

L7A: Programming Language Processing

SWS3012: Structure and Interpretation of Computer Programs

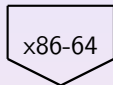
Martin Henz

July 11, 2023

- 1 T-Diagrams
- 2 Interpreters
- 3 Compilers
- 4 Combinations

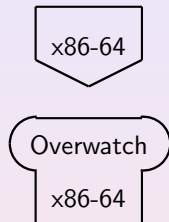
- 1 T-Diagrams
 - Program on PC
 - App on iPhone
- 2 Interpreters
- 3 Compilers
- 4 Combinations

T-Diagrams



x86-64 Processor

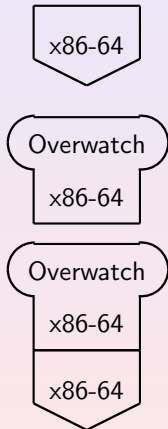
T-Diagrams



x86-64 Processor

Program “Overwatch” (x86-64 code)

T-Diagrams



x86-64 Processor

Program “Overwatch” (x86-64 code)

“Overwatch”
running on x86-64

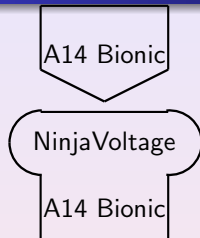
Running an app on iPhone 12



A14 Bionic

A14 Bionic, the processor of iPhone 12

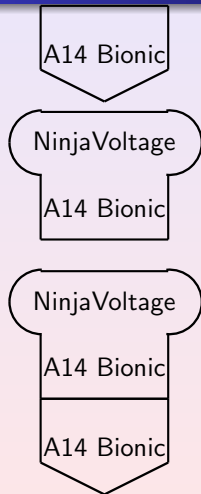
Running an app on iPhone 12



A14 Bionic, the processor of iPhone 12

Program “NinjaVoltage” (A11 build)

Running an app on iPhone 12



A14 Bionic, the processor of iPhone 12

Program “NinjaVoltage” (A11 build)

“NinjaVoltage”
running on
A14 Bionic

1 T-Diagrams

2 Interpreters

- T-Diagram of interpreter
- Chrome as interpreter
- Elixir interpreter
- Hardware emulation
- Stepper as interpreter

3 Compilers

4 Combinations

Interpreter

- Interpreter is program that executes another program

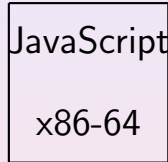
Interpreter

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- The interpreter's *source language* is the language in which the interpreter is written

Interpreter

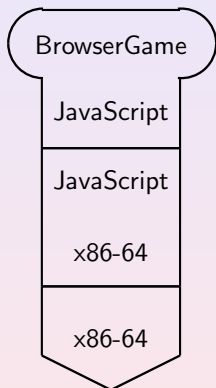
- Interpreter is program that executes another program
- The interpreter's *source language* is the language in which the interpreter is written
- The interpreter's *target language* is the language in which the programs are written which the interpreter can execute

Interpreters



Chrome browser for PC,
seen as interpreter for JavaScript,
written in x86-64 machine code

“Normal” Way of Running JavaScript on Chrome



The browser acts as
an interpreter for JavaScript.

Another example: Elixir



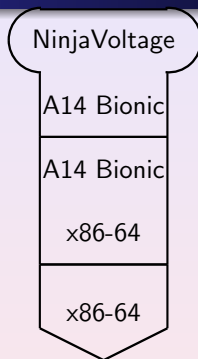
Interpreter for Elixir,
written in x86-64 machine code

Running Elixir on Server



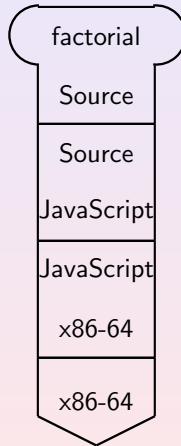
Elixir program “assessment”
running on x86-64
using interpretation

Hardware Emulation



“NinjaVoltage” app
running on a PC
using hardware emulator

Running Source §2 in Source Academy using Stepper



Source Academy stepper:
layer between your programs
and Chrome's native JavaScript

1 T-Diagrams

2 Interpreters

3 Compilers

- T-Diagram of compiler
- Compiling Source Academy
- Compiling a compiler
- Compiling an interpreter

4 Combinations

Compilers

Definition

A compiler is a program that translates from one language (the *from-language*) to another language (the *to-language*).

Compilers

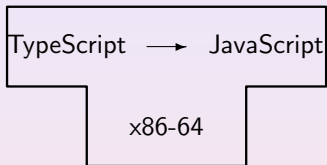
Definition

A compiler is a program that translates from one language (the *from-language*) to another language (the *to-language*).

Teaser for Lecture L12C

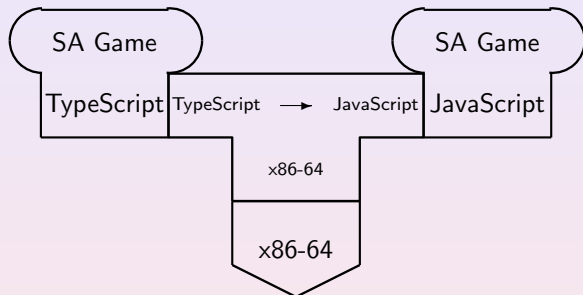
A compiler, which translates programs from one language to another, is just another program.
("Second most fundamental idea in programming")

T-Diagram of Compiler



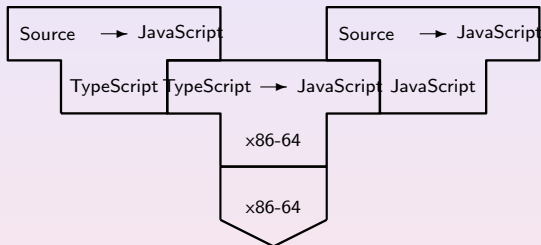
TypeScript-to-JavaScript compiler
written in x86-64 machine code

Compiling a program (SA Game of Source Academy)



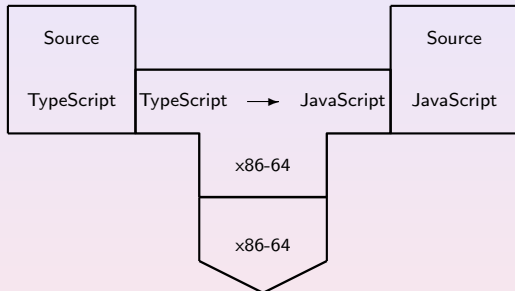
Compiling "SA Game"
from TypeScript to JavaScript

Compiling our Source Compiler



Compiling
Source-to-JavaScript compiler
from TypeScript to JavaScript

Compiling the Stepper



Compiling stepper tool
from TypeScript to JavaScript

1 T-Diagrams

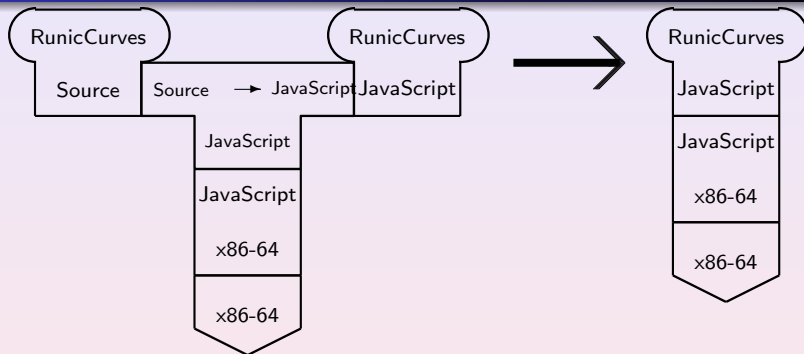
2 Interpreters

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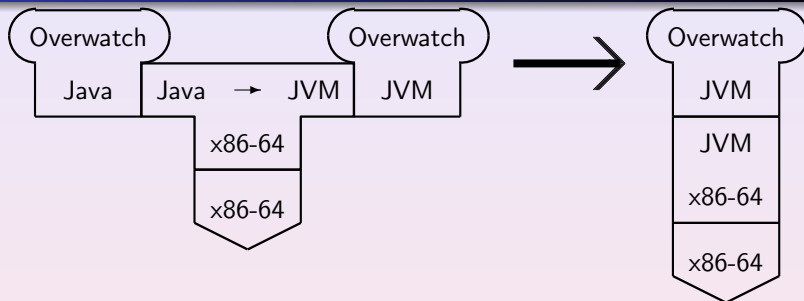
- Typical Source Academy session
- Typical execution of JavaScript
- Excursion: making these slides
- Excursion: SICP JS textbook

A typical Source Academy session



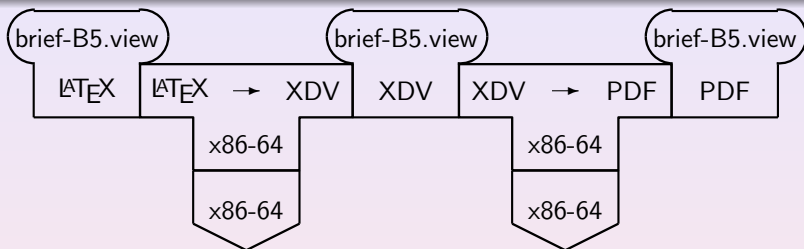
Compiling “RunicCurves” from Source to JavaScript in browser, and then running JavaScript program in browser.

Typical Execution of Java Programs



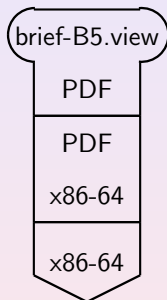
Compiling “Overwatch” from
Java to JVM code, and running
the JVM code on a JVM
running on an x86-64

Excursion: Making these Slides



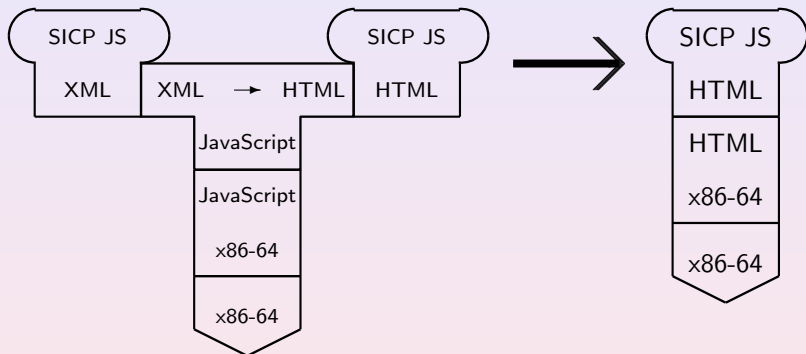
Compiling these slides
using the XeTeX *tool chain*
from \LaTeX to XDV
to PDF on x86-64

Excursion: Viewing these Slides with Acrobat Reader



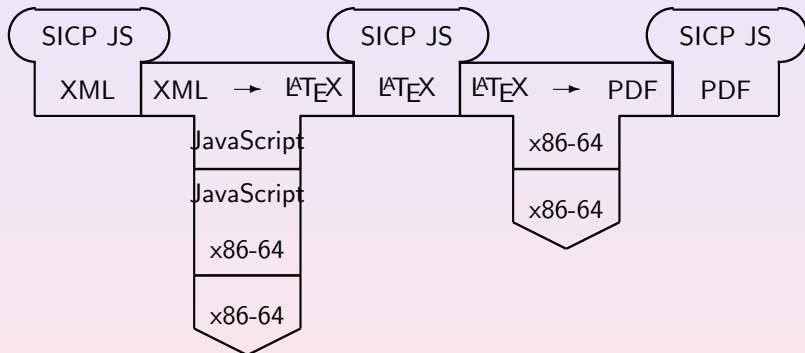
Viewing the slides on a PC

Excursion: Web edition of SICP JS



Compiling SICP JS textbook
from XML to HTML, then
Viewing textbook with browser

Excursion: PDF edition of SICP JS



Compiling SICP JS
from XML to PDF via L^AT_EX

Summary

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- Components:
programs, compilers, interpreters, machines

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compilation (tool chains) are common

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- Components:
programs, compilers, interpreters, machines
- T-diagrams
- Combination of interpretation and compilation (tool chains) are common
- Source Academy is making use of
Source interpreter and
Source-to-JavaScript compiler,
both written in TypeScript,
compiled to JavaScript,
and running on Chrome browser