Multiple dispatch

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Multiple dispatch recap

- Multiple dispatch allows us to run a different method based on the type of argument passed into a function.

```
function add_values(x, y)
    x + y
end
add_values(1, 2)  # 3
```

```
add_values("A", "B")
```

```
ERROR: MethodError: no method matching +(::String, ::String)
```

```
function add_values(x::String, y::String)
    x * y
end

add_values("A", "B")  # AB
```

Anonymous functions

- Unlike typical functions, an anonymous function has no name.
- Used to create quick functions which are discarded after use.

```
(x -> x^2 + 3)(2)
```

```
7
```

Complex anonymous functions

- Anonymous functions can have applications outside of simple function evaluation.
- map() will apply each value in a collection to a function.

```
map(x -> 2*x + x^2 + 1, [1, 2, 3])
```

```
3-element Vector{Int64}:
4 9 16
```

```
map((x, y) -> 2*x + x^2 + 1 + y, [1, 2, 3], [1, 1, 1])
```

```
3-element Vector{Int64}:
5 10 17
```

Filtering DataFrames

- The `filter` function can be used to filter data structures with conditions.
- We can use an anonymous function with `filter` which helps us filter for a certain value.

```
filter!("Date" => n -> n == "21/01/2022", stock_data)
```

```
 Row | Date        Open     High     Low      Close     Adj Close  Volume
     | String15    Float64  Float64  Float64  Float64?  Float64    Int64
<----|-----------------------------------------------------------------------
   1 | 21/01/2022   164.42   166.33    162.3    162.41    161.473  122848900
```

Let's practice!

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Importing Functions from Python and R

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Package overview

- We might want to use packages from Python or R in your Julia programs.
- There are many reasons why we might want to do this:
  - familiarity with a certain package
  - niche package only available for Python or R
  - consistency with other code
- Two Julia packages give this functionality - **PythonCall** and **RCall**.

```
using Pkg
Pkg.add("PythonCall")
Pkg.add("RCall")
```

- Note that the reverse is possible - we can also use Julia code in Python and R.

Importing python packages

- Use `PythonCall` to integrate Python functions into our Julia code.
- Any Python package can be used, as long it is also installed in Python.

```
using PythonCall
```

- To load a package from Python, use `pyimport` .

```
pytime = pyimport("time")
```

- Many advanced functions exist in PythonCall that we will not cover in this course.

Calling python functions

- We can call any function from the base time package.

```
using PythonCall
pytime = pyimport("time")
println(pytime.ctime())
```

```
Sun Jan 22 12:16:28 2023
```

- We can combine multiple functions including Python formatting.

```
println(pytime.strftime("%m-%Y", pytime.localtime()))
```

```
01-2023
```

Importing R libraries

- Use `RCall` to integrate R functions into our Julia code.
- An R installation is required before installing the `RCall` package.
- Any R package can be used, as long as that package is also installed in R.

```
using RCall
```

- To load a package in R, use `@rimport` .

```
@rimport base
@rimport ggplot2
```

- Many advanced functions exist in RCall that we will not cover in this course.

Calling R functions

- We will be calling functions from the base R environment in this example.
- We can provide an alias when importing a package.

```
using RCall
@rimport base as r_base
```

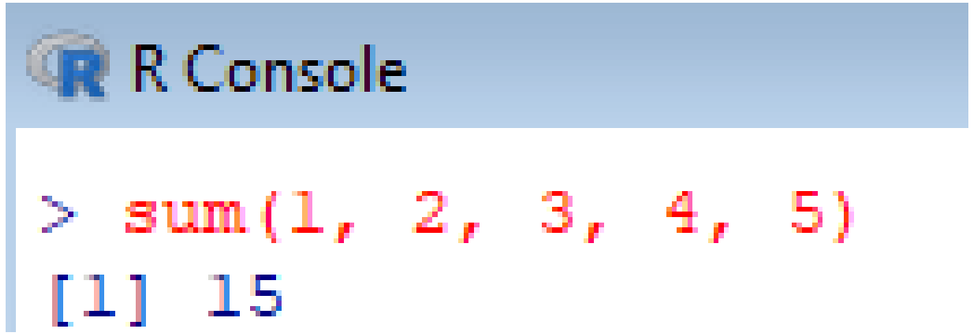
```
r_base.sum([1, 2, 3, 4, 5])
```

```
RObject{IntSxp}
[1] 15
```

R sum output

- We can quickly compare the output from Julia to the output that R gives.

```
RObject{IntSxp}
[1] 15
```

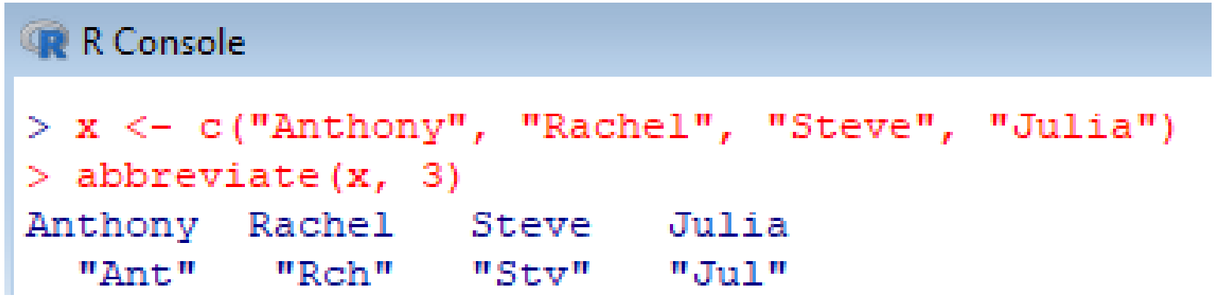


Calling further R functions

- We will now try the abbreviate function, also in the base package.

```
r_base.abbreviate(["Anthony", "Rachel", "Steve", "Julia"], 3)
```

```
RObject{StrSxp}
Anthony  Rachel   Steve   Julia
  "Ant"   "Rch"   "Stv"   "Jul"
```



Let's practice!

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Cleaning Data

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Show column information

- Column names are the first things that you will look at in a dataset.
- Generally speaking, column names should be legible and concise.

```
println(first(stock_data))
```

```
DataFrameRow
 Row | Date        Open     High     Low      Close    Adj Close  Volume
     | String15    Float64  Float64  Float64  Float64  Float64    Int64
<----|-----------------------------------------------------------------
   1 | 21/01/2022   164.42   166.33    162.3   162.41    161.473  122848900
```

Rename a column

- We might want to rename a column if we feel a different label is more appropriate.

```
 Row | Date        Open     High     Low      Close    Adj Close  Volume
     | String15    Float64  Float64  Float64  Float64  Float64    Int64
<----|-----------------------------------------------------------------
   1 | 21/01/2022   164.42   166.33    162.3   162.41    161.473  122848900
```

- In this case, `Adj Close` has a space, which we want to avoid.

```
rename!(stock_data, Dict(:Adj Close => :Adj_Close))
```

```
 Row | Date        Open     High     Low      Close    Adj_Close  Volume
     | String15    Float64  Float64  Float64  Float64  Float64    Int64
<----|-----------------------------------------------------------------
   1 | 21/01/2022   164.42   166.33    162.3   162.41    161.473  122848900
```

Describe and find missing data

- Missing values are a common source of inconsistency in data.
- There can be various reasons for missing data:
  - measurement errors
  - transcription errors
  - intentionally missing
- The describe method can be used to quickly find missing data in a DataFrame.

```
println(describe(stock_data))
```

Describe missing data

- describe() gives us a general overview of our entire DataFrame.

```
7×7 DataFrame
 Row | variable    mean        min         median     max         nmissing  eltype
     | Symbol      Union       Any          Union     Any         Int64     DataType
<-------------------------------------------------------------------------------------
   1 | Date                    1/02/2022              9/12/2022           0  String15
   2 | Open        152.613     126.01      151.19     178.55              0  Float64
   3 | High        154.721     127.77      153.72     179.61              0  Float64
   4 | Low         150.529     124.17      149.34     176.7               0  Float64
   5 | Close       152.698     125.02      151.21     178.96              4  Union
   6 | Adj_Close   152.296     125.02      151.07     178.154             0  Float64
   7 | Volume      8.70851e7   35195900    8.22912e7  182602000           0  Int64
```

Remove missing data

- We can drop the missing rows using `dropmissing` .

```
println(nrow(stock_data))
```

```
252
```

```
dropmissing!(stock_data, :"Close")
```

- We can confirm that we dropped 4 rows using nrow() again.

```
println(nrow(stock_data))
```

```
248
```

Replace missing data

- Simply removing rows with missing values is often not an acceptable approach.
- Depending on the data, we can replace missing values with a substitute.

```
replace!(stock_data[!, "Close"], missing => 130)
println(stock_data[[202, 227, 235, 240], :])
```

```
 Row | Date        Open     High     Low      Close     Adj Close  Volume
     | String15    Float64  Float64  Float64  Float64?  Float64    Int64
<----|-------------------------------------------------------------------
   1 | 8/11/2022    140.41   141.43   137.49    130       139.5    89908500
   2 | 14/12/2022   145.35   146.66   141.16    130       143.21   82291200
   3 | 25/12/2022   130.92   132.42   129.64    130       131.86   63814900
   4 | 3/01/2023    130.28   130.9    124.17    130       125.07  112117500
```

- Choosing an arbitrary value to replace missing values with is rarely correct.

Let's practice!

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Congratulations!

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Julia is growing!

Course recap

Loops and Ranges

- For loops
- While loops
- Ranges

Data Structures

- Tuples
- Dictionaries
- Structs

Advanced Functions

- Execution time measurement
- Function argument types
- Writing your own functions

DataFrame Operations

- Anonymous functions
- DataFrame filtering/cleaning
- Using Python/R in Julia

What's next?

- Keep practicing! Like anything, programming in Julia takes practice.
- Learn a new package, e.g:
  - Plots.jl
  - DataFrames.jl
  - Distributions.jl
- DataCamp courses on Julia in the future will include:
  - Data Visualization in Julia
  - Data Manipulation in Julia

Thank you!

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