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

[1] Chapter 10: Text Mining, *R and Data Mining: Examples and Case Studies*. `http://www.rdatamining.com/docs/RDataMining.pdf`

Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

Clustering

Topic Modelling

Online Resources

Retrieve Tweets

Retrieve recent tweets by @RDataMining

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

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

```r
## 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...
```

Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

Clustering

Topic Modelling

Online Resources

```r
# 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.

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

```r
# 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 completio
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
```

```r
# 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)
```

Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

Clustering

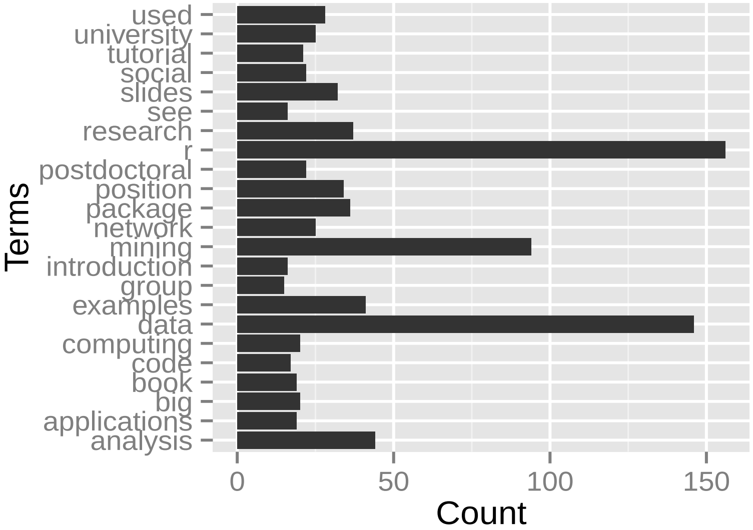
Topic Modelling

Online Resources

```
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
```

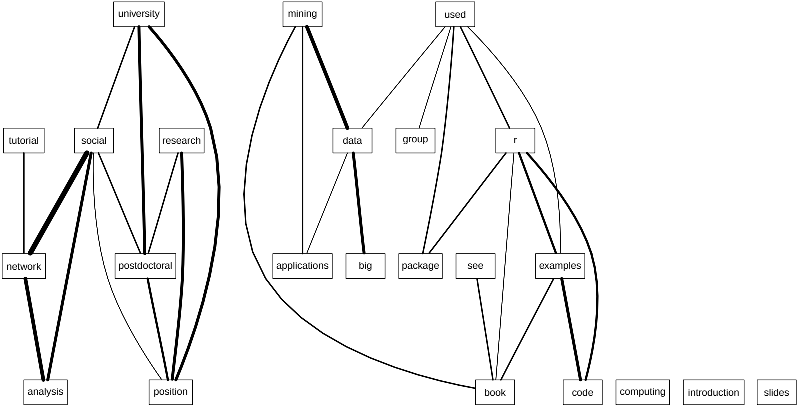
```
# inspect frequent words
(freq.terms <- findFreqTerms(tdm, lowfreq = 15))

##  [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
```

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



Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

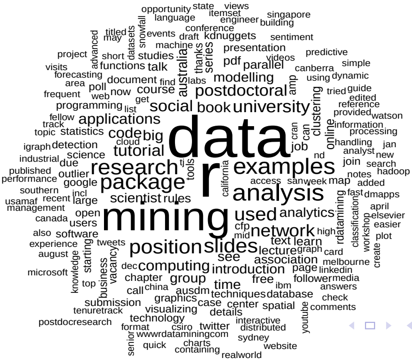
Word Cloud

Clustering

Topic Modelling

Online Resources

```r
library(wordcloud)
m <- as.matrix(tdm)
# calculate the frequency of words and sort it by frequency
word.freq <- sort(rowSums(m), decreasing = T)
wordcloud(words = names(word.freq), freq = word.freq, min.freq = 3,
    random.order = F)
```



Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

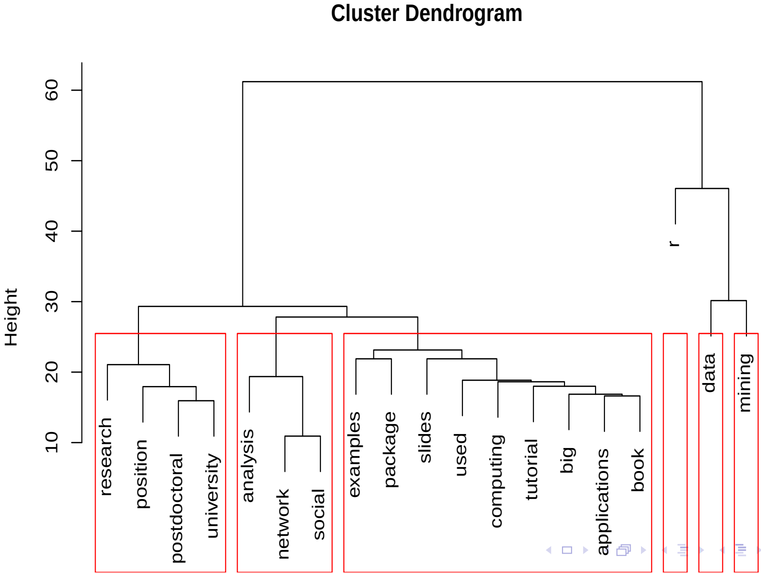
Clustering

Topic Modelling

Online Resources

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

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



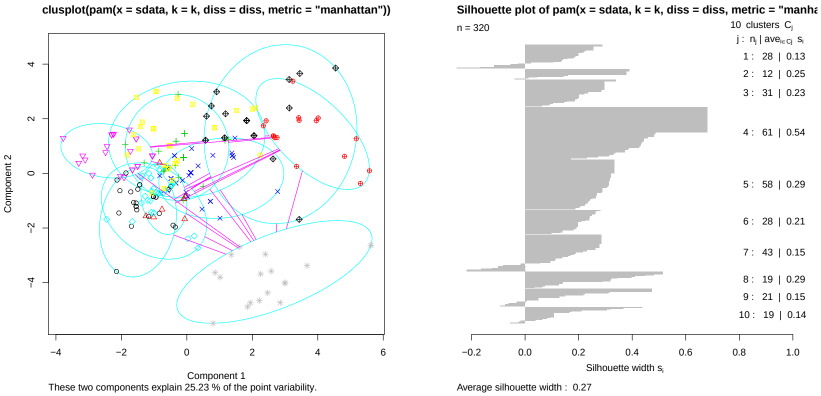
```
m3 <- t(m2)  # transpose the matrix to cluster documents (tweets)
set.seed(122)  # set a fixed random seed
k <- 6  # number of clusters
kmeansResult <- kmeans(m3, k)
round(kmeansResult$centers, digits = 3)  # cluster centers
```

```
##   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
```

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



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

Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

Clustering

Topic Modelling

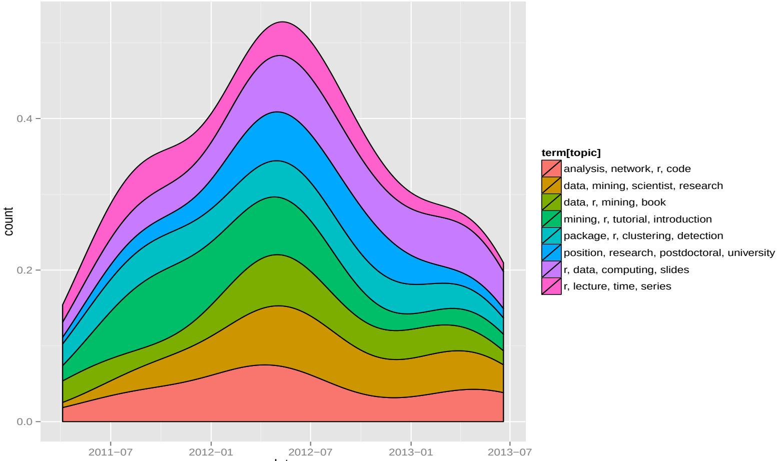
Online Resources

Topic Modelling

```
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")
```



Outline

Introduction

Extracting Tweets

Text Cleaning

Frequent Words and Associations

Word Cloud

Clustering

Topic Modelling

Online Resources

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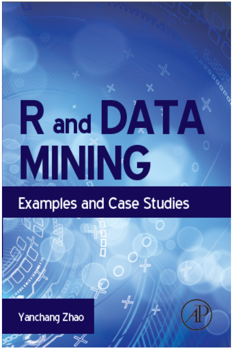
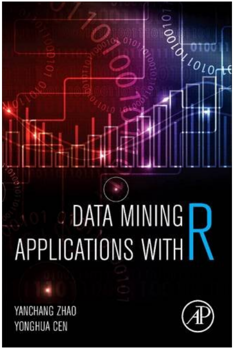
- Chapter 10: Text Mining, in book
  R and Data Mining: Examples and Case Studies
  `http://www.rdatamining.com/docs/RDataMining.pdf`
- R Reference Card for Data Mining
  `http://www.rdatamining.com/docs/R-refcard-data-mining.pdf`
- Free online courses and documents
  `http://www.rdatamining.com/resources/`
- 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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