Basic concepts with R (part 4)

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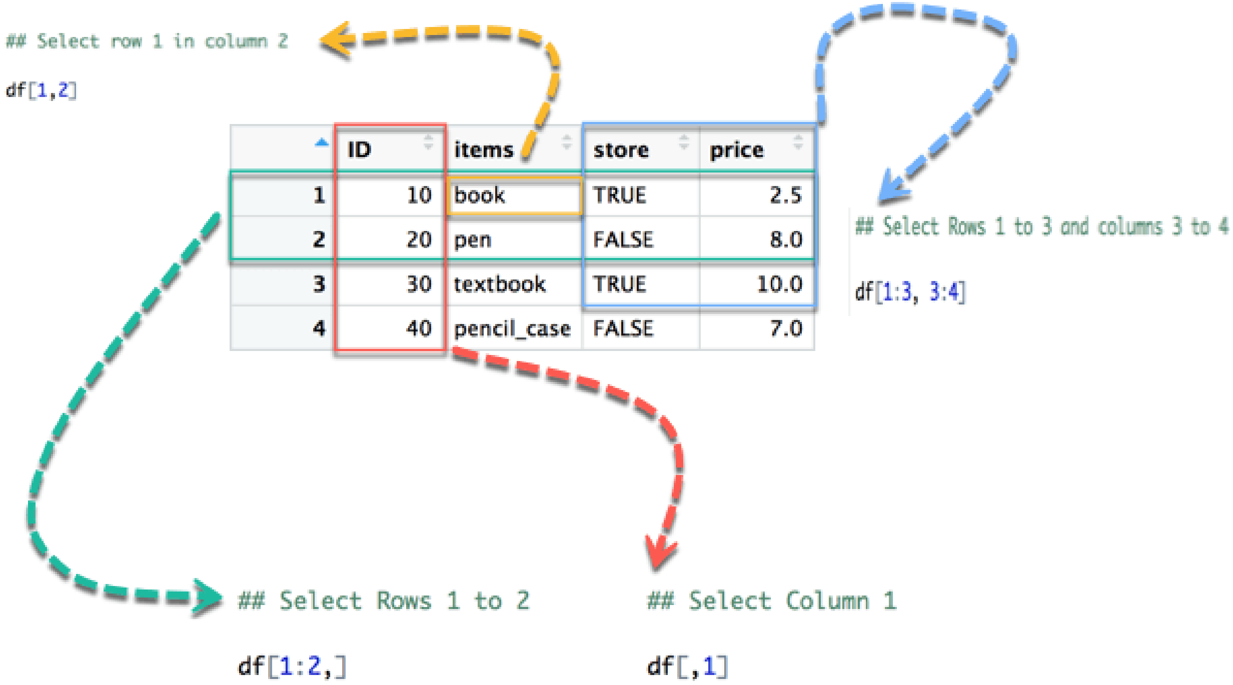
Contents

1 Introduction

In this tutorial we will work with data frames. On my little experience using R for language analysis, data frames are probably the most useful data structure. It is also important to say that there is a number of operations on data frames that probably will not be covered in this tutorial, mostly because they are so many, that we will learn them along the way.

2 Data Frames

Data frames are matrices like two-dimensional rectangular structures. However, they bring an important difference: data frame columns do not need to be all of the same data kind. In other words, we cam mix up, numbers, characters, logical, date in a complex table. A example would be:



```
## Select row 1 in column 2

df[1,2]
```

	ID	items	store	price
1	10	book	TRUE	2.5
2	20	pen	FALSE	8.0
3	30	textbook	TRUE	10.0
4	40	pencil_case	FALSE	7.0

```
## Select Rows 1 to 3 and columns 3 to 4

df[1:3, 3:4]
```

```
## Select Rows 1 to 2

df[1:2,]
```

```
## Select Column 1

df[,1]
```

Figure 1: A Data Frame in R | source: https://www.guru99.com/r-data-frames.html

Naturally there are restrictions, since such a freedom concerns only the kind of data represented within each column. for example, in the table that follows:

```
##        Names  Birthdays Gender Life.Status Possible.Age
## 1    Astolfo 1907-06-22   male       FALSE          113
## 2 Eleutério 1987-07-12   male        TRUE           33
## 3    Alarico 1941-11-10   male       FALSE           79
## 4    Genésia 1940-11-15 female        TRUE           80
## 5   Gioconda 1910-07-03 female       FALSE          110
## 6     Ondina 1982-06-21 female        TRUE           38
```

1. *Names* -> characters
2. *Birthdays* -> date
3. *Gender* -> characters
4. *Life Status* -> logical
5. *Possible age* -> numeric

Let us build this data frame:

```
names <- c('Astolfo', "Eleutério", "Alarico", "Genésia","Gioconda","Ondina")
birthdays <- as.Date(c("1907-06-22","1987-07-12","1941-11-10",
                      "1940-11-15","1910-07-03","1982-06-21"))
gender <- c("male","male",'male', "female","female","female")
life.status <- c(FALSE,TRUE,FALSE,TRUE,FALSE,TRUE)
possible.age <- c(113,33, 79,80,110,38)
my.data.frame <- data.frame(names,birthdays,gender,life.status,possible.age)
colnames(my.data.frame) <- c("Names", 'Birthdays',"Gender","Life.Status",
                            "Possible.Age")
my.data.frame
```

```
##       Names  Birthdays Gender Life.Status Possible.Age
## 1   Astolfo 1907-06-22   male       FALSE          113
## 2 Eleutério 1987-07-12   male        TRUE           33
## 3   Alarico 1941-11-10   male       FALSE           79
## 4   Genésia 1940-11-15 female        TRUE           80
## 5  Gioconda 1910-07-03 female       FALSE          110
## 6    Ondina 1982-06-21 female        TRUE           38
```

In the code above:

1. We created 5 vectors (2 characters, 1 logical, 1 number and 1 date)
2. These vectors were merged into a data frame using the command `data.frame()`
3. When I merge vectors into a data frame, the name of my vectors become the name of the columns
4. The command `colnames()` allows me to change that to a more "clear" set of names.

- Note that the new names is in a vector and it has on name per column, not more, not less.

Now let us check its structure:

```
str(my.data.frame)
```

```
## 'data.frame':    6 obs. of  5 variables:
##  $ Names       : chr  "Astolfo" "Eleutério" "Alarico" "Genésia" ...
##  $ Birthdays   : Date, format: "1907-06-22" "1987-07-12" ...
##  $ Gender      : chr  "male" "male" "male" "female" ...
##  $ Life.Status : logi  FALSE TRUE FALSE TRUE FALSE TRUE
##  $ Possible.Age: num  113 33 79 80 110 38
```

The command `str()` brings us first idea of our data frame. Besides what we already know, it tells me `my.data.frame` has 6 observations (rows) and 5 variables (columns). Let us try something new:

```
summary(my.data.frame)
```

```
##     Names             Birthdays             Gender           Life.Status
##  Length:6           Min.   :1907-06-22  Length:6           Mode :logical
##  Class :character   1st Qu.:1918-02-04  Class :character   FALSE:3
##  Mode  :character   Median :1941-05-14  Mode  :character   TRUE :3
##                     Mean   :1945-02-12
##                     3rd Qu.:1972-04-25
##                     Max.   :1987-07-12
##   Possible.Age
##  Min.   : 33.00
##  1st Qu.: 48.25
##  Median : 79.50
##  Mean   : 75.50
##  3rd Qu.:102.50
##  Max.   :113.00
```

The command `summary()` brings a different kind of information:

1. In **character** columns, it shows the number of observations and the class

2. In **date** and **numeric** columns it prints the minimum, maximum, median and mean values
3. In **logical** columns it brings the summary of *TRUE* e *FALSE* occurrences

Some particularities of data frames should be kept in mind:

- The column names cannot be empty
- Row names have to be unique
- Each column have to consist of same number of items

3 Subetting a data frame

There are some ways of accessing data inside a data frame, here we are going to discuss some

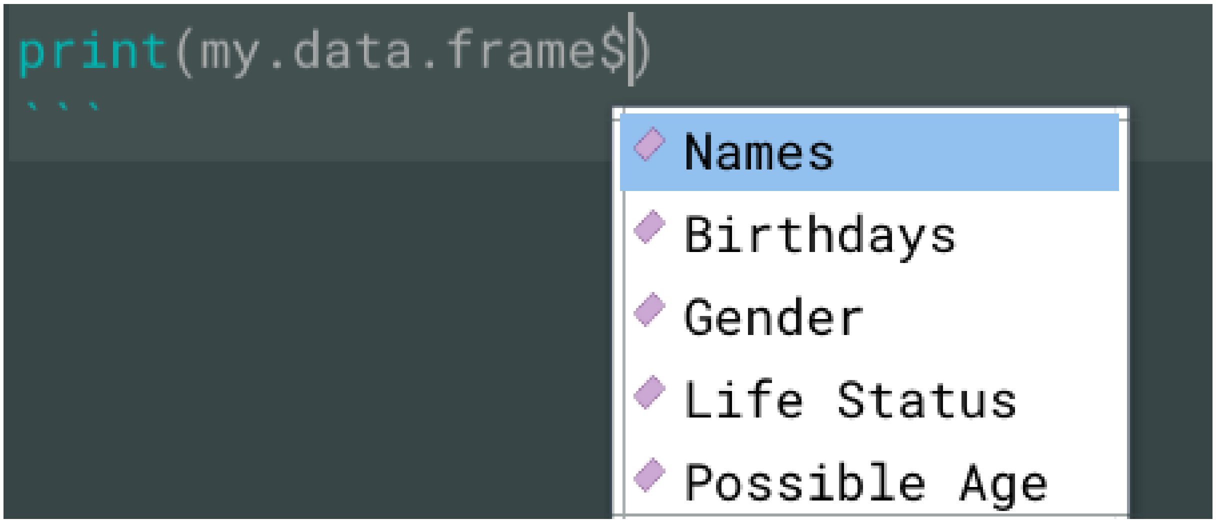
3.1 Dollar sign ($)

The dollar sign help us to access a column inside a data frame. This is useful for both creating a new variable or telling another command to use that specific data:

```
print(my.data.frame$Names)
```

```
## [1] "Astolfo"   "Eleutério" "Alarico"   "Genésia"   "Gioconda"  "Ondina"
```

The beauty of it is that your IDE already recognise the columns and will give you a hand:



```
print(my.data.frame$)
```

Figure 2: The dollar sign

3.2 Indexing

The index system we learnt to manipulate matrices is also useful for data frames. So we can access specific values inside a matrix.

Accessing a single cell

```
my.data.frame[4,3]
```

```
## [1] "female"
```

```
my.data.frame[2,1]
```

```
## [1] "Eleutério"
```

Accessing a line:

```
my.data.frame[4,]
```

```
##     Names  Birthdays Gender Life.Status Possible.Age
## 4 Genésia 1940-11-15 female        TRUE           80
```

```
my.data.frame[2,]
```

```
##       Names  Birthdays Gender Life.Status Possible.Age
## 2 Eleutério 1987-07-12   male        TRUE           33
```

Accessing a column

```
my.data.frame[,4]
```

```
## [1] FALSE  TRUE FALSE  TRUE FALSE  TRUE
```

```
my.data.frame[,2]
```

```
## [1] "1907-06-22" "1987-07-12" "1941-11-10" "1940-11-15" "1910-07-03"
## [6] "1982-06-21"
```

Accessing and interval of columns

```
my.data.frame[,1:3]
```

```
##       Names  Birthdays Gender
## 1   Astolfo 1907-06-22   male
## 2 Eleutério 1987-07-12   male
## 3   Alarico 1941-11-10   male
## 4   Genésia 1940-11-15 female
## 5  Gioconda 1910-07-03 female
## 6    Ondina 1982-06-21 female
```

Accessing and interval of rows (also applicable to columns)

```
my.data.frame[1:3,]
```

```
##       Names  Birthdays Gender Life.Status Possible.Age
## 1   Astolfo 1907-06-22   male       FALSE          113
## 2 Eleutério 1987-07-12   male        TRUE           33
## 3   Alarico 1941-11-10   male       FALSE           79
```

```
my.data.frame[1:3,4]
```

```
## [1] FALSE  TRUE FALSE
```

Accessing a couple of columns or rows

```
gender.and.age <- my.data.frame[,c(1,3,5)]
gender.and.age
```

```
##       Names Gender Possible.Age
## 1   Astolfo   male          113
## 2 Eleutério   male           33
## 3   Alarico   male           79
## 4   Genésia female           80
## 5  Gioconda female          110
## 6    Ondina female           38
```

3.3 Subset() command

The ‘subset()’ help us to get information regarding specific values

```
women <- subset(my.data.frame, Gender == "female")
women
```

```
##      Names  Birthdays Gender Life.Status Possible.Age
## 4  Genésia 1940-11-15 female        TRUE           80
## 5 Gioconda 1910-07-03 female       FALSE          110
## 6   Ondina 1982-06-21 female        TRUE           38
```

Combining two subsets

```
older.women <- subset(my.data.frame, Gender == "female" & Possible.Age > 50)
older.women
```

```
##      Names  Birthdays Gender Life.Status Possible.Age
## 4  Genésia 1940-11-15 female        TRUE           80
## 5 Gioconda 1910-07-03 female       FALSE          110
```

4 Expading

Data frames can be expanded in a number of different ways:

4.1 Addding a column

If we have a vector, we can easily make it a new column using the dollar sign (**$**):

```
place.of.birth <- rep("SP",6)
place.of.birth
```

```
## [1] "SP" "SP" "SP" "SP" "SP" "SP"
```

```
my.data.frame$Birthplace <- place.of.birth
my.data.frame
```

```
##       Names  Birthdays Gender Life.Status Possible.Age Birthplace
## 1   Astolfo 1907-06-22   male       FALSE          113         SP
## 2 Eleutério 1987-07-12   male        TRUE           33         SP
## 3   Alarico 1941-11-10   male       FALSE           79         SP
## 4   Genésia 1940-11-15 female        TRUE           80         SP
## 5  Gioconda 1910-07-03 female       FALSE          110         SP
## 6    Ondina 1982-06-21 female        TRUE           38         SP
```

4.2 Adding a row

Actually it is technically not possible to add new rows. What I have to do is to create a new data frame:

```
new.name <- "Esmeralda"
new.Birthday <- as.Date('1930-10-24')
new.gender <- 'female'
new.LS <- TRUE
New.age <- 90
newBP <- "RJ"
my.data.frame.2 <- data.frame(new.name,new.Birthday,
                              new.gender,new.LS,New.age,
                              newBP)
colnames(my.data.frame.2) <- c("Names", 'Birthdays',"Gender","Life.Status",
                            "Possible.Age","Birthplace")
my.data.frame.2
```

```
##       Names  Birthdays Gender Life.Status Possible.Age Birthplace
## 1 Esmeralda 1930-10-24 female        TRUE           90         RJ
```

Then merge both by their rows:

```
my.data.frame <- rbind(my.data.frame,my.data.frame.2)
my.data.frame
```

```
##       Names  Birthdays Gender Life.Status Possible.Age Birthplace
## 1   Astolfo 1907-06-22   male       FALSE          113         SP
## 2 Eleutério 1987-07-12   male        TRUE           33         SP
## 3   Alarico 1941-11-10   male       FALSE           79         SP
## 4   Genésia 1940-11-15 female        TRUE           80         SP
## 5  Gioconda 1910-07-03 female       FALSE          110         SP
## 6    Ondina 1982-06-21 female        TRUE           38         SP
## 7 Esmeralda 1930-10-24 female        TRUE           90         RJ
```

Data frames can also be joined by columns. For example, create a data frame with some new information:

```
Country <- data.frame(rep("Brasil", 7))
colnames(Country) <- "Country"
```

Then join them:

```
cbind(my.data.frame,Country)
```

```
##       Names  Birthdays Gender Life.Status Possible.Age Birthplace Country
## 1   Astolfo 1907-06-22   male       FALSE          113         SP  Brasil
## 2 Eleutério 1987-07-12   male        TRUE           33         SP  Brasil
## 3   Alarico 1941-11-10   male       FALSE           79         SP  Brasil
## 4   Genésia 1940-11-15 female        TRUE           80         SP  Brasil
## 5  Gioconda 1910-07-03 female       FALSE          110         SP  Brasil
## 6    Ondina 1982-06-21 female        TRUE           38         SP  Brasil
## 7 Esmeralda 1930-10-24 female        TRUE           90         RJ  Brasil
```

For more complex data frame operations, please, see the next tutorials.