

## 2. R Foundations - Lists

Data Science for OR - J. Duggan

# Recap - R Data Types

	Homogenous	Heterogenous
1d	Atomic Vector	<b>List</b>
2d	Matrix	Data Frame/Tibble
nd	Array	

- Lists are different from atomic vectors because their elements can be of any type, including lists.
- `list()` creates a list, instead of `c()`

# Creating a list

```
x <- list(1:3, "a", c(T,F,T), c(1.2, 1.3, 1.4))  
str(x)
```

```
## List of 4  
## $ : int [1:3] 1 2 3  
## $ : chr "a"  
## $ : logi [1:3] TRUE FALSE TRUE  
## $ : num [1:3] 1.2 1.3 1.4
```

# Subsetting Lists

- Works in the same way as subsetting an atomic vector
- Using `[` will always return a list
- `[[` and `$` pull out the contents of a list
- If list `x` is a train carrying objects, then `x[[5]]` is the object in car 5, `x[4:6]` is a train of cars 4-6" @RLangTip



**Figure 1:** A list and its contents

## Example

```
x <- list(1:3, c(T,F,T))  
x[1]
```

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

```
str(x[1])
```

```
## List of 1  
## $ : int [1:3] 1 2 3
```

```
x[[1]]
```

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

```
str(x[[1]])
```

```
## int [1:3] 1 2 3
```

## Naming list elements

```
x <- list(el1=1:3, el2=c(T,F,T))
```

```
x
```

```
## $el1
```

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

```
##
```

```
## $el2
```

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

# The \$ operator

- \$ is a shorthand operator, where x\$y is equivalent to x[["y",exact=FALSE]]
- Often used to access variables in a data frame
- \$ does partial matching

```
x
```

```
## $e11
## [1] 1 2 3
##
## $e12
## [1] TRUE FALSE TRUE
```

```
x$e11
```

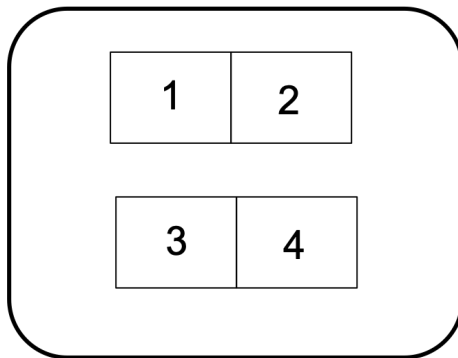
```
## [1] 1 2 3
```

```
x$e12
```

# Visualising Lists

- Lists have rounded corners.
- Atomic vectors have square corners
- Children are drawn inside their parent, and have a slightly darker background

```
y <- list(c(1,2),c(3,4))
```

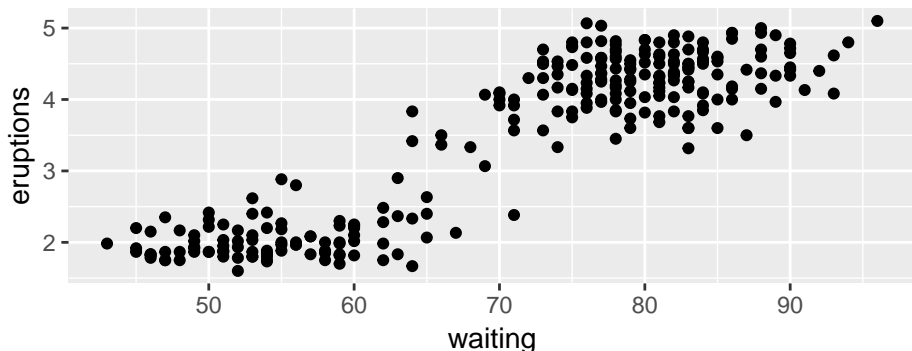




# Using Lists

- Are the basis of many S3 objects that are returned from regression functions (e.g. linear regression)
- The basis for data frames (the \$ operator identifies columns)

```
ggplot(data=faithful)+  
  geom_point(aes(x=waiting,y=eruptions))
```



## lm function - Returns a list of 12

```
mod <- lm(eruptions ~ waiting, data=faithful)
mod$coefficients
```

```
## (Intercept)      waiting
## -1.87401599  0.07562795
```

```
class(mod)
```

```
## [1] "lm"
```

```
coefficients(mod)
```

```
## (Intercept)      waiting
## -1.87401599  0.07562795
```

```
str(coefficients(mod))
```

```
##      Named num [1:2] -1.874 0.0756
##      - attr(*, "names")= chr [1:2] "(Intercept)" "waiting"
```

# Summary

- Lists are vectors, but can store many different types
- `[]` returns a subset of a list (as a list),
- `[[[]]` returns the list contents
- The function **unlist()** will convert a list to an atomic vector
- The tag (\$) operator is very useful (and used in data frames)
- In regression (and other machine learning algorithms in R), result information is returned as a list