# Basic Data Mining with n-Gram

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10/30/2019

# Why use this topic?

- During Project 3 “Which are the most valued data science skills”, I had my first experience in web scraping.
- Wondered how to get high-frequency phrases with different length from a long paragraph, instead of having “machine” and “learning” counted separately.
- N-gram was covered in
  Chapter 10: Representing and Mining Text.

# Introductions

# Introduction

- Bag-of-words:
  A text, such as a sentence or a document, being as a bag of its words.

- N-gram:  Context by breaking long text into sequences of adjacent words as terms, disregarding word order entirely.
  e.g. bi-grams: sequence of 2 words, tri-grams: sequence of 3 words

- We would like to see phrase like “natural language processing” which is more meaningful than simply knowing the individual words “language”, “natural”, and “processing”.

RStudio - Part 1

# Libraries and Functions

# Libraries and Functions

## Libraries used

- readtext
- tidyverse
- tm
- RWeka
- SnowballC

## Functions used

- NGramTokenizer
- VCorpus (from tm ver.7.0)
- content_transform
- TermDocumentMatrix

# Create functions for n-grams

```
BigramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min = 2, max = 2))
TrigramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min = 3, max = 3))
FourgramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min = 4, max = 4))
FivegramTokenizer <- function(x,n) NGramTokenizer(x, Weka_control(min = 5, max = 5))
removeURL <- function(x) str_replace_all(x,"http[[:alnum:]]*", "")
```

- BigramTokenizer: for phrase with length = 2
- TrigramTokenizer: for phrase with length = 3
- FourgramTokenizer: for phrase with length = 4
- FivegramTokenizer: for phrase with length = 5

# Create a VCorpus for tidying data

```
text_corpus <- VCorpus(VectorSource(text)) %>%
  tm_map(removeNumbers) %>%
  tm_map(removePunctuation) %>%
  tm_map(removeWords, stopwords("en")) %>%
  tm_map(content_transformer(tolower)) %>%
  tm_map(content_transformer(removeURL)) %>%
  tm_map(stripWhitespace)
```

- To remove numbers, punctuations,
- To remove stop words, e.g. myself, which, would, because, among, etc.
- To turn all alphabets to lower case
- To remove all URLs in the paragraph
- To strip extra whitespace from a text document. Multiple whitespace characters are collapsed to a single blank

Part 2

# Obtaining n-grams

# Tri-gram

## Code:

```
key_n_gram <- character()

tdm.trigram <- TermDocumentMatrix(text_corpus,
                                  control = list(wordLengths = c(10,Inf),
                                                 tokenize = TrigramTokenizer))
#inspect(tdm.bigram)

freq.tdm.trigram <- data.frame(word = tdm.trigram$dimnames$Terms, frequency = tdm.trigram$v, stringsAsFactors
= FALSE) %>%
  arrange(-frequency)

freq.tdm.trigram
```

A phrase containing 3 words while each has length ≥ 3

## Result:

| word <chr> | frequency <dbl> |
|---|---|
| natural language processing | 110 |
| nlp machine learning | 47 |
| learning nlp machine | 46 |
| machine learning nlp | 46 |
| association computational linguistics | 24 |
| language processing almost | 23 |
| almost from scratch | 22 |
| bottou karlen kavukcuoglu | 22 |
| collobert weston bottou | 22 |
| karlen kavukcuoglu and | 22 |

1-10 of 10,000 rows  Previous 1 2 3 4 5 6 … 1000 Next

- I took “natural language processing” in consideration.

# Bi-gram

## Code:

```
tdm.bigram <- TermDocumentMatrix(text_corpus,
                                 control = list(wordLengths = c(8,Inf),
                                                tokenize = BigramTokenizer))
#inspect(tdm.bigram)

freq.tdm.bigram <- data.frame(word = tdm.bigram$dimnames$Terms, frequency = tdm.bigram$v, stringsAsFactors = F
ALSE) %>%
  arrange(-frequency)

freq.tdm.bigram
```

## Result:

| word <chr> | frequency <dbl> |
|---|---|
| natural language | 159 |
| machine learning | 141 |
| neural networks | 118 |
| language processing | 117 |
| language model | 88 |
| nlp machine | 47 |
| learning nlp | 46 |
| computational linguistics | 35 |
| parse tree | 30 |
| lookup table | 29 |

1-10 of 10,000 rows  Previous 1 2 3 4 5 6 ... 1000 Next

- I took top 10 phrases in consideration.

# Four- and Five-gram

```
tdm.4gram <- TermDocumentMatrix(text_corpus,
                                control = list(wordLengths = c(14,Inf),
                                               tokenize = FourgramTokenizer))
#inspect(tdm.bigram)

freq.tdm.4gram <- data.frame(word = tdm.4gram$dimnames$Terms, frequency = tdm.4gram$v) %>%
  arrange(-frequency)

freq.tdm.4gram
```

| word <fctr> | frequency <dbl> |
|---|---|
| learning nlp machine learning | 46 |
| machine learning nlp machine | 46 |
| nlp machine learning nlp | 46 |
| natural language processing almost | 23 |
| bottou karlen kavukcuoglu and | 22 |
| collobert weston bottou karlen | 22 |
| karlen kavukcuoglu and kuksa | 22 |
| language processing almost from | 22 |
| processing almost from scratch | 22 |
| weston bottou karlen kavukcuoglu | 22 |

1-10 of 10,000 rows  Previous 1 2 3 4 5 6 ... 1000 Next

- 4-gram did not show meaningful results and so will 5-gram, therefore I skipped all these phrases.

Part 3

# Concatenate n-grams by “_”

# Concatenating n-grams by “_” in the paragraph

```
text_corpus_mod <- text_corpus

for (key in key_n_gram){
text_corpus_mod <- text_corpus_mod[[1]]$content %>%
  str_replace_all(key,str_replace_all(key,' ','_')) %>%
  VectorSource() %>%
  VCorpus()
}
text_corpus_mod
```

- This code chunk will help me concatenating the 11 n-grams (1 tri-gram and 10 bi-gram) I put in `key_n_gram` in the tidied paragraph

Part 4

# Output

# Outputs:

## Before concatenating:

```
tdm <- TermDocumentMatrix(text_corpus,control = list(wordLengths = c(4,Inf)))
#inspect(tdm2)
tdm.word <- data.frame(word = tdm$dimnames$Terms, frequency = tdm$v,stringsAsFactors = FALSE) %>%
  arrange(-frequency)

tdm.word
```

| word <chr> | frequency <dbl> |
|---|---|
| language | 326 |
| learning | 207 |
| natural | 168 |
| machine | 162 |
| neural | 158 |
| word | 157 |
| networks | 156 |
| processing | 146 |
| using | 129 |
| model | 125 |

1-10 of 3,653 rows  Previous 1 2 3 4 5 6 … 366 Next

## After concatenating:

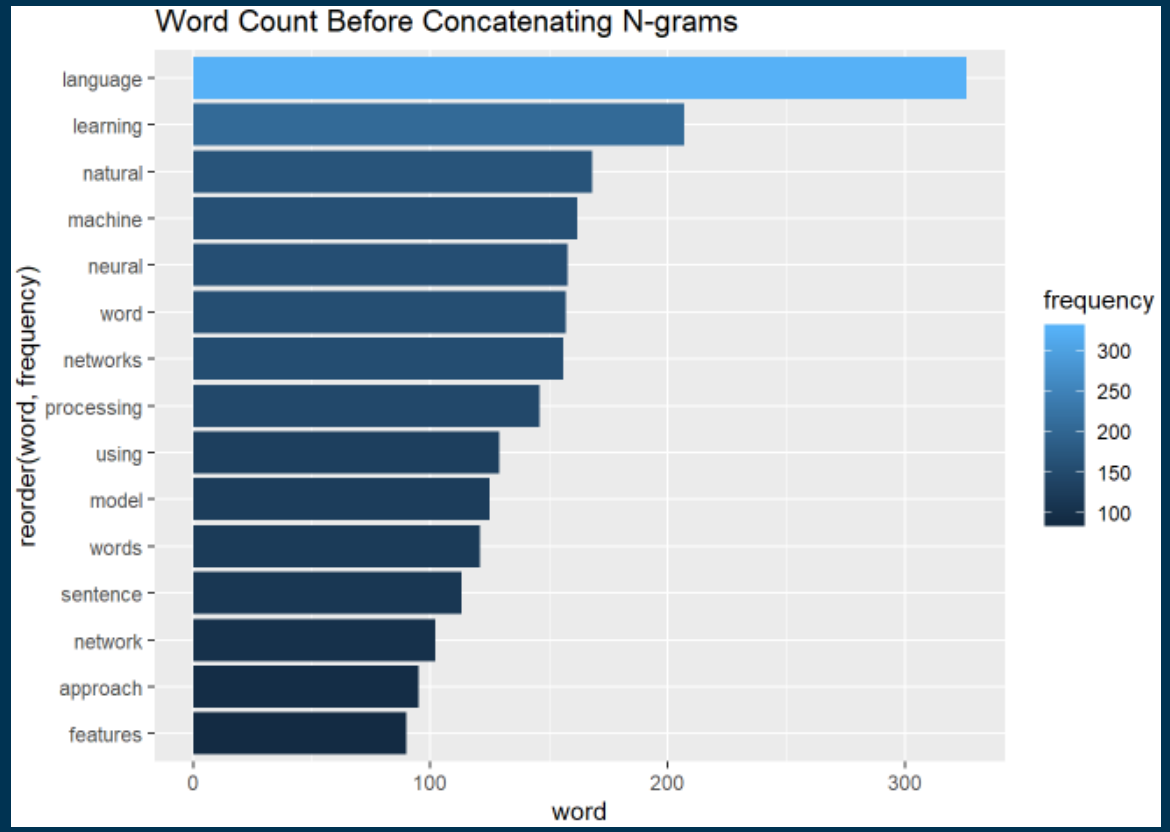
```
tdm.mod <- TermDocumentMatrix(text_corpus_mod,control = list(wordLengths = c(4,Inf)))
#inspect(tdm2)
tdm.mod.word <- data.frame(word = tdm.mod$dimnames$Terms, frequency = tdm.mod$v,stringsAsFactors = FALSE) %>%
  arrange(-frequency)

tdm.mod.word
```

| word <chr> | frequency <dbl> |
|---|---|
| word | 157 |
| using | 129 |
| words | 121 |
| neural_networks | 118 |
| sentence | 113 |
| natural_language_processing | 110 |
| network | 102 |
| approach | 95 |
| machine_learning | 94 |
| features | 90 |

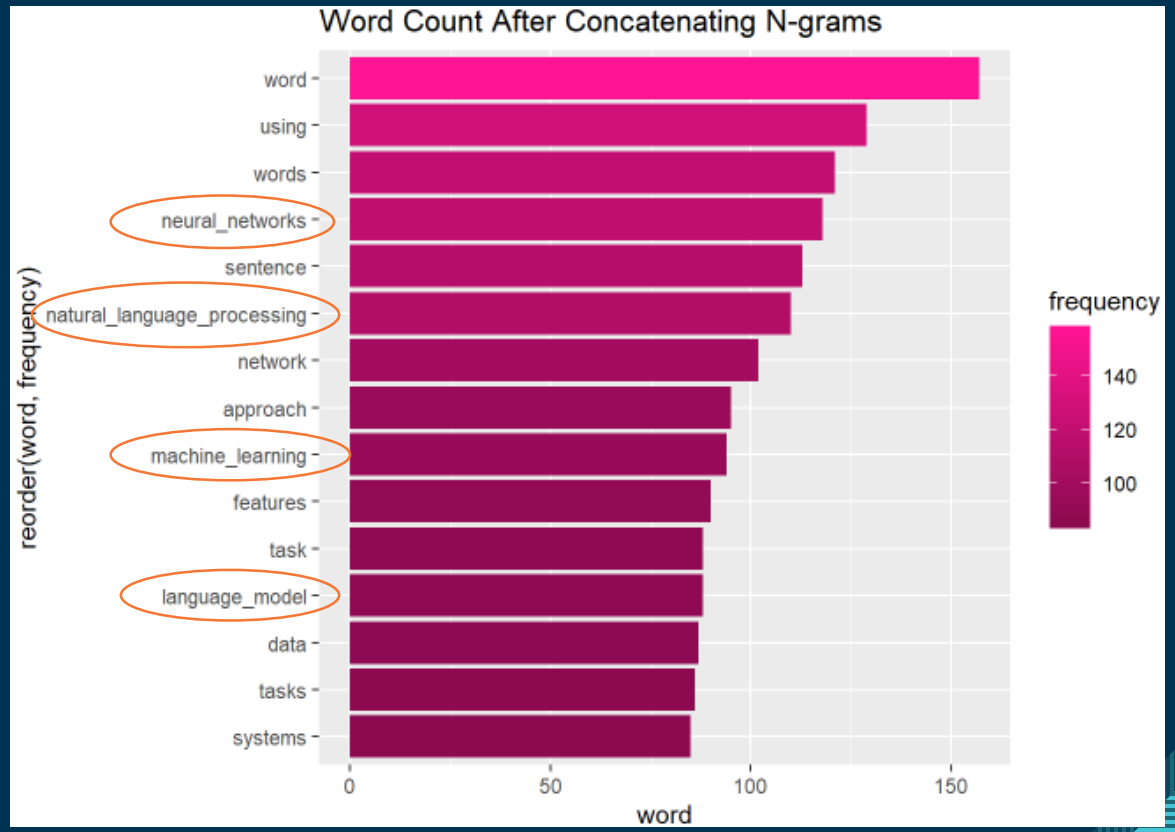
1-10 of 3,665 rows  Previous 1 2 3 4 5 6 … 367 Next

# Charts

## Before concatenating:




## After concatenating:



# Limitations

- As the outputs are scraped from paragraph, some words like “word”, “using”, “sentence” got into top 10 phrases.  But they in fact are the words appeared with most frequencies.

- Further study is needed to omit terms above.

- If these codes are being applied to the skills listed in Project 3, the problem of having separated words can be solved.

# Reference


- Introduction to the tm Package - Text Mining in R
  https://cran.r-project.org/web/packages/tm/vignettes/tm.pdf

- Package ‘tm’
  https://cran.r-project.org/web/packages/tm/tm.pdf

- RWeka Odds and Ends
  https://cran.r-project.org/web/packages/RWeka/vignettes/RWeka.pdf

- Package ‘RWeka’
  https://cran.r-project.org/web/packages/RWeka/RWeka.pdf

# Thank You

# Q & A