CT1100: Computer Systems

Topic 2: Programming in R

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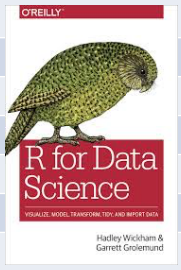
Topics to be Covered (R)

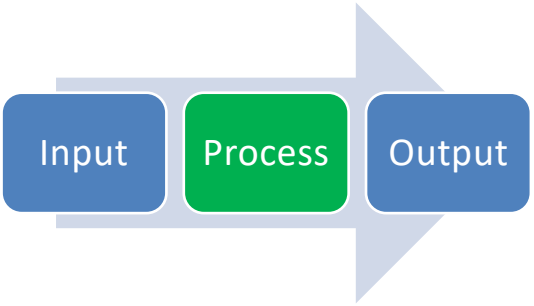
Topic	Description
1	Introduction to R and R Studio Cloud
2	A program in R
3	The tibble – a way of storing information
4	Data Visualisation I
5	Data Transformation I
6	Running a Script in R
7	Data Visualisation II
8	Data Transformation II
9	Exploring Data
10	Communicating Results

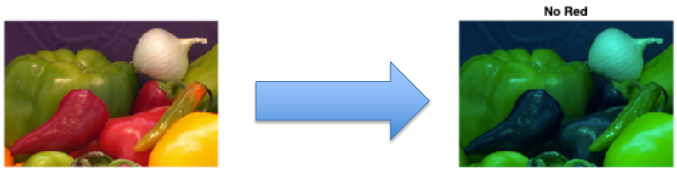


https://r4ds.had.co.nz

2

An Important Diagram!





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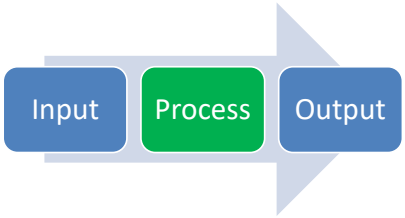
The Logic of a Program



- An algorithm is a plan for solving a problem, a program is an implementation of an algorithm
- Start by focusing on the (1) inputs and (2) outputs
- What is the key transformation(s) you want to achieve?
- What are the sequence of steps?

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Cooking as an algorithm…

Vanilla cupcakes

The hummingbird bakery cookbook

1 cup flour
a scant ¾ cup sugar
1 ½ t baking powder
3 T unsalted butter
½ cup whole milk
1 egg
¼ t pure vanilla extract

Preheat oven to 350°F.

Put the flour, sugar, baking powder, salt, and butter in a freestanding electric mixer with a paddle attachment and beat on slow speed until you get a sandy consistency and everything is combined.

Whisk the milk, egg, and vanilla together in a pitcher, then slowly pour about half into the flour mixture, beat to combine, and turn the mixer up to high speed to get rid of any lumps.

Turn the mixer down to a slower speed and slowly pour in the remaining milk mixture. Continue mixing for a couple of more minutes until the batter is smooth but do not overmix.

Spoon the batter into paper cases until 2/3 full and bake in the preheated oven for 20-25 minutes, or until the cake bounces back when touched.

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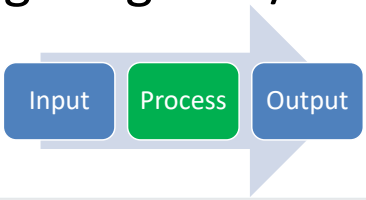
Writing Programs/Scripts




```
1  # We use this for processing the answer
2  # In programming, we "stand on the shoulders of giants"
3  library(stringi)
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5  # This gets the input from the user.
6  # The result is stored in a variable
7  # Variables are important in programming!
8  name <- readline(prompt="Enter a name: ")
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10 # We call a specially designed function to get the answer
11 # In R, we call functions all the time
12 # A function is a "mini-program"
13 ans <- stri_reverse(name)
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15 # After all this work, we output the result
16 cat("The reverse of ", name, "is ===>", ans)
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Running the Program in R

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Global Environment

Values	
ans	"yawlaG"
name	"Galway"

```
> source('~/Dropbox/R Projects/CT1100/code/01 Introduction/01 Name.R')
Enter a name: Galway
The reverse of  Galway is ===> yawlaG
```


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Challenge 2.1

- This is our first program
- Look at the output…
- Is there any way you might change or improve this?
- Think in terms of transforming the output in some further way
- Do you think R might have a function that could help?

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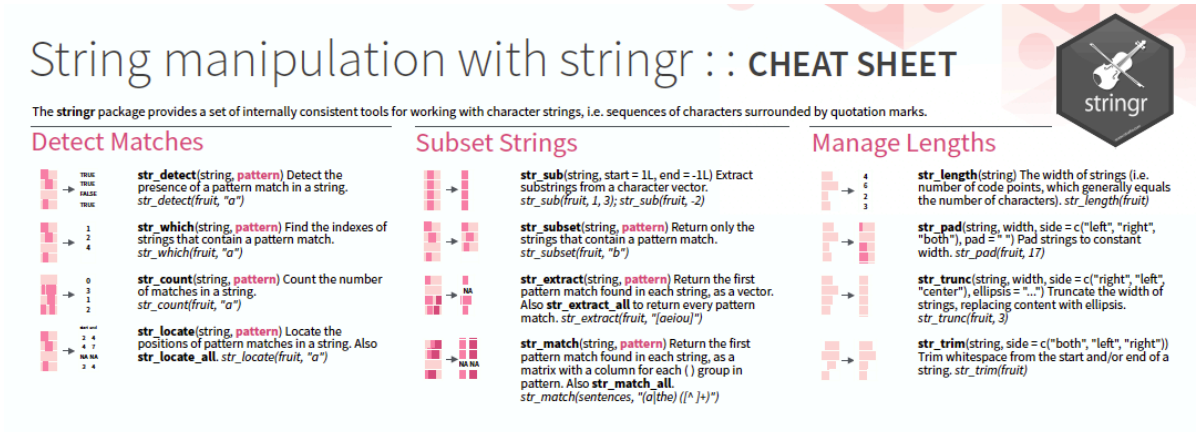
Install stringr and use and function



String manipulation with stringr : : CHEAT SHEET

The **stringr** package provides a set of internally consistent tools for working with character strings, i.e. sequences of characters surrounded by quotation marks.

Detect Matches

str_detect(string, pattern) Detect the presence of a pattern match in a string. *str_detect(fruit, "a")*

str_which(string, pattern) Find the indexes of strings that contain a pattern match. *str_which(fruit, "a")*

str_count(string, pattern) Count the number of matches in a string. *str_count(fruit, "a")*

str_locate(string, pattern) Locate the positions of pattern matches in a string. Also **str_locate_all**. *str_locate(fruit, "a")*

Subset Strings

str_sub(string, start = 1L, end = -1L) Extract substrings from a character vector. *str_sub(fruit, 1, 3); str_sub(fruit, -2)*

str_subset(string, pattern) Return only the strings that contain a pattern match. *str_subset(fruit, "b")*

str_extract(string, pattern) Return the first pattern match found in each string, as a vector. Also **str_extract_all** to return every pattern match. *str_extract(fruit, "[aeiou]")*

str_match(string, pattern) Return the first pattern match found in each string, as a matrix with a column for each ( ) group in pattern. Also **str_match_all**. *str_match(sentences, "(a|the) ([^]+)")*

Manage Lengths

str_length(string) The width of strings (i.e. number of code points, which generally equals the number of characters). *str_length(fruit)*

str_pad(string, width, side = c("left", "right", "both"), pad = " ") Pad strings to constant width. *str_pad(fruit, 17)*

str_trunc(string, width, side = c("right", "left", "center"), ellipsis = "...") Truncate the width of strings, replacing content with ellipsis. *str_trunc(fruit, 3)*

str_trim(string, side = c("both", "left", "right")) Trim whitespace from the start and/or end of a string. *str_trim(fruit)*

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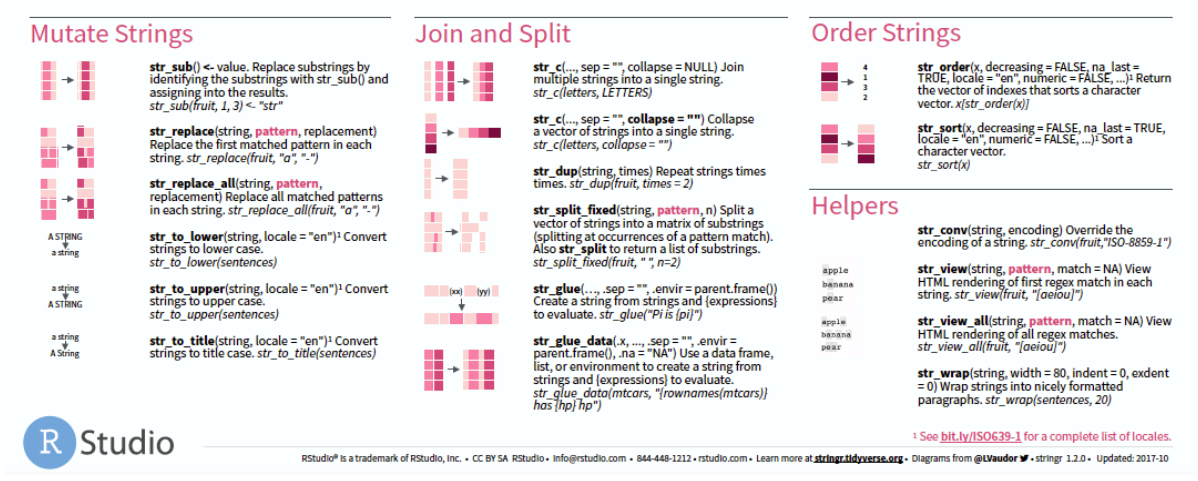
Install stringr and use



Mutate Strings

str_sub() <- value. Replace substrings by identifying the substrings with str_sub() and assigning into the results. *str_sub(fruit, 1, 3) <- "str"*

str_replace(string, pattern, replacement) Replace the first matched pattern in each string. *str_replace(fruit, "a", "-")*

str_replace_all(string, pattern, replacement) Replace all matched patterns in each string. *str_replace_all(fruit, "a", "-")*

str_to_lower(string, locale = "en")[1] Convert strings to lower case. *str_to_lower(sentences)*

str_to_upper(string, locale = "en")[1] Convert strings to upper case. *str_to_upper(sentences)*

str_to_title(string, locale = "en")[1] Convert strings to title case. *str_to_title(sentences)*

Join and Split

str_c(..., sep = "", collapse = NULL) Join multiple strings into a single string. *str_c(letters, LETTERS)*

str_c(..., sep = "", **collapse = ""**) Collapse a vector of strings into a single string. *str_c(letters, collapse = "")*

str_dup(string, times) Repeat strings times times. *str_dup(fruit, times = 2)*

str_split_fixed(string, pattern, n) Split a vector of strings into a matrix of substrings (splitting at occurrences of a pattern match). Also **str_split** to return a list of substrings. *str_split_fixed(fruit, " ", n=2)*

str_glue(..., .sep = "", .envir = parent.frame()) Create a string from strings and {expressions} to evaluate. *str_glue("Pi is {pi}")*

str_glue_data(.x, ..., .sep = "", .envir = parent.frame(), .na = "NA") Use a data frame, list, or environment to create a string from strings and {expressions} to evaluate. *str_glue_data(mtcars, "{rownames(mtcars)} has {hp} hp")*

Order Strings

str_order(x, decreasing = FALSE, na_last = TRUE, locale = "en", numeric = FALSE, ...)[1] Return the vector of indexes that sorts a character vector. *x[str_order(x)]*

str_sort(x, decreasing = FALSE, na_last = TRUE, locale = "en", numeric = FALSE, ...)[1] Sort a character vector. *str_sort(x)*

Helpers

str_conv(string, encoding) Override the encoding of a string. *str_conv(fruit,"ISO-8859-1")*

str_view(string, pattern, match = NA) View HTML rendering of first regex match in each string. *str_view(fruit, "[aeiou]")*

str_view_all(string, pattern, match = NA) View HTML rendering of all regex matches. *str_view_all(fruit, "[aeiou]")*

str_wrap(string, width = 80, indent = 0, exdent = 0) Wrap strings into nicely formatted paragraphs. *str_wrap(sentences, 20)*

RStudio

[1] See bit.ly/ISO639-1 for a complete list of locales.

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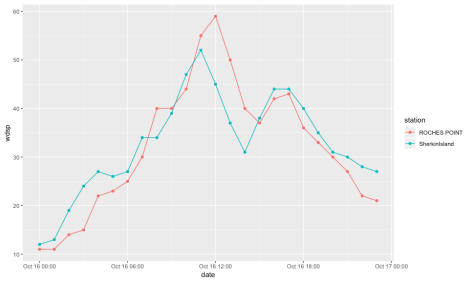
Exploring Data – the tibble

Package	Purpose
ggplot2	Produce graphics for data
dplyr	Analysis of data held in tibbles/data frames
aimsir17	2017 Weather data for Ireland
stringi	For manipulating strings

Challenge 2.2

- Install the package aimsir17
- Check out the variable:
  - observations
  - stations
  - eirgrid17
- Explore Storm Ophelia
  - https://github.com/JimDuggan/aimsir17/tree/master/data-raw/Examples/02%20Storm%20Ophelia
  - 16th October 2017



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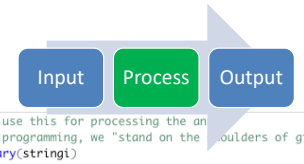


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```
> rp
# A tibble: 24 x 12
   station  year month   day  hour date                rain  temp  rhum
   <chr>    <dbl> <dbl> <int> <int> <dttm>              <dbl> <dbl> <dbl>
 1 ROCHES… 2017    10    16     0 2017-10-16 00:00:00   0    13.8    98
 2 ROCHES… 2017    10    16     1 2017-10-16 01:00:00   0.1  13.9    98
 3 ROCHES… 2017    10    16     2 2017-10-16 02:00:00   0.1  13.9    98
 4 ROCHES… 2017    10    16     3 2017-10-16 03:00:00   1.1  14      97
 5 ROCHES… 2017    10    16     4 2017-10-16 04:00:00   0.2  14      97
 6 ROCHES… 2017    10    16     5 2017-10-16 05:00:00   0    15.4    88
 7 ROCHES… 2017    10    16     6 2017-10-16 06:00:00   0    16      80
 8 ROCHES… 2017    10    16     7 2017-10-16 07:00:00   0    16.3    75
 9 ROCHES… 2017    10    16     8 2017-10-16 08:00:00   0    14.5    78
10 ROCHES… 2017    10    16     9 2017-10-16 09:00:00   0.4  13.3    77
# … with 14 more rows, and 3 more variables: msl <dbl>, wdsp <dbl>,
#   wddir <dbl>
```