N-Grams Modeling

```
In [1]: import random
        import pandas as pd

        import nltk

        from nltk.tokenize import word_tokenize
        from nltk.util import pad_sequence
        from nltk.util import bigrams
        from nltk.util import ngrams
        from nltk.util import everygrams
        from nltk.lm.preprocessing import pad_both_ends
        from nltk.lm.preprocessing import flatten
        from nltk.lm import MLE


        from nltk.lm.preprocessing import padded_everygram_pipeline
```

```
In [2]: file_content = open("textfile.txt", encoding='utf-8').read()
```

```
In [3]: file_content;
```

```
In [4]: text = str(file_content) #Convert to string
```

```
In [5]: tokens = nltk.word_tokenize(text)
```

```
In [6]: tokens;
```

Data Statistics

```
In [7]: sents = nltk.sent_tokenize(text)
        print("The number of sentences is", len(sents))
        #prints the number of sentences
```

```
The number of sentences is 1
```

```
In [8]: words = nltk.word_tokenize(text)
        print("The number of tokens is", len(words))
        #prints the number of tokens
```

```
The number of tokens is 209451
```

```
In [9]: average_tokens = round(len(words)/len(sents))
        print("The average number of tokens per sentence is",
        average_tokens)
        #prints the average number of tokens per sentence
```

```
The average number of tokens per sentence is 209451
```

```
In [10]: unique_tokens = set(words)
         print("The number of unique tokens are", len(unique_tokens))
         #prints the number of unique tokens
```

```
The number of unique tokens are 24975
```

N-Grams = 1

```
In [11]: list(ngrams(tokens,1))
```

```
Out[11]: [('given',),
 ('heart',),
 ('away',),
 ('sordid',),
 ('boon',),
 ('start',),
 ('side',),
 ('sugar',),
 ('sweet',),
 ('asian',),
 ('community',),
 ('need',),
 ('next',),
 ('thing',),
 ('know',),
 ('asian',),
 ('kid',),
 ('following',),
 ('around',),
 ('know',),
 ('shit',),
 ('boy',),
 ('wanted',),
 ('inside',),
 ('especially',),
 ('two',),
 ('particular',),
 ('thought',),
 ('wonderful',),
 ('sickened',),
 ('even',),
 ('wonderful',),
 ('reminds',),
 ('quote',),
 ('wwii',),
 ('era',),
 ('forget',),
 ('go',),
 ('say',),
 ('something',),
 ('like',),
 ('hero',),
 ('everyone',),
 ('around',),
 ('acting',),
 ('badly',),
 ('someone',),
 ('humanitarian',),
 ('award',),
 ('nicholas',),
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 ('run',),
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 ('processing',),
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 ('concrete',),
 ('fact',),
 ('work',),
 ('best',),
 ('thing',),
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 ('almost',),
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 ('challenge',),
 ('trying',),
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 ('sense',),
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 ('loving',),
 ('forced',),
 ('radically',),
 ('confront',),
 ('limitation',),
 ('speech',),
 ('economic',),
 ('inequality',),
 ('reelection',),
 ('game',),
 ('dinner',),
 ('taking',),
 ('picture',),
 ('race',),
 ('outfit',),
 ('sure',),
 ('see',),
 ('wore',),
 ('sunday',),
 ('wash',),
 ('right',),
 ('post',),
 ('pic',),
 ('next',),
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 ('heard',),
 ('loud',),
 ('clear',),
 ('family',),
 ('witness',),
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 ('heading',),
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 ('tell',),
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 ('party',),
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 ('steinberg',),
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 ('attack',),
 ('back',),
 ('burner',),
 ('thanks',),
 ('everyone',),
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 ('made',),
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 ('great',),
 ('show',),
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 ('crowd',),
 ('everyone',),
 ('already',),
 ('looking',),
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 ('month',),
 ('time',),
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 ('single',),
 ('sat',),
 ('counter',),
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 ('bought',),
 ('many',),
 ('must',),
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 ('avoid',),
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 ('beyond',),
 ('lp',),
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 ('second',),
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 ('parted',),
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 ('anything',),
 ('else',),
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 ('day',),
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 ('get',),
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 ('wrist',),
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 ('cream',),
 ('video',),
 ('talk',),
 ('tip',),
 ('give',),
 ('tour',),
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 ('could',),
 ('post',),
 ('sometimes',),
 ('better',),
 ('see',),
 ('action',),
 ('tough',),
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 ('people',),
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 ('law',),
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 ('watching',),
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 ('paladin',),
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 ('dad',),
 ('loved',),
 ('western',),
 ('top',),
 ('fact',),
 ('enjoy',),
 ('reading',),
 ('history',),
 ('mind',),
 ('read',),
 ('history',),
 ('textbook',),
 ('school',),
 ('fact',),
```

```
 ('kid',),
 ('read',),
 ('whole',),
 ('book',),
 ('math',),
 ('get',),
 ('wrong',),
 ('actually',),
 ('mind',),
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 ('today',),
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 ('imam',),
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 ('cash',),
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 ('tire',),
 ('repair',),
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 ('small',),
 ('etc',),
 ('although',),
 ('longer',),
 ('rent',),
 ('bike',),
 ('catch',),
 ('flat',),
 ('place',),
 ('go',),
 ('repair',),
 ('direction',),
 ('traif',),
 ('bike',),
 ('gesheft',),
 ('located',),
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 ('street',),
 ('click',),
 ('link',),
 ('public',),
 ('employee',),
 ('father',),
 ('top',),
 ('busy',),
 ('enjoying',),
 ('mother',),
 ('realized',),
 ('another',),
 ('presence',),
 ('kind',),
 ('dad',),
 ('altho',),
 ('pure',),
 ('energy',),
 ('physical',),
 ('recognized',),
 ('energy',),
 ('signature',),
 ('right',),
 ('franklyn',),
 ('pleiadian',),
 ('guide',),
 ...]
```

N-Grams = 2

In [12]:

```
list(ngrams(tokens,2))
```

Out[12]:

```
[('given', 'heart'),
 ('heart', 'away'),
 ('away', 'sordid'),
 ('sordid', 'boon'),
 ('boon', 'start'),
 ('start', 'side'),
 ('side', 'sugar'),
 ('sugar', 'sweet'),
 ('sweet', 'asian'),
 ('asian', 'community'),
 ('community', 'need'),
 ('need', 'next'),
 ('next', 'thing'),
 ('thing', 'know'),
 ('know', 'asian'),
 ('asian', 'kid'),
 ('kid', 'following'),
 ('following', 'around'),
 ('around', 'know'),
 ('know', 'shit'),
 ('shit', 'boy'),
 ('boy', 'wanted'),
 ('wanted', 'inside'),
 ('inside', 'especially'),
 ('especially', 'two'),
 ('two', 'particular'),
 ('particular', 'thought'),
 ('thought', 'wonderful'),
 ('wonderful', 'sickened'),
 ('sickened', 'even'),
 ('even', 'wonderful'),
 ('wonderful', 'reminds'),
 ('reminds', 'quote'),
 ('quote', 'wwii'),
 ('wwii', 'era'),
 ('era', 'forget'),
 ('forget', 'go'),
 ('go', 'say'),
 ('say', 'something'),
 ('something', 'like'),
 ('like', 'hero'),
 ('hero', 'everyone'),
 ('everyone', 'around'),
 ('around', 'acting'),
 ('acting', 'badly'),
 ('badly', 'someone'),
 ('someone', 'humanitarian'),
 ('humanitarian', 'award'),
 ('award', 'nicholas'),
 ('nicholas', 'brain'),
 ('brain', 'run'),
 ('run', 'excellent'),
 ('excellent', 'processing'),
 ('processing', 'data'),
 ('data', 'concrete'),
 ('concrete', 'fact'),
 ('fact', 'work'),
 ('work', 'best'),
 ('best', 'thing'),
 ('thing', 'quantify'),
 ('quantify', 'run'),
 ('run', 'almost'),
 ('almost', 'insurmountable'),
 ('insurmountable', 'challenge'),
 ('challenge', 'trying'),
 ('trying', 'rationalize'),
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 ('existence', 'exceptional'),
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 ('sense', 'humor'),
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 ('reelection', 'game'),
 ('game', 'dinner'),
 ('dinner', 'taking'),
 ('taking', 'picture'),
 ('picture', 'race'),
 ('race', 'outfit'),
 ('outfit', 'sure'),
 ('sure', 'see'),
 ('see', 'wore'),
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 ('sunday', 'wash'),
 ('wash', 'right'),
 ('right', 'post'),
 ('post', 'pic'),
 ('pic', 'next'),
 ('next', 'day'),
 ('day', 'heard'),
 ('heard', 'loud'),
 ('loud', 'clear'),
 ('clear', 'family'),
 ('family', 'witness'),
 ('witness', 'exclusion'),
 ('exclusion', 'apprehensive'),
 ('apprehensive', 'pusuited'),
 ('pusuited', 'grandfather'),
 ('grandfather', 'decided'),
 ('decided', 'escape'),
 ('escape', 'germany'),
 ('germany', 'heading'),
 ('heading', 'britain'),
 ('britain', 'must'),
 ('must', 'never'),
 ('never', 'happen'),
 ('happen', 'andy'),
 ('andy', 'say'),
 ('say', 'tell'),
 ('tell', 'worry'),
 ('worry', 'party'),
 ('party', 'europe'),
 ('europe', 'seem'),
 ('seem', 'get'),
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N-Grams = 3

In [13]:
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list(ngrams(tokens,3))
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 ('might', 'think', 'prescription'),
 [illegible]cessful'),
```

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 ('bad', 'way', 'write'),
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 ('work', 'way', 'writing'),
 ('way', 'writing', 'work'),
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 ('write', 'detailed', 'plan'),
 ('detailed', 'plan', 'want'),
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 ('want', 'get', 'adrian'),
 ('get', 'adrian', 'talk'),
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 ('point', 'view', 'main'),
 ('view', 'main', 'character'),
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 ('saucepan', 'combine', 'butter'),
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 ('chop', 'prefer', 'medium'),
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 ('heat', 'bring', 'mixture'),
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 ('read', 'history', 'textbook'),
 ('history', 'textbook', 'school'),
 ('textbook', 'school', 'fact'),
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 ('fact', 'may', 'kid'),
 ('may', 'kid', 'read'),
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 ('book', 'math', 'get'),
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 ('laundry', 'really', 'hate'),
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 ('bridge', 'address', 'south'),
 ('address', 'south', 'street'),
 ('south', 'street', 'bedford'),
 ('street', 'bedford', 'berry'),
 ('bedford', 'berry', 'street'),
 ('berry', 'street', 'please'),
 ('street', 'please', 'note'),
 ('please', 'note', 'open'),
 ('note', 'open', 'accept'),
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 ('accept', 'cash', 'form'),
 ('cash', 'form', 'payment'),
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 ('happen', 'get', 'flat'),
 ('get', 'flat', 'pump'),
 ('flat', 'pump', 'use'),
 ('pump', 'use', 'also'),
 ('use', 'also', 'outside'),
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 ('vending', 'machine', 'buy'),
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 ('flat', 'place', 'go'),
 ('place', 'go', 'repair'),
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 ('repair', 'direction', 'traif'),
 ('direction', 'traif', 'bike'),
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 ('bike', 'gesheft', 'located'),
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 ('south', 'street', 'click'),
 ('street', 'click', 'link'),
 ('click', 'link', 'public'),
 ('link', 'public', 'employee'),
 ('public', 'employee', 'father'),
 ('employee', 'father', 'top'),
 ('father', 'top', 'busy'),
 ('top', 'busy', 'enjoying'),
 ('busy', 'enjoying', 'mother'),
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 ('realized', 'another', 'presence'),
 ('another', 'presence', 'kind'),
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 ('kind', 'dad', 'altho'),
 ('dad', 'altho', 'pure'),
 ('altho', 'pure', 'energy'),
 ('pure', 'energy', 'physical'),
 ('energy', 'physical', 'recognized'),
 ('physical', 'recognized', 'energy'),
 ('recognized', 'energy', 'signature'),
 ('energy', 'signature', 'right'),
 ('signature', 'right', 'franklyn'),
 ('right', 'franklyn', 'pleiadian'),
 ('franklyn', 'pleiadian', 'guide'),
 ('pleiadian', 'guide', 'turn'),
 ('guide', 'turn', 'equally'),
 ...]
```

In [14]:
```
test = tokens[:10000]
```

In [15]:
```
type(test)
```

Out[15]:
```
list
```

Model Training for 3 N-Grams

In [16]:
```
# Preprocess the tokenized text for 3-grams language modelling

n = 3

train_data, padded_sents = padded_everygram_pipeline(n, test)
```

In [17]:
```
model = MLE(order=3)
```

In [18]:
```
len(model.vocab)
```

Out[18]:
```
0
```

In [19]:
```
model.fit(train_data, padded_sents)
print(model.vocab)
```

```
<Vocabulary with cutoff=1 unk_label='<UNK>' and 34 items>
```

In [20]:
```
len(model.vocab)
```

Out[20]:
```
34
```

In [21]:
```
model.vocab.lookup(test[0])
```

Out[21]:
```
'<UNK>'
```

In [22]:
```
model.vocab.lookup('heart is never random lah .'.split())
```

Out[22]:
```
('<UNK>', '<UNK>', '<UNK>', '<UNK>', '<UNK>', '<UNK>')
```

In [23]:
```
print(model.counts)
```

```
<NgramCounter with 3 ngram orders and 264657 ngrams>
```

In [24]:
```
model.counts['heart']
```

Out[24]:
```
0
```

In [25]:
```
model.score('away')
```

Out[25]:
```
0.0
```

Generation using N-gram Language Model

In [26]:
```
print(model.generate(20, random_seed=7))
```

```
['<s>', '<s>', 'p', 'a', 'r', 'd', '</s>', '</s>', '</s>', '</s>', '</s>', '</s>', '</s>', '</s>', '</s>',
'</s>', '</s>', '</s>', '</s>', '</s>']
```

In [27]:
```
# Function to extract words from model results

from nltk.tokenize.treebank import TreebankWordDetokenizer

detokenize = TreebankWordDetokenizer().detokenize

def generate_sent(model, num_words, random_seed=42):
    """
    :param model: An ngram language model from `nltk.lm.model`.
    :param num_words: Max no. of words to generate.
    :param random_seed: Seed value for random.
    """
    content = []
    for token in model.generate(num_words, random_seed=random_seed):
        if token == '<s>':
            continue
        if token == '</s>':
            break
        content.append(token)
    return detokenize(content)
```

Generating 3 random results

In [28]:
```
generate_sent(model, 20, random_seed=7)
```

Out[28]:
```
'p a r d'
```

In [29]:
```
generate_sent(model, 20, random_seed=23)
```

Out[29]:
```
't u r a p h i l d'
```

In [30]:
```
generate_sent(model, 20, random_seed=45)
```

Out[30]:
```
'b e a'
```

Load the subset 10000 lines dataset

In [31]:
```
df = pd.read_csv("blogdata.csv")
```

In [32]:
```
df
```

Out[32]:

	words
0	We have given our hearts away, a sordid boon !"
1	1. Start it on the side
2	Sugar's sweet, so is she,
3	So because the Asian community was so by need ...
4	Nicholas' brain runs on and is excellent at pr...
...	...
9995	Perfect timing for Friday Fragments! I have a ...
9996	Herbert paid his debt to society by twiddling ...
9997	20. A Warning From The Sun
9998	Sherry and John from Young House Love are team...
9999	BE CAREFUL NOT TO INCLUDE SPOILERS! (make sure...

10000 rows × 1 columns

In [33]:
```
blog_corpus = list(df['words'].apply(word_tokenize))
```

In [34]:
```
blog_corpus;
```

In [35]:
```
n = 3
train_data, padded_sents = padded_everygram_pipeline(n, blog_corpus)
```

In [36]:
```
blog_model = MLE(n) # Lets train a 3-grams model, previously we set n=3
blog_model.fit(train_data, padded_sents)
```

Generating 3 random results

In [37]:
```
generate_sent(blog_model, num_words=20, random_seed=42)
```

Out[37]:
```
'money), Susheela Raman, Lila Downs, Nelson Mandela, Aziza Mustafa Zadeh, Margaret engages in an'
```

In [38]:
```
generate_sent(blog_model, num_words=10, random_seed=0)
```

Out[38]:
```
'the reverse of the internet . Or is it generally'
```

In [39]:
```
generate_sent(blog_model, num_words=50, random_seed=10)
```

Out[39]:
```
'incredible hostesses also asked us to new heights - and changing it to 215 countries around the corner . Fr
om the parking, the word " home " and filled with excitement!!!'
```

Coded and submitted by Dennis Lam 2021