R Markdown

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Introduction

What is Markdown?

Markdown is a textual format proposed by John Gruber that can be easily converted into several different formats

> *Markdown is intended to be as easy-to-read and easy-to-write as is feasible.*

- should be publishable as-is, as plain text, without looking like it's been marked up with tags or formatting instructions

- syntax is comprised entirely of punctuation characters, carefully chosen so as to look like what they mean.

  - E.g., asterisks around a word actually look like *emphasis*.

Markdown conversion

Several tools are able to convert markdown to HTML.

The most complete tool is **Pandoc**

- able to convert to and from several formats
  https://pandoc.org
- used within R Studio to perform conversions

In R Studio you can

- click on
- use the function: `render()`, e.g.:

```
rmarkdown::render('foo.Rmd', 'html_document')
```

Markdown syntax: formatting

- *Emphasis*: `*Emphasis*`
- **Bold**: `**Bold**`
- Superscript 2^{31} : `2^31^`
- Subscript x_i : `x~i~`
- PoliTo : `[PoliTo](https://www.polito.it)`
- : `![](Knit.png)`

Markdown syntax: headings

- Paragraph are text blocks separate by empty lines

- Headings

```
# Level 1 heading
## Level 2 heading
### Level 3 heading
```

alternate syntax

```
Level 1 heading
===============


Level 2 heading
---------------
```

Markdown syntax: blocks

Fenced code blocks

- delimited by three (or more) backticks ```` ``` ````

```
```

Verbatim text
```
```

- Quotation with `>` in first column

> *Making the simple complicated is commonplace; making the complicated simple, awesomely simple, that's creativity*
>
> *— Charles Mingus*

Markdown syntax: lists

- Bullet lists start with `*`, `–`, or `+`

- Numbered lists start with a number

- Can be nested with indentation

```
– Top item
    1. 2nd level
    2. another
```

- Top item
  1. 2nd level

  2. another

Markdown syntax: tables

Tables are built by

- header: column labels separated by `|`

- rule: sequence of dashes `–` separated by `|` at column breaks

  - initial `:` means align left

  - final `:` means align right

  - both means align center

- rows: content cells, separated by `|`

Markdown syntax: tables

```
ID     | Name     | Points   |
:----  |:-------: |--------: |
  123  | aleph    |   987    |
  666  | bet      |   1234   |
  456  | gimel    |   98     |
```

ID	Name	Points
123	aleph	987
666	bet	1234
456	gimel	98

Markdown syntax: math

- Inline maths within `$`

- Equations within `$$`

- Uses LaTeX math , e.g.,

description	code	examples
Greek letters	`\alpha \beta \gamma`	$\alpha\beta\gamma$
Binary	`\times \cup \cap`	$\times \cup \cap$
Relation	`< > \subset \supset`	$<>\subset\supset$
Others	`\int \sum \prod`	$\int \sum \prod$

Code chunks

- Code blocks starting with ` ```{r ... } `
    - `r` stands for R language (can be e.g. python, java)
    - followed by an optional label for the chunk
    - followed by additional chunk parameters
        - `include` whether to include chunk results in output
        - `echo` whether to report source in output
        - `eval` whether to evaluate at all the code chunk
- By default code is echoed and output is added to result

Inline code

Result of expressions can be placed inline within regular markdown enclosed between `` `r `` and `` ` ``.

```
– A sum of squares: `r 3^2+5^2`.
```

Is rendered as:

- A sum of squares: 34.

Plots

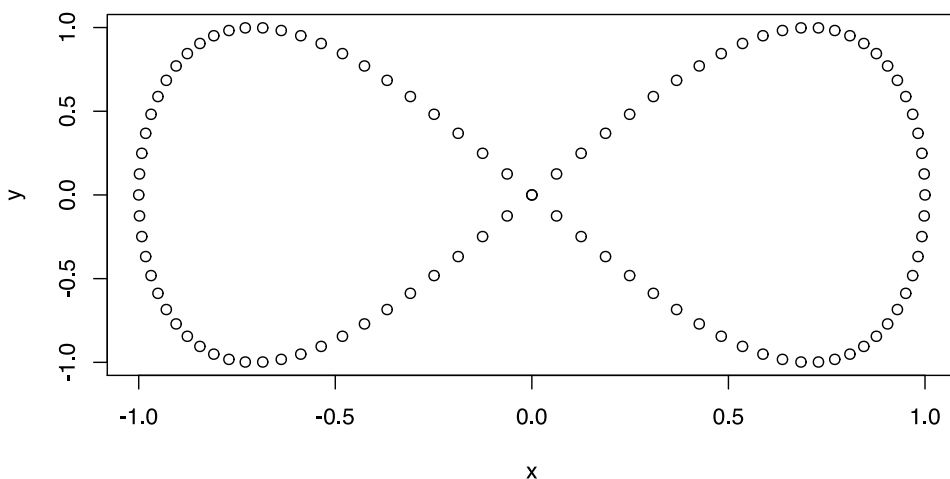Plots produced by the code are addet in the resulting document.

Userful parameters are `fig.width`, `fig.height` to define the dimension of the reulting plot, it can control:

- aspect ratio: w/h

- resolution: larger values imply higher resolution and smaller elements (e.g. chars)

Plots

```
x = cos(1:100/50*pi); y = sin(1:100/25*pi)
plot(x,y)
```
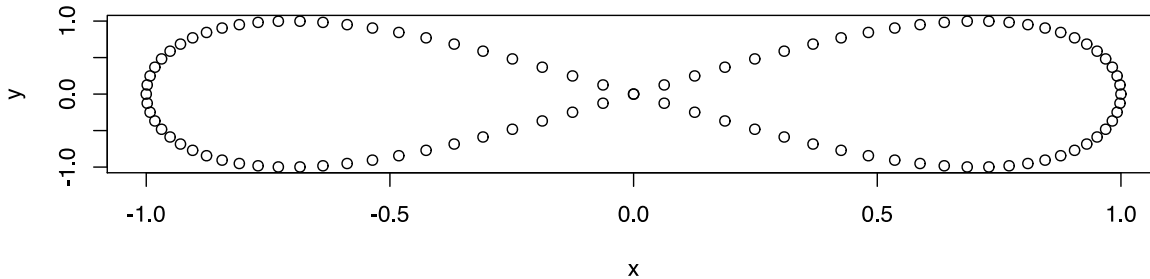
Plots

Parameters: `fig.width=9,fig.height=3`

```
x = cos(1:100/50*pi); y = sin(1:100/25*pi)
plot(x,y)
```

Tables

It is possible to format the content of a data frame as a table using the `knitr::kable()` function

---

```
knitr::kable(courses)
```

code	course	semester	credits
15AHM	Chemistry	1	8
12BHD	Computer science	1	8
16ACF	Calculus I	1	10
01PNN	Free Credits	2	6
01RKC	Linear Algebra	2	10
17AXO	Physics I	2	10

The alternative is a text-based rendering like in the console.

```
courses
```

```
##      code              course semester credits
## 1 15AHM          Chemistry        1       8
## 2 12BHD Computer science          1       8
## 3 16ACF        Calculus I         1      10
## 4 01PNN       Free Credits        2       6
## 5 01RKC     Linear Algebra        2      10
## 6 17AXO         Physics I         2      10
```

Metadata block

R markdown document can include a header block that contains meta-data.

- is included between lines with `---`

- uses the YAML syntax.

```
---
title: Habits
author: John Doe
date: March 22, 2048
output: html_document
---
```

Output formats

The `output` parameter can be:

- R Notebook: `html_notebook`

- HTML document: `html_document`

- PDF document: `pdf_document`

  - Requires LaTeX installation, e.g. package `tinytex`

- Word document `word_document`

- ODT document `odt_document`

- …

Notebook

A notebook is a R markdown document

- chunks that can be executed independently and interactively,

- output of execution appears immediately beneath the input.

A preview can be enabled

- it shows the HTML rendering of the document

  - only evaluated chunks are included

- it is updated on save

Basic chunk behavior active in any Rmd document

Basic commands

- execute current chunk
    - `Ctrl + Shift + Enter` / `Cmd + Shift + Enter`
    - green arrow on top right of chunk
- execute current statement
    - `Ctrl + Enter` / `Cmd + Enter`
- insert new chunk
    - `Ctrl + Alt + I` / `Cmd + Option + I`
    - *Insert* button on top of editor pane

Saving and sharing

When saved a notebook creates a `.nb.html` file

- the file contains the output of the evaluated chunks
- it can be viewed with a browser
- it contains also the source R markdown
- when opened in RStudio, source is extracted in placed in a `.Rmd` file.

Interactive

```
library(leaflet)
leaflet() %>% addTiles() %>%
  setView(7.659, 45.063, zoom = 16)
```


Leaflet | © OpenStreetMap contributors, CC-BY-SA

Software

- R
  - Download at: https://cran.r-project.org
- R-Studio Desktop
  - Download at: https://rstudio.com/products/rstudio/

References

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