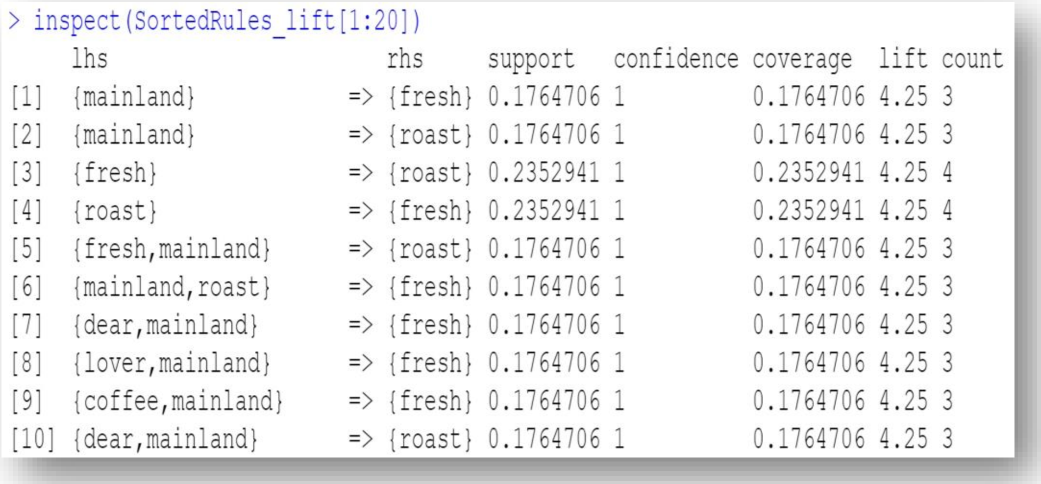


```
> inspect(SortedRules_lift[1:20])
     lhs                     rhs     support   confidence coverage  lift count
[1]  {mainland}           => {fresh} 0.1764706 1          0.1764706 4.25 3
[2]  {mainland}           => {roast} 0.1764706 1          0.1764706 4.25 3
[3]  {fresh}              => {roast} 0.2352941 1          0.2352941 4.25 4
[4]  {roast}              => {fresh} 0.2352941 1          0.2352941 4.25 4
[5]  {fresh,mainland}     => {roast} 0.1764706 1          0.1764706 4.25 3
[6]  {mainland,roast}     => {fresh} 0.1764706 1          0.1764706 4.25 3
[7]  {dear,mainland}      => {fresh} 0.1764706 1          0.1764706 4.25 3
[8]  {lover,mainland}     => {fresh} 0.1764706 1          0.1764706 4.25 3
[9]  {coffee,mainland}    => {fresh} 0.1764706 1          0.1764706 4.25 3
[10] {dear,mainland}      => {roast} 0.1764706 1          0.1764706 4.25 3
```

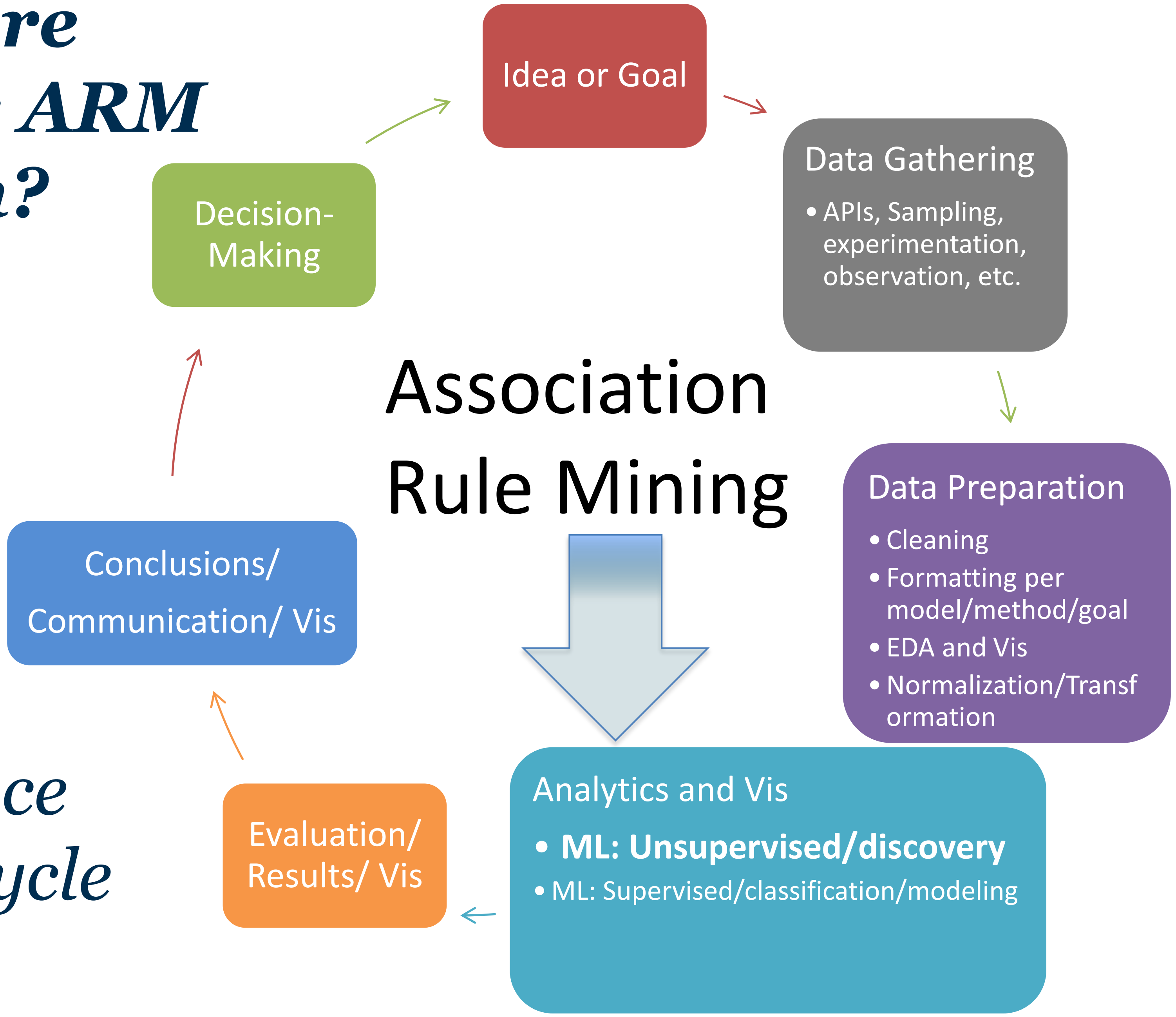
Introduction to ***Association Rule Mining (ARM)***

-and –

Thinking Outside the Basket with Twitter

Dr. Ami Gates, Director
Data Science and Analytics
Georgetown

Where does ARM fit in?



Idea or Goal

Data Gathering

- APIs, Sampling, experimentation, observation, etc.

Data Preparation

- Cleaning
- Formatting per model/method/goal
- EDA and Vis
- Normalization/Transformation

Association Rule Mining

Analytics and Vis

- **ML: Unsupervised/discovery**
- ML: Supervised/classification/modeling

Evaluation/ Results/ Vis

Conclusions/ Communication/ Vis

Decision-Making

Data Science Lifecycle

What is Association Rule Mining (ARM)

Unsupervised Learning – no labels – discovery

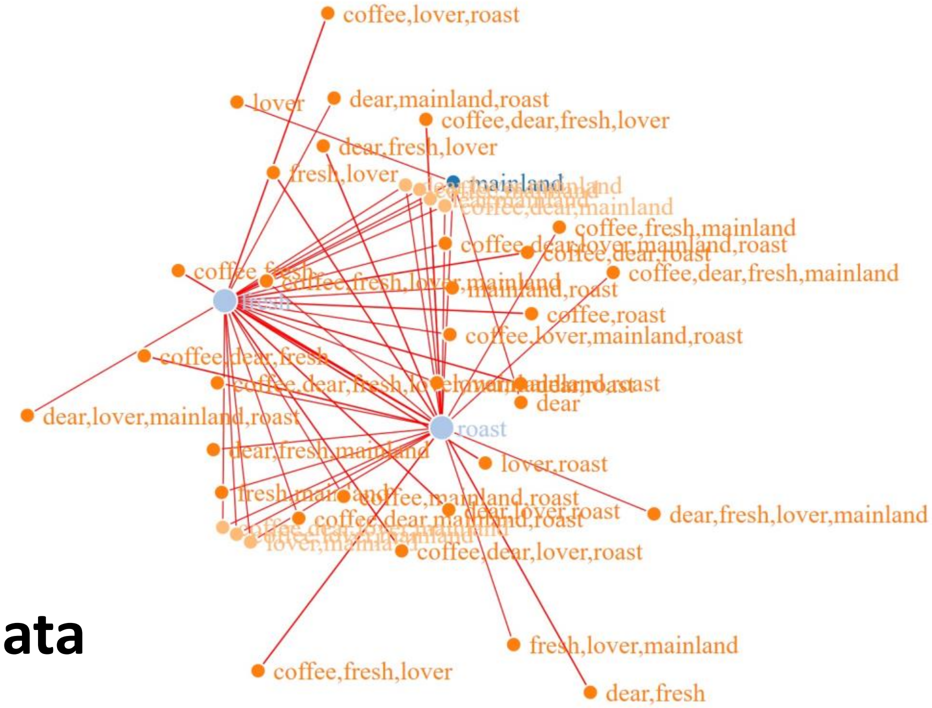
Evaluates "**transactions**" for correlations/associations.

Most common example:

Market Basket (Kumar, 2008)

Many applications, including….

- Image identification
- Text Analytics: like **Twitter data**
- Click streams
- Bio data – binding sites, AA's in proteins



Thinking About ARM (with Tweets and Coffee)

#coffee

Tweet 1:

The **coffee festival** was **delicious**. **Loved** it. Coffee **good**.

Tweet 2:

Coffee is **good** with **soymilk**. **Go** to the **Festival**.

Tweet 3:

The **coffee festival** had **soymilk, almond**, and **coconut creamers. Delicious! Go!**

Convert to Transaction Data

coffee	festival	delicious	Love	good			
coffee	good	soymilk	go	festival			
coffee	festival	soymilk	almond	coconut	creamer	delicious	go

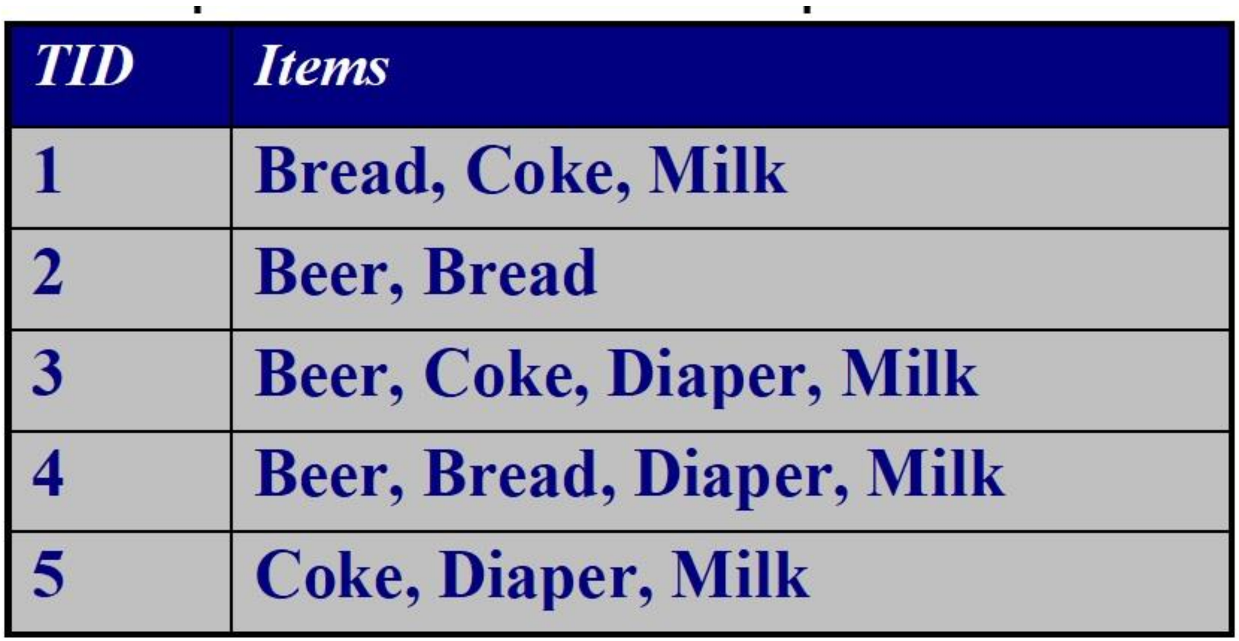
Where else can we find associations?

1) Reviews – patient, purchase, people, movie, book, etc.
2) Documents – speeches, novels
3) Articles – journal papers, news
4) Social Posts – Twitter, FB, etc.
5) Click Streams

Applications and Visual Options

1) Networks – how are things related?
2) Sentiment
3) Topic Modeling
4) Purchase preferences
5) Product placement/suggestion

Example 1
The Rules



TID	*Items*
1	Bread, Coke, Milk
2	Beer, Bread
3	Beer, Coke, Diaper, Milk
4	Beer, Bread, Diaper, Milk
5	Coke, Diaper, Milk

Introduction to Data Mining, 2nd Edition

{Diapers} → {Beer}
{Milk, Bread} → {Coke}
{Milk, Bread} → {Coke, Diaper}
{Diapers} → {Beer, Bread}

** Association (like correlation) is a measure of **co-occurrence** NOT causality.

The Measures:
Support, Confidence, Lift

Let A and B be sets and assume rule A → B

(Remember, A and B are sets of zero or more items/words)

1) Support:

Sup(A, B) = P(A, B)

[How often items in A and items in B occur together relative to all transactions.]

(Count of A and B together) / (Total # Trans)

2) Confidence:

Conf(A, B) = P(B|A) = P(A,B)/ P(A)

[How often items in A and items in B occur together – relative to transactions that contain A]

(Count of A and B together) / (Count of A)

Lift

For Rules A → B

Lift (A, B) = **P(A, B) / P(A)P(B)** = P(A | B) / P(A)

1) What is true if Lift(A,B) = 1?
2) What is true if Lift (A,B) < 1?
3) What is true if Lift (A,B) > 1?

Lift

For Rules A → B

Lift (A, B) = P(A, B) / P(A)P(B)

1) What is true if Lift(A,B) = 1? **A and B are independent!**
2) What is true if Lift (A,B) < 1?
3) What is true if Lift (A,B) > 1?

Lift

For Rules A → B

Lift (A, B) = P(A, B) / P(A)P(B)

= P(A | B) P(B) / P(A) P(B)

= P(A | B) / P(A)

1) What is true if Lift(A,B) = 1? A and B are independent
2) What is true if Lift (A,B) < 1? **A and B are negatively correlated**
3) What is true if Lift (A,B) > 1?

Lift

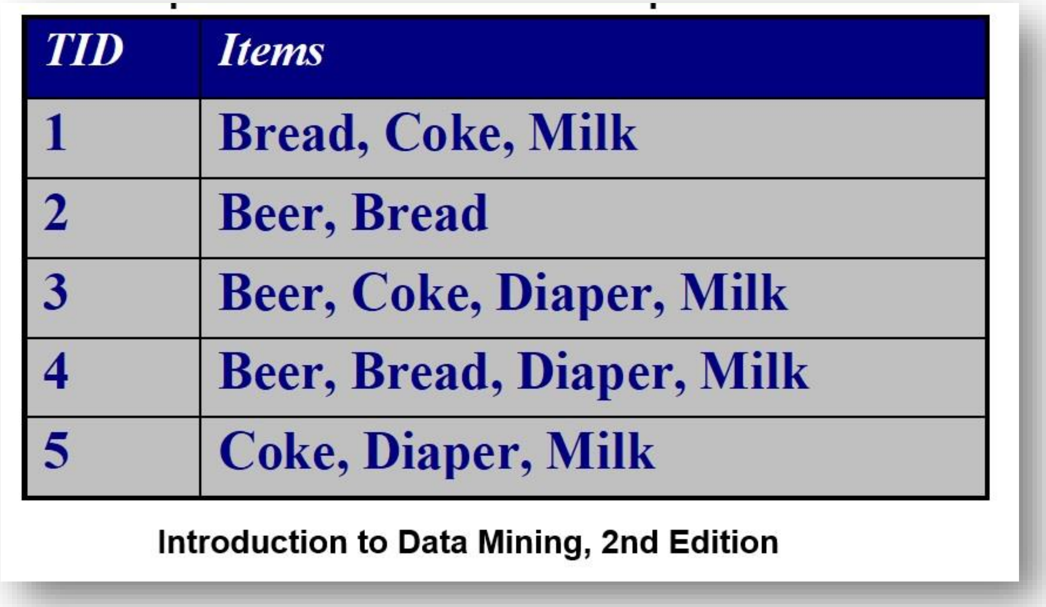
For Rules A → B

Lift (A, B) = $P(A, B) \ / \ P(A)P(B)$
$= P(A \mid B) \, P(B) \ / \ P(A) \, P(B)$
$= P(A \mid B) \ / \ P(A)$

1) What is true if Lift(A,B) = 1? A and B are independent
2) What is true if Lift (A,B) < 1? A and B are negatively correlated
3) What is true if Lift (A,B) > 1? **A and B are positively correlated**

We will consider only the rules with **Lift > 1** because we are looking for associations.

Quick Measure Examples



TID	*Items*
1	Bread, Coke, Milk
2	Beer, Bread
3	Beer, Coke, Diaper, Milk
4	Beer, Bread, Diaper, Milk
5	Coke, Diaper, Milk

Introduction to Data Mining, 2nd Edition

Given: **{Diaper}→ {Beer}**

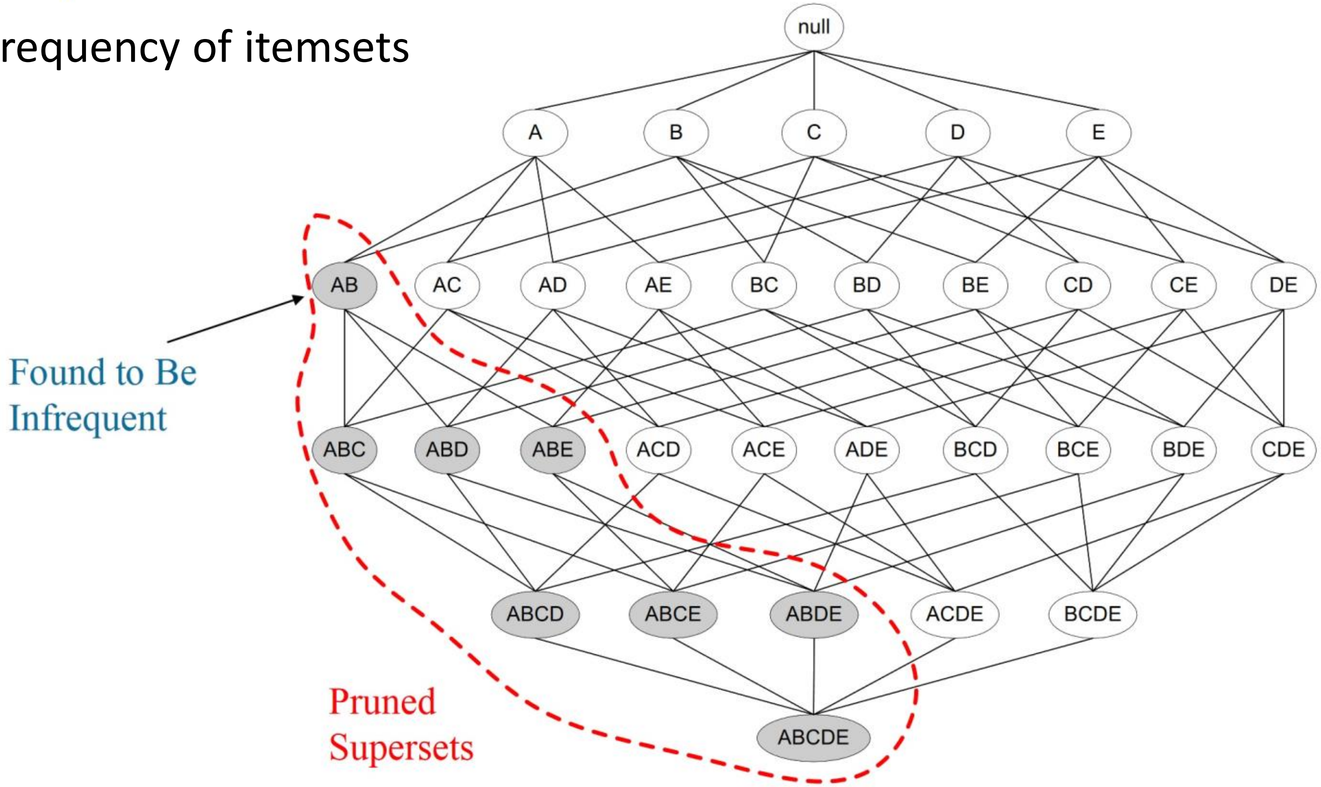
Sup({Diaper}, {Beer}) = 2/5 = .40 = 40%

Conf({Diaper}, {Beer})
= P ({Diaper}, {Beer}) / P({Diaper})
= (2/5) / (3/5) = 66.7%

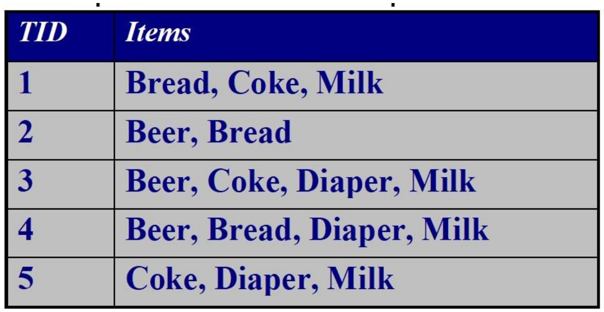
Lift ({Diaper}, {Beer}) = Sup({Diaper}, {Beer}) / P({Diaper}) * P({Beer})
= (2/5) / (3/5)* (3/5) = 1.11

Quick Reminder: The apriori algorithm

Based on frequency of itemsets

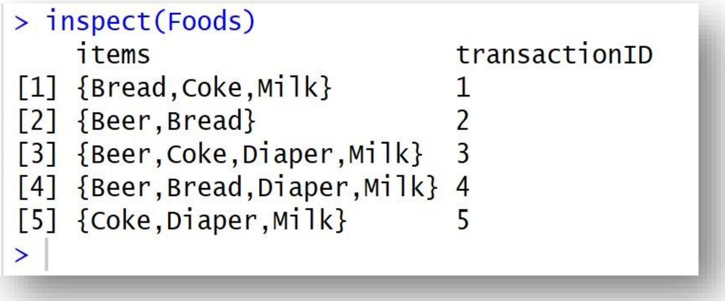


Other Ways to Represent Transaction Data



TID	Items
1	Bread, Coke, Milk
2	Beer, Bread
3	Beer, Coke, Diaper, Milk
4	Beer, Bread, Diaper, Milk
5	Coke, Diaper, Milk

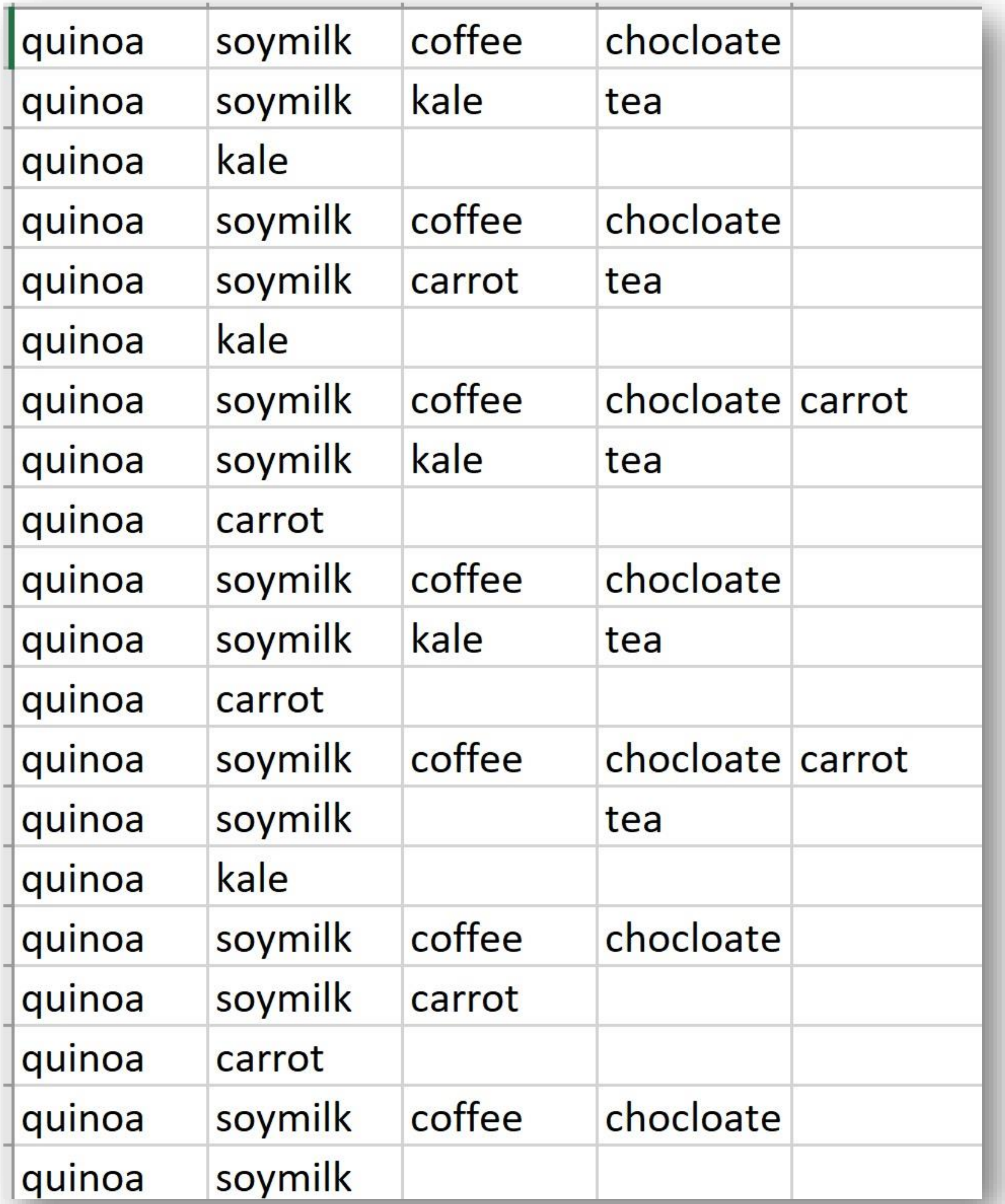
Introduction to Data Mining, 2nd Edition



```
> inspect(Foods)
    items                     transactionID
[1] {Bread,Coke,Milk}         1
[2] {Beer,Bread}              2
[3] {Beer,Coke,Diaper,Milk}   3
[4] {Beer,Bread,Diaper,Milk}  4
[5] {Coke,Diaper,Milk}        5
>
```

1	Bread
1	Coke
1	Milk
2	Beer
2	Bread
3	Beer
3	Coke
3	Diaper
3	Milk
4	Beer
4	Bread
4	Diaper
4	Milk
5	Coke
5	Diaper
5	Milk

TID	Bread	Coke	Milk	Beer	Diaper
1	1	1	1	0	0
2	1	0	0	1	0
3	0	1	1	1	1
4	1	0	1	1	1
5	0	1	1	0	1

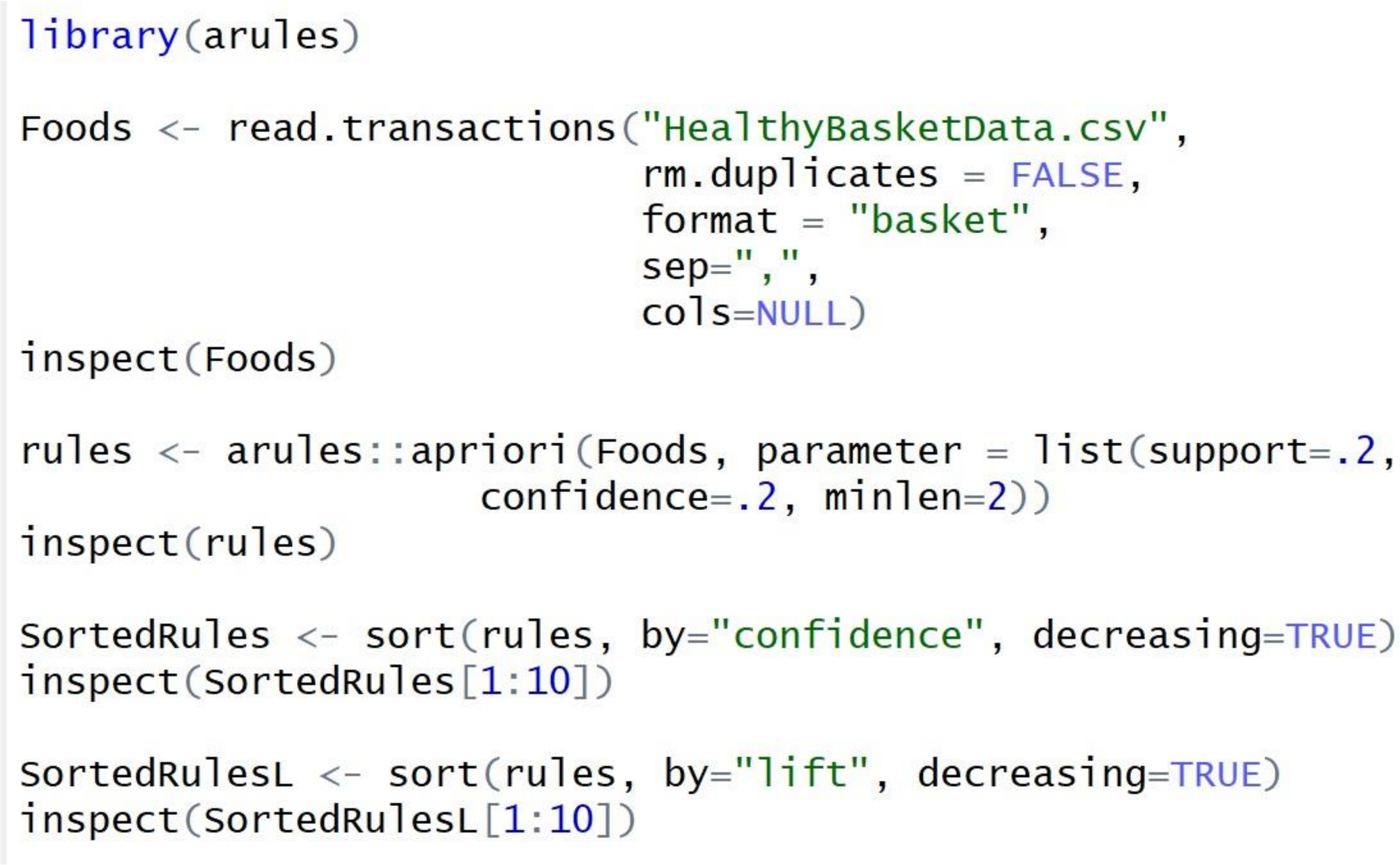


quinoa	soymilk	coffee	chocloate	
quinoa	soymilk	kale	tea	
quinoa	kale			
quinoa	soymilk	coffee	chocloate	
quinoa	soymilk	carrot	tea	
quinoa	kale			
quinoa	soymilk	coffee	chocloate	carrot
quinoa	soymilk	kale	tea	
quinoa	carrot			
quinoa	soymilk	coffee	chocloate	
quinoa	soymilk	kale	tea	
quinoa	carrot			
quinoa	soymilk	coffee	chocloate	carrot
quinoa	soymilk		tea	
quinoa	kale			
quinoa	soymilk	coffee	chocloate	
quinoa	soymilk	carrot		
quinoa	carrot			
quinoa	soymilk	coffee	chocloate	
quinoa	soymilk			

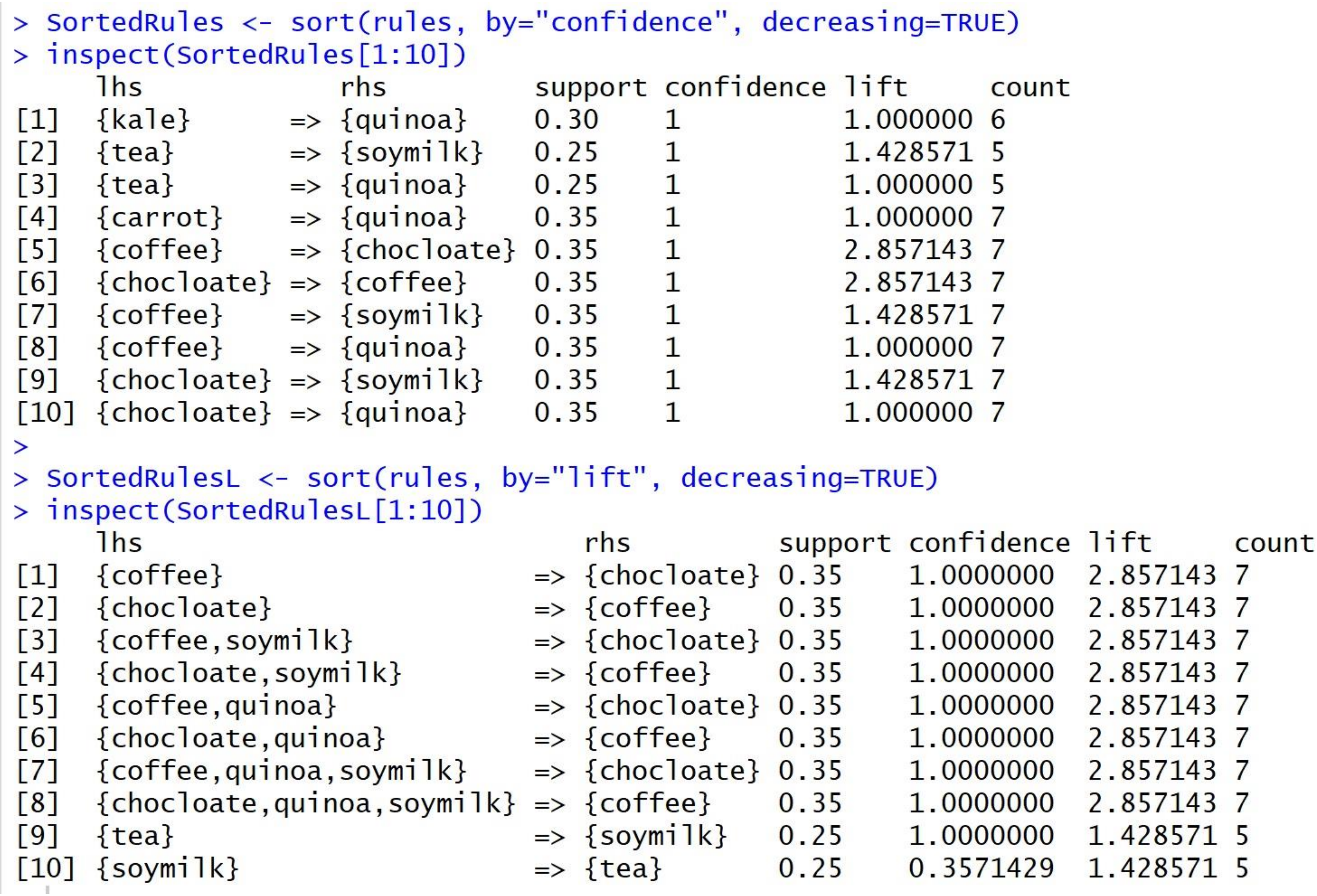
Transaction Data

Notice: It is not necessary to have a numbered transaction ID

Basic ARM R Code



```r
library(arules)

Foods <- read.transactions("HealthyBasketData.csv",
                           rm.duplicates = FALSE,
                           format = "basket",
                           sep=",",
                           cols=NULL)
inspect(Foods)

rules <- arules::apriori(Foods, parameter = list(support=.2,
                    confidence=.2, minlen=2))
inspect(rules)

SortedRules <- sort(rules, by="confidence", decreasing=TRUE)
inspect(SortedRules[1:10])

SortedRulesL <- sort(rules, by="lift", decreasing=TRUE)
inspect(SortedRulesL[1:10])
```



```
> SortedRules <- sort(rules, by="confidence", decreasing=TRUE)
> inspect(SortedRules[1:10])
     lhs              rhs         support confidence lift     count
[1]  {kale}        => {quinoa}    0.30    1          1.000000 6
[2]  {tea}         => {soymilk}   0.25    1          1.428571 5
[3]  {tea}         => {quinoa}    0.25    1          1.000000 5
[4]  {carrot}      => {quinoa}    0.35    1          1.000000 7
[5]  {coffee}      => {chocloate} 0.35    1          2.857143 7
[6]  {chocloate}   => {coffee}    0.35    1          2.857143 7
[7]  {coffee}      => {soymilk}   0.35    1          1.428571 7
[8]  {coffee}      => {quinoa}    0.35    1          1.000000 7
[9]  {chocloate}   => {soymilk}   0.35    1          1.428571 7
[10] {chocloate}   => {quinoa}    0.35    1          1.000000 7
>
> SortedRulesL <- sort(rules, by="lift", decreasing=TRUE)
> inspect(SortedRulesL[1:10])
     lhs                            rhs         support confidence lift     count
[1]  {coffee}                    => {chocloate} 0.35    1.0000000  2.857143 7
[2]  {chocloate}                 => {coffee}    0.35    1.0000000  2.857143 7
[3]  {coffee,soymilk}            => {chocloate} 0.35    1.0000000  2.857143 7
[4]  {chocloate,soymilk}         => {coffee}    0.35    1.0000000  2.857143 7
[5]  {coffee,quinoa}             => {chocloate} 0.35    1.0000000  2.857143 7
[6]  {chocloate,quinoa}          => {coffee}    0.35    1.0000000  2.857143 7
[7]  {coffee,quinoa,soymilk}     => {chocloate} 0.35    1.0000000  2.857143 7
[8]  {chocloate,quinoa,soymilk}  => {coffee}    0.35    1.0000000  2.857143 7
[9]  {tea}                       => {soymilk}   0.25    1.0000000  1.428571 5
[10] {soymilk}                   => {tea}       0.25    0.3571429  1.428571 5
```

Read Two Common Formats

```
Foods <- read.transactions("KumarGroceriesTransData.csv",
                    rm.duplicates = FALSE,
                    format = "single", ##or basket
                    sep=",",
                    skip=0,
                    cols=c(1,2) ## for single, 1 ID col , 2 is item
                         ## default is NULL for basket. Null means no IDs
 )
arules::inspect(Foods)
```

```
Foods2 <- read.transactions("KumarGroceriesTransData_ASTRANS.csv",
                    rm.duplicates = FALSE,
                    format = "basket",
                    sep=",",
                        cols=1 ##ID in col 1 if no ID then cols=NULL
)
arules::inspect(Foods2)
```

Thinking Outside the Basket
Twitter Data

1) Will need to create a "**document of transactions**" – one for each Tweet.
2) ** **Each row is a Tweet.**
3) Each column is a word (token) in that Tweet.
4) Order does not matter.
5) No duplicates

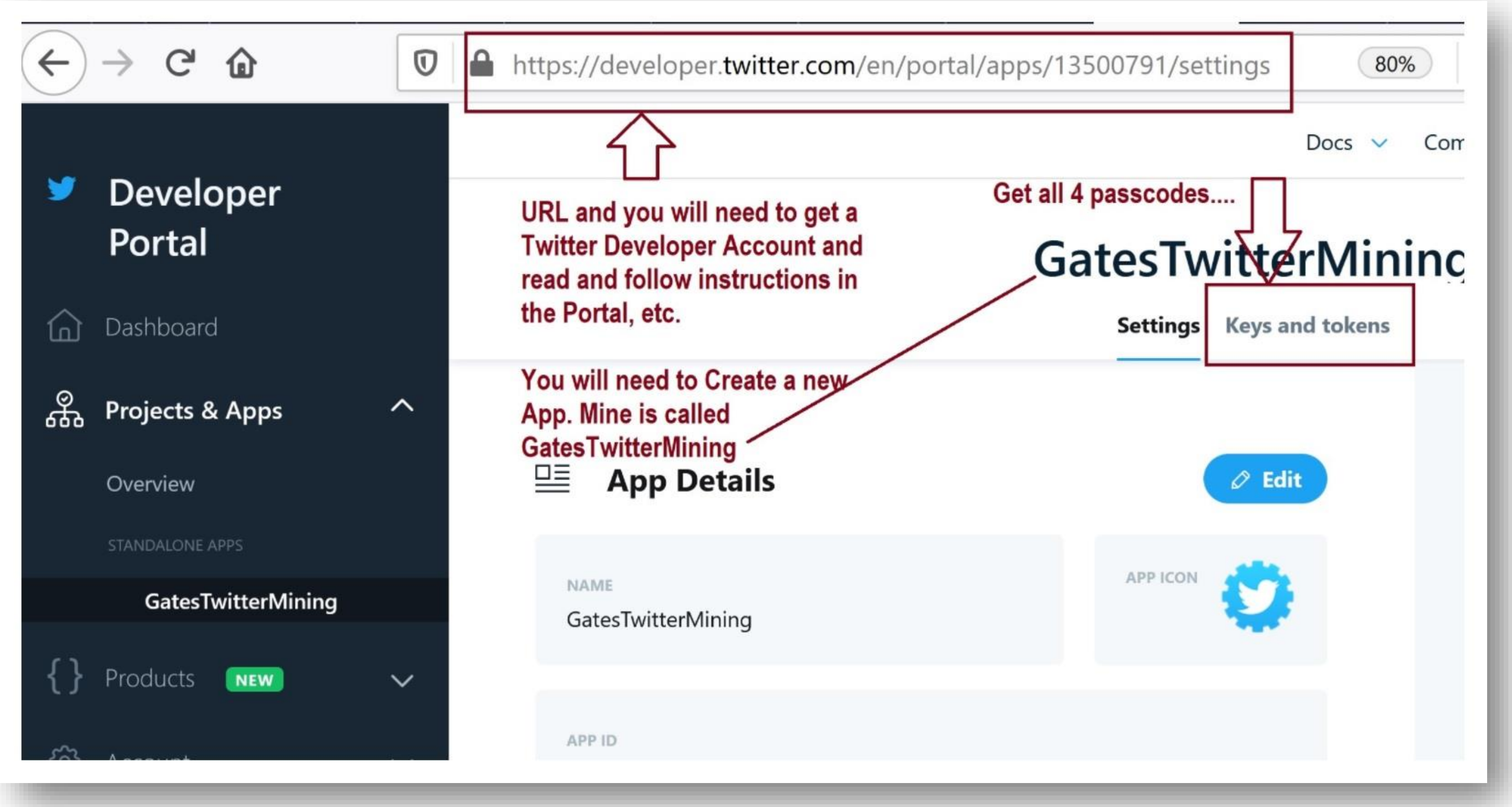
R Association Rules and Twitter: libraries

```
library(arules)
library(rtweet)
library(twitteR)
library(ROAuth)
library(jsonlite)
#library(streamR)
library(rjson)
library(tokenizers)
library(tidyverse)
library(plyr)
library(dplyr)
library(ggplot2)
#install.packages("syuzhet")
## sentiment analysis
library(syuzhet)
library(stringr)
library(arulesViz) ## load last
```

```
## Trouble with arulesViz?
## FIRST - you MUST register and log into github
## install_github("mhahsler/arulesViz")
## RE: https://github.com/mhahsler/arulesViz

## Trouble with arules not working suddenly
## detach("package:arules", unload=TRUE)
## library("arules")
```

Set Up Twitter Dev Account First

https://developer.twitter.com/en/portal/apps



URL and you will need to get a Twitter Developer Account and read and follow instructions in the Portal, etc.

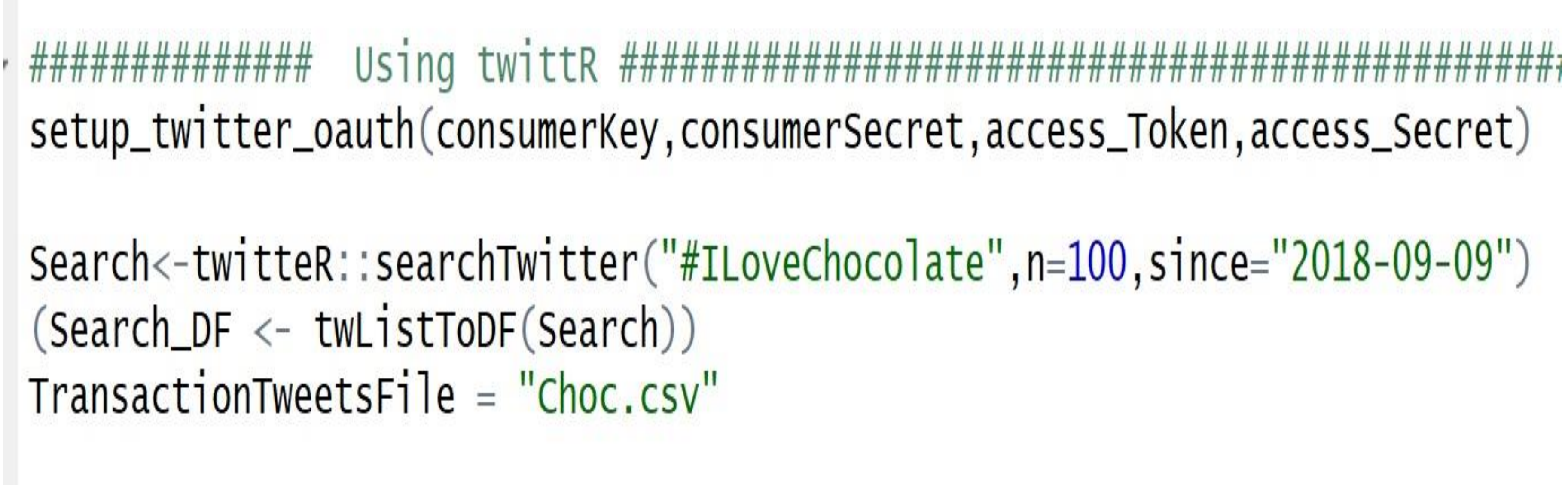
Get all 4 passcodes....

You will need to Create a new App. Mine is called GatesTwitterMining

NAME

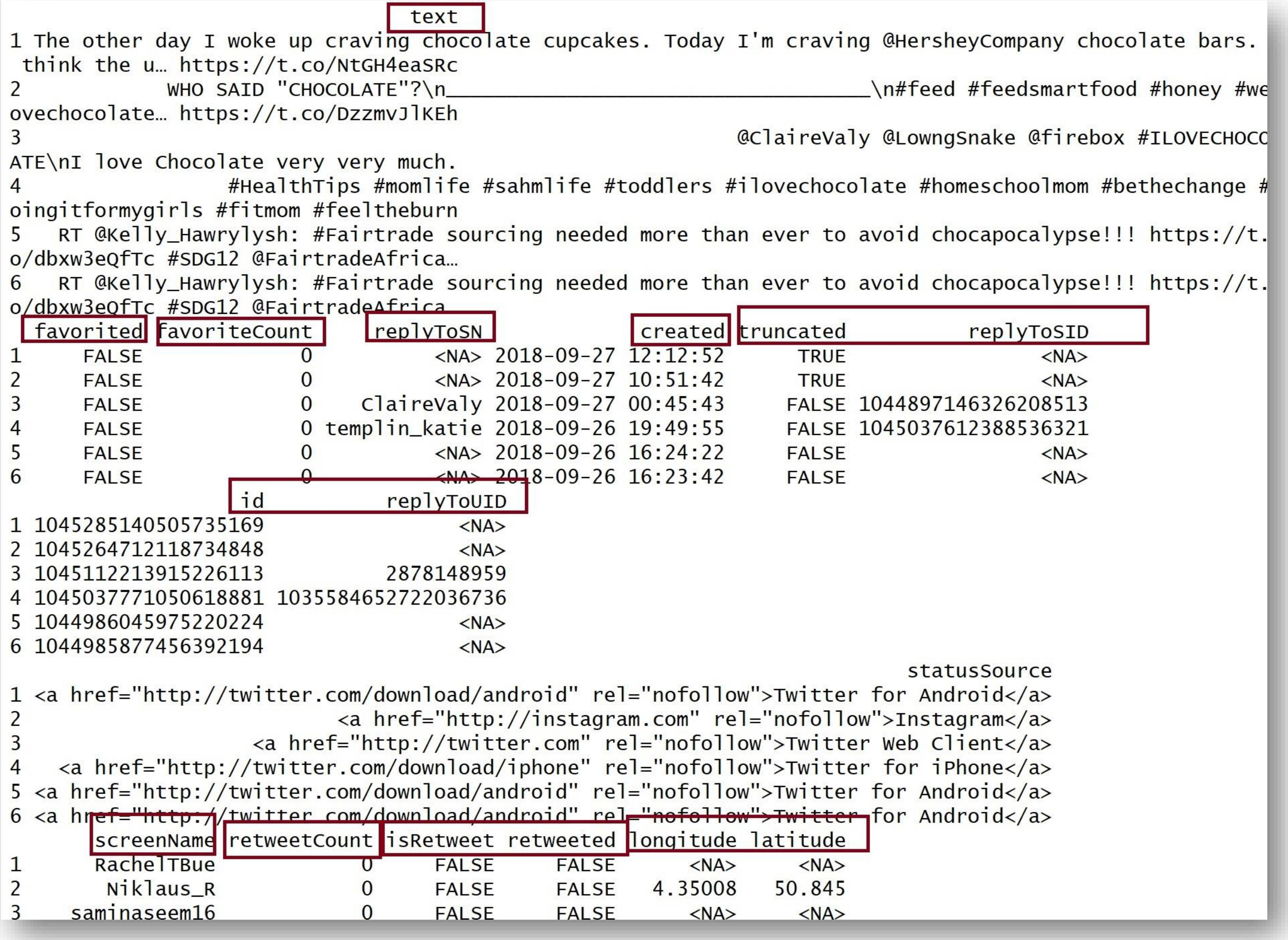
GatesTwitterMining

R Twitter Options



```
##############  Using twittR ##############################################
setup_twitter_oauth(consumerKey,consumerSecret,access_Token,access_Secret)

Search<-twitteR::searchTwitter("#ILoveChocolate",n=100,since="2018-09-09")
(Search_DF <- twListToDF(Search))
TransactionTweetsFile = "Choc.csv"
```

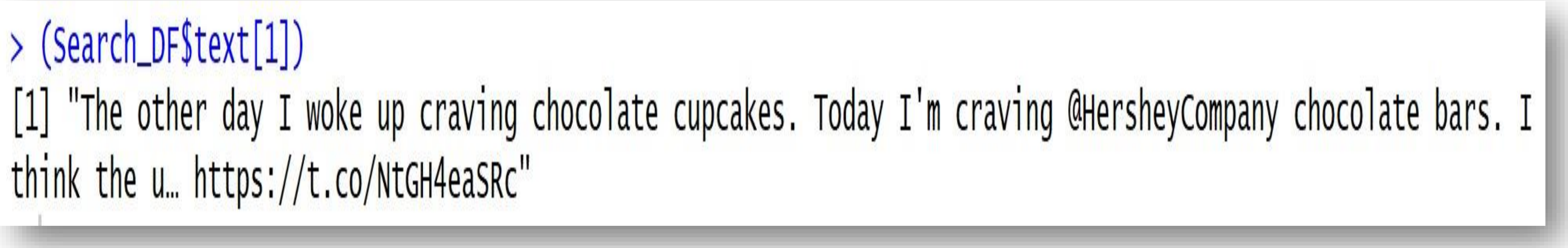
(Search_DF <- twListToDF(Search))



```
                                   text
1 The other day I woke up craving chocolate cupcakes. Today I'm craving @HersheyCompany chocolate bars.
 think the u… https://t.co/NtGH4eaSRc
2            WHO SAID "CHOCOLATE"?\n__________________________________\n#feed #feedsmartfood #honey #we
ovechocolate… https://t.co/DzzmvJlKEh
3                                                            @ClaireValy @LowngSnake @firebox #ILOVECHOCO
ATE\nI love Chocolate very very much.
4                 #HealthTips #momlife #sahmlife #toddlers #ilovechocolate #homeschoolmom #bethechange #
oingitformygirls #fitmom #feeltheburn
5   RT @Kelly_Hawrylysh: #Fairtrade sourcing needed more than ever to avoid chocapocalypse!!! https://t.
o/dbxw3eQfTc #SDG12 @FairtradeAfrica…
6   RT @Kelly_Hawrylysh: #Fairtrade sourcing needed more than ever to avoid chocapocalypse!!! https://t.
o/dbxw3eQfTc #SDG12 @FairtradeAfrica
  favorited favoriteCount     replyToSN             created truncated          replyToSID
1     FALSE             0          <NA> 2018-09-27 12:12:52      TRUE                <NA>
2     FALSE             0          <NA> 2018-09-27 10:51:42      TRUE                <NA>
3     FALSE             0    ClaireValy 2018-09-27 00:45:43     FALSE 1044897146326208513
4     FALSE             0 templin_katie 2018-09-26 19:49:55     FALSE 1045037612388536321
5     FALSE             0          <NA> 2018-09-26 16:24:22     FALSE                <NA>
6     FALSE             0          <NA> 2018-09-26 16:23:42     FALSE                <NA>
                   id          replyToUID
1 1045285140505735169                <NA>
2 1045264712118734848                <NA>
3 1045112213915226113          2878148959
4 1045037771050618881 1035584652722036736
5 1044986045975220224                <NA>
6 1044985877456392194                <NA>
                                                                          statusSource
1 <a href="http://twitter.com/download/android" rel="nofollow">Twitter for Android</a>
2                         <a href="http://instagram.com" rel="nofollow">Instagram</a>
3                  <a href="http://twitter.com" rel="nofollow">Twitter Web Client</a>
4   <a href="http://twitter.com/download/iphone" rel="nofollow">Twitter for iPhone</a>
5 <a href="http://twitter.com/download/android" rel="nofollow">Twitter for Android</a>
6 <a href="http://twitter.com/download/android" rel="nofollow">Twitter for Android</a>
       screenName retweetCount isRetweet retweeted longitude latitude
1      RachelTBue            0     FALSE     FALSE      <NA>     <NA>
2       Niklaus_R            0     FALSE     FALSE   4.35008   50.845
3    saminaseem16            0     FALSE     FALSE      <NA>     <NA>
```

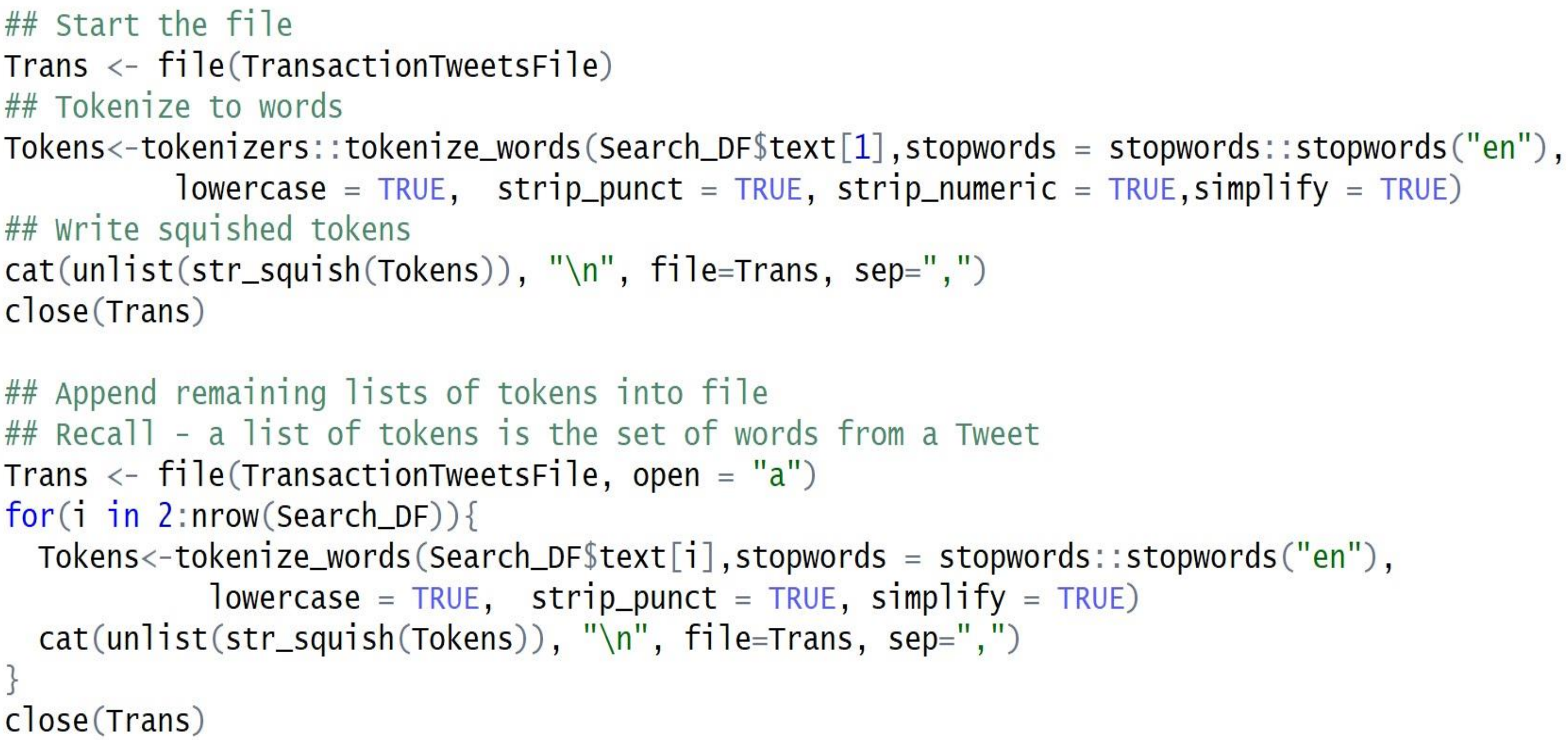
Build the Transaction File: Step 1

1) Each tweet should be one transaction.
2) Each word (token) in the tweet should be in its own column.



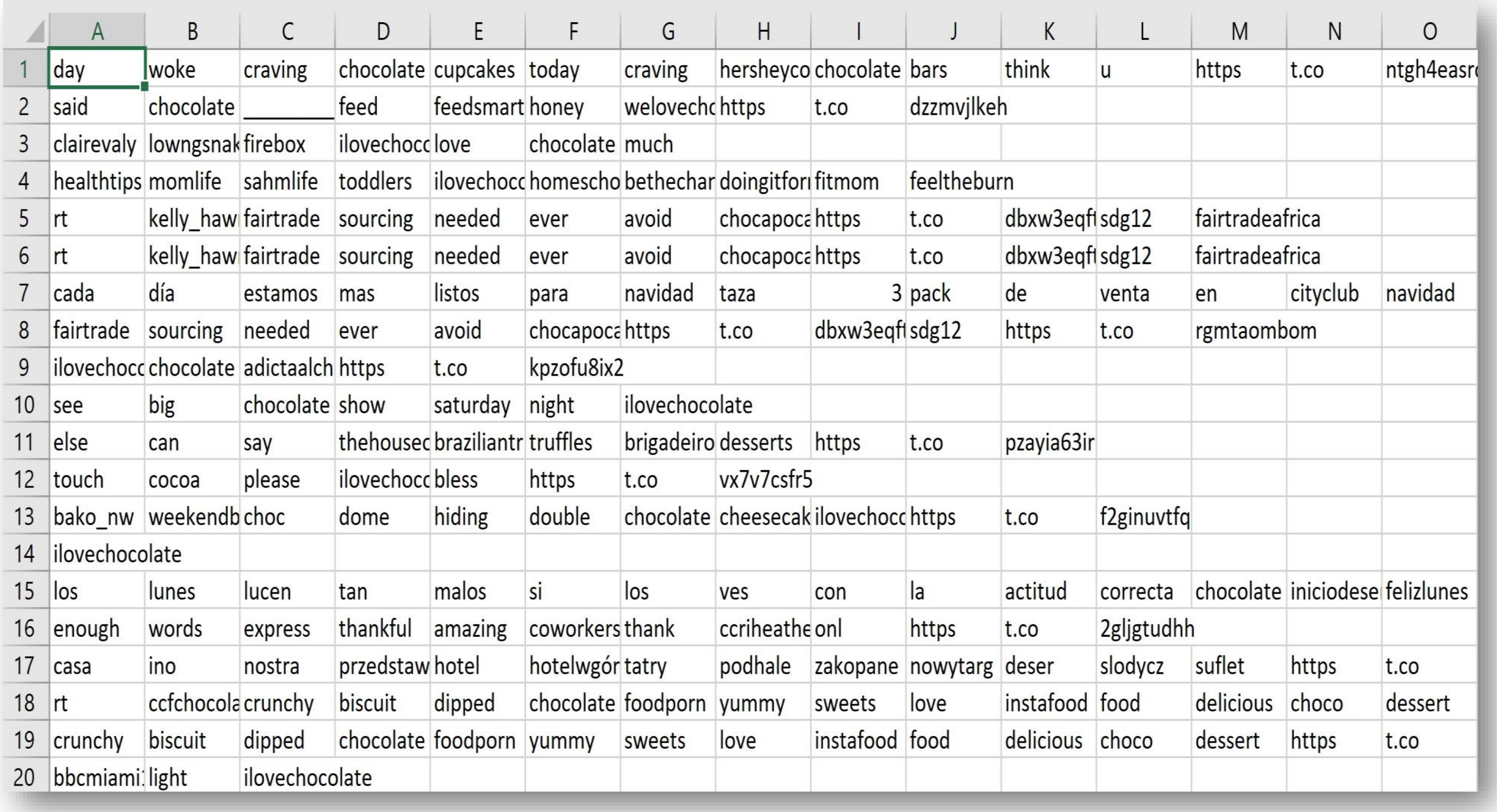
```
> (Search_DF$text[1])
[1] "The other day I woke up craving chocolate cupcakes. Today I'm craving @HersheyCompany chocolate bars. I
think the u… https://t.co/NtGH4eaSRc"
```

Build The Transaction File: Step 2



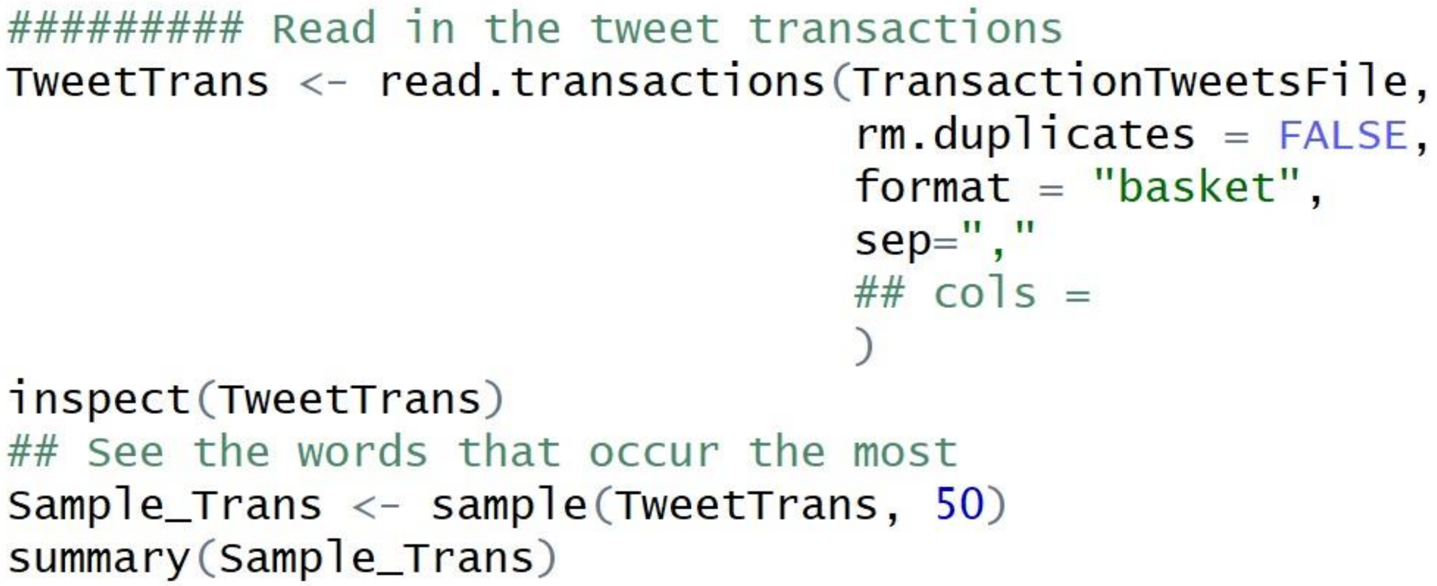
```
## Start the file
Trans <- file(TransactionTweetsFile)
## Tokenize to words
Tokens<-tokenizers::tokenize_words(Search_DF$text[1],stopwords = stopwords::stopwords("en"),
          lowercase = TRUE,  strip_punct = TRUE, strip_numeric = TRUE,simplify = TRUE)
## Write squished tokens
cat(unlist(str_squish(Tokens)), "\n", file=Trans, sep=",")
close(Trans)

## Append remaining lists of tokens into file
## Recall - a list of tokens is the set of words from a Tweet
Trans <- file(TransactionTweetsFile, open = "a")
for(i in 2:nrow(Search_DF)){
  Tokens<-tokenize_words(Search_DF$text[i],stopwords = stopwords::stopwords("en"),
          lowercase = TRUE,  strip_punct = TRUE, simplify = TRUE)
  cat(unlist(str_squish(Tokens)), "\n", file=Trans, sep=",")
}
close(Trans)
```

Transaction File: Each Row is a Tweet (Opened with Excel)

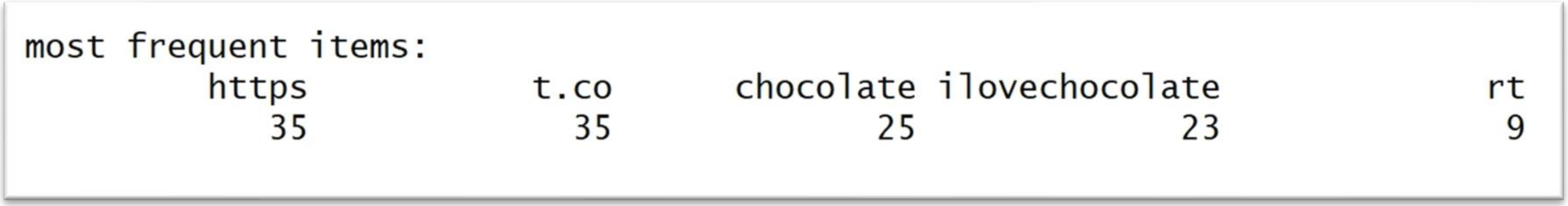


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	day	woke	craving	chocolate	cupcakes	today	craving	hersheyco	chocolate	bars	think	u	https	t.co	ntgh4easr
2	said	chocolate		feed	feedsmart	honey	welovechc	https	t.co	dzzmvjlkeh					
3	clairevaly	lowngsnak	firebox	ilovechocc	love	chocolate	much								
4	healthtips	momlife	sahmlife	toddlers	ilovechocc	homescho	bethechar	doingitfori	fitmom	feeltheburn					
5	rt	kelly_haw	fairtrade	sourcing	needed	ever	avoid	chocapoca	https	t.co	dbxw3eqft	sdg12	fairtradeafrica		
6	rt	kelly_haw	fairtrade	sourcing	needed	ever	avoid	chocapoca	https	t.co	dbxw3eqft	sdg12	fairtradeafrica		
7	cada	día	estamos	mas	listos	para	navidad	taza	3	pack	de	venta	en	cityclub	navidad
8	fairtrade	sourcing	needed	ever	avoid	chocapoca	https	t.co	dbxw3eqft	sdg12	https	t.co	rgmtaombom		
9	ilovechocc	chocolate	adictaalch	https	t.co	kpzofu8ix2									
10	see	big	chocolate	show	saturday	night	ilovechocolate								
11	else	can	say	thehousec	braziliantr	truffles	brigadeiro	desserts	https	t.co	pzayia63ir				
12	touch	cocoa	please	ilovechocc	bless	https	t.co	vx7v7csfr5							
13	bako_nw	weekendb	choc	dome	hiding	double	chocolate	cheesecak	ilovechocc	https	t.co	f2ginuvtfq			
14	ilovechocolate														
15	los	lunes	lucen	tan	malos	si	los	ves	con	la	actitud	correcta	chocolate	iniciodese	felizlunes
16	enough	words	express	thankful	amazing	coworkers	thank	ccriheathe	onl	https	t.co	2gljgtudhh			
17	casa	ino	nostra	przedstaw	hotel	hotelwgór	tatry	podhale	zakopane	nowytarg	deser	slodycz	suflet	https	t.co
18	rt	ccfchocola	crunchy	biscuit	dipped	chocolate	foodporn	yummy	sweets	love	instafood	food	delicious	choco	dessert
19	crunchy	biscuit	dipped	chocolate	foodporn	yummy	sweets	love	instafood	food	delicious	choco	dessert	https	t.co
20	bbcmiami:	light	ilovechocolate												

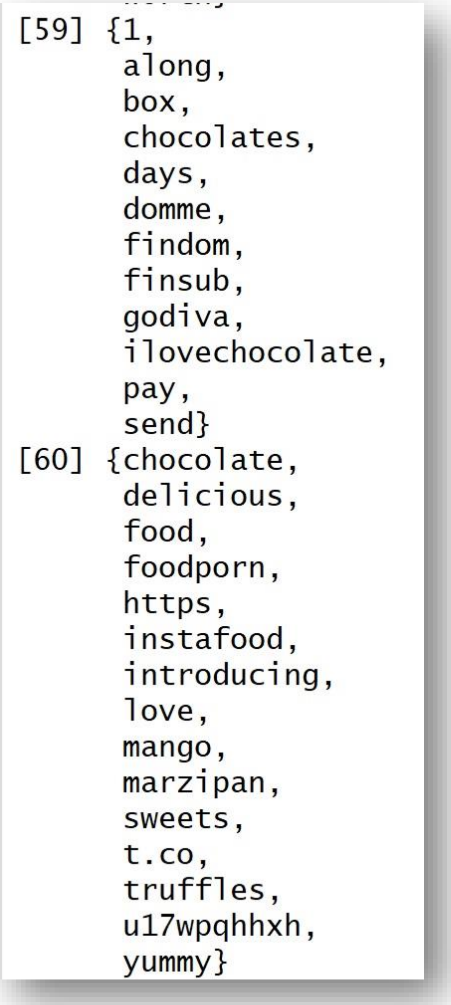
Read and Inspect the Transactions



```r
######### Read in the tweet transactions
TweetTrans <- read.transactions(TransactionTweetsFile,
                                rm.duplicates = FALSE,
                                format = "basket",
                                sep=","
                                ## cols =
                                )
inspect(TweetTrans)
## See the words that occur the most
Sample_Trans <- sample(TweetTrans, 50)
summary(Sample_Trans)
```



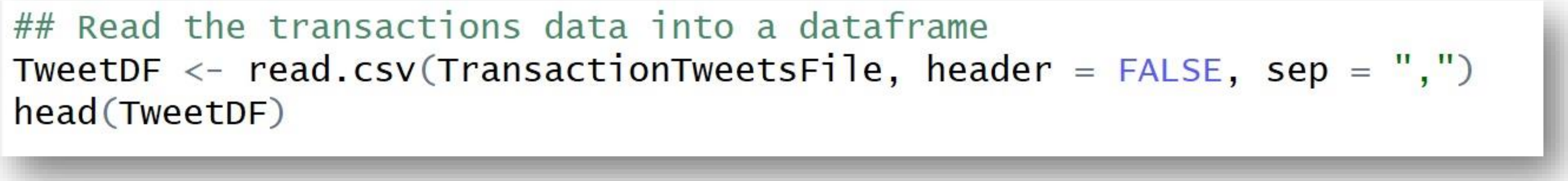
```
most frequent items:
          https            t.co       chocolate ilovechocolate              rt
             35              35              25              23               9
```



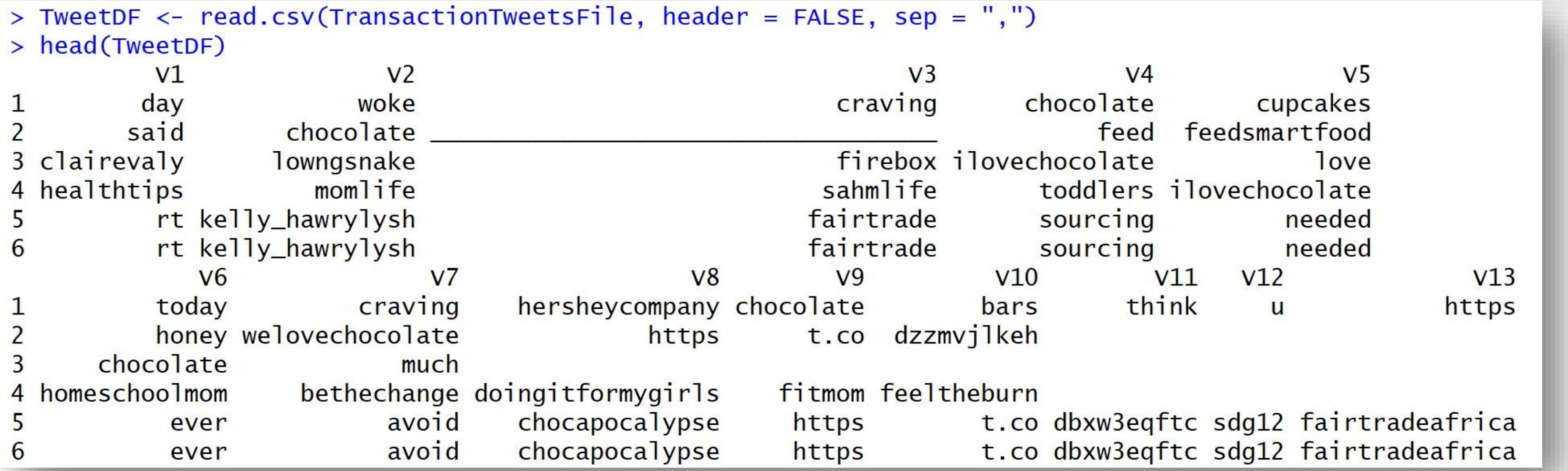
```
[59] {1,
      along,
      box,
      chocolates,
      days,
      domme,
      findom,
      finsub,
      godiva,
      ilovechocolate,
      pay,
      send}
[60] {chocolate,
      delicious,
      food,
      foodporn,
      https,
      instafood,
      introducing,
      love,
      mango,
      marzipan,
      sweets,
      t.co,
      truffles,
      u17wpqhhxh,
      yummy}
```

Transaction Sets and Summary

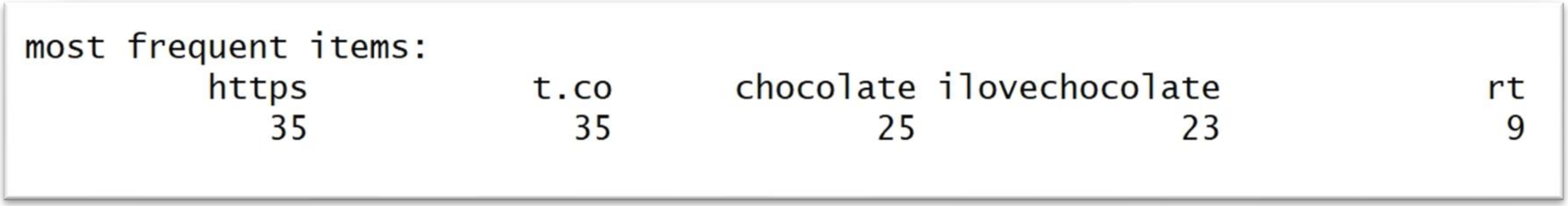
Clean Up



```
## Read the transactions data into a dataframe
TweetDF <- read.csv(TransactionTweetsFile, header = FALSE, sep = ",")
head(TweetDF)
```

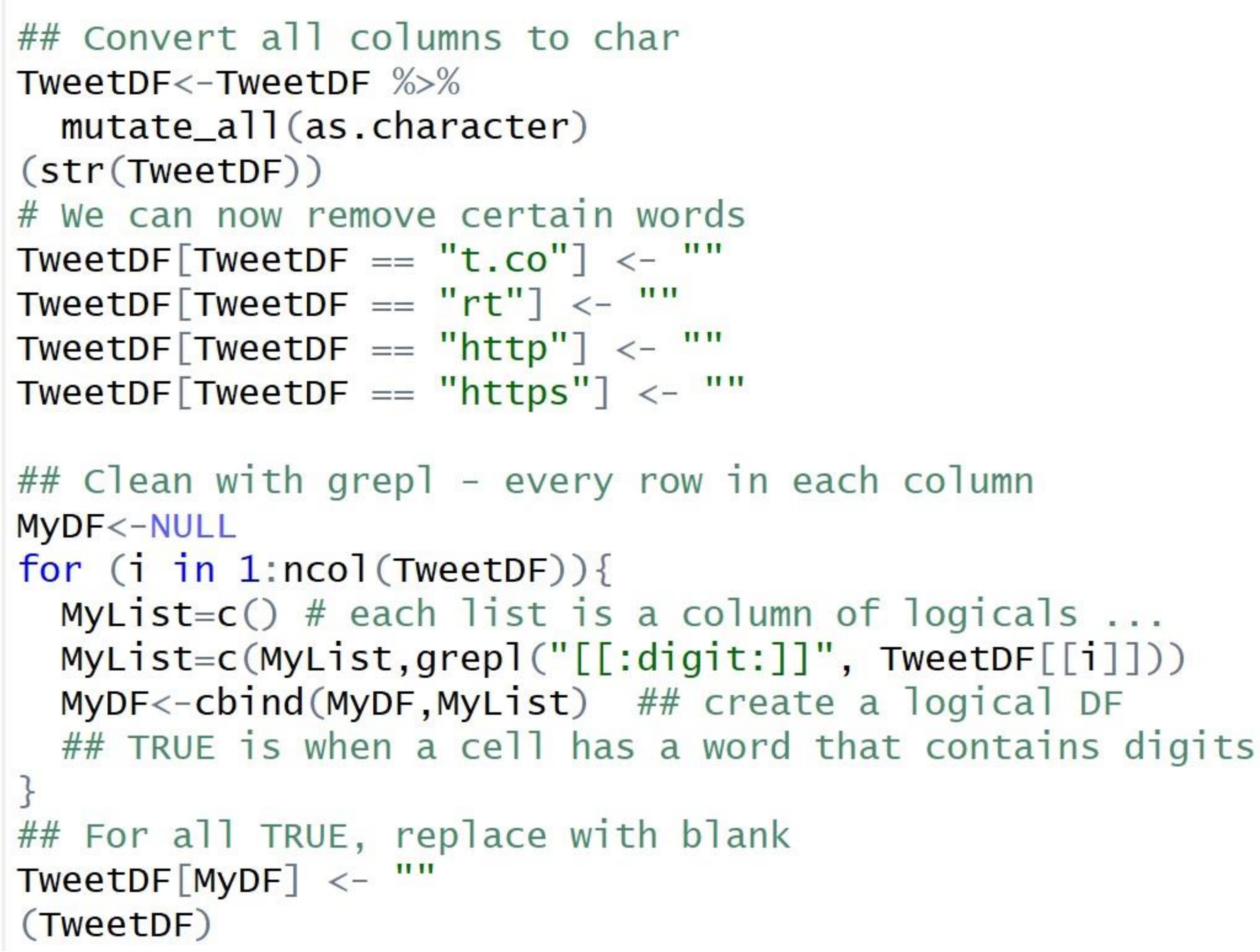


```
> TweetDF <- read.csv(TransactionTweetsFile, header = FALSE, sep = ",")
> head(TweetDF)
          V1              V2                                  V3             V4             V5
1        day            woke                             craving      chocolate       cupcakes
2       said       chocolate ___________________________________           feed  feedsmartfood
3 clairevaly      lowngsnake                             firebox ilovechocolate           love
4 healthtips         momlife                            sahmlife       toddlers ilovechocolate
5         rt kelly_hawrylysh                           fairtrade       sourcing         needed
6         rt kelly_hawrylysh                           fairtrade       sourcing         needed
             V6              V7                V8        V9         V10        V11   V12             V13
1         today         craving    hersheycompany chocolate        bars      think     u           https
2         honey welovechocolate             https      t.co  dzzmvjlkeh                                  
3     chocolate            much                                                                          
4 homeschoolmom     bethechange doingitformygirls    fitmom feeltheburn                                  
5          ever           avoid    chocapocalypse     https        t.co dbxw3eqftc sdg12 fairtradeafrica
6          ever           avoid    chocapocalypse     https        t.co dbxw3eqftc sdg12 fairtradeafrica
```

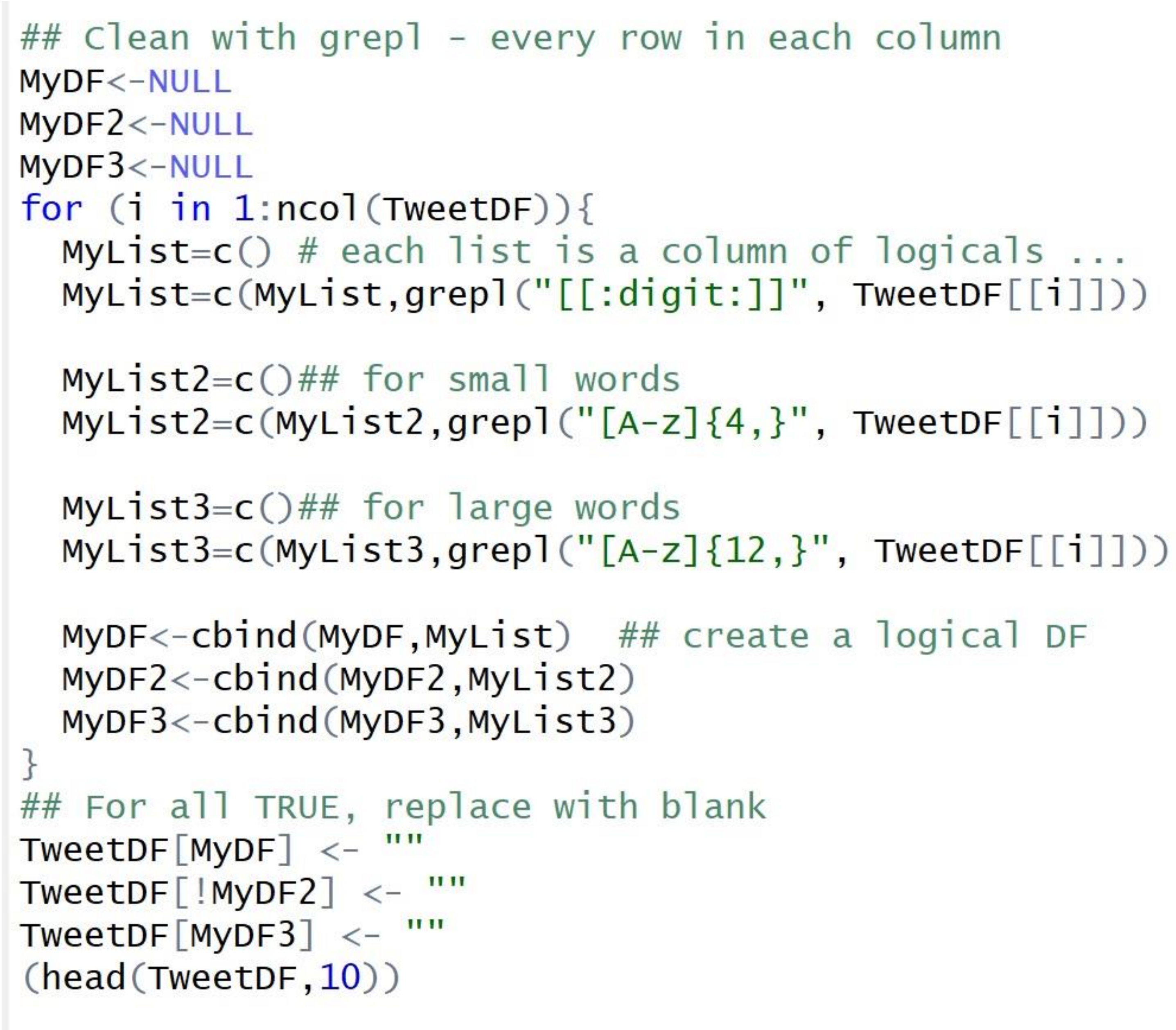


```
most frequent items:
         https           t.co      chocolate ilovechocolate             rt
            35             35             25             23              9
```

Specifically Remove Words

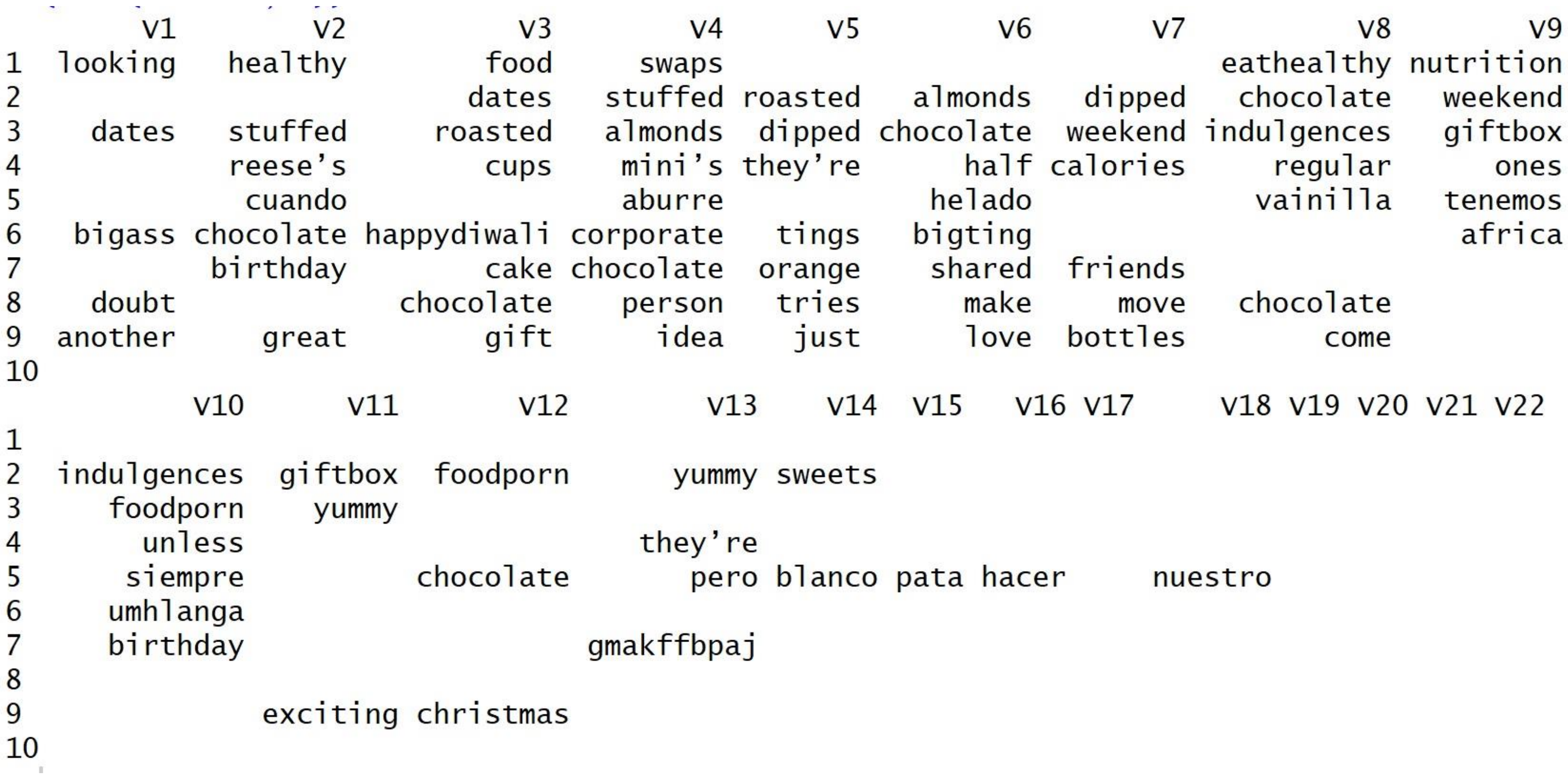


```
## Convert all columns to char
TweetDF<-TweetDF %>%
  mutate_all(as.character)
(str(TweetDF))
# We can now remove certain words
TweetDF[TweetDF == "t.co"] <- ""
TweetDF[TweetDF == "rt"] <- ""
TweetDF[TweetDF == "http"] <- ""
TweetDF[TweetDF == "https"] <- ""

## Clean with grepl - every row in each column
MyDF<-NULL
for (i in 1:ncol(TweetDF)){
  MyList=c() # each list is a column of logicals ...
  MyList=c(MyList,grepl("[[:digit:]]", TweetDF[[i]]))
  MyDF<-cbind(MyDF,MyList)  ## create a logical DF
  ## TRUE is when a cell has a word that contains digits
}
## For all TRUE, replace with blank
TweetDF[MyDF] <- ""
(TweetDF)
```



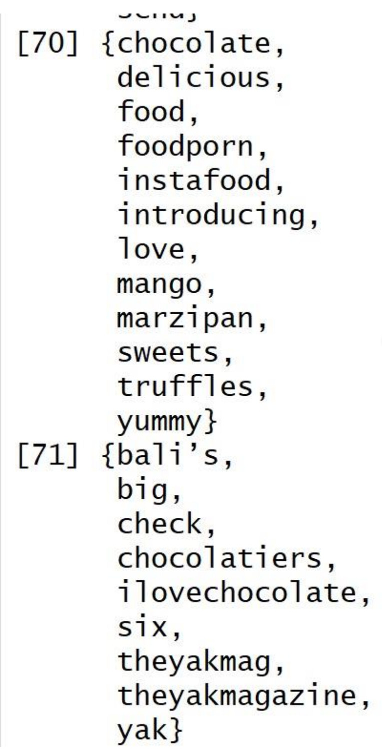
```r
## Clean with grepl - every row in each column
MyDF<-NULL
MyDF2<-NULL
MyDF3<-NULL
for (i in 1:ncol(TweetDF)){
  MyList=c() # each list is a column of logicals ...
  MyList=c(MyList,grepl("[[:digit:]]", TweetDF[[i]]))

  MyList2=c()## for small words
  MyList2=c(MyList2,grepl("[A-z]{4,}", TweetDF[[i]]))

  MyList3=c()## for large words
  MyList3=c(MyList3,grepl("[A-z]{12,}", TweetDF[[i]]))

  MyDF<-cbind(MyDF,MyList)  ## create a logical DF
  MyDF2<-cbind(MyDF2,MyList2)
  MyDF3<-cbind(MyDF3,MyList3)
}
## For all TRUE, replace with blank
TweetDF[MyDF] <- ""
TweetDF[!MyDF2] <- ""
TweetDF[MyDF3] <- ""
(head(TweetDF,10))
```

Our Transactions



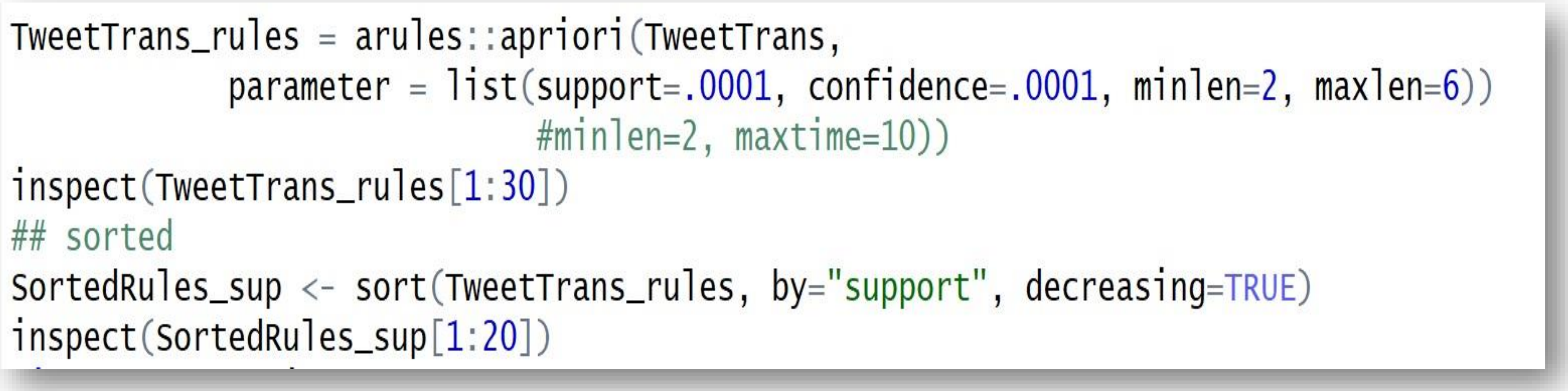
```
        V1        V2          V3        V4      V5        V6       V7          V8        V9
1  looking   healthy        food     swaps                               eathealthy nutrition
2                          dates   stuffed roasted   almonds   dipped   chocolate   weekend
3    dates   stuffed     roasted   almonds  dipped chocolate  weekend indulgences   giftbox
4            reese’s        cups    mini’s they’re      half calories     regular      ones
5             cuando                aburre            helado             vainilla   tenemos
6   bigass chocolate happydiwali corporate   tings   bigting                          africa
7           birthday        cake chocolate  orange    shared  friends
8    doubt             chocolate    person   tries      make     move   chocolate
9  another     great        gift      idea    just      love  bottles        come
10
           V10      V11       V12        V13    V14  V15   V16 V17     V18 V19 V20 V21 V22
1
2  indulgences  giftbox  foodporn      yummy sweets
3     foodporn    yummy
4       unless                       they’re
5      siempre          chocolate       pero blanco pata hacer     nuestro
6     umhlanga
7     birthday                    gmakffbpaj
8
9             exciting christmas
10
```

Association Rule Mining

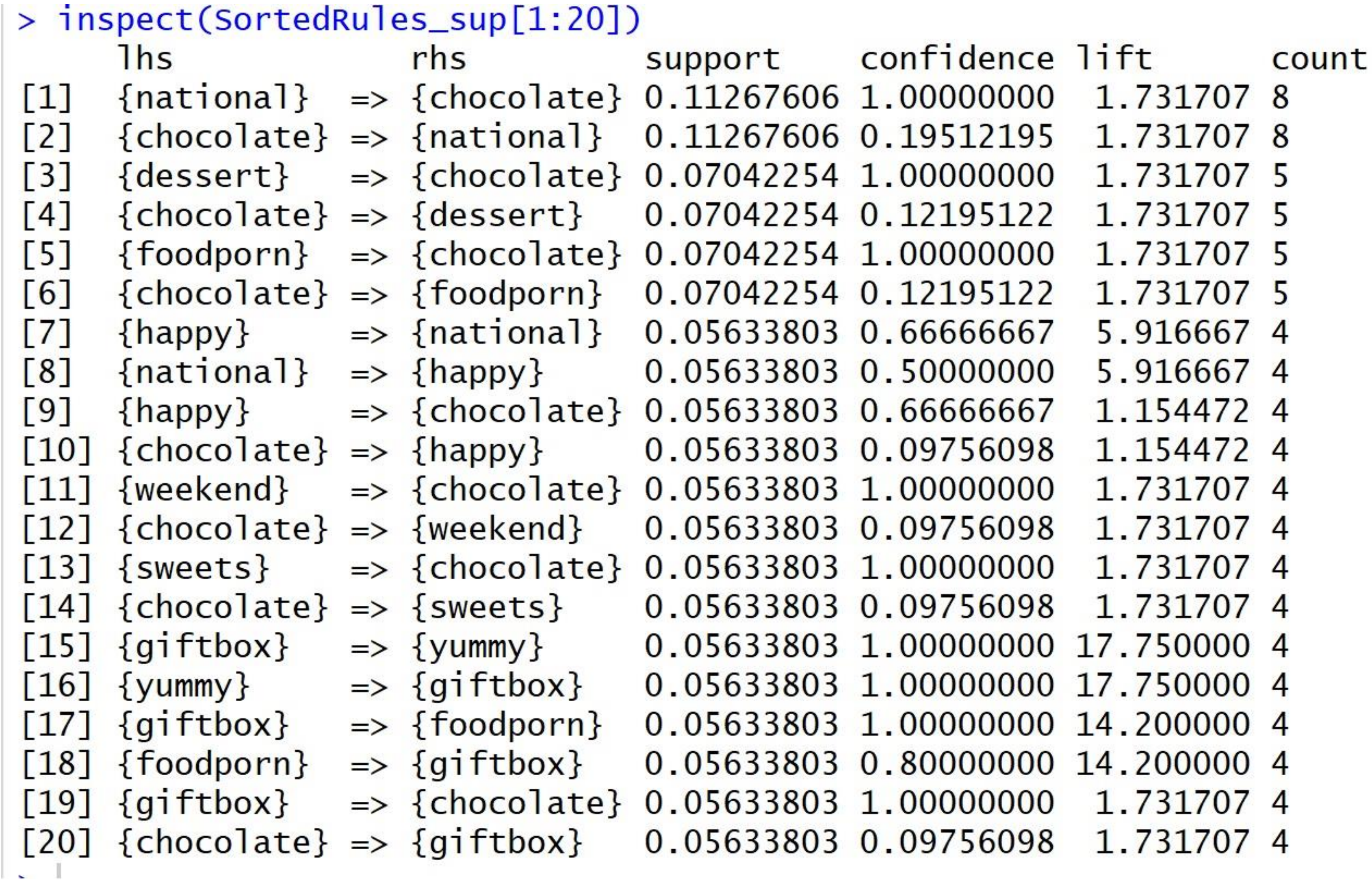


```
[70] {chocolate,
      delicious,
      food,
      foodporn,
      instafood,
      introducing,
      love,
      mango,
      marzipan,
      sweets,
      truffles,
      yummy}
[71] {bali’s,
      big,
      check,
      chocolatiers,
      ilovechocolate,
      six,
      theyakmag,
      theyakmagazine,
      yak}
```

Example cleaner tweets as individual transactions.

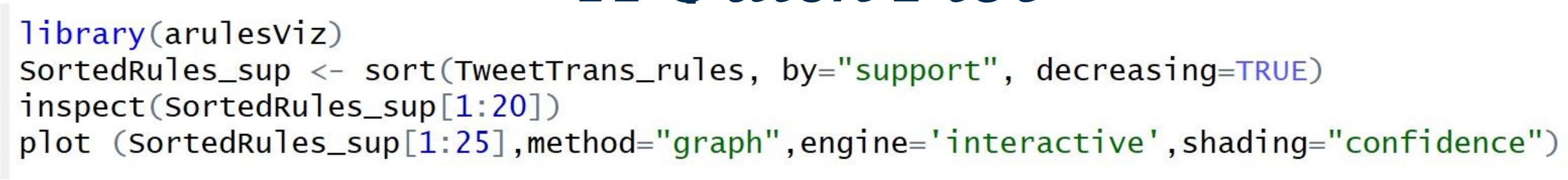


```
TweetTrans_rules = arules::apriori(TweetTrans,
               parameter = list(support=.0001, confidence=.0001, minlen=2, maxlen=6))
                                #minlen=2, maxtime=10))
inspect(TweetTrans_rules[1:30])
## sorted
SortedRules_sup <- sort(TweetTrans_rules, by="support", decreasing=TRUE)
inspect(SortedRules_sup[1:20])
```

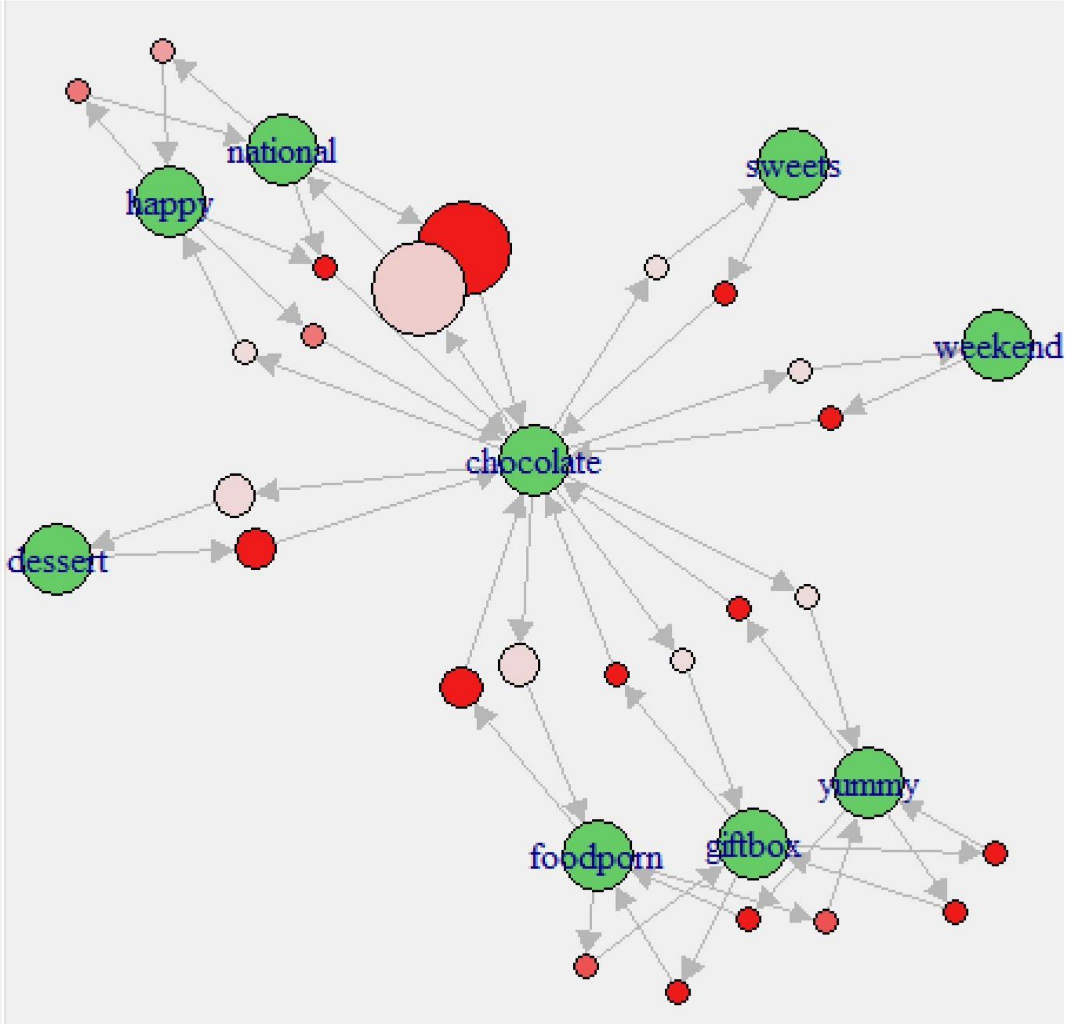


```
> inspect(SortedRules_sup[1:20])
     lhs            rhs         support    confidence lift      count
[1]  {national}  => {chocolate} 0.11267606 1.00000000  1.731707 8
[2]  {chocolate} => {national}  0.11267606 0.19512195  1.731707 8
[3]  {dessert}   => {chocolate} 0.07042254 1.00000000  1.731707 5
[4]  {chocolate} => {dessert}   0.07042254 0.12195122  1.731707 5
[5]  {foodporn}  => {chocolate} 0.07042254 1.00000000  1.731707 5
[6]  {chocolate} => {foodporn}  0.07042254 0.12195122  1.731707 5
[7]  {happy}     => {national}  0.05633803 0.66666667  5.916667 4
[8]  {national}  => {happy}     0.05633803 0.50000000  5.916667 4
[9]  {happy}     => {chocolate} 0.05633803 0.66666667  1.154472 4
[10] {chocolate} => {happy}     0.05633803 0.09756098  1.154472 4
[11] {weekend}   => {chocolate} 0.05633803 1.00000000  1.731707 4
[12] {chocolate} => {weekend}   0.05633803 0.09756098  1.731707 4
[13] {sweets}    => {chocolate} 0.05633803 1.00000000  1.731707 4
[14] {chocolate} => {sweets}    0.05633803 0.09756098  1.731707 4
[15] {giftbox}   => {yummy}     0.05633803 1.00000000 17.750000 4
[16] {yummy}     => {giftbox}   0.05633803 1.00000000 17.750000 4
[17] {giftbox}   => {foodporn}  0.05633803 1.00000000 14.200000 4
[18] {foodporn}  => {giftbox}   0.05633803 0.80000000 14.200000 4
[19] {giftbox}   => {chocolate} 0.05633803 1.00000000  1.731707 4
[20] {chocolate} => {giftbox}   0.05633803 0.09756098  1.731707 4
```

A Quick Plot



```
library(arulesViz)
SortedRules_sup <- sort(TweetTrans_rules, by="support", decreasing=TRUE)
inspect(SortedRules_sup[1:20])
plot (SortedRules_sup[1:25],method="graph",engine='interactive',shading="confidence")
```



Size: support
Color (dark=higher): conf