In [1]:

```
#Projeto Clusterização para Forense Computacional
#Disciplina de Processamento de Linguagem Natural - Prof. Dra. Nádia

#Importação das API's
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction import text
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.cluster import KMeans
from nltk.tokenize import RegexpTokenizer
from nltk.stem.snowball import SnowballStemmer
from nltk import word_tokenize
from nltk.corpus import stopwords
import string
import os
import re
import timeit
import nltk
%matplotlib inline
start = timeit.default_timer()
```

In [3]:

```
#Carregamento dos arquivos a serem processados

path="D:/Projeto/pdftotxt"
data = {}
i=0
for subdir, dirs, files in os.walk(path):
    for file in files:
        file_path = subdir + os.path.sep + file
        arquivo = open(file_path, 'r',encoding='utf8', errors='ignore')
        text = arquivo.read()
        lowers = text.lower()
        data[i] = lowers
        i=i+1

#Verificar se todos os arquivos foram carregados
print(len(data))
print(data[0])
```

```
541
table dp-1. profile of general demographic characteristics: 2000
geographic area: tenino city, washington

[for information on confidentiality protection, nonsampling error, and def
initions, see text]

subject
            number percent             subject
                                 number percent

    total population. . . . . . . . . . . . . . . . . . . . . . . . . .
            1,447    100.0 hispanic or latino and race

sex and age
              691           total population. . . . . . . . . . . . . . .
. . . . . . . . . . .            1,447    100.0
male . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . .    756
                                    55      3.8
```

In [4]:

```
#Usando expressão regular para remover o que não for letras e transformar tudo em texto min
i=0
u=len(data)
for i in range(0,len(data)):
    letters_only = re.sub("[^a-zA-Z]", # The pattern to search for
      " ", # The pattern to replace it with
      data[i] ) # The text to search
    lower_case = letters_only.lower()
    re.sub(r'\b\w{1,3}\b', '',lower_case)
    data[i]=lower_case
print(data[0])
```

```
table dp    profile of general demographic characteristics       geographi
c area  tenino city  washington   for information on confidentiality prote
ction  nonsampling error  and definitions  see text   subject
                                                                  number p
ercent             subject
             number percent      total population
                                                        hispanic or latino
and race  sex and age
                                      total population
                                                          male


                                 female
                                                             hispanic or l
atino  of any race


                                                         under   years

         mexican
```

In [5]:

```
#Stopword and punctuation
stopwords = nltk.corpus.stopwords.words('english') + list(string.punctuation)
```

In [6]:

```
# load nltk's SnowballStemmer as variabled 'stemmer'
from nltk.stem.snowball import SnowballStemmer
stemmer = SnowballStemmer("english")
```

In [7]:

```
# define a tokenizer and stemmer which returns the set of stems in the text that it is pass

def tokenize_and_stem(text):
    # first tokenize by sentence, then by word to ensure that punctuation is caught as it's
    tokens = [word for sent in nltk.sent_tokenize(text) for word in nltk.word_tokenize(sent
    filtered_tokens = []
    # filter out any tokens not containing letters (e.g., numeric tokens, raw punctuation)
    for token in tokens:
        if re.search('[a-zA-Z]', token):
            filtered_tokens.append(token)
    stems = [stemmer.stem(t) for t in filtered_tokens]
    return stems


def tokenize_only(text):
    # first tokenize by sentence, then by word to ensure that punctuation is caught as it's
    tokens = [word.lower() for sent in nltk.sent_tokenize(text) for word in nltk.word_toker
    filtered_tokens = []
    # filter out any tokens not containing letters (e.g., numeric tokens, raw punctuation)
    for token in tokens:
        if re.search('[a-zA-Z]', token):
            filtered_tokens.append(token)
    return filtered_tokens
```

In [8]:

```
#use extend so it's a big flat list of vocab
totalvocab_stemmed = []
totalvocab_tokenized = []
for i in data.values():
    allwords_stemmed = tokenize_and_stem(i)
    totalvocab_stemmed.extend(allwords_stemmed)
    allwords_tokenized = tokenize_only(i)
    totalvocab_tokenized.extend(allwords_tokenized)
print("finalizou")
```

```
finalizou
```

In [9]:

```
vocab_frame = pd.DataFrame({'words': totalvocab_tokenized}, index = totalvocab_stemmed)
print('there are ' + str(vocab_frame.shape[0]) + ' items in vocab_frame')
```

```
there are 3654055 items in vocab_frame
```

In [10]:

```
print(vocab_frame.head())
```

```
           words
tabl       table
dp            dp
profil   profile
of            of
general  general
```

In [11]:

```
from sklearn.feature_extraction.text import TfidfVectorizer

#define vectorizer parameters
tfidf_vectorizer = TfidfVectorizer(max_df=0.8, max_features=200000,
                                 min_df=0.2, stop_words='english',
                                 use_idf=True, tokenizer=tokenize_and_stem, ngram_range=(1,

%time tfidf_matrix = tfidf_vectorizer.fit_transform(data.values()) #fit the vectorizer to f

print(tfidf_matrix.shape)
```

```
c:\users\albernaz\appdata\local\programs\python\python37-32\lib\site-package
s\sklearn\feature_extraction\text.py:300: UserWarning: Your stop_words may b
e inconsistent with your preprocessing. Tokenizing the stop words generated
tokens ['abov', 'afterward', 'alon', 'alreadi', 'alway', 'ani', 'anoth', 'an
yon', 'anyth', 'anywher', 'becam', 'becaus', 'becom', 'befor', 'besid', 'cr
i', 'describ', 'dure', 'els', 'elsewher', 'empti', 'everi', 'everyon', 'ever
yth', 'everywher', 'fifti', 'forti', 'henc', 'hereaft', 'herebi', 'howev',
'hundr', 'inde', 'mani', 'meanwhil', 'moreov', 'nobodi', 'noon', 'noth', 'no
wher', 'onc', 'onli', 'otherwis', 'ourselv', 'perhap', 'pleas', 'sever', 'si
nc', 'sincer', 'sixti', 'someon', 'someth', 'sometim', 'somewher', 'themsel
v', 'thenc', 'thereaft', 'therebi', 'therefor', 'togeth', 'twelv', 'twenti',
'veri', 'whatev', 'whenc', 'whenev', 'wherea', 'whereaft', 'wherebi', 'where
v', 'whi', 'yourselv'] not in stop_words.
  'stop_words.' % sorted(inconsistent))

Wall time: 1min 59s
(541, 713)
```

In [12]:

```
terms = tfidf_vectorizer.get_feature_names()
```

In [13]:

```
from sklearn.metrics.pairwise import cosine_similarity
dist = 1 - cosine_similarity(tfidf_matrix)
```

In [14]:

```
from sklearn.cluster import KMeans

num_clusters = 8

km = KMeans(n_clusters=num_clusters,n_init = 20, n_jobs = 1)

%time km.fit(tfidf_matrix)

clusters = km.labels_.tolist()
```

```
Wall time: 49.6 s
```

In [15]:

```
from sklearn.externals import joblib

#uncomment the below to save your model
#since I've already run my model I am loading from the pickle

joblib.dump(km,  'doc_cluster.pkl')

km = joblib.load('doc_cluster.pkl')
clusters = km.labels_.tolist()
```

In [16]:

```
result = { 'termo': data.values(), 'cluster': clusters }

frame = pd.DataFrame(result, index = [clusters] , columns = ['termo', 'cluster'])
```

In [17]:

```
frame['cluster'].value_counts()
```

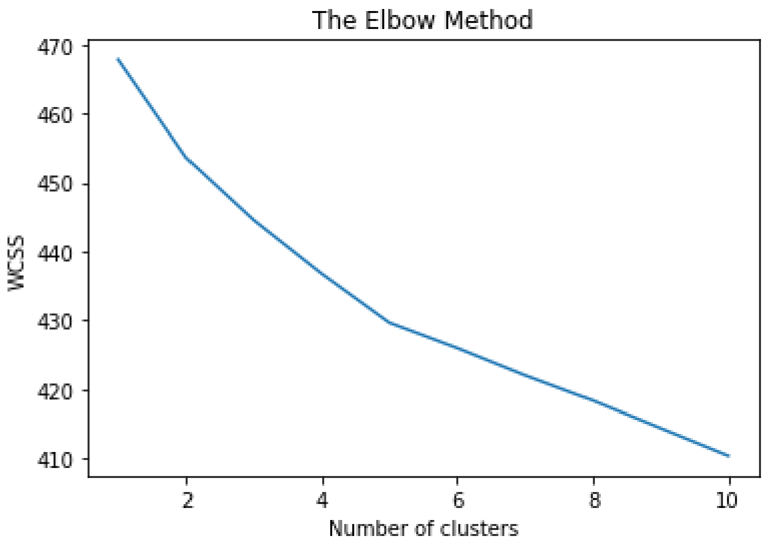
Out[17]:

```
2    143
5     85
4     75
0     75
3     58
7     48
6     39
1     18
Name: cluster, dtype: int64
```

In [18]:

```
from sklearn.cluster import KMeans
wcss = []
for i in range(1,11):
    print("Iniciando", i)
    kmeans = KMeans(n_clusters=i,init='k-means++',max_iter=300,n_init=10,random_state=0)
    kmeans.fit(tfidf_matrix)
    wcss.append(kmeans.inertia_)
    print("Finalizando", i)
plt.plot(range(1,11),wcss)
plt.title('The Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.savefig('elbow.png')
plt.show()
```

```
Iniciando 1
Finalizando 1
Iniciando 2
Finalizando 2
Iniciando 3
Finalizando 3
Iniciando 4
Finalizando 4
Iniciando 5
Finalizando 5
Iniciando 6
Finalizando 6
Iniciando 7
Finalizando 7
Iniciando 8
Finalizando 8
Iniciando 9
Finalizando 9
Iniciando 10
Finalizando 10
```



In [19]:

```
from __future__ import print_function

print("Top terms per cluster:")
print()
#sort cluster centers by proximity to centroid
order_centroids = km.cluster_centers_.argsort()[:,-1:-26:-1]

for i in range(num_clusters):
    print("Cluster %d words:" % i, end='')

    for ind in order_centroids[i, :10]: #replace 6 with n words per cluster
        print(' %s' % vocab_frame.loc[terms[ind].split(' ')].values.tolist()[0][0].encode('
    print() #add whitespace
    print() #add whitespace

    #print("Cluster %d titles:" % i, end='')
    #for termo in frame.ix[i]['termo'].values.tolist():
    #    print(' %s,' % termo, end='')
    #print() #add whitespace
    #print() #add whitespace

print()
print()
```

```
Top terms per cluster:

Cluster 0 words: b'requirements', b'applicable', b'section', b'code', b'noti
ce', b'information', b'file', b'board', b'amendment', b'any',

Cluster 1 words: b'plants', b'use', b'north', b'cover', b'area', b'located',
b'park', b'site', b'leaves', b'water',

Cluster 2 words: b'years', b'establishment', b'st', b'national', b'city',
b'service', b'states', b'total', b'department', b'park',

Cluster 3 words: b'e', b'd', b'c', b'b', b'l', b'j', b'm', b't', b'p', b'n',

Cluster 4 words: b'figure', b'm', b'use', b'measured', b'data', b'water',
b'al', b'model', b'et', b'et',

Cluster 5 words: b'medical', b'health', b'use', b'program', b'states', b'car
eful', b'provide', b'report', b'service', b'years',

Cluster 6 words: b'v', b'd', b'claim', b'f', b'states', b'u', b'units',
b'u', b'district', b'c',

Cluster 7 words: b'water', b'river', b'site', b'area', b'use', b'county',
b'sample', b'surface', b'flows', b'plants',
```

In [20]:

```
stop = timeit.default_timer()
execution_time = stop - start

print(execution_time/60) #It returns time in min
```

```
14.596097984316666
```

In [ ]: