Lists

Lists

- Atomic Structures
  - 1D: Vector: Only one type of data per vector
  - 2D: Matrix
  - nD: Array

- Non-Atomic Structures
  - 1D: List: Can contain any other type of data structure
  - 2D: Data Frame

Create a list: `list()`

```
lst <- list(1:3, matrix(1:9, 3, 3), list(1:2, c(TRUE, FALSE), c("a", "b")))
lst
```

```
## [[1]]
## [1] 1 2 3
##
## [[2]]
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## [[3]]
## [[3]][[1]]
## [1] 1 2
##
## [[3]][[2]]
## [1]  TRUE FALSE
##
## [[3]][[3]]
## [1] "a" "b"
```

To name each element of a list,

```
lst <- list("elem1" = 1:3,
            "elem2" = matrix(1:9, 3, 3),
            "elem3" = list(1:2, c(TRUE, FALSE), c("a", "b")))
lst
```

```
## $elem1
## [1] 1 2 3
##
## $elem2
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## $elem3
## $elem3[[1]]
## [1] 1 2
##
## $elem3[[2]]
## [1]  TRUE FALSE
##
## $elem3[[3]]
## [1] "a" "b"
```

Access to Elements of a List

- Single Brackets: Access to elements of a list, but not access to its object.

```
lst[1]
```

```
## $elem1
## [1] 1 2 3
```

```
lst[2]
```

```
## $elem2
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

```
lst[3]
```

```
## $elem3
## $elem3[[1]]
## [1] 1 2
##
## $elem3[[2]]
## [1]  TRUE FALSE
##
## $elem3[[3]]
## [1] "a" "b"
```

- Double Brackets: Access to an object of an element of a list.

```
lst[[1]]
```

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

```
lst[[3]]
```

```
## [[1]]
## [1] 1 2
##
## [[2]]
## [1]  TRUE FALSE
##
## [[3]]
## [1] "a" "b"
```

Combine single brackets and double brackets to access to a specific element of an object of an element of a list.

```
lst[[1]][2]
```

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

```
lst[[3]][2]
```

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

```
lst[[3]][[2]][1]
```

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

- Dollar Signs: Only if a list has names for its elements.

```
lst$elem2
```

```
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

```
lst$elem2[2, 2]
```

```
## [1] 5
```

Adding Elements to a List

- `name_of_list[[new_index]] <- new_element`

```
lst[[4]] <- c(T, F, T, F)
lst
```

```
## $elem1
## [1] 1 2 3
##
## $elem2
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## $elem3
## $elem3[[1]]
## [1] 1 2
##
## $elem3[[2]]
## [1]  TRUE FALSE
##
## $elem3[[3]]
## [1] "a" "b"
##
##
## [[4]]
## [1]  TRUE FALSE  TRUE FALSE
```

- name_of_list$new_name <- new_element

```
lst$elem5 <- 'nuevo'
lst
```

```
## $elem1
## [1] 1 2 3
##
## $elem2
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## $elem3
## $elem3[[1]]
## [1] 1 2
##
## $elem3[[2]]
## [1]  TRUE FALSE
##
## $elem3[[3]]
## [1] "a" "b"
##
##
## [[4]]
```

```
## [1]  TRUE FALSE  TRUE FALSE
##
## $elem5
## [1] "nuevo"
```

Deleting Elements of a List

Use NULL.
- `name_of_list[[index]] <- NULL`

```
lst[[4]] <- NULL
lst
```

```
## $elem1
## [1] 1 2 3
##
## $elem2
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## $elem3
## $elem3[[1]]
## [1] 1 2
##
## $elem3[[2]]
## [1]  TRUE FALSE
##
## $elem3[[3]]
## [1] "a" "b"
##
##
## $elem5
## [1] "nuevo"
```

- `name_of_list$name_of_elem <- NULL`

```
lst$elem5 <- NULL
lst
```

```
## $elem1
## [1] 1 2 3
##
## $elem2
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## $elem3
```

```
## $elem3[[1]]
## [1] 1 2
##
## $elem3[[2]]
## [1]   TRUE FALSE
##
## $elem3[[3]]
## [1] "a" "b"
```

Exercises

1) How would you create a list with your first name, middle name, and last name? For example, something like:

```
$first
[1] "Gaston"

$middle
NULL

$last
[1] "Sanchez"
```

```r
list("first" = "Gaston", "middle" = NULL, "last" = "Sanchez")
```

```
## $first
## [1] "Gaston"
##
## $middle
## NULL
##
## $last
## [1] "Sanchez"
```

2) Consider an R list `student` containing the following elements:

```
$name
[1] "Luke Skywalker"

$major_minor
            major                minor
     "jedi studies" "imperial policies"

$gpa
[1] 4

$grades
          course score
1       force-101   9.3
2    light-sabers  10.0
3 jedi-literature   8.5
```

What is the output of the following commands? Try to guess the answer without running the code.

a. student$grades$semester <- 4

b. sum(student[[2]] == "sith philosophy")

c. student["sid"] <- as.integer("123456")

d. mean(student[[4]][1:3,2], na.rm = TRUE)

e. student[[4]] <- student$grades[c(FALSE, TRUE, TRUE),]

```
student <- list("name" = "Luke Skywalker",
                "major_minor" = c("jedi studies", "imperial policies"),
                "gpa" = 4,
                "grades" = data.frame("course" = c("force-101", "light-sabers", "jedi-literature"),
                                      "score" = c(9.3, 10.0, 8.5)))
student
```

```
## $name
## [1] "Luke Skywalker"
##
## $major_minor
## [1] "jedi studies"      "imperial policies"
##
## $gpa
## [1] 4
##
## $grades
##           course score
## 1       force-101   9.3
## 2    light-sabers  10.0
## 3 jedi-literature   8.5
```

```
# a
student$grades$semester <- 4
student
```

```
## $name
## [1] "Luke Skywalker"
##
## $major_minor
## [1] "jedi studies"      "imperial policies"
##
## $gpa
## [1] 4
##
## $grades
##           course score semester
## 1       force-101   9.3        4
## 2    light-sabers  10.0        4
## 3 jedi-literature   8.5        4
```

```
# b
sum(student[[2]] == "sith philosophy")
```

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

```
# c
student["sid"] <- as.integer("123456")
student
```

```
## $name
## [1] "Luke Skywalker"
##
## $major_minor
## [1] "jedi studies"      "imperial policies"
##
## $gpa
## [1] 4
##
## $grades
##           course score semester
## 1      force-101   9.3        4
## 2    light-sabers  10.0        4
## 3 jedi-literature   8.5        4
##
## $sid
## [1] 123456
```

```
# d
mean(student[[4]][1:3,2], na.rm = TRUE)
```

```
## [1] 9.266667
```

```
# e
student[[4]] <- student$grades[c(FALSE, TRUE, TRUE), ]
student
```

```
## $name
## [1] "Luke Skywalker"
##
## $major_minor
## [1] "jedi studies"      "imperial policies"
##
## $gpa
## [1] 4
##
## $grades
##           course score semester
## 2    light-sabers  10.0        4
## 3 jedi-literature   8.5        4
##
## $sid
## [1] 123456
```