Text Summarization

1- Text Summarization with Word Frequencies:

In [31]:
```
from bs4 import BeautifulSoup as bs
'https://www.scientificamerican.com/article/nasas-james-webb-space-telescope-will-face-
import urllib.request as ur
import re,certifi
from pprint import pprint
```

1.1 - Scrapping & Processing:

In [32]:
```
def scrape_site(url):
    response = ur.urlopen(url,cafile=certifi.where())
    text = response.read()
    parsed = bs(text,'lxml')
    paras = parsed.findAll('p')
    paragraphs =''
    for p in paras:
        paragraphs+=p.text
    return paragraphs
src='https://en.wikipedia.org/wiki/Natural_language_processing'
text = scrape_site(src)
pprint(text)
```

```
<ipython-input-32-1fa1d72a8b93>:2: DeprecationWarning: cafile, capath and cadefault are
deprecated, use a custom context instead.
  response = ur.urlopen(url,cafile=certifi.where())
('Natural language processing (NLP) is a subfield of linguistics, computer '
 'science, and artificial intelligence concerned with the interactions between '
 'computers and human language, in particular how to program computers to '
 'process and analyze large amounts of natural language data.  The goal is a '
 'computer capable of "understanding" the contents of documents, including the '
 'contextual nuances of the language within them. The technology can then '
 'accurately extract information and insights contained in the documents as '
 'well as categorize and organize the documents themselves.\n'
 'Challenges in natural language processing frequently involve speech '
 'recognition, natural language understanding, and natural language '
 'generation.\n'
 'Natural language processing has its roots in the 1950s. Already in 1950, '
 'Alan Turing published an article titled "Computing Machinery and '
 'Intelligence" which proposed what is now called the Turing test as a '
 'criterion of intelligence, a task that involves the automated interpretation '
 'and generation of natural language, but at the time not articulated as a '
 'problem separate from artificial intelligence.\n'
 "The premise of symbolic NLP is well-summarized by John Searle's Chinese room "
 'experiment: Given a collection of rules (e.g., a Chinese phrasebook, with '
 'questions and matching answers), the computer emulates natural language '
 'understanding (or other NLP tasks) by applying those rules to the data it is '
 'confronted with.\n'
 'Up to the 1980s, most natural language processing systems were based on '
 'complex sets of hand-written rules.  Starting in the late 1980s, however, '
 'there was a revolution in natural language processing with the introduction '
 'of machine learning algorithms for language processing.  This was due to '
 "both the steady increase in computational power (see Moore's law) and the "
 'gradual lessening of the dominance of Chomskyan theories of linguistics '
 '(e.g. transformational grammar), whose theoretical underpinnings discouraged '
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'the sort of corpus linguistics that underlies the machine-learning approach '
'to language processing.[6]\n'
'In the 2010s, representation learning and deep neural network-style machine '
'learning methods became widespread in natural language processing, due in '
'part to a flurry of results showing that such techniques[7][8] can achieve '
'state-of-the-art results in many natural language tasks, for example in '
'language modeling,[9] parsing,[10][11] and many others. This is increasingly '
'important in medicine and healthcare, where NLP is being used to analyze '
'notes and text in electronic health records that would otherwise be '
'inaccessible for study when seeking to improve care.[12]\n'
'In the early days, many language-processing systems were designed by '
'symbolic methods, i.e., the hand-coding of a set of rules, coupled with a '
'dictionary lookup:[13][14] such as by writing grammars or devising heuristic '
'rules for stemming.\n'
'More recent systems based on machine-learning algorithms have many '
'advantages over hand-produced rules: \n'
'Despite the popularity of machine learning in NLP research, symbolic methods '
'are still (2020) commonly used:\n'
'Since the so-called "statistical revolution"[15][16] in the late 1980s and '
'mid-1990s, much natural language processing research has relied heavily on '
'machine learning. The machine-learning paradigm calls instead for using '
'statistical inference to automatically learn such rules through the analysis '
'of large corpora (the plural form of corpus, is a set of documents, possibly '
'with human or computer annotations) of typical real-world examples.\n'
'Many different classes of machine-learning algorithms have been applied to '
'natural-language-processing tasks. These algorithms take as input a large '
'set of "features" that are generated from the input data. Increasingly, '
'however, research has focused on statistical models, which make soft, '
'probabilistic decisions based on attaching real-valued weights to each input '
'feature (complex-valued embeddings,[17] and neural networks in general have '
'also been proposed, for e.g. speech[18]). Such models have the advantage '
'that they can express the relative certainty of many different possible '
'answers rather than only one, producing more reliable results when such a '
'model is included as a component of a larger system.\n'
'Some of the earliest-used machine learning algorithms, such as decision '
'trees, produced systems of hard if-then rules similar to existing '
'hand-written rules. However, part-of-speech tagging introduced the use of '
'hidden Markov models to natural language processing, and increasingly, '
'research has focused on statistical models, which make soft, probabilistic '
'decisions based on attaching real-valued weights to the features making up '
'the input data. The cache language models upon which many speech recognition '
'systems now rely are examples of such statistical models. Such models are '
'generally more robust when given unfamiliar input, especially input that '
'contains errors (as is very common for real-world data), and produce more '
'reliable results when integrated into a larger system comprising multiple '
'subtasks.\n'
'Since the neural turn, statistical methods in NLP research have been largely '
'replaced by neural networks. However, they continue to be relevant for '
'contexts in which statistical interpretability and transparency is '
'required.\n'
'A major drawback of statistical methods is that they require elaborate '
'feature engineering. Since 2015,[19] the field has thus largely abandoned '
'statistical methods and shifted to neural networks for machine learning. '
'Popular techniques include the use of word embeddings to capture semantic '
'properties of words, and an increase in end-to-end learning of a '
'higher-level task (e.g., question answering) instead of relying on a '
'pipeline of separate intermediate tasks (e.g., part-of-speech tagging and '
'dependency parsing). In some areas, this shift has entailed substantial '
'changes in how NLP systems are designed, such that deep neural network-based '
'approaches may be viewed as a new paradigm distinct from statistical natural '
'language processing. For instance, the term neural machine translation (NMT) '
'emphasizes the fact that deep learning-based approaches to machine '
'translation directly learn sequence-to-sequence transformations, obviating '
'the need for intermediate steps such as word alignment and language modeling '
'that was used in statistical machine translation (SMT). Latest works tend to '

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'use non-technical structure of a given task to build proper neural '
'network.[20]\n'
'The following is a list of some of the most commonly researched tasks in '
'natural language processing. Some of these tasks have direct real-world '
'applications, while others more commonly serve as subtasks that are used to '
'aid in solving larger tasks.\n'
'Though natural language processing tasks are closely intertwined, they can '
'be subdivided into categories for convenience. A coarse division is given '
'below.\n'
'Based on long-standing trends in the field, it is possible to extrapolate '
'future directions of NLP. As of 2020, three trends among the topics of the '
'long-standing series of CoNLL Shared Tasks can be observed:[36]\n'
'Most higher-level NLP applications involve aspects that emulate intelligent '
'behaviour and apparent comprehension of natural language. More broadly '
'speaking, the technical operationalization of increasingly advanced aspects '
'of cognitive behaviour represents one of the developmental trajectories of '
'NLP (see trends among CoNLL shared tasks above).\n'
'Cognition refers to "the mental action or process of acquiring knowledge and '
'understanding through thought, experience, and the senses."[37] Cognitive '
'science is the interdisciplinary, scientific study of the mind and its '
'processes.[38] Cognitive linguistics is an interdisciplinary branch of '
'linguistics, combining knowledge and research from both psychology and '
'linguistics.[39] Especially during the age of symbolic NLP, the area of '
'computational linguistics maintained strong ties with cognitive studies.\n'
'As an example, George Lakoff offers a methodology to build natural language '
'processing (NLP) algorithms through the perspective of cognitive science, '
'along with the findings of cognitive linguistics,[40] with two defining '
'aspects:\n'
'Ties with cognitive linguistics are part of the historical heritage of NLP, '
'but they have been less frequently addressed since the statistical turn '
'during the 1990s. Nevertheless, approaches to develop cognitive models '
'towards technically operationalizable frameworks have been pursued in the '
'context of various frameworks, e.g., of cognitive grammar,[42] functional '
'grammar,[43] construction grammar,[44] computational psycholinguistics and '
'cognitive neuroscience (e.g., ACT-R), however, with limited uptake in '
'mainstream NLP (as measured by presence on major conferences[45] of the '
'ACL). More recently, ideas of cognitive NLP have been revived as an approach '
'to achieve explainability, e.g., under the notion of "cognitive AI".[46] '
'Likewise, ideas of cognitive NLP are inherent to neural models multimodal '
'NLP (although rarely made explicit).[47]\n'
' Media related to Natural language processing at Wikimedia Commons\n')
```

1.2 - Tokenization:

In [33]:

```
import nltk
from nltk.tokenize import word_tokenize
from nltk.tokenize import sent_tokenize
from nltk.tag import pos_tag
# Remove Punctuation
from nltk.tokenize import RegexpTokenizer
```

In [34]:

```
tokenizer = RegexpTokenizer(r'\w+')
tokens= tokenizer.tokenize(text)
print('Number of tokens without stop words = {}'.format(len(tokens)))
print(tokens)
```

```
Number of tokens without stop words = 1365
['Natural', 'language', 'processing', 'NLP', 'is', 'a', 'subfield', 'of', 'linguistics',
'computer', 'science', 'and', 'artificial', 'intelligence', 'concerned', 'with', 'the',
'interactions', 'between', 'computers', 'and', 'human', 'language', 'in', 'particular',
'how', 'to', 'program', 'computers', 'to', 'process', 'and', 'analyze', 'large', 'amount
s', 'of', 'natural', 'language', 'data', 'The', 'goal', 'is', 'a', 'computer', 'capabl
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e', 'of', 'understanding', 'the', 'contents', 'of', 'documents', 'including', 'the', 'co
ntextual', 'nuances', 'of', 'the', 'language', 'within', 'them', 'The', 'technology', 'c
an', 'then', 'accurately', 'extract', 'information', 'and', 'insights', 'contained', 'i
n', 'the', 'documents', 'as', 'well', 'as', 'categorize', 'and', 'organize', 'the', 'doc
uments', 'themselves', 'Challenges', 'in', 'natural', 'language', 'processing', 'frequen
tly', 'involve', 'speech', 'recognition', 'natural', 'language', 'understanding', 'and',
'natural', 'language', 'generation', 'Natural', 'language', 'processing', 'has', 'its',
'roots', 'in', 'the', '1950s', 'Already', 'in', '1950', 'Alan', 'Turing', 'published',
'an', 'article', 'titled', 'Computing', 'Machinery', 'and', 'Intelligence', 'which', 'pr
oposed', 'what', 'is', 'now', 'called', 'the', 'Turing', 'test', 'as', 'a', 'criterion',
'of', 'intelligence', 'a', 'task', 'that', 'involves', 'the', 'automated', 'interpretati
on', 'and', 'generation', 'of', 'natural', 'language', 'but', 'at', 'the', 'time', 'no
t', 'articulated', 'as', 'a', 'problem', 'separate', 'from', 'artificial', 'intelligenc
e', 'The', 'premise', 'of', 'symbolic', 'NLP', 'is', 'well', 'summarized', 'by', 'John',
'Searle', 's', 'Chinese', 'room', 'experiment', 'Given', 'a', 'collection', 'of', 'rule
s', 'e', 'g', 'a', 'Chinese', 'phrasebook', 'with', 'questions', 'and', 'matching', 'ans
wers', 'the', 'computer', 'emulates', 'natural', 'language', 'understanding', 'or', 'oth
er', 'NLP', 'tasks', 'by', 'applying', 'those', 'rules', 'to', 'the', 'data', 'it', 'i
s', 'confronted', 'with', 'Up', 'to', 'the', '1980s', 'most', 'natural', 'language', 'pr
ocessing', 'systems', 'were', 'based', 'on', 'complex', 'sets', 'of', 'hand', 'written',
'rules', 'Starting', 'in', 'the', 'late', '1980s', 'however', 'there', 'was', 'a', 'revo
lution', 'in', 'natural', 'language', 'processing', 'with', 'the', 'introduction', 'of',
'machine', 'learning', 'algorithms', 'for', 'language', 'processing', 'This', 'was', 'du
e', 'to', 'both', 'the', 'steady', 'increase', 'in', 'computational', 'power', 'see', 'M
oore', 's', 'law', 'and', 'the', 'gradual', 'lessening', 'of', 'the', 'dominance', 'of',
'Chomskyan', 'theories', 'of', 'linguistics', 'e', 'g', 'transformational', 'grammar',
'whose', 'theoretical', 'underpinnings', 'discouraged', 'the', 'sort', 'of', 'corpus',
'linguistics', 'that', 'underlies', 'the', 'machine', 'learning', 'approach', 'to', 'lan
guage', 'processing', '6', 'In', 'the', '2010s', 'representation', 'learning', 'and', 'd
eep', 'neural', 'network', 'style', 'machine', 'learning', 'methods', 'became', 'widespr
ead', 'in', 'natural', 'language', 'processing', 'due', 'in', 'part', 'to', 'a', 'flurr
y', 'of', 'results', 'showing', 'that', 'such', 'techniques', '7', '8', 'can', 'achiev
e', 'state', 'of', 'the', 'art', 'results', 'in', 'many', 'natural', 'language', 'task
s', 'for', 'example', 'in', 'language', 'modeling', '9', 'parsing', '10', '11', 'and',
'many', 'others', 'This', 'is', 'increasingly', 'important', 'in', 'medicine', 'and', 'h
ealthcare', 'where', 'NLP', 'is', 'being', 'used', 'to', 'analyze', 'notes', 'and', 'tex
t', 'in', 'electronic', 'health', 'records', 'that', 'would', 'otherwise', 'be', 'inacce
ssible', 'for', 'study', 'when', 'seeking', 'to', 'improve', 'care', '12', 'In', 'the',
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s', 'coupled', 'with', 'a', 'dictionary', 'lookup', '13', '14', 'such', 'as', 'by', 'wri
ting', 'grammars', 'or', 'devising', 'heuristic', 'rules', 'for', 'stemming', 'More', 'r
ecent', 'systems', 'based', 'on', 'machine', 'learning', 'algorithms', 'have', 'many',
'advantages', 'over', 'hand', 'produced', 'rules', 'Despite', 'the', 'popularity', 'of',
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'15', '16', 'in', 'the', 'late', '1980s', 'and', 'mid', '1990s', 'much', 'natural', 'lan
guage', 'processing', 'research', 'has', 'relied', 'heavily', 'on', 'machine', 'learnin
g', 'The', 'machine', 'learning', 'paradigm', 'calls', 'instead', 'for', 'using', 'stati
stical', 'inference', 'to', 'automatically', 'learn', 'such', 'rules', 'through', 'the',
'analysis', 'of', 'large', 'corpora', 'the', 'plural', 'form', 'of', 'corpus', 'is',
'a', 'set', 'of', 'documents', 'possibly', 'with', 'human', 'or', 'computer', 'annotatio
ns', 'of', 'typical', 'real', 'world', 'examples', 'Many', 'different', 'classes', 'of',
'machine', 'learning', 'algorithms', 'have', 'been', 'applied', 'to', 'natural', 'langua
ge', 'processing', 'tasks', 'These', 'algorithms', 'take', 'as', 'input', 'a', 'large',
'set', 'of', 'features', 'that', 'are', 'generated', 'from', 'the', 'input', 'data', 'In
creasingly', 'however', 'research', 'has', 'focused', 'on', 'statistical', 'models', 'wh
ich', 'make', 'soft', 'probabilistic', 'decisions', 'based', 'on', 'attaching', 'real',
'valued', 'weights', 'to', 'each', 'input', 'feature', 'complex', 'valued', 'embedding
s', '17', 'and', 'neural', 'networks', 'in', 'general', 'have', 'also', 'been', 'propose
d', 'for', 'e', 'g', 'speech', '18', 'Such', 'models', 'have', 'the', 'advantage', 'tha
t', 'they', 'can', 'express', 'the', 'relative', 'certainty', 'of', 'many', 'different',
'possible', 'answers', 'rather', 'than', 'only', 'one', 'producing', 'more', 'reliable',
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'a', 'larger', 'system', 'Some', 'of', 'the', 'earliest', 'used', 'machine', 'learning',
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d', 'produce', 'more', 'reliable', 'results', 'when', 'integrated', 'into', 'a', 'large
r', 'system', 'comprising', 'multiple', 'subtasks', 'Since', 'the', 'neural', 'turn', 's
tatistical', 'methods', 'in', 'NLP', 'research', 'have', 'been', 'largely', 'replaced',
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r', 'contexts', 'in', 'which', 'statistical', 'interpretability', 'and', 'transparency',
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s', 'include', 'the', 'use', 'of', 'word', 'embeddings', 'to', 'capture', 'semantic', 'p
roperties', 'of', 'words', 'and', 'an', 'increase', 'in', 'end', 'to', 'end', 'learnin
g', 'of', 'a', 'higher', 'level', 'task', 'e', 'g', 'question', 'answering', 'instead',
'of', 'relying', 'on', 'a', 'pipeline', 'of', 'separate', 'intermediate', 'tasks', 'e',
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reas', 'this', 'shift', 'has', 'entailed', 'substantial', 'changes', 'in', 'how', 'NLP',
'systems', 'are', 'designed', 'such', 'that', 'deep', 'neural', 'network', 'based', 'app
roaches', 'may', 'be', 'viewed', 'as', 'a', 'new', 'paradigm', 'distinct', 'from', 'stat
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l', 'machine', 'translation', 'NMT', 'emphasizes', 'the', 'fact', 'that', 'deep', 'learn
ing', 'based', 'approaches', 'to', 'machine', 'translation', 'directly', 'learn', 'seque
nce', 'to', 'sequence', 'transformations', 'obviating', 'the', 'need', 'for', 'intermedi
ate', 'steps', 'such', 'as', 'word', 'alignment', 'and', 'language', 'modeling', 'that',
'was', 'used', 'in', 'statistical', 'machine', 'translation', 'SMT', 'Latest', 'works',
'tend', 'to', 'use', 'non', 'technical', 'structure', 'of', 'a', 'given', 'task', 'to',
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f', 'some', 'of', 'the', 'most', 'commonly', 'researched', 'tasks', 'in', 'natural', 'la
nguage', 'processing', 'Some', 'of', 'these', 'tasks', 'have', 'direct', 'real', 'worl
d', 'applications', 'while', 'others', 'more', 'commonly', 'serve', 'as', 'subtasks', 't
hat', 'are', 'used', 'to', 'aid', 'in', 'solving', 'larger', 'tasks', 'Though', 'natura
l', 'language', 'processing', 'tasks', 'are', 'closely', 'intertwined', 'they', 'can',
'be', 'subdivided', 'into', 'categories', 'for', 'convenience', 'A', 'coarse', 'divisio
n', 'is', 'given', 'below', 'Based', 'on', 'long', 'standing', 'trends', 'in', 'the', 'f
ield', 'it', 'is', 'possible', 'to', 'extrapolate', 'future', 'directions', 'of', 'NLP',
'As', 'of', '2020', 'three', 'trends', 'among', 'the', 'topics', 'of', 'the', 'long', 's
tanding', 'series', 'of', 'CoNLL', 'Shared', 'Tasks', 'can', 'be', 'observed', '36', 'Mo
st', 'higher', 'level', 'NLP', 'applications', 'involve', 'aspects', 'that', 'emulate',
'intelligent', 'behaviour', 'and', 'apparent', 'comprehension', 'of', 'natural', 'langua
ge', 'More', 'broadly', 'speaking', 'the', 'technical', 'operationalization', 'of', 'inc
reasingly', 'advanced', 'aspects', 'of', 'cognitive', 'behaviour', 'represents', 'one',
'of', 'the', 'developmental', 'trajectories', 'of', 'NLP', 'see', 'trends', 'among', 'Co
NLL', 'shared', 'tasks', 'above', 'Cognition', 'refers', 'to', 'the', 'mental', 'actio
n', 'or', 'process', 'of', 'acquiring', 'knowledge', 'and', 'understanding', 'through',
'thought', 'experience', 'and', 'the', 'senses', '37', 'Cognitive', 'science', 'is', 'th
e', 'interdisciplinary', 'scientific', 'study', 'of', 'the', 'mind', 'and', 'its', 'proc
esses', '38', 'Cognitive', 'linguistics', 'is', 'an', 'interdisciplinary', 'branch', 'o
f', 'linguistics', 'combining', 'knowledge', 'and', 'research', 'from', 'both', 'psychol
ogy', 'and', 'linguistics', '39', 'Especially', 'during', 'the', 'age', 'of', 'symboli
c', 'NLP', 'the', 'area', 'of', 'computational', 'linguistics', 'maintained', 'strong',
'ties', 'with', 'cognitive', 'studies', 'As', 'an', 'example', 'George', 'Lakoff', 'offe
rs', 'a', 'methodology', 'to', 'build', 'natural', 'language', 'processing', 'NLP', 'alg
orithms', 'through', 'the', 'perspective', 'of', 'cognitive', 'science', 'along', 'wit
h', 'the', 'findings', 'of', 'cognitive', 'linguistics', '40', 'with', 'two', 'definin
g', 'aspects', 'Ties', 'with', 'cognitive', 'linguistics', 'are', 'part', 'of', 'the',
'historical', 'heritage', 'of', 'NLP', 'but', 'they', 'have', 'been', 'less', 'frequentl

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y', 'addressed', 'since', 'the', 'statistical', 'turn', 'during', 'the', '1990s', 'Never
theless', 'approaches', 'to', 'develop', 'cognitive', 'models', 'towards', 'technicall
y', 'operationalizable', 'frameworks', 'have', 'been', 'pursued', 'in', 'the', 'contex
t', 'of', 'various', 'frameworks', 'e', 'g', 'of', 'cognitive', 'grammar', '42', 'functi
onal', 'grammar', '43', 'construction', 'grammar', '44', 'computational', 'psycholinguis
tics', 'and', 'cognitive', 'neuroscience', 'e', 'g', 'ACT', 'R', 'however', 'with', 'lim
ited', 'uptake', 'in', 'mainstream', 'NLP', 'as', 'measured', 'by', 'presence', 'on', 'm
ajor', 'conferences', '45', 'of', 'the', 'ACL', 'More', 'recently', 'ideas', 'of', 'cogn
itive', 'NLP', 'have', 'been', 'revived', 'as', 'an', 'approach', 'to', 'achieve', 'expl
ainability', 'e', 'g', 'under', 'the', 'notion', 'of', 'cognitive', 'AI', '46', 'Likewis
e', 'ideas', 'of', 'cognitive', 'NLP', 'are', 'inherent', 'to', 'neural', 'models', 'mul
timodal', 'NLP', 'although', 'rarely', 'made', 'explicit', '47', 'Media', 'related', 't
o', 'Natural', 'language', 'processing', 'at', 'Wikimedia', 'Commons']
```

Omission of Stopwords:

In [35]:

```
from nltk.corpus import stopwords

stop_words=stopwords.words('english')
def nostop(txt):
    clean= [word for word in txt if word.lower() not in stop_words]
    return clean
c
print('Number of tokens without stop words = {}'.format(len(txt_nostop)))
print(txt_nostop)
```

```
Number of tokens without stop words = 878
['Natural', 'language', 'processing', 'NLP', 'subfield', 'linguistics', 'computer', 'sci
ence', 'artificial', 'intelligence', 'concerned', 'interactions', 'computers', 'human',
'language', 'particular', 'program', 'computers', 'process', 'analyze', 'large', 'amount
s', 'natural', 'language', 'data', 'goal', 'computer', 'capable', 'understanding', 'cont
ents', 'documents', 'including', 'contextual', 'nuances', 'language', 'within', 'technol
ogy', 'accurately', 'extract', 'information', 'insights', 'contained', 'documents', 'wel
l', 'categorize', 'organize', 'documents', 'Challenges', 'natural', 'language', 'process
ing', 'frequently', 'involve', 'speech', 'recognition', 'natural', 'language', 'understa
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dia', 'Commons']
```

1.4 - Word Frequencies:

In [36]:

```
from nltk.stem.wordnet import WordNetLemmatizer

lmtz = nltk.WordNetLemmatizer()

lemmatized_text=[lmtz.lemmatize(w) for w in txt_nostop]

#print(lemmatized_text)

freqdist = nltk.FreqDist(lemmatized_text)
freqdist.most_common(15)
#print(max(freqdist.values()))
```

Out[36]:

```
[('language', 29),
 ('natural', 18),
 ('processing', 17),
 ('NLP', 17),
 ('machine', 13),
 ('learning', 13),
 ('task', 12),
 ('statistical', 12),
 ('cognitive', 11),
 ('model', 10),
 ('linguistics', 9),
 ('rule', 9),
 ('e', 9),
 ('neural', 9),
 ('g', 8)]
```

In [37]:

```
#weighted_freq=freqdist.values()/max(freqdist.values())
#print(weighted_freq)
fd_weighted={}
for i in freqdist:
    fd_weighted[i]=round(freqdist[i]/max(freqdist.values()),2)
print(fd_weighted)
```

```
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```

1.5 - Sentence Scroing:

In [38]:

```
# Sentence tokenization and cleaning
sentences=sent_tokenize(text)

sentences_clean=[]

for i in sentences:
    s=tokenizer.tokenize(i)
    s=nostop(s)
    sentences_clean.append(' '.join(s))


sentence_scores={}

for sentence in sentences_clean:
    for word in word_tokenize(sentence.lower()):
        # Avoid lengthy/wordy sentences
        if word in fd_weighted and len(sentence.split(' '))<20:
            if sentence not in sentence_scores:
                sentence_scores[sentence] = fd_weighted[word]
            else:
                sentence_scores[sentence] += fd_weighted[word]

print(sentence_scores)
```

```
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sing tasks closely intertwined subdivided categories convenience': 2.329999999999999, 'c
oarse division given': 0.16, 'Based long standing trends field possible extrapolate futu
re directions NLP': 0.55, 'Cognition refers mental action process acquiring knowledge un
derstanding thought experience senses': 0.4900000000000001, '37 Cognitive science interd
isciplinary scientific study mind processes': 0.7400000000000001, '38 Cognitive linguist
ics interdisciplinary branch linguistics combining knowledge research psychology linguis
tics': 1.7800000000000002, '39 Especially age symbolic NLP area computational linguistic
s maintained strong ties cognitive studies': 1.15, 'recently ideas cognitive NLP revived
approach achieve explainability e g notion cognitive AI': 1.7100000000000004, '46 Likewi
se ideas cognitive NLP inherent neural models multimodal NLP although rarely made explic
it': 0.9000000000000001, '47 Media related Natural language processing Wikimedia Common
s': 2.27}
```

1.6 - Summarize:

In [41]:

```
import heapq

# Re-introducing punctuation and stop words for proper and readable summaries
#This is based of the top n sentences with highest scores
# Summary based on # sentences:
sentences=sent_tokenize(text)
sentence_scores={}

for sentence in sentences:
    for word in word_tokenize(sentence.lower()):
        # Avoid lengthy/wordy sentences
        if word in fd_weighted and len(sentence.split(' '))<20:
            if sentence not in sentence_scores:
                sentence_scores[sentence] = fd_weighted[word]
            else:
                sentence_scores[sentence] += fd_weighted[word]
summary_sentences = heapq.nlargest(5, sentence_scores, key=sentence_scores.get)

summary = ' '.join(summary_sentences)

print(summary)
```

```
Challenges in natural language processing frequently involve speech recognition, natural
language understanding, and natural language generation. Up to the 1980s, most natural l
anguage processing systems were based on complex sets of hand-written rules. transformat
ional grammar), whose theoretical underpinnings discouraged the sort of corpus linguisti
cs that underlies the machine-learning approach to language processing. [20]
The following is a list of some of the most commonly researched tasks in natural languag
e processing. Though natural language processing tasks are closely intertwined, they can
be subdivided into categories for convenience.
```

In [10]:

```
# Summary with # of words restriction:
count = 0
max_words = 50
summary = ""
```

```
for i in sentence_scores:
    if count < max_words:
        if len(i.split(' ')) < max_words:
            count+=len(i.split(' '))
        if count < max_words:
            summary+=i+' '

print(summary+'\n','Length of summary: ',len(summary.split(' ')))
```

```
Challenges in natural language processing frequently involve speech recognition, natural
language understanding, and natural language generation. Natural language processing has
its roots in the 1950s. Up to the 1980s, most natural language processing systems were b
ased on complex sets of hand-written rules.
 Length of summary:  43
```

In [11]:

```
# Summary with ratio restriction:
ratio=0.15 # Summary size/Original size
count = 0
summary = ""
for i in sentence_scores:
    if count/len(tokens) <= ratio:
        if len(i.split(' '))/len(tokens) < ratio:
            count+=len(i.split(' '))
        if count/len(tokens) < max_words:
            summary+=i+' '

print(summary+'\n','Length of summary: ',len(summary.split(' ')),'\nRatio=',len(summary
```

```
Challenges in natural language processing frequently involve speech recognition, natural
language understanding, and natural language generation. Natural language processing has
its roots in the 1950s. Up to the 1980s, most natural language processing systems were b
ased on complex sets of hand-written rules. transformational grammar), whose theoretical
underpinnings discouraged the sort of corpus linguistics that underlies the machine-lear
ning approach to language processing. Many different classes of machine-learning algorit
hms have been applied to natural-language-processing tasks. These algorithms take as inp
ut a large set of "features" that are generated from the input data. speech[18]). The ca
che language models upon which many speech recognition systems now rely are examples of
such statistical models. Since the neural turn, statistical methods in NLP research have
been largely replaced by neural networks. However, they continue to be relevant for cont
exts in which statistical interpretability and transparency is required. A major drawbac
k of statistical methods is that they require elaborate feature engineering. Since 2015,
[19] the field has thus largely abandoned statistical methods and shifted to neural netw
orks for machine learning. Latest works tend to use non-technical structure of a given t
ask to build proper neural network. [20]
The following is a list of some of the most commonly researched tasks in natural languag
e processing.
 Length of summary:  206
Ratio= 0.1509157509157509
```

2-Text Summarization with N-grams

2.1-2:

In [42]:

```
from nltk.util import ngrams

def generate_ngrams(txt,n):
    n_grams = ngrams(word_tokenize(txt.lower()),n)
    return [' '.join(gram) for gram in n_grams]
text = scrape_site(src)
```

```
freqdist = nltk.FreqDist(generate_ngrams(text,3))
#freqdist.most_common(20)
freqdist.plot(20)
```

```
<ipython-input-32-1fa1d72a8b93>:2: DeprecationWarning: cafile, capath and cadefault are
deprecated, use a custom context instead.
  response = ur.urlopen(url,cafile=certifi.where())
['natural language', 'language processing', 'processing (', '( nlp', 'nlp )', ') is', 'i
s a', 'a subfield', 'subfield of', 'of linguistics', 'linguistics ,', ', computer', 'com
puter science', 'science ,', ', and', 'and artificial', 'artificial intelligence', 'inte
lligence concerned', 'concerned with', 'with the', 'the interactions', 'interactions bet
ween', 'between computers', 'computers and', 'and human', 'human language', 'language
,', ', in', 'in particular', 'particular how', 'how to', 'to program', 'program computer
s', 'computers to', 'to process', 'process and', 'and analyze', 'analyze large', 'large
amounts', 'amounts of', 'of natural', 'natural language', 'language data', 'data .', '.
the', 'the goal', 'goal is', 'is a', 'a computer', 'computer capable', 'capable of', 'of
``', ``` understanding', "understanding ''", "'' the", 'the contents', 'contents of', 'o
f documents', 'documents ,', ', including', 'including the', 'the contextual', 'contextu
al nuances', 'nuances of', 'of the', 'the language', 'language within', 'within them',
'them .', '. the', 'the technology', 'technology can', 'can then', 'then accurately', 'a
ccurately extract', 'extract information', 'information and', 'and insights', 'insights
contained', 'contained in', 'in the', 'the documents', 'documents as', 'as well', 'well
as', 'as categorize', 'categorize and', 'and organize', 'organize the', 'the documents',
'documents themselves', 'themselves .', '. challenges', 'challenges in', 'in natural',
'natural language', 'language processing', 'processing frequently', 'frequently involv
e', 'involve speech', 'speech recognition', 'recognition ,', ', natural', 'natural langu
age', 'language understanding', 'understanding ,', ', and', 'and natural', 'natural lang
uage', 'language generation', 'generation .', '. natural', 'natural language', 'language
processing', 'processing has', 'has its', 'its roots', 'roots in', 'in the', 'the 1950
s', '1950s .', '. already', 'already in', 'in 1950', '1950 ,', ', alan', 'alan turing',
'turing published', 'published an', 'an article', 'article titled', 'titled ``', ``` com
puting', 'computing machinery', 'machinery and', 'and intelligence', "intelligence ''",
"'' which", 'which proposed', 'proposed what', 'what is', 'is now', 'now called', 'calle
d the', 'the turing', 'turing test', 'test as', 'as a', 'a criterion', 'criterion of',
'of intelligence', 'intelligence ,', ', a', 'a task', 'task that', 'that involves', 'inv
olves the', 'the automated', 'automated interpretation', 'interpretation and', 'and gene
ration', 'generation of', 'of natural', 'natural language', 'language ,', ', but', 'but
at', 'at the', 'the time', 'time not', 'not articulated', 'articulated as', 'as a', 'a p
roblem', 'problem separate', 'separate from', 'from artificial', 'artificial intelligenc
e', 'intelligence .', '. the', 'the premise', 'premise of', 'of symbolic', 'symbolic nl
p', 'nlp is', 'is well-summarized', 'well-summarized by', 'by john', 'john searle', "sea
rle 's", "'s chinese", 'chinese room', 'room experiment', 'experiment :', ': given', 'gi
ven a', 'a collection', 'collection of', 'of rules', 'rules (', '( e.g.', 'e.g. ,', ',
a', 'a chinese', 'chinese phrasebook', 'phrasebook ,', ', with', 'with questions', 'ques
tions and', 'and matching', 'matching answers', 'answers )', ') ,', ', the', 'the comput
er', 'computer emulates', 'emulates natural', 'natural language', 'language understandin
g', 'understanding (', '( or', 'or other', 'other nlp', 'nlp tasks', 'tasks )', ') by',
'by applying', 'applying those', 'those rules', 'rules to', 'to the', 'the data', 'data
it', 'it is', 'is confronted', 'confronted with', 'with .', '. up', 'up to', 'to the',
'the 1980s', '1980s ,', ', most', 'most natural', 'natural language', 'language processi
ng', 'processing systems', 'systems were', 'were based', 'based on', 'on complex', 'comp
lex sets', 'sets of', 'of hand-written', 'hand-written rules', 'rules .', '. starting',
'starting in', 'in the', 'the late', 'late 1980s', '1980s ,', ', however', 'however ,',
', there', 'there was', 'was a', 'a revolution', 'revolution in', 'in natural', 'natural
language', 'language processing', 'processing with', 'with the', 'the introduction', 'in
troduction of', 'of machine', 'machine learning', 'learning algorithms', 'algorithms fo
r', 'for language', 'language processing', 'processing .', '. this', 'this was', 'was du
e', 'due to', 'to both', 'both the', 'the steady', 'steady increase', 'increase in', 'in
computational', 'computational power', 'power (', '( see', 'see moore', "moore 's", "'s
law", 'law )', ') and', 'and the', 'the gradual', 'gradual lessening', 'lessening of',
'of the', 'the dominance', 'dominance of', 'of chomskyan', 'chomskyan theories', 'theori
es of', 'of linguistics', 'linguistics (', '( e.g', 'e.g .', '. transformational', 'tran
sformational grammar', 'grammar )', ') ,', ', whose', 'whose theoretical', 'theoretical
underpinnings', 'underpinnings discouraged', 'discouraged the', 'the sort', 'sort of',
```

'of corpus', 'corpus linguistics', 'linguistics that', 'that underlies', 'underlies th
e', 'the machine-learning', 'machine-learning approach', 'approach to', 'to language',
'language processing', 'processing .', '. [', '[6', '6]', '] in', 'in the', 'the 2010
s', '2010s ,', ', representation', 'representation learning', 'learning and', 'and dee
p', 'deep neural', 'neural network-style', 'network-style machine', 'machine learning',
'learning methods', 'methods became', 'became widespread', 'widespread in', 'in natura
l', 'natural language', 'language processing', 'processing ,', ', due', 'due in', 'in pa
rt', 'part to', 'to a', 'a flurry', 'flurry of', 'of results', 'results showing', 'showi
ng that', 'that such', 'such techniques', 'techniques [', '[7', '7]', '] [', '[8', '8
]', '] can', 'can achieve', 'achieve state-of-the-art', 'state-of-the-art results', 'res
ults in', 'in many', 'many natural', 'natural language', 'language tasks', 'tasks ,', ',
for', 'for example', 'example in', 'in language', 'language modeling', 'modeling ,', ',
[', '[9', '9]', '] parsing', 'parsing ,', ', [', '[10', '10]', '] [', '[11', '11
]', '] and', 'and many', 'many others', 'others .', '. this', 'this is', 'is increasingl
y', 'increasingly important', 'important in', 'in medicine', 'medicine and', 'and health
care', 'healthcare ,', ', where', 'where nlp', 'nlp is', 'is being', 'being used', 'used
to', 'to analyze', 'analyze notes', 'notes and', 'and text', 'text in', 'in electronic',
'electronic health', 'health records', 'records that', 'that would', 'would otherwise',
'otherwise be', 'be inaccessible', 'inaccessible for', 'for study', 'study when', 'when
seeking', 'seeking to', 'to improve', 'improve care', 'care .', '. [', '[12', '12]',
'] in', 'in the', 'the early', 'early days', 'days ,', ', many', 'many language-processi
ng', 'language-processing systems', 'systems were', 'were designed', 'designed by', 'by
symbolic', 'symbolic methods', 'methods ,', ', i.e.', 'i.e. ,', ', the', 'the hand-codin
g', 'hand-coding of', 'of a', 'a set', 'set of', 'of rules', 'rules ,', ', coupled', 'co
upled with', 'with a', 'a dictionary', 'dictionary lookup', 'lookup :', ': [', '[13',
'13]', '] [', '[14', '14]', '] such', 'such as', 'as by', 'by writing', 'writing gram
mars', 'grammars or', 'or devising', 'devising heuristic', 'heuristic rules', 'rules fo
r', 'for stemming', 'stemming .', '. more', 'more recent', 'recent systems', 'systems ba
sed', 'based on', 'on machine-learning', 'machine-learning algorithms', 'algorithms hav
e', 'have many', 'many advantages', 'advantages over', 'over hand-produced', 'hand-produ
ced rules', 'rules :', ': despite', 'despite the', 'the popularity', 'popularity of', 'o
f machine', 'machine learning', 'learning in', 'in nlp', 'nlp research', 'research ,',
', symbolic', 'symbolic methods', 'methods are', 'are still', 'still (', '(2020', '2020
)', ') commonly', 'commonly used', 'used :', ': since', 'since the', 'the so-called', 's
o-called ``', '`` statistical', 'statistical revolution', "revolution ''", "'' [", '[1
5', '15]', '] [', '[16', '16]', '] in', 'in the', 'the late', 'late 1980s', '1980s an
d', 'and mid-1990s', 'mid-1990s ,', ', much', 'much natural', 'natural language', 'langu
age processing', 'processing research', 'research has', 'has relied', 'relied heavily',
'heavily on', 'on machine', 'machine learning', 'learning .', '. the', 'the machine-lear
ning', 'machine-learning paradigm', 'paradigm calls', 'calls instead', 'instead for', 'f
or using', 'using statistical', 'statistical inference', 'inference to', 'to automatical
ly', 'automatically learn', 'learn such', 'such rules', 'rules through', 'through the',
'the analysis', 'analysis of', 'of large', 'large corpora', 'corpora (', '(the', 'the p
lural', 'plural form', 'form of', 'of corpus', 'corpus ,', ', is', 'is a', 'a set', 'set
of', 'of documents', 'documents ,', ', possibly', 'possibly with', 'with human', 'human
or', 'or computer', 'computer annotations', 'annotations)', ') of', 'of typical', 'typi
cal real-world', 'real-world examples', 'examples .', '. many', 'many different', 'diffe
rent classes', 'classes of', 'of machine-learning', 'machine-learning algorithms', 'algo
rithms have', 'have been', 'been applied', 'applied to', 'to natural-language-processin
g', 'natural-language-processing tasks', 'tasks .', '. these', 'these algorithms', 'algo
rithms take', 'take as', 'as input', 'input a', 'a large', 'large set', 'set of', 'of `
`', '`` features', "features ''", "'' that", 'that are', 'are generated', 'generated fro
m', 'from the', 'the input', 'input data', 'data .', '. increasingly', 'increasingly ,',
', however', 'however ,', ', research', 'research has', 'has focused', 'focused on', 'on
statistical', 'statistical models', 'models ,', ', which', 'which make', 'make soft', 's
oft ,', ', probabilistic', 'probabilistic decisions', 'decisions based', 'based on', 'on
attaching', 'attaching real-valued', 'real-valued weights', 'weights to', 'to each', 'ea
ch input', 'input feature', 'feature (', '(complex-valued', 'complex-valued embedding
s', 'embeddings ,', ', [', '[17', '17]', '] and', 'and neural', 'neural networks', 'ne
tworks in', 'in general', 'general have', 'have also', 'also been', 'been proposed', 'pr
oposed ,', ', for', 'for e.g', 'e.g .', '. speech', 'speech [', '[18', '18]', '])',
') .', '. such', 'such models', 'models have', 'have the', 'the advantage', 'advantage t
hat', 'that they', 'they can', 'can express', 'express the', 'the relative', 'relative c
ertainty', 'certainty of', 'of many', 'many different', 'different possible', 'possible
answers', 'answers rather', 'rather than', 'than only', 'only one', 'one ,', ', producin

g', 'producing more', 'more reliable', 'reliable results', 'results when', 'when such',
'such a', 'a model', 'model is', 'is included', 'included as', 'as a', 'a component', 'c
omponent of', 'of a', 'a larger', 'larger system', 'system .', '. some', 'some of', 'of
the', 'the earliest-used', 'earliest-used machine', 'machine learning', 'learning algori
thms', 'algorithms ,', ', such', 'such as', 'as decision', 'decision trees', 'trees ,',
', produced', 'produced systems', 'systems of', 'of hard', 'hard if-then', 'if-then rule
s', 'rules similar', 'similar to', 'to existing', 'existing hand-written', 'hand-written
rules', 'rules .', '. however', 'however ,', ', part-of-speech', 'part-of-speech taggin
g', 'tagging introduced', 'introduced the', 'the use', 'use of', 'of hidden', 'hidden ma
rkov', 'markov models', 'models to', 'to natural', 'natural language', 'language process
ing', 'processing ,', ', and', 'and increasingly', 'increasingly ,', ', research', 'rese
arch has', 'has focused', 'focused on', 'on statistical', 'statistical models', 'models
,', ', which', 'which make', 'make soft', 'soft ,', ', probabilistic', 'probabilistic de
cisions', 'decisions based', 'based on', 'on attaching', 'attaching real-valued', 'real-
valued weights', 'weights to', 'to the', 'the features', 'features making', 'making up',
'up the', 'the input', 'input data', 'data .', '. the', 'the cache', 'cache language',
'language models', 'models upon', 'upon which', 'which many', 'many speech', 'speech rec
ognition', 'recognition systems', 'systems now', 'now rely', 'rely are', 'are examples',
'examples of', 'of such', 'such statistical', 'statistical models', 'models .', '. suc
h', 'such models', 'models are', 'are generally', 'generally more', 'more robust', 'robu
st when', 'when given', 'given unfamiliar', 'unfamiliar input', 'input ,', ', especiall
y', 'especially input', 'input that', 'that contains', 'contains errors', 'errors (', '(
as', 'as is', 'is very', 'very common', 'common for', 'for real-world', 'real-world dat
a', 'data)', ') ,', ', and', 'and produce', 'produce more', 'more reliable', 'reliable
results', 'results when', 'when integrated', 'integrated into', 'into a', 'a larger', 'l
arger system', 'system comprising', 'comprising multiple', 'multiple subtasks', 'subtask
s .', '. since', 'since the', 'the neural', 'neural turn', 'turn ,', ', statistical', 's
tatistical methods', 'methods in', 'in nlp', 'nlp research', 'research have', 'have bee
n', 'been largely', 'largely replaced', 'replaced by', 'by neural', 'neural networks',
'networks .', '. however', 'however ,', ', they', 'they continue', 'continue to', 'to b
e', 'be relevant', 'relevant for', 'for contexts', 'contexts in', 'in which', 'which sta
tistical', 'statistical interpretability', 'interpretability and', 'and transparency',
'transparency is', 'is required', 'required .', '. a', 'a major', 'major drawback', 'dra
wback of', 'of statistical', 'statistical methods', 'methods is', 'is that', 'that the
y', 'they require', 'require elaborate', 'elaborate feature', 'feature engineering', 'en
gineering .', '. since', 'since 2015', '2015 ,', ', [', '[19', '19]', '] the', 'the fi
eld', 'field has', 'has thus', 'thus largely', 'largely abandoned', 'abandoned statistic
al', 'statistical methods', 'methods and', 'and shifted', 'shifted to', 'to neural', 'ne
ural networks', 'networks for', 'for machine', 'machine learning', 'learning .', '. popu
lar', 'popular techniques', 'techniques include', 'include the', 'the use', 'use of', 'o
f word', 'word embeddings', 'embeddings to', 'to capture', 'capture semantic', 'semantic
properties', 'properties of', 'of words', 'words ,', ', and', 'and an', 'an increase',
'increase in', 'in end-to-end', 'end-to-end learning', 'learning of', 'of a', 'a higher-
level', 'higher-level task', 'task (', '(e.g.', 'e.g. ,', ', question', 'question answe
ring', 'answering)', ') instead', 'instead of', 'of relying', 'relying on', 'on a', 'a
pipeline', 'pipeline of', 'of separate', 'separate intermediate', 'intermediate tasks',
'tasks (', '(e.g.', 'e.g. ,', ', part-of-speech', 'part-of-speech tagging', 'tagging an
d', 'and dependency', 'dependency parsing', 'parsing)', ') .', '. in', 'in some', 'some
areas', 'areas ,', ', this', 'this shift', 'shift has', 'has entailed', 'entailed substa
ntial', 'substantial changes', 'changes in', 'in how', 'how nlp', 'nlp systems', 'system
s are', 'are designed', 'designed ,', ', such', 'such that', 'that deep', 'deep neural',
'neural network-based', 'network-based approaches', 'approaches may', 'may be', 'be view
ed', 'viewed as', 'as a', 'a new', 'new paradigm', 'paradigm distinct', 'distinct from',
'from statistical', 'statistical natural', 'natural language', 'language processing', 'p
rocessing .', '. for', 'for instance', 'instance ,', ', the', 'the term', 'term neural',
'neural machine', 'machine translation', 'translation (', '(nmt', 'nmt)', ') emphasize
s', 'emphasizes the', 'the fact', 'fact that', 'that deep', 'deep learning-based', 'lear
ning-based approaches', 'approaches to', 'to machine', 'machine translation', 'translati
on directly', 'directly learn', 'learn sequence-to-sequence', 'sequence-to-sequence tran
sformations', 'transformations ,', ', obviating', 'obviating the', 'the need', 'need fo
r', 'for intermediate', 'intermediate steps', 'steps such', 'such as', 'as word', 'word
alignment', 'alignment and', 'and language', 'language modeling', 'modeling that', 'that
was', 'was used', 'used in', 'in statistical', 'statistical machine', 'machine translati
on', 'translation (', '(smt', 'smt)', ') .', '. latest', 'latest works', 'works tend',
'tend to', 'to use', 'use non-technical', 'non-technical structure', 'structure of', 'of

a', 'a given', 'given task', 'task to', 'to build', 'build proper', 'proper neural', 'ne
ural network', 'network .', '. [', '[20', '20]', '] the', 'the following', 'following
is', 'is a', 'a list', 'list of', 'of some', 'some of', 'of the', 'the most', 'most comm
only', 'commonly researched', 'researched tasks', 'tasks in', 'in natural', 'natural lan
guage', 'language processing', 'processing .', '. some', 'some of', 'of these', 'these t
asks', 'tasks have', 'have direct', 'direct real-world', 'real-world applications', 'app
lications ,', ', while', 'while others', 'others more', 'more commonly', 'commonly serv
e', 'serve as', 'as subtasks', 'subtasks that', 'that are', 'are used', 'used to', 'to a
id', 'aid in', 'in solving', 'solving larger', 'larger tasks', 'tasks .', '. though', 't
hough natural', 'natural language', 'language processing', 'processing tasks', 'tasks ar
e', 'are closely', 'closely intertwined', 'intertwined ,', ', they', 'they can', 'can b
e', 'be subdivided', 'subdivided into', 'into categories', 'categories for', 'for conven
ience', 'convenience .', '. a', 'a coarse', 'coarse division', 'division is', 'is give
n', 'given below', 'below .', '. based', 'based on', 'on long-standing', 'long-standing
trends', 'trends in', 'in the', 'the field', 'field ,', ', it', 'it is', 'is possible',
'possible to', 'to extrapolate', 'extrapolate future', 'future directions', 'directions
of', 'of nlp', 'nlp .', '. as', 'as of', 'of 2020', '2020 ,', ', three', 'three trends',
'trends among', 'among the', 'the topics', 'topics of', 'of the', 'the long-standing',
'long-standing series', 'series of', 'of conll', 'conll shared', 'shared tasks', 'tasks
can', 'can be', 'be observed', 'observed :', ': [', '[36', '36]', '] most', 'most high
er-level', 'higher-level nlp', 'nlp applications', 'applications involve', 'involve aspe
cts', 'aspects that', 'that emulate', 'emulate intelligent', 'intelligent behaviour', 'b
ehaviour and', 'and apparent', 'apparent comprehension', 'comprehension of', 'of natura
l', 'natural language', 'language .', '. more', 'more broadly', 'broadly speaking', 'spe
aking ,', ', the', 'the technical', 'technical operationalization', 'operationalization
of', 'of increasingly', 'increasingly advanced', 'advanced aspects', 'aspects of', 'of c
ognitive', 'cognitive behaviour', 'behaviour represents', 'represents one', 'one of', 'o
f the', 'the developmental', 'developmental trajectories', 'trajectories of', 'of nlp',
'nlp (', '(see', 'see trends', 'trends among', 'among conll', 'conll shared', 'shared t
asks', 'tasks above', 'above)', ') .', '. cognition', 'cognition refers', 'refers to',
'to ``', '`` the', 'the mental', 'mental action', 'action or', 'or process', 'process o
f', 'of acquiring', 'acquiring knowledge', 'knowledge and', 'and understanding', 'unders
tanding through', 'through thought', 'thought ,', ', experience', 'experience ,', ', an
d', 'and the', 'the senses', 'senses .', '. ``', '`` [', '[37', '37]', '] cognitive',
'cognitive science', 'science is', 'is the', 'the interdisciplinary', 'interdisciplinary
,', ', scientific', 'scientific study', 'study of', 'of the', 'the mind', 'mind and', 'a
nd its', 'its processes', 'processes .', '. [', '[38', '38]', '] cognitive', 'cognitiv
e linguistics', 'linguistics is', 'is an', 'an interdisciplinary', 'interdisciplinary br
anch', 'branch of', 'of linguistics', 'linguistics ,', ', combining', 'combining knowled
ge', 'knowledge and', 'and research', 'research from', 'from both', 'both psychology',
'psychology and', 'and linguistics', 'linguistics .', '. [', '[39', '39]', '] especial
ly', 'especially during', 'during the', 'the age', 'age of', 'of symbolic', 'symbolic nl
p', 'nlp ,', ', the', 'the area', 'area of', 'of computational', 'computational linguist
ics', 'linguistics maintained', 'maintained strong', 'strong ties', 'ties with', 'with c
ognitive', 'cognitive studies', 'studies .', '. as', 'as an', 'an example', 'example ,',
', george', 'george lakoff', 'lakoff offers', 'offers a', 'a methodology', 'methodology
to', 'to build', 'build natural', 'natural language', 'language processing', 'processing
(', '(nlp', 'nlp)', ') algorithms', 'algorithms through', 'through the', 'the perspect
ive', 'perspective of', 'of cognitive', 'cognitive science', 'science ,', ', along', 'al
ong with', 'with the', 'the findings', 'findings of', 'of cognitive', 'cognitive linguis
tics', 'linguistics ,', ', [', '[40', '40]', '] with', 'with two', 'two defining', 'de
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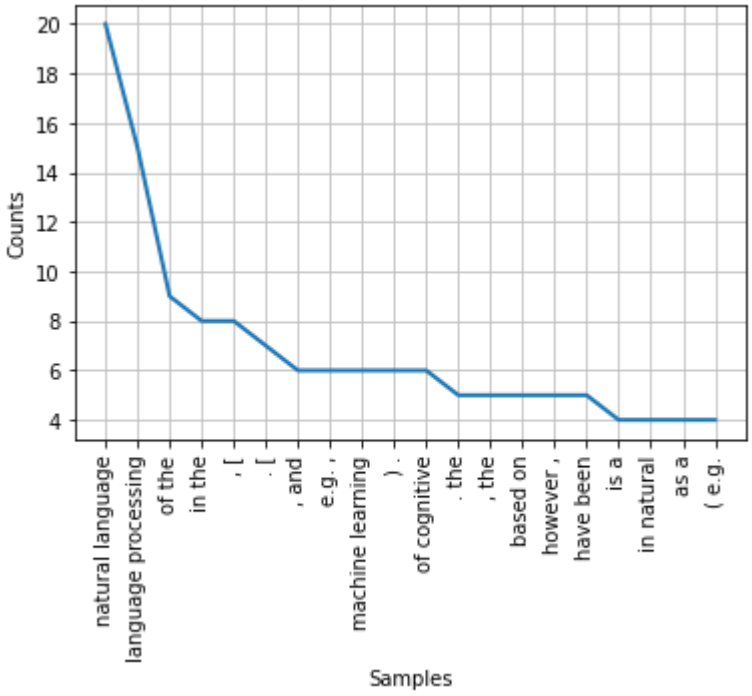

Out[42]: `<AxesSubplot:xlabel='Samples', ylabel='Counts'>`

Weighted Frequencies Calculation:

In [21]:
```
fd_weighted={}
max_freq=max(freqdist.values())
for i in freqdist:
    fd_weighted[i]=freqdist[i]/max_freq
#pprint(sorted(fd_weighted.items(), key=lambda item: item[1],reverse=True))
```

Sentence Scoring:

In [47]:
```
sentence_scores2={}

# Function only needs source_text (non-tokenized) and n_grams level (2,3...)

def calculate_sentence_scores_ngram(source_text,n_grams):

    # Computes word freqs
    freqdist = nltk.FreqDist(generate_ngrams(source_text,n_grams))

    # Weighted freqs
    fd_weighted={}
```

```
    max_freq=max(freqdist.values())
    for i in freqdist:
        fd_weighted[i]=freqdist[i]/max_freq

    for sentence in freqdist:
        if sentence in fd_weighted:
            if sentence not in sentence_scores2:
                sentence_scores2[sentence] = fd_weighted[sentence]
            else:
                sentence_scores2[sentence] += fd_weighted[sentence]

calculate_sentence_scores_ngram(text,3)

print(sentence_scores2)
```

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Summary:

In [48]:

```
sentences=sent_tokenize(text)
sentence_scores={}

for sentence in sentences:
    for word in fd_weighted:
        if word in fd_weighted:
            if sentence not in sentence_scores:
                sentence_scores[sentence] = fd_weighted[word]
            else:
                sentence_scores[sentence] += fd_weighted[word]


summary_sentences = heapq.nlargest(6, sentence_scores, key=sentence_scores.get)
summary = ' '.join(summary_sentences)

print(summary)
```

```
Natural language processing (NLP) is a subfield of linguistics, computer science, and ar
tificial intelligence concerned with the interactions between computers and human langua
ge, in particular how to program computers to process and analyze large amounts of natur
al language data. The goal is a computer capable of "understanding" the contents of docu
ments, including the contextual nuances of the language within them. The technology can
then accurately extract information and insights contained in the documents as well as c
ategorize and organize the documents themselves. Challenges in natural language processi
ng frequently involve speech recognition, natural language understanding, and natural la
nguage generation. Natural language processing has its roots in the 1950s. Already in 19
50, Alan Turing published an article titled "Computing Machinery and Intelligence" which
proposed what is now called the Turing test as a criterion of intelligence, a task that
involves the automated interpretation and generation of natural language, but at the tim
e not articulated as a problem separate from artificial intelligence.
```

3 - Comparisons:

In conclusion, introducing n-grams produces superior results. Compared to the first method, the final summary using n-grams is more grammatically precise, and descriptive, and thus achieves human-like summarization. In the below example, we compare both summaries limited to 5 sentences for each method, and it is evident that the first summary references a list without a proper description (sentence #4):

Regular 5 sentences: “Challenges in natural language processing frequently involve speech recognition, natural language understanding, and natural language generation. Up to the 1980s, most natural language processing systems were based on complex sets of hand-written rules. transformational grammar), whose theoretical underpinnings discouraged the sort of corpus linguistics that underlies the machine-learning approach to language processing. [20] The following is a list of some of the most commonly researched tasks in natural language processing. Though natural language processing tasks are closely intertwined, they can be subdivided into categories for convenience.”

N-Grams 5 sentences:

“Natural language processing (NLP) is a subfield of linguistics, computer science, and artificial intelligence concerned with the interactions between computers and human language, in particular how to program computers to process and analyze large amounts of natural language data. The goal is a computer capable of "understanding" the contents of documents, including the contextual nuances of the language within them. The technology can then accurately extract information and insights contained in the documents as well as categorize and organize the documents themselves. Challenges in natural language processing frequently involve speech recognition, natural language understanding, and natural language generation. Natural language processing has its roots in the 1950s.”