SIGPwny

SP2024 Week 07 • 2024-03-07

Esoteric languages

Henry Qiu and Pete Stenger

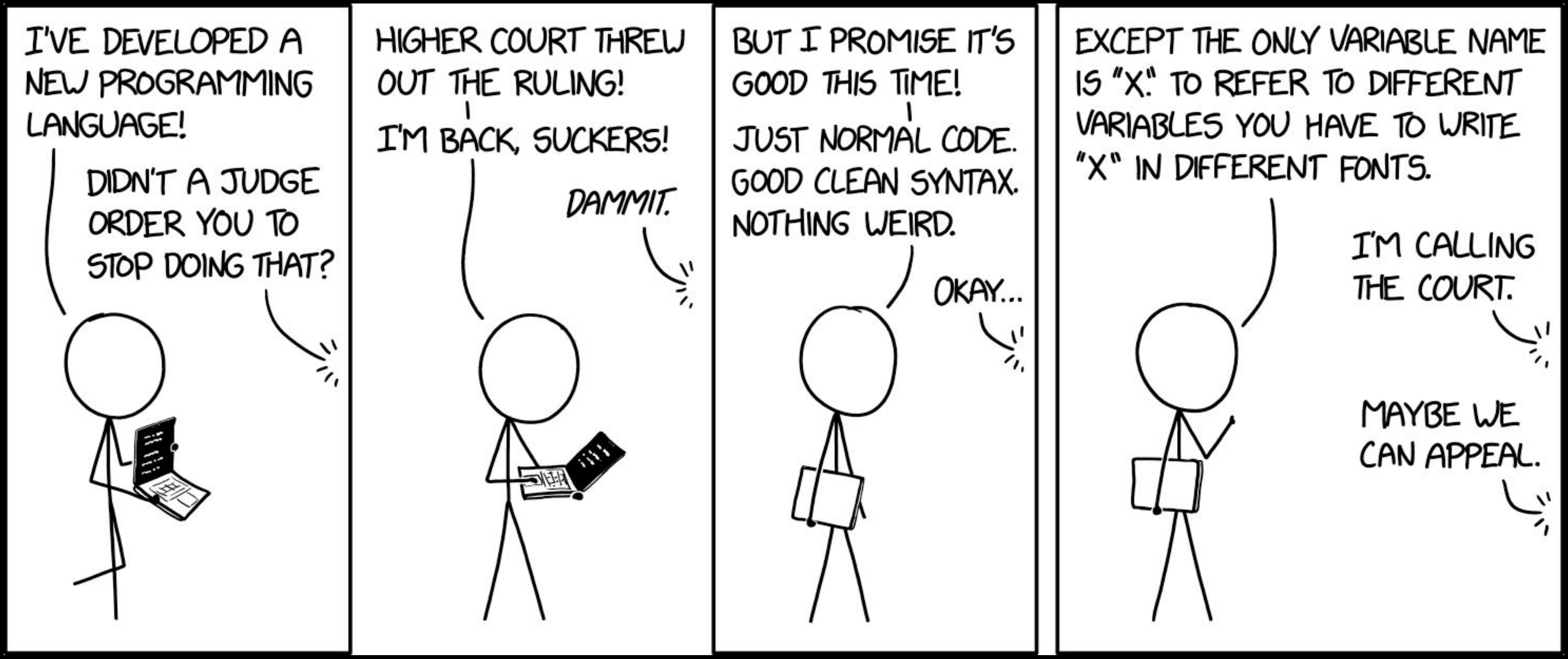
Announcements

- Tracer FIRE!
  - Forensics and blue team competition!
  - Space is limited! (first 55 applicants)
  - March 22 - 24th
  - Register at https://sigpwny.com/tracerfire2024

- Have a great spring break!

ctf.sigpwny.com

sigpwny{+[>,.<]}


I'VE DEVELOPED A NEW PROGRAMMING LANGUAGE!
DIDN'T A JUDGE ORDER YOU TO STOP DOING THAT?
HIGHER COURT THREW OUT THE RULING!
I'M BACK, SUCKERS!
DAMMIT.
BUT I PROMISE IT'S GOOD THIS TIME!
JUST NORMAL CODE. GOOD CLEAN SYNTAX. NOTHING WEIRD.
OKAY...
EXCEPT THE ONLY VARIABLE NAME IS "X." TO REFER TO DIFFERENT VARIABLES YOU HAVE TO WRITE "X" IN DIFFERENT FONTS.
I'M CALLING THE COURT.
MAYBE WE CAN APPEAL.

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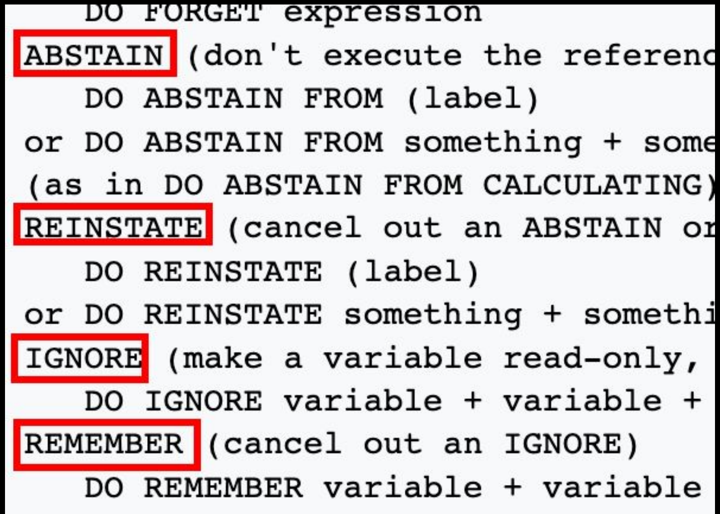
Esolangs

What is an Esolang?

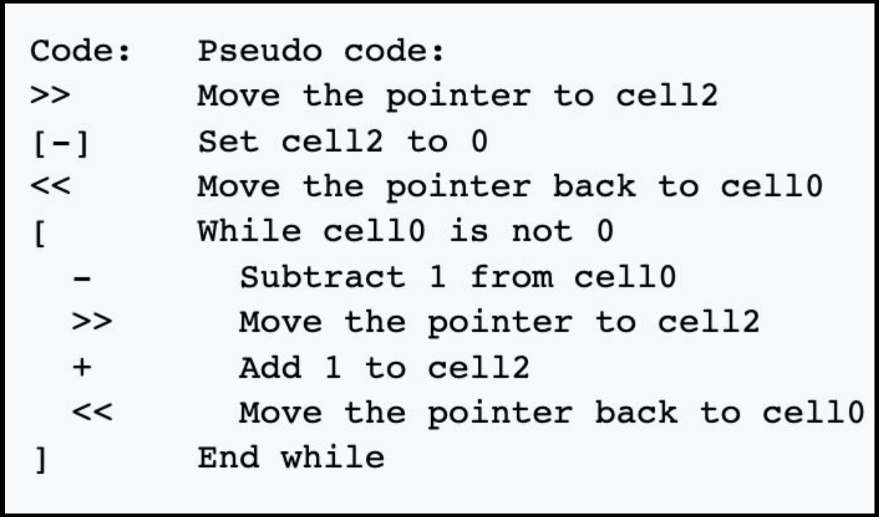
- People thought it would be funny to make a programming language as a joke
  - Have too much time on their hands - Pete
  - Highest form of programming arts - Henry
- **esolang** : a computer programming language designed to experiment with weird ideas, to be hard to program in, or as a joke, rather than for practical use – esolangs.org

Classic Esolang History



```
   DO FORGET expression
ABSTAIN (don't execute the referenc
   DO ABSTAIN FROM (label)
or DO ABSTAIN FROM something + some
(as in DO ABSTAIN FROM CALCULATING)
REINSTATE (cancel out an ABSTAIN or
   DO REINSTATE (label)
or DO REINSTATE something + somethi
IGNORE (make a variable read-only,
   DO IGNORE variable + variable +
REMEMBER (cancel out an IGNORE)
   DO REMEMBER variable + variable
```

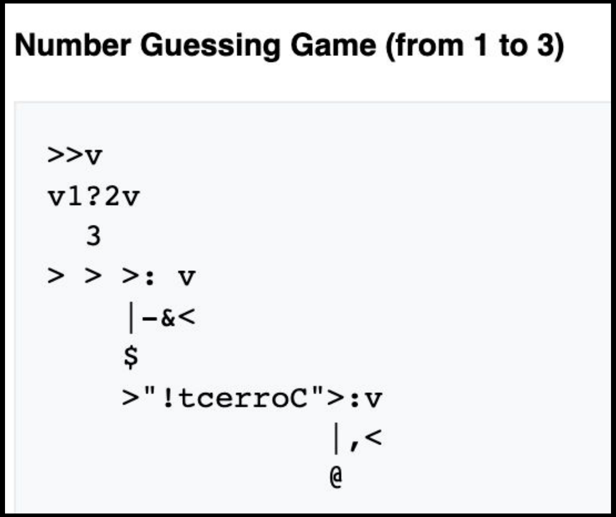
First Esolang: **INTERCAL**
(Compiler Language With No Pronounceable Acronym)



```
Code:    Pseudo code:
>>       Move the pointer to cell2
[-]      Set cell2 to 0
<<       Move the pointer back to cell0
[        While cell0 is not 0
  -        Subtract 1 from cell0
  >>       Move the pointer to cell2
  +        Add 1 to cell2
  <<       Move the pointer back to cell0
]        End while
```

Most Well-Known Esolang: **Brainfuck**

- Simple plus/minus/move operations
- The flag for this meeting is the ‘cat’ program



Number Guessing Game (from 1 to 3)

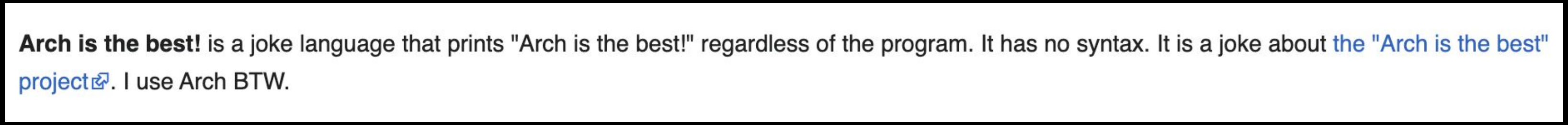
```
>>v
v1?2v
  3
> > >: v
    |-&<
    $
    >"!tcerroC">:v
               |,<
               @
```

2D Esolang: **Befunge**

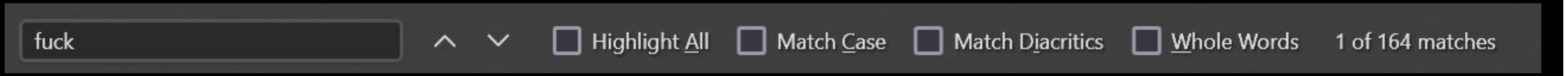
- Follow the arrows for control flow
- If statements change the direction of the instruction pointer

There are a *lot* of esolangs

- We will be covering the important ones, like AMONGUSISABIGSUSSYBAKAHAHAHAAHA
- View a complete list at **esolangs.org**
- Are not guaranteed to be turing complete

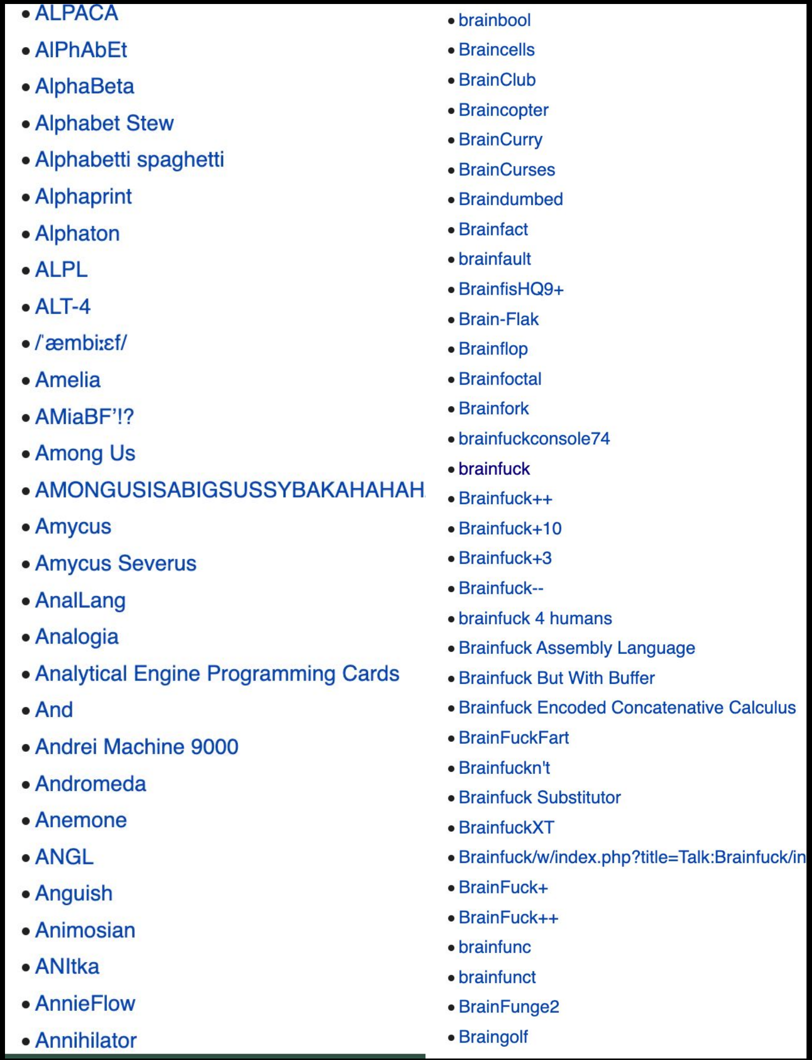


Arch is the best! is a joke language that prints "Arch is the best!" regardless of the program. It has no syntax. It is a joke about the "Arch is the best" project. I use Arch BTW.



fuck ^ ∨ ☐ Highlight All ☐ Match Case ☐ Match Diacritics ☐ Whole Words 1 of 164 matches

They are also very civil, in case you haven't noticed. /s

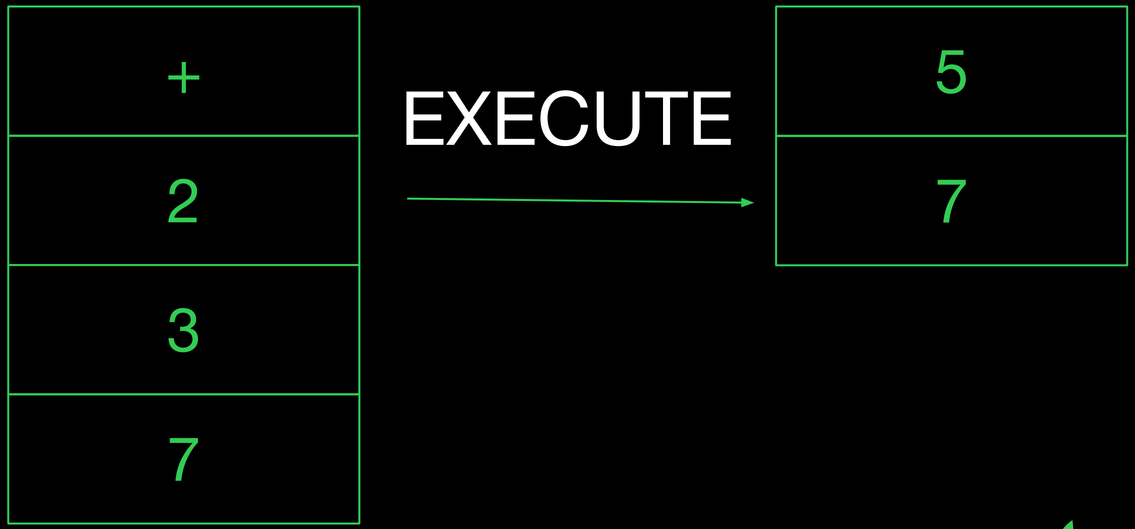


- ALPACA
- AlPhAbEt
- AlphaBeta
- Alphabet Stew
- Alphabetti spaghetti
- Alphaprint
- Alphaton
- ALPL
- ALT-4
- /ˈæmbiːɛf/
- Amelia
- AMiaBF'!?
- Among Us
- AMONGUSISABIGSUSSYBAKAHAHAH
- Amycus
- Amycus Severus
- AnalLang
- Analogia
- Analytical Engine Programming Cards
- And
- Andrei Machine 9000
- Andromeda
- Anemone
- ANGL
- Anguish
- Animosian
- ANItka
- AnnieFlow
- Annihilator
- brainbool
- Braincells
- BrainClub
- Braincopter
- BrainCurry
- BrainCurses
- Braindumbed
- Brainfact
- brainfault
- BrainfisHQ9+
- Brain-Flak
- Brainflop
- Brainfoctal
- Brainfork
- brainfuckconsole74
- brainfuck
- Brainfuck++
- Brainfuck+10
- Brainfuck+3
- Brainfuck--
- brainfuck 4 humans
- Brainfuck Assembly Language
- Brainfuck But With Buffer
- Brainfuck Encoded Concatenative Calculus
- BrainFuckFart
- Brainfuckn't
- Brainfuck Substitutor
- BrainfuckXT
- Brainfuck/w/index.php?title=Talk:Brainfuck/in
- BrainFuck+
- BrainFuck++
- brainfunc
- brainfunct
- BrainFunge2
- Braingolf

Stack-based Programming

- very simple to implement, most esolangs are stack-based
- uses a stack of values, and performs operations on the values
- Typically does not have memory you can read/write to

```
y = 7
x = 2 + 3
```



+

2

3

7

EXECUTE

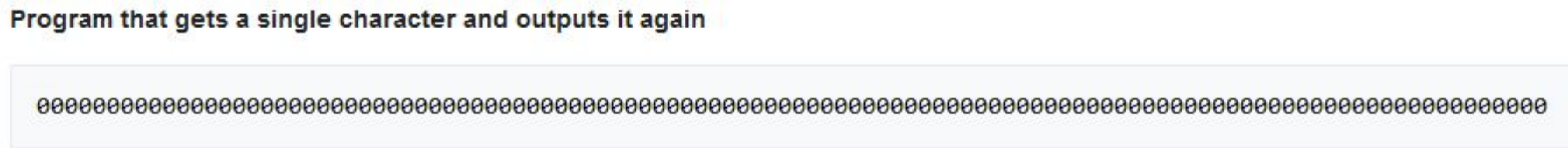
5

7

Esolang Examples

Unary

“According to the specification, Unary uses only one symbol.”



Program that gets a single character and outputs it again

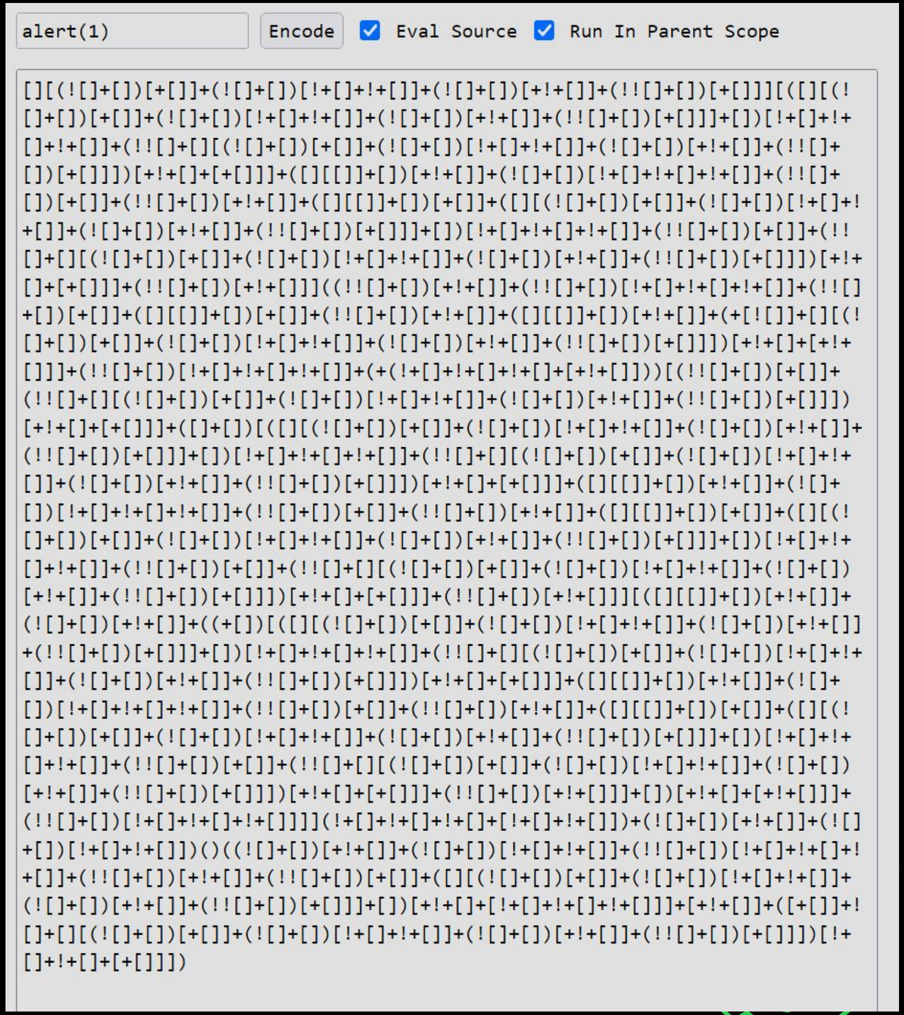
```
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
```

- no excuses for not programming even with broken keyboards
  - interpret each mouse click as a character
  - why aren’t you a 1000x dev yet 🤔

Hello, World has 142,209,095,870,573,693,396,245,504,627,320,468,349,603,549,841,832,242,891,887,476,756 zeroes

JS Fuck

- Esoteric subset of JS
- Common way to obfuscate web / JS challenges
- Uses only 6 characters ([ ] ( ) ! +)
- Abuses JS features like true + true = 2, and extract letters from “true”, “false”, etc
- jsfuck.com



```
[][(![]+[])[+[]]+(![]+[])[!+[]+!+[]]+(![]+[])[+!+[]]+(!![]+[])[+[]]][([][(!
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[]+[][(![]+[])[+[]]+(![]+[])[!+[]+!+[]]+(![]+[])[+!+[]]+(!![]+[])[+[]]])[!+
[]+!+[]+[+[]]])
```
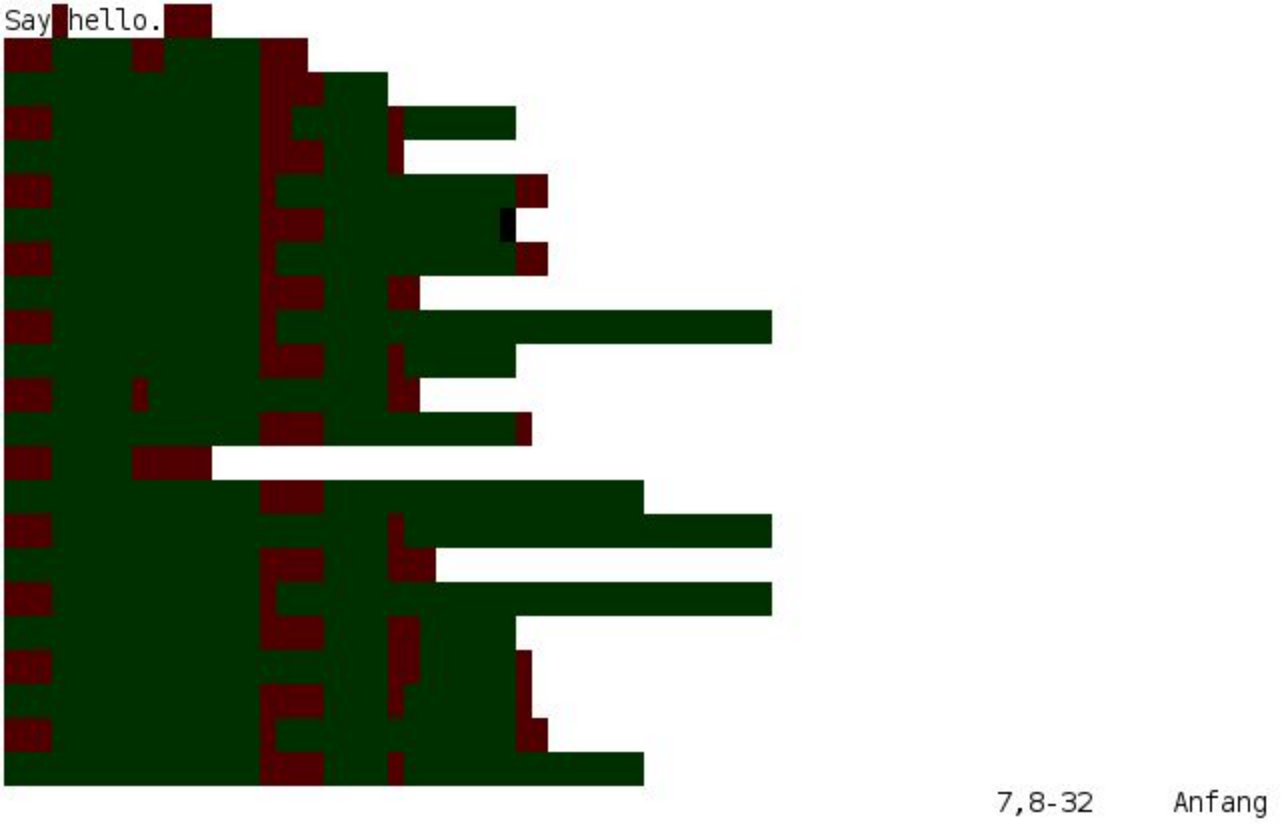

Whitespace

- Each whitespace character (space, tab, linefeed) is a different operator
- Common CTF language
- Stack-Based
- e.g. [Space] = PUSH

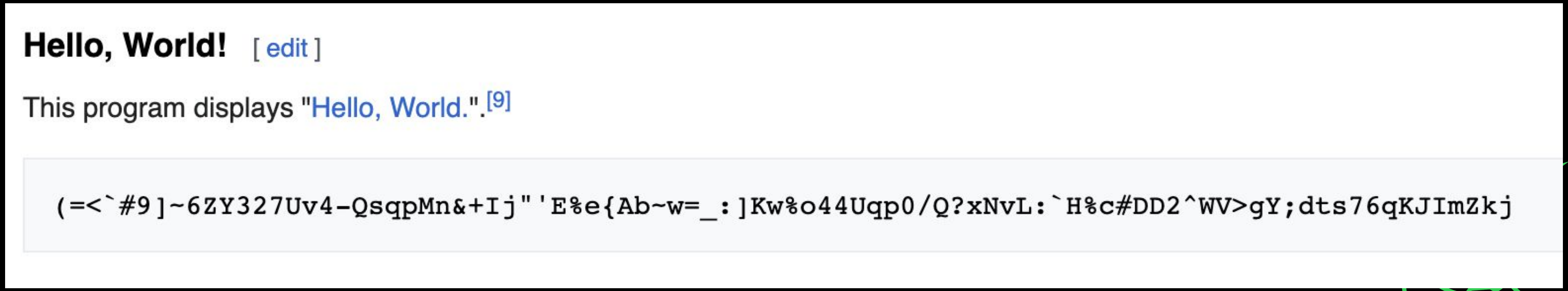


```
Say hello.
```

```
7,8-32        Anfang
```

Malbolge

- Designed to be impossible (or at least very hard) to program
- First program written by **brute-forcing** a set of constraints (article)
- After each instruction, runs the “Crazy operation”
  - Completely changes the instruction set based on what instruction was just ran



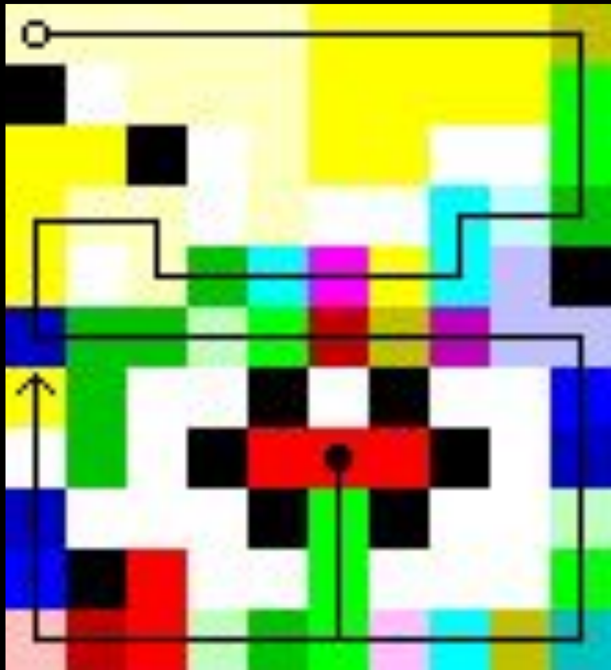
Hello, World! [edit]

This program displays "Hello, World.".[9]

```
(=<`#9]~6ZY327Uv4-QsqpMn&+Ij"'E%e{Ab~w=_:]Kw%o44Uqp0/Q?xNvL:`H%c#DD2^WV>gY;dts76qKJImZkj
```

Piet

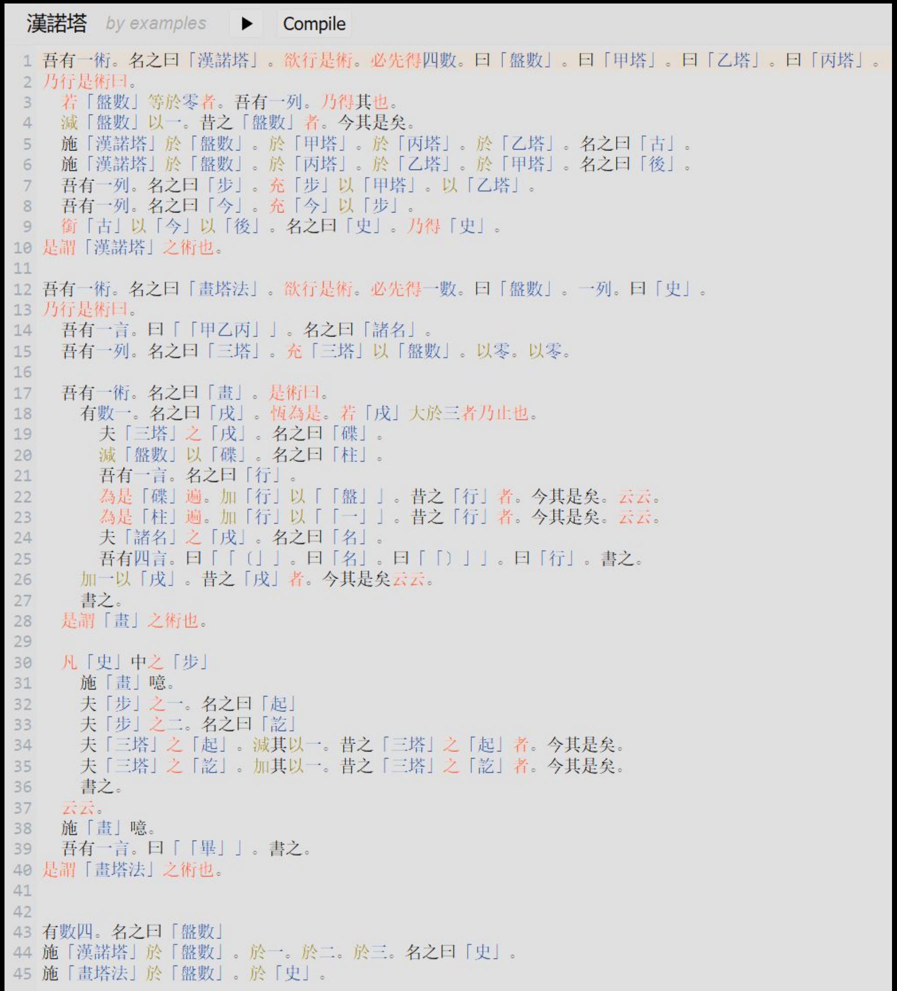
- 2D stack-based programming language
- Pixel difference correlates to opcode (which operation is run)
- Ran a challenge for UIUCTF 2022 in Piet
    - Challenge: automate reverse-engineering piet programs
    - Solution: trace execution, and reverse program from execution



Wenyan-lang 文言

- The alphabet of wenyan contains only traditional Chinese characters and 「」 quotes. (Yes, even numbers and operators.)
- Wenyan is javascript-based, but can be cross-translated into Ruby and Python. It also has an online IDE with crazy examples.
- Go do my Ancient Scroll of Wisdom challenge!

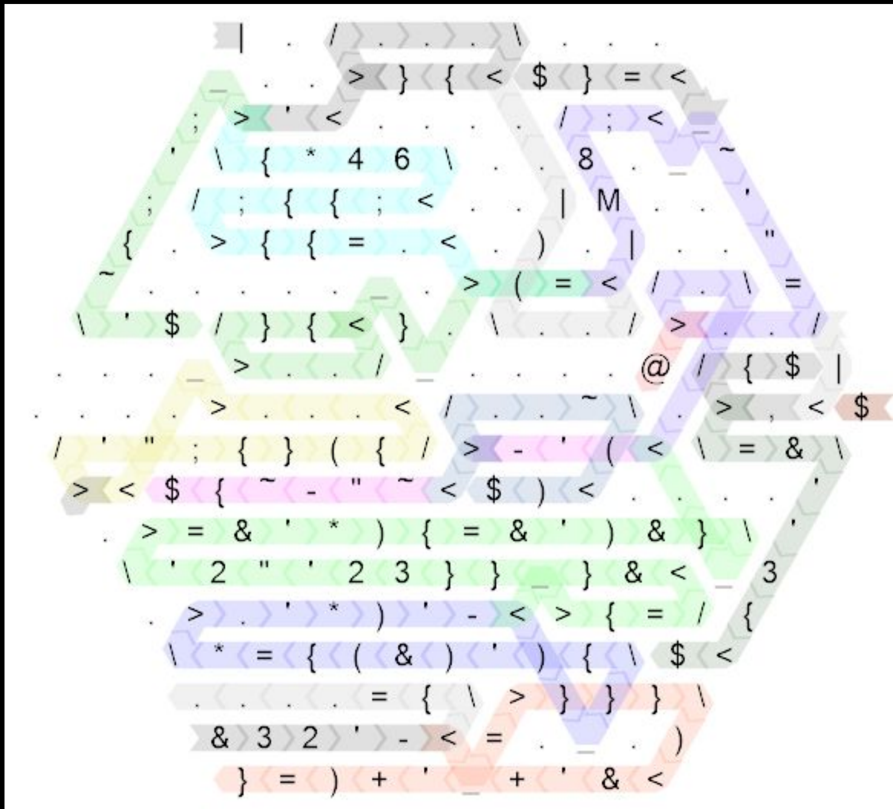
Tower of Hanoi Example



```
吾有一術。名之曰「漢諾塔」。欲行是術。必先得四數。曰「盤數」。曰「甲塔」。曰「乙塔」。曰「丙塔」。
乃行是術曰。
  若「盤數」等於零者。吾有一列。乃得其也。
  減「盤數」以一。昔之「盤數」者。今其是矣。
  施「漢諾塔」於「盤數」。於「甲塔」。於「丙塔」。於「乙塔」。名之曰「古」。
  施「漢諾塔」於「盤數」。於「丙塔」。於「乙塔」。於「甲塔」。名之曰「後」。
  吾有一列。名之曰「步」。充「步」以「甲塔」。以「乙塔」。
  吾有一列。名之曰「今」。充「今」以「步」。
  銜「古」以「今」以「後」。名之曰「史」。乃得「史」。
是謂「漢諾塔」之術也。

吾有一術。名之曰「畫塔法」。欲行是術。必先得一數。曰「盤數」。一列。曰「史」。
乃行是術曰。
  吾有一言。曰「「甲乙丙」」。名之曰「諸名」。
  吾有一列。名之曰「三塔」。充「三塔」以「盤數」。以零。以零。

  吾有一術。名之曰「畫」。是術曰。
    有數一。名之曰「戌」。恆為是。若「戌」大於三者乃止也。
      夫「三塔」之「戌」。名之曰「碟」。
      減「盤數」以「碟」。名之曰「柱」。
      吾有一言。名之曰「行」。
      為是「碟」遍。加「行」以「「盤」」。昔之「行」者。今其是矣。云云。
      為是「柱」遍。加「行」以「「一」」。昔之「行」者。今其是矣。云云。
      夫「諸名」之「戌」。名之曰「名」。
      吾有四言。曰「「（」」。曰「名」。曰「「）」」。曰「行」。書之。
    加一以「戌」。昔之「戌」者。今其是矣云云。
    書之。
  是謂「畫」之術也。

  凡「史」中之「步」
    施「畫」噫。
    夫「步」之一。名之曰「起」
    夫「步」之二。名之曰「訖」
    夫「三塔」之「起」。減其以一。昔之「三塔」之「起」者。今其是矣。
    夫「三塔」之「訖」。加其以一。昔之「三塔」之「訖」者。今其是矣。
    書之。
  云云。
  施「畫」噫。
  吾有一言。曰「「畢」」。書之。
是謂「畫塔法」之術也。


有數四。名之曰「盤數」
施「漢諾塔」於「盤數」。於一。於二。於三。名之曰「史」。
施「畫塔法」於「盤數」。於「史」。
```

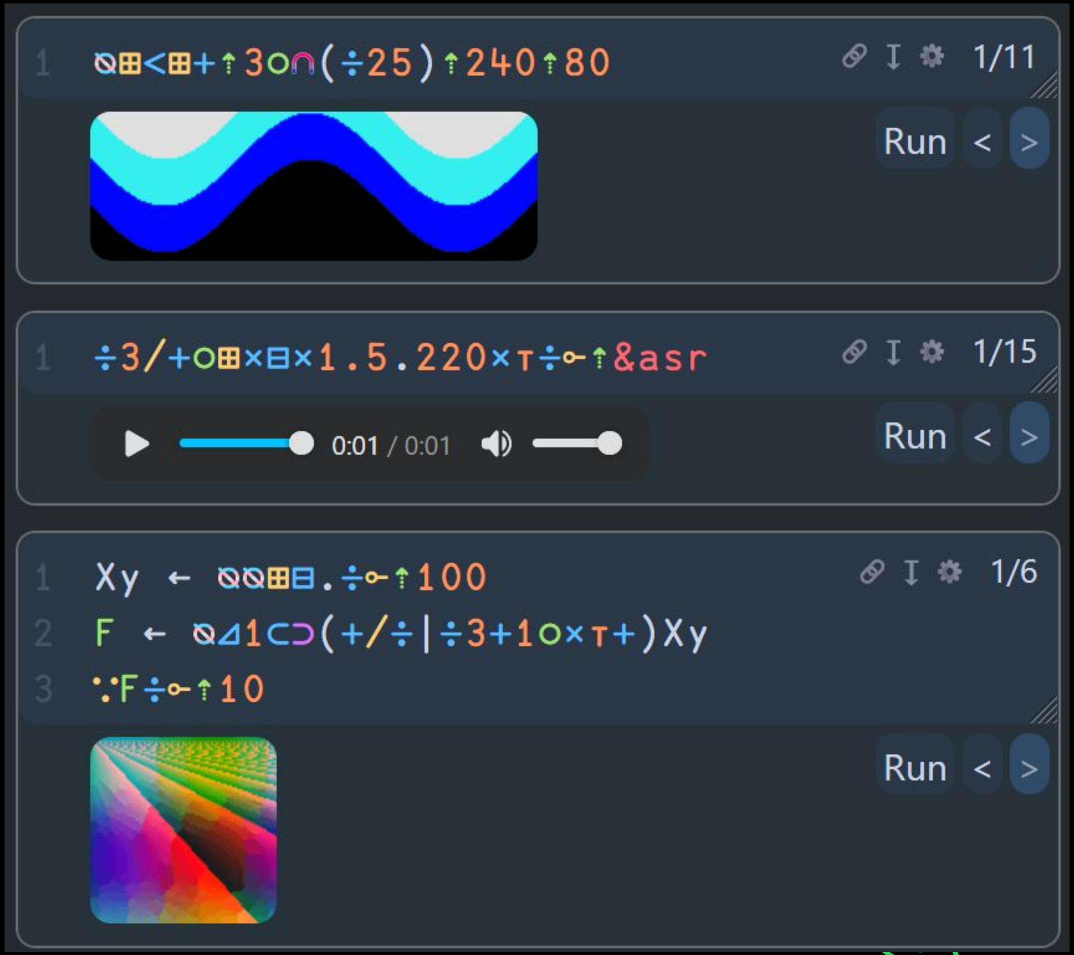
Hexagony

- 2d grid esolang
- code golfing writeup
- HexagonyColorer
- Online interpreter
- Look at these visuals!



Uiua

- a general purpose, stack-based, array-oriented programming language
- Uiua designates special glyphs for all the operations, and it’s generally all in one line.
- Code runs from right to left, top to bottom, with only one precedence rule.
- It does support many cool features though, like Multimedia output.



```
⍉⊞<⊞+⇡3○∩(÷25)⇡240⇡80
```

```
÷3/+○⊞×⊟×1.5.220×τ÷⟜⇡&asr
```

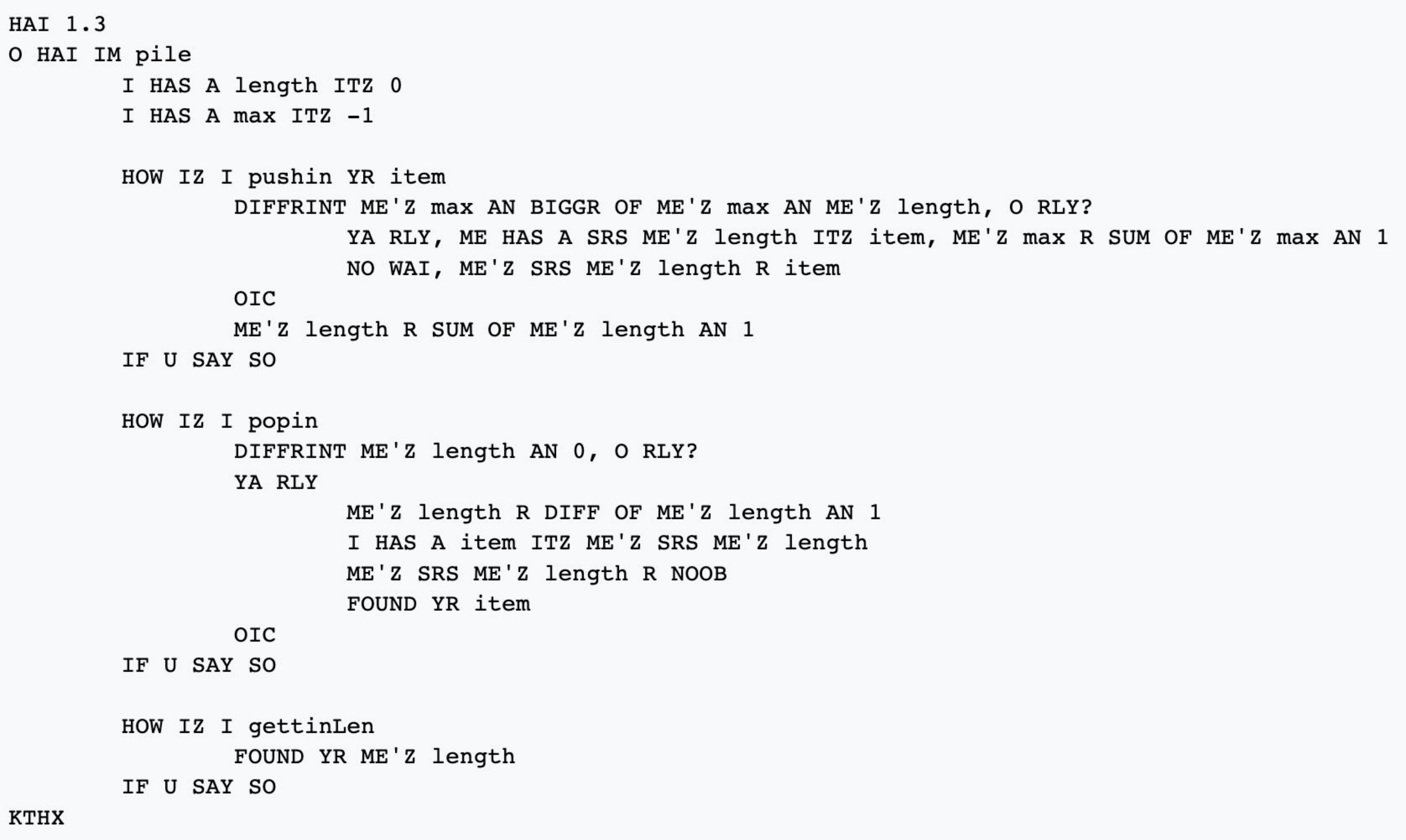
```
Xy ← ⍉⍉⊞⊟.÷⟜⇡100
F ← ⍉◿1⊂⊃(+/÷|÷3+1○×τ+)Xy
∵F÷⟜⇡10
```

Additional information

How to identify an esolang

- … Pretty hard!
- Google-fu or ChatGPT for series of operations in the code + “esolang”
- Use lists of esolangs online
- Use the list of popular languages on esolangs.org, or the esolangs.org IRC chat

Meeting Challenge - Identify This

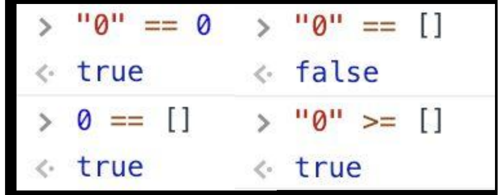


```
HAI 1.3
O HAI IM pile
        I HAS A length ITZ 0
        I HAS A max ITZ -1

        HOW IZ I pushin YR item
                DIFFRINT ME'Z max AN BIGGR OF ME'Z max AN ME'Z length, O RLY?
                        YA RLY, ME HAS A SRS ME'Z length ITZ item, ME'Z max R SUM OF ME'Z max AN 1
                        NO WAI, ME'Z SRS ME'Z length R item
                OIC
                ME'Z length R SUM OF ME'Z length AN 1
        IF U SAY SO

        HOW IZ I popin
                DIFFRINT ME'Z length AN 0, O RLY?
                YA RLY
                        ME'Z length R DIFF OF ME'Z length AN 1
                        I HAS A item ITZ ME'Z SRS ME'Z length
                        ME'Z SRS ME'Z length R NOOB
                        FOUND YR item
                OIC
        IF U SAY SO

        HOW IZ I gettinLen
                FOUND YR ME'Z length
        IF U SAY SO
KTHX
```

My interpretations of Esolang

Esoteric form (Looks like an esolang)

Uiua (Fancy alien-like script symbols, but can be very useful in certain applications)	Brainfuck (Looks complex but the operations are fairly simple to understand)	SQL (Declarative and domain-specific, unlike general-purpose languages)
Conway's Game of Life (Technically Turing complete am I right?)	Python Pickle (It's not just a serialization tool. It contains a Turing Complete stack-based VM)	C (Has a bunch of cursed features and functions, and can be as memory-unsafe as you want)

Human Civilization
(Collectively, humans have always been predictable. Maybe some Type 3 civilizations are using our society as computers to solve complex problems)
	PowerPoint and Excel
	(Yes, you can build Turing machines and even 16 bit computers in powerpoint and excel)
		Javascript
		
		`> "0" == 0`
		`< true`
		`> "0" == []`
		`< false`
		`> 0 == []`
		`< true`
		`> "0" >= []`
		`< true`

Esoteric behavior (Runs like an esolang)

What did we learn…

- Everything can be an esolang if you try hard enough

Next Meetings

`2024-03-18` • **Next Next Monday**

- SIGPwny x WiCyS Beginner Crypto CTF
- 5-7PM with prizes

`2024-03-21` • **Next Next Thursday**

- Block and Stream Ciphers with Sagnik

`2024-03-22` • **Next Next Friday**

- Tracer FIRE

ctf.sigpwny.com

sigpwny{+[>,.<]}

Meeting content can be found at sigpwny.com/meetings.

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