

Text Mining with R – an Analysis of Twitter Data

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Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

Clustering

Topic Modelling

Online Resources

Text Mining

- ▶ unstructured text data
- ▶ text categorization
- ▶ text clustering
- ▶ entity extraction
- ▶ sentiment analysis
- ▶ document summarization
- ▶ ...

Text mining of Twitter data with R ¹

1. extract data from Twitter
2. clean extracted data and build a document-term matrix
3. find frequent words and associations
4. create a word cloud to visualize important words
5. text clustering
6. topic modelling

¹Chapter 10: Text Mining, *R and Data Mining: Examples and Case Studies*.

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Retrieve Tweets

Retrieve recent tweets by @RDataMining

```
## Option 1: retrieve tweets from Twitter  
library(twitteR)  
tweets <- userTimeline("RDataMining", n = 3200)
```

```
## Option 2: download @RDataMining tweets from RDataMining.com  
url <- "http://www.rdatamining.com/data/rdmTweets.RData"  
download.file(url, destfile = "./data/rdmTweets.RData")
```

```
## load tweets into R  
load(file = "./data/rdmTweets-201306.RData")
```

```
(n.tweet <- length(tweets))

## [1] 320

tweets[1:5]

## [[1]]
## [1] "RDataMining: Examples on calling Java code from R \nht...
##
## [[2]]
## [1] "RDataMining: Simulating Map-Reduce in R for Big Data A...
##
## [[3]]
## [1] "RDataMining: Job opportunity: Senior Analyst - Big Dat...
##
## [[4]]
## [1] "RDataMining: CLAVIN: an open source software package f...
##
## [[5]]
## [1] "RDataMining: An online book on Natural Language Proces...
```

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```
# convert tweets to a data frame
# tweets.df <- do.call("rbind", lapply(tweets, as.data.frame))
tweets.df <- twListToDF(tweets)
dim(tweets.df)

## [1] 320 14

library(tm)
# build a corpus, and specify the source to be character vectors
myCorpus <- Corpus(VectorSource(tweets.df$text))
# convert to lower case
myCorpus <- tm_map(myCorpus, tolower)
```

Package tm v0.5-10 was used in this example. With tm v0.6, “content_transformer” needs to be used to wrap around normal functions.

```
# tm v0.6
myCorpus <- tm_map(myCorpus, content_transformer(tolower))
```

```
# remove punctuation
myCorpus <- tm_map(myCorpus, removePunctuation)
# remove numbers
myCorpus <- tm_map(myCorpus, removeNumbers)
# remove URLs
removeURL <- function(x) gsub("http[[:alnum:]]*", "", x)
myCorpus <- tm_map(myCorpus, removeURL)
# add two extra stop words: 'available' and 'via'
myStopwords <- c(stopwords("english"), "available", "via")
# remove 'r' and 'big' from stopwords
myStopwords <- setdiff(myStopwords, c("r", "big"))
# remove stopwords from corpus
myCorpus <- tm_map(myCorpus, removeWords, myStopwords)
```

```
# keep a copy of corpus to use later as a dictionary for stem completion
myCorpusCopy <- myCorpus
# stem words
myCorpus <- tm_map(myCorpus, stemDocument)
```

```
# inspect the first 5 documents (tweets) inspect(myCorpus[1:5])
# The code below is used for to make text fit for paper width
for (i in 1:5) {
  cat(paste("[", i, "] ", sep = ""))
  writeLines(myCorpus[[i]])
}
```

```
## [[1]] exampl call java code r
##
## [[2]] simul mapreduc r big data analysi use flight data ...
## [[3]] job opportun senior analyst big data wesfarm indust...
## [[4]] clavin open sourc softwar packag document geotag g...
## [[5]] onlin book natur languag process python
```

```
# stem completion  
myCorpus <- tm_map(myCorpus, stemCompletion,  
                    dictionary = myCorpusCopy)
```

```
## [[1]] examples call java code r  
## [[2]] simulating mapreduce r big data analysis used flights...  
## [[3]] job opportunity senior analyst big data wesfarmers in...  
## [[4]] clavin open source software package document geotaggi...  
## [[5]] online book natural language processing python
```

```
# count frequency of "mining"
miningCases <- tm_map(myCorpusCopy, grep, pattern = "\\<mining")
sum(unlist(miningCases))

## [1] 82

# count frequency of "miners"
minerCases <- tm_map(myCorpusCopy, grep, pattern = "\\<miners")
sum(unlist(minerCases))

## [1] 4

# replace "miners" with "mining"
myCorpus <- tm_map(myCorpus, gsub, pattern = "miners",
                    replacement = "mining")
```

```
tdm <- TermDocumentMatrix(myCorpus,  
                           control = list(wordLengths = c(1, Inf)))  
tdm  
  
## A term-document matrix (790 terms, 320 documents)  
##  
## Non-/sparse entries: 2449/250351  
## Sparsity           : 99%  
## Maximal term length: 27  
## Weighting          : term frequency (tf)
```

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```

idx <- which(dimnames(tdm)$Terms == "r")
inspect(tdm[idx + (0:5), 101:110])

## A term-document matrix (6 terms, 10 documents)
##
## Non-/sparse entries: 4/56
## Sparsity           : 93%
## Maximal term length: 12
## Weighting           : term frequency (tf)
##
##
##           Docs
## Terms      101 102 103 104 105 106 107 108 109 110
##   r         0   1   1   0   0   0   0   0   1   1
## ramachandran 0   0   0   0   0   0   0   0   0   0
## random       0   0   0   0   0   0   0   0   0   0
## ranked      0   0   0   0   0   0   0   0   0   0
## rann         0   0   0   0   0   0   0   0   0   0
## rapidminer   0   0   0   0   0   0   0   0   0   0

```



```
# inspect frequent words
```

```
(freq.terms <- findFreqTerms(tdm, lowfreq = 15))
```

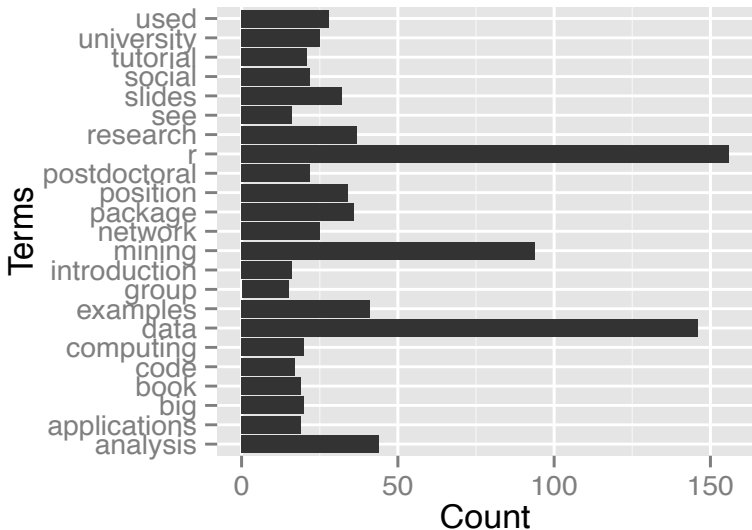
```
## [1] "analysis"      "applications"  "big"          "book"
## [5] "code"          "computing"    "data"         "examples"
## [9] "group"         "introduction" "mining"       "network"
## [13] "package"       "position"     "postdoctoral" "r"
## [17] "research"      "see"          "slides"       "social"
## [21] "tutorial"      "university"   "used"
```

```
term.freq <- rowSums(as.matrix(tdm))
```

```
term.freq <- subset(term.freq, term.freq >= 15)
```

```
df <- data.frame(term = names(term.freq), freq = term.freq)
```

```
library(ggplot2)
ggplot(df, aes(x = term, y = freq)) + geom_bar(stat = "identity") +
  xlab("Terms") + ylab("Count") + coord_flip()
```



which words are associated with 'r'?

```
findAssocs(tdm, "r", 0.2)
```

```
##           r
```

```
## examples 0.32
```

```
## code      0.29
```

```
## package   0.20
```

which words are associated with 'mining'?

```
findAssocs(tdm, "mining", 0.25)
```

```
##           mining
```

```
## data          0.47
```

```
## mahout         0.30
```

```
## recommendation 0.30
```

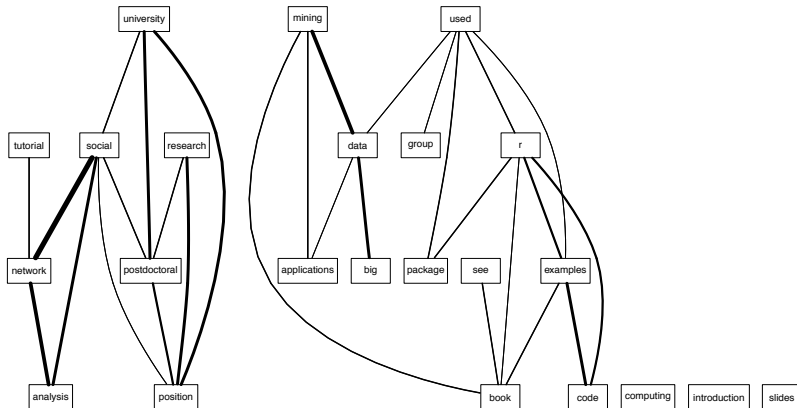
```
## sets           0.30
```

```
## supports       0.30
```

```
## frequent       0.26
```

```
## itemset        0.26
```

```
library(graph)
library(Rgraphviz)
plot(tdm, term = freq.terms, corThreshold = 0.12, weighting = T)
```



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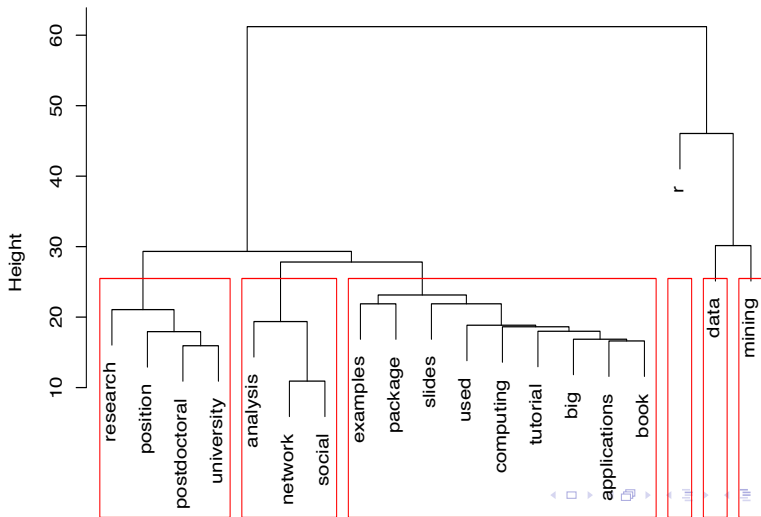
Online Resources

```
# remove sparse terms
tdm2 <- removeSparseTerms(tdm, sparse = 0.95)
m2 <- as.matrix(tdm2)
# cluster terms
distMatrix <- dist(scale(m2))
fit <- hclust(distMatrix, method = "ward")
```



```
plot(fit)
rect.hclust(fit, k = 6) # cut tree into 6 clusters
```

Cluster Dendrogram



```

m3 <- t(m2) # transpose the matrix to cluster documents (tweets)
set.seed(122) # set a fixed random seed
k <- 6 # number of clusters
kmeansResult <- kmeans(m3, k)
round(kmeansResult$centers, digits = 3) # cluster centers

```

```

##      analysis applications      big  book computing  data examples
## 1      0.147              0.088 0.147 0.015          0.059 1.015      0.088
## 2      0.028              0.167 0.167 0.250          0.028 1.556      0.194
## 3      0.810              0.000 0.000 0.000          0.000 0.048      0.095
## 4      0.080              0.036 0.007 0.058          0.087 0.000      0.181
## 5      0.000              0.000 0.000 0.067          0.067 0.333      0.067
## 6      0.119              0.048 0.071 0.000          0.048 0.357      0.000
##      mining network package position postdoctoral      r research
## 1  0.338    0.015    0.015    0.059          0.074 0.235      0.074
## 2  1.056    0.000    0.222    0.000          0.000 1.000      0.028
## 3  0.048    1.000    0.095    0.143          0.095 0.286      0.048
## 4  0.065    0.022    0.174    0.000          0.007 0.703      0.000
## 5  1.200    0.000    0.000    0.000          0.067 0.067      0.000
## 6  0.119    0.000    0.024    0.643          0.310 0.000      0.714
##      slides social tutorial university  used
## 1  0.074    0.000    0.015          0.015 0.029
## 2  0.056    0.000    0.000          0.000 0.250
## 3  0.095    0.762    0.190          0.000 0.095

```

```

for (i in 1:k) {
  cat(paste("cluster ", i, ": ", sep = ""))
  s <- sort(kmeansResult$centers[i, ], decreasing = T)
  cat(names(s)[1:5], "\n")
  # print the tweets of every cluster
  # print(tweets[which(kmeansResult$cluster==i)])
}

## cluster 1:  data mining r analysis big
## cluster 2:  data mining r book used
## cluster 3:  network analysis social r tutorial
## cluster 4:  r examples package slides used
## cluster 5:  mining tutorial slides data book
## cluster 6:  research position university data postdoctoral

```

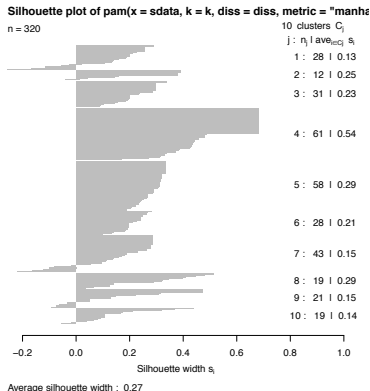
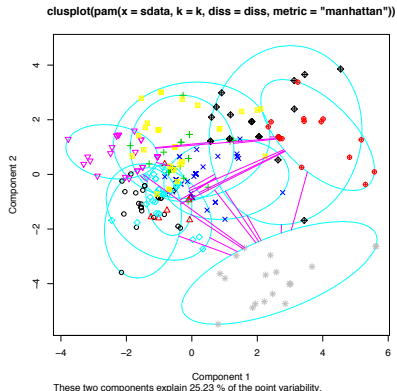
```

library(fpc)
# partitioning around medoids with estimation of number of clusters
pamResult <- pamk(m3, metric="manhattan")
k <- pamResult$nc # number of clusters identified
pamResult <- pamResult$pamobject
# print cluster medoids
for (i in 1:k) {
  cat("cluster", i, ": ",
      colnames(pamResult$medoids)[which(pamResult$medoids[i,]==1)], "\n"
  )
}

## cluster 1 :   examples r
## cluster 2 :   analysis data r
## cluster 3 :   data
## cluster 4 :
## cluster 5 :   r
## cluster 6 :   data mining r
## cluster 7 :   data mining
## cluster 8 :   analysis network social
## cluster 9 :   data position research
## cluster 10 :   position postdoctoral university

```

```
# plot clustering result
layout(matrix(c(1, 2), 1, 2)) # set to two graphs per page
plot(pamResult, col.p = pamResult$clustering)
```



```
layout(matrix(1)) # change back to one graph per page
```

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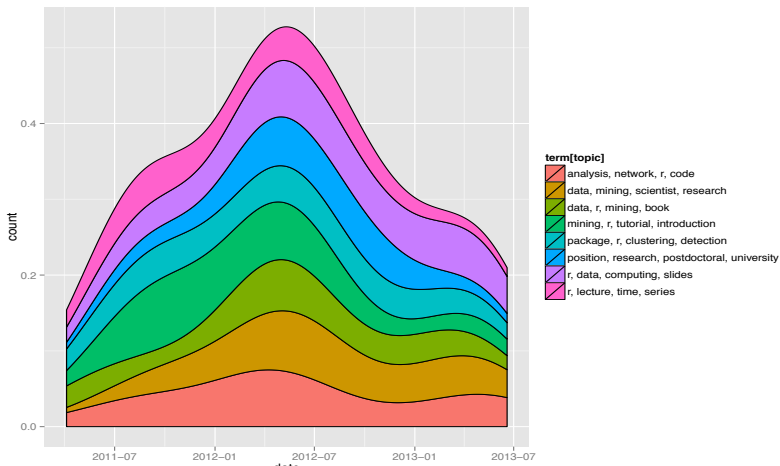
```
dtm <- as.DocumentTermMatrix(tdm)
library(topicmodels)
lda <- LDA(dtm, k = 8) # find 8 topics
term <- terms(lda, 4) # first 4 terms of every topic
term
```

```
##      Topic 1      Topic 2      Topic 3      Topic 4
## [1,] "data"      "data"      "mining"      "r"
## [2,] "mining"    "r"      "r"          "lecture"
## [3,] "scientist" "mining"  "tutorial"    "time"
## [4,] "research"  "book"    "introduction" "series"
##      Topic 5      Topic 6      Topic 7      Topic 8
## [1,] "position"   "package"  "r"          "analysis"
## [2,] "research"   "r"        "data"       "network"
## [3,] "postdoctoral" "clustering" "computing"  "r"
## [4,] "university" "detection" "slides"     "code"

term <- apply(term, MARGIN = 2, paste, collapse = ", ")
```

Topic Modelling

```
# first topic identified for every document (tweet)
topic <- topics(lda, 1)
topics <- data.frame(date=as.IDate(tweets.df$created), topic)
qplot(date, ..count.., data=topics, geom="density",
       fill=term[topic], position="stack")
```



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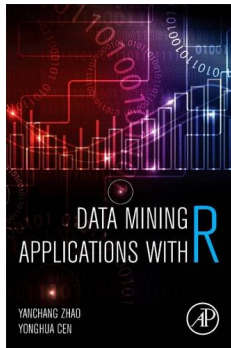
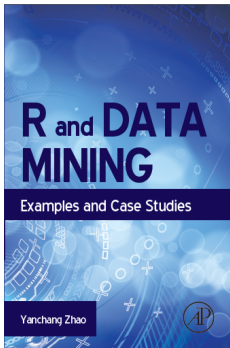
Topic Modelling

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Online Resources

- ▶ Chapter 10: Text Mining, in book
R and Data Mining: Examples and Case Studies
<http://www.rdatamining.com/docs/RDataMining.pdf>
- ▶ R Reference Card for Data Mining
<http://www.rdatamining.com/docs/R-refcard-data-mining.pdf>
- ▶ Free online courses and documents
<http://www.rdatamining.com/resources/>
- ▶ RDataMining Group on LinkedIn (7,000+ members)
<http://group.rdatamining.com>
- ▶ RDataMining on Twitter (1,700+ followers)
@RDataMining

The End



Thanks!

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