In [1]:
```python
import pymongo
import pandas as pd
import numpy as np

from pymongo import MongoClient
from bson.objectid import ObjectId

import datetime

import matplotlib.pyplot as plt

from collections import defaultdict


%matplotlib inline
import json
plt.style.use('ggplot')

import seaborn as sns

from math import log10, floor

from time import time

from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer


from sklearn.cluster import KMeans, MiniBatchKMeans
```

CU Woot Math Method 2 for unserciced discovery of new behavior traits

1) Convert response field dictionary into a document

2) Develop word vector using term frequency - inverse document frequency

3) Use K-Means to cluster documents

4) Map traits to clusters to validate technique

In the first results presented to Woot Math a 100K sample of the entire data set was chosen. In this report, I'll start with the same type of analysis to develop the same heat map. In the meeting Sean and Brent suggested using just one of the qual_id and repeat the experiment and then look at the samples in clusers without traits. I'll do that in a subsequent analysis

Part 1. Heat map with 100 K sample of all qual_id's

In [2]:
```python
## Connect to local DB

client = MongoClient('localhost', 27017)
print ("Setup db access")
```

Setup db access

In [3]:
```python
#
# Get collections from mongodb
#
#db = client.my_test_db
db = client.test
```

In [4]:
```python
chunk = 100000
start = 0
end = start + chunk
```

In [5]:
```python
#reponses = db.anon_student_task_responses.find({'correct':False})[start:end
reponses = db.anon_student_task_responses.find()[start:end]
```

In [6]:
```python
df_responses = pd.DataFrame(list(reponses))
```

In [7]:
```python
print (df_responses.shape)
```

(100000, 27)

In [8]:
```python
##  Make the documents to be analyzed
```

```
In [9]:   ## Functions for turning dictionary into document

          def make_string_from_list(key, elem_list):
              # Append key to each item in list
              ans = ''
              for elem in elem_list:
                  ans += key + '_' + elem




          def make_string(elem, key=None, top=True):
              ans = ''
              if not elem:
                  return ans
              if top:
                  top = False
                  top_keys = []
                  for idx in range(len(elem.keys())):
                      top_keys.append(True)

              for idx, key in enumerate(elem.keys()):
                  if top_keys[idx]:
                      top = True
                      top_keys[idx] = False
                      ans += ' '
                  else:
                      top = False
                  #print ('ans = ', ans)
                  #print (type(elem[key]))
                  if type(elem[key]) is str or\
                          type(elem[key]) is int:
                      #print ('add value', elem[key])
                      value = str(elem[key])
                      #ans += key + '_' + value + ' ' + value + ' '
                      ans += key + '_' + value + ' '
                  elif type(elem[key]) is list:
                      #print ('add list', elem[key])
                      temp_elem = dict()
                      for item in elem[key]:
                          temp_elem[key] = item
                          ans += make_string(temp_elem, top)
                  elif type(elem[key]) is dict:
                      #print ('add dict', elem[key])
                      for item_key in elem[key].keys():
                          temp_elem = dict()
                          temp_elem[item_key] = elem[key][item_key]
                          ans += key + '_' + make_string(temp_elem, top)
                  elif type(elem[key]) is float:
                      #print ('add dict', elem[key])
                      sig = 2
                      value = elem[key]
                      value = round(value, sig-int(
                      floor(log10(abs(value))))-1)
                      value = str(value)
```

```
            #ans += key + '_' + value + ' ' + value + ' '
            ans += key + '_' + value + ' '
        # ans += ' ' + key + ' '
        #print ('not handled', elem[key])


    return ans
```

In [10]:
```
# Makes the cut & paste below easier
df3 = df_responses
```

In [11]:
```
df3['response_doc'] = df3['response'].map(make_string)
```

In [12]:
```
df3['response_doc'] = df3['response_doc'].map(lambda x: x + ' ')
df3['response_doc'] = df3['response_doc'].map(lambda x: x.replace('/','_'))
df3['response_doc'] = df3['response_doc'] + ' ' + df3['txt']
df3['response_doc'] = df3['response_doc'].map(lambda x: x + ' ')
df3['response_doc'] = df3['response_doc'].map(lambda x: x.replace("\n", ""))
df3['response_doc'] = df3['response_doc'].map(lambda x: x.replace("?", " "))
```

In [ ]:

Sample Documents

```
In [13]: for idx in range(20):
             print ("Sample number:", idx, "\n", df3.iloc[idx]['response_doc'])
```

Sample number: 0
   fraction_cblock_chains_ right_442 fraction_cblock_chains_ sum_ numerat
or_1 sum_ denominator_2 sum_ __as3_type_Fraction fraction_cblock_chains_
pieces_1_2 fraction_cblock_chains_ left_97 fraction_cblock_chains_ lcm_su
m_ numerator_1 lcm_sum_ denominator_2 lcm_sum_ __as3_type_Fraction   plai
n_image_groups_ total_1 plain_image_groups_ url_assets_cms_wootmath_fract
ions_number_line_markers_end_marker_noline.swf plain_image_groups_ total
_1 plain_image_groups_ url_assets_cms_wootmath_fractions_number_line_mark
ers_start_marker.swf plain_image_groups_ total_1 plain_image_groups_ url
_assets_cms_wootmath_fractions_number_line_objects_dog.swf plain_image_g
roups_ total_1 plain_image_groups_ url_assets_cms_wootmath_fractions_numb
er_line_objects_cat_dog_trail.swf den_2 fraction_input_value_1_2 num_1
  fraction_cblock_total_count_1   fraction_cblock_counts_ 1_2_1   whole_
    Use the 1/2 pieces to figure out how far the dog traveled.Answer: 1/2
Sample number: 1
   fraction_cblock_total_count_4   plain_image_groups_ total_1 plain_image
groups url_assets_cms_wootmath_fractions_number_line_objects_panda.swf
plain_image_groups_ total_1 plain_image_groups_ url_assets_cms_wootmath_f
ractions_number_line_markers_start_marker.swf input_4   fraction_cblock_
chains_ right_856 fraction_cblock_chains_ sum_ numerator_1 sum_ denominat
or_1 sum_ __as3_type_Fraction fraction_cblock_chains_ pieces_1_4 pieces
_1_4 pieces_1_4 pieces_1_4 fraction_cblock_chains_ left_165 fraction_cb
lock_chains_ lcm_sum_ numerator_4 lcm_sum_ denominator_4 lcm_sum_ __as3_t
ype_Fraction   numberline_associations_ numberline_associations_ positio
n_720.0 numberline_associations_ pos_value_1.0 numberline_associations_ o
bj_name_object fraction_cblock_counts_ 1_4_4   Drag the panda to 4/4 of
a yard from the start.Answer: 4/4
Sample number: 2
   fraction_cblock_chains_ left_176 fraction_cblock_chains_ lcm_sum_ nume
rator_2 lcm_sum_ denominator_8 lcm_sum_ __as3_type_Fraction fraction_cblo
ck_chains_ right_348 fraction_cblock_chains_ pieces_1_8 pieces_1_8 frac
tion_cblock_chains_ sum_ numerator_1 sum_ denominator_4 sum_ __as3_type_F
raction fraction_cblock_chains_ left_590 fraction_cblock_chains_ lcm_sum
_ numerator_1 lcm_sum_ denominator_6 lcm_sum_ __as3_type_Fraction fractio
n_cblock_chains_ right_705 fraction_cblock_chains_ pieces_1_6 fraction_c
block_chains_ sum_ numerator_1 sum_ denominator_6 sum_ __as3_type_Fractio
n fraction_cblock_chains_ left_176 fraction_cblock_chains_ lcm_sum_ nume
rator_1 lcm_sum_ denominator_4 lcm_sum_ __as3_type_Fraction fraction_cblo
ck_chains_ right_348 fraction_cblock_chains_ pieces_1_4 fraction_cblock_
chains_ sum_ numerator_1 sum_ denominator_4 sum_ __as3_type_Fraction fra
ction_cblock_chains_ left_176 fraction_cblock_chains_ lcm_sum_ numerator_
1 lcm_sum_ denominator_1 lcm_sum_ __as3_type_Fraction fraction_cblock_cha
ins_ right_866 fraction_cblock_chains_ pieces_1 fraction_cblock_chains_
sum_ numerator_1 sum_ denominator_1 sum_ __as3_type_Fraction fraction_cb
lock_total_count_5 fraction_cblock_counts_ 1_1 fraction_cblock_counts_ 1
_8_2 fraction_cblock_counts_ 1_6_1 fraction_cblock_counts_ 1_4_1 fractio
n_cblock_containment_ piece0_ lcm_sum_ numerator_2 lcm_sum_ denominator_8
lcm_sum_ __as3_type_Fraction piece0_ piece0_ pieces_1_8 pieces_1_8 piec
e0_ sum_ numerator_1 sum_ denominator_4 sum_ __as3_type_Fraction   Model
how many eighths are equal to one fourth.Answer: 2
Sample number: 3
   fraction_cblock_chains_ left_176 fraction_cblock_chains_ lcm_sum_ nume
rator_1 lcm_sum_ denominator_2 lcm_sum_ __as3_type_Fraction fraction_cblo
ck_chains_ right_521 fraction_cblock_chains_ pieces_1_2 fraction_cblock_

chains_ sum_ numerator_1 sum_ denominator_2 sum_ __as3_type_Fraction fra
ction_cblock_chains_ left_176 fraction_cblock_chains_ lcm_sum_ numerator_
4 lcm_sum_ denominator_8 lcm_sum_ __as3_type_Fraction fraction_cblock_cha
ins_ right_521 fraction_cblock_chains_ pieces_1_8 pieces_1_8 pieces_1_
8 pieces_1_8 fraction_cblock_chains_ sum_ numerator_1 sum_ denominator_2
sum_ __as3_type_Fraction fraction_cblock_chains_ left_176 fraction_cbloc
k_chains_ lcm_sum_ numerator_1 lcm_sum_ denominator_1 lcm_sum_ __as3_type
_Fraction fraction_cblock_chains_ right_866 fraction_cblock_chains_ piec
es_1 fraction_cblock_chains_ sum_ numerator_1 sum_ denominator_1 sum_ __a
s3_type_Fraction fraction_cblock_total_count_6 fraction_cblock_counts_
1_1 fraction_cblock_counts_ 1_2_1 fraction_cblock_counts_ 1_8_4 fraction
_cblock_containment_ [Fraction] 1_2_ lcm_sum_ numerator_4 lcm_sum_ denomi
nator_8 lcm_sum_ __as3_type_Fraction [Fraction] 1_2_ [Fraction] 1_2_ pie
ces_1_8 pieces_1_8 pieces_1_8 pieces_1_8 [Fraction] 1_2_ sum_ numerato
r_1 sum_ denominator_2 sum_ __as3_type_Fraction Model how many halves a
re equal to four eighths.Answer: 1
Sample number: 4
  fraction_circle_containment_ [Fraction] 1_2_ lcm_sum_ numerator_4 lcm_s
um_ denominator_8 lcm_sum_ __as3_type_Fraction [Fraction] 1_2_ [Fraction]
1_2_ pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_8 [Fraction] 1_2_ sum_
numerator_1 sum_ denominator_2 sum_ __as3_type_Fraction fraction_circle_
total_count_6 fraction_circle_groups_ x_512 fraction_circle_groups_ y_3
00 fraction_circle_groups_ scale_1.0 fraction_circle_groups_ pieces_1_2
pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_8 pieces_1 fraction_circle_
groups_ chains_ right_180 chains_ pieces_1_8 pieces_1_8 pieces_1_8 p
ieces_1_8 chains_ left_0 fraction_circle_counts_ 1_1 fraction_circle_cou
nts_ 1_2_1 fraction_circle_counts_ 1_8_4 Cameron ate 4/8 of a pizza.C
over the pizza to model how many halves of a pizza he ate.Answer: 1
Sample number: 5
  image_object_groups_ total_6 image_object_groups_ on_3 image_object_gr
oups_ url_assets_objects_singles_watch.swf image_object_groups_ off_3 S
hade 1/2 of the 6 watches.Answer: 1/2
Sample number: 6
  Shade 1/4 of the circle.answer={:n=>3, :d=>12}
Sample number: 7
  Shade 1/3 of the rectangle.answer={:n=>2, :d=>6}
Sample number: 8
  fraction_circle_groups_ x_512 fraction_circle_groups_ scale_1 fraction
_circle_groups_ chains_ pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_8
chains_ left_0 chains_ right_180 fraction_circle_groups_ pieces_1_8 pie
ces_1_8 pieces_1_8 pieces_1_8 pieces_1_2 pieces_1 fraction_circle_gro
ups_ y_300 fraction_circle_containment_ piece_0_ sum_ denominator_2 sum_
numerator_1 sum_ __as3_type_Fraction piece_0_ piece_0_ pieces_1_8 piece
s_1_8 pieces_1_8 pieces_1_8 piece_0_ lcm_sum_ denominator_8 lcm_sum_ nu
merator_4 lcm_sum_ __as3_type_Fraction fraction_circle_counts_ 1_1 fract
ion_circle_counts_ 1_2_1 fraction_circle_counts_ 1_8_4 fraction_circle_t
otal_count_6 Drag one eighth pieces to cover all of the 1/2 piece.Ans
wer: 4
Sample number: 9
  fraction_circle_groups_ x_512 fraction_circle_groups_ scale_1.0 fracti
on_circle_groups_ chains_ pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_
8 chains_ left_0 chains_ right_180 fraction_circle_groups_ pieces_1_2 p
ieces_1_8 pieces_1_8 pieces_1_8 pieces_1_8 pieces_1 fraction_circle_g
roups_ y_300 fraction_circle_containment_ [Fraction] 1_2_ sum_ denominat
or_2 sum_ numerator_1 sum_ __as3_type_Fraction [Fraction] 1_2_ [Fraction]
1_2_ pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_8 [Fraction] 1_2_ lcm_
sum_ denominator_8 lcm_sum_ numerator_4 lcm_sum_ __as3_type_Fraction fra

ction_circle_counts_ 1_1 fraction_circle_counts_ 1_2_1 fraction_circle_co
unts_ 1_8_4 fraction_circle_total_count_6   Drag one half pieces to cove
r all of the 4/8 shown.Answer: 1
Sample number: 10
   fraction_circle_groups_ x_512 fraction_circle_groups_ scale_1.0 fracti
on_circle_groups_ chains_ pieces_1_4 pieces_1_4 chains_ left_0 chains_
right_180 fraction_circle_groups_ pieces_1_2 pieces_1_4 pieces_1_4 pi
eces_1 fraction_circle_groups_ y_300 fraction_circle_containment_ [Fract
ion] 1_2_ sum_ denominator_2 sum_ numerator_1 sum_ __as3_type_Fraction [F
raction] 1_2_ [Fraction] 1_2_ pieces_1_4 pieces_1_4 [Fraction] 1_2_ lcm
sum denominator_4 lcm_sum_ numerator_2 lcm_sum_ __as3_type_Fraction fr
action_circle_counts_ 1_1 fraction_circle_counts_ 1_2_1 fraction_circle_c
ounts_ 1_4_2 fraction_circle_total_count_4   Drag one half pieces to cov
er all of the 2/4 shown.Answer: 1
Sample number: 11
  radio_choice_C radio_group_problem_ choice_C radio_group_problem_ text
_3_6 radio_text_3_6   What fraction has 6 as the denominator () 6/7 ()
4/5 () 3/6Answer: 3/6
Sample number: 12
   fraction_cblock_chains_ sum_ denominator_10 sum_ numerator_1 sum_ __as
3_type_Fraction fraction_cblock_chains_ lcm_sum_ denominator_10 lcm_sum_
numerator_1 lcm_sum_ __as3_type_Fraction fraction_cblock_chains_ pieces_
1_10 fraction_cblock_chains_ left_1024 fraction_cblock_chains_ right_1458
  fraction_cblock_chains_ sum_ denominator_5 sum_ numerator_1 sum_ __as3_
type_Fraction fraction_cblock_chains_ lcm_sum_ denominator_10 lcm_sum_ nu
merator_2 lcm_sum_ __as3_type_Fraction fraction_cblock_chains_ pieces_1_
10 pieces_1_10 fraction_cblock_chains_ left_1024 fraction_cblock_chains_
right_1297 fraction_cblock_chains_ sum_ denominator_10 sum_ numerator_1
sum_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_ denominator_10
lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fraction fraction_cblock_chains_
  pieces_1_10 fraction_cblock_chains_ left_1024 fraction_cblock_chains_ r
ight_1531 fraction_cblock_chains_ sum_ denominator_10 sum_ numerator_1 s
um_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_ denominator_10 l
cm_sum_ numerator_1 lcm_sum_ __as3_type_Fraction fraction_cblock_chains_
pieces_1_10 fraction_cblock_chains_ left_1024 fraction_cblock_chains_ rig
ht_1214 fraction_cblock_chains_ sum_ denominator_10 sum_ numerator_1 sum
_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_ denominator_10 lcm
sum numerator_1 lcm_sum_ __as3_type_Fraction fraction_cblock_chains_ p
ieces_1_10 fraction_cblock_chains_ left_1024 fraction_cblock_chains_ righ
t_1424 fraction_cblock_chains_ sum_ denominator_5 sum_ numerator_2 sum_
__as3_type_Fraction fraction_cblock_chains_ lcm_sum_ denominator_10 lcm_s
um_ numerator_4 lcm_sum_ __as3_type_Fraction fraction_cblock_chains_ pie
ces_1_10 pieces_1_10 pieces_1_10 pieces_1_10 fraction_cblock_chains_ l
eft_544 fraction_cblock_chains_ right_820 fraction_cblock_chains_ sum_ d
enominator_84 sum_ numerator_73 sum_ __as3_type_Fraction fraction_cblock_
chains_ lcm_sum_ denominator_84 lcm_sum_ numerator_73 lcm_sum_ __as3_type
_Fraction fraction_cblock_chains_ pieces_1_7 pieces_1_7 pieces_1_6 pi
eces_1_6 pieces_1_4 fraction_cblock_chains_ left_1001 fraction_cblock_ch
ains_ right_1272 fraction_cblock_chains_ sum_ denominator_35 sum_ numera
tor_17 sum_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_ denomina
tor_35 lcm_sum_ numerator_17 lcm_sum_ __as3_type_Fraction fraction_cblock
chains pieces_1_7 pieces_1_7 pieces_1_5 fraction_cblock_chains_ left
_981 fraction_cblock_chains_ right_1316 fraction_cblock_chains_ sum_ den
ominator_28 sum_ numerator_11 sum_ __as3_type_Fraction fraction_cblock_ch
ains_ lcm_sum_ denominator_28 lcm_sum_ numerator_11 lcm_sum_ __as3_type_F
raction fraction_cblock_chains_ pieces_1_7 pieces_1_4 fraction_cblock_c
hains_ left_1001 fraction_cblock_chains_ right_1272 fraction_cblock_chai

ns_ sum_ denominator_7 sum_ numerator_1 sum_ __as3_type_Fraction fraction
_cblock_chains_ lcm_sum_ denominator_7 lcm_sum_ numerator_1 lcm_sum_ __as
3_type_Fraction fraction_cblock_chains_ pieces_1_7 fraction_cblock_chain
s_ left_1024 fraction_cblock_chains_ right_1300 fraction_cblock_chains_
sum_ denominator_7 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cbl
ock_chains_ lcm_sum_ denominator_7 lcm_sum_ numerator_1 lcm_sum_ __as3_ty
pe_Fraction fraction_cblock_chains_ pieces_1_7 fraction_cblock_chains_ l
eft_1024 fraction_cblock_chains_ right_1248 fraction_cblock_chains_ sum_
denominator_6 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_c
hains_ lcm_sum_ denominator_6 lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fr
action fraction_cblock_chains_ pieces_1_6 fraction_cblock_chains_ left_1
024 fraction_cblock_chains_ right_1316 fraction_cblock_chains_ sum_ deno
minator_6 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chain
s_ lcm_sum_ denominator_6 lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fracti
on fraction_cblock_chains_ pieces_1_6 fraction_cblock_chains_ left_1024
fraction_cblock_chains_ right_1387 fraction_cblock_chains_ sum_ denomina
tor_6 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chains_ l
cm_sum_ denominator_6 lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fraction f
raction_cblock_chains_ pieces_1_6 fraction_cblock_chains_ left_1024 frac
tion_cblock_chains_ right_1220 fraction_cblock_chains_ sum_ denominator_
6 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chains_ lcm_s
um_ denominator_6 lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fraction fract
ion_cblock_chains_ pieces_1_6 fraction_cblock_chains_ left_1024 fraction
_cblock_chains_ right_1387 fraction_cblock_chains_ sum_ denominator_5 su
m_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_
denominator_5 lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fraction fraction_
cblock_chains_ pieces_1_5 fraction_cblock_chains_ left_1024 fraction_cbl
ock_chains_ right_1358 fraction_cblock_chains_ sum_ denominator_5 sum_ n
umerator_3 sum_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_ deno
minator_5 lcm_sum_ numerator_3 lcm_sum_ __as3_type_Fraction fraction_cblo
ck_chains_ pieces_1_5 pieces_1_5 pieces_1_5 fraction_cblock_chains_ le
ft_1024 fraction_cblock_chains_ right_1337 fraction_cblock_chains_ sum_
denominator_2 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_c
hains_ lcm_sum_ denominator_4 lcm_sum_ numerator_2 lcm_sum_ __as3_type_Fr
action fraction_cblock_chains_ pieces_1_4 pieces_1_4 fraction_cblock_ch
ains_ left_1024 fraction_cblock_chains_ right_1523 fraction_cblock_chain
s_ sum_ denominator_4 sum_ numerator_1 sum_ __as3_type_Fraction fraction_
cblock_chains_ lcm_sum_ denominator_4 lcm_sum_ numerator_1 lcm_sum_ __as3
_type_Fraction fraction_cblock_chains_ pieces_1_4 fraction_cblock_chains
_ left_1024 fraction_cblock_chains_ right_1272 fraction_cblock_chains_ s
um_ denominator_4 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblo
ck_chains_ lcm_sum_ denominator_4 lcm_sum_ numerator_1 lcm_sum_ __as3_typ
e_Fraction fraction_cblock_chains_ pieces_1_4 fraction_cblock_chains_ le
ft_1024 fraction_cblock_chains_ right_1358 fraction_cblock_chains_ sum_
denominator_2 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_c
hains_ lcm_sum_ denominator_2 lcm_sum_ numerator_1 lcm_sum_ __as3_type_Fr
action fraction_cblock_chains_ pieces_1_2 fraction_cblock_chains_ left_1
024 fraction_cblock_chains_ right_1531 fraction_cblock_chains_ sum_ deno
minator_2 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chain
s_ lcm_sum_ denominator_4 lcm_sum_ numerator_2 lcm_sum_ __as3_type_Fracti
on fraction_cblock_chains_ pieces_1_4 pieces_1_4 fraction_cblock_chains
_ left_1024 fraction_cblock_chains_ right_1389 fraction_cblock_chains_ s
um_ denominator_4 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblo
ck_chains_ lcm_sum_ denominator_4 lcm_sum_ numerator_1 lcm_sum_ __as3_typ
e_Fraction fraction_cblock_chains_ pieces_1_4 fraction_cblock_chains_ le
ft_1024 fraction_cblock_chains_ right_1216 fraction_cblock_chains_ sum_
denominator_4 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_c

hains_ lcm_sum_ denominator_4 lcm_sum_ numerator_1 lcm_sum_ ___as3_type_Fr
action fraction_cblock_chains_ pieces_1_4 fraction_cblock_chains_ left_1
024 fraction_cblock_chains_ right_1351 fraction_cblock_chains_ sum_ deno
minator_1 sum_ numerator_1 sum_ ___as3_type_Fraction fraction_cblock_chain
s_ lcm_sum_ denominator_1 lcm_sum_ numerator_1 lcm_sum_ ___as3_type_Fracti
on fraction_cblock_chains_ pieces_1 fraction_cblock_chains_ left_1024 fr
action_cblock_chains_ right_2045 fraction_cblock_chains_ sum_ denominato
r_1 sum_ numerator_1 sum_ ___as3_type_Fraction fraction_cblock_chains_ lcm
sum denominator_1 lcm_sum_ numerator_1 lcm_sum_ ___as3_type_Fraction fra
ction_cblock_chains_ pieces_1 fraction_cblock_chains_ left_130 fraction_
cblock_chains_ right_820 fraction_cblock_containment_ bar1_ sum_ denomin
ator_5 sum_ numerator_2 sum_ ___as3_type_Fraction bar1_ bar1_ pieces_1_10
  pieces_1_10 pieces_1_10 pieces_1_10 bar1_ lcm_sum_ denominator_10 lcm
sum numerator_4 lcm_sum_ ___as3_type_Fraction fraction_cblock_containmen
t_ [Fraction] 1_4_ sum_ denominator_5 sum_ numerator_1 sum_ ___as3_type_Fr
action [Fraction] 1_4_ [Fraction] 1_4_ pieces_1_5 [Fraction] 1_4_ lcm_su
m_ denominator_5 lcm_sum_ numerator_1 lcm_sum_ ___as3_type_Fraction fracti
on_cblock_containment_ [Fraction] 1_ sum_ denominator_10 sum_ numerator_1
sum_ ___as3_type_Fraction [Fraction] 1_ [Fraction] 1_ pieces_1_10 [Fracti
on] 1_ lcm_sum_ denominator_10 lcm_sum_ numerator_1 lcm_sum_ ___as3_type_F
raction fraction_cblock_total_count_41 fraction_cblock_counts_ 1_2 frac
tion_cblock_counts_ 1_7_7 fraction_cblock_counts_ 1_4_10 fraction_cblock_
counts_ 1_6_6 fraction_cblock_counts_ 1_5_5 fraction_cblock_counts_ 1_2_1
fraction_cblock_counts_ 1_10_10   Model 4/10 on the black bar using the f
raction pieces below.Answer: [object Object]
Sample number: 13
  whole_ fraction_input_value_4_6   fraction_cblock_chains_ sum_ denomin
ator_3 sum_ numerator_2 sum_ ___as3_type_Fraction fraction_cblock_chains_
lcm_sum_ denominator_6 lcm_sum_ numerator_4 lcm_sum_ ___as3_type_Fraction
fraction_cblock_chains_ pieces_1_6 pieces_1_6 pieces_1_6 pieces_1_6 f
raction_cblock_chains_ left_96 fraction_cblock_chains_ right_522 num_4
  plain_image_groups_ total_1 plain_image_groups_ url_assets_cms_wootmath
_fractions_number_line_markers_end_marker.swf plain_image_groups_ total_
1 plain_image_groups_ url_assets_cms_wootmath_fractions_number_line_marke
rs_start_marker.swf plain_image_groups_ total_1 plain_image_groups_ url_
assets_cms_wootmath_fractions_number_line_objects_beetle.swf plain_image
groups total_1 plain_image_groups_ url_assets_cms_wootmath_fractions_nu
mber_line_objects_beetle_trail.swf   den_6 fraction_cblock_total_count_
4 fraction_cblock_counts_ 1_6_4   Use the 1/6 pieces to figure out how f
ar the beetle traveled.Answer: 4/6
Sample number: 14
  plain_image_groups_ total_1 plain_image_groups_ url_assets_cms_wootmat
h_fractions_number_line_objects_panda.swf plain_image_groups_ total_1 pl
ain_image_groups_ url_assets_cms_wootmath_fractions_number_line_markers_s
tart_marker.swf input_8   numberline_associations_ position_634 number
line_associations_ pos_value_0.88 numberline_associations_ obj_name_objec
t numberline_associations_ fraction_cblock_chains_ sum_ denominator_8 s
um_ numerator_7 sum_ ___as3_type_Fraction fraction_cblock_chains_ lcm_sum_
denominator_8 lcm_sum_ numerator_7 lcm_sum_ ___as3_type_Fraction fraction_
cblock_chains_ pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_8 pieces_1_
8 pieces_1_8 pieces_1_8 fraction_cblock_chains_ left_165 fraction_cbloc
k_chains_ right_769 fraction_cblock_total_count_7 fraction_cblock_count
s_ 1_8_7   Drag the panda to 7/8 of a yard from the start.Answer: 7/8
Sample number: 15
  input_8   One yard on the number line is divided intoAnswer: sixths
Sample number: 16
  numberline_associations_ position_580.0 numberline_associations_ pos_

```
value_1.0 numberline_associations_ obj_name_answer_text numberline_associ
ations_ obj_value_3_3  input_   Drag the fraction to its correct location
on the number line.Answer: 3/3
Sample number: 17
  plain_image_groups_ total_1 plain_image_groups_ url_assets_cms_wootmat
h_fractions_number_line_objects_shark.swf  plain_image_groups_ total_1 pl
ain_image_groups_ url_assets_cms_wootmath_fractions_number_line_markers_s
tart_marker.swf   input_6    numberline_associations_ position_722 number
line_associations_ pos_value_1.0 numberline_associations_ obj_name_object
numberline_associations_   fraction_cblock_chains_ sum_ denominator_1 sum
_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chains_ lcm_sum_ d
enominator_6 lcm_sum_ numerator_6 lcm_sum_ __as3_type_Fraction fraction_c
block_chains_  pieces_1_6  pieces_1_6  pieces_1_6  pieces_1_6  pieces_1_6
  pieces_1_6 fraction_cblock_chains_ left_165 fraction_cblock_chains_ rig
ht_856  fraction_cblock_total_count_6  fraction_cblock_counts_ 1_6_6   Dr
ag the shark to 1/6 of a yard from the start.Answer: 1/6
Sample number: 18
  whole_  fraction_input_value_1_3   fraction_cblock_chains_ sum_ denomin
ator_1 sum_ numerator_1 sum_ __as3_type_Fraction fraction_cblock_chains_
lcm_sum_ denominator_3 lcm_sum_ numerator_3 lcm_sum_ __as3_type_Fraction
fraction_cblock_chains_  pieces_1_3  pieces_1_3  pieces_1_3 fraction_cblo
ck_chains_ left_96 fraction_cblock_chains_ right_657  num_1   plain_imag
e_groups_ total_1 plain_image_groups_ url_assets_cms_wootmath_fractions_n
umber_line_markers_end_marker.swf  plain_image_groups_ total_1 plain_imag
e_groups_ url_assets_cms_wootmath_fractions_number_line_markers_start_mar
ker.swf  plain_image_groups_ total_1 plain_image_groups_ url_assets_cms_w
ootmath_fractions_number_line_objects_snail.swf  plain_image_groups_ tota
l_1 plain_image_groups_ url_assets_cms_wootmath_fractions_number_line_obj
ects_snail_trail.swf   den_3  fraction_cblock_total_count_3  fraction_cb
lock_counts_ 1_3_3   Use the 1/3 pieces to figure out how far the snail t
raveled.Answer: 3/3
Sample number: 19
  whole_  fraction_input_value_3_4   fraction_cblock_chains_ sum_ denomin
ator_4 sum_ numerator_3 sum_ __as3_type_Fraction fraction_cblock_chains_
lcm_sum_ denominator_4 lcm_sum_ numerator_3 lcm_sum_ __as3_type_Fraction
fraction_cblock_chains_  pieces_1_4  pieces_1_4  pieces_1_4 fraction_cblo
ck_chains_ left_96 fraction_cblock_chains_ right_545  num_3   plain_imag
e_groups_ total_1 plain_image_groups_ url_assets_cms_wootmath_fractions_n
umber_line_markers_end_marker_noline.swf  plain_image_groups_ total_1 pla
in_image_groups_ url_assets_cms_wootmath_fractions_number_line_markers_st
art_marker.swf  plain_image_groups_ total_1 plain_image_groups_ url_asset
s_cms_wootmath_fractions_number_line_objects_dog.swf  plain_image_groups_
total_1 plain_image_groups_ url_assets_cms_wootmath_fractions_number_line
_objects_cat_dog_trail.swf   den_4  fraction_cblock_total_count_3  fract
ion_cblock_counts_ 1_4_3   Use the 1/4 pieces to figure out how far the d
og traveled.Answer: 3/4
```

```
In [14]: data_samples = df3['response_doc']
```

```
In [15]: n_features = 1000
         n_samples = len(data_samples)
         n_topics = 50
         n_top_words = 20
```

In [16]:
```python
print("Extracting tf-idf features ...")
tfidf_vectorizer = TfidfVectorizer(max_df=0.95, min_df=2,
                                   max_features=n_features,
                                   stop_words='english')
t0 = time()
tfidf = tfidf_vectorizer.fit_transform(data_samples)
print("done in %0.3fs." % (time() - t0))
```

```
Extracting tf-idf features ...
done in 7.887s.
```

In [17]:
```python
# Number of clusters
true_k = 100

km = MiniBatchKMeans(n_clusters=true_k, init='k-means++', n_init=1,
                     init_size=1000, batch_size=1000, random_state=42)
```

In [18]:
```python
print("Clustering with %s" % km)
t0 = time()
km.fit(tfidf)
print("done in %0.3fs" % (time() - t0))
print()
```

```
Clustering with MiniBatchKMeans(batch_size=1000, compute_labels=True, ini
t='k-means++',
        init_size=1000, max_iter=100, max_no_improvement=10,
        n_clusters=100, n_init=1, random_state=42, reassignment_ratio=0.0
1,
        tol=0.0, verbose=0)
done in 2.938s
```

In [19]:
```python
print("Top terms per cluster:")


order_centroids = km.cluster_centers_.argsort()[:, ::-1]
terms = tfidf_vectorizer.get_feature_names()
for i in range(true_k):
    print("Cluster %d:\n" % i, end='')
    for ind in order_centroids[i, :30]:
        print(' --- %s\n' % terms[ind], end='')
    print()
```

```
Top terms per cluster:
Cluster 0:
 --- write
 --- used
 --- divideboth
 --- denominator
 --- numerator
 --- form
 --- simplest
 --- number
 --- enter
 --- divide
 --- answer
 --- 12
 --- 15
 --- 10
 --- den_8
 --- far
 --- line
 --- fraction_input_value_3_8
 --- whole_
 --- num_3
 --- fraction
 --- fraction_input_value_2_8
 --- fraction_input_value_1_8
 --- num_2
 --- num_1
 --- fraction_input_value_2_4
 --- fraction_circle_containment_
 --- fraction_circle_total_count_13
 --- fraction_input_value_3
 --- fraction_circle_total_count_12

Cluster 1:
 --- fraction_cblock_chains_
 --- pieces_1_8
 --- lcm_sum_
 --- sum_
 --- __as3_type_fraction
 --- denominator_8
 --- numerator_1
 --- denominator_1
 --- bar1_
 --- fraction_cblock_counts_
 --- fraction
 --- fraction_cblock_containment_
```

```
      --- numerator_8
      --- left_130
      --- denominator_4
      --- pieces_1
      --- numerator_5
      --- denominator_2
      --- numerator_3
      --- right_820
      --- left_176
      --- numerator_7
      --- left_100
      --- 1_4_
      --- 1_8_8
      --- bar2_
      --- gray
      --- pieces_1_4
      --- bar
      --- 1_1

  Cluster 2:
      --- pieces_1_12
      --- fraction_circle_groups_
      --- chains_
      --- sum_
      --- lcm_sum_
      --- denominator_12
      --- __as3_type_fraction
      --- circle1_
      --- fraction_circle_counts_
      --- unit_
      --- 12
      --- unit1_
      --- unit2_
      --- fraction_circle_containment_
      --- numerator_11
      --- scale_0
      --- fraction_cblock_chains_
      --- object
      --- pieces_1
      --- numerator_12
      --- y_350
      --- scale_1
      --- unit0_
      --- 1_1
      --- circle
      --- 55
      --- numerator_1
      --- fraction
      --- answer
      --- twelfth

  Cluster 3:
      --- plain_image_groups_
      --- pieces_1_9
      --- fraction_cblock_chains_
      --- total_1
      --- swf
```

```
        --- denominator_9
        --- lcm_sum_
        --- sum_
        --- __as3_type_fraction
        --- url_assets_cms_wootmath_fractions_number_line_markers_start_marker
        --- left_96
        --- bitmap_text_interp_
        --- bitmap_text_inputs_
        --- denominator_3
        --- url_assets_cms_wootmath_fractions_number_line_markers_end_marker
        --- 1_9_3
        --- travel
        --- 1_3_
        --- fraction_cblock_counts_
        --- did
        --- input_a_3
        --- numerator_2
        --- yard
        --- figure
        --- fraction_cblock_total_count_3
        --- use
        --- far
        --- 1_9_6
        --- traveled
        --- numerator_3

    Cluster 4:
     --- match
     --- shade
     --- fraction_input_value_
     --- fraction
     --- input_a_
     --- choose
     --- comparison
     --- bar
     --- correct
     --- 1_3
     --- 3_4
     --- 1_4
     --- 2_5
     --- 1_6
     --- 2_3
     --- 6_8
     --- 2_4
     --- 3_5
     --- 4_8
     --- 3_6
     --- equivalent
     --- 1_8
     --- 2_8
     --- shaded
     --- bitmap_text_inputs_
     --- bitmap_text_interp_
     --- enter
     --- 4_6
     --- answer
     --- 3_8
```

```
Cluster 5:
 --- fraction_circle_groups_
 --- circle1_1_
 --- circle1_2_
 --- lcm_sum_
 --- sum_
 --- fraction_circle_counts_
 --- y_350
 --- scale_1
 --- __as3_type_fraction
 --- numerator_1
 --- pieces_1_12
 --- object
 --- fraction_circle_containment_
 --- x_750
 --- chains_
 --- say
 --- x_250
 --- pieces_1_6
 --- pieces_1_4
 --- cover
 --- pieces_1_15
 --- pieces_1_8
 --- piece
 --- dark
 --- pieces_1_10
 --- blue
 --- denominator_12
 --- denominator_6
 --- left_270
 --- pieces_1_9

Cluster 6:
 --- numberline_associations_
 --- line
 --- number
 --- location
 --- pos_value_0
 --- drag
 --- correct
 --- obj_value_a
 --- mile
 --- label
 --- pos_value_1
 --- biked
 --- divide
 --- ran
 --- obj_name_answer_text
 --- input_8
 --- lengths
 --- answer
 --- pos_value_2
 --- obj_name_answer_text1
 --- input_12
 --- obj_name_answer_text2
 --- labels
```

```
 --- obj_name_a_text
 --- total
 --- stopped
 --- distance
 --- input_9
 --- equal
 --- 25

Cluster 7:
 --- arrange
 --- greatest
 --- order
 --- boxes
 --- fractions
 --- drag
 --- fraction
 --- 10
 --- 81
 --- 43
 --- 42
 --- 63
 --- 51
 --- 123
 --- 52
 --- 83
 --- 54
 --- 32
 --- 31
 --- answer
 --- 44
 --- 12
 --- 41
 --- decimals
 --- 15
 --- 73
 --- 14
 --- 16
 --- 18
 --- 20

Cluster 8:
 --- plain_image_groups_
 --- total_1
 --- swf
 --- choose
 --- comparison
 --- correct
 --- url_assets_cms_wootmath_fractions_number_line_mug_mug_half_01
 --- input_
 --- input_a_
 --- url_assets_cms_wootmath_fractions_number_line_juice_oj_tupperware_fo
urths_02
 --- answer
 --- fraction_cblock_total_count_7
 --- fraction_cblock_total_count_8
 --- fraction_circle_total_count_4
 --- fraction_circle_total_count_3
```

```
--- fraction_circle_total_count_2
--- fraction_circle_total_count_16
--- fraction_circle_total_count_15
--- fraction_circle_total_count_14
--- fraction_cblock_total_count_4
--- fraction_circle_total_count_13
--- fraction_cblock_total_count_17
--- fraction_cblock_total_count_5
--- fraction_circle_total_count_12
--- fraction_circle_total_count_11
--- fraction_cblock_total_count_18
--- fraction_cblock_total_count_2
--- fraction_cblock_total_count_6
--- fraction_circle_total_count_5
--- fraction_circle_total_count_10

Cluster 9:
--- object
--- tenths
--- grid
--- hundredths
--- model
--- answer
--- decimal
--- tenth
--- 10
--- 15
--- 13
--- 11
--- 14
--- 16
--- 80
--- 12
--- 17
--- 18
--- 22
--- 20
--- 60
--- 40
--- 19
--- input_a_8
--- input_8
--- fraction_circle_total_count_7
--- fraction_circle_total_count_6
--- fraction_circle_total_count_5
--- fraction_circle_total_count_4
--- fraction_circle_total_count_8

Cluster 10:
--- pieces_1_12
--- fraction_circle_groups_
--- chains_
--- 1_2_
--- lcm_sum_
--- sum_
--- 1_3_
--- fraction
```

```
    --- fraction_circle_counts_
    --- denominator_12
    --- __as3_type_fraction
    --- scale_1
    --- reds
    --- fraction_circle_containment_
    --- unit_
    --- right_270
    --- y_300
    --- x_300
    --- numerator_1
    --- 1_12_6
    --- 1_12_4
    --- input_a_6
    --- yellow
    --- input_6
    --- left_30
    --- equals
    --- numerator_6
    --- brown
    --- pieces_1_3
    --- fraction_circle_total_count_7

Cluster 11:
    --- image_object_groups_
    --- 14
    --- total_14
    --- shade
    --- swf
    --- 12
    --- 11
    --- off_2
    --- off_4
    --- 10
    --- 13
    --- answer
    --- off_3
    --- off_6
    --- url_assets_objects_singles_piranha
    --- off_1
    --- piranhas
    --- off_5
    --- light
    --- robots
    --- on_2
    --- url_assets_objects_singles_cat
    --- url_assets_objects_singles_octopus
    --- cats
    --- on_0
    --- on_4
    --- on_1
    --- on_3
    --- popcorn
    --- boxes

Cluster 12:
    --- fraction_input_value_1_7
```

```
--- den_7
--- num_1
--- whole_
--- smallest
--- enter
--- fraction
--- answer
--- plain_image_groups_
--- shaded
--- smaller
--- parts
--- circle
--- total_1
--- greatest
--- swf
--- equal
--- object
--- flower
--- wearing
--- 10
--- cats
--- polygon
--- piranhas
--- radio_text_is
--- common
--- radio_choice_b
--- fractions
--- choose
--- comparison

Cluster 13:
--- pieces_1_8
--- fraction_circle_groups_
--- chains_
--- sum_
--- lcm_sum_
--- fraction_circle_counts_
--- denominator_8
--- __as3_type_fraction
--- fraction
--- 1_2_
--- fraction_circle_containment_
--- pieces_1_4
--- piece_0_
--- scale_1
--- 1_4_
--- unit_
--- left_0
--- y_300
--- scale_0
--- unit1_
--- numerator_1
--- pieces_1
--- unit2_
--- x_512
--- denominator_4
--- circle1_
```

```
--- 1_8_4
--- 1_1
--- cover
--- numerator_2

Cluster 14:
--- pieces_1_10
--- fraction_cblock_chains_
--- sum_
--- lcm_sum_
--- __as3_type_fraction
--- denominator_10
--- numerator_1
--- denominator_1
--- fraction_cblock_counts_
--- bar1_
--- denominator_5
--- denominator_2
--- left_80
--- bar2_
--- unit1_
--- left_100
--- fraction_cblock_containment_
--- unit2_
--- pieces_1
--- numerator_5
--- numerator_3
--- 10
--- fraction
--- pieces_1_6
--- numerator_9
--- numerator_2
--- numerator_4
--- numerator_7
--- right_770
--- pieces_1_5

Cluster 15:
--- input_
--- input_a_
--- correct
--- enter
--- choose
--- comparison
--- 20
--- 100
--- 10
--- 50
--- 60
--- 30
--- 80
--- 40
--- answer
--- 12
--- 22
--- 11
--- 17
```

```
--- 16
--- 14
--- 24
--- 18
--- 52
--- 13
--- 32
--- 51
--- 42
--- 41
--- complete

Cluster 16:
--- radio_group_problem_
--- numerator
--- missing
--- object
--- enter
--- whole_
--- radio_choice_a
--- choice_a
--- denominator
--- radio_choice_b
--- choice_b
--- mult_n_1_
--- mult_d_1_
--- fraction
--- answer
--- den_6
--- num_1
--- den_10
--- den_8
--- num_4
--- den_15
--- fraction_input_value_1_6
--- estimate
--- den_12
--- num_7
--- den_4
--- num_2
--- fraction_input_value_1_10
--- num_3
--- greater

Cluster 17:
--- fraction_circle_groups_
--- y_350
--- scale_1
--- fraction_circle_counts_
--- say
--- object
--- cover
--- fraction_circle_total_count_2
--- x_750
--- piece
--- x_250
--- brown
```

```
--- orange
--- pink
--- dark
--- 1_3_1
--- blue
--- 1_5_1
--- pieces_1_3
--- reds
--- fraction_circle_total_count_1
--- red
--- pieces_1_5
--- yellow
--- 1_4_1
--- answer
--- 1_2_1
--- pieces_1_2
--- pieces_1_4
--- pinks

Cluster 18:
--- fraction_cblock_chains_
--- lcm_sum_
--- sum_
--- __as3_type_fraction
--- numerator_1
--- denominator_1
--- left_175
--- fraction_cblock_counts_
--- denominator_12
--- denominator_4
--- denominator_3
--- unit2_
--- right_865
--- pieces_1_6
--- denominator_8
--- pieces_1_12
--- pieces_1
--- unit1_
--- denominator_2
--- unit3_
--- pieces_1_3
--- pieces_1_4
--- denominator_6
--- fraction
--- left_90
--- denominator_9
--- fraction_cblock_containment_
--- 1_
--- numerator_2
--- pieces_1_8

Cluster 19:
--- 1_2_
--- fraction_circle_groups_
--- pieces_1_2
--- fraction
--- chains_
```

```
--- sum_
--- lcm_sum_
--- pieces_1_4
--- denominator_2
--- fraction_circle_counts_
--- __as3_type_fraction
--- 1_
--- fraction_circle_containment_
--- numerator_1
--- scale_1
--- numerator_2
--- y_300
--- fraction_circle_total_count_3
--- 1_2_2
--- input_2
--- pieces_1
--- yellows
--- 1_1
--- left_0
--- input_a_2
--- x_512
--- circle
--- 1_4_2
--- x_300
--- half

Cluster 20:
--- pieces_1_7
--- fraction_cblock_chains_
--- denominator_7
--- lcm_sum_
--- sum_
--- __as3_type_fraction
--- bar1_
--- numerator_1
--- left_130
--- denominator_1
--- bar
--- fraction_cblock_counts_
--- black
--- object
--- seventh
--- right_820
--- dragging
--- fraction_cblock_containment_
--- numerator_3
--- 1_1
--- numerator_5
--- pieces_1
--- numerator_4
--- numerator_2
--- numerator_6
--- model
--- pieces
--- right_228
--- light
--- answer
```

```
Cluster 21:
 --- pieces_1_15
 --- fraction_cblock_chains_
 --- lcm_sum_
 --- sum_
 --- denominator_15
 --- __as3_type_fraction
 --- numerator_1
 --- fraction_cblock_counts_
 --- denominator_1
 --- left_90
 --- denominator_3
 --- numerator_2
 --- 15
 --- fraction
 --- denominator_5
 --- pieces_1_3
 --- unit1_
 --- bar1_
 --- 1_3_
 --- right_780
 --- fraction_cblock_containment_
 --- plain_image_groups_
 --- pieces_1_5
 --- pieces_1
 --- pieces_1_12
 --- unit_
 --- numerator_5
 --- unit2_
 --- numerator_7
 --- left_130

Cluster 22:
 --- equivalent
 --- box
 --- drag
 --- fraction
 --- answer
 --- 12
 --- 10
 --- youranswer
 --- fraction_circle_total_count_16
 --- fraction_circle_total_count_13
 --- fraction_circle_total_count_14
 --- fraction_circle_total_count_15
 --- fraction_circle_total_count_4
 --- fraction_circle_total_count_2
 --- fraction_circle_total_count_3
 --- fraction_circle_total_count_11
 --- fraction_circle_total_count_5
 --- fraction_circle_total_count_6
 --- fraction_circle_total_count_12
 --- fraction_circle_total_count_1
 --- fraction_circle_total_count_10
 --- fraction_circle_total_count_8
 --- fraction_circle_groups_
```

```
        --- fraction_circle_counts_
        --- fraction_circle_containment_
        --- fraction_cblock_total_count_9
        --- fraction_cblock_total_count_8
        --- fraction_cblock_total_count_7
        --- fraction_cblock_total_count_6
        --- fraction_cblock_total_count_5

    Cluster 23:
     --- area_target_contents_
     --- plain_image_groups_
     --- image_object_groups_
     --- x_468
     --- swf
     --- total_1
     --- y_118
     --- drag
     --- night
     --- piranhas
     --- answer
     --- chocolate
     --- pizza
     --- off_5
     --- fish
     --- tenths
     --- on_0
     --- on_3
     --- box
     --- 10
     --- number
     --- total_12
     --- correct
     --- off_6
     --- off_3
     --- total_9
     --- on_2
     --- off_2
     --- total_6
     --- on_4

    Cluster 24:
     --- yards
     --- fraction_input_value_
     --- long
     --- bar
     --- length
     --- whole_
     --- divide
     --- yard
     --- lengths
     --- fraction
     --- line
     --- number
     --- num_1
     --- equal
     --- enter
     --- den_8
```

```
--- den_6
--- den_input_8
--- num_2
--- den_input_6
--- den_2
--- den_4
--- parts
--- num_3
--- den_3
--- answer
--- den_input_4
--- den_input_3
--- den_1
--- num_4

Cluster 25:
--- shaded
--- whole_
--- parts
--- den_6
--- num_5
--- fraction
--- den_8
--- equal
--- fraction_input_value_5_6
--- answer
--- rectangle
--- num_4
--- fraction_input_value_2_6
--- polygon
--- fraction_input_value_5_8
--- star
--- num_2
--- flower
--- num_3
--- den_7
--- num_1
--- wearing
--- num_7
--- fraction_input_value_3_6
--- fraction_input_value_4_6
--- greatest
--- enter
--- fraction_input_value_4_8
--- fraction_input_value_1_6
--- fraction_input_value_1_8

Cluster 26:
--- pieces_1_5
--- fraction_circle_groups_
--- chains_
--- denominator_5
--- lcm_sum_
--- sum_
--- circle1_
--- fraction_circle_counts_
--- 1_
```

```
        --- __as3_type_fraction
        --- scale_0
        --- fraction_circle_containment_
        --- fraction
        --- unit1_
        --- scale_1
        --- pieces_1
        --- circle
        --- unit2_
        --- unit_
        --- object
        --- oranges
        --- black
        --- 1_5_5
        --- x_300
        --- numerator_3
        --- 1_1
        --- numerator_5
        --- numerator_4
        --- fifth
        --- input_a_5

     Cluster 27:
      --- make
      --- true
      --- boxes
      --- fractions
      --- comparison
      --- drag
      --- answer
      --- decimal
      --- use
      --- pieces
      --- 12
      --- tenths
      --- numbers
      --- statement
      --- enter
      --- 41
      --- 54
      --- 63
      --- input_
      --- 55
      --- 42
      --- 10
      --- input_a_4
      --- input_4
      --- 58
      --- input_a_6
      --- input_6
      --- 43
      --- 73
      --- input_1

     Cluster 28:
      --- pizza
      --- ate
```

```
          --- fraction_circle_groups_
          --- eat
          --- x_475
          --- friend
          --- did
          --- y_384
          --- fraction_circle_total_count_1
          --- scale_1
          --- 1_1
          --- fraction_circle_counts_
          --- greater
          --- 10
          --- pieces_1
          --- half
          --- 12
          --- answer
          --- came
          --- cut
          --- way
          --- express
          --- radio_group_problem_
          --- simplest
          --- den_6
          --- cover
          --- fraction_input_value_1
          --- whole_1
          --- num_4
          --- model

      Cluster 29:
       --- complete
       --- sentence
       --- addition
       --- bitmap_text_inputs_
       --- bitmap_text_interp_
       --- problem_text_2
       --- problem_text_1_2
       --- input_b_2
       --- problem_text_3
       --- input_a_2
       --- problem_text_0
       --- answer
       --- input_a_3
       --- problem_text_1
       --- 2_8
       --- input_a_5
       --- input_a_4
       --- input_b_3
       --- 3_6
       --- multiplication
       --- input_5
       --- input_2
       --- input_a_1
       --- input_b_4
       --- 10
       --- 2_6
       --- input_3
```

```
--- input_4
--- 4_6
--- 6_8

Cluster 30:
--- pieces_1_6
--- fraction_circle_groups_
--- chains_
--- sum_
--- lcm_sum_
--- fraction_circle_counts_
--- __as3_type_fraction
--- denominator_6
--- fraction_circle_containment_
--- fraction
--- unit1_
--- piece_0_
--- 1_3_
--- scale_1
--- unit2_
--- scale_0
--- y_300
--- circle1_
--- unit_
--- pieces_1_3
--- numerator_1
--- 1_2_
--- pieces_1
--- piece_1_
--- left_0
--- denominator_3
--- numerator_2
--- 1_
--- x_512
--- right_120

Cluster 31:
--- fraction_circle_groups_
--- scale_0
--- fraction_circle_counts_
--- piece
--- unit_
--- x_200
--- x_675
--- scale_1
--- x_811
--- box
--- pieces_1_10
--- pieces_1_6
--- unit
--- pieces_1_9
--- fraction_circle_total_count_4
--- pieces
--- x_550
--- y_415
--- y_450
--- chains_
```

```
--- 1_10_1
--- y_300
--- drag
--- answer
--- pieces_1_4
--- half
--- 1_6_1
--- pieces_1_5
--- lcm_sum_
--- sum_

Cluster 32:
 --- represented
 --- input0_0
 --- grid
 --- enter
 --- answer
 --- decimal
 --- 55
 --- pieces
 --- drag
 --- 54
 --- fraction_circle_total_count_2
 --- fraction_circle_total_count_3
 --- fraction_circle_total_count_15
 --- fraction_circle_total_count_4
 --- fraction_circle_total_count_5
 --- fraction_circle_total_count_14
 --- fraction_circle_total_count_6
 --- fraction_circle_total_count_13
 --- fraction_circle_total_count_12
 --- fraction_circle_total_count_16
 --- youranswer
 --- fraction_circle_total_count_8
 --- fraction_circle_total_count_11
 --- fraction_circle_total_count_10
 --- fraction_circle_total_count_1
 --- fraction_circle_groups_
 --- fraction_circle_counts_
 --- fraction_circle_containment_
 --- fraction_cblock_total_count_9
 --- fraction_cblock_total_count_8

Cluster 33:
 --- plain_image_groups_
 --- total_1
 --- swf
 --- png
 --- answer
 --- url_assets_cms_wootmath_fractions_number_line_markers_start_marker
 --- total_2
 --- enter
 --- length
 --- input_a_0
 --- start
 --- url_assets_cms_wootmath_fractions_ui_right_arrow
 --- url_assets_cms_wootmath_fractions_ui_left_arrow
```

```
      --- arrows
      --- decimal
      --- use
      --- distance
      --- traveled
      --- locations
      --- points
      --- whole_
      --- shape
      --- drag
      --- far
      --- correct
      --- url_assets_cms_wootmath_fractions_number_line_markers_end_marker
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_bubble_trai
    l
      --- label
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_bug_trail
      --- swam

   Cluster 34:
      --- 12
      --- arrange
      --- greatest
      --- boxes
      --- fractions
      --- drag
      --- fraction
      --- 11
      --- answer
      --- 10
      --- grid
      --- model
      --- 100
      --- fraction_cblock_chains_
      --- middle
      --- fraction_cblock_total_count_1
      --- greater
      --- lcm_sum_
      --- sum_
      --- decimal
      --- numerator_1
      --- __as3_type_fraction
      --- bar
      --- denominator_12
      --- left_1024
      --- fraction_cblock_counts_
      --- denominator_6
      --- 1_12_1
      --- form
      --- denominator_3

   Cluster 35:
      --- pieces_1_9
      --- fraction_cblock_chains_
      --- lcm_sum_
      --- sum_
      --- denominator_9
```

```
        --- __as3_type_fraction
        --- numerator_1
        --- bar1_
        --- denominator_1
        --- fraction_cblock_counts_
        --- left_130
        --- denominator_3
        --- den_9
        --- numerator_2
        --- fraction_cblock_containment_
        --- white
        --- numerator_9
        --- fraction
        --- numerator_7
        --- pieces_1_3
        --- right_820
        --- right_819
        --- 1_1
        --- pieces_1
        --- 1_9_9
        --- bar
        --- numerator_8
        --- fraction_cblock_total_count_10
        --- 1_3_
        --- whole_

    Cluster 36:
     --- object
     --- whole_1
     --- fraction_input_value_1
     --- form
     --- mixed
     --- simplest
     --- enter
     --- number
     --- answer
     --- num_1
     --- long
     --- den_3
     --- num_2
     --- den_4
     --- mile
     --- swam
     --- num_3
     --- difference
     --- left
     --- den_2
     --- yards
     --- homework
     --- den_6
     --- 2_3
     --- biked
     --- den_8
     --- 1_4
     --- pizzas
     --- express
     --- plain_image_groups_
```

```
Cluster 37:
 --- numberline_associations_
 --- plain_image_groups_
 --- mile
 --- shark
 --- final
 --- total_1
 --- swf
 --- location
 --- pos_value_0
 --- walked
 --- flew
 --- url_assets_cms_wootmath_fractions_number_line_markers_start_marker
 --- tenths
 --- obj_name_obj
 --- thenswam
 --- input_11
 --- swam
 --- drag
 --- start
 --- obj_name_object
 --- 10
 --- input_6
 --- answer
 --- tenth
 --- input_8
 --- position_490
 --- position_550
 --- position_260
 --- input_4
 --- 75

Cluster 38:
 --- decimal
 --- object
 --- input_0
 --- input_a_0
 --- enter
 --- answer
 --- model
 --- grid
 --- 14
 --- represented
 --- 15
 --- 13
 --- 16
 --- 17
 --- 11
 --- 19
 --- 18
 --- 22
 --- 50
 --- pieces
 --- 25
 --- drag
 --- 12
```

```
--- 33
--- 24
--- 34
--- 42
--- input_
--- input_a_
--- 31

Cluster 39:
 --- number
 --- did
 --- shown
 --- line
 --- youranswer
 --- form
 --- simplest
 --- miles
 --- enter
 --- mixed
 --- bike
 --- swim
 --- far
 --- whole_2
 --- fraction_input_value_2
 --- den_5
 --- run
 --- den_4
 --- whole_
 --- whole_1
 --- fraction_input_value_1
 --- num_1
 --- den_6
 --- fraction
 --- improper
 --- 1_4
 --- num_9
 --- num_2
 --- answer
 --- num_3

Cluster 40:
 --- pieces_1_3
 --- fraction_circle_groups_
 --- chains_
 --- 1_
 --- sum_
 --- lcm_sum_
 --- fraction_circle_counts_
 --- denominator_3
 --- fraction
 --- __as3_type_fraction
 --- fraction_circle_containment_
 --- 1_3_3
 --- browns
 --- circle1_
 --- scale_1
 --- circle
```

```
           --- unit1_
           --- unit2_
           --- pieces_1
           --- scale_0
           --- input_3
           --- black
           --- x_300
           --- input_a_3
           --- numerator_3
           --- fraction_circle_total_count_4
           --- y_300
           --- numerator_1
           --- 1_1
           --- numerator_2

      Cluster 41:
       --- radio_text_
       --- choose
       --- comparison
       --- input_
       --- correct
       --- answer
       --- fraction_circle_total_count_11
       --- fraction_circle_total_count_12
       --- fraction_circle_total_count_13
       --- fraction_circle_total_count_15
       --- fraction_circle_total_count_14
       --- fraction_circle_total_count_1
       --- fraction_circle_total_count_16
       --- fraction_circle_total_count_2
       --- fraction_circle_total_count_3
       --- fraction_circle_total_count_4
       --- fraction_circle_total_count_10
       --- youranswer
       --- fraction_circle_total_count_5
       --- fraction_circle_counts_
       --- fraction_circle_containment_
       --- fraction_cblock_total_count_9
       --- fraction_cblock_total_count_8
       --- fraction_cblock_total_count_7
       --- fraction_cblock_total_count_6
       --- fraction_cblock_total_count_5
       --- fraction_cblock_total_count_4
       --- fraction_cblock_total_count_3
       --- fraction_cblock_total_count_2
       --- fraction_cblock_total_count_18

      Cluster 42:
       --- pieces_1_7
       --- fraction_circle_groups_
       --- chains_
       --- denominator_7
       --- sum_
       --- lcm_sum_
       --- 1_
       --- fraction_circle_counts_
       --- __as3_type_fraction
```

```
--- unit1_
--- fraction
--- fraction_circle_containment_
--- circle1_
--- scale_0
--- unit2_
--- scale_1
--- pieces_1
--- light
--- 1_7_7
--- circle
--- input_a_7
--- input_7
--- x_300
--- blues
--- y_350
--- fraction_circle_total_count_8
--- black
--- 1_7_
--- 1_1
--- numerator_7

Cluster 43:
--- fraction_cblock_chains_
--- pieces_1_6
--- lcm_sum_
--- sum_
--- __as3_type_fraction
--- denominator_6
--- numerator_1
--- denominator_1
--- bar1_
--- fraction_cblock_counts_
--- denominator_3
--- left_130
--- numerator_2
--- numerator_5
--- fraction_cblock_containment_
--- fraction
--- pieces_1
--- left_90
--- denominator_2
--- unit1_
--- unit2_
--- bar
--- right_820
--- numerator_4
--- left_176
--- numerator_6
--- pieces_1_3
--- object
--- 1_
--- 1_1

Cluster 44:
--- tothe
--- ans1
```

```
--- fractions
--- denominator
--- box
--- numerator
--- ans0
--- drag
--- answer
--- ans2
--- greater
--- input_a_3
--- input_a_2
--- input_a_4
--- input_a_5
--- input_a_6
--- input_a_7
--- input_a_1
--- input_a_8
--- input_a_0
--- input_a_
--- input_a_10
--- fraction_circle_total_count_12
--- fraction_circle_total_count_11
--- fraction_circle_groups_
--- fraction_circle_total_count_10
--- fraction_circle_total_count_13
--- fraction_cblock_total_count_4
--- fraction_circle_total_count_1
--- fraction_cblock_total_count_5

Cluster 45:
--- whole_
--- greatest
--- enter
--- fraction
--- num_2
--- den_7
--- den_5
--- fraction_input_value_2_3
--- num_4
--- fraction_input_value_4_5
--- den_3
--- answer
--- num_3
--- fraction_input_value_2_5
--- num_6
--- num_5
--- smallest
--- den_8
--- den_6
--- fraction_input_value_4_6
--- wearing
--- num_1
--- greater
--- num_7
--- form
--- simplest
--- fraction_input_value_1_4
```

```
--- fraction_input_value_3_8
--- num_
--- 10
```

Cluster 46:
```
--- mug
--- hot
--- chocolate
--- plain_image_groups_
--- total_1
--- swf
--- whole_
--- num_1
--- fraction
--- url_assets_cms_wootmath_fractions_number_line_mug_mug_half_01
--- fraction_input_value_1_2
--- den_4
--- den_3
--- den_2
--- fraction_input_value_1_3
--- answer
--- fraction_input_value_1_4
--- num_2
--- fraction_input_value_2_4
--- fraction_input_value_2_3
--- fraction_input_value_3_4
--- num_3
--- fraction_input_value_1_5
--- den_5
--- den_1
--- num_
--- den_
--- num_4
--- fraction_input_value_
--- fraction_input_value_1_6
```

Cluster 47:
```
--- pieces_1_10
--- fraction_circle_groups_
--- chains_
--- sum_
--- lcm_sum_
--- denominator_10
--- fraction_circle_counts_
--- fraction
--- __as3_type_fraction
--- 1_2_
--- unit_
--- scale_1
--- fraction_circle_containment_
--- circle1_
--- 10
--- 1_5_
--- purples
--- 1_
--- x_300
--- numerator_1
```

```
--- fraction_cblock_chains_
--- scale_0
--- y_300
--- numerator_10
--- pieces_1
--- right_270
--- denominator_5
--- 1_1
--- 1_10_5
--- 1_10_
```

Cluster 48:
```
--- box
--- drag
--- answer
--- shown
--- homework
--- person
--- equivalent
--- piece
--- fraction
--- shows
--- far
--- traveled
--- 25
--- 51
--- yellow
--- decimal
--- bar
--- pieces
--- greater
--- 24
--- brown
--- half
--- 22
--- unit
--- input_
--- 34
--- frog
--- 42
--- circle
--- fifth
```

Cluster 49:
```
--- numberline_associations_
--- plain_image_groups_
--- total_1
--- swf
--- start
--- obj_name_object
--- url_assets_cms_wootmath_fractions_number_line_markers_start_marker
--- pos_value_0
--- meter
--- fraction_cblock_chains_
--- input_12
--- beetle
--- drag
```

```
--- yard
--- 10
--- lcm_sum_
--- sum_
--- answer
--- pieces_1_8
--- __as3_type_fraction
--- pieces_1_6
--- left_165
--- tenths
--- pos_value_1
--- input_8
--- url_assets_cms_wootmath_fractions_number_line_objects_v2_snail
--- fraction_cblock_counts_
--- input_6
--- butterfly
--- snail

Cluster 50:
--- pitcher
--- juice
--- plain_image_groups_
--- orange
--- total_1
--- whole_
--- swf
--- fraction
--- num_1
--- answer
--- den_3
--- den_4
--- num_2
--- den_6
--- den_8
--- fraction_input_value_1_2
--- den_2
--- fraction_input_value_1_3
--- url_assets_cms_wootmath_fractions_number_line_juice_oj_tupperware_fo
urths_02
--- num_3
--- fraction_input_value_2_3
--- fraction_input_value_1_6
--- fraction_input_value_3_4
--- fraction_input_value_1_4
--- fraction_input_value_1_8
--- fraction_input_value_2_4
--- num_4
--- fraction_input_value_2_6
--- num_6
--- num_5

Cluster 51:
--- den_9
--- whole_
--- smallest
--- fraction
--- fraction_input_value_1_9
```

```
--- enter
--- answer
--- num_5
--- num_2
--- shaded
--- num_4
--- num_1
--- greater
--- wearing
--- num_8
--- num_6
--- num_7
--- num_3
--- piranhas
--- smaller
--- cats
--- greatest
--- 10
--- 15
--- fractions
--- ate
--- 12
--- different
--- num_9
--- divided

Cluster 52:
--- pieces_1_15
--- fraction_circle_groups_
--- chains_
--- 1_5_
--- 1_3_
--- denominator_15
--- fraction
--- sum_
--- lcm_sum_
--- fraction_circle_counts_
--- scale_1
--- __as3_type_fraction
--- greens
--- fraction_circle_containment_
--- x_300
--- right_270
--- orange
--- y_300
--- 1_15_5
--- pieces_1_5
--- left_342
--- 1_15_3
--- numerator_1
--- 1_5_1
--- pieces_1_3
--- left_30
--- circle1_
--- 1_15_
--- brown
--- input_a_5
```

```
Cluster 53:
 --- 19
 --- hundredths
 --- 24
 --- grid
 --- model
 --- object
 --- answer
 --- decimal
 --- 12
 --- half
 --- input_0
 --- input_a_0
 --- 31
 --- enter
 --- bigger
 --- fraction_circle_total_count_16
 --- fraction_circle_total_count_6
 --- fraction_circle_total_count_7
 --- fraction_circle_total_count_2
 --- fraction_circle_total_count_15
 --- fraction_circle_total_count_4
 --- fraction_circle_total_count_5
 --- fraction_circle_total_count_3
 --- fraction_circle_total_count_11
 --- fraction_circle_total_count_14
 --- fraction_circle_total_count_13
 --- fraction_circle_total_count_12
 --- fraction_circle_total_count_9
 --- fraction_circle_total_count_10
 --- fraction_circle_total_count_1

Cluster 54:
 --- object
 --- decimals
 --- shown
 --- input_
 --- input_a_
 --- choose
 --- comparison
 --- correct
 --- model
 --- answer
 --- fraction_circle_total_count_2
 --- fraction_circle_total_count_16
 --- fraction_circle_total_count_12
 --- fraction_circle_total_count_3
 --- fraction_circle_total_count_4
 --- fraction_circle_total_count_15
 --- fraction_circle_total_count_14
 --- fraction_circle_total_count_13
 --- youranswer
 --- fraction_circle_total_count_5
 --- fraction_circle_total_count_10
 --- fraction_circle_total_count_1
 --- fraction_circle_groups_
```

```
        --- fraction_circle_counts_
        --- fraction_circle_containment_
        --- fraction_cblock_total_count_9
        --- fraction_cblock_total_count_8
        --- fraction_cblock_total_count_7
        --- fraction_cblock_total_count_6
        --- fraction_cblock_total_count_5

    Cluster 55:
     --- half
     --- hundredths
     --- input_0
     --- input_a_0
     --- enter
     --- 09
     --- bigger
     --- 14
     --- 13
     --- radio_group_problem_
     --- answer
     --- 17
     --- 15
     --- 41
     --- 11
     --- 12
     --- 22
     --- 16
     --- 34
     --- 18
     --- 33
     --- fraction_circle_groups_
     --- estimate
     --- 40
     --- 20
     --- ate
     --- piece
     --- 24
     --- bar
     --- radio_text_one

    Cluster 56:
     --- plain_image_groups_
     --- fraction_cblock_chains_
     --- total_1
     --- swf
     --- lcm_sum_
     --- sum_
     --- __as3_type_fraction
     --- url_assets_cms_wootmath_fractions_number_line_markers_start_marker
     --- traveled
     --- url_assets_cms_wootmath_fractions_number_line_markers_end_marker
     --- fraction_cblock_counts_
     --- numerator_1
     --- far
     --- left_96
     --- figure
     --- use
```

```
--- pieces_1_8
--- pieces_1_6
--- pieces_1_10
--- denominator_3
--- pieces_1_4
--- pieces_1_3
--- denominator_4
--- denominator_2
--- answer
--- pieces
--- distance
--- fraction_cblock_total_count_1
--- shows
--- fraction_cblock_total_count_2

Cluster 57:
--- numberline_associations_
--- obj_value_1
--- obj_value_0
--- location
--- line
--- number
--- correct
--- pos_value_1
--- drag
--- pos_value_0
--- miles
--- input_9
--- pos_value_
--- obj_name_answer_text
--- input_5
--- labels
--- answer
--- object
--- label
--- input_8
--- input_7
--- input_
--- input_10
--- input_15
--- 1_3
--- 83
--- input_12
--- position_450
--- 55
--- 1_4

Cluster 58:
--- words
--- model_lbl_0
--- express
--- decimal
--- tenths
--- bitmap_text_interp_
--- bitmap_text_inputs_
--- model
--- answer
```

```
--- input_b_4
--- input_b_5
--- input_b_6
--- input_b_7
--- input_a_4
--- input_b_8
--- input_b_1
--- input_a_9
--- input_a_6
--- input_a_5
--- tenth
--- input_a_7
--- input_b_3
--- input_a_8
--- input_a_1
--- input_a_3
--- input_b_2
--- input_a_2
--- 10
--- input_a_
--- input_a_10

Cluster 59:
--- fraction_input_value_1_5
--- den_5
--- num_1
--- whole_
--- wearing
--- fraction
--- answer
--- num_3
--- shaded
--- robots
--- enter
--- plain_image_groups_
--- smallest
--- piranhas
--- smaller
--- circle
--- popcorn
--- total_1
--- rectangle
--- swf
--- greater
--- form
--- simplest
--- greatest
--- cats
--- boxes
--- object
--- 15
--- 10
--- fractions

Cluster 60:
--- image_object_groups_
--- shade
```

```
--- swf
--- off_2
--- total_8
--- on_0
--- 11
--- on_4
--- off_1
--- answer
--- on_2
--- on_3
--- off_3
--- off_4
--- 13
--- off_6
--- on_1
--- total_6
--- total_12
--- url_assets_objects_singles_cat
--- url_assets_objects_singles_octopus
--- cats
--- 12
--- 15
--- url_assets_objects_singles_piranha
--- total_3
--- total_9
--- 10
--- off_5
--- light

Cluster 61:
--- fraction_circle_groups_
--- unit_
--- lcm_sum_
--- sum_
--- unit1_
--- unit2_
--- fraction_circle_counts_
--- scale_0
--- __as3_type_fraction
--- numerator_1
--- fraction_circle_containment_
--- pieces_1_2
--- denominator_2
--- pieces_1
--- pieces_1_3
--- y_350
--- fraction_circle_total_count_2
--- denominator_3
--- y_300
--- x_512
--- x_700
--- 1_1
--- fraction_circle_total_count_4
--- bigger
--- pieces_1_4
--- 125
--- fraction
```

```
--- 1_2
--- answer
--- x_250

Cluster 62:
--- using
--- model
--- answer
--- equivalent
--- fraction
--- size
--- greater
--- pieces
--- thirds
--- browns
--- sixths
--- equal
--- fourths
--- cover
--- yellow
--- yellows
--- pinks
--- grays
--- piece
--- dark
--- blues
--- fifths
--- halves
--- oranges
--- smaller
--- cake
--- reds
--- pink
--- blue
--- fraction_circle_groups_

Cluster 63:
--- fraction_input_value_2_4
--- den_4
--- num_2
--- whole_
--- enter
--- fraction
--- answer
--- greatest
--- fractions
--- greater
--- different
--- smallest
--- equal
--- shaded
--- popcorn
--- plain_image_groups_
--- long
--- form
--- simplest
--- numerator
```

```
--- wearing
--- missing
--- parts
--- smaller
--- boxes
--- total_1
--- swf
--- flower
--- 12
--- rectangle

Cluster 64:
--- plain_image_groups_
--- url_assets_cms_wootmath_fractions_misc_objects_ant_alt
--- url_assets_cms_wootmath_fractions_misc_objects_ladybug_alt
--- bugs
--- ladybugs
--- swf
--- total_2
--- form
--- simplest
--- total_3
--- enter
--- whole_
--- total_4
--- num_1
--- fraction_input_value_1_2
--- den_2
--- fraction
--- answer
--- total_6
--- den_3
--- den_4
--- num_2
--- fraction_input_value_1_3
--- total_1
--- num_3
--- fraction_input_value_2_3
--- fraction_input_value_1_4
--- fraction_input_value_3_4
--- total_9
--- fraction_input_value_2_4

Cluster 65:
--- numberline_associations_
--- mile
--- plain_image_groups_
--- kangaroo
--- url_assets_cms_wootmath_fractions_number_line_objects_v2_kangaroo
--- obj_name_object
--- pos_value_0
--- total_1
--- swf
--- lengths
--- drag
--- divide
--- line
```

```
         --- equal
         --- bitmap_text_interp_
         --- bitmap_text_inputs_
         --- number
         --- answer
         --- den_input_6
         --- den_input_3
         --- den_input_8
         --- input_5
         --- den_input_4
         --- 25
         --- position_260
         --- input_4
         --- position_200
         --- url_assets_cms_wootmath_fractions_number_line_objects_v2_giraffe
         --- giraffe
         --- panda

     Cluster 66:
         --- amounts
         --- model
         --- answer
         --- tenths
         --- box
         --- drag
         --- fraction_circle_total_count_4
         --- fraction_circle_total_count_3
         --- fraction_circle_total_count_2
         --- fraction_circle_total_count_5
         --- fraction_circle_total_count_6
         --- fraction_circle_total_count_15
         --- fraction_circle_total_count_14
         --- fraction_circle_total_count_13
         --- fraction_circle_total_count_12
         --- fraction_circle_total_count_11
         --- fraction_circle_total_count_16
         --- youranswer
         --- fraction_circle_total_count_1
         --- fraction_circle_groups_
         --- fraction_circle_counts_
         --- fraction_circle_containment_
         --- fraction_cblock_total_count_9
         --- fraction_cblock_total_count_8
         --- fraction_cblock_total_count_7
         --- fraction_cblock_total_count_6
         --- fraction_cblock_total_count_5
         --- fraction_cblock_total_count_4
         --- fraction_cblock_total_count_3
         --- fraction_cblock_total_count_2

     Cluster 67:
         --- makes
         --- statement
         --- true
         --- bitmap_text_interp_
         --- bitmap_text_inputs_
         --- number
```

```
                      --- enter
                      --- input_1
                      --- input_3
                      --- input_a_3
                      --- input_a_1
                      --- input_a_5
                      --- input_a_4
                      --- input_5
                      --- input_4
                      --- input_2
                      --- 10
                      --- input_a_2
                      --- input_a_6
                      --- input_6
                      --- 12
                      --- input_a_7
                      --- input_7
                      --- input_0
                      --- input_a_0
                      --- input_a_8
                      --- input_8
                      --- input_a_10
                      --- input_10
                      --- input_a_9

                  Cluster 68:
                   --- fraction_circle_groups_
                   --- fraction_circle_counts_
                   --- fraction_circle_total_count_1
                   --- scale_1
                   --- x_300
                   --- circle1_
                   --- circle
                   --- dark
                   --- yellow
                   --- say
                   --- cover
                   --- y_350
                   --- black
                   --- fraction_circle_total_count_2
                   --- blue
                   --- y_300
                   --- pieces_1
                   --- piece
                   --- answer
                   --- 1_1
                   --- pieces_1_2
                   --- sum_
                   --- lcm_sum_
                   --- grays
                   --- blues
                   --- equals
                   --- pieces_1_4
                   --- 1_2_1
                   --- equal
                   --- input_a_1
```

```
Cluster 69:
 --- 15
 --- den_15
 --- whole_
 --- smallest
 --- enter
 --- fraction
 --- answer
 --- 13
 --- num_2
 --- smaller
 --- numerator
 --- 11
 --- num_11
 --- num_1
 --- denominator
 --- greatest
 --- greater
 --- num_7
 --- 12
 --- num_4
 --- grid
 --- num_8
 --- num_5
 --- num_3
 --- num_10
 --- 14
 --- num_9
 --- model
 --- 100
 --- missing

Cluster 70:
 --- fraction_cblock_chains_
 --- sum_
 --- lcm_sum_
 --- bar1_
 --- __as3_type_fraction
 --- numerator_1
 --- left_130
 --- bar
 --- denominator_1
 --- fraction_cblock_counts_
 --- black
 --- object
 --- right_820
 --- dragging
 --- fraction_cblock_total_count_2
 --- denominator_3
 --- denominator_2
 --- 1_1
 --- fraction_cblock_containment_
 --- pieces_1_3
 --- model
 --- pieces_1
 --- piece
 --- pieces_1_2
```

```
 --- numerator_2
 --- denominator_6
 --- denominator_5
 --- denominator_12
 --- denominator_9
 --- fraction_cblock_total_count_3

Cluster 71:
 --- comparison1
 --- input_
 --- input_a_
 --- correct
 --- enter
 --- 100
 --- 50
 --- 22
 --- 20
 --- 24
 --- 12
 --- 40
 --- 51
 --- 11
 --- 60
 --- 30
 --- 52
 --- 10
 --- 13
 --- 19
 --- 32
 --- 25
 --- 31
 --- 14
 --- 16
 --- 80
 --- 15
 --- 18
 --- fraction_circle_total_count_11
 --- fraction_input_value_

Cluster 72:
 --- numberline_associations_
 --- obj_value_
 --- label
 --- yard
 --- location
 --- line
 --- obj_name_eqn
 --- number
 --- pos_value_1
 --- correct
 --- drag
 --- fraction_cblock_chains_
 --- obj_name_answer_text
 --- input_
 --- pos_value_0
 --- answer
 --- lcm_sum_
```

```
--- sum_
--- miles
--- __as3_type_fraction
--- input_8
--- pieces_1_4
--- input_6
--- position_450
--- pieces_1_3
--- mile
--- pos_value_
--- fraction_cblock_counts_
--- input_7
--- numerator_1

Cluster 73:
--- plain_image_groups_
--- radio_group_mc1_
--- radio_group_mc2_
--- text_yes
--- choice_a
--- total_1
--- swf
--- shapes
--- object
--- shaded
--- text_no
--- choice_b
--- url_assets_cms_wootmath_fractions_equal_parts_fourths_fourth_03
--- answer
--- radio_group_problem_
--- radio_choice_a
--- denominator
--- numerator
--- fraction
--- fraction_cblock_total_count_2
--- fraction_cblock_total_count_3
--- fraction_circle_total_count_13
--- fraction_circle_total_count_12
--- fraction_circle_total_count_11
--- fraction_circle_total_count_10
--- fraction_circle_total_count_1
--- fraction_cblock_total_count_7
--- fraction_circle_groups_
--- fraction_circle_counts_
--- fraction_cblock_total_count_4

Cluster 74:
--- grid
--- model
--- 10
--- answer
--- 100
--- 11
--- numbers
--- 14
--- 13
--- boxes
```

```
--- drag
--- hundredths
--- decimal
--- 09
--- use
--- shown
--- covering
--- 18
--- pieces
--- 22
--- 17
--- 16
--- think
--- 20
--- 15
--- came
--- pizza
--- 1_10
--- cut
--- piece

Cluster 75:
--- bitmap_text_inputs_
--- bitmap_text_interp_
--- input_a_1
--- enter
--- missing
--- fraction_input_value_
--- form
--- simplest
--- numerator
--- input_a_2
--- answer
--- sum
--- fraction
--- numbers
--- 12
--- input_6
--- 10
--- input_a_6
--- 2_4
--- input_1
--- eqn_2
--- input_a_3
--- input_2
--- input_b_6
--- input_5
--- 15
--- 1_2
--- input_b_8
--- 2_3
--- input_a_5

Cluster 76:
--- problem_text_1
--- complete
--- addition
```

```
      --- sentence
      --- problem_text_1_2
      --- bitmap_text_interp_
      --- bitmap_text_inputs_
      --- input_b_1
      --- input_a_1
      --- 1_8
      --- 1_6
      --- problem_text_0
      --- input_1
      --- 1_4
      --- problem_text_2
      --- answer
      --- 1_10
      --- input_a_2
      --- 3_4
      --- problem_text_3
      --- 2_6
      --- 4_6
      --- 5_6
      --- input_a_3
      --- 6_8
      --- input_b_2
      --- 2_4
      --- 2_8
      --- input_a_0
      --- 1_9

   Cluster 77:
      --- long
      --- fraction_input_value_
      --- bitmap_text_inputs_
      --- bitmap_text_interp_
      --- bar
      --- fraction
      --- answer
      --- input_a_3
      --- input_a_4
      --- input_a_6
      --- input_a_2
      --- input_a_8
      --- fourths
      --- thirds
      --- halves
      --- sixths
      --- input_a_1
      --- 2_4
      --- 2_3
      --- eighths
      --- 1_2
      --- input_a_
      --- 1_8
      --- 3_4
      --- input_a_5
      --- fraction_circle_total_count_15
      --- fraction_circle_total_count_14
      --- fraction_circle_total_count_13
```

```
    --- fraction_circle_total_count_16
    --- fraction_cblock_total_count_9

Cluster 78:
 --- fraction_input_value_1_2
 --- den_2
 --- num_1
 --- whole_
 --- 50
 --- 100
 --- enter
 --- answer
 --- form
 --- simplest
 --- fractions
 --- greater
 --- fraction
 --- different
 --- smallest
 --- plain_image_groups_
 --- express
 --- 10
 --- greatest
 --- long
 --- 12
 --- total_1
 --- swf
 --- object
 --- numerator
 --- common
 --- left
 --- 30
 --- multiplication
 --- makes

Cluster 79:
 --- fraction_cblock_chains_
 --- lcm_sum_
 --- sum_
 --- pieces_1_4
 --- __as3_type_fraction
 --- denominator_4
 --- numerator_1
 --- bar1_
 --- denominator_1
 --- fraction_cblock_counts_
 --- left_130
 --- right_820
 --- denominator_2
 --- bar
 --- numerator_3
 --- fraction_cblock_containment_
 --- pieces_1
 --- numerator_2
 --- 1_1
 --- black
 --- object
```

```
--- fourth
--- fraction
--- numerator_4
--- 1_4_4
--- dark
--- model
--- blue
--- 1_4_2
--- right_475

Cluster 80:
--- math
--- sentence
--- complete
--- tenths
--- correct
--- drag
--- answer
--- people
--- equally
--- amounts
--- undefined
--- express
--- object
--- cookies
--- bitmap_text_inputs_
--- bitmap_text_interp_
--- pizzas
--- 10
--- input_a_6
--- input_6
--- input_1
--- numbers
--- input_a_1
--- input_a_5
--- input_5
--- boxes
--- greater
--- input_a_2
--- input_2
--- 11

Cluster 81:
--- object
--- form
--- simplest
--- enter
--- answer
--- num_1
--- whole_3
--- fraction_input_value_3
--- mixed
--- fraction_input_value_2
--- whole_2
--- difference
--- number
--- sum
```

```
--- whole_
--- num_3
--- den_6
--- den_3
--- bar
--- mult_d_1_
--- mult_n_1_
--- den_2
--- den_4
--- long
--- black
--- den_10
--- model
--- num_2
--- den_5
--- dragging

Cluster 82:
--- pieces_1_9
--- fraction_circle_groups_
--- chains_
--- denominator_9
--- sum_
--- lcm_sum_
--- fraction_circle_counts_
--- 1_3_
--- fraction
--- __as3_type_fraction
--- circle1_
--- scale_1
--- 1_
--- fraction_circle_containment_
--- whites
--- x_300
--- unit1_
--- brown
--- 1_9_3
--- y_300
--- unit2_
--- pieces_1_3
--- pieces_1
--- numerator_1
--- circle
--- scale_0
--- 1_3_1
--- unit_
--- 1_1
--- 1_9_

Cluster 83:
--- mult_n_2_
--- mult_d_2_
--- mult_d_1_
--- mult_n_1_
--- enter
--- bitmap_text_inputs_
--- bitmap_text_interp_
```

```
--- form
--- simplest
--- answer
--- difference
--- missing
--- 10
--- numerator
--- 15
--- fraction_input_value_1
--- whole_1
--- whole_
--- den_12
--- 12
--- input_a_1
--- num_11
--- sum
--- den_15
--- 1_10
--- equation_2
--- equation_6
--- 1_5
--- 11
--- input_b_6

Cluster 84:
--- fraction_input_value_3_4
--- num_3
--- den_4
--- whole_
--- greatest
--- enter
--- fraction
--- answer
--- plain_image_groups_
--- long
--- shaded
--- total_1
--- swf
--- greater
--- piranhas
--- form
--- simplest
--- fractions
--- smallest
--- friends
--- 75
--- ate
--- pizza
--- eat
--- wearing
--- missing
--- did
--- numerator
--- object
--- difference

Cluster 85:
```

```
--- pieces_1_4
--- fraction_circle_groups_
--- chains_
--- sum_
--- lcm_sum_
--- fraction_circle_counts_
--- denominator_4
--- __as3_type_fraction
--- 1_
--- fraction_circle_containment_
--- unit_
--- scale_1
--- unit1_
--- fraction
--- piece_0_
--- circle1_
--- pieces_1
--- unit2_
--- scale_0
--- y_300
--- numerator_1
--- 1_4_4
--- 1_1
--- circle
--- fraction_circle_total_count_5
--- numerator_4
--- x_300
--- dark
--- black
--- right_180

Cluster 86:
--- den_12
--- smallest
--- 12
--- whole_
--- fraction_input_value_1_12
--- enter
--- fraction
--- smaller
--- answer
--- num_2
--- num_1
--- num_4
--- num_3
--- num_6
--- divided
--- num_5
--- num_7
--- greatest
--- num_9
--- 10
--- fraction_input_value_2_6
--- 15
--- den_6
--- greater
--- num_8
```

```
      --- num_10
      --- fractions
      --- ate
      --- complete
      --- write

   Cluster 87:
      --- pieces_1_8
      --- fraction_cblock_chains_
      --- lcm_sum_
      --- sum_
      --- bar1_
      --- __as3_type_fraction
      --- denominator_8
      --- left_130
      --- numerator_1
      --- bar
      --- black
      --- object
      --- fraction_cblock_counts_
      --- eighth
      --- denominator_1
      --- right_820
      --- numerator_3
      --- dragging
      --- 1_1
      --- denominator_4
      --- pieces
      --- fraction_cblock_containment_
      --- numerator_5
      --- model
      --- pieces_1
      --- numerator_7
      --- numerator_6
      --- numerator_4
      --- numerator_2
      --- right_302

   Cluster 88:
      --- numberline_associations_
      --- plain_image_groups_
      --- obj_name_object
      --- mile
      --- pos_value_0
      --- total_1
      --- swf
      --- drag
      --- input_5
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_elephant
      --- elephant
      --- panda
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_panda
      --- hippo
      --- rex
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_trex
      --- answer
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_hippo
```

```
      --- input_4
      --- url_assets_cms_wootmath_fractions_number_line_objects_v2_giraffe
      --- giraffe
      --- input_7
      --- input_3
      --- 25
      --- position_260
      --- 17
      --- pos_value_1
      --- 75
      --- input_9
      --- position_200

   Cluster 89:
      --- pieces_1_12
      --- fraction_circle_groups_
      --- chains_
      --- frac_piece_
      --- fraction_circle_counts_
      --- lcm_sum_
      --- sum_
      --- scale_1
      --- denominator_12
      --- __as3_type_fraction
      --- 1_4_
      --- fraction
      --- fraction_circle_containment_
      --- reds
      --- numerator_1
      --- 1_6_
      --- piece1_
      --- x_300
      --- 1_12_3
      --- piece
      --- pieces_1_4
      --- circle1_
      --- cover
      --- piece_0_
      --- 1_12_2
      --- left_270
      --- y_350
      --- y_300
      --- 12
      --- pieces_1_3

   Cluster 90:
      --- rectangle
      --- fraction_input_value_
      --- fraction
      --- shade
      --- shaded
      --- 2_6
      --- match
      --- circle
      --- 4_8
      --- answer
      --- object
```

```
--- input_a_3
--- 12
--- equivalent
--- input_a_2
--- 2_8
--- problem
--- input_a_6
--- 24
--- radio_choice_b
--- 13
--- 10
--- 16
--- 3_8
--- input_a_8
--- 15
--- input_a_4
--- 4_6
--- 1_4
--- input_12

Cluster 91:
--- whole_
--- 10
--- answer
--- den_10
--- fraction
--- enter
--- smallest
--- num_1
--- different
--- den_8
--- mile
--- greater
--- run
--- make
--- smaller
--- fraction_input_value_1_8
--- popcorn
--- bar
--- number
--- num_7
--- fraction_input_value_1_10
--- think
--- ran
--- 20
--- fractions
--- 24
--- ate
--- num_2
--- block
--- cake

Cluster 92:
--- den_12
--- whole_
--- num_10
--- 12
```

```
          --- enter
          --- greatest
          --- fraction
          --- answer
          --- missing
          --- 10
          --- numerator
          --- greater
          --- ate
          --- num_7
          --- num_6
          --- num_2
          --- num_9
          --- different
          --- num_11
          --- fractions
          --- smaller
          --- num_4
          --- 11
          --- num_5
          --- num_3
          --- equal
          --- difference
          --- shaded
          --- numbers
          --- write

      Cluster 93:
       --- fraction_cblock_chains_
       --- pieces_1_5
       --- lcm_sum_
       --- sum_
       --- denominator_5
       --- __as3_type_fraction
       --- numerator_1
       --- bar1_
       --- denominator_1
       --- fraction_cblock_counts_
       --- numerator_3
       --- numerator_2
       --- left_130
       --- left_80
       --- numerator_4
       --- bar
       --- fraction_cblock_containment_
       --- unit2_
       --- pieces_1
       --- right_820
       --- object
       --- black
       --- numerator_5
       --- right_770
       --- model
       --- fraction
       --- 1_5_5
       --- fifth
       --- left_90
```

```
      --- unit1_

Cluster 94:
 --- match
 --- fraction_input_value_
 --- shade
 --- fraction
 --- input_a_
 --- choose
 --- comparison
 --- correct
 --- circle
 --- flower
 --- polygon
 --- 1_3
 --- 2_3
 --- 4_8
 --- 3_8
 --- 3_6
 --- 1_6
 --- 2_4
 --- 1_4
 --- 4_6
 --- 2_8
 --- 3_5
 --- 2_5
 --- 2_6
 --- 5_6
 --- 6_8
 --- 1_8
 --- 12
 --- 1_9
 --- 10

Cluster 95:
 --- pieces_1_12
 --- fraction_cblock_chains_
 --- sum_
 --- lcm_sum_
 --- __as3_type_fraction
 --- numerator_1
 --- denominator_12
 --- fraction_cblock_counts_
 --- left_100
 --- denominator_1
 --- denominator_2
 --- bar2_
 --- bar1_
 --- fraction_cblock_containment_
 --- fraction
 --- right_790
 --- denominator_3
 --- pieces_1
 --- right_445
 --- denominator_4
 --- 1_4_
 --- left_176
```

```
--- pieces_1_2
--- numerator_6
--- piece0_
--- 12
--- 1_3_
--- numerator_3
--- numerator_2
--- plain_image_groups_

Cluster 96:
--- fraction_cblock_chains_
--- lcm_sum_
--- sum_
--- __as3_type_fraction
--- numerator_1
--- bar2_
--- bar1_
--- left_100
--- denominator_1
--- denominator_2
--- fraction_cblock_counts_
--- right_790
--- fraction_cblock_containment_
--- pieces_1
--- denominator_3
--- pieces_1_2
--- denominator_4
--- bar0_
--- pieces_1_6
--- pieces_1_4
--- numerator_2
--- left_60
--- bar3_
--- left_200
--- denominator_6
--- right_445
--- pieces_1_8
--- pieces_1_3
--- 1_2
--- model

Cluster 97:
--- divided
--- fifths
--- yard
--- input_7
--- line
--- number
--- answer
--- sixths
--- input_a_2
--- input_8
--- input_a_4
--- input_a_3
--- input_a_6
--- input_a_1
--- input_a_5
```

```
--- input_a_8
--- num_1
--- whole_
--- object
--- fraction_input_value_1_6
--- mixed
--- fraction_input_value_1_8
--- fraction_input_value_1_4
--- den_6
--- enter
--- den_8
--- den_4
--- 18
--- input_a_9
--- rectangle

Cluster 98:
--- star
--- match
--- shade
--- fraction_input_value_
--- fraction
--- input_a_
--- choose
--- comparison
--- correct
--- 3_4
--- 1_4
--- 1_5
--- 1_8
--- 4_6
--- 2_5
--- 5_6
--- 2_8
--- 4_8
--- 6_8
--- 2_4
--- fraction_circle_total_count_6
--- fraction_circle_total_count_16
--- fraction_circle_total_count_5
--- fraction_circle_total_count_4
--- fraction_circle_total_count_3
--- fraction_circle_total_count_2
--- youranswer
--- fraction_circle_total_count_15
--- fraction_circle_total_count_14
--- fraction_circle_total_count_13

Cluster 99:
--- fraction_cblock_chains_
--- lcm_sum_
--- sum_
--- __as3_type_fraction
--- numerator_1
--- denominator_8
--- pieces_1_8
--- denominator_1
```

```
--- fraction_cblock_counts_
--- denominator_4
--- left_80
--- left_90
--- fraction
--- pieces_1
--- pieces_1_4
--- 1_
--- numerator_3
--- unit2_
--- fraction_cblock_containment_
--- left_176
--- denominator_2
--- right_780
--- right_770
--- numerator_2
--- left_150
--- right_262
--- 1_2
--- denominator_7
--- unit_
--- 1_8_
```

In [20]:
```python
df3['cluster_100'] = km.labels_
```

In [21]:
```python
df3['trait_1'] = df3['behavioral_traits'].apply(lambda x : x[0] if len(x) >
df3['trait_2'] = df3['behavioral_traits'].apply(lambda x : x[1] if len(x) >
```

In [22]:
```python
df_trait_1 = df3.groupby(['cluster_100', 'trait_1']).size().unstack(fill_val
df_trait_2 = df3.groupby(['cluster_100', 'trait_2']).size().unstack(fill_val
```

In [23]:
```python
df_cluster_100 = df3.groupby('cluster_100')
```

In [24]:
```python
df_trait_1.index.rename('cluster_100', inplace=True)
df_trait_2.index.rename('cluster_100', inplace=True)
df_traits = pd.concat([df_trait_1, df_trait_2], axis=1)
```
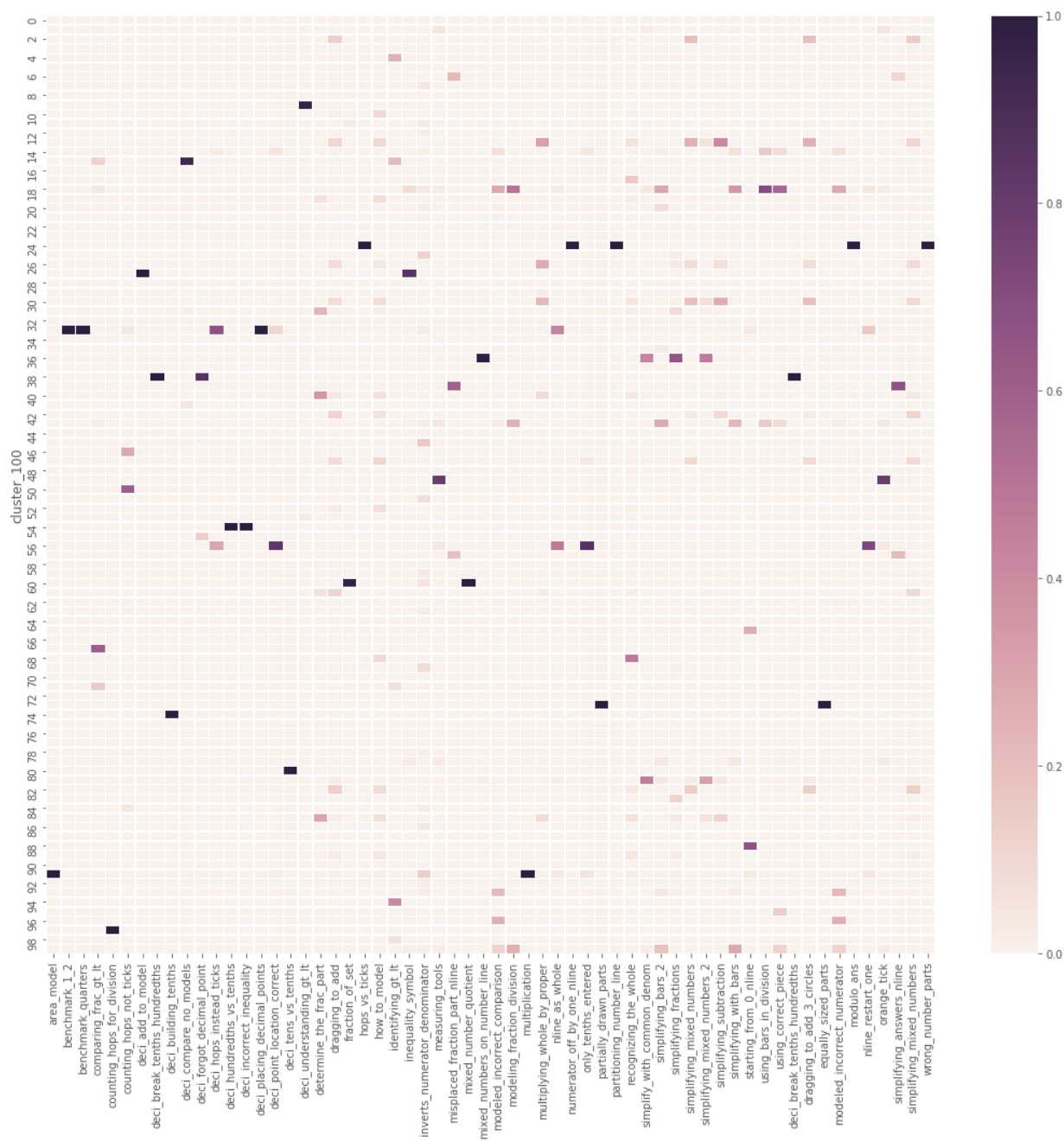
In [25]:
```python
df_traits = df_traits.drop('None', axis=1)
```

In [26]:
```python
#df_traits_norm = (df_traits - df_traits.mean()) / (df_traits.max() - df_tra
df_traits_norm = (df_traits  / (df_traits.sum()) )
```

```
In [27]: fig = plt.figure(figsize=(18.5, 16))
         cmap = sns.cubehelix_palette(light=.95, as_cmap=True)
         sns.heatmap(df_traits_norm, cmap=cmap,  linewidths=.5)

         #sns.heatmap(df_traits_norm, cmap="YlGnBu",  linewidths=.5)
```

Out[27]: <matplotlib.axes._subplots.AxesSubplot at 0x11c6da7b8>