Importing Data Into R

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Data Sets

- The majority of data analysis tasks uses as source data sets stored in a tabular format
- A data set is a bi-dimensional structure (a table)
  - Rows represent observations of a phenomenon
  - Columns contain information obtained for each observation
- The R data structure used to store these tables is the *data frame*
- In the following slides we will see illustrations on how to import data stored in different formats/infra-structures into a R data frame

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Internal R Data Sets

- Any R installation includes many data sets. The list can be obtained doing:

```
data()
```

- Each new package we install may also add new data sets for illustration purposes

```
data(package = "DMwR")   # data sets from a specific package
data(package = .packages(all.available = TRUE))   # all packages
```

- This type of data sets can be used/loaded using the function `data`

```
data(iris)
head(iris)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
## 4          4.6         3.1          1.5         0.2  setosa
## 5          5.0         3.6          1.4         0.2  setosa
## 6          5.4         3.9          1.7         0.4  setosa
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```

The RData file format

- Any data frame (in reality any R object) may be saved in a RData file

```
dat <- data.frame(x = rnorm(10), y = rnorm(10))
save(dat, file = "exp.RData")
```

- These data may be loaded back into R later

```
rm(dat)  # remove dat from the computer memory
dat  # just checking that they are not there

## Error:  object 'dat' not found

load("exp.RData")  # load them back from the file
head(dat)  # here they are again!

##          x       y
## 1 -0.5808 -0.4523
## 2 -0.2021  1.1401
## 3  0.2965 -0.5049
## 4 -0.2556 -1.2219
## 5  0.7552  1.0521
## 6  0.4378 -2.2693
```

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Importing data from text files

- Text files are a frequent way of storing and sharing data sets
  - Rows of the file usually correspond two rows of the data set
  - Values in the columns stored in a single row separated by some special character
- Text files are frequently the easiest way of importing data into R from other tools

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CSV files

The values on each line are separated by commas

File “x.csv”

```
ID, Name, Age
23424, Ana, 45
11234, Charles, 23
77654, Susanne, 76
```

To read the data into a data frame:

```
dat <- read.csv("x.csv",
                header=TRUE)
dat
```

```
##       ID     Nome Idade
## 1  23424      Ana    45
## 2  11234   Carlos    23
## 3  77654   Susana    76
```

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Variations of the CSV format

On countries where the comma is used as a decimal separator it is common to use the semi-colon to separate values

File “y.csv”

```
ID; Name; Grade
23424; Ana; 4,6
11234; Charles; 12,3
77654; Susanne; 15,9
```

Reading this into a data frame:

```
dat <- read.csv2("y.csv")
dat
```

```
##       ID    Nome Nota
## 1 23424     Ana  4.6
## 2 11234  Carlos 12.3
## 3 77654  Susana 15.9
```

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Other text formats

File “z.txt”

```
ID Name Age Phone
23424 Ana 40 ???
11234 Charles 12 34567678
77654 Susanne 45 23435567
```

To read this data into a data frame we do:

```
dat <- read.table("z.txt", header = TRUE, na.strings = "???")
dat
```

```
##       ID     Name Age     Phone
## 1 23424      Ana  40        NA
## 2 11234 Charles  12 34567678
## 3 77654 Susanne  45 23435567
```

or

```
dat <- read.table("z.txt", header = TRUE, na.strings = "???",
    colClasses = c("character", "character", "integer", "character"))
```

Summary on text formats

- Family of functions with similar syntax and parameters
  - `read.table`, `read.csv`, `read.csv2`, `read.delim`, etc.
- Some of the more relevant parameters

sep	indicates the character used as values separator
dec	indicates the character used as decimal separator
header	indicates whether the first line contains the column names
na.strings	indicates the character of vector of characters that should be interpreted as unknown values

- The result of these functions is a data frame
- *character encodings* - potential source of problems
- Other functions : `readLines`, `scan`

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Importing data from SpreadSheets

Method 1 - ODBC connection (Windows)

- ODBC is a communication protocol between data bases
- Microsoft Excel is able to communicate using this protocol

Installation

- Requires the installation of package `RODBC`

Example

```
library(RODBC)
fc <- "c:\\Documents and Settings\\xpto\\My Documents\\calc.xls"
cn <- odbcConnectExcel(fc)
shs <- sqlTables(cn)
dat <- sqlQuery(cn, paste("SELECT * FROM", shs$TABLE_NAME[1]))
```

Importing data from SpreadSheets

Method 2 - package *gdata*

- Package *gdata* includes the function `read.xls`

Installation

- Requires the installation of package `gdata`
- Requires the availability of Perl on the computer (standard on Mac OSx and Linux, but not on Windows)

Example

```
library(gdata)
fc <- "c:\\Documents and Settings\\xpto\\My Documents\\calc.xls"
dat <- read.xls(fc, sheet = 1)
```

- The help page of function `read.xls` has several other examples

Importing data from SpreadSheets

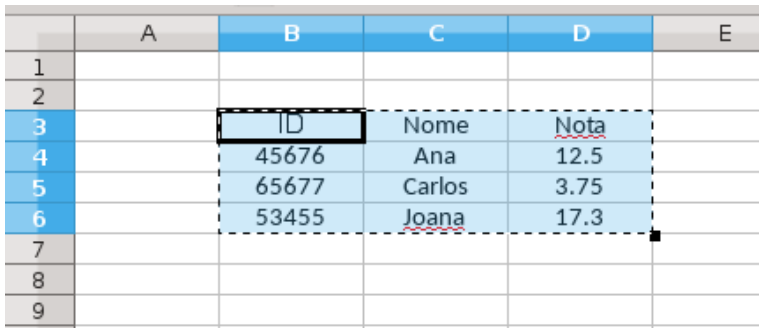
Method 3 - using CSV format

- One way of sending some data into R consists in saving the wanted spreadsheet data on a text file, for instance in format CSV
- And then, inside R, use some of the previously explained methods to import the data into a data frame from the saved text file

Importing data from SpreadSheets

Method 4 - through the *clipboard*

- When we want to import small data tables in a spreadsheet this is the easiest process



	A	B	C	D	E
1					
2					
3		ID	Nome	Nota	
4		45676	Ana	12.5	
5		65677	Carlos	3.75	
6		53455	Joana	17.3	
7					
8					
9					

Select the table and do `Edit+Copy`

```
dat <- read.table("clipboard",
    header = TRUE)
```

```
dat
```

```
##       ID    Nome  Nota
## 1 45676     Ana 12.50
## 2 65677 Carlos  3.75
## 3 53455  Joana 17.30
```

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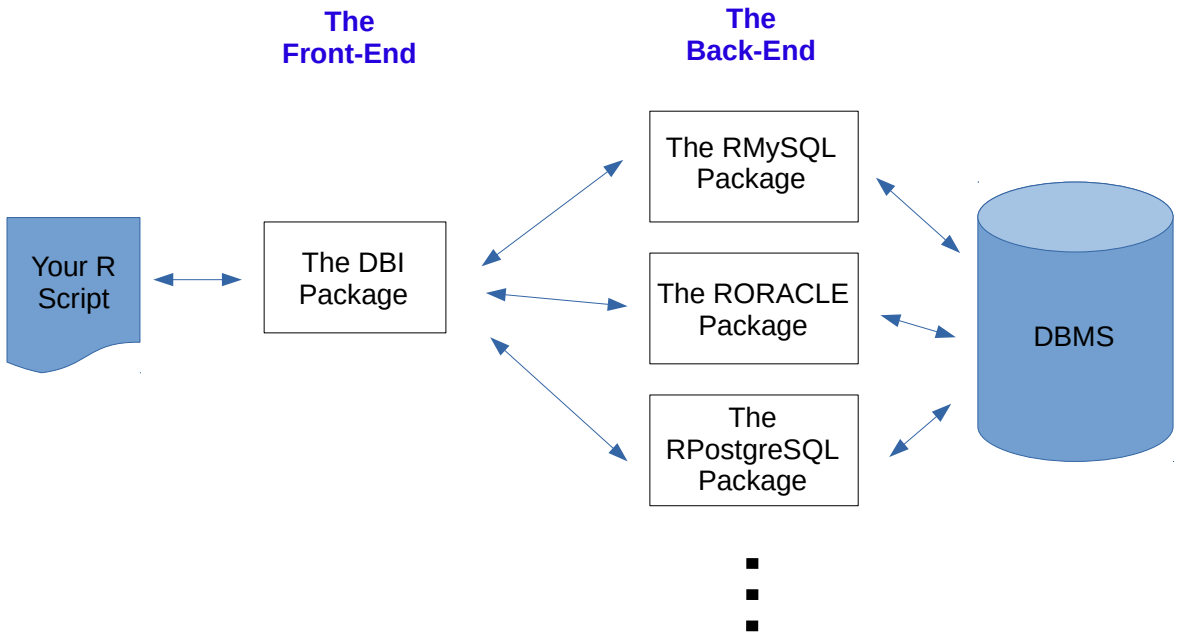
Connecting with Data Bases

The `DBI` package

- `DBI` provides a front end interface to DBMS-specific drivers



An Example with MySQL

```
library(DBI)
library(RMySQL)
drv <- dbDriver("MySQL")   # Loading the MySQL driver
con <- dbConnect(drv,dbname="transDB",   # connecting to the
                 username="myuser",password="mypasswd",
                 host="localhost")

# getting the results of a query as a data frame
data <- dbGetQuery(con,"SELECT * FROM clients")

dbDisconnect(con)   # closing up stuff
dbUnloadDriver(drv)
```

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Another Example with Results in Chunks

```
library(DBI)
library(RMySQL)
drv <- dbDriver("MySQL")   # Loading the MySQL driver
con <- dbConnect(drv,dbname="transDB",   # connecting to the
                 username="myuser",password="mypasswd",
                 host="localhost")

res  <- dbSendQuery(con,"SELECT * FROM transactions")
while (!dbHasCompleted(res)) {
    # get the next 50 records on a data frame
    someData <- fetch(res, n = 50)
    # call some function that handles the current chunck
    process(someData)
}
dbClearResult(res) # clear the results set

dbDisconnect(con)   # closing up stuff
dbUnloadDriver(drv)
```

Other forms of data importation

- Data bases
  - R has interfaces to all major DBMS (packages `DBI`, `RMySQL`, `ROracle`, etc.)
- Other statistical software
  - Importing from Minitab, S-Plus, SPSS, Stata, SAS, etc.
  - Packages `foreign`, `Hmisc`
- Several other formats / software.
- More details / information in the manual *R Data Import/Export* that comes with R

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Hands On Data Import - Audiology Data

- The site `https://archive.ics.uci.edu/ml/datasets/Audiology+%28Standardized%29` contains a data set of an Audiology problem
  1. Download the data set `audiology.standardized.data` to a local file and import that data into an R data frame. Do read the information on the web page, particularly the information on how unknown values are represented and make sure they are properly translated into R nomenclature.

Solutions

- Download the data set `audiology.standardized.data` to a local file and import that data into an R data frame.

Let us try with `read.table()`

```
dat <- read.table("../../data/audiology.standardized.data")
```

```
dat[1:2,]
```

```
## [1] f,mild,f,normal,normal,?,t,?,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,
## [2] f,moderate,f,normal,normal,?,t,?,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,
## 200 Levels: f,mild,f,absent,absent,mild,f,?,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f,f
```

Solutions

Now with `read.csv()`

```
dat <- read.csv("audiology.standardized.data",
                header=FALSE,na.strings=c("?"))
```

```
dat[1:2,]
```

```
##   V1       V2 V3     V4     V5   V6 V7   V8 V9 V10 V11 V12 V13 V14 V15 V16
## 1  f     mild  f normal normal <NA>  t <NA>  f   f   f   f   f   f   f   f
## 2  f moderate  f normal normal <NA>  t <NA>  f   f   f   f   f   f   f   f
##   V17 V18 V19 V20 V21 V22 V23 V24 V25 V26 V27 V28 V29 V30 V31 V32 V33 V34
## 1   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f
## 2   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f
##   V35 V36 V37 V38 V39 V40 V41 V42 V43 V44 V45 V46 V47 V48 V49 V50 V51 V52
## 1   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f
## 2   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f   f
##   V53 V54 V55 V56 V57 V58    V59    V60 V61 V62 V63    V64 V65 V66 V67 V68
## 1   f   f   f   f   f   f normal normal   f   f   f normal   t   a   f   f
## 2   f   f   f   f   f   f normal normal   f   f   f normal   t   a   f   f
##   V69 V70             V71
## 1   f  p1 cochlear_unknown
## 2   f  p2 cochlear_unknown
```

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Solutions

Given names to the columns is tedious given its number. The file `audiology.standard.names` contains this information. Lets extract it

```
nms <- readLines("audiology.standardized.names")
```

Lines 67 to 135 contain the names of the attributes

```
nms[67:70]
```

```
## [1] "   age_gt_60:\t\t     f, t."
## [2] "   air():\t\t     mild,moderate,severe,normal,profound."
## [3] "   airBoneGap:\t\t     f, t."
## [4] "   ar_c():\t\t     normal,elevated,absent."
```

```
fst <- strsplit(nms[67:135],":")     # split by ":"
as <- sapply(fst,function(x) x[1])   # grab the first part of the split
as <- gsub("\\(|\\)| ","",as)        # clean-up
colnames(dat)[c(1:69,71)] <- c(as,"Class")
dat <- dat[,-70]    # ID is irrelevant for modeling
```