Lending Club Loan Data Analysis Project

January 13, 2024

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense,Dropout
from tensorflow.keras.callbacks import EarlyStopping
from tensorflow.keras.models import load_model
from sklearn.metrics import confusion_matrix, classification_report
from pickle import dump, load


%matplotlib inline
```

```
2024-01-13 19:19:44.157756: I tensorflow/core/util/port.cc:110] oneDNN custom
operations are on. You may see slightly different numerical results due to
floating-point round-off errors from different computation orders. To turn them
off, set the environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
2024-01-13 19:19:44.197890: I tensorflow/core/platform/cpu_feature_guard.cc:182]
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 AVX512F AVX512_VNNI FMA, in other
operations, rebuild TensorFlow with the appropriate compiler flags.
```

```
VOC-NOTICE: GPU memory for this assignment is capped at 1024MiB
```

```
2024-01-13 19:19:46.032287: E
tensorflow/compiler/xla/stream_executor/cuda/cuda_driver.cc:268] failed call to
cuInit: CUDA_ERROR_NO_DEVICE: no CUDA-capable device is detected
```

[2]:
```
df = pd.read_csv('loan_data.csv')
```

[3]:
```
df.info()
df.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9578 entries, 0 to 9577
```

```
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   credit.policy      9578 non-null   int64
 1   purpose            9578 non-null   object
 2   int.rate           9578 non-null   float64
 3   installment        9578 non-null   float64
 4   log.annual.inc     9578 non-null   float64
 5   dti                9578 non-null   float64
 6   fico               9578 non-null   int64
 7   days.with.cr.line  9578 non-null   float64
 8   revol.bal          9578 non-null   int64
 9   revol.util         9578 non-null   float64
 10  inq.last.6mths     9578 non-null   int64
 11  delinq.2yrs        9578 non-null   int64
 12  pub.rec            9578 non-null   int64
 13  not.fully.paid     9578 non-null   int64
dtypes: float64(6), int64(7), object(1)
memory usage: 1.0+ MB
```

[3]:

	credit.policy	purpose	int.rate	installment	log.annual.inc	dti	fico	days.with.cr.line	revol.bal	revol.util	inq.last.6mths	delinq.2yrs	pub.rec	not.fully.paid
0	1	debt_consolidation	0.1189	829.10	11.350407	19.48	737	5639.958333	28854	52.1	0	0	0	0
1	1	credit_card	0.1071	228.22	11.082143	14.29	707	2760.000000	33623	76.7	0	0	0	0
2	1	debt_consolidation	0.1357	366.86	10.373491	11.63	682	4710.000000	3511	25.6	1	0	0	0
3	1	debt_consolidation	0.1008	162.34	11.350407	8.10	712	2699.958333	33667	73.2	1	0	0	0
4	1	credit_card	0.1426	102.92	11.299732	14.97	667	4066.000000	4740	39.5	0	1	0	0

[4]:
```
df.describe().transpose()
```

[4]:

	count	mean	std	min
credit.policy	9578.0	0.804970	0.396245	0.000000
int.rate	9578.0	0.122640	0.026847	0.060000
installment	9578.0	319.089413	207.071301	15.670000

```
log.annual.inc     9578.0     10.932117      0.614813    7.547502
dti                9578.0     12.606679      6.883970    0.000000
fico               9578.0    710.846314     37.970537  612.000000
days.with.cr.line  9578.0   4560.767197   2496.930377  178.958333
revol.bal          9578.0  16913.963876  33756.189557    0.000000
revol.util         9578.0     46.799236     29.014417    0.000000
inq.last.6mths     9578.0      1.577469      2.200245    0.000000
delinq.2yrs        9578.0      0.163708      0.546215    0.000000
pub.rec            9578.0      0.062122      0.262126    0.000000
not.fully.paid     9578.0      0.160054      0.366676    0.000000

                          25%          50%          75%           max
credit.policy        1.000000     1.000000     1.000000  1.000000e+00
int.rate             0.103900     0.122100     0.140700  2.164000e-01
installment        163.770000   268.950000   432.762500  9.401400e+02
log.annual.inc      10.558414    10.928884    11.291293  1.452835e+01
dti                  7.212500    12.665000    17.950000  2.996000e+01
fico               682.000000   707.000000   737.000000  8.270000e+02
days.with.cr.line 2820.000000  4139.958333  5730.000000  1.763996e+04
revol.bal         3187.000000  8596.000000 18249.500000  1.207359e+06
revol.util          22.600000    46.300000    70.900000  1.190000e+02
inq.last.6mths       0.000000     1.000000     2.000000  3.300000e+01
delinq.2yrs          0.000000     0.000000     0.000000  1.300000e+01
pub.rec              0.000000     0.000000     0.000000  5.000000e+00
not.fully.paid       0.000000     0.000000     0.000000  1.000000e+00
```

[5]:
```
df['not.fully.paid'].isnull().mean()
```

[5]:
```
0.0
```

[6]:
```
df1=pd.get_dummies(df, columns=['purpose'])
```

[7]:
```
df1['log.annual.inc'] = np.exp(df1['log.annual.inc'])
```

[8]:
```
df1.head()
```

[8]:
```
   credit.policy  int.rate  installment  log.annual.inc    dti  fico  \
0              1    0.1189       829.10    85000.000385  19.48   737
1              1    0.1071       228.22    65000.000073  14.29   707
2              1    0.1357       366.86    31999.999943  11.63   682
3              1    0.1008       162.34    85000.000385   8.10   712
4              1    0.1426       102.92    80799.999636  14.97   667

   days.with.cr.line  revol.bal  revol.util  inq.last.6mths  delinq.2yrs  \
0        5639.958333      28854        52.1               0            0
1        2760.000000      33623        76.7               0            0
2        4710.000000       3511        25.6               1            0
```

```
3        2699.958333      33667        73.2               1            0
4        4066.000000       4740        39.5               0            1

   pub.rec  not.fully.paid  purpose_all_other  purpose_credit_card  \
0        0               0                  0                    0
1        0               0                  0                    1
2        0               0                  0                    0
3        0               0                  0                    0
4        0               0                  0                    1

   purpose_debt_consolidation  purpose_educational  purpose_home_improvement  \
0                           1                    0                         0
1                           0                    0                         0
2                           1                    0                         0
3                           1                    0                         0
4                           0                    0                         0

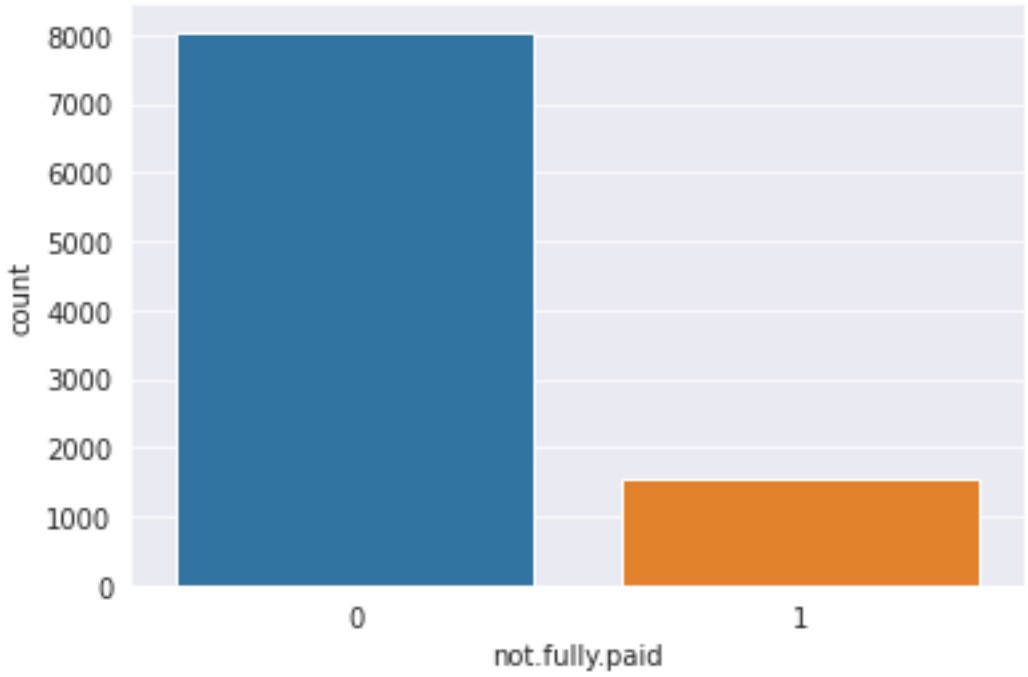
   purpose_major_purchase  purpose_small_business
0                       0                       0
1                       0                       0
2                       0                       0
3                       0                       0
4                       0                       0
```

[9]:
```
df.groupby('not.fully.paid')['not.fully.paid'].count()/len(df)
```

[9]:
```
not.fully.paid
0    0.839946
1    0.160054
Name: not.fully.paid, dtype: float64
```

[10]:
```
sns.set_style('darkgrid')
sns.countplot(x='not.fully.paid', data=df)
```

[10]:
```
<AxesSubplot: xlabel='not.fully.paid', ylabel='count'>
```



[11]:
```
count_class_0, count_class_1 = df['not.fully.paid'].value_counts()
```

[12]:
```
df_0 = df[df['not.fully.paid'] == 0]
df_1 = df[df['not.fully.paid'] == 1]
```

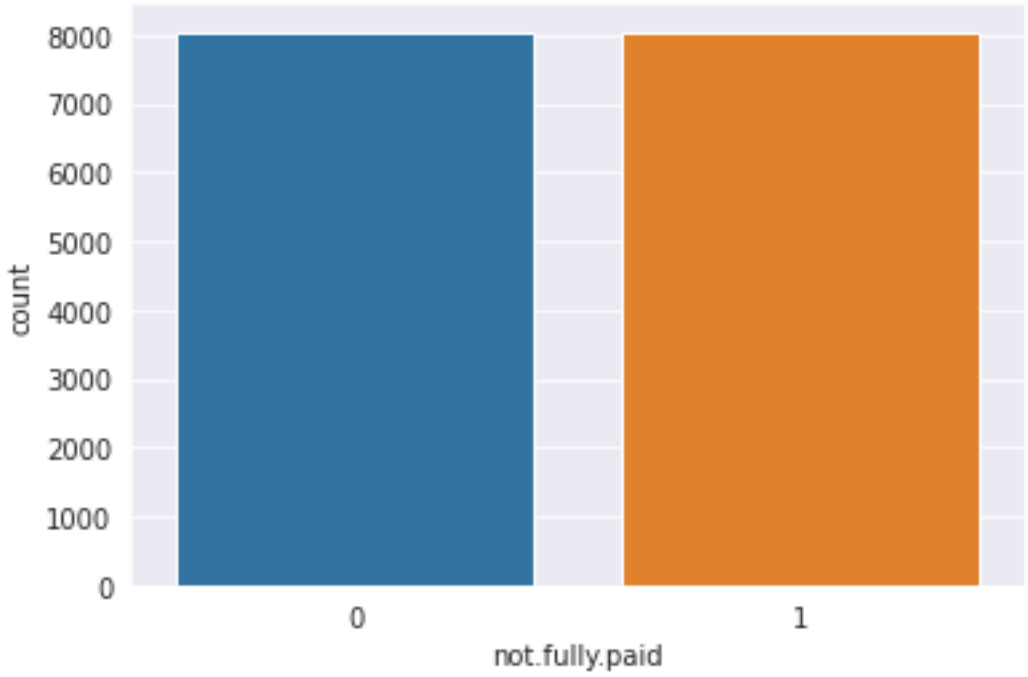
[13]:
```
df_1_over = df_1.sample(count_class_0, replace=True)
df_test_over = pd.concat([df_0, df_1_over], axis=0)
```

[14]:
```
print('Random over-sampling:')
print(df_test_over['not.fully.paid'].value_counts())
```

```
Random over-sampling:
0    8045
1    8045
Name: not.fully.paid, dtype: int64
```

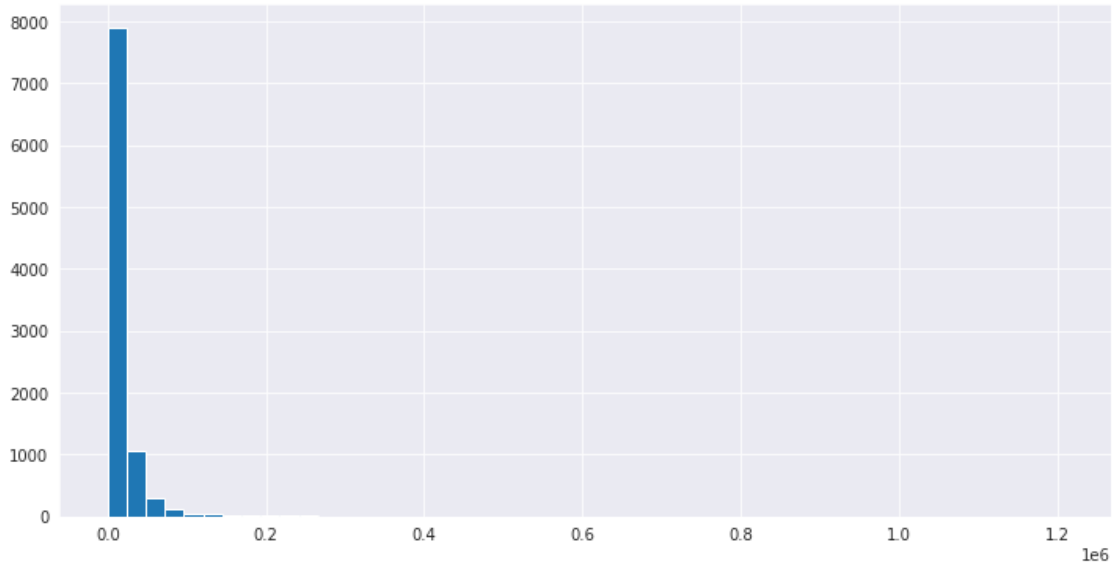
[15]:
```
sns.set_style('darkgrid')
sns.countplot(x='not.fully.paid', data=df_test_over)
```

[15]: <AxesSubplot: xlabel='not.fully.paid', ylabel='count'>



[16]:
```
df['revol.bal'].hist(figsize=[12,6], bins=50)
```

[16]: <AxesSubplot: >



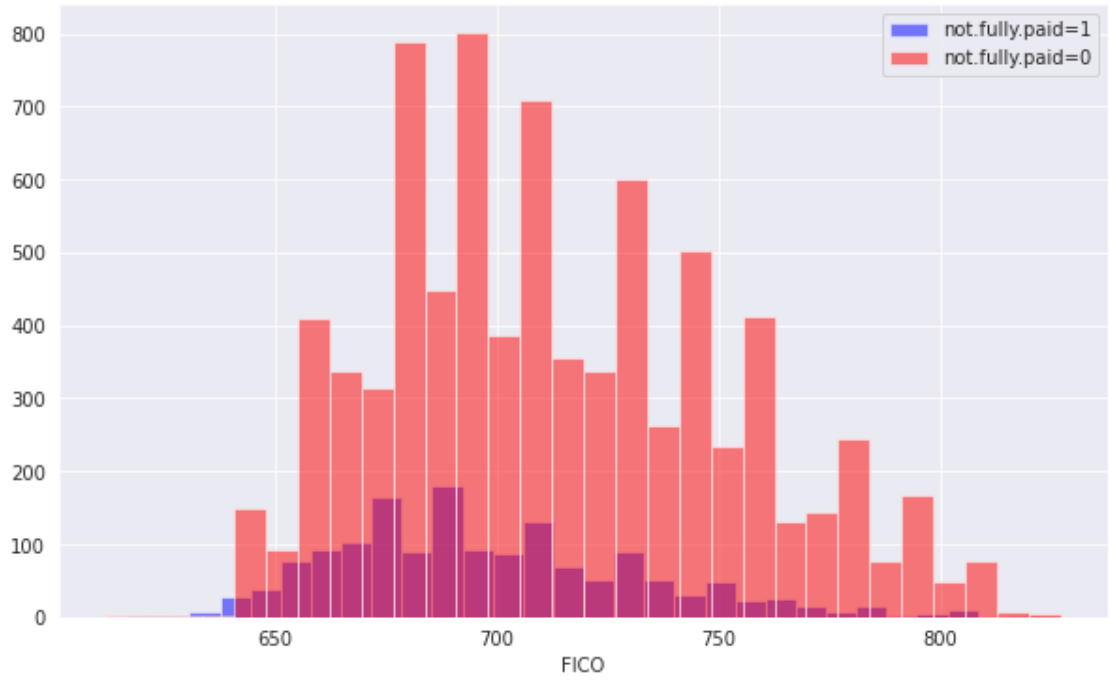
[17]:
```
df1=pd.get_dummies(df, columns=['purpose'])
```

[18]:
```
plt.figure(figsize=(10,6))
df[df['credit.policy']==1]['fico'].hist(alpha=0.
  ↪5,color='blue',bins=30,label='Credit.Policy=1')
df[df['credit.policy']==0]['fico'].hist(alpha=0.
  ↪5,color='red',bins=30,label='Credit.Policy=0')
plt.legend()
plt.xlabel('FICO')
```

[18]: Text(0.5, 0, 'FICO')

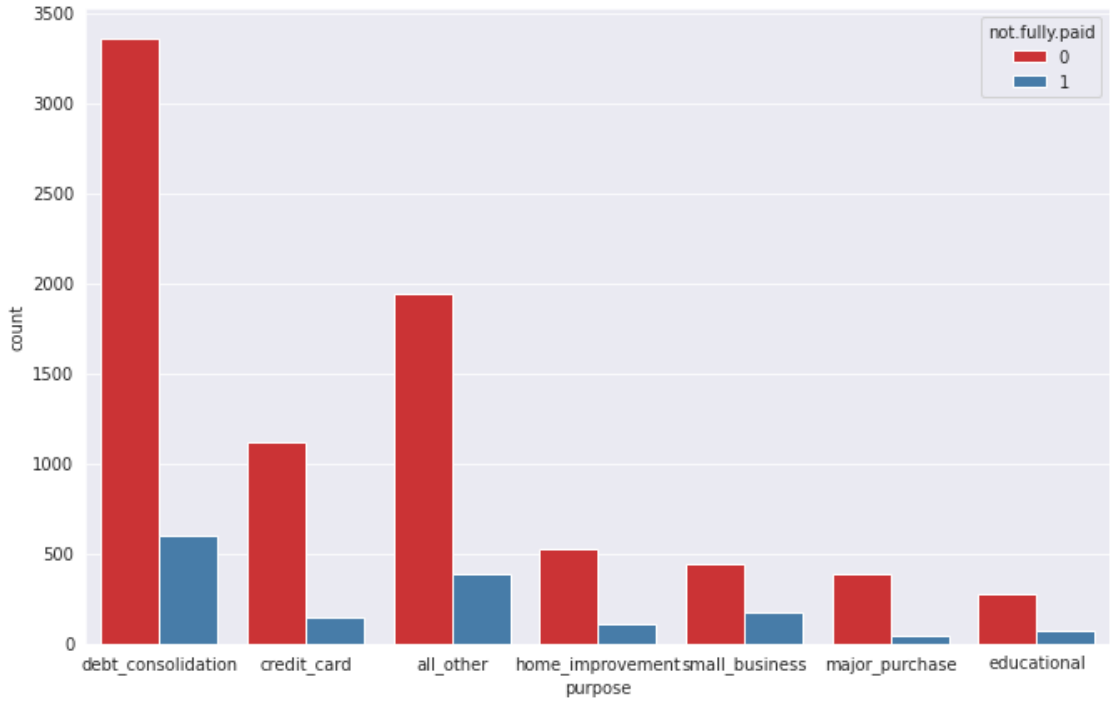
[19]:
```
plt.figure(figsize=(10,6))
df[df['not.fully.paid']==1]['fico'].hist(alpha=0.5,color='blue',
                                         bins=30,label='not.fully.paid=1')
df[df['not.fully.paid']==0]['fico'].hist(alpha=0.5,color='red',
                                         bins=30,label='not.fully.paid=0')
plt.legend()
plt.xlabel('FICO')
```

[19]: Text(0.5, 0, 'FICO')



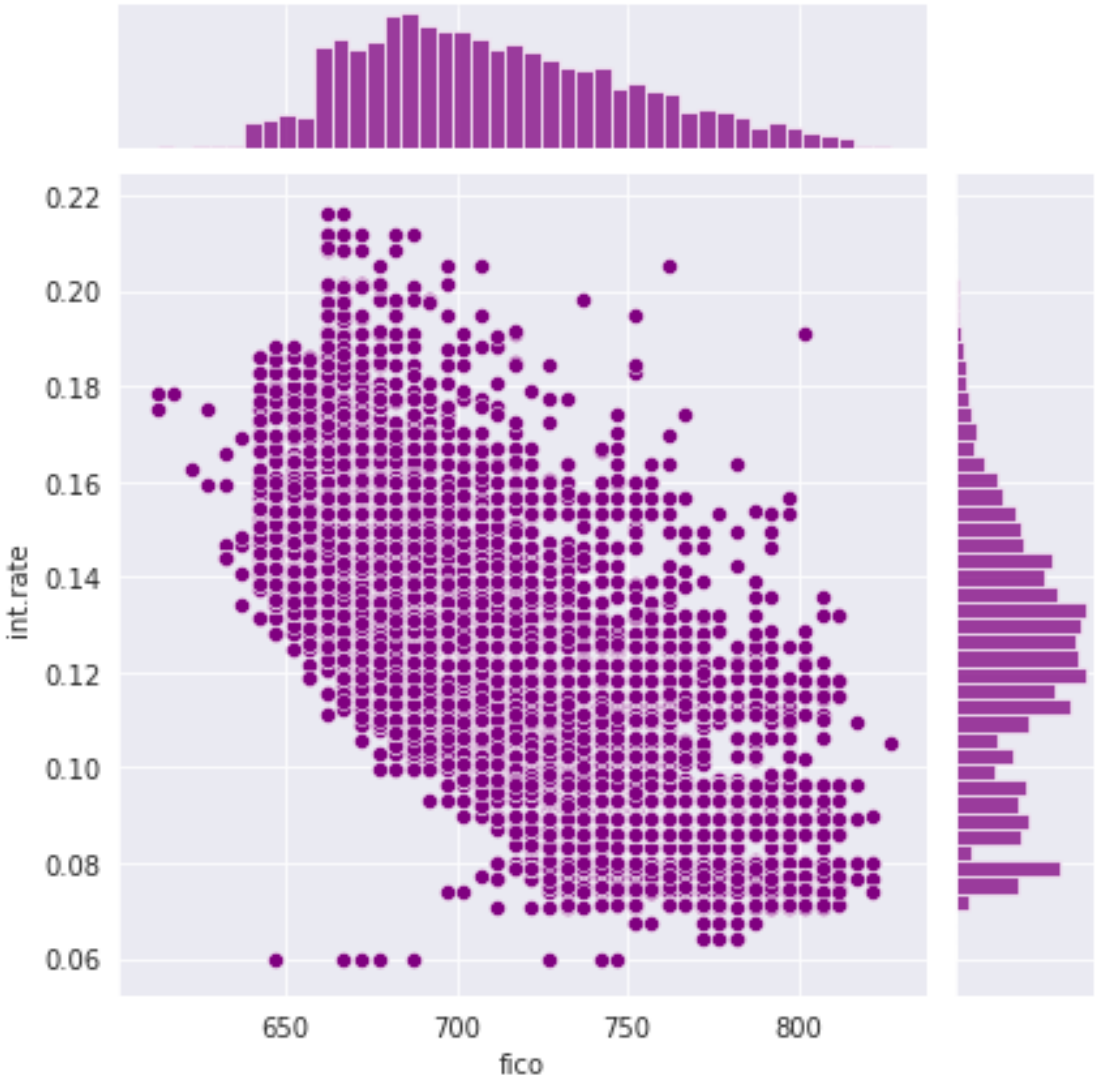
[20]:
```
plt.figure(figsize=(11,7))
sns.countplot(x='purpose',hue='not.fully.paid',data=df,palette='Set1')
```

[20]: <AxesSubplot: xlabel='purpose', ylabel='count'>



[21]:
```
sns.jointplot(x='fico',y='int.rate',data=df,color='purple')
```

[21]: <seaborn.axisgrid.JointGrid at 0x7fef47e06320>



[22]:
```
plt.figure(figsize=(11,7))
sns.lmplot(y='int.rate',x='fico',data=df,hue='credit.policy',
           col='not.fully.paid',palette='Set1')
```

[22]: <seaborn.axisgrid.FacetGrid at 0x7fef479e6740>

<Figure size 792x504 with 0 Axes>

[24]:
```
#cat =df_test_over
cat = ['purpose']
```

[25]:
```
#final_data = pd.get_dummies(df,columns=cat,drop_first=True)
final_data = pd.get_dummies(df_test_over,columns=cat,drop_first=True)
```

[26]:
```
final_data.info()
final_data.head()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 16090 entries, 0 to 7990
Data columns (total 19 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   credit.policy               16090 non-null  int64
 1   int.rate                    16090 non-null  float64
 2   installment                 16090 non-null  float64
 3   log.annual.inc              16090 non-null  float64
 4   dti                         16090 non-null  float64
 5   fico                        16090 non-null  int64
 6   days.with.cr.line           16090 non-null  float64
 7   revol.bal                   16090 non-null  int64
 8   revol.util                  16090 non-null  float64
 9   inq.last.6mths              16090 non-null  int64
 10  delinq.2yrs                 16090 non-null  int64
 11  pub.rec                     16090 non-null  int64
 12  not.fully.paid              16090 non-null  int64
 13  purpose_credit_card         16090 non-null  uint8
 14  purpose_debt_consolidation  16090 non-null  uint8
 15  purpose_educational         16090 non-null  uint8
```

```
 16  purpose_home_improvement    16090 non-null  uint8
 17  purpose_major_purchase      16090 non-null  uint8
 18  purpose_small_business      16090 non-null  uint8
dtypes: float64(6), int64(7), uint8(6)
memory usage: 1.8 MB
```

[26]:

	credit.policy	int.rate	installment	log.annual.inc	dti	fico	\
0	1	0.1189	829.10	11.350407	19.48	737	
1	1	0.1071	228.22	11.082143	14.29	707	
2	1	0.1357	366.86	10.373491	11.63	682	
3	1	0.1008	162.34	11.350407	8.10	712	
4	1	0.1426	102.92	11.299732	14.97	667	

	days.with.cr.line	revol.bal	revol.util	inq.last.6mths	delinq.2yrs	\
0	5639.958333	28854	52.1	0	0	
1	2760.000000	33623	76.7	0	0	
2	4710.000000	3511	25.6	1	0	
3	2699.958333	33667	73.2	1	0	
4	4066.000000	4740	39.5	0	1	

	pub.rec	not.fully.paid	purpose_credit_card	purpose_debt_consolidation	\
0	0	0	0	1	
1	0	0	1	0	
2	0	0	0	1	
3	0	0	0	1	
4	0	0	1	0	

	purpose_educational	purpose_home_improvement	purpose_major_purchase	\
0	0	0	0	
1	0	0	0	
2	0	0	0	
3	0	0	0	
4	0	0	0	

	purpose_small_business
0	0
1	0
2	0
3	0
4	0

[27]:
```
final_data.corr()
```

[27]:

	credit.policy	int.rate	installment	\
credit.policy	1.000000	-0.289283	0.061706	
int.rate	-0.289283	1.000000	0.268816	
installment	0.061706	0.268816	1.000000	

```
log.annual.inc                  0.021497  0.076230     0.474401
dti                            -0.094707  0.193884     0.018823
fico                            0.378253 -0.678045     0.117787
days.with.cr.line               0.092575 -0.096885     0.182100
revol.bal                      -0.188060  0.090163     0.254101
revol.util                     -0.093077  0.418919     0.045253
inq.last.6mths                 -0.547679  0.185112    -0.021168
delinq.2yrs                    -0.063473  0.152646    -0.002454
pub.rec                        -0.072808  0.105766    -0.023658
not.fully.paid                 -0.200215  0.225666     0.068163
purpose_credit_card             0.002024 -0.042292     0.007798
purpose_debt_consolidation      0.039930  0.075892     0.106183
purpose_educational            -0.029810 -0.015291    -0.103938
purpose_home_improvement       -0.017452 -0.041250     0.035959
purpose_major_purchase          0.028011 -0.060634    -0.051060
purpose_small_business         -0.002790  0.183748     0.187774

                           log.annual.inc       dti      fico  \
credit.policy                    0.021497 -0.094707  0.378253
int.rate                         0.076230  0.193884 -0.678045
installment                      0.474401  0.018823  0.117787
log.annual.inc                   1.000000 -0.038214  0.110237
dti                             -0.038214  1.000000 -0.216070
fico                             0.110237 -0.216070  1.000000
days.with.cr.line                0.344314  0.091449  0.257549
revol.bal                        0.398760  0.179443  0.002416
revol.util                       0.070953  0.322415 -0.501762
inq.last.6mths                   0.032401  0.028583 -0.193626
delinq.2yrs                      0.012771 -0.039978 -0.203008
pub.rec                          0.022025  0.028230 -0.157496
not.fully.paid                  -0.041956  0.051480 -0.211935
purpose_credit_card              0.081272  0.075680 -0.008011
purpose_debt_consolidation      -0.036586  0.174768 -0.140090
purpose_educational             -0.133568 -0.030793 -0.020571
purpose_home_improvement         0.107927 -0.088411  0.092760
purpose_major_purchase          -0.025726 -0.085678  0.058652
purpose_small_business           0.111604 -0.065699  0.071830

                           days.with.cr.line  revol.bal  revol.util  \
credit.policy                       0.092575  -0.188060   -0.093077
int.rate                           -0.096885   0.090163    0.418919
installment                         0.182100   0.254101    0.045253
log.annual.inc                      0.344314   0.398760    0.070953
dti                                 0.091449   0.179443    0.322415
fico                                0.257549   0.002416   -0.501762
days.with.cr.line                   1.000000   0.279911    0.013468
revol.bal                           0.279911   1.000000    0.181225
```

```
revol.util                          0.013468   0.181225    1.000000
inq.last.6mths                     -0.029292   0.014048   -0.026215
delinq.2yrs                         0.085697  -0.027238   -0.048792
pub.rec                             0.064314  -0.037237    0.077071
not.fully.paid                     -0.046594   0.057401    0.117790
purpose_credit_card                 0.056971   0.060689    0.082524
purpose_debt_consolidation         -0.002262  -0.013797    0.190038
purpose_educational                -0.056818  -0.038605   -0.049580
purpose_home_improvement            0.059564  -0.016523   -0.117841
purpose_major_purchase             -0.028091  -0.060458   -0.111932
purpose_small_business              0.046484   0.091854   -0.061126

                           inq.last.6mths  delinq.2yrs   pub.rec  \
credit.policy                  -0.547679    -0.063473 -0.072808
int.rate                        0.185112     0.152646  0.105766
installment                    -0.021168    -0.002454 -0.023658
log.annual.inc                  0.032401     0.012771  0.022025
dti                             0.028583    -0.039978  0.028230
fico                           -0.193626    -0.203008 -0.157496
days.with.cr.line              -0.029292     0.085697  0.064314
revol.bal                       0.014048    -0.027238 -0.037237
revol.util                     -0.026215    -0.048792  0.077071
inq.last.6mths                  1.000000     0.017783  0.103086
delinq.2yrs                     0.017783     1.000000 -0.002125
pub.rec                         0.103086    -0.002125  1.000000
not.fully.paid                  0.184368     0.009774  0.061461
purpose_credit_card            -0.032431    -0.004863  0.030776
purpose_debt_consolidation     -0.054588    -0.014405  0.044514
purpose_educational             0.027542     0.008499 -0.019363
purpose_home_improvement        0.070591    -0.015685 -0.000424
purpose_major_purchase          0.003339     0.007183 -0.016291
purpose_small_business          0.036802     0.023252 -0.001695

                           not.fully.paid  purpose_credit_card  \
credit.policy                  -0.200215             0.002024
int.rate                        0.225666            -0.042292
installment                     0.068163             0.007798
log.annual.inc                 -0.041956             0.081272
dti                             0.051480             0.075680
fico                           -0.211935            -0.008011
days.with.cr.line              -0.046594             0.056971
revol.bal                       0.057401             0.060689
revol.util                      0.117790             0.082524
inq.last.6mths                  0.184368            -0.032431
delinq.2yrs                     0.009774            -0.004863
pub.rec                         0.061461             0.030776
not.fully.paid                  1.000000            -0.067058
```

purpose_credit_card	-0.067058	1.000000
purpose_debt_consolidation	-0.023673	-0.300718
purpose_educational	0.037387	-0.075815
purpose_home_improvement	0.016186	-0.099161
purpose_major_purchase	-0.042900	-0.074202
purpose_small_business	0.099555	-0.109618

	purpose_debt_consolidation	purpose_educational	\
credit.policy	0.039930	-0.029810	
int.rate	0.075892	-0.015291	
installment	0.106183	-0.103938	
log.annual.inc	-0.036586	-0.133568	
dti	0.174768	-0.030793	
fico	-0.140090	-0.020571	
days.with.cr.line	-0.002262	-0.056818	
revol.bal	-0.013797	-0.038605	
revol.util	0.190038	-0.049580	
inq.last.6mths	-0.054588	0.027542	
delinq.2yrs	-0.014405	0.008499	
pub.rec	0.044514	-0.019363	
not.fully.paid	-0.023673	0.037387	
purpose_credit_card	-0.300718	-0.075815	
purpose_debt_consolidation	1.000000	-0.171807	
purpose_educational	-0.171807	1.000000	
purpose_home_improvement	-0.224714	-0.056653	
purpose_major_purchase	-0.168152	-0.042393	
purpose_small_business	-0.248412	-0.062628	

	purpose_home_improvement	purpose_major_purchase	\
credit.policy	-0.017452	0.028011	
int.rate	-0.041250	-0.060634	
installment	0.035959	-0.051060	
log.annual.inc	0.107927	-0.025726	
dti	-0.088411	-0.085678	
fico	0.092760	0.058652	
days.with.cr.line	0.059564	-0.028091	
revol.bal	-0.016523	-0.060458	
revol.util	-0.117841	-0.111932	
inq.last.6mths	0.070591	0.003339	
delinq.2yrs	-0.015685	0.007183	
pub.rec	-0.000424	-0.016291	
not.fully.paid	0.016186	-0.042900	
purpose_credit_card	-0.099161	-0.074202	
purpose_debt_consolidation	-0.224714	-0.168152	
purpose_educational	-0.056653	-0.042393	
purpose_home_improvement	1.000000	-0.055448	
purpose_major_purchase	-0.055448	1.000000	

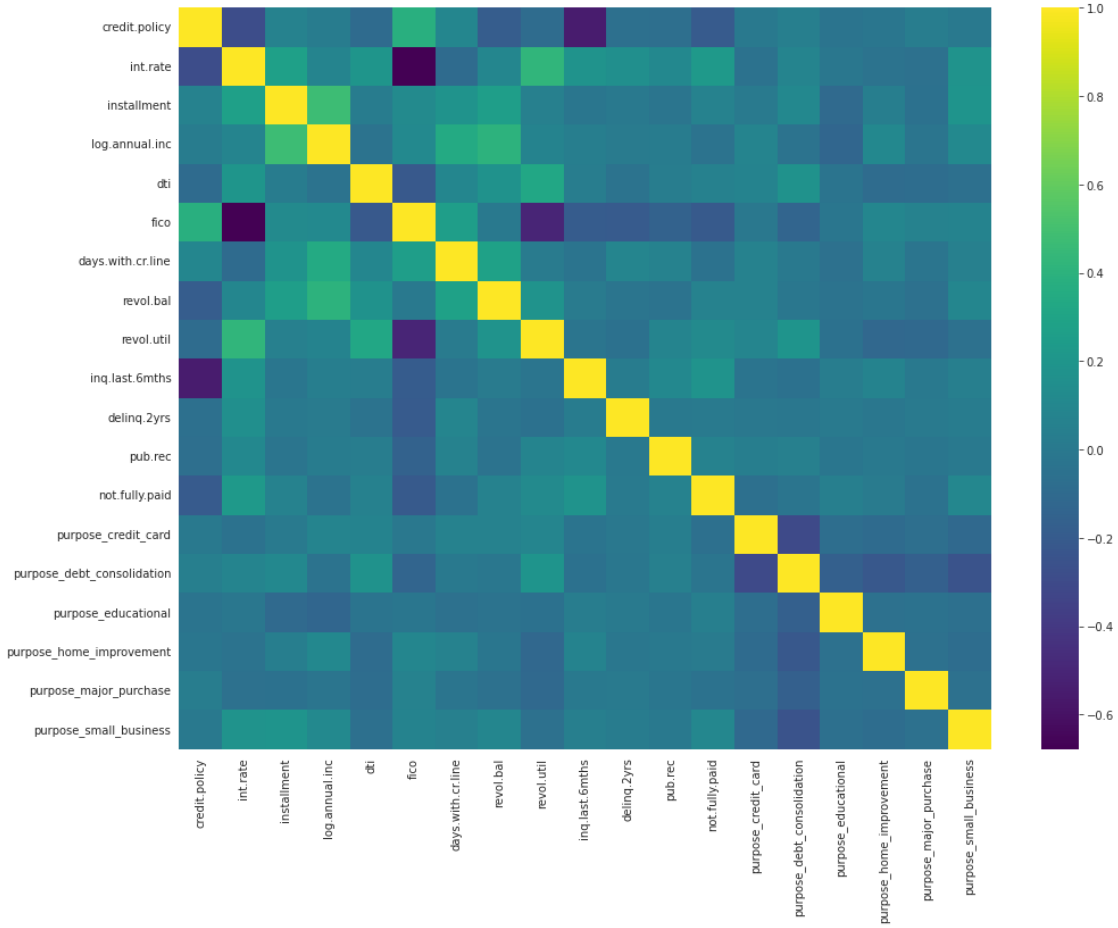
```
purpose_small_business                    -0.081913                -0.061295
```

```
                                purpose_small_business
credit.policy                                -0.002790
int.rate                                      0.183748
installment                                   0.187774
log.annual.inc                                0.111604
dti                                          -0.065699
fico                                          0.071830
days.with.cr.line                             0.046484
revol.bal                                     0.091854
revol.util                                   -0.061126
inq.last.6mths                                0.036802
delinq.2yrs                                   0.023252
pub.rec                                      -0.001695
not.fully.paid                                0.099555
purpose_credit_card                          -0.109618
purpose_debt_consolidation                   -0.248412
purpose_educational                          -0.062628
purpose_home_improvement                     -0.081913
purpose_major_purchase                       -0.061295
purpose_small_business                        1.000000
```

[28]:
```
plt.figure(
        figsize=[16,12]
)

sns.heatmap(
        data=final_data.corr(),
        cmap='viridis',
        annot=False,
        fmt='.2g'
)
```

[28]:
```
<AxesSubplot: >
```



[29]:
```
#focus on the grids of yellow or very light green. After comparing with the␣
 ↪feature description again,  revol.bal,day.with.cr.line,installment can␣
 ↪repsent by annual income. revol.util can repsent by int.rate,
to_drop2 = ['revol.bal', 'days.with.cr.line', 'installment', 'revol.bal']

final_data.drop(to_drop2, axis=1, inplace=True)
```

[30]:
```
final_data.isnull().mean()
```

[30]:
```
credit.policy                0.0
int.rate                     0.0
log.annual.inc               0.0
dti                          0.0
fico                         0.0
revol.util                   0.0
inq.last.6mths               0.0
delinq.2yrs                  0.0
pub.rec                      0.0
```

```
not.fully.paid                0.0
purpose_credit_card           0.0
purpose_debt_consolidation    0.0
purpose_educational           0.0
purpose_home_improvement      0.0
purpose_major_purchase        0.0
purpose_small_business        0.0
dtype: float64
```

[31]:
```
to_train = final_data[final_data['not.fully.paid'].isin([0,1])]
to_pred = final_data[final_data['not.fully.paid'] == 2]
```

[32]:
```
X = to_train.drop('not.fully.paid', axis=1).values
y = to_train['not.fully.paid'].values

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
 ↪random_state = 101)
```

[34]:
```
scaler = MinMaxScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

[35]:
```
X_train.shape
```

[35]:
```
(11263, 15)
```

[36]:
```
model = Sequential()

model.add(
        Dense(94, activation='relu')
)

model.add(
        Dense(30, activation='relu')
)

model.add(
        Dense(15, activation='relu')
)


model.add(
        Dense(1, activation='sigmoid')
)

model.compile(
        optimizer='adam',
```

```
        loss='binary_crossentropy',
        metrics=['accuracy']
)
```

[37]:
```
early_stop = EarlyStopping(
        monitor='val_loss',
        mode='min',
        verbose=1,
        patience=25
)

model.fit(
        X_train,
        y_train,
        epochs=200,
        batch_size=256,
        validation_data=(X_test, y_test),
         callbacks=[early_stop]
)
```

```
Epoch 1/200
44/44 [==============================] - 1s 5ms/step - loss: 0.6743 - accuracy:
0.5922 - val_loss: 0.6592 - val_accuracy: 0.6091
Epoch 2/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6504 - accuracy:
0.6204 - val_loss: 0.6509 - val_accuracy: 0.6095
Epoch 3/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6443 - accuracy:
0.6222 - val_loss: 0.6479 - val_accuracy: 0.6143
Epoch 4/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6409 - accuracy:
0.6228 - val_loss: 0.6458 - val_accuracy: 0.6124
Epoch 5/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6401 - accuracy:
0.6275 - val_loss: 0.6441 - val_accuracy: 0.6159
Epoch 6/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6370 - accuracy:
0.6283 - val_loss: 0.6435 - val_accuracy: 0.6180
Epoch 7/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6357 - accuracy:
0.6349 - val_loss: 0.6419 - val_accuracy: 0.6236
Epoch 8/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6348 - accuracy:
0.6277 - val_loss: 0.6443 - val_accuracy: 0.6161
Epoch 9/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6329 - accuracy:
0.6319 - val_loss: 0.6399 - val_accuracy: 0.6261
```

```
Epoch 10/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6325 - accuracy:
0.6361 - val_loss: 0.6395 - val_accuracy: 0.6242
Epoch 11/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6317 - accuracy:
0.6330 - val_loss: 0.6407 - val_accuracy: 0.6279
Epoch 12/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6314 - accuracy:
0.6367 - val_loss: 0.6390 - val_accuracy: 0.6225
Epoch 13/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6296 - accuracy:
0.6386 - val_loss: 0.6400 - val_accuracy: 0.6176
Epoch 14/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6292 - accuracy:
0.6370 - val_loss: 0.6377 - val_accuracy: 0.6335
Epoch 15/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6281 - accuracy:
0.6413 - val_loss: 0.6380 - val_accuracy: 0.6308
Epoch 16/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6282 - accuracy:
0.6363 - val_loss: 0.6372 - val_accuracy: 0.6275
Epoch 17/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6265 - accuracy:
0.6430 - val_loss: 0.6367 - val_accuracy: 0.6341
Epoch 18/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6247 - accuracy:
0.6410 - val_loss: 0.6369 - val_accuracy: 0.6333
Epoch 19/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6240 - accuracy:
0.6430 - val_loss: 0.6355 - val_accuracy: 0.6339
Epoch 20/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6233 - accuracy:
0.6481 - val_loss: 0.6358 - val_accuracy: 0.6377
Epoch 21/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6230 - accuracy:
0.6421 - val_loss: 0.6351 - val_accuracy: 0.6381
Epoch 22/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6213 - accuracy:
0.6475 - val_loss: 0.6358 - val_accuracy: 0.6339
Epoch 23/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6221 - accuracy:
0.6464 - val_loss: 0.6342 - val_accuracy: 0.6333
Epoch 24/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6194 - accuracy:
0.6504 - val_loss: 0.6399 - val_accuracy: 0.6269
Epoch 25/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6229 - accuracy:
0.6465 - val_loss: 0.6349 - val_accuracy: 0.6343
```

```
Epoch 26/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6186 - accuracy:
0.6495 - val_loss: 0.6345 - val_accuracy: 0.6246
Epoch 27/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6175 - accuracy:
0.6482 - val_loss: 0.6328 - val_accuracy: 0.6346
Epoch 28/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6172 - accuracy:
0.6488 - val_loss: 0.6336 - val_accuracy: 0.6290
Epoch 29/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6162 - accuracy:
0.6489 - val_loss: 0.6329 - val_accuracy: 0.6383
Epoch 30/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6159 - accuracy:
0.6505 - val_loss: 0.6331 - val_accuracy: 0.6341
Epoch 31/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6142 - accuracy:
0.6541 - val_loss: 0.6315 - val_accuracy: 0.6372
Epoch 32/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6146 - accuracy:
0.6497 - val_loss: 0.6312 - val_accuracy: 0.6323
Epoch 33/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6134 - accuracy:
0.6533 - val_loss: 0.6305 - val_accuracy: 0.6381
Epoch 34/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6119 - accuracy:
0.6536 - val_loss: 0.6318 - val_accuracy: 0.6323
Epoch 35/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6101 - accuracy:
0.6573 - val_loss: 0.6320 - val_accuracy: 0.6343
Epoch 36/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6112 - accuracy:
0.6534 - val_loss: 0.6305 - val_accuracy: 0.6360
Epoch 37/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6098 - accuracy:
0.6576 - val_loss: 0.6298 - val_accuracy: 0.6391
Epoch 38/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6095 - accuracy:
0.6545 - val_loss: 0.6321 - val_accuracy: 0.6387
Epoch 39/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6073 - accuracy:
0.6567 - val_loss: 0.6293 - val_accuracy: 0.6404
Epoch 40/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6062 - accuracy:
0.6575 - val_loss: 0.6287 - val_accuracy: 0.6399
Epoch 41/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6065 - accuracy:
0.6590 - val_loss: 0.6324 - val_accuracy: 0.6288
```

```
Epoch 42/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6041 - accuracy:
0.6606 - val_loss: 0.6279 - val_accuracy: 0.6341
Epoch 43/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6041 - accuracy:
0.6579 - val_loss: 0.6280 - val_accuracy: 0.6364
Epoch 44/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6074 - accuracy:
0.6523 - val_loss: 0.6310 - val_accuracy: 0.6314
Epoch 45/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6037 - accuracy:
0.6596 - val_loss: 0.6269 - val_accuracy: 0.6433
Epoch 46/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6011 - accuracy:
0.6658 - val_loss: 0.6297 - val_accuracy: 0.6395
Epoch 47/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6037 - accuracy:
0.6571 - val_loss: 0.6371 - val_accuracy: 0.6331
Epoch 48/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5996 - accuracy:
0.6644 - val_loss: 0.6300 - val_accuracy: 0.6408
Epoch 49/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5991 - accuracy:
0.6625 - val_loss: 0.6285 - val_accuracy: 0.6410
Epoch 50/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5959 - accuracy:
0.6702 - val_loss: 0.6272 - val_accuracy: 0.6418
Epoch 51/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5955 - accuracy:
0.6697 - val_loss: 0.6264 - val_accuracy: 0.6404
Epoch 52/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5940 - accuracy:
0.6684 - val_loss: 0.6265 - val_accuracy: 0.6406
Epoch 53/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5939 - accuracy:
0.6658 - val_loss: 0.6267 - val_accuracy: 0.6406
Epoch 54/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5916 - accuracy:
0.6718 - val_loss: 0.6270 - val_accuracy: 0.6422
Epoch 55/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5911 - accuracy:
0.6753 - val_loss: 0.6315 - val_accuracy: 0.6350
Epoch 56/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5909 - accuracy:
0.6725 - val_loss: 0.6253 - val_accuracy: 0.6404
Epoch 57/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5892 - accuracy:
0.6775 - val_loss: 0.6275 - val_accuracy: 0.6433
```

```
Epoch 58/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5887 - accuracy:
0.6751 - val_loss: 0.6246 - val_accuracy: 0.6397
Epoch 59/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5890 - accuracy:
0.6742 - val_loss: 0.6282 - val_accuracy: 0.6377
Epoch 60/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5899 - accuracy:
0.6726 - val_loss: 0.6259 - val_accuracy: 0.6476
Epoch 61/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5860 - accuracy:
0.6786 - val_loss: 0.6235 - val_accuracy: 0.6449
Epoch 62/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5859 - accuracy:
0.6766 - val_loss: 0.6263 - val_accuracy: 0.6408
Epoch 63/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5844 - accuracy:
0.6767 - val_loss: 0.6285 - val_accuracy: 0.6433
Epoch 64/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5821 - accuracy:
0.6781 - val_loss: 0.6272 - val_accuracy: 0.6457
Epoch 65/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5830 - accuracy:
0.6819 - val_loss: 0.6235 - val_accuracy: 0.6426
Epoch 66/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5815 - accuracy:
0.6771 - val_loss: 0.6253 - val_accuracy: 0.6497
Epoch 67/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5798 - accuracy:
0.6844 - val_loss: 0.6270 - val_accuracy: 0.6399
Epoch 68/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5796 - accuracy:
0.6827 - val_loss: 0.6257 - val_accuracy: 0.6491
Epoch 69/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5782 - accuracy:
0.6842 - val_loss: 0.6232 - val_accuracy: 0.6532
Epoch 70/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5769 - accuracy:
0.6837 - val_loss: 0.6254 - val_accuracy: 0.6522
Epoch 71/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5788 - accuracy:
0.6835 - val_loss: 0.6264 - val_accuracy: 0.6522
Epoch 72/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5751 - accuracy:
0.6834 - val_loss: 0.6226 - val_accuracy: 0.6482
Epoch 73/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5759 - accuracy:
0.6869 - val_loss: 0.6205 - val_accuracy: 0.6470
```

```
Epoch 74/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5723 - accuracy:
0.6916 - val_loss: 0.6230 - val_accuracy: 0.6470
Epoch 75/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5740 - accuracy:
0.6907 - val_loss: 0.6281 - val_accuracy: 0.6433
Epoch 76/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5757 - accuracy:
0.6821 - val_loss: 0.6207 - val_accuracy: 0.6451
Epoch 77/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5762 - accuracy:
0.6837 - val_loss: 0.6259 - val_accuracy: 0.6482
Epoch 78/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5704 - accuracy:
0.6912 - val_loss: 0.6205 - val_accuracy: 0.6480
Epoch 79/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5695 - accuracy:
0.6899 - val_loss: 0.6203 - val_accuracy: 0.6493
Epoch 80/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5683 - accuracy:
0.6896 - val_loss: 0.6214 - val_accuracy: 0.6520
Epoch 81/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5689 - accuracy:
0.6956 - val_loss: 0.6173 - val_accuracy: 0.6542
Epoch 82/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5660 - accuracy:
0.6963 - val_loss: 0.6193 - val_accuracy: 0.6549
Epoch 83/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5660 - accuracy:
0.6933 - val_loss: 0.6204 - val_accuracy: 0.6507
Epoch 84/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5654 - accuracy:
0.6983 - val_loss: 0.6185 - val_accuracy: 0.6592
Epoch 85/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5651 - accuracy:
0.6897 - val_loss: 0.6207 - val_accuracy: 0.6551
Epoch 86/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5624 - accuracy:
0.6986 - val_loss: 0.6193 - val_accuracy: 0.6538
Epoch 87/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5609 - accuracy:
0.7000 - val_loss: 0.6198 - val_accuracy: 0.6573
Epoch 88/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5627 - accuracy:
0.6953 - val_loss: 0.6187 - val_accuracy: 0.6486
Epoch 89/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5587 - accuracy:
0.6979 - val_loss: 0.6161 - val_accuracy: 0.6522
```

```
Epoch 90/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5659 - accuracy:
0.6901 - val_loss: 0.6167 - val_accuracy: 0.6495
Epoch 91/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5567 - accuracy:
0.7013 - val_loss: 0.6167 - val_accuracy: 0.6555
Epoch 92/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5573 - accuracy:
0.7016 - val_loss: 0.6179 - val_accuracy: 0.6524
Epoch 93/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5543 - accuracy:
0.7032 - val_loss: 0.6158 - val_accuracy: 0.6592
Epoch 94/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5538 - accuracy:
0.7040 - val_loss: 0.6205 - val_accuracy: 0.6524
Epoch 95/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5545 - accuracy:
0.7067 - val_loss: 0.6237 - val_accuracy: 0.6497
Epoch 96/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5525 - accuracy:
0.6991 - val_loss: 0.6134 - val_accuracy: 0.6491
Epoch 97/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5517 - accuracy:
0.7023 - val_loss: 0.6268 - val_accuracy: 0.6468
Epoch 98/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5543 - accuracy:
0.7080 - val_loss: 0.6131 - val_accuracy: 0.6559
Epoch 99/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5520 - accuracy:
0.7047 - val_loss: 0.6217 - val_accuracy: 0.6501
Epoch 100/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5483 - accuracy:
0.7106 - val_loss: 0.6117 - val_accuracy: 0.6629
Epoch 101/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5504 - accuracy:
0.7063 - val_loss: 0.6118 - val_accuracy: 0.6563
Epoch 102/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5489 - accuracy:
0.7074 - val_loss: 0.6145 - val_accuracy: 0.6584
Epoch 103/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5493 - accuracy:
0.7074 - val_loss: 0.6266 - val_accuracy: 0.6511
Epoch 104/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5500 - accuracy:
0.7054 - val_loss: 0.6191 - val_accuracy: 0.6555
Epoch 105/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5453 - accuracy:
0.7137 - val_loss: 0.6135 - val_accuracy: 0.6611
```

```
Epoch 106/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5453 - accuracy:
0.7098 - val_loss: 0.6094 - val_accuracy: 0.6580
Epoch 107/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5437 - accuracy:
0.7100 - val_loss: 0.6169 - val_accuracy: 0.6507
Epoch 108/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5443 - accuracy:
0.7082 - val_loss: 0.6135 - val_accuracy: 0.6563
Epoch 109/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5416 - accuracy:
0.7106 - val_loss: 0.6081 - val_accuracy: 0.6590
Epoch 110/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5395 - accuracy:
0.7162 - val_loss: 0.6112 - val_accuracy: 0.6592
Epoch 111/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5420 - accuracy:
0.7110 - val_loss: 0.6098 - val_accuracy: 0.6598
Epoch 112/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5431 - accuracy:
0.7120 - val_loss: 0.6121 - val_accuracy: 0.6621
Epoch 113/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5415 - accuracy:
0.7114 - val_loss: 0.6085 - val_accuracy: 0.6658
Epoch 114/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5416 - accuracy:
0.7112 - val_loss: 0.6053 - val_accuracy: 0.6644
Epoch 115/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5403 - accuracy:
0.7131 - val_loss: 0.6103 - val_accuracy: 0.6652
Epoch 116/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5365 - accuracy:
0.7169 - val_loss: 0.6131 - val_accuracy: 0.6698
Epoch 117/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5374 - accuracy:
0.7138 - val_loss: 0.6070 - val_accuracy: 0.6671
Epoch 118/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5369 - accuracy:
0.7154 - val_loss: 0.6068 - val_accuracy: 0.6725
Epoch 119/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5357 - accuracy:
0.7193 - val_loss: 0.6070 - val_accuracy: 0.6718
Epoch 120/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5384 - accuracy:
0.7099 - val_loss: 0.6068 - val_accuracy: 0.6625
Epoch 121/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5340 - accuracy:
0.7174 - val_loss: 0.6097 - val_accuracy: 0.6689
```

```
Epoch 122/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5331 - accuracy:
0.7185 - val_loss: 0.6031 - val_accuracy: 0.6739
Epoch 123/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5326 - accuracy:
0.7187 - val_loss: 0.6076 - val_accuracy: 0.6609
Epoch 124/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5348 - accuracy:
0.7168 - val_loss: 0.6027 - val_accuracy: 0.6673
Epoch 125/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5314 - accuracy:
0.7187 - val_loss: 0.6059 - val_accuracy: 0.6671
Epoch 126/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5281 - accuracy:
0.7244 - val_loss: 0.6057 - val_accuracy: 0.6679
Epoch 127/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5305 - accuracy:
0.7224 - val_loss: 0.6027 - val_accuracy: 0.6663
Epoch 128/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5288 - accuracy:
0.7239 - val_loss: 0.6036 - val_accuracy: 0.6718
Epoch 129/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5262 - accuracy:
0.7233 - val_loss: 0.6066 - val_accuracy: 0.6733
Epoch 130/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5265 - accuracy:
0.7260 - val_loss: 0.6084 - val_accuracy: 0.6656
Epoch 131/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5299 - accuracy:
0.7237 - val_loss: 0.6016 - val_accuracy: 0.6723
Epoch 132/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5257 - accuracy:
0.7219 - val_loss: 0.6048 - val_accuracy: 0.6689
Epoch 133/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5261 - accuracy:
0.7227 - val_loss: 0.6080 - val_accuracy: 0.6694
Epoch 134/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5252 - accuracy:
0.7242 - val_loss: 0.6029 - val_accuracy: 0.6766
Epoch 135/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5237 - accuracy:
0.7279 - val_loss: 0.6063 - val_accuracy: 0.6654
Epoch 136/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5227 - accuracy:
0.7283 - val_loss: 0.5995 - val_accuracy: 0.6714
Epoch 137/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5200 - accuracy:
0.7301 - val_loss: 0.6055 - val_accuracy: 0.6673
```

```
Epoch 138/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5213 - accuracy:
0.7283 - val_loss: 0.6009 - val_accuracy: 0.6779
Epoch 139/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5212 - accuracy:
0.7245 - val_loss: 0.6001 - val_accuracy: 0.6710
Epoch 140/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5168 - accuracy:
0.7322 - val_loss: 0.6003 - val_accuracy: 0.6727
Epoch 141/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5162 - accuracy:
0.7284 - val_loss: 0.6030 - val_accuracy: 0.6723
Epoch 142/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5178 - accuracy:
0.7304 - val_loss: 0.6001 - val_accuracy: 0.6710
Epoch 143/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5183 - accuracy:
0.7290 - val_loss: 0.6045 - val_accuracy: 0.6814
Epoch 144/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5184 - accuracy:
0.7282 - val_loss: 0.6156 - val_accuracy: 0.6700
Epoch 145/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5184 - accuracy:
0.7297 - val_loss: 0.6017 - val_accuracy: 0.6700
Epoch 146/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5191 - accuracy:
0.7237 - val_loss: 0.5985 - val_accuracy: 0.6729
Epoch 147/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5140 - accuracy:
0.7316 - val_loss: 0.6109 - val_accuracy: 0.6671
Epoch 148/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5160 - accuracy:
0.7311 - val_loss: 0.5973 - val_accuracy: 0.6708
Epoch 149/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5207 - accuracy:
0.7241 - val_loss: 0.6061 - val_accuracy: 0.6737
Epoch 150/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5138 - accuracy:
0.7329 - val_loss: 0.6112 - val_accuracy: 0.6725
Epoch 151/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5158 - accuracy:
0.7286 - val_loss: 0.6153 - val_accuracy: 0.6644
Epoch 152/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5101 - accuracy:
0.7327 - val_loss: 0.5957 - val_accuracy: 0.6793
Epoch 153/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5132 - accuracy:
0.7318 - val_loss: 0.6027 - val_accuracy: 0.6721
```

```
Epoch 154/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5107 - accuracy:
0.7339 - val_loss: 0.5996 - val_accuracy: 0.6851
Epoch 155/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5133 - accuracy:
0.7301 - val_loss: 0.6043 - val_accuracy: 0.6772
Epoch 156/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5089 - accuracy:
0.7373 - val_loss: 0.5964 - val_accuracy: 0.6789
Epoch 157/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5089 - accuracy:
0.7369 - val_loss: 0.6069 - val_accuracy: 0.6675
Epoch 158/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5101 - accuracy:
0.7299 - val_loss: 0.6030 - val_accuracy: 0.6750
Epoch 159/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5056 - accuracy:
0.7388 - val_loss: 0.5992 - val_accuracy: 0.6741
Epoch 160/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5057 - accuracy:
0.7384 - val_loss: 0.5969 - val_accuracy: 0.6783
Epoch 161/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5077 - accuracy:
0.7344 - val_loss: 0.6058 - val_accuracy: 0.6805
Epoch 162/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5068 - accuracy:
0.7346 - val_loss: 0.5998 - val_accuracy: 0.6766
Epoch 163/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5058 - accuracy:
0.7366 - val_loss: 0.5976 - val_accuracy: 0.6845
Epoch 164/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5103 - accuracy:
0.7289 - val_loss: 0.6044 - val_accuracy: 0.6702
Epoch 165/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5005 - accuracy:
0.7387 - val_loss: 0.5953 - val_accuracy: 0.6892
Epoch 166/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5022 - accuracy:
0.7390 - val_loss: 0.5950 - val_accuracy: 0.6814
Epoch 167/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5011 - accuracy:
0.7389 - val_loss: 0.6002 - val_accuracy: 0.6776
Epoch 168/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4987 - accuracy:
0.7407 - val_loss: 0.6029 - val_accuracy: 0.6747
Epoch 169/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5020 - accuracy:
0.7397 - val_loss: 0.5999 - val_accuracy: 0.6745
```

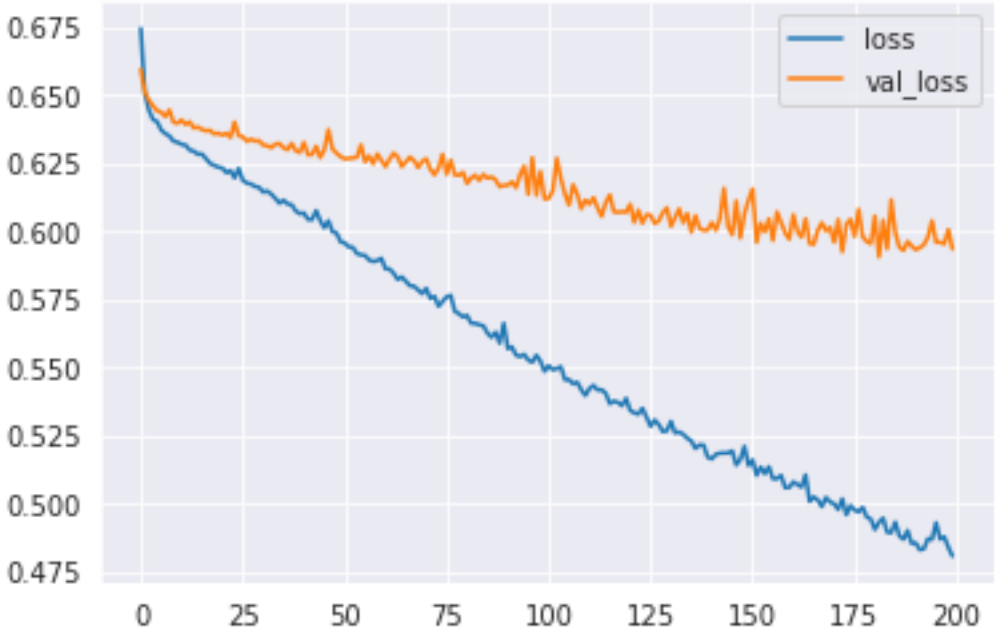
```
Epoch 170/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5003 - accuracy:
0.7404 - val_loss: 0.6013 - val_accuracy: 0.6793
Epoch 171/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4997 - accuracy:
0.7422 - val_loss: 0.5958 - val_accuracy: 0.6832
Epoch 172/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4976 - accuracy:
0.7406 - val_loss: 0.6041 - val_accuracy: 0.6847
Epoch 173/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5015 - accuracy:
0.7396 - val_loss: 0.5923 - val_accuracy: 0.6832
Epoch 174/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4957 - accuracy:
0.7416 - val_loss: 0.6024 - val_accuracy: 0.6762
Epoch 175/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4990 - accuracy:
0.7384 - val_loss: 0.6042 - val_accuracy: 0.6756
Epoch 176/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4974 - accuracy:
0.7425 - val_loss: 0.5979 - val_accuracy: 0.6820
Epoch 177/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4967 - accuracy:
0.7415 - val_loss: 0.6079 - val_accuracy: 0.6638
Epoch 178/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4984 - accuracy:
0.7447 - val_loss: 0.5978 - val_accuracy: 0.6845
Epoch 179/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4948 - accuracy:
0.7453 - val_loss: 0.5960 - val_accuracy: 0.6853
Epoch 180/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4941 - accuracy:
0.7447 - val_loss: 0.5952 - val_accuracy: 0.6863
Epoch 181/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4902 - accuracy:
0.7447 - val_loss: 0.6054 - val_accuracy: 0.6681
Epoch 182/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4929 - accuracy:
0.7423 - val_loss: 0.5904 - val_accuracy: 0.6874
Epoch 183/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4944 - accuracy:
0.7422 - val_loss: 0.6038 - val_accuracy: 0.6679
Epoch 184/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4893 - accuracy:
0.7439 - val_loss: 0.5933 - val_accuracy: 0.6824
Epoch 185/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4891 - accuracy:
0.7436 - val_loss: 0.6114 - val_accuracy: 0.6700
```

```
Epoch 186/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4930 - accuracy:
0.7432 - val_loss: 0.5994 - val_accuracy: 0.6845
Epoch 187/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4879 - accuracy:
0.7481 - val_loss: 0.5939 - val_accuracy: 0.6874
Epoch 188/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4866 - accuracy:
0.7498 - val_loss: 0.5928 - val_accuracy: 0.6911
Epoch 189/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4899 - accuracy:
0.7446 - val_loss: 0.5960 - val_accuracy: 0.6839
Epoch 190/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4852 - accuracy:
0.7518 - val_loss: 0.5943 - val_accuracy: 0.6824
Epoch 191/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4853 - accuracy:
0.7515 - val_loss: 0.5931 - val_accuracy: 0.6863
Epoch 192/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4828 - accuracy:
0.7500 - val_loss: 0.5937 - val_accuracy: 0.6837
Epoch 193/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4831 - accuracy:
0.7530 - val_loss: 0.5948 - val_accuracy: 0.6899
Epoch 194/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4869 - accuracy:
0.7478 - val_loss: 0.5976 - val_accuracy: 0.6785
Epoch 195/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4866 - accuracy:
0.7509 - val_loss: 0.6037 - val_accuracy: 0.6843
Epoch 196/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4927 - accuracy:
0.7422 - val_loss: 0.5958 - val_accuracy: 0.6874
Epoch 197/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4867 - accuracy:
0.7497 - val_loss: 0.5958 - val_accuracy: 0.6849
Epoch 198/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4876 - accuracy:
0.7472 - val_loss: 0.5951 - val_accuracy: 0.6826
Epoch 199/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4837 - accuracy:
0.7527 - val_loss: 0.6004 - val_accuracy: 0.6805
Epoch 200/200
44/44 [==============================] - 0s 2ms/step - loss: 0.4805 - accuracy:
0.7506 - val_loss: 0.5933 - val_accuracy: 0.6874
```

[37]: <keras.src.callbacks.History at 0x7fef3d825ed0>

[39]:
```
pd.DataFrame(model.history.history)[['loss','val_loss']].plot()
#over fitting
```

[39]: <AxesSubplot: >



[44]:
```
predictions = (model.predict(X_test) > 0.5).astype("int32")

print(
        confusion_matrix(y_test,predictions),
        '\n',
        classification_report(y_test,predictions)
)
```

```
151/151 [==============================] - 0s 595us/step
[[1597  840]
 [ 669 1721]]
              precision    recall  f1-score   support

           0       0.70      0.66      0.68      2437
           1       0.67      0.72      0.70      2390

    accuracy                           0.69      4827
   macro avg       0.69      0.69      0.69      4827
weighted avg       0.69      0.69      0.69      4827
```

[45]:
```
model_new = Sequential()

model_new.add(
        Dense(94, activation='relu')
)

model_new.add(Dropout(0.2))

model_new.add(
        Dense(30, activation='relu')
)

model_new.add(Dropout(0.2))

model_new.add(
        Dense(15, activation='relu')
)

model_new.add(Dropout(0.2))

model_new.add(
        Dense(1, activation='sigmoid')
)

model_new.compile(
        optimizer='adam',
        loss='binary_crossentropy',
        metrics=['binary_accuracy']
)


model_new.fit(
        X_train,
        y_train,
        epochs=200,
        batch_size=256,
        validation_data=(X_test, y_test),
         callbacks=[early_stop]
)
```

```
Epoch 1/200
44/44 [==============================] - 1s 4ms/step - loss: 0.6805 -
binary_accuracy: 0.5616 - val_loss: 0.6648 - val_binary_accuracy: 0.6101
Epoch 2/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6659 -
binary_accuracy: 0.6033 - val_loss: 0.6563 - val_binary_accuracy: 0.6143
Epoch 3/200
```

```
44/44 [==============================] - 0s 2ms/step - loss: 0.6584 -
binary_accuracy: 0.6130 - val_loss: 0.6523 - val_binary_accuracy: 0.6138
Epoch 4/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6558 -
binary_accuracy: 0.6174 - val_loss: 0.6503 - val_binary_accuracy: 0.6101
Epoch 5/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6509 -
binary_accuracy: 0.6165 - val_loss: 0.6485 - val_binary_accuracy: 0.6130
Epoch 6/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6498 -
binary_accuracy: 0.6196 - val_loss: 0.6472 - val_binary_accuracy: 0.6109
Epoch 7/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6481 -
binary_accuracy: 0.6213 - val_loss: 0.6457 - val_binary_accuracy: 0.6165
Epoch 8/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6449 -
binary_accuracy: 0.6246 - val_loss: 0.6441 - val_binary_accuracy: 0.6174
Epoch 9/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6473 -
binary_accuracy: 0.6243 - val_loss: 0.6441 - val_binary_accuracy: 0.6172
Epoch 10/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6449 -
binary_accuracy: 0.6249 - val_loss: 0.6430 - val_binary_accuracy: 0.6194
Epoch 11/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6438 -
binary_accuracy: 0.6288 - val_loss: 0.6426 - val_binary_accuracy: 0.6196
Epoch 12/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6431 -
binary_accuracy: 0.6271 - val_loss: 0.6414 - val_binary_accuracy: 0.6176
Epoch 13/200
44/44 [==============================] - 0s 3ms/step - loss: 0.6403 -
binary_accuracy: 0.6292 - val_loss: 0.6407 - val_binary_accuracy: 0.6205
Epoch 14/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6400 -
binary_accuracy: 0.6299 - val_loss: 0.6406 - val_binary_accuracy: 0.6221
Epoch 15/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6391 -
binary_accuracy: 0.6330 - val_loss: 0.6399 - val_binary_accuracy: 0.6207
Epoch 16/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6389 -
binary_accuracy: 0.6329 - val_loss: 0.6389 - val_binary_accuracy: 0.6211
Epoch 17/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6381 -
binary_accuracy: 0.6340 - val_loss: 0.6387 - val_binary_accuracy: 0.6242
Epoch 18/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6374 -
binary_accuracy: 0.6395 - val_loss: 0.6387 - val_binary_accuracy: 0.6219
Epoch 19/200
```

```
44/44 [==============================] - 0s 2ms/step - loss: 0.6386 -
binary_accuracy: 0.6313 - val_loss: 0.6385 - val_binary_accuracy: 0.6217
Epoch 20/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6336 -
binary_accuracy: 0.6362 - val_loss: 0.6375 - val_binary_accuracy: 0.6269
Epoch 21/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6352 -
binary_accuracy: 0.6359 - val_loss: 0.6380 - val_binary_accuracy: 0.6279
Epoch 22/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6355 -
binary_accuracy: 0.6353 - val_loss: 0.6370 - val_binary_accuracy: 0.6341
Epoch 23/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6341 -
binary_accuracy: 0.6332 - val_loss: 0.6368 - val_binary_accuracy: 0.6256
Epoch 24/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6326 -
binary_accuracy: 0.6385 - val_loss: 0.6356 - val_binary_accuracy: 0.6331
Epoch 25/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6330 -
binary_accuracy: 0.6352 - val_loss: 0.6348 - val_binary_accuracy: 0.6321
Epoch 26/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6315 -
binary_accuracy: 0.6400 - val_loss: 0.6349 - val_binary_accuracy: 0.6298
Epoch 27/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6294 -
binary_accuracy: 0.6375 - val_loss: 0.6347 - val_binary_accuracy: 0.6335
Epoch 28/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6317 -
binary_accuracy: 0.6385 - val_loss: 0.6341 - val_binary_accuracy: 0.6269
Epoch 29/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6307 -
binary_accuracy: 0.6385 - val_loss: 0.6339 - val_binary_accuracy: 0.6271
Epoch 30/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6286 -
binary_accuracy: 0.6441 - val_loss: 0.6349 - val_binary_accuracy: 0.6321
Epoch 31/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6299 -
binary_accuracy: 0.6398 - val_loss: 0.6331 - val_binary_accuracy: 0.6306
Epoch 32/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6289 -
binary_accuracy: 0.6388 - val_loss: 0.6337 - val_binary_accuracy: 0.6329
Epoch 33/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6265 -
binary_accuracy: 0.6484 - val_loss: 0.6337 - val_binary_accuracy: 0.6343
Epoch 34/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6280 -
binary_accuracy: 0.6432 - val_loss: 0.6323 - val_binary_accuracy: 0.6333
Epoch 35/200
```

```
44/44 [==============================] - 0s 2ms/step - loss: 0.6241 -
binary_accuracy: 0.6465 - val_loss: 0.6320 - val_binary_accuracy: 0.6354
Epoch 36/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6245 -
binary_accuracy: 0.6481 - val_loss: 0.6312 - val_binary_accuracy: 0.6387
Epoch 37/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6233 -
binary_accuracy: 0.6491 - val_loss: 0.6316 - val_binary_accuracy: 0.6414
Epoch 38/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6239 -
binary_accuracy: 0.6433 - val_loss: 0.6307 - val_binary_accuracy: 0.6393
Epoch 39/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6238 -
binary_accuracy: 0.6478 - val_loss: 0.6307 - val_binary_accuracy: 0.6393
Epoch 40/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6204 -
binary_accuracy: 0.6514 - val_loss: 0.6311 - val_binary_accuracy: 0.6379
Epoch 41/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6224 -
binary_accuracy: 0.6510 - val_loss: 0.6290 - val_binary_accuracy: 0.6387
Epoch 42/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6227 -
binary_accuracy: 0.6509 - val_loss: 0.6294 - val_binary_accuracy: 0.6395
Epoch 43/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6192 -
binary_accuracy: 0.6514 - val_loss: 0.6281 - val_binary_accuracy: 0.6401
Epoch 44/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6208 -
binary_accuracy: 0.6449 - val_loss: 0.6289 - val_binary_accuracy: 0.6379
Epoch 45/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6183 -
binary_accuracy: 0.6520 - val_loss: 0.6279 - val_binary_accuracy: 0.6459
Epoch 46/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6190 -
binary_accuracy: 0.6507 - val_loss: 0.6284 - val_binary_accuracy: 0.6437
Epoch 47/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6201 -
binary_accuracy: 0.6525 - val_loss: 0.6277 - val_binary_accuracy: 0.6428
Epoch 48/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6185 -
binary_accuracy: 0.6470 - val_loss: 0.6276 - val_binary_accuracy: 0.6383
Epoch 49/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6164 -
binary_accuracy: 0.6531 - val_loss: 0.6270 - val_binary_accuracy: 0.6443
Epoch 50/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6141 -
binary_accuracy: 0.6607 - val_loss: 0.6269 - val_binary_accuracy: 0.6430
Epoch 51/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.6182 -
binary_accuracy: 0.6561 - val_loss: 0.6261 - val_binary_accuracy: 0.6455
Epoch 52/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6148 -
binary_accuracy: 0.6591 - val_loss: 0.6252 - val_binary_accuracy: 0.6414
Epoch 53/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6153 -
binary_accuracy: 0.6591 - val_loss: 0.6256 - val_binary_accuracy: 0.6368
Epoch 54/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6144 -
binary_accuracy: 0.6551 - val_loss: 0.6249 - val_binary_accuracy: 0.6449
Epoch 55/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6111 -
binary_accuracy: 0.6569 - val_loss: 0.6265 - val_binary_accuracy: 0.6464
Epoch 56/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6133 -
binary_accuracy: 0.6578 - val_loss: 0.6240 - val_binary_accuracy: 0.6449
Epoch 57/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6116 -
binary_accuracy: 0.6567 - val_loss: 0.6250 - val_binary_accuracy: 0.6443
Epoch 58/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6103 -
binary_accuracy: 0.6596 - val_loss: 0.6230 - val_binary_accuracy: 0.6499
Epoch 59/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6117 -
binary_accuracy: 0.6639 - val_loss: 0.6226 - val_binary_accuracy: 0.6480
Epoch 60/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6091 -
binary_accuracy: 0.6623 - val_loss: 0.6233 - val_binary_accuracy: 0.6497
Epoch 61/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6092 -
binary_accuracy: 0.6600 - val_loss: 0.6220 - val_binary_accuracy: 0.6412
Epoch 62/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6096 -
binary_accuracy: 0.6598 - val_loss: 0.6220 - val_binary_accuracy: 0.6515
Epoch 63/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6099 -
binary_accuracy: 0.6615 - val_loss: 0.6217 - val_binary_accuracy: 0.6491
Epoch 64/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6069 -
binary_accuracy: 0.6593 - val_loss: 0.6229 - val_binary_accuracy: 0.6449
Epoch 65/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6068 -
binary_accuracy: 0.6683 - val_loss: 0.6203 - val_binary_accuracy: 0.6501
Epoch 66/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6052 -
binary_accuracy: 0.6666 - val_loss: 0.6223 - val_binary_accuracy: 0.6468
Epoch 67/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.6085 -
binary_accuracy: 0.6623 - val_loss: 0.6194 - val_binary_accuracy: 0.6522
Epoch 68/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6058 -
binary_accuracy: 0.6700 - val_loss: 0.6201 - val_binary_accuracy: 0.6509
Epoch 69/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6042 -
binary_accuracy: 0.6679 - val_loss: 0.6203 - val_binary_accuracy: 0.6507
Epoch 70/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6017 -
binary_accuracy: 0.6686 - val_loss: 0.6222 - val_binary_accuracy: 0.6426
Epoch 71/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6027 -
binary_accuracy: 0.6668 - val_loss: 0.6195 - val_binary_accuracy: 0.6511
Epoch 72/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6013 -
binary_accuracy: 0.6693 - val_loss: 0.6197 - val_binary_accuracy: 0.6596
Epoch 73/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6009 -
binary_accuracy: 0.6693 - val_loss: 0.6183 - val_binary_accuracy: 0.6489
Epoch 74/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6023 -
binary_accuracy: 0.6729 - val_loss: 0.6201 - val_binary_accuracy: 0.6495
Epoch 75/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6016 -
binary_accuracy: 0.6708 - val_loss: 0.6174 - val_binary_accuracy: 0.6547
Epoch 76/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5989 -
binary_accuracy: 0.6711 - val_loss: 0.6177 - val_binary_accuracy: 0.6549
Epoch 77/200
44/44 [==============================] - 0s 2ms/step - loss: 0.6008 -
binary_accuracy: 0.6651 - val_loss: 0.6174 - val_binary_accuracy: 0.6486
Epoch 78/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5970 -
binary_accuracy: 0.6709 - val_loss: 0.6170 - val_binary_accuracy: 0.6549
Epoch 79/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5986 -
binary_accuracy: 0.6713 - val_loss: 0.6165 - val_binary_accuracy: 0.6542
Epoch 80/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5983 -
binary_accuracy: 0.6753 - val_loss: 0.6172 - val_binary_accuracy: 0.6538
Epoch 81/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5983 -
binary_accuracy: 0.6729 - val_loss: 0.6160 - val_binary_accuracy: 0.6549
Epoch 82/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5970 -
binary_accuracy: 0.6709 - val_loss: 0.6143 - val_binary_accuracy: 0.6596
Epoch 83/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.5956 -
binary_accuracy: 0.6760 - val_loss: 0.6142 - val_binary_accuracy: 0.6538
Epoch 84/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5964 -
binary_accuracy: 0.6701 - val_loss: 0.6147 - val_binary_accuracy: 0.6582
Epoch 85/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5953 -
binary_accuracy: 0.6766 - val_loss: 0.6157 - val_binary_accuracy: 0.6499
Epoch 86/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5947 -
binary_accuracy: 0.6712 - val_loss: 0.6140 - val_binary_accuracy: 0.6530
Epoch 87/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5935 -
binary_accuracy: 0.6726 - val_loss: 0.6132 - val_binary_accuracy: 0.6629
Epoch 88/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5919 -
binary_accuracy: 0.6765 - val_loss: 0.6125 - val_binary_accuracy: 0.6592
Epoch 89/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5941 -
binary_accuracy: 0.6735 - val_loss: 0.6106 - val_binary_accuracy: 0.6596
Epoch 90/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5929 -
binary_accuracy: 0.6767 - val_loss: 0.6117 - val_binary_accuracy: 0.6602
Epoch 91/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5911 -
binary_accuracy: 0.6763 - val_loss: 0.6104 - val_binary_accuracy: 0.6588
Epoch 92/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5945 -
binary_accuracy: 0.6756 - val_loss: 0.6113 - val_binary_accuracy: 0.6582
Epoch 93/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5931 -
binary_accuracy: 0.6781 - val_loss: 0.6112 - val_binary_accuracy: 0.6600
Epoch 94/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5907 -
binary_accuracy: 0.6813 - val_loss: 0.6118 - val_binary_accuracy: 0.6567
Epoch 95/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5909 -
binary_accuracy: 0.6796 - val_loss: 0.6108 - val_binary_accuracy: 0.6532
Epoch 96/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5888 -
binary_accuracy: 0.6817 - val_loss: 0.6138 - val_binary_accuracy: 0.6553
Epoch 97/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5902 -
binary_accuracy: 0.6787 - val_loss: 0.6099 - val_binary_accuracy: 0.6621
Epoch 98/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5877 -
binary_accuracy: 0.6771 - val_loss: 0.6098 - val_binary_accuracy: 0.6584
Epoch 99/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.5863 -
binary_accuracy: 0.6785 - val_loss: 0.6102 - val_binary_accuracy: 0.6607
Epoch 100/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5897 -
binary_accuracy: 0.6777 - val_loss: 0.6100 - val_binary_accuracy: 0.6644
Epoch 101/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5891 -
binary_accuracy: 0.6812 - val_loss: 0.6078 - val_binary_accuracy: 0.6658
Epoch 102/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5878 -
binary_accuracy: 0.6813 - val_loss: 0.6085 - val_binary_accuracy: 0.6611
Epoch 103/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5889 -
binary_accuracy: 0.6781 - val_loss: 0.6073 - val_binary_accuracy: 0.6648
Epoch 104/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5835 -
binary_accuracy: 0.6852 - val_loss: 0.6089 - val_binary_accuracy: 0.6615
Epoch 105/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5829 -
binary_accuracy: 0.6879 - val_loss: 0.6068 - val_binary_accuracy: 0.6638
Epoch 106/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5870 -
binary_accuracy: 0.6845 - val_loss: 0.6089 - val_binary_accuracy: 0.6623
Epoch 107/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5840 -
binary_accuracy: 0.6845 - val_loss: 0.6086 - val_binary_accuracy: 0.6615
Epoch 108/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5837 -
binary_accuracy: 0.6814 - val_loss: 0.6085 - val_binary_accuracy: 0.6644
Epoch 109/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5834 -
binary_accuracy: 0.6851 - val_loss: 0.6061 - val_binary_accuracy: 0.6694
Epoch 110/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5833 -
binary_accuracy: 0.6847 - val_loss: 0.6056 - val_binary_accuracy: 0.6646
Epoch 111/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5815 -
binary_accuracy: 0.6828 - val_loss: 0.6080 - val_binary_accuracy: 0.6607
Epoch 112/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5854 -
binary_accuracy: 0.6838 - val_loss: 0.6059 - val_binary_accuracy: 0.6673
Epoch 113/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5829 -
binary_accuracy: 0.6867 - val_loss: 0.6067 - val_binary_accuracy: 0.6596
Epoch 114/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5809 -
binary_accuracy: 0.6871 - val_loss: 0.6064 - val_binary_accuracy: 0.6658
Epoch 115/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.5803 -
binary_accuracy: 0.6841 - val_loss: 0.6053 - val_binary_accuracy: 0.6658
Epoch 116/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5804 -
binary_accuracy: 0.6838 - val_loss: 0.6057 - val_binary_accuracy: 0.6640
Epoch 117/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5836 -
binary_accuracy: 0.6877 - val_loss: 0.6090 - val_binary_accuracy: 0.6571
Epoch 118/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5755 -
binary_accuracy: 0.6948 - val_loss: 0.6105 - val_binary_accuracy: 0.6640
Epoch 119/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5804 -
binary_accuracy: 0.6842 - val_loss: 0.6097 - val_binary_accuracy: 0.6607
Epoch 120/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5793 -
binary_accuracy: 0.6873 - val_loss: 0.6047 - val_binary_accuracy: 0.6687
Epoch 121/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5748 -
binary_accuracy: 0.6896 - val_loss: 0.6043 - val_binary_accuracy: 0.6638
Epoch 122/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5768 -
binary_accuracy: 0.6882 - val_loss: 0.6058 - val_binary_accuracy: 0.6625
Epoch 123/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5803 -
binary_accuracy: 0.6821 - val_loss: 0.6066 - val_binary_accuracy: 0.6640
Epoch 124/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5776 -
binary_accuracy: 0.6902 - val_loss: 0.6072 - val_binary_accuracy: 0.6660
Epoch 125/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5784 -
binary_accuracy: 0.6868 - val_loss: 0.6067 - val_binary_accuracy: 0.6598
Epoch 126/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5754 -
binary_accuracy: 0.6897 - val_loss: 0.6051 - val_binary_accuracy: 0.6677
Epoch 127/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5737 -
binary_accuracy: 0.6973 - val_loss: 0.6040 - val_binary_accuracy: 0.6708
Epoch 128/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5724 -
binary_accuracy: 0.6914 - val_loss: 0.6025 - val_binary_accuracy: 0.6735
Epoch 129/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5796 -
binary_accuracy: 0.6863 - val_loss: 0.6050 - val_binary_accuracy: 0.6689
Epoch 130/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5743 -
binary_accuracy: 0.6943 - val_loss: 0.6012 - val_binary_accuracy: 0.6733
Epoch 131/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.5762 -
binary_accuracy: 0.6882 - val_loss: 0.6036 - val_binary_accuracy: 0.6675
Epoch 132/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5716 -
binary_accuracy: 0.6964 - val_loss: 0.6029 - val_binary_accuracy: 0.6654
Epoch 133/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5784 -
binary_accuracy: 0.6883 - val_loss: 0.6015 - val_binary_accuracy: 0.6607
Epoch 134/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5738 -
binary_accuracy: 0.6964 - val_loss: 0.6014 - val_binary_accuracy: 0.6631
Epoch 135/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5743 -
binary_accuracy: 0.6858 - val_loss: 0.6006 - val_binary_accuracy: 0.6629
Epoch 136/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5717 -
binary_accuracy: 0.6936 - val_loss: 0.6000 - val_binary_accuracy: 0.6696
Epoch 137/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5697 -
binary_accuracy: 0.6937 - val_loss: 0.6035 - val_binary_accuracy: 0.6642
Epoch 138/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5697 -
binary_accuracy: 0.6947 - val_loss: 0.6001 - val_binary_accuracy: 0.6596
Epoch 139/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5701 -
binary_accuracy: 0.6954 - val_loss: 0.6023 - val_binary_accuracy: 0.6673
Epoch 140/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5707 -
binary_accuracy: 0.6960 - val_loss: 0.6002 - val_binary_accuracy: 0.6677
Epoch 141/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5687 -
binary_accuracy: 0.6976 - val_loss: 0.5988 - val_binary_accuracy: 0.6685
Epoch 142/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5715 -
binary_accuracy: 0.6977 - val_loss: 0.5981 - val_binary_accuracy: 0.6710
Epoch 143/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5719 -
binary_accuracy: 0.6947 - val_loss: 0.6044 - val_binary_accuracy: 0.6658
Epoch 144/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5695 -
binary_accuracy: 0.6940 - val_loss: 0.6002 - val_binary_accuracy: 0.6679
Epoch 145/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5692 -
binary_accuracy: 0.6937 - val_loss: 0.5990 - val_binary_accuracy: 0.6681
Epoch 146/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5703 -
binary_accuracy: 0.6979 - val_loss: 0.6001 - val_binary_accuracy: 0.6677
Epoch 147/200
```

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44/44 [==============================] - 0s 2ms/step - loss: 0.5704 -
binary_accuracy: 0.6927 - val_loss: 0.6027 - val_binary_accuracy: 0.6687
Epoch 148/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5649 -
binary_accuracy: 0.6952 - val_loss: 0.6001 - val_binary_accuracy: 0.6718
Epoch 149/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5690 -
binary_accuracy: 0.7021 - val_loss: 0.5993 - val_binary_accuracy: 0.6710
Epoch 150/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5658 -
binary_accuracy: 0.6990 - val_loss: 0.5989 - val_binary_accuracy: 0.6689
Epoch 151/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5681 -
binary_accuracy: 0.6965 - val_loss: 0.5964 - val_binary_accuracy: 0.6646
Epoch 152/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5630 -
binary_accuracy: 0.7016 - val_loss: 0.5968 - val_binary_accuracy: 0.6745
Epoch 153/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5649 -
binary_accuracy: 0.7024 - val_loss: 0.5978 - val_binary_accuracy: 0.6692
Epoch 154/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5622 -
binary_accuracy: 0.7037 - val_loss: 0.5960 - val_binary_accuracy: 0.6727
Epoch 155/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5641 -
binary_accuracy: 0.6967 - val_loss: 0.5968 - val_binary_accuracy: 0.6747
Epoch 156/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5622 -
binary_accuracy: 0.7060 - val_loss: 0.5995 - val_binary_accuracy: 0.6723
Epoch 157/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5620 -
binary_accuracy: 0.6983 - val_loss: 0.5965 - val_binary_accuracy: 0.6706
Epoch 158/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5612 -
binary_accuracy: 0.6987 - val_loss: 0.6007 - val_binary_accuracy: 0.6677
Epoch 159/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5630 -
binary_accuracy: 0.7014 - val_loss: 0.5991 - val_binary_accuracy: 0.6687
Epoch 160/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5650 -
binary_accuracy: 0.6948 - val_loss: 0.5986 - val_binary_accuracy: 0.6679
Epoch 161/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5653 -
binary_accuracy: 0.6965 - val_loss: 0.5947 - val_binary_accuracy: 0.6700
Epoch 162/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5635 -
binary_accuracy: 0.6940 - val_loss: 0.5951 - val_binary_accuracy: 0.6739
Epoch 163/200
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44/44 [==============================] - 0s 2ms/step - loss: 0.5631 -
binary_accuracy: 0.6985 - val_loss: 0.5936 - val_binary_accuracy: 0.6727
Epoch 164/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5627 -
binary_accuracy: 0.7020 - val_loss: 0.5936 - val_binary_accuracy: 0.6710
Epoch 165/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5642 -
binary_accuracy: 0.6966 - val_loss: 0.5945 - val_binary_accuracy: 0.6687
Epoch 166/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5613 -
binary_accuracy: 0.6978 - val_loss: 0.5933 - val_binary_accuracy: 0.6692
Epoch 167/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5627 -
binary_accuracy: 0.6971 - val_loss: 0.5960 - val_binary_accuracy: 0.6685
Epoch 168/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5605 -
binary_accuracy: 0.7021 - val_loss: 0.5949 - val_binary_accuracy: 0.6669
Epoch 169/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5582 -
binary_accuracy: 0.7056 - val_loss: 0.5967 - val_binary_accuracy: 0.6733
Epoch 170/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5600 -
binary_accuracy: 0.7059 - val_loss: 0.5941 - val_binary_accuracy: 0.6692
Epoch 171/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5595 -
binary_accuracy: 0.6998 - val_loss: 0.5959 - val_binary_accuracy: 0.6737
Epoch 172/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5619 -
binary_accuracy: 0.7005 - val_loss: 0.5944 - val_binary_accuracy: 0.6752
Epoch 173/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5607 -
binary_accuracy: 0.7009 - val_loss: 0.5912 - val_binary_accuracy: 0.6741
Epoch 174/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5588 -
binary_accuracy: 0.7023 - val_loss: 0.5950 - val_binary_accuracy: 0.6754
Epoch 175/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5591 -
binary_accuracy: 0.7004 - val_loss: 0.5907 - val_binary_accuracy: 0.6752
Epoch 176/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5596 -
binary_accuracy: 0.7040 - val_loss: 0.5910 - val_binary_accuracy: 0.6756
Epoch 177/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5572 -
binary_accuracy: 0.7029 - val_loss: 0.5918 - val_binary_accuracy: 0.6752
Epoch 178/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5588 -
binary_accuracy: 0.7068 - val_loss: 0.5905 - val_binary_accuracy: 0.6725
Epoch 179/200
```

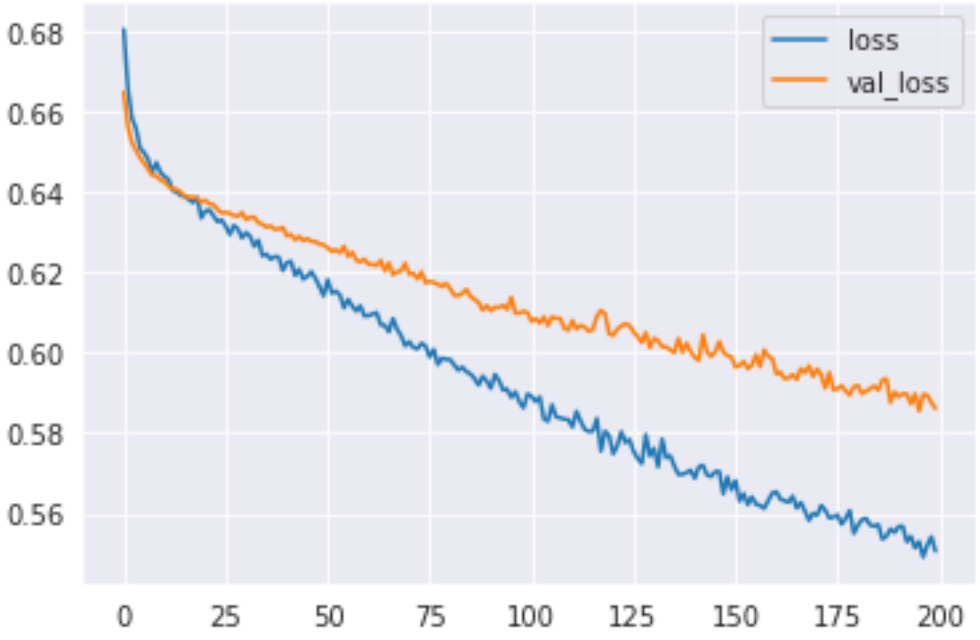
```
44/44 [==============================] - 0s 2ms/step - loss: 0.5606 -
binary_accuracy: 0.7013 - val_loss: 0.5895 - val_binary_accuracy: 0.6743
Epoch 180/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5550 -
binary_accuracy: 0.7068 - val_loss: 0.5915 - val_binary_accuracy: 0.6776
Epoch 181/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5570 -
binary_accuracy: 0.7037 - val_loss: 0.5918 - val_binary_accuracy: 0.6716
Epoch 182/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5584 -
binary_accuracy: 0.7025 - val_loss: 0.5898 - val_binary_accuracy: 0.6776
Epoch 183/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5587 -
binary_accuracy: 0.7013 - val_loss: 0.5904 - val_binary_accuracy: 0.6764
Epoch 184/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5571 -
binary_accuracy: 0.7046 - val_loss: 0.5910 - val_binary_accuracy: 0.6727
Epoch 185/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5568 -
binary_accuracy: 0.7044 - val_loss: 0.5916 - val_binary_accuracy: 0.6745
Epoch 186/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5572 -
binary_accuracy: 0.7047 - val_loss: 0.5906 - val_binary_accuracy: 0.6739
Epoch 187/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5536 -
binary_accuracy: 0.7057 - val_loss: 0.5932 - val_binary_accuracy: 0.6729
Epoch 188/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5543 -
binary_accuracy: 0.7041 - val_loss: 0.5934 - val_binary_accuracy: 0.6681
Epoch 189/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5561 -
binary_accuracy: 0.7022 - val_loss: 0.5876 - val_binary_accuracy: 0.6764
Epoch 190/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5552 -
binary_accuracy: 0.7053 - val_loss: 0.5902 - val_binary_accuracy: 0.6762
Epoch 191/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5567 -
binary_accuracy: 0.7105 - val_loss: 0.5890 - val_binary_accuracy: 0.6808
Epoch 192/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5567 -
binary_accuracy: 0.6992 - val_loss: 0.5897 - val_binary_accuracy: 0.6712
Epoch 193/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5529 -
binary_accuracy: 0.7100 - val_loss: 0.5896 - val_binary_accuracy: 0.6756
Epoch 194/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5542 -
binary_accuracy: 0.7042 - val_loss: 0.5872 - val_binary_accuracy: 0.6731
Epoch 195/200
```

```
44/44 [==============================] - 0s 2ms/step - loss: 0.5514 -
binary_accuracy: 0.7116 - val_loss: 0.5897 - val_binary_accuracy: 0.6747
Epoch 196/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5529 -
binary_accuracy: 0.7039 - val_loss: 0.5854 - val_binary_accuracy: 0.6741
Epoch 197/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5491 -
binary_accuracy: 0.7060 - val_loss: 0.5895 - val_binary_accuracy: 0.6785
Epoch 198/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5521 -
binary_accuracy: 0.7057 - val_loss: 0.5894 - val_binary_accuracy: 0.6785
Epoch 199/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5541 -
binary_accuracy: 0.7068 - val_loss: 0.5876 - val_binary_accuracy: 0.6772
Epoch 200/200
44/44 [==============================] - 0s 2ms/step - loss: 0.5506 -
binary_accuracy: 0.7089 - val_loss: 0.5861 - val_binary_accuracy: 0.6799
```

[45]: <keras.src.callbacks.History at 0x7fef47d28ac0>

[46]:
```
#Added dropout layouts to reduce overfitting issue
pd.DataFrame(model_new.history.history)[['loss','val_loss']].plot()
```

[46]: <AxesSubplot: >



[55]:
```
predictions_new = (model.predict(X_test) >= 0.2).astype('int')

print(
        confusion_matrix(y_test,predictions_new),
        '\n',
        classification_report(y_test,predictions_new)
)
```

```
151/151 [==============================] - 0s 564us/step
[[ 671 1766]
 [  69 2321]]
              precision    recall  f1-score   support

           0       0.91      0.28      0.42      2437
           1       0.57      0.97      0.72      2390

    accuracy                           0.62      4827
   macro avg       0.74      0.62      0.57      4827
weighted avg       0.74      0.62      0.57      4827
```

[57]:
```
dump(scaler, open('scaler.pkl', 'wb'))
model.save('model_lending_club.h5')
```

[58]:
```
later_scaler = load(open('scaler.pkl', 'rb'))
later_model = load_model('model_lending_club.h5')
```

[59]:
```
X_OOT = to_pred.drop('not.fully.paid', axis=1).values
to_pred.drop('not.fully.paid', axis=1).values

print(X_OOT.shape)
```

```
(0, 15)
```

[ ]:
```

```