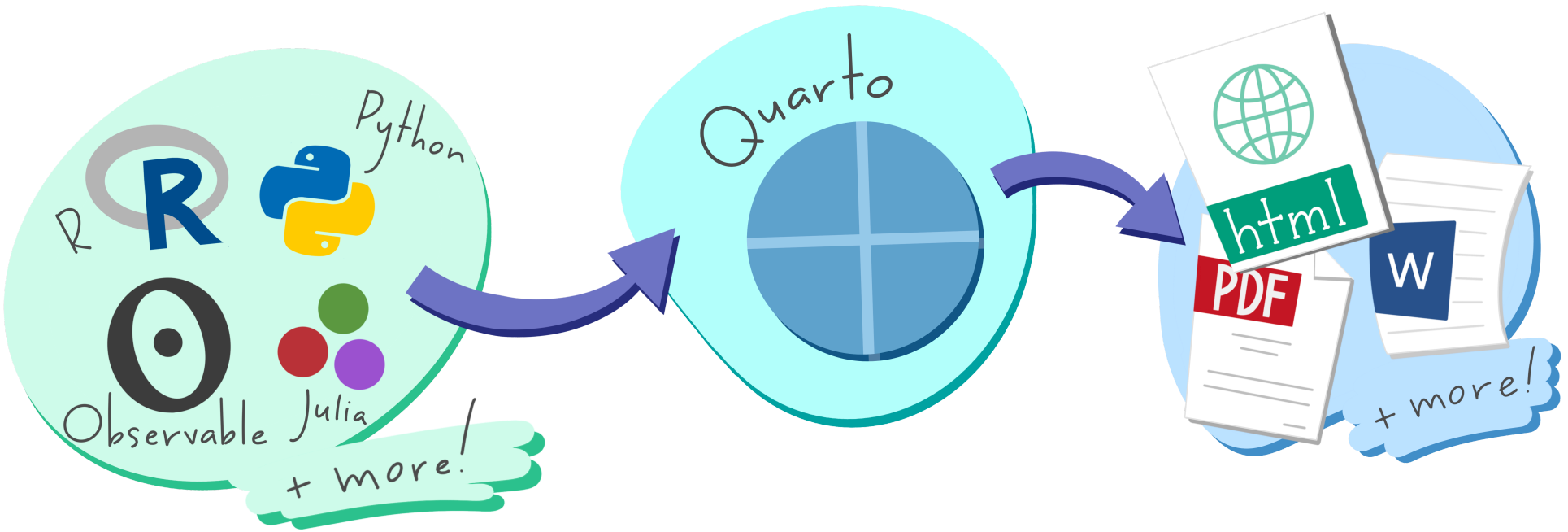
Dynamic documents in Python

reproducible research with Quarto

2025-07-05



Artwork from “Hello, Quarto” keynote by Julia Lowndes and Mine Çetinkaya-Rundel, presented at RStudio Conference 2022. Illustrated by Allison Horst.

Source

````
---
title: "ggplot2 demo"
author: "Norah Jones"
date: "5/22/2021"
format:
  html:
    fig-width: 8
    fig-height: 4
    code-fold: true
---

## Air Quality

@fig-airquality further explores the impact of
temperature on ozone level.

```{r}
#| label: fig-airquality
#| fig-cap: Temperature and ozone level.
#| warning: false

library(ggplot2)

ggplot(airquality, aes(Temp, Ozone)) +
  geom_point() +
  geom_smooth(method = "loess"
)
```
````

Output

ggplot2 demo

Norah Jones

May 22nd, 2021

Air Quality

Figure 1 further explores the impact of temperature on ozone level.

▶ Code

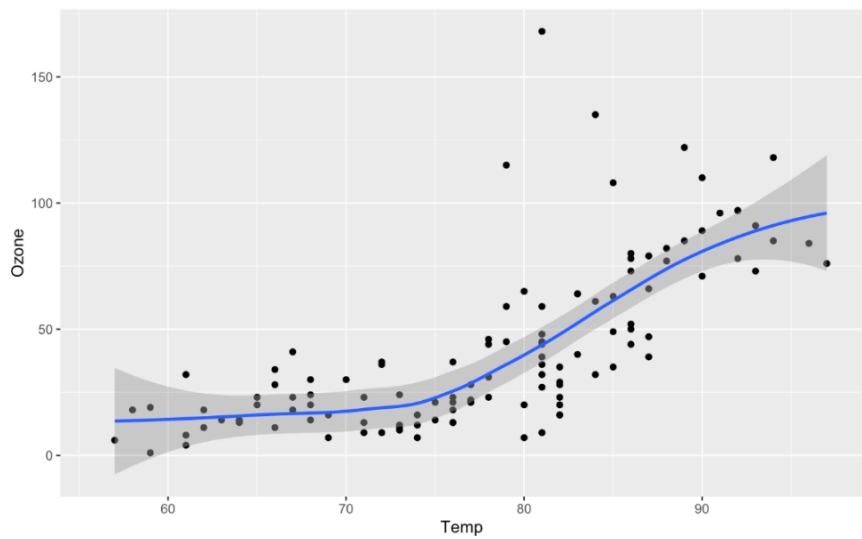
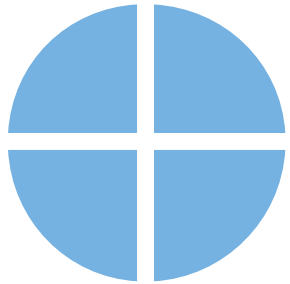


Figure 1: Temperature and ozone level.

Quarto

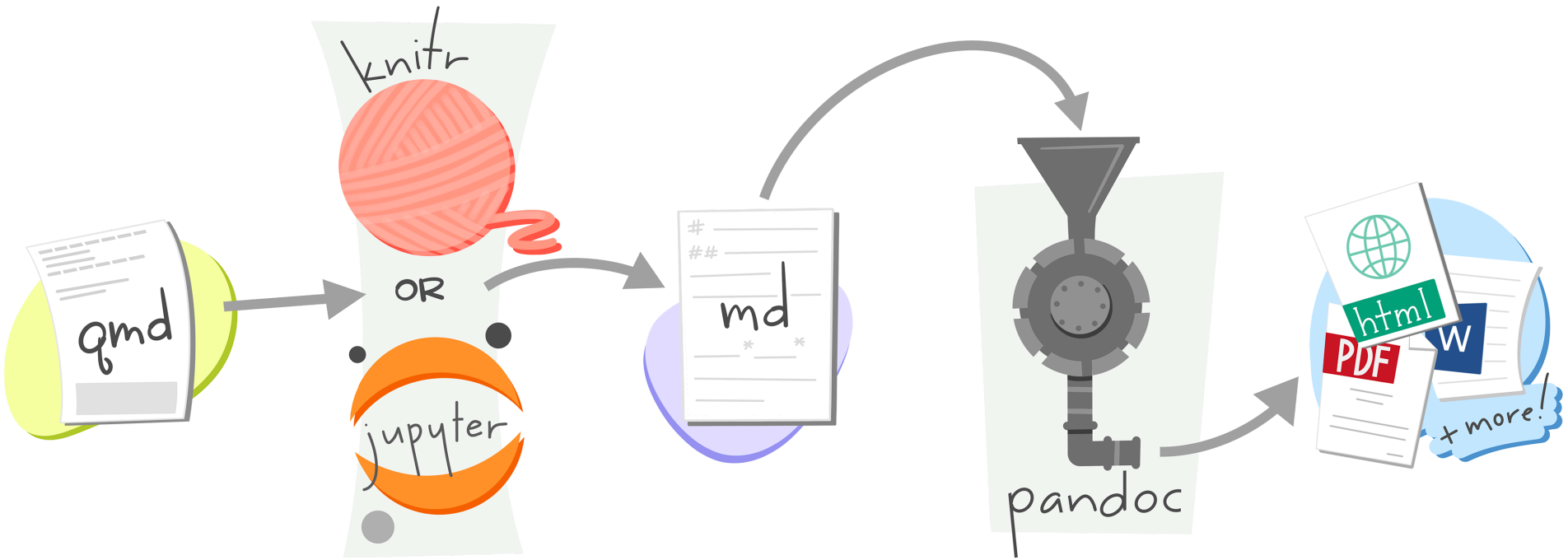


Dynamic: code and text in same document

Reproducible: re-run your analysis, re-render your document

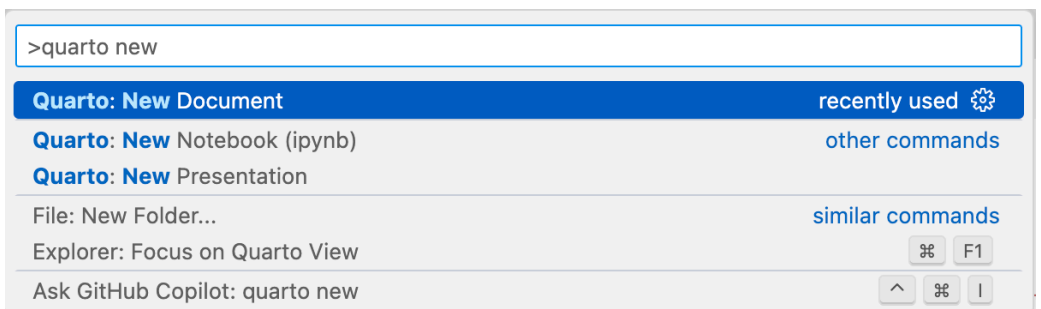
Flexible: output to different formats easily

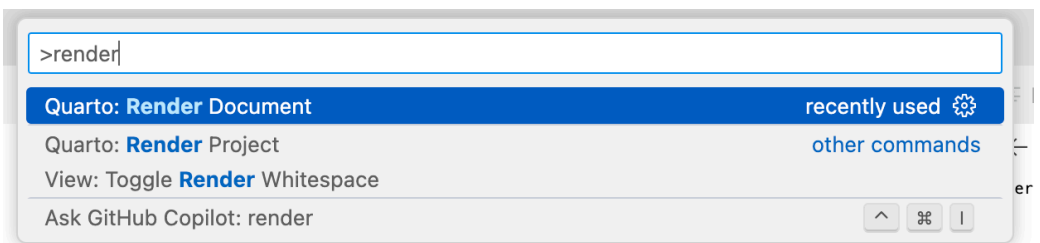
Rendering

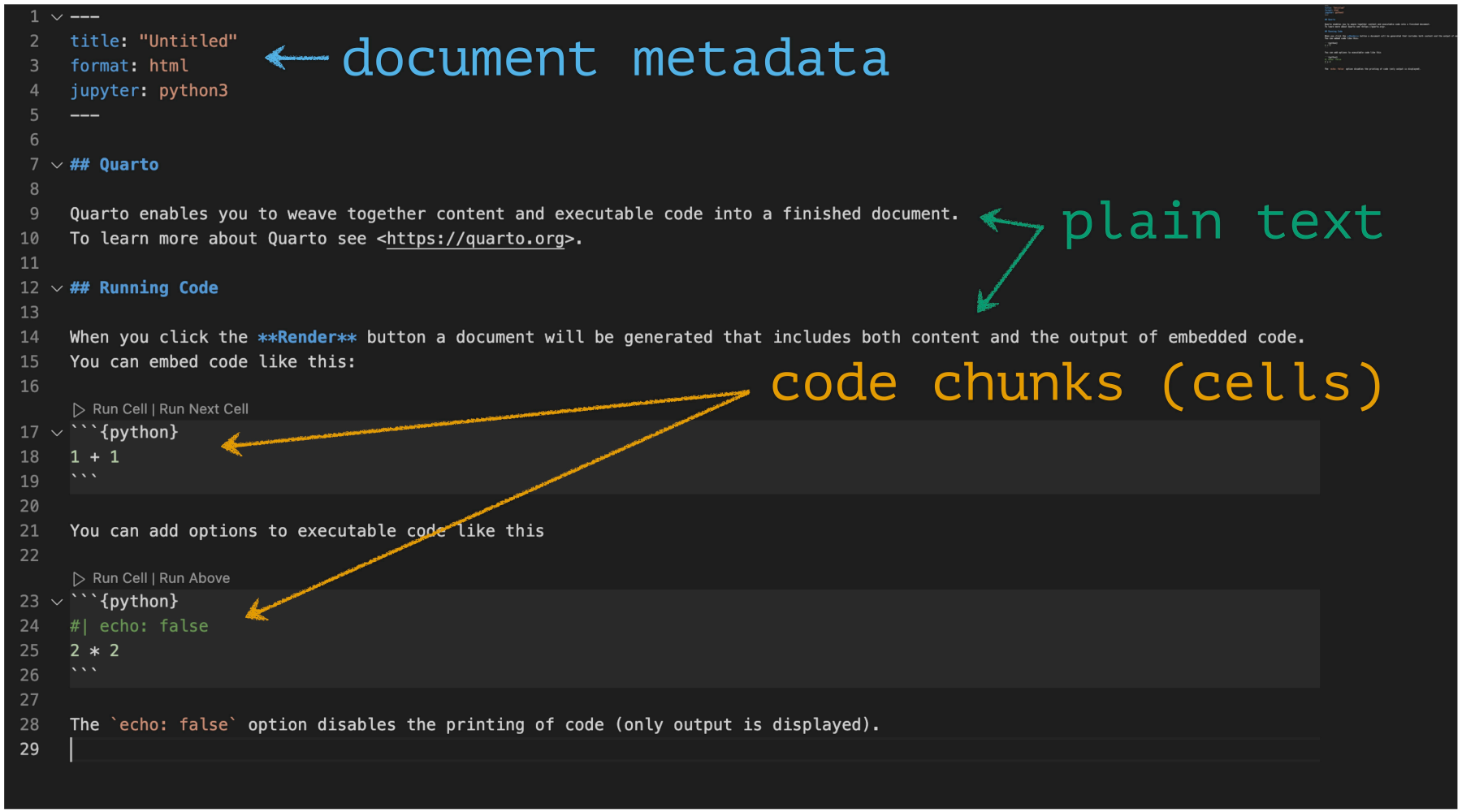


Your Turn 1

Create a new Quarto file. Use the Command Palette (Cmd/ctrl + Shift + P) in VS Code to create a new Quarto document. Save the file and run the Render command.





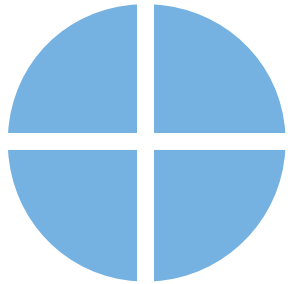

---
title: "Untitled"
format: html
jupyter: python3
---
document metadata
Quarto
Quarto enables you to weave together content and executable code into a finished document.
To learn more about Quarto see <https://quarto.org>.
plain text
Running Code
When you click the **Render** button a document will be generated that includes both content and the output of embedded code.
You can embed code like this:
code chunks (cells)
Run Cell | Run Next Cell
```{python}
1 + 1
```
You can add options to executable code like this
Run Cell | Run Above
```{python}
#| echo: false
2 * 2
```
The `echo: false` option disables the printing of code (only output is displayed).

Quarto

Prose

Code

Metadata

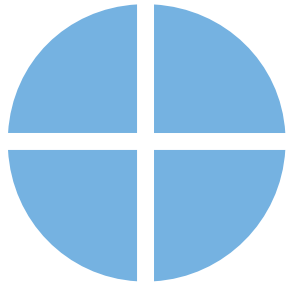


Quarto

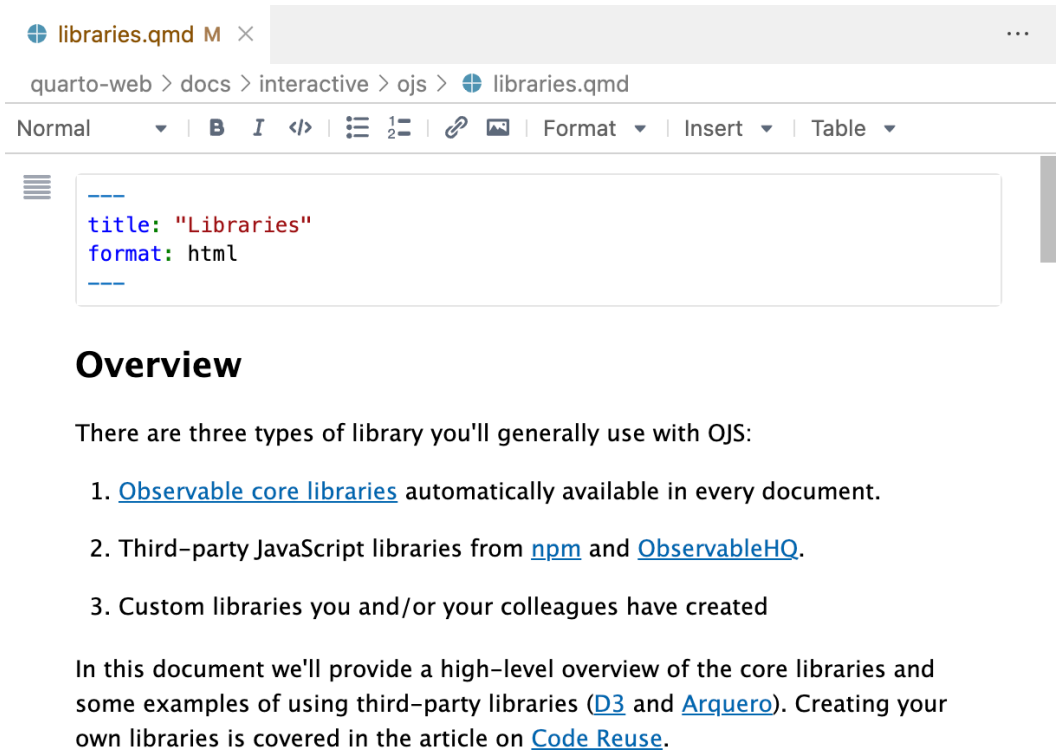
Prose = ***Markdown***

Code

Metadata



the Visual Editor



Basic Markdown Syntax

```
*italic*   **bold**

_italic_   __bold__
```

Basic Markdown Syntax

```
# Header 1

## Header 2

### Header 3
```

Basic Markdown Syntax

```
http://example.com

[linked phrase](http://example.com)
```

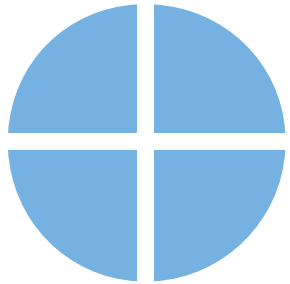
Learn more about Markdown Syntax with the ten-twenty minute tutorial on markdown at https://commonmark.org/help/tutorial.

Your Turn 2 (open `exercises.qmd`)

Read this short introduction to the Visual Editor:
https://quarto.org/docs/visual-editor/vscode/

Use the Visual Editor to stylize the text from the Gapminder website below. Experiment with bolding, italicizing, making lists, etc.

Quarto



Prose

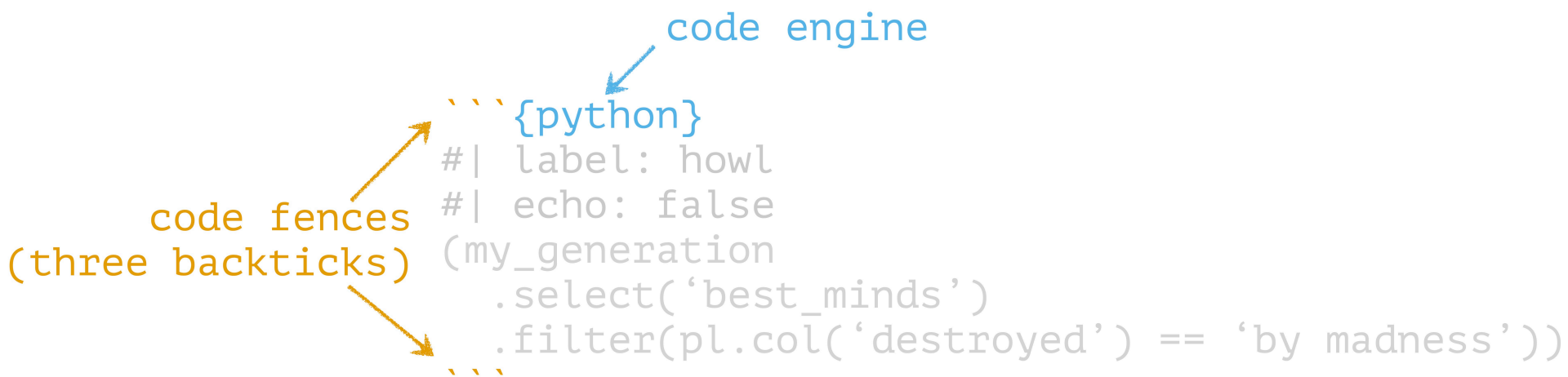
Code = ***Python code chunks***

Metadata

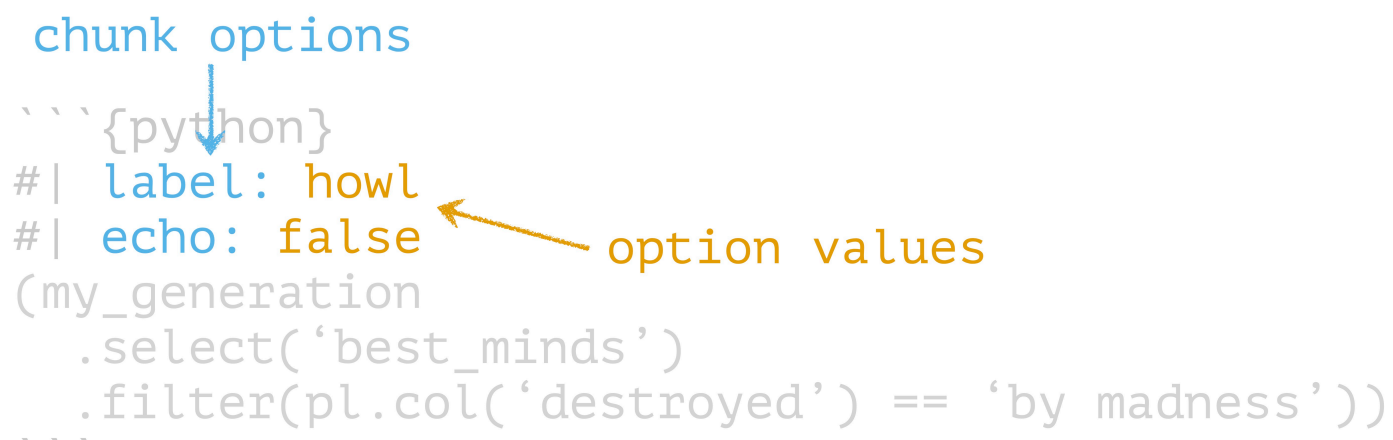
Code chunks

````
```{python}
#| label: howl
#| echo: false
(my_generation
  .select('best_minds')
  .filter(pl.col('destroyed') == 'by madness'))
```
````

Code chunks


code engine
code fences
(three backticks)
```{python}
#| label: howl
#| echo: false
(my_generation
.select('best_minds')
.filter(pl.col('destroyed') == 'by madness'))
```

Code chunks


chunk options
option values
```{python}
#| label: howl
#| echo: false
(my_generation
  .select('best_minds')
  .filter(pl.col('destroyed') == 'by madness'))
```

Code chunks

code chunk comments

```
```{python}
#| label: howl
#| echo: false
(my_generation
  .select('best_minds')
  .filter(pl.col('destroyed') == 'by madness'))
```
```

Chunk options

Option	Effect
`include: false`	run the code but don't print it or results
`eval: false`	don't evaluate the code
`echo: false`	run the code and output but don't print code
`message: false`	don't print messages (e.g. from a function)
`warning: false`	don't print warnings
`fig-cap: "Figure 1"`	caption output plot with "Figure 1"

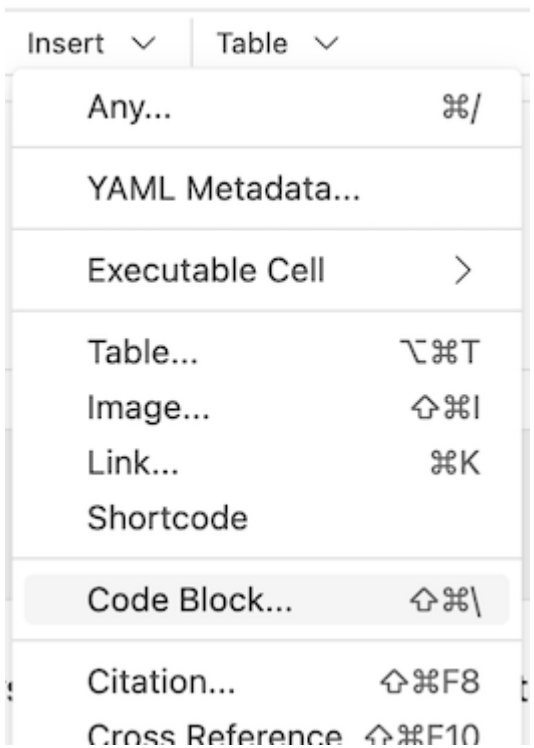
See the Quarto documentation

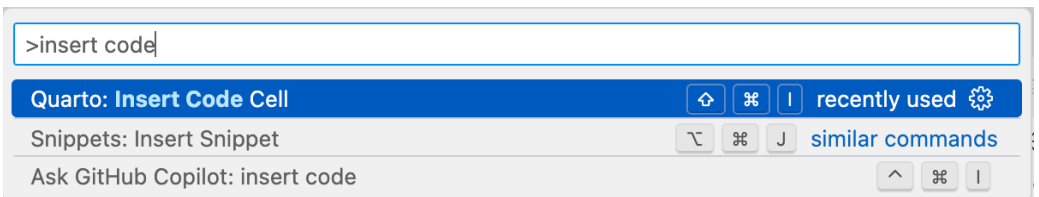
Other languages

First-class support for R, Julia, and Observable JS

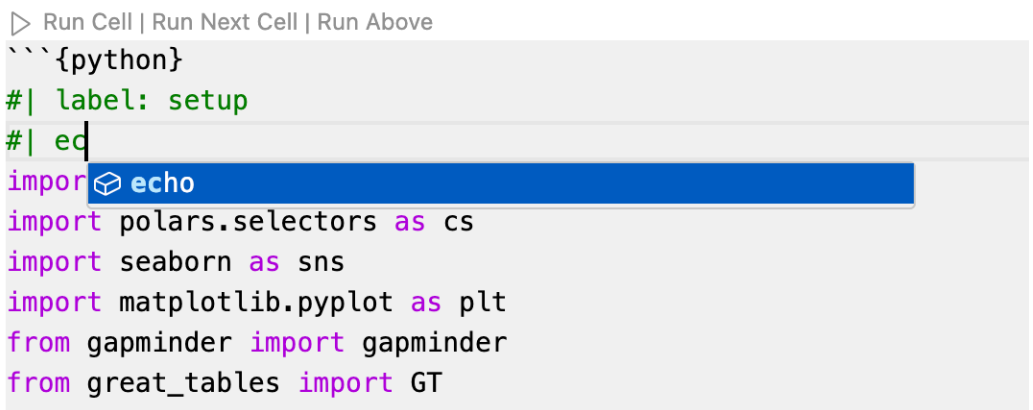
Supports Jupyter notebooks

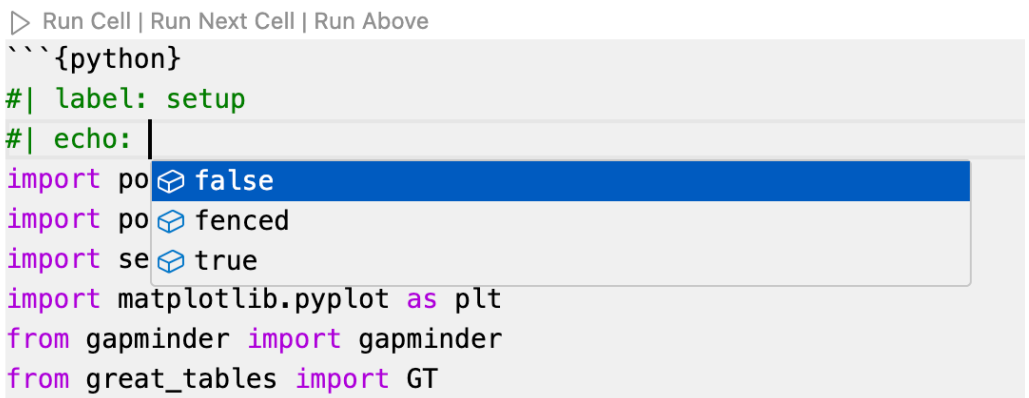
Insert code chunks with `cmd/ctrl + alt/option + I`, Command Palette, or Visual Editor





Start typing and press `tab` to autocomplete chunk options





Your Turn 3

Create a code chunk. You can type it in manually, use the keyboard short-cut (Cmd/Ctrl + Option/Alt + I), or use the "Insert" button above. Put the following code in it:

```
GT(gapminder.head())
```

Render the document

Your Turn 4

Add `echo: false` to the code chunk you created and re-render. What's the difference in the output?

Inline Code

```
who wept at the romance of the
streets with their pushcarts full of
onions and bad music,
who sat in boxes breathing in the
darkness under the bridge, and rose
up to build `{python}
instruments.select('harpsichord')` in
their lofts,
who coughed on the `{python}
len(floors)` floor of Harlem crowned
with flame under the tubercular sky
surrounded by orange crates of
theology,
who scribbled all night rocking and
rolling over lofty incantations which
in the yellow morning were stanzas of
gibberish,
```

Inline Code

single backtick + {python}

any Python code

```
who wept at the romance of the
streets with their pushcarts full of
onions and bad music,
who sat in boxes breathing in the
darkness under the bridge, and rose
up to build `{python}
instruments.select('harpsichord')` in
their lofts,
who coughed on the `{python}
len(floors)` floor of Harlem crowned
with flame under the tubercular sky
surrounded by orange crates of
theology,
who scribbled all night rocking and
rolling over lofty incantations which
in the yellow morning were stanzas of
gibberish,
```

Your Turn 5

Remove `eval: false` so that Quarto evaluates the code.

Fill in the column name to use `.select()` and `to_numpy()` to get the the number of unique `years` in gapminder as a scalar.

Save the results as `n_years`.

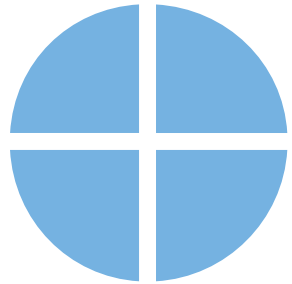
Use inline code to describe the data set in the text below the code chunk and re-render.

Quarto

Prose

Code

Metadata = ***YAML***



YAML Metadata

```yaml
---
title: "Howl"
author: "Allen Ginsberg"
date: "March 18, 1956"
format:
  html: default
  pdf:
    toc: true
    number-sections: true
---
```

Output formats

Format	Outputs
`html`	HTML
`pdf`	PDF
`word`	Word `.docx`
`odt`	OpenOffice `.odt`
`gfm`	GitHub-flavored Markdown
`revealjs`	Reveal Slides (HTML)
`beamer`	Beamer Slides (PDF)
`pptx`	Powerpoint Slides

Your Turn 6

Set figure chunk options to the code chunk below, such as `dpi`, `fig-width`, and `fig-height`.

Add your name to the YAML header using `author: Your Name`.

Change `format: html` to use the `toc: true` and `code-fold: true` options and re-render

Parameters

```
#| tags: [parameters]
param1 = x
param2 = y
data = df
```

Calling parameters in Python

```
param1
param2
data
```

From the Command Line

```
quarto render document.qmd -P param1:0.2 -P param2:0.3
```

Your Turn 7

Change the `params` option in the YAML header to use a different continent. Re-render.

```
gapminder_filtered = gapminder.filter(pl.col("continent") == continent)

sns.lineplot(
  data=gapminder_filtered,
  x="year",
  y="lifeExp",
  hue="country",
  palette="Spectral",
  linewidth=1,
  legend=False
)
plt.title(f"Continent: {continent}")
sns.set_theme(style="whitegrid")
```

Bibliographies and citations

Bibliography files: `.bib`, Zotero, others

Citation styles: `.csl`

`[@citation-label]`

Visual Editor's citation wizard can help!

Including bibliography files in YAML

```yaml
---
bibliography: file.bib
csl: file.csl
---
```

the Visual Editor can also manage this for you.

Your turn 8

Cite Causal Inference in text below. Using the citation wizard, find the right citation under My sources > Bibliography.

Add the American Journal of Epidemiology CSL to the YAML using csl: `aje.csl`

Re-render

Make cool stuff in Quarto!

- Books
- Blogs
- These slides!

See the Gallery for inspiration

Resources

Quarto Documentation: **A comprehensive but friendly introduction to Quarto. Written in Quarto!**