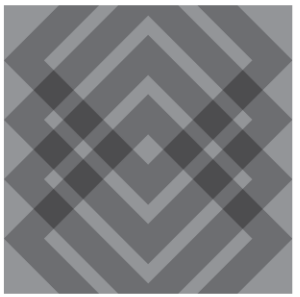
Eric Pitman Summer Workshop in Computational Science

4. Writing Functions



CENTER FOR **COMPUTATIONAL RESEARCH**

University at Buffalo
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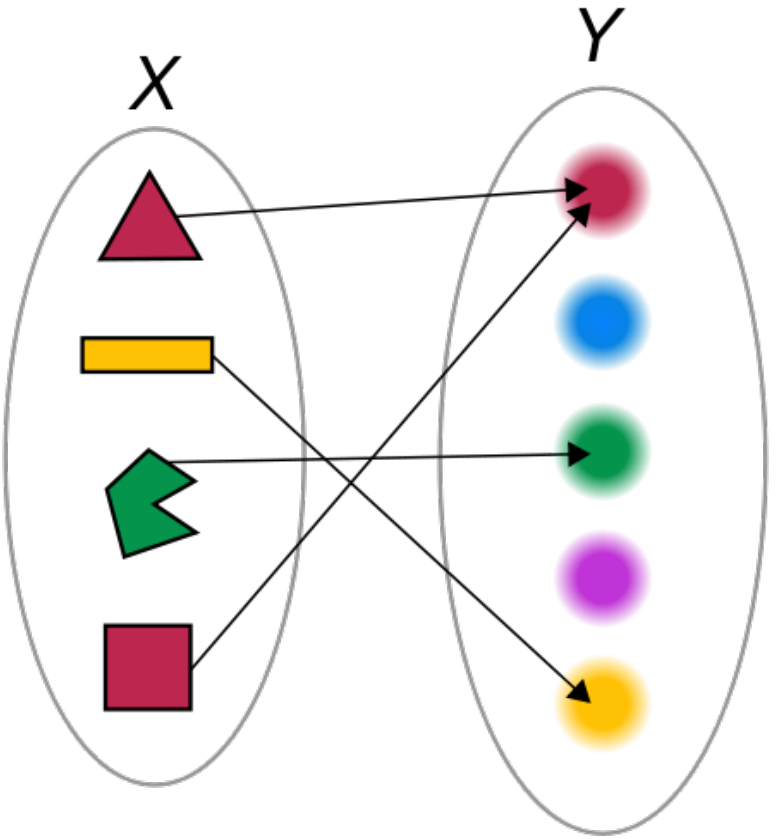
Functions

A function generates an output (Y), given an input (X).



Control Structures: if/else

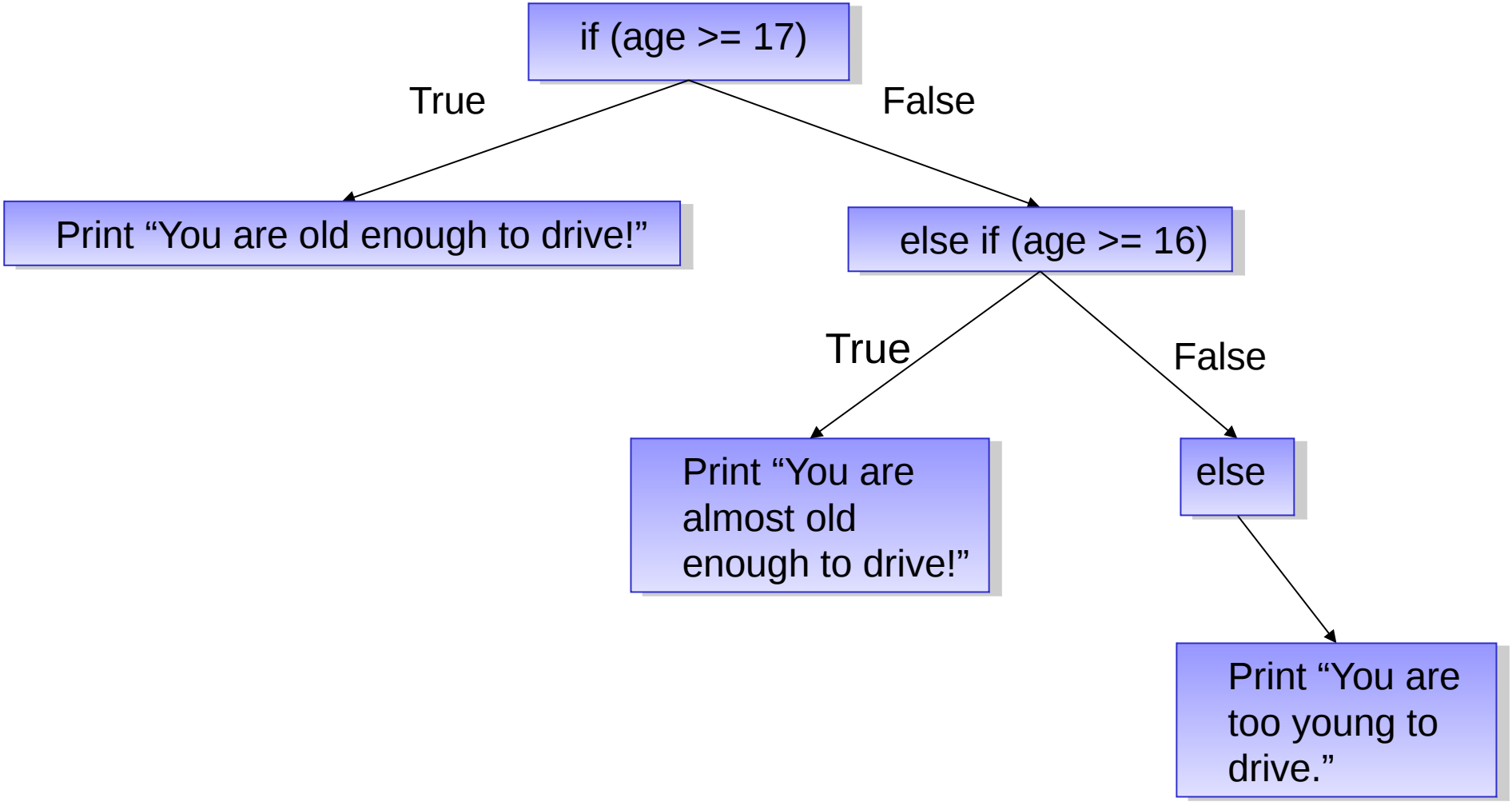
- Make a logical test
- Perform operations based on the outcome

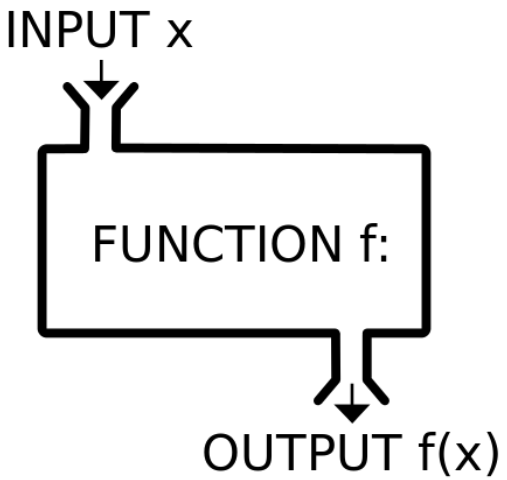
```
if (condition is true)
{
    # do something
}
```

Control Structures: if/else

```
age = 21;

if (age >= 17) {

      print(“You can drive!”);

} else if (age >= 16) {

      print(“You are almost old enough to drive!”);

} else {

      print(“You are not old enough to drive.”);
}
```

if/else Flowchart

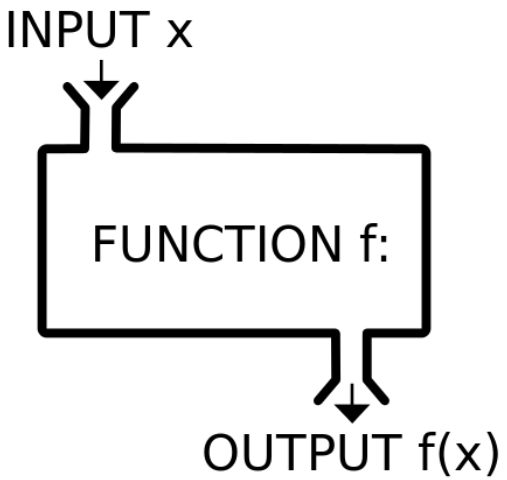




Functions

- A function f takes an input, x, and returns an output $f(x)$.

- It's like a machine that converts an input into an output.



Functions

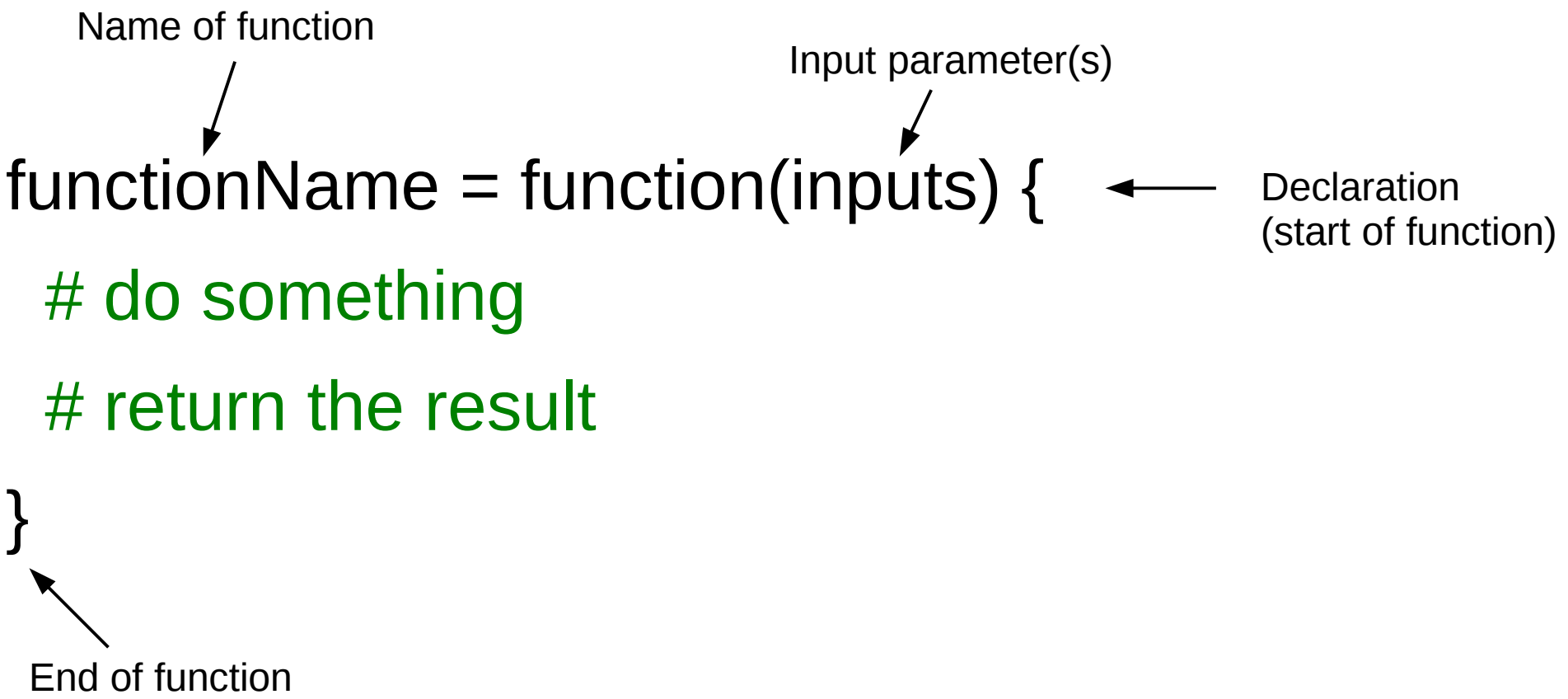
Function: a piece of code that can be called again and again

To call it, specify:

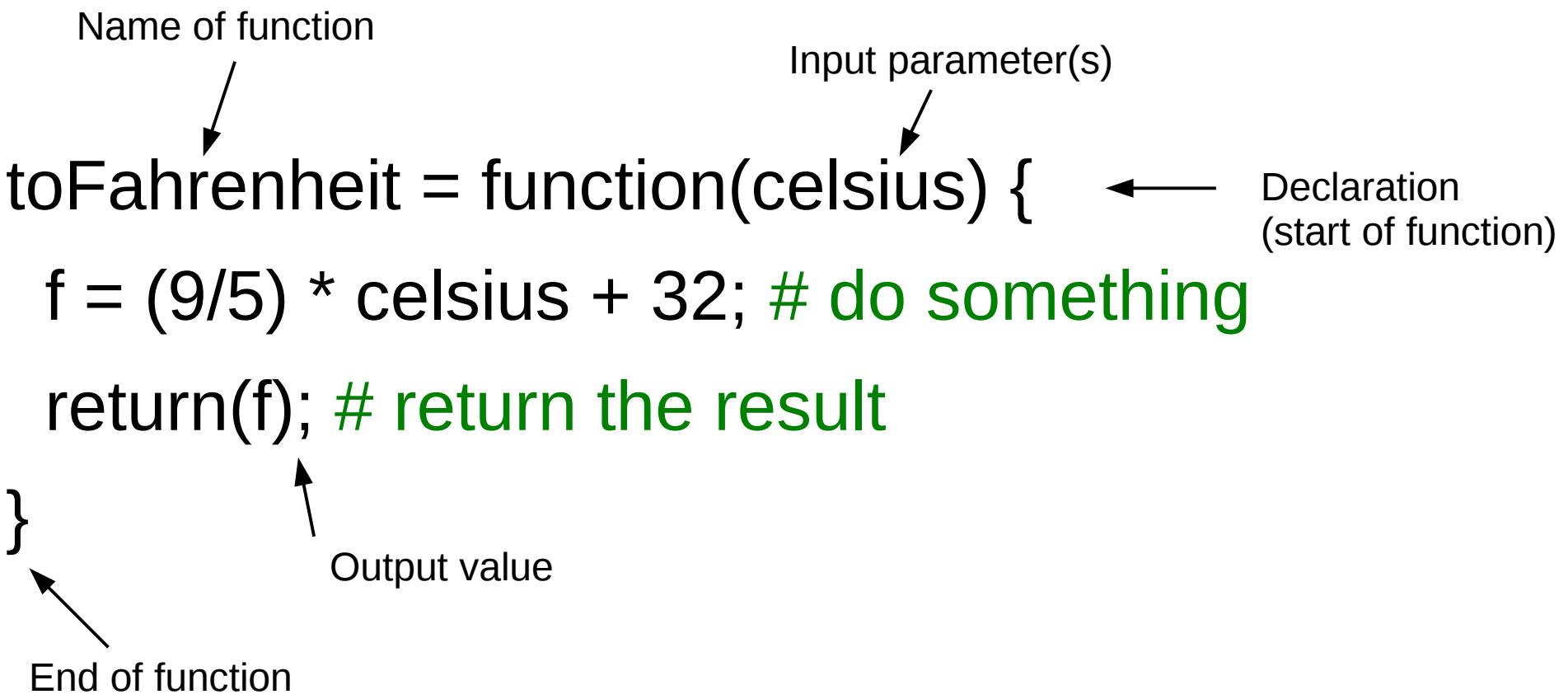
- Function name
- Input values

It may return an output value

Functions in R



Functions in R



Functions in R

```
toFahrenheit = function(celsius) {
  f = (9/5) * celsius + 32; # do something
  return(f); # return the result
}
```

Functions in R

```
celsius = c(20:25); # define input temperatures

toFahrenheit = function(celsius) {
  f = (9/5) * celsius + 32;  # perform the conversion
  return(f);
}

# call the function to convert temperatures to Fahrenheit:
toFahrenheit(celsius);
[1] 68.0  69.8  71.6  73.4  75.2  77.0
```

Control Structures for Iteration

- In other languages we write loops
- But R is a (functional, vector) language
- We can operate on multiple data subsets with one line of code!

apply()

by()

Control Structures: apply() Family

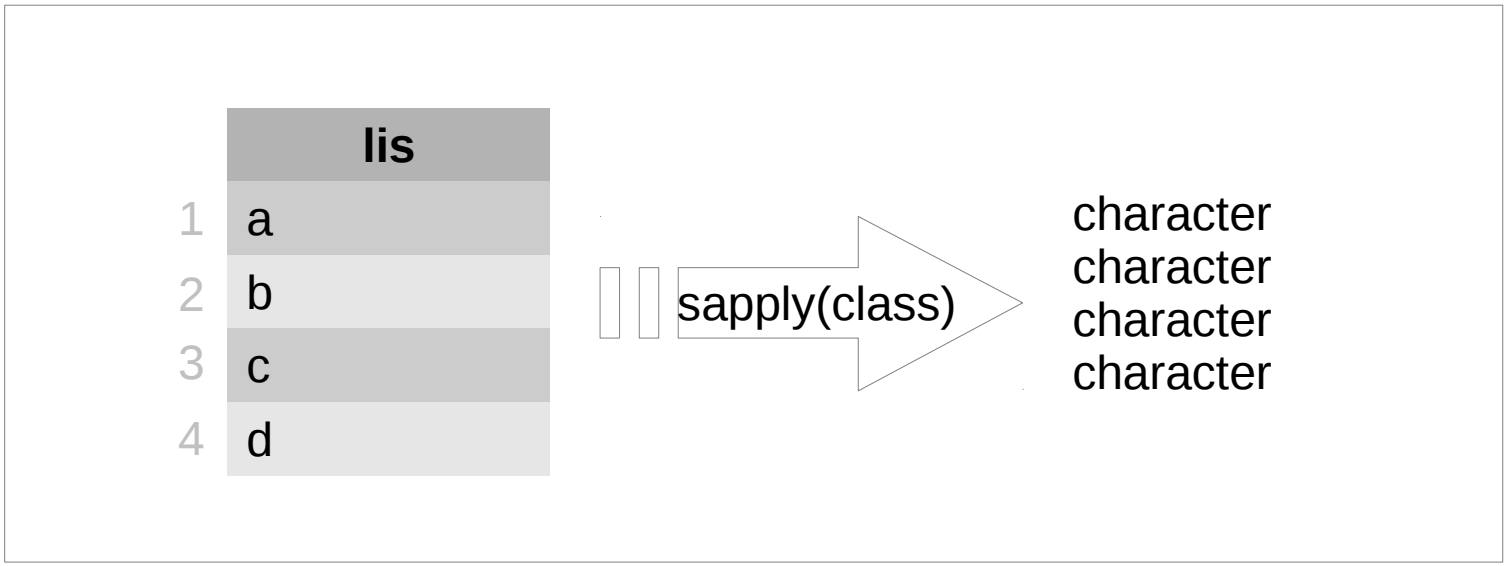
- What if we want to call a function over and over?
- We can do this with a single line of R code!
- Use it on native R functions, or functions you wrote yourself.

sapply(*vector*, *function*)

Control Structures: sapply()

```
> lis = c("a", "b", "c", "d")
> sapply(lis, class)
```

```
        a         b         c         d
"character" "character" "character" "character"
```



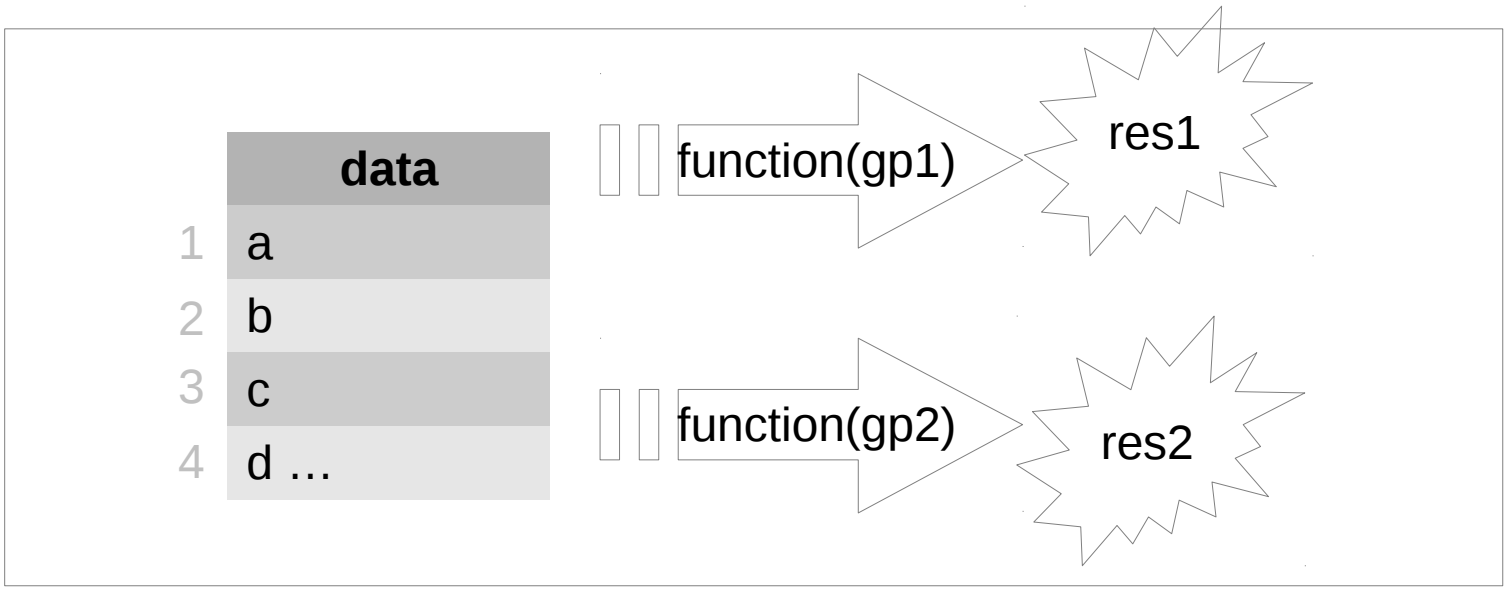
Control Structures: by()

- What if we want to call a function several times, on several *groups* of data?
- We can use a single line of R code:

by(*data*, *group, function*)

Control Structures: by()

by(data-to-operate-on,
data-to-group-by,
function)



iris and by()

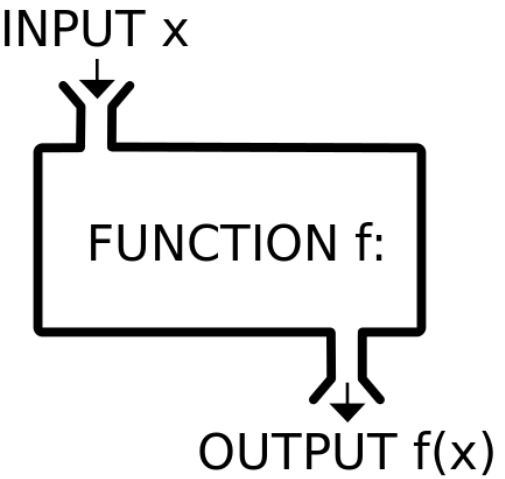
Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa

Compute summaries and means of data, grouping by Species:

<workshop>/examples/by-example.R

Tips: Writing Functions

- Use an editor window (not the command line) to compose functions
- Try out one line at a time, and test!
- Start with the simplest case and build.
- Comment your function to indicate:
  - input
  - output
  - purpose



Student Dataset Example

Remember our own dataset:

`firstInitial, lastInitial, school, height, htUnit, age, handed, gender`

Let's write functions that:

- Convert heights to a uniform unit
- List initials of students that are old enough to drive

Interlude

Complete function exercises.

Open in the RStudio source editor:

<workshop>/exercises/4-exercises-functions.R

Interlude++

Function reading assignment:

“How to write and debug an R function”:

https://vidia.ccr.buffalo.edu/resources/686