In [34]:
```python
import pandas as pd
import numpy as np
import pickle
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import average_precision_score
import ml_metrics as metrics
import operator
```
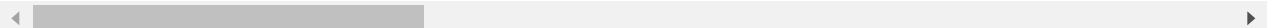
In [3]:
```python
df = pd.read_csv('data/hotel/train.csv',chunksize=100).get_chunk(100000)
df
```

Out[3]:

	date_time	site_name	posa_continent	user_location_country	user_location_region	user_location_c
0	2014-08-11 07:46:59	2	3	66	348	488
1	2014-08-11 08:22:12	2	3	66	348	488
2	2014-08-11 08:24:33	2	3	66	348	488
3	2014-08-09 18:05:16	2	3	66	442	353
4	2014-08-09 18:08:18	2	3	66	442	353
...	...	...	...	...	...	
99995	2013-04-01 14:26:31	37	1	69	612	30
99996	2013-04-01 17:01:22	37	1	69	612	30
99997	2013-04-01 17:04:26	37	1	69	612	30
99998	2013-04-01 17:05:01	37	1	69	612	30
99999	2013-04-01 18:15:01	37	1	69	612	30

100000 rows × 24 columns

In [4]:
```python
#check for null values
df.isnull().sum()
```

Out[4]:
```
date_time                        0
site_name                        0
posa_continent                   0
user_location_country            0
user_location_region             0
user_location_city               0
orig_destination_distance    36922
user_id                          0
is_mobile                        0
is_package                       0
channel                          0
srch_ci                         71
srch_co                         71
srch_adults_cnt                  0
srch_children_cnt                0
srch_rm_cnt                      0
srch_destination_id              0
srch_destination_type_id         0
is_booking                       0
cnt                              0
hotel_continent                  0
hotel_country                    0
hotel_market                     0
hotel_cluster                    0
dtype: int64
```

In [5]:
```python
#fill null with average and drop every other null that isn't too big
df.orig_destination_distance.fillna(df.orig_destination_distance.median(),inplace=True)
df.dropna(axis=0,inplace=True)
df.isnull().sum()
```

Out[5]:
```
date_time                   0
site_name                   0
posa_continent              0
user_location_country       0
user_location_region        0
user_location_city          0
orig_destination_distance   0
user_id                     0
is_mobile                   0
is_package                  0
channel                     0
srch_ci                     0
srch_co                     0
srch_adults_cnt             0
srch_children_cnt           0
srch_rm_cnt                 0
srch_destination_id         0
srch_destination_type_id    0
is_booking                  0
cnt                         0
hotel_continent             0
hotel_country               0
hotel_market                0
hotel_cluster               0
dtype: int64
```

In [6]:

```python
#still have similar data
len(df)
```

Out[6]: 99929

In [8]:
```python
#copy data
df2 = df.copy()

df.drop(["date_time","srch_ci","srch_co"],axis=1,inplace=True)

#X and Y
y = df.hotel_cluster.copy()
X=df.drop("hotel_cluster",axis=1).copy()
X[X.columns] = StandardScaler().fit_transform(X[X.columns])

#train split
xtrain,xtest,ytrain,ytest = train_test_split(X,y,random_state=0,stratify=y)
```

In [9]:
```python
try:
    with open('./log.pickle','rb') as f:
        logistic = pickle.load(f)

except:
    print('nope')
    logistic = LogisticRegression(solver='saga',max_iter=1000,verbose=True)
    logistic.fit(xtrain,ytrain)
```

nope

[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
convergence after 800 epochs took 663 seconds

[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed: 11.0min finished

In [10]:
```python
with open("log.pickle",'wb') as file:
    pickle.dump(logistic,file)
```

In [11]:
```python
ypred = logistic.predict_proba(xtest)
ypred
```

Out[11]:
```
array([[3.62835307e-02, 1.89748621e-02, 8.37763802e-03, ...,
        2.49219515e-02, 2.76096801e-02, 8.61009445e-03],
       [4.94452621e-03, 7.28883378e-03, 5.40202137e-03, ...,
        4.38088511e-03, 1.19844622e-02, 4.67728771e-03],
       [4.70286675e-03, 1.17233632e-03, 1.00810186e-02, ...,
        5.10296453e-03, 9.95776876e-03, 1.15588238e-02],
       ...,
       [1.89309206e-04, 1.09738755e-05, 3.35989960e-02, ...,
        1.64317682e-02, 1.05136179e-02, 2.07020040e-02],
       [1.02905648e-02, 2.39395954e-02, 4.59790710e-03, ...,
        8.55217628e-03, 2.03208853e-02, 5.74334481e-03],
       [7.39087803e-03, 2.38623650e-02, 3.02088271e-03, ...,
        5.94436578e-03, 1.50854783e-02, 4.77530756e-03]])
```

In [14]:
```python
topk = np.argsort(ypred, axis = 1)[:,-5:]
print(topk.shape)
topk = topk.tolist()
```

```
(24983, 5)
```

In [15]:
```python
ytest_np = ytest.to_numpy()
ytest_prep = [[item] for item in ytest_np]
```

In [16]:
```python
#8% we can do better!
metrics.mapk(ytest_prep,topk,5)
```

Out[16]: 0.08335334694258761

In [17]:
```python
def make_key(items):
    return "_".join([str(i) for i in items])
```

In [27]:
```python
unique_users = df2.user_id.unique()
len(unique_users)
```

Out[27]: 3478

In [30]:
```python
#Attempt 2 - Top clusters based on hotel_cluster
import random


df2["date_time"] = pd.to_datetime(df2["date_time"])
df2["year"] = df2["date_time"].dt.year
df2["month"] = df2["date_time"].dt.month


#pick users
sel_user_id = random.sample(list(unique_users),3478)
sel_train = df2[df2.user_id.isin(sel_user_id)]

#new training set
t1 = sel_train[((sel_train.year == 2013) | ((sel_train.year == 2014) & (sel_train.month
t2 = sel_train[((sel_train.year == 2014) & (sel_train.month >= 8))]
```

In [31]:
```python
match_cols = ["srch_destination_id"]
cluster_cols = match_cols + ['hotel_cluster']
groups = t1.groupby(cluster_cols)
top_clusters = {}
```

In [32]:
```python
#Assign 1 point to each hotel cluster where is_booking is True.
#Assign .15 points to each hotel cluster where is_booking is False.
#Assign the score to the srch_destination_id / hotel_cluster combination in a dictionar

for name, group in groups:
    clicks = len(group.is_booking[group.is_booking == False])
    bookings = len(group.is_booking[group.is_booking == True])

    score = bookings + .15 * clicks

    clus_name = make_key(name[:len(match_cols)])
```

```
        if clus_name not in top_clusters:
            top_clusters[clus_name] = {}
        top_clusters[clus_name][name[-1]] = score
```

In [33]:
```
top_clusters
```

Out[33]:
```
{'8': {32: 1.15, 60: 0.15, 77: 1.15},
 '11': {94: 1.15},
 '14': {20: 1.3, 75: 0.3},
 '19': {64: 0.3},
 '21': {3: 0.15,
  36: 0.15,
  44: 3.1,
  46: 1.15,
  57: 0.15,
  61: 0.15,
  64: 0.15,
  65: 0.15,
  82: 0.3},
 '24': {3: 0.15, 18: 0.15, 32: 2.45, 76: 0.15, 91: 0.3, 94: 1.0},
 '25': {5: 0.15, 39: 0.15, 48: 1.15, 90: 0.15},
 '27': {30: 1.15, 86: 1.75, 89: 2.3},
 '32': {3: 0.3},
 '33': {78: 0.75},
 '40': {7: 0.15, 12: 0.15, 48: 0.3, 62: 2.3, 82: 1.3},
 '43': {76: 0.15, 91: 0.15},
 '44': {36: 0.15},
 '56': {57: 0.15},
 '57': {39: 1.15, 42: 0.15, 43: 0.15},
 '62': {43: 0.15, 50: 1.3},
 '66': {15: 2.3, 47: 1.3, 50: 0.15, 51: 0.15, 77: 0.15, 94: 0.15},
 '70': {2: 0.15},
 '76': {52: 0.3},
 '87': {58: 0.15, 97: 1.15},
 '103': {95: 0.15},
 '105': {4: 0.15, 42: 0.15, 51: 0.15, 77: 0.15, 91: 0.15},
 '106': {48: 1.15},
 '107': {26: 0.15},
 '108': {6: 0.44999999999999996, 7: 0.15, 13: 0.15},
 '109': {11: 0.15, 46: 0.3, 58: 0.3, 97: 0.15},
 '112': {5: 0.15,
  62: 0.44999999999999996,
  64: 0.6,
  82: 0.15,
  86: 0.3,
  90: 0.15,
  99: 0.15},
 '114': {63: 0.15, 86: 0.15, 92: 0.15},
 '119': {29: 0.3, 48: 1.3},
 '120': {57: 0.15},
 '148': {6: 0.3,
  32: 1.15,
  36: 0.3,
  39: 0.15,
  47: 0.44999999999999996,
  50: 1.3,
  51: 0.3,
  76: 0.3,
  91: 0.15},
 '154': {26: 1.3, 34: 3.05},
 '159': {5: 0.15,
  14: 0.15,
```

```
   21: 0.15,
   28: 0.15,
   39: 0.15,
   42: 0.15,
   43: 0.15,
   83: 0.44999999999999996},
'170': {90: 0.15},
'172': {50: 0.15, 76: 0.15, 89: 1.15, 91: 0.15, 94: 0.15},
'181': {26: 0.15, 30: 0.15, 31: 0.15, 38: 0.3, 57: 0.15, 61: 0.15, 67: 0.15},
'210': {9: 0.15, 55: 0.15},
'211': {53: 0.15, 57: 0.15, 81: 0.15},
'212': {6: 0.15},
'226': {13: 0.15, 16: 0.15, 18: 0.3, 29: 0.44999999999999996, 59: 2.6},
'235': {3: 1.0, 76: 0.15, 77: 0.44999999999999996},
'243': {30: 0.15, 58: 1.15, 82: 1.3},
'245': {28: 0.15, 39: 1.6, 41: 0.15, 50: 0.15},
'248': {20: 0.15},
'259': {13: 0.3, 15: 1.15, 42: 0.15, 47: 0.15, 48: 1.15, 91: 1.45},
'263': {3: 0.15,
   7: 0.6,
   11: 0.15,
   13: 1.6,
   15: 0.44999999999999996,
   16: 0.15,
   18: 0.15,
   21: 1.45,
   28: 1.6,
   37: 0.3,
   39: 0.15,
   42: 2.6,
   48: 0.15,
   60: 0.3,
   72: 1.45,
   76: 0.6,
   77: 0.15,
   91: 0.3,
   94: 0.15},
'268': {3: 1.15,
   20: 0.6,
   30: 0.3,
   38: 2.2,
   46: 0.15,
   53: 0.3,
   57: 0.44999999999999996,
   60: 2.05,
   61: 0.6,
   62: 0.15,
   64: 0.15,
   67: 0.6,
   78: 2.3499999999999996,
   81: 1.45,
   82: 1.5,
   89: 0.15},
'287': {51: 0.15},
'289': {60: 0.3},
'304': {36: 1.15},
'305': {2: 0.15,
   7: 0.15,
   16: 0.15,
   42: 0.3,
   47: 0.15,
   48: 1.6,
   50: 0.15,
   59: 0.3,
   72: 0.44999999999999996,
```

```
  77: 0.44999999999999996,
  89: 0.6,
  91: 0.8999999999999999},
'317': {36: 2.3},
'325': {41: 0.75,
  42: 1.15,
  47: 0.15,
  55: 0.15,
  91: 0.15,
  94: 0.15,
  96: 0.44999999999999996},
'328': {48: 0.15},
'330': {3: 1.15},
'343': {30: 0.44999999999999996, 60: 0.15, 85: 1.3},
'347': {3: 0.44999999999999996,
  12: 1.5,
  20: 0.15,
  36: 0.15,
  44: 0.15,
  46: 0.3,
  57: 0.15,
  58: 0.15,
  60: 0.15,
  61: 0.8999999999999999,
  62: 0.3,
  63: 0.6,
  81: 2.55,
  85: 0.15,
  92: 0.3,
  97: 0.3},
'356': {7: 0.3,
  39: 0.15,
  41: 0.15,
  42: 0.15,
  47: 0.15,
  48: 0.15,
  77: 0.3,
  91: 2.45,
  94: 0.15},
'358': {38: 0.15, 43: 0.15, 62: 0.3, 73: 0.15, 90: 0.15},
'365': {20: 0.15, 76: 0.15},
'367': {4: 0.15,
  5: 0.3,
  6: 0.15,
  7: 0.15,
  13: 1.45,
  16: 0.15,
  21: 0.15,
  23: 0.15,
  32: 0.3,
  33: 1.9,
  41: 0.15,
  42: 1.45,
  47: 0.15,
  76: 0.15,
  90: 0.15,
  91: 0.15},
'369': {14: 0.3, 15: 0.15, 48: 0.44999999999999996, 50: 0.15, 91: 1.45},
'375': {3: 0.3,
  5: 0.15,
  20: 0.15,
  22: 0.15,
  25: 0.15,
  26: 0.15,
  37: 1.05,
```

```
         38: 0.8999999999999999,
         52: 0.44999999999999996,
         58: 0.15,
         60: 0.6,
         65: 0.15,
         75: 0.3,
         76: 2.3,
         78: 0.15,
         81: 0.15,
         82: 0.3,
         85: 0.3,
         93: 0.15,
         99: 1.3},
 '383': {26: 0.15, 65: 0.3, 84: 0.15},
 '390': {42: 1.3, 94: 0.15},
 '399': {89: 0.15},
 '406': {36: 0.15, 63: 0.15, 92: 0.3},
 '407': {12: 0.3,
         15: 0.15,
         20: 0.15,
         38: 1.15,
         62: 0.15,
         75: 1.0,
         78: 4.75,
         85: 0.15},
 '411': {48: 0.15},
 '416': {48: 1.15},
 '436': {57: 0.15},
 '438': {14: 0.15, 33: 0.15, 41: 0.15, 47: 0.15, 75: 1.15, 77: 1.15, 94: 0.3},
 '448': {11: 0.15, 20: 0.3, 29: 0.15, 44: 1.5, 58: 1.6, 86: 0.15, 89: 0.3},
 '449': {5: 0.15, 64: 0.15},
 '467': {36: 1.3, 62: 0.3},
 '468': {2: 2.5,
         5: 1.9,
         6: 0.44999999999999996,
         7: 0.3,
         8: 5.6499999999999995,
         9: 0.44999999999999996,
         10: 0.44999999999999996,
         11: 0.75,
         13: 5.9,
         15: 0.15,
         16: 0.15,
         17: 0.15,
         20: 0.15,
         21: 0.44999999999999996,
         23: 0.15,
         25: 0.44999999999999996,
         26: 1.05,
         29: 1.6,
         30: 0.3,
         35: 2.65,
         37: 0.15,
         38: 1.05,
         41: 0.75,
         42: 0.15,
         46: 5.6,
         48: 0.44999999999999996,
         57: 1.2,
         58: 1.75,
         61: 0.15,
         64: 11.45,
         66: 0.75,
         68: 0.44999999999999996,
         69: 0.44999999999999996,
```

```
        70: 1.15,
        76: 2.25,
        78: 0.15,
        80: 0.15,
        81: 0.15,
        82: 0.15,
        83: 0.15,
        86: 0.15,
        89: 0.44999999999999996,
        90: 0.15,
        92: 0.3,
        94: 0.15,
        97: 5.85},
 '470': {42: 0.3, 60: 0.15, 91: 1.3},
 '474': {67: 0.15, 81: 0.15},
 '475': {30: 0.44999999999999996, 81: 0.15},
 '478': {13: 1.3},
 '484': {47: 1.15},
 '485': {13: 0.15},
 '486': {6: 1.15,
        16: 1.15,
        40: 0.15,
        42: 1.3,
        47: 1.45,
        48: 1.3,
        50: 0.3,
        59: 1.15,
        91: 0.3},
 '496': {7: 0.15,
        13: 0.15,
        18: 0.44999999999999996,
        23: 0.3,
        32: 1.15,
        42: 0.15,
        48: 1.3,
        60: 0.3,
        77: 0.44999999999999996,
        91: 0.15,
        94: 1.15},
 '498': {85: 1.15},
 '500': {20: 0.15, 32: 0.15, 47: 0.15},
 '503': {8: 1.5, 62: 0.15},
 '505': {58: 1.3, 67: 0.15},
 '511': {26: 0.3, 84: 0.3, 89: 0.3, 96: 0.15, 98: 0.3},
 '512': {6: 2.3, 15: 1.3, 42: 0.44999999999999996},
 '516': {48: 1.15},
 '520': {3: 0.15, 17: 0.15, 22: 2.6, 42: 0.15, 83: 0.15, 87: 0.15, 99: 0.6},
 '529': {0: 0.15, 31: 0.15},
 '531': {9: 0.15,
        14: 0.3,
        22: 0.44999999999999996,
        43: 0.3,
        60: 0.15,
        64: 0.15,
        76: 0.15,
        86: 1.15,
        97: 1.6},
 '539': {7: 1.15},
 '540': {44: 7.5, 89: 0.15},
 '546': {53: 0.15},
 '547': {62: 0.15, 85: 0.15},
 '551': {29: 0.15, 82: 0.6, 89: 0.15},
 '552': {15: 0.3,
        30: 0.44999999999999996,
        33: 0.15,
```

```
  42: 1.75,
  61: 0.15,
  62: 0.15,
  78: 0.3,
  82: 0.3,
  85: 0.3},
 '559': {38: 0.15},
 '561': {48: 1.15},
 '562': {2: 0.3, 5: 0.3, 37: 0.44999999999999996, 41: 1.2, 59: 1.3, 68: 0.3},
 '564': {6: 1.15,
  33: 0.15,
  47: 0.15,
  48: 0.3,
  55: 0.3,
  80: 0.44999999999999996,
  83: 0.15,
  94: 0.15},
 '565': {2: 0.3,
  5: 0.3,
  12: 0.15,
  33: 0.3,
  36: 0.44999999999999996,
  44: 0.15,
  46: 0.3,
  57: 2.3,
  58: 0.15,
  68: 0.15,
  82: 0.15,
  85: 0.15},
 '574': {8: 0.15},
 '576': {14: 0.3,
  15: 1.15,
  28: 0.15,
  39: 0.44999999999999996,
  40: 0.8999999999999999,
  42: 0.3,
  47: 0.3,
  48: 0.15,
  50: 1.3,
  51: 0.15,
  60: 0.15,
  77: 0.15,
  91: 1.75,
  94: 0.15},
 '584': {15: 3.05, 42: 2.3, 48: 0.15},
 '586': {12: 0.15, 16: 0.15, 29: 0.15, 47: 0.15, 48: 0.15, 60: 0.15},
 '589': {3: 0.44999999999999996,
  7: 0.15,
  10: 0.8999999999999999,
  13: 0.6,
  14: 0.15,
  16: 0.3,
  19: 1.3,
  20: 0.15,
  25: 1.5,
  28: 0.3,
  33: 1.3499999999999999,
  34: 3.65,
  39: 0.75,
  42: 0.3,
  43: 0.15,
  48: 0.75,
  50: 0.15,
  68: 1.45,
  72: 0.75,
```

```
 73: 0.15,
 77: 0.3,
 83: 0.44999999999999996,
 91: 0.6,
 94: 0.15,
 95: 1.3499999999999999},
'597': {82: 0.15, 99: 0.15},
'599': {43: 1.3},
'600': {4: 0.44999999999999996,
 10: 0.15,
 37: 1.3,
 42: 0.15,
 48: 0.3,
 59: 0.44999999999999996,
 90: 0.15,
 91: 3.6999999999999997,
 94: 0.15},
'601': {42: 0.15, 48: 1.3, 60: 0.15, 91: 0.15, 94: 1.3},
'607': {82: 0.15},
'626': {67: 0.15, 90: 0.15},
'628': {46: 2.6, 67: 0.15},
'635': {12: 1.15, 29: 0.15, 36: 1.6, 46: 1.3, 58: 0.15, 62: 0.3, 78: 0.15},
'651': {61: 1.3, 78: 1.15},
'656': {90: 0.15},
'666': {13: 2.3},
'667': {30: 1.45},
'669': {0: 17.65,
 4: 3.05,
 5: 1.05,
 9: 1.3499999999999999,
 14: 0.15,
 16: 0.15,
 17: 0.44999999999999996,
 19: 1.7999999999999998,
 21: 2.3499999999999996,
 25: 0.15,
 28: 0.3,
 33: 2.95,
 37: 0.8999999999999999,
 40: 1.5,
 41: 3.25,
 47: 0.8999999999999999,
 48: 3.9,
 50: 1.3,
 51: 0.15,
 55: 0.44999999999999996,
 56: 1.7999999999999998,
 69: 0.3,
 70: 1.75,
 72: 0.44999999999999996,
 73: 0.44999999999999996,
 83: 8.85,
 84: 3.4,
 91: 1.05,
 92: 2.05,
 93: 0.3,
 94: 0.75,
 95: 0.3,
 96: 3.85,
 97: 3.8,
 98: 0.15},
'672': {3: 0.3, 48: 1.45, 76: 0.15, 91: 0.3},
'678': {48: 0.15, 94: 1.15},
'686': {12: 0.15,
 20: 1.95,
```

```
     29: 1.95,
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```

In [35]:
```python
#Loop through each key in top_clusters
#Find the top 5 clusters for that key.

cluster_dict = {}
for n in top_clusters:
    tc = top_clusters[n]
    top = [l[0] for l in sorted(tc.items(), key=operator.itemgetter(1), reverse=True)[:
    cluster_dict[n] = top
```

In [36]:
```python
#Extract the srch_destination_id for the row.
#Find the top clusters for that destination id.

preds = []
for index, row in t2.iterrows():
    key = make_key([row[m] for m in match_cols])
    if key in cluster_dict:
        preds.append(cluster_dict[key])
    else:
        preds.append([])
```

In [37]:
```python
preds
```

Out[37]:
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In [38]:
```python
metrics.mapk([[l] for l in t2["hotel_cluster"]], preds, k=5)
```

Out[38]: 0.19827196727143365

In [40]:
```python
"""We got a lot better I am wondering which classifiers the class will come up with and
```

Out[40]: "We got a lot better I am wondering which classifiers the class will come up with and I
see our discussions because even though I followed a tutorial it wasn't exactly the same
and that creates differences in the accuracy. But Top clusters based on hotel_cluster wa
s much better than logistic regression, doubling the prediction accuracy and you can see
the top clusters."

In [ ]: