

Intro to R for Biologists

Session 1

R basics

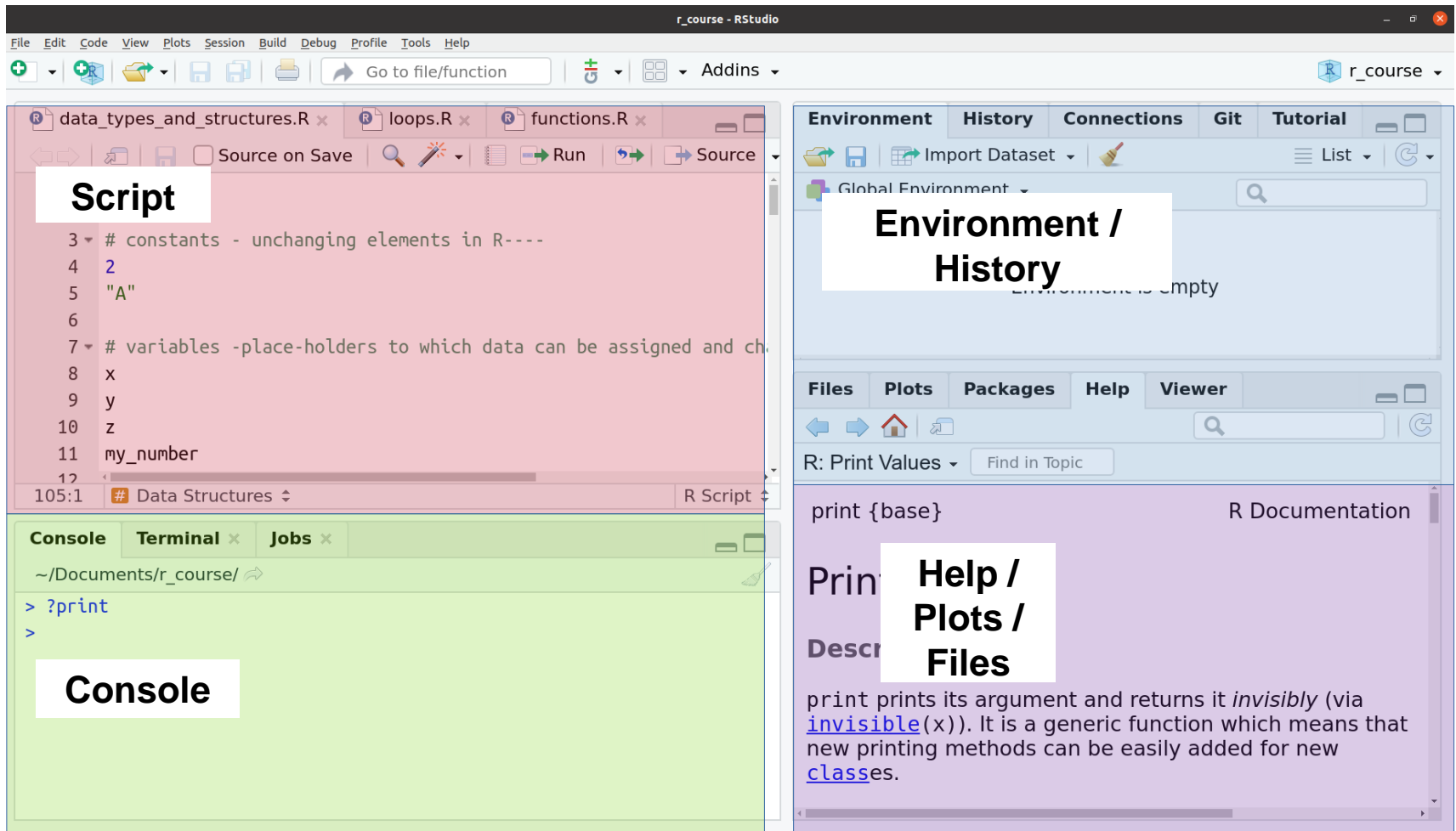
Irina & Rao
Michaelmas 2021

- Vevox
- GitHub account
- Screen sharing

INTRO TO R FOR BIOLOGISTS

► **Basic concepts**

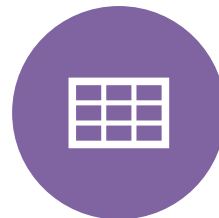
- Your R environment
- Getting help
- Assignment to variables
- Data types
- Data structures
- Subsetting
- Conditionals
- Loops
- Functions
- Packages/libraries



SCRIPT



CONSOLE



HELP/PLOTS/FILES



ENVIRONMENT/HISTORY

**Let's
explore
practically**



Constants vs. variables

Constants
are
unchanging

Pi, Avogadro's
number

Variables are
placeholders

$x = 10, y = 20;$
 $x + y = 30$

How to get help

? and ??

help()

Google!

Assignment of data to variables



The 'arrow': `x <- 2`

Equals sign: `x = 2`

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Data types in R

Character

- “a”, “apple”

Numeric

- 1, 23, 3.14

Logical

- TRUE, FALSE (also 1, 0 or T, F)

Factor

- For categorical variables, when data is classified into groups

Quotations

`' '` `" "` – denote character or string data

Conversion (and coercion)

- `as.character()`
 - **Numeric, logical** and **factor** types can be converted to character
- `as.numeric()`
 - **Logical**, and **character variables that are purely numbers** can be converted to numeric
- `as.logical()`
 - **“FALSE”** or **0** is converted to FALSE, **“TRUE”** or **any non-zero number** is converted to TRUE
- `as.factor()`
 - Any other data type can be converted to a factor

Warnings

```
Warning message:  
NAs introduced by coercion
```

Silent effects

```
> as.numeric(as.character(14))  
[1] 14  
> as.numeric(as.factor(14))  
[1] 1
```

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Data Structures: atomic vector

- atomic vector
 - All elements are of the same type

atomic vector

1	2	3	4
"a"	"a"	"c"	"f"

1	2	3	4
1	2	1	4

1	2	3	4
T	F	T	T

Data Structures: matrix

- matrix
 - All elements are of the same type, data organised in rows and columns

matrix

	1	2	3	4
1				
2				
3				

	1	2	3	4
1				
2				
3				

	1	2	3	4
1				
2				
3				

Data Structures: data.frame

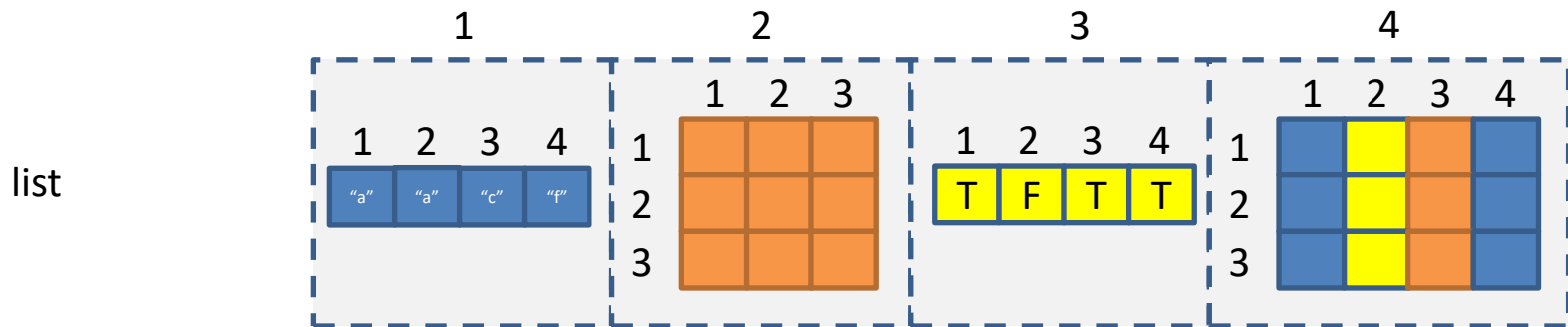
- data.frame
 - Data organised into rows and columns; elements of each column are of the same type, but different columns can be of different types

data.frame

	1	2	3	4
1	blue	yellow	orange	blue
2	blue	yellow	orange	blue
3	blue	yellow	orange	blue

Data Structures: list

- list
 - Elements can be different types, elements can also be other data structures



atomic vector

1	2	3	4
"a"	"a"	"c"	"f"

1	2	3	4
1	2	1	4

1	2	3	4
T	F	T	T

matrix

	1	2	3	4
1				
2				
3				

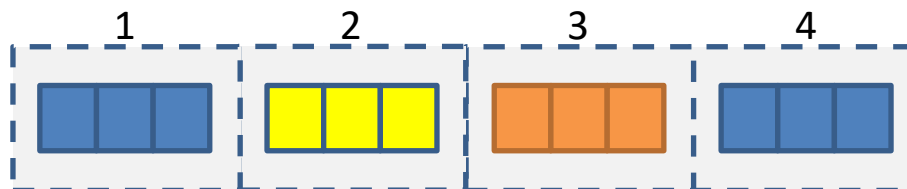
	1	2	3	4
1				
2				
3				

	1	2	3	4
1				
2				
3				

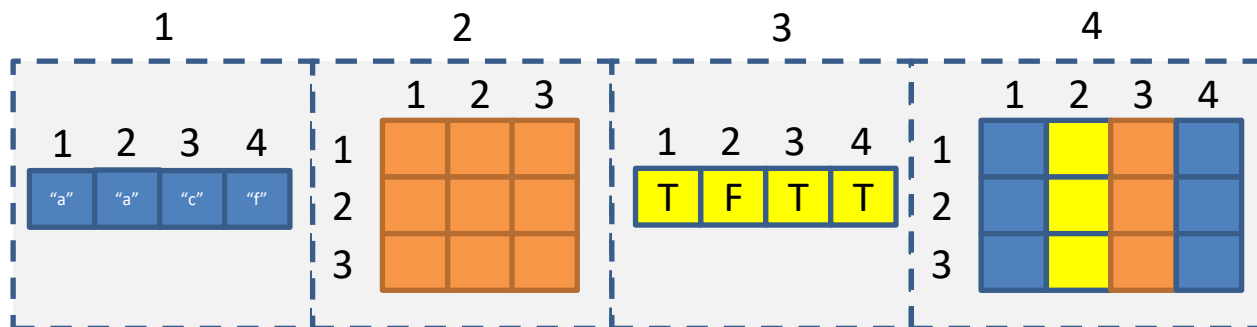
A data.frame is actually a list! (where each element of the list is an atomic vector of equal length)

data.frame

	1	2	3	4
1				
2				
3				



list



Subsetting R objects

- `[]` – To get a subset of elements
- `[[]]` – To get a specific element from a list (or a column of a `data.frame`)
- `$` - To subset a specific column in a `data.frame`

Subsetting R objects

My_av

1	2	3	4
"a"	"a"	"c"	"f"

My_av[2]

My_av[c(F, T, F, F)]

2
"a"

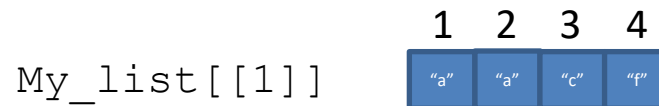
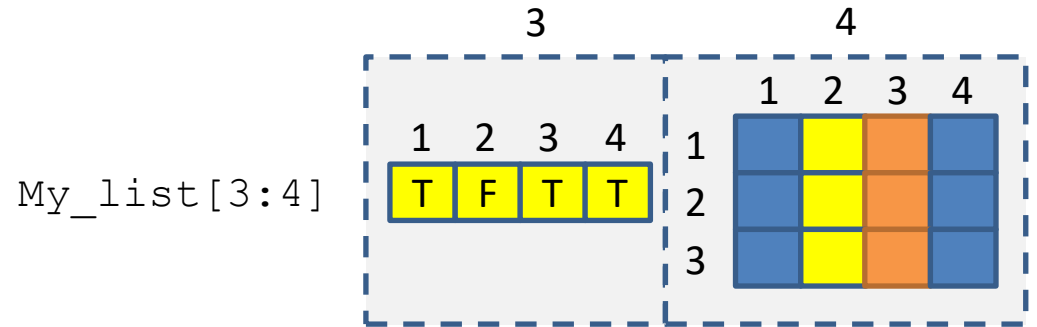
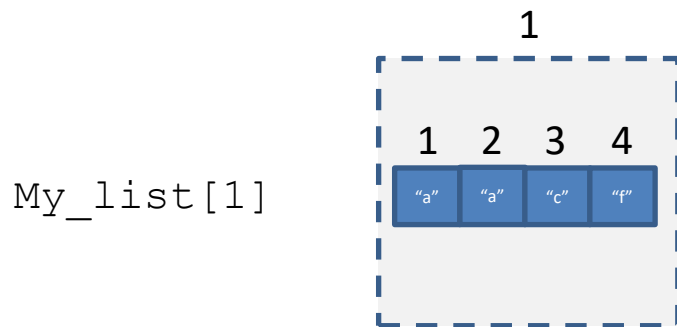
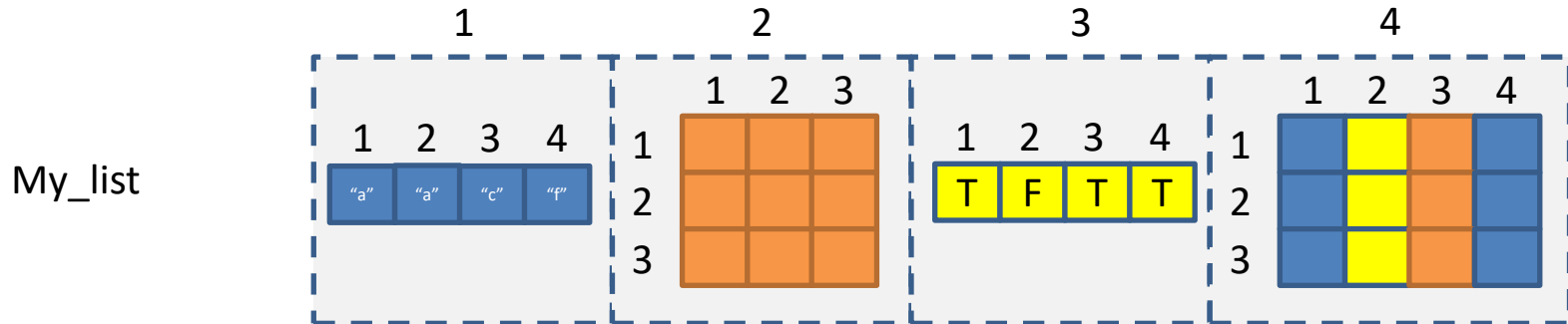
My_mat

	1	2	3	4
1	blue	red	blue	blue
2	lightblue	red	lightblue	lightblue
3	blue	red	blue	blue

My_mat[2,]

My_mat[, 2]

Subsetting R objects: list



Subsetting R objects: data.frame

Diagram illustrating the structure of a data frame (My_df) with row and column names.

Column names: Gene_name, Gene_id, Gene_count, Alt_name

Row names: S1, S2, S3

		Gene_name	Gene_id	Gene_count	Alt_name
		1	2	3	4
My_df	S1	1			
	S2	2			
	S3	3			

```
My_df[3, ]
```

```
My_df["S3", ]
```

```
My_df[, 3]
```

```
My_df[, "Gene_count"]
```

```
My_df$S3
```

```
My_df[["Gene_count"]]
```

**Let's
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practically**



Math operations

- Add, subtract, divide, multiply
 - $+$ $-$ $/$ $*$
- Modulo (remainder of division)
 - $\%$
- Exponent
 - $^$
- Rounding
 - `round()`, `floor()`, `ceiling()`

Comparisons

- Comparison between two objects returns TRUE or FALSE or NA
 - == (Note the difference between this and = for assignment)
 - <
 - >
 - <=
 - >=
 - != (Negation of anything in R is done with !)
 - %in%

Comparing integers with characters

?Comparison

```
x <- "c"
```

```
x > 1000
```

```
TRUE
```

```
y <- "i"
```

```
x > y
```

```
FALSE
```

```
z <- "A"
```

```
x > z
```

```
TRUE
```

If the two arguments are atomic vectors of different types, one is coerced to the type of the other, the (decreasing) order of precedence being character, complex, numeric, integer, logical and raw.

Note: A character is smaller than another if it comes first in alphabetical order.

Similar to sorting your Excel sheet:

If you sort ascending -> numbers come first, then all the rest alphabetically

Logical operators

(Boolean operations)

<code>!x</code>	Logical NOT
<code>x&y</code>	Element-wise logical AND
<code>x&& y</code>	Logical AND
<code>x y</code>	Element-wise logical OR
<code>x y</code>	Logical OR

Note: Zero is considered as FALSE,
non-zero values are considered as TRUE!
Only “numeric-like” or logical vectors!

```
x <- c(TRUE, FALSE, 0, 6)
y <- c(FALSE, TRUE, FALSE, TRUE)
!x
FALSE TRUE TRUE FALSE
x&y
FALSE FALSE FALSE TRUE
x&&y
FALSE
x|y
TRUE TRUE FALSE TRUE
x||y
TRUE
```

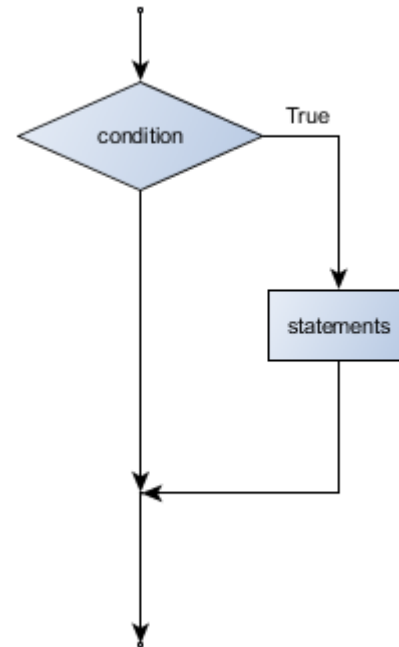
Conditionals

if statement

```
if(TRUE or FALSE) {  
    Do something  
}
```

```
x <- 4  
if(x > 0) {  
    print("Positive  
number")  
}
```

```
x <- -4
```

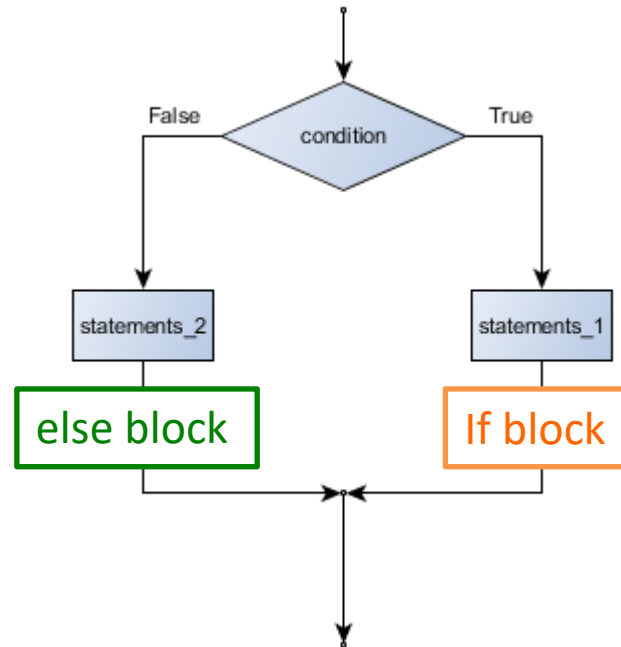


Conditionals

if ... else statement

```
if(TRUE or FALSE) {  
  Do something  
} else {  
  Do some other thing  
}
```

```
x <- 4  
if(x > 0) {  
  print("Positive number")  
} else {  
  print("Not positive number")  
}  
x <- -4
```

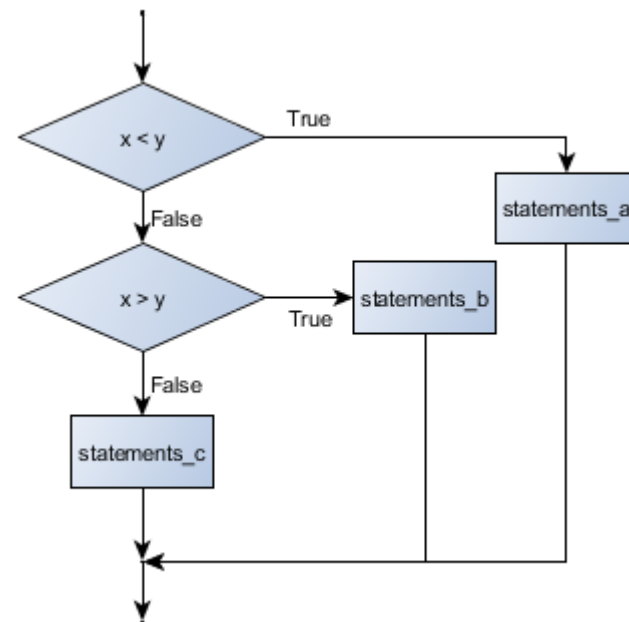


Chained conditionals

if ... else if ... else

```
if (x < y) {  
    STATEMENTS_A  
} else if (x > y) {  
    STATEMENTS_B  
} else {  
    STATEMENTS_C  
}
```

```
x <- 0  
if (x < 0) {  
    print("Negative number")  
} else if (x > 0) {  
    print("Positive number")  
} else {  
    print("Zero")  
}
```



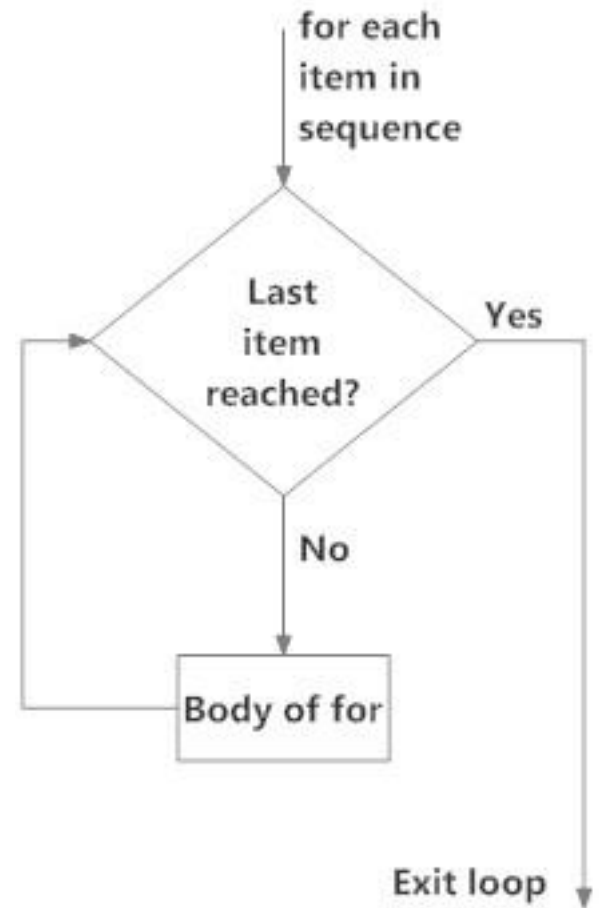
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Loops for

```
for (val in sequence)
{
statement
}
```

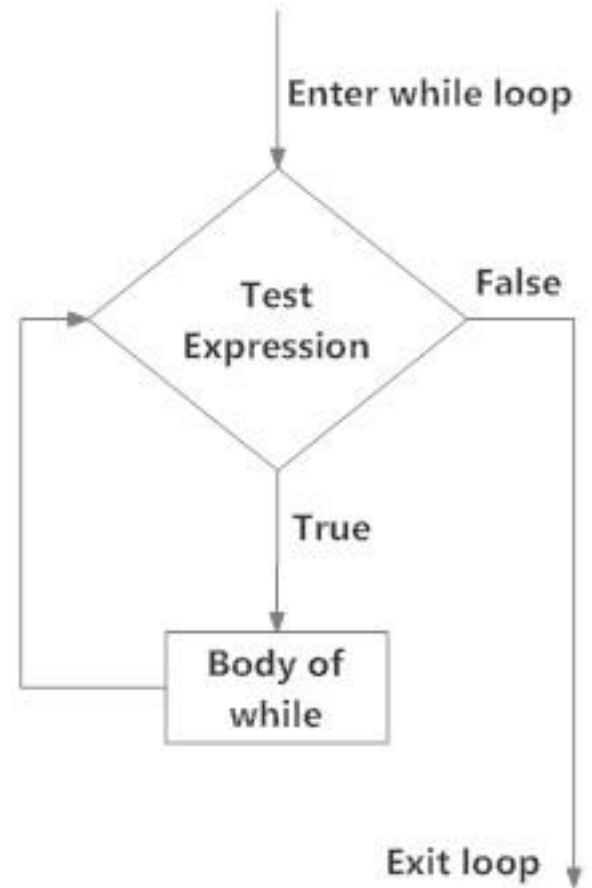
```
for (year in
c(2011,2012,2013,2014,2015,2016))
{
  print(paste("The year is", year))
}
```



Loops while

```
while (test_expression)
{
statement
}
```

```
i <- 1
while (i < 6) {
print(i)
i = i+1
}
```



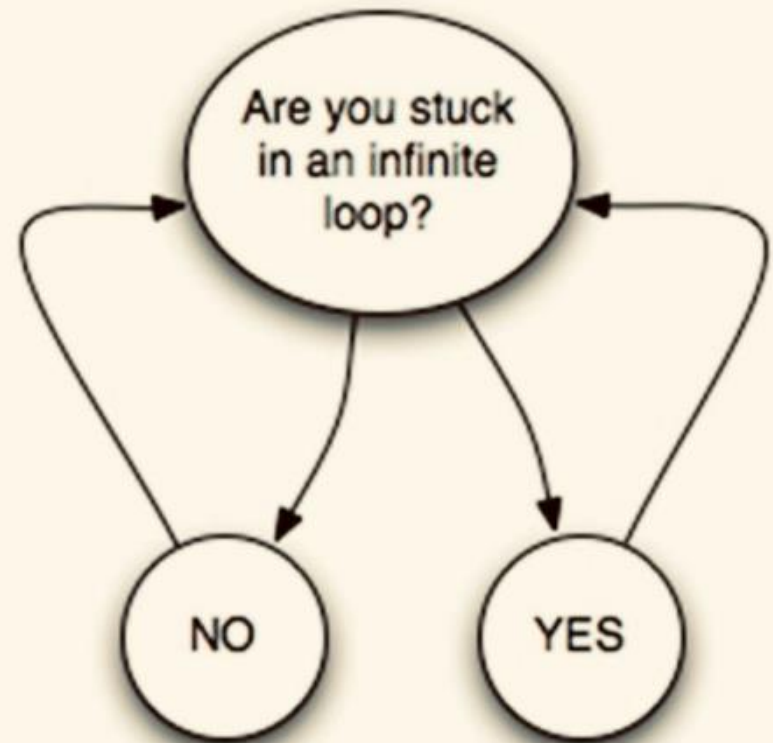
Infinite loops

```
x <- 1
while (x=1)
{
  Print("Let's move on!")
}
```

Something to keep in mind!

*break and next statements might help –
advanced level

Arguing with yourself at
3am



Getting nowhere

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Functions

Functions are created using the `function()` directive and are stored as R objects just like anything else. In particular, they are R objects of class “function”.

```
f <- function(<arguments>) {  
    ## Do something interesting  
}
```

Note: majority of the functions you would try to create already exist in the libraries!

Packages/libraries

A **package** is a collection of R functions, data and compiled code. The location where the packages are stored is called the **library**.

Package extends basic R functionality and standardizes the distribution of code. For example, a package can contain a set of functions relating to a specific topic or tasks.

Where to get the libraries/packages?

- CRAN (<https://cran.r-project.org>)

Install:

```
install.packages("dplyr")
```

Activate:

```
library("dplyr")
```

- Bioconductor (<https://bioconductor.org>)

```
if (!requireNamespace("BiocManager", quietly =  
TRUE))
```

```
  install.packages("BiocManager")
```

```
BiocManager::install("limma")
```

- Github (<https://github.com>)

```
install.packages("devtools")
```

```
library(devtools)
```

```
install_github("hadley/dplyr")
```

Our Github page

[https://github.com/sraorao/MSD R course July2021/](https://github.com/sraorao/MSD_R_course_July2021/)

Is available for all of you!

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