Data science basics

Data types

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The following content is based on Mine Çetinkaya-Rundel's excellent book Data Science in a Box

Why should you care about data types?

Example: Cat lovers

A survey asked respondents their name and number of cats. The instructions said to enter the number of cats as a numerical value.

```
cat_lovers <- read_csv("data/cat-lovers.csv")
```

```
## # A tibble: 60 x 3
##   name           number_of_cats handedness
##   <chr>          <chr>          <chr>
## 1 Bernice Warren 0              left
## 2 Woodrow Stone  0              left
## 3 Willie Bass    1              left
## 4 Tyrone Estrada 3              left
## 5 Alex Daniels   3              left
## 6 Jane Bates     2              left
## # … with 54 more rows
```

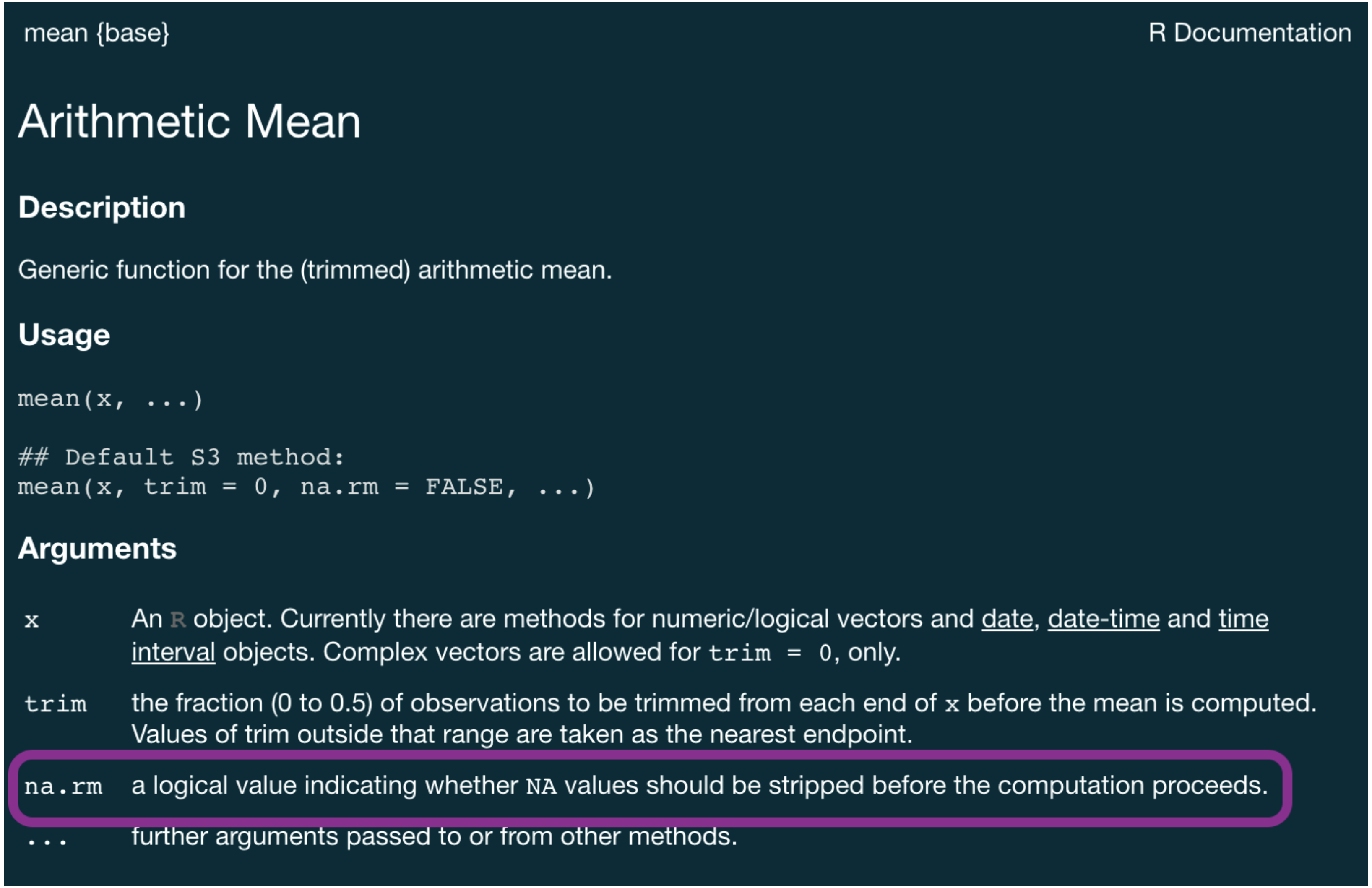
Oh why won't you work?!

```
cat_lovers %>%
  summarise(mean_cats = mean(number_of_cats))
```

```
## Warning in mean.default(number_of_cats): argument is not numeric
## or logical: returning NA
```

```
## # A tibble: 1 x 1
##   mean_cats
##       <dbl>
## 1        NA
```

```
?mean
```



mean {base} R Documentation

Arithmetic Mean

Description

Generic function for the (trimmed) arithmetic mean.

Usage

```
mean(x, ...)

## Default S3 method:
mean(x, trim = 0, na.rm = FALSE, ...)
```

Arguments

`x` An R object. Currently there are methods for numeric/logical vectors and date, date-time and time interval objects. Complex vectors are allowed for `trim = 0`, only.

`trim` the fraction (0 to 0.5) of observations to be trimmed from each end of `x` before the mean is computed. Values of trim outside that range are taken as the nearest endpoint.

`na.rm` a logical value indicating whether `NA` values should be stripped before the computation proceeds.

`...` further arguments passed to or from other methods.

Oh why won't you still work??!!

```
cat_lovers %>%
  summarise(mean_cats = mean(number_of_cats, na.rm = TRUE))
```

```
## Warning in mean.default(number_of_cats, na.rm = TRUE): argument
## is not numeric or logical: returning NA
```

```
## # A tibble: 1 x 1
##   mean_cats
##       <dbl>
## 1        NA
```

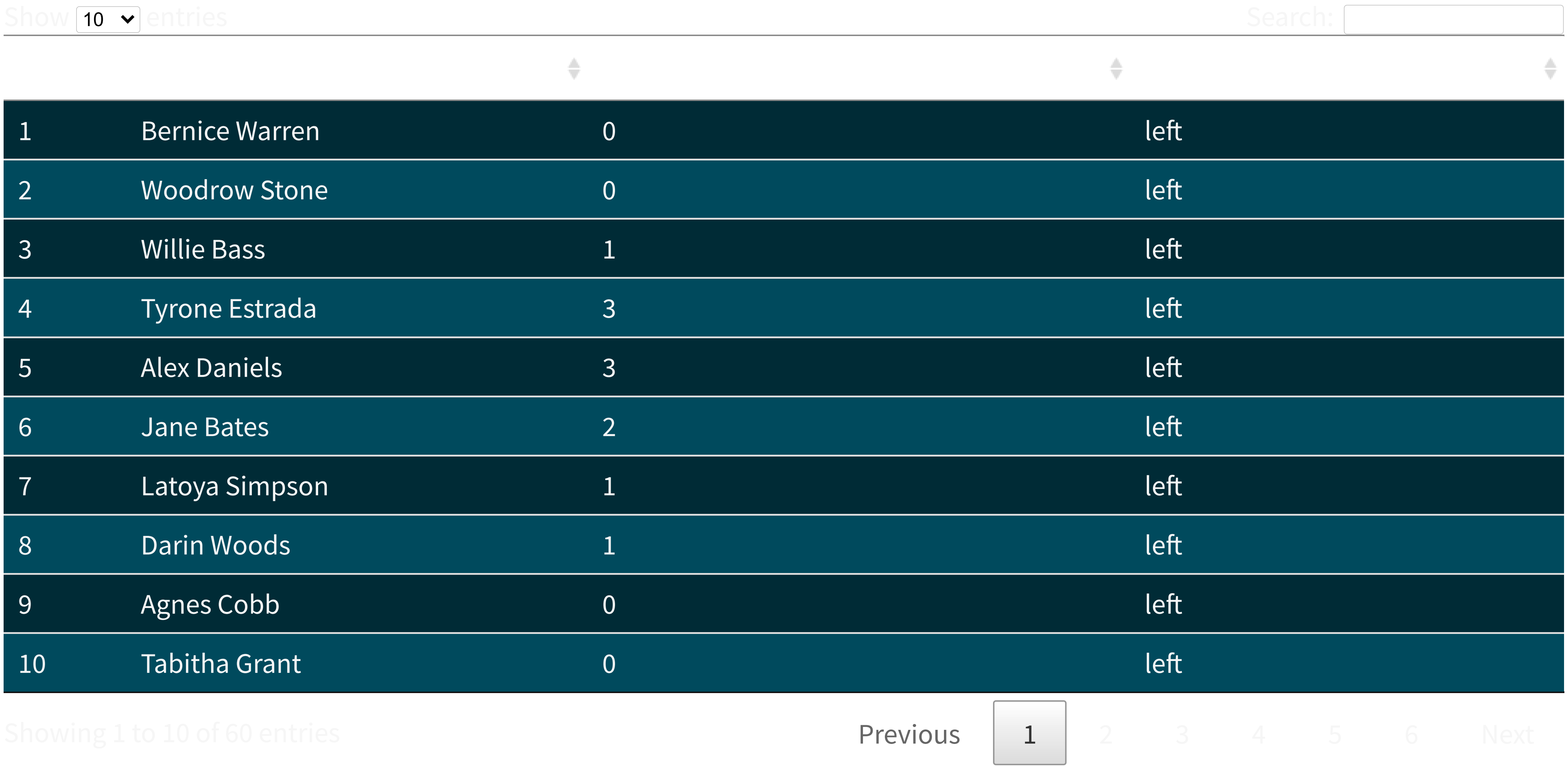
Take a breath and look at your data

> What is the type of the `number_of_cats` variable?

```
glimpse(cat_lovers)
```

```
## Rows: 60
## Columns: 3
## $ name           <chr> "Bernice Warren", "Woodrow Stone", "Wil…
## $ number_of_cats <chr> "0", "0", "1", "3", "3", "2", "1", "1",…
## $ handedness     <chr> "left", "left", "left", "left", "left",…
```

Let's take another look



Show 10 entries

Search:

1	Bernice Warren	0	left
2	Woodrow Stone	0	left
3	Willie Bass	1	left
4	Tyrone Estrada	3	left
5	Alex Daniels	3	left
6	Jane Bates	2	left
7	Latoya Simpson	1	left
8	Darin Woods	1	left
9	Agnes Cobb	0	left
10	Tabitha Grant	0	left

Showing 1 to 10 of 60 entries

Sometimes you might need to babysit your respondents

```
cat_lovers %>%
  mutate(number_of_cats = case_when(
    name == "Ginger Clark" ~ 2,
    name == "Doug Bass"    ~ 3,
    TRUE                   ~ as.numeric(number_of_cats)
    )) %>%
  summarise(mean_cats = mean(number_of_cats))
```

```
## Warning: Problem with `mutate()` input `number_of_cats`.
## ℹ NAs durch Umwandlung erzeugt
## ℹ Input `number_of_cats` is `case_when(...)`.

## Warning in eval_tidy(pair$rhs, env = default_env): NAs durch
## Umwandlung erzeugt

## # A tibble: 1 x 1
##   mean_cats
##       <dbl>
## 1     0.833
```

Always you need to respect data types

```r
cat_lovers %>%
  mutate(
    number_of_cats = case_when(
      name == "Ginger Clark" ~ "2",
      name == "Doug Bass"    ~ "3",
      TRUE                   ~ number_of_cats
      ),
    number_of_cats = as.numeric(number_of_cats)
    ) %>%
  summarise(mean_cats = mean(number_of_cats))
```

```
## # A tibble: 1 x 1
##   mean_cats
##       <dbl>
## 1     0.833
```

Now that we know what we're doing...

```
cat_lovers <- cat_lovers %>% #<<
  mutate(
    number_of_cats = case_when(
      name == "Ginger Clark" ~ "2",
      name == "Doug Bass"    ~ "3",
      TRUE                   ~ number_of_cats
      ),
    number_of_cats = as.numeric(number_of_cats)
    )
```

Moral of the story

- If your data does not behave how you expect it to, type coercion upon reading in the data might be the reason.
- Go in and investigate your data, apply the fix and *save your data*

Data types

Data types in R

- logical
- character
- double
- integer
- character
- and some more, but we won't be focusing on those

Logical

logical - boolean values TRUE and FALSE

```
typeof(TRUE)
```

```
## [1] "logical"
```

character - character strings

```
typeof("hello")
```

```
## [1] "character"
```

Double & integer

double - floating point numerical values (default numerical type)

```r
typeof(1.335)
```

```
## [1] "double"
```

```r
typeof(7)
```

```
## [1] "double"
```

integer - integer numerical values (indicated with an `L`)

```r
typeof(7L)
```

```
## [1] "integer"
```

```r
typeof(1:3)
```

```
## [1] "integer"
```

Concatenation

Vectors can be constructed using the `c()` function.

```r
c(1, 2, 3)
```

```
## [1] 1 2 3
```

```r
c("Hello", "World!")
```

```
## [1] "Hello"  "World!"
```

```r
c(c("hi", "hello"), c("bye", "jello"))
```

```
## [1] "hi"    "hello" "bye"   "jello"
```

Converting between types

with intention...

```r
x <- 1:3
x
```

```
## [1] 1 2 3
```

```r
typeof(x)
```

```
## [1] "integer"
```

```r
y <- as.character(x)
y
```

```
## [1] "1" "2" "3"
```

```r
typeof(y)
```

```
## [1] "character"
```

Converting between types

with intention...

```r
x <- c(TRUE, FALSE)
x
```

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

```r
typeof(x)
```

```
## [1] "logical"
```

```r
y <- as.numeric(x)
y
```

```
## [1] 1 0
```

```r
typeof(y)
```

```
## [1] "double"
```

Converting between types

without intention...

R will happily convert between various types without complaint when different types of data are concatenated in a vector, and that's not always a great thing!

```
c(1, "Hello")
```

```
## [1] "1"     "Hello"
```

```
c(FALSE, 3L)
```

```
## [1] 0 3
```

```
c(1.2, 3L)
```

```
## [1] 1.2 3.0
```

```
c(2L, "two")
```

```
## [1] "2"   "two"
```

Explicit vs. implicit coercion

Let's give formal names to what we've seen so far:

- **Explicit coercion** is when you call a function like `as.logical()`, `as.numeric()`, `as.integer()`, `as.double()`, or `as.character()`

- **Implicit coercion** happens when you use a vector in a specific context that expects a certain type of vector

Your turn!

> - RStudio Cloud > `AE 05 - Hotels + Data types` > open `type-coercion.Rmd` and knit.
> - What is the type of the given vectors? First, guess. Then, try it out in R. If your guess was correct, great! If not, discuss why they have that type.

Example: Suppose we want to know the type of `c(1, "a")`. First, I'd look at:

```
typeof(1)
```

```
## [1] "double"
```

```
typeof("a")
```

```
## [1] "character"
```

and make a guess based on these. Then finally I'd check:

```
typeof(c(1, "a"))
```

```
## [1] "character"
```

Special values

Special values

- `NA`: Not available
- `NaN`: Not a number
- `Inf`: Positive infinity
- `-Inf`: Negative infinity

```r
pi / 0
```

```
## [1] Inf
```

```r
0 / 0
```

```
## [1] NaN
```

```r
1/0 - 1/0
```

```
## [1] NaN
```

```r
1/0 + 1/0
```

```
## [1] Inf
```

NAs are special

```
x <- c(1, 2, 3, 4, NA)
```

```
mean(x)
```

```
## [1] NA
```

```
mean(x, na.rm = TRUE)
```

```
## [1] 2.5
```

```
summary(x)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    1.00    1.75    2.50    2.50    3.25    4.00       1
```