Université de Montréal

IFT6285 (TALN)

Devoir 1: Compter des mots

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Automne 2021

In [1]:

```
import nltk
import sys
from collections import Counter
import pandas as pd
from os import listdir
from tqdm import tqdm
import time
import matplotlib.pyplot as plt
```

In [2]:

```
folder = 'training-monolingual.tokenized.shuffled/'
folder_short = '1bshort/'
```

Part 1 : Counting Words without transformation (Questions 1 to 4)

In [114…

```
def count_words_wc(folder):
    files = listdir(folder)
    wc = Counter()
    times = []
    types = []
    start_time = time.time()
    for fn in tqdm(files):
        with open(folder+fn, 'r',encoding="utf8") as f:
            corpus = f.read()
            tokens = corpus.split()
            wc += Counter(tokens)
            times.append(time.time() - start_time)
            types.append(len(wc))
        f.close()
    total_time = (time.time() - start_time)
    print("Total time : --- %s seconds ---" % total_time)
    vocab_size = len(wc)
    print("Vocab size :", vocab_size)
    return total_time, wc, times, types
```

In [4]:

```
total_time, wc, times, types = count_words_wc(folder)
```

```
100%|██████████| 99/99 [02:44<00:00,  1.66s/it]
Total time : --- 164.3430995941162 seconds ---
Vocab size : 2425337
```

In [5]:

```
df = pd.DataFrame.from_dict(wc, orient='index', columns = ['frequency'])
print(df)
```

```
                     frequency
The                    5264636
U.S.                    639841
```

```
Centers                     8863
for                      6509312
Disease                     8823
...                          ...
Carefully-regulated            1
LabNearly                      1
benefitsor                     1
Ndoungou                       1
un-prepossessing               1

[2425337 rows x 1 columns]
```

In [6]:

```
total_words = df['frequency'].sum()
total_types = len(df)
```

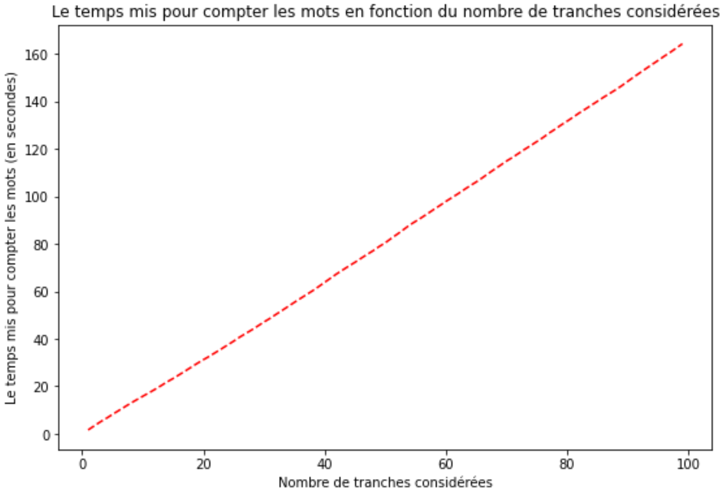
In [7]:

```
# number of tokens
print("Number of tokens: ", total_words)
# vocab size: len(wc) = = len(df)
vocab_size = len(wc)
print("Vocab size: ", len(wc))
```

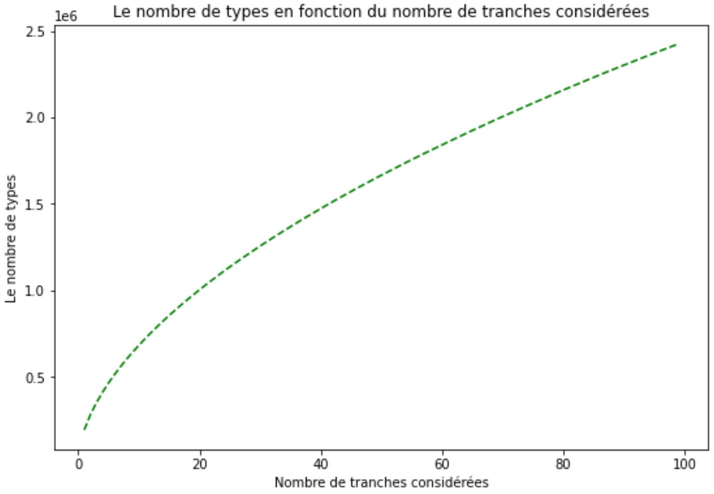
```
Number of tokens:  768648884
Vocab size:  2425337
```

In [8]:

```
tranches = list(range(1,100))
plt.figure(figsize=(9,6))
plt.plot(tranches, times,'r--')
plt.title("Le temps mis pour compter les mots en fonction du nombre de tranches considérées")
plt.xlabel("Nombre de tranches considérées")
plt.ylabel("Le temps mis pour compter les mots (en secondes)")
plt.show()

plt.figure(figsize=(9,6))
plt.plot(tranches, types , 'g--')
plt.title("Le nombre de types en fonction du nombre de tranches considérées")
plt.xlabel("Nombre de tranches considérées")
plt.ylabel("Le nombre de types")
plt.show()
```



Le temps mis pour compter les mots en fonction du nombre de tranches considérées

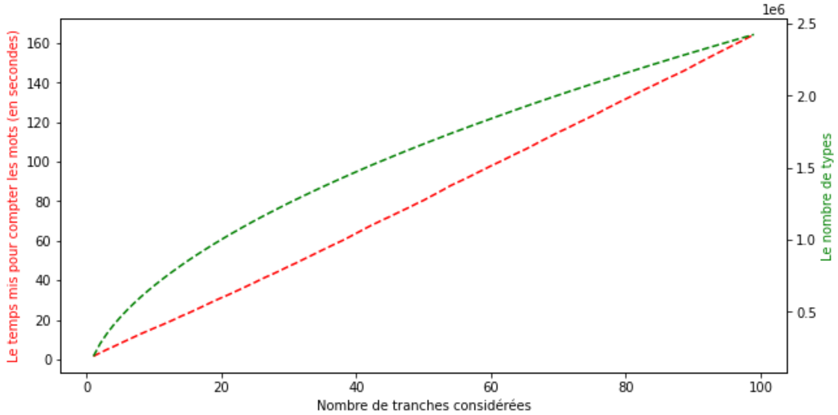


Le nombre de types en fonction du nombre de tranches considérées

In [9]:

```
fig, ax = plt.subplots(figsize=(10, 5))
```

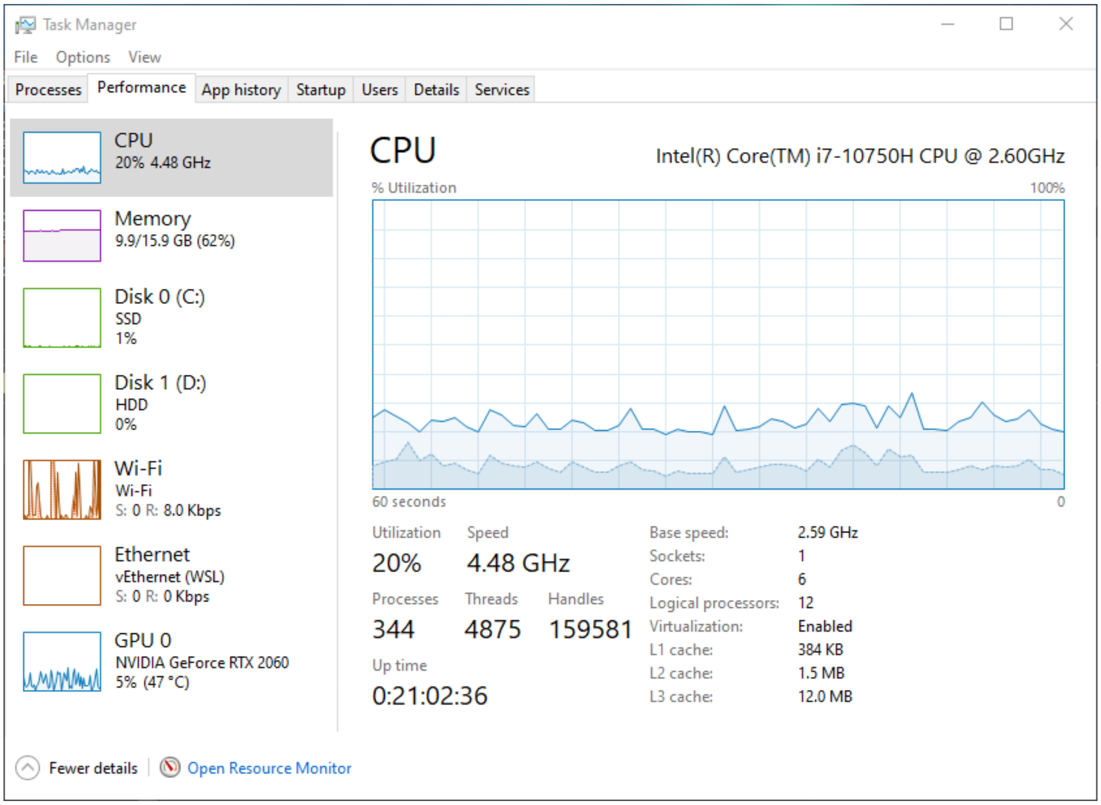
```
ax.plot(tranches, times,'r--')
ax.set_xlabel("Nombre de tranches considérées")
ax.set_ylabel("Le temps mis pour compter les mots (en secondes)", color = 'r')

ax2=ax.twinx()

ax2.plot(tranches, types , 'g--')
ax2.set_xlabel("Nombre de tranches considérées")
ax2.set_ylabel("Le nombre de types", color = 'g')
plt.show()
```



CPU Specifications:

Processor
10th Generation Intel® Core™ i7-10750H Processor (2.60 GHz, up to 5.00 GHz with Turbo Boost, 6 Cores, 12 Threads, 12 MB Cache)

A screenshot while running the notebook shows that the CPU speed is varying @ around 4.40 GHz:



CPU
20% 4.48 GHz

Memory
9.9/15.9 GB (62%)

Disk 0 (C:)
SSD
1%

Disk 1 (D:)
HDD
0%

Wi-Fi
Wi-Fi
S: 0 R: 8.0 Kbps

Ethernet
vEthernet (WSL)
S: 0 R: 0 Kbps

GPU 0
NVIDIA GeForce RTX 2060
5% (47 °C)

CPU Intel(R) Core(TM) i7-10750H CPU @ 2.60GHz

Utilization 20%
Speed 4.48 GHz
Processes 344
Threads 4875
Handles 159581
Up time 0:21:02:36

Base speed: 2.59 GHz
Sockets: 1
Cores: 6
Logical processors: 12
Virtualization: Enabled
L1 cache: 384 KB
L2 cache: 1.5 MB
L3 cache: 12.0 MB

Part 2 : Multiple transformations comparison (Question 5)

In [10]:

```
!pip install clean-text
```

```
Requirement already satisfied: clean-text in c:\users\kacem\anaconda3\lib\site-packages (0.5.0)
Requirement already satisfied: emoji in c:\users\kacem\anaconda3\lib\site-packages (from clean-text) (1.4.2)
Requirement already satisfied: ftfy<7.0,>=6.0 in c:\users\kacem\anaconda3\lib\site-packages (from clean-text) (6.0.3)
Requirement already satisfied: wcwidth in c:\users\kacem\anaconda3\lib\site-packages (from ftfy<7.0,>=6.0->clean-text) (0.2.5)
```

In [11]:

```
import nltk
from nltk.corpus import stopwords
```

```python
from nltk.stem import PorterStemmer
import string
from nltk.stem import   WordNetLemmatizer

from cleantext import clean

nltk.download('wordnet')
wordnet_lemmatizer = WordNetLemmatizer()
stemmer = PorterStemmer()
stopwords_english = stopwords.words('english')
```

```
Since the GPL-licensed package `unidecode` is not installed, using Python's `unicodedata` package which yields worse results.
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\kacem\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

In [12]:

```python
def count_words(folder, lower = False, numeric = False, url = False,
                stem = False, lem = False, puncts = False, stopwords = False):
    files = listdir(folder)
    wc = Counter()
    times = []
    types = []
    start_time = time.time()
    for fn in tqdm(files):
        with open(folder+fn, 'r',encoding="utf8") as f:
            corpus = f.read()
            if numeric or url:
                corpus = clean(corpus,fix_unicode=False,to_ascii = False,
                            lower=False, no_numbers=numeric,
                            replace_with_number="__NUM__", no_urls=url,
                            replace_with_url="__URL__")
            tokens = corpus.split()
            if puncts:
                tokens = [ t for t in tokens if t not in string.punctuation]
            if lower:
                tokens = [t.lower() for t in tokens]
            if stem:
                tokens = [stemmer.stem(t) for t in tokens]
            if lem:
                tokens = [wordnet_lemmatizer.lemmatize(t) for t in tokens]
            if stopwords:
                tokens = [ t for t in tokens if t not in stopwords_english]

            wc += Counter(tokens)
            times.append(time.time() - start_time)
            types.append(len(wc))
        f.close()
    total_time = (time.time() - start_time)
    vocab_size = len(wc)
    print("Vocab size :", vocab_size)
    print("Total time : --- %s seconds ---" % total_time)
    return total_time, vocab_size, times, types
```

Transformations :

In [13]:

```python
# simple: no transformation
total_time, vocab_size, times, types = count_words(folder, lower = False, numeric = False,
                                        url = False, stem = False, lem = False,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [02:53<00:00,  1.75s/it]
Vocab size : 2425337
Total time : --- 173.46188163757324 seconds ---
```

In [14]:

```python
# transformation 1 : lower
total_time_1, vocab_size_1, times_1, types_1 = count_words(folder, lower = True, numeric = False,
                                        url = False, stem = False, lem = False,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [04:15<00:00,  2.58s/it]
Vocab size : 2183893
Total time : --- 255.00604128837585 seconds ---
```

In [15]:

```python
# transformation 2 : no puncts
total_time_2, vocab_size_2, times_2, types_2 = count_words(folder, lower = False, numeric = False,
                                        url = False, stem = False, lem = False,
                                        puncts = True, stopwords = False)
```

```
100%|██████████| 99/99 [04:11<00:00,  2.54s/it]
Vocab size : 2425305
Total time : --- 251.06745886802673 seconds ---
```

In [16]:

```python
# transformation 3 : no stopwords
total_time_3, vocab_size_3, times_3, types_3 = count_words(folder, lower = False, numeric = False,
                                        url = False, stem = False, lem = False,
                                        puncts = False, stopwords = True)
```

```
100%|██████████| 99/99 [20:59<00:00, 12.72s/it]
```

```
Vocab size : 2425184
Total time : --- 1259.3751766681671 seconds ---
```

In [17]:

```
# transformation 4 : stem
total_time_4, vocab_size_4, times_4, types_4 = count_words(folder, lower = False, numeric = False,
                                        url = False, stem = True, lem = False,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [2:28:03<00:00, 89.74s/it]
Vocab size : 1978573
Total time : --- 8883.943012714386 seconds ---
```

In [18]:

```
# transformation 5 : lem
total_time_5, vocab_size_5, times_5, types_5  = count_words(folder, lower = False, numeric = False,
                                        url = False, stem = False, lem = True,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [40:28<00:00, 24.53s/it]
Vocab size : 2402521
Total time : --- 2428.058193206787 seconds ---
```

In [19]:

```
# transformation 6 : no numeric
total_time_6, vocab_size_6, times_6, types_6 = count_words(folder, lower = False, numeric = True,
                                        url = False, stem = False, lem = False,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [18:11<00:00, 11.02s/it]
Vocab size : 2097094
Total time : --- 1091.4372432231903 seconds ---
```

In [20]:

```
# transformation 7 : no url
total_time_7, vocab_size_7, times_7, types_7 = count_words(folder, lower = False, numeric = False,
                                        url = True, stem = False, lem = False,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [14:48<00:00,  8.97s/it]
Vocab size : 2365863
Total time : --- 888.0872147083282 seconds ---
```

In [21]:

```
# save the curves data in csv files
all_times = [times, times_1, times_2, times_3, times_4, times_5, times_6, times_7]
all_types = [types, types_1, types_2, types_3, types_4, types_5, times_6, times_7]
import numpy as np
np.savetxt("outputs/times.csv",
           all_times,
           delimiter =", ",
           fmt ='% s')
np.savetxt("outputs/types.csv",
           all_types,
           delimiter =", ",
           fmt ='% s')
```

In [22]:

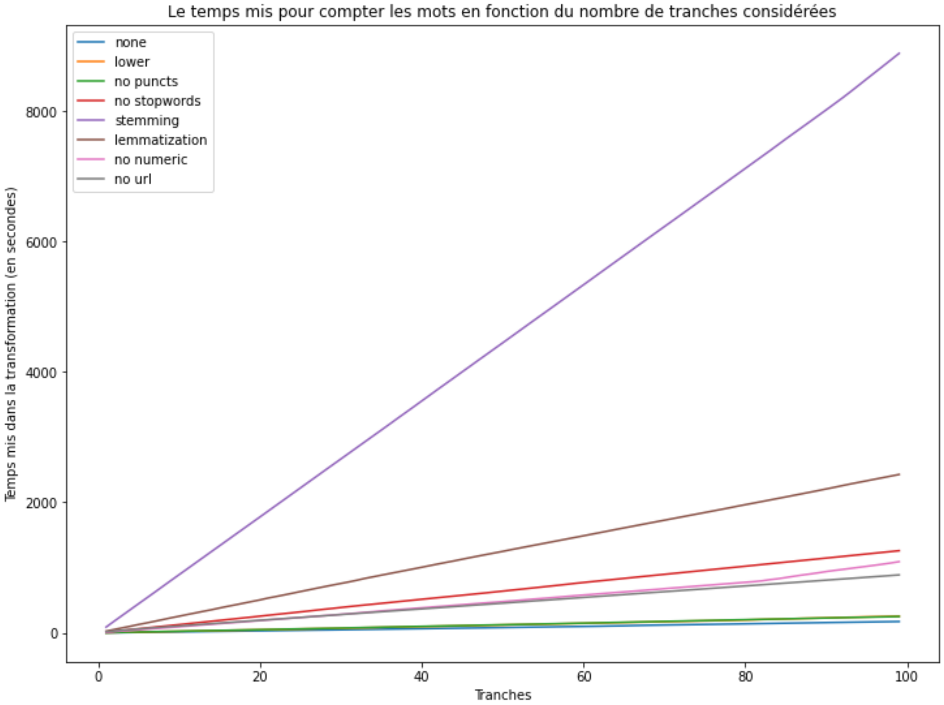
```
transformations = ['none','lower','no puncts','no stopwords','stemming','lemmatization','no numeric','no url']
vocab_sizes = [vocab_size, vocab_size_1, vocab_size_2, vocab_size_3, vocab_size_4, vocab_size_5, vocab_size_6, vocab_size_7]
total_times = [total_time, total_time_1, total_time_2, total_time_3, total_time_4, total_time_5, total_time_6, total_time_7]
```

In [23]:

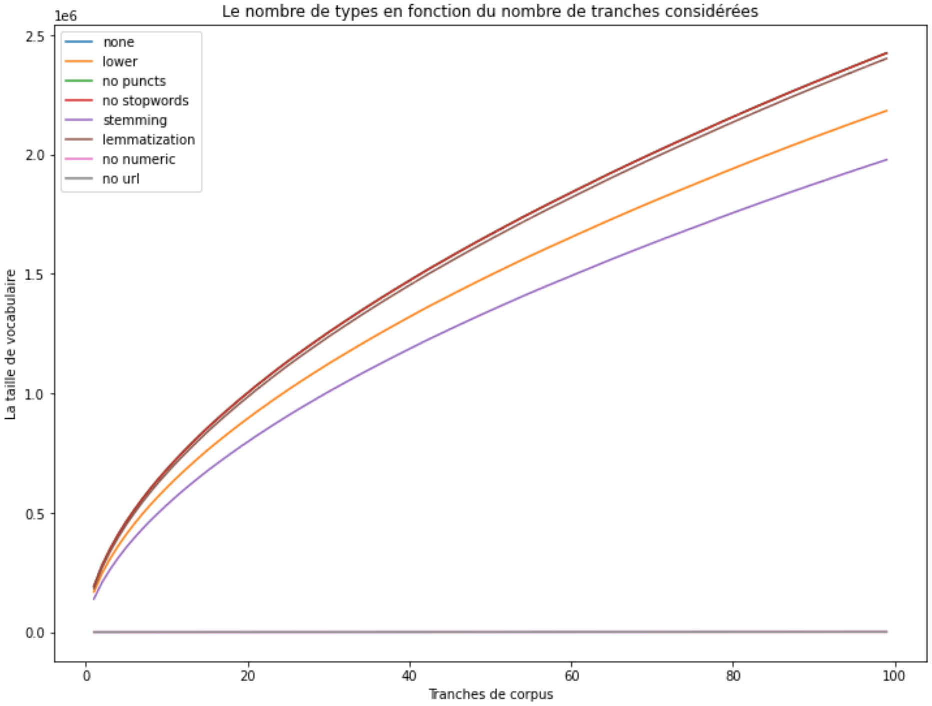
```
def plot_curve(values, transformations, title = '',xlabel = '',ylabel='',n=100):
    tranches = list(range(1,n))
    plt.figure(figsize=(12,9))
    for i in range(len(transformations)):
        plt.plot(tranches, values[i], label=transformations[i])
    plt.title(title)
    plt.xlabel(xlabel)
    plt.ylabel(ylabel)
    plt.legend(loc="upper left")
    plt.show()
```

In [24]:

```
plot_curve(all_times,transformations,
           title="Le temps mis pour compter les mots en fonction du nombre de tranches considérées",
          xlabel = "Tranches",
          ylabel = "Temps mis dans la transformation (en secondes)")
plot_curve(all_types,transformations,
           title="Le nombre de types en fonction du nombre de tranches considérées",
          xlabel = "Tranches de corpus",
          ylabel = "La taille de vocabulaire")
```



Le temps mis pour compter les mots en fonction du nombre de tranches considérées



Le nombre de types en fonction du nombre de tranches considérées

In [25]:

```
d = {'Transformations': transformations, 'Vocabulary size': vocab_sizes, 'Execution time (s)': total_times,
     'Reduced Vocab ‰': [(v - vocab_sizes[0])*1000/vocab_sizes[0] for v in vocab_sizes],'Lost time': [t - total_times[0] for t in total_times]
df_results = pd.DataFrame(data=d)
```

In [26]:

```
df_results
```

Out[26]:

	Transformations	Vocabulary size	Execution time (s)	Reduced Vocab ‰	Lost time
0	none	2425337	173.461882	0.000000	0.000000
1	lower	2183893	255.006041	-99.550702	81.544160
2	no puncts	2425305	251.067459	-0.013194	77.605577
3	no stopwords	2425184	1259.375177	-0.063084	1085.913295
4	stemming	1978573	8883.943013	-184.206978	8710.481131
5	lemmatization	2402521	2428.058193	-9.407352	2254.596312
6	no numeric	2097094	1091.437243	-135.339130	917.975362
7	no url	2365863	888.087215	-24.521953	714.625333

In [27]:

```
df_results.sort_values(by=['Vocabulary size'])
```

Out[27]:

	Transformations	Vocabulary size	Execution time (s)	Reduced Vocab ‰	Lost time
4	stemming	1978573	8883.943013	-184.206978	8710.481131
6	no numeric	2097094	1091.437243	-135.339130	917.975362
1	lower	2183893	255.006041	-99.550702	81.544160
7	no url	2365863	888.087215	-24.521953	714.625333
5	lemmatization	2402521	2428.058193	-9.407352	2254.596312
3	no stopwords	2425184	1259.375177	-0.063084	1085.913295
2	no puncts	2425305	251.067459	-0.013194	77.605577
0	none	2425337	173.461882	0.000000	0.000000

In [28]:

```
df_results.sort_values(by=['Execution time (s)'])
```

Out[28]:

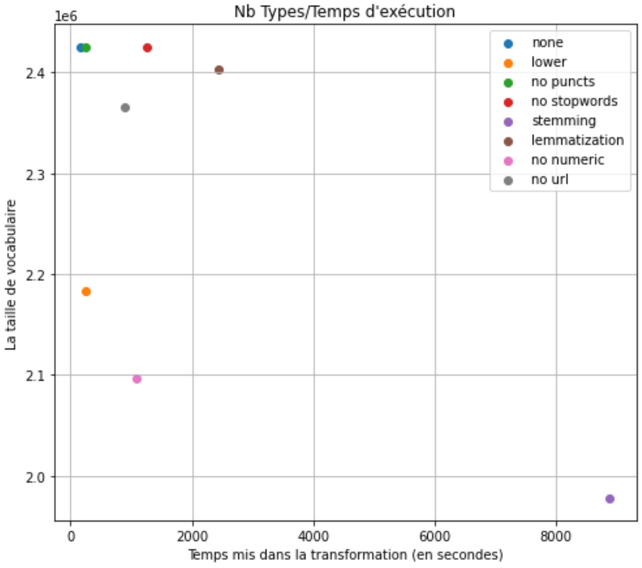
	Transformations	Vocabulary size	Execution time (s)	Reduced Vocab ‰	Lost time
0	none	2425337	173.461882	0.000000	0.000000
2	no puncts	2425305	251.067459	-0.013194	77.605577
1	lower	2183893	255.006041	-99.550702	81.544160
7	no url	2365863	888.087215	-24.521953	714.625333
6	no numeric	2097094	1091.437243	-135.339130	917.975362
3	no stopwords	2425184	1259.375177	-0.063084	1085.913295
5	lemmatization	2402521	2428.058193	-9.407352	2254.596312
4	stemming	1978573	8883.943013	-184.206978	8710.481131

In [186…

```
import matplotlib.pyplot as plt

def plot_vocab_time_per_transf(total_times,vocab_sizes, transformations):
    fig, ax = plt.subplots(figsize=(8,7))
    for i in range(len(transformations)):

        ax.scatter(total_times[i],vocab_sizes[i],  label=transformations[i],
                   alpha=1)

    ax.legend()
    ax.grid(True)
    plt.title("Nb Types/Temps d'exécution")
    plt.xlabel("Temps mis dans la transformation (en secondes)")
    plt.ylabel("La taille de vocabulaire")
    fig.savefig("outputs/types Vs time of "+str(len(transformations)-1)+" transformations.svg",format="svg")
    plt.show()
```

In [187…

```
plot_vocab_time_per_transf(total_times,vocab_sizes, transformations)
```



Chosen transformations: "Execution time" wise

{lower, no puncts, no url, no numeric}

In [31]:

```
def count_words_multiple_1(folder, lower = False, numeric = False, url = False,
                stem = False, lem = False, puncts = False, stopwords = False):
    files = listdir(folder)
    wc = Counter()
    times = []
    types = []
    start_time = time.time()
    for fn in tqdm(files):
        with open(folder+fn, 'r',encoding="utf8") as f:
            corpus = f.read()
            if numeric or url or lower or puncts:
                corpus = clean(corpus,fix_unicode=False,to_ascii = False,
                            lower=lower, no_numbers=numeric,no_punct = puncts,
                            replace_with_number="__NUM__", no_urls=url,
                            replace_with_url="__URL__")
            tokens = corpus.split()
            #if puncts and lower:
            #    tokens = [ t.lower() for t in tokens if t not in string.punctuation]
            if stem:
                tokens = [stemmer.stem(t) for t in tokens]
            if lem:
                tokens = [wordnet_lemmatizer.lemmatize(t) for t in tokens]
            if stopwords:
                tokens = [ t for t in tokens if t not in stopwords_english]
            wc += Counter(tokens)
            times.append(time.time() - start_time)
            types.append(len(wc))
        f.close()
    total_time = (time.time() - start_time)
    vocab_size = len(wc)
    print("Vocab size :", vocab_size)
    print("Total time : --- %s seconds ---" % total_time)
    return total_time, vocab_size, times, types, wc
```

In [32]:

```
# transformation  : lower, no puncts, no url, no numeric
total_time_i, vocab_size_i, times_i, types_i, wc_i = count_words_multiple_1(folder, lower = True, numeric = True,
                                        url = True, stem = False, lem = False,
                                        puncts = True, stopwords = False)
```

```
100%|██████████| 99/99 [22:34<00:00, 13.68s/it]
Vocab size : 1664128
Total time : --- 1354.6343467235565 seconds ---
```

Chosen transformations: "Vocabulary size" wise

{stemming, no numeric, lower, no url}

In [33]:

```
def count_words_multiple_2(folder, lower = False, numeric = False, url = False,
                stem = False, lem = False, puncts = False, stopwords = False):
    files = listdir(folder)
    wc = Counter()
    times = []
    types = []
    start_time = time.time()
    for fn in tqdm(files):
        with open(folder+fn, 'r',encoding="utf8") as f:
            corpus = f.read()
            if numeric or url or lower:
                corpus = clean(corpus,fix_unicode=False,to_ascii = False,
                            lower=lower, no_numbers=numeric,
                            replace_with_number="__NUM__", no_urls=url,
                            replace_with_url="__URL__")
            tokens = corpus.split()
            #if puncts and lower:
            #    tokens = [ t.lower() for t in tokens if t not in string.punctuation]
            if stem:
                tokens = [stemmer.stem(t) for t in tokens]
            if lem:
                tokens = [wordnet_lemmatizer.lemmatize(t) for t in tokens]
            if stopwords:
                tokens = [ t for t in tokens if t not in stopwords_english]
            wc += Counter(tokens)
            times.append(time.time() - start_time)
            types.append(len(wc))
        f.close()
    total_time = (time.time() - start_time)
    vocab_size = len(wc)
    print("Vocab size :", vocab_size)
    print("Total time : --- %s seconds ---" % total_time)
    return total_time, vocab_size, times, types, wc
```

In [34]:

```
# transformation  : stemming, no numeric, lower, no url
total_time_ii, vocab_size_ii, times_ii, types_ii, wc_ii = count_words_multiple_2(folder, lower = True, numeric = True,
                                        url = True, stem = True, lem = False,
                                        puncts = False, stopwords = False)
```

```
100%|██████████| 99/99 [2:56:24<00:00, 106.92s/it]
Vocab size : 1592196
Total time : --- 10584.886978387833 seconds ---
```

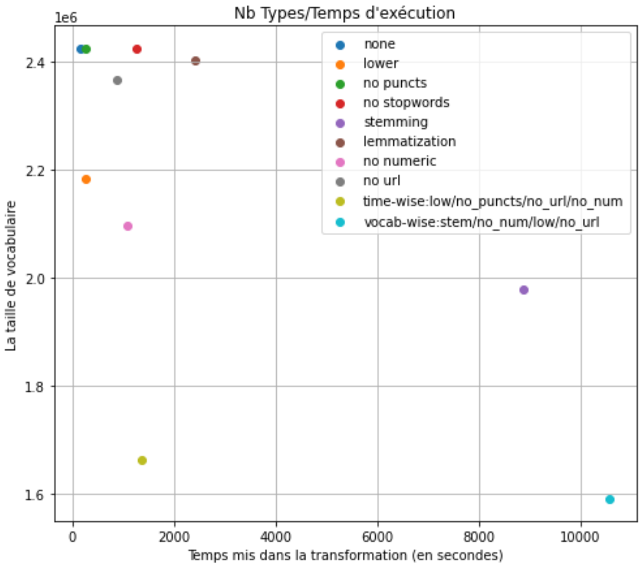
Comparison : "Execution time" wise Vs "Vocabulary size" wise

In [175…

```
new_transformations = transformations + ['time-wise:low/no_puncts/no_url/no_num','vocab-wise:stem/no_num/low/no_url']
new_vocab_sizes = vocab_sizes + [vocab_size_i,vocab_size_ii]
new_total_times = total_times + [total_time_i,total_time_ii]
```

In [188…

```
plot_vocab_time_per_transf(new_total_times,new_vocab_sizes, new_transformations)
```



Final combination: Trade-off between speed and vocab size

{lower, no url, no numeric}

In [37]:

```
def count_words_multiple_final(folder, lower = False, numeric = False, url = False,
                stem = False, lem = False, puncts = False, stopwords = False):
    files = listdir(folder)
    wc = Counter()
    times = []
    types = []
    start_time = time.time()
    for fn in tqdm(files):
        with open(folder+fn, 'r',encoding="utf8") as f:
            corpus = f.read()
            if numeric or url:
                corpus = clean(corpus,fix_unicode=False,to_ascii = False,
                        no_numbers=numeric, #no_punct = puncts, lower=lower,
                        replace_with_number="__NUM__", no_urls=url,
                        replace_with_url="__URL__")
            tokens = corpus.split()
            if lower:
                tokens = [ t.lower() for t in tokens]

            wc += Counter(tokens)
            times.append(time.time() - start_time)
            types.append(len(wc))
        f.close()
    total_time = (time.time() - start_time)
    vocab_size = len(wc)
    print("Vocab size :", vocab_size)
    print("Total time : --- %s seconds ---" % total_time)
    return total_time, vocab_size, times, types, wc
```

In [38]:

```
# transformation  : lower, no url, no numeric
total_time_final, vocab_size_final, times_final, types_final, wc_final = count_words_multiple_final(folder, lower = True, numeric = True,
                                        url = True, stem = False, lem = False,
                                        puncts = False, stopwords = False)
```

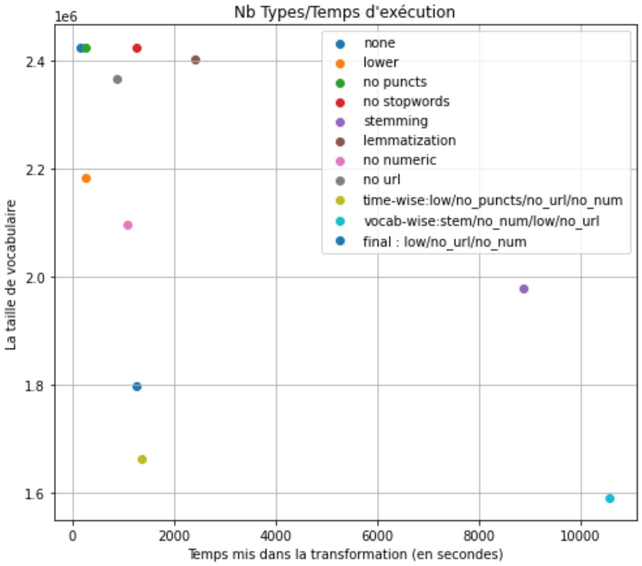
```
100%|██████████| 99/99 [21:06<00:00, 12.80s/it]
Vocab size : 1797611
Total time : --- 1266.9220066070557 seconds ---
```

In [39]:

```
final_transformations = new_transformations + ['final : low/no_url/no_num']
final_vocab_sizes = new_vocab_sizes + [vocab_size_final]
final_total_times = new_total_times + [total_time_final]
```

In [189…

```
plot_vocab_time_per_transf(final_total_times,final_vocab_sizes, final_transformations)
```



Part 3

1- Counting words in `1bshort`

In [115…

```
total_time_short, wc_short, _, _ = count_words_wc(folder_short)
```

```
100%|██████████| 9/9 [00:17<00:00,  1.91s/it]
Total time : --- 17.206393003463745 seconds ---
Vocab size : 642641
```

In [116…

```
df_short = pd.DataFrame.from_dict(wc_short, orient='index', columns = ['frequency'])
df_short.index.name = 'word'
df_short = df_short.reset_index()
```

In [118…

```
df_short
```

Out[118…

	word	frequency
0	The	479626
1	U.S.	58474
2	Centers	805
3	for	591740
4	Disease	787
...	...	...
642636	involute	1
642637	lotsa	1
642638	L-Tyrosine	1
642639	6605	1
642640	hollandandbarrett.com	1

642641 rows × 2 columns

In [119…

```
df_short_sorted = df_short.sort_values(by=['frequency'], ascending= False)
df_short_sorted.head(100).to_csv('outputs/df_short.txt',  sep=' ',  header = False, columns =['frequency','word'], index = False)
```

In [120…

```
df_short_sorted
```

Out[120…

	word	frequency
22	the	3268925
17	,	3194618
43	.	2726336

	word	frequency
12	to	1650316
25	of	1577381
...	...	...
361920	mini-fishing	1
361918	calorie-stuffed	1
361917	potholing	1
361916	Jubur	1
642640	hollandandbarrett.com	1

642641 rows × 2 columns

2- Counting most frequent and less frequent words in processed corpus

In [61]:

```
df_final = pd.DataFrame.from_dict(wc_final, orient='index', columns = ['frequency'])
df_final.index.name = 'word'
df_final = df_final.reset_index()
```

In [62]:

```
df_final
```

Out[62]:

	word	frequency
0	the	41223601
1	u.s.	640048
2	centers	28868
3	for	6763830
4	disease	77275
...	...	...
1797606	carefully-regulated	1
1797607	labnearly	1
1797608	benefitsor	1
1797609	ndoungou	1
1797610	un-prepossessing	1

1797611 rows × 2 columns

In [63]:

```
# freq top 1000
df_top_1000 = df_final.sort_values(by=['frequency'], ascending= False).head(1000)
df_top_1000.to_csv('outputs/freq-top1000.txt',  sep=' ', line_terminator = ' ', header = False, columns =['word'], index = False)
# visualize the result
df_top_1000
```

Out[63]:

	word	frequency
0	the	41223601
17	,	35089484
41	.	29969612
12	to	18251267
24	of	17407846
...	...	...
3249	sector	80870
1461	caused	80770
2466	term	80742
125	everything	80664
369	reason	80532

1000 rows × 2 columns

In [64]:

```
#freq less 1000
df_less_100 = df_final.sort_values(by=['frequency'], ascending= True)
df_less_100.head(1000).to_csv('outputs/freq-less1000.txt',  sep=' ', line_terminator = ' ', header = False, columns =['word'], index = False)
# visualize the result
df_less_100
```

Out[64]:

	word	frequency
898805	explosives-to-bullets	1
1196986	hippie-slang	1
1196985	niqabi	1
1196984	issue-centred	1
1196983	pro-assimilation	1
...	...	...
24	of	17407846
12	to	18251267
41	.	29969612
17	,	35089484
0	the	41223601

1797611 rows × 2 columns

Par curiosité, on voulait savoir le nombre des mots qui ne se repètent pas dans le corpus, c'est à dire, les mots ayants une fréquence égale à 1. C'est environ 950k mots. Ça peut être consideré comme un nombre significatif en le comparant à la taille globale du vocabulaire 2400k: ~40% des mots de vocabulaire sont des mots uniques.

In [65]:

```
df_final[(df_final['frequency']==1)].count()
```

Out[65]:

```
word         954331
frequency    954331
dtype: int64
```

Observation :

L'énoncé dit que les "l'espace est séparateur de mots", si on précise explicitement dans le code qu'on fera le `split(' ')` avec les espaces seulement, ça ignore les autres séparateurs (comme le retour à la ligne (`\n`) et ça augmente notemment la taille de vocabulaire avec des mots mélangés avec des séparateurs. Alors, nous avons fait une séparation plus générale qui inclut les autres séparateurs du texte: `split()` .

Exemple:

```
>>> S = "The girl is\tsitting on the chair , she\nis reading a paper !"
>>> S.split()
['The', 'girl', 'is', 'sitting', 'on', 'the', 'chair', ',', 'she', 'is', 'reading', 'a', 'paper', '!']
>>> S.split(" ")
['The', 'girl', 'is\tsitting', 'on', 'the', 'chair', ',', 'she\nis', 'reading', 'a', 'paper', '!']
>>> print(S)

    The girl is     sitting on the chair , she
    is reading a paper !
```

In [ ]: