

Project (CSCI 6515)

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Notebook imports

```
In [1]: import os
import numpy as np
import pandas as pd
import numpy as np
from bs4 import BeautifulSoup
from os import walk
from os.path import join
import nltk
from nltk.stem import PorterStemmer
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import MultiLabelBinarizer
from sklearn.metrics import recall_score
from sklearn.metrics import precision_score
from sklearn.metrics import f1_score
from sklearn.multiclass import OneVsRestClassifier
import xml.etree.ElementTree as ET
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.tree import DecisionTreeClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import cross_validate
from sklearn.svm import SVC
from numpy.random import seed
from sklearn.preprocessing import minmax_scale
from sklearn.model_selection import train_test_split
from keras.layers import Input, Dense
from keras.models import Model
from keras import regularizers
from sklearn.model_selection import KFold
from scipy.sparse import vstack
from scipy.sparse import csr_matrix
from keras.models import Sequential
from sklearn.cluster import MiniBatchKMeans
from keras import layers
from sklearn.metrics import silhouette_samples
from sklearn.metrics import accuracy_score
import ast
import sys
import csv
from sklearn.cluster import KMeans
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans, SpectralClustering
```

Using TensorFlow backend.

Function to extract news from all xml files from all the directories

Extracting the filename, headline, text, biptopics, date published and itemid from every news article

```
In [26]: def read_xml_files():

    rows = []
    dataframe = pd.DataFrame()
    for root, dirnames, filenames in walk('xml_files'):
        for file_name in filenames:
            filepath = join(root, file_name)
            if(filepath.find("DS_Store") == -1):
                xml_file_name = file_name
                xml_tree = ET.parse(filepath)
                xml_root = xml_tree.getroot()
                item_id = xml_root.attrib['itemid']
                headline = xml_root.find('headline').text
                text = ""
                text_tag = xml_root.find('text')
                for text_data in text_tag:
                    text = text+text_data.text
                metadata = xml_root.find('metadata')
                bip_topics = []
                codes = metadata.findall('codes')
                # to have multiple labels
                for code in codes:
                    if code.attrib['class'] == "bip:topics:1.0":
                        code_data = code.findall('code')
                        for temp_code_data in code_data:
                            bip_topics.append(temp_code_data.attrib['code'])

                dc_list = metadata.findall('dc')
                for dc_data in dc_list:
                    if dc_data.attrib['element'] == 'dc.date.published':
                        dc_date_published = dc_data.attrib['value']

                data = pd.DataFrame({'headline':headline,'text':text,'bip_topics':[bip_topics], 'dc.date.published':dc_date_published, 'itemid':item_id, 'filename':xml_file_name})
                rows.append(data)

    return pd.concat(rows,ignore_index=True)
```

```
In [27]: modified_df = read_xml_files() # initial dataframe with the original data from all the .xml files
```

Function to clean the text body

This function removes html tags, tokenize, stemming, remove stopwords & remove non-alphabets from the text body for all the documents

We have mainly used all the text cleaning techniques used in Assignment-1

- We have used Stop words to remove the frequently used stop words from the text data which does not provide much meaning to the text data
- We have used word_tokenize to take each word separately and convert it to word tokens.
- We have used PorterStemmer for categorizing all the different forms of a word into a single stemmed word.
- isalpha() is used to remove all the words which are not alphabets

```
In [28]: def text_processing(data):

    list_rows = []

    stop_words = set(stopwords.words('english')) #convert the stopwords to a set and store it in the variable
    stemmer = PorterStemmer() #variable to use porterstemmer object

    for row in data.text:

        #news_text = row['text']

        token_words=[]
        filtered_words = ""
        soup = BeautifulSoup(row, 'html.parser') #html.parser is the type of parser used to remove html tags
        text = soup.get_text() #get the text from the BeautifulSoup object

        text_lower = text.lower() #convert the words to lowercase
        text_lower = text_lower.strip()
        token_words = (word_tokenize(text_lower)) #method to tokenize the message

        for word in token_words:
            if word not in stop_words and word.isalpha(): #remove/filter non-alphabets
                stemmed_word = stemmer.stem(word) #stemming to the root word
                filtered_words = filtered_words + " " + stemmed_word

        list_rows.append(filtered_words)

    return list_rows #return the list of all the cleaned news articles
```

Function to extract all the features and convert to a dataframe and sparse matrix

- We have used TF-IDF Vectorizer to extract all the features in all the documents.
- Tfidf normalizes the the frequency for each word by using inverse document frequency
- Tfidf reduces the weight of words which occur more frequently in the entire dataset.

```
In [31]: def extract_features(modified_df):

    new_list = text_processing(modified_df) # call the text_processing function
    new_cleaned_data = modified_df #copy the dataframe to a new one to modify with the cleaned text
    new_cleaned_data.text = new_list # replacing the original text with the cleaned, stemmed news text

    vectorizer = TfidfVectorizer(stop_words = 'english', strip_accents='unicode',min_df=0.001)

    #to create the vocabulary and the document term matrix

    all_features = vectorizer.fit_transform(new_cleaned_data.text) # to create a sparse matrix of the words in the text

    converted_df = pd.DataFrame(all_features.toarray(), columns = vectorizer.get_feature_names())#convert the sparse matrix to a dataframe
    converted_df['bip_topics'] = modified_df['bip_topics']

    return all_features,converted_df
```

```
In [32]: all_features,converted_df = extract_features(modified_df) #call the above function
```

```
In [33]: labels = converted_df["bip_topics"]
```

Multilabel Binarizer to work with multiple labels

- We are working with multi-label and multi-class problem in this project as the documents are tagged to more than one biptopic.
- Hence, we have used multilabelbinarizer to convert our list of labels into a matrix of multiple labels represented by 1 and 0 which can be used to cluster multilabel documents.

```
In [37]: multilabel_binarizer = MultiLabelBinarizer()  
         multilabel_binarizer.fit(labels)  
         multi_labels = multilabel_binarizer.transform(labels)
```

Elbow Method

- We have used elbow method in our project to estimate the optimal number of clusters that can effectively cluster our dataset.
- The code below will cluster the documents in the range of 3 to 12 clusters to find the best value of 'k'.
- The point where an elbow forms represents the best value of 'k' for any dataset.
- The elbow method has provided with an elbow at 6 & 8 clusters which helped us to determine the approximate value of k.

```
In [41]: # We have used the minibatchKmeans for the evaulation criteria. To get f  
aster output. However there is  
# not much significant difference in the sum of square distance value of  
the clusters for minibatchKmeans and Kmeans.  
sse = []  
list_k = list(range(3, 12))  
  
for k in list_k:  
    km = MiniBatchKMeans(n_clusters=k, verbose=10)  
    km.fit(all_features)  
    sse.append(km.inertia_)  
  
# Plot sse against k  
plt.figure(figsize=(6, 6))  
plt.plot(list_k, sse, '-o')  
plt.xlabel('Number of clusters')  
plt.ylabel('Sum of squared distance')
```

```
Init 1/3 with method: k-means++
Inertia for init 1/3: 286.137486
Init 2/3 with method: k-means++
Inertia for init 2/3: 286.611037
Init 3/3 with method: k-means++
Inertia for init 3/3: 287.542421
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Minibatch iteration 188/48400: mean batch inertia: 0.950812, ewa inertia: 0.959234
Minibatch iteration 189/48400: mean batch inertia: 0.952574, ewa inertia: 0.959207
Minibatch iteration 190/48400: mean batch inertia: 0.955787, ewa inertia: 0.959193
Minibatch iteration 191/48400: mean batch inertia: 0.963585, ewa inertia: 0.959211
Minibatch iteration 192/48400: mean batch inertia: 0.941566, ewa inertia: 0.959138
Minibatch iteration 193/48400: mean batch inertia: 0.950646, ewa inertia: 0.959103
Minibatch iteration 194/48400: mean batch inertia: 0.955961, ewa inertia: 0.959090
Minibatch iteration 195/48400: mean batch inertia: 0.955997, ewa inertia: 0.959077
Minibatch iteration 196/48400: mean batch inertia: 0.953517, ewa inertia: 0.959054
Minibatch iteration 197/48400: mean batch inertia: 0.954580, ewa inertia:

a: 0.959036
Minibatch iteration 198/48400: mean batch inertia: 0.956135, ewa inertia: 0.959024
Minibatch iteration 199/48400: mean batch inertia: 0.954999, ewa inertia: 0.959007
Minibatch iteration 200/48400: mean batch inertia: 0.947570, ewa inertia: 0.958960
Minibatch iteration 201/48400: mean batch inertia: 0.956690, ewa inertia: 0.958950
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Minibatch iteration 203/48400: mean batch inertia: 0.953353, ewa inertia: 0.958889
Minibatch iteration 204/48400: mean batch inertia: 0.941991, ewa inertia: 0.958819
Minibatch iteration 205/48400: mean batch inertia: 0.958170, ewa inertia: 0.958816
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Minibatch iteration 207/48400: mean batch inertia: 0.946227, ewa inertia: 0.958731
Minibatch iteration 208/48400: mean batch inertia: 0.959826, ewa inertia: 0.958736
Minibatch iteration 209/48400: mean batch inertia: 0.962518, ewa inertia: 0.958751
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Minibatch iteration 211/48400: mean batch inertia: 0.958765, ewa inertia: 0.958736
Minibatch iteration 212/48400: mean batch inertia: 0.945165, ewa inertia: 0.958680
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Minibatch iteration 214/48400: mean batch inertia: 0.937680, ewa inertia: 0.958574
Minibatch iteration 215/48400: mean batch inertia: 0.931404, ewa inertia: 0.958462
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Minibatch iteration 217/48400: mean batch inertia: 0.959439, ewa inertia: 0.958424
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Minibatch iteration 219/48400: mean batch inertia: 0.933633, ewa inertia: 0.958277
Minibatch iteration 220/48400: mean batch inertia: 0.937602, ewa inertia: 0.958191
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Minibatch iteration 222/48400: mean batch inertia: 0.958359, ewa inertia: 0.958210
Minibatch iteration 223/48400: mean batch inertia: 0.964428, ewa inertia: 0.958236
Minibatch iteration 224/48400: mean batch inertia: 0.959171, ewa inertia: 0.958240
Minibatch iteration 225/48400: mean batch inertia: 0.956040, ewa inertia: 0.958231

Minibatch iteration 226/48400: mean batch inertia: 0.942242, ewa inertia: 0.958165
Minibatch iteration 227/48400: mean batch inertia: 0.934235, ewa inertia: 0.958066
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Minibatch iteration 229/48400: mean batch inertia: 0.966633, ewa inertia: 0.958080
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Minibatch iteration 231/48400: mean batch inertia: 0.962785, ewa inertia: 0.958022
Minibatch iteration 232/48400: mean batch inertia: 0.933745, ewa inertia: 0.957922
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Minibatch iteration 236/48400: mean batch inertia: 0.955664, ewa inertia: 0.957799
Minibatch iteration 237/48400: mean batch inertia: 0.968029, ewa inertia: 0.957841
Minibatch iteration 238/48400: mean batch inertia: 0.950164, ewa inertia: 0.957809
Minibatch iteration 239/48400: mean batch inertia: 0.952583, ewa inertia: 0.957788
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Minibatch iteration 248/48400: mean batch inertia: 0.958825, ewa inertia: 0.957669
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a: 0.957391
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Minibatch iteration 256/48400: mean batch inertia: 0.950025, ewa inertia: 0.957286
Minibatch iteration 257/48400: mean batch inertia: 0.956830, ewa inertia: 0.957284
Minibatch iteration 258/48400: mean batch inertia: 0.932063, ewa inertia: 0.957180
Minibatch iteration 259/48400: mean batch inertia: 0.947954, ewa inertia: 0.957141
Minibatch iteration 260/48400: mean batch inertia: 0.952527, ewa inertia: 0.957122
Minibatch iteration 261/48400: mean batch inertia: 0.941520, ewa inertia: 0.957058
Minibatch iteration 262/48400: mean batch inertia: 0.957314, ewa inertia: 0.957059
Minibatch iteration 263/48400: mean batch inertia: 0.958083, ewa inertia: 0.957063
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Minibatch iteration 265/48400: mean batch inertia: 0.960016, ewa inertia: 0.957055
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Minibatch iteration 268/48400: mean batch inertia: 0.962423, ewa inertia: 0.957044
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Minibatch iteration 271/48400: mean batch inertia: 0.952557, ewa inertia: 0.956952
Minibatch iteration 272/48400: mean batch inertia: 0.967885, ewa inertia: 0.956997
Minibatch iteration 273/48400: mean batch inertia: 0.948561, ewa inertia: 0.956962
Minibatch iteration 274/48400: mean batch inertia: 0.951212, ewa inertia: 0.956938
Minibatch iteration 275/48400: mean batch inertia: 0.950890, ewa inertia: 0.956913
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Minibatch iteration 277/48400: mean batch inertia: 0.945788, ewa inertia: 0.956832
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Minibatch iteration 280/48400: mean batch inertia: 0.935109, ewa inertia: 0.956715
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Minibatch iteration 282/48400: mean batch inertia: 0.937538, ewa inertia: 0.956577

Minibatch iteration 283/48400: mean batch inertia: 0.965323, ewa inertia: 0.956613
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Minibatch iteration 287/48400: mean batch inertia: 0.957563, ewa inertia: 0.956560
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Minibatch iteration 290/48400: mean batch inertia: 0.944108, ewa inertia: 0.956405
Minibatch iteration 291/48400: mean batch inertia: 0.949299, ewa inertia: 0.956376
Minibatch iteration 292/48400: mean batch inertia: 0.958537, ewa inertia: 0.956385
Minibatch iteration 293/48400: mean batch inertia: 0.958126, ewa inertia: 0.956392
Minibatch iteration 294/48400: mean batch inertia: 0.960848, ewa inertia: 0.956410
Minibatch iteration 295/48400: mean batch inertia: 0.968996, ewa inertia: 0.956462
Minibatch iteration 296/48400: mean batch inertia: 0.960546, ewa inertia: 0.956479
Minibatch iteration 297/48400: mean batch inertia: 0.948818, ewa inertia: 0.956448
Minibatch iteration 298/48400: mean batch inertia: 0.957786, ewa inertia: 0.956453
Minibatch iteration 299/48400: mean batch inertia: 0.953185, ewa inertia: 0.956440
Minibatch iteration 300/48400: mean batch inertia: 0.952079, ewa inertia: 0.956422
Minibatch iteration 301/48400: mean batch inertia: 0.950271, ewa inertia: 0.956396
Converged (lack of improvement in inertia) at iteration 301/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 285.053798
Init 2/3 with method: k-means++
Inertia for init 2/3: 284.710856
Init 3/3 with method: k-means++
Inertia for init 3/3: 285.814316
Minibatch iteration 1/48400: mean batch inertia: 0.966475, ewa inertia: 0.966475
Minibatch iteration 2/48400: mean batch inertia: 0.959008, ewa inertia: 0.966444
Minibatch iteration 3/48400: mean batch inertia: 0.951611, ewa inertia: 0.966383
Minibatch iteration 4/48400: mean batch inertia: 0.959654, ewa inertia: 0.966355
Minibatch iteration 5/48400: mean batch inertia: 0.946000, ewa inertia: 0.966271
Minibatch iteration 6/48400: mean batch inertia: 0.946632, ewa inertia:

0.966189
Minibatch iteration 7/48400: mean batch inertia: 0.947463, ewa inertia:
0.966112
Minibatch iteration 8/48400: mean batch inertia: 0.945038, ewa inertia:
0.966025
Minibatch iteration 9/48400: mean batch inertia: 0.960350, ewa inertia:
0.966001
Minibatch iteration 10/48400: mean batch inertia: 0.942810, ewa inertia:
0.965905
Minibatch iteration 11/48400: mean batch inertia: 0.962860, ewa inertia:
0.965893
Minibatch iteration 12/48400: mean batch inertia: 0.942516, ewa inertia:
0.965796
Minibatch iteration 13/48400: mean batch inertia: 0.945063, ewa inertia:
0.965711
Minibatch iteration 14/48400: mean batch inertia: 0.945713, ewa inertia:
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Minibatch iteration 15/48400: mean batch inertia: 0.955541, ewa inertia:
0.965586
Minibatch iteration 16/48400: mean batch inertia: 0.954178, ewa inertia:
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Minibatch iteration 17/48400: mean batch inertia: 0.951455, ewa inertia:
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Minibatch iteration 18/48400: mean batch inertia: 0.945627, ewa inertia:
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Minibatch iteration 19/48400: mean batch inertia: 0.939648, ewa inertia:
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Minibatch iteration 20/48400: mean batch inertia: 0.955739, ewa inertia:
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Minibatch iteration 21/48400: mean batch inertia: 0.948897, ewa inertia:
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0.965099
Minibatch iteration 23/48400: mean batch inertia: 0.945181, ewa inertia:
0.965017
Minibatch iteration 24/48400: mean batch inertia: 0.952666, ewa inertia:
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Minibatch iteration 25/48400: mean batch inertia: 0.952300, ewa inertia:
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Minibatch iteration 26/48400: mean batch inertia: 0.937951, ewa inertia:
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Minibatch iteration 27/48400: mean batch inertia: 0.953057, ewa inertia:
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Minibatch iteration 28/48400: mean batch inertia: 0.934748, ewa inertia:
0.964630
Minibatch iteration 29/48400: mean batch inertia: 0.952273, ewa inertia:
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Minibatch iteration 30/48400: mean batch inertia: 0.949156, ewa inertia:
0.964515
Minibatch iteration 31/48400: mean batch inertia: 0.934276, ewa inertia:
0.964390
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Minibatch iteration 33/48400: mean batch inertia: 0.946545, ewa inertia:
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Minibatch iteration 34/48400: mean batch inertia: 0.928395, ewa inertia:
0.964062

Minibatch iteration 35/48400: mean batch inertia: 0.944879, ewa inertia: 0.963983
Minibatch iteration 36/48400: mean batch inertia: 0.954915, ewa inertia: 0.963945
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Minibatch iteration 41/48400: mean batch inertia: 0.944686, ewa inertia: 0.963751
Minibatch iteration 42/48400: mean batch inertia: 0.953252, ewa inertia: 0.963708
Minibatch iteration 43/48400: mean batch inertia: 0.938382, ewa inertia: 0.963603
Minibatch iteration 44/48400: mean batch inertia: 0.945930, ewa inertia: 0.963530
Minibatch iteration 45/48400: mean batch inertia: 0.952715, ewa inertia: 0.963486
Minibatch iteration 46/48400: mean batch inertia: 0.940352, ewa inertia: 0.963390
Minibatch iteration 47/48400: mean batch inertia: 0.943181, ewa inertia: 0.963306
Minibatch iteration 48/48400: mean batch inertia: 0.936535, ewa inertia: 0.963196
Minibatch iteration 49/48400: mean batch inertia: 0.953612, ewa inertia: 0.963156
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Minibatch iteration 52/48400: mean batch inertia: 0.945962, ewa inertia: 0.962985
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Minibatch iteration 60/48400: mean batch inertia: 0.957119, ewa inertia: 0.962361
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Minibatch iteration 63/48400: mean batch inertia: 0.959016, ewa inertia:

a: 0.962106
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Minibatch iteration 66/48400: mean batch inertia: 0.954383, ewa inertia: 0.961816
Minibatch iteration 67/48400: mean batch inertia: 0.950614, ewa inertia: 0.961769
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Minibatch iteration 70/48400: mean batch inertia: 0.939878, ewa inertia: 0.961572
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Minibatch iteration 73/48400: mean batch inertia: 0.950208, ewa inertia: 0.961355
Minibatch iteration 74/48400: mean batch inertia: 0.951271, ewa inertia: 0.961314
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Minibatch iteration 78/48400: mean batch inertia: 0.927924, ewa inertia: 0.960918
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Minibatch iteration 82/48400: mean batch inertia: 0.943225, ewa inertia: 0.960628
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Minibatch iteration 84/48400: mean batch inertia: 0.947991, ewa inertia: 0.960548
Minibatch iteration 85/48400: mean batch inertia: 0.948573, ewa inertia: 0.960498
Minibatch iteration 86/48400: mean batch inertia: 0.936851, ewa inertia: 0.960401
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Minibatch iteration 138/48400: mean batch inertia: 0.954824, ewa inertia: 0.957054
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Minibatch iteration 142/48400: mean batch inertia: 0.952313, ewa inertia: 0.956855
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Minibatch iteration 153/48400: mean batch inertia: 0.929469, ewa inertia: 0.956033
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Minibatch iteration 426/48400: mean batch inertia: 0.932578, ewa inertia: 0.945793
Minibatch iteration 427/48400: mean batch inertia: 0.928210, ewa inertia: 0.945720
Minibatch iteration 428/48400: mean batch inertia: 0.943879, ewa inertia: 0.945713
Minibatch iteration 429/48400: mean batch inertia: 0.932916, ewa inertia: 0.945660
Minibatch iteration 430/48400: mean batch inertia: 0.935682, ewa inertia: 0.945619
Minibatch iteration 431/48400: mean batch inertia: 0.934771, ewa inertia: 0.945574
Minibatch iteration 432/48400: mean batch inertia: 0.945528, ewa inertia: 0.945574
Minibatch iteration 433/48400: mean batch inertia: 0.950516, ewa inertia: 0.945594

Minibatch iteration 434/48400: mean batch inertia: 0.946816, ewa inertia: 0.945599
Minibatch iteration 435/48400: mean batch inertia: 0.946991, ewa inertia: 0.945605
Minibatch iteration 436/48400: mean batch inertia: 0.944017, ewa inertia: 0.945598
Minibatch iteration 437/48400: mean batch inertia: 0.952235, ewa inertia: 0.945626
Minibatch iteration 438/48400: mean batch inertia: 0.938870, ewa inertia: 0.945598
Minibatch iteration 439/48400: mean batch inertia: 0.948202, ewa inertia: 0.945608
Minibatch iteration 440/48400: mean batch inertia: 0.931016, ewa inertia: 0.945548
Minibatch iteration 441/48400: mean batch inertia: 0.930724, ewa inertia: 0.945487
Minibatch iteration 442/48400: mean batch inertia: 0.935783, ewa inertia: 0.945447
Minibatch iteration 443/48400: mean batch inertia: 0.933461, ewa inertia: 0.945397
Minibatch iteration 444/48400: mean batch inertia: 0.935636, ewa inertia: 0.945357
Minibatch iteration 445/48400: mean batch inertia: 0.942941, ewa inertia: 0.945347
Minibatch iteration 446/48400: mean batch inertia: 0.933125, ewa inertia: 0.945296
Minibatch iteration 447/48400: mean batch inertia: 0.940551, ewa inertia: 0.945277
Minibatch iteration 448/48400: mean batch inertia: 0.946410, ewa inertia: 0.945281
Minibatch iteration 449/48400: mean batch inertia: 0.948323, ewa inertia: 0.945294
Minibatch iteration 450/48400: mean batch inertia: 0.934719, ewa inertia: 0.945250
Minibatch iteration 451/48400: mean batch inertia: 0.931956, ewa inertia: 0.945195
Minibatch iteration 452/48400: mean batch inertia: 0.939086, ewa inertia: 0.945170
Minibatch iteration 453/48400: mean batch inertia: 0.948881, ewa inertia: 0.945185
Minibatch iteration 454/48400: mean batch inertia: 0.954555, ewa inertia: 0.945224
Minibatch iteration 455/48400: mean batch inertia: 0.944815, ewa inertia: 0.945222
Minibatch iteration 456/48400: mean batch inertia: 0.946884, ewa inertia: 0.945229
Minibatch iteration 457/48400: mean batch inertia: 0.943575, ewa inertia: 0.945222
Minibatch iteration 458/48400: mean batch inertia: 0.944434, ewa inertia: 0.945219
Minibatch iteration 459/48400: mean batch inertia: 0.943483, ewa inertia: 0.945212
Minibatch iteration 460/48400: mean batch inertia: 0.942779, ewa inertia: 0.945202
Minibatch iteration 461/48400: mean batch inertia: 0.941645, ewa inertia: 0.945187
Minibatch iteration 462/48400: mean batch inertia: 0.948964, ewa inertia:

a: 0.945203
Converged (lack of improvement in inertia) at iteration 462/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 282.532260
Init 2/3 with method: k-means++
Inertia for init 2/3: 282.077527
Init 3/3 with method: k-means++
Inertia for init 3/3: 281.839504
Minibatch iteration 1/48400: mean batch inertia: 0.959552, ewa inertia: 0.959552
Minibatch iteration 2/48400: mean batch inertia: 0.956004, ewa inertia: 0.959537
Minibatch iteration 3/48400: mean batch inertia: 0.960400, ewa inertia: 0.959541
Minibatch iteration 4/48400: mean batch inertia: 0.952215, ewa inertia: 0.959510
Minibatch iteration 5/48400: mean batch inertia: 0.954540, ewa inertia: 0.959490
Minibatch iteration 6/48400: mean batch inertia: 0.954302, ewa inertia: 0.959468
Minibatch iteration 7/48400: mean batch inertia: 0.933444, ewa inertia: 0.959361
Minibatch iteration 8/48400: mean batch inertia: 0.952684, ewa inertia: 0.959333
Minibatch iteration 9/48400: mean batch inertia: 0.945748, ewa inertia: 0.959277
Minibatch iteration 10/48400: mean batch inertia: 0.952565, ewa inertia: 0.959249
Minibatch iteration 11/48400: mean batch inertia: 0.955597, ewa inertia: 0.959234
Minibatch iteration 12/48400: mean batch inertia: 0.941852, ewa inertia: 0.959162
Minibatch iteration 13/48400: mean batch inertia: 0.945354, ewa inertia: 0.959105
Minibatch iteration 14/48400: mean batch inertia: 0.941487, ewa inertia: 0.959032
Minibatch iteration 15/48400: mean batch inertia: 0.956576, ewa inertia: 0.959022
Minibatch iteration 16/48400: mean batch inertia: 0.948311, ewa inertia: 0.958978
Minibatch iteration 17/48400: mean batch inertia: 0.948936, ewa inertia: 0.958936
Minibatch iteration 18/48400: mean batch inertia: 0.950798, ewa inertia: 0.958903
Minibatch iteration 19/48400: mean batch inertia: 0.933764, ewa inertia: 0.958799
Minibatch iteration 20/48400: mean batch inertia: 0.924656, ewa inertia: 0.958658
Minibatch iteration 21/48400: mean batch inertia: 0.938806, ewa inertia: 0.958575
Minibatch iteration 22/48400: mean batch inertia: 0.951848, ewa inertia: 0.958548
Minibatch iteration 23/48400: mean batch inertia: 0.938098, ewa inertia: 0.958463
Minibatch iteration 24/48400: mean batch inertia: 0.945718, ewa inertia: 0.958410

Minibatch iteration 25/48400: mean batch inertia: 0.942190, ewa inertia: 0.958343
Minibatch iteration 26/48400: mean batch inertia: 0.949998, ewa inertia: 0.958309
Minibatch iteration 27/48400: mean batch inertia: 0.948005, ewa inertia: 0.958266
Minibatch iteration 28/48400: mean batch inertia: 0.927590, ewa inertia: 0.958139
Minibatch iteration 29/48400: mean batch inertia: 0.943621, ewa inertia: 0.958079
Minibatch iteration 30/48400: mean batch inertia: 0.945571, ewa inertia: 0.958028
Minibatch iteration 31/48400: mean batch inertia: 0.952708, ewa inertia: 0.958006
Minibatch iteration 32/48400: mean batch inertia: 0.941571, ewa inertia: 0.957938
Minibatch iteration 33/48400: mean batch inertia: 0.936466, ewa inertia: 0.957849
Minibatch iteration 34/48400: mean batch inertia: 0.944146, ewa inertia: 0.957792
Minibatch iteration 35/48400: mean batch inertia: 0.954746, ewa inertia: 0.957780
Minibatch iteration 36/48400: mean batch inertia: 0.938144, ewa inertia: 0.957699
Minibatch iteration 37/48400: mean batch inertia: 0.936784, ewa inertia: 0.957612
Minibatch iteration 38/48400: mean batch inertia: 0.936831, ewa inertia: 0.957526
Minibatch iteration 39/48400: mean batch inertia: 0.936270, ewa inertia: 0.957438
Minibatch iteration 40/48400: mean batch inertia: 0.941621, ewa inertia: 0.957373
Minibatch iteration 41/48400: mean batch inertia: 0.927183, ewa inertia: 0.957248
Minibatch iteration 42/48400: mean batch inertia: 0.945631, ewa inertia: 0.957200
Minibatch iteration 43/48400: mean batch inertia: 0.939027, ewa inertia: 0.957125
Minibatch iteration 44/48400: mean batch inertia: 0.939988, ewa inertia: 0.957054
Minibatch iteration 45/48400: mean batch inertia: 0.944152, ewa inertia: 0.957001
Minibatch iteration 46/48400: mean batch inertia: 0.937887, ewa inertia: 0.956922
Minibatch iteration 47/48400: mean batch inertia: 0.942649, ewa inertia: 0.956863
Minibatch iteration 48/48400: mean batch inertia: 0.950102, ewa inertia: 0.956835
Minibatch iteration 49/48400: mean batch inertia: 0.928050, ewa inertia: 0.956716
Minibatch iteration 50/48400: mean batch inertia: 0.944972, ewa inertia: 0.956667
Minibatch iteration 51/48400: mean batch inertia: 0.943985, ewa inertia: 0.956615
Minibatch iteration 52/48400: mean batch inertia: 0.945638, ewa inertia: 0.956569
Minibatch iteration 53/48400: mean batch inertia: 0.932765, ewa inertia:

a: 0.956471
Minibatch iteration 54/48400: mean batch inertia: 0.943147, ewa inertia: 0.956416
Minibatch iteration 55/48400: mean batch inertia: 0.934170, ewa inertia: 0.956324
Minibatch iteration 56/48400: mean batch inertia: 0.910991, ewa inertia: 0.956137
Minibatch iteration 57/48400: mean batch inertia: 0.941098, ewa inertia: 0.956074
Minibatch iteration 58/48400: mean batch inertia: 0.917583, ewa inertia: 0.955915
Minibatch iteration 59/48400: mean batch inertia: 0.953300, ewa inertia: 0.955904
Minibatch iteration 60/48400: mean batch inertia: 0.940640, ewa inertia: 0.955841
Minibatch iteration 61/48400: mean batch inertia: 0.946911, ewa inertia: 0.955804
Minibatch iteration 62/48400: mean batch inertia: 0.950247, ewa inertia: 0.955781
Minibatch iteration 63/48400: mean batch inertia: 0.947488, ewa inertia: 0.955747
Minibatch iteration 64/48400: mean batch inertia: 0.926099, ewa inertia: 0.955625
Minibatch iteration 65/48400: mean batch inertia: 0.935835, ewa inertia: 0.955543
Minibatch iteration 66/48400: mean batch inertia: 0.945476, ewa inertia: 0.955501
Minibatch iteration 67/48400: mean batch inertia: 0.945463, ewa inertia: 0.955460
Minibatch iteration 68/48400: mean batch inertia: 0.938282, ewa inertia: 0.955389
Minibatch iteration 69/48400: mean batch inertia: 0.943492, ewa inertia: 0.955339
Minibatch iteration 70/48400: mean batch inertia: 0.938319, ewa inertia: 0.955269
Minibatch iteration 71/48400: mean batch inertia: 0.931757, ewa inertia: 0.955172
Minibatch iteration 72/48400: mean batch inertia: 0.944798, ewa inertia: 0.955129
Minibatch iteration 73/48400: mean batch inertia: 0.938827, ewa inertia: 0.955062
Minibatch iteration 74/48400: mean batch inertia: 0.943599, ewa inertia: 0.955014
Minibatch iteration 75/48400: mean batch inertia: 0.930831, ewa inertia: 0.954914
Minibatch iteration 76/48400: mean batch inertia: 0.935756, ewa inertia: 0.954835
Minibatch iteration 77/48400: mean batch inertia: 0.937531, ewa inertia: 0.954763
Minibatch iteration 78/48400: mean batch inertia: 0.942762, ewa inertia: 0.954714
Minibatch iteration 79/48400: mean batch inertia: 0.949425, ewa inertia: 0.954692
Minibatch iteration 80/48400: mean batch inertia: 0.934094, ewa inertia: 0.954607
Minibatch iteration 81/48400: mean batch inertia: 0.939701, ewa inertia: 0.954545

Minibatch iteration 82/48400: mean batch inertia: 0.919728, ewa inertia: 0.954401
Minibatch iteration 83/48400: mean batch inertia: 0.946485, ewa inertia: 0.954368
Minibatch iteration 84/48400: mean batch inertia: 0.949961, ewa inertia: 0.954350
Minibatch iteration 85/48400: mean batch inertia: 0.953671, ewa inertia: 0.954347
Minibatch iteration 86/48400: mean batch inertia: 0.942565, ewa inertia: 0.954299
Minibatch iteration 87/48400: mean batch inertia: 0.941092, ewa inertia: 0.954244
Minibatch iteration 88/48400: mean batch inertia: 0.946496, ewa inertia: 0.954212
Minibatch iteration 89/48400: mean batch inertia: 0.940065, ewa inertia: 0.954154
Minibatch iteration 90/48400: mean batch inertia: 0.916108, ewa inertia: 0.953996
Minibatch iteration 91/48400: mean batch inertia: 0.922460, ewa inertia: 0.953866
Minibatch iteration 92/48400: mean batch inertia: 0.947851, ewa inertia: 0.953841
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Minibatch iteration 99/48400: mean batch inertia: 0.938191, ewa inertia: 0.953400
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Minibatch iteration 101/48400: mean batch inertia: 0.933738, ewa inertia: 0.953221
Minibatch iteration 102/48400: mean batch inertia: 0.936486, ewa inertia: 0.953152
Minibatch iteration 103/48400: mean batch inertia: 0.950718, ewa inertia: 0.953142
Minibatch iteration 104/48400: mean batch inertia: 0.955790, ewa inertia: 0.953153
Minibatch iteration 105/48400: mean batch inertia: 0.932008, ewa inertia: 0.953065
Minibatch iteration 106/48400: mean batch inertia: 0.943633, ewa inertia: 0.953026
Minibatch iteration 107/48400: mean batch inertia: 0.932132, ewa inertia: 0.952940
Minibatch iteration 108/48400: mean batch inertia: 0.944214, ewa inertia: 0.952904
Minibatch iteration 109/48400: mean batch inertia: 0.940949, ewa inertia: 0.952854
Minibatch iteration 110/48400: mean batch inertia: 0.948259, ewa inertia:

a: 0.952835
Minibatch iteration 111/48400: mean batch inertia: 0.944719, ewa inertia: 0.952802
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Minibatch iteration 124/48400: mean batch inertia: 0.945203, ewa inertia: 0.952235
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Minibatch iteration 126/48400: mean batch inertia: 0.952133, ewa inertia: 0.952189
Minibatch iteration 127/48400: mean batch inertia: 0.945256, ewa inertia: 0.952160
Minibatch iteration 128/48400: mean batch inertia: 0.934086, ewa inertia: 0.952085
Minibatch iteration 129/48400: mean batch inertia: 0.925622, ewa inertia: 0.951976
Minibatch iteration 130/48400: mean batch inertia: 0.931323, ewa inertia: 0.951890
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Minibatch iteration 133/48400: mean batch inertia: 0.941905, ewa inertia: 0.951735
Minibatch iteration 134/48400: mean batch inertia: 0.925660, ewa inertia: 0.951627
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Minibatch iteration 136/48400: mean batch inertia: 0.939232, ewa inertia: 0.951486
Minibatch iteration 137/48400: mean batch inertia: 0.934731, ewa inertia: 0.951416
Minibatch iteration 138/48400: mean batch inertia: 0.944016, ewa inertia: 0.951386

Minibatch iteration 139/48400: mean batch inertia: 0.944871, ewa inertia: 0.951359
Minibatch iteration 140/48400: mean batch inertia: 0.941895, ewa inertia: 0.951320
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Minibatch iteration 143/48400: mean batch inertia: 0.949562, ewa inertia: 0.951237
Minibatch iteration 144/48400: mean batch inertia: 0.922336, ewa inertia: 0.951117
Minibatch iteration 145/48400: mean batch inertia: 0.927149, ewa inertia: 0.951018
Minibatch iteration 146/48400: mean batch inertia: 0.928416, ewa inertia: 0.950925
Minibatch iteration 147/48400: mean batch inertia: 0.941511, ewa inertia: 0.950886
Minibatch iteration 148/48400: mean batch inertia: 0.916028, ewa inertia: 0.950742
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Minibatch iteration 157/48400: mean batch inertia: 0.939174, ewa inertia: 0.950278
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Minibatch iteration 160/48400: mean batch inertia: 0.944752, ewa inertia: 0.950192
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Minibatch iteration 162/48400: mean batch inertia: 0.935654, ewa inertia: 0.950121
Minibatch iteration 163/48400: mean batch inertia: 0.946415, ewa inertia: 0.950105
Minibatch iteration 164/48400: mean batch inertia: 0.923092, ewa inertia: 0.949994
Minibatch iteration 165/48400: mean batch inertia: 0.926667, ewa inertia: 0.949897
Minibatch iteration 166/48400: mean batch inertia: 0.947415, ewa inertia: 0.949887
Minibatch iteration 167/48400: mean batch inertia: 0.937312, ewa inertia:

a: 0.949835
Minibatch iteration 168/48400: mean batch inertia: 0.929564, ewa inertia: 0.949751
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Minibatch iteration 178/48400: mean batch inertia: 0.944450, ewa inertia: 0.949281
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Minibatch iteration 182/48400: mean batch inertia: 0.939614, ewa inertia: 0.949016
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Minibatch iteration 185/48400: mean batch inertia: 0.951231, ewa inertia: 0.948934
Minibatch iteration 186/48400: mean batch inertia: 0.946240, ewa inertia: 0.948923
Minibatch iteration 187/48400: mean batch inertia: 0.940773, ewa inertia: 0.948890
Minibatch iteration 188/48400: mean batch inertia: 0.956744, ewa inertia: 0.948922
Minibatch iteration 189/48400: mean batch inertia: 0.934952, ewa inertia: 0.948864
Minibatch iteration 190/48400: mean batch inertia: 0.942531, ewa inertia: 0.948838
Minibatch iteration 191/48400: mean batch inertia: 0.929765, ewa inertia: 0.948759
Minibatch iteration 192/48400: mean batch inertia: 0.930360, ewa inertia: 0.948683
Minibatch iteration 193/48400: mean batch inertia: 0.948045, ewa inertia: 0.948681
Minibatch iteration 194/48400: mean batch inertia: 0.932649, ewa inertia: 0.948614
Minibatch iteration 195/48400: mean batch inertia: 0.926629, ewa inertia: 0.948523

Minibatch iteration 196/48400: mean batch inertia: 0.921150, ewa inertia: 0.948410
Minibatch iteration 197/48400: mean batch inertia: 0.929393, ewa inertia: 0.948332
Minibatch iteration 198/48400: mean batch inertia: 0.946215, ewa inertia: 0.948323
Minibatch iteration 199/48400: mean batch inertia: 0.945918, ewa inertia: 0.948313
Minibatch iteration 200/48400: mean batch inertia: 0.930061, ewa inertia: 0.948238
Minibatch iteration 201/48400: mean batch inertia: 0.935439, ewa inertia: 0.948185
Minibatch iteration 202/48400: mean batch inertia: 0.927080, ewa inertia: 0.948097
Minibatch iteration 203/48400: mean batch inertia: 0.940874, ewa inertia: 0.948067
Minibatch iteration 204/48400: mean batch inertia: 0.938735, ewa inertia: 0.948029
Minibatch iteration 205/48400: mean batch inertia: 0.935630, ewa inertia: 0.947978
Minibatch iteration 206/48400: mean batch inertia: 0.940910, ewa inertia: 0.947948
Minibatch iteration 207/48400: mean batch inertia: 0.938195, ewa inertia: 0.947908
Minibatch iteration 208/48400: mean batch inertia: 0.929321, ewa inertia: 0.947831
Minibatch iteration 209/48400: mean batch inertia: 0.932286, ewa inertia: 0.947767
Minibatch iteration 210/48400: mean batch inertia: 0.939709, ewa inertia: 0.947734
Minibatch iteration 211/48400: mean batch inertia: 0.947469, ewa inertia: 0.947733
Minibatch iteration 212/48400: mean batch inertia: 0.935947, ewa inertia: 0.947684
Minibatch iteration 213/48400: mean batch inertia: 0.941952, ewa inertia: 0.947660
Minibatch iteration 214/48400: mean batch inertia: 0.939204, ewa inertia: 0.947625
Minibatch iteration 215/48400: mean batch inertia: 0.940031, ewa inertia: 0.947594
Minibatch iteration 216/48400: mean batch inertia: 0.938518, ewa inertia: 0.947556
Minibatch iteration 217/48400: mean batch inertia: 0.934393, ewa inertia: 0.947502
Minibatch iteration 218/48400: mean batch inertia: 0.950986, ewa inertia: 0.947516
Minibatch iteration 219/48400: mean batch inertia: 0.915261, ewa inertia: 0.947383
Minibatch iteration 220/48400: mean batch inertia: 0.951134, ewa inertia: 0.947398
Minibatch iteration 221/48400: mean batch inertia: 0.930117, ewa inertia: 0.947327
Minibatch iteration 222/48400: mean batch inertia: 0.934446, ewa inertia: 0.947274
Minibatch iteration 223/48400: mean batch inertia: 0.943178, ewa inertia: 0.947257
Minibatch iteration 224/48400: mean batch inertia: 0.960023, ewa inertia:

a: 0.947310
Minibatch iteration 225/48400: mean batch inertia: 0.953621, ewa inertia: 0.947336
Minibatch iteration 226/48400: mean batch inertia: 0.941072, ewa inertia: 0.947310
Minibatch iteration 227/48400: mean batch inertia: 0.938291, ewa inertia: 0.947272
Minibatch iteration 228/48400: mean batch inertia: 0.943986, ewa inertia: 0.947259
Minibatch iteration 229/48400: mean batch inertia: 0.935917, ewa inertia: 0.947212
Minibatch iteration 230/48400: mean batch inertia: 0.930826, ewa inertia: 0.947144
Minibatch iteration 231/48400: mean batch inertia: 0.925008, ewa inertia: 0.947053
Minibatch iteration 232/48400: mean batch inertia: 0.940193, ewa inertia: 0.947024
Minibatch iteration 233/48400: mean batch inertia: 0.939283, ewa inertia: 0.946992
Minibatch iteration 234/48400: mean batch inertia: 0.949502, ewa inertia: 0.947003
Minibatch iteration 235/48400: mean batch inertia: 0.943661, ewa inertia: 0.946989
Minibatch iteration 236/48400: mean batch inertia: 0.949846, ewa inertia: 0.947001
Minibatch iteration 237/48400: mean batch inertia: 0.936912, ewa inertia: 0.946959
Minibatch iteration 238/48400: mean batch inertia: 0.944787, ewa inertia: 0.946950
Minibatch iteration 239/48400: mean batch inertia: 0.923587, ewa inertia: 0.946853
Minibatch iteration 240/48400: mean batch inertia: 0.944085, ewa inertia: 0.946842
Minibatch iteration 241/48400: mean batch inertia: 0.945384, ewa inertia: 0.946836
Minibatch iteration 242/48400: mean batch inertia: 0.954818, ewa inertia: 0.946869
Minibatch iteration 243/48400: mean batch inertia: 0.930424, ewa inertia: 0.946801
Minibatch iteration 244/48400: mean batch inertia: 0.931268, ewa inertia: 0.946737
Minibatch iteration 245/48400: mean batch inertia: 0.952226, ewa inertia: 0.946759
Minibatch iteration 246/48400: mean batch inertia: 0.938657, ewa inertia: 0.946726
Minibatch iteration 247/48400: mean batch inertia: 0.954265, ewa inertia: 0.946757
Minibatch iteration 248/48400: mean batch inertia: 0.934681, ewa inertia: 0.946707
Minibatch iteration 249/48400: mean batch inertia: 0.931870, ewa inertia: 0.946646
Minibatch iteration 250/48400: mean batch inertia: 0.933378, ewa inertia: 0.946591
Minibatch iteration 251/48400: mean batch inertia: 0.932691, ewa inertia: 0.946534
Minibatch iteration 252/48400: mean batch inertia: 0.935629, ewa inertia: 0.946488

Minibatch iteration 253/48400: mean batch inertia: 0.917774, ewa inertia: 0.946370
Minibatch iteration 254/48400: mean batch inertia: 0.924100, ewa inertia: 0.946278
Minibatch iteration 255/48400: mean batch inertia: 0.949931, ewa inertia: 0.946293
Minibatch iteration 256/48400: mean batch inertia: 0.943380, ewa inertia: 0.946281
Minibatch iteration 257/48400: mean batch inertia: 0.942896, ewa inertia: 0.946267
Minibatch iteration 258/48400: mean batch inertia: 0.936217, ewa inertia: 0.946225
Minibatch iteration 259/48400: mean batch inertia: 0.926340, ewa inertia: 0.946143
Minibatch iteration 260/48400: mean batch inertia: 0.935632, ewa inertia: 0.946100
Minibatch iteration 261/48400: mean batch inertia: 0.945536, ewa inertia: 0.946097
Minibatch iteration 262/48400: mean batch inertia: 0.939594, ewa inertia: 0.946070
Minibatch iteration 263/48400: mean batch inertia: 0.934850, ewa inertia: 0.946024
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Minibatch iteration 266/48400: mean batch inertia: 0.950655, ewa inertia: 0.945872
Minibatch iteration 267/48400: mean batch inertia: 0.941236, ewa inertia: 0.945852
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Minibatch iteration 269/48400: mean batch inertia: 0.925911, ewa inertia: 0.945756
Minibatch iteration 270/48400: mean batch inertia: 0.953024, ewa inertia: 0.945786
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Minibatch iteration 272/48400: mean batch inertia: 0.928132, ewa inertia: 0.945721
Minibatch iteration 273/48400: mean batch inertia: 0.949871, ewa inertia: 0.945738
Minibatch iteration 274/48400: mean batch inertia: 0.936620, ewa inertia: 0.945700
Minibatch iteration 275/48400: mean batch inertia: 0.948725, ewa inertia: 0.945712
Minibatch iteration 276/48400: mean batch inertia: 0.928047, ewa inertia: 0.945639
Minibatch iteration 277/48400: mean batch inertia: 0.945131, ewa inertia: 0.945637
Minibatch iteration 278/48400: mean batch inertia: 0.934257, ewa inertia: 0.945590
Minibatch iteration 279/48400: mean batch inertia: 0.948795, ewa inertia: 0.945604
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Minibatch iteration 281/48400: mean batch inertia: 0.942290, ewa inertia:

a: 0.945567
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Minibatch iteration 283/48400: mean batch inertia: 0.947227, ewa inertia: 0.945523
Minibatch iteration 284/48400: mean batch inertia: 0.939655, ewa inertia: 0.945498
Minibatch iteration 285/48400: mean batch inertia: 0.948990, ewa inertia: 0.945513
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Minibatch iteration 287/48400: mean batch inertia: 0.947862, ewa inertia: 0.945484
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Minibatch iteration 293/48400: mean batch inertia: 0.940254, ewa inertia: 0.945417
Minibatch iteration 294/48400: mean batch inertia: 0.923237, ewa inertia: 0.945326
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Minibatch iteration 297/48400: mean batch inertia: 0.950789, ewa inertia: 0.945320
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Minibatch iteration 305/48400: mean batch inertia: 0.929518, ewa inertia: 0.944683
Minibatch iteration 306/48400: mean batch inertia: 0.939848, ewa inertia: 0.944663
Minibatch iteration 307/48400: mean batch inertia: 0.929539, ewa inertia: 0.944601
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Minibatch iteration 309/48400: mean batch inertia: 0.950444, ewa inertia: 0.944601

Minibatch iteration 310/48400: mean batch inertia: 0.953514, ewa inertia: 0.944637
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Minibatch iteration 312/48400: mean batch inertia: 0.930541, ewa inertia: 0.944581
Minibatch iteration 313/48400: mean batch inertia: 0.935664, ewa inertia: 0.944544
Minibatch iteration 314/48400: mean batch inertia: 0.926025, ewa inertia: 0.944468
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Minibatch iteration 318/48400: mean batch inertia: 0.944485, ewa inertia: 0.944327
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Minibatch iteration 330/48400: mean batch inertia: 0.923458, ewa inertia: 0.943906
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Minibatch iteration 332/48400: mean batch inertia: 0.930643, ewa inertia: 0.943835
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Minibatch iteration 337/48400: mean batch inertia: 0.935872, ewa inertia: 0.943798
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a: 0.943725
Minibatch iteration 339/48400: mean batch inertia: 0.939639, ewa inertia: 0.943708
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Minibatch iteration 341/48400: mean batch inertia: 0.958337, ewa inertia: 0.943753
Minibatch iteration 342/48400: mean batch inertia: 0.929516, ewa inertia: 0.943694
Minibatch iteration 343/48400: mean batch inertia: 0.954100, ewa inertia: 0.943737
Minibatch iteration 344/48400: mean batch inertia: 0.946523, ewa inertia: 0.943749
Minibatch iteration 345/48400: mean batch inertia: 0.925450, ewa inertia: 0.943673
Minibatch iteration 346/48400: mean batch inertia: 0.950384, ewa inertia: 0.943701
Minibatch iteration 347/48400: mean batch inertia: 0.956403, ewa inertia: 0.943753
Minibatch iteration 348/48400: mean batch inertia: 0.930477, ewa inertia: 0.943698
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Minibatch iteration 354/48400: mean batch inertia: 0.920602, ewa inertia: 0.943326
Minibatch iteration 355/48400: mean batch inertia: 0.938186, ewa inertia: 0.943305
Minibatch iteration 356/48400: mean batch inertia: 0.935824, ewa inertia: 0.943274
Minibatch iteration 357/48400: mean batch inertia: 0.934416, ewa inertia: 0.943237
Minibatch iteration 358/48400: mean batch inertia: 0.937768, ewa inertia: 0.943215
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Minibatch iteration 361/48400: mean batch inertia: 0.948708, ewa inertia: 0.943111
Minibatch iteration 362/48400: mean batch inertia: 0.930565, ewa inertia: 0.943059
Minibatch iteration 363/48400: mean batch inertia: 0.928173, ewa inertia: 0.942997
Minibatch iteration 364/48400: mean batch inertia: 0.953109, ewa inertia: 0.943039
Minibatch iteration 365/48400: mean batch inertia: 0.938552, ewa inertia: 0.943021
Minibatch iteration 366/48400: mean batch inertia: 0.926160, ewa inertia: 0.942951

Minibatch iteration 367/48400: mean batch inertia: 0.944756, ewa inertia: 0.942958
Minibatch iteration 368/48400: mean batch inertia: 0.943550, ewa inertia: 0.942961
Minibatch iteration 369/48400: mean batch inertia: 0.951763, ewa inertia: 0.942997
Minibatch iteration 370/48400: mean batch inertia: 0.949288, ewa inertia: 0.943023
Minibatch iteration 371/48400: mean batch inertia: 0.937735, ewa inertia: 0.943001
Minibatch iteration 372/48400: mean batch inertia: 0.949488, ewa inertia: 0.943028
Minibatch iteration 373/48400: mean batch inertia: 0.953777, ewa inertia: 0.943073
Minibatch iteration 374/48400: mean batch inertia: 0.945563, ewa inertia: 0.943083
Minibatch iteration 375/48400: mean batch inertia: 0.921366, ewa inertia: 0.942993
Minibatch iteration 376/48400: mean batch inertia: 0.941249, ewa inertia: 0.942986
Converged (lack of improvement in inertia) at iteration 376/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 281.909069
Init 2/3 with method: k-means++
Inertia for init 2/3: 281.812874
Init 3/3 with method: k-means++
Inertia for init 3/3: 281.851469
Minibatch iteration 1/48400: mean batch inertia: 0.967545, ewa inertia: 0.967545
Minibatch iteration 2/48400: mean batch inertia: 0.963177, ewa inertia: 0.967527
Minibatch iteration 3/48400: mean batch inertia: 0.943697, ewa inertia: 0.967428
Minibatch iteration 4/48400: mean batch inertia: 0.963772, ewa inertia: 0.967413
Minibatch iteration 5/48400: mean batch inertia: 0.959834, ewa inertia: 0.967382
Minibatch iteration 6/48400: mean batch inertia: 0.956181, ewa inertia: 0.967336
Minibatch iteration 7/48400: mean batch inertia: 0.941922, ewa inertia: 0.967231
Minibatch iteration 8/48400: mean batch inertia: 0.940149, ewa inertia: 0.967119
Minibatch iteration 9/48400: mean batch inertia: 0.951376, ewa inertia: 0.967054
Minibatch iteration 10/48400: mean batch inertia: 0.935682, ewa inertia: 0.966924
Minibatch iteration 11/48400: mean batch inertia: 0.942462, ewa inertia: 0.966823
Minibatch iteration 12/48400: mean batch inertia: 0.961141, ewa inertia: 0.966799
Minibatch iteration 13/48400: mean batch inertia: 0.958948, ewa inertia: 0.966767
Minibatch iteration 14/48400: mean batch inertia: 0.930218, ewa inertia: 0.966616
Minibatch iteration 15/48400: mean batch inertia: 0.937659, ewa inertia:

a: 0.966496
Minibatch iteration 16/48400: mean batch inertia: 0.937656, ewa inertia: 0.966377
Minibatch iteration 17/48400: mean batch inertia: 0.947339, ewa inertia: 0.966298
Minibatch iteration 18/48400: mean batch inertia: 0.941862, ewa inertia: 0.966197
Minibatch iteration 19/48400: mean batch inertia: 0.949921, ewa inertia: 0.966130
Minibatch iteration 20/48400: mean batch inertia: 0.947620, ewa inertia: 0.966053
Minibatch iteration 21/48400: mean batch inertia: 0.945791, ewa inertia: 0.965969
Minibatch iteration 22/48400: mean batch inertia: 0.923332, ewa inertia: 0.965793
Minibatch iteration 23/48400: mean batch inertia: 0.950091, ewa inertia: 0.965728
Minibatch iteration 24/48400: mean batch inertia: 0.944352, ewa inertia: 0.965640
Minibatch iteration 25/48400: mean batch inertia: 0.928901, ewa inertia: 0.965488
Minibatch iteration 26/48400: mean batch inertia: 0.937213, ewa inertia: 0.965371
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Minibatch iteration 28/48400: mean batch inertia: 0.947120, ewa inertia: 0.965204
Minibatch iteration 29/48400: mean batch inertia: 0.943289, ewa inertia: 0.965114
Minibatch iteration 30/48400: mean batch inertia: 0.935202, ewa inertia: 0.964990
Minibatch iteration 31/48400: mean batch inertia: 0.936007, ewa inertia: 0.964870
Minibatch iteration 32/48400: mean batch inertia: 0.927278, ewa inertia: 0.964715
Minibatch iteration 33/48400: mean batch inertia: 0.955026, ewa inertia: 0.964675
Minibatch iteration 34/48400: mean batch inertia: 0.949862, ewa inertia: 0.964614
Minibatch iteration 35/48400: mean batch inertia: 0.944120, ewa inertia: 0.964529
Minibatch iteration 36/48400: mean batch inertia: 0.951114, ewa inertia: 0.964473
Minibatch iteration 37/48400: mean batch inertia: 0.954604, ewa inertia: 0.964433
Minibatch iteration 38/48400: mean batch inertia: 0.939531, ewa inertia: 0.964330
Minibatch iteration 39/48400: mean batch inertia: 0.937851, ewa inertia: 0.964220
Minibatch iteration 40/48400: mean batch inertia: 0.939871, ewa inertia: 0.964119
Minibatch iteration 41/48400: mean batch inertia: 0.939955, ewa inertia: 0.964020
Minibatch iteration 42/48400: mean batch inertia: 0.947680, ewa inertia: 0.963952
Minibatch iteration 43/48400: mean batch inertia: 0.937993, ewa inertia: 0.963845

Minibatch iteration 44/48400: mean batch inertia: 0.945933, ewa inertia: 0.963771
Minibatch iteration 45/48400: mean batch inertia: 0.948402, ewa inertia: 0.963707
Minibatch iteration 46/48400: mean batch inertia: 0.940861, ewa inertia: 0.963613
Minibatch iteration 47/48400: mean batch inertia: 0.941121, ewa inertia: 0.963520
Minibatch iteration 48/48400: mean batch inertia: 0.917856, ewa inertia: 0.963331
Minibatch iteration 49/48400: mean batch inertia: 0.941494, ewa inertia: 0.963241
Minibatch iteration 50/48400: mean batch inertia: 0.946132, ewa inertia: 0.963170
Minibatch iteration 51/48400: mean batch inertia: 0.930512, ewa inertia: 0.963035
Minibatch iteration 52/48400: mean batch inertia: 0.939066, ewa inertia: 0.962936
Minibatch iteration 53/48400: mean batch inertia: 0.927164, ewa inertia: 0.962788
Minibatch iteration 54/48400: mean batch inertia: 0.946231, ewa inertia: 0.962719
Minibatch iteration 55/48400: mean batch inertia: 0.947425, ewa inertia: 0.962656
Minibatch iteration 56/48400: mean batch inertia: 0.953287, ewa inertia: 0.962617
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Minibatch iteration 58/48400: mean batch inertia: 0.941857, ewa inertia: 0.962460
Minibatch iteration 59/48400: mean batch inertia: 0.940486, ewa inertia: 0.962369
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Minibatch iteration 62/48400: mean batch inertia: 0.932975, ewa inertia: 0.962038
Minibatch iteration 63/48400: mean batch inertia: 0.915937, ewa inertia: 0.961848
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Minibatch iteration 65/48400: mean batch inertia: 0.934364, ewa inertia: 0.961683
Minibatch iteration 66/48400: mean batch inertia: 0.930116, ewa inertia: 0.961552
Minibatch iteration 67/48400: mean batch inertia: 0.949380, ewa inertia: 0.961502
Minibatch iteration 68/48400: mean batch inertia: 0.946496, ewa inertia: 0.961440
Minibatch iteration 69/48400: mean batch inertia: 0.931410, ewa inertia: 0.961316
Minibatch iteration 70/48400: mean batch inertia: 0.929184, ewa inertia: 0.961183
Minibatch iteration 71/48400: mean batch inertia: 0.930842, ewa inertia: 0.961057
Minibatch iteration 72/48400: mean batch inertia: 0.925122, ewa inertia:

a: 0.960909
Minibatch iteration 73/48400: mean batch inertia: 0.938651, ewa inertia: 0.960817
Minibatch iteration 74/48400: mean batch inertia: 0.944309, ewa inertia: 0.960749
Minibatch iteration 75/48400: mean batch inertia: 0.943661, ewa inertia: 0.960678
Minibatch iteration 76/48400: mean batch inertia: 0.934526, ewa inertia: 0.960570
Minibatch iteration 77/48400: mean batch inertia: 0.918993, ewa inertia: 0.960398
Minibatch iteration 78/48400: mean batch inertia: 0.949304, ewa inertia: 0.960352
Minibatch iteration 79/48400: mean batch inertia: 0.947139, ewa inertia: 0.960297
Minibatch iteration 80/48400: mean batch inertia: 0.942735, ewa inertia: 0.960225
Minibatch iteration 81/48400: mean batch inertia: 0.951051, ewa inertia: 0.960187
Minibatch iteration 82/48400: mean batch inertia: 0.954135, ewa inertia: 0.960162
Minibatch iteration 83/48400: mean batch inertia: 0.907462, ewa inertia: 0.959944
Minibatch iteration 84/48400: mean batch inertia: 0.929056, ewa inertia: 0.959816
Minibatch iteration 85/48400: mean batch inertia: 0.940496, ewa inertia: 0.959736
Minibatch iteration 86/48400: mean batch inertia: 0.938934, ewa inertia: 0.959650
Minibatch iteration 87/48400: mean batch inertia: 0.926155, ewa inertia: 0.959512
Minibatch iteration 88/48400: mean batch inertia: 0.949975, ewa inertia: 0.959472
Minibatch iteration 89/48400: mean batch inertia: 0.943565, ewa inertia: 0.959407
Minibatch iteration 90/48400: mean batch inertia: 0.940549, ewa inertia: 0.959329
Minibatch iteration 91/48400: mean batch inertia: 0.932449, ewa inertia: 0.959218
Minibatch iteration 92/48400: mean batch inertia: 0.935137, ewa inertia: 0.959118
Minibatch iteration 93/48400: mean batch inertia: 0.928587, ewa inertia: 0.958992
Minibatch iteration 94/48400: mean batch inertia: 0.951234, ewa inertia: 0.958960
Minibatch iteration 95/48400: mean batch inertia: 0.934100, ewa inertia: 0.958857
Minibatch iteration 96/48400: mean batch inertia: 0.925815, ewa inertia: 0.958720
Minibatch iteration 97/48400: mean batch inertia: 0.943282, ewa inertia: 0.958657
Minibatch iteration 98/48400: mean batch inertia: 0.943227, ewa inertia: 0.958593
Minibatch iteration 99/48400: mean batch inertia: 0.944284, ewa inertia: 0.958534
Minibatch iteration 100/48400: mean batch inertia: 0.942444, ewa inertia: 0.958467

Minibatch iteration 101/48400: mean batch inertia: 0.937758, ewa inertia: 0.958381
Minibatch iteration 102/48400: mean batch inertia: 0.939391, ewa inertia: 0.958303
Minibatch iteration 103/48400: mean batch inertia: 0.936929, ewa inertia: 0.958215
Minibatch iteration 104/48400: mean batch inertia: 0.942715, ewa inertia: 0.958151
Minibatch iteration 105/48400: mean batch inertia: 0.940589, ewa inertia: 0.958078
Minibatch iteration 106/48400: mean batch inertia: 0.938200, ewa inertia: 0.957996
Minibatch iteration 107/48400: mean batch inertia: 0.941516, ewa inertia: 0.957928
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Minibatch iteration 109/48400: mean batch inertia: 0.915592, ewa inertia: 0.957711
Minibatch iteration 110/48400: mean batch inertia: 0.949978, ewa inertia: 0.957679
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Minibatch iteration 112/48400: mean batch inertia: 0.935096, ewa inertia: 0.957523
Minibatch iteration 113/48400: mean batch inertia: 0.926356, ewa inertia: 0.957394
Minibatch iteration 114/48400: mean batch inertia: 0.951476, ewa inertia: 0.957370
Minibatch iteration 115/48400: mean batch inertia: 0.933783, ewa inertia: 0.957272
Minibatch iteration 116/48400: mean batch inertia: 0.945197, ewa inertia: 0.957223
Minibatch iteration 117/48400: mean batch inertia: 0.947930, ewa inertia: 0.957184
Minibatch iteration 118/48400: mean batch inertia: 0.939232, ewa inertia: 0.957110
Minibatch iteration 119/48400: mean batch inertia: 0.943871, ewa inertia: 0.957055
Minibatch iteration 120/48400: mean batch inertia: 0.938862, ewa inertia: 0.956980
Minibatch iteration 121/48400: mean batch inertia: 0.934958, ewa inertia: 0.956889
Minibatch iteration 122/48400: mean batch inertia: 0.939053, ewa inertia: 0.956815
Minibatch iteration 123/48400: mean batch inertia: 0.932783, ewa inertia: 0.956716
Minibatch iteration 124/48400: mean batch inertia: 0.945866, ewa inertia: 0.956671
Minibatch iteration 125/48400: mean batch inertia: 0.940214, ewa inertia: 0.956603
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Minibatch iteration 400/48400: mean batch inertia: 0.936581, ewa inertia: 0.941996
Minibatch iteration 401/48400: mean batch inertia: 0.946539, ewa inertia: 0.942015
Minibatch iteration 402/48400: mean batch inertia: 0.922831, ewa inertia: 0.941935
Minibatch iteration 403/48400: mean batch inertia: 0.919365, ewa inertia: 0.941842
Minibatch iteration 404/48400: mean batch inertia: 0.946709, ewa inertia: 0.941862
Minibatch iteration 405/48400: mean batch inertia: 0.939242, ewa inertia: 0.941851
Minibatch iteration 406/48400: mean batch inertia: 0.933326, ewa inertia: 0.941816
Minibatch iteration 407/48400: mean batch inertia: 0.929058, ewa inertia: 0.941763
Minibatch iteration 408/48400: mean batch inertia: 0.942691, ewa inertia: 0.941767
Minibatch iteration 409/48400: mean batch inertia: 0.936471, ewa inertia: 0.941745
Minibatch iteration 410/48400: mean batch inertia: 0.918327, ewa inertia: 0.941648
Minibatch iteration 411/48400: mean batch inertia: 0.944453, ewa inertia: 0.941660
Minibatch iteration 412/48400: mean batch inertia: 0.942225, ewa inertia: 0.941662
Minibatch iteration 413/48400: mean batch inertia: 0.933816, ewa inertia: 0.941630
Minibatch iteration 414/48400: mean batch inertia: 0.927719, ewa inertia:

a: 0.941572
Minibatch iteration 415/48400: mean batch inertia: 0.923959, ewa inertia: 0.941500
Minibatch iteration 416/48400: mean batch inertia: 0.921225, ewa inertia: 0.941416
Minibatch iteration 417/48400: mean batch inertia: 0.935346, ewa inertia: 0.941391
Minibatch iteration 418/48400: mean batch inertia: 0.947504, ewa inertia: 0.941416
Minibatch iteration 419/48400: mean batch inertia: 0.927268, ewa inertia: 0.941357
Minibatch iteration 420/48400: mean batch inertia: 0.937683, ewa inertia: 0.941342
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Minibatch iteration 423/48400: mean batch inertia: 0.931769, ewa inertia: 0.941257
Minibatch iteration 424/48400: mean batch inertia: 0.934630, ewa inertia: 0.941230
Minibatch iteration 425/48400: mean batch inertia: 0.932953, ewa inertia: 0.941196
Minibatch iteration 426/48400: mean batch inertia: 0.937448, ewa inertia: 0.941180
Minibatch iteration 427/48400: mean batch inertia: 0.954221, ewa inertia: 0.941234
Minibatch iteration 428/48400: mean batch inertia: 0.950207, ewa inertia: 0.941271
Minibatch iteration 429/48400: mean batch inertia: 0.937695, ewa inertia: 0.941257
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Minibatch iteration 432/48400: mean batch inertia: 0.928862, ewa inertia: 0.941207
Minibatch iteration 433/48400: mean batch inertia: 0.909525, ewa inertia: 0.941076
Minibatch iteration 434/48400: mean batch inertia: 0.937687, ewa inertia: 0.941062
Minibatch iteration 435/48400: mean batch inertia: 0.946045, ewa inertia: 0.941083
Minibatch iteration 436/48400: mean batch inertia: 0.946788, ewa inertia: 0.941106
Minibatch iteration 437/48400: mean batch inertia: 0.926725, ewa inertia: 0.941047
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Minibatch iteration 440/48400: mean batch inertia: 0.931955, ewa inertia: 0.940928
Minibatch iteration 441/48400: mean batch inertia: 0.915079, ewa inertia: 0.940821
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Minibatch iteration 443/48400: mean batch inertia: 0.927602, ewa inertia: 0.940665
Minibatch iteration 444/48400: mean batch inertia: 0.945075, ewa inertia: 0.940684
Minibatch iteration 445/48400: mean batch inertia: 0.919940, ewa inertia: 0.940598
Minibatch iteration 446/48400: mean batch inertia: 0.943107, ewa inertia: 0.940608
Minibatch iteration 447/48400: mean batch inertia: 0.933724, ewa inertia: 0.940580
Minibatch iteration 448/48400: mean batch inertia: 0.929729, ewa inertia: 0.940535
Minibatch iteration 449/48400: mean batch inertia: 0.923655, ewa inertia: 0.940465
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Minibatch iteration 453/48400: mean batch inertia: 0.943725, ewa inertia: 0.940345
Minibatch iteration 454/48400: mean batch inertia: 0.939591, ewa inertia: 0.940342
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Minibatch iteration 456/48400: mean batch inertia: 0.938243, ewa inertia: 0.940242
Minibatch iteration 457/48400: mean batch inertia: 0.945941, ewa inertia: 0.940266
Minibatch iteration 458/48400: mean batch inertia: 0.935923, ewa inertia: 0.940248
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Minibatch iteration 464/48400: mean batch inertia: 0.933074, ewa inertia: 0.940082
Minibatch iteration 465/48400: mean batch inertia: 0.938666, ewa inertia: 0.940076
Minibatch iteration 466/48400: mean batch inertia: 0.935655, ewa inertia: 0.940058
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Minibatch iteration 468/48400: mean batch inertia: 0.927725, ewa inertia: 0.939975
Minibatch iteration 469/48400: mean batch inertia: 0.930014, ewa inertia: 0.939934
Minibatch iteration 470/48400: mean batch inertia: 0.925688, ewa inertia: 0.939875
Minibatch iteration 471/48400: mean batch inertia: 0.921007, ewa inertia:

a: 0.939797
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Minibatch iteration 475/48400: mean batch inertia: 0.927844, ewa inertia: 0.939774
Minibatch iteration 476/48400: mean batch inertia: 0.906199, ewa inertia: 0.939635
Minibatch iteration 477/48400: mean batch inertia: 0.925758, ewa inertia: 0.939578
Minibatch iteration 478/48400: mean batch inertia: 0.924239, ewa inertia: 0.939514
Minibatch iteration 479/48400: mean batch inertia: 0.936558, ewa inertia: 0.939502
Minibatch iteration 480/48400: mean batch inertia: 0.942727, ewa inertia: 0.939516
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Minibatch iteration 483/48400: mean batch inertia: 0.931500, ewa inertia: 0.939291
Minibatch iteration 484/48400: mean batch inertia: 0.924491, ewa inertia: 0.939230
Minibatch iteration 485/48400: mean batch inertia: 0.921997, ewa inertia: 0.939159
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Minibatch iteration 489/48400: mean batch inertia: 0.942647, ewa inertia: 0.939078
Minibatch iteration 490/48400: mean batch inertia: 0.937734, ewa inertia: 0.939072
Minibatch iteration 491/48400: mean batch inertia: 0.940512, ewa inertia: 0.939078
Minibatch iteration 492/48400: mean batch inertia: 0.939079, ewa inertia: 0.939078
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Minibatch iteration 495/48400: mean batch inertia: 0.936771, ewa inertia: 0.939084
Minibatch iteration 496/48400: mean batch inertia: 0.938639, ewa inertia: 0.939082
Minibatch iteration 497/48400: mean batch inertia: 0.923163, ewa inertia: 0.939016
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Minibatch iteration 500/48400: mean batch inertia: 0.945781, ewa inertia: 0.938992
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Minibatch iteration 504/48400: mean batch inertia: 0.944921, ewa inertia: 0.938947
Minibatch iteration 505/48400: mean batch inertia: 0.933245, ewa inertia: 0.938924
Minibatch iteration 506/48400: mean batch inertia: 0.939562, ewa inertia: 0.938926
Minibatch iteration 507/48400: mean batch inertia: 0.940376, ewa inertia: 0.938932
Minibatch iteration 508/48400: mean batch inertia: 0.937444, ewa inertia: 0.938926
Minibatch iteration 509/48400: mean batch inertia: 0.942902, ewa inertia: 0.938943
Minibatch iteration 510/48400: mean batch inertia: 0.938299, ewa inertia: 0.938940
Minibatch iteration 511/48400: mean batch inertia: 0.941766, ewa inertia: 0.938952
Minibatch iteration 512/48400: mean batch inertia: 0.932667, ewa inertia: 0.938926
Minibatch iteration 513/48400: mean batch inertia: 0.935705, ewa inertia: 0.938912
Minibatch iteration 514/48400: mean batch inertia: 0.944020, ewa inertia: 0.938934
Minibatch iteration 515/48400: mean batch inertia: 0.935552, ewa inertia: 0.938920
Minibatch iteration 516/48400: mean batch inertia: 0.932964, ewa inertia: 0.938895
Minibatch iteration 517/48400: mean batch inertia: 0.923142, ewa inertia: 0.938830
Minibatch iteration 518/48400: mean batch inertia: 0.913511, ewa inertia: 0.938725
Minibatch iteration 519/48400: mean batch inertia: 0.922604, ewa inertia: 0.938658
Minibatch iteration 520/48400: mean batch inertia: 0.915424, ewa inertia: 0.938562
Minibatch iteration 521/48400: mean batch inertia: 0.940684, ewa inertia: 0.938571
Minibatch iteration 522/48400: mean batch inertia: 0.945844, ewa inertia: 0.938601
Minibatch iteration 523/48400: mean batch inertia: 0.915395, ewa inertia: 0.938505
Minibatch iteration 524/48400: mean batch inertia: 0.944952, ewa inertia: 0.938532
Minibatch iteration 525/48400: mean batch inertia: 0.924223, ewa inertia: 0.938473
Minibatch iteration 526/48400: mean batch inertia: 0.938489, ewa inertia: 0.938473
Minibatch iteration 527/48400: mean batch inertia: 0.937956, ewa inertia: 0.938471
Minibatch iteration 528/48400: mean batch inertia: 0.928353, ewa inertia:

a: 0.938429
Minibatch iteration 529/48400: mean batch inertia: 0.945866, ewa inertia: 0.938460
Minibatch iteration 530/48400: mean batch inertia: 0.907164, ewa inertia: 0.938330
Minibatch iteration 531/48400: mean batch inertia: 0.949663, ewa inertia: 0.938377
Minibatch iteration 532/48400: mean batch inertia: 0.928518, ewa inertia: 0.938336
Minibatch iteration 533/48400: mean batch inertia: 0.932038, ewa inertia: 0.938310
Minibatch iteration 534/48400: mean batch inertia: 0.937709, ewa inertia: 0.938308
Minibatch iteration 535/48400: mean batch inertia: 0.943525, ewa inertia: 0.938329
Minibatch iteration 536/48400: mean batch inertia: 0.926684, ewa inertia: 0.938281
Minibatch iteration 537/48400: mean batch inertia: 0.944051, ewa inertia: 0.938305
Minibatch iteration 538/48400: mean batch inertia: 0.949677, ewa inertia: 0.938352
Minibatch iteration 539/48400: mean batch inertia: 0.932010, ewa inertia: 0.938326
Minibatch iteration 540/48400: mean batch inertia: 0.923835, ewa inertia: 0.938266
Minibatch iteration 541/48400: mean batch inertia: 0.940417, ewa inertia: 0.938275
Minibatch iteration 542/48400: mean batch inertia: 0.943805, ewa inertia: 0.938298
Minibatch iteration 543/48400: mean batch inertia: 0.923375, ewa inertia: 0.938236
Minibatch iteration 544/48400: mean batch inertia: 0.941173, ewa inertia: 0.938248
Minibatch iteration 545/48400: mean batch inertia: 0.938412, ewa inertia: 0.938249
Minibatch iteration 546/48400: mean batch inertia: 0.941522, ewa inertia: 0.938262
Minibatch iteration 547/48400: mean batch inertia: 0.947772, ewa inertia: 0.938302
Minibatch iteration 548/48400: mean batch inertia: 0.943299, ewa inertia: 0.938322
Minibatch iteration 549/48400: mean batch inertia: 0.945826, ewa inertia: 0.938353
Minibatch iteration 550/48400: mean batch inertia: 0.927682, ewa inertia: 0.938309
Minibatch iteration 551/48400: mean batch inertia: 0.945006, ewa inertia: 0.938337
Minibatch iteration 552/48400: mean batch inertia: 0.931864, ewa inertia: 0.938310
Minibatch iteration 553/48400: mean batch inertia: 0.948650, ewa inertia: 0.938353
Converged (lack of improvement in inertia) at iteration 553/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 280.613173
Init 2/3 with method: k-means++
Inertia for init 2/3: 278.612757

```
Init 3/3 with method: k-means++
Inertia for init 3/3: 277.367473
Minibatch iteration 1/48400: mean batch inertia: 0.952430, ewa inertia:
0.952430
Minibatch iteration 2/48400: mean batch inertia: 0.967319, ewa inertia:
0.952492
Minibatch iteration 3/48400: mean batch inertia: 0.953694, ewa inertia:
0.952497
Minibatch iteration 4/48400: mean batch inertia: 0.950361, ewa inertia:
0.952488
Minibatch iteration 5/48400: mean batch inertia: 0.952029, ewa inertia:
0.952486
Minibatch iteration 6/48400: mean batch inertia: 0.944988, ewa inertia:
0.952455
Minibatch iteration 7/48400: mean batch inertia: 0.947635, ewa inertia:
0.952435
Minibatch iteration 8/48400: mean batch inertia: 0.957673, ewa inertia:
0.952457
Minibatch iteration 9/48400: mean batch inertia: 0.941540, ewa inertia:
0.952412
Minibatch iteration 10/48400: mean batch inertia: 0.953100, ewa inertia:
0.952414
Minibatch iteration 11/48400: mean batch inertia: 0.956125, ewa inertia:
0.952430
Minibatch iteration 12/48400: mean batch inertia: 0.948932, ewa inertia:
0.952415
Minibatch iteration 13/48400: mean batch inertia: 0.948468, ewa inertia:
0.952399
Minibatch iteration 14/48400: mean batch inertia: 0.958276, ewa inertia:
0.952423
Minibatch iteration 15/48400: mean batch inertia: 0.952139, ewa inertia:
0.952422
Minibatch iteration 16/48400: mean batch inertia: 0.936264, ewa inertia:
0.952355
Minibatch iteration 17/48400: mean batch inertia: 0.953621, ewa inertia:
0.952361
Minibatch iteration 18/48400: mean batch inertia: 0.942751, ewa inertia:
0.952321
Minibatch iteration 19/48400: mean batch inertia: 0.951152, ewa inertia:
0.952316
Minibatch iteration 20/48400: mean batch inertia: 0.937272, ewa inertia:
0.952254
Minibatch iteration 21/48400: mean batch inertia: 0.955988, ewa inertia:
0.952269
Minibatch iteration 22/48400: mean batch inertia: 0.948916, ewa inertia:
0.952255
Minibatch iteration 23/48400: mean batch inertia: 0.934559, ewa inertia:
0.952182
Minibatch iteration 24/48400: mean batch inertia: 0.952346, ewa inertia:
0.952183
Minibatch iteration 25/48400: mean batch inertia: 0.946348, ewa inertia:
0.952159
Minibatch iteration 26/48400: mean batch inertia: 0.922938, ewa inertia:
0.952038
Minibatch iteration 27/48400: mean batch inertia: 0.942194, ewa inertia:
0.951997
Minibatch iteration 28/48400: mean batch inertia: 0.933816, ewa inertia:
```

a: 0.951922
Minibatch iteration 29/48400: mean batch inertia: 0.944188, ewa inertia: 0.951890
Minibatch iteration 30/48400: mean batch inertia: 0.945223, ewa inertia: 0.951862
Minibatch iteration 31/48400: mean batch inertia: 0.946302, ewa inertia: 0.951840
Minibatch iteration 32/48400: mean batch inertia: 0.942628, ewa inertia: 0.951801
Minibatch iteration 33/48400: mean batch inertia: 0.932608, ewa inertia: 0.951722
Minibatch iteration 34/48400: mean batch inertia: 0.948730, ewa inertia: 0.951710
Minibatch iteration 35/48400: mean batch inertia: 0.936800, ewa inertia: 0.951648
Minibatch iteration 36/48400: mean batch inertia: 0.940823, ewa inertia: 0.951603
Minibatch iteration 37/48400: mean batch inertia: 0.923320, ewa inertia: 0.951486
Minibatch iteration 38/48400: mean batch inertia: 0.941035, ewa inertia: 0.951443
Minibatch iteration 39/48400: mean batch inertia: 0.934115, ewa inertia: 0.951372
Minibatch iteration 40/48400: mean batch inertia: 0.932149, ewa inertia: 0.951292
Minibatch iteration 41/48400: mean batch inertia: 0.945088, ewa inertia: 0.951266
Minibatch iteration 42/48400: mean batch inertia: 0.934117, ewa inertia: 0.951196
Minibatch iteration 43/48400: mean batch inertia: 0.941526, ewa inertia: 0.951156
Minibatch iteration 44/48400: mean batch inertia: 0.935827, ewa inertia: 0.951092
Minibatch iteration 45/48400: mean batch inertia: 0.933228, ewa inertia: 0.951018
Minibatch iteration 46/48400: mean batch inertia: 0.944242, ewa inertia: 0.950990
Minibatch iteration 47/48400: mean batch inertia: 0.932599, ewa inertia: 0.950914
Minibatch iteration 48/48400: mean batch inertia: 0.923588, ewa inertia: 0.950801
Minibatch iteration 49/48400: mean batch inertia: 0.934246, ewa inertia: 0.950733
Minibatch iteration 50/48400: mean batch inertia: 0.938945, ewa inertia: 0.950684
Minibatch iteration 51/48400: mean batch inertia: 0.940074, ewa inertia: 0.950640
Minibatch iteration 52/48400: mean batch inertia: 0.939639, ewa inertia: 0.950595
Minibatch iteration 53/48400: mean batch inertia: 0.949882, ewa inertia: 0.950592
Minibatch iteration 54/48400: mean batch inertia: 0.936929, ewa inertia: 0.950535
Minibatch iteration 55/48400: mean batch inertia: 0.941584, ewa inertia: 0.950498
Minibatch iteration 56/48400: mean batch inertia: 0.942999, ewa inertia: 0.950467

Minibatch iteration 57/48400: mean batch inertia: 0.938988, ewa inertia: 0.950420
Minibatch iteration 58/48400: mean batch inertia: 0.919412, ewa inertia: 0.950292
Minibatch iteration 59/48400: mean batch inertia: 0.932946, ewa inertia: 0.950220
Minibatch iteration 60/48400: mean batch inertia: 0.924708, ewa inertia: 0.950114
Minibatch iteration 61/48400: mean batch inertia: 0.937588, ewa inertia: 0.950063
Minibatch iteration 62/48400: mean batch inertia: 0.944565, ewa inertia: 0.950040
Minibatch iteration 63/48400: mean batch inertia: 0.945509, ewa inertia: 0.950021
Minibatch iteration 64/48400: mean batch inertia: 0.937746, ewa inertia: 0.949970
Minibatch iteration 65/48400: mean batch inertia: 0.943002, ewa inertia: 0.949942
Minibatch iteration 66/48400: mean batch inertia: 0.930741, ewa inertia: 0.949862
Minibatch iteration 67/48400: mean batch inertia: 0.933112, ewa inertia: 0.949793
Minibatch iteration 68/48400: mean batch inertia: 0.932290, ewa inertia: 0.949721
Minibatch iteration 69/48400: mean batch inertia: 0.937810, ewa inertia: 0.949671
Minibatch iteration 70/48400: mean batch inertia: 0.947942, ewa inertia: 0.949664
Minibatch iteration 71/48400: mean batch inertia: 0.922521, ewa inertia: 0.949552
Minibatch iteration 72/48400: mean batch inertia: 0.951236, ewa inertia: 0.949559
Minibatch iteration 73/48400: mean batch inertia: 0.933005, ewa inertia: 0.949491
Minibatch iteration 74/48400: mean batch inertia: 0.949462, ewa inertia: 0.949490
Minibatch iteration 75/48400: mean batch inertia: 0.942965, ewa inertia: 0.949463
Minibatch iteration 76/48400: mean batch inertia: 0.929834, ewa inertia: 0.949382
Minibatch iteration 77/48400: mean batch inertia: 0.928542, ewa inertia: 0.949296
Minibatch iteration 78/48400: mean batch inertia: 0.927684, ewa inertia: 0.949207
Minibatch iteration 79/48400: mean batch inertia: 0.938010, ewa inertia: 0.949161
Minibatch iteration 80/48400: mean batch inertia: 0.952206, ewa inertia: 0.949173
Minibatch iteration 81/48400: mean batch inertia: 0.933069, ewa inertia: 0.949107
Minibatch iteration 82/48400: mean batch inertia: 0.954494, ewa inertia: 0.949129
Minibatch iteration 83/48400: mean batch inertia: 0.935190, ewa inertia: 0.949071
Minibatch iteration 84/48400: mean batch inertia: 0.941397, ewa inertia: 0.949039
Minibatch iteration 85/48400: mean batch inertia: 0.926790, ewa inertia:

a: 0.948947
Minibatch iteration 86/48400: mean batch inertia: 0.944022, ewa inertia: 0.948927
Minibatch iteration 87/48400: mean batch inertia: 0.939227, ewa inertia: 0.948887
Minibatch iteration 88/48400: mean batch inertia: 0.934139, ewa inertia: 0.948826
Minibatch iteration 89/48400: mean batch inertia: 0.940288, ewa inertia: 0.948791
Minibatch iteration 90/48400: mean batch inertia: 0.942519, ewa inertia: 0.948765
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Minibatch iteration 92/48400: mean batch inertia: 0.930376, ewa inertia: 0.948631
Minibatch iteration 93/48400: mean batch inertia: 0.922303, ewa inertia: 0.948522
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Minibatch iteration 99/48400: mean batch inertia: 0.942618, ewa inertia: 0.948260
Minibatch iteration 100/48400: mean batch inertia: 0.922317, ewa inertia: 0.948153
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Minibatch iteration 103/48400: mean batch inertia: 0.934875, ewa inertia: 0.948073
Minibatch iteration 104/48400: mean batch inertia: 0.942961, ewa inertia: 0.948052
Minibatch iteration 105/48400: mean batch inertia: 0.934297, ewa inertia: 0.947995
Minibatch iteration 106/48400: mean batch inertia: 0.925530, ewa inertia: 0.947902
Minibatch iteration 107/48400: mean batch inertia: 0.928202, ewa inertia: 0.947821
Minibatch iteration 108/48400: mean batch inertia: 0.922113, ewa inertia: 0.947714
Minibatch iteration 109/48400: mean batch inertia: 0.946473, ewa inertia: 0.947709
Minibatch iteration 110/48400: mean batch inertia: 0.950578, ewa inertia: 0.947721
Minibatch iteration 111/48400: mean batch inertia: 0.936581, ewa inertia: 0.947675
Minibatch iteration 112/48400: mean batch inertia: 0.912164, ewa inertia: 0.947528
Minibatch iteration 113/48400: mean batch inertia: 0.926419, ewa inertia: 0.947441

Minibatch iteration 114/48400: mean batch inertia: 0.938174, ewa inertia: 0.947403
Minibatch iteration 115/48400: mean batch inertia: 0.943512, ewa inertia: 0.947387
Minibatch iteration 116/48400: mean batch inertia: 0.915612, ewa inertia: 0.947255
Minibatch iteration 117/48400: mean batch inertia: 0.921360, ewa inertia: 0.947148
Minibatch iteration 118/48400: mean batch inertia: 0.927848, ewa inertia: 0.947068
Minibatch iteration 119/48400: mean batch inertia: 0.935382, ewa inertia: 0.947020
Minibatch iteration 120/48400: mean batch inertia: 0.935092, ewa inertia: 0.946971
Minibatch iteration 121/48400: mean batch inertia: 0.930547, ewa inertia: 0.946903
Minibatch iteration 122/48400: mean batch inertia: 0.932451, ewa inertia: 0.946843
Minibatch iteration 123/48400: mean batch inertia: 0.925973, ewa inertia: 0.946757
Minibatch iteration 124/48400: mean batch inertia: 0.923662, ewa inertia: 0.946661
Minibatch iteration 125/48400: mean batch inertia: 0.911174, ewa inertia: 0.946515
Minibatch iteration 126/48400: mean batch inertia: 0.944776, ewa inertia: 0.946507
Minibatch iteration 127/48400: mean batch inertia: 0.914575, ewa inertia: 0.946375
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Minibatch iteration 130/48400: mean batch inertia: 0.941005, ewa inertia: 0.946262
Minibatch iteration 131/48400: mean batch inertia: 0.940449, ewa inertia: 0.946238
Minibatch iteration 132/48400: mean batch inertia: 0.943346, ewa inertia: 0.946226
Minibatch iteration 133/48400: mean batch inertia: 0.922405, ewa inertia: 0.946127
Minibatch iteration 134/48400: mean batch inertia: 0.920312, ewa inertia: 0.946020
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Minibatch iteration 137/48400: mean batch inertia: 0.924933, ewa inertia: 0.945830
Minibatch iteration 138/48400: mean batch inertia: 0.939387, ewa inertia: 0.945803
Minibatch iteration 139/48400: mean batch inertia: 0.948553, ewa inertia: 0.945815
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Minibatch iteration 141/48400: mean batch inertia: 0.950036, ewa inertia: 0.945751
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a: 0.945679
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Minibatch iteration 145/48400: mean batch inertia: 0.936057, ewa inertia: 0.945572
Minibatch iteration 146/48400: mean batch inertia: 0.930342, ewa inertia: 0.945509
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Minibatch iteration 151/48400: mean batch inertia: 0.937105, ewa inertia: 0.945223
Minibatch iteration 152/48400: mean batch inertia: 0.913937, ewa inertia: 0.945094
Minibatch iteration 153/48400: mean batch inertia: 0.928292, ewa inertia: 0.945024
Minibatch iteration 154/48400: mean batch inertia: 0.939682, ewa inertia: 0.945002
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Minibatch iteration 167/48400: mean batch inertia: 0.938366, ewa inertia: 0.944585
Minibatch iteration 168/48400: mean batch inertia: 0.940133, ewa inertia: 0.944567
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a: 0.943321
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Minibatch iteration 204/48400: mean batch inertia: 0.942940, ewa inertia: 0.943358
Minibatch iteration 205/48400: mean batch inertia: 0.934536, ewa inertia: 0.943321
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Minibatch iteration 209/48400: mean batch inertia: 0.939790, ewa inertia: 0.943279
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Minibatch iteration 227/48400: mean batch inertia: 0.934227, ewa inertia: 0.942278

Minibatch iteration 228/48400: mean batch inertia: 0.937637, ewa inertia: 0.942258
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Minibatch iteration 230/48400: mean batch inertia: 0.934565, ewa inertia: 0.942143
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Minibatch iteration 233/48400: mean batch inertia: 0.927536, ewa inertia: 0.942007
Minibatch iteration 234/48400: mean batch inertia: 0.946161, ewa inertia: 0.942024
Minibatch iteration 235/48400: mean batch inertia: 0.941829, ewa inertia: 0.942024
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Minibatch iteration 237/48400: mean batch inertia: 0.928632, ewa inertia: 0.941906
Minibatch iteration 238/48400: mean batch inertia: 0.924705, ewa inertia: 0.941835
Minibatch iteration 239/48400: mean batch inertia: 0.935186, ewa inertia: 0.941807
Minibatch iteration 240/48400: mean batch inertia: 0.944954, ewa inertia: 0.941820
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Minibatch iteration 245/48400: mean batch inertia: 0.943768, ewa inertia: 0.941533
Minibatch iteration 246/48400: mean batch inertia: 0.944568, ewa inertia: 0.941545
Minibatch iteration 247/48400: mean batch inertia: 0.929567, ewa inertia: 0.941496
Minibatch iteration 248/48400: mean batch inertia: 0.935746, ewa inertia: 0.941472
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Minibatch iteration 250/48400: mean batch inertia: 0.943250, ewa inertia: 0.941464
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Minibatch iteration 252/48400: mean batch inertia: 0.928541, ewa inertia: 0.941402
Minibatch iteration 253/48400: mean batch inertia: 0.940640, ewa inertia: 0.941399
Minibatch iteration 254/48400: mean batch inertia: 0.930925, ewa inertia: 0.941355
Minibatch iteration 255/48400: mean batch inertia: 0.938589, ewa inertia: 0.941344
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a: 0.941271
Minibatch iteration 257/48400: mean batch inertia: 0.919025, ewa inertia: 0.941180
Minibatch iteration 258/48400: mean batch inertia: 0.924162, ewa inertia: 0.941109
Minibatch iteration 259/48400: mean batch inertia: 0.922772, ewa inertia: 0.941033
Minibatch iteration 260/48400: mean batch inertia: 0.945354, ewa inertia: 0.941051
Minibatch iteration 261/48400: mean batch inertia: 0.936298, ewa inertia: 0.941032
Minibatch iteration 262/48400: mean batch inertia: 0.943113, ewa inertia: 0.941040
Minibatch iteration 263/48400: mean batch inertia: 0.921902, ewa inertia: 0.940961
Minibatch iteration 264/48400: mean batch inertia: 0.933907, ewa inertia: 0.940932
Minibatch iteration 265/48400: mean batch inertia: 0.937350, ewa inertia: 0.940917
Minibatch iteration 266/48400: mean batch inertia: 0.922557, ewa inertia: 0.940841
Minibatch iteration 267/48400: mean batch inertia: 0.929654, ewa inertia: 0.940795
Minibatch iteration 268/48400: mean batch inertia: 0.941341, ewa inertia: 0.940797
Minibatch iteration 269/48400: mean batch inertia: 0.941939, ewa inertia: 0.940802
Minibatch iteration 270/48400: mean batch inertia: 0.933114, ewa inertia: 0.940770
Minibatch iteration 271/48400: mean batch inertia: 0.945577, ewa inertia: 0.940790
Minibatch iteration 272/48400: mean batch inertia: 0.942613, ewa inertia: 0.940798
Minibatch iteration 273/48400: mean batch inertia: 0.915372, ewa inertia: 0.940692
Minibatch iteration 274/48400: mean batch inertia: 0.926361, ewa inertia: 0.940633
Minibatch iteration 275/48400: mean batch inertia: 0.932883, ewa inertia: 0.940601
Minibatch iteration 276/48400: mean batch inertia: 0.923255, ewa inertia: 0.940529
Minibatch iteration 277/48400: mean batch inertia: 0.927414, ewa inertia: 0.940475
Minibatch iteration 278/48400: mean batch inertia: 0.932449, ewa inertia: 0.940442
Minibatch iteration 279/48400: mean batch inertia: 0.929730, ewa inertia: 0.940398
Minibatch iteration 280/48400: mean batch inertia: 0.930230, ewa inertia: 0.940356
Minibatch iteration 281/48400: mean batch inertia: 0.933592, ewa inertia: 0.940328
Minibatch iteration 282/48400: mean batch inertia: 0.938805, ewa inertia: 0.940321
Minibatch iteration 283/48400: mean batch inertia: 0.943176, ewa inertia: 0.940333
Minibatch iteration 284/48400: mean batch inertia: 0.933914, ewa inertia: 0.940307

Minibatch iteration 285/48400: mean batch inertia: 0.947351, ewa inertia: 0.940336
Minibatch iteration 286/48400: mean batch inertia: 0.945987, ewa inertia: 0.940359
Minibatch iteration 287/48400: mean batch inertia: 0.909221, ewa inertia: 0.940230
Minibatch iteration 288/48400: mean batch inertia: 0.927510, ewa inertia: 0.940178
Minibatch iteration 289/48400: mean batch inertia: 0.948889, ewa inertia: 0.940214
Minibatch iteration 290/48400: mean batch inertia: 0.936750, ewa inertia: 0.940200
Minibatch iteration 291/48400: mean batch inertia: 0.938809, ewa inertia: 0.940194
Minibatch iteration 292/48400: mean batch inertia: 0.927573, ewa inertia: 0.940142
Minibatch iteration 293/48400: mean batch inertia: 0.924625, ewa inertia: 0.940077
Minibatch iteration 294/48400: mean batch inertia: 0.932927, ewa inertia: 0.940048
Minibatch iteration 295/48400: mean batch inertia: 0.945271, ewa inertia: 0.940069
Minibatch iteration 296/48400: mean batch inertia: 0.941373, ewa inertia: 0.940075
Minibatch iteration 297/48400: mean batch inertia: 0.941926, ewa inertia: 0.940083
Minibatch iteration 298/48400: mean batch inertia: 0.947184, ewa inertia: 0.940112
Minibatch iteration 299/48400: mean batch inertia: 0.936361, ewa inertia: 0.940096
Minibatch iteration 300/48400: mean batch inertia: 0.945641, ewa inertia: 0.940119
Minibatch iteration 301/48400: mean batch inertia: 0.938553, ewa inertia: 0.940113
Minibatch iteration 302/48400: mean batch inertia: 0.929125, ewa inertia: 0.940067
Minibatch iteration 303/48400: mean batch inertia: 0.951530, ewa inertia: 0.940115
Minibatch iteration 304/48400: mean batch inertia: 0.941235, ewa inertia: 0.940119
Converged (lack of improvement in inertia) at iteration 304/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 273.557004
Init 2/3 with method: k-means++
Inertia for init 2/3: 275.795922
Init 3/3 with method: k-means++
Inertia for init 3/3: 276.444276
Minibatch iteration 1/48400: mean batch inertia: 0.956973, ewa inertia: 0.956973
Minibatch iteration 2/48400: mean batch inertia: 0.960813, ewa inertia: 0.956989
Minibatch iteration 3/48400: mean batch inertia: 0.943398, ewa inertia: 0.956933
Minibatch iteration 4/48400: mean batch inertia: 0.948637, ewa inertia: 0.956899
Minibatch iteration 5/48400: mean batch inertia: 0.933092, ewa inertia:

0.956800
Minibatch iteration 6/48400: mean batch inertia: 0.939350, ewa inertia: 0.956728
Minibatch iteration 7/48400: mean batch inertia: 0.942134, ewa inertia: 0.956668
Minibatch iteration 8/48400: mean batch inertia: 0.945857, ewa inertia: 0.956623
Minibatch iteration 9/48400: mean batch inertia: 0.930964, ewa inertia: 0.956517
Minibatch iteration 10/48400: mean batch inertia: 0.940008, ewa inertia: 0.956449
Minibatch iteration 11/48400: mean batch inertia: 0.934451, ewa inertia: 0.956358
Minibatch iteration 12/48400: mean batch inertia: 0.933381, ewa inertia: 0.956263
Minibatch iteration 13/48400: mean batch inertia: 0.952942, ewa inertia: 0.956249
Minibatch iteration 14/48400: mean batch inertia: 0.943913, ewa inertia: 0.956198
Minibatch iteration 15/48400: mean batch inertia: 0.930037, ewa inertia: 0.956090
Minibatch iteration 16/48400: mean batch inertia: 0.927158, ewa inertia: 0.955970
Minibatch iteration 17/48400: mean batch inertia: 0.932598, ewa inertia: 0.955874
Minibatch iteration 18/48400: mean batch inertia: 0.942011, ewa inertia: 0.955817
Minibatch iteration 19/48400: mean batch inertia: 0.939812, ewa inertia: 0.955750
Minibatch iteration 20/48400: mean batch inertia: 0.941670, ewa inertia: 0.955692
Minibatch iteration 21/48400: mean batch inertia: 0.937825, ewa inertia: 0.955618
Minibatch iteration 22/48400: mean batch inertia: 0.937068, ewa inertia: 0.955542
Minibatch iteration 23/48400: mean batch inertia: 0.941730, ewa inertia: 0.955484
Minibatch iteration 24/48400: mean batch inertia: 0.925847, ewa inertia: 0.955362
Minibatch iteration 25/48400: mean batch inertia: 0.946249, ewa inertia: 0.955324
Minibatch iteration 26/48400: mean batch inertia: 0.925745, ewa inertia: 0.955202
Minibatch iteration 27/48400: mean batch inertia: 0.931143, ewa inertia: 0.955103
Minibatch iteration 28/48400: mean batch inertia: 0.950847, ewa inertia: 0.955085
Minibatch iteration 29/48400: mean batch inertia: 0.939607, ewa inertia: 0.955021
Minibatch iteration 30/48400: mean batch inertia: 0.939006, ewa inertia: 0.954955
Minibatch iteration 31/48400: mean batch inertia: 0.921288, ewa inertia: 0.954816
Minibatch iteration 32/48400: mean batch inertia: 0.935566, ewa inertia: 0.954736
Minibatch iteration 33/48400: mean batch inertia: 0.928748, ewa inertia: 0.954629

Minibatch iteration 34/48400: mean batch inertia: 0.912180, ewa inertia: 0.954453
Minibatch iteration 35/48400: mean batch inertia: 0.930848, ewa inertia: 0.954355
Minibatch iteration 36/48400: mean batch inertia: 0.919908, ewa inertia: 0.954213
Minibatch iteration 37/48400: mean batch inertia: 0.938471, ewa inertia: 0.954148
Minibatch iteration 38/48400: mean batch inertia: 0.944190, ewa inertia: 0.954107
Minibatch iteration 39/48400: mean batch inertia: 0.941571, ewa inertia: 0.954055
Minibatch iteration 40/48400: mean batch inertia: 0.926734, ewa inertia: 0.953942
Minibatch iteration 41/48400: mean batch inertia: 0.915025, ewa inertia: 0.953781
Minibatch iteration 42/48400: mean batch inertia: 0.930661, ewa inertia: 0.953685
Minibatch iteration 43/48400: mean batch inertia: 0.942260, ewa inertia: 0.953638
Minibatch iteration 44/48400: mean batch inertia: 0.943884, ewa inertia: 0.953598
Minibatch iteration 45/48400: mean batch inertia: 0.928259, ewa inertia: 0.953493
Minibatch iteration 46/48400: mean batch inertia: 0.941331, ewa inertia: 0.953443
Minibatch iteration 47/48400: mean batch inertia: 0.919803, ewa inertia: 0.953304
Minibatch iteration 48/48400: mean batch inertia: 0.914603, ewa inertia: 0.953144
Minibatch iteration 49/48400: mean batch inertia: 0.914407, ewa inertia: 0.952984
Minibatch iteration 50/48400: mean batch inertia: 0.915490, ewa inertia: 0.952829
Minibatch iteration 51/48400: mean batch inertia: 0.920560, ewa inertia: 0.952695
Minibatch iteration 52/48400: mean batch inertia: 0.926878, ewa inertia: 0.952589
Minibatch iteration 53/48400: mean batch inertia: 0.911497, ewa inertia: 0.952419
Minibatch iteration 54/48400: mean batch inertia: 0.922239, ewa inertia: 0.952294
Minibatch iteration 55/48400: mean batch inertia: 0.934424, ewa inertia: 0.952220
Minibatch iteration 56/48400: mean batch inertia: 0.911164, ewa inertia: 0.952050
Minibatch iteration 57/48400: mean batch inertia: 0.946570, ewa inertia: 0.952028
Minibatch iteration 58/48400: mean batch inertia: 0.950633, ewa inertia: 0.952022
Minibatch iteration 59/48400: mean batch inertia: 0.920498, ewa inertia: 0.951891
Minibatch iteration 60/48400: mean batch inertia: 0.930948, ewa inertia: 0.951805
Minibatch iteration 61/48400: mean batch inertia: 0.937602, ewa inertia: 0.951746
Minibatch iteration 62/48400: mean batch inertia: 0.928707, ewa inertia:

a: 0.951651
Minibatch iteration 63/48400: mean batch inertia: 0.907930, ewa inertia: 0.951470
Minibatch iteration 64/48400: mean batch inertia: 0.917964, ewa inertia: 0.951332
Minibatch iteration 65/48400: mean batch inertia: 0.933536, ewa inertia: 0.951258
Minibatch iteration 66/48400: mean batch inertia: 0.931036, ewa inertia: 0.951174
Minibatch iteration 67/48400: mean batch inertia: 0.927712, ewa inertia: 0.951077
Minibatch iteration 68/48400: mean batch inertia: 0.935356, ewa inertia: 0.951012
Minibatch iteration 69/48400: mean batch inertia: 0.946541, ewa inertia: 0.950994
Minibatch iteration 70/48400: mean batch inertia: 0.931272, ewa inertia: 0.950912
Minibatch iteration 71/48400: mean batch inertia: 0.930563, ewa inertia: 0.950828
Minibatch iteration 72/48400: mean batch inertia: 0.928877, ewa inertia: 0.950738
Minibatch iteration 73/48400: mean batch inertia: 0.923693, ewa inertia: 0.950626
Minibatch iteration 74/48400: mean batch inertia: 0.932015, ewa inertia: 0.950549
Minibatch iteration 75/48400: mean batch inertia: 0.932203, ewa inertia: 0.950473
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Minibatch iteration 351/48400: mean batch inertia: 0.919990, ewa inertia: 0.934090
Minibatch iteration 352/48400: mean batch inertia: 0.948233, ewa inertia: 0.934148
Minibatch iteration 353/48400: mean batch inertia: 0.922464, ewa inertia: 0.934100
Minibatch iteration 354/48400: mean batch inertia: 0.942382, ewa inertia: 0.934134
Minibatch iteration 355/48400: mean batch inertia: 0.915402, ewa inertia: 0.934057
Minibatch iteration 356/48400: mean batch inertia: 0.926287, ewa inertia: 0.934025
Minibatch iteration 357/48400: mean batch inertia: 0.915959, ewa inertia: 0.933950
Minibatch iteration 358/48400: mean batch inertia: 0.931272, ewa inertia: 0.933939
Minibatch iteration 359/48400: mean batch inertia: 0.922302, ewa inertia: 0.933891
Minibatch iteration 360/48400: mean batch inertia: 0.933938, ewa inertia: 0.933891
Minibatch iteration 361/48400: mean batch inertia: 0.910145, ewa inertia: 0.933793
Minibatch iteration 362/48400: mean batch inertia: 0.916071, ewa inertia: 0.933719
Minibatch iteration 363/48400: mean batch inertia: 0.936618, ewa inertia: 0.933731
Minibatch iteration 364/48400: mean batch inertia: 0.931123, ewa inertia: 0.933721
Minibatch iteration 365/48400: mean batch inertia: 0.933349, ewa inertia: 0.933719
Minibatch iteration 366/48400: mean batch inertia: 0.924489, ewa inertia: 0.933681
Minibatch iteration 367/48400: mean batch inertia: 0.936021, ewa inertia: 0.933691
Minibatch iteration 368/48400: mean batch inertia: 0.921726, ewa inertia: 0.933641
Minibatch iteration 369/48400: mean batch inertia: 0.929193, ewa inertia: 0.933623
Minibatch iteration 370/48400: mean batch inertia: 0.931209, ewa inertia: 0.933613
Minibatch iteration 371/48400: mean batch inertia: 0.943615, ewa inertia: 0.933654
Minibatch iteration 372/48400: mean batch inertia: 0.933015, ewa inertia: 0.933651
Minibatch iteration 373/48400: mean batch inertia: 0.929634, ewa inertia: 0.933635
Minibatch iteration 374/48400: mean batch inertia: 0.929099, ewa inertia: 0.933616
Minibatch iteration 375/48400: mean batch inertia: 0.908102, ewa inertia: 0.933511

Minibatch iteration 376/48400: mean batch inertia: 0.926301, ewa inertia: 0.933481
Minibatch iteration 377/48400: mean batch inertia: 0.922353, ewa inertia: 0.933435
Minibatch iteration 378/48400: mean batch inertia: 0.902190, ewa inertia: 0.933306
Minibatch iteration 379/48400: mean batch inertia: 0.933853, ewa inertia: 0.933308
Minibatch iteration 380/48400: mean batch inertia: 0.905060, ewa inertia: 0.933191
Minibatch iteration 381/48400: mean batch inertia: 0.919590, ewa inertia: 0.933135
Minibatch iteration 382/48400: mean batch inertia: 0.926815, ewa inertia: 0.933109
Minibatch iteration 383/48400: mean batch inertia: 0.932427, ewa inertia: 0.933106
Minibatch iteration 384/48400: mean batch inertia: 0.922404, ewa inertia: 0.933062
Minibatch iteration 385/48400: mean batch inertia: 0.927392, ewa inertia: 0.933038
Minibatch iteration 386/48400: mean batch inertia: 0.939464, ewa inertia: 0.933065
Minibatch iteration 387/48400: mean batch inertia: 0.927243, ewa inertia: 0.933041
Minibatch iteration 388/48400: mean batch inertia: 0.933911, ewa inertia: 0.933044
Minibatch iteration 389/48400: mean batch inertia: 0.919910, ewa inertia: 0.932990
Minibatch iteration 390/48400: mean batch inertia: 0.930431, ewa inertia: 0.932979
Minibatch iteration 391/48400: mean batch inertia: 0.925802, ewa inertia: 0.932950
Minibatch iteration 392/48400: mean batch inertia: 0.923419, ewa inertia: 0.932910
Minibatch iteration 393/48400: mean batch inertia: 0.913122, ewa inertia: 0.932829
Minibatch iteration 394/48400: mean batch inertia: 0.927108, ewa inertia: 0.932805
Minibatch iteration 395/48400: mean batch inertia: 0.936026, ewa inertia: 0.932818
Minibatch iteration 396/48400: mean batch inertia: 0.932642, ewa inertia: 0.932818
Minibatch iteration 397/48400: mean batch inertia: 0.905414, ewa inertia: 0.932704
Minibatch iteration 398/48400: mean batch inertia: 0.926537, ewa inertia: 0.932679
Minibatch iteration 399/48400: mean batch inertia: 0.926927, ewa inertia: 0.932655
Minibatch iteration 400/48400: mean batch inertia: 0.912098, ewa inertia: 0.932570
Minibatch iteration 401/48400: mean batch inertia: 0.917136, ewa inertia: 0.932506
Minibatch iteration 402/48400: mean batch inertia: 0.933278, ewa inertia: 0.932509
Minibatch iteration 403/48400: mean batch inertia: 0.915153, ewa inertia: 0.932438
Minibatch iteration 404/48400: mean batch inertia: 0.923446, ewa inertia:

a: 0.932400
Minibatch iteration 405/48400: mean batch inertia: 0.931343, ewa inertia: 0.932396
Minibatch iteration 406/48400: mean batch inertia: 0.924012, ewa inertia: 0.932361
Minibatch iteration 407/48400: mean batch inertia: 0.945069, ewa inertia: 0.932414
Minibatch iteration 408/48400: mean batch inertia: 0.933589, ewa inertia: 0.932419
Minibatch iteration 409/48400: mean batch inertia: 0.894230, ewa inertia: 0.932261
Minibatch iteration 410/48400: mean batch inertia: 0.918712, ewa inertia: 0.932205
Minibatch iteration 411/48400: mean batch inertia: 0.927051, ewa inertia: 0.932184
Minibatch iteration 412/48400: mean batch inertia: 0.909394, ewa inertia: 0.932089
Minibatch iteration 413/48400: mean batch inertia: 0.929544, ewa inertia: 0.932079
Minibatch iteration 414/48400: mean batch inertia: 0.920395, ewa inertia: 0.932031
Minibatch iteration 415/48400: mean batch inertia: 0.939392, ewa inertia: 0.932061
Minibatch iteration 416/48400: mean batch inertia: 0.906339, ewa inertia: 0.931955
Minibatch iteration 417/48400: mean batch inertia: 0.933265, ewa inertia: 0.931960
Minibatch iteration 418/48400: mean batch inertia: 0.908565, ewa inertia: 0.931863
Minibatch iteration 419/48400: mean batch inertia: 0.937418, ewa inertia: 0.931886
Minibatch iteration 420/48400: mean batch inertia: 0.927120, ewa inertia: 0.931867
Minibatch iteration 421/48400: mean batch inertia: 0.926977, ewa inertia: 0.931846
Minibatch iteration 422/48400: mean batch inertia: 0.928885, ewa inertia: 0.931834
Minibatch iteration 423/48400: mean batch inertia: 0.946805, ewa inertia: 0.931896
Minibatch iteration 424/48400: mean batch inertia: 0.913459, ewa inertia: 0.931820
Minibatch iteration 425/48400: mean batch inertia: 0.932817, ewa inertia: 0.931824
Minibatch iteration 426/48400: mean batch inertia: 0.925965, ewa inertia: 0.931800
Minibatch iteration 427/48400: mean batch inertia: 0.911593, ewa inertia: 0.931716
Minibatch iteration 428/48400: mean batch inertia: 0.926178, ewa inertia: 0.931693
Minibatch iteration 429/48400: mean batch inertia: 0.924158, ewa inertia: 0.931662
Minibatch iteration 430/48400: mean batch inertia: 0.935367, ewa inertia: 0.931677
Minibatch iteration 431/48400: mean batch inertia: 0.947981, ewa inertia: 0.931745
Minibatch iteration 432/48400: mean batch inertia: 0.931053, ewa inertia: 0.931742

Minibatch iteration 433/48400: mean batch inertia: 0.946371, ewa inertia: 0.931802
Minibatch iteration 434/48400: mean batch inertia: 0.926109, ewa inertia: 0.931779
Minibatch iteration 435/48400: mean batch inertia: 0.940492, ewa inertia: 0.931815
Minibatch iteration 436/48400: mean batch inertia: 0.929827, ewa inertia: 0.931807
Minibatch iteration 437/48400: mean batch inertia: 0.941370, ewa inertia: 0.931846
Minibatch iteration 438/48400: mean batch inertia: 0.917304, ewa inertia: 0.931786
Minibatch iteration 439/48400: mean batch inertia: 0.910125, ewa inertia: 0.931697
Converged (lack of improvement in inertia) at iteration 439/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 275.725058
Init 2/3 with method: k-means++
Inertia for init 2/3: 274.905831
Init 3/3 with method: k-means++
Inertia for init 3/3: 275.257271
Minibatch iteration 1/48400: mean batch inertia: 0.959982, ewa inertia: 0.959982
Minibatch iteration 2/48400: mean batch inertia: 0.954619, ewa inertia: 0.959960
Minibatch iteration 3/48400: mean batch inertia: 0.959724, ewa inertia: 0.959959
Minibatch iteration 4/48400: mean batch inertia: 0.954010, ewa inertia: 0.959935
Minibatch iteration 5/48400: mean batch inertia: 0.944193, ewa inertia: 0.959869
Minibatch iteration 6/48400: mean batch inertia: 0.937248, ewa inertia: 0.959776
Minibatch iteration 7/48400: mean batch inertia: 0.947198, ewa inertia: 0.959724
Minibatch iteration 8/48400: mean batch inertia: 0.934877, ewa inertia: 0.959621
Minibatch iteration 9/48400: mean batch inertia: 0.936526, ewa inertia: 0.959526
Minibatch iteration 10/48400: mean batch inertia: 0.951222, ewa inertia: 0.959491
Minibatch iteration 11/48400: mean batch inertia: 0.939678, ewa inertia: 0.959409
Minibatch iteration 12/48400: mean batch inertia: 0.929321, ewa inertia: 0.959285
Minibatch iteration 13/48400: mean batch inertia: 0.946914, ewa inertia: 0.959234
Minibatch iteration 14/48400: mean batch inertia: 0.936907, ewa inertia: 0.959142
Minibatch iteration 15/48400: mean batch inertia: 0.945017, ewa inertia: 0.959083
Minibatch iteration 16/48400: mean batch inertia: 0.931639, ewa inertia: 0.958970
Minibatch iteration 17/48400: mean batch inertia: 0.944551, ewa inertia: 0.958910
Minibatch iteration 18/48400: mean batch inertia: 0.927157, ewa inertia:

a: 0.958779
Minibatch iteration 19/48400: mean batch inertia: 0.918540, ewa inertia: 0.958613
Minibatch iteration 20/48400: mean batch inertia: 0.939839, ewa inertia: 0.958535
Minibatch iteration 21/48400: mean batch inertia: 0.938742, ewa inertia: 0.958453
Minibatch iteration 22/48400: mean batch inertia: 0.925451, ewa inertia: 0.958317
Minibatch iteration 23/48400: mean batch inertia: 0.941563, ewa inertia: 0.958247
Minibatch iteration 24/48400: mean batch inertia: 0.934528, ewa inertia: 0.958149
Minibatch iteration 25/48400: mean batch inertia: 0.940339, ewa inertia: 0.958076
Minibatch iteration 26/48400: mean batch inertia: 0.931107, ewa inertia: 0.957964
Minibatch iteration 27/48400: mean batch inertia: 0.937694, ewa inertia: 0.957880
Minibatch iteration 28/48400: mean batch inertia: 0.949548, ewa inertia: 0.957846
Minibatch iteration 29/48400: mean batch inertia: 0.930887, ewa inertia: 0.957734
Minibatch iteration 30/48400: mean batch inertia: 0.936832, ewa inertia: 0.957648
Minibatch iteration 31/48400: mean batch inertia: 0.925360, ewa inertia: 0.957515
Minibatch iteration 32/48400: mean batch inertia: 0.941616, ewa inertia: 0.957449
Minibatch iteration 33/48400: mean batch inertia: 0.928374, ewa inertia: 0.957329
Minibatch iteration 34/48400: mean batch inertia: 0.936227, ewa inertia: 0.957241
Minibatch iteration 35/48400: mean batch inertia: 0.937819, ewa inertia: 0.957161
Minibatch iteration 36/48400: mean batch inertia: 0.920283, ewa inertia: 0.957009
Minibatch iteration 37/48400: mean batch inertia: 0.914021, ewa inertia: 0.956831
Minibatch iteration 38/48400: mean batch inertia: 0.944137, ewa inertia: 0.956778
Minibatch iteration 39/48400: mean batch inertia: 0.922704, ewa inertia: 0.956638
Minibatch iteration 40/48400: mean batch inertia: 0.939236, ewa inertia: 0.956566
Minibatch iteration 41/48400: mean batch inertia: 0.928680, ewa inertia: 0.956450
Minibatch iteration 42/48400: mean batch inertia: 0.926116, ewa inertia: 0.956325
Minibatch iteration 43/48400: mean batch inertia: 0.932246, ewa inertia: 0.956225
Minibatch iteration 44/48400: mean batch inertia: 0.935966, ewa inertia: 0.956142
Minibatch iteration 45/48400: mean batch inertia: 0.945761, ewa inertia: 0.956099
Minibatch iteration 46/48400: mean batch inertia: 0.930849, ewa inertia: 0.955994

Minibatch iteration 47/48400: mean batch inertia: 0.938928, ewa inertia: 0.955924
Minibatch iteration 48/48400: mean batch inertia: 0.922609, ewa inertia: 0.955786
Minibatch iteration 49/48400: mean batch inertia: 0.925153, ewa inertia: 0.955659
Minibatch iteration 50/48400: mean batch inertia: 0.926084, ewa inertia: 0.955537
Minibatch iteration 51/48400: mean batch inertia: 0.929896, ewa inertia: 0.955431
Minibatch iteration 52/48400: mean batch inertia: 0.936450, ewa inertia: 0.955353
Minibatch iteration 53/48400: mean batch inertia: 0.933758, ewa inertia: 0.955263
Minibatch iteration 54/48400: mean batch inertia: 0.922712, ewa inertia: 0.955129
Minibatch iteration 55/48400: mean batch inertia: 0.925472, ewa inertia: 0.955006
Minibatch iteration 56/48400: mean batch inertia: 0.927688, ewa inertia: 0.954893
Minibatch iteration 57/48400: mean batch inertia: 0.928998, ewa inertia: 0.954786
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Minibatch iteration 60/48400: mean batch inertia: 0.936219, ewa inertia: 0.954541
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Minibatch iteration 62/48400: mean batch inertia: 0.921401, ewa inertia: 0.954371
Minibatch iteration 63/48400: mean batch inertia: 0.926696, ewa inertia: 0.954257
Minibatch iteration 64/48400: mean batch inertia: 0.931571, ewa inertia: 0.954163
Minibatch iteration 65/48400: mean batch inertia: 0.930067, ewa inertia: 0.954063
Minibatch iteration 66/48400: mean batch inertia: 0.932949, ewa inertia: 0.953976
Minibatch iteration 67/48400: mean batch inertia: 0.938107, ewa inertia: 0.953910
Minibatch iteration 68/48400: mean batch inertia: 0.923420, ewa inertia: 0.953784
Minibatch iteration 69/48400: mean batch inertia: 0.946472, ewa inertia: 0.953754
Minibatch iteration 70/48400: mean batch inertia: 0.939269, ewa inertia: 0.953694
Minibatch iteration 71/48400: mean batch inertia: 0.929806, ewa inertia: 0.953595
Minibatch iteration 72/48400: mean batch inertia: 0.929544, ewa inertia: 0.953496
Minibatch iteration 73/48400: mean batch inertia: 0.921899, ewa inertia: 0.953365
Minibatch iteration 74/48400: mean batch inertia: 0.928327, ewa inertia: 0.953262
Minibatch iteration 75/48400: mean batch inertia: 0.942881, ewa inertia:

a: 0.953219
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Minibatch iteration 77/48400: mean batch inertia: 0.930293, ewa inertia: 0.953090
Minibatch iteration 78/48400: mean batch inertia: 0.935565, ewa inertia: 0.953017
Minibatch iteration 79/48400: mean batch inertia: 0.926201, ewa inertia: 0.952906
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Minibatch iteration 83/48400: mean batch inertia: 0.930555, ewa inertia: 0.952667
Minibatch iteration 84/48400: mean batch inertia: 0.942183, ewa inertia: 0.952624
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Minibatch iteration 87/48400: mean batch inertia: 0.917590, ewa inertia: 0.952297
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Minibatch iteration 93/48400: mean batch inertia: 0.946938, ewa inertia: 0.951939
Minibatch iteration 94/48400: mean batch inertia: 0.923472, ewa inertia: 0.951821
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Minibatch iteration 103/48400: mean batch inertia: 0.936267, ewa inertia: 0.951162

Minibatch iteration 104/48400: mean batch inertia: 0.932466, ewa inertia: 0.951085
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Minibatch iteration 106/48400: mean batch inertia: 0.931670, ewa inertia: 0.950964
Minibatch iteration 107/48400: mean batch inertia: 0.942523, ewa inertia: 0.950930
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Minibatch iteration 109/48400: mean batch inertia: 0.928424, ewa inertia: 0.950757
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Minibatch iteration 142/48400: mean batch inertia: 0.924287, ewa inertia: 0.948051
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Minibatch iteration 148/48400: mean batch inertia: 0.935021, ewa inertia: 0.947611
Minibatch iteration 149/48400: mean batch inertia: 0.925191, ewa inertia: 0.947518
Minibatch iteration 150/48400: mean batch inertia: 0.936303, ewa inertia: 0.947472
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Minibatch iteration 152/48400: mean batch inertia: 0.933818, ewa inertia: 0.947316
Minibatch iteration 153/48400: mean batch inertia: 0.929224, ewa inertia: 0.947241
Minibatch iteration 154/48400: mean batch inertia: 0.924011, ewa inertia: 0.947145
Minibatch iteration 155/48400: mean batch inertia: 0.926844, ewa inertia: 0.947061
Minibatch iteration 156/48400: mean batch inertia: 0.936896, ewa inertia: 0.947019
Minibatch iteration 157/48400: mean batch inertia: 0.937784, ewa inertia: 0.946981
Minibatch iteration 158/48400: mean batch inertia: 0.922292, ewa inertia: 0.946879
Minibatch iteration 159/48400: mean batch inertia: 0.942500, ewa inertia: 0.946861
Minibatch iteration 160/48400: mean batch inertia: 0.924719, ewa inertia: 0.946769

Minibatch iteration 161/48400: mean batch inertia: 0.934720, ewa inertia: 0.946719
Minibatch iteration 162/48400: mean batch inertia: 0.934300, ewa inertia: 0.946668
Minibatch iteration 163/48400: mean batch inertia: 0.947300, ewa inertia: 0.946671
Minibatch iteration 164/48400: mean batch inertia: 0.925112, ewa inertia: 0.946581
Minibatch iteration 165/48400: mean batch inertia: 0.923721, ewa inertia: 0.946487
Minibatch iteration 166/48400: mean batch inertia: 0.933885, ewa inertia: 0.946435
Minibatch iteration 167/48400: mean batch inertia: 0.933070, ewa inertia: 0.946380
Minibatch iteration 168/48400: mean batch inertia: 0.945708, ewa inertia: 0.946377
Minibatch iteration 169/48400: mean batch inertia: 0.940264, ewa inertia: 0.946351
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Minibatch iteration 171/48400: mean batch inertia: 0.927885, ewa inertia: 0.946220
Minibatch iteration 172/48400: mean batch inertia: 0.938030, ewa inertia: 0.946186
Minibatch iteration 173/48400: mean batch inertia: 0.910593, ewa inertia: 0.946039
Minibatch iteration 174/48400: mean batch inertia: 0.931557, ewa inertia: 0.945979
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Minibatch iteration 177/48400: mean batch inertia: 0.940008, ewa inertia: 0.945888
Minibatch iteration 178/48400: mean batch inertia: 0.908169, ewa inertia: 0.945732
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Minibatch iteration 453/48400: mean batch inertia: 0.905689, ewa inertia: 0.932162
Minibatch iteration 454/48400: mean batch inertia: 0.922196, ewa inertia: 0.932121
Minibatch iteration 455/48400: mean batch inertia: 0.940306, ewa inertia: 0.932155
Minibatch iteration 456/48400: mean batch inertia: 0.903341, ewa inertia: 0.932036
Minibatch iteration 457/48400: mean batch inertia: 0.925906, ewa inertia: 0.932011
Minibatch iteration 458/48400: mean batch inertia: 0.928583, ewa inertia: 0.931996
Minibatch iteration 459/48400: mean batch inertia: 0.936183, ewa inertia: 0.932014
Minibatch iteration 460/48400: mean batch inertia: 0.934070, ewa inertia: 0.932022
Minibatch iteration 461/48400: mean batch inertia: 0.918795, ewa inertia: 0.931967
Minibatch iteration 462/48400: mean batch inertia: 0.903696, ewa inertia: 0.931851
Minibatch iteration 463/48400: mean batch inertia: 0.918807, ewa inertia: 0.931797
Minibatch iteration 464/48400: mean batch inertia: 0.925888, ewa inertia: 0.931772
Minibatch iteration 465/48400: mean batch inertia: 0.928413, ewa inertia: 0.931758
Minibatch iteration 466/48400: mean batch inertia: 0.925138, ewa inertia: 0.931731
Minibatch iteration 467/48400: mean batch inertia: 0.921924, ewa inertia: 0.931690
Minibatch iteration 468/48400: mean batch inertia: 0.927465, ewa inertia: 0.931673
Minibatch iteration 469/48400: mean batch inertia: 0.916441, ewa inertia: 0.931610
Minibatch iteration 470/48400: mean batch inertia: 0.922360, ewa inertia: 0.931572
Minibatch iteration 471/48400: mean batch inertia: 0.934572, ewa inertia: 0.931584
Minibatch iteration 472/48400: mean batch inertia: 0.935305, ewa inertia: 0.931600
Minibatch iteration 473/48400: mean batch inertia: 0.926163, ewa inertia: 0.931577
Minibatch iteration 474/48400: mean batch inertia: 0.908420, ewa inertia:

a: 0.931481
Minibatch iteration 475/48400: mean batch inertia: 0.927830, ewa inertia: 0.931466
Minibatch iteration 476/48400: mean batch inertia: 0.943627, ewa inertia: 0.931517
Minibatch iteration 477/48400: mean batch inertia: 0.933527, ewa inertia: 0.931525
Minibatch iteration 478/48400: mean batch inertia: 0.925921, ewa inertia: 0.931502
Minibatch iteration 479/48400: mean batch inertia: 0.928257, ewa inertia: 0.931488
Minibatch iteration 480/48400: mean batch inertia: 0.938031, ewa inertia: 0.931515
Minibatch iteration 481/48400: mean batch inertia: 0.918211, ewa inertia: 0.931460
Minibatch iteration 482/48400: mean batch inertia: 0.915095, ewa inertia: 0.931393
Minibatch iteration 483/48400: mean batch inertia: 0.926512, ewa inertia: 0.931372
Minibatch iteration 484/48400: mean batch inertia: 0.928466, ewa inertia: 0.931360
Minibatch iteration 485/48400: mean batch inertia: 0.929760, ewa inertia: 0.931354
Minibatch iteration 486/48400: mean batch inertia: 0.933210, ewa inertia: 0.931361
Minibatch iteration 487/48400: mean batch inertia: 0.920508, ewa inertia: 0.931317
Minibatch iteration 488/48400: mean batch inertia: 0.921800, ewa inertia: 0.931277
Minibatch iteration 489/48400: mean batch inertia: 0.934240, ewa inertia: 0.931290
Minibatch iteration 490/48400: mean batch inertia: 0.939106, ewa inertia: 0.931322
Minibatch iteration 491/48400: mean batch inertia: 0.929958, ewa inertia: 0.931316
Minibatch iteration 492/48400: mean batch inertia: 0.927695, ewa inertia: 0.931301
Minibatch iteration 493/48400: mean batch inertia: 0.932854, ewa inertia: 0.931308
Minibatch iteration 494/48400: mean batch inertia: 0.939148, ewa inertia: 0.931340
Minibatch iteration 495/48400: mean batch inertia: 0.928652, ewa inertia: 0.931329
Minibatch iteration 496/48400: mean batch inertia: 0.934713, ewa inertia: 0.931343
Minibatch iteration 497/48400: mean batch inertia: 0.932599, ewa inertia: 0.931348
Minibatch iteration 498/48400: mean batch inertia: 0.927508, ewa inertia: 0.931332
Converged (lack of improvement in inertia) at iteration 498/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 276.888962
Init 2/3 with method: k-means++
Inertia for init 2/3: 275.894545
Init 3/3 with method: k-means++
Inertia for init 3/3: 275.657503

Minibatch iteration 1/48400: mean batch inertia: 0.961834, ewa inertia: 0.961834
Minibatch iteration 2/48400: mean batch inertia: 0.958356, ewa inertia: 0.961820
Minibatch iteration 3/48400: mean batch inertia: 0.950589, ewa inertia: 0.961774
Minibatch iteration 4/48400: mean batch inertia: 0.946361, ewa inertia: 0.961710
Minibatch iteration 5/48400: mean batch inertia: 0.947989, ewa inertia: 0.961653
Minibatch iteration 6/48400: mean batch inertia: 0.936447, ewa inertia: 0.961549
Minibatch iteration 7/48400: mean batch inertia: 0.939164, ewa inertia: 0.961456
Minibatch iteration 8/48400: mean batch inertia: 0.942532, ewa inertia: 0.961378
Minibatch iteration 9/48400: mean batch inertia: 0.939385, ewa inertia: 0.961287
Minibatch iteration 10/48400: mean batch inertia: 0.943216, ewa inertia: 0.961213
Minibatch iteration 11/48400: mean batch inertia: 0.940187, ewa inertia: 0.961126
Minibatch iteration 12/48400: mean batch inertia: 0.942121, ewa inertia: 0.961047
Minibatch iteration 13/48400: mean batch inertia: 0.951776, ewa inertia: 0.961009
Minibatch iteration 14/48400: mean batch inertia: 0.935889, ewa inertia: 0.960905
Minibatch iteration 15/48400: mean batch inertia: 0.936387, ewa inertia: 0.960803
Minibatch iteration 16/48400: mean batch inertia: 0.918016, ewa inertia: 0.960627
Minibatch iteration 17/48400: mean batch inertia: 0.948697, ewa inertia: 0.960577
Minibatch iteration 18/48400: mean batch inertia: 0.916583, ewa inertia: 0.960395
Minibatch iteration 19/48400: mean batch inertia: 0.939491, ewa inertia: 0.960309
Minibatch iteration 20/48400: mean batch inertia: 0.941388, ewa inertia: 0.960231
Minibatch iteration 21/48400: mean batch inertia: 0.933932, ewa inertia: 0.960122
Minibatch iteration 22/48400: mean batch inertia: 0.915608, ewa inertia: 0.959938
Minibatch iteration 23/48400: mean batch inertia: 0.948387, ewa inertia: 0.959890
Minibatch iteration 24/48400: mean batch inertia: 0.936552, ewa inertia: 0.959794
Minibatch iteration 25/48400: mean batch inertia: 0.941135, ewa inertia: 0.959717
Minibatch iteration 26/48400: mean batch inertia: 0.934144, ewa inertia: 0.959611
Minibatch iteration 27/48400: mean batch inertia: 0.925031, ewa inertia: 0.959468
Minibatch iteration 28/48400: mean batch inertia: 0.925664, ewa inertia: 0.959328
Minibatch iteration 29/48400: mean batch inertia: 0.925592, ewa inertia:

a: 0.959189
Minibatch iteration 30/48400: mean batch inertia: 0.937535, ewa inertia: 0.959099
Minibatch iteration 31/48400: mean batch inertia: 0.934785, ewa inertia: 0.958999
Minibatch iteration 32/48400: mean batch inertia: 0.934437, ewa inertia: 0.958897
Minibatch iteration 33/48400: mean batch inertia: 0.938751, ewa inertia: 0.958814
Minibatch iteration 34/48400: mean batch inertia: 0.929269, ewa inertia: 0.958692
Minibatch iteration 35/48400: mean batch inertia: 0.914622, ewa inertia: 0.958509
Minibatch iteration 36/48400: mean batch inertia: 0.922881, ewa inertia: 0.958362
Minibatch iteration 37/48400: mean batch inertia: 0.921370, ewa inertia: 0.958209
Minibatch iteration 38/48400: mean batch inertia: 0.924978, ewa inertia: 0.958072
Minibatch iteration 39/48400: mean batch inertia: 0.927366, ewa inertia: 0.957945
Minibatch iteration 40/48400: mean batch inertia: 0.919237, ewa inertia: 0.957785
Minibatch iteration 41/48400: mean batch inertia: 0.920865, ewa inertia: 0.957632
Minibatch iteration 42/48400: mean batch inertia: 0.921872, ewa inertia: 0.957484
Minibatch iteration 43/48400: mean batch inertia: 0.935208, ewa inertia: 0.957392
Minibatch iteration 44/48400: mean batch inertia: 0.926918, ewa inertia: 0.957266
Minibatch iteration 45/48400: mean batch inertia: 0.926621, ewa inertia: 0.957140
Minibatch iteration 46/48400: mean batch inertia: 0.918225, ewa inertia: 0.956979
Minibatch iteration 47/48400: mean batch inertia: 0.936215, ewa inertia: 0.956893
Minibatch iteration 48/48400: mean batch inertia: 0.931784, ewa inertia: 0.956789
Minibatch iteration 49/48400: mean batch inertia: 0.940607, ewa inertia: 0.956722
Minibatch iteration 50/48400: mean batch inertia: 0.903886, ewa inertia: 0.956504
Minibatch iteration 51/48400: mean batch inertia: 0.924071, ewa inertia: 0.956370
Minibatch iteration 52/48400: mean batch inertia: 0.911766, ewa inertia: 0.956185
Minibatch iteration 53/48400: mean batch inertia: 0.921410, ewa inertia: 0.956041
Minibatch iteration 54/48400: mean batch inertia: 0.926651, ewa inertia: 0.955920
Minibatch iteration 55/48400: mean batch inertia: 0.933637, ewa inertia: 0.955828
Minibatch iteration 56/48400: mean batch inertia: 0.908402, ewa inertia: 0.955632
Minibatch iteration 57/48400: mean batch inertia: 0.911838, ewa inertia: 0.955451

Minibatch iteration 58/48400: mean batch inertia: 0.946632, ewa inertia: 0.955414
Minibatch iteration 59/48400: mean batch inertia: 0.919500, ewa inertia: 0.955266
Minibatch iteration 60/48400: mean batch inertia: 0.928079, ewa inertia: 0.955153
Minibatch iteration 61/48400: mean batch inertia: 0.923566, ewa inertia: 0.955023
Minibatch iteration 62/48400: mean batch inertia: 0.913852, ewa inertia: 0.954853
Minibatch iteration 63/48400: mean batch inertia: 0.934321, ewa inertia: 0.954768
Minibatch iteration 64/48400: mean batch inertia: 0.935418, ewa inertia: 0.954688
Minibatch iteration 65/48400: mean batch inertia: 0.896999, ewa inertia: 0.954449
Minibatch iteration 66/48400: mean batch inertia: 0.925605, ewa inertia: 0.954330
Minibatch iteration 67/48400: mean batch inertia: 0.931725, ewa inertia: 0.954236
Minibatch iteration 68/48400: mean batch inertia: 0.941584, ewa inertia: 0.954184
Minibatch iteration 69/48400: mean batch inertia: 0.922679, ewa inertia: 0.954054
Minibatch iteration 70/48400: mean batch inertia: 0.907802, ewa inertia: 0.953863
Minibatch iteration 71/48400: mean batch inertia: 0.922693, ewa inertia: 0.953734
Minibatch iteration 72/48400: mean batch inertia: 0.917366, ewa inertia: 0.953583
Minibatch iteration 73/48400: mean batch inertia: 0.927156, ewa inertia: 0.953474
Minibatch iteration 74/48400: mean batch inertia: 0.922354, ewa inertia: 0.953346
Minibatch iteration 75/48400: mean batch inertia: 0.907873, ewa inertia: 0.953158
Minibatch iteration 76/48400: mean batch inertia: 0.932072, ewa inertia: 0.953070
Minibatch iteration 77/48400: mean batch inertia: 0.926184, ewa inertia: 0.952959
Minibatch iteration 78/48400: mean batch inertia: 0.921354, ewa inertia: 0.952829
Minibatch iteration 79/48400: mean batch inertia: 0.898938, ewa inertia: 0.952606
Minibatch iteration 80/48400: mean batch inertia: 0.926104, ewa inertia: 0.952496
Minibatch iteration 81/48400: mean batch inertia: 0.929117, ewa inertia: 0.952400
Minibatch iteration 82/48400: mean batch inertia: 0.931453, ewa inertia: 0.952313
Minibatch iteration 83/48400: mean batch inertia: 0.920055, ewa inertia: 0.952180
Minibatch iteration 84/48400: mean batch inertia: 0.933909, ewa inertia: 0.952104
Minibatch iteration 85/48400: mean batch inertia: 0.928985, ewa inertia: 0.952008
Minibatch iteration 86/48400: mean batch inertia: 0.934526, ewa inertia:

a: 0.951936
Minibatch iteration 87/48400: mean batch inertia: 0.923890, ewa inertia: 0.951820
Minibatch iteration 88/48400: mean batch inertia: 0.920519, ewa inertia: 0.951691
Minibatch iteration 89/48400: mean batch inertia: 0.917143, ewa inertia: 0.951548
Minibatch iteration 90/48400: mean batch inertia: 0.908741, ewa inertia: 0.951371
Minibatch iteration 91/48400: mean batch inertia: 0.947219, ewa inertia: 0.951354
Minibatch iteration 92/48400: mean batch inertia: 0.911663, ewa inertia: 0.951190
Minibatch iteration 93/48400: mean batch inertia: 0.932430, ewa inertia: 0.951112
Minibatch iteration 94/48400: mean batch inertia: 0.914764, ewa inertia: 0.950962
Minibatch iteration 95/48400: mean batch inertia: 0.934048, ewa inertia: 0.950892
Minibatch iteration 96/48400: mean batch inertia: 0.929742, ewa inertia: 0.950805
Minibatch iteration 97/48400: mean batch inertia: 0.927805, ewa inertia: 0.950709
Minibatch iteration 98/48400: mean batch inertia: 0.915565, ewa inertia: 0.950564
Minibatch iteration 99/48400: mean batch inertia: 0.923762, ewa inertia: 0.950453
Minibatch iteration 100/48400: mean batch inertia: 0.926920, ewa inertia: 0.950356
Minibatch iteration 101/48400: mean batch inertia: 0.923359, ewa inertia: 0.950244
Minibatch iteration 102/48400: mean batch inertia: 0.933481, ewa inertia: 0.950175
Minibatch iteration 103/48400: mean batch inertia: 0.918864, ewa inertia: 0.950046
Minibatch iteration 104/48400: mean batch inertia: 0.919396, ewa inertia: 0.949919
Minibatch iteration 105/48400: mean batch inertia: 0.927877, ewa inertia: 0.949828
Minibatch iteration 106/48400: mean batch inertia: 0.933716, ewa inertia: 0.949761
Minibatch iteration 107/48400: mean batch inertia: 0.915673, ewa inertia: 0.949620
Minibatch iteration 108/48400: mean batch inertia: 0.920267, ewa inertia: 0.949499
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Minibatch iteration 110/48400: mean batch inertia: 0.930071, ewa inertia: 0.949326
Minibatch iteration 111/48400: mean batch inertia: 0.923652, ewa inertia: 0.949220
Minibatch iteration 112/48400: mean batch inertia: 0.924916, ewa inertia: 0.949120
Minibatch iteration 113/48400: mean batch inertia: 0.899727, ewa inertia: 0.948916
Minibatch iteration 114/48400: mean batch inertia: 0.925517, ewa inertia: 0.948819

Minibatch iteration 115/48400: mean batch inertia: 0.928673, ewa inertia: 0.948736
Minibatch iteration 116/48400: mean batch inertia: 0.940673, ewa inertia: 0.948702
Minibatch iteration 117/48400: mean batch inertia: 0.900214, ewa inertia: 0.948502
Minibatch iteration 118/48400: mean batch inertia: 0.935465, ewa inertia: 0.948448
Minibatch iteration 119/48400: mean batch inertia: 0.915327, ewa inertia: 0.948311
Minibatch iteration 120/48400: mean batch inertia: 0.935192, ewa inertia: 0.948257
Minibatch iteration 121/48400: mean batch inertia: 0.910102, ewa inertia: 0.948099
Minibatch iteration 122/48400: mean batch inertia: 0.940336, ewa inertia: 0.948067
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Minibatch iteration 124/48400: mean batch inertia: 0.924054, ewa inertia: 0.947811
Minibatch iteration 125/48400: mean batch inertia: 0.922396, ewa inertia: 0.947705
Minibatch iteration 126/48400: mean batch inertia: 0.930802, ewa inertia: 0.947636
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Minibatch iteration 130/48400: mean batch inertia: 0.948467, ewa inertia: 0.947441
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Minibatch iteration 133/48400: mean batch inertia: 0.921473, ewa inertia: 0.947106
Minibatch iteration 134/48400: mean batch inertia: 0.930687, ewa inertia: 0.947038
Minibatch iteration 135/48400: mean batch inertia: 0.908765, ewa inertia: 0.946880
Minibatch iteration 136/48400: mean batch inertia: 0.930420, ewa inertia: 0.946812
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Minibatch iteration 138/48400: mean batch inertia: 0.926216, ewa inertia: 0.946670
Minibatch iteration 139/48400: mean batch inertia: 0.902164, ewa inertia: 0.946486
Minibatch iteration 140/48400: mean batch inertia: 0.914863, ewa inertia: 0.946356
Minibatch iteration 141/48400: mean batch inertia: 0.916888, ewa inertia: 0.946234
Minibatch iteration 142/48400: mean batch inertia: 0.921697, ewa inertia: 0.946132
Minibatch iteration 143/48400: mean batch inertia: 0.934683, ewa inertia:

a: 0.946085
Minibatch iteration 144/48400: mean batch inertia: 0.931385, ewa inertia: 0.946024
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Minibatch iteration 146/48400: mean batch inertia: 0.931956, ewa inertia: 0.945916
Minibatch iteration 147/48400: mean batch inertia: 0.909014, ewa inertia: 0.945764
Minibatch iteration 148/48400: mean batch inertia: 0.932171, ewa inertia: 0.945708
Minibatch iteration 149/48400: mean batch inertia: 0.923841, ewa inertia: 0.945617
Minibatch iteration 150/48400: mean batch inertia: 0.925791, ewa inertia: 0.945535
Minibatch iteration 151/48400: mean batch inertia: 0.925978, ewa inertia: 0.945454
Minibatch iteration 152/48400: mean batch inertia: 0.923902, ewa inertia: 0.945365
Minibatch iteration 153/48400: mean batch inertia: 0.940595, ewa inertia: 0.945346
Minibatch iteration 154/48400: mean batch inertia: 0.926457, ewa inertia: 0.945267
Minibatch iteration 155/48400: mean batch inertia: 0.937713, ewa inertia: 0.945236
Minibatch iteration 156/48400: mean batch inertia: 0.917902, ewa inertia: 0.945123
Minibatch iteration 157/48400: mean batch inertia: 0.939603, ewa inertia: 0.945100
Minibatch iteration 158/48400: mean batch inertia: 0.903718, ewa inertia: 0.944929
Minibatch iteration 159/48400: mean batch inertia: 0.928496, ewa inertia: 0.944861
Minibatch iteration 160/48400: mean batch inertia: 0.933209, ewa inertia: 0.944813
Minibatch iteration 161/48400: mean batch inertia: 0.918185, ewa inertia: 0.944703
Minibatch iteration 162/48400: mean batch inertia: 0.941864, ewa inertia: 0.944691
Minibatch iteration 163/48400: mean batch inertia: 0.927394, ewa inertia: 0.944620
Minibatch iteration 164/48400: mean batch inertia: 0.932578, ewa inertia: 0.944570
Minibatch iteration 165/48400: mean batch inertia: 0.918483, ewa inertia: 0.944462
Minibatch iteration 166/48400: mean batch inertia: 0.937932, ewa inertia: 0.944435
Minibatch iteration 167/48400: mean batch inertia: 0.930089, ewa inertia: 0.944376
Minibatch iteration 168/48400: mean batch inertia: 0.910573, ewa inertia: 0.944236
Minibatch iteration 169/48400: mean batch inertia: 0.918679, ewa inertia: 0.944130
Minibatch iteration 170/48400: mean batch inertia: 0.932573, ewa inertia: 0.944083
Minibatch iteration 171/48400: mean batch inertia: 0.921720, ewa inertia: 0.943990

Minibatch iteration 172/48400: mean batch inertia: 0.931142, ewa inertia: 0.943937
Minibatch iteration 173/48400: mean batch inertia: 0.924110, ewa inertia: 0.943855
Minibatch iteration 174/48400: mean batch inertia: 0.894935, ewa inertia: 0.943653
Minibatch iteration 175/48400: mean batch inertia: 0.905521, ewa inertia: 0.943495
Minibatch iteration 176/48400: mean batch inertia: 0.942160, ewa inertia: 0.943490
Minibatch iteration 177/48400: mean batch inertia: 0.919608, ewa inertia: 0.943391
Minibatch iteration 178/48400: mean batch inertia: 0.929263, ewa inertia: 0.943333
Minibatch iteration 179/48400: mean batch inertia: 0.937478, ewa inertia: 0.943308
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Minibatch iteration 181/48400: mean batch inertia: 0.935131, ewa inertia: 0.943169
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Minibatch iteration 183/48400: mean batch inertia: 0.909689, ewa inertia: 0.942991
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Minibatch iteration 185/48400: mean batch inertia: 0.924753, ewa inertia: 0.942881
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Minibatch iteration 187/48400: mean batch inertia: 0.936149, ewa inertia: 0.942816
Minibatch iteration 188/48400: mean batch inertia: 0.915750, ewa inertia: 0.942704
Minibatch iteration 189/48400: mean batch inertia: 0.922224, ewa inertia: 0.942619
Minibatch iteration 190/48400: mean batch inertia: 0.916306, ewa inertia: 0.942511
Minibatch iteration 191/48400: mean batch inertia: 0.923147, ewa inertia: 0.942431
Minibatch iteration 192/48400: mean batch inertia: 0.942202, ewa inertia: 0.942430
Minibatch iteration 193/48400: mean batch inertia: 0.918397, ewa inertia: 0.942330
Minibatch iteration 194/48400: mean batch inertia: 0.906291, ewa inertia: 0.942181
Minibatch iteration 195/48400: mean batch inertia: 0.931403, ewa inertia: 0.942137
Minibatch iteration 196/48400: mean batch inertia: 0.919881, ewa inertia: 0.942045
Minibatch iteration 197/48400: mean batch inertia: 0.931275, ewa inertia: 0.942000
Minibatch iteration 198/48400: mean batch inertia: 0.913808, ewa inertia: 0.941884
Minibatch iteration 199/48400: mean batch inertia: 0.912235, ewa inertia: 0.941761
Minibatch iteration 200/48400: mean batch inertia: 0.909079, ewa inertia:

a: 0.941626
Minibatch iteration 201/48400: mean batch inertia: 0.924497, ewa inertia: 0.941555
Minibatch iteration 202/48400: mean batch inertia: 0.922928, ewa inertia: 0.941478
Minibatch iteration 203/48400: mean batch inertia: 0.928119, ewa inertia: 0.941423
Minibatch iteration 204/48400: mean batch inertia: 0.919838, ewa inertia: 0.941334
Minibatch iteration 205/48400: mean batch inertia: 0.915369, ewa inertia: 0.941226
Minibatch iteration 206/48400: mean batch inertia: 0.928495, ewa inertia: 0.941174
Minibatch iteration 207/48400: mean batch inertia: 0.921935, ewa inertia: 0.941094
Minibatch iteration 208/48400: mean batch inertia: 0.924642, ewa inertia: 0.941026
Minibatch iteration 209/48400: mean batch inertia: 0.926985, ewa inertia: 0.940968
Minibatch iteration 210/48400: mean batch inertia: 0.934686, ewa inertia: 0.940942
Minibatch iteration 211/48400: mean batch inertia: 0.917491, ewa inertia: 0.940845
Minibatch iteration 212/48400: mean batch inertia: 0.937072, ewa inertia: 0.940830
Minibatch iteration 213/48400: mean batch inertia: 0.931821, ewa inertia: 0.940792
Minibatch iteration 214/48400: mean batch inertia: 0.907877, ewa inertia: 0.940656
Minibatch iteration 215/48400: mean batch inertia: 0.925041, ewa inertia: 0.940592
Minibatch iteration 216/48400: mean batch inertia: 0.929017, ewa inertia: 0.940544
Minibatch iteration 217/48400: mean batch inertia: 0.927042, ewa inertia: 0.940488
Minibatch iteration 218/48400: mean batch inertia: 0.930679, ewa inertia: 0.940447
Minibatch iteration 219/48400: mean batch inertia: 0.925669, ewa inertia: 0.940386
Minibatch iteration 220/48400: mean batch inertia: 0.922922, ewa inertia: 0.940314
Minibatch iteration 221/48400: mean batch inertia: 0.926036, ewa inertia: 0.940255
Minibatch iteration 222/48400: mean batch inertia: 0.923553, ewa inertia: 0.940186
Minibatch iteration 223/48400: mean batch inertia: 0.910853, ewa inertia: 0.940065
Minibatch iteration 224/48400: mean batch inertia: 0.927353, ewa inertia: 0.940012
Minibatch iteration 225/48400: mean batch inertia: 0.931172, ewa inertia: 0.939976
Minibatch iteration 226/48400: mean batch inertia: 0.935336, ewa inertia: 0.939957
Minibatch iteration 227/48400: mean batch inertia: 0.926950, ewa inertia: 0.939903
Minibatch iteration 228/48400: mean batch inertia: 0.905567, ewa inertia: 0.939761

Minibatch iteration 229/48400: mean batch inertia: 0.929668, ewa inertia: 0.939719
Minibatch iteration 230/48400: mean batch inertia: 0.926859, ewa inertia: 0.939666
Minibatch iteration 231/48400: mean batch inertia: 0.914785, ewa inertia: 0.939563
Minibatch iteration 232/48400: mean batch inertia: 0.923405, ewa inertia: 0.939496
Minibatch iteration 233/48400: mean batch inertia: 0.934112, ewa inertia: 0.939474
Minibatch iteration 234/48400: mean batch inertia: 0.914537, ewa inertia: 0.939371
Minibatch iteration 235/48400: mean batch inertia: 0.917284, ewa inertia: 0.939280
Minibatch iteration 236/48400: mean batch inertia: 0.898597, ewa inertia: 0.939111
Minibatch iteration 237/48400: mean batch inertia: 0.922238, ewa inertia: 0.939042
Minibatch iteration 238/48400: mean batch inertia: 0.938427, ewa inertia: 0.939039
Minibatch iteration 239/48400: mean batch inertia: 0.944118, ewa inertia: 0.939060
Minibatch iteration 240/48400: mean batch inertia: 0.901679, ewa inertia: 0.938906
Minibatch iteration 241/48400: mean batch inertia: 0.938738, ewa inertia: 0.938905
Minibatch iteration 242/48400: mean batch inertia: 0.927130, ewa inertia: 0.938856
Minibatch iteration 243/48400: mean batch inertia: 0.917520, ewa inertia: 0.938768
Minibatch iteration 244/48400: mean batch inertia: 0.910102, ewa inertia: 0.938649
Minibatch iteration 245/48400: mean batch inertia: 0.932316, ewa inertia: 0.938623
Minibatch iteration 246/48400: mean batch inertia: 0.913870, ewa inertia: 0.938521
Minibatch iteration 247/48400: mean batch inertia: 0.939697, ewa inertia: 0.938526
Minibatch iteration 248/48400: mean batch inertia: 0.918104, ewa inertia: 0.938441
Minibatch iteration 249/48400: mean batch inertia: 0.926082, ewa inertia: 0.938390
Minibatch iteration 250/48400: mean batch inertia: 0.910085, ewa inertia: 0.938273
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Minibatch iteration 253/48400: mean batch inertia: 0.922995, ewa inertia: 0.938109
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Minibatch iteration 255/48400: mean batch inertia: 0.917776, ewa inertia: 0.938044
Minibatch iteration 256/48400: mean batch inertia: 0.930325, ewa inertia: 0.938012
Minibatch iteration 257/48400: mean batch inertia: 0.933584, ewa inertia:

a: 0.937994
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Minibatch iteration 263/48400: mean batch inertia: 0.919643, ewa inertia: 0.937732
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Minibatch iteration 269/48400: mean batch inertia: 0.909837, ewa inertia: 0.937291
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Minibatch iteration 273/48400: mean batch inertia: 0.910441, ewa inertia: 0.937119
Minibatch iteration 274/48400: mean batch inertia: 0.929888, ewa inertia: 0.937089
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a: 0.935290
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Minibatch iteration 348/48400: mean batch inertia: 0.926680, ewa inertia: 0.933801
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Minibatch iteration 354/48400: mean batch inertia: 0.931789, ewa inertia: 0.933531
Minibatch iteration 355/48400: mean batch inertia: 0.932265, ewa inertia: 0.933525
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Minibatch iteration 359/48400: mean batch inertia: 0.919274, ewa inertia: 0.933401
Minibatch iteration 360/48400: mean batch inertia: 0.922522, ewa inertia: 0.933356
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Minibatch iteration 362/48400: mean batch inertia: 0.915216, ewa inertia: 0.933304
Minibatch iteration 363/48400: mean batch inertia: 0.943943, ewa inertia: 0.933348
Minibatch iteration 364/48400: mean batch inertia: 0.939847, ewa inertia: 0.933375
Minibatch iteration 365/48400: mean batch inertia: 0.938885, ewa inertia: 0.933398
Minibatch iteration 366/48400: mean batch inertia: 0.926809, ewa inertia: 0.933371
Minibatch iteration 367/48400: mean batch inertia: 0.936390, ewa inertia: 0.933383
Minibatch iteration 368/48400: mean batch inertia: 0.916581, ewa inertia: 0.933314
Minibatch iteration 369/48400: mean batch inertia: 0.924362, ewa inertia: 0.933277
Minibatch iteration 370/48400: mean batch inertia: 0.920023, ewa inertia: 0.933222
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a: 0.933163
Minibatch iteration 372/48400: mean batch inertia: 0.919934, ewa inertia: 0.933108
Minibatch iteration 373/48400: mean batch inertia: 0.938633, ewa inertia: 0.933131
Minibatch iteration 374/48400: mean batch inertia: 0.926707, ewa inertia: 0.933104
Minibatch iteration 375/48400: mean batch inertia: 0.913271, ewa inertia: 0.933022
Minibatch iteration 376/48400: mean batch inertia: 0.923678, ewa inertia: 0.932984
Minibatch iteration 377/48400: mean batch inertia: 0.929352, ewa inertia: 0.932969
Minibatch iteration 378/48400: mean batch inertia: 0.937958, ewa inertia: 0.932989
Minibatch iteration 379/48400: mean batch inertia: 0.928549, ewa inertia: 0.932971
Minibatch iteration 380/48400: mean batch inertia: 0.920122, ewa inertia: 0.932918
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Minibatch iteration 382/48400: mean batch inertia: 0.927460, ewa inertia: 0.932883
Minibatch iteration 383/48400: mean batch inertia: 0.938657, ewa inertia: 0.932907
Minibatch iteration 384/48400: mean batch inertia: 0.915719, ewa inertia: 0.932836
Minibatch iteration 385/48400: mean batch inertia: 0.936336, ewa inertia: 0.932850
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Minibatch iteration 388/48400: mean batch inertia: 0.927381, ewa inertia: 0.932733
Minibatch iteration 389/48400: mean batch inertia: 0.924502, ewa inertia: 0.932699
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Minibatch iteration 391/48400: mean batch inertia: 0.912951, ewa inertia: 0.932570
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Minibatch iteration 393/48400: mean batch inertia: 0.938384, ewa inertia: 0.932523
Minibatch iteration 394/48400: mean batch inertia: 0.934220, ewa inertia: 0.932530
Minibatch iteration 395/48400: mean batch inertia: 0.892514, ewa inertia: 0.932365
Minibatch iteration 396/48400: mean batch inertia: 0.908046, ewa inertia: 0.932264
Minibatch iteration 397/48400: mean batch inertia: 0.930996, ewa inertia: 0.932259
Minibatch iteration 398/48400: mean batch inertia: 0.934183, ewa inertia: 0.932267
Minibatch iteration 399/48400: mean batch inertia: 0.926708, ewa inertia: 0.932244

Minibatch iteration 400/48400: mean batch inertia: 0.906976, ewa inertia: 0.932140
Minibatch iteration 401/48400: mean batch inertia: 0.915361, ewa inertia: 0.932070
Minibatch iteration 402/48400: mean batch inertia: 0.914028, ewa inertia: 0.931996
Minibatch iteration 403/48400: mean batch inertia: 0.932100, ewa inertia: 0.931996
Minibatch iteration 404/48400: mean batch inertia: 0.933482, ewa inertia: 0.932002
Minibatch iteration 405/48400: mean batch inertia: 0.918511, ewa inertia: 0.931946
Minibatch iteration 406/48400: mean batch inertia: 0.943779, ewa inertia: 0.931995
Minibatch iteration 407/48400: mean batch inertia: 0.914160, ewa inertia: 0.931922
Minibatch iteration 408/48400: mean batch inertia: 0.919187, ewa inertia: 0.931869
Minibatch iteration 409/48400: mean batch inertia: 0.931192, ewa inertia: 0.931866
Minibatch iteration 410/48400: mean batch inertia: 0.931176, ewa inertia: 0.931863
Minibatch iteration 411/48400: mean batch inertia: 0.916408, ewa inertia: 0.931799
Minibatch iteration 412/48400: mean batch inertia: 0.917056, ewa inertia: 0.931739
Minibatch iteration 413/48400: mean batch inertia: 0.922420, ewa inertia: 0.931700
Minibatch iteration 414/48400: mean batch inertia: 0.920500, ewa inertia: 0.931654
Minibatch iteration 415/48400: mean batch inertia: 0.916936, ewa inertia: 0.931593
Minibatch iteration 416/48400: mean batch inertia: 0.937504, ewa inertia: 0.931617
Minibatch iteration 417/48400: mean batch inertia: 0.922716, ewa inertia: 0.931580
Minibatch iteration 418/48400: mean batch inertia: 0.934871, ewa inertia: 0.931594
Minibatch iteration 419/48400: mean batch inertia: 0.924659, ewa inertia: 0.931565
Minibatch iteration 420/48400: mean batch inertia: 0.917385, ewa inertia: 0.931507
Minibatch iteration 421/48400: mean batch inertia: 0.926800, ewa inertia: 0.931487
Minibatch iteration 422/48400: mean batch inertia: 0.934465, ewa inertia: 0.931500
Minibatch iteration 423/48400: mean batch inertia: 0.914848, ewa inertia: 0.931431
Minibatch iteration 424/48400: mean batch inertia: 0.924791, ewa inertia: 0.931403
Minibatch iteration 425/48400: mean batch inertia: 0.921685, ewa inertia: 0.931363
Minibatch iteration 426/48400: mean batch inertia: 0.939576, ewa inertia: 0.931397
Minibatch iteration 427/48400: mean batch inertia: 0.944445, ewa inertia: 0.931451
Minibatch iteration 428/48400: mean batch inertia: 0.929875, ewa inertia:

```
a: 0.931445
Minibatch iteration 429/48400: mean batch inertia: 0.949016, ewa inertia: 0.931517
Minibatch iteration 430/48400: mean batch inertia: 0.939855, ewa inertia: 0.931552
Minibatch iteration 431/48400: mean batch inertia: 0.932101, ewa inertia: 0.931554
Minibatch iteration 432/48400: mean batch inertia: 0.929370, ewa inertia: 0.931545
Minibatch iteration 433/48400: mean batch inertia: 0.924519, ewa inertia: 0.931516
Minibatch iteration 434/48400: mean batch inertia: 0.928190, ewa inertia: 0.931502
Minibatch iteration 435/48400: mean batch inertia: 0.918112, ewa inertia: 0.931447
Converged (lack of improvement in inertia) at iteration 435/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 274.570751
Init 2/3 with method: k-means++
Inertia for init 2/3: 273.980052
Init 3/3 with method: k-means++
Inertia for init 3/3: 274.547011
Minibatch iteration 1/48400: mean batch inertia: 0.956127, ewa inertia: 0.956127
Minibatch iteration 2/48400: mean batch inertia: 0.946790, ewa inertia: 0.956088
Minibatch iteration 3/48400: mean batch inertia: 0.945325, ewa inertia: 0.956044
Minibatch iteration 4/48400: mean batch inertia: 0.960318, ewa inertia: 0.956062
Minibatch iteration 5/48400: mean batch inertia: 0.943103, ewa inertia: 0.956008
Minibatch iteration 6/48400: mean batch inertia: 0.937138, ewa inertia: 0.955930
Minibatch iteration 7/48400: mean batch inertia: 0.929129, ewa inertia: 0.955819
Minibatch iteration 8/48400: mean batch inertia: 0.920292, ewa inertia: 0.955672
Minibatch iteration 9/48400: mean batch inertia: 0.936135, ewa inertia: 0.955592
Minibatch iteration 10/48400: mean batch inertia: 0.936983, ewa inertia: 0.955515
Minibatch iteration 11/48400: mean batch inertia: 0.941463, ewa inertia: 0.955457
Minibatch iteration 12/48400: mean batch inertia: 0.937448, ewa inertia: 0.955382
Minibatch iteration 13/48400: mean batch inertia: 0.932690, ewa inertia: 0.955288
Minibatch iteration 14/48400: mean batch inertia: 0.903056, ewa inertia: 0.955072
Minibatch iteration 15/48400: mean batch inertia: 0.927759, ewa inertia: 0.954959
Minibatch iteration 16/48400: mean batch inertia: 0.924527, ewa inertia: 0.954834
Minibatch iteration 17/48400: mean batch inertia: 0.927144, ewa inertia: 0.954719
```

Minibatch iteration 18/48400: mean batch inertia: 0.955795, ewa inertia: 0.954724
Minibatch iteration 19/48400: mean batch inertia: 0.938201, ewa inertia: 0.954655
Minibatch iteration 20/48400: mean batch inertia: 0.930015, ewa inertia: 0.954553
Minibatch iteration 21/48400: mean batch inertia: 0.929167, ewa inertia: 0.954448
Minibatch iteration 22/48400: mean batch inertia: 0.930182, ewa inertia: 0.954348
Minibatch iteration 23/48400: mean batch inertia: 0.940446, ewa inertia: 0.954291
Minibatch iteration 24/48400: mean batch inertia: 0.922379, ewa inertia: 0.954159
Minibatch iteration 25/48400: mean batch inertia: 0.946798, ewa inertia: 0.954128
Minibatch iteration 26/48400: mean batch inertia: 0.939386, ewa inertia: 0.954067
Minibatch iteration 27/48400: mean batch inertia: 0.925369, ewa inertia: 0.953949
Minibatch iteration 28/48400: mean batch inertia: 0.923666, ewa inertia: 0.953824
Minibatch iteration 29/48400: mean batch inertia: 0.925787, ewa inertia: 0.953708
Minibatch iteration 30/48400: mean batch inertia: 0.918754, ewa inertia: 0.953563
Minibatch iteration 31/48400: mean batch inertia: 0.921035, ewa inertia: 0.953429
Minibatch iteration 32/48400: mean batch inertia: 0.927654, ewa inertia: 0.953322
Minibatch iteration 33/48400: mean batch inertia: 0.921171, ewa inertia: 0.953189
Minibatch iteration 34/48400: mean batch inertia: 0.938430, ewa inertia: 0.953128
Minibatch iteration 35/48400: mean batch inertia: 0.937339, ewa inertia: 0.953063
Minibatch iteration 36/48400: mean batch inertia: 0.927323, ewa inertia: 0.952956
Minibatch iteration 37/48400: mean batch inertia: 0.933997, ewa inertia: 0.952878
Minibatch iteration 38/48400: mean batch inertia: 0.919273, ewa inertia: 0.952739
Minibatch iteration 39/48400: mean batch inertia: 0.927574, ewa inertia: 0.952635
Minibatch iteration 40/48400: mean batch inertia: 0.918527, ewa inertia: 0.952494
Minibatch iteration 41/48400: mean batch inertia: 0.928683, ewa inertia: 0.952396
Minibatch iteration 42/48400: mean batch inertia: 0.941155, ewa inertia: 0.952349
Minibatch iteration 43/48400: mean batch inertia: 0.934074, ewa inertia: 0.952274
Minibatch iteration 44/48400: mean batch inertia: 0.934198, ewa inertia: 0.952199
Minibatch iteration 45/48400: mean batch inertia: 0.928853, ewa inertia: 0.952102
Minibatch iteration 46/48400: mean batch inertia: 0.930166, ewa inertia:

a: 0.952012
Minibatch iteration 47/48400: mean batch inertia: 0.909871, ewa inertia: 0.951837
Minibatch iteration 48/48400: mean batch inertia: 0.926525, ewa inertia: 0.951733
Minibatch iteration 49/48400: mean batch inertia: 0.919116, ewa inertia: 0.951598
Minibatch iteration 50/48400: mean batch inertia: 0.930687, ewa inertia: 0.951511
Minibatch iteration 51/48400: mean batch inertia: 0.933269, ewa inertia: 0.951436
Minibatch iteration 52/48400: mean batch inertia: 0.937122, ewa inertia: 0.951377
Minibatch iteration 53/48400: mean batch inertia: 0.919708, ewa inertia: 0.951246
Minibatch iteration 54/48400: mean batch inertia: 0.921697, ewa inertia: 0.951124
Minibatch iteration 55/48400: mean batch inertia: 0.936130, ewa inertia: 0.951062
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Minibatch iteration 57/48400: mean batch inertia: 0.925858, ewa inertia: 0.950888
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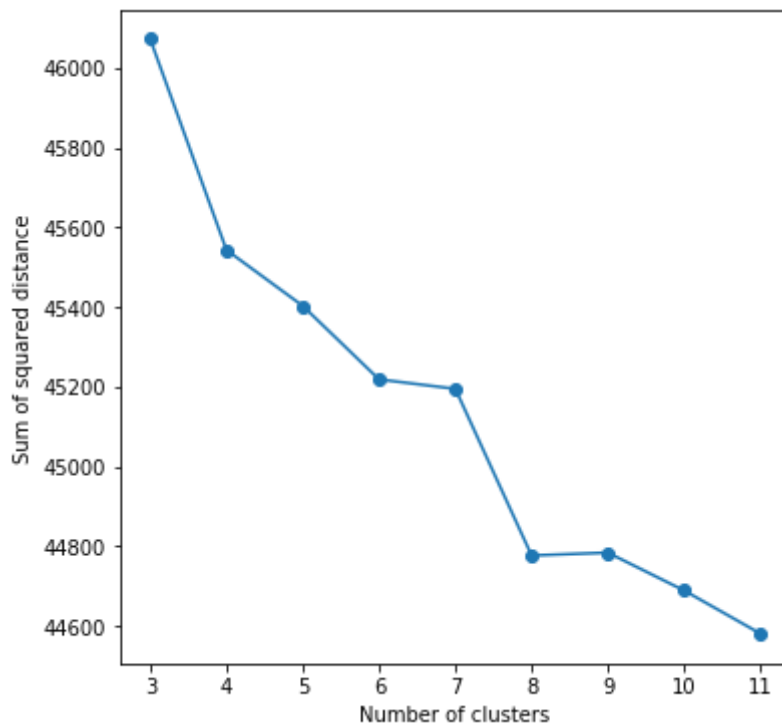
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Minibatch iteration 598/48400: mean batch inertia: 0.912337, ewa inertia: 0.924475
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Minibatch iteration 600/48400: mean batch inertia: 0.919325, ewa inertia: 0.924455
Minibatch iteration 601/48400: mean batch inertia: 0.927423, ewa inertia: 0.924467
Minibatch iteration 602/48400: mean batch inertia: 0.929997, ewa inertia: 0.924490
Minibatch iteration 603/48400: mean batch inertia: 0.896977, ewa inertia: 0.924376
Minibatch iteration 604/48400: mean batch inertia: 0.933709, ewa inertia: 0.924415
Minibatch iteration 605/48400: mean batch inertia: 0.921660, ewa inertia: 0.924403
Minibatch iteration 606/48400: mean batch inertia: 0.922513, ewa inertia: 0.924396
Minibatch iteration 607/48400: mean batch inertia: 0.929284, ewa inertia: 0.924416
Minibatch iteration 608/48400: mean batch inertia: 0.910029, ewa inertia: 0.924356
Minibatch iteration 609/48400: mean batch inertia: 0.910822, ewa inertia: 0.924300
Minibatch iteration 610/48400: mean batch inertia: 0.918055, ewa inertia: 0.924275
Minibatch iteration 611/48400: mean batch inertia: 0.927819, ewa inertia: 0.924289
Minibatch iteration 612/48400: mean batch inertia: 0.936810, ewa inertia: 0.924341
Minibatch iteration 613/48400: mean batch inertia: 0.914285, ewa inertia: 0.924299
Minibatch iteration 614/48400: mean batch inertia: 0.901017, ewa inertia: 0.924203
Minibatch iteration 615/48400: mean batch inertia: 0.907153, ewa inertia: 0.924133
Minibatch iteration 616/48400: mean batch inertia: 0.918419, ewa inertia:

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a: 0.924109
Minibatch iteration 617/48400: mean batch inertia: 0.921663, ewa inertia: 0.924099
Minibatch iteration 618/48400: mean batch inertia: 0.928090, ewa inertia: 0.924115
Minibatch iteration 619/48400: mean batch inertia: 0.934264, ewa inertia: 0.924157
Minibatch iteration 620/48400: mean batch inertia: 0.916752, ewa inertia: 0.924127
Minibatch iteration 621/48400: mean batch inertia: 0.903924, ewa inertia: 0.924043
Minibatch iteration 622/48400: mean batch inertia: 0.910435, ewa inertia: 0.923987
Minibatch iteration 623/48400: mean batch inertia: 0.906152, ewa inertia: 0.923913
Minibatch iteration 624/48400: mean batch inertia: 0.910631, ewa inertia: 0.923858
Minibatch iteration 625/48400: mean batch inertia: 0.923086, ewa inertia: 0.923855
Minibatch iteration 626/48400: mean batch inertia: 0.921193, ewa inertia: 0.923844
Minibatch iteration 627/48400: mean batch inertia: 0.936330, ewa inertia: 0.923896
Minibatch iteration 628/48400: mean batch inertia: 0.914714, ewa inertia: 0.923858
Minibatch iteration 629/48400: mean batch inertia: 0.926952, ewa inertia: 0.923871
Minibatch iteration 630/48400: mean batch inertia: 0.929591, ewa inertia: 0.923894
Minibatch iteration 631/48400: mean batch inertia: 0.918379, ewa inertia: 0.923871
Minibatch iteration 632/48400: mean batch inertia: 0.924558, ewa inertia: 0.923874
Minibatch iteration 633/48400: mean batch inertia: 0.927978, ewa inertia: 0.923891
Minibatch iteration 634/48400: mean batch inertia: 0.932461, ewa inertia: 0.923927
Minibatch iteration 635/48400: mean batch inertia: 0.920756, ewa inertia: 0.923914
Minibatch iteration 636/48400: mean batch inertia: 0.921914, ewa inertia: 0.923905
Converged (lack of improvement in inertia) at iteration 636/48400
Computing label assignment and total inertia
```

```
Out[41]: Text(0, 0.5, 'Sum of squared distance')
```



Graph for Silhouette Score for a range of clusters 5,6,7,8,9

This is to estimate the optimal number of clusters

- The Silhouette co-efficient measures the average distance between a data point in a cluster to all the other data points in the same cluster and also the average distance between a data point in a cluster and all the other data points in the nearest cluster
- The best clusters are chosen which has the minimum average distance between the points into the same cluster and maximum possible average distance between points in the nearest cluster
- Based on the output from the above elbow method we decided to perform silhouette score to find the optimal number of clusters for the given dataset.
- The graph we have plotted below displays the silhouette scores for cluster values $k=5,6,7,8,9$.
- As we have used `TfidfVectorizer` in our project, it assigns low values to every datapoint due to which the silhouette scores for the clusters are close to zero.
- We have chosen the value of $k=7$ because according to the plotted graphs, for $k=7$ majority of the silhouette coefficients for the clusters stay in the +ve region.
- The clusters that are plotted in the -ve region has data points belonging to the wrong clusters.

```
In [44]: %%time
for i, k in enumerate([5,6,7,8,9]):
    fig, (ax1,ax2) = plt.subplots(1, 2)
    fig.set_size_inches(18, 7)

    # Run the Kmeans algorithm
    km = MiniBatchKMeans(n_clusters=k,verbose=10)
    labels = km.fit_predict(all_features)
    centroids = km.cluster_centers_

    # Get silhouette samples
    silhouette_vals = silhouette_samples(all_features, labels)

    # Silhouette plot
    y_ticks = []
    y_lower, y_upper = 0, 0
    for i, cluster in enumerate(np.unique(labels)):
        cluster_silhouette_vals = silhouette_vals[labels == cluster]
        cluster_silhouette_vals.sort()
        y_upper += len(cluster_silhouette_vals)
        ax1.barh(range(y_lower, y_upper), cluster_silhouette_vals, edgec
olor='none', height=1)
        ax1.text(-0.03, (y_lower + y_upper) / 2, str(i + 1))
        y_lower += len(cluster_silhouette_vals)

    # Get the average silhouette score and plot it
    avg_score = np.mean(silhouette_vals)
    ax1.axvline(avg_score, linestyle='--', linewidth=2, color='green')
    ax1.set_yticks([])
    ax1.set_xlim([-0.1, 1])
    ax1.set_xlabel('Silhouette coefficient values')
    ax1.set_ylabel('Cluster labels')
    ax1.set_title('Silhouette plot for the various clusters', y=1.02)
```

```
Init 1/3 with method: k-means++
Inertia for init 1/3: 280.455864
Init 2/3 with method: k-means++
Inertia for init 2/3: 283.532729
Init 3/3 with method: k-means++
Inertia for init 3/3: 280.510424
Minibatch iteration 1/48400: mean batch inertia: 0.963632, ewa inertia:
0.963632
Minibatch iteration 2/48400: mean batch inertia: 0.945730, ewa inertia:
0.963558
Minibatch iteration 3/48400: mean batch inertia: 0.950740, ewa inertia:
0.963505
Minibatch iteration 4/48400: mean batch inertia: 0.956679, ewa inertia:
0.963477
Minibatch iteration 5/48400: mean batch inertia: 0.961667, ewa inertia:
0.963470
Minibatch iteration 6/48400: mean batch inertia: 0.958921, ewa inertia:
0.963451
Minibatch iteration 7/48400: mean batch inertia: 0.955610, ewa inertia:
0.963419
Minibatch iteration 8/48400: mean batch inertia: 0.954380, ewa inertia:
0.963381
Minibatch iteration 9/48400: mean batch inertia: 0.947964, ewa inertia:
0.963317
Minibatch iteration 10/48400: mean batch inertia: 0.950262, ewa inertia:
0.963263
Minibatch iteration 11/48400: mean batch inertia: 0.948191, ewa inertia:
0.963201
Minibatch iteration 12/48400: mean batch inertia: 0.949899, ewa inertia:
0.963146
Minibatch iteration 13/48400: mean batch inertia: 0.949333, ewa inertia:
0.963089
[MiniBatchKMeans] Reassigning 1 cluster centers.
Minibatch iteration 14/48400: mean batch inertia: 0.949078, ewa inertia:
0.963031
Minibatch iteration 15/48400: mean batch inertia: 0.946556, ewa inertia:
0.962963
Minibatch iteration 16/48400: mean batch inertia: 0.941117, ewa inertia:
0.962873
Minibatch iteration 17/48400: mean batch inertia: 0.958952, ewa inertia:
0.962856
Minibatch iteration 18/48400: mean batch inertia: 0.950373, ewa inertia:
0.962805
Minibatch iteration 19/48400: mean batch inertia: 0.944230, ewa inertia:
0.962728
Minibatch iteration 20/48400: mean batch inertia: 0.941431, ewa inertia:
0.962640
Minibatch iteration 21/48400: mean batch inertia: 0.943102, ewa inertia:
0.962559
Minibatch iteration 22/48400: mean batch inertia: 0.933764, ewa inertia:
0.962440
Minibatch iteration 23/48400: mean batch inertia: 0.948883, ewa inertia:
0.962384
Minibatch iteration 24/48400: mean batch inertia: 0.954431, ewa inertia:
0.962351
Minibatch iteration 25/48400: mean batch inertia: 0.961635, ewa inertia:
0.962348
```


Minibatch iteration 26/48400: mean batch inertia: 0.934199, ewa inertia: 0.962232
Minibatch iteration 27/48400: mean batch inertia: 0.948376, ewa inertia: 0.962175
Minibatch iteration 28/48400: mean batch inertia: 0.948766, ewa inertia: 0.962119
Minibatch iteration 29/48400: mean batch inertia: 0.934257, ewa inertia: 0.962004
Minibatch iteration 30/48400: mean batch inertia: 0.960335, ewa inertia: 0.961997
Minibatch iteration 31/48400: mean batch inertia: 0.941838, ewa inertia: 0.961914
Minibatch iteration 32/48400: mean batch inertia: 0.954659, ewa inertia: 0.961884
Minibatch iteration 33/48400: mean batch inertia: 0.939342, ewa inertia: 0.961791
Minibatch iteration 34/48400: mean batch inertia: 0.935059, ewa inertia: 0.961680
Minibatch iteration 35/48400: mean batch inertia: 0.945404, ewa inertia: 0.961613
Minibatch iteration 36/48400: mean batch inertia: 0.943490, ewa inertia: 0.961538
Minibatch iteration 37/48400: mean batch inertia: 0.950313, ewa inertia: 0.961491
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Minibatch iteration 40/48400: mean batch inertia: 0.954886, ewa inertia: 0.961295
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Minibatch iteration 44/48400: mean batch inertia: 0.954415, ewa inertia: 0.961099
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a: 0.957705
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Minibatch iteration 172/48400: mean batch inertia: 0.959786, ewa inertia: 0.955396
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Minibatch iteration 175/48400: mean batch inertia: 0.948306, ewa inertia: 0.955225
Minibatch iteration 176/48400: mean batch inertia: 0.922479, ewa inertia: 0.955090
Minibatch iteration 177/48400: mean batch inertia: 0.929551, ewa inertia: 0.954984
[MiniBatchKMeans] Reassigning 1 cluster centers.
Minibatch iteration 178/48400: mean batch inertia: 0.947712, ewa inertia: 0.954954
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Minibatch iteration 196/48400: mean batch inertia: 0.953849, ewa inertia:

a: 0.954250
Minibatch iteration 197/48400: mean batch inertia: 0.953667, ewa inertia: 0.954248
Minibatch iteration 198/48400: mean batch inertia: 0.937512, ewa inertia: 0.954179
Minibatch iteration 199/48400: mean batch inertia: 0.941042, ewa inertia: 0.954125
Minibatch iteration 200/48400: mean batch inertia: 0.953754, ewa inertia: 0.954123
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Minibatch iteration 475/48400: mean batch inertia: 0.927625, ewa inertia: 0.946355
Minibatch iteration 476/48400: mean batch inertia: 0.926614, ewa inertia: 0.946273
Minibatch iteration 477/48400: mean batch inertia: 0.947114, ewa inertia: 0.946277
Minibatch iteration 478/48400: mean batch inertia: 0.930703, ewa inertia: 0.946212
Minibatch iteration 479/48400: mean batch inertia: 0.956709, ewa inertia: 0.946256
Minibatch iteration 480/48400: mean batch inertia: 0.942980, ewa inertia: 0.946242
Minibatch iteration 481/48400: mean batch inertia: 0.944663, ewa inertia:

a: 0.946236
Minibatch iteration 482/48400: mean batch inertia: 0.941297, ewa inertia: 0.946215
Minibatch iteration 483/48400: mean batch inertia: 0.947378, ewa inertia: 0.946220
Minibatch iteration 484/48400: mean batch inertia: 0.929797, ewa inertia: 0.946152
Minibatch iteration 485/48400: mean batch inertia: 0.959340, ewa inertia: 0.946207
Minibatch iteration 486/48400: mean batch inertia: 0.928856, ewa inertia: 0.946135
Minibatch iteration 487/48400: mean batch inertia: 0.949140, ewa inertia: 0.946147
Minibatch iteration 488/48400: mean batch inertia: 0.930045, ewa inertia: 0.946081
Minibatch iteration 489/48400: mean batch inertia: 0.948713, ewa inertia: 0.946092
Minibatch iteration 490/48400: mean batch inertia: 0.952112, ewa inertia: 0.946117
Minibatch iteration 491/48400: mean batch inertia: 0.937185, ewa inertia: 0.946080
Minibatch iteration 492/48400: mean batch inertia: 0.957475, ewa inertia: 0.946127
Minibatch iteration 493/48400: mean batch inertia: 0.942774, ewa inertia: 0.946113
Minibatch iteration 494/48400: mean batch inertia: 0.936999, ewa inertia: 0.946075
Minibatch iteration 495/48400: mean batch inertia: 0.924558, ewa inertia: 0.945986
Minibatch iteration 496/48400: mean batch inertia: 0.948150, ewa inertia: 0.945995
Minibatch iteration 497/48400: mean batch inertia: 0.945592, ewa inertia: 0.945994
Minibatch iteration 498/48400: mean batch inertia: 0.937640, ewa inertia: 0.945959
Minibatch iteration 499/48400: mean batch inertia: 0.932070, ewa inertia: 0.945902
Minibatch iteration 500/48400: mean batch inertia: 0.941714, ewa inertia: 0.945884
Minibatch iteration 501/48400: mean batch inertia: 0.945495, ewa inertia: 0.945883
Minibatch iteration 502/48400: mean batch inertia: 0.944395, ewa inertia: 0.945877
Minibatch iteration 503/48400: mean batch inertia: 0.945484, ewa inertia: 0.945875
Minibatch iteration 504/48400: mean batch inertia: 0.947998, ewa inertia: 0.945884
Minibatch iteration 505/48400: mean batch inertia: 0.934928, ewa inertia: 0.945838
Minibatch iteration 506/48400: mean batch inertia: 0.946807, ewa inertia: 0.945842
Minibatch iteration 507/48400: mean batch inertia: 0.946871, ewa inertia: 0.945847
Minibatch iteration 508/48400: mean batch inertia: 0.937174, ewa inertia: 0.945811
Minibatch iteration 509/48400: mean batch inertia: 0.927372, ewa inertia: 0.945735

Minibatch iteration 510/48400: mean batch inertia: 0.953463, ewa inertia: 0.945767
Minibatch iteration 511/48400: mean batch inertia: 0.952756, ewa inertia: 0.945795
Minibatch iteration 512/48400: mean batch inertia: 0.943287, ewa inertia: 0.945785
Minibatch iteration 513/48400: mean batch inertia: 0.946472, ewa inertia: 0.945788
Minibatch iteration 514/48400: mean batch inertia: 0.939071, ewa inertia: 0.945760
Minibatch iteration 515/48400: mean batch inertia: 0.929098, ewa inertia: 0.945691
Minibatch iteration 516/48400: mean batch inertia: 0.941236, ewa inertia: 0.945673
Minibatch iteration 517/48400: mean batch inertia: 0.945610, ewa inertia: 0.945673
Minibatch iteration 518/48400: mean batch inertia: 0.947859, ewa inertia: 0.945682
Minibatch iteration 519/48400: mean batch inertia: 0.939544, ewa inertia: 0.945656
Minibatch iteration 520/48400: mean batch inertia: 0.933046, ewa inertia: 0.945604
Minibatch iteration 521/48400: mean batch inertia: 0.944950, ewa inertia: 0.945601
Minibatch iteration 522/48400: mean batch inertia: 0.931860, ewa inertia: 0.945545
Minibatch iteration 523/48400: mean batch inertia: 0.956682, ewa inertia: 0.945591
Minibatch iteration 524/48400: mean batch inertia: 0.940692, ewa inertia: 0.945570
Minibatch iteration 525/48400: mean batch inertia: 0.956147, ewa inertia: 0.945614
Minibatch iteration 526/48400: mean batch inertia: 0.924054, ewa inertia: 0.945525
Minibatch iteration 527/48400: mean batch inertia: 0.916831, ewa inertia: 0.945406
Minibatch iteration 528/48400: mean batch inertia: 0.952980, ewa inertia: 0.945438
Minibatch iteration 529/48400: mean batch inertia: 0.941462, ewa inertia: 0.945421
Minibatch iteration 530/48400: mean batch inertia: 0.928135, ewa inertia: 0.945350
Minibatch iteration 531/48400: mean batch inertia: 0.961336, ewa inertia: 0.945416
Minibatch iteration 532/48400: mean batch inertia: 0.960867, ewa inertia: 0.945480
Minibatch iteration 533/48400: mean batch inertia: 0.944454, ewa inertia: 0.945476
Minibatch iteration 534/48400: mean batch inertia: 0.952856, ewa inertia: 0.945506
Minibatch iteration 535/48400: mean batch inertia: 0.941962, ewa inertia: 0.945491
Minibatch iteration 536/48400: mean batch inertia: 0.936263, ewa inertia: 0.945453
Minibatch iteration 537/48400: mean batch inertia: 0.931427, ewa inertia: 0.945395
Minibatch iteration 538/48400: mean batch inertia: 0.955884, ewa inertia:

a: 0.945439
Minibatch iteration 539/48400: mean batch inertia: 0.948472, ewa inertia: 0.945451
Minibatch iteration 540/48400: mean batch inertia: 0.943506, ewa inertia: 0.945443
Converged (lack of improvement in inertia) at iteration 540/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 280.323621
Init 2/3 with method: k-means++
Inertia for init 2/3: 281.755151
Init 3/3 with method: k-means++
Inertia for init 3/3: 281.505744
Minibatch iteration 1/48400: mean batch inertia: 0.976371, ewa inertia: 0.976371
Minibatch iteration 2/48400: mean batch inertia: 0.967670, ewa inertia: 0.976335
Minibatch iteration 3/48400: mean batch inertia: 0.957413, ewa inertia: 0.976256
Minibatch iteration 4/48400: mean batch inertia: 0.961124, ewa inertia: 0.976194
Minibatch iteration 5/48400: mean batch inertia: 0.965241, ewa inertia: 0.976149
Minibatch iteration 6/48400: mean batch inertia: 0.956367, ewa inertia: 0.976067
Minibatch iteration 7/48400: mean batch inertia: 0.956327, ewa inertia: 0.975985
Minibatch iteration 8/48400: mean batch inertia: 0.952183, ewa inertia: 0.975887
Minibatch iteration 9/48400: mean batch inertia: 0.957014, ewa inertia: 0.975809
Minibatch iteration 10/48400: mean batch inertia: 0.956061, ewa inertia: 0.975727
Minibatch iteration 11/48400: mean batch inertia: 0.948832, ewa inertia: 0.975616
Minibatch iteration 12/48400: mean batch inertia: 0.962653, ewa inertia: 0.975562
Minibatch iteration 13/48400: mean batch inertia: 0.956083, ewa inertia: 0.975482
Minibatch iteration 14/48400: mean batch inertia: 0.958666, ewa inertia: 0.975412
Minibatch iteration 15/48400: mean batch inertia: 0.955883, ewa inertia: 0.975332
Minibatch iteration 16/48400: mean batch inertia: 0.956120, ewa inertia: 0.975252
Minibatch iteration 17/48400: mean batch inertia: 0.947610, ewa inertia: 0.975138
Minibatch iteration 18/48400: mean batch inertia: 0.951640, ewa inertia: 0.975041
Minibatch iteration 19/48400: mean batch inertia: 0.953498, ewa inertia: 0.974952
Minibatch iteration 20/48400: mean batch inertia: 0.956581, ewa inertia: 0.974876
Minibatch iteration 21/48400: mean batch inertia: 0.961951, ewa inertia: 0.974822
Minibatch iteration 22/48400: mean batch inertia: 0.959530, ewa inertia: 0.974759

Minibatch iteration 23/48400: mean batch inertia: 0.952020, ewa inertia: 0.974665
Minibatch iteration 24/48400: mean batch inertia: 0.945622, ewa inertia: 0.974545
Minibatch iteration 25/48400: mean batch inertia: 0.953471, ewa inertia: 0.974458
Minibatch iteration 26/48400: mean batch inertia: 0.950978, ewa inertia: 0.974361
Minibatch iteration 27/48400: mean batch inertia: 0.943978, ewa inertia: 0.974235
Minibatch iteration 28/48400: mean batch inertia: 0.948316, ewa inertia: 0.974128
Minibatch iteration 29/48400: mean batch inertia: 0.956101, ewa inertia: 0.974053
Minibatch iteration 30/48400: mean batch inertia: 0.946795, ewa inertia: 0.973941
Minibatch iteration 31/48400: mean batch inertia: 0.948836, ewa inertia: 0.973837
Minibatch iteration 32/48400: mean batch inertia: 0.944945, ewa inertia: 0.973718
Minibatch iteration 33/48400: mean batch inertia: 0.954205, ewa inertia: 0.973637
Minibatch iteration 34/48400: mean batch inertia: 0.946482, ewa inertia: 0.973525
Minibatch iteration 35/48400: mean batch inertia: 0.954773, ewa inertia: 0.973447
Minibatch iteration 36/48400: mean batch inertia: 0.948240, ewa inertia: 0.973343
Minibatch iteration 37/48400: mean batch inertia: 0.951109, ewa inertia: 0.973251
Minibatch iteration 38/48400: mean batch inertia: 0.950960, ewa inertia: 0.973159
Minibatch iteration 39/48400: mean batch inertia: 0.948691, ewa inertia: 0.973058
Minibatch iteration 40/48400: mean batch inertia: 0.948561, ewa inertia: 0.972956
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Minibatch iteration 43/48400: mean batch inertia: 0.954471, ewa inertia: 0.972658
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Minibatch iteration 51/48400: mean batch inertia: 0.951128, ewa inertia:

a: 0.971918
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Minibatch iteration 67/48400: mean batch inertia: 0.956609, ewa inertia: 0.970562
Minibatch iteration 68/48400: mean batch inertia: 0.946142, ewa inertia: 0.970461
Minibatch iteration 69/48400: mean batch inertia: 0.955326, ewa inertia: 0.970399
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Minibatch iteration 72/48400: mean batch inertia: 0.951672, ewa inertia: 0.970101
Minibatch iteration 73/48400: mean batch inertia: 0.948589, ewa inertia: 0.970012
Minibatch iteration 74/48400: mean batch inertia: 0.952623, ewa inertia: 0.969940
Minibatch iteration 75/48400: mean batch inertia: 0.950708, ewa inertia: 0.969861
Minibatch iteration 76/48400: mean batch inertia: 0.946204, ewa inertia: 0.969763
Minibatch iteration 77/48400: mean batch inertia: 0.950071, ewa inertia: 0.969681
Minibatch iteration 78/48400: mean batch inertia: 0.947129, ewa inertia: 0.969588
Minibatch iteration 79/48400: mean batch inertia: 0.942183, ewa inertia: 0.969475

Minibatch iteration 80/48400: mean batch inertia: 0.945712, ewa inertia: 0.969377
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Minibatch iteration 83/48400: mean batch inertia: 0.949630, ewa inertia: 0.969154
Minibatch iteration 84/48400: mean batch inertia: 0.939930, ewa inertia: 0.969033
Minibatch iteration 85/48400: mean batch inertia: 0.953368, ewa inertia: 0.968968
Minibatch iteration 86/48400: mean batch inertia: 0.947067, ewa inertia: 0.968878
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Minibatch iteration 106/48400: mean batch inertia: 0.944430, ewa inertia: 0.967219
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a: 0.967068
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Minibatch iteration 129/48400: mean batch inertia: 0.952100, ewa inertia: 0.965522
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Minibatch iteration 137/48400: mean batch inertia: 0.950499, ewa inertia: 0.964789
Minibatch iteration 138/48400: mean batch inertia: 0.943147, ewa inertia: 0.964699
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Minibatch iteration 148/48400: mean batch inertia: 0.943666, ewa inertia: 0.963927
Minibatch iteration 149/48400: mean batch inertia: 0.958417, ewa inertia: 0.963904
Minibatch iteration 150/48400: mean batch inertia: 0.950394, ewa inertia: 0.963848
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Minibatch iteration 158/48400: mean batch inertia: 0.946477, ewa inertia: 0.963238
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Minibatch iteration 163/48400: mean batch inertia: 0.950846, ewa inertia: 0.962941
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a: 0.962779
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Minibatch iteration 168/48400: mean batch inertia: 0.949146, ewa inertia: 0.962615
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Minibatch iteration 173/48400: mean batch inertia: 0.940506, ewa inertia: 0.962310
Minibatch iteration 174/48400: mean batch inertia: 0.952888, ewa inertia: 0.962271
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Minibatch iteration 176/48400: mean batch inertia: 0.944997, ewa inertia: 0.962133
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Minibatch iteration 179/48400: mean batch inertia: 0.943632, ewa inertia: 0.961935
Minibatch iteration 180/48400: mean batch inertia: 0.949486, ewa inertia: 0.961883
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Minibatch iteration 182/48400: mean batch inertia: 0.947778, ewa inertia: 0.961742
Minibatch iteration 183/48400: mean batch inertia: 0.952979, ewa inertia: 0.961706
Minibatch iteration 184/48400: mean batch inertia: 0.944557, ewa inertia: 0.961635
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Minibatch iteration 186/48400: mean batch inertia: 0.957127, ewa inertia: 0.961553
Minibatch iteration 187/48400: mean batch inertia: 0.943267, ewa inertia: 0.961477
Minibatch iteration 188/48400: mean batch inertia: 0.942807, ewa inertia: 0.961400
Minibatch iteration 189/48400: mean batch inertia: 0.945083, ewa inertia: 0.961333
Minibatch iteration 190/48400: mean batch inertia: 0.945553, ewa inertia: 0.961268
Minibatch iteration 191/48400: mean batch inertia: 0.946182, ewa inertia: 0.961205
Minibatch iteration 192/48400: mean batch inertia: 0.948447, ewa inertia: 0.961152
Minibatch iteration 193/48400: mean batch inertia: 0.948520, ewa inertia: 0.961100

Minibatch iteration 194/48400: mean batch inertia: 0.947479, ewa inertia: 0.961044
Minibatch iteration 195/48400: mean batch inertia: 0.947100, ewa inertia: 0.960986
Minibatch iteration 196/48400: mean batch inertia: 0.940599, ewa inertia: 0.960902
Minibatch iteration 197/48400: mean batch inertia: 0.949645, ewa inertia: 0.960855
Minibatch iteration 198/48400: mean batch inertia: 0.952218, ewa inertia: 0.960820
Minibatch iteration 199/48400: mean batch inertia: 0.948005, ewa inertia: 0.960767
Minibatch iteration 200/48400: mean batch inertia: 0.949865, ewa inertia: 0.960722
Minibatch iteration 201/48400: mean batch inertia: 0.941852, ewa inertia: 0.960644
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Minibatch iteration 478/48400: mean batch inertia: 0.945784, ewa inertia: 0.950579

Minibatch iteration 479/48400: mean batch inertia: 0.950406, ewa inertia: 0.950578
Minibatch iteration 480/48400: mean batch inertia: 0.944282, ewa inertia: 0.950552
Minibatch iteration 481/48400: mean batch inertia: 0.951507, ewa inertia: 0.950556
Minibatch iteration 482/48400: mean batch inertia: 0.943371, ewa inertia: 0.950527
Minibatch iteration 483/48400: mean batch inertia: 0.943936, ewa inertia: 0.950499
Minibatch iteration 484/48400: mean batch inertia: 0.952153, ewa inertia: 0.950506
Minibatch iteration 485/48400: mean batch inertia: 0.943992, ewa inertia: 0.950479
Minibatch iteration 486/48400: mean batch inertia: 0.956991, ewa inertia: 0.950506
Minibatch iteration 487/48400: mean batch inertia: 0.951505, ewa inertia: 0.950510
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Minibatch iteration 489/48400: mean batch inertia: 0.942077, ewa inertia: 0.950459
Minibatch iteration 490/48400: mean batch inertia: 0.947496, ewa inertia: 0.950447
Minibatch iteration 491/48400: mean batch inertia: 0.947558, ewa inertia: 0.950435
Minibatch iteration 492/48400: mean batch inertia: 0.951959, ewa inertia: 0.950441
Minibatch iteration 493/48400: mean batch inertia: 0.945784, ewa inertia: 0.950422
Minibatch iteration 494/48400: mean batch inertia: 0.948010, ewa inertia: 0.950412
Minibatch iteration 495/48400: mean batch inertia: 0.949772, ewa inertia: 0.950409
Minibatch iteration 496/48400: mean batch inertia: 0.949676, ewa inertia: 0.950406
Minibatch iteration 497/48400: mean batch inertia: 0.942972, ewa inertia: 0.950375
Minibatch iteration 498/48400: mean batch inertia: 0.946449, ewa inertia: 0.950359
Minibatch iteration 499/48400: mean batch inertia: 0.948797, ewa inertia: 0.950353
Minibatch iteration 500/48400: mean batch inertia: 0.947024, ewa inertia: 0.950339
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Minibatch iteration 502/48400: mean batch inertia: 0.942167, ewa inertia: 0.950310
Minibatch iteration 503/48400: mean batch inertia: 0.934928, ewa inertia: 0.950246
Minibatch iteration 504/48400: mean batch inertia: 0.940792, ewa inertia: 0.950207
Minibatch iteration 505/48400: mean batch inertia: 0.946834, ewa inertia: 0.950193
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a: 0.950161
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a: 0.949303
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Minibatch iteration 608/48400: mean batch inertia: 0.948642, ewa inertia: 0.948692
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a: 0.948562
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Minibatch iteration 626/48400: mean batch inertia: 0.943791, ewa inertia: 0.948511
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Minibatch iteration 654/48400: mean batch inertia: 0.947663, ewa inertia: 0.948111
Minibatch iteration 655/48400: mean batch inertia: 0.952470, ewa inertia: 0.948129
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Minibatch iteration 660/48400: mean batch inertia: 0.950848, ewa inertia: 0.948092
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a: 0.947878
Minibatch iteration 679/48400: mean batch inertia: 0.943404, ewa inertia: 0.947859
Minibatch iteration 680/48400: mean batch inertia: 0.950117, ewa inertia: 0.947868
Minibatch iteration 681/48400: mean batch inertia: 0.933855, ewa inertia: 0.947810
Minibatch iteration 682/48400: mean batch inertia: 0.941313, ewa inertia: 0.947784
Minibatch iteration 683/48400: mean batch inertia: 0.939335, ewa inertia: 0.947749
Minibatch iteration 684/48400: mean batch inertia: 0.949636, ewa inertia: 0.947756
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Minibatch iteration 689/48400: mean batch inertia: 0.940298, ewa inertia: 0.947729
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Minibatch iteration 696/48400: mean batch inertia: 0.950854, ewa inertia: 0.947637
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Minibatch iteration 698/48400: mean batch inertia: 0.940485, ewa inertia: 0.947622
Minibatch iteration 699/48400: mean batch inertia: 0.948224, ewa inertia: 0.947624
Minibatch iteration 700/48400: mean batch inertia: 0.946477, ewa inertia: 0.947619
Minibatch iteration 701/48400: mean batch inertia: 0.947893, ewa inertia: 0.947621
Minibatch iteration 702/48400: mean batch inertia: 0.954913, ewa inertia: 0.947651
Minibatch iteration 703/48400: mean batch inertia: 0.940459, ewa inertia: 0.947621
Minibatch iteration 704/48400: mean batch inertia: 0.948088, ewa inertia: 0.947623
Minibatch iteration 705/48400: mean batch inertia: 0.949685, ewa inertia: 0.947631
Minibatch iteration 706/48400: mean batch inertia: 0.941550, ewa inertia: 0.947606

Minibatch iteration 707/48400: mean batch inertia: 0.950591, ewa inertia: 0.947619
Minibatch iteration 708/48400: mean batch inertia: 0.950641, ewa inertia: 0.947631
Minibatch iteration 709/48400: mean batch inertia: 0.944479, ewa inertia: 0.947618
Minibatch iteration 710/48400: mean batch inertia: 0.946388, ewa inertia: 0.947613
Minibatch iteration 711/48400: mean batch inertia: 0.937289, ewa inertia: 0.947570
Minibatch iteration 712/48400: mean batch inertia: 0.950560, ewa inertia: 0.947583
Minibatch iteration 713/48400: mean batch inertia: 0.952090, ewa inertia: 0.947601
Minibatch iteration 714/48400: mean batch inertia: 0.950612, ewa inertia: 0.947614
Minibatch iteration 715/48400: mean batch inertia: 0.951424, ewa inertia: 0.947630
Minibatch iteration 716/48400: mean batch inertia: 0.942261, ewa inertia: 0.947607
Minibatch iteration 717/48400: mean batch inertia: 0.955679, ewa inertia: 0.947641
Minibatch iteration 718/48400: mean batch inertia: 0.955173, ewa inertia: 0.947672
Minibatch iteration 719/48400: mean batch inertia: 0.949144, ewa inertia: 0.947678
Minibatch iteration 720/48400: mean batch inertia: 0.944425, ewa inertia: 0.947664
Minibatch iteration 721/48400: mean batch inertia: 0.937525, ewa inertia: 0.947623
Converged (lack of improvement in inertia) at iteration 721/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 278.386600
Init 2/3 with method: k-means++
Inertia for init 2/3: 277.623485
Init 3/3 with method: k-means++
Inertia for init 3/3: 280.229091
Minibatch iteration 1/48400: mean batch inertia: 0.966201, ewa inertia: 0.966201
Minibatch iteration 2/48400: mean batch inertia: 0.963011, ewa inertia: 0.966188
Minibatch iteration 3/48400: mean batch inertia: 0.953328, ewa inertia: 0.966135
Minibatch iteration 4/48400: mean batch inertia: 0.950020, ewa inertia: 0.966068
Minibatch iteration 5/48400: mean batch inertia: 0.954158, ewa inertia: 0.966019
Minibatch iteration 6/48400: mean batch inertia: 0.957645, ewa inertia: 0.965984
Minibatch iteration 7/48400: mean batch inertia: 0.953117, ewa inertia: 0.965931
Minibatch iteration 8/48400: mean batch inertia: 0.946133, ewa inertia: 0.965849
Minibatch iteration 9/48400: mean batch inertia: 0.955345, ewa inertia: 0.965806
Minibatch iteration 10/48400: mean batch inertia: 0.947219, ewa inertia:

a: 0.965729
Minibatch iteration 11/48400: mean batch inertia: 0.949933, ewa inertia: 0.965664
Minibatch iteration 12/48400: mean batch inertia: 0.946364, ewa inertia: 0.965584
Minibatch iteration 13/48400: mean batch inertia: 0.949142, ewa inertia: 0.965516
Minibatch iteration 14/48400: mean batch inertia: 0.938585, ewa inertia: 0.965405
Minibatch iteration 15/48400: mean batch inertia: 0.945655, ewa inertia: 0.965323
Minibatch iteration 16/48400: mean batch inertia: 0.946214, ewa inertia: 0.965244
Minibatch iteration 17/48400: mean batch inertia: 0.949832, ewa inertia: 0.965180
Minibatch iteration 18/48400: mean batch inertia: 0.953379, ewa inertia: 0.965131
Minibatch iteration 19/48400: mean batch inertia: 0.936522, ewa inertia: 0.965013
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Minibatch iteration 295/48400: mean batch inertia: 0.946122, ewa inertia:

a: 0.945778
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Minibatch iteration 297/48400: mean batch inertia: 0.943118, ewa inertia: 0.945671
Minibatch iteration 298/48400: mean batch inertia: 0.933253, ewa inertia: 0.945620
Minibatch iteration 299/48400: mean batch inertia: 0.936364, ewa inertia: 0.945582
Minibatch iteration 300/48400: mean batch inertia: 0.933337, ewa inertia: 0.945531
Minibatch iteration 301/48400: mean batch inertia: 0.928702, ewa inertia: 0.945462
Minibatch iteration 302/48400: mean batch inertia: 0.916438, ewa inertia: 0.945342
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Minibatch iteration 305/48400: mean batch inertia: 0.930587, ewa inertia: 0.945246
Minibatch iteration 306/48400: mean batch inertia: 0.944263, ewa inertia: 0.945242
Minibatch iteration 307/48400: mean batch inertia: 0.932475, ewa inertia: 0.945189
Minibatch iteration 308/48400: mean batch inertia: 0.935569, ewa inertia: 0.945149
Minibatch iteration 309/48400: mean batch inertia: 0.943492, ewa inertia: 0.945143
Minibatch iteration 310/48400: mean batch inertia: 0.927592, ewa inertia: 0.945070
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Minibatch iteration 314/48400: mean batch inertia: 0.925473, ewa inertia: 0.944833
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Minibatch iteration 317/48400: mean batch inertia: 0.924301, ewa inertia: 0.944540
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Minibatch iteration 323/48400: mean batch inertia: 0.935780, ewa inertia: 0.944285

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Minibatch iteration 343/48400: mean batch inertia: 0.920498, ewa inertia: 0.943633
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Minibatch iteration 352/48400: mean batch inertia: 0.946221, ewa inertia:

a: 0.943273
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Minibatch iteration 435/48400: mean batch inertia: 0.932498, ewa inertia: 0.940208
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a: 0.939143
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Minibatch iteration 500/48400: mean batch inertia: 0.931777, ewa inertia: 0.938175
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Minibatch iteration 514/48400: mean batch inertia: 0.933736, ewa inertia: 0.937865
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Minibatch iteration 517/48400: mean batch inertia: 0.931261, ewa inertia: 0.937833
Minibatch iteration 518/48400: mean batch inertia: 0.939519, ewa inertia: 0.937840
Minibatch iteration 519/48400: mean batch inertia: 0.927148, ewa inertia: 0.937796
Minibatch iteration 520/48400: mean batch inertia: 0.927392, ewa inertia: 0.937753
Minibatch iteration 521/48400: mean batch inertia: 0.937216, ewa inertia: 0.937750
Minibatch iteration 522/48400: mean batch inertia: 0.927914, ewa inertia: 0.937710
Minibatch iteration 523/48400: mean batch inertia: 0.938903, ewa inertia:

a: 0.937715
Minibatch iteration 524/48400: mean batch inertia: 0.944755, ewa inertia: 0.937744
Minibatch iteration 525/48400: mean batch inertia: 0.925265, ewa inertia: 0.937692
Minibatch iteration 526/48400: mean batch inertia: 0.939204, ewa inertia: 0.937698
Minibatch iteration 527/48400: mean batch inertia: 0.928199, ewa inertia: 0.937659
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Minibatch iteration 536/48400: mean batch inertia: 0.921937, ewa inertia: 0.937490
Minibatch iteration 537/48400: mean batch inertia: 0.942098, ewa inertia: 0.937509
Minibatch iteration 538/48400: mean batch inertia: 0.948201, ewa inertia: 0.937553
Minibatch iteration 539/48400: mean batch inertia: 0.937872, ewa inertia: 0.937555
Minibatch iteration 540/48400: mean batch inertia: 0.948081, ewa inertia: 0.937598
Minibatch iteration 541/48400: mean batch inertia: 0.930950, ewa inertia: 0.937571
Minibatch iteration 542/48400: mean batch inertia: 0.923674, ewa inertia: 0.937513
Minibatch iteration 543/48400: mean batch inertia: 0.946427, ewa inertia: 0.937550
Minibatch iteration 544/48400: mean batch inertia: 0.929352, ewa inertia: 0.937516
Minibatch iteration 545/48400: mean batch inertia: 0.939569, ewa inertia: 0.937525
Minibatch iteration 546/48400: mean batch inertia: 0.939906, ewa inertia: 0.937534
Converged (lack of improvement in inertia) at iteration 546/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 277.298098
Init 2/3 with method: k-means++
Inertia for init 2/3: 278.042913
Init 3/3 with method: k-means++
Inertia for init 3/3: 278.349828
Minibatch iteration 1/48400: mean batch inertia: 0.968374, ewa inertia: 0.968374

Minibatch iteration 2/48400: mean batch inertia: 0.959730, ewa inertia: 0.968338
Minibatch iteration 3/48400: mean batch inertia: 0.946285, ewa inertia: 0.968247
Minibatch iteration 4/48400: mean batch inertia: 0.958552, ewa inertia: 0.968207
Minibatch iteration 5/48400: mean batch inertia: 0.938704, ewa inertia: 0.968085
Minibatch iteration 6/48400: mean batch inertia: 0.934390, ewa inertia: 0.967946
Minibatch iteration 7/48400: mean batch inertia: 0.949863, ewa inertia: 0.967871
Minibatch iteration 8/48400: mean batch inertia: 0.944908, ewa inertia: 0.967776
Minibatch iteration 9/48400: mean batch inertia: 0.941331, ewa inertia: 0.967667
Minibatch iteration 10/48400: mean batch inertia: 0.937595, ewa inertia: 0.967543
Minibatch iteration 11/48400: mean batch inertia: 0.943841, ewa inertia: 0.967445
Minibatch iteration 12/48400: mean batch inertia: 0.947260, ewa inertia: 0.967361
Minibatch iteration 13/48400: mean batch inertia: 0.956432, ewa inertia: 0.967316
Minibatch iteration 14/48400: mean batch inertia: 0.936569, ewa inertia: 0.967189
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Minibatch iteration 16/48400: mean batch inertia: 0.946718, ewa inertia: 0.966948
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Minibatch iteration 289/48400: mean batch inertia: 0.947404, ewa inertia: 0.943203
Minibatch iteration 290/48400: mean batch inertia: 0.932635, ewa inertia: 0.943160
Minibatch iteration 291/48400: mean batch inertia: 0.917319, ewa inertia: 0.943053
Minibatch iteration 292/48400: mean batch inertia: 0.922314, ewa inertia: 0.942967
Minibatch iteration 293/48400: mean batch inertia: 0.936016, ewa inertia: 0.942938
Minibatch iteration 294/48400: mean batch inertia: 0.925613, ewa inertia: 0.942867
Minibatch iteration 295/48400: mean batch inertia: 0.937747, ewa inertia: 0.942845
Minibatch iteration 296/48400: mean batch inertia: 0.934023, ewa inertia: 0.942809
Minibatch iteration 297/48400: mean batch inertia: 0.931375, ewa inertia: 0.942762
Minibatch iteration 298/48400: mean batch inertia: 0.923135, ewa inertia: 0.942681
Minibatch iteration 299/48400: mean batch inertia: 0.912770, ewa inertia: 0.942557
Minibatch iteration 300/48400: mean batch inertia: 0.928856, ewa inertia: 0.942500
Minibatch iteration 301/48400: mean batch inertia: 0.932967, ewa inertia: 0.942461
Minibatch iteration 302/48400: mean batch inertia: 0.936187, ewa inertia: 0.942435
Minibatch iteration 303/48400: mean batch inertia: 0.930406, ewa inertia: 0.942385
Minibatch iteration 304/48400: mean batch inertia: 0.934904, ewa inertia: 0.942354
Minibatch iteration 305/48400: mean batch inertia: 0.920017, ewa inertia: 0.942262
Minibatch iteration 306/48400: mean batch inertia: 0.931459, ewa inertia: 0.942217
Minibatch iteration 307/48400: mean batch inertia: 0.942171, ewa inertia: 0.942217
Minibatch iteration 308/48400: mean batch inertia: 0.920740, ewa inertia: 0.942128
Minibatch iteration 309/48400: mean batch inertia: 0.936194, ewa inertia: 0.942104
Minibatch iteration 310/48400: mean batch inertia: 0.928886, ewa inertia: 0.942049
Minibatch iteration 311/48400: mean batch inertia: 0.922140, ewa inertia: 0.941967
Minibatch iteration 312/48400: mean batch inertia: 0.932193, ewa inertia: 0.941926
Minibatch iteration 313/48400: mean batch inertia: 0.933831, ewa inertia: 0.941893
Minibatch iteration 314/48400: mean batch inertia: 0.925560, ewa inertia: 0.941825
Minibatch iteration 315/48400: mean batch inertia: 0.935147, ewa inertia:

a: 0.941798
Minibatch iteration 316/48400: mean batch inertia: 0.936415, ewa inertia: 0.941776
Minibatch iteration 317/48400: mean batch inertia: 0.914699, ewa inertia: 0.941664
Minibatch iteration 318/48400: mean batch inertia: 0.918110, ewa inertia: 0.941566
Minibatch iteration 319/48400: mean batch inertia: 0.929032, ewa inertia: 0.941514
Minibatch iteration 320/48400: mean batch inertia: 0.927639, ewa inertia: 0.941457
Minibatch iteration 321/48400: mean batch inertia: 0.930017, ewa inertia: 0.941410
Minibatch iteration 322/48400: mean batch inertia: 0.919947, ewa inertia: 0.941321
Minibatch iteration 323/48400: mean batch inertia: 0.934835, ewa inertia: 0.941294
Minibatch iteration 324/48400: mean batch inertia: 0.939463, ewa inertia: 0.941287
Minibatch iteration 325/48400: mean batch inertia: 0.926696, ewa inertia: 0.941226
Minibatch iteration 326/48400: mean batch inertia: 0.929560, ewa inertia: 0.941178
Minibatch iteration 327/48400: mean batch inertia: 0.908583, ewa inertia: 0.941043
Minibatch iteration 328/48400: mean batch inertia: 0.940639, ewa inertia: 0.941042
Minibatch iteration 329/48400: mean batch inertia: 0.909505, ewa inertia: 0.940911
Minibatch iteration 330/48400: mean batch inertia: 0.923415, ewa inertia: 0.940839
Minibatch iteration 331/48400: mean batch inertia: 0.921609, ewa inertia: 0.940759
Minibatch iteration 332/48400: mean batch inertia: 0.935001, ewa inertia: 0.940736
Minibatch iteration 333/48400: mean batch inertia: 0.902136, ewa inertia: 0.940576
Minibatch iteration 334/48400: mean batch inertia: 0.944954, ewa inertia: 0.940594
Minibatch iteration 335/48400: mean batch inertia: 0.908779, ewa inertia: 0.940463
Minibatch iteration 336/48400: mean batch inertia: 0.930172, ewa inertia: 0.940420
Minibatch iteration 337/48400: mean batch inertia: 0.934455, ewa inertia: 0.940395
Minibatch iteration 338/48400: mean batch inertia: 0.930081, ewa inertia: 0.940353
Minibatch iteration 339/48400: mean batch inertia: 0.931983, ewa inertia: 0.940318
Minibatch iteration 340/48400: mean batch inertia: 0.930926, ewa inertia: 0.940279
Minibatch iteration 341/48400: mean batch inertia: 0.934113, ewa inertia: 0.940254
Minibatch iteration 342/48400: mean batch inertia: 0.932118, ewa inertia: 0.940220
Minibatch iteration 343/48400: mean batch inertia: 0.936839, ewa inertia: 0.940206

Minibatch iteration 344/48400: mean batch inertia: 0.932982, ewa inertia: 0.940176
Minibatch iteration 345/48400: mean batch inertia: 0.923150, ewa inertia: 0.940106
Minibatch iteration 346/48400: mean batch inertia: 0.930243, ewa inertia: 0.940065
Minibatch iteration 347/48400: mean batch inertia: 0.940036, ewa inertia: 0.940065
Minibatch iteration 348/48400: mean batch inertia: 0.920471, ewa inertia: 0.939984
Minibatch iteration 349/48400: mean batch inertia: 0.912412, ewa inertia: 0.939870
Minibatch iteration 350/48400: mean batch inertia: 0.942105, ewa inertia: 0.939879
Minibatch iteration 351/48400: mean batch inertia: 0.929228, ewa inertia: 0.939835
Minibatch iteration 352/48400: mean batch inertia: 0.935237, ewa inertia: 0.939816
Minibatch iteration 353/48400: mean batch inertia: 0.928737, ewa inertia: 0.939770
Minibatch iteration 354/48400: mean batch inertia: 0.929043, ewa inertia: 0.939726
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Minibatch iteration 364/48400: mean batch inertia: 0.932996, ewa inertia: 0.939318
Minibatch iteration 365/48400: mean batch inertia: 0.929622, ewa inertia: 0.939278
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Minibatch iteration 367/48400: mean batch inertia: 0.931590, ewa inertia: 0.939220
Minibatch iteration 368/48400: mean batch inertia: 0.930992, ewa inertia: 0.939186
Minibatch iteration 369/48400: mean batch inertia: 0.936629, ewa inertia: 0.939175
Minibatch iteration 370/48400: mean batch inertia: 0.938583, ewa inertia: 0.939173
Minibatch iteration 371/48400: mean batch inertia: 0.940849, ewa inertia: 0.939180
Minibatch iteration 372/48400: mean batch inertia: 0.920516, ewa inertia:

a: 0.939103
Minibatch iteration 373/48400: mean batch inertia: 0.937797, ewa inertia: 0.939097
Minibatch iteration 374/48400: mean batch inertia: 0.934629, ewa inertia: 0.939079
Minibatch iteration 375/48400: mean batch inertia: 0.915625, ewa inertia: 0.938982
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Minibatch iteration 379/48400: mean batch inertia: 0.923867, ewa inertia: 0.938795
Minibatch iteration 380/48400: mean batch inertia: 0.939840, ewa inertia: 0.938800
Minibatch iteration 381/48400: mean batch inertia: 0.932996, ewa inertia: 0.938776
Minibatch iteration 382/48400: mean batch inertia: 0.951456, ewa inertia: 0.938828
Minibatch iteration 383/48400: mean batch inertia: 0.927390, ewa inertia: 0.938781
Minibatch iteration 384/48400: mean batch inertia: 0.947391, ewa inertia: 0.938816
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Minibatch iteration 387/48400: mean batch inertia: 0.917815, ewa inertia: 0.938695
Minibatch iteration 388/48400: mean batch inertia: 0.919291, ewa inertia: 0.938615
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Minibatch iteration 391/48400: mean batch inertia: 0.918454, ewa inertia: 0.938360
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Minibatch iteration 394/48400: mean batch inertia: 0.914431, ewa inertia: 0.938245
Minibatch iteration 395/48400: mean batch inertia: 0.936795, ewa inertia: 0.938239
Minibatch iteration 396/48400: mean batch inertia: 0.919229, ewa inertia: 0.938160
Minibatch iteration 397/48400: mean batch inertia: 0.931900, ewa inertia: 0.938134
Minibatch iteration 398/48400: mean batch inertia: 0.902843, ewa inertia: 0.937988
Minibatch iteration 399/48400: mean batch inertia: 0.906423, ewa inertia: 0.937858
Minibatch iteration 400/48400: mean batch inertia: 0.923308, ewa inertia: 0.937798

Minibatch iteration 401/48400: mean batch inertia: 0.942488, ewa inertia: 0.937817
Minibatch iteration 402/48400: mean batch inertia: 0.937522, ewa inertia: 0.937816
Minibatch iteration 403/48400: mean batch inertia: 0.941362, ewa inertia: 0.937831
Minibatch iteration 404/48400: mean batch inertia: 0.920964, ewa inertia: 0.937761
Minibatch iteration 405/48400: mean batch inertia: 0.924185, ewa inertia: 0.937705
Minibatch iteration 406/48400: mean batch inertia: 0.933084, ewa inertia: 0.937686
Minibatch iteration 407/48400: mean batch inertia: 0.937736, ewa inertia: 0.937686
Minibatch iteration 408/48400: mean batch inertia: 0.934999, ewa inertia: 0.937675
Minibatch iteration 409/48400: mean batch inertia: 0.936919, ewa inertia: 0.937672
Minibatch iteration 410/48400: mean batch inertia: 0.952005, ewa inertia: 0.937731
Minibatch iteration 411/48400: mean batch inertia: 0.926480, ewa inertia: 0.937684
Minibatch iteration 412/48400: mean batch inertia: 0.929721, ewa inertia: 0.937651
Minibatch iteration 413/48400: mean batch inertia: 0.927102, ewa inertia: 0.937608
Minibatch iteration 414/48400: mean batch inertia: 0.924915, ewa inertia: 0.937555
Minibatch iteration 415/48400: mean batch inertia: 0.916510, ewa inertia: 0.937468
Minibatch iteration 416/48400: mean batch inertia: 0.916083, ewa inertia: 0.937380
Minibatch iteration 417/48400: mean batch inertia: 0.931046, ewa inertia: 0.937354
Minibatch iteration 418/48400: mean batch inertia: 0.927213, ewa inertia: 0.937312
Minibatch iteration 419/48400: mean batch inertia: 0.928744, ewa inertia: 0.937276
Minibatch iteration 420/48400: mean batch inertia: 0.920528, ewa inertia: 0.937207
Minibatch iteration 421/48400: mean batch inertia: 0.924168, ewa inertia: 0.937153
Minibatch iteration 422/48400: mean batch inertia: 0.937240, ewa inertia: 0.937154
Minibatch iteration 423/48400: mean batch inertia: 0.935601, ewa inertia: 0.937147
Minibatch iteration 424/48400: mean batch inertia: 0.917159, ewa inertia: 0.937064
Minibatch iteration 425/48400: mean batch inertia: 0.925285, ewa inertia: 0.937016
Minibatch iteration 426/48400: mean batch inertia: 0.927422, ewa inertia: 0.936976
Minibatch iteration 427/48400: mean batch inertia: 0.931167, ewa inertia: 0.936952
Minibatch iteration 428/48400: mean batch inertia: 0.920073, ewa inertia: 0.936882
Minibatch iteration 429/48400: mean batch inertia: 0.923788, ewa inertia:

a: 0.936828
Minibatch iteration 430/48400: mean batch inertia: 0.925936, ewa inertia: 0.936783
Minibatch iteration 431/48400: mean batch inertia: 0.935991, ewa inertia: 0.936780
Minibatch iteration 432/48400: mean batch inertia: 0.917045, ewa inertia: 0.936698
Minibatch iteration 433/48400: mean batch inertia: 0.932419, ewa inertia: 0.936681
Minibatch iteration 434/48400: mean batch inertia: 0.915166, ewa inertia: 0.936592
Minibatch iteration 435/48400: mean batch inertia: 0.931408, ewa inertia: 0.936570
Minibatch iteration 436/48400: mean batch inertia: 0.929910, ewa inertia: 0.936543
Minibatch iteration 437/48400: mean batch inertia: 0.940318, ewa inertia: 0.936558
Minibatch iteration 438/48400: mean batch inertia: 0.918318, ewa inertia: 0.936483
Minibatch iteration 439/48400: mean batch inertia: 0.926346, ewa inertia: 0.936441
Minibatch iteration 440/48400: mean batch inertia: 0.943699, ewa inertia: 0.936471
Minibatch iteration 441/48400: mean batch inertia: 0.918055, ewa inertia: 0.936395
Minibatch iteration 442/48400: mean batch inertia: 0.916386, ewa inertia: 0.936312
Minibatch iteration 443/48400: mean batch inertia: 0.914758, ewa inertia: 0.936223
Minibatch iteration 444/48400: mean batch inertia: 0.927135, ewa inertia: 0.936185
Minibatch iteration 445/48400: mean batch inertia: 0.942427, ewa inertia: 0.936211
Minibatch iteration 446/48400: mean batch inertia: 0.934273, ewa inertia: 0.936203
Minibatch iteration 447/48400: mean batch inertia: 0.916108, ewa inertia: 0.936120
Minibatch iteration 448/48400: mean batch inertia: 0.940331, ewa inertia: 0.936138
Minibatch iteration 449/48400: mean batch inertia: 0.913039, ewa inertia: 0.936042
Minibatch iteration 450/48400: mean batch inertia: 0.938840, ewa inertia: 0.936054
Minibatch iteration 451/48400: mean batch inertia: 0.939413, ewa inertia: 0.936068
Minibatch iteration 452/48400: mean batch inertia: 0.940086, ewa inertia: 0.936084
Minibatch iteration 453/48400: mean batch inertia: 0.928745, ewa inertia: 0.936054
Minibatch iteration 454/48400: mean batch inertia: 0.927745, ewa inertia: 0.936019
Minibatch iteration 455/48400: mean batch inertia: 0.925372, ewa inertia: 0.935975
Minibatch iteration 456/48400: mean batch inertia: 0.928303, ewa inertia: 0.935944
Minibatch iteration 457/48400: mean batch inertia: 0.924135, ewa inertia: 0.935895

Minibatch iteration 458/48400: mean batch inertia: 0.929617, ewa inertia: 0.935869
Minibatch iteration 459/48400: mean batch inertia: 0.938770, ewa inertia: 0.935881
Minibatch iteration 460/48400: mean batch inertia: 0.938025, ewa inertia: 0.935890
Minibatch iteration 461/48400: mean batch inertia: 0.920068, ewa inertia: 0.935824
Minibatch iteration 462/48400: mean batch inertia: 0.938112, ewa inertia: 0.935834
Minibatch iteration 463/48400: mean batch inertia: 0.931029, ewa inertia: 0.935814
Minibatch iteration 464/48400: mean batch inertia: 0.936050, ewa inertia: 0.935815
Minibatch iteration 465/48400: mean batch inertia: 0.918961, ewa inertia: 0.935745
Minibatch iteration 466/48400: mean batch inertia: 0.931989, ewa inertia: 0.935730
Minibatch iteration 467/48400: mean batch inertia: 0.917118, ewa inertia: 0.935653
Minibatch iteration 468/48400: mean batch inertia: 0.943044, ewa inertia: 0.935683
Minibatch iteration 469/48400: mean batch inertia: 0.926596, ewa inertia: 0.935646
Minibatch iteration 470/48400: mean batch inertia: 0.932632, ewa inertia: 0.935633
Minibatch iteration 471/48400: mean batch inertia: 0.915062, ewa inertia: 0.935548
Minibatch iteration 472/48400: mean batch inertia: 0.920700, ewa inertia: 0.935487
Minibatch iteration 473/48400: mean batch inertia: 0.930942, ewa inertia: 0.935468
Minibatch iteration 474/48400: mean batch inertia: 0.934333, ewa inertia: 0.935463
Minibatch iteration 475/48400: mean batch inertia: 0.927781, ewa inertia: 0.935432
Minibatch iteration 476/48400: mean batch inertia: 0.945436, ewa inertia: 0.935473
Minibatch iteration 477/48400: mean batch inertia: 0.933270, ewa inertia: 0.935464
Minibatch iteration 478/48400: mean batch inertia: 0.918336, ewa inertia: 0.935393
Minibatch iteration 479/48400: mean batch inertia: 0.922868, ewa inertia: 0.935341
Minibatch iteration 480/48400: mean batch inertia: 0.940093, ewa inertia: 0.935361
Minibatch iteration 481/48400: mean batch inertia: 0.935626, ewa inertia: 0.935362
Minibatch iteration 482/48400: mean batch inertia: 0.943576, ewa inertia: 0.935396
Minibatch iteration 483/48400: mean batch inertia: 0.933729, ewa inertia: 0.935389
Minibatch iteration 484/48400: mean batch inertia: 0.931499, ewa inertia: 0.935373
Minibatch iteration 485/48400: mean batch inertia: 0.936384, ewa inertia: 0.935377
Minibatch iteration 486/48400: mean batch inertia: 0.936148, ewa inertia:


```
a: 0.935380
Minibatch iteration 487/48400: mean batch inertia: 0.941088, ewa inertia: 0.935404
Minibatch iteration 488/48400: mean batch inertia: 0.937738, ewa inertia: 0.935414
Minibatch iteration 489/48400: mean batch inertia: 0.937373, ewa inertia: 0.935422
Converged (lack of improvement in inertia) at iteration 489/48400
Computing label assignment and total inertia
Init 1/3 with method: k-means++
Inertia for init 1/3: 275.333400
Init 2/3 with method: k-means++
Inertia for init 2/3: 276.986619
Init 3/3 with method: k-means++
Inertia for init 3/3: 274.451086
Minibatch iteration 1/48400: mean batch inertia: 0.950170, ewa inertia: 0.950170
Minibatch iteration 2/48400: mean batch inertia: 0.955065, ewa inertia: 0.950190
Minibatch iteration 3/48400: mean batch inertia: 0.950864, ewa inertia: 0.950193
Minibatch iteration 4/48400: mean batch inertia: 0.950412, ewa inertia: 0.950194
Minibatch iteration 5/48400: mean batch inertia: 0.950229, ewa inertia: 0.950194
Minibatch iteration 6/48400: mean batch inertia: 0.940848, ewa inertia: 0.950155
Minibatch iteration 7/48400: mean batch inertia: 0.940561, ewa inertia: 0.950115
Minibatch iteration 8/48400: mean batch inertia: 0.947897, ewa inertia: 0.950106
Minibatch iteration 9/48400: mean batch inertia: 0.954369, ewa inertia: 0.950124
Minibatch iteration 10/48400: mean batch inertia: 0.945742, ewa inertia: 0.950106
Minibatch iteration 11/48400: mean batch inertia: 0.936999, ewa inertia: 0.950052
Minibatch iteration 12/48400: mean batch inertia: 0.927980, ewa inertia: 0.949960
Minibatch iteration 13/48400: mean batch inertia: 0.951605, ewa inertia: 0.949967
Minibatch iteration 14/48400: mean batch inertia: 0.940612, ewa inertia: 0.949928
Minibatch iteration 15/48400: mean batch inertia: 0.932337, ewa inertia: 0.949856
Minibatch iteration 16/48400: mean batch inertia: 0.931985, ewa inertia: 0.949782
Minibatch iteration 17/48400: mean batch inertia: 0.932764, ewa inertia: 0.949711
Minibatch iteration 18/48400: mean batch inertia: 0.921715, ewa inertia: 0.949596
Minibatch iteration 19/48400: mean batch inertia: 0.944811, ewa inertia: 0.949576
Minibatch iteration 20/48400: mean batch inertia: 0.933146, ewa inertia: 0.949508
Minibatch iteration 21/48400: mean batch inertia: 0.935212, ewa inertia: 0.949449
```

Minibatch iteration 22/48400: mean batch inertia: 0.926325, ewa inertia: 0.949353
Minibatch iteration 23/48400: mean batch inertia: 0.934105, ewa inertia: 0.949290
Minibatch iteration 24/48400: mean batch inertia: 0.934957, ewa inertia: 0.949231
Minibatch iteration 25/48400: mean batch inertia: 0.934478, ewa inertia: 0.949170
Minibatch iteration 26/48400: mean batch inertia: 0.919223, ewa inertia: 0.949046
Minibatch iteration 27/48400: mean batch inertia: 0.927017, ewa inertia: 0.948955
Minibatch iteration 28/48400: mean batch inertia: 0.937451, ewa inertia: 0.948908
Minibatch iteration 29/48400: mean batch inertia: 0.936578, ewa inertia: 0.948857
Minibatch iteration 30/48400: mean batch inertia: 0.942859, ewa inertia: 0.948832
Minibatch iteration 31/48400: mean batch inertia: 0.939395, ewa inertia: 0.948793
Minibatch iteration 32/48400: mean batch inertia: 0.928254, ewa inertia: 0.948708
Minibatch iteration 33/48400: mean batch inertia: 0.942724, ewa inertia: 0.948683
Minibatch iteration 34/48400: mean batch inertia: 0.919040, ewa inertia: 0.948561
Minibatch iteration 35/48400: mean batch inertia: 0.919023, ewa inertia: 0.948438
Minibatch iteration 36/48400: mean batch inertia: 0.939263, ewa inertia: 0.948401
Minibatch iteration 37/48400: mean batch inertia: 0.920289, ewa inertia: 0.948284
Minibatch iteration 38/48400: mean batch inertia: 0.924199, ewa inertia: 0.948185
Minibatch iteration 39/48400: mean batch inertia: 0.925699, ewa inertia: 0.948092
Minibatch iteration 40/48400: mean batch inertia: 0.951141, ewa inertia: 0.948104
Minibatch iteration 41/48400: mean batch inertia: 0.912049, ewa inertia: 0.947955
Minibatch iteration 42/48400: mean batch inertia: 0.947501, ewa inertia: 0.947953
Minibatch iteration 43/48400: mean batch inertia: 0.947146, ewa inertia: 0.947950
Minibatch iteration 44/48400: mean batch inertia: 0.929523, ewa inertia: 0.947874
Minibatch iteration 45/48400: mean batch inertia: 0.927418, ewa inertia: 0.947789
Minibatch iteration 46/48400: mean batch inertia: 0.937456, ewa inertia: 0.947747
Minibatch iteration 47/48400: mean batch inertia: 0.936192, ewa inertia: 0.947699
Minibatch iteration 48/48400: mean batch inertia: 0.940933, ewa inertia: 0.947671
Minibatch iteration 49/48400: mean batch inertia: 0.919772, ewa inertia: 0.947556
Minibatch iteration 50/48400: mean batch inertia: 0.944978, ewa inertia: 0.947556

a: 0.947545
Minibatch iteration 51/48400: mean batch inertia: 0.915199, ewa inertia: 0.947411
[MiniBatchKMeans] Reassigning 1 cluster centers.
Minibatch iteration 52/48400: mean batch inertia: 0.938514, ewa inertia: 0.947374
Minibatch iteration 53/48400: mean batch inertia: 0.954817, ewa inertia: 0.947405
Minibatch iteration 54/48400: mean batch inertia: 0.935068, ewa inertia: 0.947354
Minibatch iteration 55/48400: mean batch inertia: 0.921099, ewa inertia: 0.947246
Minibatch iteration 56/48400: mean batch inertia: 0.931477, ewa inertia: 0.947180
Minibatch iteration 57/48400: mean batch inertia: 0.944395, ewa inertia: 0.947169
Minibatch iteration 58/48400: mean batch inertia: 0.915253, ewa inertia: 0.947037
Minibatch iteration 59/48400: mean batch inertia: 0.933926, ewa inertia: 0.946983
Minibatch iteration 60/48400: mean batch inertia: 0.944951, ewa inertia: 0.946974
Minibatch iteration 61/48400: mean batch inertia: 0.927965, ewa inertia: 0.946896
Minibatch iteration 62/48400: mean batch inertia: 0.919545, ewa inertia: 0.946783
Minibatch iteration 63/48400: mean batch inertia: 0.933652, ewa inertia: 0.946728
Minibatch iteration 64/48400: mean batch inertia: 0.933933, ewa inertia: 0.946675
Minibatch iteration 65/48400: mean batch inertia: 0.945120, ewa inertia: 0.946669
Minibatch iteration 66/48400: mean batch inertia: 0.916755, ewa inertia: 0.946545
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Minibatch iteration 339/48400: mean batch inertia: 0.933889, ewa inertia: 0.936113
Minibatch iteration 340/48400: mean batch inertia: 0.932224, ewa inertia: 0.936097
Minibatch iteration 341/48400: mean batch inertia: 0.917187, ewa inertia: 0.936019
Minibatch iteration 342/48400: mean batch inertia: 0.931004, ewa inertia: 0.935998
Minibatch iteration 343/48400: mean batch inertia: 0.928997, ewa inertia: 0.935969
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Minibatch iteration 346/48400: mean batch inertia: 0.920791, ewa inertia: 0.935872
Minibatch iteration 347/48400: mean batch inertia: 0.939417, ewa inertia: 0.935887
Minibatch iteration 348/48400: mean batch inertia: 0.937296, ewa inertia: 0.935893
Minibatch iteration 349/48400: mean batch inertia: 0.926103, ewa inertia: 0.935852
Minibatch iteration 350/48400: mean batch inertia: 0.916529, ewa inertia: 0.935772
Minibatch iteration 351/48400: mean batch inertia: 0.937295, ewa inertia: 0.935779
Minibatch iteration 352/48400: mean batch inertia: 0.929135, ewa inertia: 0.935751
Minibatch iteration 353/48400: mean batch inertia: 0.902172, ewa inertia: 0.935612
Minibatch iteration 354/48400: mean batch inertia: 0.941628, ewa inertia: 0.935637
Minibatch iteration 355/48400: mean batch inertia: 0.931267, ewa inertia: 0.935619
Minibatch iteration 356/48400: mean batch inertia: 0.927279, ewa inertia: 0.935585
Minibatch iteration 357/48400: mean batch inertia: 0.925538, ewa inertia: 0.935543
Minibatch iteration 358/48400: mean batch inertia: 0.938727, ewa inertia: 0.935556
Minibatch iteration 359/48400: mean batch inertia: 0.916280, ewa inertia: 0.935476
Minibatch iteration 360/48400: mean batch inertia: 0.938358, ewa inertia: 0.935488
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Minibatch iteration 362/48400: mean batch inertia: 0.931147, ewa inertia: 0.935406
Minibatch iteration 363/48400: mean batch inertia: 0.929225, ewa inertia:

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Minibatch iteration 366/48400: mean batch inertia: 0.941621, ewa inertia: 0.935347
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Minibatch iteration 368/48400: mean batch inertia: 0.924484, ewa inertia: 0.935230
Minibatch iteration 369/48400: mean batch inertia: 0.929974, ewa inertia: 0.935208
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Minibatch iteration 377/48400: mean batch inertia: 0.930764, ewa inertia: 0.934874
Minibatch iteration 378/48400: mean batch inertia: 0.942647, ewa inertia: 0.934906
Minibatch iteration 379/48400: mean batch inertia: 0.935311, ewa inertia: 0.934908
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Minibatch iteration 387/48400: mean batch inertia: 0.937745, ewa inertia: 0.934699
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Minibatch iteration 389/48400: mean batch inertia: 0.918786, ewa inertia: 0.934628
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Minibatch iteration 391/48400: mean batch inertia: 0.934459, ewa inertia: 0.934573

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Minibatch iteration 393/48400: mean batch inertia: 0.917423, ewa inertia: 0.934486
Minibatch iteration 394/48400: mean batch inertia: 0.936889, ewa inertia: 0.934496
Minibatch iteration 395/48400: mean batch inertia: 0.945954, ewa inertia: 0.934543
Minibatch iteration 396/48400: mean batch inertia: 0.931452, ewa inertia: 0.934530
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Minibatch iteration 412/48400: mean batch inertia: 0.937885, ewa inertia: 0.934149
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Minibatch iteration 415/48400: mean batch inertia: 0.933112, ewa inertia: 0.934068
Minibatch iteration 416/48400: mean batch inertia: 0.924207, ewa inertia: 0.934027
Minibatch iteration 417/48400: mean batch inertia: 0.915741, ewa inertia: 0.933951
Minibatch iteration 418/48400: mean batch inertia: 0.928457, ewa inertia: 0.933929
Minibatch iteration 419/48400: mean batch inertia: 0.922875, ewa inertia: 0.933883
Minibatch iteration 420/48400: mean batch inertia: 0.923834, ewa inertia:

a: 0.933841
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Minibatch iteration 424/48400: mean batch inertia: 0.923406, ewa inertia: 0.933719
Minibatch iteration 425/48400: mean batch inertia: 0.922216, ewa inertia: 0.933671
Minibatch iteration 426/48400: mean batch inertia: 0.914839, ewa inertia: 0.933593
Minibatch iteration 427/48400: mean batch inertia: 0.902160, ewa inertia: 0.933463
Minibatch iteration 428/48400: mean batch inertia: 0.943625, ewa inertia: 0.933505
Minibatch iteration 429/48400: mean batch inertia: 0.937346, ewa inertia: 0.933521
Minibatch iteration 430/48400: mean batch inertia: 0.923548, ewa inertia: 0.933480
Minibatch iteration 431/48400: mean batch inertia: 0.940008, ewa inertia: 0.933507
Minibatch iteration 432/48400: mean batch inertia: 0.926204, ewa inertia: 0.933477
Minibatch iteration 433/48400: mean batch inertia: 0.929914, ewa inertia: 0.933462
Minibatch iteration 434/48400: mean batch inertia: 0.930699, ewa inertia: 0.933450
Minibatch iteration 435/48400: mean batch inertia: 0.934168, ewa inertia: 0.933453
Minibatch iteration 436/48400: mean batch inertia: 0.918071, ewa inertia: 0.933390
Minibatch iteration 437/48400: mean batch inertia: 0.928251, ewa inertia: 0.933369
Minibatch iteration 438/48400: mean batch inertia: 0.935452, ewa inertia: 0.933377
Minibatch iteration 439/48400: mean batch inertia: 0.921843, ewa inertia: 0.933330
Minibatch iteration 440/48400: mean batch inertia: 0.943125, ewa inertia: 0.933370
Minibatch iteration 441/48400: mean batch inertia: 0.930305, ewa inertia: 0.933357
Minibatch iteration 442/48400: mean batch inertia: 0.918370, ewa inertia: 0.933295
Minibatch iteration 443/48400: mean batch inertia: 0.936268, ewa inertia: 0.933308
Minibatch iteration 444/48400: mean batch inertia: 0.929081, ewa inertia: 0.933290
Minibatch iteration 445/48400: mean batch inertia: 0.933846, ewa inertia: 0.933292
Minibatch iteration 446/48400: mean batch inertia: 0.939019, ewa inertia: 0.933316
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Minibatch iteration 448/48400: mean batch inertia: 0.920720, ewa inertia: 0.933300

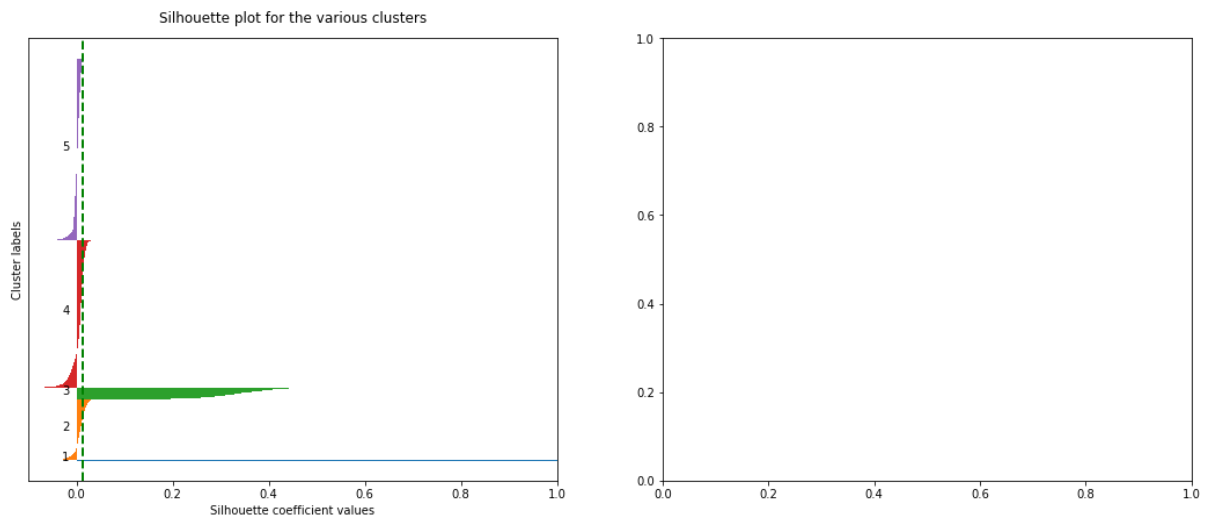
Minibatch iteration 449/48400: mean batch inertia: 0.922834, ewa inertia: 0.933257
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Minibatch iteration 451/48400: mean batch inertia: 0.926620, ewa inertia: 0.933234
Minibatch iteration 452/48400: mean batch inertia: 0.948241, ewa inertia: 0.933296
Minibatch iteration 453/48400: mean batch inertia: 0.913316, ewa inertia: 0.933213
Minibatch iteration 454/48400: mean batch inertia: 0.938035, ewa inertia: 0.933233
Minibatch iteration 455/48400: mean batch inertia: 0.936492, ewa inertia: 0.933247
Minibatch iteration 456/48400: mean batch inertia: 0.913845, ewa inertia: 0.933166
Minibatch iteration 457/48400: mean batch inertia: 0.941864, ewa inertia: 0.933202
Minibatch iteration 458/48400: mean batch inertia: 0.928011, ewa inertia: 0.933181
Minibatch iteration 459/48400: mean batch inertia: 0.928883, ewa inertia: 0.933163
Minibatch iteration 460/48400: mean batch inertia: 0.937935, ewa inertia: 0.933183
Minibatch iteration 461/48400: mean batch inertia: 0.942154, ewa inertia: 0.933220
Minibatch iteration 462/48400: mean batch inertia: 0.947119, ewa inertia: 0.933277
Minibatch iteration 463/48400: mean batch inertia: 0.925232, ewa inertia: 0.933244
Minibatch iteration 464/48400: mean batch inertia: 0.940412, ewa inertia: 0.933274
Minibatch iteration 465/48400: mean batch inertia: 0.930817, ewa inertia: 0.933264
Minibatch iteration 466/48400: mean batch inertia: 0.929766, ewa inertia: 0.933249
Minibatch iteration 467/48400: mean batch inertia: 0.933642, ewa inertia: 0.933251
Minibatch iteration 468/48400: mean batch inertia: 0.906735, ewa inertia: 0.933141
Minibatch iteration 469/48400: mean batch inertia: 0.917168, ewa inertia: 0.933075
Minibatch iteration 470/48400: mean batch inertia: 0.927963, ewa inertia: 0.933054
Minibatch iteration 471/48400: mean batch inertia: 0.929207, ewa inertia: 0.933038
Minibatch iteration 472/48400: mean batch inertia: 0.932683, ewa inertia: 0.933037
Minibatch iteration 473/48400: mean batch inertia: 0.926887, ewa inertia: 0.933011
Minibatch iteration 474/48400: mean batch inertia: 0.952087, ewa inertia: 0.933090
Minibatch iteration 475/48400: mean batch inertia: 0.939515, ewa inertia: 0.933117
Minibatch iteration 476/48400: mean batch inertia: 0.931546, ewa inertia: 0.933110
Minibatch iteration 477/48400: mean batch inertia: 0.922218, ewa inertia:

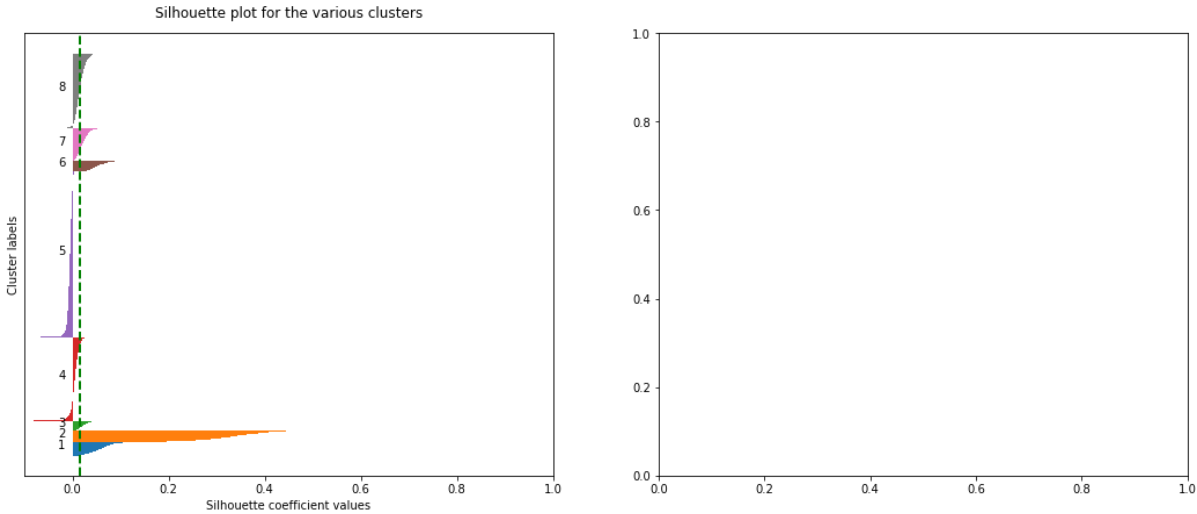
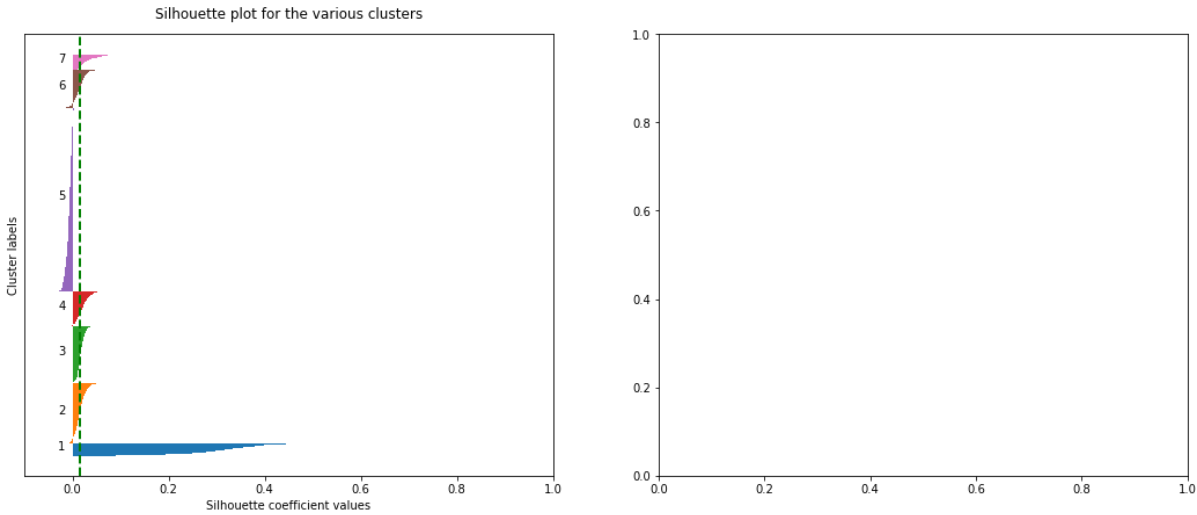
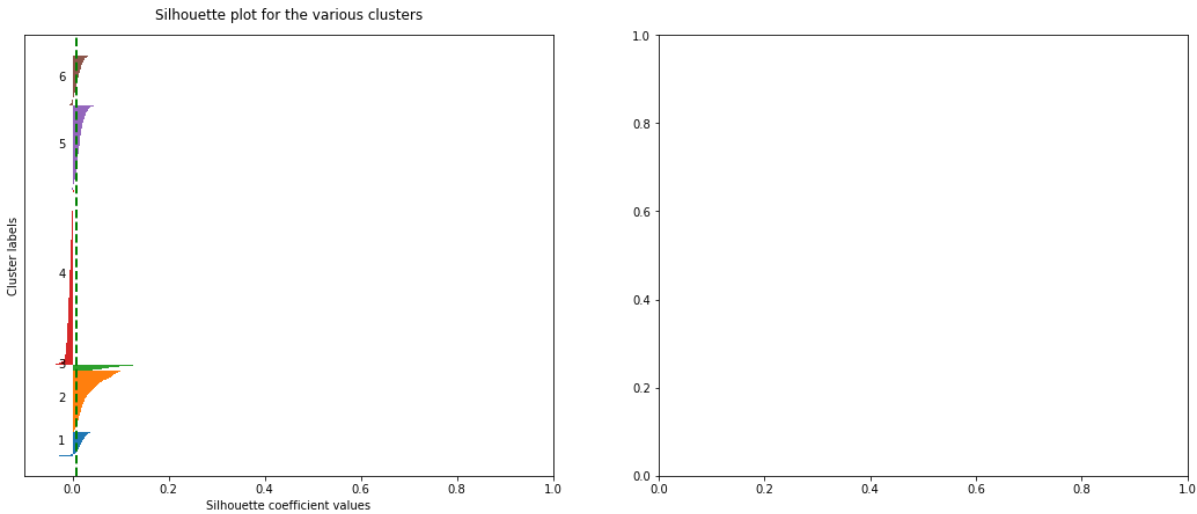
a: 0.933065
Minibatch iteration 478/48400: mean batch inertia: 0.923147, ewa inertia: 0.933024
Minibatch iteration 479/48400: mean batch inertia: 0.933001, ewa inertia: 0.933024
Minibatch iteration 480/48400: mean batch inertia: 0.945456, ewa inertia: 0.933075
Minibatch iteration 481/48400: mean batch inertia: 0.922719, ewa inertia: 0.933033
Minibatch iteration 482/48400: mean batch inertia: 0.923230, ewa inertia: 0.932992
Minibatch iteration 483/48400: mean batch inertia: 0.943736, ewa inertia: 0.933036
Minibatch iteration 484/48400: mean batch inertia: 0.936929, ewa inertia: 0.933053
Minibatch iteration 485/48400: mean batch inertia: 0.932934, ewa inertia: 0.933052
Minibatch iteration 486/48400: mean batch inertia: 0.909721, ewa inertia: 0.932956
Minibatch iteration 487/48400: mean batch inertia: 0.899063, ewa inertia: 0.932815
Minibatch iteration 488/48400: mean batch inertia: 0.933519, ewa inertia: 0.932818
Minibatch iteration 489/48400: mean batch inertia: 0.917642, ewa inertia: 0.932756
Minibatch iteration 490/48400: mean batch inertia: 0.933594, ewa inertia: 0.932759
Minibatch iteration 491/48400: mean batch inertia: 0.928976, ewa inertia: 0.932743
Minibatch iteration 492/48400: mean batch inertia: 0.928488, ewa inertia: 0.932726
Minibatch iteration 493/48400: mean batch inertia: 0.928906, ewa inertia: 0.932710
Minibatch iteration 494/48400: mean batch inertia: 0.940542, ewa inertia: 0.932742
Minibatch iteration 495/48400: mean batch inertia: 0.931422, ewa inertia: 0.932737
Minibatch iteration 496/48400: mean batch inertia: 0.935738, ewa inertia: 0.932749
Minibatch iteration 497/48400: mean batch inertia: 0.937122, ewa inertia: 0.932767
Minibatch iteration 498/48400: mean batch inertia: 0.927337, ewa inertia: 0.932745
Minibatch iteration 499/48400: mean batch inertia: 0.910620, ewa inertia: 0.932654
Minibatch iteration 500/48400: mean batch inertia: 0.914735, ewa inertia: 0.932579
Minibatch iteration 501/48400: mean batch inertia: 0.905857, ewa inertia: 0.932469
Minibatch iteration 502/48400: mean batch inertia: 0.930416, ewa inertia: 0.932460
Minibatch iteration 503/48400: mean batch inertia: 0.924033, ewa inertia: 0.932426
Minibatch iteration 504/48400: mean batch inertia: 0.939393, ewa inertia: 0.932454
Minibatch iteration 505/48400: mean batch inertia: 0.940544, ewa inertia: 0.932488

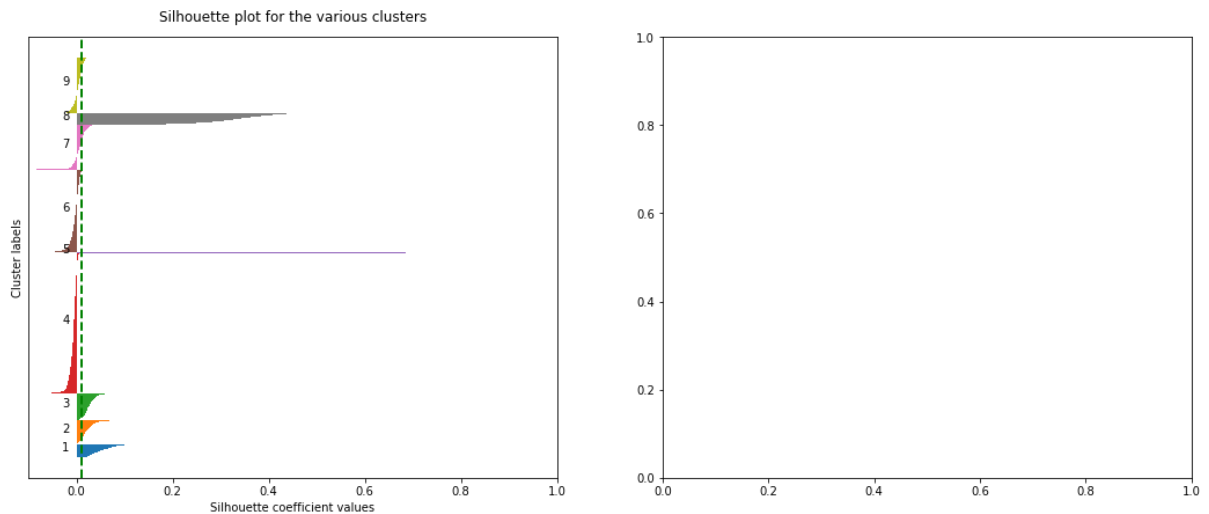
```

Minibatch iteration 506/48400: mean batch inertia: 0.923240, ewa inertia: 0.932450
Minibatch iteration 507/48400: mean batch inertia: 0.922261, ewa inertia: 0.932408
Minibatch iteration 508/48400: mean batch inertia: 0.928829, ewa inertia: 0.932393
Minibatch iteration 509/48400: mean batch inertia: 0.922615, ewa inertia: 0.932352
Minibatch iteration 510/48400: mean batch inertia: 0.934828, ewa inertia: 0.932363
Minibatch iteration 511/48400: mean batch inertia: 0.945977, ewa inertia: 0.932419
Minibatch iteration 512/48400: mean batch inertia: 0.932349, ewa inertia: 0.932419
Minibatch iteration 513/48400: mean batch inertia: 0.941705, ewa inertia: 0.932457
Minibatch iteration 514/48400: mean batch inertia: 0.919606, ewa inertia: 0.932404
Minibatch iteration 515/48400: mean batch inertia: 0.934107, ewa inertia: 0.932411
Minibatch iteration 516/48400: mean batch inertia: 0.929963, ewa inertia: 0.932401
Minibatch iteration 517/48400: mean batch inertia: 0.945148, ewa inertia: 0.932453
Minibatch iteration 518/48400: mean batch inertia: 0.937402, ewa inertia: 0.932474
Minibatch iteration 519/48400: mean batch inertia: 0.945140, ewa inertia: 0.932526
Converged (lack of improvement in inertia) at iteration 519/48400
Computing label assignment and total inertia
CPU times: user 11min 40s, sys: 1min 36s, total: 13min 16s
Wall time: 13min 28s

```







Clustering using k-means

- We have used k-means clustering method to cluster documents in our project as it can perform well with large datasets
- Since, we deal with clusters having different shapes, densities and sizes, K-means is the best choice of clustering algorithm.
- We have assigned cluster number to every document after clustering.
- The function returns a dataframe with the document id and assigned cluster number.

```
In [39]: number_of_cluster = 7
```

```
In [88]: def create_cluster(all_features):
    # Provided a random state so that the Kmeans provides the same output everytime we run it.
    kmcl = KMeans(n_clusters=number_of_cluster, verbose = 10, random_state=42, n_jobs=-1)
    kmcl.fit(all_features)
    cluster_labels = kmcl.labels_
    cluster_ids = pd.DataFrame(cluster_labels, columns=['Cluster ID'])
    cluster_ids.index.name = 'Doc_ID'
    doc_id = list(range(0, len(kmcl.labels_)))
    doc_values = dict()
    # Creating a dictionary with cluster id as key and list of documents associated with the cluster as value.
    for i in doc_id:
        if kmcl.labels_[i] in doc_values:
            doc_values[kmcl.labels_[i]].append(i)
        else:
            doc_values[kmcl.labels_[i]] = [i]
    return kmcl, doc_values, cluster_ids
```

```
In [89]: kmcl, doc_values, cluster_ids = create_cluster(all_features)
```

Function to evaluate the quality of the clusters using the silhouette score

```
In [92]: #Function to evaluate the cluster score.
def evaluate_cluster(cluster_model, values):
    labels = cluster_model.labels_
    score = silhouette_score(values, labels, metric='euclidean')
    return score
```

```
In [96]: # As mentioned above, we are using Tfidf due to which the silhouette score is low.
print('Average Silhouette score for the clusters: ', evaluate_cluster(kmc1, all_features))
```

Average Silhouette score for the clusters: 0.017982874867146146

Training a different classifier for each cluster

(using k-fold cross validation)

- In this we have selected all the 5 classifiers used in the first assignment and applied them to different clusters in repeating way. i.e after first 5 classifiers, it will again start with the first classifier for the next cluster.
- As MNBClassifier and SVMClassifier cannot handle multiple labels by default, we have used OneVsRestClassifier so that both of these classifiers can work properly with our multi-label documents.
- We have made sure that we use the best possible parameters for each classifier based on our first assignment results. ie. kernel='linear' for SVC and solver='adam' for MLPClassifier.
- We have also made sure that we trained each classifier with 10 KFold. We have used 'accuracy' as the measure to evaluate the classifiers, as we have used the same for the deep neural network in Keras model.

```
In [59]: def get_accuracy_score(classifier, X_test, y_test):
y_pred = classifier.predict(X_test)
score = accuracy_score(y_test, y_pred)
return score
```

```

In [99]: def classifier_for_cluster(doc_values,classifiers):
    classifiers_index = 0
    #going through every clusters
    for i in range(0,number_of_cluster):
        documents = doc_values.get(i)
        features=None
        clust_labels = []
        #going through every documents in the cluster
        for j in documents:
            if(features is None):
                features = all_features[j]
            else:
                a = features
                b = all_features[j]
                features = vstack((a,b))
            clust_labels.append(multi_labels[j])
        if(classifiers_index == len(classifiers)):
            classifiers_index = 0
        classifier = classifiers[classifiers_index]
        classifiers_index = classifiers_index + 1
        kfold_number = 10
        #Performing K-Folds
        kf = KFold(n_splits=kfold_number)
        kf.get_n_splits(features)
        classifier_score = []
        clust_labels = np.array(clust_labels)
        for train_index, test_index in kf.split(features):
            X_train, X_test = features[train_index], features[test_index]

            y_train, y_test = clust_labels[train_index], clust_labels[test_index]

            classifier.fit(X_train,y_train)
            classifier_score.append(get_accuracy_score(classifier,X_test,y_test))

        cluster_classifier_score.append(sum(classifier_score)/kfold_number)

        print("Classifier Score for cluster",i+1," : ",sum(classifier_score)/kfold_number)

```

```
In [100]: # Creating a list of classifiers to train on the clusters data
classifiers = []
MNB_classifier = OneVsRestClassifier(MultinomialNB(alpha=0.005))
DT_classifier = DecisionTreeClassifier(random_state=1000)
RF_classifier = RandomForestClassifier(random_state=1000,n_estimators=200,n_jobs=-1)
SVC_classifier = OneVsRestClassifier(SVC(kernel='linear'))
NN_classifier = MLPClassifier(solver='adam')
classifiers.append(MNB_classifier)
classifiers.append(SVC_classifier)
classifiers.append(RF_classifier)
classifiers.append(DT_classifier)
classifiers.append(NN_classifier)

classifiers_index = 0
cluster_classifier_score = []

classifier_for_cluster(doc_values,classifiers)
```

```
Classifier Score for cluster 1 : 0.3662815117102525
Classifier Score for cluster 2 : 0.8529660643659613
Classifier Score for cluster 3 : 0.41145061289987805
Classifier Score for cluster 4 : 0.3183756807038098
Classifier Score for cluster 5 : 0.7253415920946183
Classifier Score for cluster 6 : 0.6390188447799644
Classifier Score for cluster 7 : 0.8517699115044248
```


Function to Extract meaningful features using Deep Autoencoder

- We applied Autoencoder based on the Paper-1: Liang, Hong et al. "Text feature extraction based on deep learning: a review." EURASIP journal on wireless communications and networking vol. 2017,1 (2017): 211. doi:10.1186/s13638-017-0993-1
- In this paper the author has explained various deep learning methods that can be used for the feature extractions. There were multiple options provided but as our data was purely based on text data, we decided to go with deep autoencoder to extract feature from the given set of text data.
- We have created a deep autoencoder that takes the features of every cluster and returns the encoded features which is exactly half the size of the passed feature size.
- In the deep autoencoder we have used 3 layers for encoding the features and 3 layers for decoding the features.
- We have used l1 & l2 regularizers to reduce the loss of the autoencoder and hence prevent overfitting and provide the best feature extraction.
- We can see a significant reduction in the loss when we train the autoencoder. This helps to improve the encoder performance
- For all of the layers(except the last one in the decoder layer) in the autoencoder we used 'relu' as our activation, as it helps the model to train faster and is the one recommended by the Keras team.
- 'relu' also provides a wider range to encode the features and it does not adjust the encoded value due to a broad range.
- The TfidfVectorizer converts the features into a sparse matrix containing values ranging from 0 to 1.
- We used loss='binary_crossentropy' because the input features have a range of 0 to 1 and the output features are to be decoded in the same range.
- For the last layer we used 'sigmoid' because, when the input features have a range of 0 to 1, it is recommended to use the activation function of the last layer as 'sigmoid'
- We used optimizer='adam' because Adam is the best optimizer when we are working large datasets having huge number of features as in our case. 'Adam' also produces outcomes faster compared to other optimizers, and is memory efficient. Hence preferred for deep networks

```

In [61]: def get_autoencoder_features(features):
    ncol = features.shape[1]

    #Defining size for the hidden layers of the autoencoder
    encoding_1 = int(round(ncol/1.2))
    encoding_2 = int(round(ncol/1.5))
    encoding_dim = int(round(ncol/2))

    input_dim = Input(shape = (ncol, ))

    encoded1 = Dense(encoding_1, activation = 'relu',activity_regularizer=regularizers.l1_l2(l1=10e-8,l2=10e-8)) (input_dim)
    encoded2 = Dense(encoding_2, activation = 'relu',activity_regularizer=regularizers.l1_l2(l1=10e-8,l2=10e-8)) (encoded1)
    encoded3 = Dense(encoding_dim, activation = 'relu',activity_regularizer=regularizers.l1_l2(l1=10e-8,l2=10e-8)) (encoded2)

    decoded3 = Dense(encoding_2, activation = 'relu')(encoded3)
    decoded2 = Dense(encoding_1, activation = 'relu')(decoded3)
    decoded1 = Dense(ncol, activation = 'sigmoid')(decoded2)

    autoencoder = Model(inputs = input_dim, outputs = decoded1)

    autoencoder.compile(optimizer='adam', loss='binary_crossentropy')

    trainX2,testX2 = train_test_split(features,test_size=0.2)

    autoencoder.fit(trainX2, trainX2, nb_epoch = 10, batch_size = 1000,
shuffle = False, validation_data = (testX2, testX2))
    #predicting the encoded output based on the encoded layer
    encoder = Model(inputs = input_dim, outputs = encoded3)
    encoded_input = Input(shape = (encoding_dim, ))
    encoded_train = pd.DataFrame(encoder.predict(features))
    #returning the encoded features
    return encoded_train

```

```
In [62]: # creating encoded features for all of the clusters
encoded_features = []
for i in range(0,number_of_cluster):
    documents = doc_values.get(i)
    features=None
    clust_labels = []
    for j in documents:
        if(features is None):
            features = all_features[j]
        else:
            a = features
            b = all_features[j]
            features = vstack((a,b))
        clust_labels.append(multi_labels[j])
    new_feature = get_autoencoder_features(features)
    encoded_features.append(new_feature)
```

Train on 14648 samples, validate on 3663 samples

Epoch 1/10

14648/14648 [=====] - 126s 9ms/step - loss: 0.5260 - val_loss: 0.0411

Epoch 2/10

14648/14648 [=====] - 129s 9ms/step - loss: 0.0368 - val_loss: 0.0147

Epoch 3/10

14648/14648 [=====] - 128s 9ms/step - loss: 0.0112 - val_loss: 0.0092

Epoch 4/10

14648/14648 [=====] - 126s 9ms/step - loss: 0.0091 - val_loss: 0.0088

Epoch 5/10

14648/14648 [=====] - 126s 9ms/step - loss: 0.0087 - val_loss: 0.0086

Epoch 6/10

14648/14648 [=====] - 124s 8ms/step - loss: 0.0085 - val_loss: 0.0085

Epoch 7/10

14648/14648 [=====] - 124s 8ms/step - loss: 0.0085 - val_loss: 0.0084

Epoch 8/10

14648/14648 [=====] - 124s 8ms/step - loss: 0.0084 - val_loss: 0.0084

Epoch 9/10

14648/14648 [=====] - 125s 9ms/step - loss: 0.0084 - val_loss: 0.0084

Epoch 10/10

14648/14648 [=====] - 125s 9ms/step - loss: 0.0084 - val_loss: 0.0084

Train on 2573 samples, validate on 644 samples

Epoch 1/10

2573/2573 [=====] - 25s 10ms/step - loss: 0.6964 - val_loss: 0.6917

Epoch 2/10

2573/2573 [=====] - 22s 9ms/step - loss: 0.6900 - val_loss: 0.6796

Epoch 3/10

2573/2573 [=====] - 23s 9ms/step - loss: 0.6674 - val_loss: 0.6028

Epoch 4/10

2573/2573 [=====] - 22s 9ms/step - loss: 0.5290 - val_loss: 0.2171

Epoch 5/10

2573/2573 [=====] - 22s 9ms/step - loss: 0.1042 - val_loss: 0.0158

Epoch 6/10

2573/2573 [=====] - 22s 9ms/step - loss: 0.0280 - val_loss: 0.0468

Epoch 7/10

2573/2573 [=====] - 24s 9ms/step - loss: 0.0477 - val_loss: 0.0338

Epoch 8/10

2573/2573 [=====] - 24s 9ms/step - loss: 0.0316 - val_loss: 0.0214

Epoch 9/10

```
2573/2573 [=====] - 24s 9ms/step - loss: 0.019
5 - val_loss: 0.0133
Epoch 10/10
2573/2573 [=====] - 23s 9ms/step - loss: 0.013
2 - val_loss: 0.0111
Train on 5994 samples, validate on 1499 samples
Epoch 1/10
5994/5994 [=====] - 54s 9ms/step - loss: 0.692
9 - val_loss: 0.6797
Epoch 2/10
5994/5994 [=====] - 53s 9ms/step - loss: 0.594
1 - val_loss: 0.2744
Epoch 3/10
5994/5994 [=====] - 52s 9ms/step - loss: 0.080
2 - val_loss: 0.0459
Epoch 4/10
5994/5994 [=====] - 52s 9ms/step - loss: 0.036
5 - val_loss: 0.0243
Epoch 5/10
5994/5994 [=====] - 58s 10ms/step - loss: 0.02
25 - val_loss: 0.0197
Epoch 6/10
5994/5994 [=====] - 56s 9ms/step - loss: 0.016
7 - val_loss: 0.0113
Epoch 7/10
5994/5994 [=====] - 52s 9ms/step - loss: 0.010
4 - val_loss: 0.0095
Epoch 8/10
5994/5994 [=====] - 52s 9ms/step - loss: 0.009
3 - val_loss: 0.0083
Epoch 9/10
5994/5994 [=====] - 52s 9ms/step - loss: 0.008
4 - val_loss: 0.0084
Epoch 10/10
5994/5994 [=====] - 52s 9ms/step - loss: 0.008
0 - val_loss: 0.0076
Train on 9216 samples, validate on 2305 samples
Epoch 1/10
9216/9216 [=====] - 87s 9ms/step - loss: 0.676
9 - val_loss: 0.4888
Epoch 2/10
9216/9216 [=====] - 84s 9ms/step - loss: 0.136
2 - val_loss: 0.0423
Epoch 3/10
9216/9216 [=====] - 82s 9ms/step - loss: 0.025
2 - val_loss: 0.0150
Epoch 4/10
9216/9216 [=====] - 82s 9ms/step - loss: 0.011
4 - val_loss: 0.0090
Epoch 5/10
9216/9216 [=====] - 81s 9ms/step - loss: 0.008
4 - val_loss: 0.0081
Epoch 6/10
9216/9216 [=====] - 82s 9ms/step - loss: 0.007
6 - val_loss: 0.0073
Epoch 7/10
9216/9216 [=====] - 82s 9ms/step - loss: 0.007
```

```
3 - val_loss: 0.0071
Epoch 8/10
9216/9216 [=====] - 82s 9ms/step - loss: 0.007
1 - val_loss: 0.0071
Epoch 9/10
9216/9216 [=====] - 161s 17ms/step - loss: 0.0
071 - val_loss: 0.0070
Epoch 10/10
9216/9216 [=====] - 247s 27ms/step - loss: 0.0
070 - val_loss: 0.0070
Train on 880 samples, validate on 220 samples
Epoch 1/10
880/880 [=====] - 36s 41ms/step - loss: 0.6978
- val_loss: 0.6930
Epoch 2/10
880/880 [=====] - 37s 42ms/step - loss: 0.6949
- val_loss: 0.6918
Epoch 3/10
880/880 [=====] - 35s 40ms/step - loss: 0.6930
- val_loss: 0.6901
Epoch 4/10
880/880 [=====] - 11s 13ms/step - loss: 0.6909
- val_loss: 0.6876
Epoch 5/10
880/880 [=====] - 10s 12ms/step - loss: 0.6881
- val_loss: 0.6830
Epoch 6/10
880/880 [=====] - 9s 10ms/step - loss: 0.6833
- val_loss: 0.6743
Epoch 7/10
880/880 [=====] - 8s 10ms/step - loss: 0.6746
- val_loss: 0.6577
Epoch 8/10
880/880 [=====] - 8s 9ms/step - loss: 0.6579 -
val_loss: 0.6265
Epoch 9/10
880/880 [=====] - 8s 9ms/step - loss: 0.6266 -
val_loss: 0.5705
Epoch 10/10
880/880 [=====] - 8s 9ms/step - loss: 0.5707 -
val_loss: 0.4777
Train on 4301 samples, validate on 1076 samples
Epoch 1/10
4301/4301 [=====] - 42s 10ms/step - loss: 0.69
50 - val_loss: 0.6864
Epoch 2/10
4301/4301 [=====] - 41s 10ms/step - loss: 0.66
56 - val_loss: 0.5343
Epoch 3/10
4301/4301 [=====] - 41s 10ms/step - loss: 0.29
00 - val_loss: 0.0226
Epoch 4/10
4301/4301 [=====] - 42s 10ms/step - loss: 0.04
82 - val_loss: 0.0483
Epoch 5/10
4301/4301 [=====] - 43s 10ms/step - loss: 0.03
45 - val_loss: 0.0178
```

```
Epoch 6/10
4301/4301 [=====] - 41s 10ms/step - loss: 0.01
58 - val_loss: 0.0126
Epoch 7/10
4301/4301 [=====] - 41s 10ms/step - loss: 0.01
15 - val_loss: 0.0094
Epoch 8/10
4301/4301 [=====] - 41s 10ms/step - loss: 0.00
88 - val_loss: 0.0074
Epoch 9/10
4301/4301 [=====] - 41s 9ms/step - loss: 0.007
4 - val_loss: 0.0070
Epoch 10/10
4301/4301 [=====] - 40s 9ms/step - loss: 0.007
0 - val_loss: 0.0068
Train on 1084 samples, validate on 272 samples
Epoch 1/10
1084/1084 [=====] - 16s 15ms/step - loss: 0.69
82 - val_loss: 0.6920
Epoch 2/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.69
32 - val_loss: 0.6878
Epoch 3/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.68
83 - val_loss: 0.6736
Epoch 4/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.67
25 - val_loss: 0.6007
Epoch 5/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.59
07 - val_loss: 0.1807
Epoch 6/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.16
90 - val_loss: 0.0115
Epoch 7/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.01
94 - val_loss: 0.0365
Epoch 8/10
1084/1084 [=====] - 12s 11ms/step - loss: 0.05
29 - val_loss: 0.0523
Epoch 9/10
1084/1084 [=====] - 11s 10ms/step - loss: 0.07
32 - val_loss: 0.0747
Epoch 10/10
1084/1084 [=====] - 11s 10ms/step - loss: 0.09
35 - val_loss: 0.0673
```

Function to implement Deep Neural Network

- For the final deep neural network, we have created a simple deep neural network which has three hidden layers.
- We have created this deep neural network for multi-label and multi-class classification.
- This deep neural network will take the encoded features from the autoencoder for each cluster, train on them and provide an output for the same.
- For the first two layers, we have used the activation of relu as it helps the model to train faster and is recommended by the Keras team.
- 'relu' also provides a wider range to encode the features and it does not adjust the encoded values due to a broad range.
- We used optimizer='adam' because Adam is the best optimizer when we are working with large datasets having a huge number of features as in our case. 'Adam' also produces outcomes faster compared to other optimizers, and is memory efficient. Hence preferred for deep networks.
- For the last layer we have used sigmoid as the activation function, instead of softmax as it calculates the probability of each class as independent from the other class and hence helps us in having multiple labels as our output.
- If we were dealing with only multi-class we would have used categorical crossentropy as our loss function but as we want to penalize each and every output node independently of the other nodes (for multi-label), we have used the binary crossentropy as our loss function.
- We have also used KFold of 10 folds to train the deep neural network.


```

In [73]: def deep_neural_network(features, labels):
    labels_size = labels.shape[1]
    features = csr_matrix(features)
    input_dim = features.shape[1]
    #Defining size for the hidden layers of the autoencoder
    layer_1 = int(round(input_dim/3))
    layer_2 = int(round(layer_1/2))
    #We have used a sequential model for our deep neural network
    model = Sequential()
    model.add(layers.Dense(layer_1, input_dim=input_dim, activation='relu'))
    model.add(layers.Dense(layer_1, activation='relu'))
    model.add(layers.Dense(labels_size, activation='sigmoid'))
    model.compile(loss='binary_crossentropy', optimizer="adam", metrics=[ 'accuracy' ])
    #Performing Kfold for training the neural network
    kfold_number = 10
    kf = KFold(n_splits=kfold_number)
    kf.get_n_splits(features)
    deep_network_score = []
    clust_labels = np.array(labels)
    for train_index, test_index in kf.split(features):
        X_train, X_test = features[train_index], features[test_index]
        y_train, y_test = clust_labels[train_index], clust_labels[test_index]

        model.fit(X_train, y_train, epochs=10, batch_size=500, verbose=0)
        deep_network_score.append(model.evaluate(X_test, y_test, verbose=0)[1])

    return sum(deep_network_score)/kfold_number

```

```

In [74]: # For every clusters training the deep neural network with the new encoded features
for i in range(0, number_of_cluster):
    documents = doc_values.get(i)
    clust_labels = []
    for j in documents:
        clust_labels.append(multi_labels[j])
    # taking the encoded features
    features = encoded_features[i]
    clust_labels = np.array(clust_labels)
    deep_network_score = deep_neural_network(features, clust_labels)
    print("Score of deep neural network for cluster ", i+1, ": ", deep_network_score)

```

```

Score of deep neural network for cluster 1 : 0.974214514096578
Score of deep neural network for cluster 2 : 0.9687356352806091
Score of deep neural network for cluster 3 : 0.972237586975098
Score of deep neural network for cluster 4 : 0.9751835068066915
Score of deep neural network for cluster 5 : 0.996165911356608
Score of deep neural network for cluster 6 : 0.9782718221346537
Score of deep neural network for cluster 7 : 0.9955101013183594

```

Changes we have introduced in the project with respect to the approach we have taken for Assignment-1

- In Assignment-1, we have trained the classifiers with single labels. However, in our project we have considered the multiple labels tagged to every document.
- We have used MultilabelBinarizer to work with multiple labels assigned to a document in the project.
- In Assignment-1 we had split the data using train test split. However, in the project we have used k-fold cross validation to split the entire data into train and test data.
- K-fold iteratively split the train and test data into k-blocks by changing the testing block and the training blocks in every iteration.
- This helps in training the model to perform better.
- We have used Accuracy as our evaluation metric for the classifier. As we had to use the same for the deep neural network.

References

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