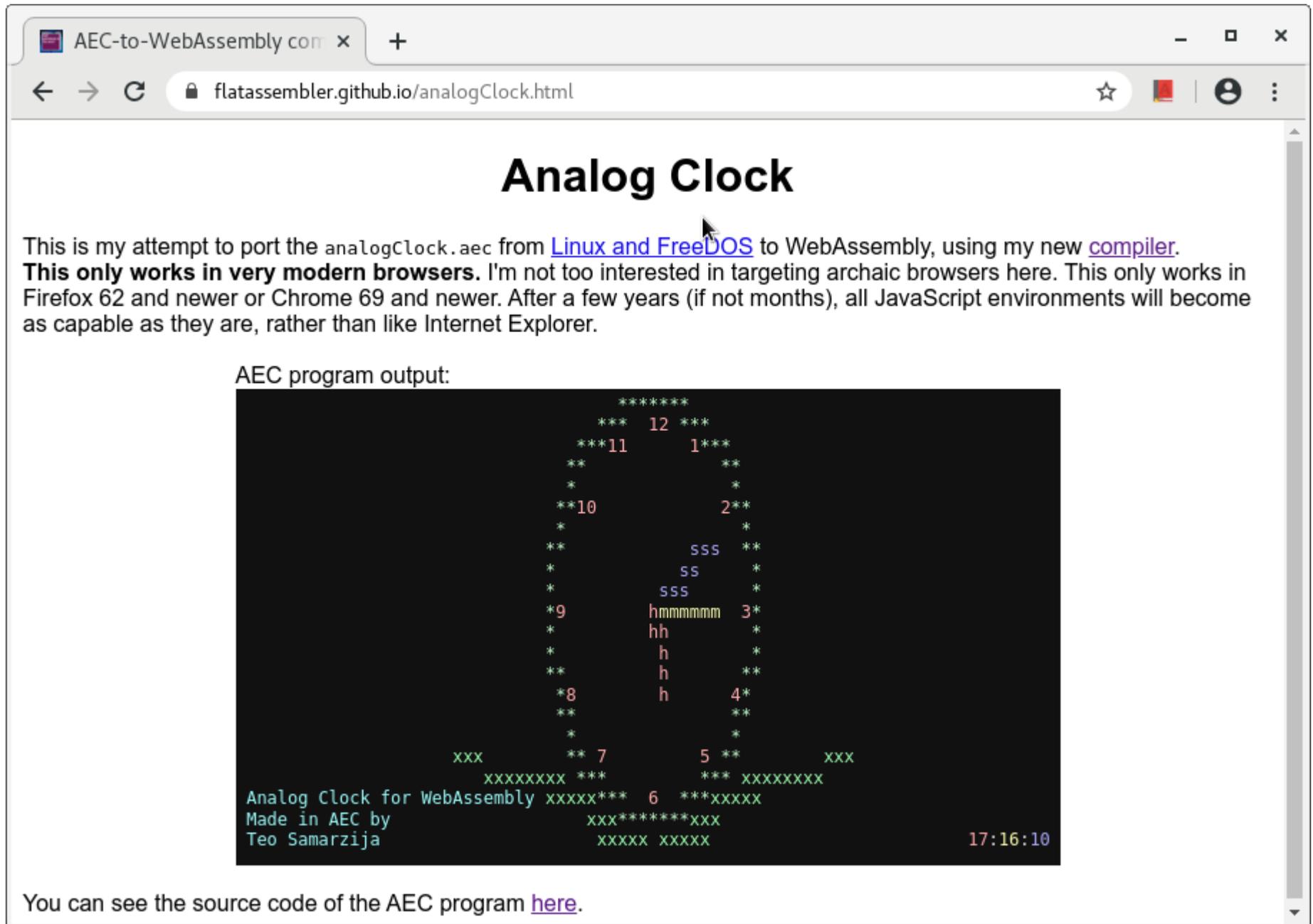


FERIT

# Basics of Compiler Theory

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# My experience with making compilers...



AEC-to-WebAssembly.com x +

flatassembler.github.io/analogClock.html

## Analog Clock

This is my attempt to port the `analogClock.aec` from [Linux and FreeDOS](#) to WebAssembly, using my new [compiler](#). **This only works in very modern browsers.** I'm not too interested in targeting archaic browsers here. This only works in Firefox 62 and newer or Chrome 69 and newer. After a few years (if not months), all JavaScript environments will become as capable as they are, rather than like Internet Explorer.

AEC program output:

```
*****
*** 12 ***
***11 1***
**          **
*          *
**10        2**
*          *
**          sss **
*          ss  *
*          sss *
*9         hhhhhh 3*
*         hh      *
*         h       *
**        h       **
*8        h       **
**        *       *
*         *       *
xxx       ** 7   5 **       xxx
xxxxxxx  ***   *** xxxxxxxx
Analog Clock for WebAssembly xxxxx*** 6 ***xxxxxx
Made in AEC by          xxxxxxxxxx
Teo Samarzija          xxxxx xxxxx          17:16:10
```

You can see the source code of the AEC program [here](#).

I have made two compilers for my programming language. One is targeting x86 and the other one targeting WebAssembly. 2 / 11

# Tokenizer

- A part (usually the first one) of the compiler that tells other parts of the compiler where one word in a programming language ends and where another begins.

```
sin(3.14*x+arccos(y)...
```

漢字（かんじ）は、中国古代の黄河文明で発祥した表語文字。

Non-tokenized code looks to a computer like Japanese writing looks to us.

# Lexical Analyzer

- What type of the word is each word.
- Necessary in programming languages such as C (`typedef` – usually considered a bug in the C programming language).

**Time flies like an arrow.**

Is *time* a noun or an adjective? Is *flies* a verb or a noun? Is *like* a verb or a conjunction?

# Parser

- Tells other parts of the compiler which word is connected to each word grammatically.
- Many frameworks that are supposed to make writing parsers easier: YACC, BISON...

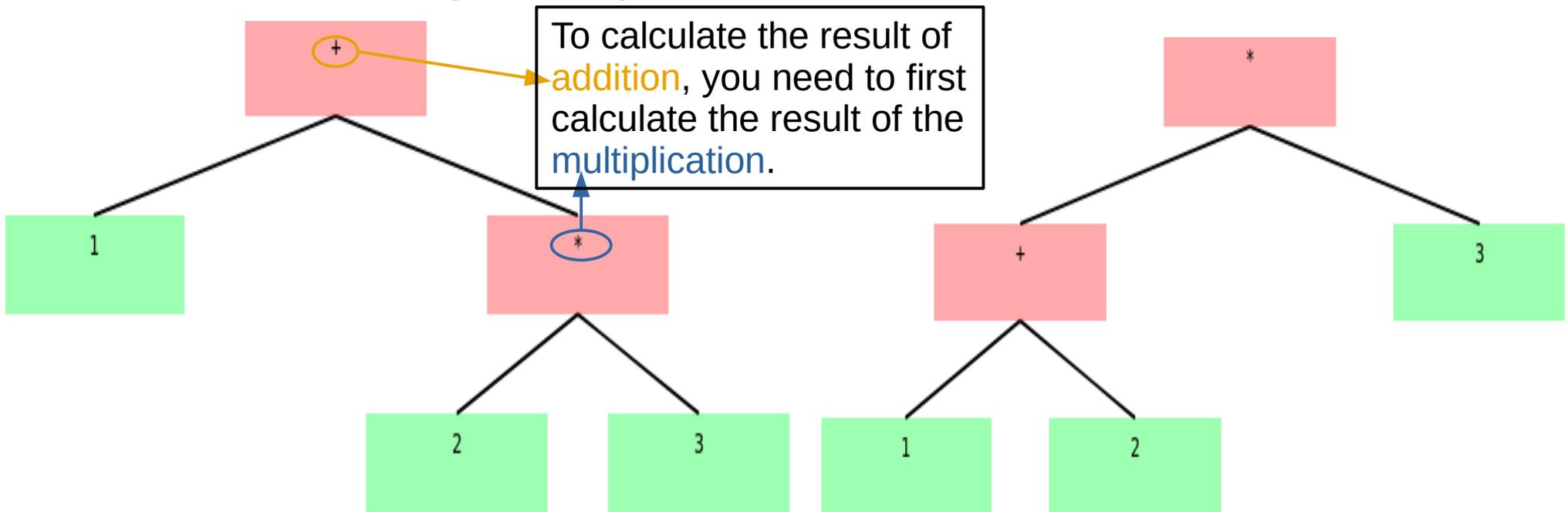
Ea, quae fertilissima totius Germaniae sunt, loca  
Graecis aliquibus nota fama esse loquuntur.

“known rumor” - wrong

“known places” - correct

# Abstract Syntax Tree

- A structure in the memory of the computer created by the parser.



Abstract syntax tree of  $1+2*3$

Abstract syntax tree of  $(1+2)*3$



# Semantic Analyzer

- Not all sentences that the parser accepts are syntactically correct. The same seems to be true for the parser of natural language in the human brain: *More people have been to Russia than I have.*
- Parser does not denote parts of the sentence (*types* in programming languages), that is the job of semantic analyzer.

# Compiler

- The word has two meanings:
  - (broad sense) A program that converts code written in one programming language to another programming language (usually machine code): GCC, CLANG, Visual Studio C++...
  - (strict sense) A subprogram that converts an abstract syntax tree into assembly code. Also called *code generator*. LLVM is a framework supposed to help with that.

# Assembly Code

- The machine code (ones and zeros that the computer understands) full of shortened forms (to be easier to read and write).
- Assembler – the program that replaces those contracted forms with ones and zeros.

**BTW, IMHO, U R taking it 2 serious.**

Assembly language reads to a computer similar to what this sentence reads to an English speaker unfamiliar with the Internet slang.

# Linker

- A file with raw machine code is not very useful to a computer.
  - How can the computer even know it is machine code, rather than image or a sound (also represented by ones and zeros)?
- Two types of linkers:
  - Dynamic linker – executable file only contains a part of the program, it calls external libraries assumed to be present in the operating system.
  - Static linker – executable file contains everything necessary for the program to run on some operating system.



Thank you for watching!