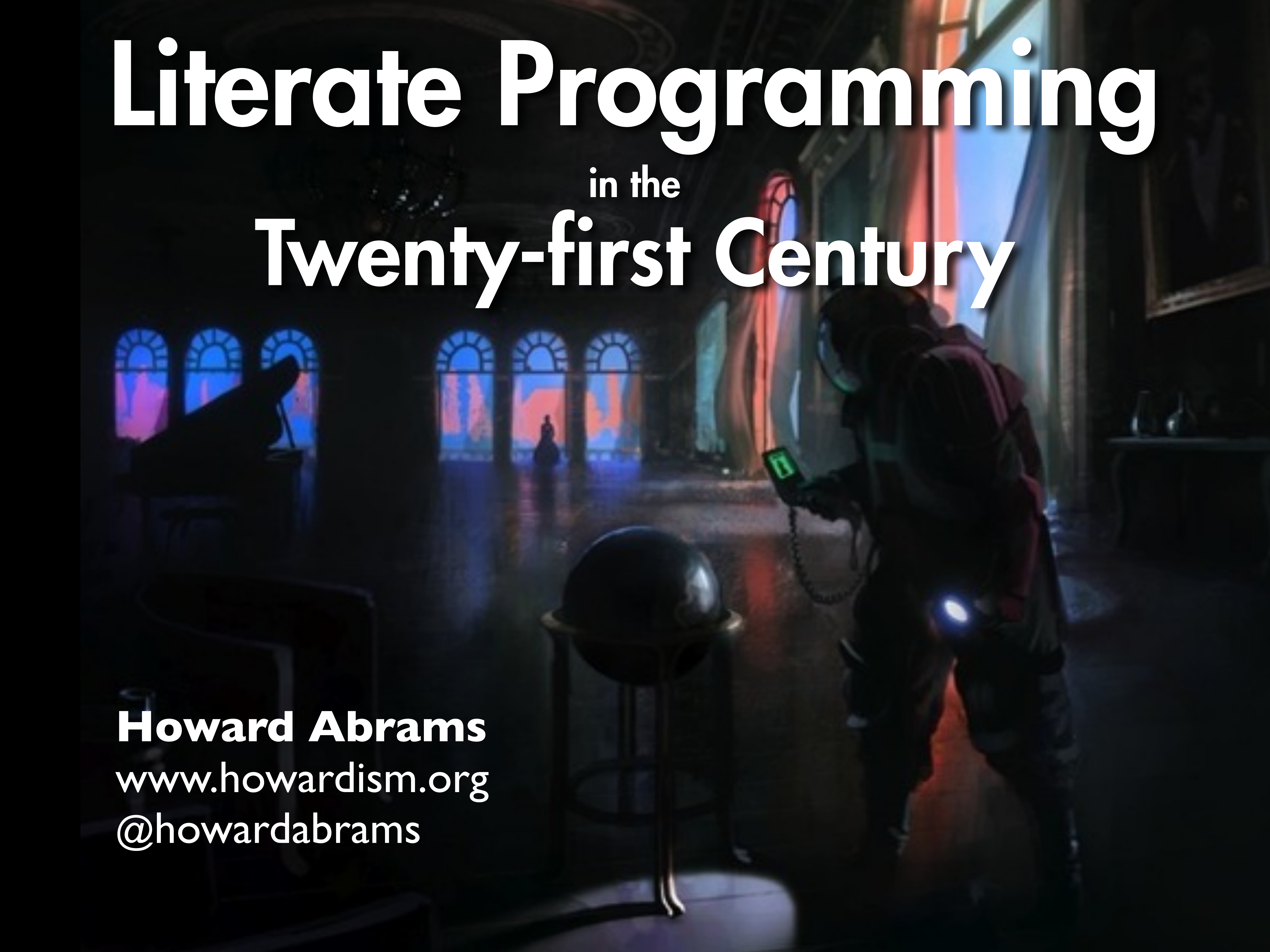
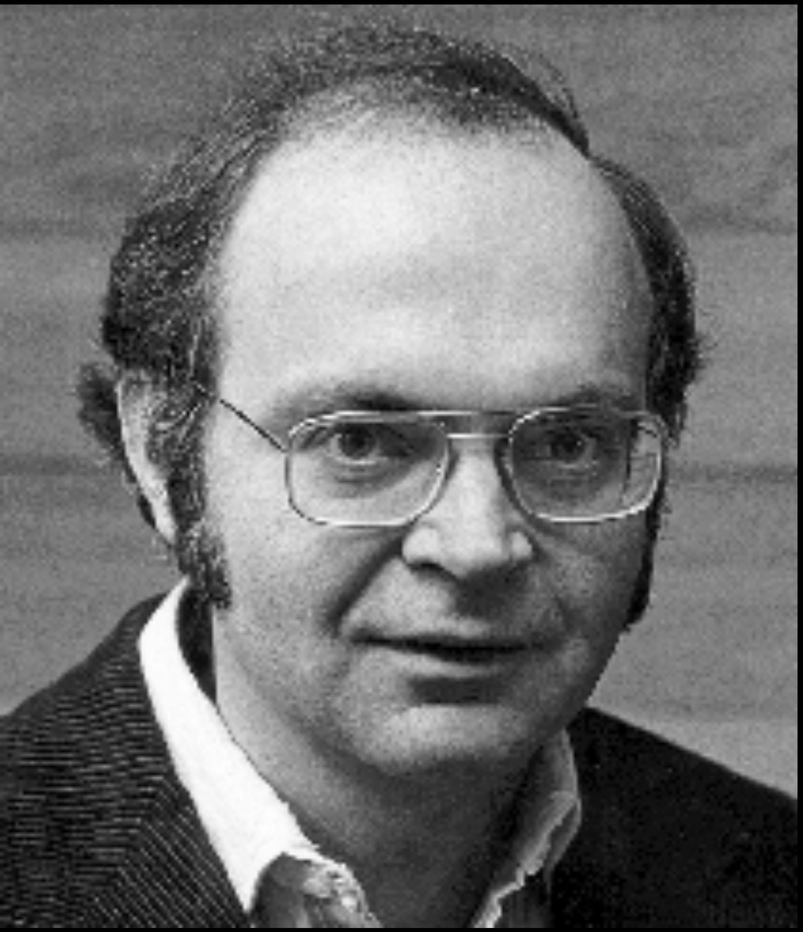


Literate Programming in the Twenty-first Century

Howard Abrams
www.howardism.org
@howardabrams

Thesis



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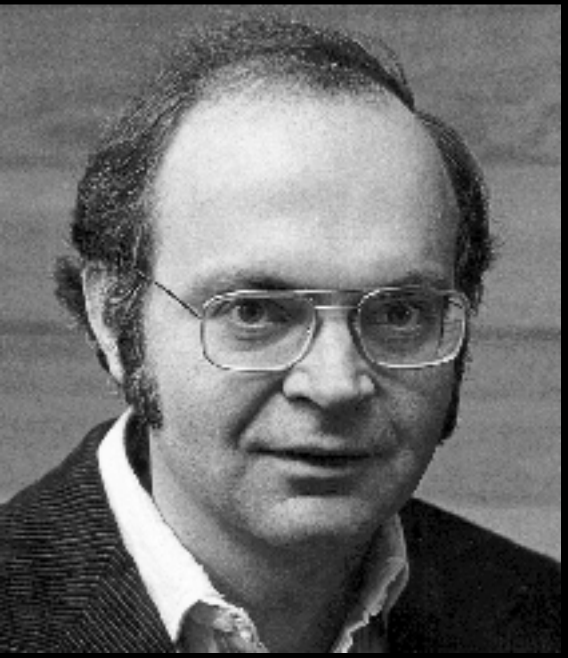
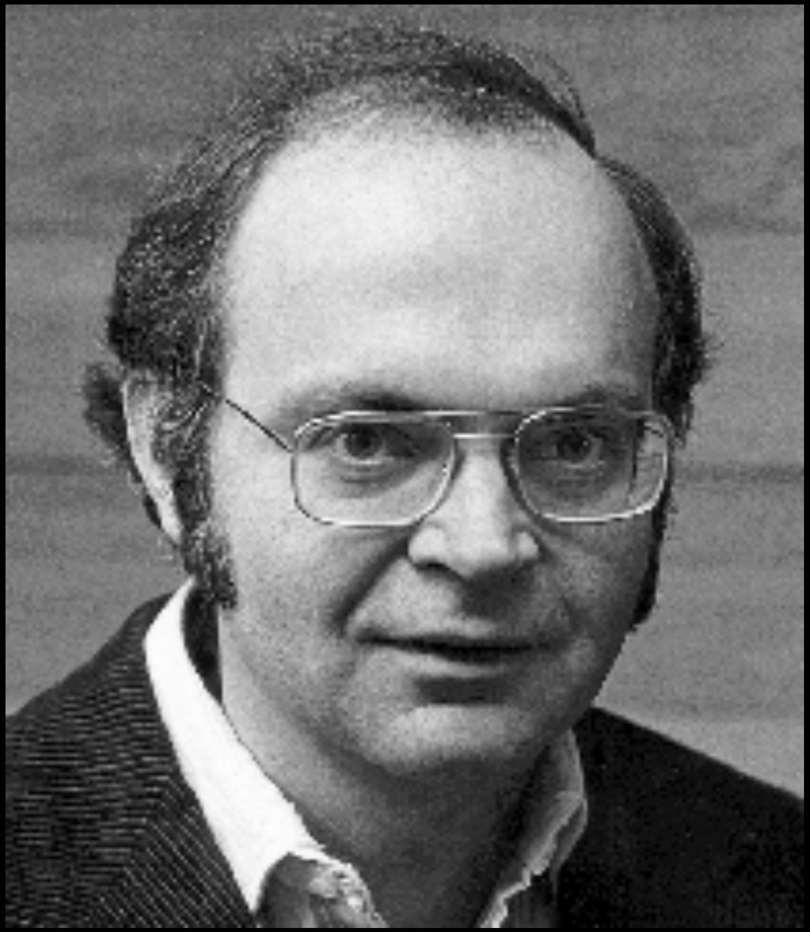
—Donald Knuth



The programmer's task is to state [the] parts and relationships, in whatever order is best for human comprehension not in some rigidly determined order like top-down or bottom-up.

—Donald Knuth

Computer programming is an art… especially because it produces objects of beauty. A programmer who subconsciously views himself as an artist will enjoy what he does and will do it better.



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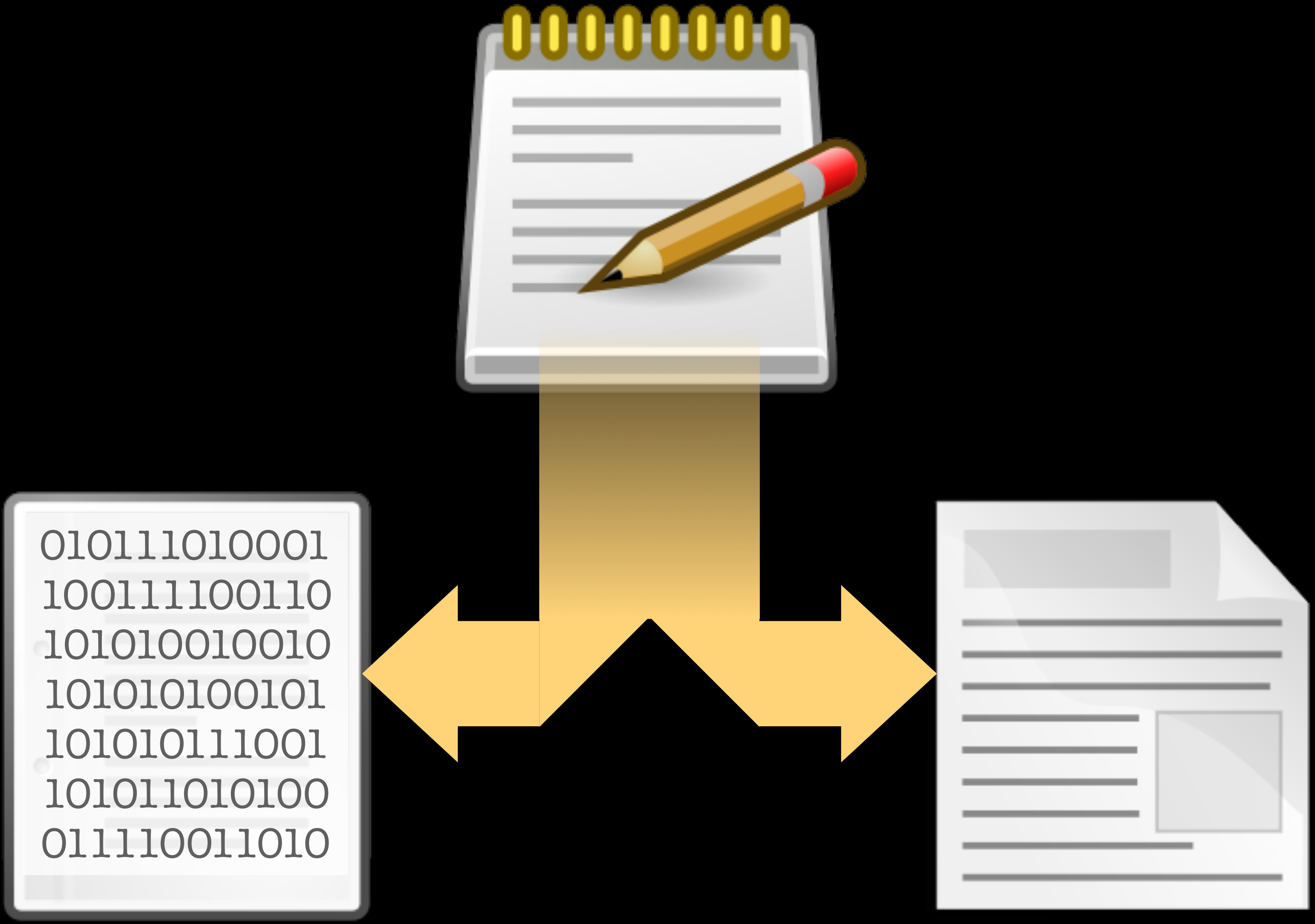
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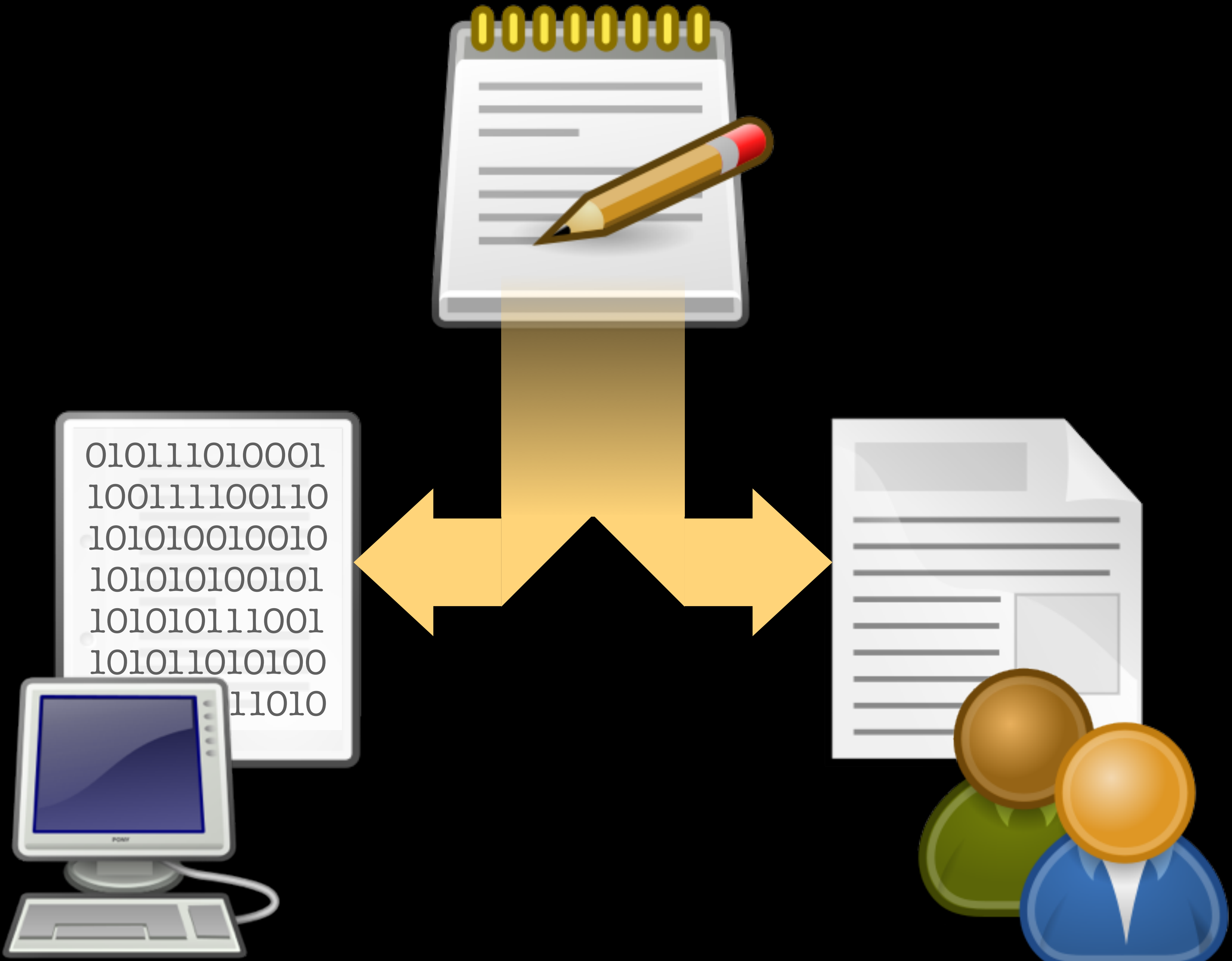
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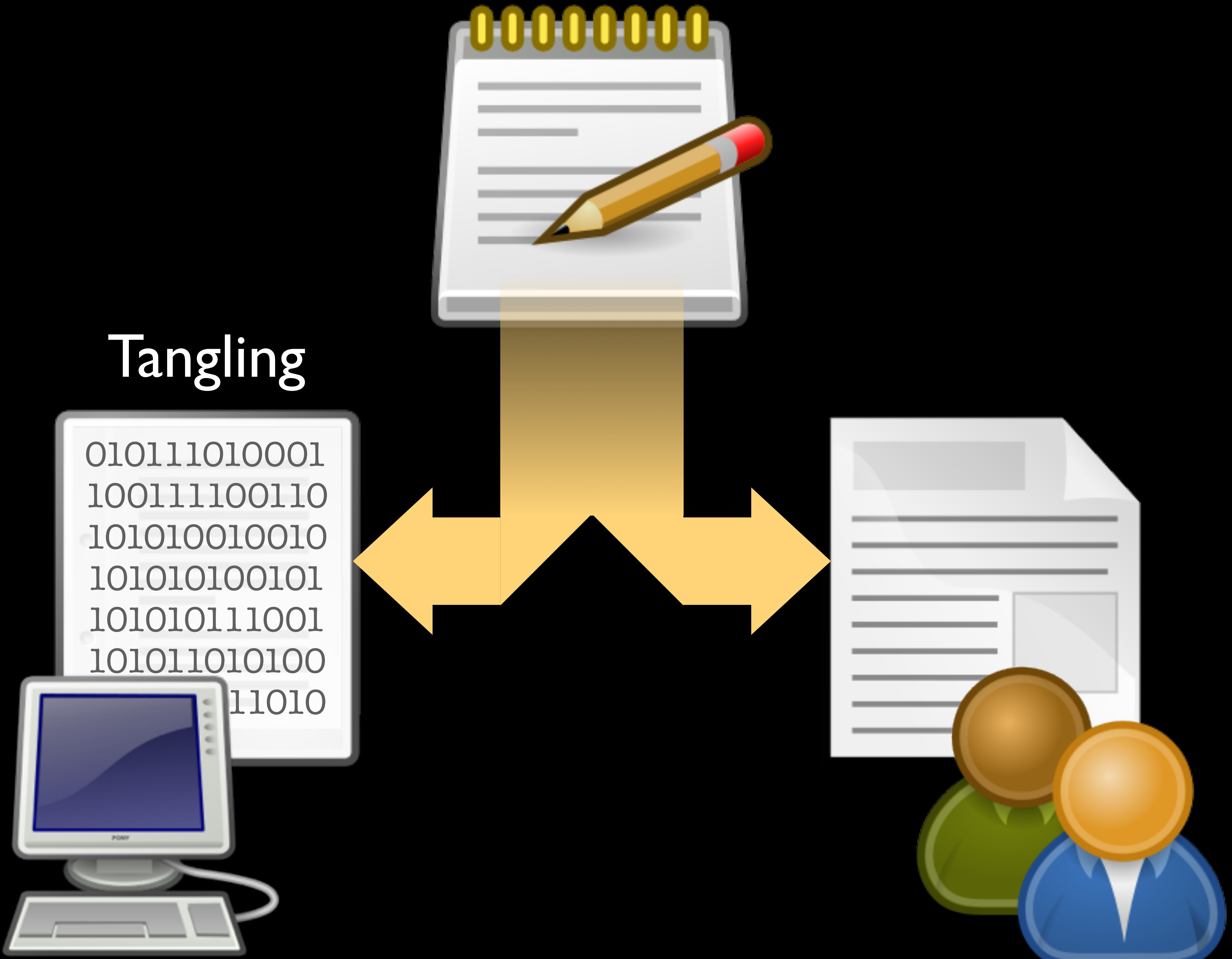
Tangling



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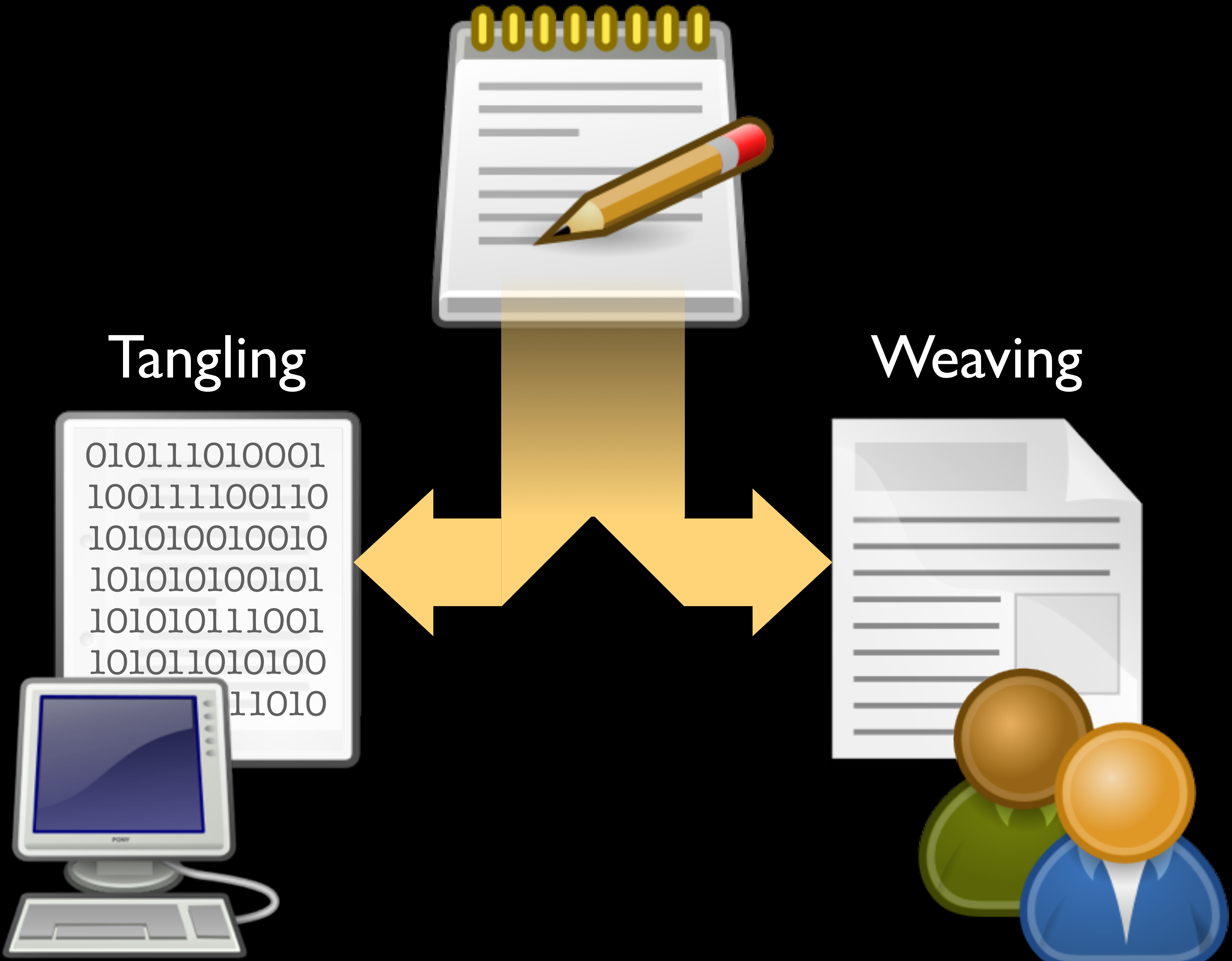
Tangling
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11010

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```
<<Global variables>>=
long total_word_count,
     total_line_count,
     total_char_count;
@
```

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Start of code block marker

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End of code block

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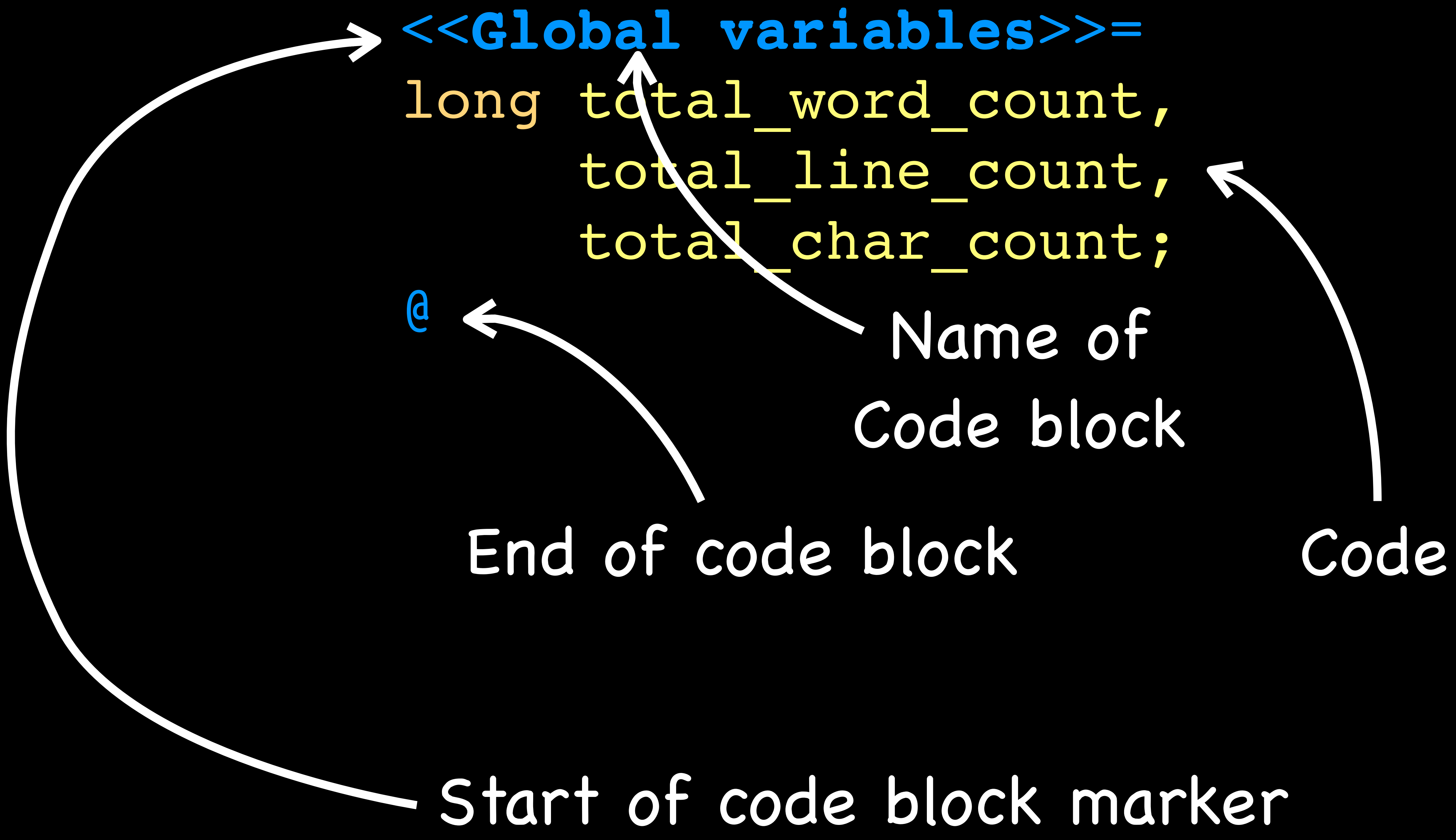
End of code block

Code

Start of code block marker

We must include the standard I/O definitions, since we want to send formatted output to stdout and stderr.



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The purpose of wc is to count lines, words, and/or characters in a list of files. The number of lines in a file is …

Here, then, is an overview of the file wc.c that is defined by the noweb program wc.nw:

```
<<*>>=
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    <<Definitions>>
    <<Global variables>>
    <<Functions>>
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@
```

```
<<Functions>>=
  <<Count words in array>>
  <<Separate words>>
  <<Is punctuation?>>
@
```

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     total_char_count;
@
```

```
<<Count words in array>>=
  // ...
@
```

```
<<Separate words>>=
  // ...
@
```

```
<<Is punctuation?>>=
  // ...
@
```

```
<<Functions>>=
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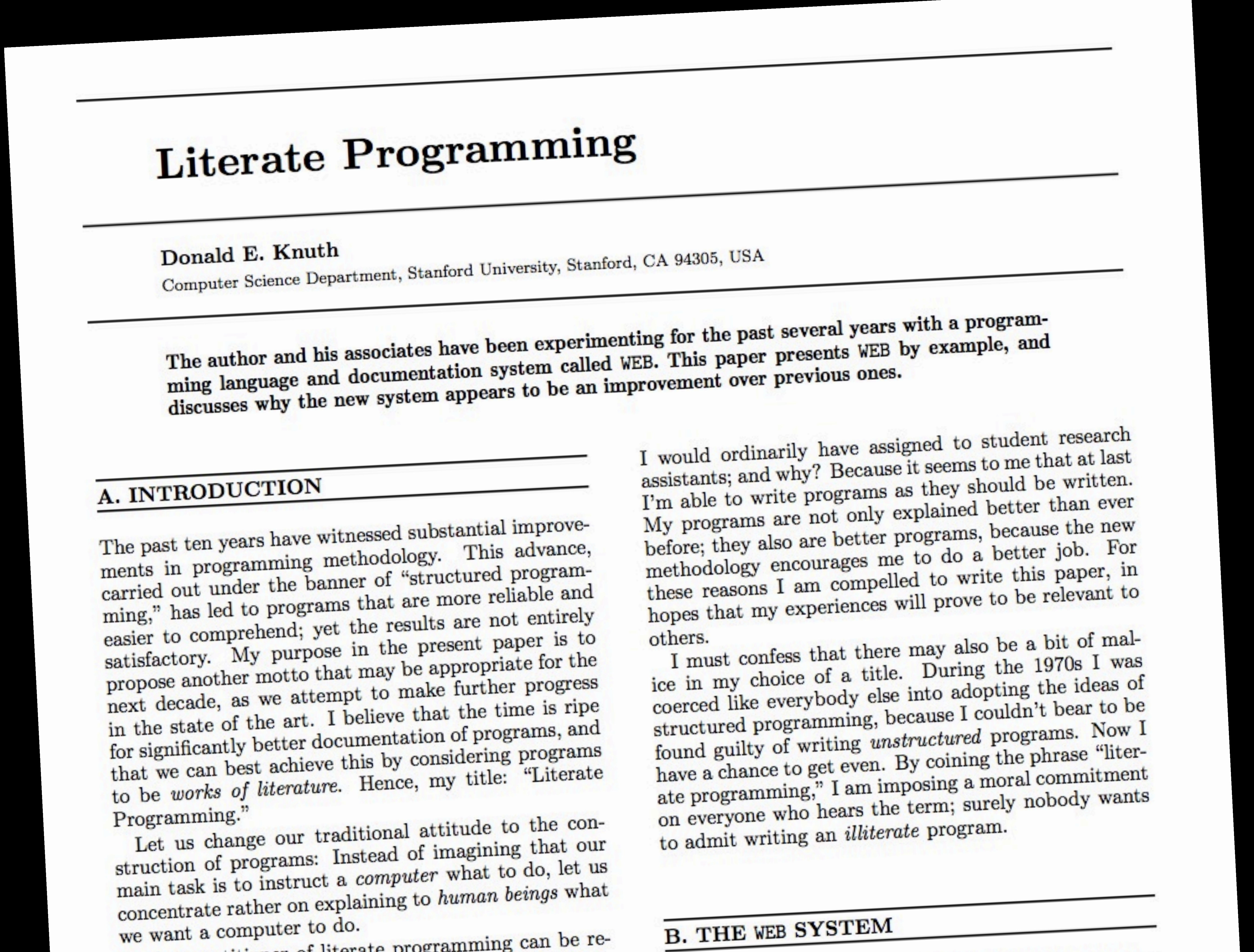


Literate Programming

Donald E. Knuth
Computer Science Department, Stanford University, Stanford, CA 94305, USA

The author and his associates have been experimenting for the past several years with a programming language and documentation system called `WEB`. This paper presents `WEB` by example, and discusses why the new system appears to be an improvement over previous ones.

A. INTRODUCTION

The past ten years have witnessed substantial improvements in programming methodology. This advance, carried out under the banner of "structured programming," has led to programs that are more reliable and easier to comprehend; yet the results are not entirely satisfactory. My purpose in the present paper is to propose another motto that may be appropriate for the next decade, as we attempt to make further progress in the state of the art. I believe that the time is ripe for significantly better documentation of programs, and that we can best achieve this by considering programs to be *works of literature*. Hence, my title: "Literate Programming."

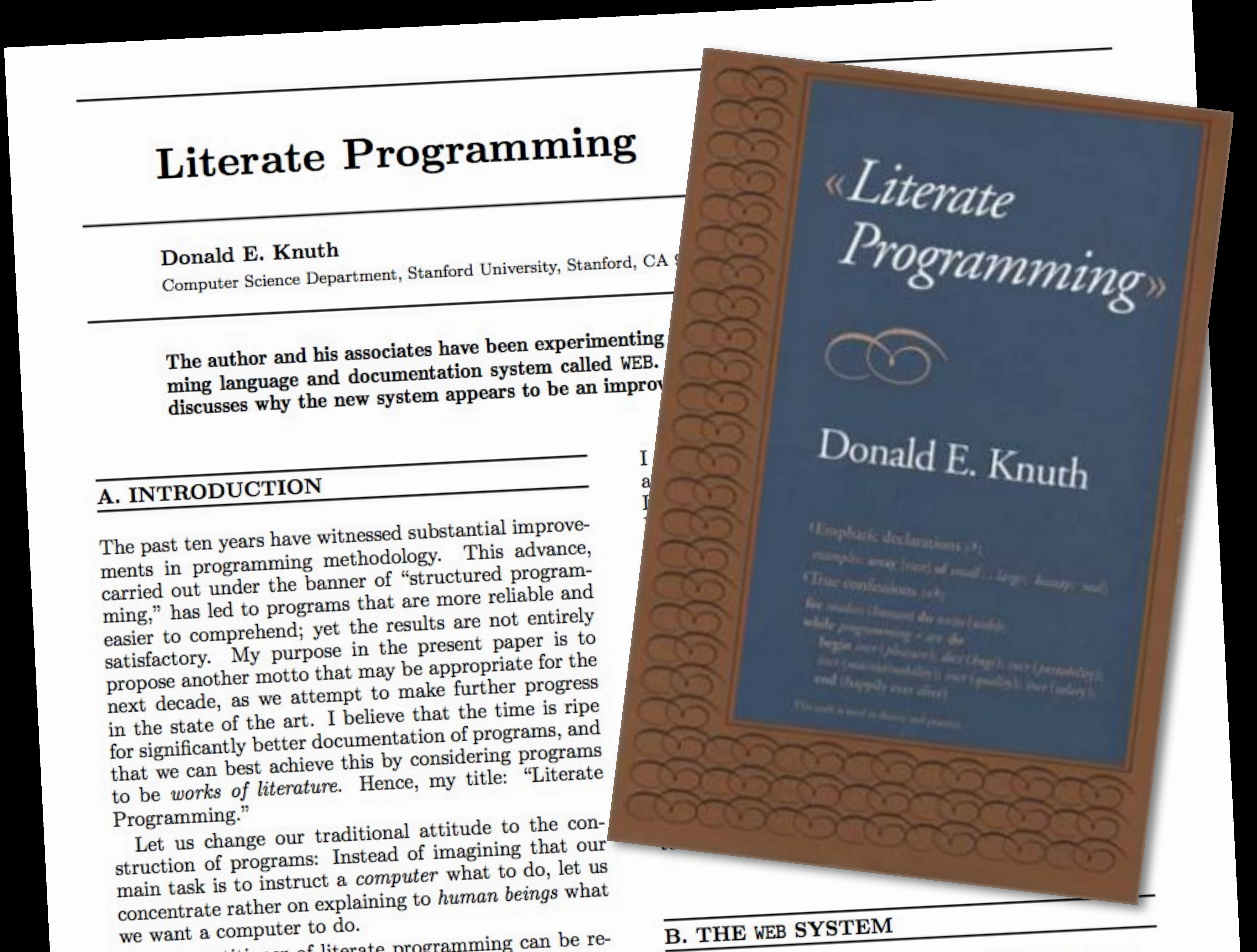
Let us change our traditional attitude to the construction of programs: Instead of imagining that our main task is to instruct a *computer* what to do, let us concentrate rather on explaining to *human beings* what we want a computer to do.

titioner of literate programming can be re-

I would ordinarily have assigned to student research assistants; and why? Because it seems to me that at last I'm able to write programs as they should be written. My programs are not only explained better than ever before; they also are better programs, because the new methodology encourages me to do a better job. For these reasons I am compelled to write this paper, in hopes that my experiences will prove to be relevant to others.

I must confess that there may also be a bit of malice in my choice of a title. During the 1970s I was coerced like everybody else into adopting the ideas of structured programming, because I couldn't bear to be found guilty of writing *unstructured* programs. Now I have a chance to get even. By coining the phrase "literate programming," I am imposing a moral commitment on everyone who hears the term; surely nobody wants to admit writing an *illiterate* program.

B. THE WEB SYSTEM



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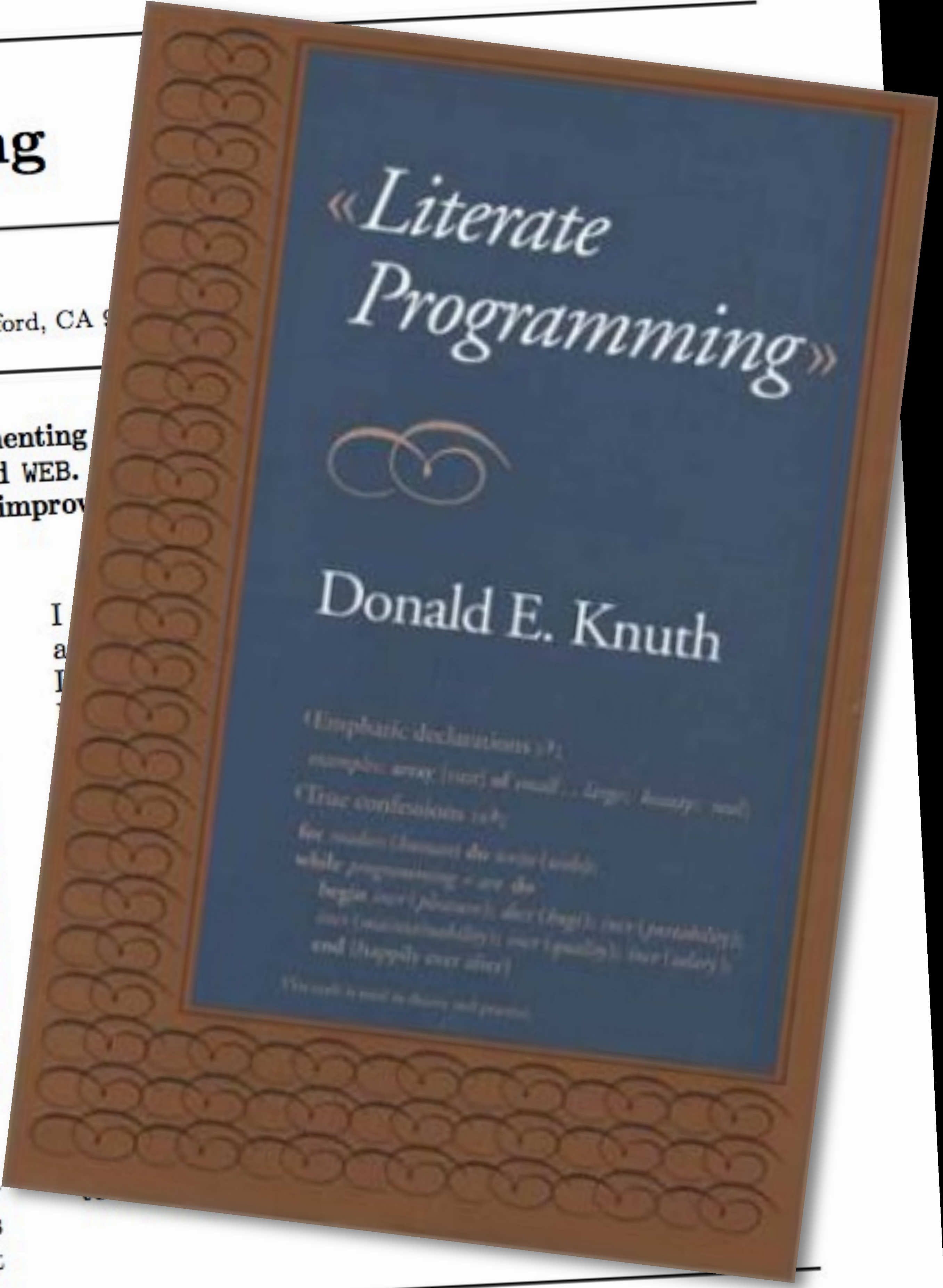

«Literate Programming»

Donald E. Knuth

Antithesis

A wise engineering solution would produce—or better, exploit—reusable parts.

—Doug McIlory

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```
tr -cs A-Za-z '\n' |
tr A-Z a-z |
sort |
uniq -c |
sort -rn |
sed ${1}q
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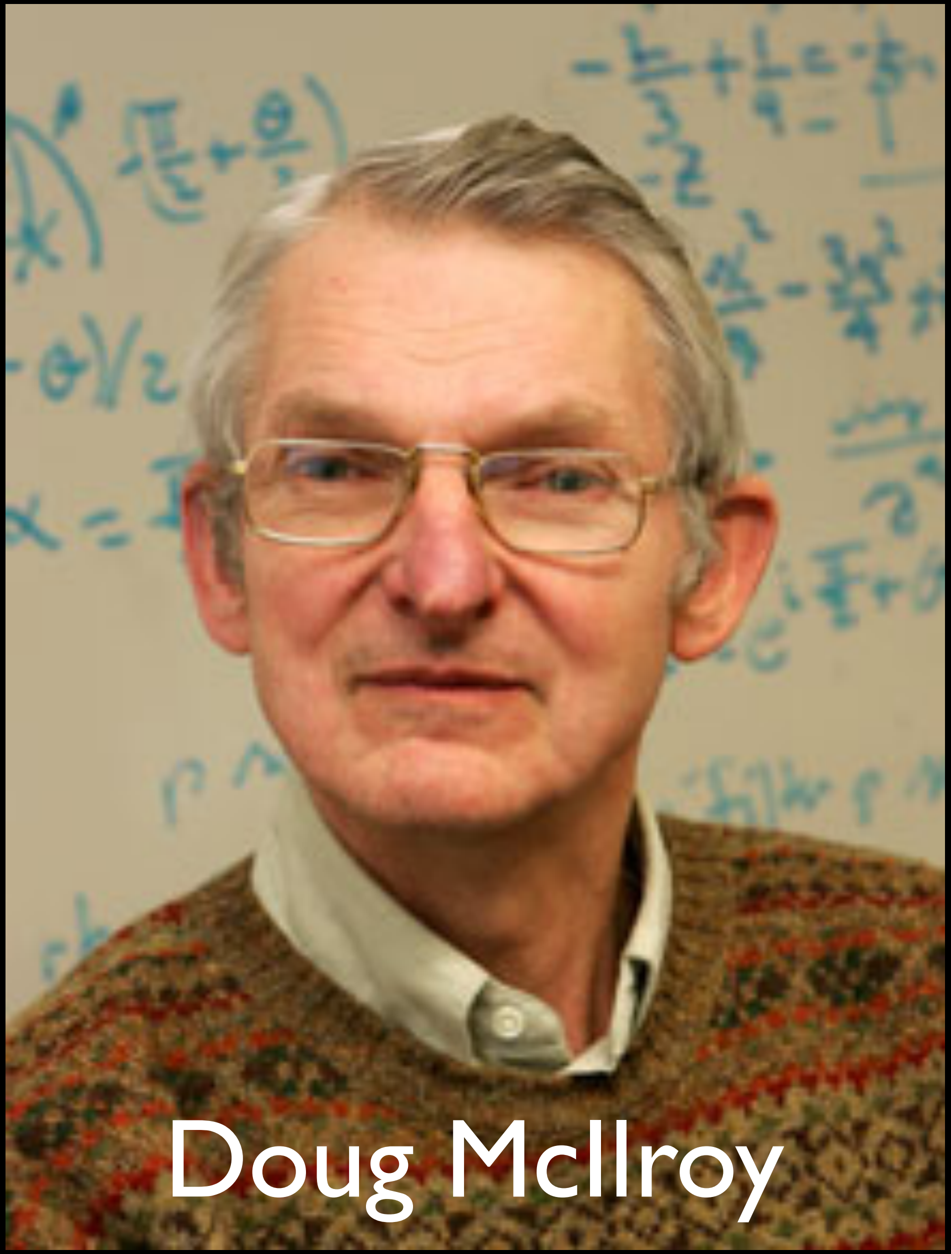
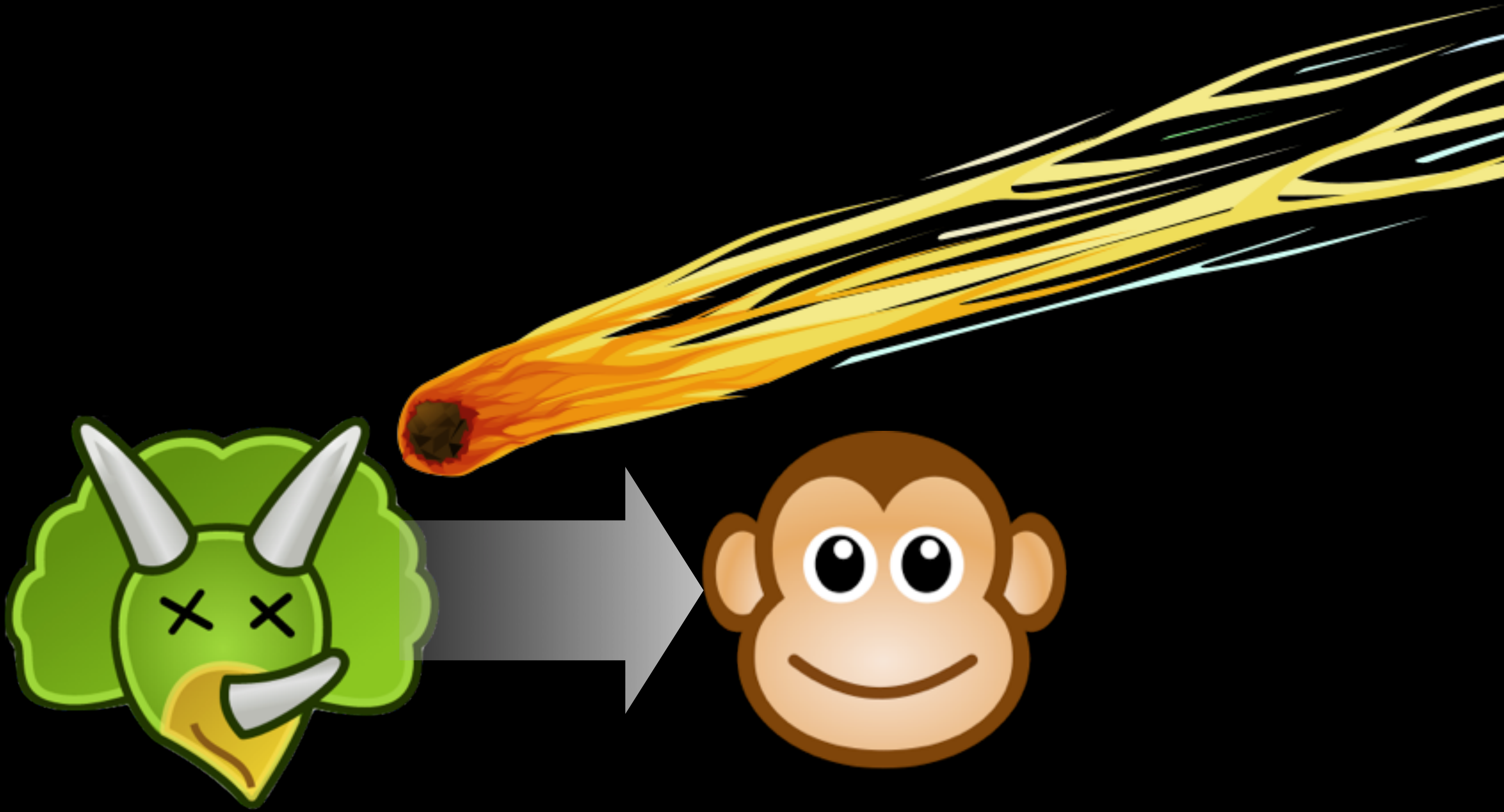
```

It's funny, it's reusable, and it wildly misses Knuth's point.
—Po Petz



Code re-use

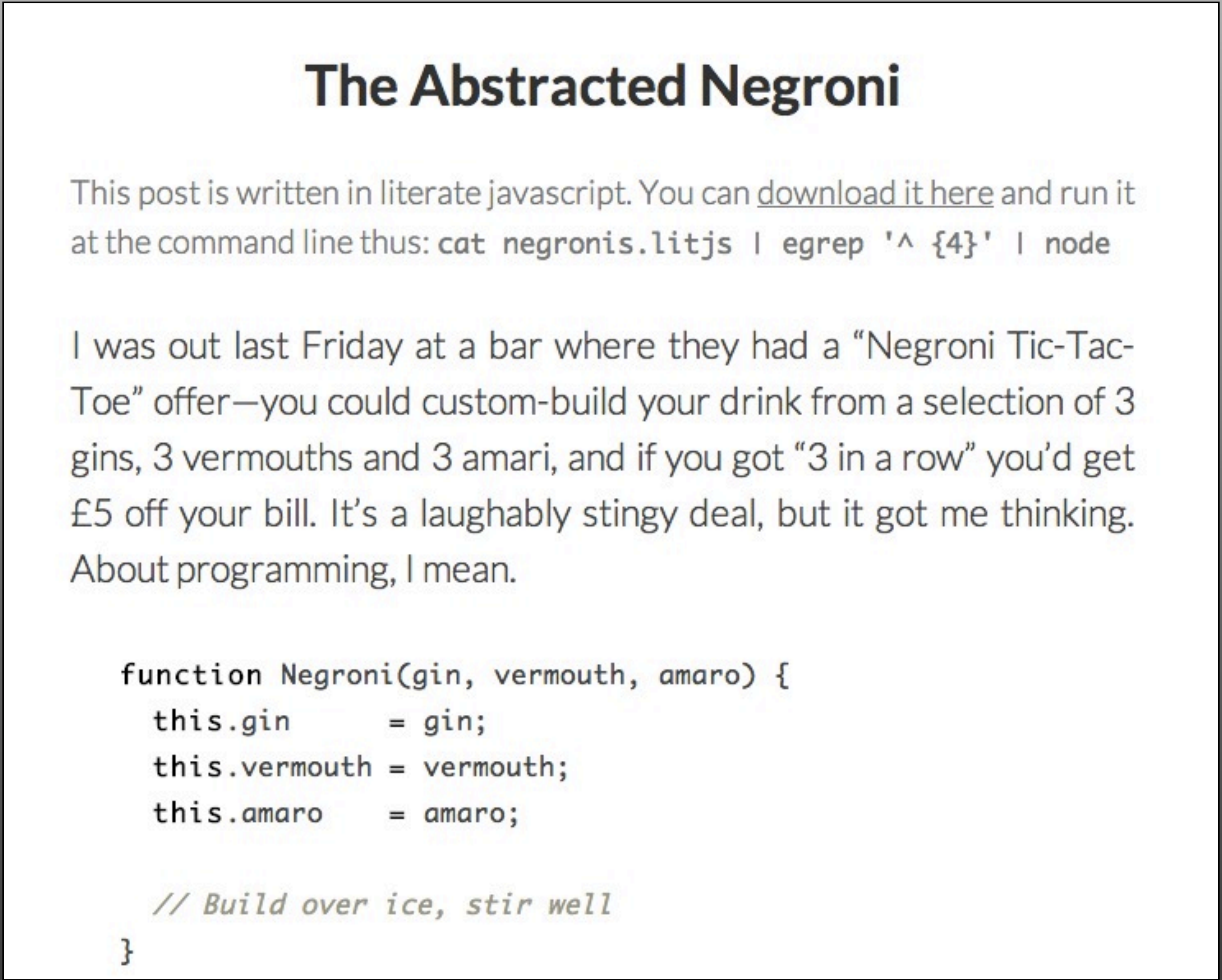
Better thinking
through
better tools



Influences

- Javadoc System
- Docco
- iPython Notebook
- Haskell
- Embraced by Cryptic Languages

http://aanandprasad.com/articles/negronis/



The Abstracted Negroni

This post is written in literate javascript. You can download it here and run it at the command line thus: `cat negronis.litjs | egrep '^ {4}' | node`

I was out last Friday at a bar where they had a "Negroni Tic-Tac-Toe" offer—you could custom-build your drink from a selection of 3 gins, 3 vermouths and 3 amari, and if you got "3 in a row" you'd get £5 off your bill. It's a laughably stingy deal, but it got me thinking. About programming, I mean.

```
function Negroni(gin, vermouth, amaro) {
  this.gin      = gin;
  this.vermouth = vermouth;
  this.amaro    = amaro;

  // Build over ice, stir well
}
```

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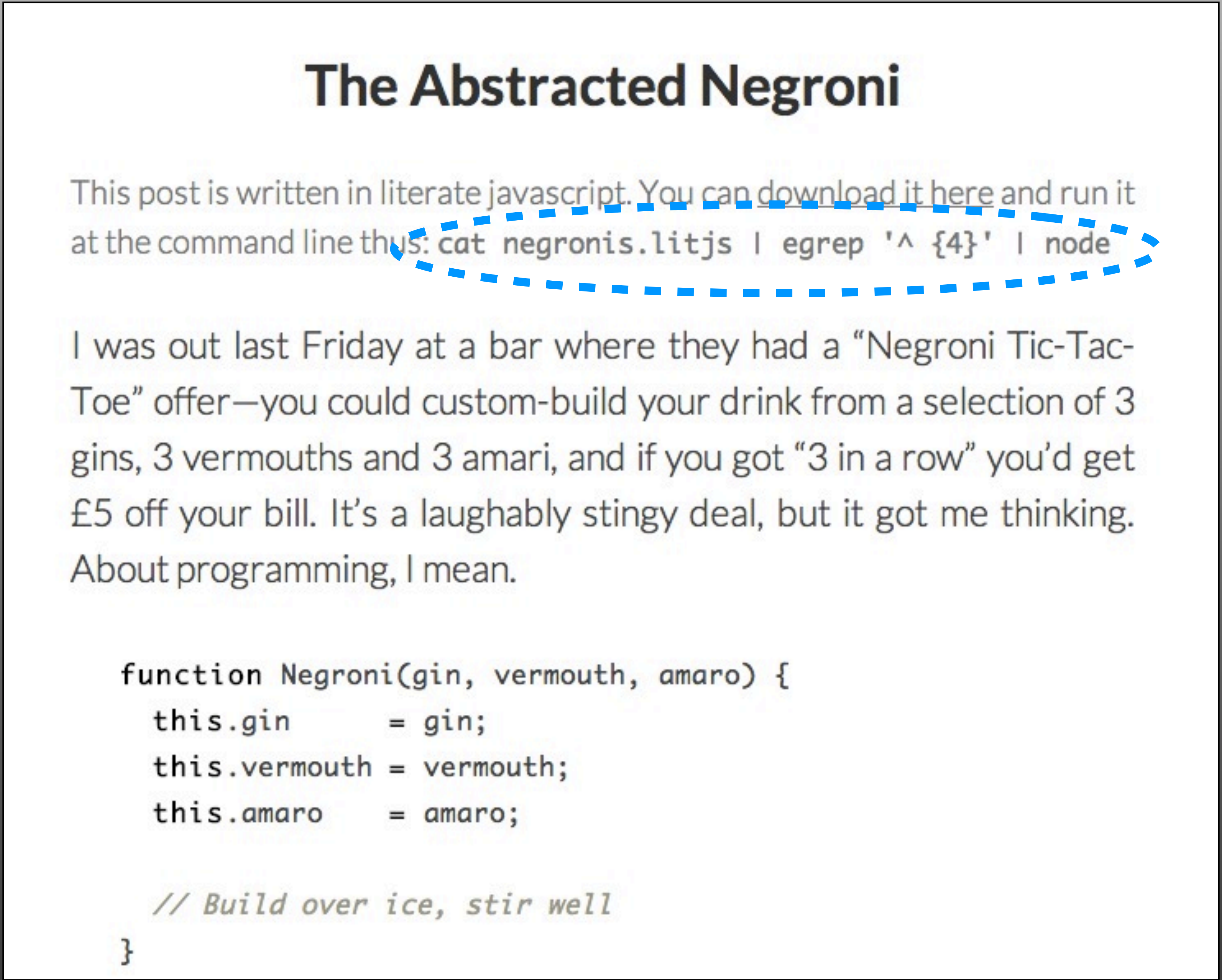

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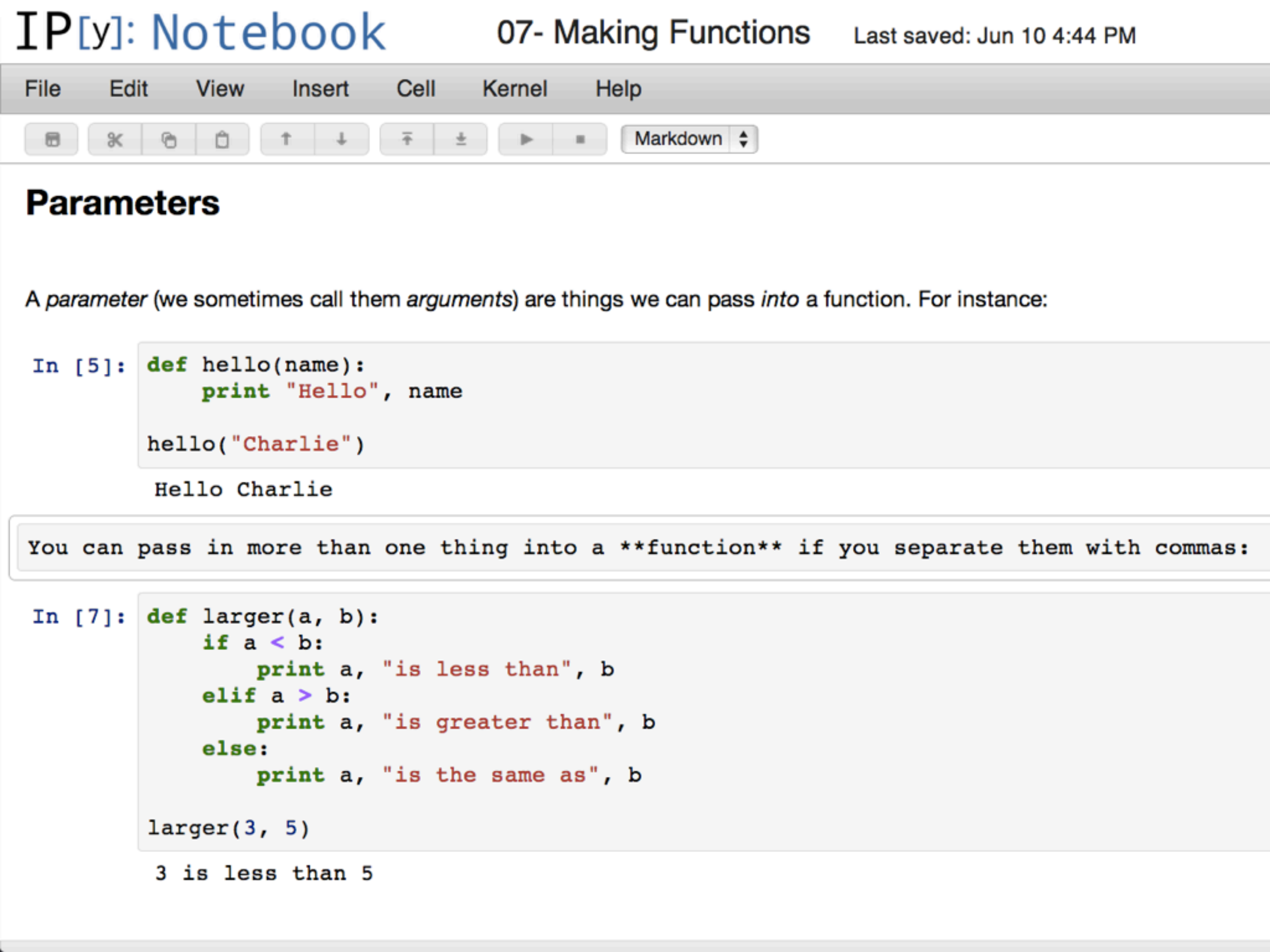

IP[y]: Notebook
07- Making Functions
Last saved: Jun 10 4:44 PM
File Edit View Insert Cell Kernel Help
Markdown

Parameters

A *parameter* (we sometimes call them *arguments*) are things we can pass *into* a function. For instance:

In [5]:
```
def hello(name):
    print "Hello", name

hello("Charlie")
```

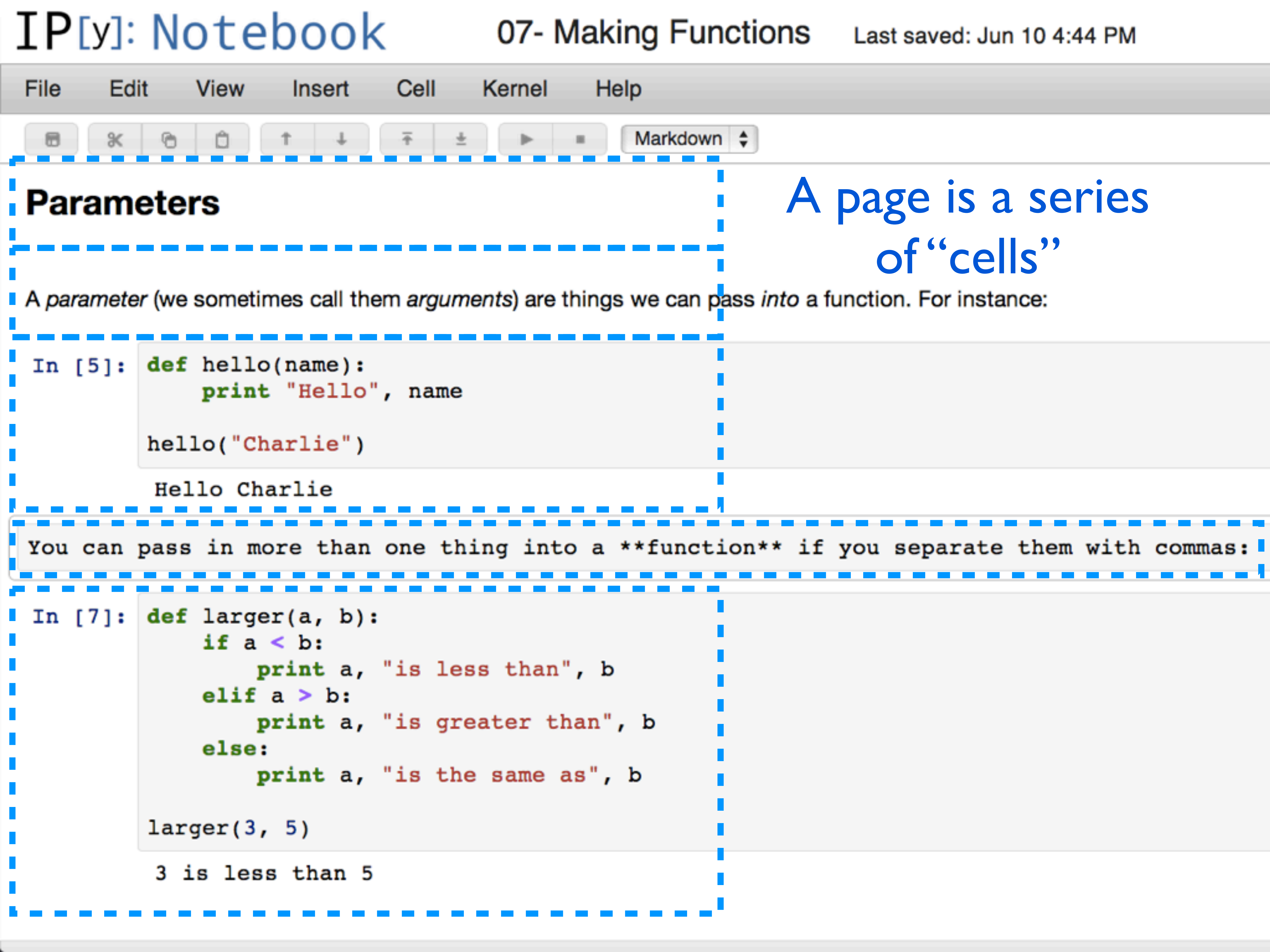
```
Hello Charlie
```

```
You can pass in more than one thing into a **function** if you separate them with commas:
```

In [7]:
```
def larger(a, b):
    if a < b:
        print a, "is less than", b
    elif a > b:
        print a, "is greater than", b
    else:
        print a, "is the same as", b

larger(3, 5)
```

```
3 is less than 5
```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A page is a series of "cells"

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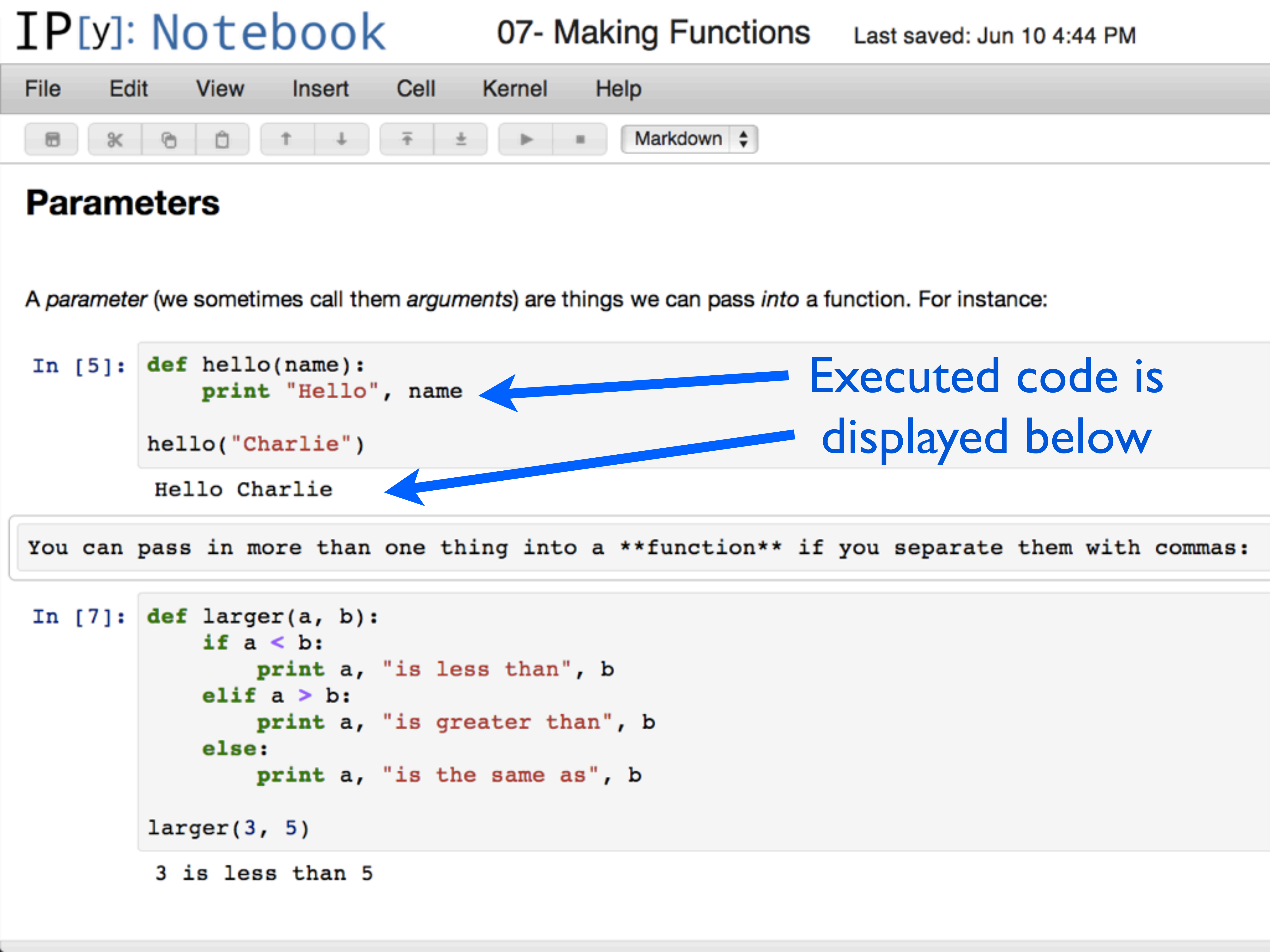

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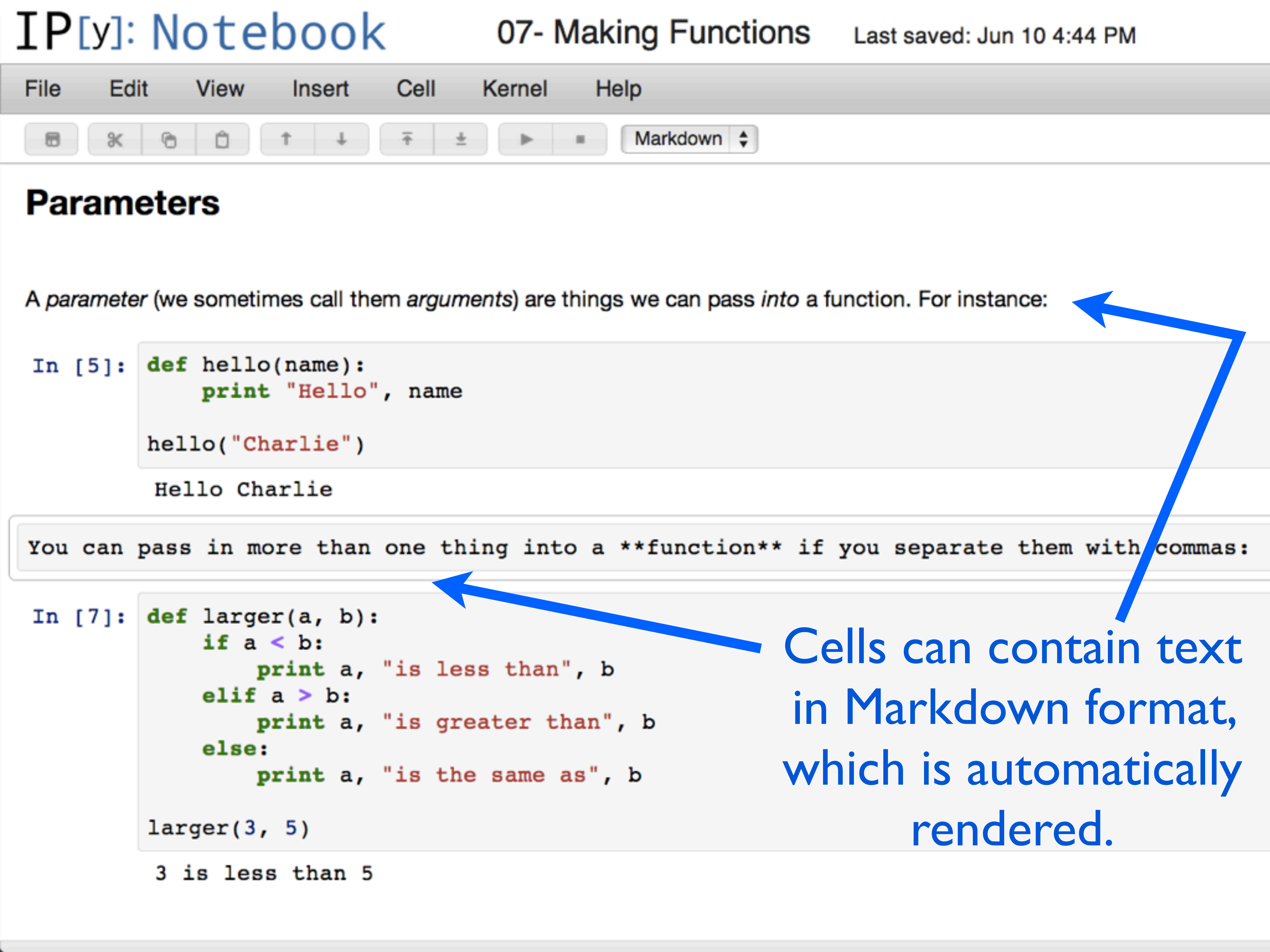

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3 is less than 5
```

Cells can contain text in Markdown format, which is automatically rendered.

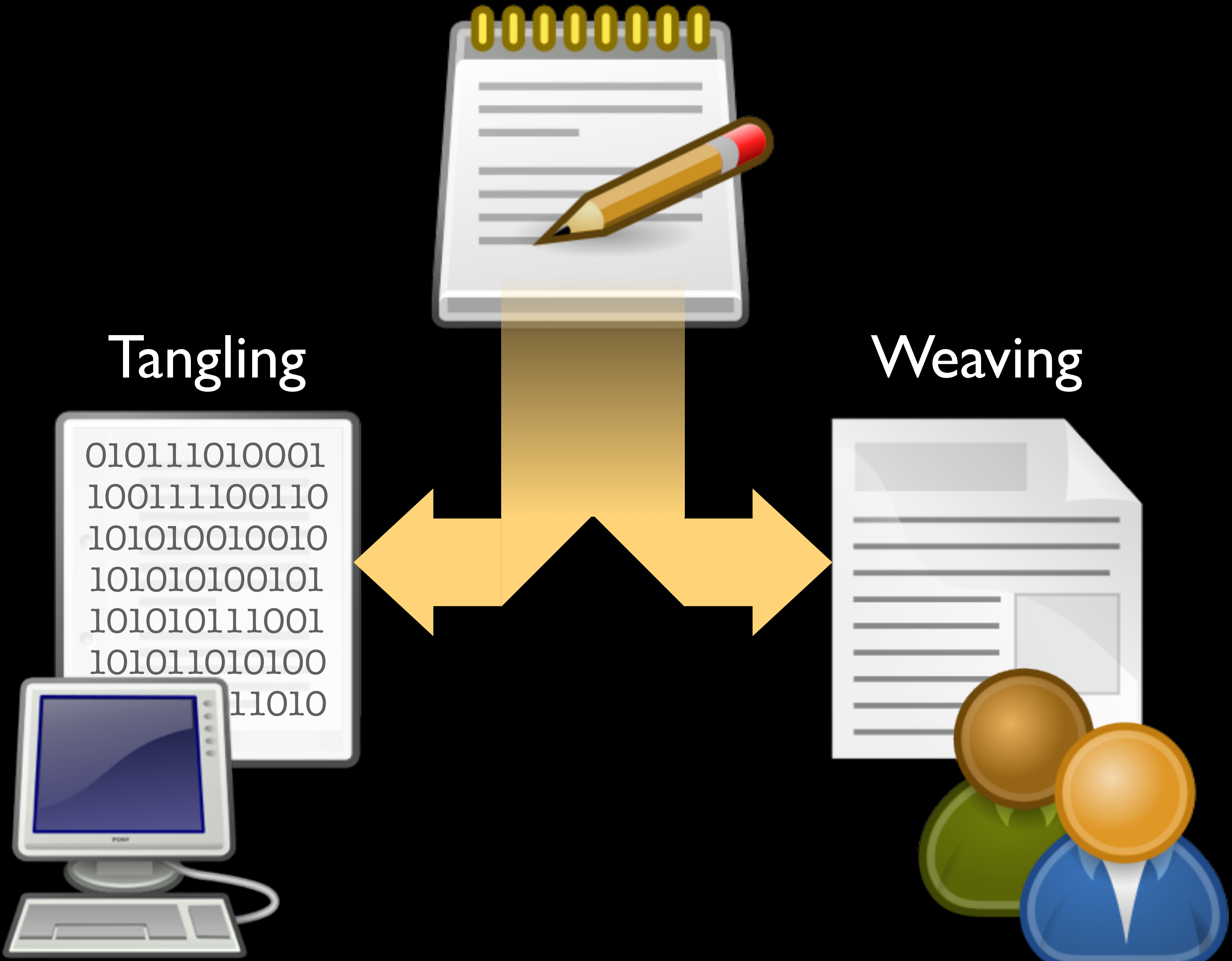
Synthesis

What is Needed?

- Good text processing *and* programming
- Identify and separate source code snippets
- Code block evaluation support
- Link and reference code block snippets
- Use evaluated code output
- Render both code and documentation

In the third millenium, does it still make sense to work with text files? Text files are the only truly portable format for files. The data will never get lost.

—Carsten Dominik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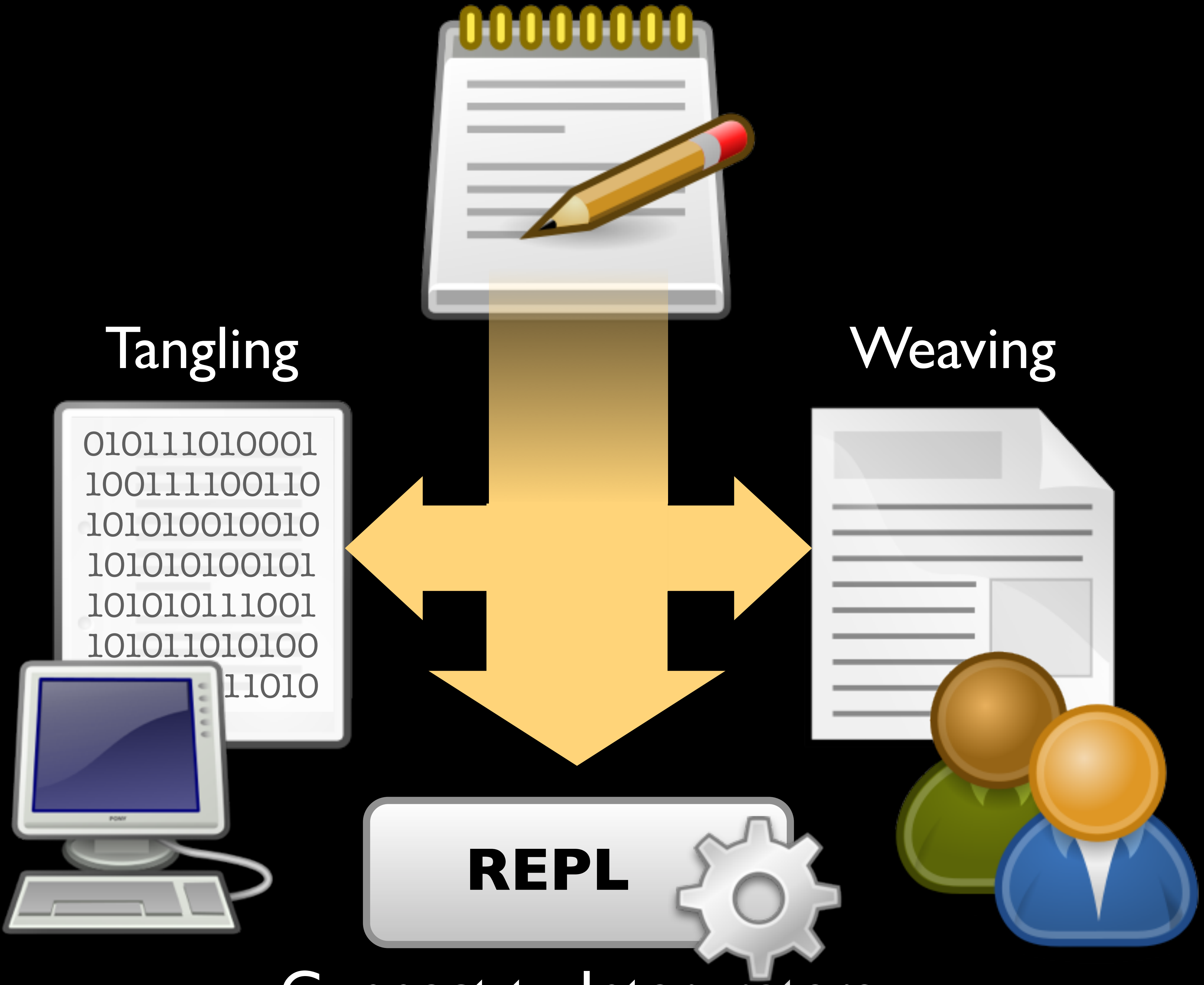
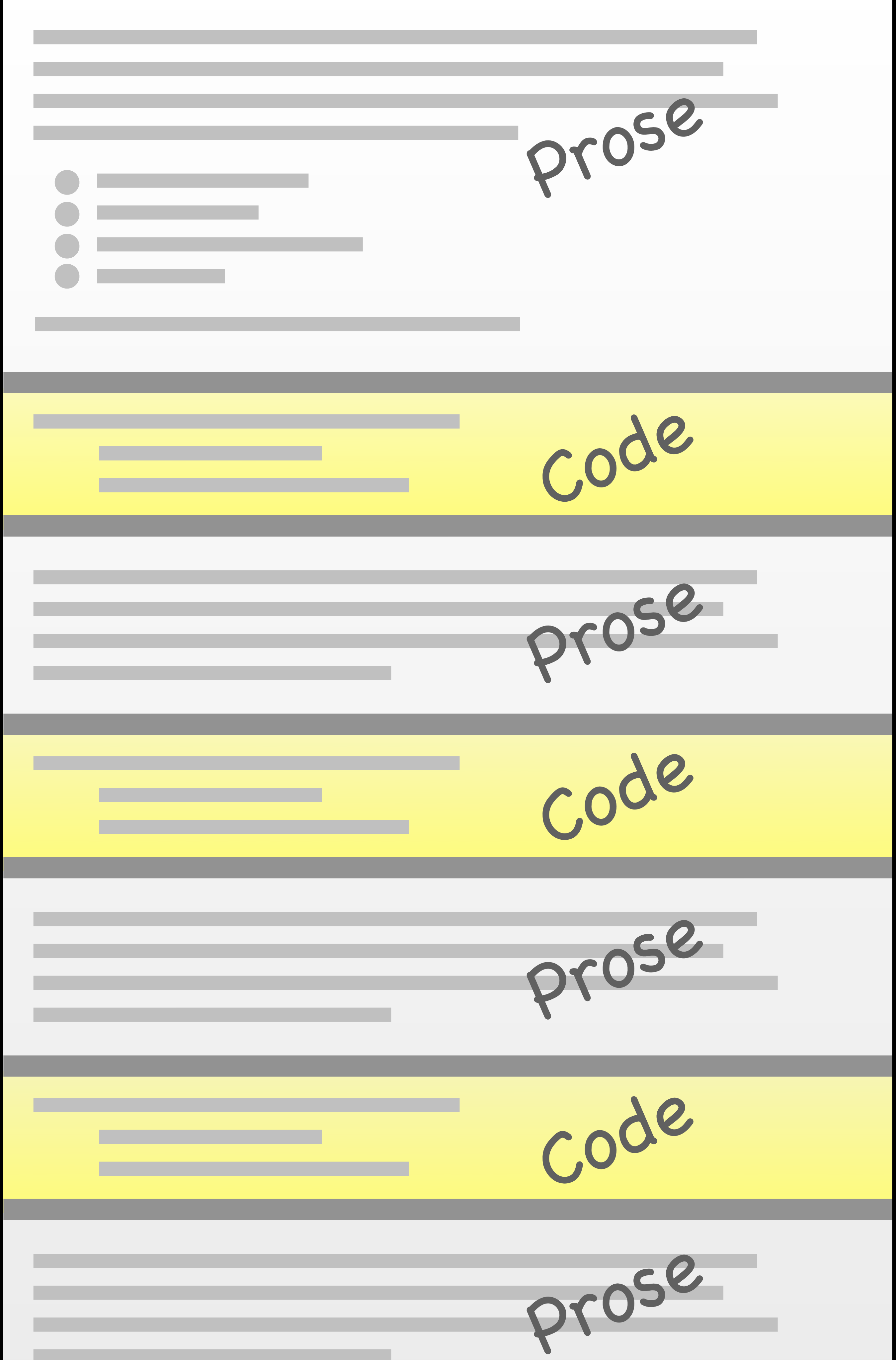


Connect to Interpreters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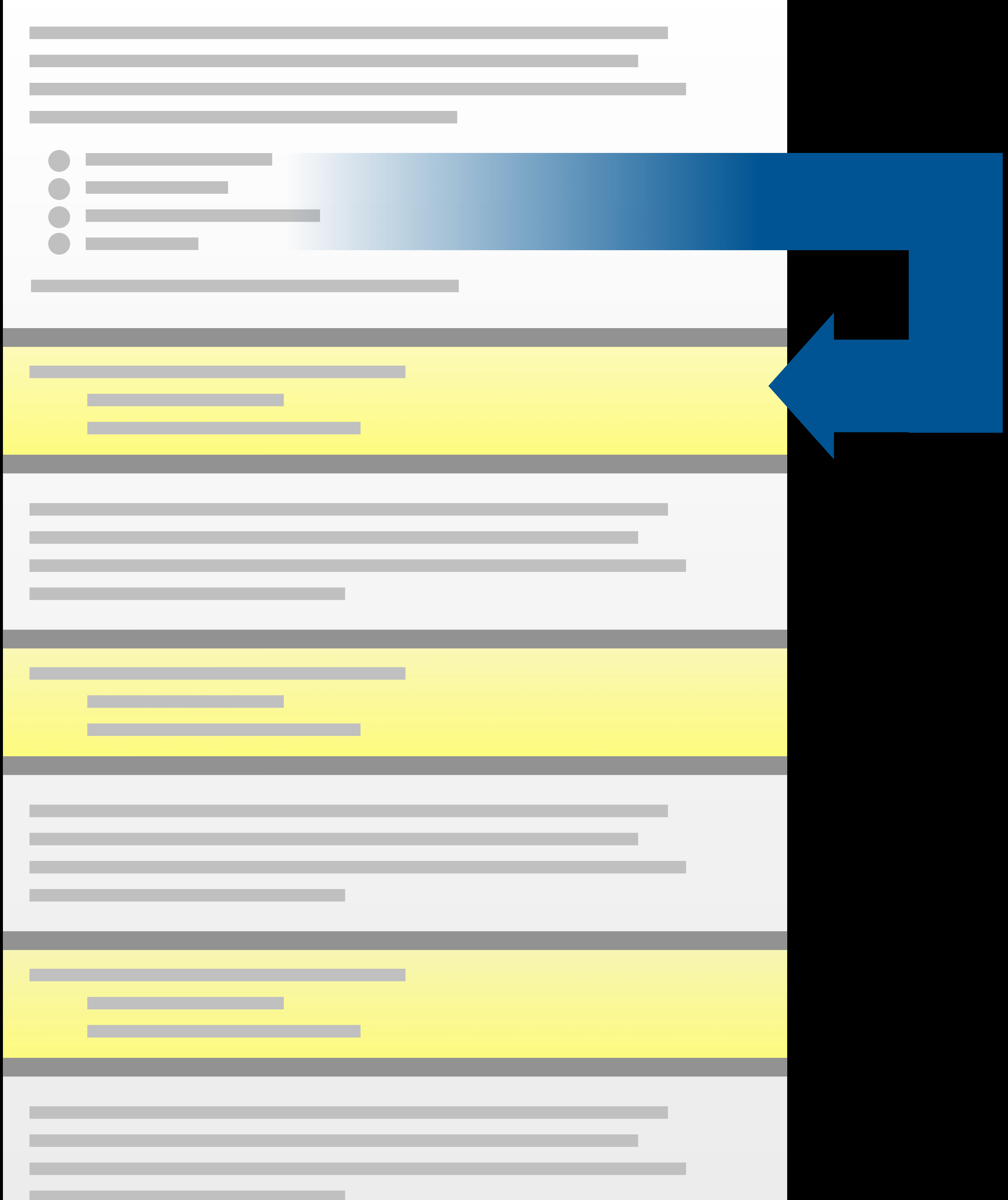
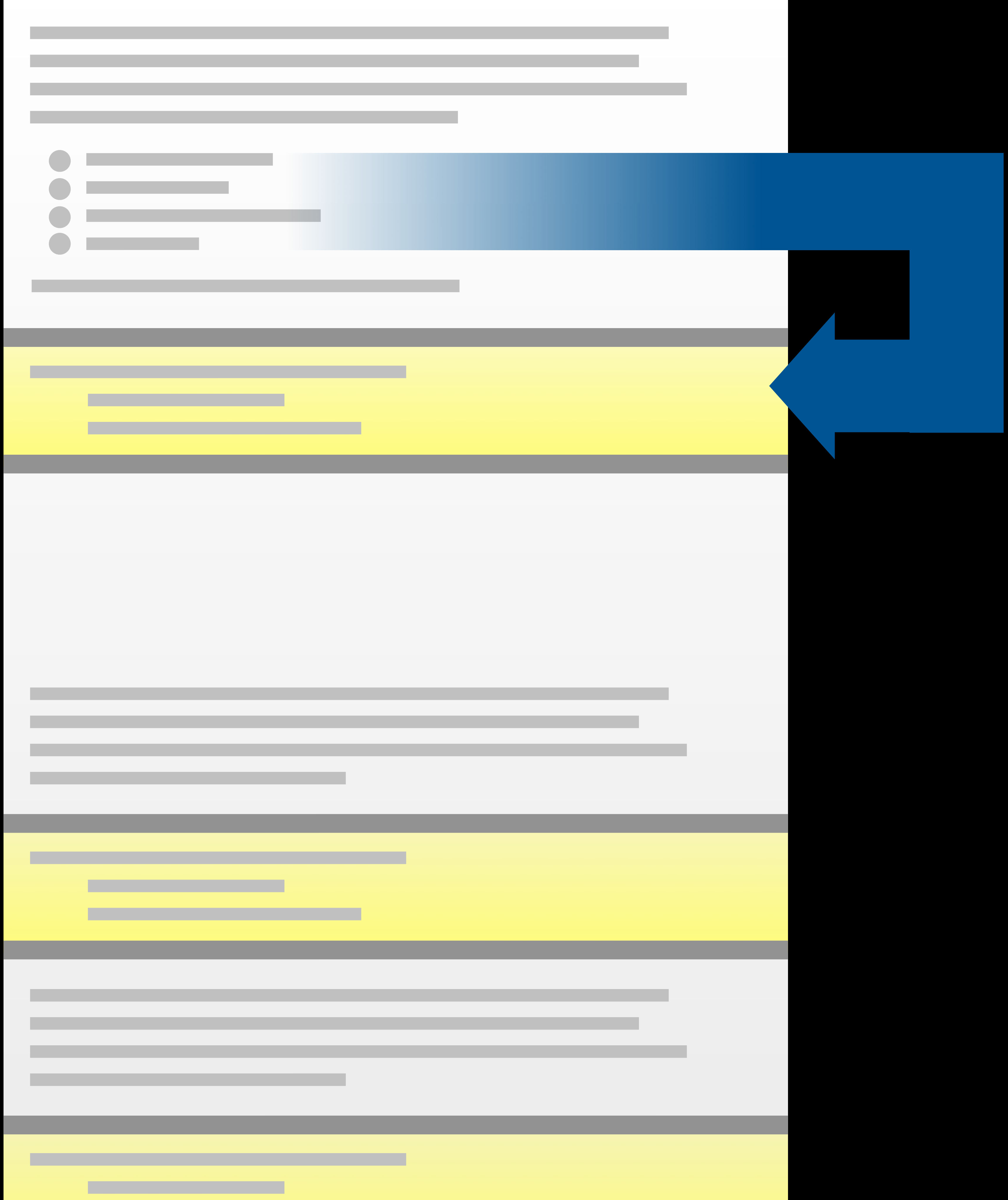


Lists, tables and textual data fed in as variables



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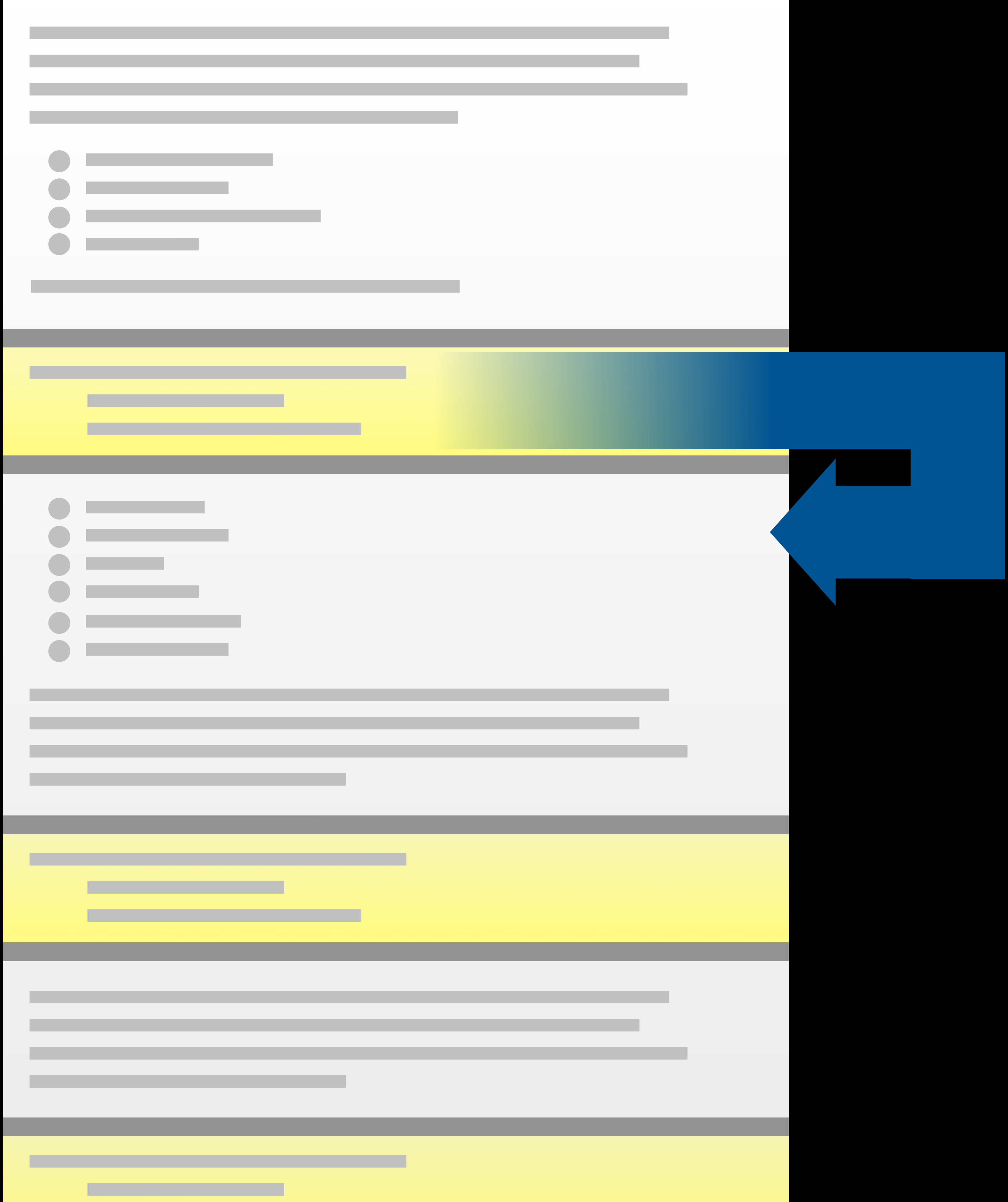
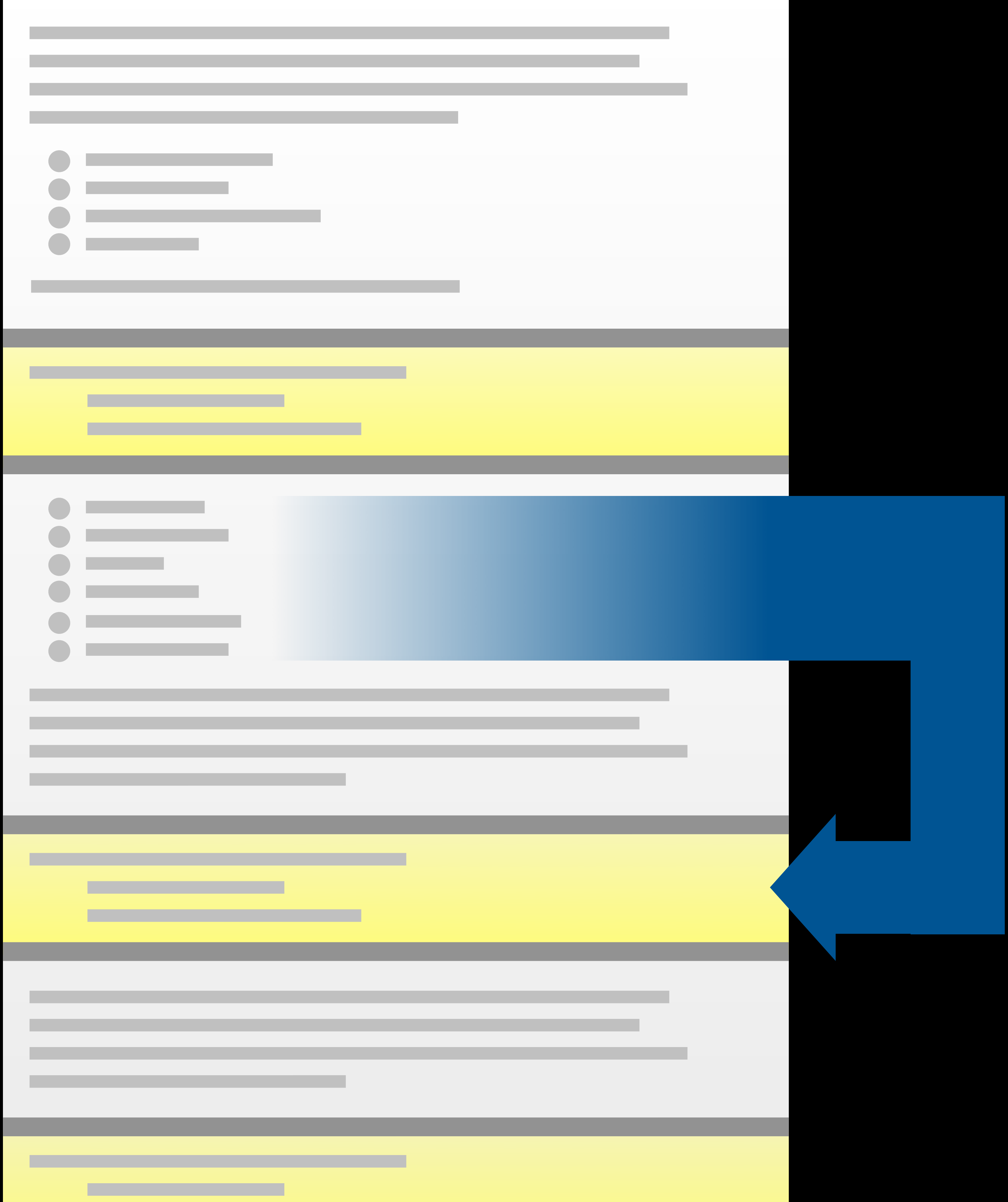


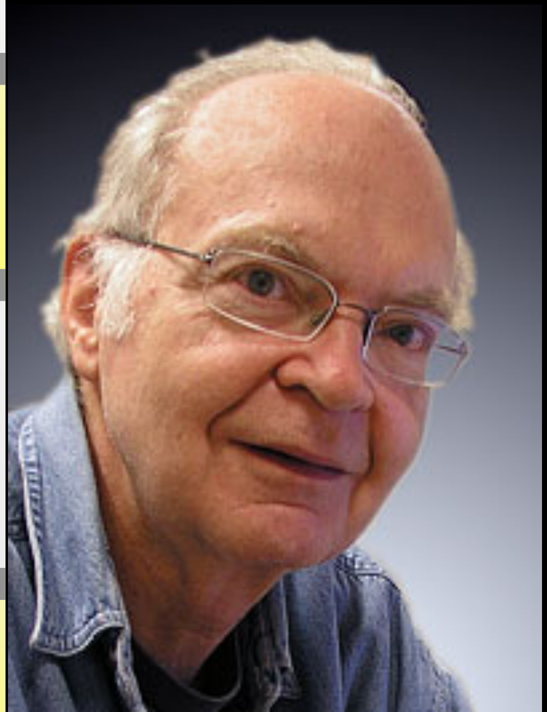
Results of running code inserted as data



Results of *that* code given as variables to other code blocks

A complex piece of software is best regarded as *a web of ideas* that has been delicately pieced together from simple materials.

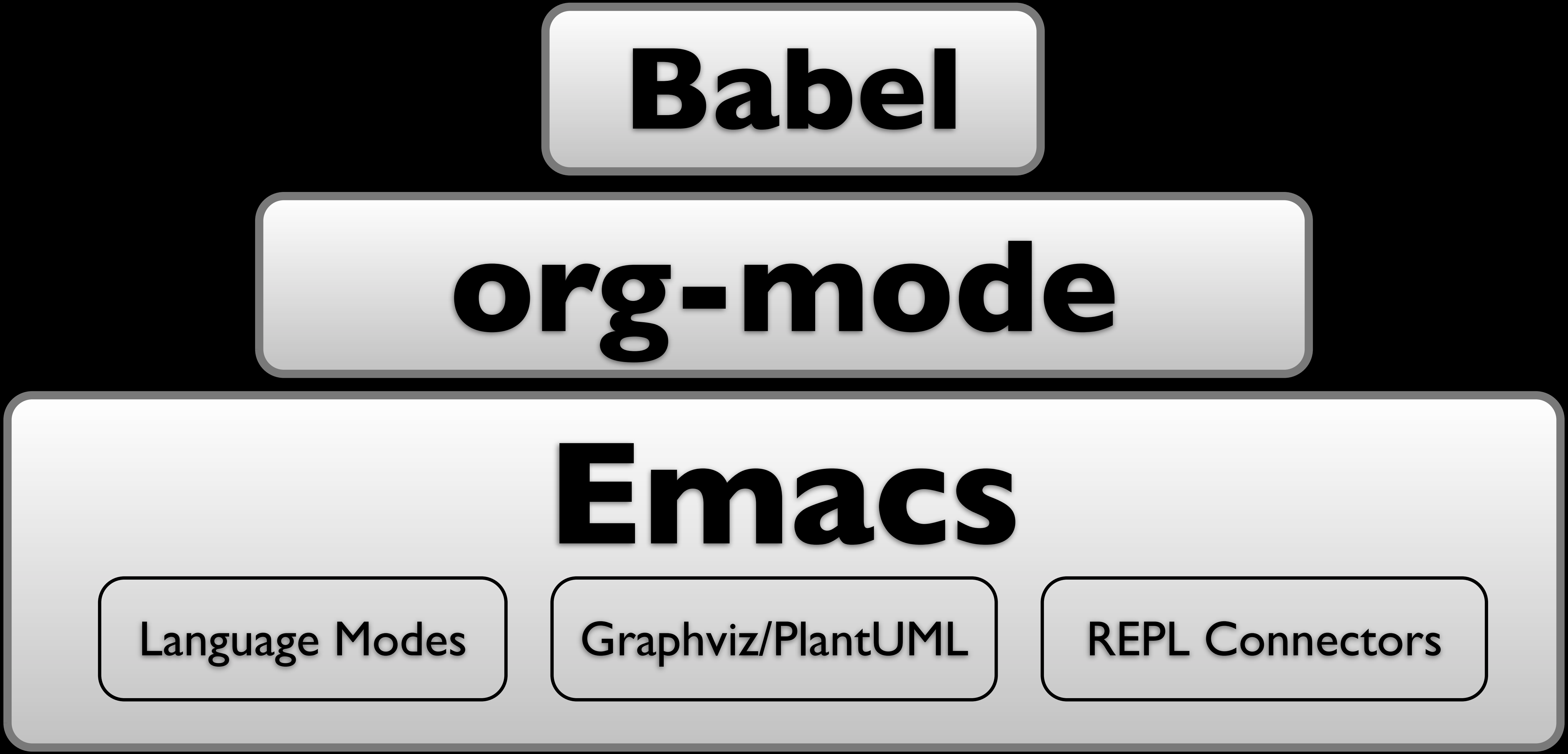
—Knuth



Knuth originally interconnected code.

Now we can interconnect both code and data in a literate way.

The Toolbox


Babel
org-mode
Emacs
Language Modes
Graphviz/PlantUML
REPL Connectors

Demonstration

Possible Uses

- Learning a new language or technology
- Better REPL for non-interactive languages
- Problems require multiple languages
- Embedded UML or other diagrams
- Combining code with its tests
- Easier to brain-storm over complex analysis
- Describe complex code:
  - Regular Expressions
  - Odd inheritance trees
  - SQL and ORM

Questions?

Links to this presentation and other bookmarks available at either this URL or scan this QR code:

`http://is.gd/XPGMR6`