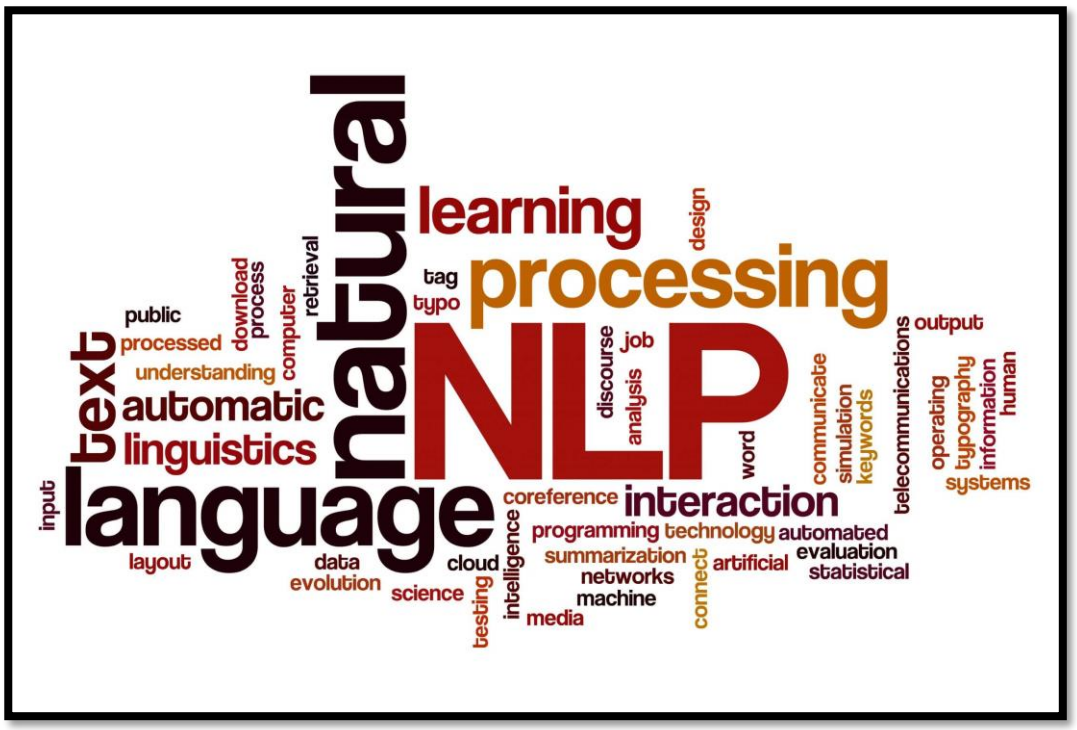
GLA UNIVERSITY MATHURA

Session: 2022-23

Subject - NATURAL LANGUAGE PROCESSING

ASSIGNMENT



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V Semester

1. Consider an example to find the similarity between two vectors – **'x'** and **'y'**, using Cosine Similarity.

The 'x' vector has values, **x = { 3, 2, 0, 5 }**

The 'y' vector has values, **y = { 1, 0, 0, 0 }**

Design a program to compute the similarity between x and y.

2. Consider two sets A = (0,1,2,5,6) and B = (0, 2,3, 5, 7,9). How similar are A and B? Design a program to compute the similarity using Jaccard similarity.

```
[1] import math
```

```
x=[3,2,0,5]
y=[1,0,0,0]

# Cosine Similarity

def SOS(x):
    res=0
    for i in x:
        res+=(i*i)
    return res

def dotProd(x,y):
    res=0
    for i in range(len(x)):
        res+=(x[i]*y[i])
    return res

def CS(x,y):
    return dotProd(x,y)/math.sqrt(SOS(x)*SOS(y))

print("Cosine Similarity between x & y is",CS(x,y))
```

```
Cosine Similarity between x & y is 0.48666426339228763
```

```
A=[0,1,2,5,6]
B=[0,2,3,5,7,9]

#Jaccard Similarity

def JS(a,b):
  setA=set(a)
  setB=set(b)
  return len(setA.intersection(setB))/len(setA.union(setB))

print("Similarity between A & B is",JS(A,B))
```

```
Similarity between A & B is 0.375
```

3. Consider Three documents:

*d*1: “Jack London traveled to Oakland”

*d*2: “Jack London traveled to the city of Oakland”

*d*3: “Jack traveled from Oakland to London”

Based on shingles of size 2 (2-grams or bigrams), what are the Jaccard coefficients *J*(*d*1, *d*2) and *J*(*d*1, *d*3)?

```
from nltk.tokenize import word_tokenize
from nltk.util import bigrams
```

```
d1="Jack London traveled to Oakland"
d2="Jack London traveled to the city of Oakland"
d3="Jack traveled from Oakland to London"

# doc to Bigrams
def d2bigram(d):
  return set(bigrams(word_tokenize(d)))

# Jaccard Coefficient
def JC(d1,d2):
  bgram_d1=d2bigram(d1)
  bgram_d2=d2bigram(d2)
  return len(bgram_d1.intersection(bgram_d2))/len(bgram_d1.union(bgram_d2))

print("J(d1, d2) =",JC(d1,d2))
print("J(d1, d3) =",JC(d1,d3))
```

```
J(d1, d2) = 0.375
J(d1, d3) = 0.0
```

4. Consider set of documents as

D1 : I am Sam.

D2 : Sam I am.

D3 : I do not like green eggs and ham.

D4 : I do not like them, Sam I am.

a) **Design a program for (k = 1)-shingles of D1 U D2U D3 U D4 : U is UNION**
b) **Design a program for (k = 2)-shingles of D1 U D2U D3 U D4 : U is UNION**
c) **Design a program for (k = 3)-Character shingles of D1 U D2**
d) **Design a program for (k = 4)-Character shingles of D1 U D2**

```
from nltk.tokenize import word_tokenize
from nltk.util import ngrams

d1="I am Sam."
d2="Sam I am."
d3="I do not like green eggs and ham."
d4="I do not like them, Sam I am."

# doc to ngrams
def d2ngram(d,n):
  return set(ngrams(word_tokenize(d),n))

# doc to k character shingles
def d2k_shingle(d,k):
  return set(ngrams(d,k))

# union of results
def d_s2union(docs):
  res=set()
  for i in docs:
    res=res.union(i)
  return res

print('a)')
l=[]
n=1
l.append(d2ngram(d1,n))
l.append(d2ngram(d2,n))
l.append(d2ngram(d3,n))
l.append(d2ngram(d4,n))
print(d_s2union(l))

print('\nb)')
l=[]
n=2
l.append(d2ngram(d1,n))
l.append(d2ngram(d2,n))
l.append(d2ngram(d3,n))
l.append(d2ngram(d4,n))
print(d_s2union(l))

print('\nc)')
l=[]
k=3
l.append(d2k_shingle(d1,k))
l.append(d2k_shingle(d1,k))
print(d_s2union(l))

print('\nd)')
l=[]
k=4
l.append(d2k_shingle(d1,k))
l.append(d2k_shingle(d1,k))
print(d_s2union(l))
```

Output:

a) {('not',), ('and',), ('.',), (',',), ('like',), ('I',), ('eggs',), ('am',), ('them',), ('green',), ('Sam',), ('ham',), ('do',)}
b) {('I', 'am'), ('I', 'do'), ('and', 'ham'), ('am', '.'), ('do', 'not'), ('not', 'like'), ('eggs', 'and'), ('Sam', '.'), ('like', 'green'), (',', 'Sam'), ('like', 'them'), ('am', 'Sam'), ('ham', '.'), ('Sam', 'I'), ('them', ','), ('green', 'eggs')}
c) {('I', ' ', 'a'), (' ', 'S', 'a'), ('a', 'm', '.'), (' ', 'a', 'm'), ('S', 'a', 'm'), ('a', 'm', ' '), ('m', ' ', 'S')
d) {('I', ' ', 'a', 'm'), (' ', 'a', 'm', ' '), (' ', 'S', 'a', 'm'), ('a', 'm', ' ', 'S'), ('m', ' ', 'S', 'a'), ('S', 'a', 'm', '.')}

5. Suppose our document D is the string abcdabd, and we pick k = 2. Then the set of 2-shingles for D is {ab, bc, cd, da, bd}. Note that the substring ab appears twice within D, but appears only once as a shingle. A variation of shingling produces a bag, rather than

a set, so each shingle would appear in the result as many times as it appears in the document. Design a program to model the above scenario.

```
from nltk.util import ngrams

d="abcdabd"

# doc to k character shingles with repitition
def d2k_shingle(d,k):
  return list(ngrams(d,k))

print(d2k_shingle(d,2))
```

```
[('a', 'b'), ('b', 'c'), ('c', 'd'), ('d', 'a'), ('a', 'b'), ('b', 'd')]
```

6. **A database contains 80 records on a particular topic. A search was conducted on that topic and 60 records were retrieved. Of the 60 records retrieved, 45 were relevant. Design a Program to compute the precision and recall scores for the search.**

```
#precison
def precision(retrieved,relevant):
  return (relevant/retrieved)*100

#recall
def recall(total,relevant):
  return (relevant/total)*100

#func
def fun(total,retrieved,relevant):
  print("Total Records =",total)
  print("Retrieved Records =",retrieved)
  print("Relevant Records Retrieved =",relevant)
  print()
  print("Precision =",precision(retrieved,relevant),"%")
  print("Recall =",recall(total,relevant),"%")

total=80
retrieved=60
relevant=45

fun(total,retrieved,relevant)
```

```
Total Records = 80
Retrieved Records = 60
Relevant Records Retrieved = 45

Precision = 75.0 %
Recall = 56.25 %
```

7. **Consider this sentence: "a rose is a rose is a rose". And represent this document as set of shingles (Word n gram). Design a program for extracting shingles for *n* = 3 and n = 4 for above sentence.**

```
from nltk.tokenize import word_tokenize
from nltk.util import ngrams

d="a rose is a rose is a rose"

# doc to ngrams
def d2ngram(d,n):
  return set(ngrams(word_tokenize(d),n))

print("Word ngram for n=3:")
print(d2ngram(d,3))
print()
print("Word ngram for n=4:")
print(d2ngram(d,4))
```

```
Word ngram for n=3:
{('a', 'rose', 'is'), ('is', 'a', 'rose'), ('rose', 'is', 'a')}

Word ngram for n=4:
{('is', 'a', 'rose', 'is'), ('rose', 'is', 'a', 'rose'), ('a', 'rose', 'is', 'a')}
```

8. **Compute the similarity between:**
   a) night and nacht
   b) Ashish and Aasheesh

```
[11] from nltk.util import ngrams
```

```
# doc to k character shingles
def d2k_shingle(d,k):
  return set(ngrams(d,k))

# Jaccard Similarity
def JS(d1,d2,n):
  nshingle_d1=d2k_shingle(d1,n)
  nshingle_d2=d2k_shingle(d2,n)
  return len(nshingle_d1.intersection(nshingle_d2))/len(nshingle_d1.union(nshingle_d2))

print("a)")
print("Similarity between night and nacht is",JS("night","nacht",2))

print("\nb)")
print("Similarity between Ashish and Aasheesh is",JS("Ashish","Aasheesh",2))
```

```
a)
Similarity between night and nacht is 0.14285714285714285

b)
Similarity between Ashish and Aasheesh is 0.1111111111111111
```

9. **Consider a case insensitive query and document collection with a query Q and a document collection consisting of the following three documents:**

Q: "gold silver truck"
D1: "Shipment of gold damaged in a fire"
D2: "Delivery of silver arrived in a silver truck"
D3: "Shipment of gold arrived in a truck"

Design a program to compute the similarity between

a) Q & D1
b) Q & D2
c) Q & D3

Find which document (D) matches best with the query (Q)

```
from nltk.tokenize import word_tokenize
from nltk.util import bigrams

q="gold silver truck"
d1="Shipment of gold damaged in a fire"
d2="Delivery of silver arrived in a silver truck"
d3="Shipment of gold arrived in a truck"

# doc to Bigrams
def d2bigram(d):
  return set(bigrams(word_tokenize(d)))

# Jaccard Coefficient
def JS(d1,d2):
  bgram_d1=d2bigram(d1)
  bgram_d2=d2bigram(d2)
  return len(bgram_d1.intersection(bgram_d2))/len(bgram_d1.union(bgram_d2))

#find best match
def findBestMatch(q,*d):
  res=0
  ans=""
  d_num=0
  for i in range(len(d)):
    doc=d[i]
    tmp=JS(q,doc)
    print("For JS(Q, D{}): {}".format(i+1,tmp))
    if tmp>res:
      res=tmp
      ans=doc
      d_num=i+1
  print("Document D{} matches best with the given Query.".format(d_num))

findBestMatch(q,d1,d2,d3)
```

```
For JS(Q, D1): 0.0
For JS(Q, D2): 0.125
For JS(Q, D3): 0.0
Document D2 matches best with the given Query.
```


Thank You!