Finding And Predicting who will Default OR Not

Necessary Imports

In [48]:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import numpy as np
```

Read Data

In [49]:

```
indataset = pd.read_csv('input.csv',header=None)
loan_dataset = pd.read_csv('loan_data.csv')
loan_dataset.head()
```

Out[49]:

	credit.policy	purpose	int.rate	installment	log.annual.inc	dti	fico	days.with.c
0	1	debt_consolidation	0.1189	829.10	11.350407	19.48	737	5639.95
1	1	credit_card	0.1071	228.22	11.082143	14.29	707	2760.00
2	1	debt_consolidation	0.1357	366.86	10.373491	11.63	682	4710.00
3	1	debt_consolidation	0.1008	162.34	11.350407	8.10	712	2699.95
4	1	credit_card	0.1426	102.92	11.299732	14.97	667	4066.00

In [50]:

```
loan_dataset.shape
```

Out[50]:

```
(9578, 14)
```

In [51]:

```
indataset.shape
```

Out[51]:

```
(9578, 18)
```

In [52]:

```
indataset.head()
```

Out[52]:

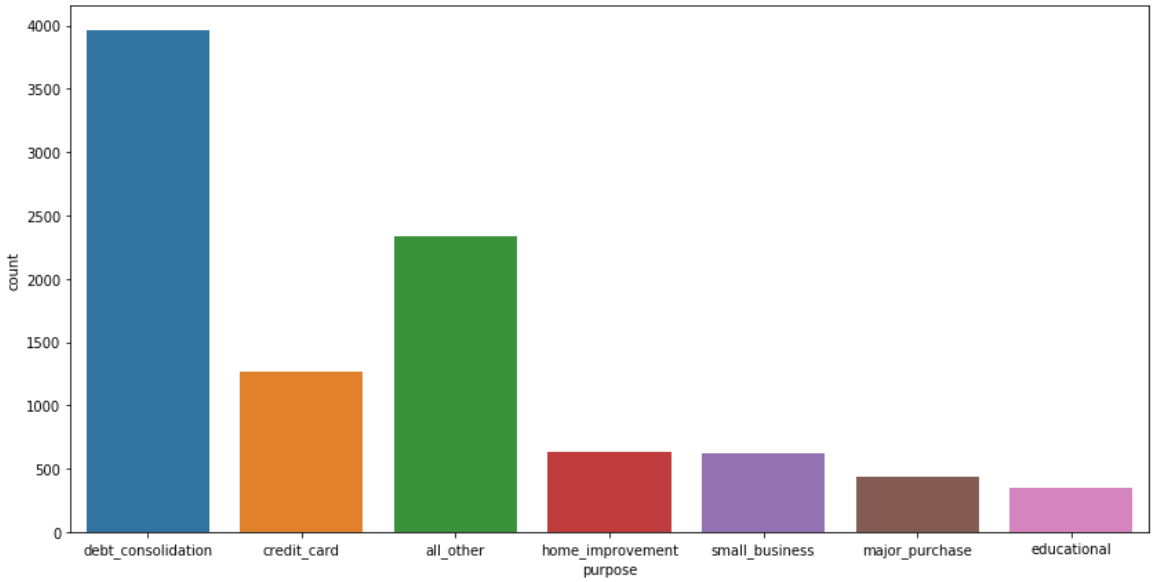
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	1	0.1189	829.10	11.350407	19.48	737	5639.958333	28854	52.1	0	0	0	0	0	1
1	1	0.1071	228.22	11.082143	14.29	707	2760.000000	33623	76.7	0	0	0	0	1	0
2	1	0.1357	366.86	10.373491	11.63	682	4710.000000	3511	25.6	1	0	0	0	0	1
3	1	0.1008	162.34	11.350407	8.10	712	2699.958333	33667	73.2	1	0	0	0	0	1
4	1	0.1426	102.92	11.299732	14.97	667	4066.000000	4740	39.5	0	1	0	0	1	0

In [53]:

```
plt.figure(figsize=(14,7))
sns.countplot(loan_dataset['purpose'])
```

Out[53]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1298eab10>
```



In [54]:

```
#Highest no of loans are in debt consolidation category
```

In [55]:

```
loan_dataset['delinq.2yrs'].value_counts()
```

Out[55]:

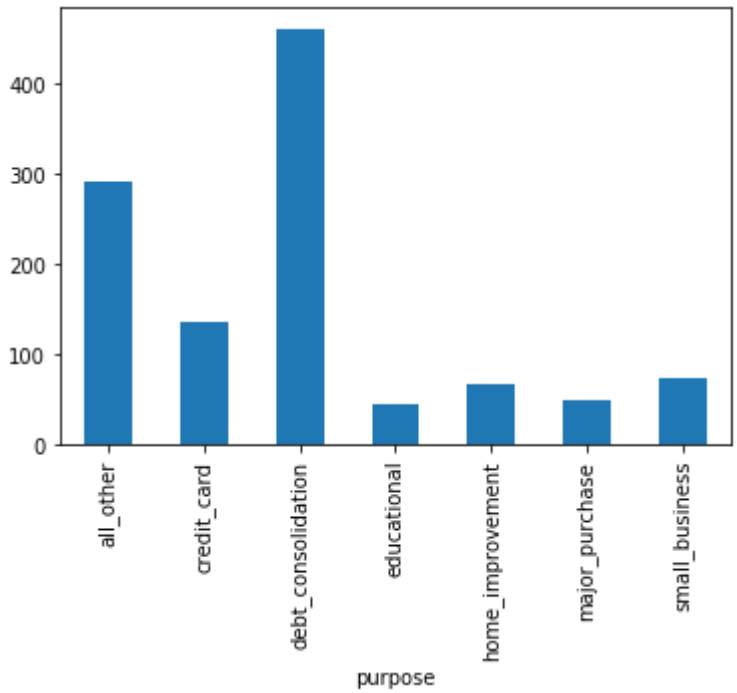
```
0     8458
1      832
2      192
3       65
4       19
5        6
6        2
7        1
13       1
11       1
8        1
Name: delinq.2yrs, dtype: int64
```

In [56]:

```
loan_dataset[loan_dataset['delinq.2yrs']!=0].groupby('purpose').fico.count().plo
t(kind='bar')
```

Out[56]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x145a41910>
```



In [57]:

```
#Three Categories have highest deliquencies - debt consolidation creadit_cards a
nd ,all_other
```

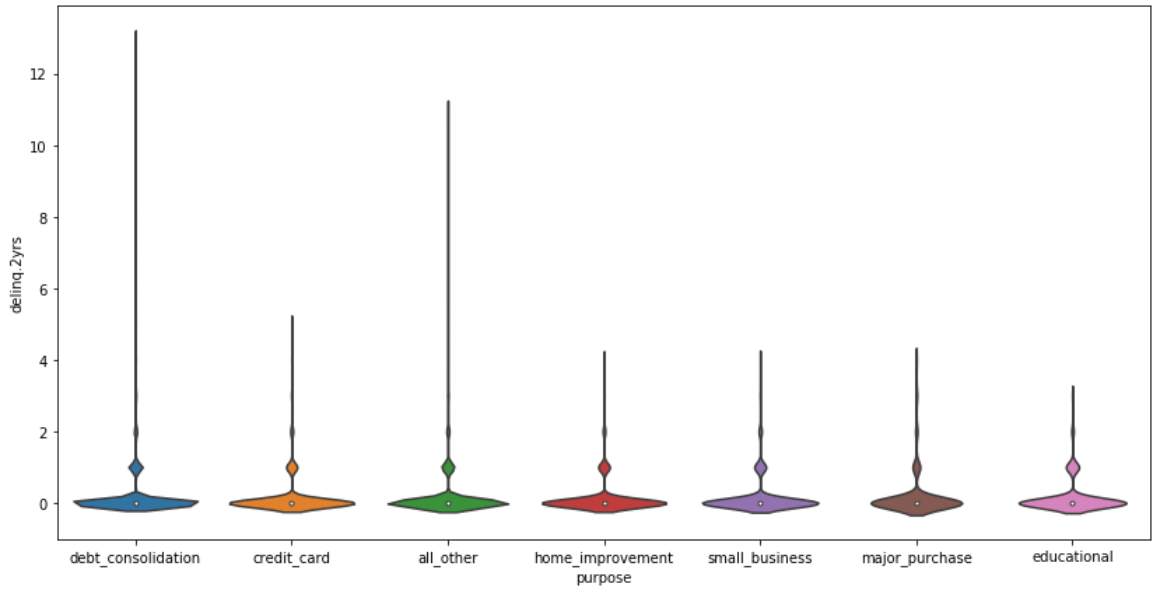
In [58]:

```
plt.figure(figsize=(14,7))

sns.violinplot(x='purpose',y='delinq.2yrs',data=loan_dataset)
```

Out[58]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x128f37690>
```

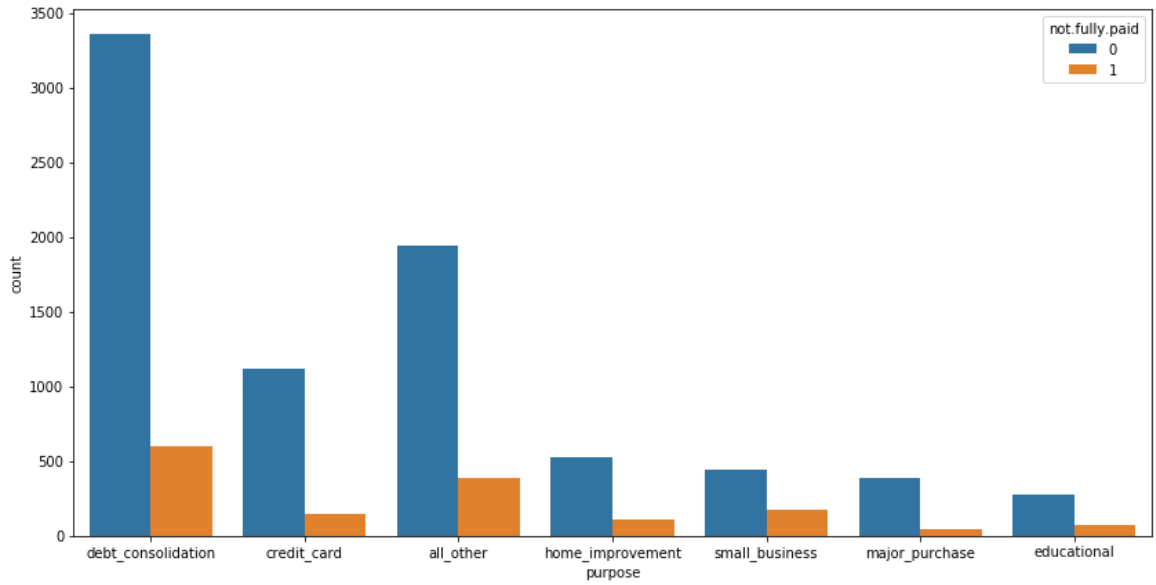


In [59]:

```
plt.figure(figsize=(14,7))
sns.countplot(data=loan_dataset,x='purpose',hue='not.fully.paid')
```

Out[59]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1460c2410>
```

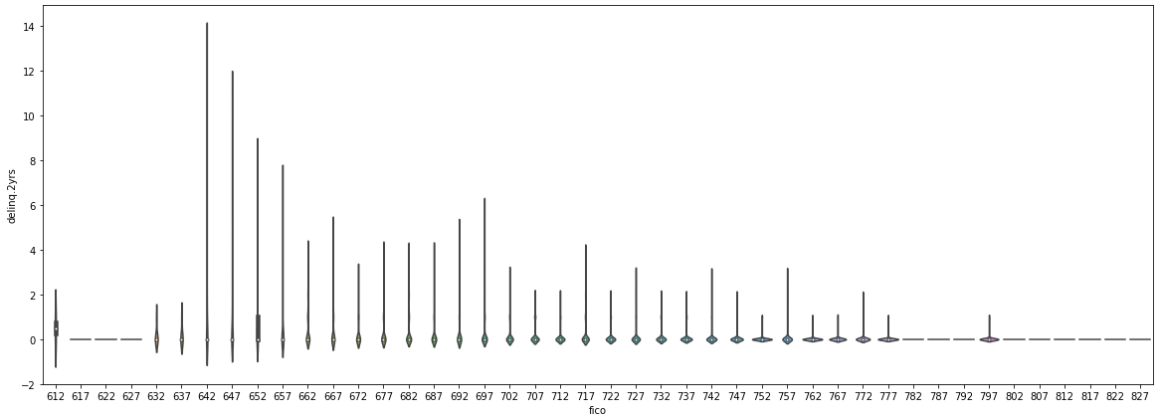


In [60]:

```
plt.figure(figsize=(20,7))
#sns.violinplot(y='delinq.2yrs',x='fico',hue='not.fully.paid',data=loan_dataset)
sns.violinplot(y='delinq.2yrs',x='fico',data=loan_dataset)
```

Out[60]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1463f8310>
```



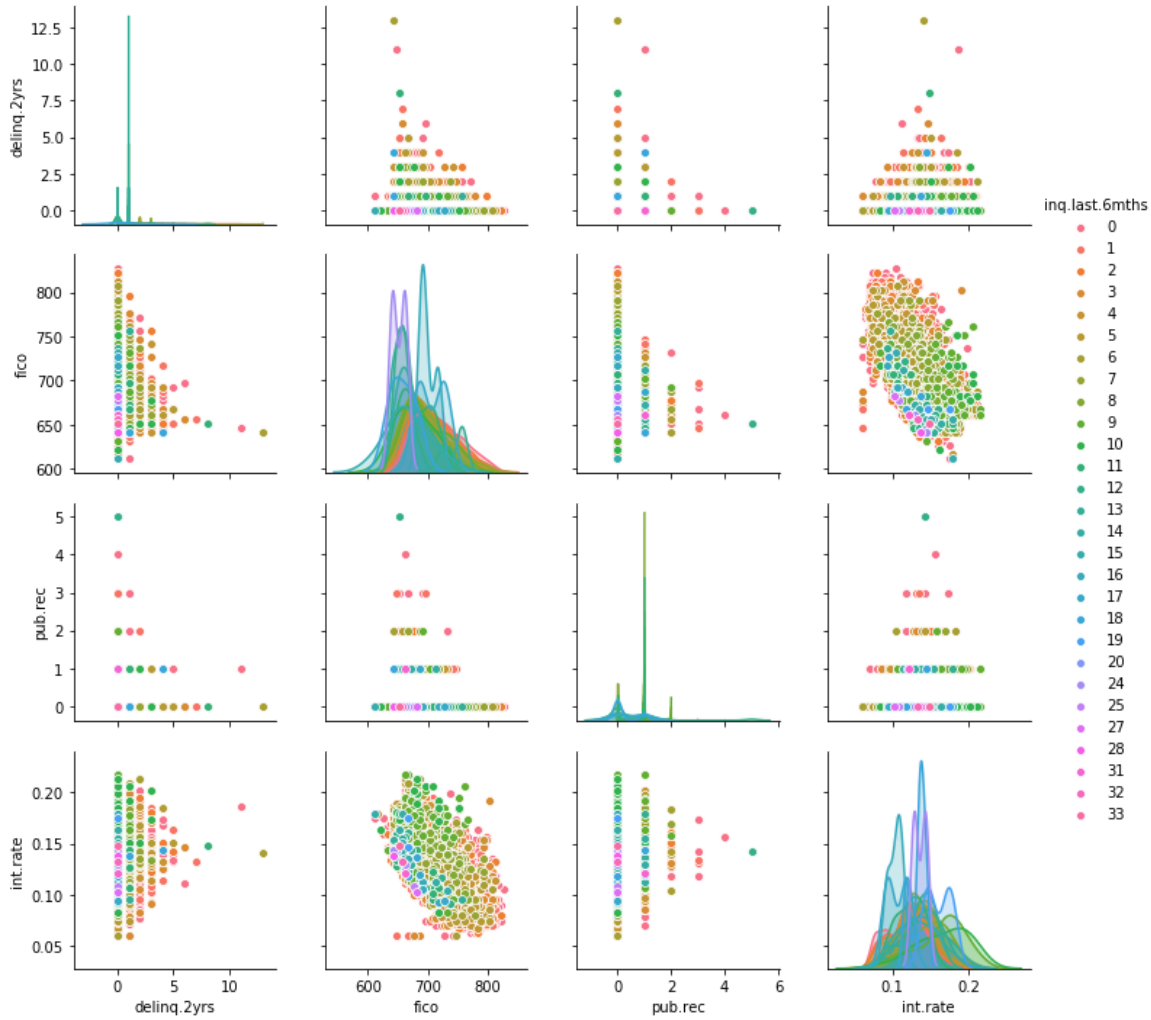
In [61]:

```
sns.pairplot(vars=['delinq.2yrs','fico','pub.rec','int.rate'],hue='inq.last.6mth
s',data=loan_dataset)
```

```
/Users/admin/opt/anaconda3/lib/python3.7/site-packages/statsmodels/n
onparametric/kde.py:487: RuntimeWarning: invalid value encountered i
n true_divide
  binned = fast_linbin(X, a, b, gridsize) / (delta * nobs)
/Users/admin/opt/anaconda3/lib/python3.7/site-packages/statsmodels/n
onparametric/kdetools.py:34: RuntimeWarning: invalid value encounter
ed in double_scalars
  FAC1 = 2*(np.pi*bw/RANGE)**2
/Users/admin/opt/anaconda3/lib/python3.7/site-packages/numpy/core/_m
ethods.py:217: RuntimeWarning: Degrees of freedom <= 0 for slice
  keepdims=keepdims)
/Users/admin/opt/anaconda3/lib/python3.7/site-packages/numpy/core/_m
ethods.py:209: RuntimeWarning: invalid value encountered in double_s
calars
  ret = ret.dtype.type(ret / rcount)
```

Out[61]:

```
<seaborn.axisgrid.PairGrid at 0x1463e5050>
```



In [62]:

```
loan_dataset.columns
```

Out[62]:

```
Index(['credit.policy', 'purpose', 'int.rate', 'installment', 'log.a
nnual.inc',
       'dti', 'fico', 'days.with.cr.line', 'revol.bal', 'revol.uti
l',
       'inq.last.6mths', 'delinq.2yrs', 'pub.rec', 'not.fully.pai
d'],
      dtype='object')
```

In [63]:

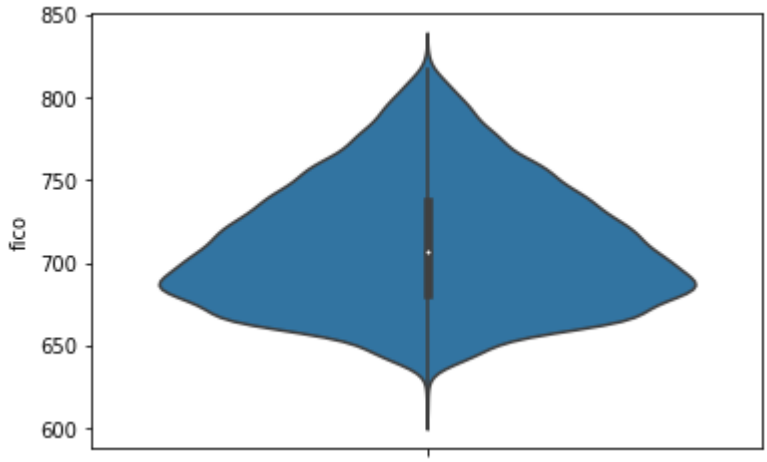
```
# fico and deliquency have sig negative Correlations
# More inquiries many times are related to negative public records and higher in
t rate
# fico and int rate are inversely proportional
```

In [64]:

```
sns.violinplot(y=loan_dataset['fico'],hue=loan_dataset['not.fully.paid'])
```

Out[64]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x148a80810>
```



In [65]:

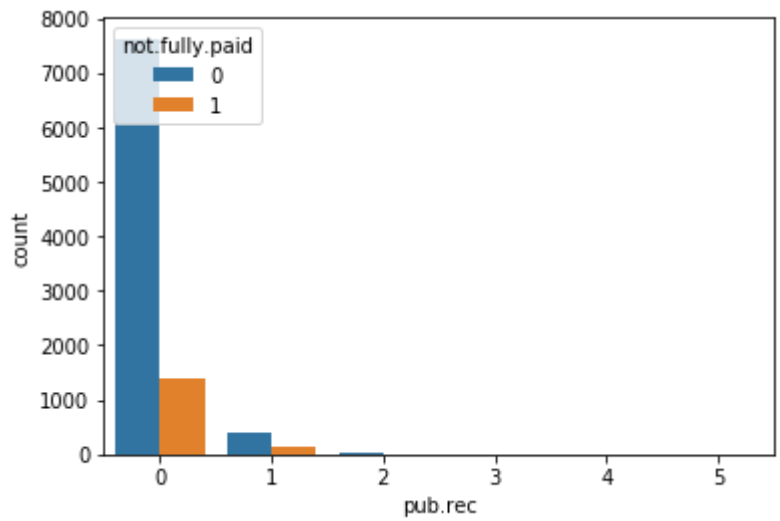
```
# High fico score correspond to better recovery of loans,Loans are fully paid fo
r high fico score
#650-725 fico score is the highest concentration of borrowers and possibly defau
lters also
```

In [66]:

```
sns.countplot(x='pub.rec',hue='not.fully.paid',data=loan_dataset)
```

Out[66]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x14881a490>
```

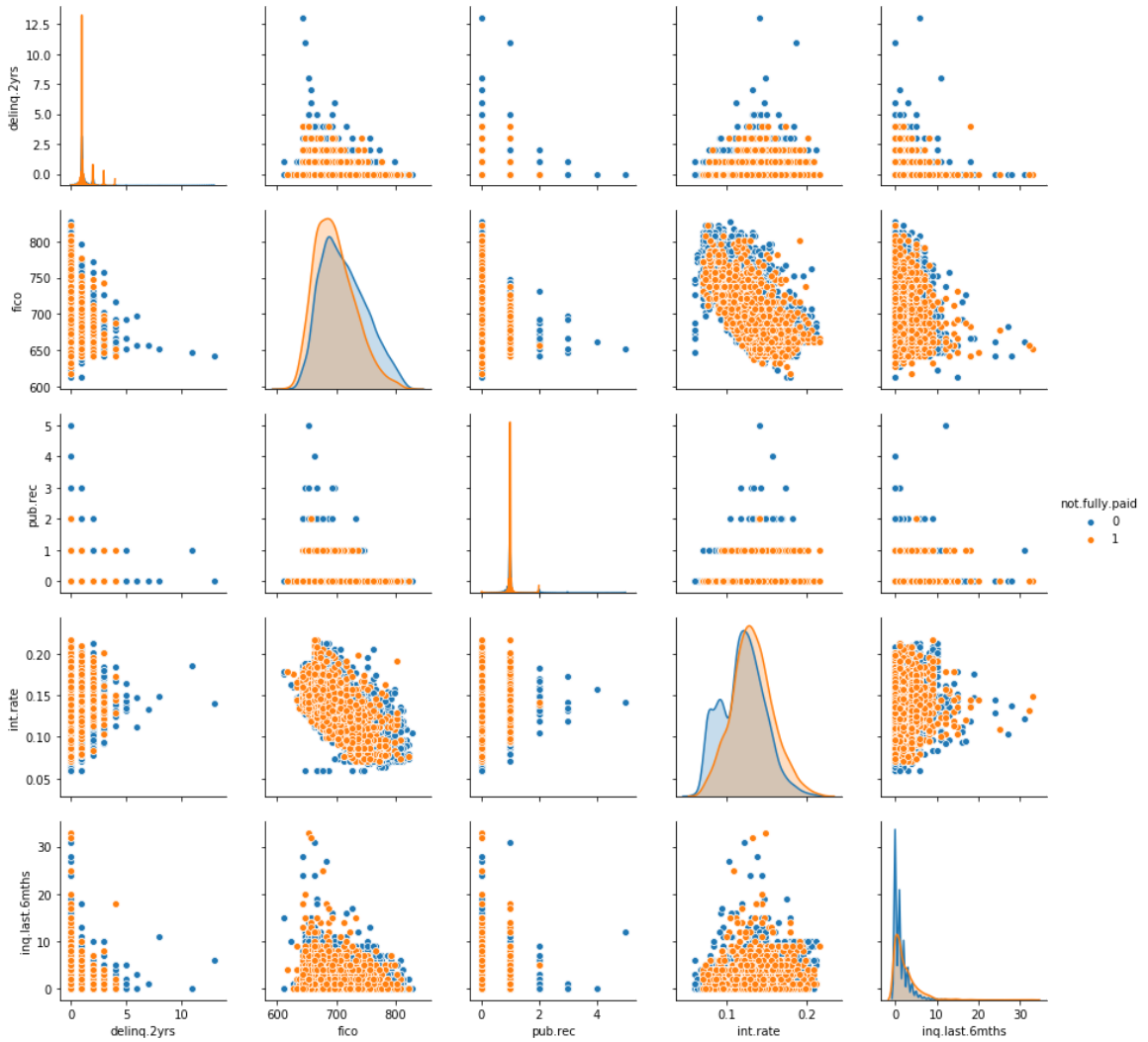


In [67]:

```
sns.pairplot(vars=['delinq.2yrs','fico','pub.rec','int.rate','inq.last.6mths'],h
ue='not.fully.paid',data=loan_dataset)
```

Out[67]:

```
<seaborn.axisgrid.PairGrid at 0x148406890>
```



In [68]:

```
#Lets change the purpose column to numerical
```

In [69]:

```
from sklearn import  preprocessing
labelEncoder=preprocessing.LabelEncoder()
loan_dataset.purpose=labelEncoder.fit_transform(loan_dataset.purpose)
```

In [70]:

```
labelEncoder.classes_
```

Out[70]:

```
array(['all_other', 'credit_card', 'debt_consolidation', 'educationa
l',
       'home_improvement', 'major_purchase', 'small_business'],
      dtype=object)
```

In [71]:

```
import numpy as np
np.unique(loan_dataset.purpose)
```

Out[71]:

```
array([0, 1, 2, 3, 4, 5, 6])
```

In [72]:

```
loan_dataset.dtypes
```

Out[72]:

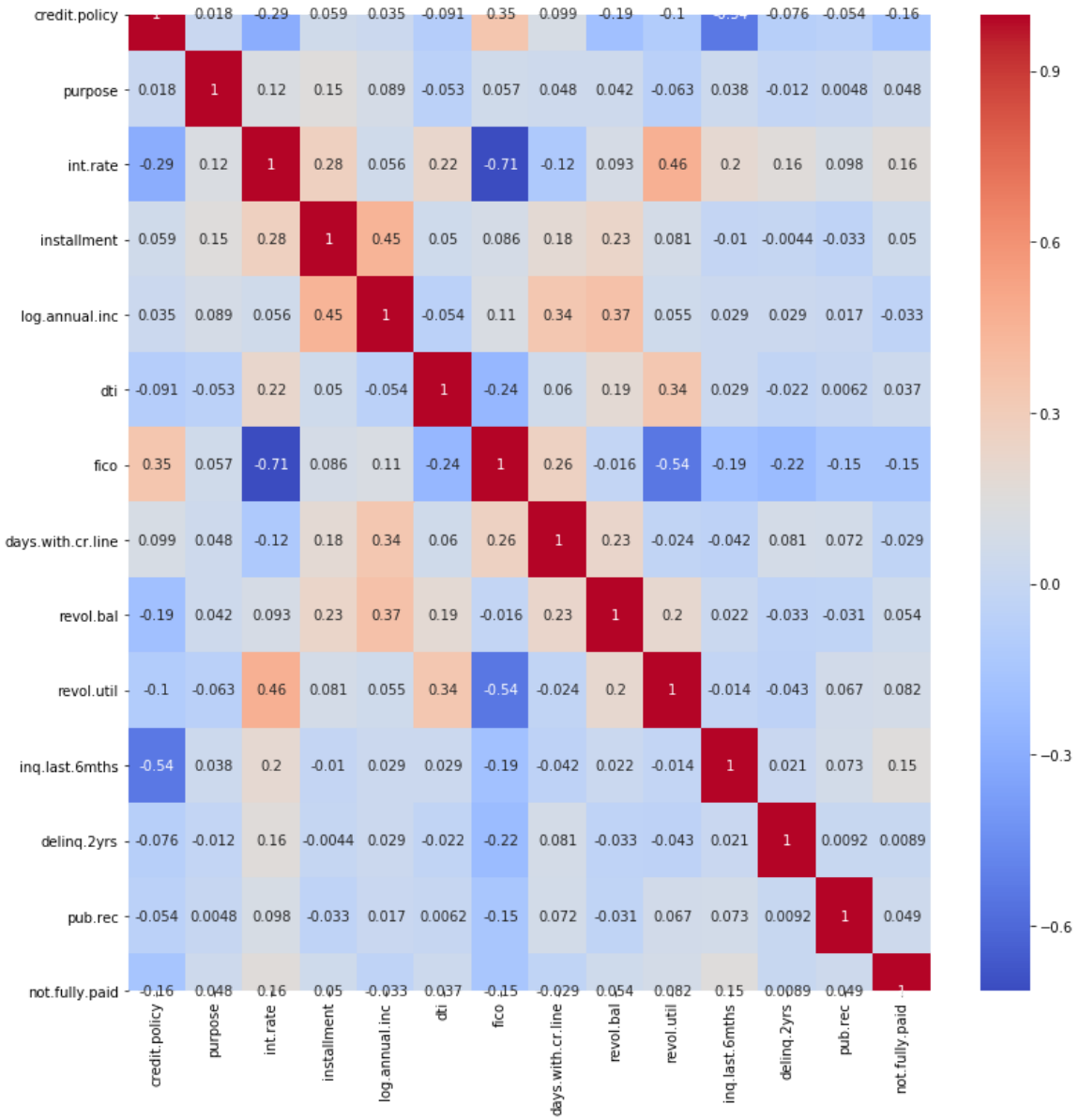
```
credit.policy          int64
purpose                int64
int.rate             float64
installment          float64
log.annual.inc       float64
dti                  float64
fico                   int64
days.with.cr.line    float64
revol.bal              int64
revol.util           float64
inq.last.6mths         int64
delinq.2yrs            int64
pub.rec                int64
not.fully.paid         int64
dtype: object
```

In [73]:

```
plt.figure(figsize=(13,13))
corrMap = loan_dataset.corr()
sns.heatmap(corrMap,annot=True,cmap='coolwarm')
```

Out[73]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x148329f10>
```



Lets load the inputs and labels

In [74]:

```
inputdata = pd.read_csv('input.csv',header=None)
```

In [75]:

```
indataset.shape
```

Out[75]:

```
(9578, 18)
```

In [76]:

```
labels = pd.read_csv('output.csv',header=None)
labels.shape
```

Out[76]:

```
(9578, 2)
```

In [77]:

```
inputdata.dtypes
```

Out[77]:

```
0       int64
1     float64
2     float64
3     float64
4     float64
5       int64
6     float64
7       int64
8     float64
9       int64
10      int64
11      int64
12      int64
13      int64
14      int64
15      int64
16      int64
17      int64
dtype: object
```

split Between training and testing

In [78]:

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test =train_test_split(inputdata,labels,test_size=0.25,
random_state=10)
```

In [79]:

```
X_train.shape
```

Out[79]:

```
(7183, 18)
```

In [80]:

```
X_test.shape
```

Out[80]:

```
(2395, 18)
```

In [81]:

```
y_train.shape
```

Out[81]:

```
(7183, 2)
```

In [82]:

```
y_test.shape
```

Out[82]:

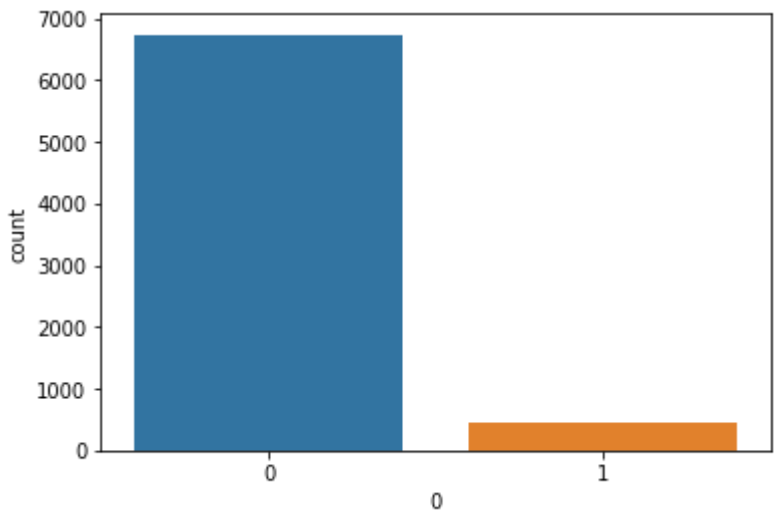
```
(2395, 2)
```

In [83]:

```
sns.countplot(y_train.iloc[:,0])
```

Out[83]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x148624b50>
```



In [84]:

```
# Highly imbalanced dataset
```

Create Model

In [85]:

```
#we will first try with a DNN classifier
```

In [86]:

```
import keras
from keras.models import Sequential
from keras.layers import Dense, Dropout
np.random.seed(42)
dnnmodel = Sequential()
dnnmodel.add(Dense(12, input_dim=18, activation='relu'))
dnnmodel.add(Dropout(0.2))
dnnmodel.add(Dense(24,activation='relu'))
dnnmodel.add(Dropout(0.2))
dnnmodel.add(Dense(36,activation='relu'))
dnnmodel.add(Dropout(0.2))
dnnmodel.add(Dense(2,activation='sigmoid'))
print(dnnmodel.summary())
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 12)                228
_________________________________________________________________
dropout_1 (Dropout)          (None, 12)                0
_________________________________________________________________
dense_2 (Dense)              (None, 24)                312
_________________________________________________________________
dropout_2 (Dropout)          (None, 24)                0
_________________________________________________________________
dense_3 (Dense)              (None, 36)                900
_________________________________________________________________
dropout_3 (Dropout)          (None, 36)                0
_________________________________________________________________
dense_4 (Dense)              (None, 2)                 74
=================================================================
Total params: 1,514
Trainable params: 1,514
Non-trainable params: 0
_________________________________________________________________
None
```

In [89]:

```
dnnmodel.compile(loss='binary_crossentropy',optimizer='adam',metrics=['accuracy'
])
dnnmodel.fit(X_train,y_train,epochs=50,batch_size=36)

#check Final Accuracy

scores = dnnmodel.evaluate(X_test,y_test)
print("\n%s: %0.2f%%"%(dnnmodel.metrics_names[1],scores[1]*100))
```

```
2395/2395 [==============================] - 0s 78us/step

accuracy: 92.94%
```

In [98]:

```
predictions = dnnmodel.predict(X_test)

def converToBinary(dec):
    if dec < 0.5:
        return 0
    else:
        return 1
predictions_df = pd.DataFrame(predictions)

predictions_df.iloc[:,0] = predictions_df.iloc[:,0].apply(converToBinary)

from sklearn.metrics import confusion_matrix

print(confusion_matrix(y_test.iloc[:,0],predictions_df.iloc[:,0]))
```

```
[[2226    0]
 [ 169    0]]
```

In [99]:

```
# we were able to predict 2226 non deafaulters
#Not Able to predict even a single defaulters !!!
```

In [100]:

```
predictions[:20,0]
```

Out[100]:

```
array([0.06367076, 0.06367076, 0.06367076, 0.06367076, 0.06367076,
       0.06367076, 0.06367076, 0.06367076, 0.06367076, 0.06367076,
       0.06367076, 0.06367076, 0.06367076, 0.06367076, 0.06367076,
       0.06367076, 0.06367076, 0.06367076, 0.06367076, 0.06367076],
      dtype=float32)
```

In [101]:

```
# Lets build an Autoencoder
# Encoder Layer : 9 Neurons
# Decoder Layer : 18 Neurons
# Use mean squeres error(mse) for indiv observation as a measure of defaulter po
ssibiliuty
# Use the mse as an additional feature and then create a DNN for Prediction
```

In [ ]:

```
```