```
import nltk
nltk.download('stopwords') #불용어 데이터 download
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
True
```

6.2 PCA를 이용한 차원 축소

```
from sklearn.datasets import fetch_20newsgroups

#20개의 토픽 중 선택하고자 하는 토픽을 리스트로 생성
categories = ['alt.atheism', 'talk.religion.misc', 'comp.graphics', 'sci.space']

#학습 데이터셋을 가져옴
newsgroups_train = fetch_20newsgroups(subset='train',
#메일 내용에서 hint가 되는 부분을 삭제 - 순수하게 내용만으로 분류
                                      remove=('headers', 'footers', 'quotes'),
                                      categories=categories)
#검증 데이터셋을 가져옴
newsgroups_test = fetch_20newsgroups(subset='test',
                                     remove=('headers', 'footers', 'quotes'),
                                     categories=categories)

X_train = newsgroups_train.data   #학습 데이터셋 문서
y_train = newsgroups_train.target #학습 데이터셋 라벨

X_test = newsgroups_test.data     #검증 데이터셋 문서
y_test = newsgroups_test.target   #검증 데이터셋 라벨

from sklearn.feature_extraction.text import TfidfVectorizer

from nltk.corpus import stopwords
cachedStopWords = stopwords.words("english")

from nltk.tokenize import RegexpTokenizer
from nltk.stem.porter import PorterStemmer

RegTok = RegexpTokenizer("[₩w']{3,}") # 정규포현식으로 토크나이저를 정의
english_stops = set(stopwords.words('english')) #영어 불용어를 가져옴

def tokenizer(text):
    tokens = RegTok.tokenize(text.lower()) #이렇게 해도 되는지 확인
    # stopwords 제외
    words = [word for word in tokens if (word not in english_stops) and len(word) > 2]
    # portr stemmer 적용
    features = (list(map(lambda token: PorterStemmer().stem(token),words)))
    return features

tfidf = TfidfVectorizer(tokenizer=tokenizer)
X_train_tfidf = tfidf.fit_transform(X_train) # train set을 변환
X_test_tfidf = tfidf.transform(X_test) # test set을 변환
X_test_tfidf = tfidf.transform(X_test) # test set을 변환
```

```
from sklearn.linear_model import LogisticRegression

LR_clf = LogisticRegression() #분류기 선언
LR_clf.fit(X_train_tfidf, y_train) # train data를 이용하여 분류기를 학습
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_tfidf, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_tfidf, y_test)))
```

```
    #Train set score: 0.962
    #Test set score: 0.761
```

```
from sklearn.decomposition import PCA

pca = PCA(n_components=2000, random_state=7)
X_train_pca = pca.fit_transform(X_train_tfidf.toarray())
X_test_pca = pca.transform(X_test_tfidf.toarray())

print('Original tfidf matrix shape:', X_train_tfidf.shape)
print('PCA Converted matrix shape:', X_train_pca.shape)
print('Sum of explained variance ratio: {:.3f}'.format(pca.explained_variance_ratio_.sum()))
```

```
    Original tfidf matrix shape: (2034, 20085)
    PCA Converted matrix shape: (2034, 2000)
    Sum of explained variance ratio: 1.000
```

```
LR_clf.fit(X_train_pca, y_train)
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_pca, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_pca, y_test)))
```

```
    #Train set score: 0.962
    #Test set score: 0.761
```

```
lasso_clf = LogisticRegression(penalty='l1', solver='liblinear', C=1)
lasso_clf.fit(X_train_tfidf, y_train)

print('#Train set score: {:.3f}'.format(lasso_clf.score(X_train_tfidf, y_train)))
print('#Test set score: {:.3f}'.format(lasso_clf.score(X_test_tfidf, y_test)))

import numpy as np
# 계수(coefficient) 중에서 0이 아닌 것들의 개수를 출력
print('#Used features count: {}'.format(np.sum(lasso_clf.coef_ != 0)), 'out of', X_train_tfidf.shap
```

```
    #Train set score: 0.790
    #Test set score: 0.718
    #Used features count: 321 out of 20085
```

```
pca = PCA(n_components=321, random_state=7)

X_train_pca = pca.fit_transform(X_train_tfidf.toarray())
X_test_pca = pca.transform(X_test_tfidf.toarray())
print('PCA Converted X shape:', X_train_pca.shape)
print('Sum of explained variance ratio: {:.3f}'.format(pca.explained_variance_ratio_.sum()))

LR_clf.fit(X_train_pca, y_train)
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_pca, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_pca, y_test)))
```

```
    PCA Converted X shape: (2034, 321)
    Sum of explained variance ratio: 0.437
    #Train set score: 0.875
    #Test set score: 0.751
```

```
pca = PCA(n_components=100, random_state=7)

X_train_pca = pca.fit_transform(X_train_tfidf.toarray())
X_test_pca = pca.transform(X_test_tfidf.toarray())
print('PCA Converted X shape:', X_train_pca.shape)
print('Sum of explained variance ratio: {:.3f}'.format(pca.explained_variance_ratio_.sum()))

LR_clf.fit(X_train_pca, y_train)
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_pca, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_pca, y_test)))
```

```
    PCA Converted X shape: (2034, 100)
    Sum of explained variance ratio: 0.211
    #Train set score: 0.807
    #Test set score: 0.738
```

▾ 6.3 LSA를 이용한 차원 축소와 의미 파악

```
from sklearn.decomposition import TruncatedSVD
svd = TruncatedSVD(n_components=2000, random_state=7) #압축할 component의 수 지정
X_train_lsa = svd.fit_transform(X_train_tfidf)
X_test_lsa = svd.transform(X_test_tfidf)

print('LSA Converted X shape:', X_train_lsa.shape)
print('Sum of explained variance ratio: {:.3f}'.format(svd.explained_variance_ratio_.sum()))

LR_clf.fit(X_train_lsa, y_train)
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_lsa, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_lsa, y_test)))
```

```
    LSA Converted X shape: (2034, 2000)
    Sum of explained variance ratio: 1.000
    #Train set score: 0.962
    #Test set score: 0.761
```

```
svd = TruncatedSVD(n_components=100, random_state=1) #압축할 component의 수 지정
X_train_lsa = svd.fit_transform(X_train_tfidf)
X_test_lsa = svd.transform(X_test_tfidf)

print('LSA Converted X shape:', X_train_lsa.shape)
print('Sum of explained variance ratio: {:.3f}'.format(svd.explained_variance_ratio_.sum()))
```

```
LR_clf.fit(X_train_lsa, y_train)
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_lsa, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_lsa, y_test)))
```

```
    LSA Converted X shape: (2034, 100)
    Sum of explained variance ratio: 0.209
    #Train set score: 0.810
    #Test set score: 0.745
```

```
svd = TruncatedSVD(n_components=100, random_state=1) #압축할 component의 수 지정
X_train_lsa = svd.fit_transform(X_train_tfidf)
X_test_lsa = svd.transform(X_test_tfidf)

print('LSA Converted X shape:', X_train_lsa.shape)
print('Sum of explained variance ratio: {:.3f}'.format(svd.explained_variance_ratio_.sum()))

LR_clf.fit(X_train_lsa, y_train)
print('#Train set score: {:.3f}'.format(LR_clf.score(X_train_lsa, y_train)))
print('#Test set score: {:.3f}'.format(LR_clf.score(X_test_lsa, y_test)))
```

```
    LSA Converted X shape: (2034, 100)
    Sum of explained variance ratio: 0.209
    #Train set score: 0.810
    #Test set score: 0.745
```

6.3.2 LSA를 이용한 의미 기반의 문서 간 유사도 계산

```
from sklearn.metrics.pairwise import cosine_similarity

print('#사용된 전체 카테고리:', newsgroups_train.target_names)
print('#첫 문서의 카테고리:', y_train[0])

#변환된 count vector와 기존 값들과의 similarity 계산
sim_result = cosine_similarity([X_train_lsa[0]], X_train_lsa)

print("#Top 20 유사도(lsa):₩n", sorted(sim_result[0].round(2), reverse=True)[:20])
sim_index = (-sim_result[0]).argsort()[:20]
print('#Top 20 유사 뉴스의 인덱스(lsa):₩n', sim_index)
sim_labels = [y_train[i] for i in sim_index]
print('#Top 20 유사 뉴스의 카테고리(lsa):₩n', sim_labels)
```

```
    #사용된 전체 카테고리: ['alt.atheism', 'comp.graphics', 'sci.space', 'talk.religion.misc']
    #첫 문서의 카테고리: 1
    #Top 20 유사도(lsa):
     [1.0, 0.74, 0.74, 0.72, 0.7, 0.7, 0.69, 0.67, 0.66, 0.65, 0.65, 0.65, 0.63, 0.62, 0.62, 0.62
    #Top 20 유사 뉴스의 인덱스(lsa):
     [   0 1957 1674  501 1995 1490  790 1902 1575 1209 1728  892 1892  998
     1038 1826 1290 1089  867  151]
    #Top 20 유사 뉴스의 카테고리(lsa):
     [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]
```

```
sim_result = cosine_similarity(X_train_tfidf[0], X_train_tfidf)

print("#Top 20 유사도(tfidf):₩n", sorted(sim_result[0].round(2), reverse=True)[:20])
sim_index = (-sim_result[0]).argsort()[:20]
print('#Top 20 유사 뉴스의 인덱스(tfidf):₩n', sim_index)
sim_labels = [y_train[i] for i in sim_index]
print('#Top 20 유사 뉴스의 카테고리(tfidf):₩n', sim_labels)
```

```
#Top 20 유사도(tfidf):
 [1.0, 0.3, 0.22, 0.21, 0.19, 0.19, 0.19, 0.17, 0.16, 0.16, 0.16, 0.15, 0.15, 0.15, 0.15, 0.1
#Top 20 유사 뉴스의 인덱스(tfidf):
 [   0 1575 1892 1490  501 1290 1013  998 1636 1705 1995 1957 1664  651
 1038  429 1089 1209 1728 1803]
#Top 20 유사 뉴스의 카테고리(tfidf):
 [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]
```

6.3.3 잠재된 토픽의 분석

```
svd = TruncatedSVD(n_components=10, random_state=1) #압축할 component의 수 지정
X_train_lsa = svd.fit_transform(X_train_tfidf)
X_test_lsa = svd.transform(X_test_tfidf)

print('LSA Converted X shape:', X_train_lsa.shape)
print('Sum of explained variance ratio: {:.3f}'.format(svd.explained_variance_ratio_.sum()))

terms = tfidf.get_feature_names_out()
def get_topics(model, feature_names, n=10):
    for idx, topic in enumerate(model.components_):
        print("Topic %d:" % (idx+1),
              [feature_names[i] for i in topic.argsort()[:-n - 1:-1]])
get_topics(svd, terms)
```

```
LSA Converted X shape: (2034, 10)
Sum of explained variance ratio: 0.045
Topic 1: ['would', 'one', 'god', 'think', 'use', 'peopl', 'know', 'like', 'say', 'space']
Topic 2: ['file', 'imag', 'thank', 'program', 'graphic', 'space', 'format', 'use', 'color', '
Topic 3: ['space', 'orbit', 'nasa', 'launch', 'shuttl', 'satellit', 'year', 'moon', 'lunar',
Topic 4: ['moral', 'object', 'system', 'valu', 'goal', 'think', 'anim', 'absolut', 'natur', '
Topic 5: ['ico', 'bobb', 'tek', 'beauchain', 'bronx', 'manhattan', 'sank', 'queen', 'vice', '
Topic 6: ['god', 'file', 'imag', 'object', 'moral', 'exist', 'space', 'format', 'system', 'cc
Topic 7: ['file', 'islam', 'imag', 'cview', 'use', 'format', 'color', 'muslim', 'religion', '
Topic 8: ['post', 'file', 'space', 'islam', 'read', 'cview', 'format', 'articl', 'group', 'mc
Topic 9: ['christian', 'graphic', 'imag', 'jesu', 'book', 'data', 'group', 'softwar', 'law',
Topic 10: ['exist', 'atheism', 'atheist', 'graphic', 'delet', 'post', 'god', 'one', 'group',
```

6.3.4 단어 간 의미 유사도 분석

```
tfidf = TfidfVectorizer(max_features=1000, min_df=5, max_df=0.5)
X_train_tfidf = tfidf.fit_transform(X_train) # train set을 변환
```

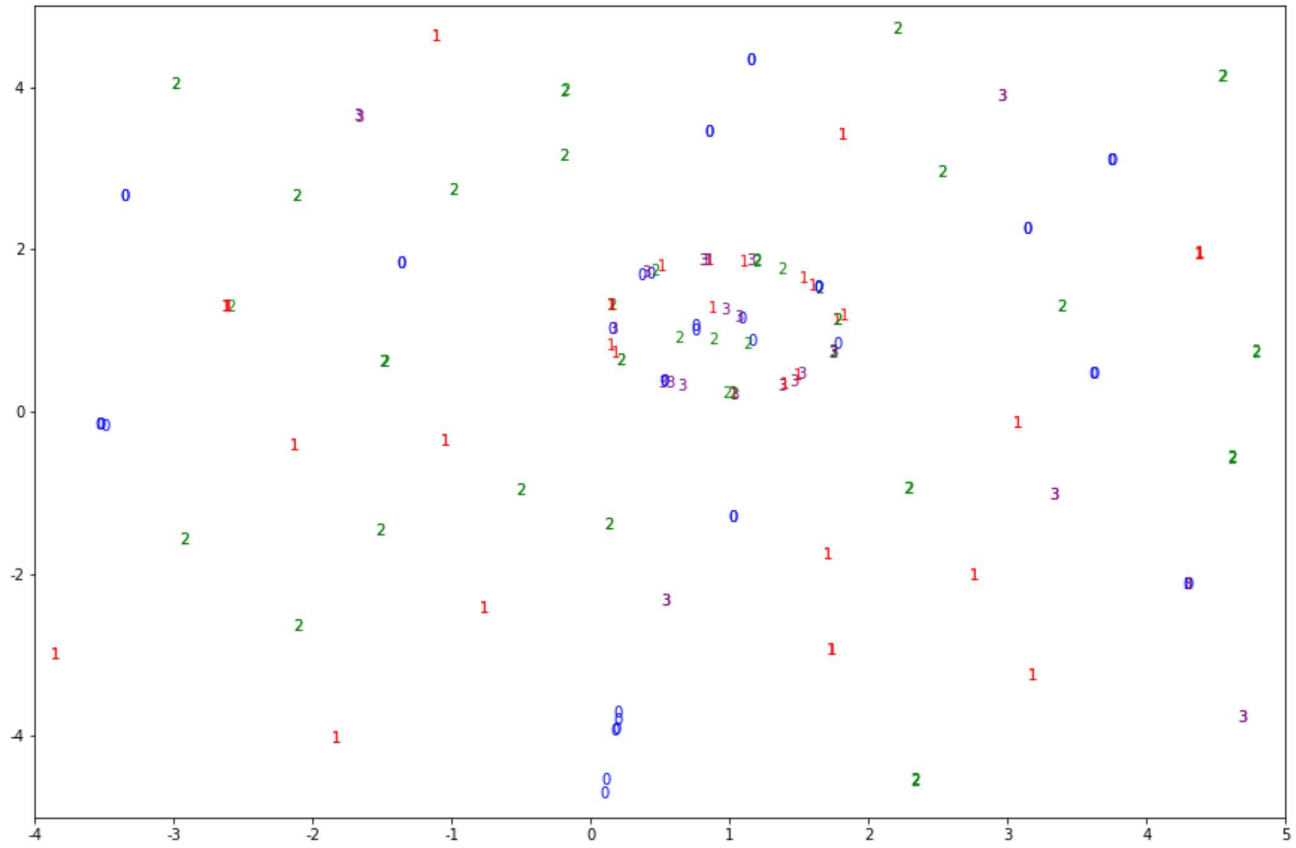
```
svd = TruncatedSVD(n_components=100, random_state=1) #압축할 component의 수 지정
X_train_lsa = svd.fit_transform(X_train_tfidf)

print('#components_의 shape:', svd.components_.shape)
print('#singular_values_의 shape:', svd.singular_values_.shape)
t_words = np.diag(svd.singular_values_).dot(svd.components_).T
print('#변환된 단어-잠재의미 행렬의 shape:', t_words.shape)

# space에 해당하는 벡터를 가져옴
source = t_words[np.where(tfidf.get_feature_names_out() == 'space')[0][0]]

sim_result = cosine_similarity([source], t_words) #변환된 count vector와 기존 값들과의 similarity

print("#Top 20 유사도(tfidf):", sorted(sim_result[0].round(2), reverse=True)[:20])
sim_index = (-sim_result[0]).argsort()[:20]
print('#Top 20 유사 뉴스의 인덱스(tfidf):', sim_index)
sim_labels = [tfidf.get_feature_names_out()[i] for i in sim_index]
print('#Top 20 유사 뉴스의 카테고리(tfidf):', sim_labels)
```

```
#components_의 shape: (100, 1000)
#singular_values_의 shape: (100,)
#변환된 단어-잠재의미 행렬의 shape: (1000, 100)
#Top 20 유사도(tfidf): [1.0, 0.73, 0.72, 0.69, 0.66, 0.58, 0.56, 0.56, 0.54, 0.54, 0.52, 0.52
#Top 20 유사 뉴스의 인덱스(tfidf): [812 314 754 829 594 679 720 650 785 565 101 435 606 545 8
 611 564]
#Top 20 유사 뉴스의 카테고리(tfidf): ['space', 'exploration', 'sci', 'station', 'office', 'pr
```

6.4 tSNE를 이용한 시각화와 차원축소의 효과

```
%matplotlib inline
import matplotlib.pyplot as plt
import matplotlib as mpl

# 그래프에서 마이너스 폰트 깨지는 문제에 대한 대처
mpl.rcParams['axes.unicode_minus'] = False


from sklearn.manifold import TSNE

tfidf = TfidfVectorizer(tokenizer=tokenizer)
X_train_tfidf = tfidf.fit_transform(X_train) # train set을 변환
X_test_tfidf = tfidf.transform(X_test) # test set을 변환

tsne = TSNE(n_components=2, random_state=7)
tsne_tfidf = tsne.fit_transform(X_train_tfidf)
print('TSNE dimension:', tsne_tfidf.shape)

def tsne_graph(tsne_2, label, lim=None):
    colors = {0:'blue', 1:'red', 2:'green', 3:'purple'}
    x = tsne_2[:,0] #압축된 첫 차원을 x축으로 이용
    y = tsne_2[:,1] #압축된 둘째 차원은 y축으로 이용
    plt.figure(figsize=(15,10))
    plt.figure(figsize=(15,10))
    if lim == None:
        lim = [min(x), max(x), min(y), max(y)]
    plt.xlim(lim[0], lim[1])
    plt.ylim(lim[2], lim[3])
    #for i in range(500):
    for i in range(len(x)):
        #각 값에 대해 y값 즉 label에 따라 색을 바꿔가며 text로 그래프에 출력
        if (lim[0] < x[i] < lim[1]) and (lim[2] < y[i] < lim[3]):
            plt.text(x[i], y[i], label[i], color = colors[label[i]])
    plt.show()

tsne_graph(tsne_tfidf, y_train, (-4, 5, -5, 5))
```

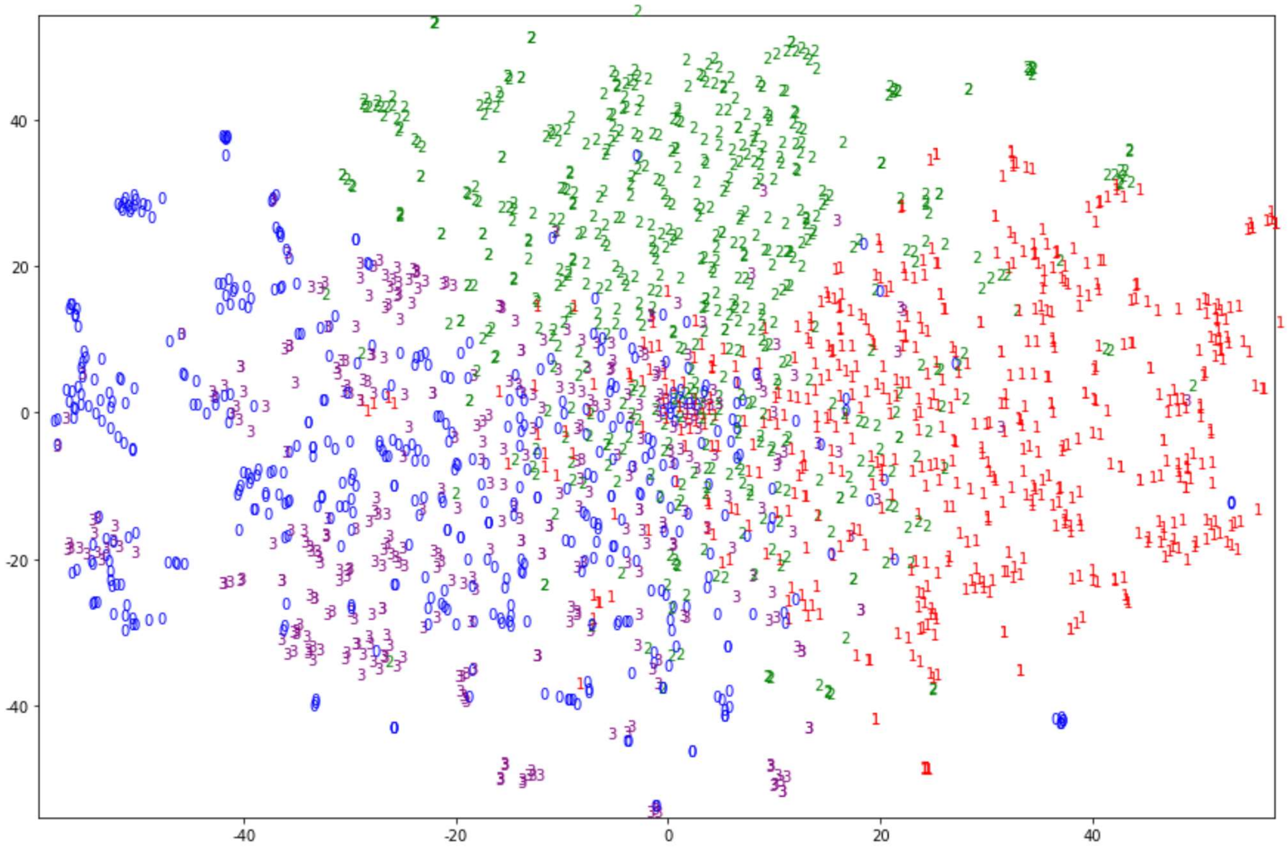
```
TSNE dimension: (2034, 2)
```



```
svd = TruncatedSVD(n_components=100, random_state=1) #압축할 component의 수 지정
X_train_lsa = svd.fit_transform(X_train_tfidf)
X_test_lsa = svd.transform(X_test_tfidf)

print('LSA Converted X shape:', X_train_lsa.shape)
print('Sum of explained variance ratio: {:.3f}'.format(svd.explained_variance_ratio_.sum()))

tsne_lsa = tsne.fit_transform(X_train_lsa)
```

```
print('TSNE dimension:', tsne_lsa.shape)
print('#Selected categories:', newsgroups_train.target_names)

tsne_graph(tsne_lsa, y_train)
```

```
LSA Converted X shape: (2034, 100)
Sum of explained variance ratio: 0.209
TSNE dimension: (2034, 2)
#Selected categories: ['alt.atheism', 'comp.graphics', 'sci.space', 'talk.religion.misc']
```



✓ 35초 오후 8:42에 완료됨 ● ×