

Objects in R

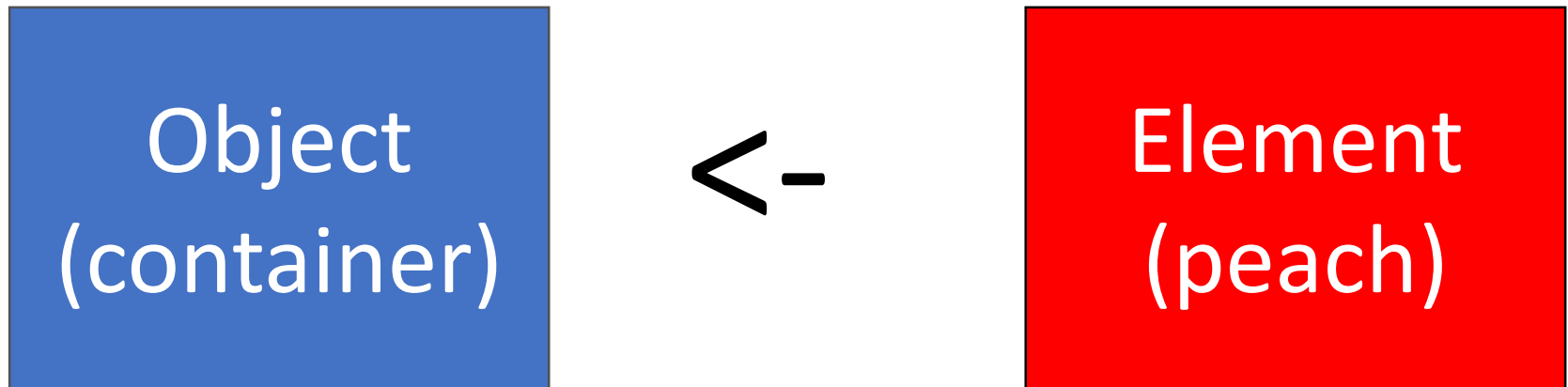
Lukáš Lehotský

Object: what is it?

- **Object** is container
- **Element** is anything in container – a peach
- To reuse elements, they must be **stored as objects**
 - Any name **defined** by user
 - **Remain the same** unless overwritten
 - Must be **removed** by user as well



Object: creating/storing objects



Tips and tricks

- Keyboard hacks
 - For Czech keyboard and Win machine users, **Right Alt** (AltGr) allows you to type some special characters (AltGr + < for <)
- Script hacks
 - **#** allows you to write comments in scripts
 - When writing code, R will automatically add closing bracket, as well as closing quote symbol
 - **Tab** will finish the name of function or argument in R Studio – try typing help(and press Tab

Object types



Object types: vector



Object types: vector

- Vector is the **default object type**
 - Any object without more specific data structure is **vector** – least fancy object type
 - If contains **more than 1 element, always** created using function `c()`
 - **Same data class** within vector – otherwise converted to character

```
c(2, 3, 5)
[1] 2 3 5
```

```
vec <- c("aa", "bb", "cc", "dd", "ee")
vec
[1] "aa" "bb" "cc" "dd" "ee"
```

Object types: matrix



Object types: matrix

- 2 dimensions
- **Same data class** within matrix – otherwise converted to character
- Created using function `matrix()`

```
mat <- matrix(data = c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12),  
              nrow = 3,  
              ncol = 4)
```

```
mat
```

	<code>[,1]</code>	<code>[,2]</code>	<code>[,3]</code>	<code>[,4]</code>
<code>[1,]</code>	1	4	7	10
<code>[2,]</code>	2	5	8	11
<code>[3,]</code>	3	6	9	12

Object types: data frame



Object types: data frame

- 2 dimensions
- Typical **data set** – observations (rows) and variables (columns) – data class **per column**
- Function `data.frame()`
- In fact, it's a set of vectors (columns)
 - Always has to have **same number of elements** in vectors, from which it is created
 - Data classes may be different in each column, but **same within a column**

Object types: data frame

```
cars <- c("BMW", "Audi", "VW")
type <- c("3", "A4", "Passat")
price <- c(1200000, 1164000, 950500)
consumption <- c(6.2, 5.9, 5.9)
```

```
mydf <- data.frame(cars, type, price, consumption)
mydf
```

	<i>cars</i>	<i>type</i>	<i>price</i>	<i>consumption</i>
1	<i>BMW</i>	<i>3</i>	<i>1200000</i>	<i>6.2</i>
2	<i>Audi</i>	<i>A4</i>	<i>1164000</i>	<i>5.9</i>
3	<i>VW</i>	<i>Passat</i>	<i>950500</i>	<i>5.9</i>

Object types: list



Object types: list

- Heterogeneous – objects **nested** within an object
- Function `list()` creates nested structure

```
num.vector <- c(2, 3, 5)
char.vector <- c("aa", "bb", "cc", "dd", "ee")
mylist <- list(num.vector, char.vector, 3)
mylist
[[1]]
[1] 2 3 5

[[2]]
[1] "aa" "bb" "cc" "dd" "ee"

[[3]]
[1] 3
```

Libraries/packages

- Libraries combine together many pre-defined functions according to problem at hand
 - Most libraries download and install automatically from the integrated R repository (called CRAN) – only a proper **library name** needs to be entered
- As of September 17, 2019, 14925 libraries available (43 packages published on Sep. 17 alone)

Libraries/packages



Libraries/packages

- If libraries are not available, they have to be installed

```
install.packages("sna")
```

- Libraries must be loaded

```
library("sna")
```

```
library(sna)
```

```
1 install.packages("sna")
```

```
2 |
```

Environment History Connections

Import Dataset

Global Environment

Environment is empty

Files Plots Packages Help Viewer

Install Update

Name	Description	Version
<input type="checkbox"/> rworldmap	Mapping Global Data	1.3-6
<input type="checkbox"/> rworldxtra	Country boundaries at high resolution.	1.01
<input type="checkbox"/> sandwich	Robust Covariance Matrix Estimators	2.4-0
<input type="checkbox"/> scales	Scale Functions for Visualization	0.5.0
<input type="checkbox"/> selectr	Translate CSS Selectors to XPath Expressions	0.4-1
<input type="checkbox"/> shadowtext	Shadow Text Grob and Layer	0.0.2
<input type="checkbox"/> shiny	Web Application Framework for R	1.1.0
<input type="checkbox"/> slam	Sparse Lightweight Arrays and Matrices	0.1-43
<input checked="" type="checkbox"/> sna	Tools for Social Network Analysis	2.4
<input type="checkbox"/> snow	Simple Network of Workstations	0.4-2
<input type="checkbox"/> SnowballC	Snowball stemmers based on the C libstemmer UTF-8 library	0.5.1
<input type="checkbox"/> sourcetools	Tools for Reading, Tokenizing and Parsing R Code	0.1.7
<input type="checkbox"/> sp	Classes and Methods for Spatial Data	1.2-7
<input type="checkbox"/> spacyr	Wrapper to the 'spaCy' 'NLP' Library	0.9.9
<input type="checkbox"/> spam	SPARse Matrix	2.1-4
<input type="checkbox"/> SparseM	Sparse Linear Algebra	1.77
<input type="checkbox"/> spatstat	Spatial Point Pattern Analysis, Model-Fitting, Simulation, Tests	1.55-1
<input type="checkbox"/> spatstat.data	Datasets for 'spatstat'	1.2-0

```
> install.packages("sna")
Installing package into 'C:/Users/Lukas/Documents/R/win-library/3.4'
(as 'lib' is unspecified)
trying URL 'https://cran.rstudio.com/bin/windows/contrib/3.4/sna_2.4.zip'
Content type 'application/zip' length 884807 bytes (864 KB)
downloaded 864 KB
```

```
package 'sna' successfully unpacked and MD5 sums checked
```

```
The downloaded binary packages are in
  C:\Users\Lukas\AppData\Local\Temp\Rtmp0Ydee2\downloaded_packages
```

```
> |
```

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function Addins

Project: (None)

Untitled1*

Source on Save

Run Source

```

1 install.packages("sna")
2
3 library("sna")

```

Environment History Connections

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List

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Environment is empty

Files Plots Packages Help Viewer

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<input type="checkbox"/>	rworldmap	Mapping Global Data	1.3-6	⊗
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3:15 (Top Level)

R Script

Console Terminal

```

> library("sna")
Loading required package: statnet.common

Attaching package: 'statnet.common'

The following object is masked from 'package:base':

    order

Loading required package: network
network: Classes for Relational Data
Version 1.13.0.1 created on 2015-08-31.
copyright (c) 2005, Carter T. Butts, University of California-Irvine
Mark S. Handcock, University of California, Los Angeles

```

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function Addins

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Run Source

```
1 install.packages("sna")
2
3 library("sna")
```

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3:15 (Top Level)

R Script

Console Terminal

```
~/ > library("sna")
Loading required package: statnet.common

Attaching package: 'statnet.common'

The following object is masked from 'package:base':

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Loading required package: network
network: Classes for Relational Data
Version 1.13.0.1 created on 2015-08-31.
copyright (c) 2005, Carter T. Butts, University of California-Irvine
Mark S. Handcock, University of California, Los Angeles
```

Libraries/packages

- Libraries **don't** load/unload **automatically**
 - Any time R is started, libraries have to be **reloaded**
 - Packages may be unloaded when necessary

```
library("sna")
```

```
detach("package:sna", unload = TRUE)
```

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function Addins

Untitled1*

Source on Save

Run

Source

```

1 install.packages("sna")
2
3 library("sna")
4
5 detach("package:sna", unload = TRUE)
6

```

5:38

(Top Level)

R Script

Console Terminal

```

Type help("network-package") to get started.

```

```

sna: Tools for Social Network Analysis
Version 2.4 created on 2016-07-23.
copyright (c) 2005, Carter T. Butts, University of California-Irvine
For citation information, type citation("sna").
Type help(package="sna") to get started.

```

```

Warning messages:

```

```

1: package 'sna' was built under R version 3.4.4
2: package 'network' was built under R version 3.4.4
> detach("package:sna", unload = TRUE)
>

```

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Object analysis

- Data **classes** and **object types**
 - Function `class()` returns data class/object type of object
- Object **structure** (organization of object type)
 - Function `str()`
- Object **dimensions**
 - One dimension - `length()`
 - Two and more dimensions – `dim()`, `nrow()`, `ncol()`

Object analysis

```
length(1:30)  
[1] 30
```

```
dim(mydf)  
[1] 3 4
```

```
length(mydf)  
[1] 4
```

```
nrow(mydf)  
[1] 3
```

```
ncol(mydf)  
[1] 4
```


Object analysis

```
class(mydf)
```

```
[1] "data.frame"
```

```
str(mydf)
```

```
'data.frame':      3 obs. of  4 variables:
 $ cars          : chr  "BMW" "Audi" "VW"
 $ type          : chr  "3"  "A4" "Passat"
 $ price         : num  1200000 1164000 950500
 $ consumption: num  6.2 5.9 5.9
```

Object analysis

- More sophisticated function `describe()` included in **library “psych”**

```
str(mydf)
```

```
'data.frame': 3 obs. of 4 variables:  
 $ cars      : chr  "BMW" "Audi" "VW"  
 $ type      : chr  "3"  "A4" "Passat"  
 $ price     : num  1200000 1164000 950500  
 $ consumption: num  6.2 5.9 5.9
```

```
describe(mydf)
```

	vars	n	mean	sd	median
cars*	1	3	2	1.00	2.0
type*	2	3	2	1.00	2.0
price	3	3	1104833	134863.20	1164000.0
consumption	4	3	6	0.17	5.9

Object analysis

- Data frame or matrix **preview**
 - Function `head()` and `tail()` returns first or last 5 rows of the data frame
- Object **names**
 - Vector or list names may be accessed using `names()`
 - Data frame or matrix row and column names may be accessed using `colnames()` and `rownames()`

```
head(mydf)
```

```
tail(mydf)
```

```
colnames(mydf)
```

Object analysis

- **Visual inspection** of data is possible using function `View()`
 - Useful especially in visual inspection of matrices or data frames
 - There's inconsistency in implementation – function `view()` does not exist
- Manual edit of the data (Excel-like) is possible – function `fix()` – **not advised** (replicability)

```
View(mydf)
```

```
fix(mydf)
```

Object analysis: useful functions

```
class() # explore elements' data class
length() # explore number of first dim. of object
dim() # explore dimensions of two-dimensional obj.
nrow() # number of rows
ncol() # number of columns

head() # first few rows of data
tail() # last few rows of data
str() # explore structure of object

names() # names in the named vector - one dimension
rownames() # names of rows - two dimensions
colnames() # names of columns - two dimensions
```

Practice 1

- Create a data frame with the following structure

name	age	sex	econ_scale	soc_scale
Jose	17	male	-3	-7.2
Sara	22	female	0.6	0.2
Maria	21	female	2	0
Frank	21	male	-3	0.5
John	18	male	3.1	3

Practice 2

- Install a library called “psych”
- Enable the library
- Summarize and explore the data frame created in the Practice 1
 - Find and use all available functions (creative task)

Practice 3

- Type `eurodist` in your script
- Create an object from the eurodist dataset
- Visually inspect the data source
- Figure out the type of the data source

Practice 4

- Create a matrix with following parameters
 - 6 by 6 layout
 - Contains numbers 0 and 1 in a 0 1 0 1 0 1 0 1 pattern (creative task)
 - The pattern is organized by rows

	[, 1]	[, 2]	[, 3]	[, 4]	[, 5]	[, 6]
[1,]	0	1	0	1	0	1
[2,]	0	1	0	1	0	1
[3,]	0	1	0	1	0	1
[4,]	0	1	0	1	0	1
[5,]	0	1	0	1	0	1
[6,]	0	1	0	1	0	1