

The Language of Programming

@AnjanaVakil

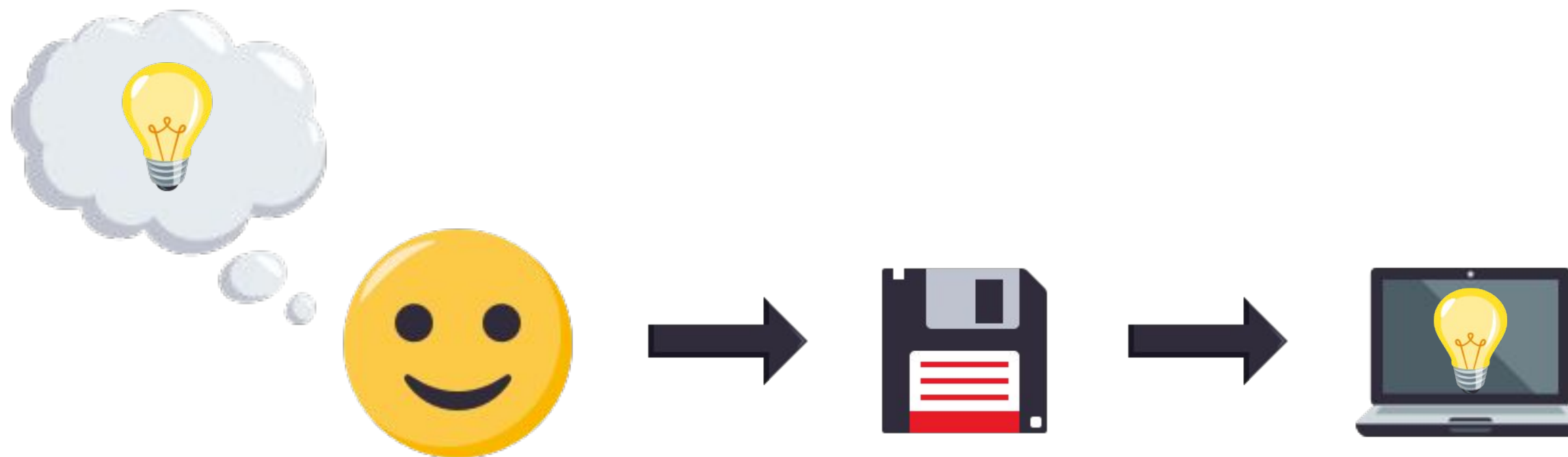
speakerdeck.com/vakila/the-language-of-programming

what is code?

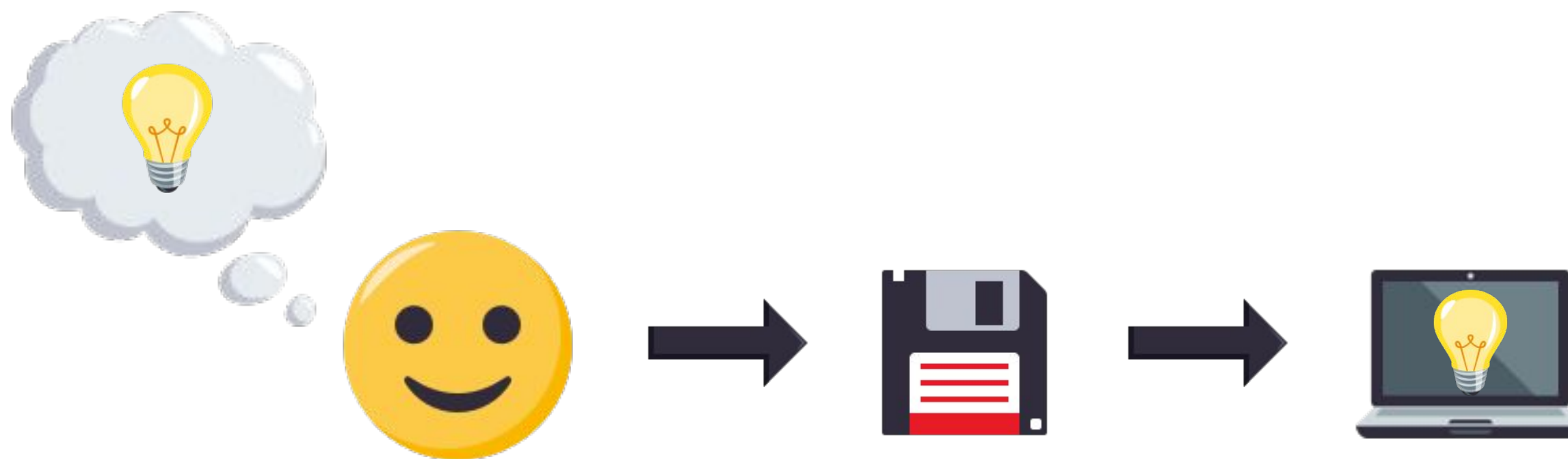
language

language
for machines

language for machines



language for machines?



“[Code] is not just a way of getting a computer to perform operations...

*-Structure & Interpretation
of Computer Programs*

“[Code] is not just a way of getting a computer to perform operations... it is a novel formal medium for expressing ideas about methodology.”

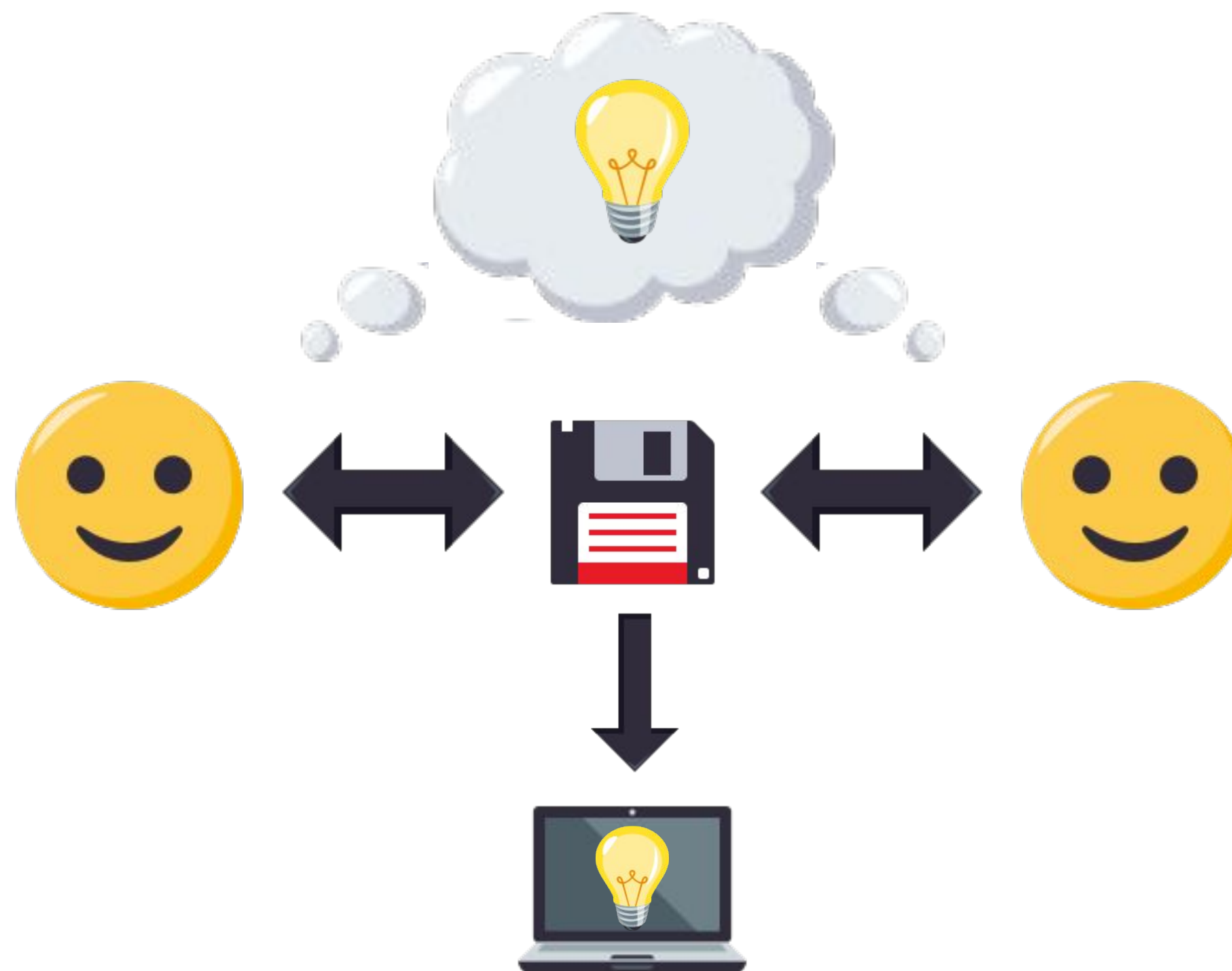
*-Structure & Interpretation
of Computer Programs*

“Thus, programs must be written for people to read, and only incidentally for machines to execute.”

*-Structure & Interpretation
of Computer Programs*

language
for ~~machines~~
humans

it's all about collaboration

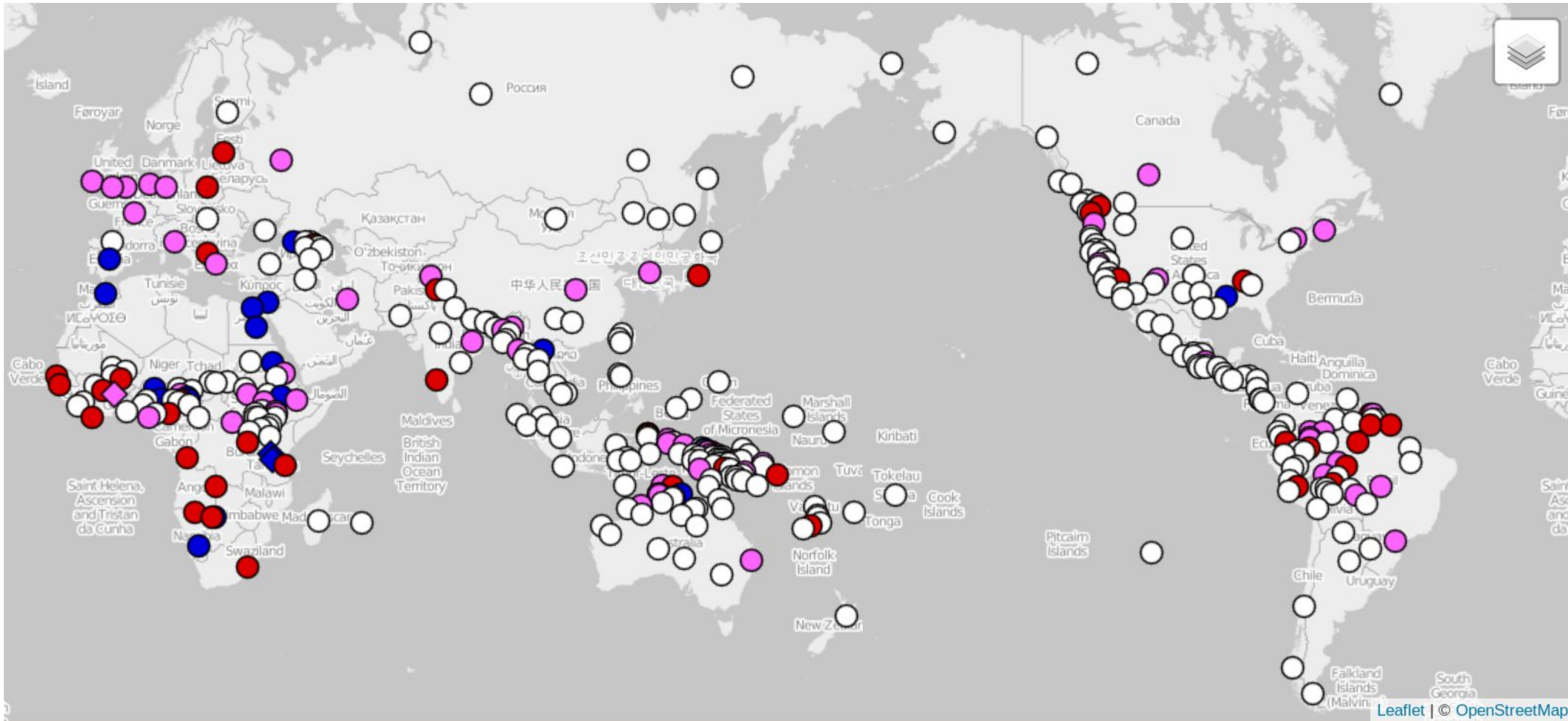


language is power

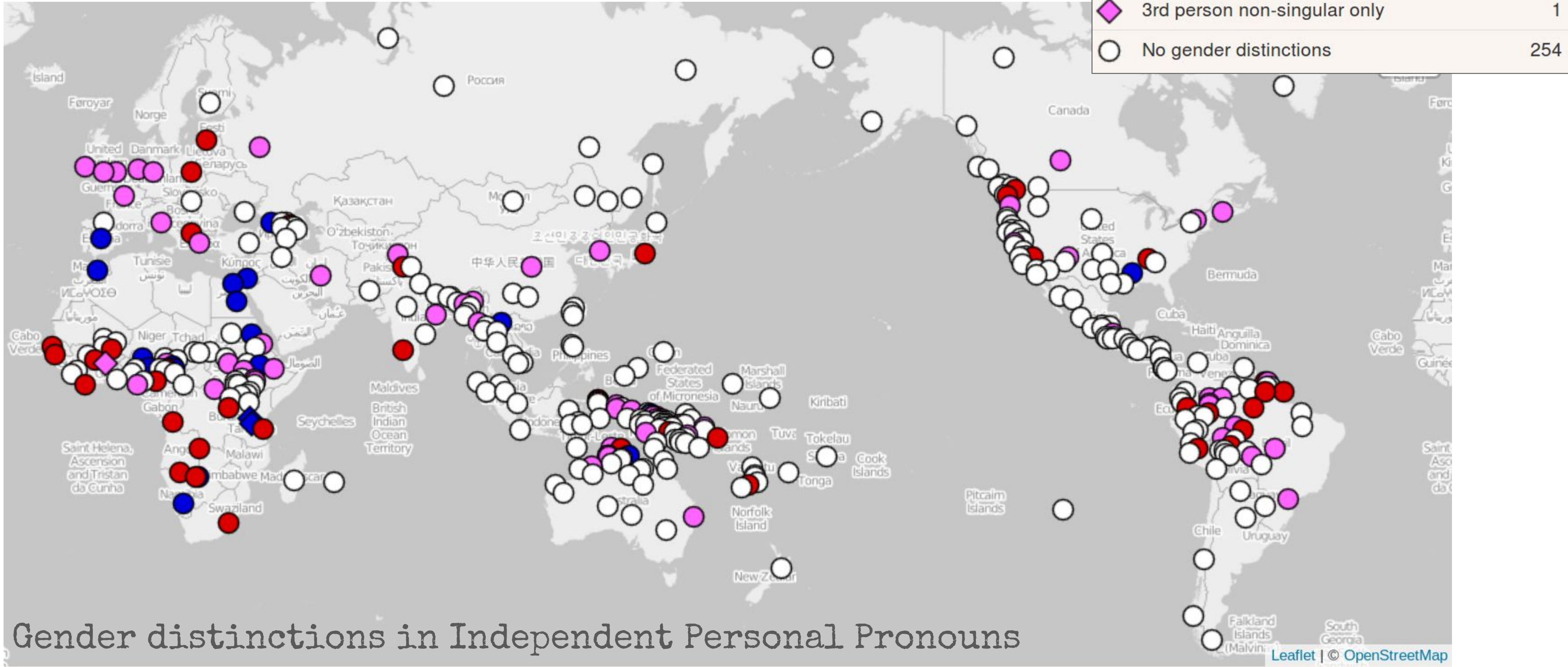


language
with many faces

every language matters

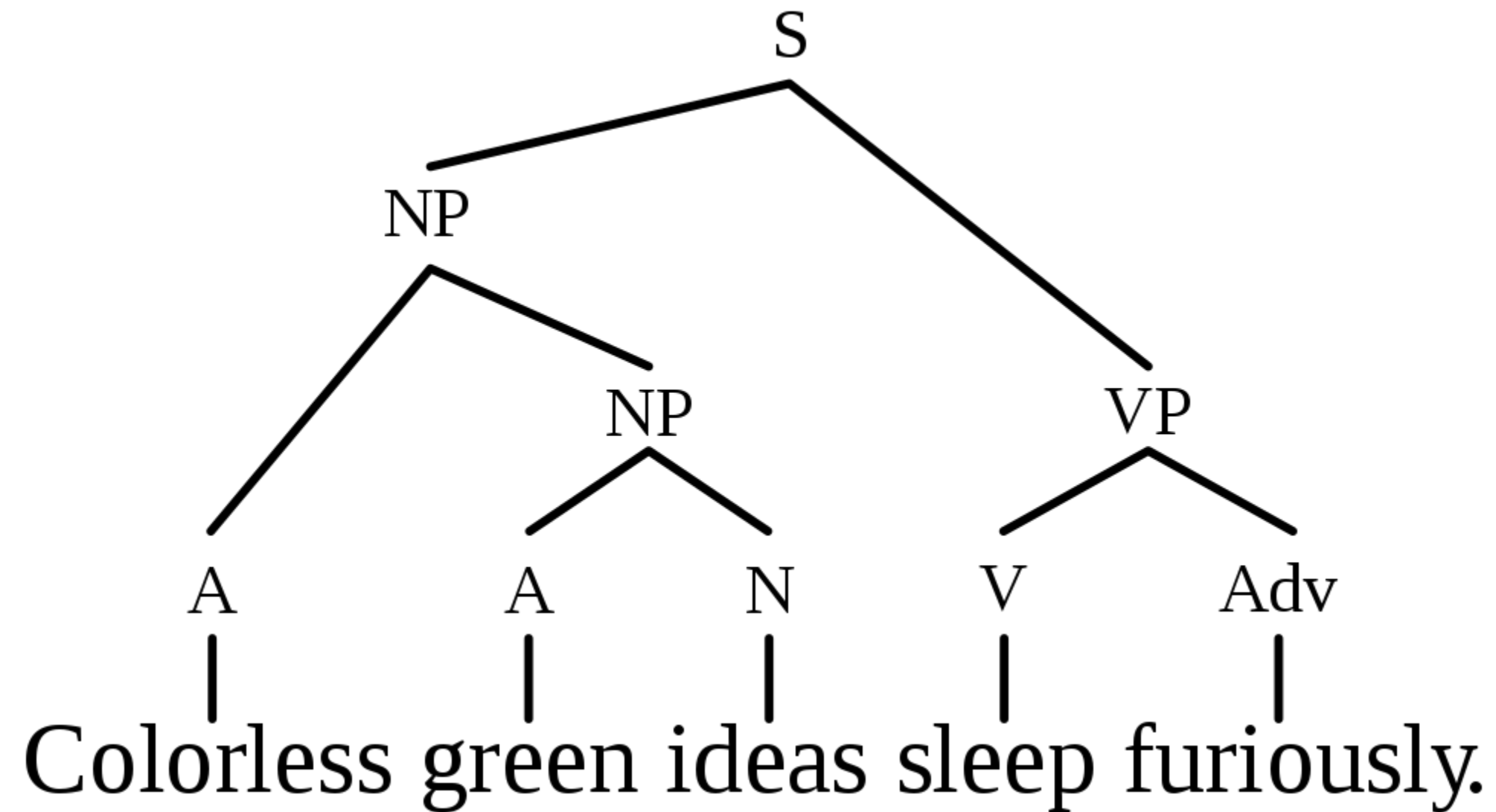


every language matters



deconstructing language

deconstructing language



deconstructing language

texts
turns
sentences
phrases
words
morphemes
syllables
phonemes
phones
...etc

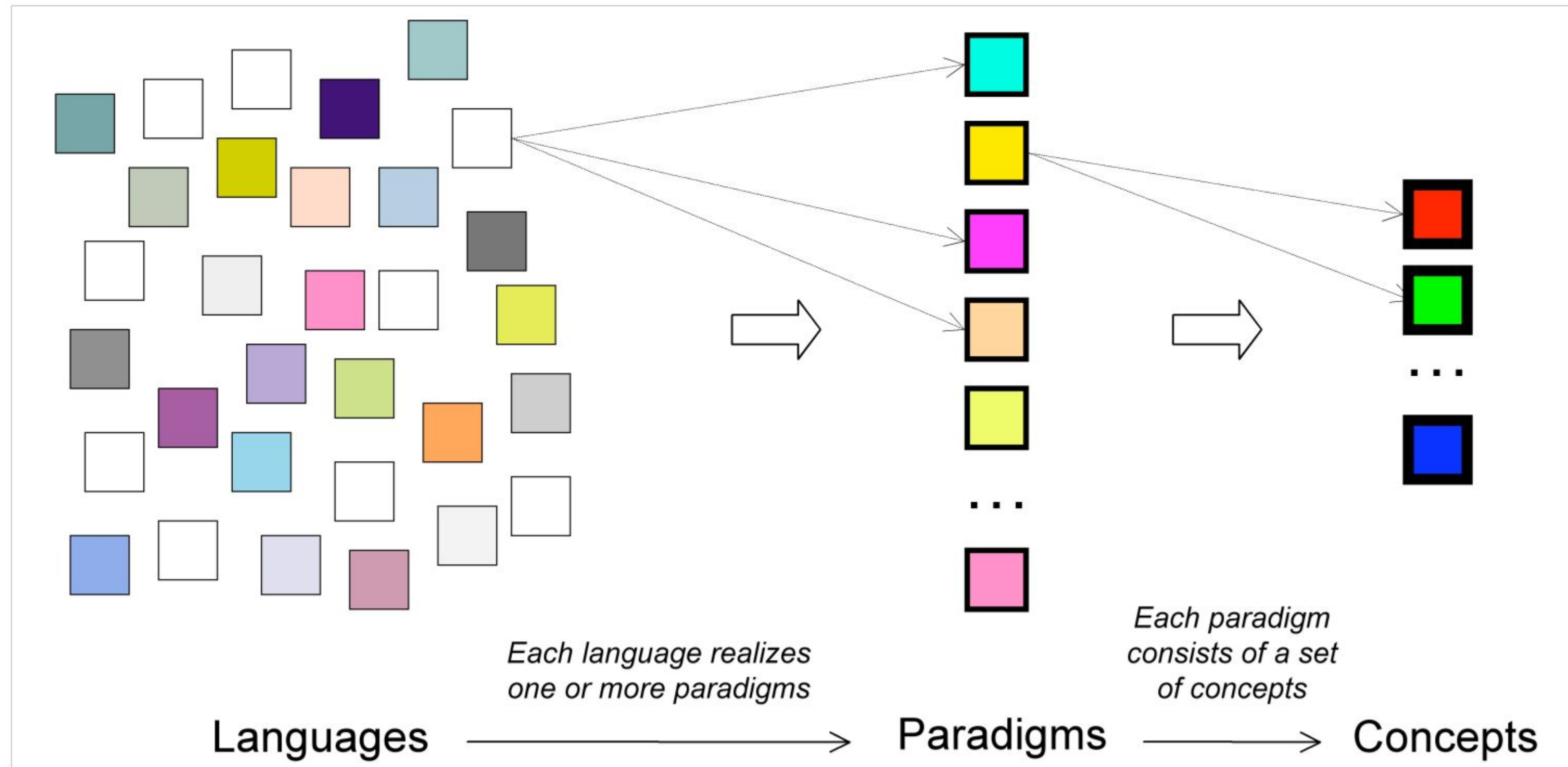
deconstructing programs

modules functions
objects types expressions
lines statements
instructions bytes ...etc

“There are no theory-neutral
structures in linguistics.”

-Michael Tomasello, Linguist

deconstructing paradigms



“Each paradigm supports a set of concepts that make it the best for a certain kind of problem.”

–Peter van Roy, Computer Scientist

prescriptivism

prescriptivism

“FORTRAN [is an] ‘infantile disorder’”

“BASIC [coders are] ‘mentally mutilated’”

“COBOL ... cripples the mind”

“APL is a mistake”

–Edsger Dijkstra, Curmudgeon

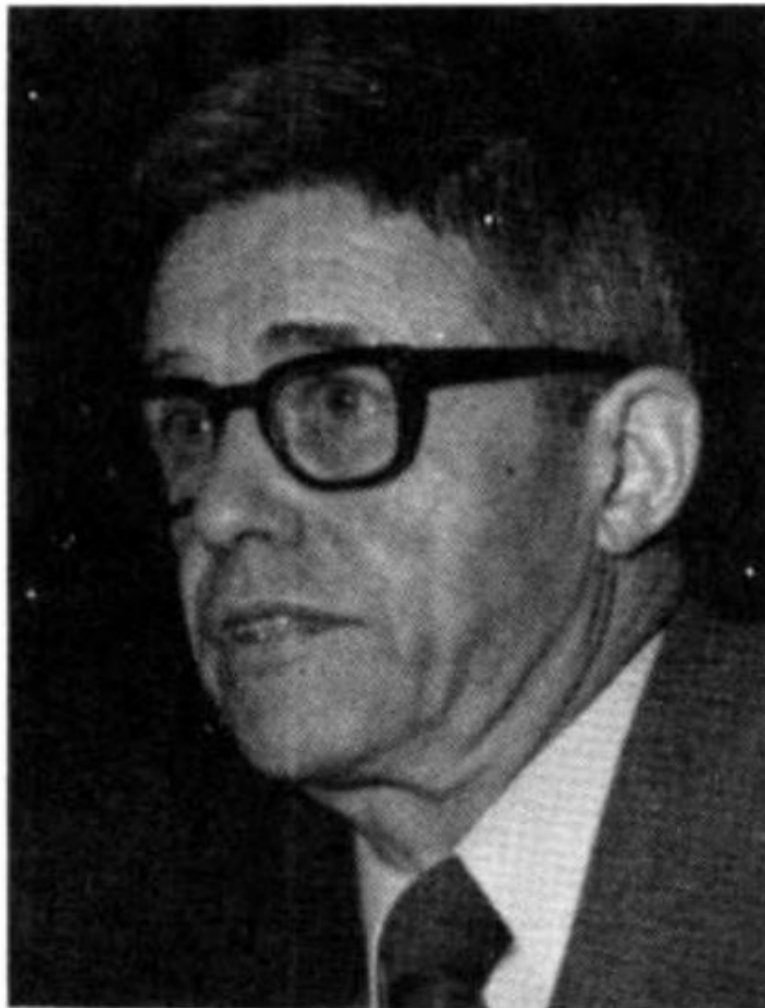
~~prescriptivism~~

NOPE

“FORTRAN is an ‘infantile disorder’”
“BASIC [coders are] ‘mentally mutilated’”
“COBOL ... cripples the mind”
“APL is a mistake”

–Edsger Dijkstra, Curmudgeon

APL ain't no mistake



1979 ACM Turing Award Lecture

Delivered at ACM '79, Detroit, Oct. 29, 1979

Notation as a Tool of Thought

Kenneth E. Iverson

IBM Thomas J. Watson Research Center

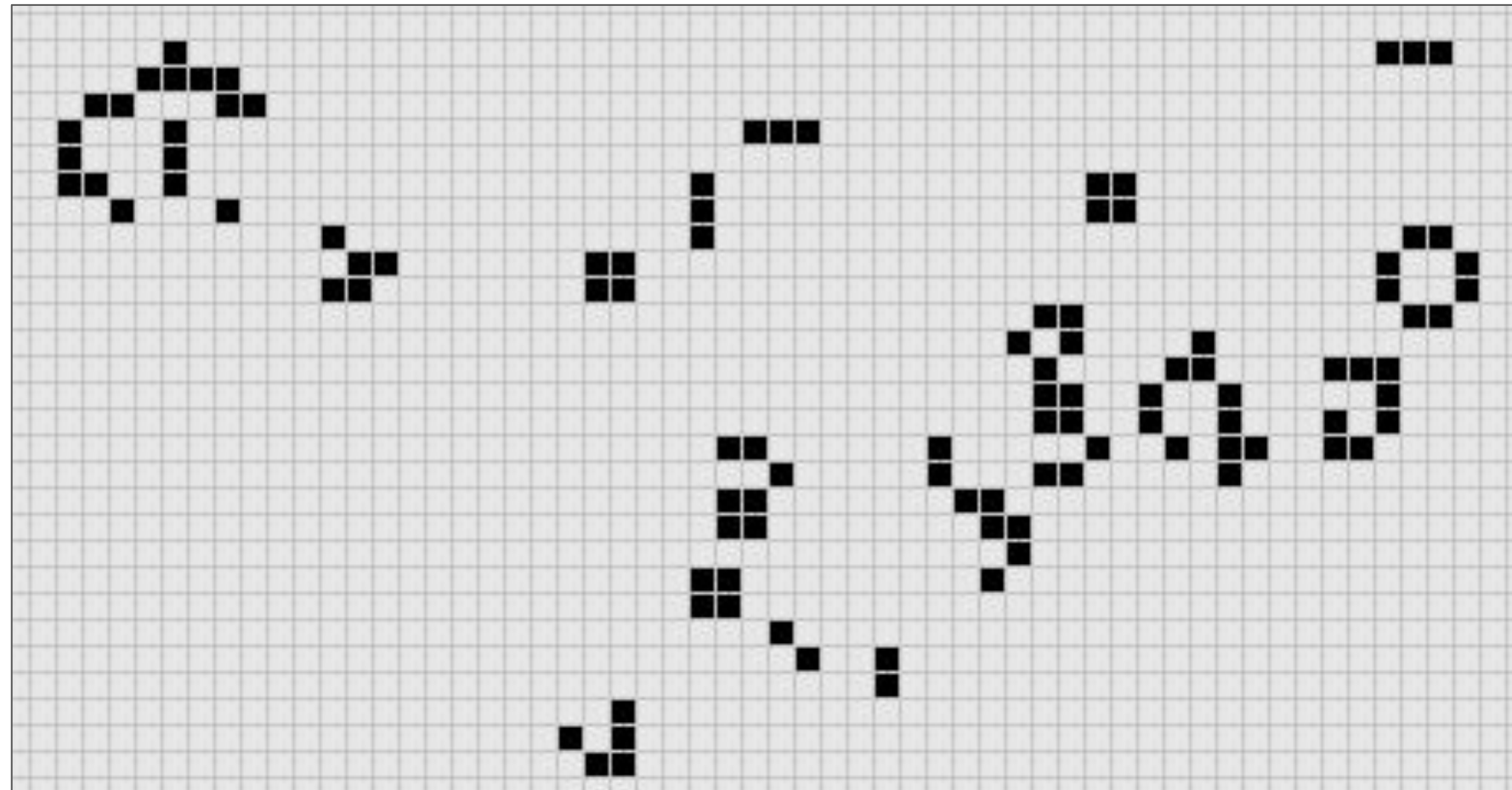
APL ain't no mistake

life ← {↑1 ω V . ∧ 3 4 = + / , ¯1 0 1 ° . ⊖ ¯1 0 1 ° . ϕ ⊂ ω}

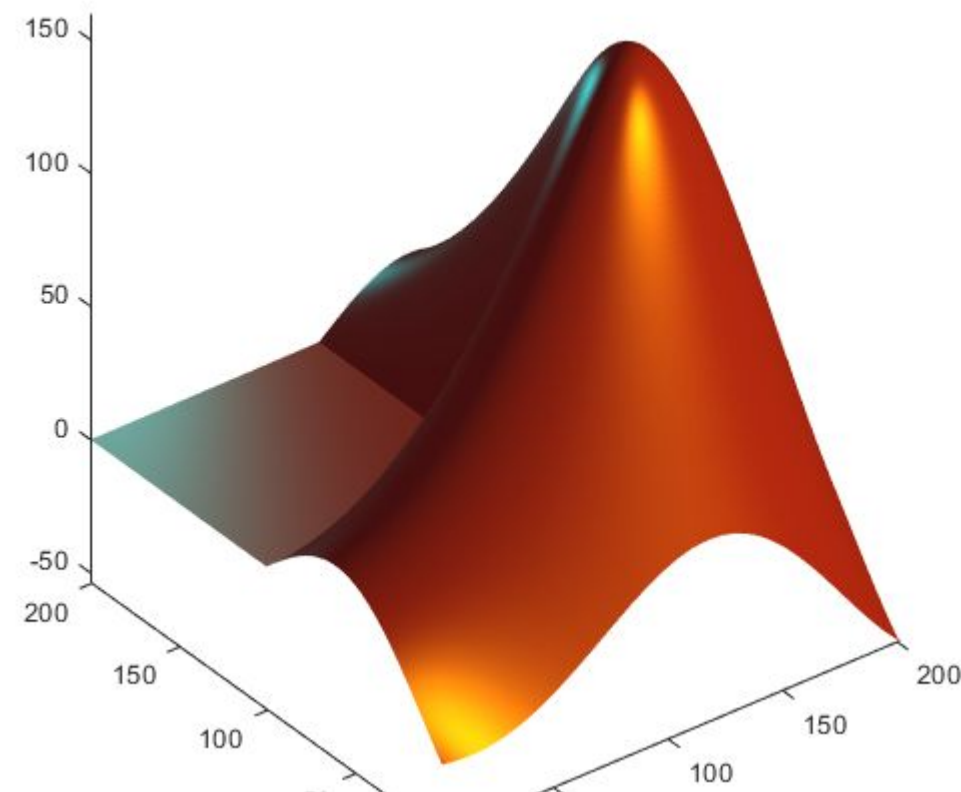
APL ain't no mistake

life ← {↑1 ω V . ∧ 3 4=+/,⁻1 0 1[∘].⊖⁻1 0 1[∘].ϕ⊂ω}

Conway's Game of Life in Dyalog APL



APL ain't no mistake



MATLAB®



APL ain't no mistake



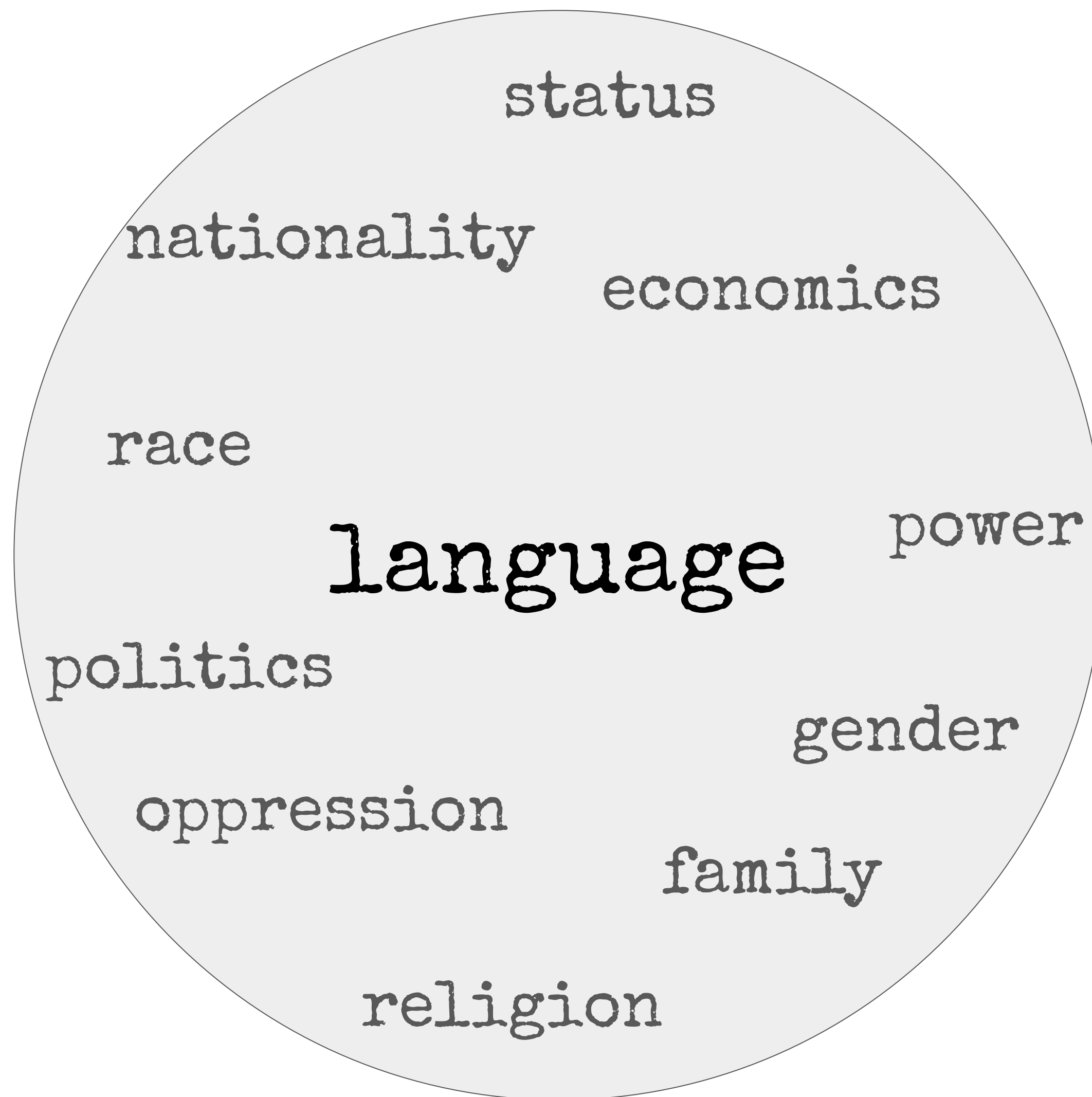
“Languages are cultural artifacts that differ radically among different cultures, and languages change in important ways as the communicative needs of their speakers evolve over time.”

–Michael Tomasello, Linguist

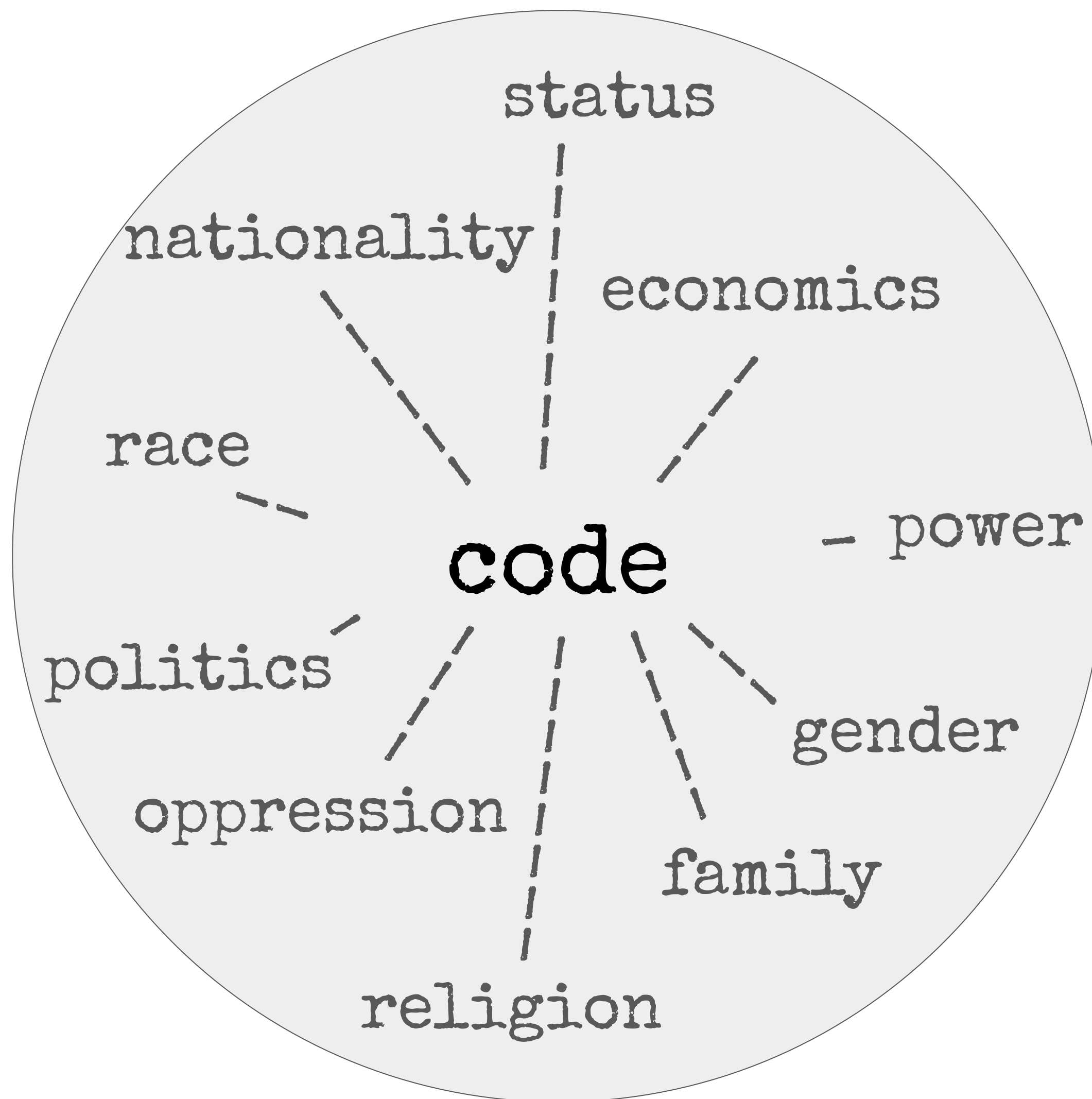
language
in context



language







words are actions

words are actions



Kaya Thomas ✓

@kthomas901

Following



Today in security class we learned about "whitelist" (certificates you trust) and "blacklist" (certificates you don't trust). Sigh.



10:17 AM - 19 Oct 2015



Kaya Thomas ✓ @kthomas901 · 19 Oct 2015



Replying to @kthomas901

This reminds me of the master, slave analogy that was used in another one of my classes.



3



12



13



Kaya Thomas ✓ @kthomas901 · 19 Oct 2015



Black is consistently used to represent untrustworthy, bad, etc in CS language (blacklist, black hat..). You think that's not internalized?



2



23



20



words are actions



Kaya Thomas ✓

@kthomas901

Following

Today in security class we learned about "whitelist" (certificates you trust) and "blacklist" (certificates you don't trust). Sigh.



10:17 AM - 19 Oct 2015



Kaya Thomas ✓ @kthomas901 · 19 Oct 2015

Replying to @kthomas901

This reminds me of the master, slave analogy that was used in another one of my classes.



3



12



13



Kaya Thomas ✓ @kthomas901 · 19 Oct 2015

Black is consistently used to represent untrustworthy, bad, etc in CS language (blacklist, black hat..). You think that's not internalized?



2



23



20



s/whitelist/safelist
s/blacklist/blocklist

s/master/leader
s/slave/follower

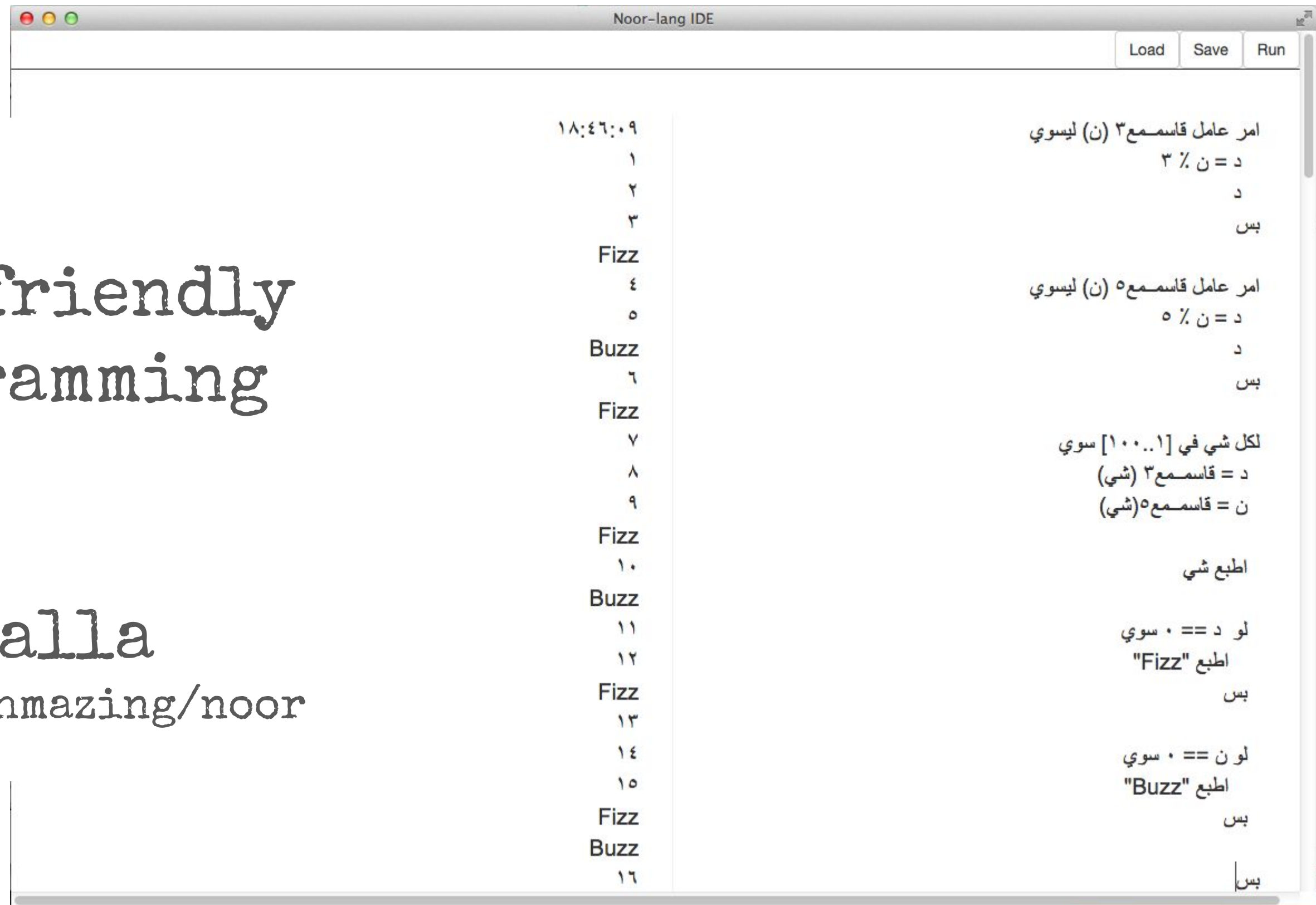
“If we're going to teach programming around the world, we have to be aware of what the cultural biases are.”

–Ramsey Nasser, Creator of قلب

teaching in context

Noor:
a beginner-friendly
Arabic programming
language

by Ahmed Abdalla
github.com/SimplyAhmazing/noor



The screenshot shows the Noor-lang IDE with a FizzBuzz program written in Arabic. The code is as follows:

```
18:46:09
1
2
3
Fizz
4
5
Buzz
6
Fizz
7
8
9
Fizz
10
Buzz
11
12
Fizz
13
14
15
Fizz
Buzz
16
```

The right side of the IDE shows the output of the program, which is the same as the code on the left, but with the numbers 1 through 16 replaced by their corresponding FizzBuzz output in Arabic:

```
امر عامل قاسممع 3 (ن) ليسوي
د = ن % 3
د
بس
امر عامل قاسممع 5 (ن) ليسوي
د = ن % 5
د
بس
لكل شي في [1..100] سوي
د = قاسممع 3 (شي)
ن = قاسممع 5 (شي)
اطبع شي
لو د == 0 سوي
اطبع "Fizz"
بس
لو ن == 0 سوي
اطبع "Buzz"
بس
بس
```

language
to be acquired

we learn through context

we learn through context

```
foo = bar('baz')
```

we learn through context

```
result = analyze('data')
```

we learn out loud

```
result = analyze('data')
```

we learn out loud

`result = analyze('data')`

“result equals analyze data”?

“set result to analyze of data”?

“analyze string data becomes result”?

...?

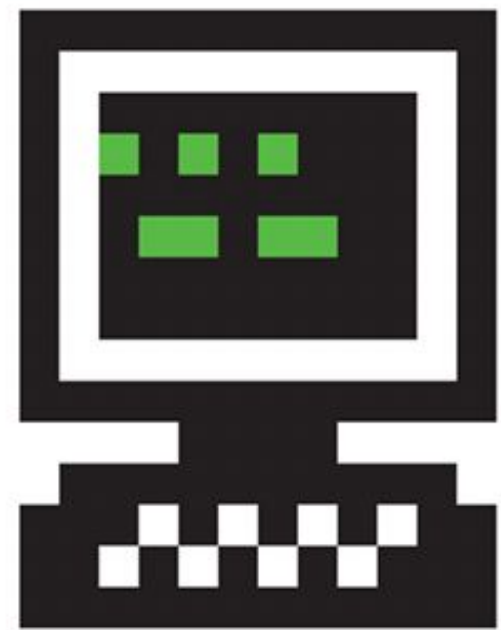
we learn out loud

“... can we really comprehend and communicate source code if we cannot vocalise it?”

– Felienne Hermans, Computer Scientist

we can't learn alone

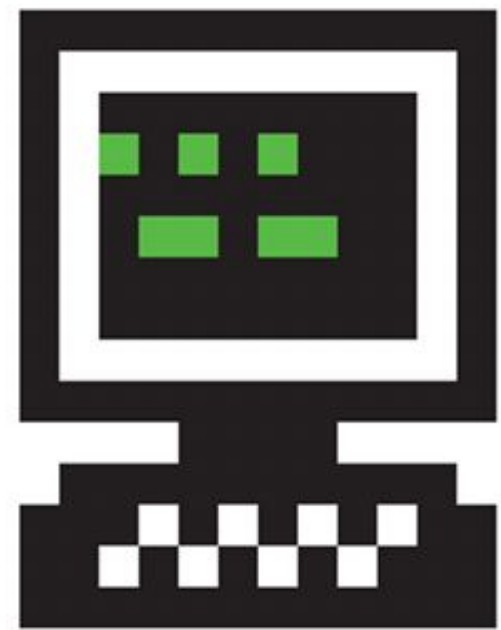
we can't learn alone



The
Recurse
Center

recurse.com

we can't learn alone



The
Recurse
Center

recurse.com



outreachy.org

we can't learn alone



The
Recurse
Center

recurse.com



outreachy.org



mapbox.com/careers

code
is
language
is
collaboration
is
power

what will we
do with it?

Thank you!

GOTO Berlin team

István "Flaki" Szmozsánszky, Perry Eising, Nicole Orchard, Max Rabkin, John Sylak-Glassman & everyone else who let me talk their ear off

The Recurse Center

Mozilla TechSpeakers

Mapbox

References speakerdeck.com/vakila/the-language-of-programming

- H. Abelson, G.J. Sussman, & J. Sussman, *Structure and Interpretation of Computer Programs* (1996), via mitpress.mit.edu/sicp
- World Atlas of Language Structures, "Gender distinctions in Independent Personal Pronouns", via wals.info/feature/44A
- M. Tomasello, "Language is Not an Instinct", in *Cognitive Development 10* (1995)
- P. van Roy, "Programming Paradigms for Dummies: What Every Programmer Should Know", in *New Computational Paradigms for Computer Music* (2009), via [UCL](https://www.ucl.ac.uk)
- E. Dijkstra, "How do we tell truths that might hurt?" (1975), cited in V. Chandra, *Geek Sublime* (2014)
- K.E. Iverson, "Notation as a tool of thought" (awarded 1979), in *ACM Turing award lectures* (2007), via [ACM](https://www.acm.org)
- Conway's Game of Life in Dyalog APL, from "APL (programming language)", [Wikipedia](https://en.wikipedia.org/wiki/APL_(programming_language))
- K. Thomas tweet (2015) via [Twitter](https://twitter.com), via A. van Kesteren, "Avoid whitelist/blacklist" on [Github](https://github.com)
- R. Nasser, "Arabic Programming Language at Eyebeam" (2013) via nas.sr/قلب
- A. Abdalla, "Creating an Arabic Programming Language!", [!!Con 2018](https://con2018.com)
- F. Hermans, "Code Phonology" (2018), via feliienne.com/archives/5947

Image Credits

- Icons by [EmojiOne](https://emojione.com)
- "The Tower of Babel" painting by Pieter Bruegel the Elder (1563), via Wikimedia
- "Syntax tree diagram of a sentence from Syntactic Structures (1957) by N. Chomsky" by Gringer, via Wikipedia/Wikimedia
- Figure from Peter van Roy, "Programming Paradigms for Dummies: What Every Programmer Should Know"
- Image from "Conway's Game of Life" via [Cornell Math Explorers' Club](https://cornell-math-explorers-club.org)
- MATLAB logo image via [MathWorks](https://mathworks.com), R logo image via [The R Foundation](https://www.r-project.org/)
- Poster for Tron ©1982 Disney, image via [IMDb](https://www.imdb.com)