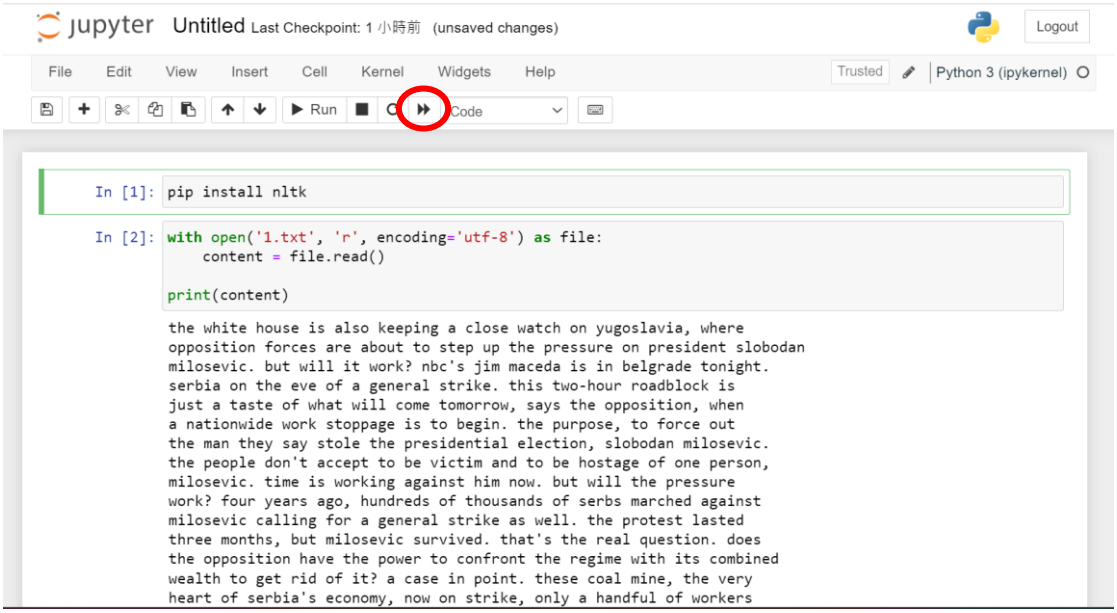
文字探勘 HW2

資管三 B11705033 江睿宸

1. 執行環境：Jupyter Notebook
2. 程式語言：Python3
3.



如果沒有 ntlk 套件需要先安裝(執行第一個 cell)

使用 jupyter notebook 執行全部

4.

```
In [2]: import os
        import glob
        import nltk
        from nltk.stem import PorterStemmer
        import numpy as np
        from collections import defaultdict
        import math


        nltk.download('punkt')
```

Import 需要的套件

```
In [3]: # Tokenize & Calculate frequency
        stopwords = ["i", "me", "my", "myself", "we", "our", "ours", "ourselves", "you", "your", "yours", "your

        document_frequencies = {} #紀錄單字出現次數
        filtered_tokens_list = {} #紀錄所有token
        num_files = 1095

        for i in range(1, num_files + 1):
            filename = os.path.join('IRTM', f"{i}.txt")
            with open(filename, 'r', encoding='utf-8') as file:
                content = file.read()
                text = content

                # Remove punctuation mark and lowercasing
                punctuation = ',.!?;:"`()_'
                punctuation += "'" # except -
                for char in punctuation:
                    text = text.replace(char, '')
                tokens = text.lower().split()
```

```
        # Stemming
        stemmer = PorterStemmer()
        stemmed_words = [stemmer.stem(word) for word in tokens]

        # Remove stopwords
        filtered_tokens = [word for word in tokens if word not in stopwords]
        filtered_tokens_list[i] = filtered_tokens

        for term in filtered_tokens:
            if term in document_frequencies:
                document_frequencies[term] += 1
            else:
                document_frequencies[term] = 1
```

使用作業一的 tokenize 取出 token，並計算每個單字的出現次數

```
In [4]: i=1
        with open('dictionary.txt', 'w') as f:
            for term in sorted(document_frequencies.keys()):
                f.write(f"{i} {term} {document_frequencies[term]}\n")
                i+=1
```

將結果根據單字升序寫入 dictionary 文件中

```
In [5]: tf_list = []
        df = defaultdict(int)
        for i in range(1, num_files + 1):
            term_frequencies = {}
            for term in filtered_tokens_list[i]:
                if term in term_frequencies:
                        term_frequencies[term] += 1
                else:
                    term_frequencies[term] = 1

            sum_term = sum(term_frequencies.values())
            tf = {}

            for term, count in term_frequencies.items():
                tf[term] = count / sum_term  # 計算 TF
                df[term] += 1

            tf_list.append(tf)
        # 計算 IDF
        idf = {}
        for term, doc_count in df.items():
            idf[term] = math.log(num_files / doc_count)

        # 計算 TF-IDF
        tf_idf_list = []
        for tf in tf_list:
            tf_idf = {}
            for term, tf_value in tf.items():
                tf_idf[term] = tf_value * idf[term]
            tf_idf_list.append(tf_idf)

         # 將 TF-IDF 轉換為單位向量
        unit_vectors = []
        for tf_idf in tf_idf_list:
            magnitude = math.sqrt(sum(value ** 2 for value in tf_idf.values()))
            unit_vector = {term: value / magnitude for term, value in tf_idf.items()} if magnitude > 0 else {}
            unit_vectors.append(unit_vector)
```

根據公式計算 TF-IDF

TF = 計算每個單字在該篇的出現次數 / 該篇單字量

IDF = 根據單字計算總文章數 / 在出現在各幾篇文章中並取 log

相乘後除以長度得單位向量

```
In [6]: terms = sorted(document_frequencies.keys())  # 按詞的字母順序排序
        term_to_index = {term: index for index, term in enumerate(terms)} #單字的編號順序

        for i in range(1, num_files + 1):
            filename = os.path.join('Result', f"{i}.txt")
            with open(filename, 'w', encoding='utf-8') as file:
                current_tf_idf = tf_idf_list[i - 1]
                file.write(f"{len(current_tf_idf)}\n") #The number of terms document has

                for term in terms:
                    if term in current_tf_idf:
                        index = term_to_index[term]
                        value = current_tf_idf[term]
                        file.write(f"{index}    {value:.6f}\n")
```

在 Result 資料夾中根據每個 document 寫入單字的及其 TF-IDF 值

In [7]:
```
# 讀取檔案
def load_vector(doc_name):
    vector = {}
    with open(doc_name, 'r', encoding='utf-8') as file:
        next(file)  # The number of terms document has
        for line in file:
            index, value = line.split()
            vector[int(index)] = float(value)
    return vector

def cosine(docx, docy):
    vector_x = load_vector(docx)
    vector_y = load_vector(docy)
```

```
    # 所有出現的單字集
    all_indices = set(vector_x.keys()).union(set(vector_y.keys()))

    # 統一長度將沒出現的單字填入0
    tf_idf_x = np.array([vector_x.get(term, 0) for term in all_indices])
    tf_idf_y = np.array([vector_y.get(term, 0) for term in all_indices])

    # Calculate the cosine similarity
    dot = np.dot(tf_idf_x, tf_idf_y)
    len_x = np.linalg.norm(tf_idf_x)
    len_y = np.linalg.norm(tf_idf_y)
    if len_x == 0 or len_y == 0:
        return 0.0

    cosine_similarity = dot / (len_x * len_y)
    return cosine_similarity
```

使用 numpy 函數取得內積及兩 vector 長度，並計算 cosine similarity

In [8]:
```
x=1
y=2
similarity = cosine(f"output/{x}.txt", f"output/{y}.txt")
print(f"Cosine Similarity: {similarity:.9f}")
```

```
Cosine Similarity: 0.136289845
```

在 x y 分別輸入想確認的兩個文件編號，便可得 cosine similarity