

Self learning Practice Labs Self learning lending club... - JupyterLab

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lending club.ipynb

### Lending Club Loan Data Analysis

Create a model that predicts whether or not a loan will be default using the historical data.

```
[1]: # import necessary Librarys
```

```
[2]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
print("All library imported")

All library imported
```

```
[3]: # Load the dataset
df = pd.read_csv("loan_data.csv")
```

```
[4]: df.head()
```

	credit.policy	purpose	int.rate	installment	log.annual.inc	dti	fico	days.with.cc.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

```
[5]: df.shape
```

```
[5]: (9578, 14)
```

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```
[5]: df.shape
```

```
[5]: (9578, 14)
```

```
[6]: df.describe()
```

	credit.policy	int.rate	installment	log.annual.inc	dti	fico	days.with.cc.line	revol.bal	revol.util	inq.last.6mths	delinq.2yrs	pub.rec
count	9578.000000	9578.000000	9578.000000	9578.000000	9578.000000	9578.000000	9578.000000	9.578000e+03	9578.000000	9578.000000	9578.000000	9578.000000
mean	0.804970	0.122640	319.089413	10.932117	12.606679	710.846314	4560.767197	1.691396e+04	46.799236	1.577469	0.163708	0.062122
std	0.396245	0.026847	207.071301	0.614813	6.883970	37.970537	2496.930377	3.375619e+04	29.014417	2.200245	0.546215	0.262126
min	0.000000	0.060000	15.670000	7.547502	0.000000	612.000000	178.958333	0.000000e+00	0.000000	0.000000	0.000000	0.000000
25%	1.000000	0.103900	163.770000	10.558414	7.212500	682.000000	2820.000000	3.187000e+03	22.600000	0.000000	0.000000	0.000000
50%	1.000000	0.122100	268.950000	10.928884	12.665000	707.000000	4139.958333	8.596000e+03	46.300000	1.000000	0.000000	0.000000
75%	1.000000	0.140700	432.762500	11.291293	17.950000	737.000000	5730.000000	1.824950e+04	70.900000	2.000000	0.000000	0.000000
max	1.000000	0.216400	940.140000	14.528354	29.960000	827.000000	17639.958330	1.207359e+06	119.000000	33.000000	13.000000	5.000000

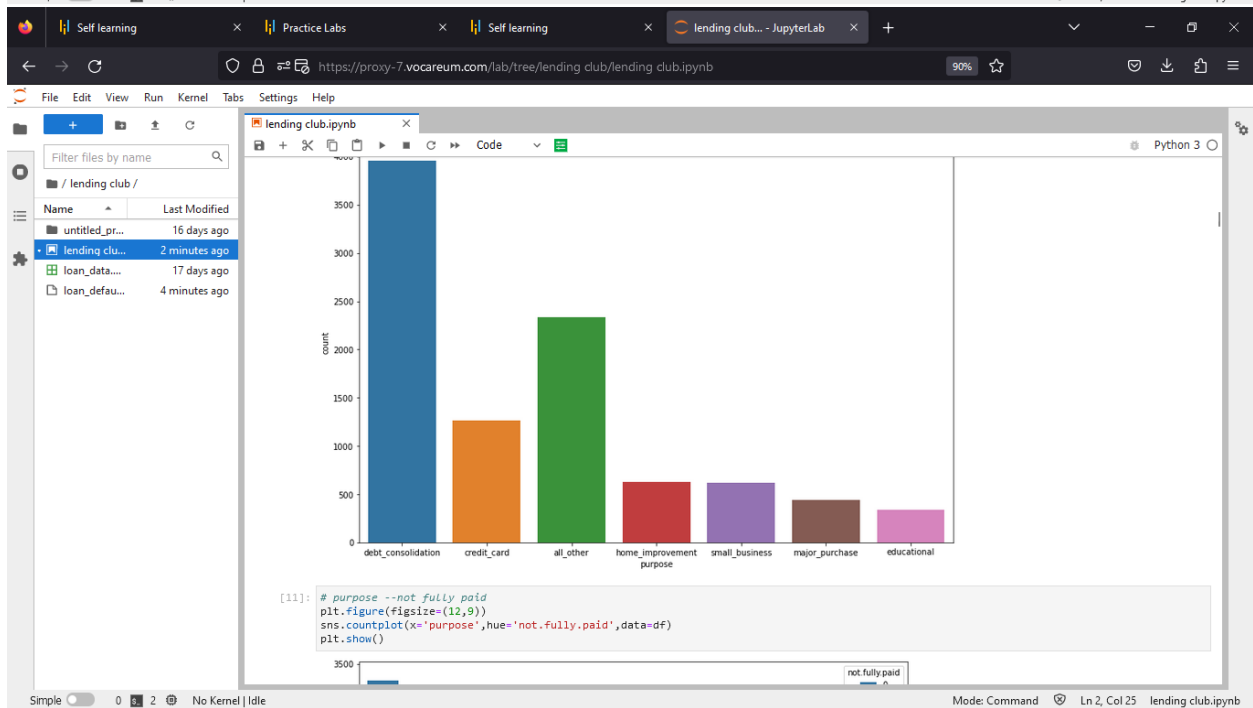
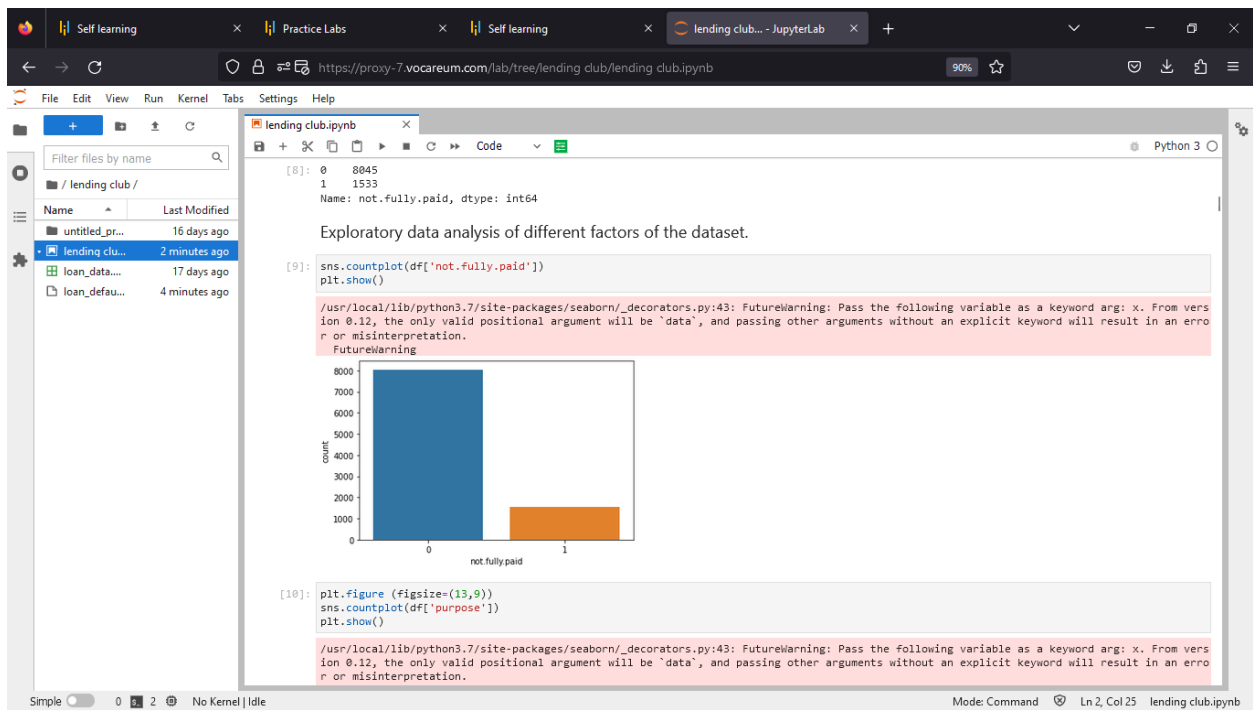
```
[7]: #missing values
df.isna().sum().any()
```

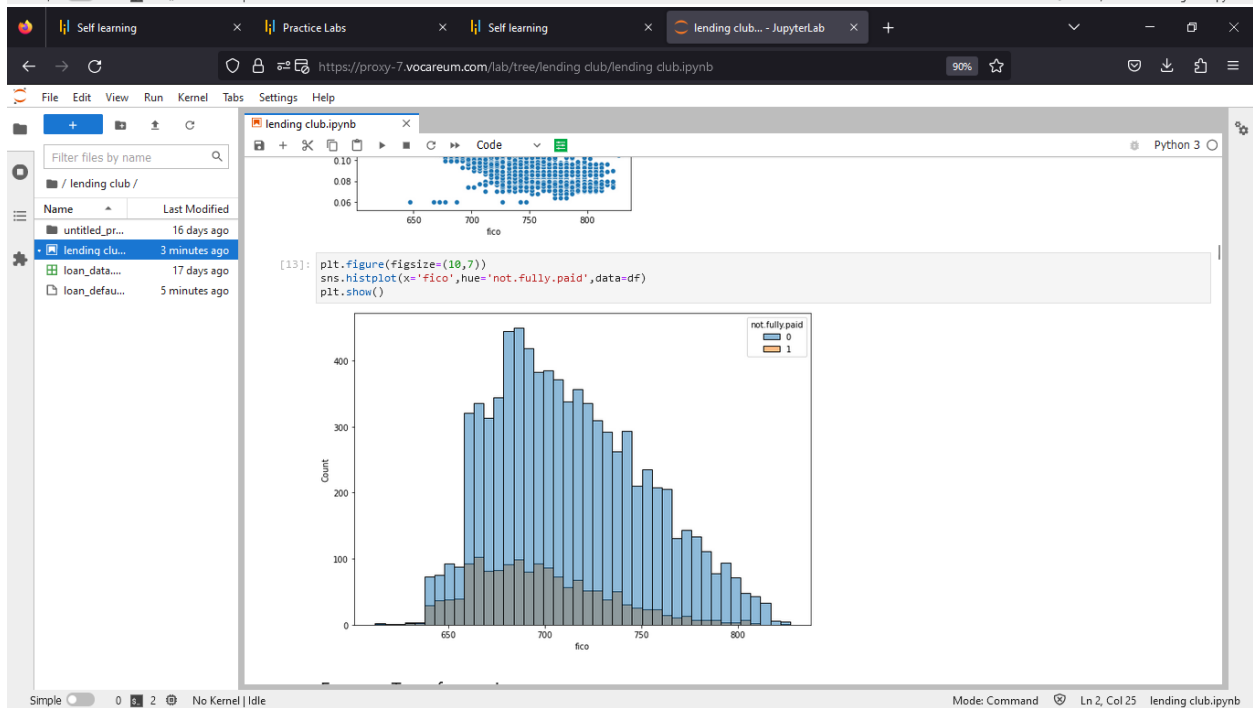
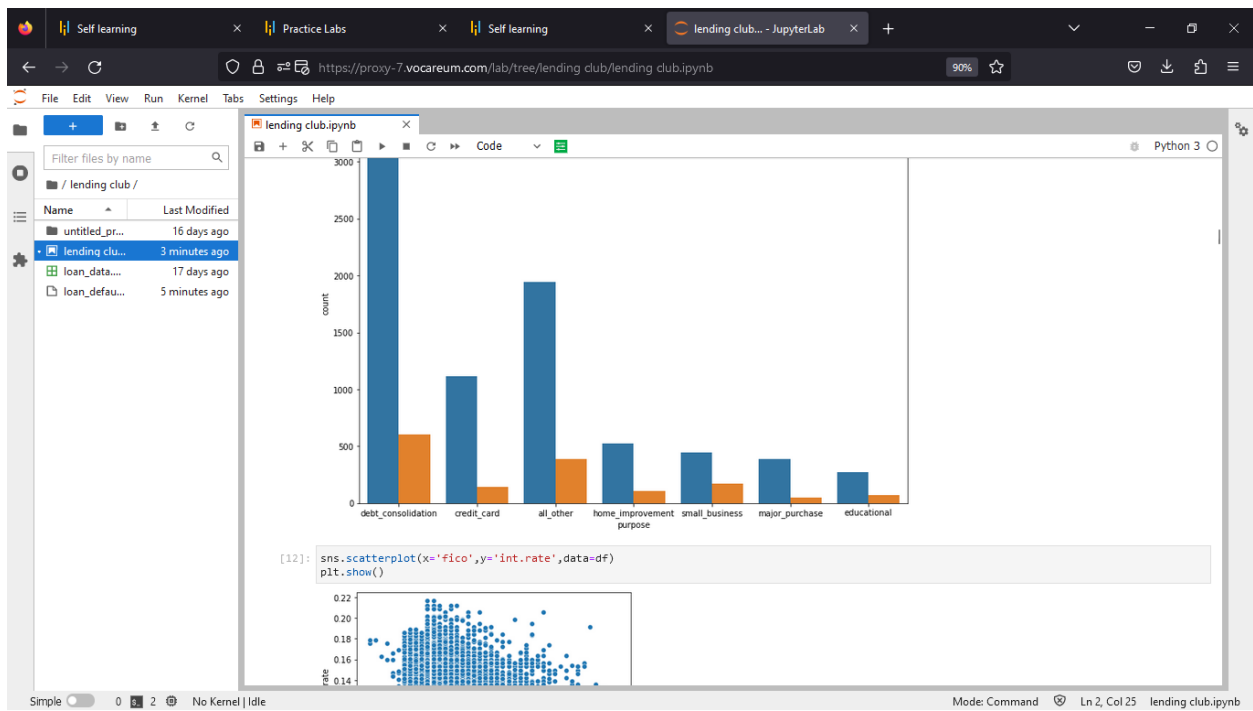
```
[7]: False
```

```
[8]: df['not.fully.paid'].value_counts()
# 0- means fully paid , 1-means not paid
# my observation is imbalance data
```

```
[8]: 0    8045
1    1533
Name: not.fully.paid, dtype: int64
```

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### Feature Transformation

Transform categorical values into numerical values (discrete)

```
[14]: df['not_fully_paid'].value_counts()
[14]: 0    8045
      1    1533
      Name: not_fully_paid, dtype: int64

[15]: not_fully_paid_0=df[df['not_fully_paid']==0]
      not_fully_paid_1=df[df['not_fully_paid']==1]

[16]: # resample
      from sklearn.utils import resample
      df_minor_upsample=resample(not_fully_paid_1,replace=True,n_samples=8045)

[17]: new_df=pd.concat([not_fully_paid_0,df_minor_upsample])

[18]: # shuffle
      from sklearn.utils import shuffle
      new_df=shuffle(new_df)

[19]: new_df['not_fully_paid'].value_counts()
[19]: 1    8045
      0    8045
      Name: not_fully_paid, dtype: int64

[20]: new_df.shape
```

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lending club.ipynb

```
[21]: new_df.dtypes
[21]: credit.policy    int64
      purpose      object
      int.rate     float64
      installment  float64
      log.annual.inc float64
      dti          float64
      fico         int64
      days.with.cr.line float64
      revol.bal    int64
      revol.util   float64
      inq.last.6mths int64
      delinq.2yrs  int64
      pub.rec      int64
      not_fully_paid int64
      dtype: object

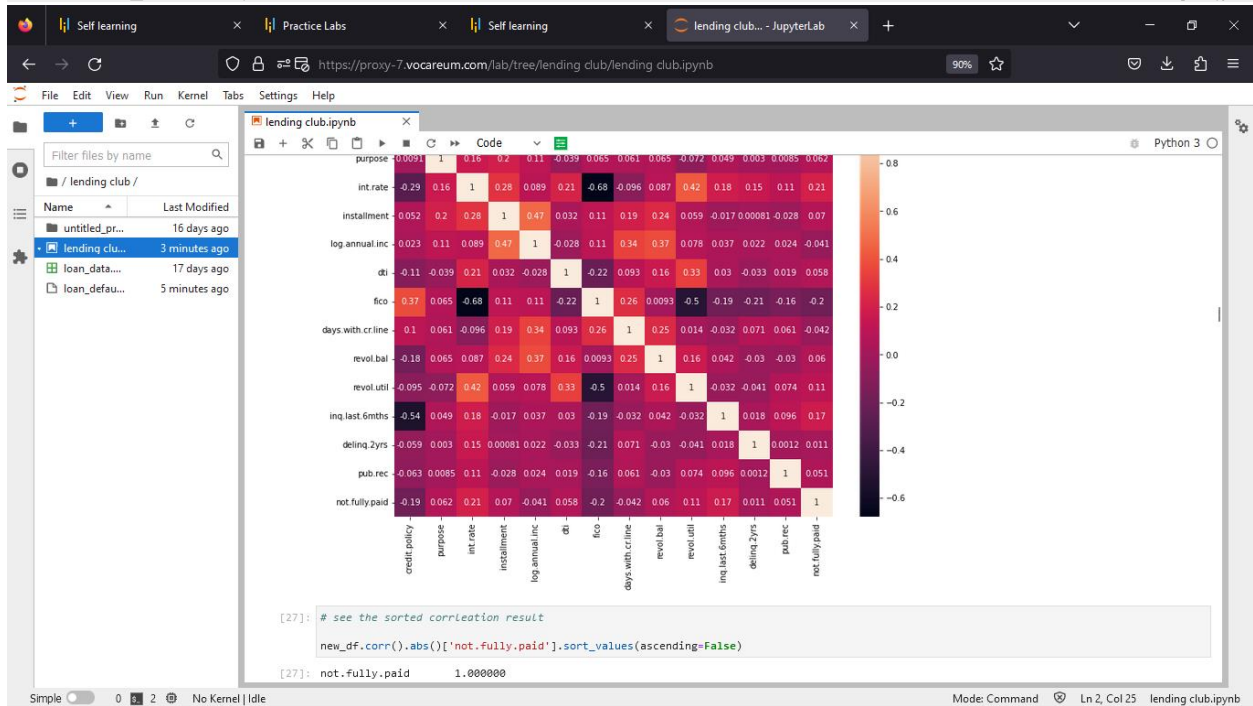
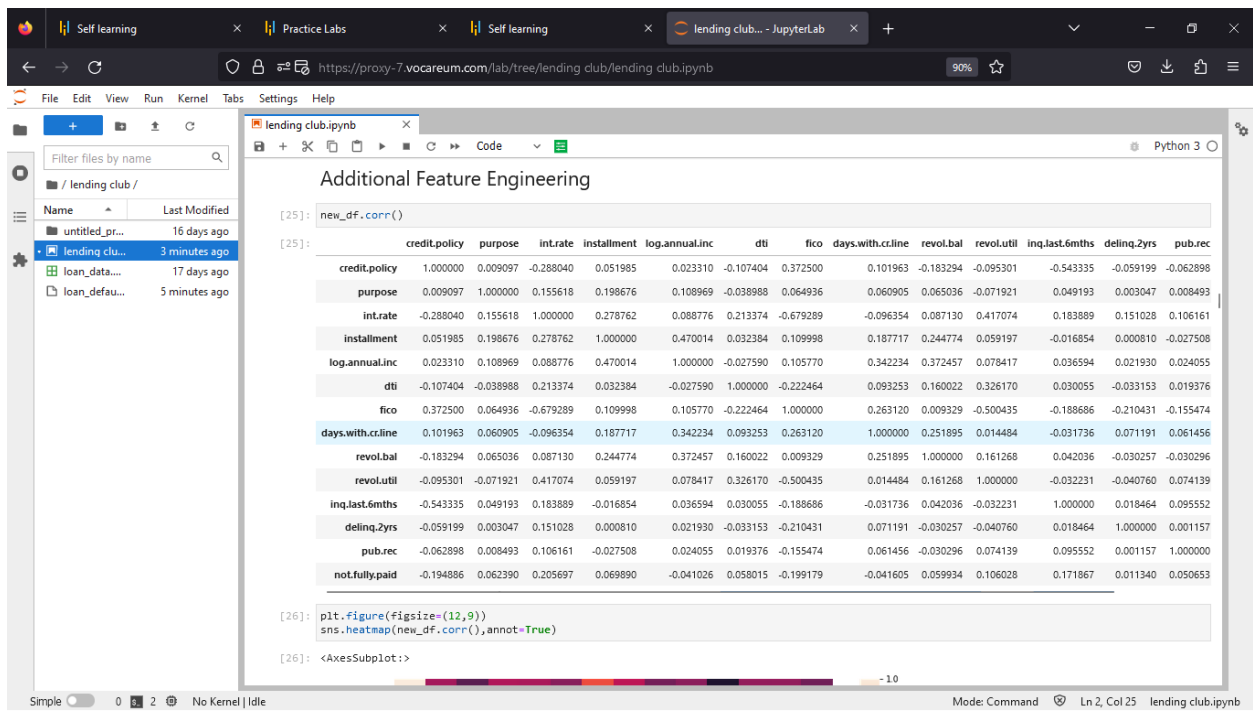
[22]: # convert purpose into numerical data
      from sklearn.preprocessing import LabelEncoder
      le =LabelEncoder()

[23]: for i in new_df.columns:
      if new_df[i].dtypes=='object':
          new_df[i]=le.fit_transform(new_df[i])

[24]: new_df.head()
[24]:
```

	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
8782	0	0	0.1412	119.83	10.714418	10.19	657	3210.000000	9771	86.4	4	0	0	0
3492	1	2	0.1221	666.30	11.184421	14.63	727	4320.000000	28585	60.8	0	0	0	1
3821	1	0	0.1095	163.57	11.603680	15.75	717	4680.000000	34267	67.5	2	0	0	0
8257	0	2	0.1103	818.83	12.323856	12.66	712	4409.000000	242194	56.0	0	0	0	1

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untitled\_pr... 16 days ago  
lending club... 3 minutes ago  
loan\_data... 17 days ago  
loan\_defau... 5 minutes ago

```
credit.policy 0.194000  
inq.last.6mths 0.171867  
revol.util 0.106028  
installment 0.069890  
purpose 0.062390  
revol.bal 0.059934  
dti 0.058015  
pub.rec 0.050653  
days.with.cr.line 0.041605  
log.annual.inc 0.041026  
delinq.2yrs 0.011340  
Name: not.fully.paid, dtype: float64
```

```
[28]: # take columns with respect to correlation  
X=new_df[['credit.policy', 'purpose', 'int.rate', 'installment', 'fico', 'revol.bal', 'revol.util', 'inq.last.6mths', 'pub.rec']]
```

```
[29]: y=new_df['not.fully.paid']
```

```
[30]: # create a train test split  
from sklearn.model_selection import train_test_split
```

```
[31]: X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=.2,random_state=42)
```

```
[32]: # Apply scaling  
from sklearn.preprocessing import StandardScaler  
sc=StandardScaler()
```

```
[33]: X_train=sc.fit_transform(X_train)  
X_test=sc.transform(X_test)
```

```
[34]: X_train.shape
```

```
[35]: X_test.shape
```

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untitled\_pr... 16 days ago  
lending club... 3 minutes ago  
loan\_data... 17 days ago  
loan\_defau... 5 minutes ago

### Create a deep learning keras with tensorflow

```
[36]: from tensorflow.keras.models import Sequential  
from tensorflow.keras.layers import Dense,Dropout  
from tensorflow.keras.callbacks import EarlyStopping
```

```
[37]: # create the architecture  
model=Sequential()  
model.add(Dense(19,activation='relu',input_shape=[9]))  
model.add(Dropout(0.20))  
  
model.add(Dense(10,activation='relu'))  
model.add(Dropout(0.20))  
  
# output layer  
model.add(Dense(1,activation='sigmoid'))
```

```
[38]: model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
dense (Dense)	(None, 19)	190
dropout (Dropout)	(None, 19)	0
dense_1 (Dense)	(None, 10)	200
dropout_1 (Dropout)	(None, 10)	0
dense_2 (Dense)	(None, 1)	11

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lending club.ipynb

Non-trainable params: 0

```
[39]: #compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])

[40]: early_stop = EarlyStopping(monitor='val_loss', min_delta=0.001, mode='min', patience=10, verbose=1)

[41]: history=model.fit(X_train,y_train,
                      epochs=50,
                      batch_size=256,
                      validation_data=(X_test,y_test),
                      callbacks=[early_stop])
```

Epoch 1/50  
51/51 [=====] - 1s 4ms/step - loss: 0.7168 - accuracy: 0.5332 - val\_loss: 0.6653 - val\_accuracy: 0.5914  
Epoch 2/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6817 - accuracy: 0.5761 - val\_loss: 0.6578 - val\_accuracy: 0.6022  
Epoch 3/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6785 - accuracy: 0.5754 - val\_loss: 0.6554 - val\_accuracy: 0.6109  
Epoch 4/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6678 - accuracy: 0.5851 - val\_loss: 0.6536 - val\_accuracy: 0.6085  
Epoch 5/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6684 - accuracy: 0.5852 - val\_loss: 0.6529 - val\_accuracy: 0.6085  
Epoch 6/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6633 - accuracy: 0.5938 - val\_loss: 0.6519 - val\_accuracy: 0.6122  
Epoch 7/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6619 - accuracy: 0.5958 - val\_loss: 0.6511 - val\_accuracy: 0.6103  
Epoch 8/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6607 - accuracy: 0.5954 - val\_loss: 0.6510 - val\_accuracy: 0.6088  
Epoch 9/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6585 - accuracy: 0.5959 - val\_loss: 0.6503 - val\_accuracy: 0.6081  
Epoch 10/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6562 - accuracy: 0.6045 - val\_loss: 0.6496 - val\_accuracy: 0.6094  
Epoch 11/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6567 - accuracy: 0.6052 - val\_loss: 0.6491 - val\_accuracy: 0.6112  
Epoch 12/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6566 - accuracy: 0.6047 - val\_loss: 0.6487 - val\_accuracy: 0.6134

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```
Epoch 14/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6543 - accuracy: 0.6057 - val_loss: 0.6480 - val_accuracy: 0.6112  
Epoch 15/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6572 - accuracy: 0.6060 - val_loss: 0.6481 - val_accuracy: 0.6137  
Epoch 16/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6526 - accuracy: 0.6096 - val_loss: 0.6473 - val_accuracy: 0.6109  
Epoch 17/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6528 - accuracy: 0.6103 - val_loss: 0.6471 - val_accuracy: 0.6181  
Epoch 18/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6558 - accuracy: 0.6067 - val_loss: 0.6469 - val_accuracy: 0.6147  
Epoch 19/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6530 - accuracy: 0.6098 - val_loss: 0.6466 - val_accuracy: 0.6122  
Epoch 20/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6519 - accuracy: 0.6106 - val_loss: 0.6459 - val_accuracy: 0.6140  
Epoch 21/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6511 - accuracy: 0.6116 - val_loss: 0.6459 - val_accuracy: 0.6156  
Epoch 22/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6539 - accuracy: 0.6132 - val_loss: 0.6457 - val_accuracy: 0.6168  
Epoch 23/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6514 - accuracy: 0.6135 - val_loss: 0.6452 - val_accuracy: 0.6134  
Epoch 24/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6497 - accuracy: 0.6161 - val_loss: 0.6452 - val_accuracy: 0.6137  
Epoch 25/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6504 - accuracy: 0.6148 - val_loss: 0.6451 - val_accuracy: 0.6140  
Epoch 26/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6508 - accuracy: 0.6112 - val_loss: 0.6447 - val_accuracy: 0.6153  
Epoch 27/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6524 - accuracy: 0.6119 - val_loss: 0.6446 - val_accuracy: 0.6150  
Epoch 28/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6510 - accuracy: 0.6141 - val_loss: 0.6443 - val_accuracy: 0.6144  
Epoch 29/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6496 - accuracy: 0.6140 - val_loss: 0.6443 - val_accuracy: 0.6168  
Epoch 30/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6499 - accuracy: 0.6154 - val_loss: 0.6441 - val_accuracy: 0.6168  
Epoch 31/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6487 - accuracy: 0.6119 - val_loss: 0.6442 - val_accuracy: 0.6153  
Epoch 32/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6504 - accuracy: 0.6127 - val_loss: 0.6439 - val_accuracy: 0.6181
```

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Python 3

Epoch 31/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6487 - accuracy: 0.6119 - val\_loss: 0.6442 - val\_accuracy: 0.6153  
Epoch 32/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6504 - accuracy: 0.6127 - val\_loss: 0.6439 - val\_accuracy: 0.6181  
Epoch 33/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6503 - accuracy: 0.6081 - val\_loss: 0.6438 - val\_accuracy: 0.6178  
Epoch 34/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6494 - accuracy: 0.6125 - val\_loss: 0.6434 - val\_accuracy: 0.6144  
Epoch 35/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6490 - accuracy: 0.6169 - val\_loss: 0.6434 - val\_accuracy: 0.6178  
Epoch 36/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6491 - accuracy: 0.6152 - val\_loss: 0.6435 - val\_accuracy: 0.6147  
Epoch 37/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6475 - accuracy: 0.6120 - val\_loss: 0.6427 - val\_accuracy: 0.6200  
Epoch 38/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6497 - accuracy: 0.6176 - val\_loss: 0.6434 - val\_accuracy: 0.6172  
Epoch 39/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6483 - accuracy: 0.6154 - val\_loss: 0.6432 - val\_accuracy: 0.6203  
Epoch 40/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6497 - accuracy: 0.6171 - val\_loss: 0.6430 - val\_accuracy: 0.6172  
Epoch 41/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6484 - accuracy: 0.6146 - val\_loss: 0.6428 - val\_accuracy: 0.6187  
Epoch 42/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6470 - accuracy: 0.6193 - val\_loss: 0.6429 - val\_accuracy: 0.6159  
Epoch 43/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6488 - accuracy: 0.6137 - val\_loss: 0.6430 - val\_accuracy: 0.6165  
Epoch 44/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6487 - accuracy: 0.6123 - val\_loss: 0.6430 - val\_accuracy: 0.6187  
Epoch 44: early stopping

[42]: history  
<keras.callbacks.History at 0x7f419e248710>

[43]: history=model.fit(X\_train,y\_train,  
epochs=50,  
batch\_size=256,

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Python 3

Epoch 44/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6487 - accuracy: 0.6123 - val\_loss: 0.6430 - val\_accuracy: 0.6187  
Epoch 44: early stopping

[42]: history  
<keras.callbacks.History at 0x7f419e248710>

[43]: history=model.fit(X\_train,y\_train,  
epochs=50,  
batch\_size=256,  
validation\_data=(X\_test,y\_test))

Epoch 1/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6479 - accuracy: 0.6149 - val\_loss: 0.6425 - val\_accuracy: 0.6196  
Epoch 2/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6475 - accuracy: 0.6179 - val\_loss: 0.6425 - val\_accuracy: 0.6184  
Epoch 3/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6477 - accuracy: 0.6127 - val\_loss: 0.6430 - val\_accuracy: 0.6181  
Epoch 4/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6445 - accuracy: 0.6202 - val\_loss: 0.6423 - val\_accuracy: 0.6193  
Epoch 5/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6487 - accuracy: 0.6133 - val\_loss: 0.6430 - val\_accuracy: 0.6193  
Epoch 6/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6461 - accuracy: 0.6187 - val\_loss: 0.6426 - val\_accuracy: 0.6147  
Epoch 7/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6468 - accuracy: 0.6161 - val\_loss: 0.6422 - val\_accuracy: 0.6165  
Epoch 8/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6464 - accuracy: 0.6185 - val\_loss: 0.6419 - val\_accuracy: 0.6218  
Epoch 9/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6482 - accuracy: 0.6173 - val\_loss: 0.6421 - val\_accuracy: 0.6237  
Epoch 10/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6462 - accuracy: 0.6210 - val\_loss: 0.6419 - val\_accuracy: 0.6206  
Epoch 11/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6468 - accuracy: 0.6172 - val\_loss: 0.6417 - val\_accuracy: 0.6203  
Epoch 12/50  
51/51 [=====] - 0s 2ms/step - loss: 0.6472 - accuracy: 0.6182 - val\_loss: 0.6422 - val\_accuracy: 0.6178  
Epoch 13/50



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lending club.ipynb

```
51/51 [=====] - 0s 2ms/step - loss: 0.6468 - accuracy: 0.6172 - val_loss: 0.6417 - val_accuracy: 0.6203
Epoch 12/50
51/51 [=====] - 0s 2ms/step - loss: 0.6472 - accuracy: 0.6182 - val_loss: 0.6422 - val_accuracy: 0.6178
Epoch 13/50
51/51 [=====] - 0s 2ms/step - loss: 0.6479 - accuracy: 0.6177 - val_loss: 0.6417 - val_accuracy: 0.6162
Epoch 14/50
51/51 [=====] - 0s 2ms/step - loss: 0.6473 - accuracy: 0.6184 - val_loss: 0.6417 - val_accuracy: 0.6218
Epoch 15/50
51/51 [=====] - 0s 2ms/step - loss: 0.6446 - accuracy: 0.6220 - val_loss: 0.6413 - val_accuracy: 0.6215
Epoch 16/50
51/51 [=====] - 0s 2ms/step - loss: 0.6447 - accuracy: 0.6220 - val_loss: 0.6412 - val_accuracy: 0.6262
Epoch 17/50
51/51 [=====] - 0s 2ms/step - loss: 0.6457 - accuracy: 0.6155 - val_loss: 0.6411 - val_accuracy: 0.6271
Epoch 18/50
51/51 [=====] - 0s 2ms/step - loss: 0.6472 - accuracy: 0.6198 - val_loss: 0.6421 - val_accuracy: 0.6209
Epoch 19/50
51/51 [=====] - 0s 2ms/step - loss: 0.6446 - accuracy: 0.6193 - val_loss: 0.6416 - val_accuracy: 0.6234
Epoch 20/50
51/51 [=====] - 0s 2ms/step - loss: 0.6451 - accuracy: 0.6223 - val_loss: 0.6416 - val_accuracy: 0.6243
Epoch 21/50
51/51 [=====] - 0s 2ms/step - loss: 0.6469 - accuracy: 0.6171 - val_loss: 0.6417 - val_accuracy: 0.6246
Epoch 22/50
51/51 [=====] - 0s 2ms/step - loss: 0.6463 - accuracy: 0.6186 - val_loss: 0.6416 - val_accuracy: 0.6209
Epoch 23/50
51/51 [=====] - 0s 2ms/step - loss: 0.6443 - accuracy: 0.6195 - val_loss: 0.6411 - val_accuracy: 0.6215
Epoch 24/50
51/51 [=====] - 0s 2ms/step - loss: 0.6455 - accuracy: 0.6193 - val_loss: 0.6409 - val_accuracy: 0.6190
Epoch 25/50
51/51 [=====] - 0s 2ms/step - loss: 0.6452 - accuracy: 0.6196 - val_loss: 0.6414 - val_accuracy: 0.6224
Epoch 26/50
51/51 [=====] - 0s 2ms/step - loss: 0.6444 - accuracy: 0.6229 - val_loss: 0.6410 - val_accuracy: 0.6227
Epoch 27/50
51/51 [=====] - 0s 2ms/step - loss: 0.6453 - accuracy: 0.6223 - val_loss: 0.6409 - val_accuracy: 0.6231
Epoch 28/50
51/51 [=====] - 0s 2ms/step - loss: 0.6446 - accuracy: 0.6225 - val_loss: 0.6404 - val_accuracy: 0.6252
Epoch 29/50
51/51 [=====] - 0s 2ms/step - loss: 0.6448 - accuracy: 0.6209 - val_loss: 0.6403 - val_accuracy: 0.6231
Epoch 30/50
```

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lending club.ipynb

```
Epoch 30/50
51/51 [=====] - 0s 2ms/step - loss: 0.6446 - accuracy: 0.6225 - val_loss: 0.6404 - val_accuracy: 0.6252
Epoch 29/50
51/51 [=====] - 0s 2ms/step - loss: 0.6448 - accuracy: 0.6209 - val_loss: 0.6403 - val_accuracy: 0.6231
Epoch 30/50
51/51 [=====] - 0s 2ms/step - loss: 0.6439 - accuracy: 0.6211 - val_loss: 0.6407 - val_accuracy: 0.6200
Epoch 31/50
51/51 [=====] - 0s 2ms/step - loss: 0.6445 - accuracy: 0.6273 - val_loss: 0.6403 - val_accuracy: 0.6227
Epoch 32/50
51/51 [=====] - 0s 2ms/step - loss: 0.6456 - accuracy: 0.6241 - val_loss: 0.6403 - val_accuracy: 0.6215
Epoch 33/50
51/51 [=====] - 0s 2ms/step - loss: 0.6438 - accuracy: 0.6219 - val_loss: 0.6401 - val_accuracy: 0.6212
Epoch 34/50
51/51 [=====] - 0s 2ms/step - loss: 0.6450 - accuracy: 0.6210 - val_loss: 0.6396 - val_accuracy: 0.6187
Epoch 35/50
51/51 [=====] - 0s 2ms/step - loss: 0.6444 - accuracy: 0.6211 - val_loss: 0.6403 - val_accuracy: 0.6240
Epoch 36/50
51/51 [=====] - 0s 2ms/step - loss: 0.6432 - accuracy: 0.6255 - val_loss: 0.6399 - val_accuracy: 0.6203
Epoch 37/50
51/51 [=====] - 0s 2ms/step - loss: 0.6422 - accuracy: 0.6262 - val_loss: 0.6397 - val_accuracy: 0.6243
Epoch 38/50
51/51 [=====] - 0s 2ms/step - loss: 0.6440 - accuracy: 0.6261 - val_loss: 0.6397 - val_accuracy: 0.6231
Epoch 39/50
51/51 [=====] - 0s 2ms/step - loss: 0.6433 - accuracy: 0.6228 - val_loss: 0.6397 - val_accuracy: 0.6215
Epoch 40/50
51/51 [=====] - 0s 2ms/step - loss: 0.6430 - accuracy: 0.6261 - val_loss: 0.6397 - val_accuracy: 0.6224
Epoch 41/50
51/51 [=====] - 0s 2ms/step - loss: 0.6431 - accuracy: 0.6196 - val_loss: 0.6393 - val_accuracy: 0.6196
Epoch 42/50
51/51 [=====] - 0s 2ms/step - loss: 0.6434 - accuracy: 0.6258 - val_loss: 0.6397 - val_accuracy: 0.6240
Epoch 43/50
51/51 [=====] - 0s 2ms/step - loss: 0.6449 - accuracy: 0.6234 - val_loss: 0.6398 - val_accuracy: 0.6255
Epoch 44/50
51/51 [=====] - 0s 2ms/step - loss: 0.6436 - accuracy: 0.6231 - val_loss: 0.6398 - val_accuracy: 0.6227
Epoch 45/50
51/51 [=====] - 0s 2ms/step - loss: 0.6431 - accuracy: 0.6248 - val_loss: 0.6395 - val_accuracy: 0.6240
Epoch 46/50
51/51 [=====] - 0s 2ms/step - loss: 0.6437 - accuracy: 0.6217 - val_loss: 0.6396 - val_accuracy: 0.6209
Epoch 47/50
```

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lending club.ipynb

```
51/51 [=====] - 0s 2ms/step - loss: 0.6434 - accuracy: 0.6250 - val_loss: 0.6397 - val_accuracy: 0.6240
Epoch 43/50
51/51 [=====] - 0s 2ms/step - loss: 0.6449 - accuracy: 0.6234 - val_loss: 0.6398 - val_accuracy: 0.6255
Epoch 44/50
51/51 [=====] - 0s 2ms/step - loss: 0.6436 - accuracy: 0.6231 - val_loss: 0.6398 - val_accuracy: 0.6227
Epoch 45/50
51/51 [=====] - 0s 2ms/step - loss: 0.6431 - accuracy: 0.6248 - val_loss: 0.6395 - val_accuracy: 0.6240
Epoch 46/50
51/51 [=====] - 0s 2ms/step - loss: 0.6437 - accuracy: 0.6217 - val_loss: 0.6396 - val_accuracy: 0.6209
Epoch 47/50
51/51 [=====] - 0s 2ms/step - loss: 0.6429 - accuracy: 0.6228 - val_loss: 0.6394 - val_accuracy: 0.6221
Epoch 48/50
51/51 [=====] - 0s 2ms/step - loss: 0.6420 - accuracy: 0.6228 - val_loss: 0.6388 - val_accuracy: 0.6255
Epoch 49/50
51/51 [=====] - 0s 2ms/step - loss: 0.6449 - accuracy: 0.6210 - val_loss: 0.6402 - val_accuracy: 0.6190
Epoch 50/50
51/51 [=====] - 0s 2ms/step - loss: 0.6422 - accuracy: 0.6200 - val_loss: 0.6394 - val_accuracy: 0.6215

[44]: model.evaluate(X_test,y_test)
101/101 [=====] - 0s 828us/step - loss: 0.6394 - accuracy: 0.6215
[44]: [0.6394385695457458, 0.6215040683746338]

[45]: y_pred=model.predict(X_test)

[46]: y_pred

[46]: array([[0.49597514],
          [0.6811866 ],
          [0.36741394],
          ...,
          [0.4140299 ],
          [0.6708174 ],
          [0.6873083 ]], dtype=float32)

[47]: predictions=(y_pred>0.5).astype('int')
```

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```
[0.6873083 ]], dtype=float32)

[47]: predictions=(y_pred>0.5).astype('int')

[48]: predictions

[48]: array([[0],
          [1],
          [0],
          ...,
          [0],
          [1],
          [1]])

[49]: y_test

[49]: 201 1
5025 1
4066 1
8642 0
7866 1
..
8580 1
9340 1
6737 0
9071 1
9021 1
Name: not.fully.paid, Length: 3218, dtype: int64

[50]: from sklearn.metrics import accuracy_score,confusion_matrix,classification_report
accuracy_score(predictions,y_test)

[50]: 0.6215040397762586

[51]: print(classification_report(predictions,y_test))
```

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lending club.ipynb

```
[50]: 0.6215040397762586
```

```
[51]: print(classification_report(predictions,y_test))
```

	precision	recall	f1-score	support
0	0.64	0.62	0.63	1659
1	0.61	0.63	0.62	1559
accuracy			0.62	3218
macro avg	0.62	0.62	0.62	3218
weighted avg	0.62	0.62	0.62	3218

```
[52]: model.save('loan_default1.h5')
```

```
[53]: # batch Normalization
from tensorflow.keras.layers import BatchNormalization
```

```
[54]: # create the architecture model2
# First ANN Layer
model1=Sequential()
model1.add(Dense(128,activation='relu',input_shape=(9)))
model1.add(BatchNormalization())
model1.add(Dropout(0.20))

# Second ANN Layer
model1.add(Dense(64,activation='tanh'))
model1.add(BatchNormalization())
model1.add(Dropout(0.20))

# third ANN Layer
model1.add(Dense(32,activation='relu'))
model1.add(BatchNormalization())
model1.add(Dropout(0.20))
```

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lending club.ipynb

```
# third ANN Layer
model1.add(Dense(32,activation='relu'))
model1.add(BatchNormalization())
model1.add(Dropout(0.20))

# output Layer
model1.add(Dense(1,activation='sigmoid'))
```

```
[55]: model1.summary()
```

```
Model: "sequential_1"
```

Layer (type)	Output Shape	Param #
dense_3 (Dense)	(None, 128)	1280
batch_normalization (Batch Normalization)	(None, 128)	512
dropout_2 (Dropout)	(None, 128)	0
dense_4 (Dense)	(None, 64)	8256
batch_normalization_1 (Batch Normalization)	(None, 64)	256
dropout_3 (Dropout)	(None, 64)	0
dense_5 (Dense)	(None, 32)	2080
batch_normalization_2 (Batch Normalization)	(None, 32)	128
dropout_4 (Dropout)	(None, 32)	0
dense_6 (Dense)	(None, 1)	33

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```
dropout_4 (Dropout) (None, 32)
dense_6 (Dense) (None, 1) 33

Total params: 12,545
Trainable params: 12,097
Non-trainable params: 448
```

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

[57]: `history=model.fit(X_train,y_train, epochs=100, batch_size=256, validation_data=(X_test,y_test))`

Epoch 1/100  
51/51 [=====] - 1s 10ms/step - loss: 0.7692 - accuracy: 0.5635 - val\_loss: 0.6613 - val\_accuracy: 0.5970  
Epoch 2/100  
51/51 [=====] - 0s 4ms/step - loss: 0.7133 - accuracy: 0.5794 - val\_loss: 0.6523 - val\_accuracy: 0.6106  
Epoch 3/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6928 - accuracy: 0.5883 - val\_loss: 0.6472 - val\_accuracy: 0.6134  
Epoch 4/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6764 - accuracy: 0.5999 - val\_loss: 0.6439 - val\_accuracy: 0.6165  
Epoch 5/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6672 - accuracy: 0.6015 - val\_loss: 0.6395 - val\_accuracy: 0.6212  
Epoch 6/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6646 - accuracy: 0.6071 - val\_loss: 0.6388 - val\_accuracy: 0.6271  
Epoch 7/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6594 - accuracy: 0.6101 - val\_loss: 0.6368 - val\_accuracy: 0.6249  
Epoch 8/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6602 - accuracy: 0.6078 - val\_loss: 0.6357 - val\_accuracy: 0.6342  
Epoch 9/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6498 - accuracy: 0.6178 - val\_loss: 0.6348 - val\_accuracy: 0.6374  
Epoch 10/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6501 - accuracy: 0.6193 - val\_loss: 0.6342 - val\_accuracy: 0.6349

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lending club.ipynb

```
51/51 [=====] - 0s 4ms/step - loss: 0.6457 - accuracy: 0.6200 - val_loss: 0.6332 - val_accuracy: 0.6377  
Epoch 13/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6421 - accuracy: 0.6269 - val_loss: 0.6324 - val_accuracy: 0.6417  
Epoch 14/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6430 - accuracy: 0.6276 - val_loss: 0.6322 - val_accuracy: 0.6417  
Epoch 15/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6398 - accuracy: 0.6304 - val_loss: 0.6318 - val_accuracy: 0.6401  
Epoch 16/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6413 - accuracy: 0.6318 - val_loss: 0.6312 - val_accuracy: 0.6485  
Epoch 17/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6397 - accuracy: 0.6314 - val_loss: 0.6288 - val_accuracy: 0.6445  
Epoch 18/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6378 - accuracy: 0.6312 - val_loss: 0.6298 - val_accuracy: 0.6411  
Epoch 19/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6384 - accuracy: 0.6338 - val_loss: 0.6307 - val_accuracy: 0.6489  
Epoch 20/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6366 - accuracy: 0.6302 - val_loss: 0.6304 - val_accuracy: 0.6445  
Epoch 21/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6355 - accuracy: 0.6370 - val_loss: 0.6281 - val_accuracy: 0.6523  
Epoch 22/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6342 - accuracy: 0.6372 - val_loss: 0.6282 - val_accuracy: 0.6479  
Epoch 23/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6342 - accuracy: 0.6329 - val_loss: 0.6287 - val_accuracy: 0.6448  
Epoch 24/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6323 - accuracy: 0.6388 - val_loss: 0.6281 - val_accuracy: 0.6510  
Epoch 25/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6335 - accuracy: 0.6397 - val_loss: 0.6274 - val_accuracy: 0.6510  
Epoch 26/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6316 - accuracy: 0.6380 - val_loss: 0.6252 - val_accuracy: 0.6504  
Epoch 27/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6328 - accuracy: 0.6410 - val_loss: 0.6245 - val_accuracy: 0.6554  
Epoch 28/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6268 - accuracy: 0.6448 - val_loss: 0.6263 - val_accuracy: 0.6520  
Epoch 29/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6292 - accuracy: 0.6416 - val_loss: 0.6240 - val_accuracy: 0.6510  
Epoch 30/100  
51/51 [=====] - 0s 4ms/step - loss: 0.6258 - accuracy: 0.6445 - val_loss: 0.6232 - val_accuracy: 0.6607  
Epoch 31/100
```

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```
51/51 [=====] - 0s 4ms/step - loss: 0.6267 - accuracy: 0.6471 - val_loss: 0.6215 - val_accuracy: 0.6613
Epoch 33/100
51/51 [=====] - 0s 4ms/step - loss: 0.6257 - accuracy: 0.6471 - val_loss: 0.6212 - val_accuracy: 0.6563
Epoch 34/100
51/51 [=====] - 0s 4ms/step - loss: 0.6237 - accuracy: 0.6536 - val_loss: 0.6216 - val_accuracy: 0.6566
Epoch 35/100
51/51 [=====] - 0s 4ms/step - loss: 0.6228 - accuracy: 0.6493 - val_loss: 0.6193 - val_accuracy: 0.6579
Epoch 36/100
51/51 [=====] - 0s 4ms/step - loss: 0.6221 - accuracy: 0.6493 - val_loss: 0.6176 - val_accuracy: 0.6591
Epoch 37/100
51/51 [=====] - 0s 4ms/step - loss: 0.6221 - accuracy: 0.6529 - val_loss: 0.6177 - val_accuracy: 0.6591
Epoch 38/100
51/51 [=====] - 0s 4ms/step - loss: 0.6207 - accuracy: 0.6545 - val_loss: 0.6188 - val_accuracy: 0.6576
Epoch 39/100
51/51 [=====] - 0s 4ms/step - loss: 0.6209 - accuracy: 0.6509 - val_loss: 0.6166 - val_accuracy: 0.6563
Epoch 40/100
51/51 [=====] - 0s 4ms/step - loss: 0.6175 - accuracy: 0.6565 - val_loss: 0.6146 - val_accuracy: 0.6628
Epoch 41/100
51/51 [=====] - 0s 5ms/step - loss: 0.6179 - accuracy: 0.6514 - val_loss: 0.6129 - val_accuracy: 0.6669
Epoch 42/100
51/51 [=====] - 0s 4ms/step - loss: 0.6195 - accuracy: 0.6586 - val_loss: 0.6130 - val_accuracy: 0.6684
Epoch 43/100
51/51 [=====] - 0s 4ms/step - loss: 0.6153 - accuracy: 0.6576 - val_loss: 0.6157 - val_accuracy: 0.6678
Epoch 44/100
51/51 [=====] - 0s 4ms/step - loss: 0.6160 - accuracy: 0.6579 - val_loss: 0.6118 - val_accuracy: 0.6728
Epoch 45/100
51/51 [=====] - 0s 4ms/step - loss: 0.6140 - accuracy: 0.6639 - val_loss: 0.6106 - val_accuracy: 0.6718
Epoch 46/100
51/51 [=====] - 0s 4ms/step - loss: 0.6155 - accuracy: 0.6567 - val_loss: 0.6099 - val_accuracy: 0.6681
Epoch 47/100
51/51 [=====] - 0s 4ms/step - loss: 0.6089 - accuracy: 0.6636 - val_loss: 0.6078 - val_accuracy: 0.6737
Epoch 48/100
51/51 [=====] - 0s 4ms/step - loss: 0.6095 - accuracy: 0.6693 - val_loss: 0.6083 - val_accuracy: 0.6750
Epoch 49/100
51/51 [=====] - 0s 4ms/step - loss: 0.6107 - accuracy: 0.6632 - val_loss: 0.6067 - val_accuracy: 0.6706
Epoch 50/100
51/51 [=====] - 0s 4ms/step - loss: 0.6093 - accuracy: 0.6633 - val_loss: 0.6050 - val_accuracy: 0.6743
Epoch 51/100
```

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lending club.ipynb

```
51/51 [=====] - 0s 4ms/step - loss: 0.6088 - accuracy: 0.6665 - val_loss: 0.6056 - val_accuracy: 0.6746
Epoch 53/100
51/51 [=====] - 0s 4ms/step - loss: 0.6110 - accuracy: 0.6627 - val_loss: 0.6020 - val_accuracy: 0.6762
Epoch 54/100
51/51 [=====] - 0s 4ms/step - loss: 0.6068 - accuracy: 0.6648 - val_loss: 0.6005 - val_accuracy: 0.6750
Epoch 55/100
51/51 [=====] - 0s 4ms/step - loss: 0.6056 - accuracy: 0.6730 - val_loss: 0.6002 - val_accuracy: 0.6796
Epoch 56/100
51/51 [=====] - 0s 4ms/step - loss: 0.6060 - accuracy: 0.6648 - val_loss: 0.5983 - val_accuracy: 0.6818
Epoch 57/100
51/51 [=====] - 0s 4ms/step - loss: 0.6019 - accuracy: 0.6738 - val_loss: 0.5963 - val_accuracy: 0.6833
Epoch 58/100
51/51 [=====] - 0s 4ms/step - loss: 0.6023 - accuracy: 0.6735 - val_loss: 0.5938 - val_accuracy: 0.6917
Epoch 59/100
51/51 [=====] - 0s 4ms/step - loss: 0.6019 - accuracy: 0.6702 - val_loss: 0.5955 - val_accuracy: 0.6892
Epoch 60/100
51/51 [=====] - 0s 4ms/step - loss: 0.6024 - accuracy: 0.6696 - val_loss: 0.5947 - val_accuracy: 0.6852
Epoch 61/100
51/51 [=====] - 0s 4ms/step - loss: 0.5980 - accuracy: 0.6805 - val_loss: 0.5928 - val_accuracy: 0.6830
Epoch 62/100
51/51 [=====] - 0s 4ms/step - loss: 0.5997 - accuracy: 0.6733 - val_loss: 0.5924 - val_accuracy: 0.6914
Epoch 63/100
51/51 [=====] - 0s 4ms/step - loss: 0.5973 - accuracy: 0.6821 - val_loss: 0.5930 - val_accuracy: 0.6886
Epoch 64/100
51/51 [=====] - 0s 4ms/step - loss: 0.5970 - accuracy: 0.6757 - val_loss: 0.5887 - val_accuracy: 0.6855
Epoch 65/100
51/51 [=====] - 0s 4ms/step - loss: 0.5961 - accuracy: 0.6778 - val_loss: 0.5887 - val_accuracy: 0.6883
Epoch 66/100
51/51 [=====] - 0s 4ms/step - loss: 0.5941 - accuracy: 0.6778 - val_loss: 0.5897 - val_accuracy: 0.6930
Epoch 67/100
51/51 [=====] - 0s 4ms/step - loss: 0.5950 - accuracy: 0.6753 - val_loss: 0.5870 - val_accuracy: 0.6942
Epoch 68/100
51/51 [=====] - 0s 4ms/step - loss: 0.5942 - accuracy: 0.6789 - val_loss: 0.5879 - val_accuracy: 0.6917
Epoch 69/100
51/51 [=====] - 0s 4ms/step - loss: 0.5943 - accuracy: 0.6750 - val_loss: 0.5865 - val_accuracy: 0.6933
Epoch 70/100
51/51 [=====] - 0s 4ms/step - loss: 0.5942 - accuracy: 0.6815 - val_loss: 0.5859 - val_accuracy: 0.6942
Epoch 71/100
```

Simple 0 2 No Kernel | Idle Mode: Edit Ln 1, Col 28 lending club.ipynb

Self learning Practice Labs Self learning lending club... - JupyterLab

https://proxy-7.vocareum.com/lab/tree/lending club/lending club.ipynb

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lending club.ipynb

```
51/51 [=====] - 0s 4ms/step - loss: 0.5891 - accuracy: 0.6816 - val_loss: 0.5829 - val_accuracy: 0.6976
Epoch 73/100
51/51 [=====] - 0s 4ms/step - loss: 0.5885 - accuracy: 0.6869 - val_loss: 0.5809 - val_accuracy: 0.7035
Epoch 74/100
51/51 [=====] - 0s 4ms/step - loss: 0.5883 - accuracy: 0.6853 - val_loss: 0.5806 - val_accuracy: 0.6992
Epoch 75/100
51/51 [=====] - 0s 4ms/step - loss: 0.5866 - accuracy: 0.6855 - val_loss: 0.5801 - val_accuracy: 0.6933
Epoch 76/100
51/51 [=====] - 0s 4ms/step - loss: 0.5874 - accuracy: 0.6862 - val_loss: 0.5800 - val_accuracy: 0.6973
Epoch 77/100
51/51 [=====] - 0s 4ms/step - loss: 0.5847 - accuracy: 0.6862 - val_loss: 0.5797 - val_accuracy: 0.6958
Epoch 78/100
51/51 [=====] - 0s 4ms/step - loss: 0.5872 - accuracy: 0.6855 - val_loss: 0.5784 - val_accuracy: 0.6995
Epoch 79/100
51/51 [=====] - 0s 4ms/step - loss: 0.5855 - accuracy: 0.6868 - val_loss: 0.5780 - val_accuracy: 0.6939
Epoch 80/100
51/51 [=====] - 0s 4ms/step - loss: 0.5817 - accuracy: 0.6919 - val_loss: 0.5750 - val_accuracy: 0.6998
Epoch 81/100
51/51 [=====] - 0s 4ms/step - loss: 0.5819 - accuracy: 0.6899 - val_loss: 0.5756 - val_accuracy: 0.6992
Epoch 82/100
51/51 [=====] - 0s 4ms/step - loss: 0.5804 - accuracy: 0.6913 - val_loss: 0.5752 - val_accuracy: 0.7054
Epoch 83/100
51/51 [=====] - 0s 4ms/step - loss: 0.5784 - accuracy: 0.6927 - val_loss: 0.5720 - val_accuracy: 0.7119
Epoch 84/100
51/51 [=====] - 0s 4ms/step - loss: 0.5838 - accuracy: 0.6843 - val_loss: 0.5740 - val_accuracy: 0.7039
Epoch 85/100
51/51 [=====] - 0s 4ms/step - loss: 0.5770 - accuracy: 0.6916 - val_loss: 0.5718 - val_accuracy: 0.7091
Epoch 86/100
51/51 [=====] - 0s 4ms/step - loss: 0.5788 - accuracy: 0.6936 - val_loss: 0.5720 - val_accuracy: 0.7098
Epoch 87/100
51/51 [=====] - 0s 4ms/step - loss: 0.5777 - accuracy: 0.6923 - val_loss: 0.5729 - val_accuracy: 0.7042
Epoch 88/100
51/51 [=====] - 0s 4ms/step - loss: 0.5808 - accuracy: 0.6896 - val_loss: 0.5733 - val_accuracy: 0.7048
Epoch 89/100
51/51 [=====] - 0s 4ms/step - loss: 0.5755 - accuracy: 0.6966 - val_loss: 0.5690 - val_accuracy: 0.7054
Epoch 90/100
51/51 [=====] - 0s 4ms/step - loss: 0.5752 - accuracy: 0.6919 - val_loss: 0.5671 - val_accuracy: 0.7060
```

Simple 0 2 No Kernel Idle Mode: Edit Ln 1, Col 28 lending club.ipynb

Self learning Practice Labs Self learning lending club... - JupyterLab

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lending club.ipynb

```
51/51 [=====] - 0s 4ms/step - loss: 0.5755 - accuracy: 0.6966 - val_loss: 0.5690 - val_accuracy: 0.7054
Epoch 90/100
51/51 [=====] - 0s 4ms/step - loss: 0.5752 - accuracy: 0.6919 - val_loss: 0.5671 - val_accuracy: 0.7060
Epoch 91/100
51/51 [=====] - 0s 4ms/step - loss: 0.5719 - accuracy: 0.6985 - val_loss: 0.5683 - val_accuracy: 0.7070
Epoch 92/100
51/51 [=====] - 0s 4ms/step - loss: 0.5731 - accuracy: 0.6990 - val_loss: 0.5667 - val_accuracy: 0.7107
Epoch 93/100
51/51 [=====] - 0s 4ms/step - loss: 0.5733 - accuracy: 0.6983 - val_loss: 0.5653 - val_accuracy: 0.7147
Epoch 94/100
51/51 [=====] - 0s 4ms/step - loss: 0.5711 - accuracy: 0.7011 - val_loss: 0.5650 - val_accuracy: 0.7213
Epoch 95/100
51/51 [=====] - 0s 4ms/step - loss: 0.5755 - accuracy: 0.6982 - val_loss: 0.5649 - val_accuracy: 0.7144
Epoch 96/100
51/51 [=====] - 0s 4ms/step - loss: 0.5718 - accuracy: 0.6960 - val_loss: 0.5640 - val_accuracy: 0.7091
Epoch 97/100
51/51 [=====] - 0s 4ms/step - loss: 0.5715 - accuracy: 0.6990 - val_loss: 0.5633 - val_accuracy: 0.7119
Epoch 98/100
51/51 [=====] - 0s 4ms/step - loss: 0.5738 - accuracy: 0.6980 - val_loss: 0.5637 - val_accuracy: 0.7116
Epoch 99/100
51/51 [=====] - 0s 4ms/step - loss: 0.5652 - accuracy: 0.6978 - val_loss: 0.5585 - val_accuracy: 0.7116
Epoch 100/100
51/51 [=====] - 0s 4ms/step - loss: 0.5690 - accuracy: 0.6980 - val_loss: 0.5569 - val_accuracy: 0.7172

[58]: model.evaluate(X_test,y_test)
101/101 [=====] - 0s 941us/step - loss: 0.5569 - accuracy: 0.7172
[58]: [0.5568888187408447, 0.7172156572341919]

[59]: model.evaluate(X_train,y_train)
403/403 [=====] - 0s 936us/step - loss: 0.4978 - accuracy: 0.7685
[59]: [0.4978392720222473, 0.7684897184371948]
```

Hyperparameter tuning in keras

Simple 0 2 No Kernel Idle Mode: Edit Ln 1, Col 28 lending club.ipynb

Self learning Practice Labs Self learning lending club... - JupyterLab

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lending.club.ipynb

Python 3

```
Requirement already satisfied: packaging in /usr/local/lib/python3.7/site-packages (from keras-tuner) (21.0)
Requirement already satisfied: requests in /usr/local/lib/python3.7/site-packages (from keras-tuner) (2.23.0)
Requirement already satisfied: prompt-toolkit!=3.0.0,!=3.0.1,<3.1.0,>=2.0.0 in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (3.0.5)
Requirement already satisfied: traitlets>=4.2 in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (5.1.1)
Requirement already satisfied: setuptools>=18.5 in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (41.2.0)
Requirement already satisfied: jedi>=0.10 in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (0.16.0)
Requirement already satisfied: backcall in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (0.1.0)
Requirement already satisfied: pickleshare in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (0.7.5)
Requirement already satisfied: pexpect in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (4.8.0)
Requirement already satisfied: pygments in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (2.6.1)
Requirement already satisfied: decorator in /usr/local/lib/python3.7/site-packages (from ipython->keras-tuner) (4.4.2)
Requirement already satisfied: pyparsing>=2.0.2 in /usr/local/lib/python3.7/site-packages (from packaging->keras-tuner) (2.4.6)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/python3.7/site-packages (from requests->keras-tuner) (1.25.8)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/site-packages (from requests->keras-tuner) (2.9)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/site-packages (from requests->keras-tuner) (3.0.4)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/site-packages (from requests->keras-tuner) (2019.11.28)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (0.4.1)
Requirement already satisfied: protobuf>=3.6.0 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (3.20.1)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (1.13.1)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (3.2.1)
Requirement already satisfied: wheel>=0.26 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (0.34.2)
Requirement already satisfied: werkzeug>=0.11.15 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (1.0.1)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (1.6.0.post2)
Requirement already satisfied: grpcio>=1.24.3 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (1.27.2)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (0.6.1)
Requirement already satisfied: absl-py>=0.4 in /usr/local/lib/python3.7/site-packages (from tensorboard->keras-tuner) (0.9.0)
Requirement already satisfied: six in /usr/local/lib/python3.7/site-packages (from absl-py>=0.4->tensorboard->keras-tuner) (1.14.0)
Requirement already satisfied: cachetools<5.0,>=2.0.0 in /usr/local/lib/python3.7/site-packages (from google-auth<3,>=1.6.3->tensorboard->keras-tuner) (4.0.0)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.7/site-packages (from google-auth<3,>=1.6.3->tensorboard->keras-tuner) (0.2.8)
Requirement already satisfied: rsa<4.1,>=3.1.4 in /usr/local/lib/python3.7/site-packages (from google-auth<3,>=1.6.3->tensorboard->keras-tuner) (4.0)
```

Simple 0 2 No Kernel Idle Mode: Edit Ln 1, Col 28 lending.club.ipynb

Self learning Practice Labs Self learning lending club... - JupyterLab

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lending.club.ipynb

Python 3

```
Requirement already satisfied: wcwidth in /usr/local/lib/python3.7/site-packages (from prompt-toolkit!=3.0.0,!=3.0.1,<3.1.0,>=2.0.0->ipython->keras-tuner) (0.1.9)
Requirement already satisfied: ptyprocess>=0.5 in /usr/local/lib/python3.7/site-packages (from pexpect->ipython->keras-tuner) (0.6.0)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /usr/local/lib/python3.7/site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard->keras-tuner) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard->keras-tuner) (3.1.0)
WARNING: You are using pip version 22.0.3; however, version 23.0.1 is available.
You should consider upgrading via the '/usr/local/bin/python3 -m pip install --upgrade pip' command.

[61]: import keras_tuner
import tensorflow

[62]: def build_model(hp):
    model=Sequential()

    # first hidden layer
    model.add(Dense(units=hp.Int('units',min_value=32,max_value=1024,step=16),
        activation=hp.Choice('activation',['relu','tanh']),input_shape=[9]))

    model.add(BatchNormalization())
    model.add(Dropout(hp.Float('rate',min_value=0.1,max_value=0.5,step=0.1)))

    # Second hidden Layer
    model.add(Dense(units=hp.Int('units',min_value=32,max_value=1024,step=16),
        activation=hp.Choice('activation',['relu','tanh'])))

    model.add(BatchNormalization())
    model.add(Dropout(hp.Float('rate',min_value=0.1,max_value=0.5,step=0.1)))

    # third hidden Layer
    model.add(Dense(units=hp.Int('units',min_value=32,max_value=1024,step=16),
        activation=hp.Choice('activation',['relu','tanh'])))

    model.add(BatchNormalization())
```

Simple 0 2 No Kernel Idle Mode: Edit Ln 1, Col 28 lending.club.ipynb

Self learning x Practice Labs x Self learning x lending club... - JupyterLab

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lending club /

untitled\_pr... 16 days ago

lending club... 6 minutes ago

loan\_data... 17 days ago

loan\_defau... 8 minutes ago

```

learning_rate=hp.Float('learning_rate',min_value=0.001,max_value=0.1,step=0.01)

model.compile(loss='binary_crossentropy',
              optimizer=tensorflow.keras.optimizers.Adam(learning_rate),
              metrics=['accuracy'])

return model

[63]: import keras_tuner as kt

[64]: build_model(kt.HyperParameters())

[64]: <keras.engine.sequential.Sequential at 0x7f41645b3d0>

[65]: rtuner=kt.RandomSearch(hypermodel=build_model,
                          objective='val_accuracy',
                          max_trials=10
                          )

INFO:tensorflow:Reloading Oracle from existing project ./untitled_project/oracle.json
INFO:tensorflow:Reloading Tuner from ./untitled_project/tuner0.json

[66]: rtuner.search(X_train,y_train,
                  epochs=50,validation_data=(X_test,y_test),
                  verbose=2)

INFO:tensorflow:Oracle triggered exit

[68]: models=rtuner.get_best_models()

[69]: len(models)

[69]: 1

[70]: models[0].summary()

Model: "sequential"

```

Simple 0 2 No Kernel Idle Mode: Edit Ln 1, Col 28 lending.club.ipynb

Self learning x Practice Labs x Self learning x lending club... - JupyterLab

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lending club /

untitled\_pr... 16 days ago

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loan\_defau... 8 minutes ago

```

[70]: models[0].summary()

Model: "sequential"

Layer (type)                Output Shape                Param #
-----
dense (Dense)                (None, 416)                 4160
batch_normalization (BatchN (None, 416)                 1664
ormalization)
dropout (Dropout)            (None, 416)                 0
dense_1 (Dense)              (None, 416)                 173472
batch_normalization_1 (Batc (None, 416)                 1664
hNormalization)
dropout_1 (Dropout)          (None, 416)                 0
dense_2 (Dense)              (None, 416)                 173472
batch_normalization_2 (Batc (None, 416)                 1664
hNormalization)
dropout_2 (Dropout)          (None, 416)                 0
dense_3 (Dense)              (None, 1)                   417

Total params: 356,513
Trainable params: 354,017
Non-trainable params: 2,496

[71]: y_pred=models[0].predict(X_test)>=0.5

```

Simple 0 2 No Kernel Idle Mode: Edit Ln 1, Col 28 lending.club.ipynb



Self learningPractice LabsSelf learninglending club... - JupyterLab

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lending club /

Name	Last Modified
untitled_pr...	16 days ago
lending clu...	7 minutes ago
loan_data...	17 days ago
loan_defau...	9 minutes ago

lending club.ipynb

Python 3

dense_2 (Dense)	(None, 416)	173472
batch_normalization_2 (Batch Normalization)	(None, 416)	1664
dropout_2 (Dropout)	(None, 416)	0
dense_3 (Dense)	(None, 1)	417

=====

Total params: 356,513

Trainable params: 354,017

Non-trainable params: 2,496

=====

[71]: y\_pred=models[0].predict(X\_test)>=0.5

[72]: from sklearn.metrics import accuracy\_score

accuracy\_score(y\_test,y\_pred)

[72]: 0.7992541951522685

[ ]:

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