Frequency Analysis on N-gram phrases

```r
# Read and parse HTML file
library("XML")
```

```
## Warning: package 'XML' was built under R version 3.6.2
```

```r
library("RCurl")
```

```
## Warning: package 'RCurl' was built under R version 3.6.2
```

Importing data from website

```r
doc.url1<-getURL(
"https://www.blog.google/technology/safety-security/safety-center-helping-you-stay-safe-online/")
doc.html1 <- htmlParse(doc.url1)

# Extract all the paragraphs (HTML tag is p, starting at
# the root of the document). Unlist flattens the list to
# create a character vector.

plain.text1 <- xpathApply(doc.html1, "//div[@class='h-c-grid']/div[@class='uni-paragraph
          h-c-grid__col h-c-grid__col--8 h-c-grid__col-m--6 h-c-grid__col-l--6
          h-c-grid__col--offset-2 h-c-grid__col-m--offset-3 h-c-grid__col-l--offset-3']",
          xmlValue)
cat(paste(plain.text1, collapse = " "),file="Corpus/outfile1.txt")
actual.text1<-paste(readLines("Corpus/outfile1.txt"),collapse=" ")
```

```
## Warning in readLines("Corpus/outfile1.txt"): incomplete final line found on
## 'Corpus/outfile1.txt'
```

```r
doc.url2<-getURL(
  "https://www.blog.google/products/google-cloud/new-security-tools-to-help-improve/")
doc.html2 <- htmlParse(doc.url2)

# Extract all the paragraphs (HTML tag is p, starting at
# the root of the document). Unlist flattens the list to
# create a character vector.
plain.text2 <- xpathApply(doc.html2, "//div[@class='h-c-grid']/div[@class='uni-paragraph
          h-c-grid__col h-c-grid__col--8 h-c-grid__col-m--6 h-c-grid__col-l--6
          h-c-grid__col--offset-2 h-c-grid__col-m--offset-3 h-c-grid__col-l--offset-3']",
          xmlValue)
cat(paste(plain.text2, collapse = " "),file="Corpus/outfile2.txt")
actual.text2<-paste(readLines("Corpus/outfile2.txt"),collapse=" ")
```

```
## Warning in readLines("Corpus/outfile2.txt"): incomplete final line found on
## 'Corpus/outfile2.txt'
```

```r
doc.url3<-getURL("https://www.blog.google/products/google-cloud/bolstering-security-across-google-cloud
doc.html3 <- htmlParse(doc.url3)

# Extract all the paragraphs (HTML tag is p, starting at
# the root of the document). Unlist flattens the list to
# create a character vector.
```

```
plain.text3 <- xpathApply(doc.html3, "//div[@class='h-c-grid']/div[@class='uni-paragraph
          h-c-grid__col h-c-grid__col--8 h-c-grid__col-m--6 h-c-grid__col-l--6
          h-c-grid__col--offset-2 h-c-grid__col-m--offset-3 h-c-grid__col-l--offset-3']",
          xmlValue)
cat(paste(plain.text3, collapse = " "),file="Corpus/outfile3.txt")
actual.text3<-paste(readLines("Corpus/outfile3.txt"),collapse=" ")
```

```
## Warning in readLines("Corpus/outfile3.txt"): incomplete final line found on
## 'Corpus/outfile3.txt'
```

Cleaning text data in R

```
library(tm)
```

```
## Warning: package 'tm' was built under R version 3.6.2
```

```
## Loading required package: NLP
```

To find out the path of the destination folder

##{r} ##file.choose() ##

To retrieve only the txt files from the destinaton folder

```
folder<- "C:\\Users\\roopa\\Documents\\Corpus"
list.files(path=folder)
```

```
## [1] "outfile1.txt"              "outfile2.txt"
## [3] "outfile3.txt"              "R-Graphics4-data viz.pdf"
## [5] "Rgraphics-data viz.pdf"
```

```
filelist<-list.files(path=folder,pattern="*.txt")
```

Building the corpus

```
filelist<-paste(folder, "\\", filelist, sep="")
typeof(filelist)
```

```
## [1] "character"
```

```
a<-lapply(filelist, FUN=readLines)
```

```
## Warning in FUN(X[[i]], ...): incomplete final line found on 'C:
## \Users\roopa\Documents\Corpus\outfile1.txt'
```

```
## Warning in FUN(X[[i]], ...): incomplete final line found on 'C:
## \Users\roopa\Documents\Corpus\outfile2.txt'
```

```
## Warning in FUN(X[[i]], ...): incomplete final line found on 'C:
## \Users\roopa\Documents\Corpus\outfile3.txt'
```

```
corpus<-lapply(a, FUN=paste, collapse=" ")
```

Cleaning the corpus‘

```
# Removing spaces and punctuations
clean.corpus<- gsub(pattern="\\W", replace=" ", corpus)

# Removing digits
clean.corpus<- gsub("\\d", replace=" ", clean.corpus)

# converting all words to lowercase
clean.corpus<- tolower(clean.corpus)

# removing stopwords
clean.corpus<- removeWords(clean.corpus, stopwords("english"))

# removing single length words
# if we want to remove words starting with a
#particular alphabet, say 'd', then write gsub("\\bd\\b, replace=" ", clean.text)

# if we want to remove words starting with a particular alphabet,
#say 'd' of length 1, then write gsub("\\bd\\b{1},replace=" ",clean.text)

# Similarly for removing words starting with a set of alphabets
#(say: d,a and s), write \\b[c('d','a','s')]\\b inside gsub

#Here, we are removing only single letter words
clean.corpus<- gsub("\\b[A-z]\\b{1}",replace=" ", clean.corpus)

#Removing extra whitespaces
clean.corpus<- stripWhitespace(clean.corpus)
```

```
library(stringr)
```

```
## Warning: package 'stringr' was built under R version 3.6.2
```

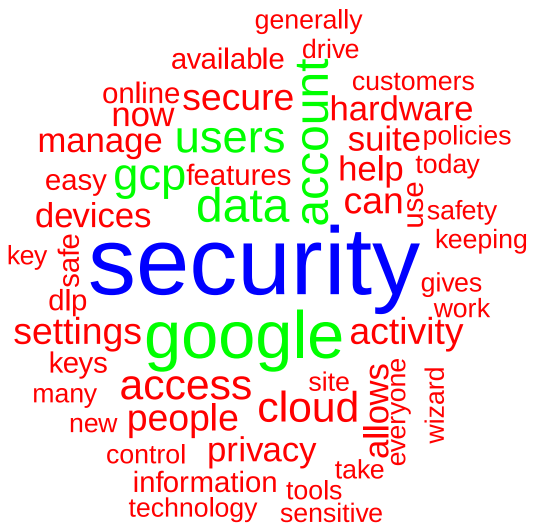
```
library(wordcloud)
```

```
## Warning: package 'wordcloud' was built under R version 3.6.2

## Loading required package: RColorBrewer
```

Creating wordcloud

```
wordcloud(clean.corpus,random.order=FALSE, scale=c(3,0.5),color=rainbow(3))
```

```
## Warning in tm_map.SimpleCorpus(corpus, tm::removePunctuation):
## transformation drops documents

## Warning in tm_map.SimpleCorpus(corpus, function(x) tm::removeWords(x,
## tm::stopwords())): transformation drops documents
```



```
real.corpus<-VCorpus(VectorSource(clean.corpus))
real.corpus
```

```
## <<VCorpus>>
## Metadata:  corpus specific: 0, document level (indexed): 0
## Content:  documents: 3
```

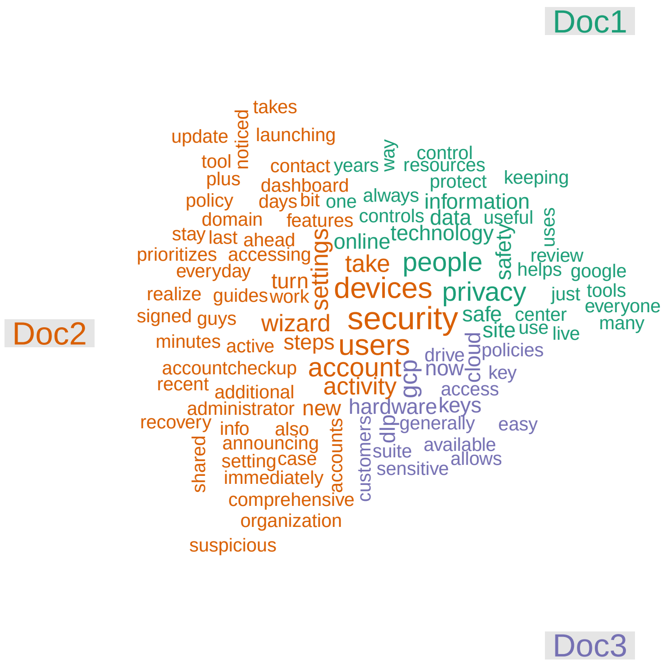
Creating Document Matrix

```
doc.matrix<-TermDocumentMatrix(real.corpus)
doc.matrix
```

```
## <<TermDocumentMatrix (terms: 352, documents: 3)>>
## Non-/sparse entries: 412/644
## Sparsity           : 61%
## Maximal term length: 17
## Weighting          : term frequency (tf)
```

```
matrixformat<-as.matrix(doc.matrix)
```

```
colnames(matrixformat)<-c("Doc1","Doc2","Doc3")
comparison.cloud(matrixformat,random.order=FALSE,scale=c(1,.5),
                 max.words = 100,title.size=1,match.colors=TRUE)
```



Sentiment analysis

```
#Identify working directory and copy paste the sentiments words to text files
#and place it in that directory
getwd()
```

```
## [1] "C:/Users/roopa/Documents"
```

```
pos.text<-scan('positive_sentiments.txt',what='character',comment.char=';')
neg.text<-scan('negative_sentiments.txt', what='character',comment.char=';')

#to convert to bag or list of words
clean.corpus.bag <- str_split(clean.corpus,pattern="\\s+")
clean.corpus.bag
```

```
## [[1]]
##   [1] ""               "making"         "technology"     "everyone"
##   [5] "means"          "protecting"     "everyone"       "uses"
##   [9] "years"          "google"         "building"       "useful"
##  [13] "products"       "help"           "make"           "people"
##  [17] "lives"          "easier"         "beginning"      "ve"
##  [21] "always"         "known"          "people"         "use"
##  [25] "services"       "re"             "trusting"       "us"
##  [29] "information"    "job"            "protect"        "today"
##  [33] "started"        "rolling"        "newly"          "expanded"
##  [37] "google"         "safety"         "center"         "ve"
##  [41] "updated"        "resources"      "pulled"         "even"
##  [45] "information"    "one"            "site"           "dedicated"
##  [49] "educating"      "empowering"     "people"         "important"
##  [53] "topics"         "like"           "data"           "security"
##  [57] "privacy"        "controls"       "online"         "protections"
##  [61] "users"          "site"           "will"           "available"
##  [65] "languages"      "coming"         "weeks"          "safety"
##  [69] "center"         "just"           "one"            "way"
##  [73] "inform"         "people"         "keep"           "personal"
##  [77] "information"    "private"        "safe"           "give"
##  [81] "control"        "links"          "many"           "easy"
##  [85] "use"            "privacy"        "controls"       "people"
##  [89] "can"            "choose"         "settings"       "right"
##  [93] "features"       "helpful"        "security"       "tips"
##  [97] "care"           "keeping"        "safe"           "whenever"
## [101] "re"             "online"         "just"           "google"
## [105] "help"           "families"       "better"         "manage"
## [109] "technology"     "provides"       "useful"         "resources"
## [113] "tools"          "teach"          "kids"           "digital"
## [117] "safety"         "citizenship"    "helping"        "people"
## [121] "manage"         "privacy"        "security"       "integral"
## [125] "everything"     "years"          "ve"             "created"
## [129] "many"           "tools"          "always"         "improving"
## [133] "upon"           "re"             "control"        "google"
## [137] "account"        "gives"          "access"         "settings"
## [141] "safeguard"      "data"           "privacy"        "privacy"
## [145] "checkup"        "helps"          "quickly"        "review"
## [149] "adjust"         "data"           "google"         "uses"
## [153] "personalize"    "experience"     "activity"       "helps"
## [157] "review"         "delete"         "activity"       "data"
## [161] "connected"      "account"        "technology"     "continues"
## [165] "change"         "way"            "live"           "work"
## [169] "play"           "commitment"     "keeping"        "safe"
## [173] "secure"         "online"         "grows"          "site"
## [177] "latest"         "example"        "live"           "responsibility"
## [181] "protect"        ""
##
## [[2]]
##   [1] ""               "manager"        "realize"        "spend"
##   [5] "lot"            "time"           "managing"       "devices"
##   [9] "applications"   "security"       "settings"       "everyone"
##  [13] "organization"   "make"           "job"            "bit"
##  [17] "easier"         "today"          "re"             "announcing"
##  [21] "new"            "security"       "tools"          "help"
##  [25] "suite"          "users"          "take"           "control"
##  [29] "security"       "online"         "new"            "devices"
##  [33] "activity"       "dashboard"      "gives"          "users"
##  [37] "additional"     "insight"        "devices"        "accessing"
##  [41] "google"         "account"        "page"           "shows"
##  [45] "comprehensive"  "view"           "devices"        "active"
##  [49] "account"        "last"           "days"           "currently"
##  [53] "signed"         "case"           "suspicious"     "activity"
##  [57] "noticed"        "setting"        "immediately"    "take"
##  [61] "steps"          "secure"         "account"        "change"
##  [65] "password"       "also"           "launching"      "security"
##  [69] "wizard"         "google"         "work"           "accounts"
##  [73] "security"       "wizard"         "guides"         "users"
##  [77] "steps"          "can"            "take"           "turn"
##  [81] "adjust"         "security"       "features"       "like"
##  [85] "providing"      "contact"        "info"           "account"
##  [89] "recovery"       "domain"         "security"       "policy"
##  [93] "allows"         "reviewing"      "recent"         "account"
##  [97] "activity"       "account"        "permissions"    "plus"
## [101] "takes"          "minutes"        "users"          "update"
## [105] "settings"       "tool"           "prioritizes"    "administrator"
## [109] "settings"       "security"       "features"       "end"
## [113] "users"          "permitted"      "turn"           "access"
## [117] "wizard"         "co"             "accountcheckup" "security"
## [121] "cloud"          "shared"         "responsibility" "keeping"
## [125] "company"        "information"    "secure"         "core"
## [129] "everyday"       "making"         "users"          "aware"
## [133] "security"       "settings"       "activity"       "devices"
## [137] "can"            "work"           "together"       "stay"
## [141] "step"           "ahead"          "bad"            "guys"
## [145] ""
##
## [[3]]
##   [1] ""                   "san"                "francisco"
##   [4] "today"              "google"             "cloud"
##   [7] "next"               "launched"           "following"
##  [10] "new"                "features"           "google"
##  [13] "cloud"              "platform"           "gcp"
##  [16] "suite"              "designed"           "help"
##  [19] "safeguard"          "company"            "assets"
##  [22] "prevent"            "disruption"         "business"
##  [25] "identity"           "aware"              "proxy"
##  [28] "iap"                "gcp"                "now"
##  [31] "beta"               "allows"             "manage"
##  [34] "granular"           "access"             "applications"
##  [37] "running"            "gcp"                "based"
##  [40] "risk"               "rather"             "nothing"
##  [43] "approach"           "vpn"                "access"
##  [46] "provides"           "secure"             "application"
##  [49] "access"             "anywhere"           "access"
##  [52] "determined"         "user"               "identity"
##  [55] "group"              "iap"                "easy"
##  [58] "deploy"             "can"                "integrated"
##  [61] "phishing"           "resistant"          "security"
##  [64] "keys"               "data"               "loss"
##  [67] "prevention"         "dlp"                "api"
##  [70] "gcp"                "now"                "beta"
##  [73] "lets"               "scan"               "sensitive"
##  [76] "data"               "types"              "can"
##  [79] "identify"           "redact"             "sensitive"
##  [82] "data"               "dlp"                "deep"
##  [85] "content"            "analysis"           "help"
##  [88] "ensure"             "matter"             "want"
##  [91] "keep"               "safe"               "credit"
##  [94] "cards"              "account"            "numbers"
##  [97] "know"               "protected"          "level"
## [100] "want"               "dlp"                "api"
## [103] "gcp"                "joins"              "dlp"
## [106] "gmail"              "drive"              "allowing"
## [109] "admins"             "write"              "policies"
## [112] "manage"             "sensitive"          "data"
## [115] "ways"               "aren"               "possible"
## [118] "cloud"              "key"                "management"
## [121] "service"            "gcp"                "now"
## [124] "generally"          "available"          "allows"
## [127] "generate"           "use"                "rotate"
## [130] "destroy"            "symmetric"          "encryption"
## [133] "keys"               "use"                "cloud"
## [136] "gives"              "customers"          "ability"
## [139] "manage"             "encryption"         "keys"
## [142] "multi"              "tenant"             "cloud"
## [145] "service"            "without"            "need"
## [148] "maintain"           "premise"            "key"
## [151] "management"         "system"             "hardware"
## [154] "security"           "module"             "security"
## [157] "key"                "enforcement"        "ske"
## [160] "gcp"                "suite"              "now"
## [163] "generally"          "available"          "allows"
## [166] "require"            "security"           "keys"
## [169] "used"               "two"                "step"
## [172] "verification"       "factor"             "stronger"
## [175] "authentication"     "whenever"           "user"
## [178] "signs"              "suite"              "accesses"
## [181] "gcp"                "resource"           "ske"
## [184] "easy"               "admins"             "easy"
## [187] "users"              "hard"               "phishers"
## [190] "google"             "vault"              "google"
## [193] "drive"              "team"               "drives"
## [196] "google"             "groups"             "now"
## [199] "generally"          "available"          "ediscovery"
## [202] "compliance"         "solution"           "suite"
## [205] "vault"              "allows"             "customers"
## [208] "set"                "retention"          "policies"
## [211] "place"              "legal"              "holds"
## [214] "perform"            "searches"           "across"
## [217] "drive"              "gmail"              "hangouts"
## [220] "groups"             "export"             "search"
## [223] "results"            "support"            "legal"
## [226] "compliance"         "requirementstitan" "google"
## [229] "purpose"            "built"              "chip"
## [232] "establish"          "hardware"           "root"
## [235] "trust"              "machines"           "peripherals"
## [238] "cloud"              "infrastructure"     "allowing"
## [241] "us"                 "securely"           "identify"
## [244] "authenticate"       "legitimate"         "access"
## [247] "hardware"           "level"              "purpose"
## [250] "built"              "hardware"           "titan"
## [253] "part"               "google"             "layered"
## [256] "security"           "architecture"      "spanning"
## [259] "physical"           "security"          "data"
## [262] "centers"            "secure"            "boot"
## [265] "across"             "hardware"          "software"
## [268] "operational"        "security"          "baking"
## [271] "security"           "everything"        "offering"
## [274] "innovative"         "capabilities"      "build"
## [277] "upon"               "secure"            "foundation"
## [280] "create"             "many"              "different"
## [283] "layers"             "prevent"           "defend"
## [286] "attacks"            "implement"         "enterprise"
## [289] "security"           "policies"          "customers"
## [292] "can"                "feel"              "confident"
## [295] "partnering"         "us"                "achieve"
## [298] "business"           "goals"             ""
```

```
#Finding matching positive word count
lapply(clean.corpus.bag, function(x){sum(!is.na(match(x,pos.text)))})
```

```
## [[1]]
## [1] 23
##
## [[2]]
## [1] 8
##
## [[3]]
## [1] 20
```

```
#Finding matching negative word count
lapply(clean.corpus.bag, function(x){sum(!is.na(match(x,neg.text)))})
```

```
## [[1]]
## [1] 0
##
## [[2]]
## [1] 3
##
## [[3]]
## [1] 12
```

```
#Finding total sentiment score
score<-unlist(lapply(clean.corpus.bag,
       function(x){sum(!is.na(match(x,pos.text)))- sum(!is.na(match(x,neg.text)))}))
score
```

```
## [1] 23  5  8
```

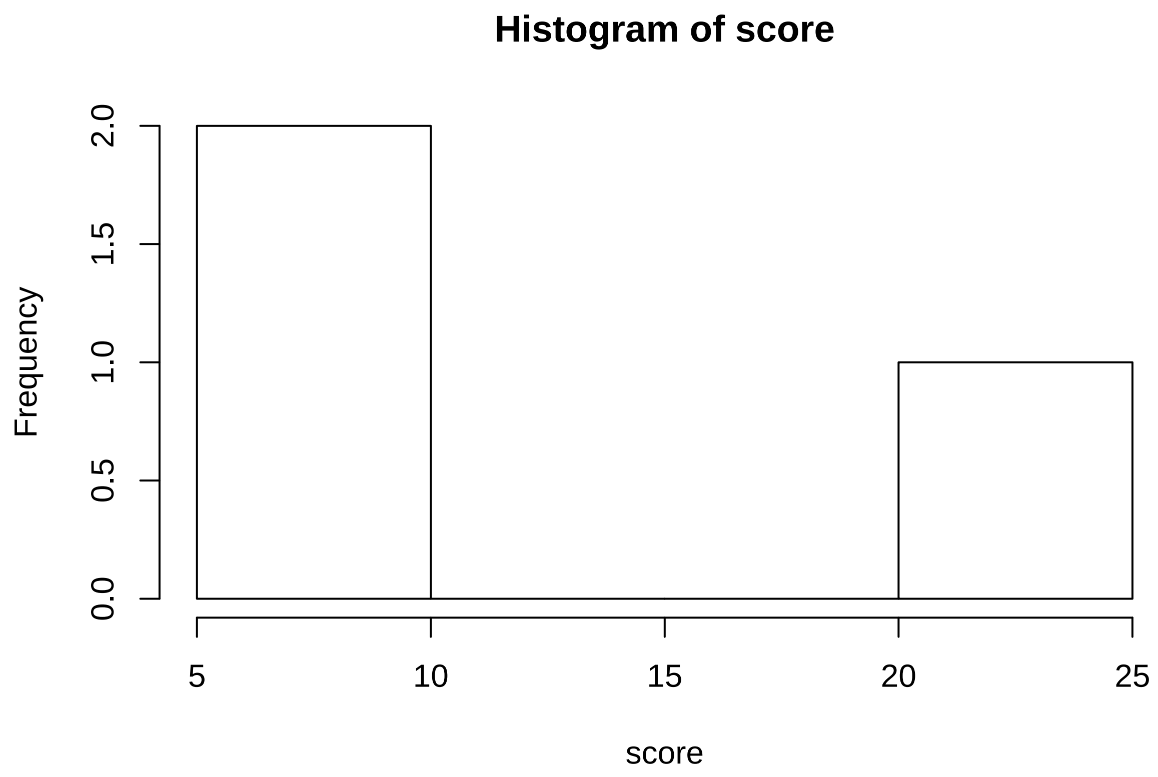
```
# mean of sentiment scores
mean(score)
```

```
## [1] 12
```

```
# standard deviation of sentiment score
sd(score)
```

```
## [1] 9.643651
```

```
# Histogram for sentiment scores
hist(score)
```



Unigram Tokenization

```
library(rJava)
```

```
##
## Attaching package: 'rJava'
## The following object is masked from 'package:RCurl':
##
##     clone
```

```
library(RWeka)
```

```
## Warning: package 'RWeka' was built under R version 3.6.2
```

```
library(ggplot2)
```

```
##
## Attaching package: 'ggplot2'
## The following object is masked from 'package:NLP':
##
##     annotate
```

```
rm(tdm)
```

```
## Warning in rm(tdm): object 'tdm' not found
```

```r
rm(tdm1)
```

```
## Warning in rm(tdm1): object 'tdm1' not found
```

```r
rm(tdm2)
```

```
## Warning in rm(tdm2): object 'tdm2' not found
```

```r
rm(word)
```

```
## Warning in rm(word): object 'word' not found
```

```r
rm(word1)
```

```
## Warning in rm(word1): object 'word1' not found
```

```r
rm(word2)
```

```
## Warning in rm(word2): object 'word2' not found
```

```r
rm(freq)
```

```
## Warning in rm(freq): object 'freq' not found
```

```r
rm(freq1)
```

```
## Warning in rm(freq1): object 'freq1' not found
```

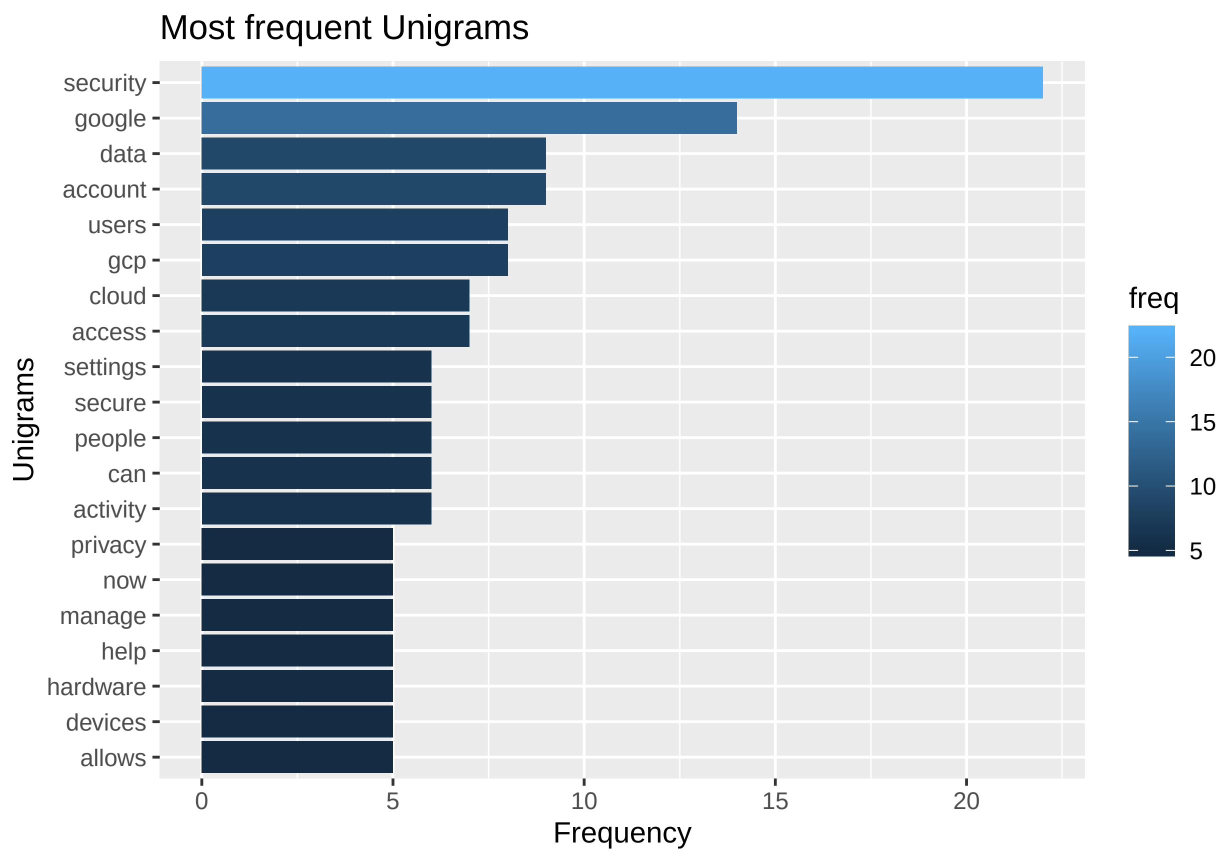
```r
rm(freq2)
```

```
## Warning in rm(freq2): object 'freq2' not found
```

```r
# Use Weka's n-gram tokenizer to create a TDM
# that uses as terms the unigrams that appear in the corpus.


Unigram_Tokenizer <- function(x){
  NGramTokenizer(x, Weka_control(min=1, max=1))
}

#create a matrix
tdm <- TermDocumentMatrix(real.corpus, control = list(tokenize = Unigram_Tokenizer))


# Extract the frequency of each unigram and analyse the twenty most frequent ones.

freq <-sort(rowSums(as.matrix(tdm)),decreasing = TRUE)
freq.df <- data.frame(word=names(freq), freq=freq)
head(freq.df, 20)
```

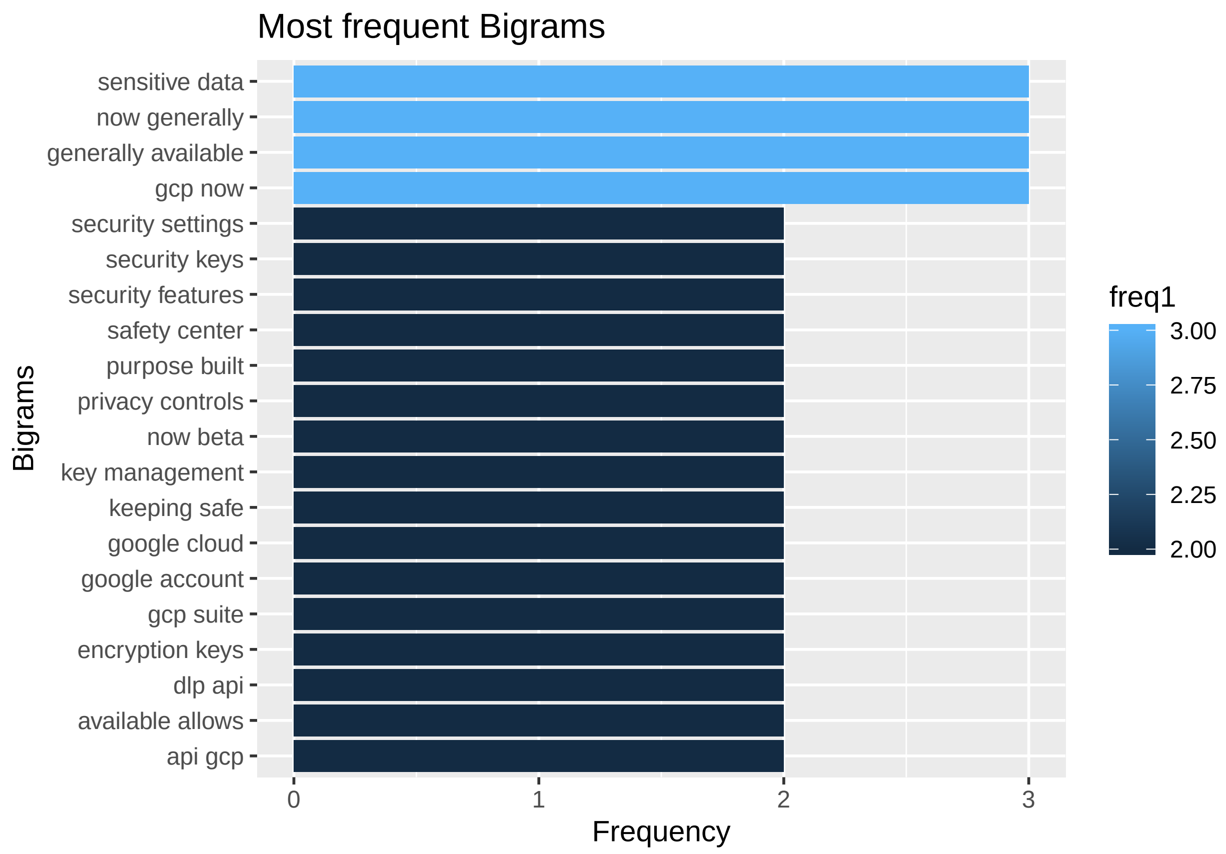
```
##              word freq
## security security   22
## google     google   14
## account   account    9
## data         data    9
## gcp           gcp    8
## users       users    8
## access     access    7
## cloud       cloud    7
## activity activity    6
## can            can     6
## people      people     6
## secure      secure     6
## settings settings     6
## allows      allows     5
## devices    devices     5
## hardware hardware     5
## help          help     5
## manage      manage     5
## now            now     5
## privacy    privacy     5
```

```
# Plotting the Unigram model

ggplot(head(freq.df,20), aes(reorder(word,freq), freq, fill=freq)) +
  geom_bar(stat="identity") + coord_flip() +
  xlab("Unigrams") + ylab("Frequency") +  scale_fill_continuous(type="gradient")+
  ggtitle("Most frequent Unigrams")
```



```
Bigram_Tokenizer <- function(y){
  NGramTokenizer(y, Weka_control(min=2, max=2))
}


#create a matrix
tdm1<- TermDocumentMatrix(real.corpus, control = list(tokenize = Bigram_Tokenizer))
```

```
# Extract the frequency of each bigram and analyse the twenty most frequent ones.

freq1 <-sort(rowSums(as.matrix(tdm1)),decreasing = TRUE)
freq1.df <- data.frame(word1=names(freq1), freq1=freq1)
freq1_head<-head(freq1.df, 20)



# Plotting the Bigram model

g_bigram<-ggplot(freq1_head, aes(reorder(word1,freq1), freq1, fill=freq1)) +
  geom_bar(stat="identity") + coord_flip() +
  xlab("Bigrams") + ylab("Frequency")+
  ggtitle("Most frequent Bigrams")
print(g_bigram)
```

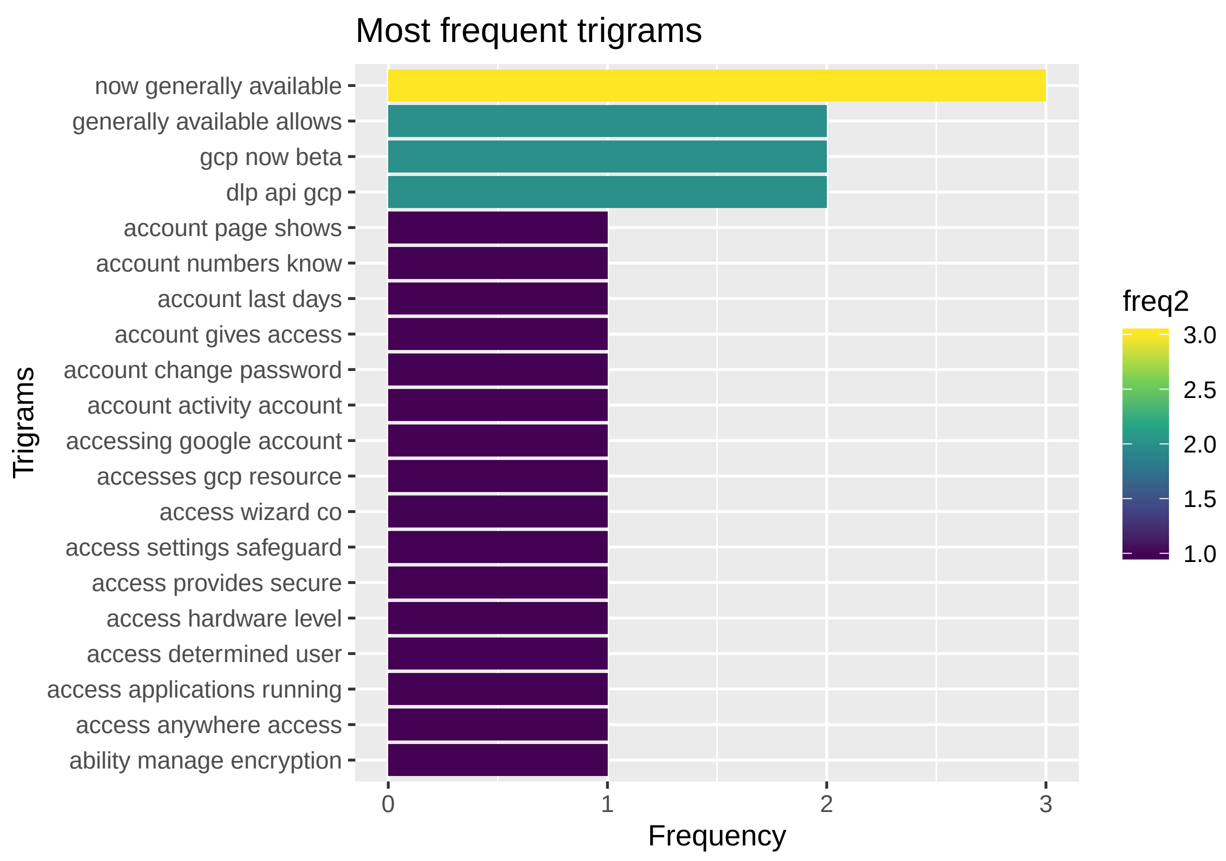


```
# Trigram Tokenizer

# Use Weka's n-gram tokenizer to create a TDM
# that uses as terms the trigrams that appear in the corpus.

Trigram_Tokenizer <- function(z){
  NGramTokenizer(z, Weka_control(min=3, max=3))
}
```

```r
#create a matrix
tdm2 <- TermDocumentMatrix(real.corpus, control = list(tokenize = Trigram_Tokenizer))


# Extract the frequency of each trigram and analyse the twenty most frequent ones.

freq2 <-sort(rowSums(as.matrix(tdm2)),decreasing = TRUE)
freq2.df <- data.frame(word2=names(freq2), freq2=freq2)
head(freq2.df, 20)
```

```
##                                                     word2 freq2
## now generally available         now generally available     3
## dlp api gcp                                 dlp api gcp     2
## gcp now beta                               gcp now beta     2
## generally available allows   generally available allows     2
## ability manage encryption     ability manage encryption     1
## access anywhere access           access anywhere access     1
## access applications running access applications running     1
## access determined user           access determined user     1
## access hardware level             access hardware level     1
## access provides secure           access provides secure     1
## access settings safeguard     access settings safeguard     1
## access wizard co                       access wizard co     1
## accesses gcp resource             accesses gcp resource     1
## accessing google account       accessing google account     1
## account activity account       account activity account     1
## account change password         account change password     1
## account gives access               account gives access     1
## account last days                     account last days     1
## account numbers know               account numbers know     1
## account page shows                   account page shows     1
```

```r
# Plotting the Trigram model

ggplot(head(freq2.df,20), aes(reorder(word2,freq2), freq2,fill=freq2)) +
  geom_bar(stat="identity") + coord_flip() +
  xlab("Trigrams") + ylab("Frequency") +   scale_fill_continuous(type="viridis")+
  scale_colour_hue(h = c(90, 180))+
  ggtitle("Most frequent trigrams")
```


Most frequent trigrams
Trigrams
now generally available
generally available allows
gcp now beta
dlp api gcp
account page shows
account numbers know
account last days
account gives access
account change password
account activity account
accessing google account
accesses gcp resource
access wizard co
access settings safeguard
access provides secure
access hardware level
access determined user
access applications running
access anywhere access
ability manage encryption
0
1
2
3
Frequency
freq2
3.0
2.5
2.0
1.5
1.0