빅데이터: assignment #3

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패키지

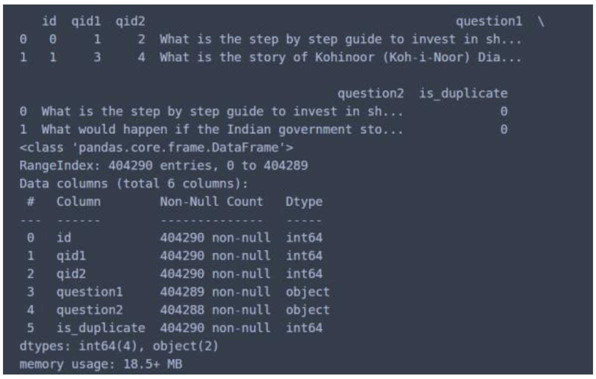
```
import numpy as np
import pandas as pd
import os
import random
import matplotlib.pyplot as plt
%matplotlib inline
```

Step 1: Download dataset

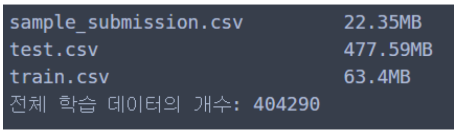
코드

```
DATA_IN_PATH = './quora/'
train_data = pd.read_csv(DATA_IN_PATH + 'train.csv')
print(train_data.head(2))
train_data.info()
print("파일 크기:")
for file in os.listdir(DATA_IN_PATH):
    if 'csv' in file and 'zip' not in file:
        print(file.ljust(30) + str(round(os.path.getsize(DATA_IN_PATH +
file)/1000000, 2)) + 'MB')

print('전체 학습 데이터의 개수: {}'.format(len(train_data)))
```

결과



```
   id  qid1  qid2                                          question1  \
0   0     1     2  What is the step by step guide to invest in sh...
1   1     3     4  What is the story of Kohinoor (Koh-i-Noor) Dia...

                                           question2  is_duplicate
0  What is the step by step guide to invest in sh...             0
1  What would happen if the Indian government sto...             0
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 404290 entries, 0 to 404289
Data columns (total 6 columns):
 #   Column        Non-Null Count   Dtype
---  ------        --------------   -----
 0   id            404290 non-null  int64
 1   qid1          404290 non-null  int64
 2   qid2          404290 non-null  int64
 3   question1     404289 non-null  object
 4   question2     404288 non-null  object
 5   is_duplicate  404290 non-null  int64
dtypes: int64(4), object(2)
memory usage: 18.5+ MB
```



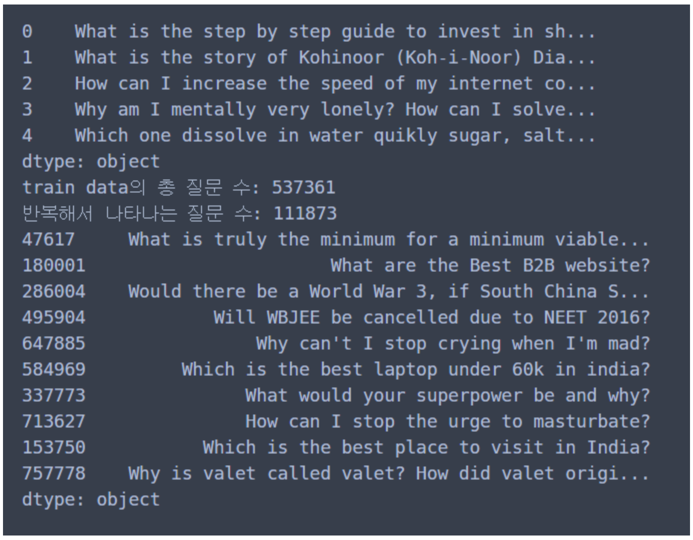
```
sample_submission.csv         22.35MB
test.csv                      477.59MB
train.csv                     63.4MB
전체 학습 데이터의 개수: 404290
```

Train_data 는 'id', 'qid1', 'qid2', 'question1', 'question2', 'is_duplicate'로 구성되어있다.

코드

```
train_set = pd.Series(train_data['question1'].tolist() +
train_data['question2'].tolist()).astype(str)
train_set.head()
print(train_set.head())
print('train data의 총 질문 수: {}'.format(len(np.unique(train_set))))
print('반복해서 나타나는 질문 수: {}'.format(np.sum(train_set.value_counts() >
1)))
print(train_set.sample(10, random_state =42))
```

결과

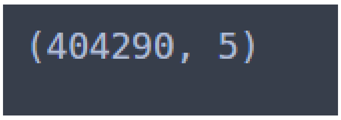


```
0    What is the step by step guide to invest in sh...
1    What is the story of Kohinoor (Koh-i-Noor) Dia...
2    How can I increase the speed of my internet co...
3    Why am I mentally very lonely? How can I solve...
4    Which one dissolve in water quikly sugar, salt...
dtype: object
train data의 총 질문 수: 537361
반복해서 나타나는 질문 수: 111873
47617     What is truly the minimum for a minimum viable...
180001                       What are the Best B2B website?
286004    Would there be a World War 3, if South China S...
495904             Will WBJEE be cancelled due to NEET 2016?
647885                 Why can't I stop crying when I'm mad?
584969          Which is the best laptop under 60k in india?
337773                  What would your superpower be and why?
713627                  How can I stop the urge to masturbate?
153750             Which is the best place to visit in India?
757778    Why is valet called valet? How did valet origi...
dtype: object
```

코드

```
data = pd.read_csv('./quora/train.csv',index_col='id')
data.shape
```

결과



```
(404290, 5)
```

Step 2: Make a corpus/shingling vocabulary/shingling-based matrix

코드(필요한 패키지 불러오기 및 1-gram, 1-shingle 로 정의 후 단어 토큰화 진행)

Preprocess 1, 2, 3, 4 다 다른 토큰화 과정이고 preprocess4 가 가장 결과가 잘 나와 채택

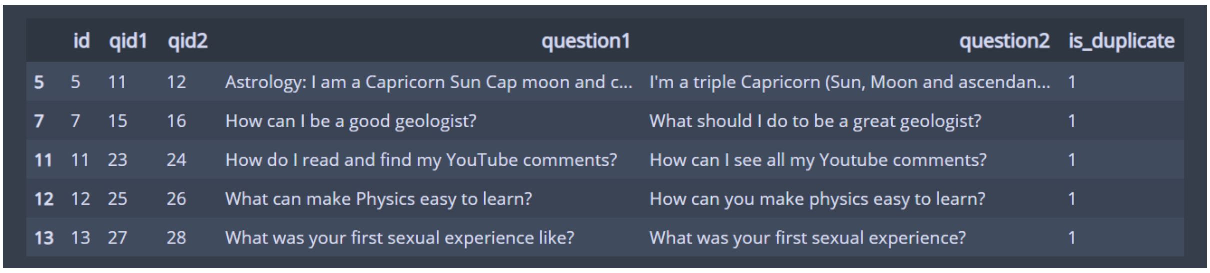
```
import re
import nltk
from nltk.tokenize import TreebankWordTokenizer
from nltk.tokenize.casual import casual_tokenize
def preprocess(text):
    text = re.sub(r'[^\w\s]', '', text)
    tokens = text.lower()
    tokens = tokens.split()
    return tokens
def preprocess2(text):
    tokenizer = TreebankWordTokenizer()
    tokens = tokenizer.tokenize(text)
    return tokens
def preprocess3(text):
    tokens = casual_tokenize(text)
    return tokens
def preprocess4(text):
    ''' text 를 list 로 전처리하는 과정 '''
    text = re.sub(r"[^A-Za-z0-9^,!.\/'+-=]", " ", text)
    text = re.sub(r"what's", "what is ", text)
    text = re.sub(r"\'s", " ", text)
    text = re.sub(r"\'ve", " have ", text)
    text = re.sub(r"can't", "cannot ", text)
    text = re.sub(r"n't", " not ", text)
    text = re.sub(r"i'm", "i am ", text)
    text = re.sub(r"\'re", " are ", text)
    text = re.sub(r"\'d", " would ", text)
    text = re.sub(r"\'ll", " will ", text)
    text = re.sub(r",", " ", text)
    text = re.sub(r"\.", " ", text)
    text = re.sub(r"!", " ! ", text)
    text = re.sub(r"\/", " ", text)
    text = re.sub(r"\^", " ^ ", text)
    text = re.sub(r"\+", " + ", text)
    text = re.sub(r"\-", " - ", text)
    text = re.sub(r"\=", " = ", text)
    text = re.sub(r"'", " ", text)
    text = re.sub(r"(\d+)(k)", r"\g<1>000", text)
    text = re.sub(r":", " : ", text)
    text = re.sub(r" e g ", " eg ", text)
    text = re.sub(r" b g ", " bg ", text)
    text = re.sub(r" u s ", " american ", text)
    text = re.sub(r"\0s", "0", text)
    text = re.sub(r" 9 11 ", "911", text)
    text = re.sub(r"e - mail", "email", text)
    text = re.sub(r"j k", "jk", text)
    text = re.sub(r"\s{2,}", " ", text)
    text = text.lower()
    text = text.split()

    return text
```

코드

```
is_duplicate_pairs = train_data['is_duplicate']== 1
new_train_data01 = train_data[is_duplicate_pairs]
new_train_data01.head()
```

is_duplicate = 1 인 행만 추출

결과

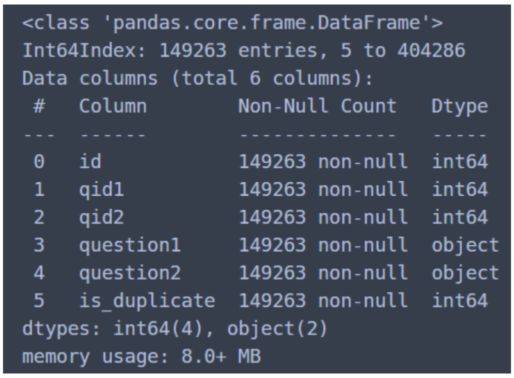


	id	qid1	qid2	question1	question2	is_duplicate
5	5	11	12	Astrology: I am a Capricorn Sun Cap moon and c...	I'm a triple Capricorn (Sun, Moon and ascendan...	1
7	7	15	16	How can I be a good geologist?	What should I do to be a great geologist?	1
11	11	23	24	How do I read and find my YouTube comments?	How can I see all my Youtube comments?	1
12	12	25	26	What can make Physics easy to learn?	How can you make physics easy to learn?	1
13	13	27	28	What was your first sexual experience like?	What was your first sexual experience?	1

코드

```
new_train_data01.info()
```

결과



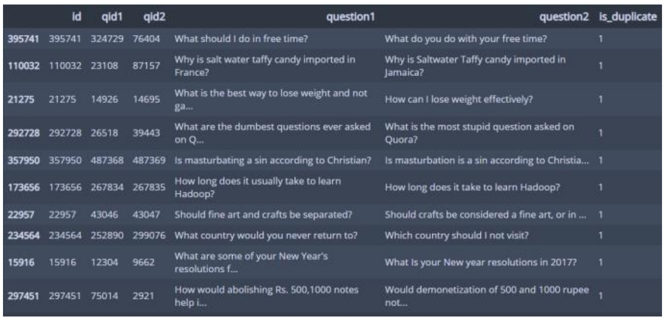
```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 149263 entries, 5 to 404286
Data columns (total 6 columns):
 #   Column        Non-Null Count   Dtype 
---  ------        --------------   ----- 
 0   id            149263 non-null  int64 
 1   qid1          149263 non-null  int64 
 2   qid2          149263 non-null  int64 
 3   question1     149263 non-null  object
 4   question2     149263 non-null  object
 5   is_duplicate  149263 non-null  int64 
dtypes: int64(4), object(2)
memory usage: 8.0+ MB
```

코드

```
new_duplicate_pairs = new_train_data01.sample(n=10)
new_duplicate_pairs.head(10)
```

결과

10 개의 페어만 추출한 결과 확인



	id	qid1	qid2	question1	question2	is_duplicate
395741	395741	324729	76404	What should I do in free time?	What do you do with your free time?	1
110032	110032	23108	87157	Why is salt water taffy candy imported in France?	Why is Saltwater Taffy candy imported in Jamaica?	1
21275	21275	14926	14695	What is the best way to lose weight and not ga...	How can I lose weight effectively?	1
292728	292728	26518	39443	What are the dumbest questions ever asked on Q...	What is the most stupid question asked on Quora?	1
357950	357950	487368	487369	Is masturbating a sin according to Christian?	Is masturbation is a sin according to Christia...	1
173656	173656	267834	267835	How long does it usually take to learn Hadoop?	How long does it take to learn Hadoop?	1
22957	22957	43046	43047	Should fine art and crafts be separated?	Should crafts be considered a fine art, or in ...	1
234564	234564	252890	299076	What country would you never return to?	Which country should I not visit?	1
15916	15916	12304	9662	What are some of your New Year's resolutions f...	What Is your New year resolutions in 2017?	1
297451	297451	75014	2921	How would abolishing Rs. 500,1000 notes help i...	Would demonetization of 500 and 1000 rupee not...	1

코드

```
x1 = new_duplicate_pairs['question1'].tolist()
x2 = new_duplicate_pairs['question2'].tolist()
print(x1, x2)
```

결과

```
['What should I do in free time?', 'Why is salt water taffy candy imported in France?',
'What is the best way to lose weight and not gain it back?', 'What are the dumbest
questions ever asked on Quora?', 'Is masturbating a sin according to Christian?', 'How
long does it usually take to learn Hadoop?', 'Should fine art and crafts be separated?',
'What country would you never return to?', "What are some of your New Year's resolutions
for 2017?", 'How would abolishing Rs. 500,1000 notes help in stopping the production of
black money and curb corruption?'] ['What do you do with your free time?', 'Why is
Saltwater Taffy candy imported in Jamaica?', 'How can I lose weight effectively?', 'What
is the most stupid question asked on Quora?', 'Is masturbation is a sin according to
Christianity?', 'How long does it take to learn Hadoop?', 'Should crafts be considered a
fine art, or in a category of its own?', 'Which country should I not visit?', 'What Is
your New year resolutions in 2017?', 'Would demonetization of 500 and 1000 rupee notes
actually help in curbing black money in India?']
```

코드

```
l1 = []
for i in x1:
    x11 = preprocess4(i)
    l1.append(x11)
l2 = []
for i in x2:
    x22 = preprocess4(i)
    l2.append(x22)
print(l1)
print('################1-shingles, one-gram 으로 추출했을
경우########################')
print(l2)
```

결과

Question1, Question2 가 리스트 형태로 출력된 것을 확인가능

```
[['what', 'should', 'i', 'do', 'in', 'free', 'time'], ['why', 'is', 'salt', 'water',
'taffy', 'candy', 'imported', 'in', 'france'], ['what', 'is', 'the', 'best', 'way',
'to', 'lose', 'weight', 'and', 'not', 'gain', 'it', 'back'], ['what', 'are', 'the',
'dumbest', 'questions', 'ever', 'asked', 'on', 'quora'], ['is', 'masturbating', 'a',
'sin', 'according', 'to', 'christian'], ['how', 'long', 'does', 'it', 'usually', 'take',
'to', 'learn', 'hadoop'], ['should', 'fine', 'art', 'and', 'crafts', 'be', 'separated'],
['what', 'country', 'would', 'you', 'never', 'return', 'to'], ['what', 'are', 'some',
'of', 'your', 'new', 'year', 'resolutions', 'for', '2017'], ['how', 'would',
'abolishing', 'rs', '500', '1000', 'notes', 'help', 'in', 'stopping', 'the',
'production', 'of', 'black', 'money', 'and', 'curb', 'corruption']]
################1-shingles, one-gram 으로 추출했을 경우########################
[['what', 'do', 'you', 'do', 'with', 'your', 'free', 'time'], ['why', 'is', 'saltwater',
'taffy', 'candy', 'imported', 'in', 'jamaica'], ['how', 'can', 'i', 'lose', 'weight',
'effectively'], ['what', 'is', 'the', 'most', 'stupid', 'question', 'asked', 'on',
'quora'], ['is', 'masturbation', 'is', 'a', 'sin', 'according', 'to', 'christianity'],
['how', 'long', 'does', 'it', 'take', 'to', 'learn', 'hadoop'], ['should', 'crafts',
'be', 'considered', 'a', 'fine', 'art', 'or', 'in', 'a', 'category', 'of', 'its',
'own'], ['which', 'country', 'should', 'i', 'not', 'visit'], ['what', 'is', 'your',
'new', 'year', 'resolutions', 'in', '2017'], ['would', 'demonetization', 'of', '500',
'and', '1000', 'rupee', 'notes', 'actually', 'help', 'in', 'curbing', 'black', 'money',
'in', 'india']]
```

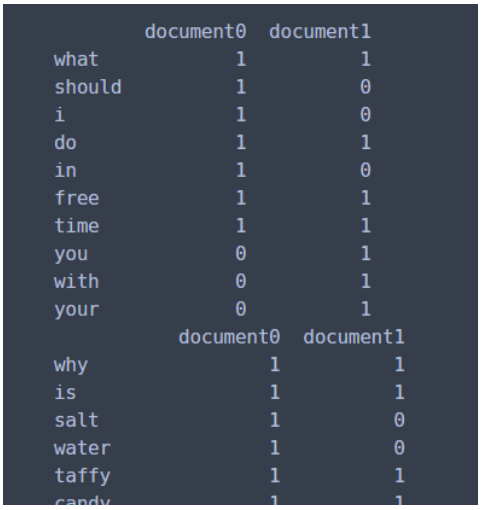
코드

```
#shingle 을 한 문장으로 추출 후 다시 vector 로 표현
def shingles_to_one_list(long):
    short = ''
    for k in long:
        if long.index(k) == len(long) - 1:
            short = short + k
        else:
            short = short + k + ' '
    return short
```

코드

```
corpus_l1 = []
corpus_l2 = []
for i in range(10):
    aa = shingles_to_one_list(l1[i])
    bb = shingles_to_one_list(l2[i])
    corpus_l1.append(str(aa))
    corpus_l2.append(str(bb))

def get_document_vector(d1, d2):
    """
    z = set()
    for i in d1:
        z.add(i)
    for j in d2:
        z.add(i)
    """
    corpus = {}
    sentences = d1 + '\n'
    sentences += d2
    for i, document in enumerate(sentences.split('\n')):
        corpus['document{}'.format(i)] = dict((tok, 1) for tok in
document.split(' '))
    df = pd.DataFrame.from_records(corpus).fillna(0).astype(int)
    return df
for i in range(10):
    document_vector = get_document_vector(corpus_l1[i], corpus_l2[i])
    print(document_vector)
```

결과–document vector 출력(총 10 쌍)



```
            document0  document1
what                1          1
should              1          0
i                   1          0
do                  1          1
in                  1          0
free                1          1
time                1          1
you                 0          1
with                0          1
your                0          1
               document0  document1
why                    1          1
is                     1          1
salt                   1          0
water                  1          0
taffy                  1          1
candy                  1          1
```

Step 3: Implement Min-hashing

Make the signature matrix M. Using open-source code is also possible. But if so, please leave the source origin on your report.

Step 4: Evaluate Min-hashing

Let's compare A) the approximated similarity (jaccard similarity based on signature) with B) the gold similarity (jaccard similarity based on shingles), while varying the number of hash functions used for min-hashing.

You must add a figure where x-axis represents the number of used hash functions and y-axis represents the average gap of the similarities between A and B for 10 duplicate pairs.

We can see the effect of used hash functions to the approximation accuracy.

코드(datasketch 패키지의 Minhash import)

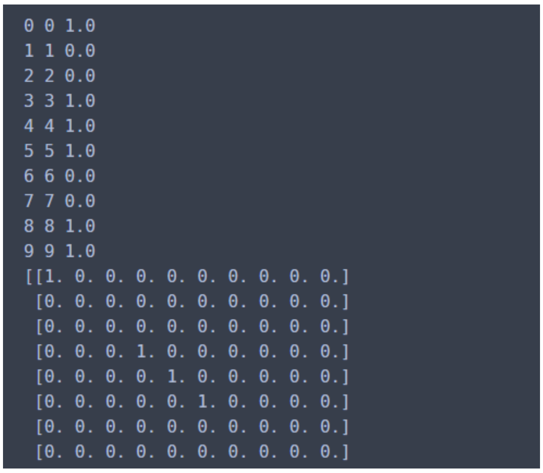
```
from datasketch import MinHash
```

코드

```
x_axis = [w for w in range(1, 21)]
y_axis = []
for s in range(1, 21):
    matrix_estimated_jaccard = np.zeros((len(l1), len(l2)))
    for i in range(len(l1)):
        for j in range(len(l2)):
            if i == j:
                m1, m2 = MinHash(num_perm = s), MinHash(num_perm = s)
                for d in l1[i]:
                    m1.update(d.encode('utf8'))
                for d in l2[j]:
                    m2.update(d.encode('utf8'))
                matrix_estimated_jaccard[i, j] = m1.jaccard(m2)
                print(i, j, m1.jaccard(m2))
            else:
                pass
    print(matrix_estimated_jaccard)
    matrix_true_jaccard = np.zeros((len(l1), len(l2)))
    for i in range(len(l1)):
        for j in range(len(l2)):
            s1 = set(l1[i])
            s2 = set(l2[j])
            if i == j:
                actual_jaccard =
float(len(s1.intersection(s2)))/float(len(s1.union(s2)))
                matrix_true_jaccard[i, j] = actual_jaccard
                print(i, j, actual_jaccard)
            else:
                pass
    print(matrix_true_jaccard)
    for i in range(len(l1)):
        for j in range(len(l2)):
            total_p = 0
            if i == j:
                total_p += abs(matrix_estimated_jaccard[i, j] -
matrix_true_jaccard[i, j])
            else:
                pass
    average_gap = total_p/len(l1)
    y_axis.append(average_gap)
plt.figure()
plt.xlabel('')
plt.plot(x_axis, y_axis, marker = 'o')
plt.grid(True)
plt.xlabel('the number of used hash functions')
plt.ylabel('the average gap of the similarities between A and B')
plt.show()
```

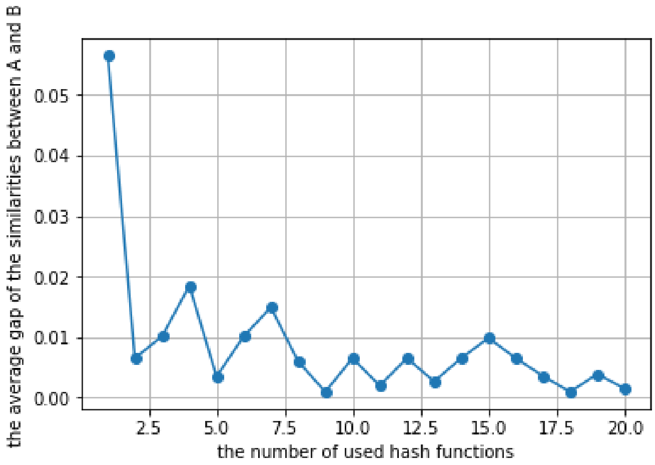
결과

1) 아래 그림과 같이 각 쌍에 대하여 actual-jaccard-similarity 와 estimated-jaccard-similarity 출력



```
0 0 1.0
1 1 0.0
2 2 0.0
3 3 1.0
4 4 1.0
5 5 1.0
6 6 0.0
7 7 0.0
8 8 1.0
9 9 1.0
[[1. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 1. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 1. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 1. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
```

2) Performance 확인(y 축은 average gap, x 축은 사용된 minhash function 의 개수)



5-shingles 로 정의했을 경우 (5 개의 vocabulary)

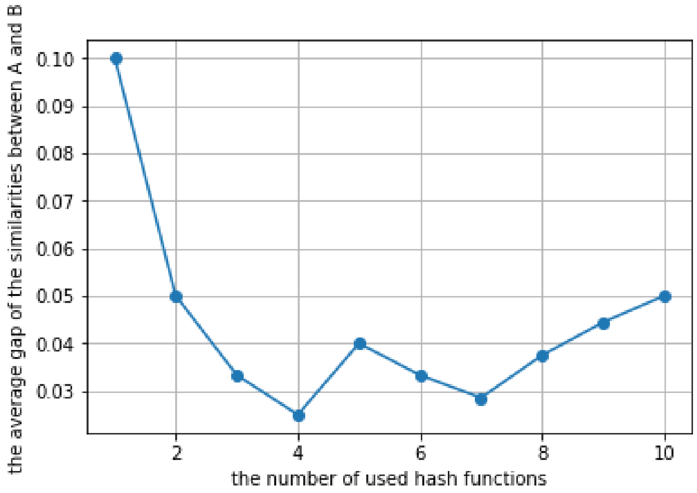
코드-5 쉥글인 corpus 만들기

```
# k = 5 로 잡았을 때
def get_shingles(size, f):
    for i in range(0, len(f)-5+1):
        yield tuple(f[i:i+5])
def set_to_list(xx):
    l = list(xx)
    return l
x234 = []
for i in l1:
    shingles = { i for i in get_shingles(5, i)}
    set_to_list(shingles)
    x234.append(list(shingles))
x235 = []
for i in l2:
    shingles = { i for i in get_shingles(5, i)}
    set_to_list(shingles)
    x235.append(list(shingles))
```

코드-5 쉥글일 때, performance 확인(10-permutation 으로 진행)

```
xxx = [w for w in range(1, 11)]
yyy = []
for s in range(1, 11):
    matrix_estimated_jaccard = np.zeros((len(l1), len(l2)))
    for i in range(len(l1)):
        for j in range(len(l2)):
                if i == j:
                    m1, m2 = MinHash(num_perm = s), MinHash(num_perm = s)
                    for k in x234[i]:
                        for d in k:
                            m1.update(d.encode('utf8'))
                    for k in x235[j]:
                        for d in k:
                            m2.update(d.encode('utf8'))
                    matrix_estimated_jaccard[i, j] = m1.jaccard(m2)
                    print(i, j, m1.jaccard(m2))
                else:
                    pass
    print(matrix_estimated_jaccard)
    matrix_true_jaccard = np.zeros((len(l1), len(l2)))
    for i in range(len(l1)):
        for j in range(len(l2)):
            if i == j:
                s1 = set()
                s2 = set()
                for k in x234[i]:
                    s1.add(k)
                for m in x235[j]:
                    s2.add(m)
                if float(len(s1.union(s2))) == 0:
                    matrix_true_jaccard[i, j] = 0
                    actual_jaccard = 0
                else:
                    actual_jaccard =
float(len(s1.intersection(s2)))/float(len(s1.union(s2)))
                    matrix_true_jaccard[i, j] = actual_jaccard
                print(i, j, actual_jaccard)
            else:
                pass
    print(matrix_true_jaccard)
    for i in range(len(l1)):
        for j in range(len(l2)):
            total_p = 0
            if i == j:
                total_p += abs(matrix_estimated_jaccard[i, j] -
matrix_true_jaccard[i, j])
            else:
                pass
    average_gap_k_5 = total_p/len(l1)
    yyy.append(average_gap_k_5)
plt.figure()
plt.xlabel('')
plt.plot(xxx, yyy, marker = 'o')
plt.grid(True)
plt.xlabel('the number of used hash functions')
plt.ylabel('the average gap of the similarities between A and B')
plt.show()
```

결과



Step 5: Scale up

Repeat step 2 to step 4, picking 100 pairs of duplicate questions instead of 10 pairs.

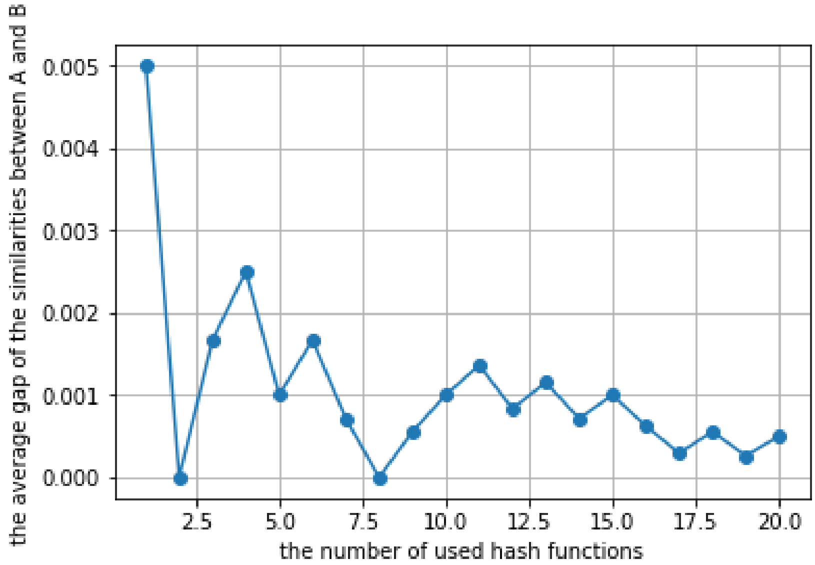
코드

```
new_duplicate_pairs = new_train_data01.sample(n=100)
new_duplicate_pairs.head(10)
```

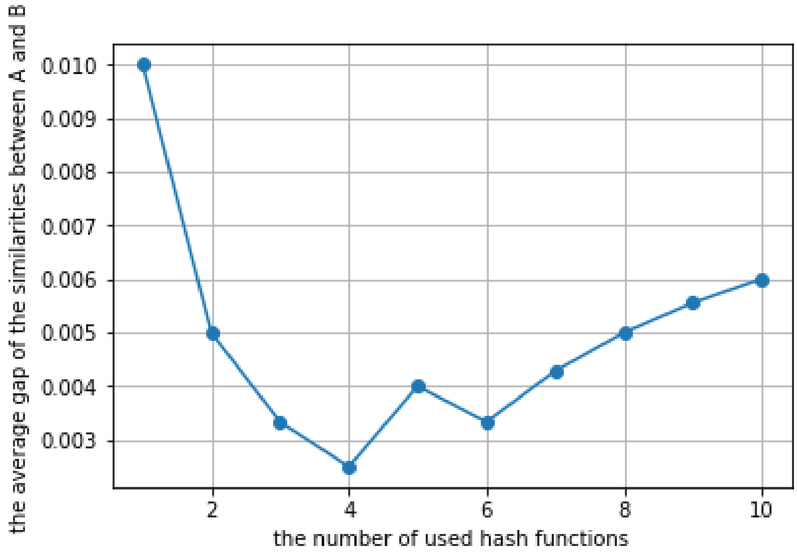
duplicate=1 인 데이터에서 100 개 추출

결과

1-gram,1-shingle 로 정의했을 때,



5-shingle 로 정의했을 때,



Reference

1) https://github.com/ekzhu/datasketch

2) https://gist.github.com/Renien/a738b614b224bafdfc783994536c44a9

3) https://github.com/vedanshsharma/Quora-Questions-Pairs-Similarity-Problem/blob/master/2_Preprocessing.ipynb

code-github

1) https://github.com/yorrbowakeup/bigdata3week.git