Natural language processing

Practical list

1. To install Python Idle and NLTK.
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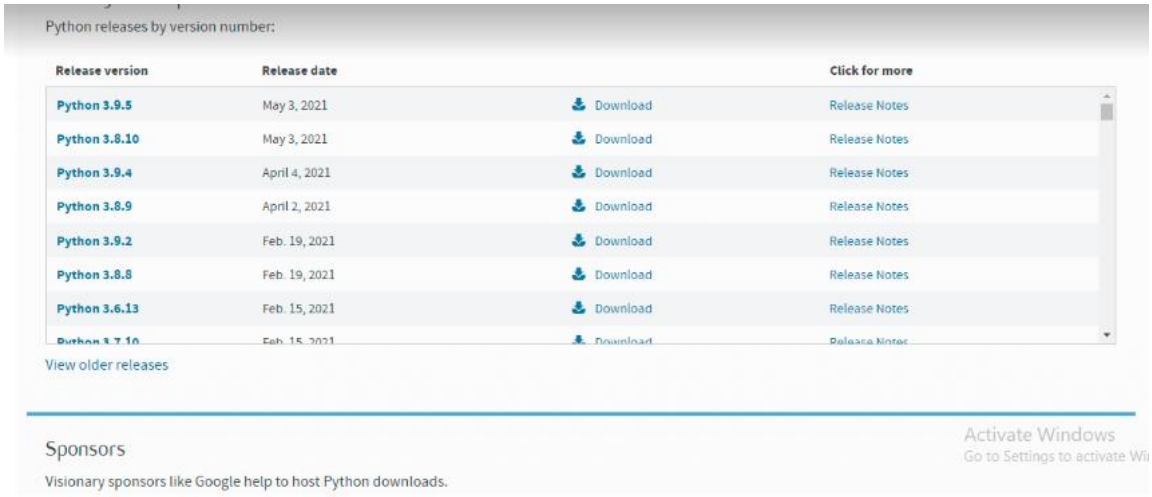
Practical 1

❖ **Aim**: To install Python Idle and NLTK.

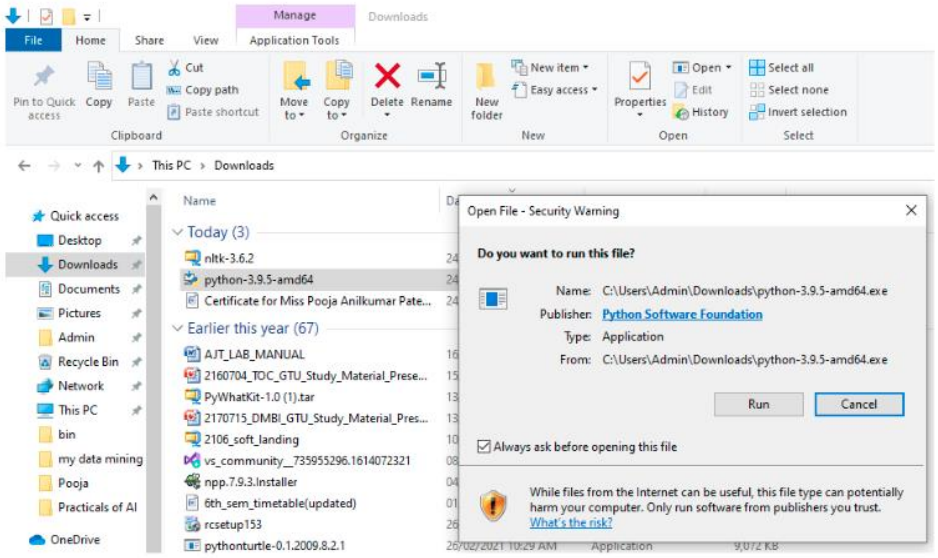
Step1: visit the link and download Python.

https://www.python.org/downloads/

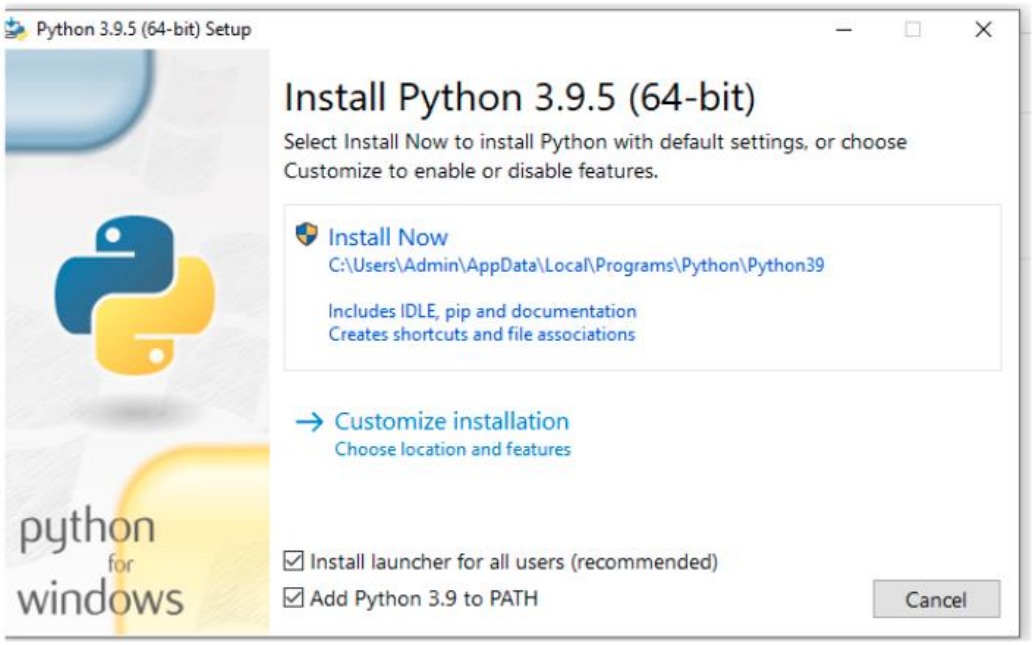
Step2: choose the latest version of Python .



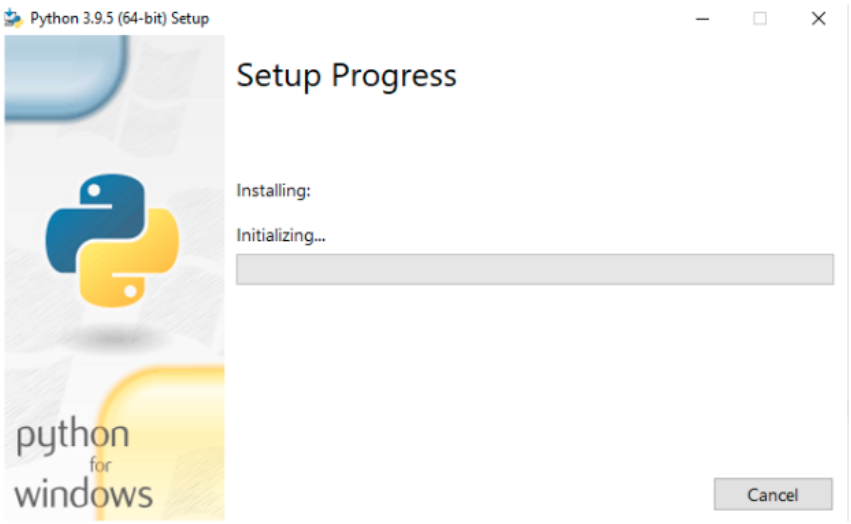
Step 3: select run.

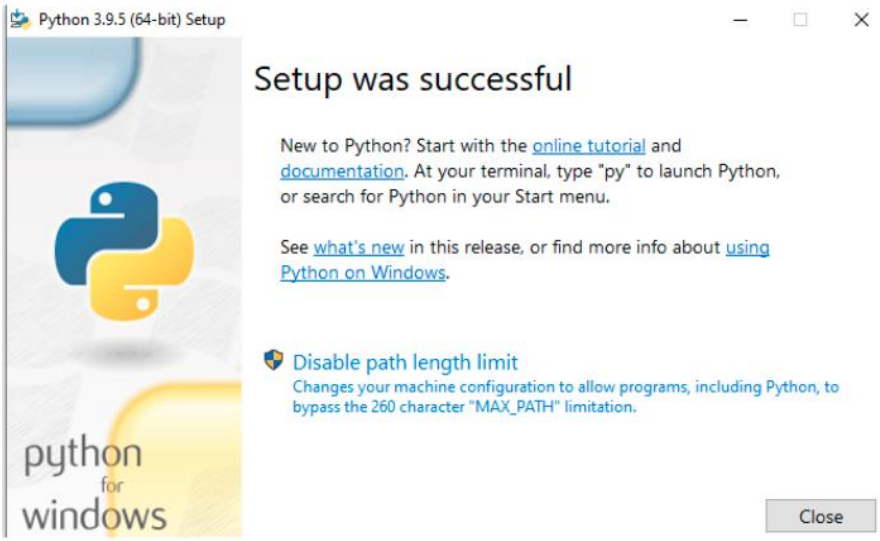


Step 4: select “Install now.”

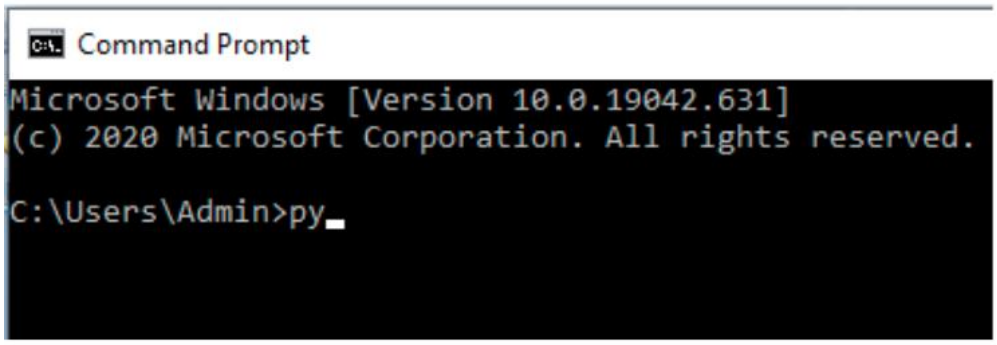


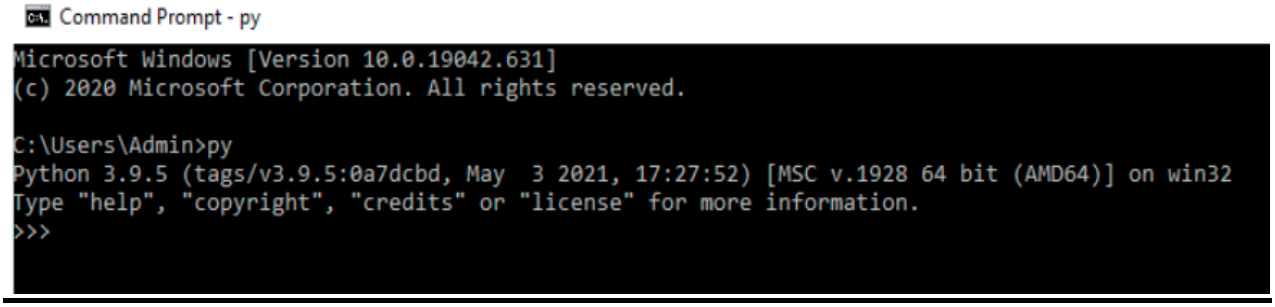
Step 5: then select “yes”.





Step 6: then confirm the python Version in command prompt by typing "py".

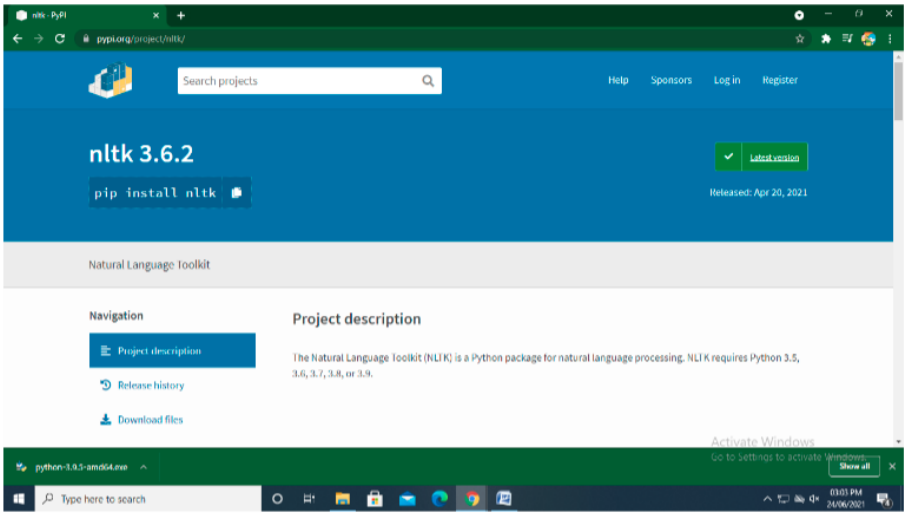




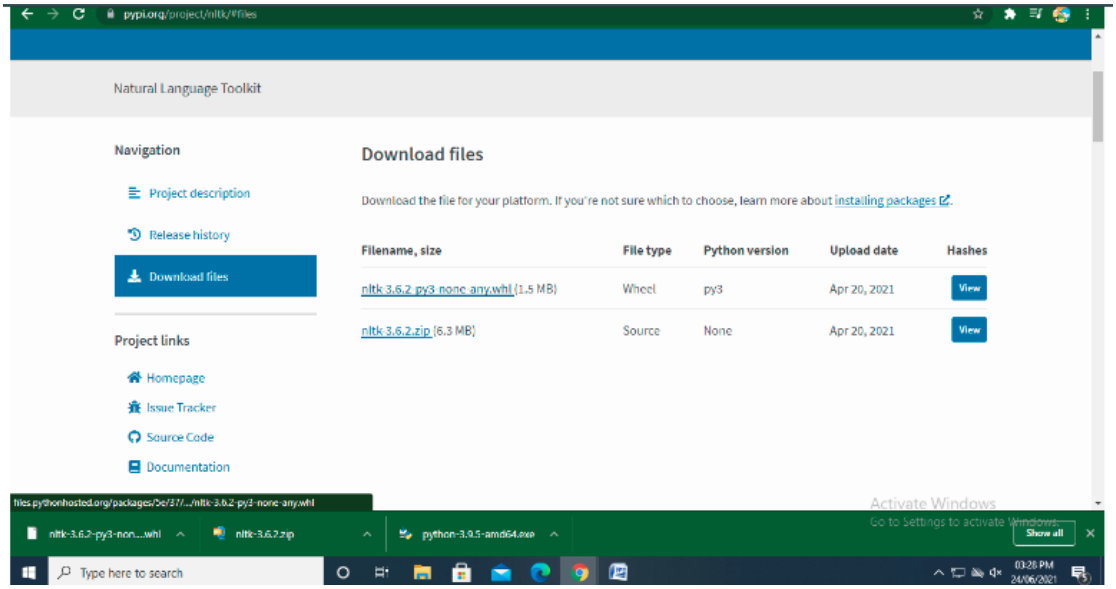
NLTK installation:

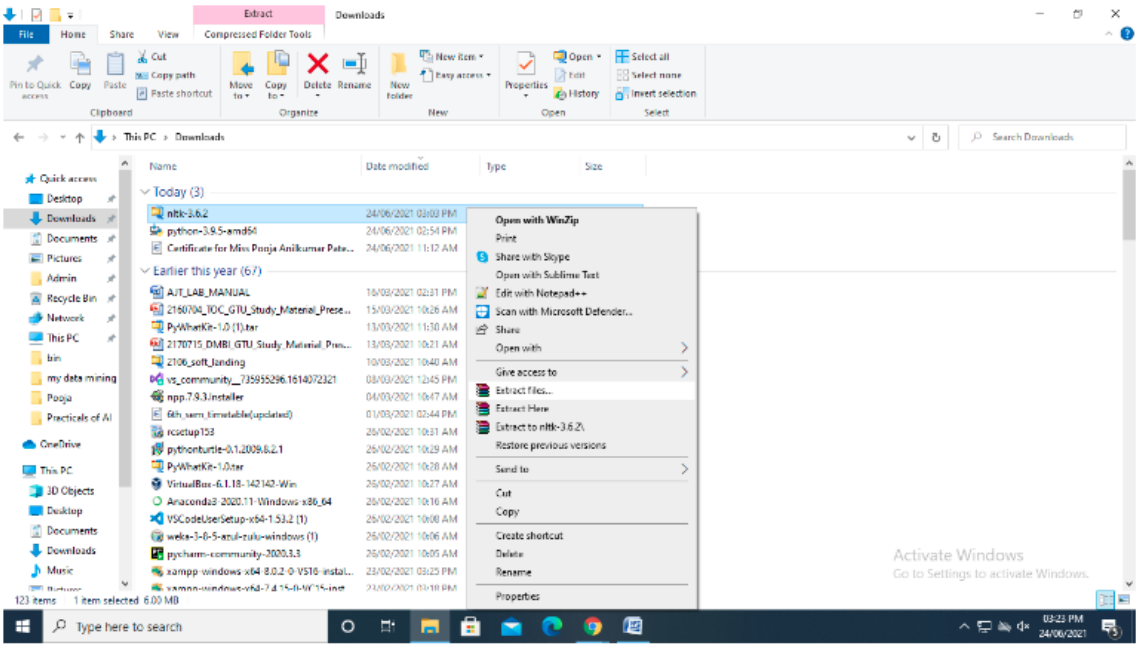
Step 1:Visit the link

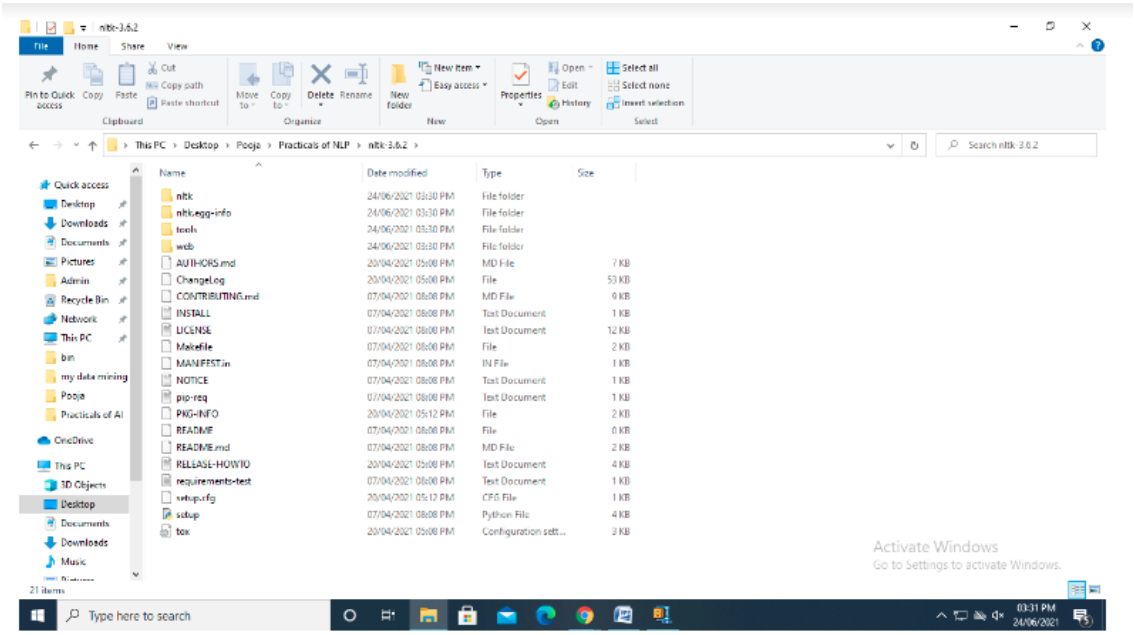
https://pypi.org/project/nltk/#files



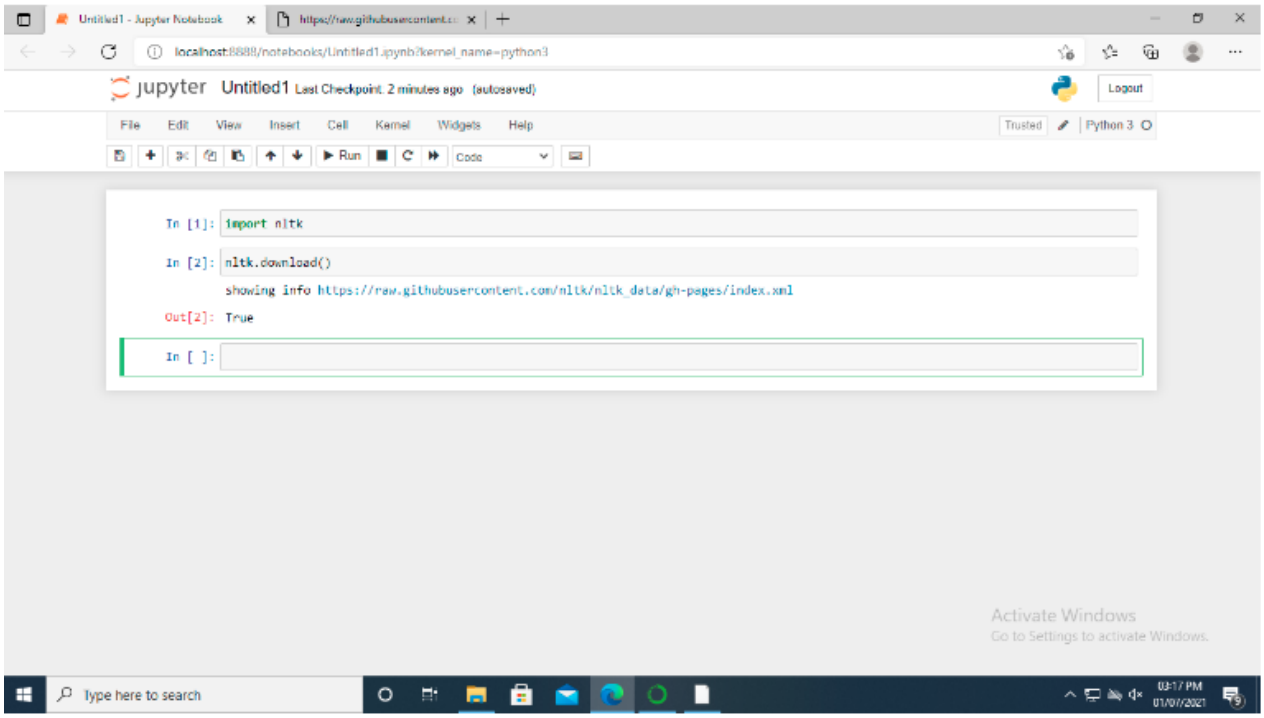
Step2: select download files and then extract the zip files.

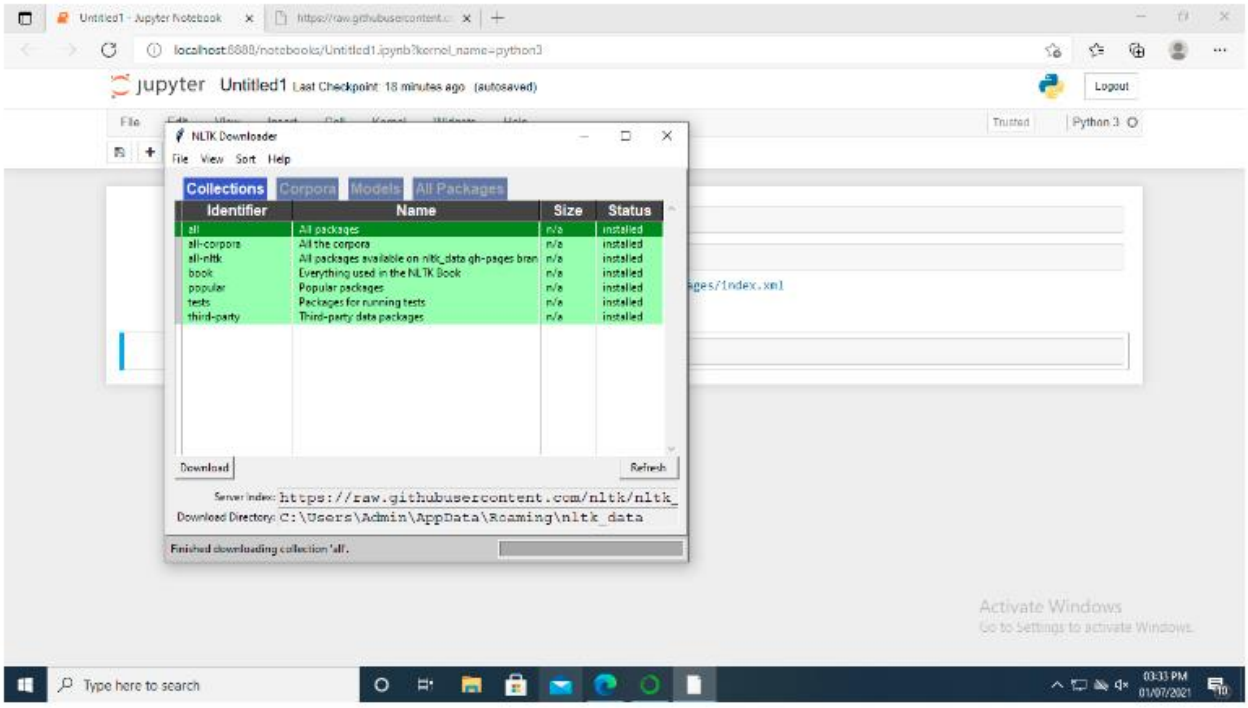






Step 3: open jupyter notebook and then download nltk packages.





Your natural language toolkit is installed!!!

Practical 2

❖ **Aim:** To implement n grams model in NLP.

Program:

```
#Implementation of unigram bigram and tigrsm in  NLP

#imports

import string

import random

import nltk

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

text = [['a', 'b', 'c'], ['a', 'c', 'd', 'c', 'e', 'f']]


list(bigrams(text[0]))  #bigrams
```

Output:

```
list(bigrams(text[0]))  #bigrams
```

```
Out[4]: [('a', 'b'), ('b', 'c')]
```

Out[4]: [('a', 'b'), ('b', 'c')]

```
In [5]: list(ngrams(text[1], n=3))  #tri-grams
Out[5]: [('a', 'c', 'd'), ('c', 'd', 'c'), ('d', 'c', 'e'), ('c', 'e', 'f')]

In [7]: list(ngrams(text[1], n=1))  #unigram
Out[7]: [('a',), ('c',), ('d',), ('c',), ('e',), ('f',)]

In [8]: list(ngrams(text[1], n=2))  #bigams
Out[8]: [('a', 'c'), ('c', 'd'), ('d', 'c'), ('c', 'e'), ('e', 'f')]

In [9]: list(ngrams(text[1], n=4))  #quadragrams
Out[9]: [('a', 'c', 'd', 'c'), ('c', 'd', 'c', 'e'), ('d', 'c', 'e', 'f')]

In [10]: list(ngrams(text[1], n=5)) #pentagrams
Out[10]: [('a', 'c', 'd', 'c', 'e'), ('c', 'd', 'c', 'e', 'f')]
```

Practical 3

❖ **Aim:** To implement Part of Speech tagging in NLP.

Program:

```
#implementation of POS tagging in NLP
import nltk
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize, sent_tokenize
stop_words = set(stopwords.words(&#39;english&#39;))

# Dummy text
txt = &quot;Sukanya, Rajib and Naba are my good friends. &quot; \
&quot;Sukanya is getting married next year. &quot; \
&quot;Marriage is a big step in one’s life.&quot; \
&quot;It is both exciting and frightening. &quot; \
&quot;But friendship is a sacred bond between people.&quot; \
&quot;It is a special kind of love between us. &quot; \
&quot;Many of you must have tried searching for a friend &quot;\
&quot;but never found the right one.&quot;

# sent_tokenize is one of instances of
```

```
# PunktSentenceTokenizer from the nltk.tokenize.punkt module
tokenized = sent_tokenize(txt)
for i in tokenized:
# Word tokenizers is used to find the words
# and punctuation in a string
wordsList = nltk.word_tokenize(i)
# removing stop words from wordList
wordsList = [w for w in wordsList if not w in stop_words]
# Using a Tagger. Which is part-of-speech
# tagger or POS-tagger.
tagged = nltk.pos_tag(wordsList)
print(tagged)
```

output:

```
[('Sukanya', 'NNP'), (',', ','), ('Rajib', 'NNP'), ('Naba', 'NNP'), ('good', 'JJ'), ('friends', 'NNS'), ('.', '.')]
[('Sukanya', 'NNP'), ('getting', 'VBG'), ('married', 'VBN'), ('next', 'JJ'), ('year', 'NN'), ('.', '.')]
[('Marriage', 'NN'), ('big', 'JJ'), ('step', 'NN'), ('one', 'CD'), ('’', 'NN'), ('life.It', 'NN'), ('exciting', 'VBG'), ('frigh
tening', 'NN'), ('.', '.')]
[('But', 'CC'), ('friendship', 'NN'), ('sacred', 'VBD'), ('bond', 'NN'), ('people.It', 'NN'), ('special', 'JJ'), ('kind', 'N
N'), ('love', 'VB'), ('us', 'PRP'), ('.', '.')]
[('Many', 'JJ'), ('must', 'MD'), ('tried', 'VB'), ('searching', 'VBG'), ('friend', 'NN'), ('never', 'RB'), ('found', 'VBD'),
('right', 'JJ'), ('one', 'CD'), ('.', '.')]
```

Practical 4

❖ **Aim:** To implement kneeser ney smoothing technique in NLP.

Program:

```
#trigrams probability

#kneeser ney implementation

import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \

form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \

the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)

kneser_ney = nltk.KneserNeyProbDist(freq_dist)

prob_sum = 0

for i in kneser_ney.samples():

    prob_sum += kneser_ney.prob(i)

print(prob_sum)
```

Output:

```
40.881547619047 62
```

Example 1:

In [10]:
```
#trigrams probability
#kneeser ney implementation
import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \
form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \
the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)
kneser_ney = nltk.KneserNeyProbDist(freq_dist)
prob_sum = 0
for i in kneser_ney.samples():
    prob_sum += kneser_ney.prob(i)
print(prob_sum)
```

```
40.88154761904762
```

Example 2:

In [33]:
```
import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \
form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \
the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)
kneser_ney = nltk.KneserNeyProbDist(freq_dist)
prob_sum = 1
for i in kneser_ney.samples():
    prob_sum += kneser_ney.prob(i)
print(prob_sum)
```

```
41.88154761904762
```

Example 3:

In [34]:
```
import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \
form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \
the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)
kneser_ney = nltk.KneserNeyProbDist(freq_dist)
prob_sum = 0.5
for i in kneser_ney.samples():
    prob_sum += kneser_ney.prob(i)
print(prob_sum)
```

```
41.38154761904762
```

Example 4:

In [35]:
```
import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \
form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \
the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)
kneser_ney = nltk.KneserNeyProbDist(freq_dist)
prob_sum = 0.16
for i in kneser_ney.samples():
    prob_sum += kneser_ney.prob(i)
print(prob_sum)
```

```
41.04154761904762
```

Example 5:

In [38]:
```
import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \
form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \
the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)
kneser_ney = nltk.KneserNeyProbDist(freq_dist)
prob_sum = 2
for i in kneser_ney.samples():
    prob_sum += kneser_ney.prob(i)
print(prob_sum)
```

```
42.881547619047616
```

In [39]:
```
import nltk

ngrams = nltk.trigrams("What a piece of work is man! how noble in reason! how infinite in faculty! in \
form and moving how express and admirable! in action how like an angel! in apprehension how like a god! \
the beauty of the world, the paragon of animals!")

freq_dist = nltk.FreqDist(ngrams)
kneser_ney = nltk.KneserNeyProbDist(freq_dist)
prob_sum = 3
for i in kneser_ney.samples():
    prob_sum += kneser_ney.prob(i)
print(prob_sum)
```

```
43.88154761904761
```

Practical 5

- Aim: To implementation of TF-Idf algorithm using python.

Program:

```
# import and instantiate TfidfVectorizer (with the default
parameters)
from sklearn.feature_extraction.text import TfidfVectorizer
vect = TfidfVectorizer()
vect
# use TreeankWordTokenizer
from nltk.tokenize import TreebankWordTokenizer
tokenizer = TreebankWordTokenizer()
vect.set_params(tokenizer=tokenizer.tokenize)
# remove English stop words
vect.set_params(stop_words=&#39;english&#39;)

# include 1-grams and 2-grams
vect.set_params(ngram_range=(1, 2))
# ignore terms that appear in more than 50% of the documents
vect.set_params(max_df=0.5)
# only keep terms that appear in at least 2 documents
```

vect.set_params(min_df=2)

output:

```
In [ ]: # import and instantiate TfidfVectorizer (with the default parameters)
        from sklearn.feature_extraction.text import TfidfVectorizer
        vect = TfidfVectorizer()
        vect

Out[1]: TfidfVectorizer()
```

```
In [2]: # use TreebankWordTokenizer
        from nltk.tokenize import TreebankWordTokenizer
        tokenizer = TreebankWordTokenizer()
        vect.set_params(tokenizer=tokenizer.tokenize)

        # remove English stop words
        vect.set_params(stop_words='english')

        # include 1-grams and 2-grams
        vect.set_params(ngram_range=(1, 2))

        # ignore terms that appear in more than 50% of the documents
        vect.set_params(max_df=0.5)

        # only keep terms that appear in at least 2 documents
        vect.set_params(min_df=2)

Out[2]: TfidfVectorizer(max_df=0.5, min_df=2, ngram_range=(1, 2), stop_words='english',
                        tokenizer=<bound method TreebankWordTokenizer.tokenize of <nltk.tokenize.treebank.TreebankWordTokenizer object
        at 0x000001B3E606CC70>>)
```

Practical 6

- Aim: To implementation of Bag of words using python.

Program:

```
#implement of bag of wrods in python

def vectorize(tokens):

&#39;&#39;&#39; This function takes list of words in a sentence as input

and returns a vector of size of filtered_vocab.It puts 0 if the

word is not present in tokens and count of token if present.&#39;&#39;&#39;

vector=[]

for w in filtered_vocab:

vector.append(tokens.count(w))

return vector

def unique(sequence):

&#39;&#39;&#39;This functions returns a list in which the order remains

same and no item repeats.Using the set() function does not

preserve the original ordering,so i didnt use that instead&#39;&#39;&#39;

seen = set()

return [x for x in sequence if not (x in seen or seen.add(x))]
```

```
#create a list of stopwords.You can import stopwords from nltk too

stopwords=[&quot;to&quot;,&quot;is&quot;,&quot;a&quot;]

#list of special characters.You can use regular expressions too

special_char=[&quot;,&quot;,&quot;:&quot;,&quot;
&quot;,&quot;;&quot;,&quot;.&quot;,&quot;?&quot;]

#Write the sentences in the corpus,in our case, just two

string1=&quot;It was the best of times&quot;

string2=&quot;It was the worst of times&quot;

#convert them to lower case

string1=string1.lower()

string2=string2.lower()

#split the sentences into tokens

tokens1=string1.split()

tokens2=string2.split()

print(tokens1)

print(tokens2)

#create a vocabulary list

vocab=unique(tokens1+tokens2)

print(vocab)

#filter the vocabulary list

filtered_vocab=[]
```

```
for w in vocab:
if w not in stopwords and w not in special_char:
filtered_vocab.append(w)
print(filtered_vocab)
#convert sentences into vectords
vector1=vectorize(tokens1)
print(vector1)
vector2=vectorize(tokens2)
print(vector2)
```

output:

```
['it', 'was', 'the', 'best', 'of', 'times']
['it', 'was', 'the', 'worst', 'of', 'times']
['it', 'was', 'the', 'best', 'of', 'times', 'worst']
['it', 'was', 'the', 'best', 'of', 'times', 'worst']
[1, 1, 1, 1, 1, 1, 0]
[1, 1, 1, 0, 1, 1, 1]
```

Practical 7

❖ **Aim:** Implement one hot embedding modeling algorithm in NLP.

Program:

```
#one hot encoding


import numpy as np

samples = {&#39;Jupiter has 79 known moons .&#39;, &#39;Neptune has 14 confirmed

moons !&#39;} # Sample set for our example

# Create an empty dictionary

token_index = {}

#Create a counter for counting the number of key-value pairs in the

token_length

counter = 0


# Select the elements of the samples which are the two sentences

for sample in samples:

for considered_word in sample.split():

if considered_word not in token_index:


# If the considered word is not present in the dictionary token_index,
```

add it to the token_index

The index of the word in the dictionary begins from 1

NLP(2170723)Enrollment_no.:181010107008

token_index.update({considered_word : counter + 1})

updating the value of counter

counter = counter + 1

print(token_index)

Output:

```
[14]: print(token_index)
{'Neptune': 1, 'has': 2, '14': 3, 'confirmed': 4, 'moons': 5, '!': 6, 'Jupiter': 7, '79': 8, 'known': 9, '.': 10}
```

Practical 8

- **Aim**: To implement text summarization in NLP.

Program:

```
#To implement text summarization in python.

# importing libraries

import nltk

from nltk.corpus import stopwords

from nltk.tokenize import word_tokenize, sent_tokenize

# Input text - to summarize

text = &amp;quot;&amp;quot;&amp;quot; There are many techniques available to generate

extractive summarization to keep it simple,

I will be using an unsupervised learning approach to find the

sentences similarity and rank them.

Summarization can be defined as a task of producing a concise and

fluent summary while preserving key

information and overall meaning. One benefit of this will be,

you don’t need to train and build a model prior start using it for

your project.

It’s good to understand Cosine similarity to make the best use of

the code you are going to see.
```

Cosine similarity is a measure of similarity between two non-zero vectors of an inner product

space that measures the cosine of the angle between them. Its measures cosine of the angle between vectors.

The angle will be 0 if sentences are similar."""

Tokenizing the text

stopWords = set(stopwords.words("english"))

words = word_tokenize(text)

Creating a frequency table to keep the

score of each word

freqTable = dict()

for word in words:

word = word.lower()

if word in stopWords:

continue

if word in freqTable:

freqTable[word] += 1

else:

freqTable[word] = 1

Creating a dictionary to keep the score

```
# of each sentence
sentences = sent_tokenize(text)
sentenceValue = dict()
for sentence in sentences:
for word, freq in freqTable.items():
if word in sentence.lower():
if sentence in sentenceValue:
sentenceValue[sentence] += freq
else:
sentenceValue[sentence] = freq
sumValues = 1
for sentence in sentenceValue:
sumValues += sentenceValue[sentence]
# Average value of a sentence from the original text

average = int(sumValues/len(sentenceValue))
# Storing sentences into our summary.
summary = &#39;&#39;
for sentence in sentences:
if (sentence in sentenceValue) and (sentenceValue[sentence] &gt;
```

(1.2 * average)):

summary += " " + sentence

print(summary)

Output:

```
There are many techniques available to generate extractive summarization to keep it simple, I will be using an unsupervised l
earning approach to find the sentences similarity and rank them. Cosine similarity is a measure of similarity between two non-z
ero vectors of an inner product space that measures the cosine of the angle between them.
```

Practical 9

❖ **Aim**: To implement CountVectorizer in NLP.

Program:

```
from sklearn.feature_extraction.text import CountVectorizer


document = [&amp;quot;My name is Pooja&amp;quot;,
&amp;quot;my name is Aditya&amp;quot;,
&amp;quot;Each Friend helps many other friends at


anywhere&amp;quot;]


# Create a Vectorizer Object
vectorizer = CountVectorizer()
vectorizer.fit(document)


# Printing the identified Unique words along with their indices
print(&amp;quot;Vocabulary: &amp;quot;, vectorizer.vocabulary_)


# Encode the Document
```

vector = vectorizer.transform(document)

Summarizing the Encoded Texts

print("Encoded Document is:")

print(vector.toarray())

Output:

```
: from sklearn.feature_extraction.text import CountVectorizer

document = ["My name is Pooja",
           "my name is Aditya",
           "Each Friend helps many other friends at anywhere"]

# Create a Vectorizer Object
vectorizer = CountVectorizer()

vectorizer.fit(document)

# Printing the identified Unique words along with their indices
print("Vocabulary: ", vectorizer.vocabulary_)

# Encode the Document
vector = vectorizer.transform(document)

# Summarizing the Encoded Texts
print("Encoded Document is:")
print(vector.toarray())
```

```
/srv/conda/envs/notebook/lib/python3.7/site-packages/sklearn/feature_extraction/image.py:167: DeprecationWarning: `np.int
` is a deprecated alias for the builtin `int`. To silence this warning, use `int` by itself. Doing this will not modify a
ny behavior and is safe. When replacing `np.int`, you may wish to use e.g. `np.int64` or `np.int32` to specify the precis
ion. If you wish to review your current use, check the release note link for additional information.
Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations
  dtype=np.int):
```



```
Vocabulary:  {'my': 9, 'name': 10, 'is': 7, 'pooja': 12, 'aditya': 0, 'each': 3, 'friend': 4, 'helps': 6, 'many': 8, 'oth
er': 11, 'friends': 5, 'at': 2, 'anywhere': 1}
Encoded Document is:
[[0 0 0 0 0 0 0 1 0 1 1 0 1]
 [1 0 0 0 0 0 0 1 0 1 1 0 0]
 [0 1 1 1 1 1 1 0 1 0 0 1 0]]
```

Practical 10

❖ **Aim:** To implement Skip gram model in NLP.

Program:

"Note: this code is divided in 3 parts"

➢ Part 1:

```
#Skip gram model in python
#code part 1
import numpy as np
import string
from nltk.corpus import stopwords

def softmax(x):
    """Compute softmax values for each sets of scores in x."""
    e_x = np.exp(x - np.max(x))
    return e_x / e_x.sum()

class word2vec(object):
    def __init__(self):
        self.N = 10
```

```
        self.X_train = []
        self.y_train = []
        self.window_size = 2
        self.alpha = 0.001
        self.words = []
        self.word_index = {}

    def initialize(self,V,data):
        self.V = V
        self.W = np.random.uniform(-0.8, 0.8, (self.V, self.N))
        self.W1 = np.random.uniform(-0.8, 0.8, (self.N, self.V))

        self.words = data
        for i in range(len(data)):
            self.word_index[data[i]] = i


    def feed_forward(self,X):
        self.h = np.dot(self.W.T,X).reshape(self.N,1)
        self.u = np.dot(self.W1.T,self.h)
```

```
        #print(self.u)
        self.y = softmax(self.u)
        return self.y

    def backpropagate(self,x,t):
        e = self.y - np.asarray(t).reshape(self.V,1)
        # e.shape is V x 1
        dLdW1 = np.dot(self.h,e.T)
        X = np.array(x).reshape(self.V,1)
        dLdW = np.dot(X, np.dot(self.W1,e).T)
        self.W1 = self.W1 - self.alpha*dLdW1
        self.W = self.W - self.alpha*dLdW

    def train(self,epochs):
        for x in range(1,epochs):
            self.loss = 0
            for j in range(len(self.X_train)):
                self.feed_forward(self.X_train[j])
                self.backpropagate(self.X_train[j],self.y_train[j])
                C = 0
```

```
                for m in range(self.V):
                    if(self.y_train[j][m]):
                        self.loss += -1*self.u[m][0]
                        C += 1
                self.loss += C*np.log(np.sum(np.exp(self.u)))
            print("epoch ",x, " loss = ",self.loss)
            self.alpha *= 1/( (1+self.alpha*x) )

    def predict(self,word,number_of_predictions):
        if word in self.words:
            index = self.word_index[word]
            X = [0 for i in range(self.V)]
            X[index] = 1
            prediction = self.feed_forward(X)
            output = {}
            for i in range(self.V):
                output[prediction[i][0]] = i

            top_context_words = []
            for k in sorted(output,reverse=True):
```

```
                    top_context_words.append(self.words[output[k]])

    if(len(top_context_words)>=number_of_predictions):
                        break


            return top_context_words
        else:
            print("Word not found in dicitonary")
```

- Part 2:

```
#Skip gram model in python
#code part 2

def preprocessing(corpus):
    stop_words = set(stopwords.words('english'))
    training_data = []
    sentences = corpus.split(".")
    for i in range(len(sentences)):
        sentences[i] = sentences[i].strip()
        sentence = sentences[i].split()
        x = [word.strip(string.punctuation) for word in sentence
                                                if word not in
stop_words]
        x = [word.lower() for word in x]
        training_data.append(x)
```

```
    return training_data


def prepare_data_for_training(sentences,w2v):
    data = {}
    for sentence in sentences:
        for word in sentence:
            if word not in data:
                data[word] = 1
            else:
                data[word] += 1
    V = len(data)
    data = sorted(list(data.keys()))
    vocab = {}
    for i in range(len(data)):
        vocab[data[i]] = i

    #for i in range(len(words)):
    for sentence in sentences:
        for i in range(len(sentence)):
            center_word = [0 for x in range(V)]
            center_word[vocab[sentence[i]]] = 1
            context = [0 for x in range(V)]

            for j in range(i-
w2v.window_size,i+w2v.window_size):
                if i!=j and j>=0 and j<len(sentence):
                    context[vocab[sentence[j]]] += 1
            w2v.X_train.append(center_word)
            w2v.y_train.append(context)
```

```
        w2v.initialize(V,data)

        return w2v.X_train,w2v.y_train
```

- Part 3:

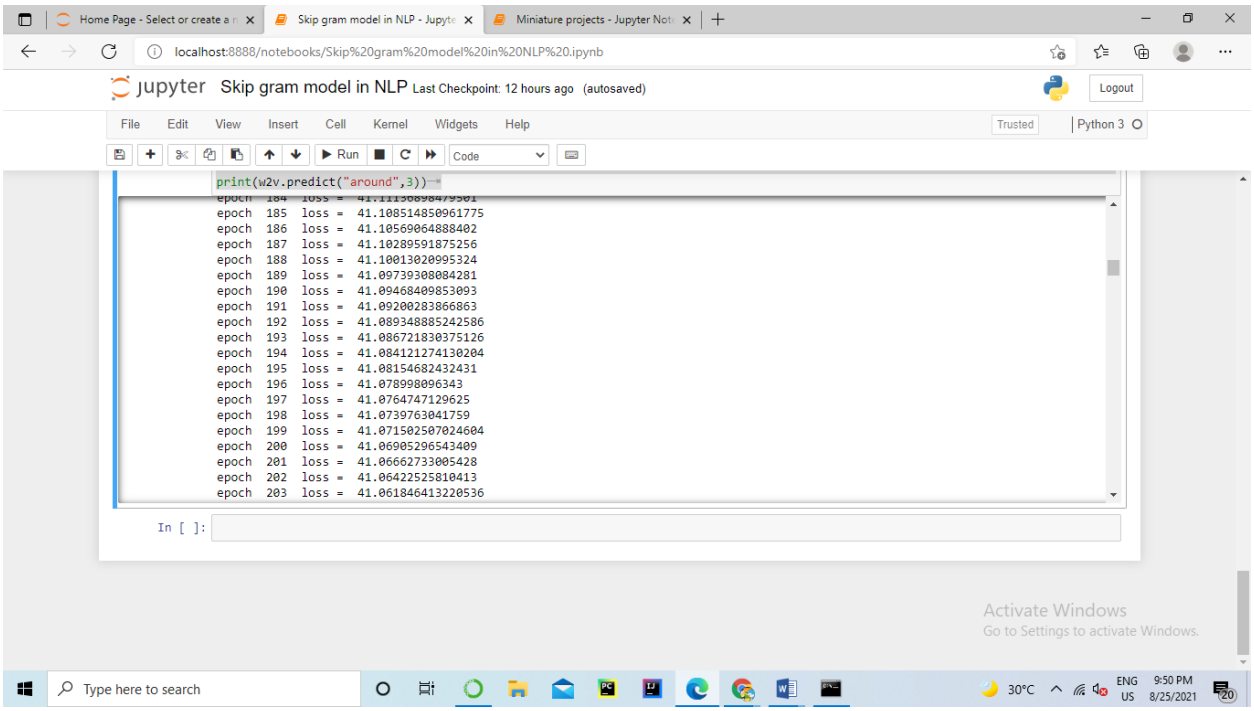
```
#Skip gram model in python
#code part 3
corpus = ""
corpus += "The earth revolves around the sun. The moon revolves
around the earth"
epochs = 1000

training_data = preprocessing(corpus)
w2v = word2vec()

prepare_data_for_training(training_data,w2v)
w2v.train(epochs)

print(w2v.predict("around",3))
```

Output:


Skip gram model in NLP - Jupyter
localhost:8888/notebooks/Skip%20gram%20model%20in%20NLP%20.ipynb
jupyter Skip gram model in NLP Last Checkpoint: 12 hours ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code
print(w2v.predict("around",3))
epoch 185 loss = 41.108514850961775
epoch 186 loss = 41.10569064888402
epoch 187 loss = 41.10289591875256
epoch 188 loss = 41.10013020995324
epoch 189 loss = 41.09739308084281
epoch 190 loss = 41.09468409853093
epoch 191 loss = 41.09200283866863
epoch 192 loss = 41.089348885242586
epoch 193 loss = 41.086721830375126
epoch 194 loss = 41.084121274130204
epoch 195 loss = 41.08154682432431
epoch 196 loss = 41.078998096343
epoch 197 loss = 41.0764747129625
epoch 198 loss = 41.0739763041759
epoch 199 loss = 41.071502507024604
epoch 200 loss = 41.06905296543409
epoch 201 loss = 41.06662733005428
epoch 202 loss = 41.06422525810413
epoch 203 loss = 41.061846413220536
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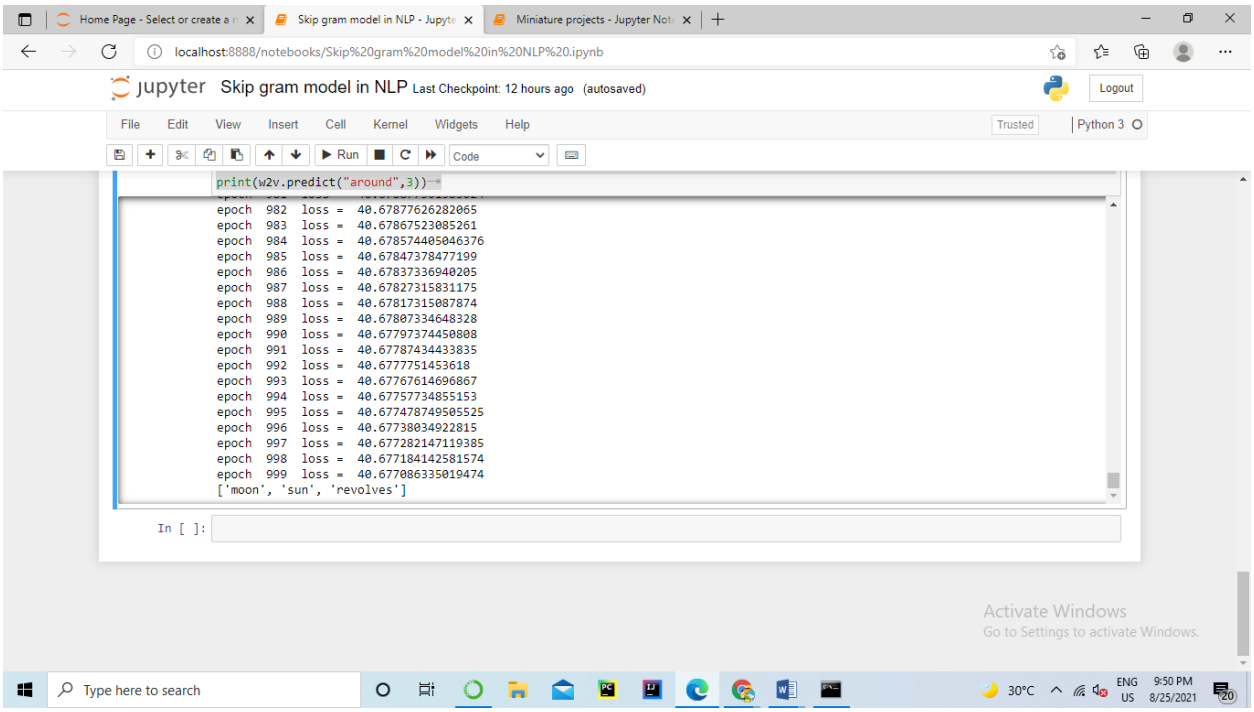
Skip gram model in NLP - Jupyter
localhost:8888/notebooks/Skip%20gram%20model%20in%20NLP%20.ipynb
jupyter Skip gram model in NLP Last Checkpoint: 12 hours ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code
print(w2v.predict("around",3))
epoch 982 loss = 40.67877626282065
epoch 983 loss = 40.67867523085261
epoch 984 loss = 40.678574405046376
epoch 985 loss = 40.67847378477199
epoch 986 loss = 40.67837336940205
epoch 987 loss = 40.67827315831175
epoch 988 loss = 40.67817315087874
epoch 989 loss = 40.67807334648328
epoch 990 loss = 40.67797374450808
epoch 991 loss = 40.67787434433835
epoch 992 loss = 40.6777751453618
epoch 993 loss = 40.67767614696867
epoch 994 loss = 40.67757734855153
epoch 995 loss = 40.677478749505525
epoch 996 loss = 40.6773803492281 5
epoch 997 loss = 40.677282147119385
epoch 998 loss = 40.677184142581574
epoch 999 loss = 40.677086335019474
['moon', 'sun', 'revolves']
In [ ]:
Activate Windows
Go to Settings to activate Windows.
Type here to search
30°C
ENG US
9:50 PM 8/25/2021