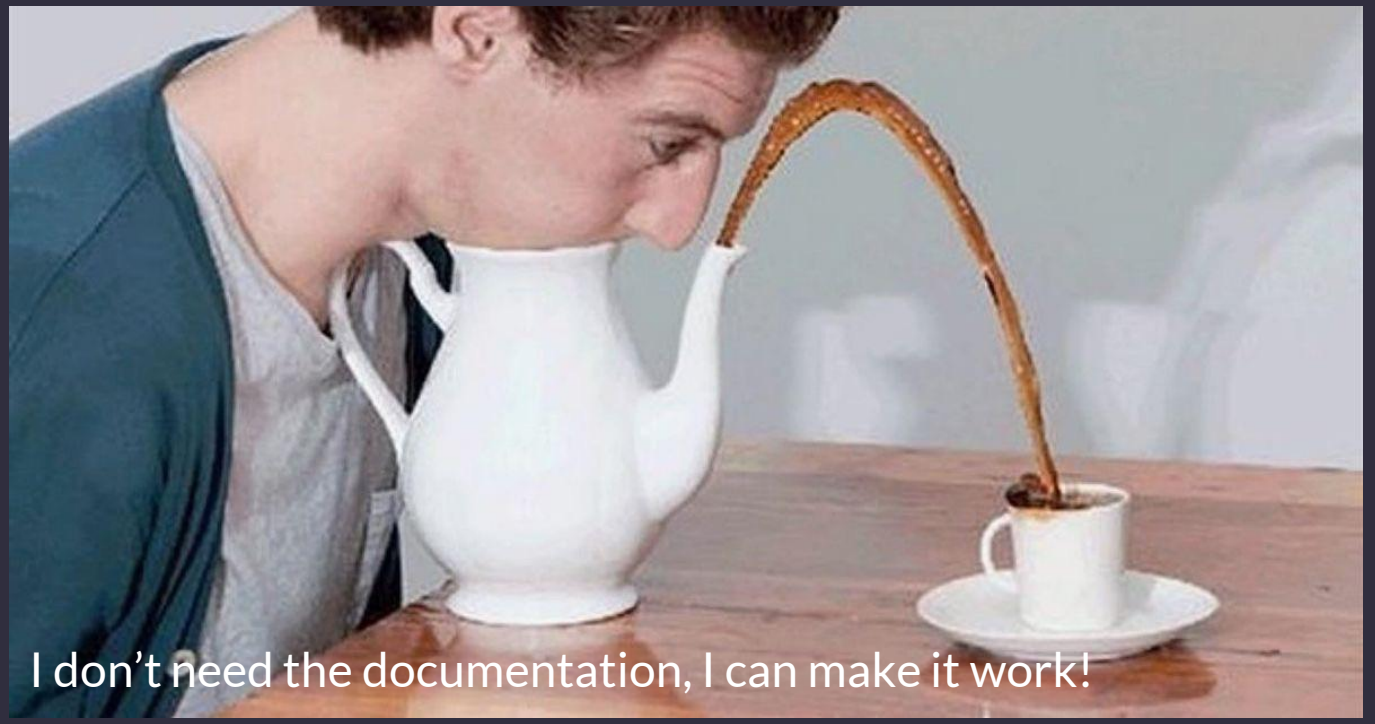
Documenting software

WRITE DOCUMENTATION THAT CONVEYS INFORMATION EFFICIENTLY AND INTUITIVELY


I don’t need the documentation, I can make it work!

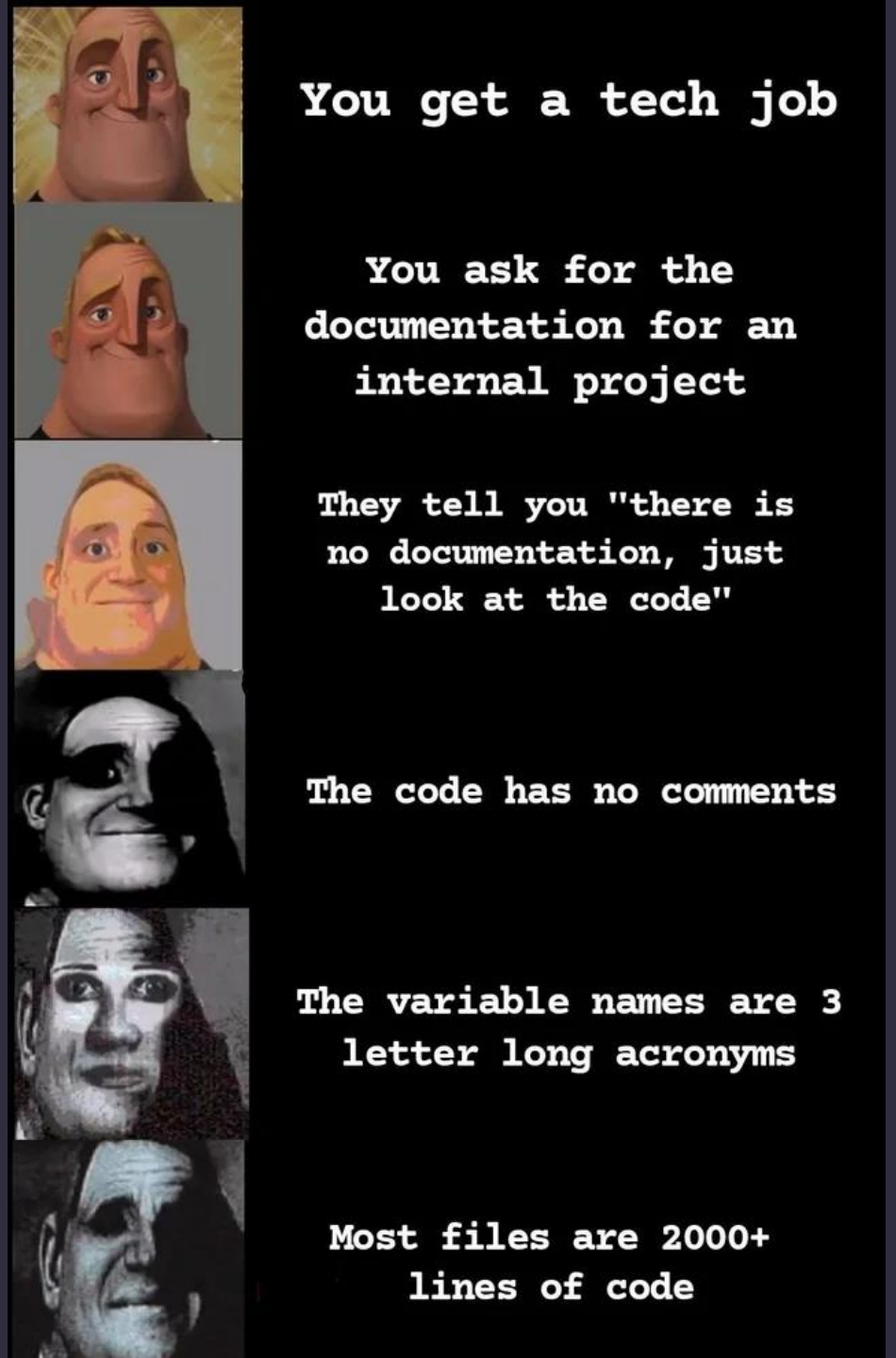
Why even bother with documentation...?

- Because you want people to use your code! But...
  - If people can't figure out what is the purpose of your code, how to install your code, or how to use your code, they won't use it! Sounds obvious, right? ***Because it is.***

- Leaning a software by its source code is tremendously inefficient
  - *"There is a **vanishingly small** number of people who will source-dive to use any code out there, compared to the people who will use your code when properly documented."*
    ~ Eric Holscher, co-founder of readthedocs and writethedocs
  - Actually, for complex software it is literally impossible to learn it from source code alone!

- Good documentation, like good code, will motivate contributions!
  - You can only get contributions after having users, which happens ***after having a documentation***

- ***Documentation is the most important part of a software if you want >1 user count.***



sounds familiar...?

Documentation

- What's the role of documentation?

1. Teach new users the software
2. Serve as reference for existing users
3. Define the public API (how to use the software) → also defines what is a bug or not! (remember: only the ***intended*** behavior of software can be described!)

- A ***good documentation*** will make the user:
  - Understand what this software is about
  - Get an immediate overview of the features of the software
  - Find the information they need fast
  - Find it where they expect it to be
  - Understand the information quickly
  - Have no ambiguity after reading the docs (no guessing!!!)

The Markdown syntax

- We will be writing documentation using Markdown, so we better learn the basics!

```
# Markdown intro
Markdown is a way to style text by using plain text that is later rendered into HTML.

## Basics
Text prefaced with one to six `#` and then an empty space creates headers.
- Markdown can do lists like the one you read now with `-`
- Make text **bold** or _italic_, and can even do [links](www.google.com)
- Markdown can also do math with $ and $$, once rendered, depending on renderer.

1. Markdown can also do numbered lists, like the one you read now.
2. Tables, in-line `code` (backticks), code blocks (three backticks), and many more!
3. See https://www.markdownguide.org/ for more syntax guidance!

Here is a code block with Julia highlighting:
```julia
rand()
x = 1 + 1
```
```

Documentation strings

- ***Documentation strings*** are descriptions of what a function does and how it can be used, and form the basis of a scientific software documentation
  - They are written in human language using Markdown, but they are ***not*** comments
  - They are ***superior*** to comments and should be preferred for explaining things when possible

- They are accessible from within the language, interactively. Example.

- Public API should be defined entirely on the docstrings of the exported names

- ***First write the docstring, then write the function (imagine what it should do)***

Writing good documentation strings

- Example: Lyapunov exponent function from DynamicalSystems.jl
  - Docstring in the source code
  - Docstring expanded/rendered in the documentation
- Documentation string structure according to DynamicalSystems.jl:
  1. Clear call signature in code syntax, including expected input types if necessary
  2. Brief summary of the function
  3. [Optional] Return value and type if not obvious
  4. [Optional] References to related functions if sensible
  5. [Optional] Keyword arguments list if the function has some
  6. [Optional] Detailed discussion of functionality if function behavior is scientifically involved
  7. [Optional] Citations to relevant scientific papers
- Clear distinction between code and human-language-text using backticks `. E.g., when referring to something in the call signature, use code formatting explicitly!
- Examples extremely useful! Best showcased via runnable code executed during documentation generation!

Exercises: Documentation strings

- Write documentation strings for the generalized code for temporal means
  - File `running_means_generalized.jl` from block 3

- Fully leverage markdown syntax, and reference related functions!
  - In Julia this is done as [`function_to_ref`](@ref)

- ***Max time: 15 minutes!***

Skeleton of the documentation pages

- After you have the docstrings, you can use them to make a full documentation that can be hosted online… But what should be in your documentation?

- It is as easy as 1-2-3

1. Homepage: first thing any user will see
2. API declaration: literally expanding the documentation strings with guiding/connecting sentences when necessary
3. Tutorial(s) / Examples: educative usage of the code base

What to include in the homepage?

1. Logo!
   - Makes your software unique, memorable.
   - Shows you care for it enough to give it a “face”.
2. Introductory paragraph
   - must capture, in only a couple of sentences, what is this software about.
3. Getting started
   - how to install, preliminary knowledge, how to navigate the documentation
4. List of features (if too extensive, can be a dedicated page)
5. Design philosophy (optional)
   - More in-depth description of the software design, what makes it special
   - Can also include a comparison with competing software
6. How to contact the authors / ask questions / get involved in development

Depth of exposition

- Good documentation: ***various levels of depth of exposition***
- Highest level: Summary of what the software does
- High level: One overarching tutorial on the core of the software

- Intermediate level: Examples that showcase end-to-end usage of specific functionality

- ***Examples must be RUN. Not written!***
  - Tremendously lowers the risk of broken / un-updated docpages!
  - Specific language packages provide tooling for achieving this, see later slides

- Lowest level: Declaration of pubic API / docstring expansion.

Documentation example: Agents.jl

- Docs of Agents.jl have been celebrated many times, so let's see how they satisfy the above tips
- https://juliadynamics.github.io/Agents.jl/stable/

- Specially highlight:
  - Structure of index page (home page)
  - Dedicated tutorial
  - API page and its relation to the side bar
  - Examples are run, not written (go to an example, click "Edit on GitHub")

ToC: Table Of Contents

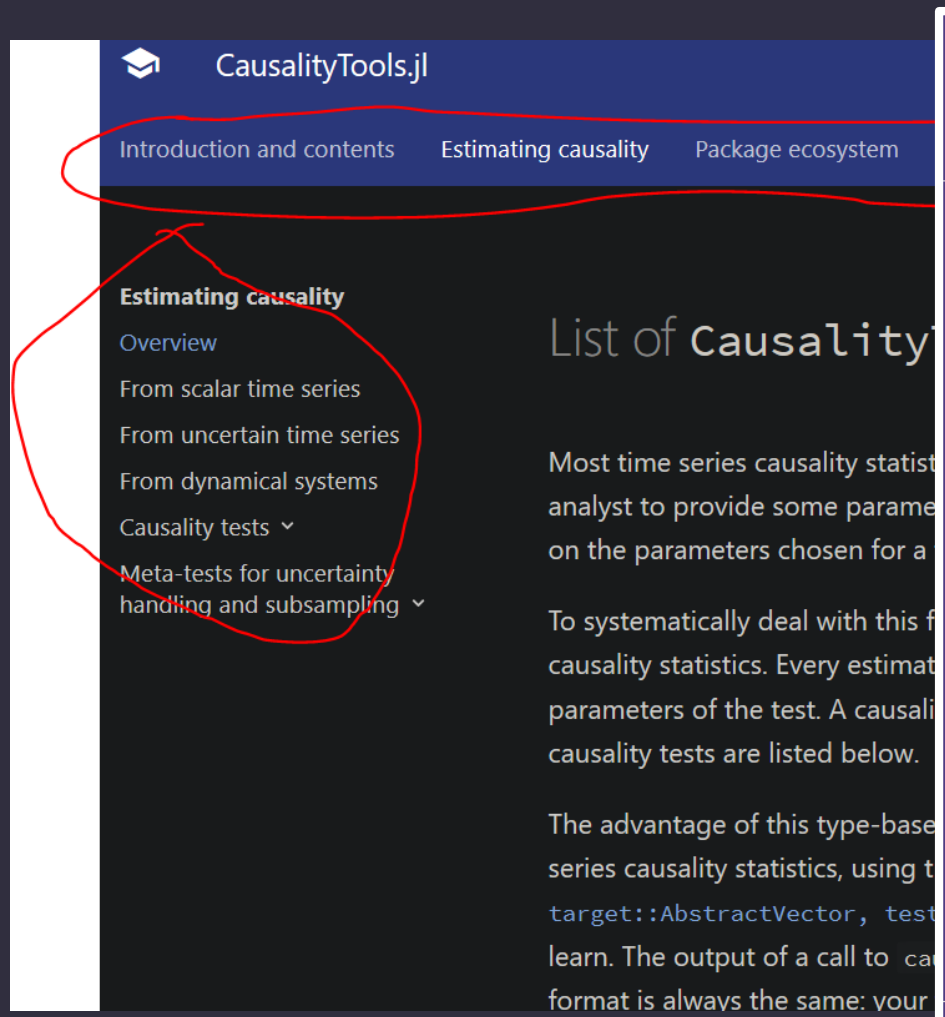
- ***The Eye Horizon:***
  - The viewer will scan the page content currently in front;
  - This scan should indicated if the information the user needs is in this page

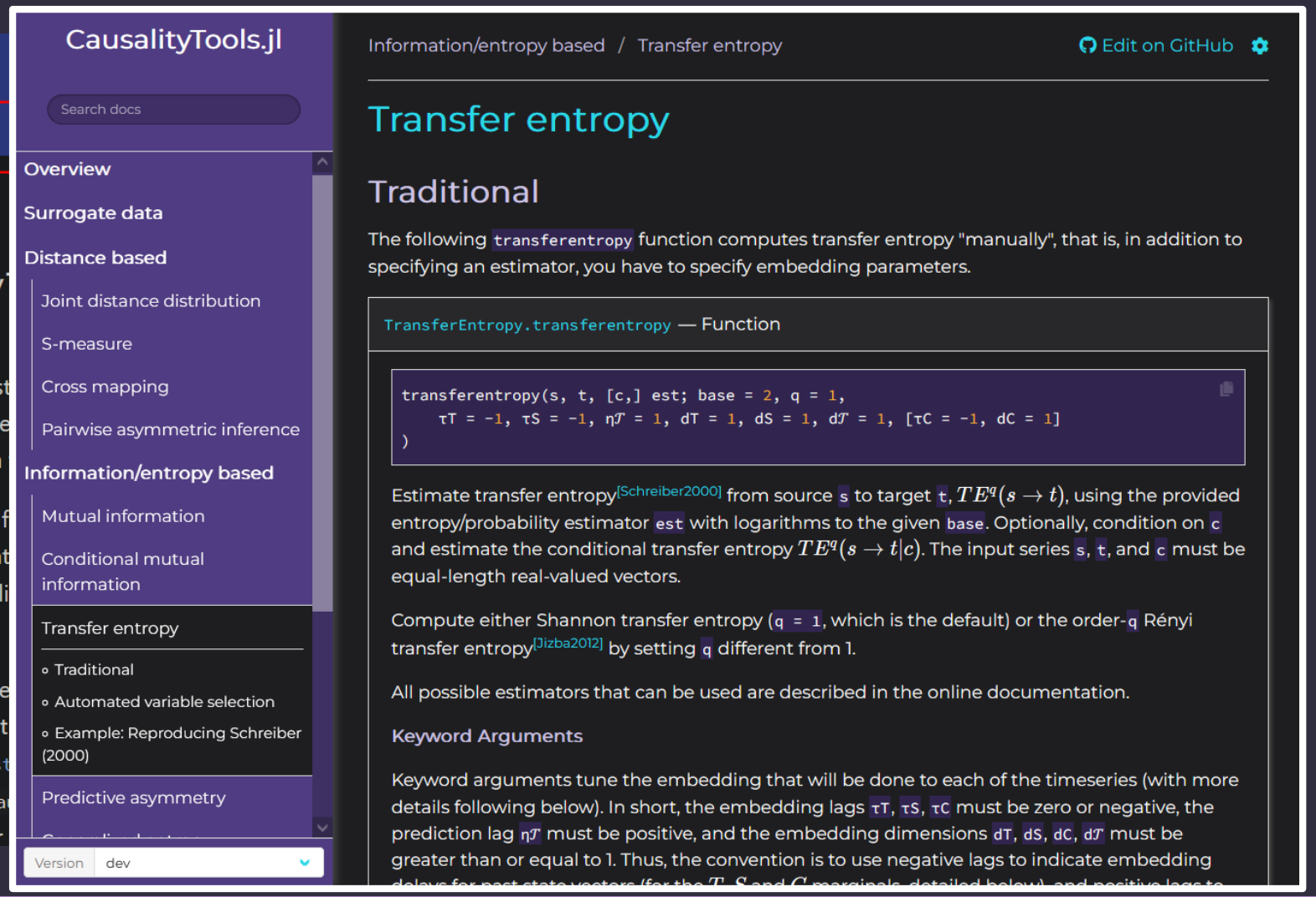
- The Table of Contents is the best way to satisfy the “eye horizon” problem!
  - Requires you to structure the doc page around headers and subheaders
- Get header ordering right!
  - Subheaders must really be subtopics of the upper level
  - Same level of information variety must be same header level
  - Sweet-spot balance between overview and information exposure

- All ToC information must be in the same place (a.k.a. proximity)
  - Do not split ToC information to the left, right, or top of the layout. All in the same place!

ToC: Proximity illustration

- From a discussion on how to improve the docs of CausalityTools.jl





The one true ~~Morty~~ Documentation

- You want to eliminate chances of “forgetting to update something”. Two rules:

1. Documentation ***must exist only at one place***
   - GitHub webpage hosting, READMEs, GitHub Wiki, Private Webpages, GitLab pages, …
   - ***NO!*** Keep it in ***ONE*** place, coherently, and allowing cross-referencing everything!
   - I am against having anything in the README.md besides the “opening paragraph”!
   - Clarification: for small projects, the README is the entire documentation

2. Thing X must be ***defined only once, at one place***, and explained at that place in your documentation with as much detail as necessary
   - All other parts of the documentation that use X must cross-reference its definition
   - Not explain it again! Avoid duplicating information!
   - Actually cross reference via the documentation pipeline, so actual hyperlink!

PRAISE THE ONE TRUE ~~MORTY~~ DOCUMENTATION

Use unique identifiers

- Also known as “Pick One Word Per Concept”
  - *Clean Code – A Handbook of Agile Software Craftmanship*
- When referring to the same things, use the same words. Exactly the same.
  - This is a good advice for any form of technical writing (paper, docs, code)
  - The same advice therefore also applies to naming variables in your code!
- This establishes ***an unambiguous connection*** between the English words, and the object they refer to, which is typically code
- It is much more important for a technical document to be clear and precise, than to be poetic. ***Do not optimize word variety, optimize word clarity.***
- E.g.: Fetch, Retrieve, Get, Obtain… Pick one!
- E.g.: Sketch, Diagram, Concept, Idea... Pick one!

Actually writing documentation pages

- Each language has some packages that help create documentation…
  - Expand documentation strings
  - Allow cross referencing documentation strings
  - Creating HTML pages out of markdown documents
  - Additional markdown decorators like enabling math or running code in the docstring
- Then GitHub can be used to host the documentation via CI

- Julia recommended tool: Documenter.jl - https://juliadocs.github.io/Documenter.jl
- Python recommended tool: Sphinx - https://www.sphinx-doc.org

- It's beyond the timetable of the workshop to teach these tools in detail…
- But a working template for each exists in the default repositories we've shared

Creating & hosting a documentation

- Let's go through the default template and demonstrate how to make some documentation pages, auto-generate them and host them online
- Reminder, default project templates are in:
- https://github.com/JuliaDynamics/ScienceProjectTemplate Julia
- https://github.com/lkluft/example-python Python

Your code → documented

- Create a documentation for your code that is also hosted online ☺
- Remember our tips on good docs
  - (scroll up the slides, I won't repeat them here!)