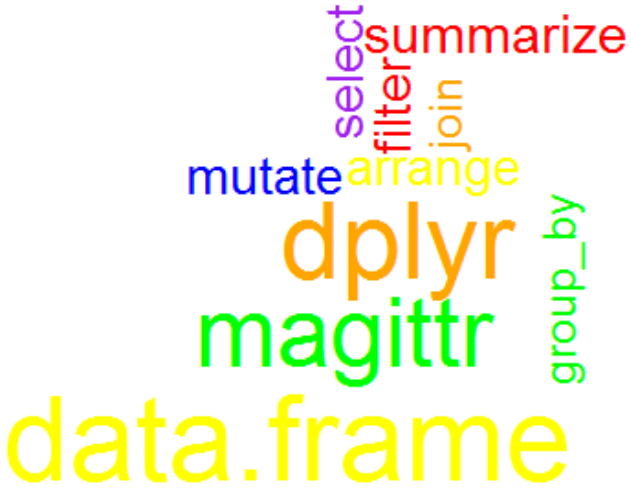
dplyr




```
wordcloud(dplyr_verb$verbs,dplyr_verb$power,random.order=T,random.color=T,colors=c("black","red","green","yellow","blue","orange","magenta","pink","purple"),rot.per=.51)
```

dplyr with pipe

```
url<-"https://sites.google.com/site/pocketecoworld/sampledata.csv"
```

```
dframe<-read.csv(url,sep=",",head=T)

require(magrittr)  # pipe %>%

require(dplyr)
```

```
dframe %>% filter( Index=='A')
# without pipe →filter(dframe,Index=='A')
dframe %>% filter(Y2005>1200000 & Index=='A')

# without pipe →filter(dframe, Y2005>1200000 & Index=='A')
```

Verbs of dplyr
filter
select
summarize
mutate
arrange
join
group_by

dplyr:select

dframe %>% *select*(Index, State)

Same as

select(dframe,Index,State)

Verbs of dplyr
Filter
select
summarize
Mutate
arrange
Join
Group_by

dplyr:combining verbs

dframe %>% ***filter***(Y2005>1200000 & Index=='A') %>%
select (State,Y2002,Y2007,Y2008)

Using magittr.pipe

Regular way

select (***filter***(dframe,Y2005>1200000 & Index=='A') State,Y2002,Y2007,Y2008)

mutating (changing)

```
mutate(select(filter(dframe,Index=='A'),State,Y2002,Y2004),
+ Y2002onY2004=Y2004/Y2002-1)
```

```
dframe %>% filter(Index =='A') %>% select (State,Y2002,Y2004) %>%
mutate(Y2002onY2004=Y2004/Y2002-1)
```

Note that mutate creates a new variable (or column)

Select NOT commutative!!!!!! with mutate or filter than…

```
dframe %>% mutate(Y2002onY2004=Y2004/Y2002-1)
%>% select (State,Y2002,Y2004)
%>% filter(Index =='A')
## WILL FAIL … WHY?
## AND what happened to my new variable….
```

dframe %>% filter(Index =='A') %>%
select (State,Y2002,Y2004) %>%
mutate(Y2002onY2004=Y2004/Y2002-1)

arrange:sorting

dframe %>% *filter* (Index == 'A') %>%
arrange(Y2002) %>% *select*
(State,Y2002,Y2004)

select(*arrange*(*filter*(*dframe*,Index == 'A'),Y2002),
State,Y2002,Y2004)

dframe %>% filter (Index == 'A') %>%
arrange(desc(Y2002)) %>% select
(State,Y2002,Y2004)

summarize

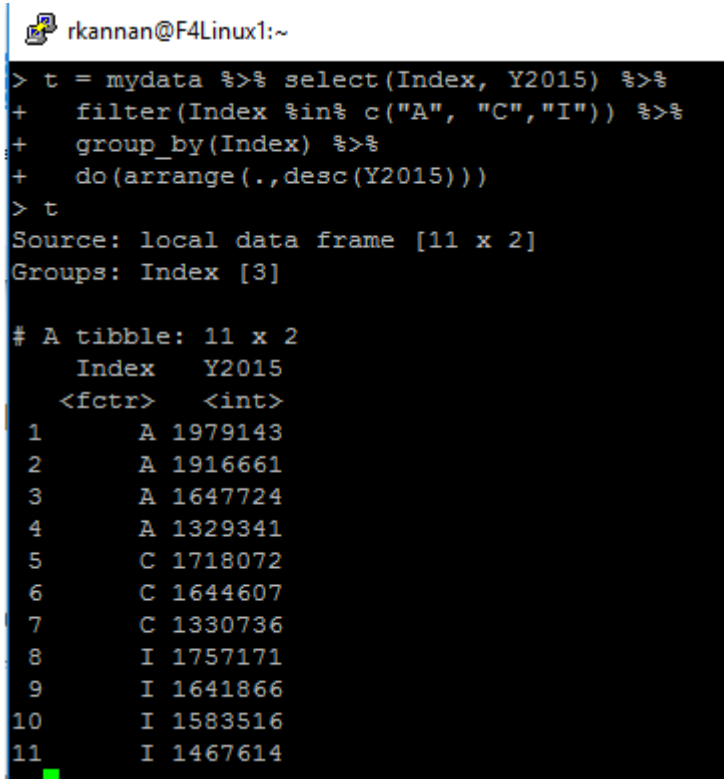
```
summarize_at(group_by(dframe,Index),vars(Y2
002:Y2004),funs(n(),mean(.,na.rm=TRUE)))
```

```
dframe %>% group_by (Index) %>%
summarize_at(vars(Y2002:Y2004),
funs(n(),mean(.,na.rm=TRUE)))
```

```
dframe %>% filter (Index %in% c("A","C","I"))
%>% group_by (Index) %>% do(head(.,2))
```

Operating on subgroups

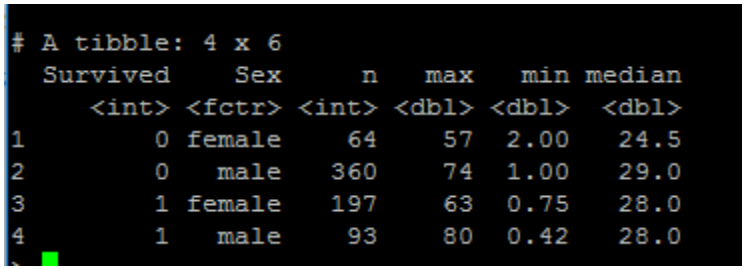
```
t = mydata %>% select(Index, Y2015) %>%
  filter(Index %in% c("A", "C","I")) %>%
  group_by(Index) %>%
  do(arrange(.,desc(Y2015)))
```



Loading titanic

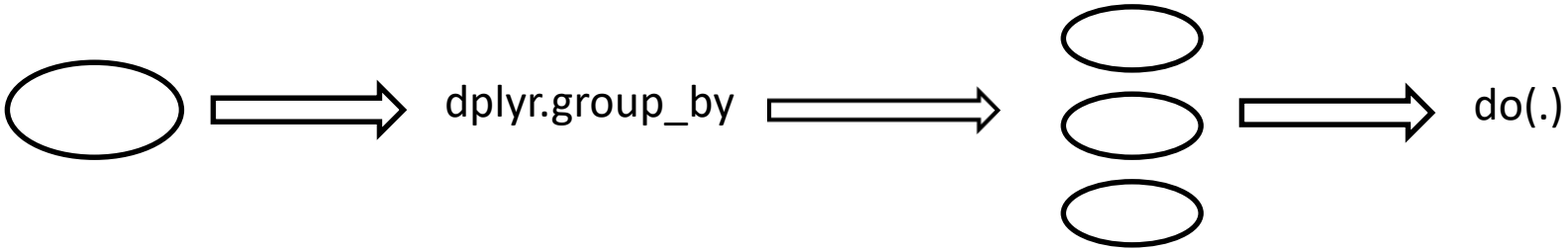
```
require(magrittr)
 require(dplyr)

titanic<-read.csv("./titanic-train.csv",head=T)
t_cc<-titanic[complete.cases(titanic),]
# what difference does it make?
dim(titanic) == dim(t_cc)
#examine
head(t_cc)
#let us find the youngest and oldest person
 t_cc %>% group_by (Survived,Sex) %>%
summarize_at(vars(Survived,Sex,Age),
funs(n(),max(Age),min(Age),median(Age)))
```



```
# A tibble: 4 x 6
  Survived    Sex     n   max   min median
     <int> <fctr> <int> <dbl> <dbl>  <dbl>
1        0 female    64    57  2.00   24.5
2        0   male   360    74  1.00   29.0
3        1 female   197    63  0.75   28.0
4        1   male    93    80  0.42   28.0
```

Group_by: processing each subgroup




```
> titanic %>% group_by(Sex) %>% do(head(select(.,Age,Sex,Name,Survived),3))
Source: local data frame [6 x 4]
Groups: Sex [2]

# A tibble: 6 x 4
    Age    Sex                                                 Name Survived
  <dbl> <fctr>                                               <fctr>    <int>
1    38 female Cumings, Mrs. John Bradley (Florence Briggs Thayer)        1
2    26 female                                  Heikkinen, Miss. Laina        1
3    35 female        Futrelle, Mrs. Jacques Heath (Lily May Peel)        1
4    22   male                                Braund, Mr. Owen Harris        0
5    35   male                               Allen, Mr. William Henry        0
6    NA   male                                       Moran, Mr. James        0
```

Join

df1<-data.frame(**first_name** = c("john", "bill", "madison", "abby", "zzz"), stringsAsFactors = FALSE)

df2<-data.frame(**name**= c("john", "bill", "madison", "abby", "thomas"), gender=c("M", "either", "M", "either", "M"),stringsAsFactors = FALSE)

```
> inner_join(df1,df2)
Error: No common variables. Please specify `by` param.
```

```
> df3<-df2
> names(df3)
[1] "name"   "gender"
> names(df1)
[1] "first_name"
> names(df3)[1]<-names(df1)
> names(df3)
[1] "first_name" "gender"
> inner_join(df1,df3)
Joining, by = "first_name"
  first_name gender
1       john      M
2       bill either
3    madison      M
4       abby either
```

We will keep df2 for other experiments.

We will copy df2 to df3 and make the names of df3 same as df1 and then do the inner_join

A data science brain must ask many questions at this time!!!

Join

df1<-data.frame(**first_name** = c("john", "bill", "madison", "abby", "zzz"), stringsAsFactors = FALSE)

df2<-data.frame(**name**= c("john", "bill", "madison", "abby", "thomas"), gender=c("M", "either", "M", "either", "M"),stringsAsFactors = FALSE)

```
> inner_join(df1,df2)
Error: No common variables. Please specify `by` param.
```

```
> inner_join(df1,df2,by=c("first_name" ="name"))
  first_name gender
1       john      M
2       bill either
3    madison      M
4       abby either
>
```

Join

df1<-data.frame(first_name = c("john", "bill", "madison", "abby", "zzz"), stringsAsFactors = FALSE)

df2<-data.frame(name= c("john", "bill", "madison", "abby", "thomas"), gender=c("M", "either", "M", "either", "M"),stringsAsFactors = FALSE)

```
> left_join(df1,df2,by=c("first_name" = "name"))
  first_name gender
1       john      M
2       bill either
3    madison      M
4       abby either
5        zzz   <NA>
> left_join(df1,df2,c("first_name" = "name"))
  first_name gender
1       john      M
2       bill either
3    madison      M
4       abby either
5        zzz   <NA>
```

Join

df1<-data.frame(first_name = c("john", "bill", "madison", "abby", "zzz"), stringsAsFactors = FALSE)

df2<-data.frame(name= c("john", "bill", "madison", "abby", "thomas"), gender=c("M", "either", "M", "either", "M"),stringsAsFactors = FALSE)

```
> right_join(df1,df2,by=c("first_name" ="name"))
  first_name gender
1       john      M
2       bill either
3    madison      M
4       abby either
5     thomas      M
>
```

Random → uncorrelated

```
x<-rnorm(100)
y<-rnorm(100)
```

What levels of correlation is acceptable between X and Y given they were randomly generated?

```
cor(x,y)
[1] 0.1480642
```

Is 14% correlation acceptable?
0% is perfectly uncorrelated.

```
LMOBJ<-lm(y~x)
```

R functions return something…mostly gets evaluated by the R-Shell. Default evaluation is to print it to the console. Assigning to LMOBJ prevents further evaluation.

```
> lm(y~x)

Call:
lm(formula = y ~ x)

Coefficients:
(Intercept)            x
    0.09244      0.17713

> invisible(lm(y~x))
>
```

Here lm returns an object and it is evaluated. Printing partially.

We can suppress it with invisible.

Inside R objects

You just downloaded a great new package and you want to find what the package functions return. Let us start with good old OLS function lm.

```
x<-rnorm(100)
y<-rnorm(100)
```

R functions return something…mostly gets evaluated by the R-Shell. Default evaluation is to print it to the console. Assigning to LMOBJ prevents further evaluation.

```
LMOBJ<-lm(y~x)
```

```
> lm(y~x)

Call:
lm(formula = y ~ x)

Coefficients:
(Intercept)            x
    0.09244      0.17713

> invisible(lm(y~x))
>
```

Here lm returns an object and it is evaluated. Printing partially.

We can suppress it with invisible.

Inside an lm object:str(lmobj)

```
> str(LMOBJ)
List of 12
 $ coefficients : Named num [1:2] 0.0924 0.1771
  ..- attr(*, "names")= chr [1:2] "(Intercept)" "x"
 $ residuals    : Named num [1:100] -0.125 0.736 -0.959 -2.665 -0.209 ...
  ..- attr(*, "names")= chr [1:100] "1" "2" "3" "4" ...
 $ effects      : Named num [1:100] -1.056 1.645 -0.763 -2.581 -0.257 ...
  ..- attr(*, "names")= chr [1:100] "(Intercept)" "x" "" "" ...
 $ rank         : int 2
 $ fitted.values: Named num [1:100] 0.2392 0.0797 0.5325 0.2821 -0.0165 ...
  ..- attr(*, "names")= chr [1:100] "1" "2" "3" "4" ...
 $ assign       : int [1:2] 0 1
 $ qr           :List of 5
  ..$ qr   : num [1:100, 1:2] -10 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 ...
  .. ..- attr(*, "dimnames")=List of 2
  .. .. ..$ : chr [1:100] "1" "2" "3" "4" ...
  .. .. ..$ : chr [1:2] "(Intercept)" "x"
  .. ..- attr(*, "assign")= int [1:2] 0 1
  ..$ qraux: num [1:2] 1.1 1.02
  ..$ pivot: int [1:2] 1 2
  ..$ tol  : num 1e-07
  ..$ rank : int 2
  ..- attr(*, "class")= chr "qr"
 $ df.residual  : int 98
 $ xlevels      : Named list()
 $ call         : language lm(formula = y ~ x)
 $ terms        :Classes 'terms', 'formula'  language y ~ x
  .. ..- attr(*, "variables")= language list(y, x)
  .. ..- attr(*, "factors")= int [1:2, 1] 0 1
  .. .. ..- attr(*, "dimnames")=List of 2
```

LMOBJ$residuals == (LMOBJ$model$y - LMOBJ$fitted.values)

Lm returns a list of 12 objects

```
$ call          : language lm(formula = y ~ x)
$ terms         :Classes 'terms', 'formula'  language y ~ x
 .. ..- attr(*, "variables")= language list(y, x)
 .. ..- attr(*, "factors")= int [1:2, 1] 0 1
 .. .. ..- attr(*, "dimnames")=List of 2
 .. .. .. ..$ : chr [1:2] "y" "x"
 .. .. .. ..$ : chr "x"
 .. ..- attr(*, "term.labels")= chr "x"
 .. ..- attr(*, "order")= int 1
 .. ..- attr(*, "intercept")= int 1
 .. ..- attr(*, "response")= int 1
 .. ..- attr(*, ".Environment")=<environment: R_GlobalEnv>
 .. ..- attr(*, "predvars")= language list(y, x)
 .. ..- attr(*, "dataClasses")= Named chr [1:2] "numeric" "numeric"
 .. .. ..- attr(*, "names")= chr [1:2] "y" "x"
$ model         :'data.frame':  100 obs. of  2 variables:
 ..$ y: num [1:100] 0.114 0.816 -0.426 -2.383 -0.225 ...
 ..$ x: num [1:100] 0.828 -0.072 2.484 1.071 -0.615 ...
 ..- attr(*, "terms")=Classes 'terms', 'formula'  language y ~ x
 .. .. ..- attr(*, "variables")= language list(y, x)
 .. .. ..- attr(*, "factors")= int [1:2, 1] 0 1
 .. .. .. ..- attr(*, "dimnames")=List of 2
 .. .. .. .. ..$ : chr [1:2] "y" "x"
 .. .. .. .. ..$ : chr "x"
 .. .. ..- attr(*, "term.labels")= chr "x"
 .. .. ..- attr(*, "order")= int 1
 .. .. ..- attr(*, "intercept")= int 1
 .. .. ..- attr(*, "response")= int 1
 .. .. ..- attr(*, ".Environment")=<environment: R_GlobalEnv>
 .. .. ..- attr(*, "predvars")= language list(y, x)
 .. .. ..- attr(*, "dataClasses")= Named chr [1:2] "numeric" "numeric"
 .. .. .. ..- attr(*, "names")= chr [1:2] "y" "x"
- attr(*, "class")= chr "lm"
```

[1] "coefficients"
[2] "residuals"
[3] "effects"
[4] "rank"
[5] "fitted.values"
[6] "assign"
[7] "qr"
[8] "df.residual"
[9] "xlevels"
[10] "call"
[11] "terms"
[12] "model"

Basics in R:dissecting R Objects

```
> uLMOBJ<-unclass(LMOBJ)
> names(uLMOBJ)
 [1] "coefficients"  "residuals"     "effects"       "rank"
 [5] "fitted.values" "assign"        "qr"            "df.residual"
 [9] "xlevels"       "call"          "terms"         "model"
> uLMOBJ$coefficients
(Intercept)           x
 0.09244066  0.17712573
> uLMOBJ$coefficients[[1]]
[1] 0.09244066
> uLMOBJ$coefficients[1]
(Intercept)
 0.09244066
>
```

Dissecting lm

```
> names(LMOBJ)
 [1] "coefficients"  "residuals"     "effects"       "rank"
 [5] "fitted.values" "assign"        "qr"            "df.residual"
 [9] "xlevels"       "call"          "terms"         "model"
>
```

```
> typeof(LMOBJ)
[1] "list"
> LMOBJ[[1]]
(Intercept)           x
 0.09244066  0.17712573
```

SVD

r1<-c(3, −1, 2, −5, 4, 1)
r2<-c(4, 2, −3, −1, 1, 3)
r3<-c(−1, 5, 4, 2, −3, −2)
r4<-c(3, 1, 2, −3, 0, −3)
r5<-c(−5, 4, −2, 2, −5, −1)

```
> m2
   [,1] [,2] [,3] [,4] [,5] [,6]
r1    3   -1    2   -5    4    1
r2    4    2   -3   -1    1    3
r3   -1    5    4    2   -3   -2
r4    3    1    2   -3    0   -3
r5   -5    4   -2    2   -5   -1
> svd_m2<-svd(m2)
> str(svd_m2)
List of 3
 $ d: num [1:5] 12.43 7.56 5.71 3.28 2.66
 $ u: num [1:5, 1:5] -0.546 -0.235 0.424 -0.173 0.661 ...
 $ v: num [1:6, 1:5] -0.549 0.376 -0.029 0.455 -0.563 ...
> ??svd
> svd_m2$d
[1] 12.427510  7.561830  5.706228  3.278029  2.658798
> svd_m2$u %*% svd_m2$d %*% t(svd_m2$v)
Error in svd_m2$u %*% svd_m2$d %*% t(svd_m2$v) :
  non-conformable arguments
> svd_m2$u %*% diag(svd_m2$d) %*% t(svd_m2$v)
     [,1] [,2] [,3] [,4]          [,5] [,6]
[1,]    3   -1    2   -5  4.000000e+00    1
[2,]    4    2   -3   -1  1.000000e+00    3
[3,]   -1    5    4    2 -3.000000e+00   -2
[4,]    3    1    2   -3 -2.220446e-16   -3
[5,]   -5    4   -2    2 -5.000000e+00   -1
> round(svd_m2$u %*% diag(svd_m2$d) %*% t(svd_m2$v))
     [,1] [,2] [,3] [,4] [,5] [,6]
[1,]    3   -1    2   -5    4    1
[2,]    4    2   -3   -1    1    3
[3,]   -1    5    4    2   -3   -2
[4,]    3    1    2   -3    0   -3
[5,]   -5    4   -2    2   -5   -1
>
```