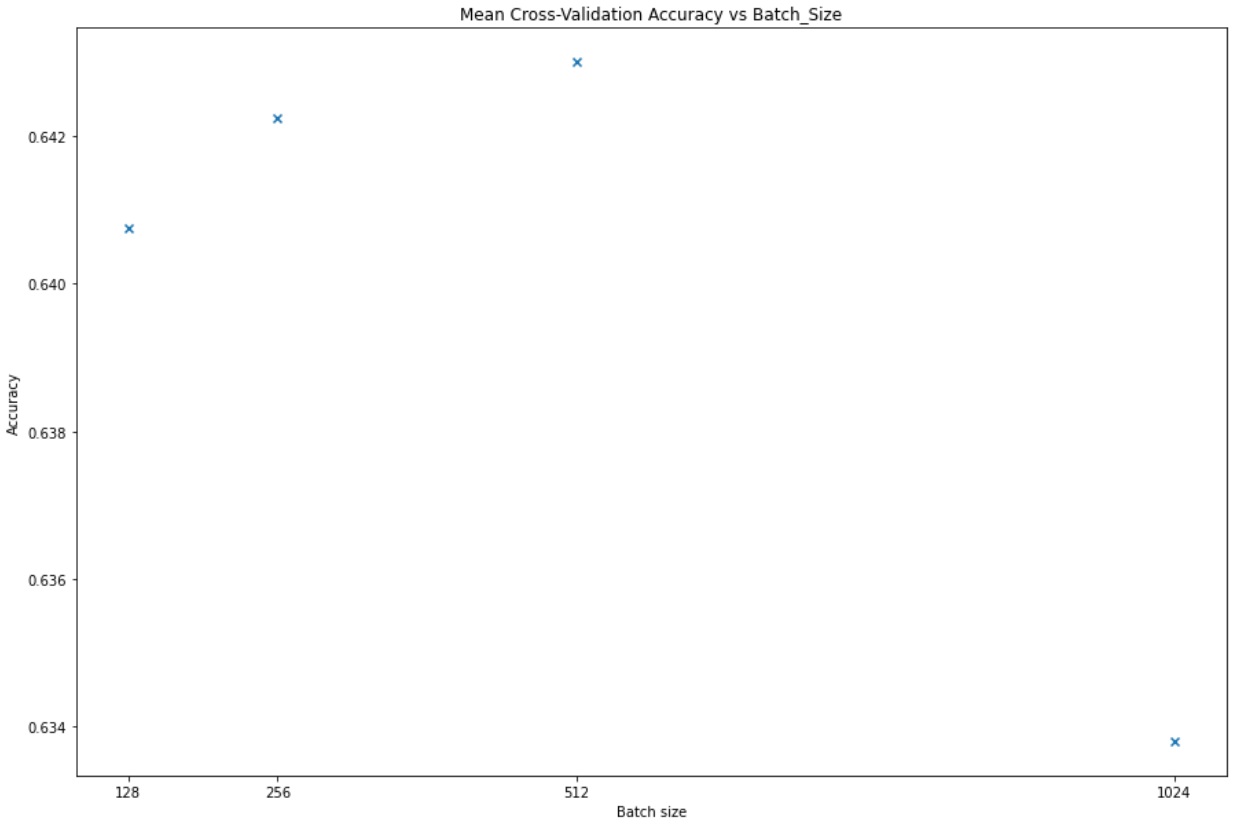
Scatter plot of Mean Cross-validation accuracies against different batch_sizes

In [ ]:

```
mean_val_acc = []
for key, value in model_acc.items():
    mean_val_acc.append(np.mean(value))

mean_val_loss = []
for key, value in model_loss.items():
    mean_val_loss.append(np.mean(value))

plt_1 = plt.figure(figsize=(15, 10))
plt.scatter(batch_size_list, mean_val_acc, marker = 'x')
plt.title('Mean Cross-Validation Accuracy vs Batch_Size')
plt.ylabel('Accuracy')
plt.xlabel('Batch size')
plt.xticks(batch_size_list)
plt.show()
```



Question 2B

Scatter plot of mean time taken of final epoch against batch size

In [ ]:
```
mean_time_taken = []
for key, value in time_taken_dict.items():
    mean_time_taken.append(np.mean(value))

plt_1 = plt.figure(figsize=(15, 10))
plt.scatter(batch_size_list, mean_time_taken, marker = 'x')
plt.title('Mean Time Taken vs Batch_Size')
plt.ylabel('Mean Time Taken')
plt.xlabel('Batch size')
plt.xticks(batch_size_list)
plt.show()
```

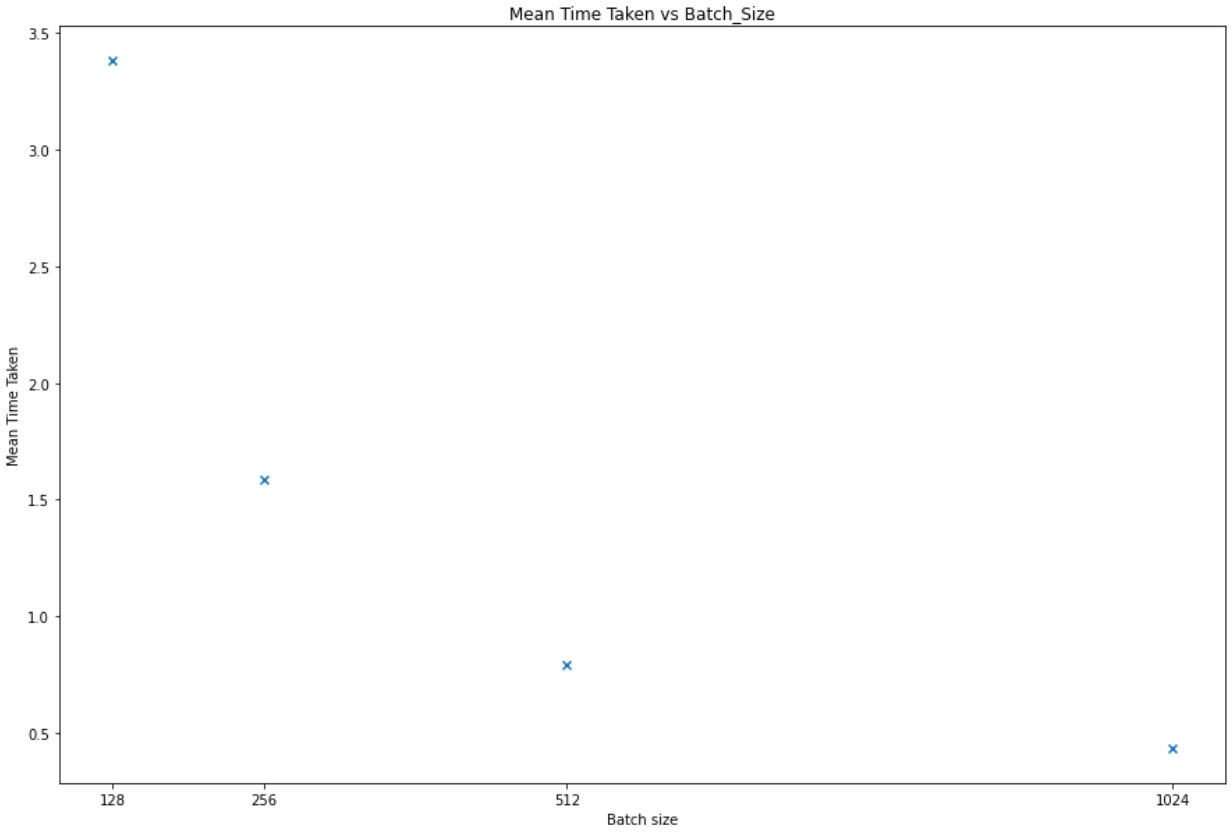


Table of time taken to train the last epoch

In [ ]:
```
table_df = pd.DataFrame.from_dict(model_acc,orient='index', columns=["fold_0", "fold_1"
table_dict = {"Mean Val Acc": mean_val_acc,
              "Mean Val Loss": mean_val_loss,
              "Mean Time Taken": mean_time_taken,
              "Batch Model": model_list,
              "Batch Size": batch_size_list}
data_df = pd.DataFrame.from_dict(table_dict)
table_df.reset_index(drop=True, inplace=True)
data_df.reset_index(drop=True, inplace=True)

table_df = pd.concat([table_df, data_df], axis=1)
table_df.set_index('Batch Size', inplace = True)
table_df
```

Out[ ]:

Batch Size	fold_0	fold_1	fold_2	fold_3	fold_4	Mean Val Acc	Mean Val Loss	Mean Time Taken	Batch Model
128	0.634582	0.643479	0.639193	0.642406	0.644092	0.640750	0.622247	3.383751	model_128
256	0.642381	0.646222	0.657221	0.642798	0.622575	0.642240	0.621721	1.587143	model_256
512	0.647476	0.647241	0.645777	0.638056	0.636528	0.643016	0.622008	0.794015	model_512
1024	0.635562	0.637443	0.627004	0.633745	0.635195	0.633790	0.630484	0.432640	model_1024

In [ ]:
```
optimal_batch_size = int(table_df['Mean Val Acc'].idxmax())
print("Optimal batch size: ", optimal_batch_size)
```

```
Optimal batch size:  512
```

Question 2C

Select the optimal batch size and state a reason for your selection

The optimal batch size is: 512

The optimal batch size is selected based on the highest mean validation accuracy that is evaluated through the K-fold cross validation.

Even though, we can see a decrease in mean time taken when the batch size increases, we should generally focus on the mean validation accuracy unless training time is defined as a significant measure when we are evaluating a model's performance

Overall, the model's performance that is evaluated through the K-fold cross validation generally results in a less-biased estimate of the model performance as compared to a simple train-test split method.

Question 2D

What happens when batch size increases, and why does it happen?

As the batch size increases, the training time taken for the final epoch decreases. Holding the number of epochs constant, the total number of gradient descent steps decreases when batch size increases. With bigger batch size, it is equivalent to taking "bigger steps" which would speed up computation time.

However, higher batch size may lead to poorer accuracies as large batch methods tend to converge to sharp minimizers of training and testing functions-and that sharp minima lead to poorer generalization.

Question 2E

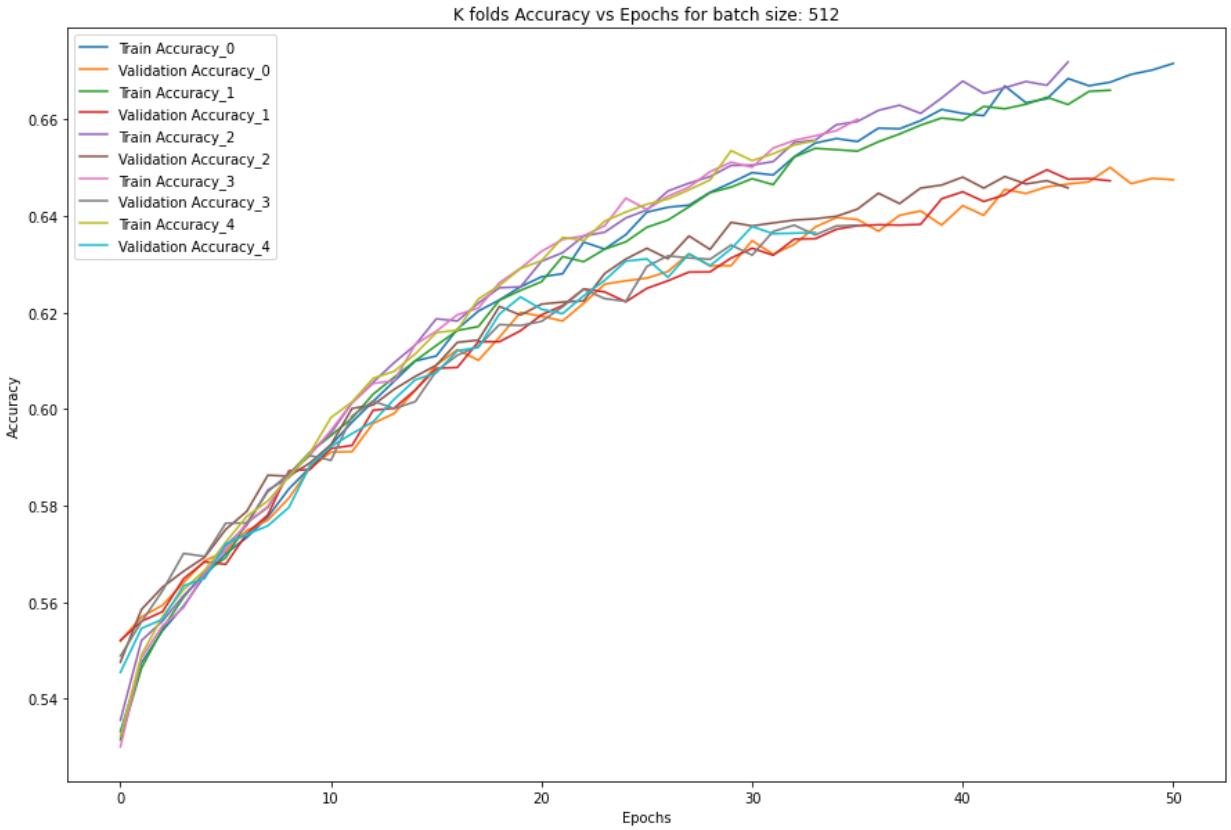
Line Plot of Accuracy vs Epochs for optimal batch size with different folds

In [ ]:
```
plt_1 = plt.figure(figsize=(15, 10))
optimal_batch_model = str(table_df.loc[optimal_batch_size, "Batch Model"])
fold = 0

Q2_legend_list = []

while(fold<no_folds):
    plt.plot(Q2_history[optimal_batch_model + model_fold[fold]].history["accuracy"])
    Q2_legend_list.append("Train Accuracy" + model_fold[fold])
    plt.plot(Q2_history[optimal_batch_model + model_fold[fold]].history["val_accuracy"]
    Q2_legend_list.append("Validation Accuracy" + model_fold[fold])
    fold+=1
```

```
plt.legend(Q2_legend_list)
plt.title('K folds Accuracy vs Epochs for batch size: ' + str(optimal_batch_size))
plt.ylabel('Accuracy')
plt.xlabel('Epochs')
plt.show()
```



Training of a model with optimal batch size

In [ ]:

```
Q2E_model = Sequential([Dense(num_neurons, activation='relu'),
                Dropout(0.2), Dense(num_neurons, activation ='relu'),
                Dropout(0.2), Dense(num_neurons, activation='relu'),
                Dropout(0.2), Dense(1, activation='sigmoid')])

Q2E_model.compile(optimizer='adam',
            loss='binary_crossentropy',
            metrics=['accuracy'])

Q2E_history = {}
Q2E_history["Q2E_model"] = Q2E_model.fit(X_train_scaled, y_train,
                batch_size = optimal_batch_size,
                epochs=no_epochs,
                verbose=1,
                use_multiprocessing=True,
                validation_data=(X_test_scaled, y_test), callbacks=[callback, cb])
```

```
Epoch 1/100
250/250 [==============================] - 2s 6ms/step - loss: 0.6913 - accuracy: 0.534
3 - val_loss: 0.6853 - val_accuracy: 0.5493
Epoch 2/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6844 - accuracy: 0.548
9 - val_loss: 0.6818 - val_accuracy: 0.5558
Epoch 3/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6809 - accuracy: 0.559
1 - val_loss: 0.6808 - val_accuracy: 0.5577
Epoch 4/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6788 - accuracy: 0.562
4 - val_loss: 0.6774 - val_accuracy: 0.5662
Epoch 5/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6760 - accuracy: 0.569
4 - val_loss: 0.6751 - val_accuracy: 0.5731
Epoch 6/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6737 - accuracy: 0.573
1 - val_loss: 0.6731 - val_accuracy: 0.5757
Epoch 7/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6701 - accuracy: 0.581
0 - val_loss: 0.6691 - val_accuracy: 0.5819
Epoch 8/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6665 - accuracy: 0.585
2 - val_loss: 0.6663 - val_accuracy: 0.5902
Epoch 9/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6633 - accuracy: 0.591
0 - val_loss: 0.6643 - val_accuracy: 0.5922
Epoch 10/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6601 - accuracy: 0.594
6 - val_loss: 0.6633 - val_accuracy: 0.5904
Epoch 11/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6559 - accuracy: 0.603
4 - val_loss: 0.6577 - val_accuracy: 0.6008
Epoch 12/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6535 - accuracy: 0.605
7 - val_loss: 0.6553 - val_accuracy: 0.6054
Epoch 13/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6509 - accuracy: 0.609
5 - val_loss: 0.6524 - val_accuracy: 0.6088
Epoch 14/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6478 - accuracy: 0.612
9 - val_loss: 0.6502 - val_accuracy: 0.6133
Epoch 15/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6456 - accuracy: 0.617
5 - val_loss: 0.6481 - val_accuracy: 0.6170
Epoch 16/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6426 - accuracy: 0.621
4 - val_loss: 0.6449 - val_accuracy: 0.6184
Epoch 17/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6400 - accuracy: 0.623
4 - val_loss: 0.6427 - val_accuracy: 0.6218
Epoch 18/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6376 - accuracy: 0.625
9 - val_loss: 0.6396 - val_accuracy: 0.6251
Epoch 19/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6350 - accuracy: 0.628
6 - val_loss: 0.6398 - val_accuracy: 0.6236
Epoch 20/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6316 - accuracy: 0.634
3 - val_loss: 0.6376 - val_accuracy: 0.6238
```

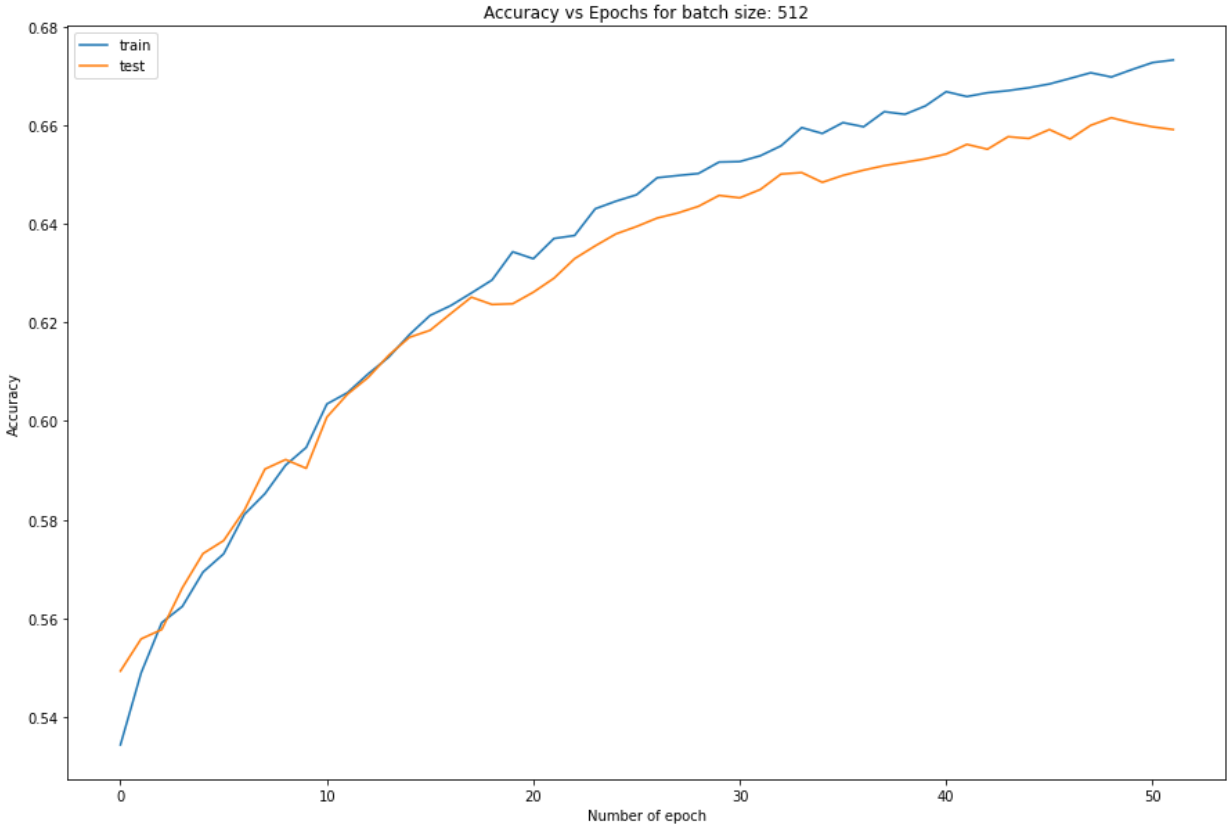
```
Epoch 21/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6301 - accuracy: 0.632
9 - val_loss: 0.6363 - val_accuracy: 0.6261
Epoch 22/100
250/250 [==============================] - 1s 5ms/step - loss: 0.6271 - accuracy: 0.637
0 - val_loss: 0.6348 - val_accuracy: 0.6289
Epoch 23/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6263 - accuracy: 0.637
6 - val_loss: 0.6323 - val_accuracy: 0.6329
Epoch 24/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6232 - accuracy: 0.643
0 - val_loss: 0.6306 - val_accuracy: 0.6355
Epoch 25/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6223 - accuracy: 0.644
5 - val_loss: 0.6282 - val_accuracy: 0.6379
Epoch 26/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6193 - accuracy: 0.645
8 - val_loss: 0.6265 - val_accuracy: 0.6394
Epoch 27/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6172 - accuracy: 0.649
3 - val_loss: 0.6254 - val_accuracy: 0.6411
Epoch 28/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6161 - accuracy: 0.649
7 - val_loss: 0.6240 - val_accuracy: 0.6422
Epoch 29/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6158 - accuracy: 0.650
2 - val_loss: 0.6229 - val_accuracy: 0.6435
Epoch 30/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6139 - accuracy: 0.652
5 - val_loss: 0.6221 - val_accuracy: 0.6457
Epoch 31/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6131 - accuracy: 0.652
6 - val_loss: 0.6204 - val_accuracy: 0.6452
Epoch 32/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6115 - accuracy: 0.653
8 - val_loss: 0.6199 - val_accuracy: 0.6469
Epoch 33/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6090 - accuracy: 0.655
8 - val_loss: 0.6176 - val_accuracy: 0.6501
Epoch 34/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6072 - accuracy: 0.659
5 - val_loss: 0.6181 - val_accuracy: 0.6503
Epoch 35/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6082 - accuracy: 0.658
3 - val_loss: 0.6181 - val_accuracy: 0.6484
Epoch 36/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6048 - accuracy: 0.660
5 - val_loss: 0.6163 - val_accuracy: 0.6498
Epoch 37/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6059 - accuracy: 0.659
6 - val_loss: 0.6162 - val_accuracy: 0.6508
Epoch 38/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6042 - accuracy: 0.662
7 - val_loss: 0.6154 - val_accuracy: 0.6518
Epoch 39/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6018 - accuracy: 0.662
2 - val_loss: 0.6137 - val_accuracy: 0.6524
Epoch 40/100
250/250 [==============================] - 1s 4ms/step - loss: 0.6017 - accuracy: 0.663
9 - val_loss: 0.6130 - val_accuracy: 0.6531
```

```
Epoch 41/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5990 - accuracy: 0.666
8 - val_loss: 0.6123 - val_accuracy: 0.6541
Epoch 42/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5989 - accuracy: 0.665
8 - val_loss: 0.6102 - val_accuracy: 0.6561
Epoch 43/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5983 - accuracy: 0.666
5 - val_loss: 0.6098 - val_accuracy: 0.6551
Epoch 44/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5966 - accuracy: 0.667
0 - val_loss: 0.6099 - val_accuracy: 0.6576
Epoch 45/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5965 - accuracy: 0.667
5 - val_loss: 0.6090 - val_accuracy: 0.6573
Epoch 46/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5965 - accuracy: 0.668
3 - val_loss: 0.6091 - val_accuracy: 0.6591
Epoch 47/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5957 - accuracy: 0.669
4 - val_loss: 0.6085 - val_accuracy: 0.6572
Epoch 48/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5943 - accuracy: 0.670
6 - val_loss: 0.6070 - val_accuracy: 0.6599
Epoch 49/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5939 - accuracy: 0.669
7 - val_loss: 0.6072 - val_accuracy: 0.6615
Epoch 50/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5926 - accuracy: 0.671
2 - val_loss: 0.6062 - val_accuracy: 0.6604
Epoch 51/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5919 - accuracy: 0.672
7 - val_loss: 0.6050 - val_accuracy: 0.6596
Epoch 52/100
250/250 [==============================] - 1s 4ms/step - loss: 0.5901 - accuracy: 0.673
2 - val_loss: 0.6058 - val_accuracy: 0.6591
```

Line Plot of Accuracy vs Epochs for optimal batch size

In [ ]:

```
plt_1 = plt.figure(figsize=(15, 10))
plt.plot(Q2E_history['Q2E_model'].history['accuracy'])
plt.plot(Q2E_history['Q2E_model'].history['val_accuracy'])
plt.title('Accuracy vs Epochs for batch size: ' + str(optimal_batch_size))
plt.ylabel('Accuracy')
plt.xlabel('Number of epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```


Accuracy vs Epochs for batch size: 512
train
test
Accuracy
Number of epoch
0.68
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0
10
20
30
40
50