CSML1010 Coding Exercise, Week 4, Dec 15 2019

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## PART 1: Multi-Class Text Classification

Based on code at: https://github.com/susanli2016/Machine-Learning-with-Python/blob/master/Consumer_complaints.ipynb (https://github.com/susanli2016/Machine-Learning-with-Python/blob/master/Consumer_complaints.ipynb)

```
In [1]: import pandas as pd
        df = pd.read_csv('Consumer_Complaints.csv')
        df.head()
```

Out[1]:

	Date received	Product	Sub-product	Issue	Sub-issue	Consumer complaint narrative	Comp pu respo
0	08/09/2015	Credit reporting	NaN	Incorrect information on credit report	Information is not mine	NaN	Comp choc n provi p respo
1	01/29/2019	Credit reporting, credit repair services, or o...	Credit reporting	Problem with a credit reporting company's inve...	Was not notified of investigation status or re...	NaN	
2	08/19/2015	Mortgage	Conventional adjustable mortgage (ARM)	Loan servicing, payments, escrow account	NaN	NaN	Comp choc n provi p respo
3	03/04/2016	Credit card	NaN	Billing disputes	NaN	I am dissatisfied with the current outcome of ...	
4	03/18/2013	Mortgage	Other mortgage	Loan modification,collection,foreclosure	NaN	NaN	
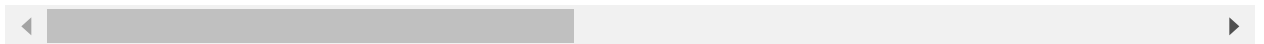
```
In [2]: df = df[pd.notnull(df['Consumer complaint narrative'])]
```

```
In [3]: df = df[0:6000]
```

```
In [4]:  df.info()

         <class 'pandas.core.frame.DataFrame'>
         Int64Index: 6000 entries, 3 to 18894
         Data columns (total 18 columns):
         Date received                  6000 non-null object
         Product                        6000 non-null object
         Sub-product                    5256 non-null object
         Issue                          6000 non-null object
         Sub-issue                      4366 non-null object
         Consumer complaint narrative   6000 non-null object
         Company public response        2830 non-null object
         Company                        6000 non-null object
         State                          5977 non-null object
         ZIP code                       4659 non-null object
         Tags                           1025 non-null object
         Consumer consent provided?     6000 non-null object
         Submitted via                  6000 non-null object
         Date sent to company           6000 non-null object
         Company response to consumer   6000 non-null object
         Timely response?               6000 non-null object
         Consumer disputed?             2317 non-null object
         Complaint ID                   6000 non-null int64
         dtypes: int64(1), object(17)
         memory usage: 890.6+ KB
```

```
In [5]:  col = ['Product', 'Consumer complaint narrative']
         df = df[col]
```

```
In [6]:  df.columns
```

```
Out[6]:  Index(['Product', 'Consumer complaint narrative'], dtype='object')
```

```
In [7]:  df.columns = ['Product', 'Consumer_complaint_narrative']
```

```
In [8]:  df['category_id'] = df['Product'].factorize()[0]
         from io import StringIO
         category_id_df = df[['Product', 'category_id']].drop_duplicates().sort_values('c
         category_to_id = dict(category_id_df.values)
         id_to_category = dict(category_id_df[['category_id', 'Product']].values)
```

```
In [9]: df.head()
```

Out[9]:

	Product	Consumer_complaint_narrative	category_id
3	Credit card	I am dissatisfied with the current outcome of ...	0
7	Credit reporting, credit repair services, or o...	On XX/XX/18 an item showed up on my credit rep...	1
8	Debt collection	Saw on my credit report that there is a collec...	2
9	Credit reporting, credit repair services, or o...	Capital one auto finacing XX/XX/2018 unknown i...	1
11	Credit card or prepaid card	I own a small trucking company. One of my truc...	3

```
In [10]: import matplotlib.pyplot as plt
         fig = plt.figure(figsize=(8,6))
         df.groupby('Product').Consumer_complaint_narrative.count().plot.bar(ylim=0)
         plt.show()
```

```
<Figure size 800x600 with 1 Axes>
```

```
In [11]: from sklearn.feature_extraction.text import TfidfVectorizer

         tfidf = TfidfVectorizer(sublinear_tf=True, min_df=5, norm='l2', encoding='latin-

         features = tfidf.fit_transform(df.Consumer_complaint_narrative).toarray()
         labels = df.category_id
         features.shape
```

Out[11]: (6000, 16849)

```
In [12]:  from sklearn.feature_selection import chi2
          import numpy as np

          N = 2
          for Product, category_id in sorted(category_to_id.items()):
            features_chi2 = chi2(features, labels == category_id)
            indices = np.argsort(features_chi2[0])
            feature_names = np.array(tfidf.get_feature_names())[indices]
            unigrams = [v for v in feature_names if len(v.split(' ')) == 1]
            bigrams = [v for v in feature_names if len(v.split(' ')) == 2]
            print("# '{}':".format(Product))
            print("  . Most correlated unigrams:\n      . {}".format('\n      . '.join(u
            print("  . Most correlated bigrams:\n      . {}".format('\n      . '.join(bi
```

```
# 'Bank account or service':
  . Most correlated unigrams:
      . atm
      . scottrade
  . Most correlated bigrams:
      . checking account
      . citigold checking
# 'Checking or savings account':
  . Most correlated unigrams:
      . overdraft
      . deposit
  . Most correlated bigrams:
      . checking account
      . savings account
# 'Consumer Loan':
  . Most correlated unigrams:
      . car
      . vehicle
  . Most correlated bigrams:
      . chrysler capital
      . auto finance
# 'Credit card':
  . Most correlated unigrams:
      . macy
      . card
  . Most correlated bigrams:
      . synchrony bank
      . credit card
# 'Credit card or prepaid card':
  . Most correlated unigrams:
      . purchases
      . card
  . Most correlated bigrams:
      . balance transfer
      . credit card
# 'Credit reporting':
  . Most correlated unigrams:
      . transunion
      . experian
  . Most correlated bigrams:
      . verified disputed
      . disputed resolve
```

```
# 'Credit reporting, credit repair services, or other personal consumer repor
ts':
  . Most correlated unigrams:
        . inquiries
        . equifax
  . Most correlated bigrams:
        . appear report
        . credit report
# 'Debt collection':
  . Most correlated unigrams:
        . collection
        . debt
  . Most correlated bigrams:
        . collection agency
        . collect debt
# 'Money transfer, virtual currency, or money service':
  . Most correlated unigrams:
        . paypal
        . coinbase
  . Most correlated bigrams:
        . coinbase xx
        . account coinbase
# 'Money transfers':
  . Most correlated unigrams:
        . google
        . trace
  . Most correlated bigrams:
        . contacted paypal
        . western union
# 'Mortgage':
  . Most correlated unigrams:
        . modification
        . mortgage
  . Most correlated bigrams:
        . mortgage company
        . loan modification
# 'Other financial service':
  . Most correlated unigrams:
        . compensate
        . hostile
  . Most correlated bigrams:
        . twice month
        . money order
# 'Payday loan':
  . Most correlated unigrams:
        . central
        . net
  . Most correlated bigrams:
        . loan taken
        . calls received
# 'Payday loan, title loan, or personal loan':
  . Most correlated unigrams:
        . loan
        . bankers
  . Most correlated bigrams:
        . installment loan
        . 00 loan
```

```
# 'Prepaid card':
  . Most correlated unigrams:
       . gift
       . rush
  . Most correlated bigrams:
       . use cards
       . rush card
# 'Student loan':
  . Most correlated unigrams:
       . loans
       . navient
  . Most correlated bigrams:
       . student loan
       . student loans
# 'Vehicle loan or lease':
  . Most correlated unigrams:
       . gm
       . car
  . Most correlated bigrams:
       . chase auto
       . gm financial
```

In [13]:
```python
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.naive_bayes import MultinomialNB

X_train, X_test, y_train, y_test = train_test_split(df['Consumer_complaint_narra
count_vect = CountVectorizer()
X_train_counts = count_vect.fit_transform(X_train)
tfidf_transformer = TfidfTransformer()
X_train_tfidf = tfidf_transformer.fit_transform(X_train_counts)

clf = MultinomialNB().fit(X_train_tfidf, y_train)
```

In [14]:
```python
print(clf.predict(count_vect.transform(["This company refuses to provide me veri
```

```
['Debt collection']
```

In [15]:
```python
print(clf.predict(count_vect.transform(["I am disputing the inaccurate informatio
```

```
['Credit reporting, credit repair services, or other personal consumer report
s']
```

In [16]:
```python
df[df['Consumer_complaint_narrative'] == "This company refuses to provide me veri
```

Out[16]:

Product	Consumer_complaint_narrative	category_id

```
In [17]: df[df['Consumer_complaint_narrative'] == "I am disputing the inaccurate informat
```
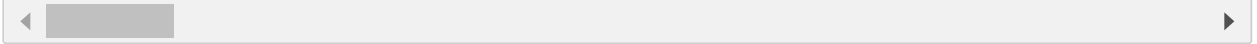
Out[17]:

Product	Consumer_complaint_narrative	category_id

```python
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import LinearSVC

from sklearn.model_selection import cross_val_score


models = [
    RandomForestClassifier(n_estimators=200, max_depth=3, random_state=0),
    LinearSVC(),
    MultinomialNB(),
    LogisticRegression(random_state=0),
]
CV = 5
cv_df = pd.DataFrame(index=range(CV * len(models)))
entries = []
for model in models:
    model_name = model.__class__.__name__
    accuracies = cross_val_score(model, features, labels, scoring='accuracy', cv=CV
    for fold_idx, accuracy in enumerate(accuracies):
        entries.append((model_name, fold_idx, accuracy))
cv_df = pd.DataFrame(entries, columns=['model_name', 'fold_idx', 'accuracy'])
```

```
C:\Users\Dell\Anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:9
39: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html. (https://scik
it-learn.org/stable/modules/preprocessing.html.)
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regres
sion (https://scikit-learn.org/stable/modules/linear_model.html#logistic-regr
ession)
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
C:\Users\Dell\Anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:9
39: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html. (https://scik
it-learn.org/stable/modules/preprocessing.html.)
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regres
sion (https://scikit-learn.org/stable/modules/linear_model.html#logistic-regr
ession)
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
C:\Users\Dell\Anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:9
39: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html. (https://scik
it-learn.org/stable/modules/preprocessing.html.)
Please also refer to the documentation for alternative solver options:
```

In [19]:
```python
import seaborn as sns

sns.boxplot(x='model_name', y='accuracy', data=cv_df)
sns.stripplot(x='model_name', y='accuracy', data=cv_df,
              size=8, jitter=True, edgecolor="gray", linewidth=2)
plt.show()
```
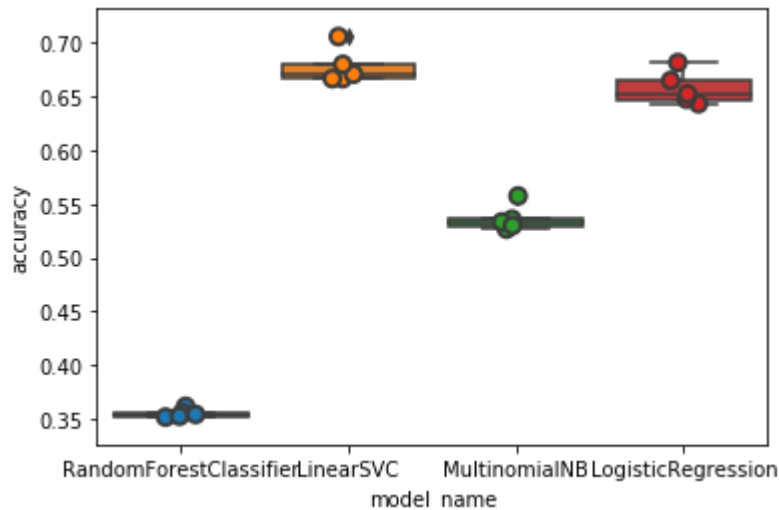
```
In [20]: cv_df.groupby('model_name').accuracy.mean()
```

```
Out[20]: model_name
         LinearSVC               0.678000
         LogisticRegression      0.658000
         MultinomialNB           0.536667
         RandomForestClassifier  0.355167
         Name: accuracy, dtype: float64
```

```
In [21]: from sklearn.model_selection import train_test_split

         model = LinearSVC()

         X_train, X_test, y_train, y_test, indices_train, indices_test = train_test_split
         model.fit(X_train, y_train)
         y_pred = model.predict(X_test)
```

```python
from sklearn.metrics import confusion_matrix

conf_mat = confusion_matrix(y_test, y_pred)
fig, ax = plt.subplots(figsize=(8,6))
sns.heatmap(conf_mat, annot=True, fmt='d',
            xticklabels=category_id_df.Product.values, yticklabels=category_id_d
plt.ylabel('Actual')
plt.xlabel('Predicted')
plt.show()
```
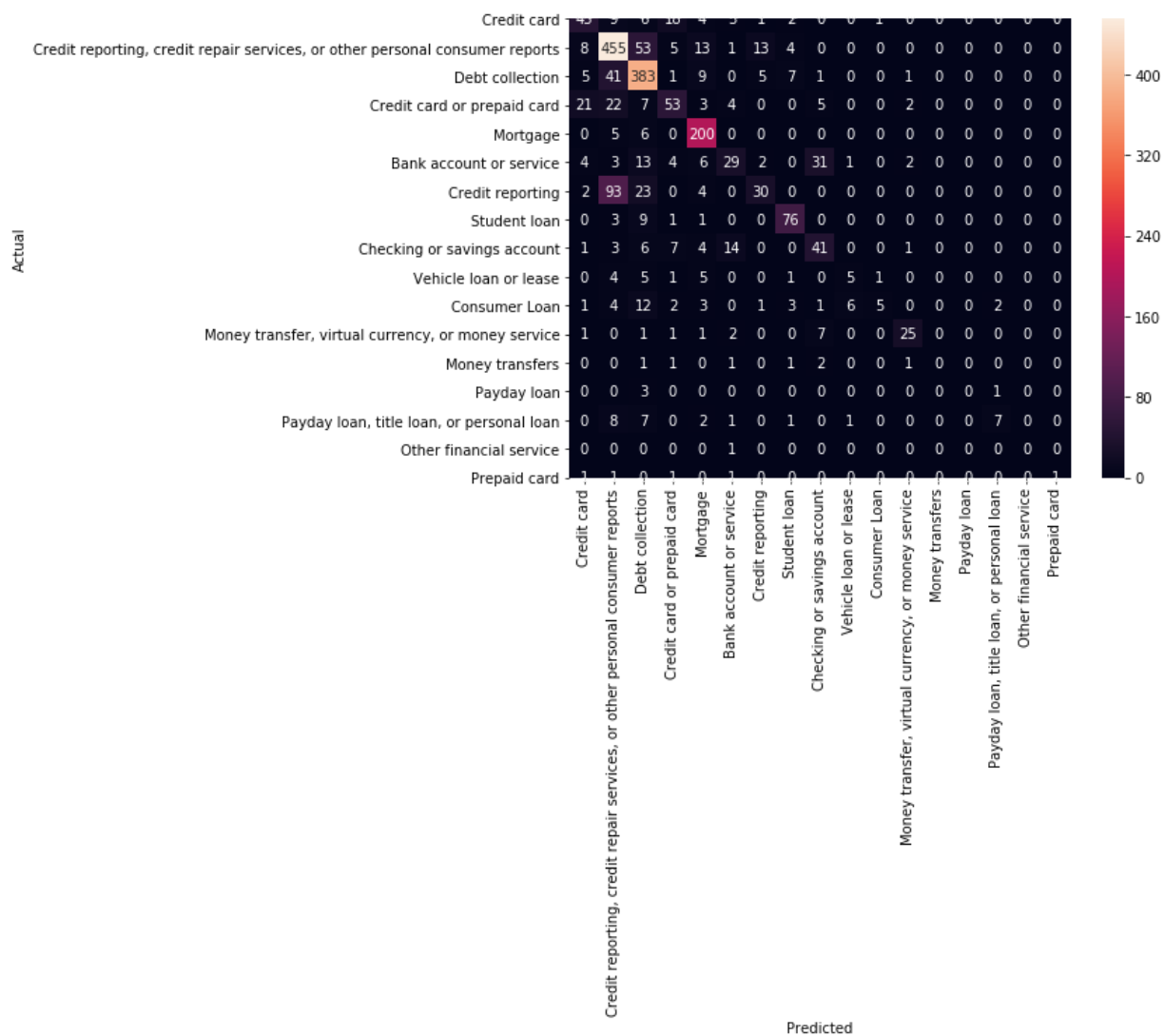
```
In [23]:  from IPython.display import display

          for predicted in category_id_df.category_id:
            for actual in category_id_df.category_id:
              if predicted != actual and conf_mat[actual, predicted] >= 6:
                print("'{}' predicted as '{}' : {} examples.".format(id_to_category[actual
                display(df.loc[indices_test[(y_test == actual) & (y_pred == predicted)]][[
                print('')
```

'Credit reporting, credit repair services, or other personal consumer reports'
predicted as 'Credit card' : 8 examples.

	Product	Consumer_complaint_narrative
6930	Credit reporting, credit repair services, or o...	I noticed in XXXX XXXX that a hard Inquiry was...
12836	Credit reporting, credit repair services, or o...	The compliant is with Citibank whom I never op...
8125	Credit reporting, credit repair services, or o...	Some one dryed to apply for a capital one cred...
18632	Credit reporting, credit repair services, or o...	see attached for full complaint. bank card not...
12840	Credit reporting, credit repair services, or o...	My American Express show late payment I called...
12879	Credit reporting, credit repair services, or o...	Hello, I was looking at my credit report via t...
16087	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX XXXX is demanding that I get a ...
788	Credit reporting, credit repair services, or o...	Capitol One Auto has placed 5-30 day late mark...

'Credit card or prepaid card' predicted as 'Credit card' : 21 examples.

	Product	Consumer_complaint_narrative
11822	Credit card or prepaid card	I am writing to report unexplainable fees char...
16689	Credit card or prepaid card	I am asking for clarification on the Fair Cred...
15336	Credit card or prepaid card	Upon reading Citi Bank 's response letter sent...
12477	Credit card or prepaid card	I WAS CONTACTED BY THIS COMPANY THAT THEY HAD ...
14932	Credit card or prepaid card	I applied for an aadvantage gold credit card w...
6412	Credit card or prepaid card	i am 7 years relationship customer with chase ...
11283	Credit card or prepaid card	On or about XX/XX/XXXX, My concern is card iss...
15803	Credit card or prepaid card	I have a credit card with Discover, first open...
13530	Credit card or prepaid card	I've already spent 3 months working directly w...
7563	Credit card or prepaid card	Wrong address. No activity. Asked for a card. ...
9461	Credit card or prepaid card	I did an online purchase at XXXX XXXX XXXX for...
12476	Credit card or prepaid card	Barclays had closed all my credit card product...
5229	Credit card or prepaid card	XXXX XXXX, XXXX a credit charge of {$1400.00} ...
389	Credit card or prepaid card	Called Bank of America credit card costumer s...
7178	Credit card or prepaid card	On XX/XX/2017 approx. XXXX est. I spoke ...

	Product	Consumer_complaint_narrative
6230	Credit card or prepaid card	I applied for an Amex Delta SkyMile card. I ma...
2409	Credit card or prepaid card	I have a credit card listed on my credit repor...
10493	Credit card or prepaid card	Capital One took over for the XXXX card I have...
8518	Credit card or prepaid card	On XX/XX/XXXX I paid off the remaining balance...
10379	Credit card or prepaid card	I filed the dispute twice and the Barclay Bank...
7992	Credit card or prepaid card	CBNA is listed on My credit report as having a...

'Credit card' predicted as 'Credit reporting, credit repair services, or other personal consumer reports' : 9 examples.

	Product	Consumer_complaint_narrative
1723	Credit card	I have contacted citibank and can not get thro...
8190	Credit card	When my new Citi XXXX was opened in 2014 it wa...
13177	Credit card	I am under the impression that Capital One is ...
18440	Credit card	Complaint against Barclaycard XXXX XXXX advant...
9145	Credit card	Ref : Bank of AmericaI have been working with ...
8525	Credit card	I had an account with Target XXXX Bank Account...
14016	Credit card	PayPal extended me a line of online credit wit...
108	Credit card	i have apply for credit card at Brclysbank DE ...
6439	Credit card	I am a victim of identity theft. We have been ...

'Debt collection' predicted as 'Credit reporting, credit repair services, or other personal consumer reports' : 41 examples.

	Product	Consumer_complaint_narrative
14593	Debt collection	The co XXXX XXXX XXXX is claiming that I purch...
4717	Debt collection	I was denied credit due to a collection accoun...
13157	Debt collection	Disputed with the company on XX/XX/2018 and ag...
7172	Debt collection	reported XXXX XXXX, XXXX XXXX : XXXX damaged c...
8844	Debt collection	I I have paid agreed the credit collection age...
13895	Debt collection	There is an agreement between XXXX XXXX and pr...
53	Debt collection	HSBC, I am enclosing a response from XXXX XXXX...
9143	Debt collection	judgement should have been removed in XX/XX/XX...
10464	Debt collection	My name is XXXX XXXX. \nI have noticed that a ...
6005	Debt collection	Dear Sir/Madam the reason for this compliant i...
9352	Debt collection	I was living at XXXX XXXX ..in XXXX Texas ... ...

	Product	Consumer_complaint_narrative
11276	Debt collection	I have been a victim of Identity theft since X...
14563	Debt collection	XX/XX/2017 Phone call transcript. \nCalled fro...
17840	Debt collection	American Accounts Advisors Inc. Is incorrectly...
6817	Debt collection	I have constantly Informed this company that I...
6024	Debt collection	After numerous attempts to contact XXXX and XX...
15649	Debt collection	This company failed to provide me with a truly...
4461	Debt collection	I have told USAA BANK for four years that I am...
8049	Debt collection	There was an spotloan account opened underr my...
14849	Debt collection	XXXX XXXX XXXX of XXXX XXXX XXXX, XXXX, WI XXX...
18229	Debt collection	A guarantee on a lease I signed, whose name is...
12651	Debt collection	Due to money issues I have a consent judgement...
14261	Debt collection	XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX LA XXX...
11449	Debt collection	Midland Credit Management (MCM) has inaccura...
7765	Debt collection	Zwicker and Associates checked my credit repor...
14619	Debt collection	My issue with this Debt Buyer is that I keep h...
4524	Debt collection	This was an account that was opened in my name...
15750	Debt collection	In XX/XX/2017 I reached a settlement with a la...
5988	Debt collection	XXXX Law Dictionary, 9th Edition, 2009, define...
15930	Debt collection	Ran my credit for the first time via XXXX XXXX...
10616	Debt collection	The collection company in question, DIVERSIFIE...
11231	Debt collection	CRA VIOLATION / HIPAA VIOLATION / NO KNOWLEDGE...
4739	Debt collection	Im writing to dispute an account fraudently op...
603	Debt collection	I received a credit alert on XX/XX/2018 that a...
7516	Debt collection	This collection agency called erc has been har...
3522	Debt collection	FURNISHING FALSE REPORTS TO CREDIT BUREAU 'S
15689	Debt collection	Portfolio Recovery Associates placed a negativ...
18126	Debt collection	Equifax reply meet FCRA requirement as and exp...
7432	Debt collection	The original creditor and account number is li...
9378	Debt collection	Portfolio Recovery Assets (PRA XXXX acquired ...
17006	Debt collection	Southwest Credit Systems are reporting XXXX ac...

'Credit card or prepaid card' predicted as 'Credit reporting, credit repair services, or other personal consumer reports' : 22 examples.

	Product	Consumer_complaint_narrative
12588	Credit card or prepaid card	Within the last year, I receive on a daily bas...
6372	Credit card or prepaid card	I was approved for a XXXX XXXX dollar credit c...

	Product	Consumer_complaint_narrative
5955	Credit card or prepaid card	I am currently Disputing on charge on my credi...
3594	Credit card or prepaid card	I did not receive a statement in XX/XX/XXXX or...
11837	Credit card or prepaid card	I have been going through a severe financial h...
13087	Credit card or prepaid card	On XXXX XXXX, 2017, I opened a Credit Card wit...
14740	Credit card or prepaid card	XXXX XXXX make it a practice to periodically c...
6664	Credit card or prepaid card	I am A XXXX Veteran being treated for XXXX XXX...
16371	Credit card or prepaid card	it will not allow me to add external accounts
10580	Credit card or prepaid card	Equifax has been non-compliant with removing t...
1929	Credit card or prepaid card	capital one bank pulled a fraud inquiry on my ...
5142	Credit card or prepaid card	capital one card, state that someone has open ...
3308	Credit card or prepaid card	On XX/XX/XXXX I changed my email address for m...
18743	Credit card or prepaid card	Have had a credit card wi th Amazon.com for a ...
15595	Credit card or prepaid card	Starting XX/XX/XXXX, I asked American Express ...
1473	Credit card or prepaid card	XX/XX/2017 XXXX XXXX is blocking access to my ...
13956	Credit card or prepaid card	credit card number was stolen in XXXX by XXXX ...
16777	Credit card or prepaid card	Keep getting same call from Capital One saying...
17178	Credit card or prepaid card	I was looking at my credit report as i am look...
2589	Credit card or prepaid card	I have been a loyal card member of Capital One...
18886	Credit card or prepaid card	Nordstrom claims on my credit report that I ha...

'Credit reporting' predicted as 'Credit reporting, credit repair services, or o
ther personal consumer reports' : 93 examples.

	Product	Consumer_complaint_narrative
16756	Credit reporting	I noticed XXXX wrong addresses on a free credi...
15408	Credit reporting	Inaccurate information on my credit file. Acco...
6288	Credit reporting	Failure to report credit experience correctly ...
12259	Credit reporting	THIS ACCOUNT HAS BEEN REPORTING ON MY CREDIT R...
16386	Credit reporting	The Car Loan for XXXX Lincoln Navigator with X...
...	...	...
2795	Credit reporting	On XX/XX/2015 I refreshed by Trans-union credi...
983	Credit reporting	BACK ON XXXX XXXX 2016 I RECEIVED A CALL FROM ...
104	Credit reporting	Because I filed bankruptcy and included the de...
7943	Credit reporting	TransUnion is making its customers listen to X...
7768	Credit reporting	This is not a Duplicate. \n\nI have tried to e...

93 rows × 2 columns

'Payday loan, title loan, or personal loan' predicted as 'Credit reporting, credit repair services, or other personal consumer reports' : 8 examples.

	Product	Consumer_complaint_narrative
12014	Payday loan, title loan, or personal loan	XX/XX/XXXX {$5000.00} I applied for the first ...
11657	Payday loan, title loan, or personal loan	I am currently out on XXXX XXXX after having X...
5739	Payday loan, title loan, or personal loan	Tide water finance company has reported my pur...
6429	Payday loan, title loan, or personal loan	TD bank takes exceptionaly long reporting inco...
4173	Payday loan, title loan, or personal loan	Filed a dispute with an old credit card that h...
7311	Payday loan, title loan, or personal loan	XXXX, XXXX, XX/XX/2017 I had late payments due...
5506	Payday loan, title loan, or personal loan	I received a loan from One Main Financial i n...
3955	Payday loan, title loan, or personal loan	At the end of XX/XX/XXXX I advised personal Fi...

'Credit card' predicted as 'Debt collection' : 6 examples.

	Product	Consumer_complaint_narrative
5263	Credit card	I received a call from citi stating that i had...
15659	Credit card	I had a credit card with Banamex. My account i...
14823	Credit card	I paid off my credit card via a third party ag...
13135	Credit card	Someone opened a credit card with XXXX.This wa...
18671	Credit card	I recieved calls and messages from my XXXX bro...
4823	Credit card	I paid a TD Bank (Target Credit Card) judgem...

'Credit reporting, credit repair services, or other personal consumer reports' predicted as 'Debt collection' : 53 examples.

	Product	Consumer_complaint_narrative
13737	Credit reporting, credit repair services, or o...	On XX/XX/XXXX I received a letter from Avante ...
6645	Credit reporting, credit repair services, or o...	I am submitting this complaint after numerous ...
10758	Credit reporting, credit repair services, or o...	XXXX XXXX collection agency contacted me to di...
11488	Credit reporting, credit repair services, or o...	I keep getting my father 's credit report -- h...
17838	Credit reporting, credit repair services, or o...	I received notice from XXXX that this creditor...
7939	Credit reporting, credit repair services, or o...	This account is in someone else name a XXXX XX...

	Product	Consumer_complaint_narrative
9199	Credit reporting, credit repair services, or o...	I've been getting emails saying I might be a v...
5499	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX REASON IS EXPLAINED BELOW XX/XX...
9273	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX XXXX stated that XXXX XXXX veri...
2779	Credit reporting, credit repair services, or o...	OnXX/XX/XXXX I enrolled in a debt settlement p...
15237	Credit reporting, credit repair services, or o...	NOTICE OF PENDING LITIGATION SEEKING RELIEF AN...
13377	Credit reporting, credit repair services, or o...	This is the second time I am complaining about...
7	Credit reporting, credit repair services, or o...	On XX/XX/18 an item showed up on my credit rep...
8782	Credit reporting, credit repair services, or o...	I checked my credit report and midland funding...
2455	Credit reporting, credit repair services, or o...	I was set up on ACH with XXXX XXXX XXXX and ha...
12960	Credit reporting, credit repair services, or o...	Services were not rendered as expected. Very u...
9458	Credit reporting, credit repair services, or o...	This is on my credit reports, but is not my ac...
6104	Credit reporting, credit repair services, or o...	Portfolio Recovery Associates is listing 2 sep...
11076	Credit reporting, credit repair services, or o...	I placed a complaint yesterday though CFPB and...
13800	Credit reporting, credit repair services, or o...	I sent my fourth m and final dispute letter to...
6722	Credit reporting, credit repair services, or o...	Dear Whom it XXXX concern, This is a formal le...
2969	Credit reporting, credit repair services, or o...	I have contacted the agency several time about...
14956	Credit reporting, credit repair services, or o...	This is my 10th time disputing, complaining, a...
14237	Credit reporting, credit repair services, or o...	I had an existing credit card with Capital One...
544	Credit reporting, credit repair services, or o...	I am contacting you all because on XXXX2017 I ...
8516	Credit reporting, credit repair services, or o...	XXXX IS REPORTING ON MY CREDIT FILE THAT I OWE...
14572	Credit reporting, credit repair services, or o...	To whom this may concern, OnXX/XX/XXXX and XX/...
7635	Credit reporting, credit repair services, or o...	I keep getting unwanted phone solicitations fr...
7622	Credit reporting, credit repair services, or o...	This is a phantom debt from another collection...

	Product	Consumer_complaint_narrative
8288	Credit reporting, credit repair services, or o...	On XXXX XXXX XXXX I filed a complaint ...
16426	Credit reporting, credit repair services, or o...	After reviewing my XXXX credit report I found ...
4993	Credit reporting, credit repair services, or o...	I filed investigation for collection account o...
5507	Credit reporting, credit repair services, or o...	i have reached out to XXXX on several attempts...
12748	Credit reporting, credit repair services, or o...	In a letter dated XX/XX/2019 addressed to XXXX...
5690	Credit reporting, credit repair services, or o...	This was not me. I had identity theft 2 years ...
4670	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX, XXXX. filled suit claiming I o...
2132	Credit reporting, credit repair services, or o...	I am writing concerning a {$210.00} balance re...
2437	Credit reporting, credit repair services, or o...	I'am XXXX and a victim of identity theft.I w...
18499	Credit reporting, credit repair services, or o...	XXXX Account # XXXX has not been updated since...
18417	Credit reporting, credit repair services, or o...	XX/XX/2018 at XXXX XXXX. I contacted Amsher Co...
17698	Credit reporting, credit repair services, or o...	TransUnion reporting collections debt over 7 y...
1905	Credit reporting, credit repair services, or o...	Ive tried contacting XXXX to let them know tha...
3575	Credit reporting, credit repair services, or o...	A debt in the amount of {$3000.00} from Nation...
9920	Credit reporting, credit repair services, or o...	Collection agency XXXX XXXX XXXX XXXX XXXX fir...
4996	Credit reporting, credit repair services, or o...	To Whom It May Concern : I am trying to resolv...
6678	Credit reporting, credit repair services, or o...	on XX/XX/XXXXa confirmation that a dispute i h...
3514	Credit reporting, credit repair services, or o...	I was reviewing my Credit Report and I noticed...
13684	Credit reporting, credit repair services, or o...	In 2016 I filled litigation with my bankruptcy...
11180	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX XXXX agree to remove the collec...
11206	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX account number XXXX for {$18000...
6873	Credit reporting, credit repair services, or o...	Although this dated collection from XX/XX/XXXX...
15275	Credit reporting, credit repair services, or o...	On the XXXX of XXXX I applied and pay the app ...

	Product	Consumer_complaint_narrative
7654	Credit reporting, credit repair services, or o...	I have a documentation from the state of Wisco...

'Credit card or prepaid card' predicted as 'Debt collection' : 7 examples.

	Product	Consumer_complaint_narrative
17047	Credit card or prepaid card	Due to miscommunication with Ideal Image and X...
9866	Credit card or prepaid card	XXXX, XXXX SOC SEC # XXXX DOB XX/XX/XXXX ADDRE...
1217	Credit card or prepaid card	Sometime several years ago I began getting sta...
12616	Credit card or prepaid card	yes I provided citi bank with all the proof fr...
1956	Credit card or prepaid card	I had opened an Wells Fargo secured credit car...
8599	Credit card or prepaid card	Sears Card. Sears did not answer when I disput...
15669	Credit card or prepaid card	An online purchase was made on XXXX/XXXX/2017 ...

'Mortgage' predicted as 'Debt collection' : 6 examples.

	Product	Consumer_complaint_narrative
1820	Mortgage	My ex-husband and I took out a second mortgage...
5756	Mortgage	I want to refinance my Mortgage but Select Por...
9095	Mortgage	COMPLAINT # XXXXAfter request for help from XX...
15673	Mortgage	On XXXX XXXX, 2015, I contacted my lender, Fla...
3310	Mortgage	XXXX/XXXX/15 here is a copy of the letter I se...
14961	Mortgage	Pacific Union XXXX County Clerk XXXX FL Police...

'Bank account or service' predicted as 'Debt collection' : 13 examples.

	Product	Consumer_complaint_narrative
16662	Bank account or service	On the following dates I used Navy Federal Cre...
16528	Bank account or service	On at least 5 previous occasions, I request Sc...
2816	Bank account or service	What justifies CEO XXXX XXXX To get such a lar...
10558	Bank account or service	I am a victim of ID Theft, I had two accounts ...
9112	Bank account or service	My account was closed by PNC Bank .... My acco...
15482	Bank account or service	My accounts were closed and {$260000.00} was t...
2302	Bank account or service	I requested to have my account closed and fund...
10583	Bank account or service	File against : PayPal Credit (Bill Me Later, ...
2917	Bank account or service	On XXXX/XXXX/XXXX I cashed a check at US Bank ...

	Product	Consumer_complaint_narrative
3080	Bank account or service	Union bank reported me to XXXX and ca n't tell...
16498	Bank account or service	On at least XXXX previous occasions, I request...
15824	Bank account or service	Dear Sir/Madam, After reviewing this document ...
17702	Bank account or service	I had an account with fifth third bank that I ...

'Credit reporting' predicted as 'Debt collection' : 23 examples.

	Product	Consumer_complaint_narrative
1727	Credit reporting	This company has a debt on my credit report th...
51	Credit reporting	XXXX addresses are here the I 've never lived ...
6764	Credit reporting	My cell phone contract ended XXXX of 2012 (? i...
4230	Credit reporting	Noticed some fraudulent stuff on my credit rep...
3440	Credit reporting	Experian is showing a debt from XXXX XXXX XXXX...
18333	Credit reporting	The below letters shows XXXX of many attempts ...
5541	Credit reporting	Consolidated Recovery System is reporting coll...
17482	Credit reporting	XXXX has reported a fraudulent debt, they alle...
13173	Credit reporting	After receiving a debt that I knew nothing of ...
10521	Credit reporting	XXXX took money from my credit card for paymen...
814	Credit reporting	The public record in question has been reporti...
1737	Credit reporting	I have repeatedly requested information/valida...
11120	Credit reporting	Experian has listed on my credit report a debt...
16588	Credit reporting	I have informed you that the XXXX account that...
7850	Credit reporting	There has been an bankrupty on my account that...
18250	Credit reporting	My credit report shows I have an outstanding d...
6185	Credit reporting	Equifax , XXXX and XXXX continue to list and u...
6623	Credit reporting	I do not owe this company any money. I never r...
17681	Credit reporting	I HAVE SENT IN NUMEROUS CERTIFIED MAIL TO ALL ...
11425	Credit reporting	This account was included in a bankruptcy and ...
2443	Credit reporting	I request and update on my credit report throu...
7408	Credit reporting	I have disputed with all XXXX credit reporting...
18114	Credit reporting	Equifax Information Services , LLC XXXX. XXXX ...

'Student loan' predicted as 'Debt collection' : 9 examples.

	Product	Consumer_complaint_narrative

	Product	Consumer_complaint_narrative
12508	Student loan	The lender continues to attempt to collect on ...
8833	Student loan	My student loan has been transferred to variou...
9442	Student loan	Got set up with XXXX XXXX in XXXX NY at age XX...
10131	Student loan	I was in a Chapter XXXX bankruptcy that was XX...
12064	Student loan	An appeal dispute was reissued after a plausib...
1814	Student loan	I am co signer on daughters loan and daughter ...
12313	Student loan	I am the cosigner on this loan. Current balanc...
4796	Student loan	Lawsuit filed against me onXX/XX/2016. \nCAN N...
17265	Student loan	I called American Education ServicesXXXX for a...

'Checking or savings account' predicted as 'Debt collection' : 6 examples.

	Product	Consumer_complaint_narrative
2592	Checking or savings account	On XX/XX/XXXX, a legal order was put on my acc...
5667	Checking or savings account	FACT : My name is XXXX XXXX. On XX/XX/XXXX, Ba...
5187	Checking or savings account	I have a savings account with XXXX XXXX Bank a...
116	Checking or savings account	The bank keeps charging me fees of {$30.00} a ...
321	Checking or savings account	On XX/XX/XXXX I wrote a check to XXXX XXXX for...
8175	Checking or savings account	My father, XXXX XXXX XXXX, opened a savings ac...

'Consumer Loan' predicted as 'Debt collection' : 12 examples.

	Product	Consumer_complaint_narrative
1274	Consumer Loan	In or around XXXX XXXX I was laid off and soon...
2523	Consumer Loan	I leased a brand new vehicle and in XXXX 2016,...
14783	Consumer Loan	This was for a XXXX bill in Nevada, which I be...
473	Consumer Loan	I had a car that was financed through Chrysler...
9478	Consumer Loan	I have a car loan with American Credit Accepta...
12241	Consumer Loan	Republic Finance agreed to a reduced payment a...
11933	Consumer Loan	I have a car loan that is through Santander Co...
14179	Consumer Loan	On, XXXX/XXXX/2015 I received a phone call fro...
1086	Consumer Loan	Three years ago, roughly, I partially applied ...
878	Consumer Loan	On XX/XX/XXXX I leased a car through Nissan. X...
10252	Consumer Loan	My husband is constantly getting phone calls f...
12953	Consumer Loan	I continue to get automated calls to my work c...

'Payday loan, title loan, or personal loan' predicted as 'Debt collection' : 7 examples.

	Product	Consumer_complaint_narrative
10690	Payday loan, title loan, or personal loan	I recieved an installment loan from spot loan....
11400	Payday loan, title loan, or personal loan	Garnishment Notification and Arrest Notice LEG...
1219	Payday loan, title loan, or personal loan	I fell Behind on my be payment.. the CSR calle...
7776	Payday loan, title loan, or personal loan	I had a loan with myloansite.com. I had issues...
17386	Payday loan, title loan, or personal loan	I hit a hard time with finances when my husban...
15188	Payday loan, title loan, or personal loan	XX/XX/2017 I took out a XXXX loan from speedyc...
5049	Payday loan, title loan, or personal loan	I contacted One Main Financial for an installm...

'Credit card' predicted as 'Credit card or prepaid card' : 18 examples.

	Product	Consumer_complaint_narrative
3718	Credit card	American Express will not allow me to pay off ...
8733	Credit card	I was a cardholder of Chase Saphire Preffered ...
5548	Credit card	American Express credit cards have a benefit c...
10417	Credit card	I was at XXXX XXXX to purchase appliances on X...
6644	Credit card	I applied for a chase marriott rewards card th...
15342	Credit card	I recently applied for a Chase freedom card. I...
1667	Credit card	I have applied and was approved for a new XXXX...
5913	Credit card	I am submitting a complaint about Lowes ' Stor...
4738	Credit card	I responded to an email I received that appear...
2617	Credit card	Since XXXX XXXX, I have made payments to the M...
18804	Credit card	I have tried unsuccessfully with Bank Of Ameri...
3454	Credit card	Identity thieves have obtained sufficient info...
70	Credit card	I suffered a work-related injury in XXXX and a...
18346	Credit card	I was contacted via email by my American Expre...
15575	Credit card	My mother, XXXX XXXX, opened a Capital One sec...
1402	Credit card	I first obtained this credit card in approxima...
3534	Credit card	On XXXX my financial institution sent an elect...
8912	Credit card	I was activated and protected under XXXX durin...

'Checking or savings account' predicted as 'Credit card or prepaid card' : 7 examples.

	Product	Consumer_complaint_narrative
10812	Checking or savings account	On XXXX XXXX 2017, I opened a business account...
15023	Checking or savings account	Dear CFPB, Thank you very for helping me regar...
18613	Checking or savings account	Claim number XXXX. I disputed a charge and Ban...
11137	Checking or savings account	Below sent to Bank in PDF letter To whom it ma...
18375	Checking or savings account	TD Bank goes out of their way to find creative...
13501	Checking or savings account	on XX/XX/2018 i contacted XXXX XXXX about a un...
3651	Checking or savings account	In XX/XX/XXXX we realized our debit cards were...

'Credit reporting, credit repair services, or other personal consumer reports' predicted as 'Mortgage' : 13 examples.

	Product	Consumer_complaint_narrative
10540	Credit reporting, credit repair services, or o...	XXXX XXXX respond to the complaint, and only r...
8587	Credit reporting, credit repair services, or o...	I was closing on a refinance Va Loan on XX/XX/...
15703	Credit reporting, credit repair services, or o...	My mortgage was sold 4 times since original pu...
5897	Credit reporting, credit repair services, or o...	Hello, My wife and I just moved to XXXX, WA fo...
10783	Credit reporting, credit repair services, or o...	I had a mortgage with XXXX XXXX XXXX undergoin...
2923	Credit reporting, credit repair services, or o...	My wife and I filled chapter XXXX bankruptcy a...
404	Credit reporting, credit repair services, or o...	Fifth 3rd Bank has listed in credit reports th...
8968	Credit reporting, credit repair services, or o...	XXXX XXXX, XXXX First of all, thank you, whom ...
3285	Credit reporting, credit repair services, or o...	I have the XXXX XXXX and it need my capital on...
11868	Credit reporting, credit repair services, or o...	I was mistakenly reported 30 days late and 60 ...
5909	Credit reporting, credit repair services, or o...	I have a mortgage with US BANK and i am curren...
6971	Credit reporting, credit repair services, or o...	XXXX Mortgage compnay transferred my mortgage ...
4203	Credit reporting, credit repair services, or o...	On XX/XX/XXXX I call Preferred Credit to pay o...

'Debt collection' predicted as 'Mortgage' : 9 examples.

	Product	Consumer_complaint_narrative
5687	Debt collection	Please note that the issue we are having is no...
4333	Debt collection	My ex husband refinanced his house on XX/XX/XX...
13680	Debt collection	This pertains to Selene Finance, the mortgage ...
17986	Debt collection	Loan was a home I purchased in XXXX XXXX NV. L...
10644	Debt collection	I am applying for a mortgage ; the debt collec...
10028	Debt collection	Reverse Mortgage Solutions Inc. by and through...
11122	Debt collection	I paid off my timeshare loan ({$2100.00}) wi...
541	Debt collection	I am a XXXX XXXX old unemployed and XXXX indiv...

	Product	Consumer_complaint_narrative
6556	Debt collection	Received a call about a charge off and I reque...

'Bank account or service' predicted as 'Mortgage' : 6 examples.

	Product	Consumer_complaint_narrative
6657	Bank account or service	Case number : XXXX I do not have any response ...
10889	Bank account or service	My wife and I applied for a Home Equity Line o...
5887	Bank account or service	My mortgage is due the XXXX of each month as u...
9406	Bank account or service	Bank of America (XXXX) will not close the cl...
9436	Bank account or service	We are seeking your assistance as an advocate ...
11138	Bank account or service	The representatives of XXXX went to Wells Farg...

'Checking or savings account' predicted as 'Bank account or service' : 14 examples.

	Product	Consumer_complaint_narrative
424	Checking or savings account	Chase is the bank I will no longer bank with. ...
6936	Checking or savings account	Hello, I opened Citibank Account Package on XX...
2878	Checking or savings account	I deposited a Business Check written to myself...
16414	Checking or savings account	On XX/XX/XXXX US BANK I had a balance of XXXX ...
11650	Checking or savings account	The card i own was stolen and account hacked. ...
9402	Checking or savings account	Citibank does not properly disclosure how the ...
9104	Checking or savings account	I am a freshman at XXXX College. I opened a st...
17899	Checking or savings account	I have a complaint regarding your ATM machine ...
1056	Checking or savings account	Im continuously harassed while at Wells Fargo ...
3147	Checking or savings account	On XXXX/XXXX/XXXX SUNTRUST, my bank took out a...
14908	Checking or savings account	ON XX/XX/XXXX I DEPOSITED ACHASHIER CHECK IN T...
13866	Checking or savings account	This is a follow up complaint regarding CFPB C...
8162	Checking or savings account	I used my card on Thursday XX/XX/XXXX to make ...
14595	Checking or savings account	5 fraudulent charges to my debit card at five ...

'Credit reporting, credit repair services, or other personal consumer reports' predicted as 'Credit reporting' : 13 examples.

	Product	Consumer_complaint_narrative
7240	Credit reporting, credit repair services, or o...	Address is incorrect on my credit report. I ha...

	Product	Consumer_complaint_narrative
3655	Credit reporting, credit repair services, or o...	Equifax continues to report that collections f...
12629	Credit reporting, credit repair services, or o...	I have requested corrections to my personal in...
10435	Credit reporting, credit repair services, or o...	Transunion has placed a tradeline on my credit...
10557	Credit reporting, credit repair services, or o...	This complaint is about my credit score. The ...
17097	Credit reporting, credit repair services, or o...	I have 5 accounts that are on my credit file t...
15067	Credit reporting, credit repair services, or o...	My case for X/X/2010 should not even be on my ...
14764	Credit reporting, credit repair services, or o...	XXXX XXXX XXXX reports MONTHLY on all XX...
205	Credit reporting, credit repair services, or o...	PLEASE REMOVE XXXX XXXX OFF AUTH USER. SS # XX...
12498	Credit reporting, credit repair services, or o...	On XX/XX/2019 I sent a letter to transunion re...
3676	Credit reporting, credit repair services, or o...	On today I spoke with XXXX who said he was a s...
18567	Credit reporting, credit repair services, or o...	I contacted the XXXX credit bureau to make u...
4866	Credit reporting, credit repair services, or o...	I was doing an annual credit report update and...

'Debt collection' predicted as 'Student loan' : 7 examples.

	Product	Consumer_complaint_narrative
14101	Debt collection	My signature was copied and used on a promisso...
5121	Debt collection	I received a letter from GC Services Limited P...
12215	Debt collection	I am writing to file a complaint against Abili...
5823	Debt collection	i am a college student every year i apply for ...
5916	Debt collection	This company contacted my employer without my ...
5388	Debt collection	I consolidated my loans through FedLoan Servic...
18403	Debt collection	I enter into a payment plan but it was impossi...

'Bank account or service' predicted as 'Checking or savings account' : 31 examples.

	Product	Consumer_complaint_narrative

	Product	Consumer_complaint_narrative
13765	Bank account or service	Over {$63.00} was taken from my Comerica check...
16123	Bank account or service	I went to a XXXX ATM and made a deposit. It wa...
14897	Bank account or service	My family and I have had the worst experience ...
15194	Bank account or service	I have XXXX accounts with Wells Fargo. I was t...
16838	Bank account or service	I came across promotional banner on Citibank w...
4661	Bank account or service	A trustee withdrew all money from a checking a...
17374	Bank account or service	We had a XXXX XXXX walk away from us in the mi...
4602	Bank account or service	This company took {$300.00} out of my checking...
1432	Bank account or service	CHASE Bank sent me a letter indicating that it...
3832	Bank account or service	submitted my retirement check to bank through ...
5545	Bank account or service	On XX/XX/2016 I used my US Bank ATM card to wi...
11684	Bank account or service	I thought that I had an online banking account...
13687	Bank account or service	Sun Trust Bank has been arranging it 's deduct...
9888	Bank account or service	I closed my account in person at the XXXX, NJ ...
16114	Bank account or service	I made a wire transfer of XXXX {$2500.00} to m...
9034	Bank account or service	Hello - I write this in the hopes it helps oth...
4987	Bank account or service	Wells Fargo opened XXXX debit cards under my X...
12739	Bank account or service	I am contacting you for assistance in initiati...
14758	Bank account or service	On XXXX XXXX I made a " CASH " deposit of {$5...
13661	Bank account or service	I deposited my refund check from the IRS. My b...
18521	Bank account or service	Capital One 360 is my retail bank. XX/XX/2016,...
8737	Bank account or service	I went to my local credit union and applied fo...
2691	Bank account or service	I deposited a XXXX loan check via the app and ...
12610	Bank account or service	On XXXX/XXXX/16 I went into a Wells Fargo bran...
2190	Bank account or service	Received a Chase Quick pay for move in payment...
5042	Bank account or service	I had made a deposit into my account with Jp M...
4152	Bank account or service	I got employed by the company in XXXX 2015. I ...
8535	Bank account or service	Wells Fargo " lost " over {$2400.00} in funds...
5526	Bank account or service	I OPENED A TD BANK ACCOUNT XXXX XXXX, 2015, WI...
2222	Bank account or service	The bank sent my money to the wrong account th...
1073	Bank account or service	I have double charges by merchants, and very l...

'Money transfer, virtual currency, or money service' predicted as 'Checking or savings account' : 7 examples.

	Product	Consumer_complaint_narrative
11885	Money transfer, virtual currency, or money ser...	I previously tried to remove my bank account t...

	Product	Consumer_complaint_narrative
18194	Money transfer, virtual currency, or money ser...	Someone fraudulently collected {$290.00}, {$40...
17913	Money transfer, virtual currency, or money ser...	Reference ID : XXXX I received an email statin...
13450	Money transfer, virtual currency, or money ser...	Citizens Bank allowed approximately {$3000.00}...
1753	Money transfer, virtual currency, or money ser...	I started using heartland payment systems comp...
14878	Money transfer, virtual currency, or money ser...	Dear XXXX, This is XXXX XXXX, my family is a v...

'Consumer Loan' predicted as 'Vehicle loan or lease' : 6 examples.

	Product	Consumer_complaint_narrative
9063	Consumer Loan	Today Ally financial sent and order to XXXX XX...
15309	Consumer Loan	I bought a car originally through a dealership...
2841	Consumer Loan	I co signed a car loan with my husband XXXX XX...
14456	Consumer Loan	miss lead by sells rep during time of purchase...
13984	Consumer Loan	after months of trying to work with USAA to st...
12253	Consumer Loan	My problems began with Santander Consumer USA ...

In [24]:
```
model.fit(features, labels)
```

Out[24]:
```
LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
          intercept_scaling=1, loss='squared_hinge', max_iter=1000,
          multi_class='ovr', penalty='l2', random_state=None, tol=0.0001,
          verbose=0)
```

```
In [25]:  from sklearn.feature_selection import chi2

          N = 2
          for Product, category_id in sorted(category_to_id.items()):
            indices = np.argsort(model.coef_[category_id])
            feature_names = np.array(tfidf.get_feature_names())[indices]
            unigrams = [v for v in reversed(feature_names) if len(v.split(' ')) == 1][:N]
            bigrams = [v for v in reversed(feature_names) if len(v.split(' ')) == 2][:N]
            print("# '{}':".format(Product))
            print("  . Top unigrams:\n       . {}".format('\n       . '.join(unigrams)))
            print("  . Top bigrams:\n       . {}".format('\n       . '.join(bigrams)))
```

```
# 'Bank account or service':
  . Top unigrams:
       . scottrade
       . bank
  . Top bigrams:
       . xxxx 15
       . nsf fees
# 'Checking or savings account':
  . Top unigrams:
       . bank
       . fees
  . Top bigrams:
       . savings account
       . unable open
# 'Consumer Loan':
  . Top unigrams:
       . vehicle
       . finance
  . Top bigrams:
       . auto finance
       . inquires credit
# 'Credit card':
  . Top unigrams:
       . card
       . citi
  . Top bigrams:
       . credit card
       . synchrony bank
# 'Credit card or prepaid card':
  . Top unigrams:
       . card
       . external
  . Top bigrams:
       . balance transfer
       . citi bank
# 'Credit reporting':
  . Top unigrams:
       . experian
       . disputed
  . Top bigrams:
       . xxxx bureaus
       . incorrect addresses
# 'Credit reporting, credit repair services, or other personal consumer report
s':
```

. Top unigrams:
    . report
    . freeze
. Top bigrams:
    . xxxx xxxx
    . transunion xxxx
'Debt collection':
  . Top unigrams:
      . debt
      . collection
  . Top bigrams:
      . account victim
      . account opened
'Money transfer, virtual currency, or money service':
  . Top unigrams:
      . coinbase
      . paypal
  . Top bigrams:
      . pay overdraft
      . paypal account
'Money transfers':
  . Top unigrams:
      . money
      . google
  . Top bigrams:
      . refund money
      . company keeps
'Mortgage':
  . Top unigrams:
      . mortgage
      . escrow
  . Top bigrams:
      . mortgage payment
      . mortgage company
'Other financial service':
  . Top unigrams:
      . period
      . impression
  . Top bigrams:
      . money order
      . twice month
'Payday loan':
  . Top unigrams:
      . cash
      . net
  . Top bigrams:
      . calls received
      . loan services
'Payday loan, title loan, or personal loan':
  . Top unigrams:
      . loan
      . remove
  . Top bigrams:
      . 00 loan
      . line credit
'Prepaid card':
  . Top unigrams:

```
          . rush
          . cards
        . Top bigrams:
            . rush card
            . cards xxxx
    # 'Student loan':
      . Top unigrams:
          . navient
          . loans
      . Top bigrams:
          . sallie mae
          . fedloan servicing
    # 'Vehicle loan or lease':
      . Top unigrams:
          . car
          . gm
      . Top bigrams:
          . gm financial
          . response given
```

In [26]:
```python
texts = ["I requested a home loan modification through Bank of America. Bank of A
         "It has been difficult for me to find my past due balance. I missed a r
         "I can't get the money out of the country.",
         "I have no money to pay my tuition",
         "Coinbase closed my account for no reason and furthermore refused to gi
text_features = tfidf.transform(texts)
predictions = model.predict(text_features)
for text, predicted in zip(texts, predictions):
  print('"{}"'.format(text))
  print("  - Predicted as: '{}'".format(id_to_category[predicted]))
  print("")
```

```
"I requested a home loan modification through Bank of America. Bank of America
never got back to me."
  - Predicted as: 'Mortgage'

"It has been difficult for me to find my past due balance. I missed a regular m
onthly payment"
  - Predicted as: 'Credit reporting, credit repair services, or other personal
consumer reports'

"I can't get the money out of the country."
  - Predicted as: 'Debt collection'

"I have no money to pay my tuition"
  - Predicted as: 'Debt collection'

"Coinbase closed my account for no reason and furthermore refused to give me a
reason despite dozens of request"
  - Predicted as: 'Money transfer, virtual currency, or money service'
```

```
In [27]: from sklearn import metrics
         print(metrics.classification_report(y_test, y_pred,
                                target_names=df['Product'].unique()))
```

                                                                               p
            recision   recall f1-score   support

                                                                     Credit card
            0.51   0.51   0.51   89
    Credit reporting, credit repair services, or other personal consumer reports
            0.70   0.82   0.76   552
                                                                 Debt collection
            0.72   0.85   0.78   453
                                                       Credit card or prepaid card
            0.56   0.45   0.50   117
                                                                         Mortgage
            0.78   0.95   0.86   211
                                                           Bank account or service
            0.51   0.31   0.38   95
                                                                 Credit reporting
            0.58   0.20   0.29   152
                                                                     Student loan
            0.80   0.84   0.82   90
                                                         Checking or savings account
            0.47   0.53   0.50   77
                                                             Vehicle loan or lease
            0.38   0.23   0.29   22
                                                                     Consumer Loan
            0.71   0.12   0.21   40
                                    Money transfer, virtual currency, or money service
            0.78   0.66   0.71   38
                                                                   Money transfers
            0.00   0.00   0.00   7
                                                                       Payday loan
            0.00   0.00   0.00   4
                                          Payday loan, title loan, or personal loan
            0.70   0.26   0.38   27
                                                             Other financial service
            0.00   0.00   0.00   1
                                                                     Prepaid card
            1.00   0.20   0.33   5

                                                                         accuracy
            0.68   1980
                                                                        macro avg
            0.54   0.41   0.43   1980
                                                                     weighted avg
            0.67   0.68   0.66   1980

    C:\Users\Dell\Anaconda3\lib\site-packages\sklearn\metrics_classification.py:12
    68: UndefinedMetricWarning: Precision and F-score are ill-defined and being set
    to 0.0 in labels with no predicted samples. Use `zero_division` parameter to co
    ntrol this behavior.
      _warn_prf(average, modifier, msg_start, len(result))

==========================

End of Part 1

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In [ ]: