Compiler Construction

Lecture 16

Bootstrapping

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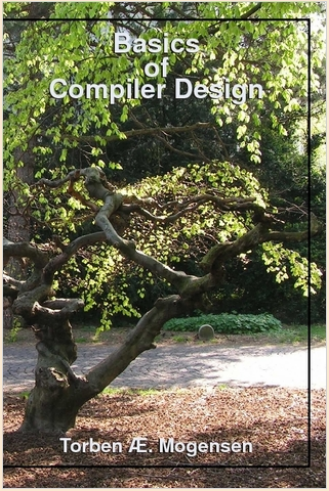
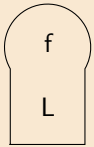
Recommended book



Chapter 13 of
Basics of Compiler Design
Torben Ægidius Mogensen
`http://hjemmesider.diku.dk/~torbenm/Basics/`

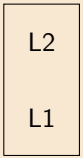
Notation

A program



Computes function f written in language L

An interpreter

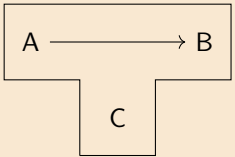


Interprets language L2 written in language L1

A machine

Executes code in language L

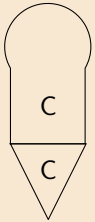
A compiler



Translates language A into language B
Written in language C

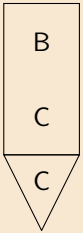
Examples

To execute a program



we run it on a machine

To execute an interpreter



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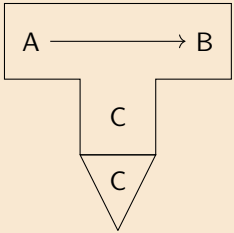
To execute a compiler



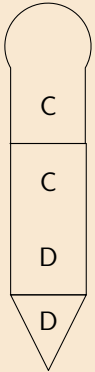
we run it on a machine

Interpreting a program

Run a program written in language C

on an interpreter for C written in language D

on a D machine

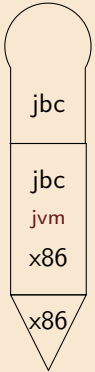


(Note: the languages must match)

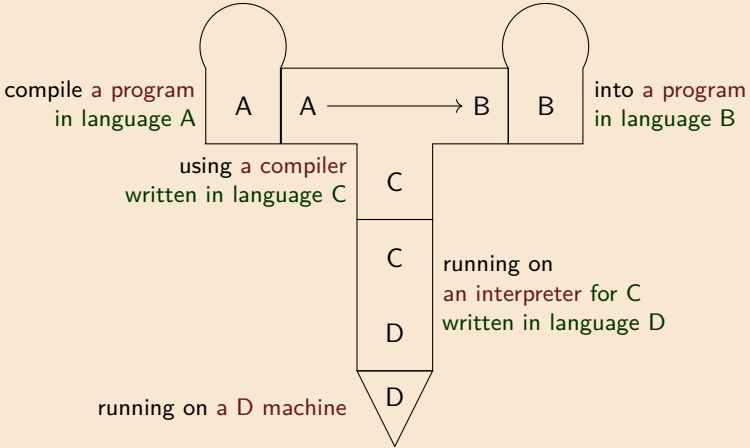
Run a program
written in Java byte code

on an interpreter for Java byte code
written in x86 code

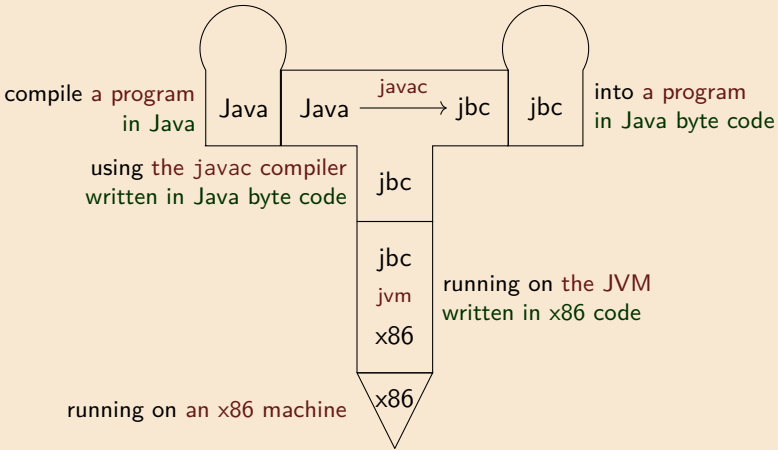
on a x86 machine



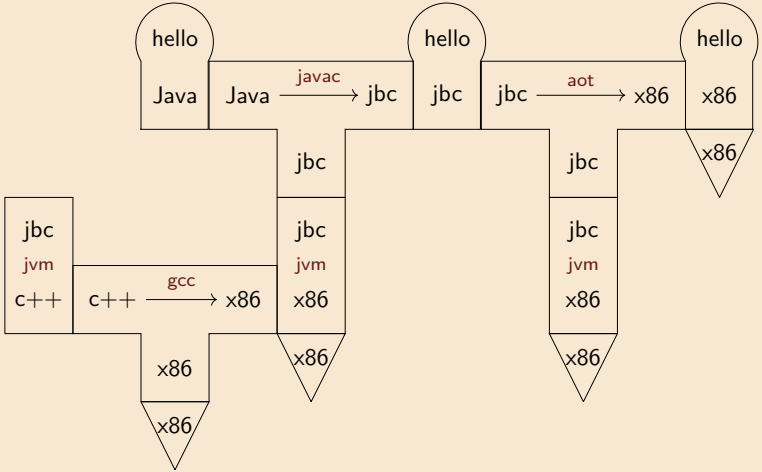
Running a compiler on an interpreter



Running javac on the JVM



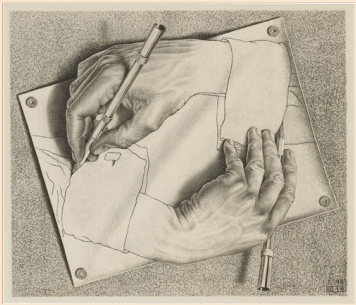
Ahead-of-time compilation for Java



Thanks to David Greaves for the example

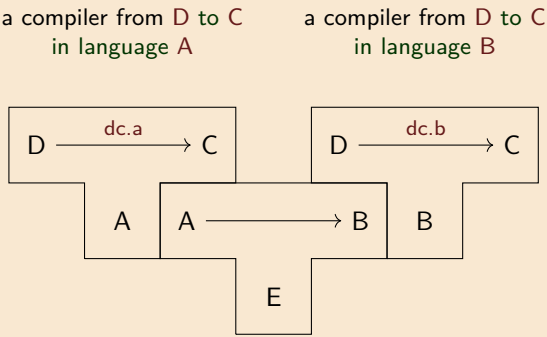
Compiling compilers

The OCaml compiler
is written in OCaml



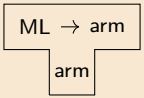
Puzzle: how was the compiler compiled?

Compilers can be translated, just like any other program:



Porting a compiler to a new platform

We have:
a compiler from ML to arm
that runs on arm



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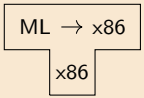

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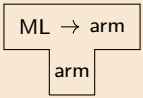

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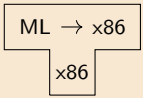
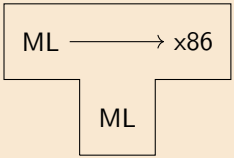


1. write an ML-to-x86 compiler in ML



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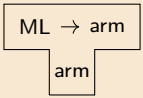

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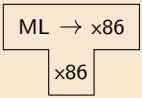
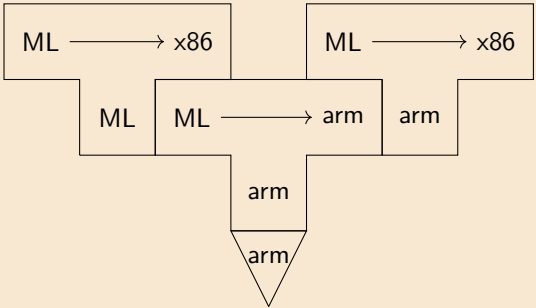


1. write an ML-to-x86 compiler in ML
2. compile the compiler for arm



Porting a compiler to a new platform

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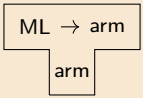

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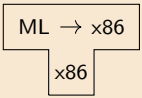
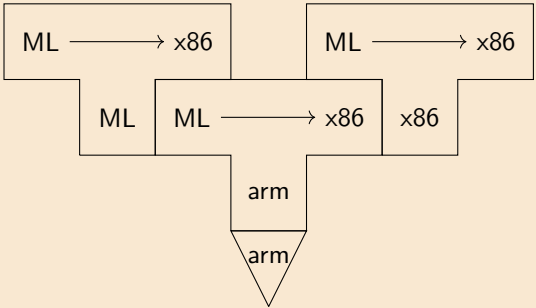


1. write an ML-to-x86 compiler in ML
2. compile the compiler for arm
3. run the compiler on arm to compile itself

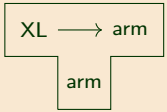


Full bootstrap

Previous example: *half bootstrap* (needs existing compiler for the language).

New example: *full bootstrap* (no existing ML compiler for the language)

We want:
a compiler from **XL** to arm
that runs on arm



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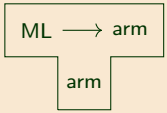

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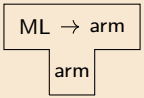

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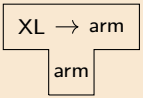

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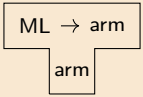

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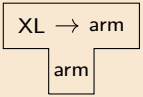
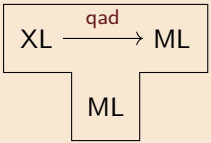


1. write a quick-and-dirty (QAD) **XL-to-ML** compiler in ML



Full bootstrap

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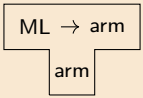

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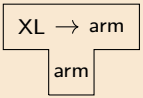
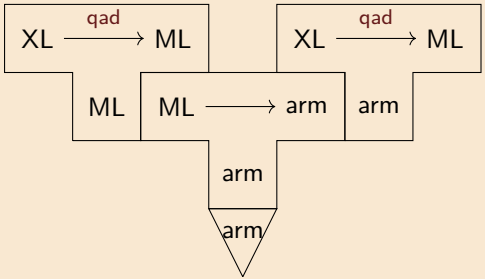


1. write a quick-and-dirty (QAD) **XL-to-ML** compiler in ML

2. compile the QAD compiler for arm



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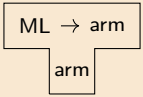

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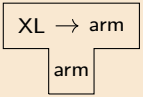
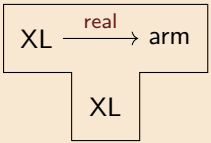


1. write a quick-and-dirty (QAD) **XL-to-ML** compiler in ML
2. compile the QAD compiler for arm
3. Write a real **XL-to-arm** compiler in **XL**



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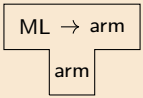

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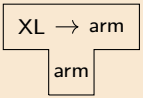
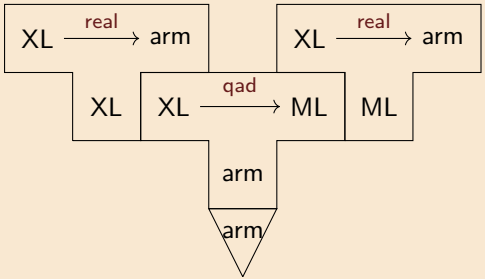


1. write a quick-and-dirty (QAD) **XL-to-ML** compiler in ML
2. compile the QAD compiler for arm
3. Write a real **XL-to-arm** compiler in **XL**
4. Use the QAD compiler to compile the real compiler to ML



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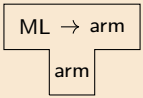

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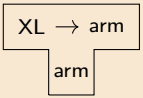
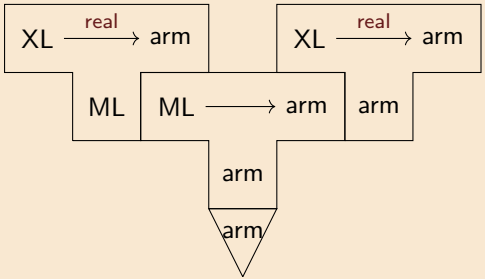


1. write a quick-and-dirty (QAD) **XL-to-ML** compiler in ML
2. compile the QAD compiler for arm
3. Write a real **XL-to-arm** compiler in **XL**
4. Use the QAD compiler to compile the real compiler to ML
5. Compile the resulting ML program to arm



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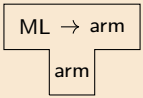

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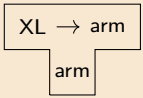

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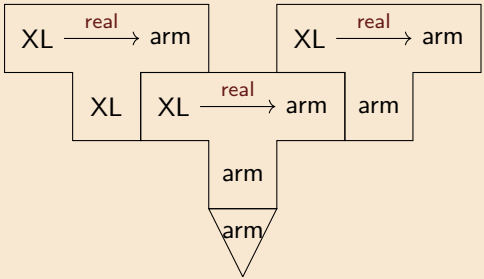
2. compile the QAD compiler for arm
3. Write a real **XL-to-arm** compiler in **XL**
4. Use the QAD compiler to compile the real compiler to ML
5. Compile the resulting ML program to arm
6. Use the generated compiler to compile itself



The *speed* of the quick-and-dirty compiler does not matter much
(We could even use a quick-and-dirty interpreter instead)

We don't need to give the quick-and-dirty compiler to users

Once the real compiler works,
we can discard the quick-and-dirty compiler altogether