Association Rule Mining With Tweets: ***Thinking Outside the Basket***

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What is Association Rule Mining

1) **Unsupervised Learning**
2) Evaluates "**transactions**" (collections of sets) for correlations/associations.

3) Most common example: **Market Basket**

4) **Can also apply to** :
- Image identification
- Text: like **Twitter data**
  a tweet is a *basket of words*
- Any collection of words
- Click streams
- Bio data – binding sites, AA's in proteins, etc.

Quick Review:

Examples of association rules

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

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

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

Measures of Set Correlation

Let X and Y be sets and assume rule X → Y

1) Support:

Sup(X, Y) = P(X, Y)

(Count of X and Y together) / (Total # Trans)

2) Confidence:

Conf(X, Y) = P(Y|X) = P(X,Y)/ P(X)

(Count of X and Y together) / (Count of X)

Lift

Measure of dependent or correlated events: Lift

Lift (A => B) = support({A,B})/(support(A) × support(B))

$$lift(A \rightarrow B) = \frac{P(A \quad B)}{P(A)P(B)}$$

Association rules should have >1 lift to be meaningful.

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

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Given: {Beer }→ {Diaper}

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

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

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

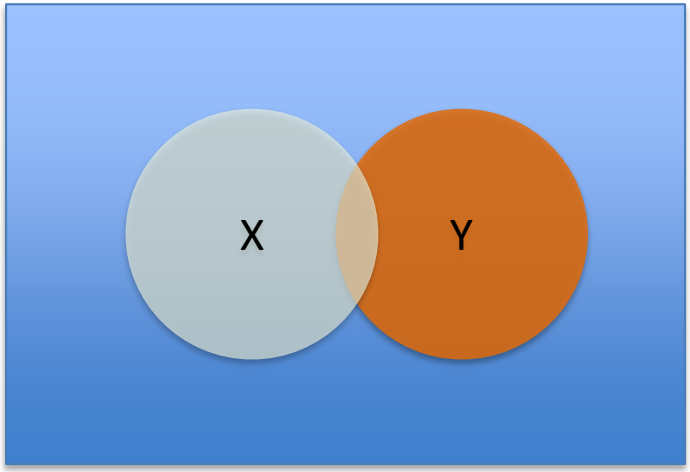
Conceptually

X→ Y

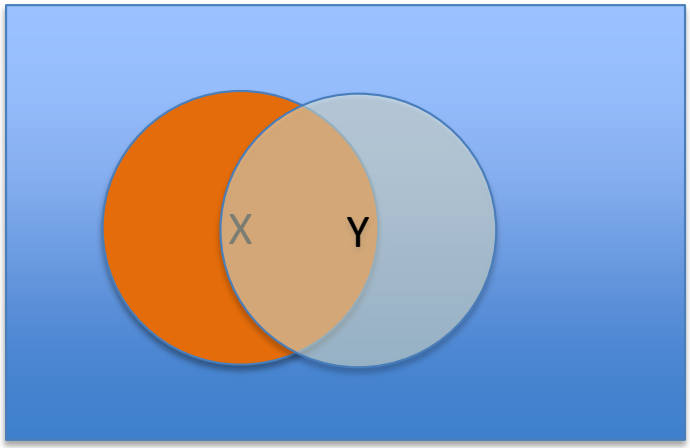
Sup: P(X and Y) –
Measure of joint occurrence.
The more X and Y occur together, the higher the Support. Range: 0 to 1.

Conf: **P(X and Y) / P(X) = P(Y|X)** –
Measure of joint occurrence assuming X
As P(X) increases, conf X → Y decreases. Range: 0 to 1.

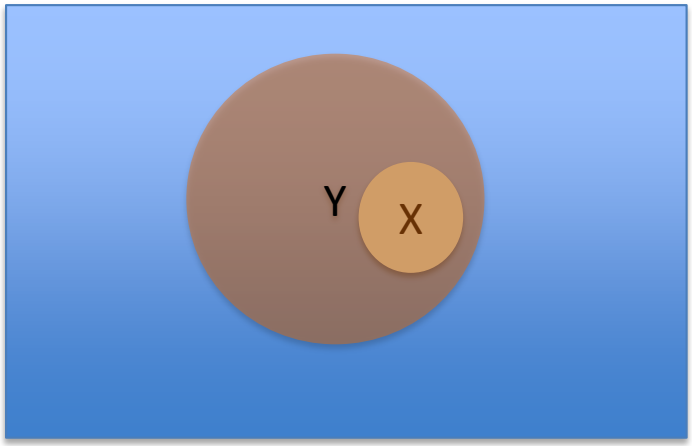
Lift: P(X and Y) / P(X)P(Y) –
= 1 when X and Y are independent.
< 1 when X and Y have little or no intersection.
> 1 when X and Y have an intersection larger than their probability product.



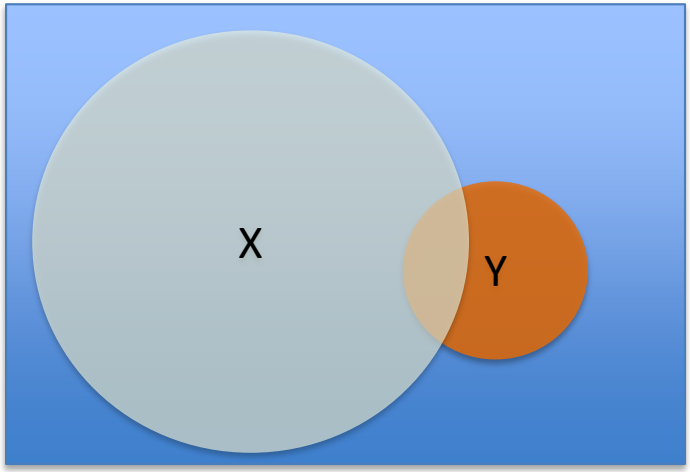
Support: P(X and Y) = low
Conf: P(X and Y)/P(X) = higher than Sup, but still low
Lift: P(X and Y)/ P(X)*P(Y) < 1



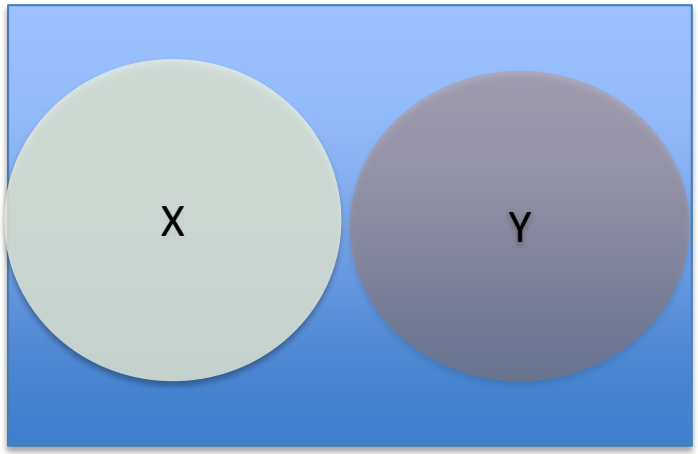
Support: P(X and Y) = high
Conf: P(X and Y)/P(X) = high and higher than Sup
Lift: P(X and Y)/ P(X)*P(Y) > 1 Interesting



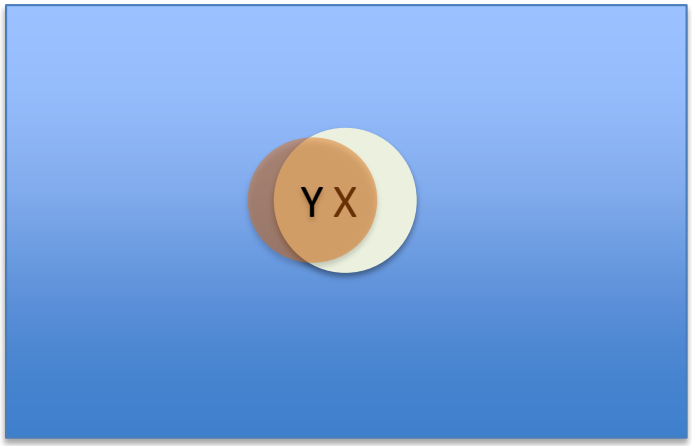
Support: P(X and Y) = P(X) = small – based on X
Conf: P(X and Y)/P(X) = 1 (highest possible)
Lift: P(X and Y)/ P(X)*P(Y) = 1/P(Y) > 1
Interesting because X only occurs if Y



Support: P(X and Y) = low
Conf: P(X and Y)/P(X) = higher than Sup, but still low
Lift: P(X and Y)/ P(X)*P(Y) < 1

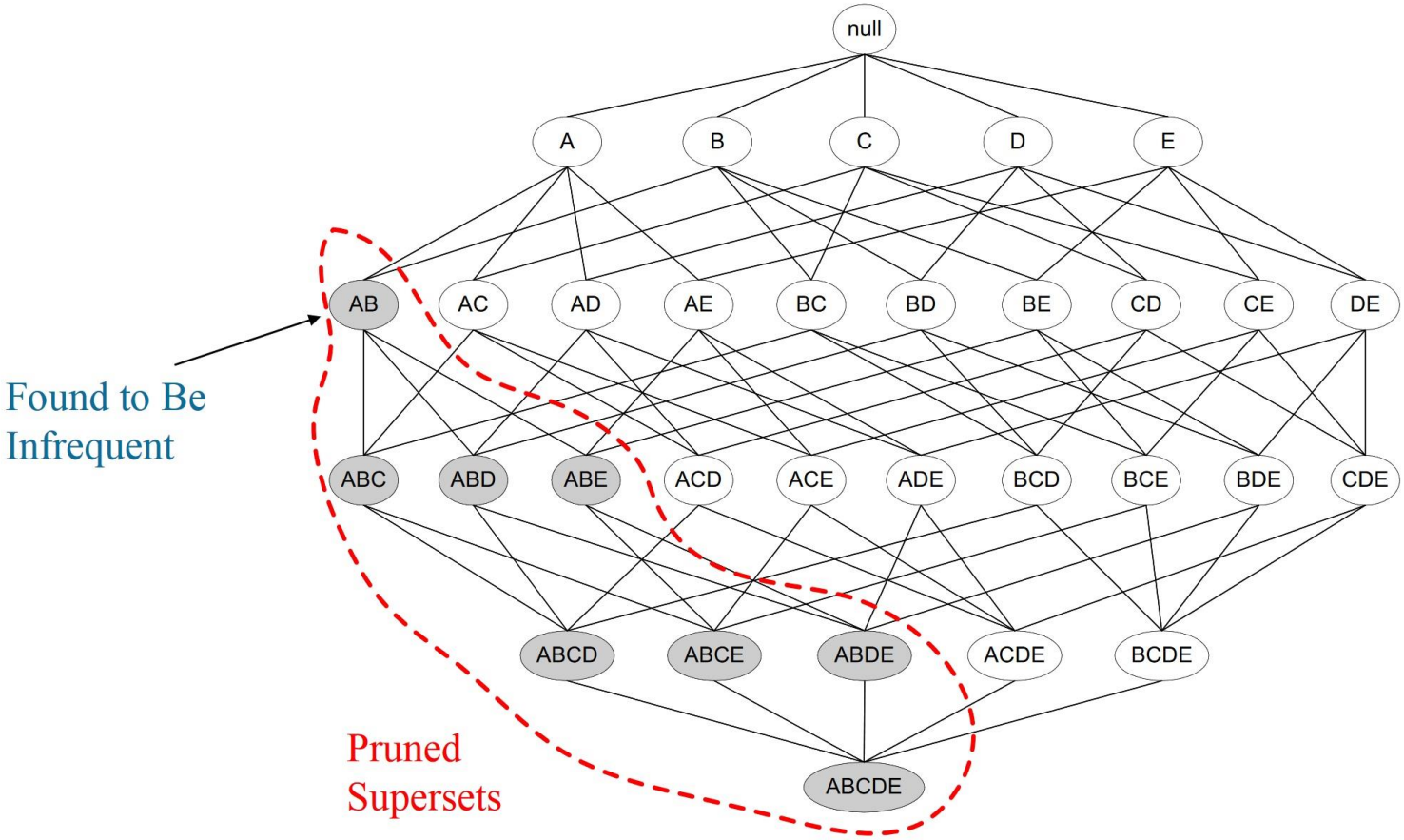


Support: P(X and Y) = 0
Conf: P(X and Y)/P(X) = 0
Lift: P(X and Y)/ P(X)*P(Y) = 0

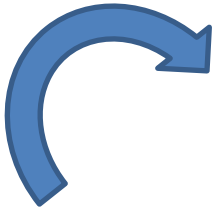


Support: P(X and Y) = low
Conf: P(X and Y)/P(X) = high
Lift: P(X and Y)/ P(X)*P(Y) = very high

Quick Reminder: The apriori algorithm



Other Ways to Represent Transaction Data



TID	Items
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5	Coke, Diaper, Milk

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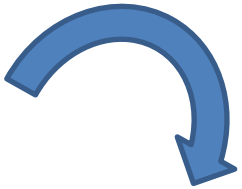
1	Bread
1	Coke
1	Milk
2	Beer
2	Bread
3	Beer
3	Coke
3	Diaper
3	Milk
4	Beer
4	Bread
4	Diaper
4	Milk
5	Coke
5	Diaper
5	Milk



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

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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

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Basic ARM R Code

```
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) **Do not want a "bag of words"** or a table of word frequencies.
2) Will need to create a "**set of transactions**" – one for each Tweet.
3) Items in the transactions will be words.

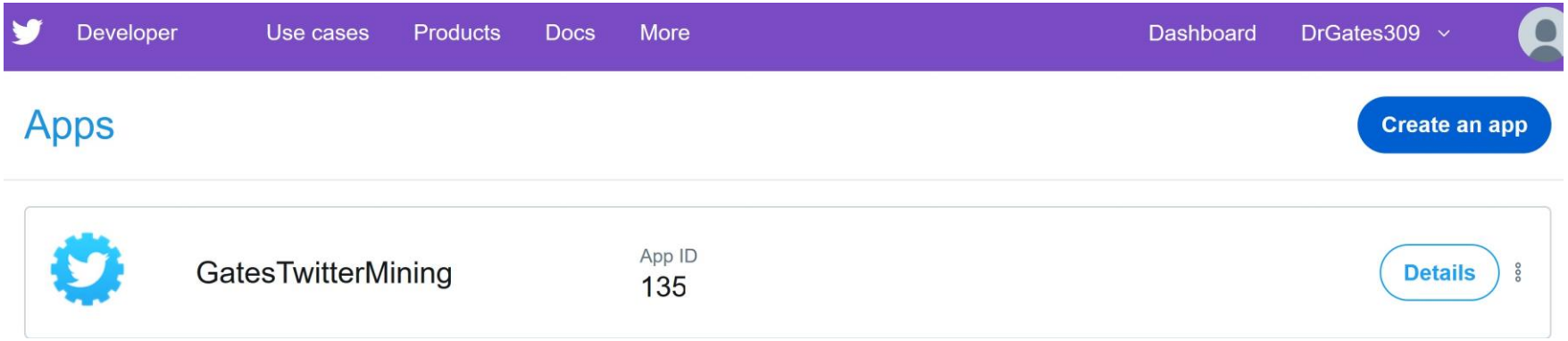
R Association Rules and Twitter: libraries

```
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
```

Set Up Twitter Dev Account First

https://developer.twitter.com/



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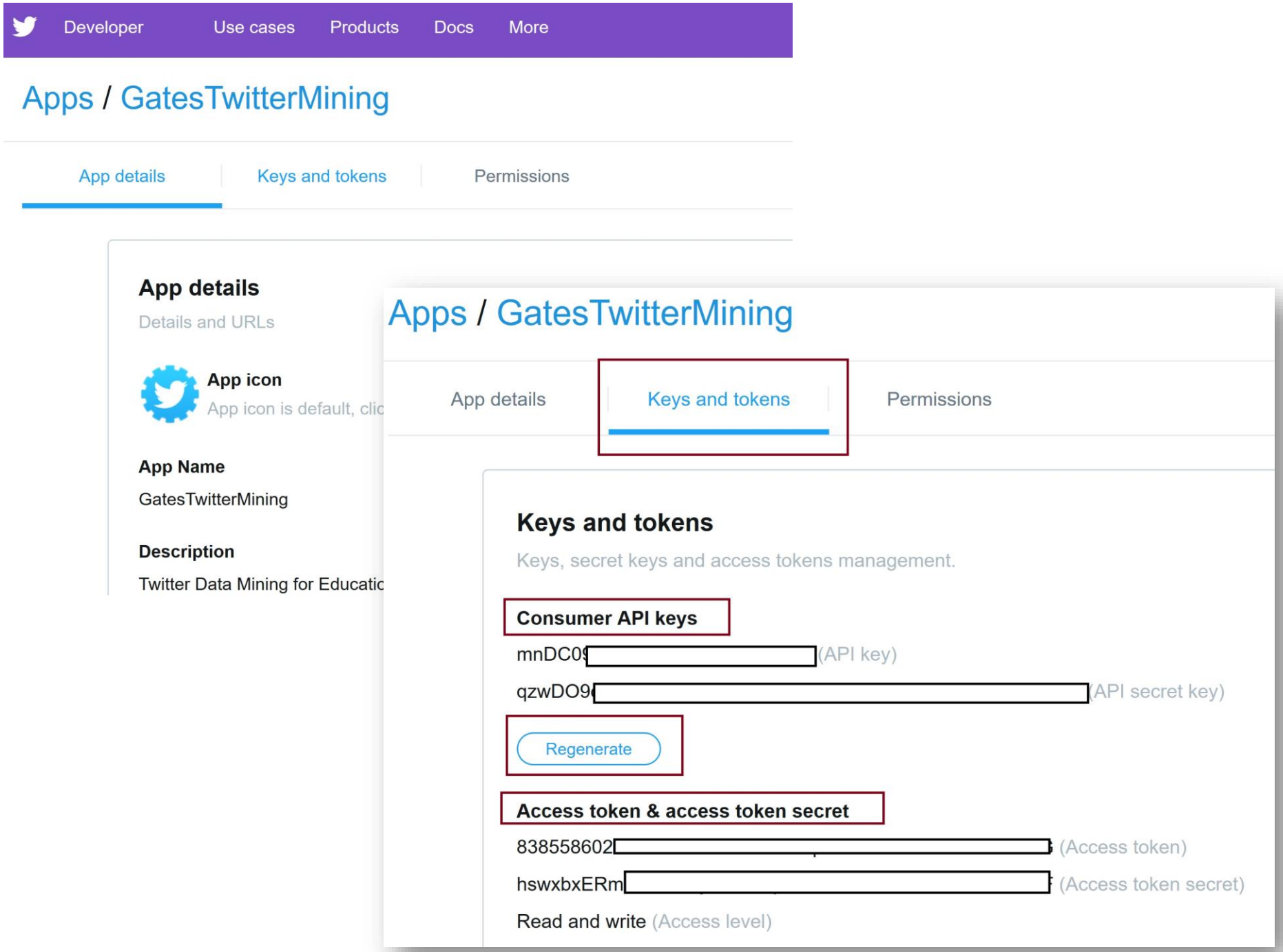
Developer
Use cases
Products
Docs
More
Apps / GatesTwitterMining
App details
Keys and tokens
Permissions
App details
Details and URLs
App icon
App icon is default, clic
App Name
GatesTwitterMining
Description
Twitter Data Mining for Educatic
Apps / GatesTwitterMining
App details
Keys and tokens
Permissions
Keys and tokens
Keys, secret keys and access tokens management.
Consumer API keys
mnDC0 (API key)
qzwDO9 (API secret key)
Regenerate
Access token & access token secret
838558602 (Access token)
hswxbxERm (Access token secret)
Read and write (Access level)

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"
```

```
                            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>
```

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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"
```

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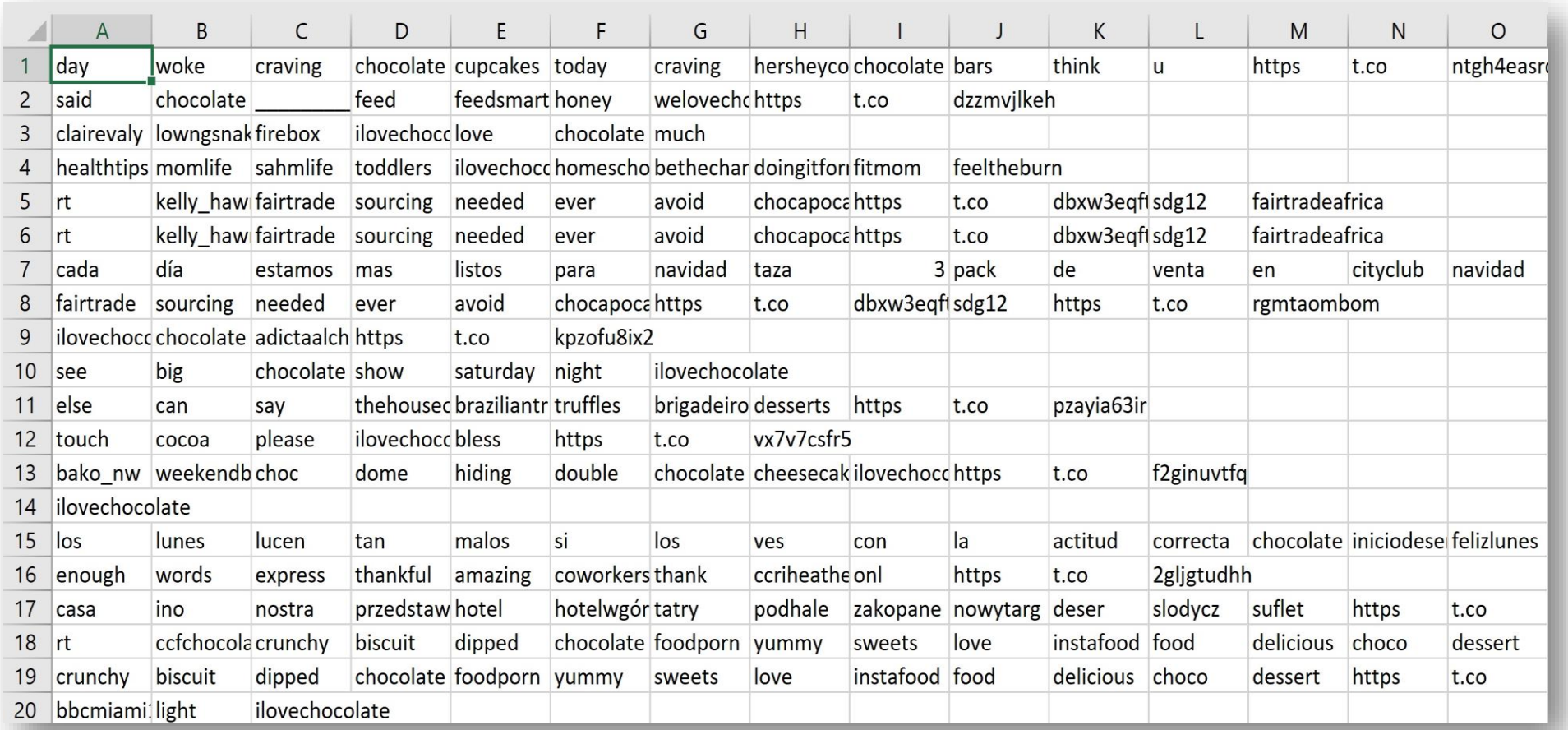
Build The Transaction File: Step 2

```
## 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



	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	welovecho	https	t.co	dzzmvjlkeh					
3	clairevaly	lowngsnak	firebox	ilovechocc	love	chocolate	much								
4	healthtips	momlife	sahmlife	toddlers	ilovechocc	homescho	bethechar	doingitfor	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												

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Read and Inspect the Transactions

```
######### 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

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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
```

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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)
```

Our Transactions

```
> (head(TweetDF,10))
               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                kelly_hawrylysh                           fairtrade      sourcing        needed
6                kelly_hawrylysh                           fairtrade      sourcing        needed
7             cada           día                             estamos           mas        listos
8
9       fairtrade       sourcing                              needed          ever         avoid
10 ilovechocolate      chocolate                      adictaalchocolate
               V6             V7                 V8        V9         V10   V11   V12            V13
1           today       craving    hersheycompany chocolate        bars think     u
2           honey welovechocolate                             dzzmvjlkeh
3       chocolate           much
4   homeschoolmom     bethechange doingitformygirls    fitmom feeltheburn
5            ever           avoid    chocapocalypse                                  fairtradeafrica
6            ever           avoid    chocapocalypse                                  fairtradeafrica
7            para         navidad              taza                 pack    de venta             en
8
9  chocapocalypse                                                                            rgmtaombom
10
       V14     V15       V16
```

```
# Now we save the dataframe using the write table command
write.table(TweetDF, file = "UpdatedChocolate.csv", col.names = FALSE,
            row.names = FALSE, sep = ",")
TweetTrans <- read.transactions("UpdatedChocolate.csv", sep =",",
            format("basket"),  rm.duplicates = TRUE)
inspect(TweetTrans)
```

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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 cleaned tweets as individual transactions.

```
TweetTrans_rules = arules::apriori(TweetTrans,
              parameter = list(support=.01, confidence=.01, minlen=2))
inspect(TweetTrans_rules[1:10])
## sorted
SortedRules_conf <- sort(TweetTrans_rules, by="confidence", decreasing=TRUE)
inspect(SortedRules_conf[1:15])

SortedRules_sup <- sort(TweetTrans_rules, by="support", decreasing=TRUE)
inspect(SortedRules_sup[1:15])
```

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```
> SortedRules_conf <- sort(TweetTrans_rules, by="confidence", decreasing=TRUE)
> inspect(SortedRules_conf[1:15])
     lhs                       rhs                 support    confidence lift      count
[1]  {light}                => {ilovechocolate}    0.01388889 1           2.571429 1
[2]  {bvlgariilcioccolato}  => {ilovechocolate}    0.01388889 1           2.571429 1
[3]  {bvlgariilcioccolato}  => {chocolate}         0.01388889 1           2.482759 1
[4]  {mourespi}             => {foramorango}       0.01388889 1          72.000000 1
[5]  {foramorango}          => {mourespi}          0.01388889 1          72.000000 1
[6]  {mourespi}             => {ilovechocolate}    0.01388889 1           2.571429 1
[7]  {foramorango}          => {ilovechocolate}    0.01388889 1           2.571429 1
[8]  {adictaalchocolate}    => {ilovechocolate}    0.01388889 1           2.571429 1
[9]  {adictaalchocolate}    => {chocolate}         0.01388889 1           2.482759 1
[10] {free}                 => {sugar}             0.01388889 1          72.000000 1
[11] {sugar}                => {free}              0.01388889 1          72.000000 1
[12] {free}                 => {days}              0.01388889 1          36.000000 1
[13] {free}                 => {ilovechocolate}    0.01388889 1           2.571429 1
[14] {free}                 => {chocolate}         0.01388889 1           2.482759 1
[15] {sugar}                => {days}              0.01388889 1          36.000000 1
>
> SortedRules_sup <- sort(TweetTrans_rules, by="support", decreasing=TRUE)
> inspect(SortedRules_sup[1:15])
     lhs                       rhs                 support    confidence lift      count
[1]  {ilovechocolate}      => {chocolate}         0.18055556 0.4642857   1.152709 13
[2]  {chocolate}           => {ilovechocolate}    0.18055556 0.4482759   1.152709 13
[3]  {yummy}               => {chocolate}         0.09722222 1.0000000   2.482759  7
[4]  {chocolate}           => {yummy}             0.09722222 0.2413793   2.482759  7
[5]  {foodporn}            => {yummy}             0.08333333 1.0000000  10.285714  6
[6]  {yummy}               => {foodporn}          0.08333333 0.8571429  10.285714  6
[7]  {foodporn}            => {chocolate}         0.08333333 1.0000000   2.482759  6
[8]  {chocolate}           => {foodporn}          0.08333333 0.2068966   2.482759  6
[9]  {foodporn,yummy}      => {chocolate}         0.08333333 1.0000000   2.482759  6
[10] {chocolate,foodporn}  => {yummy}             0.08333333 1.0000000  10.285714  6
[11] {chocolate,yummy}     => {foodporn}          0.08333333 0.8571429  10.285714  6
[12] {love}                => {chocolate}         0.06944444 1.0000000   2.482759  5
[13] {chocolate}           => {love}              0.06944444 0.1724138   2.482759  5
[14] {sweets}              => {delicious}         0.06944444 1.0000000  14.400000  5
[15] {delicious}           => {sweets}            0.06944444 1.0000000  14.400000  5
```

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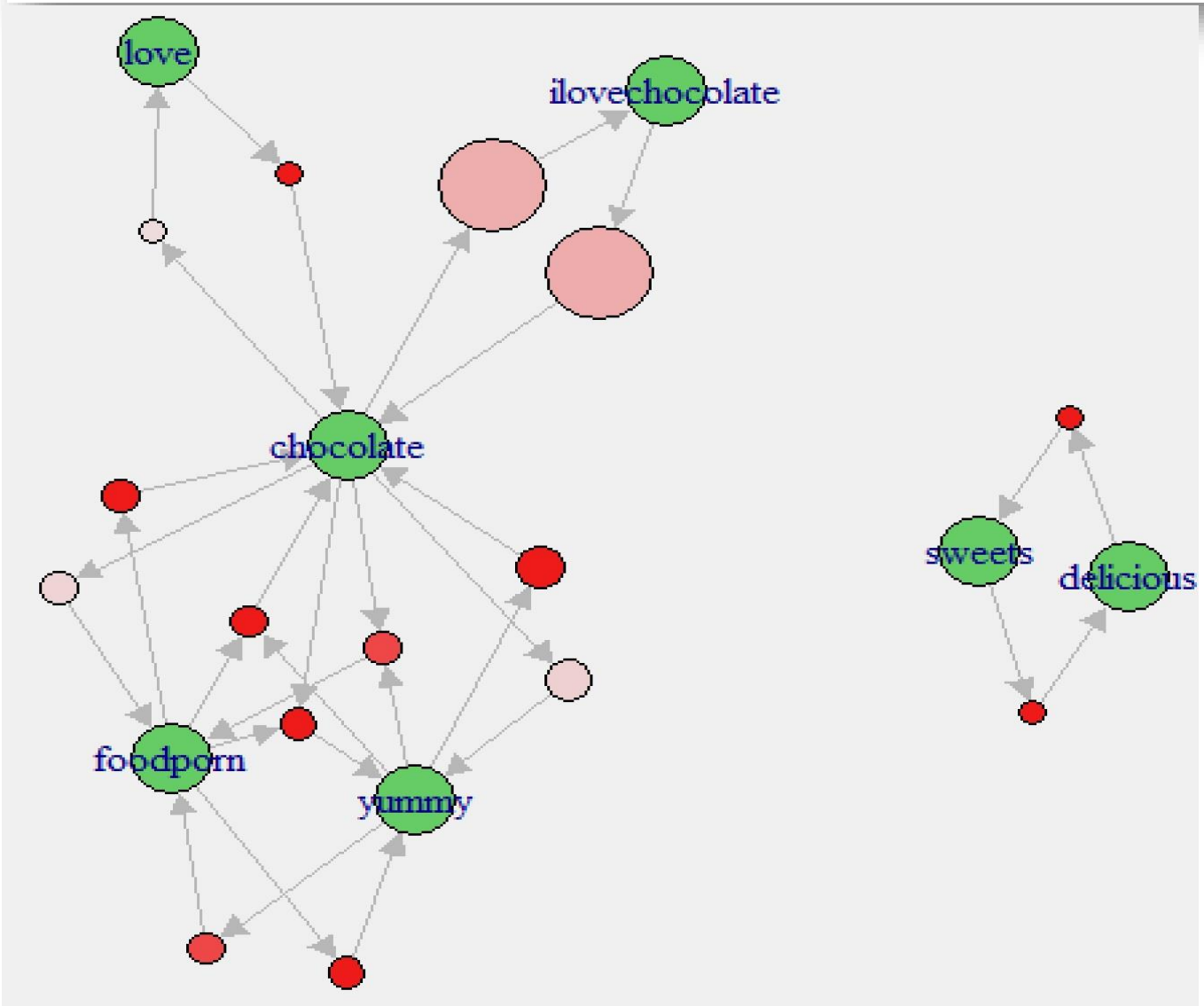
A Quick Plot

```
plot (SortedRules_sup[1:15],method="graph",interactive=TRUE,shading="confidence")
```



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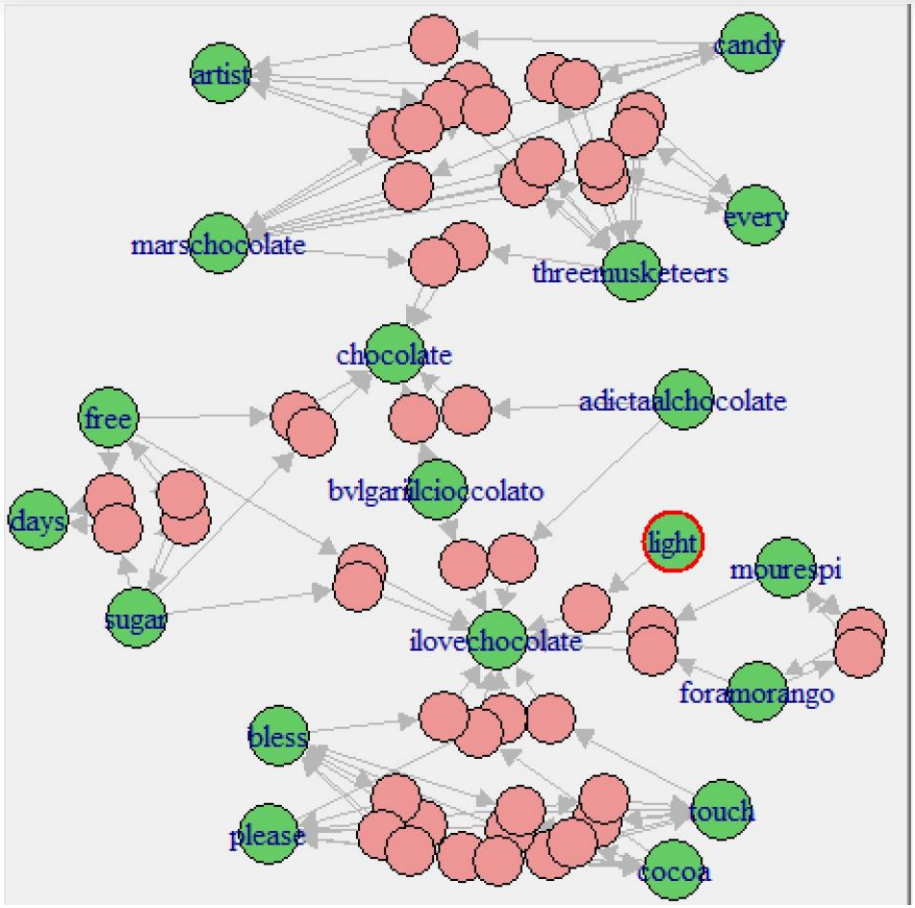
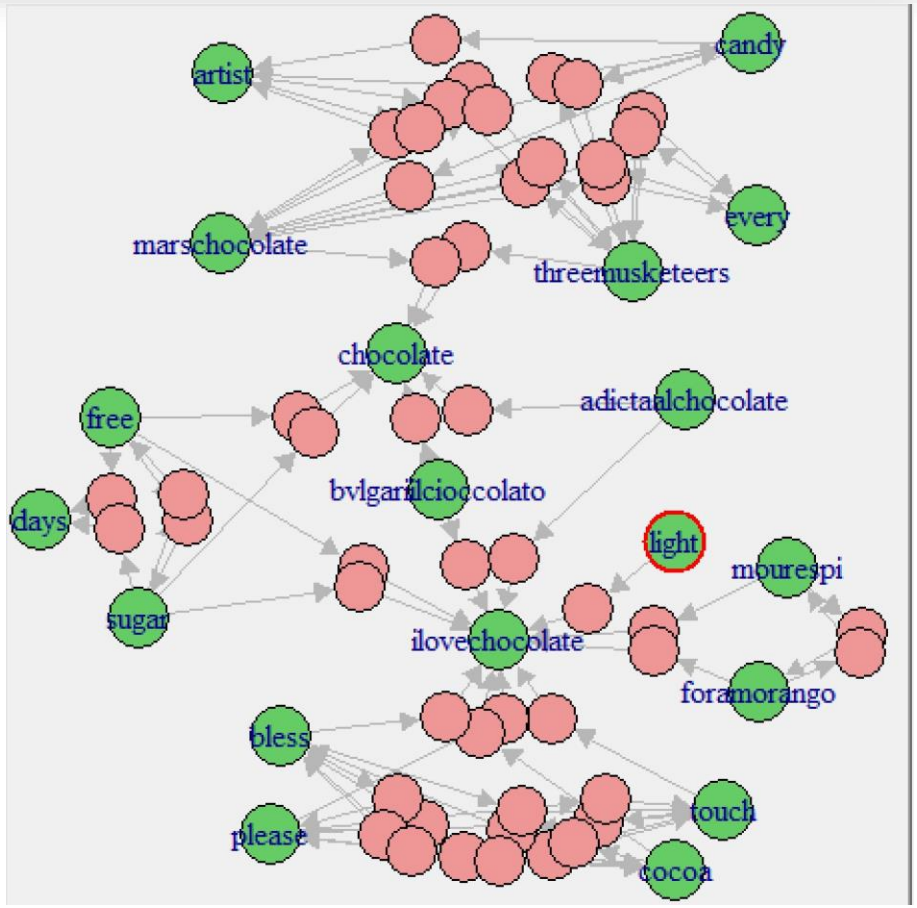
Looking at More Rules

```
plot (SortedRules_sup[1:50],method="graph",interactive=TRUE,shading="confidence")
plot (SortedRules_conf[1:50],method="graph",interactive=TRUE,shading="confidence")
```





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