Advanced object types

Theoretical and Empirical Research Methodology,
Implementation Lab 4 - Part II

Prof. Dr. Claudius Gräbner-Radkowitsch
Europa-University Flensburg, Department of Pluralist Economics
www.claudius-graebner.com | @ClaudiusGraebner | claudius@claudius-graebner.com

Europa-Universität Flensburg

Europa-Universität Flensburg
International Institute of Management and Economic Education
Department of Pluralist Economics

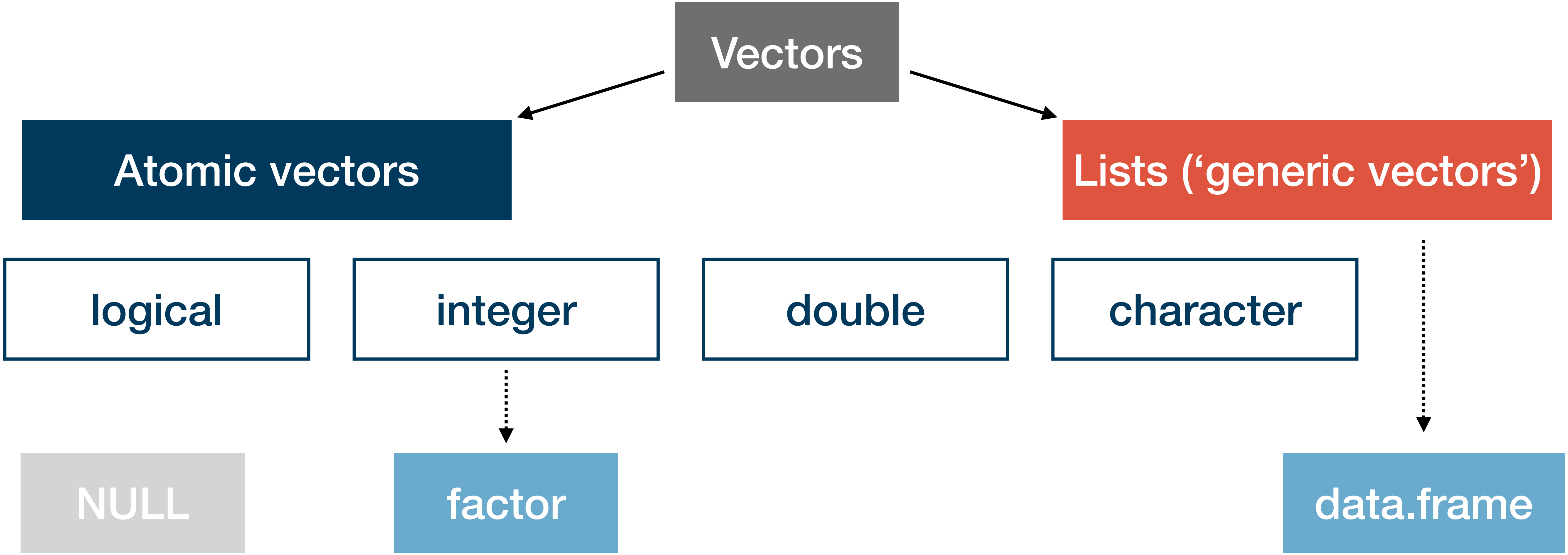
Goals for today

I. Learn about three advanced object types: `factor`, `data.frame`, and `tibble`

II. Understand and their relation to the basic types discussed previously

Advanced object types in R

Summary and outlook



Vectors

Atomic vectors

Lists ('generic vectors')

logical

integer

double

character

NULL

factor

data.frame

On more advanced object types

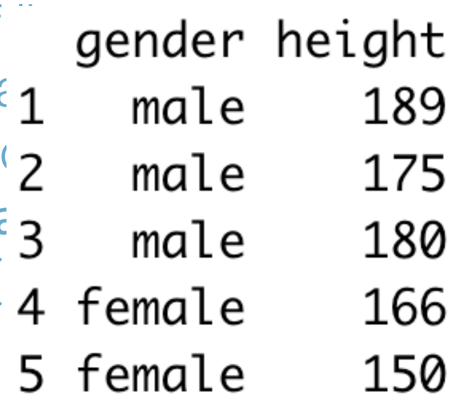
- While there are many object types in R, understanding the basics is key
  - These are by far the most common ones
  - All other object types are somehow ‘built upon’ the basic types by adding **attributes**
- Among the special types, two stand out in their prevalence:

Categorical data: factor

- Can also take a pre-specified number of values: levels
- Classical example: Male, Female, Diverse
- Created using the function `factor()`

Data frames: data.frame & tibble

- A kind of ‘table’ in which different variables are stored as vectors
- A table-like form of
- Tibbles as a new va that “do less and c
- Created using `data` `tibble::tibble(`



```
  gender height
1   male    189
2   male    175
3   male    180
4 female    166
5 female    150
```

- Others that we will not cover here are, e.g., matrices, durations, or dates

Digression: some remarks on attributes

- To turn our basic object types into something more fancy we can give them **attributes**, one of which is called **class**
  - This changes their behaviour when functions are applied to them
  - Technically, adding a class attribute changes the class but not the type:

    ```
    ff <- factor(c("F", "M", "M"), levels = c("F", "M", "D"))

    typeof(ff)

    class(ff)
    ```

- The class `factor` is an integer with two attributes:

  ```
  attributes(ff)
  ```

- Not too important for us right now, but good to keep in mind!

Factors

- Factors are used to represent ordinal or categorial data
  - Elements of factors can take one out of several pre-specified values: levels
  - Factors are integers with the attributes `levels` and `class`
- We create factors using the function `factor()`, which takes a vector and an optional argument levels:

```
f_1 <- factor(c(rep("F", 4), rep("D", 5), rep("M", 3)),
              levels = c("D", "F", "M"))
```

Your turn

- What happens if we do not specify `levels` explicitly?
- What happens if the vector contains elements not pre-specified as levels?

Factors

- Usually levels are not ordered, but for ordinal data you can use the argument ordered:

```
f_2 <- factor(c("high", "high", "low"),
              levels = c("low", "mid", "high"),
              ordered=TRUE)
```

- There are some useful factor-specific functions such as `table()`.

What does the function `table()` do?

Try it on the factors you defined so far!
How can you make sure the frequency of elements that do not show up in the vector is displayed as zero?

General remark on using factors in practice

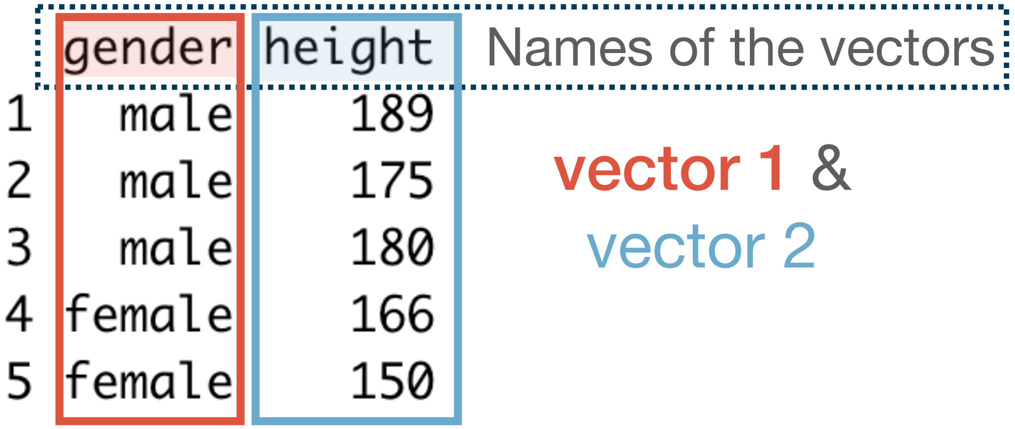
In my experience, its usually better to store categorial data as character, and only transform them to factors if necessary

Data frames

- Data frames are special lists of vectors where the length of each vector is equal!

  → Most list operations also work for data.frames

- We usually represent data frames as tables:



```
  gender height
1   male    189
2   male    175
3   male    180
4 female    166
5 female    150
```

- To create a data frame from scratch use `data.frame()`:

```
df_1 <- data.frame(
  "gender" = c(rep("male", 3), rep("female", 2)),
  "height" = c(189, 175, 180, 166, 150)
)
```

- To create a data frame from a list use `as.data.frame()`

- If you read in data into R, it almost always starts off as a data.frame

- How to transform them is the main subject of the sessions on **data wrangling**

Data frames and tibbles

- A modern version of the data.frame is the `tibble` (from the package *tibble*)
  - We will mostly use `tibbles` in this course, but make sure you familiarise yourself with the differences to the `data.frame`, which continues to be widespread (see the tutorial reading)

```
df_1 <- data.frame(
  "gender" = c(rep("male", 3), rep("female", 2)),
  "height" = c(189, 175, 180, 166, 150)
)
```

- To transform a `data.frame` (or a `list`) into a `tibble`, use `tibble::as_tibble()`:

```
tb_1 <- tibble::as_tibble(df_1)
```

- To extract single columns use the `[` or `[[` operators
  - What's the difference between the two?
  - How do you think you can test for the type of a column vector?

Data frames and tibbles

- To get a quick overview about the content, use `dplyr::glimpse()` or `head()`
- A complete overview can be obtained via `View()`
- Data frames are among the most widely used data types
  - There different approaches of how to handle and transform them, each associated with an R **dialect**
  - We mainly rely on the **tidyverse** dialect, which is the easiest to learn and comprehend → built upon **tibbles**
  - Alternatives are the **base** (classical) and **data.table** (fastest) dialect, which mainly use **data.frames** and **data.tables**
- This is useful to keep in mind when searching help in the internet

Final exercises

- Create a factor with the levels `"still"`, `"medium", "sparkling"`, and arbitrary instances of the three levels

- Get the relative frequencies for `"medium"` of this factor

- Create a data frame with two columns, one called `"nb"` containing the numbers `1` to `5` as double, the other called `"char"` containing the numbers `6` to `10` as character

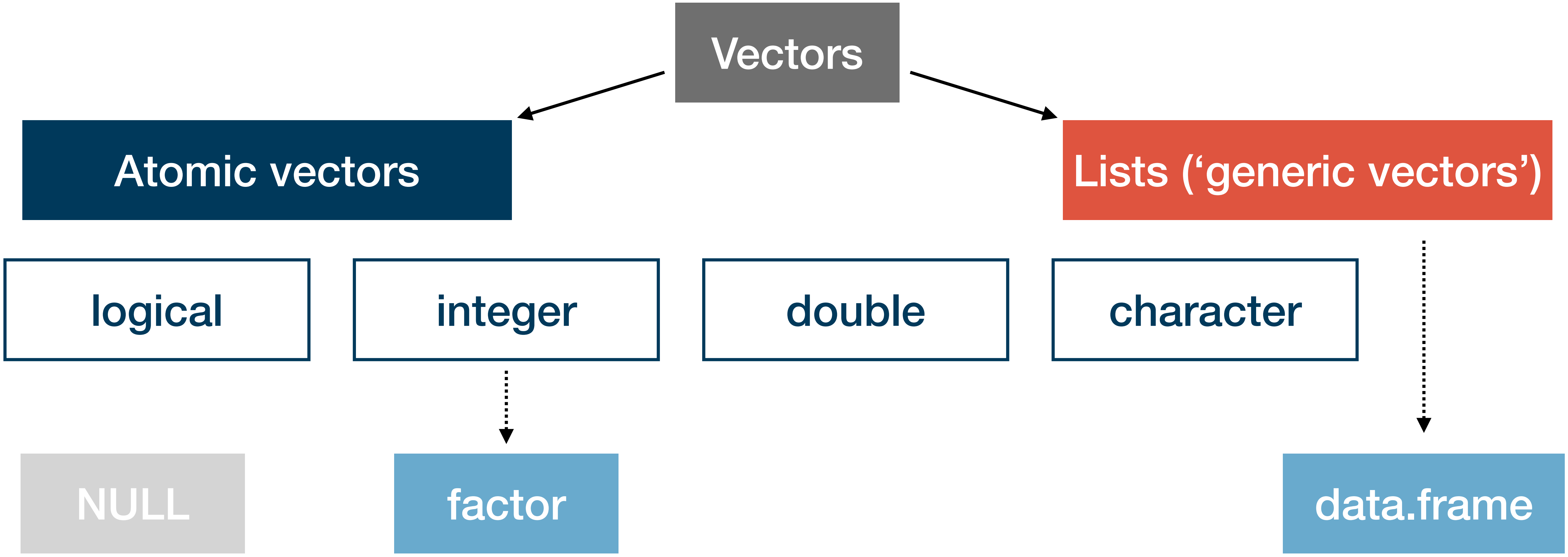
- Transform this data frame into a `tibble`!

- Extract the second column of this `tibble` such that you have a vector

Photo from Brett Jordan auf Unsplash.

Summary and outlook

- This was the last session on the fundamentals of R
- We learned about the most important object types in R
- Functions do different things when applied to different objects → understanding object types is absolutely fundamental



Summary and outlook

- Next session will be dedicated to recap and practicing
- I will explain unclear concepts or answer open questions → use the Moodle forum
- We will do some exercises together in class

Tasks until next time:

1. Fill in the **quick feedback survey** on Moodle
2. Read the **tutorials** posted on the course page
3. Do the **exercises** provided on the course page and **discuss problems** and difficulties via the Moodle forum