Partners:

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In [ ]:

```

```

Reading Data; Data Prep.

In [444]:

```
import os
import pandas as pd
import numpy as np
import seaborn as sns
import json
import re
```

In [2]:

```
os.listdir()
```

Out[2]:

```
['sample.reviews.json',
 'GOOGLE LOCAL.ipynb',
 'reviews.clean.json',
 'users.clean.json',
 '.ipynb_checkpoints',
 'places.clean.json']
```

In [11]:

```
def parseData(fname):
    data = []
    with open(fname,'rb') as f:
        for l in f.readlines():
            data.append(eval(l))
    return data
```

In [18]:

```
reviews = []
with open('sample.reviews.json') as f:
    reviews = json.load(f)
```

In [20]:
```
review_df = pd.DataFrame(reviews)
```

In [21]:
```
user = parseData('users.clean.json')
```

In [22]:
```
user_df = pd.DataFrame(user)
```

In [23]:
```
places = parseData('places.clean.json')
```

In [24]:
```
places_df = pd.DataFrame(places)
```

In [ ]:
```

```

In [ ]:
```

```

We notice that more than 90% of the reviews have unique ids, which means that a lot of those users are

inactive users, which is meaningless to analyze, thus we clean the data by ensuring that the each user and place

have more than 3 comments.

In [44]:
```
# Select Active User
user_count = review_df['gPlusUserId'].value_counts()
active_user_id = user_count.where(user_count >3).dropna().index
# Select Active Places
place_count = review_df['gPlusPlaceId'].value_counts()
active_place_id = place_count.where(place_count >3).dropna().index
```

In [ ]:
```
## Valid User df and valid place df are those with active ids with active reviews
```

In [26]:
```
valid_user_df = user_df[user_df['gPlusUserId'].isin(active_user_id)]
```

In [295]:
```
valid_place_df = places_df[places_df['gPlusPlaceId'].isin(active_place_id)]
```

In [ ]:
```
## select reviews with both user and places being active
```

```
In [27]: valid_review_df = review_df[review_df['gPlusUserId'].isin(active_user_
         id) & review_df['gPlusPlaceId'].isin(active_place_id)]
```

```
In [30]: valid_review_df.shape

Out[30]: (5801, 8)
```

```
In [ ]: ## Drop those not inside user_df and places_df
```

```
In [34]: valid_review_df_dropped = valid_review_df[valid_review_df['gPlusUserId
         '].isin(user_df['gPlusUserId']) & \
                                                     valid_review_df['gPlusPlaceI
         d'].isin(places_df['gPlusPlaceId'])]
```

```
In [47]: valid_user_df.shape

Out[47]: (5929, 6)
```

```
In [296]: valid_place_df.shape

Out[296]: (7298, 8)
```

```
In [49]: valid_review_df_dropped.shape

Out[49]: (4461, 8)
```

Task

Task: We focus on predict the rating given a pair of random user and place.

Business Insight: If we can predict how likely a user would like a random place based on user's activities history and the characteristic of the place, we can recommend the places to users by ranking the ratings of places around them.

BaseLine Model

BaseLine Model: we predict the rating by the mean of average rating of the user and the average rating of the place with equal weights.

In [50]:
```
from sklearn.utils import shuffle
df = shuffle(valid_review_df_dropped)
size = len(df)
train_data = df[:int(size * 0.8)]
validate_data = df[int(size * 0.8): int(size * 0.9)]
test_data = df[int(size * 0.9):]
```

In [51]:
```
user_rating_avg = train_data.groupby('gPlusUserId')['rating'].mean().t
o_dict()
place_rating_avg = train_data.groupby('gPlusPlaceId')['rating'].mean()
.to_dict()
total_avg = train_data['rating'].mean()
```

In [52]:
```
def predict(row):
    hasUser = row['gPlusUserId'] in user_rating_avg.keys()
    hasPlace = row['gPlusPlaceId'] in place_rating_avg.keys()
    if hasUser and hasPlace:
        return (user_rating_avg[row['gPlusUserId']] + place_rating_avg
[row['gPlusPlaceId']]) / 2
    elif hasUser:
        return user_rating_avg[row['gPlusUserId']]
    elif hasPlace:
        return place_rating_avg[row['gPlusPlaceId']]
    else:
        return total_avg
predictions = validate_data.apply(predict, axis = 1)
((validate_data['rating'] - predictions) ** 2).mean()
```

Out[52]:
```
0.8264152661431119
```

In [ ]:

Feature Engineering and Feature Augumentation and Data Imputation

User DataFrame

Deal with hours:

Here we get opening hours, closing hours, length of opening and days of opening per week from the original "hours" column by feature augmentation.

In [298]:

```
open_times = []
close_times = []
num_dayss = []

existence = valid_place_df['hours'].isna()

for i in range(len(valid_place_df)):

    l = valid_place_df['hours'].iloc[i]

    if existence.iloc[i]:
        open_times.append(np.nan)
        close_times.append(np.nan)
        num_dayss.append(np.nan)
        continue
    num_days = len(l)

    open_time = []
    close_time = []
    opening_time_lst = [day[1][0][0] for day in l]
    for time in opening_time_lst:
        if '24' in time:
            open_time.append(0)
            close_time.append(24)

        if '-' in time:
            open_time_str = time.split('-')[0]
            close_time_str = time.split('-')[2]
            open_time_num = 0
            close_time_num = 0

            if 'am' in open_time_str:
                open_time_num = int(open_time_str[:-6])
            elif 'pm' in open_time_str:
                open_time_num = int(open_time_str[:-6]) + 12
            else:
                continue
            open_time.append(open_time_num)

            if 'am' in close_time_str:
                close_time_num = int(close_time_str[:-6])
            elif 'pm' in close_time_str:
                close_time_num = int(close_time_str[:-6]) + 12
            else:
                continue
            close_time.append(close_time_num)
    avg_open_time = np.mean(open_time)
    open_times.append(avg_open_time)
    avg_close_time = np.mean(close_time)
    close_times.append(avg_close_time)
    num_dayss.append(num_days)
```

```
/anaconda3/lib/python3.7/site-packages/numpy/core/fromnumeric.py:292
0: RuntimeWarning: Mean of empty slice.
  out=out, **kwargs)
/anaconda3/lib/python3.7/site-packages/numpy/core/_methods.py:85: Ru
ntimeWarning: invalid value encountered in double_scalars
  ret = ret.dtype.type(ret / rcount)
```

In [299]:

```
valid_place_df['open_times'] = open_times
valid_place_df['close_times'] = close_times
valid_place_df['num_days'] = num_dayss
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:1: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:2: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy

/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:3: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  This is separate from the ipykernel package so we can avoid doing
imports until
```

deal with price

```
In [301]: valid_place_df['price_size'] = valid_place_df['price'].apply(lambda x:
          0 if x is None else len(x))
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:1: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

deal with phone number by checking availablility of phone number

```
In [303]: valid_place_df['phone_available'] = 1 - valid_place_df['phone'].isna()
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:1: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

```
In [304]: valid_place_df['num_hours_opening'] = valid_place_df['close_times'] -
          valid_place_df['open_times']
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:1: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

Data imputation of filling missing values.

In [305]:

```
val = valid_place_df['open_times'].loc[valid_place_df['open_times'].notna()].mean()
valid_place_df['open_times'].fillna(val, inplace = True)
```

In [306]:

```
val = valid_place_df['close_times'].loc[valid_place_df['close_times'].notna()].mean()
valid_place_df['close_times'].fillna(val, inplace = True)
val = valid_place_df['num_days'].loc[valid_place_df['num_days'].notna()].mean()
valid_place_df['num_days'].fillna(val, inplace = True)
val = valid_place_df['num_hours_opening'].loc[valid_place_df['num_hours_opening'].notna()].mean()
valid_place_df['num_hours_opening'].fillna(val, inplace = True)
```

In [311]:

```
val = valid_place_df['price_size'].loc[valid_place_df['price_size'] != 0].mean()
```

In [313]:

```
valid_place_df['price_size'].replace(0, val,inplace = True)
```

```
/anaconda3/lib/python3.7/site-packages/pandas/core/generic.py:5890:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-versus-copy
  self._update_inplace(new_data)
```

In [324]:

```
cleaned_place_df = valid_place_df
```

In [325]:

```
cleaned_place_df.set_index('gPlusPlaceId', inplace=True)
```

In [326]:

```
final_place_df = cleaned_place_df[cleaned_place_df.columns[7:]]
```

In [327]:

```
val = final_place_df['price_size'].loc[final_place_df['price_size'] != 0].mean()
```

In [328]:

```
final_place_df['price_size'] = final_place_df['price_size'].replace(to
_replace = 0, value = val)
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:1: Sett
ingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

In [332]:

```
valid_user_df.set_index('gPlusUserId', inplace=True)
```

In [ ]:

In [333]:

```
merged = valid_review_df_dropped.merge(final_place_df, right_index=Tru
e, left_on = 'gPlusPlaceId', how = 'left')
```

In [334]:

```
user_interested_cols = ['open_times', 'close_times', 'num_days', 'pric
e_size', 'num_hours_opening']
```

In [335]:

```
user_avg_info = merged.groupby('gPlusUserId')[user_interested_cols].me
an()
```

In [337]:

```
final_user_df = user_avg_info.copy()
```

In [ ]:

In [361]:

```
words = []
for cat in list(valid_review_df_dropped.categories.values):
    if cat is not None:
        for l in cat:

            for s in l.split():
                if len(re.findall(r'[a-zA-Z]', s)) > 0:
                    words.append(s)
cat_counts = pd.Series(words).value_counts()
common_cat = list(cat_counts.where(cat_counts > 100).dropna().index)
```

In [362]:

```
df = valid_review_df_dropped#.dropna(subset = ['categories'])#.loc[val
id_review_df_dropped['gPlusUserId'] == '110090296112763745586']
user_rating_cat = {}
for i in range(len(df)):
    row = df.iloc[i]
    if row['gPlusUserId'] not in user_rating_cat.keys():
        user_rating_cat[row['gPlusUserId']] = {}
        for cat in common_cat:
            user_rating_cat[row['gPlusUserId']][cat] = []
        user_rating_cat[row['gPlusUserId']]['Other'] = []
    #if row['gPlusUserId'] in user_rating_cat.keys():
    if row['categories'] is not None:
        for words in row['categories']:
            for w in words.split():
                if w in common_cat:
                    user_rating_cat[row['gPlusUserId']][w].append(row[
'rating'])
                else:
                    user_rating_cat[row['gPlusUserId']]['Other'].appen
d(row['rating'])
```

In [364]:

```
place_dict = {}
for i in range(len(df)):
    row = df.iloc[i]
    place = row['gPlusPlaceId']

    if place not in place_dict.keys():
        place_dict[place] = []
    if row['categories'] is not None:
        for s in row['categories']:
            for w in s.split():
                if w in common_cat:
                    place_dict[place].append(w)
                else:
                    place_dict[place].append('Other')
place_dict = {s:list(set(place_dict[s])) for s in place_dict.keys()}
```

Exploratory Data Analysis

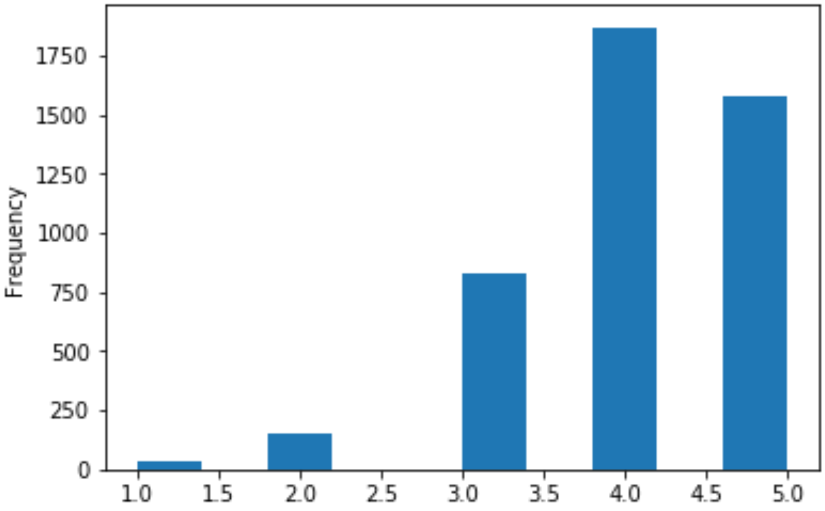
In [475]:

```
%matplotlib inline
rating = valid_review_df_dropped.rating
print(rating.describe())
rating.plot(kind='hist')
```

```
count    4461.000000
mean        4.076440
std         0.860041
min         1.000000
25%         4.000000
50%         4.000000
75%         5.000000
max         5.000000
Name: rating, dtype: float64
```

Out[475]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1a21617668>
```



In [476]:
```
final_place_df.describe()
```

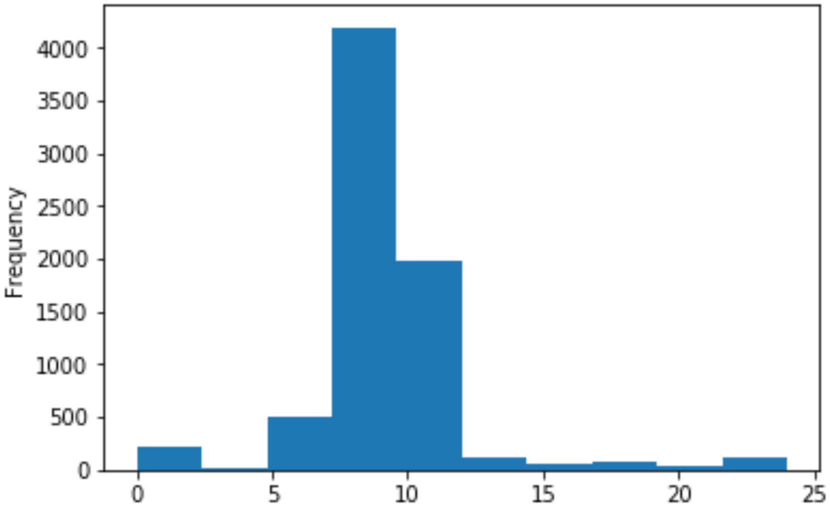
Out[476]:

	open_times	close_times	num_days	price_size	phone_available	num_hours_opening
count	7298.000000	7298.000000	7298.0	7298.000000	7298.000000	7298.000000
mean	9.486074	17.355601	7.0	2.057252	0.950945	7.869528
std	2.955122	4.815404	0.0	0.325923	0.215997	6.730079
min	0.000000	1.000000	7.0	1.000000	0.000000	-23.000000
25%	9.000000	17.355601	7.0	2.057252	1.000000	7.869528
50%	9.486074	17.355601	7.0	2.057252	1.000000	7.869528
75%	10.000000	20.142857	7.0	2.057252	1.000000	11.000000
max	24.000000	24.000000	7.0	3.000000	1.000000	24.000000

In [483]:
```
import matplotlib.pyplot as plt
```

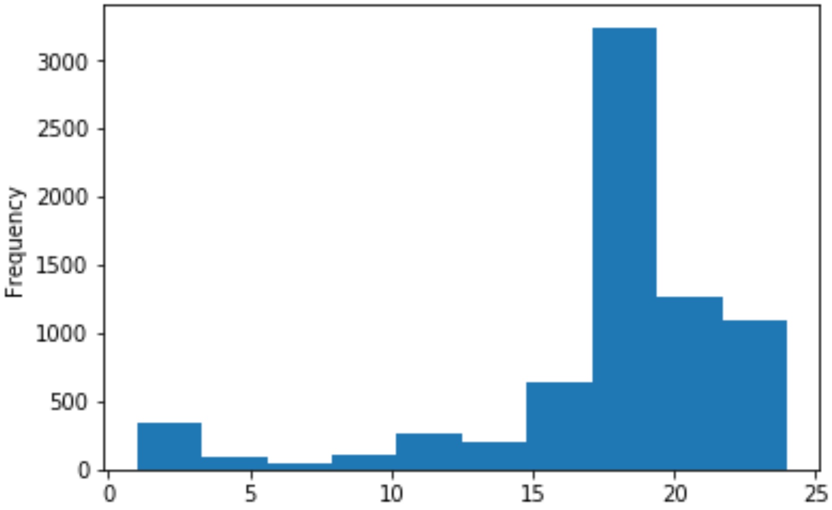
In [487]:
```
final_place_df.open_times.plot(kind='hist')
```

Out[487]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a219faac8>
```



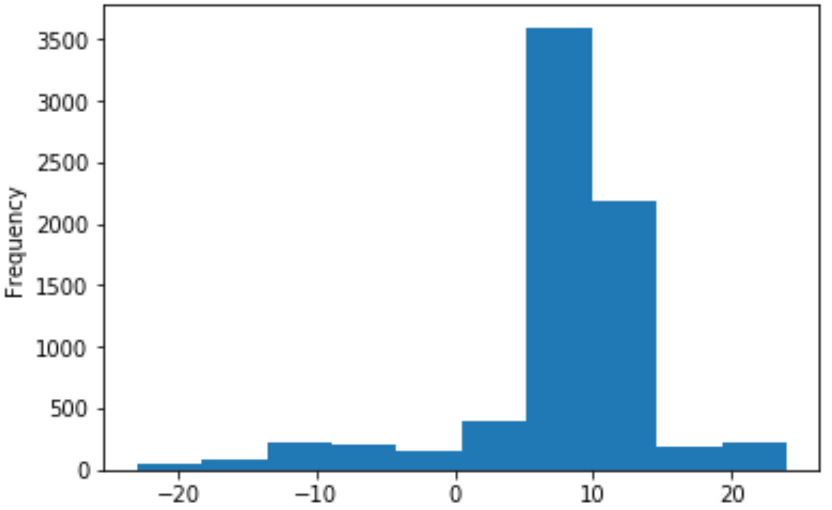
```
In [488]: final_place_df.close_times.plot(kind='hist')
```

```
Out[488]: <matplotlib.axes._subplots.AxesSubplot at 0x1a21aba518>
```



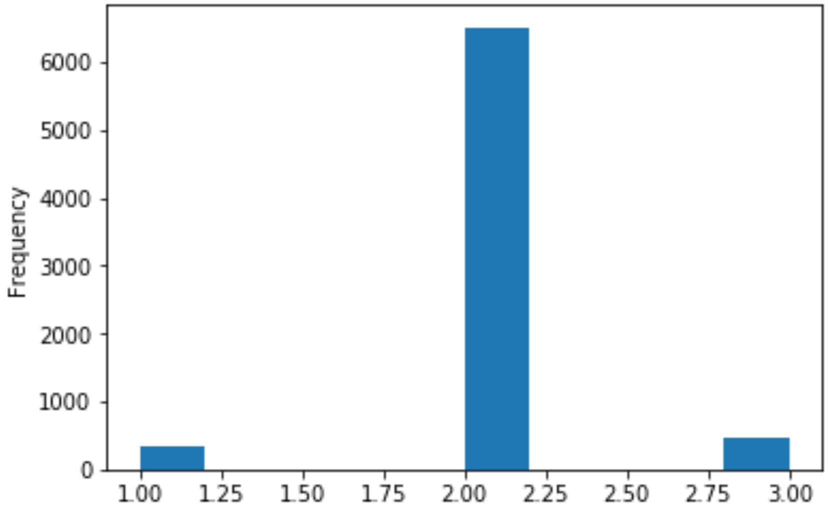
```
In [491]: final_place_df.num_hours_opening.plot(kind='hist')
```

```
Out[491]: <matplotlib.axes._subplots.AxesSubplot at 0x1a2250cbe0>
```



```
In [489]: final_place_df.price_size.plot(kind='hist')
```

```
Out[489]: <matplotlib.axes._subplots.AxesSubplot at 0x1a222f5ef0>
```



```
In [492]: final_user_df.describe()
```

Out[492]:

	open_times	close_times	num_days	price_size	num_hours_opening
count	2287.000000	2287.000000	2287.0	2287.000000	2287.000000
mean	9.953349	16.440953	7.0	2.039904	6.487604
std	3.101200	5.155286	0.0	0.393921	7.084057
min	0.000000	1.000000	7.0	1.000000	-22.714286
25%	9.142857	14.357143	7.0	2.000000	4.000000
50%	9.750000	17.355601	7.0	2.057252	7.869528
75%	11.000000	19.838900	7.0	2.057252	10.183096
max	24.000000	24.000000	7.0	3.000000	24.000000

```
In [ ]:
```

Extract Features

```
In [ ]:
```

```
In [493]: mean_rate= valid_review_df_dropped.rating.mean()
          avg_place_feat = list(final_place_df.mean().values)
```

```python
avg_user_feat = list(final_user_df.mean().values)
def feature(row):
    #print(1)
    # constant feature for wx+b
    u = row.iloc[0]
    p = row.iloc[1]
    datum = [1]
    # user data
    #print(4)
    if u in final_user_df.index:
        u_d = list(final_user_df.loc[u].values)
    else:
        u_d = avg_user_feat
    #print(3)
    #place data
    if p in final_place_df.index:
        p_d = list(final_place_df.loc[p].values)
    else:
        p_d = avg_place_feat
    # combined data
    cd = []
    cd += [u_d[0]-p_d[0]]
    cd += [u_d[1]-p_d[1]]
    cd += [u_d[3]-p_d[3]]
    cd += [u_d[4]-p_d[5]]
    cats = []
    if p in place_dict:
        cats = place_dict[p]
    total = []
    #print(2)
    if u in user_rating_cat:
        for c in cats:
            total += user_rating_cat[u][c]
        if len(total)>0:
            avg = np.mean(total)
        else:
            concat = np.concatenate(list(user_rating_cat[u].values()))
            if len(concat):
                avg = np.mean(concat)
            else:
                avg = mean_rate
    else:
        avg = mean_rate
#     print(datum)
#     print(u_d)
#     print(cd)
#     print(p_d)
    datum = datum + u_d + p_d +cd+[avg]
    return datum
```

In [440]:
```
Original_X = valid_review_df_dropped[['gPlusUserId','gPlusPlaceId']]
Y = valid_review_df_dropped.rating
Original_X.head()
```

Out[440]:

	gPlusUserId	gPlusPlaceId
213	110090296112763745586	107762553597304912662
234	102172401918858106420	111280162645644452653
305	113939131914163721697	105539817238070523193
508	109529024903466465111	103566537416444715680
669	104960884941951050236	105361852687606942835

In [439]:
```
X = Original_X.apply(feature,axis=1)
```

In [ ]:
```

```

Train Model and Predict

In [451]:
```
from sklearn.model_selection import train_test_split
from sklearn.svm import SVR
```

In [456]:
```
X_train, X_test, y_train, y_test = train_test_split(list(X), list(Y),
test_size=0.1)
```

In [459]:
```
clf = SVR()
clf.fit(X_train, y_train)
predictions = clf.predict(X_test)
# clf.score(X_test, y_test)
sum((predictions - y_test)**2) / len(y_test)
```

```
/anaconda3/lib/python3.7/site-packages/sklearn/svm/base.py:196: Futu
reWarning: The default value of gamma will change from 'auto' to 'sc
ale' in version 0.22 to account better for unscaled features. Set ga
mma explicitly to 'auto' or 'scale' to avoid this warning.
  "avoid this warning.", FutureWarning)
```

Out[459]:
```
0.27126172033829243
```

The Mean Squared Error here we got from the linear SVR regression is 0.27126, which is a big jump from our baseline model (MSE = 0.826)