Chapter 1

Introduction to Compilers

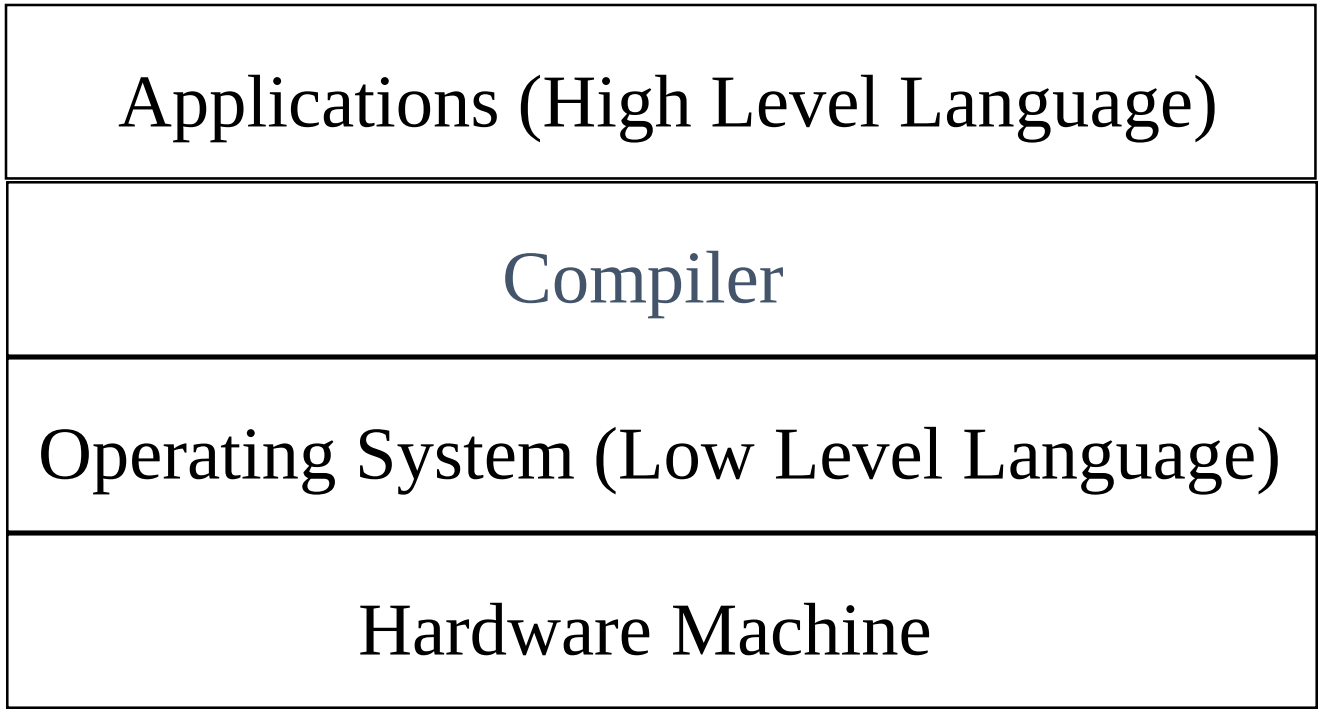
Outline of This Chapter

- ♥Introduction to compilers
- ♥Introduction to compiler generators
- ♥Introduction to automatic tool generators

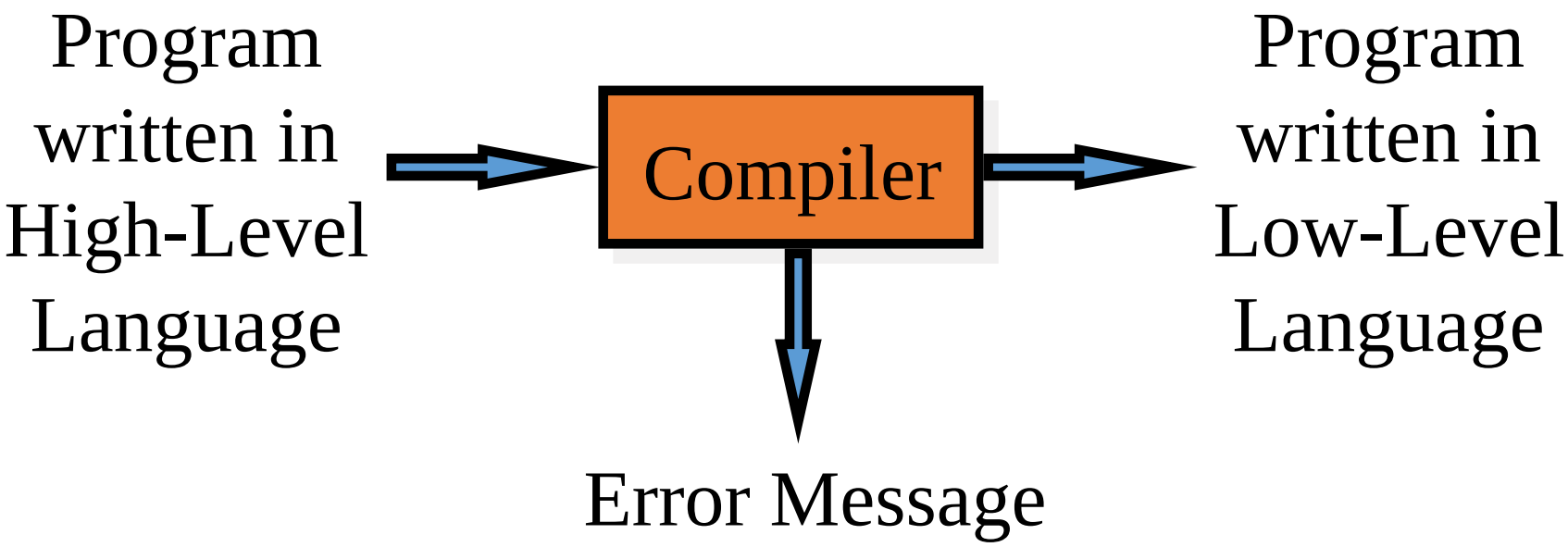
Programming Languages

- ♥Human uses human languages to communicate with each other
  - Chinese, English, French
- ♥Human uses programming languages to communicate with computers
  - Fortran, C, Java

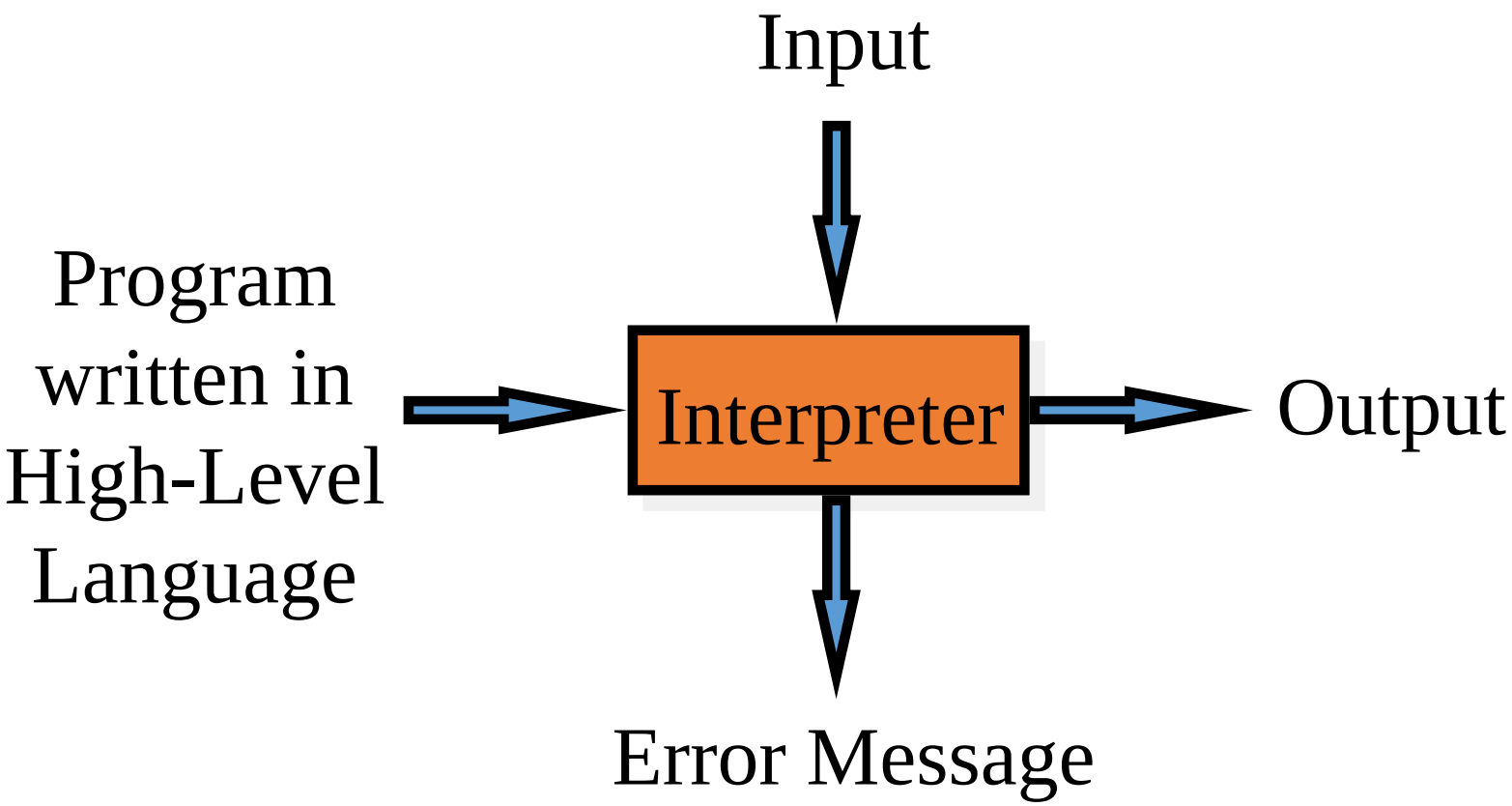
Computer Organization



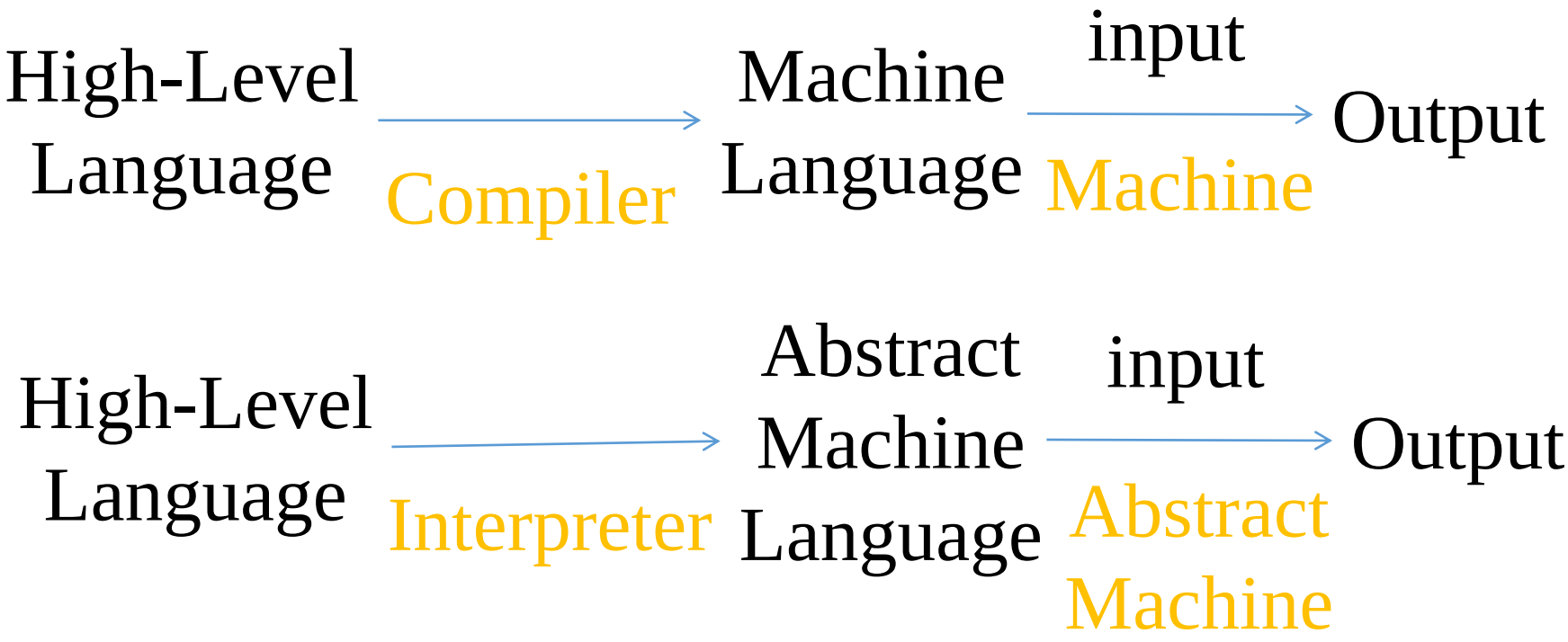
Compilers


Program written in High-Level Language
Compiler
Program written in Low-Level Language
Error Message

Interpreters



Compilers and Interpreters



Components of a Compiler

♥Analysis

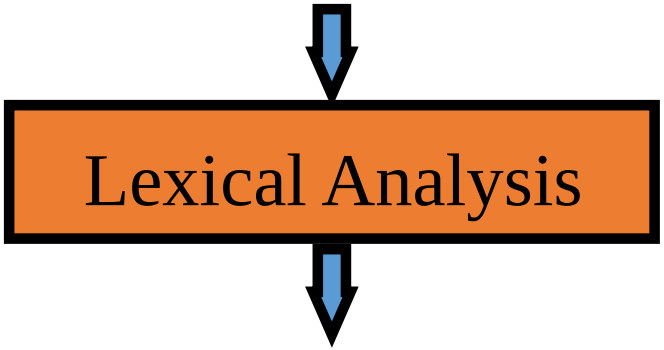
- Lexical Analysis
- Syntax Analysis
- Semantic Analysis

♥Synthesis

- Intermediate Code Generation
- Code Optimization
- Code Generation

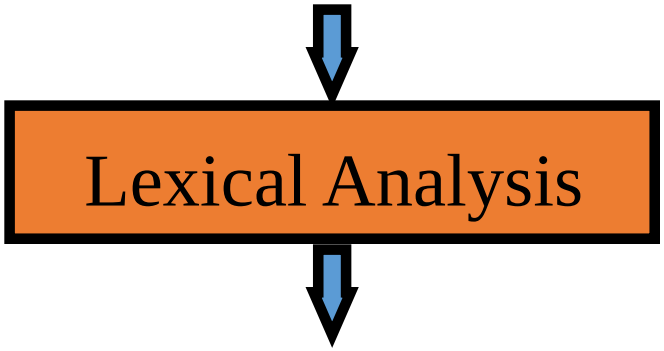
Lexical Analysis

S o m e o n e b r e a k s
t h e i c e



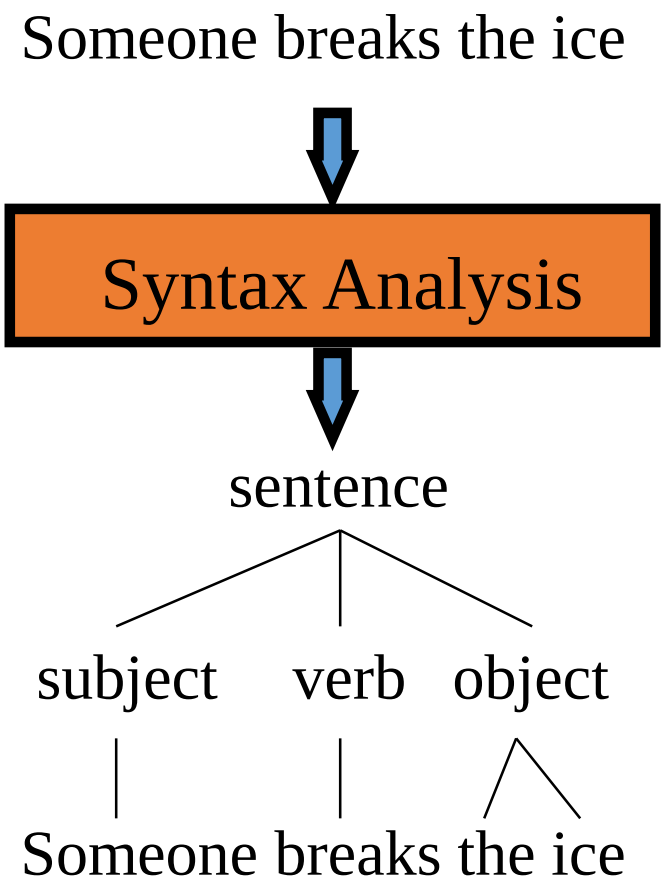
Someone breaks the ice

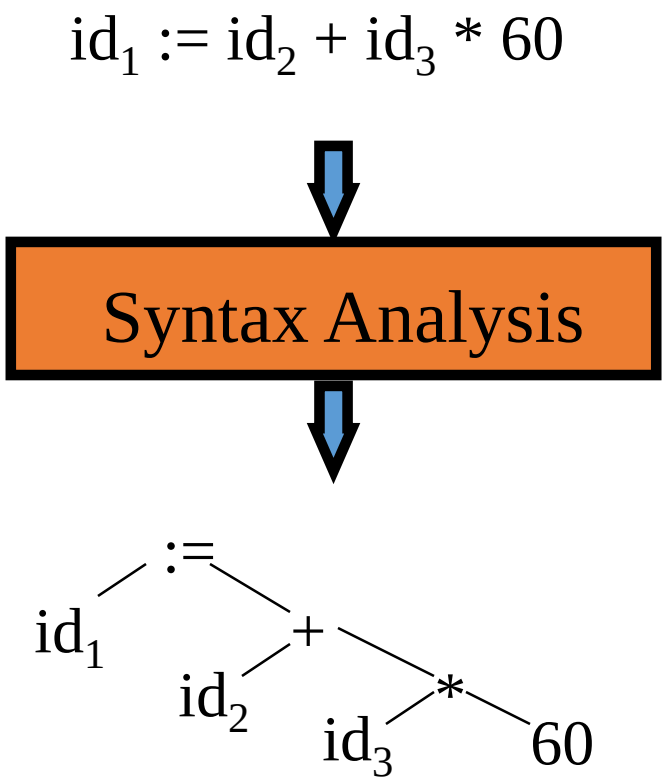
final := initial + rate * 60



$id_1 := id_2 + id_3 * 60$

Syntax Analysis

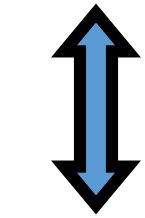




Semantic Analysis

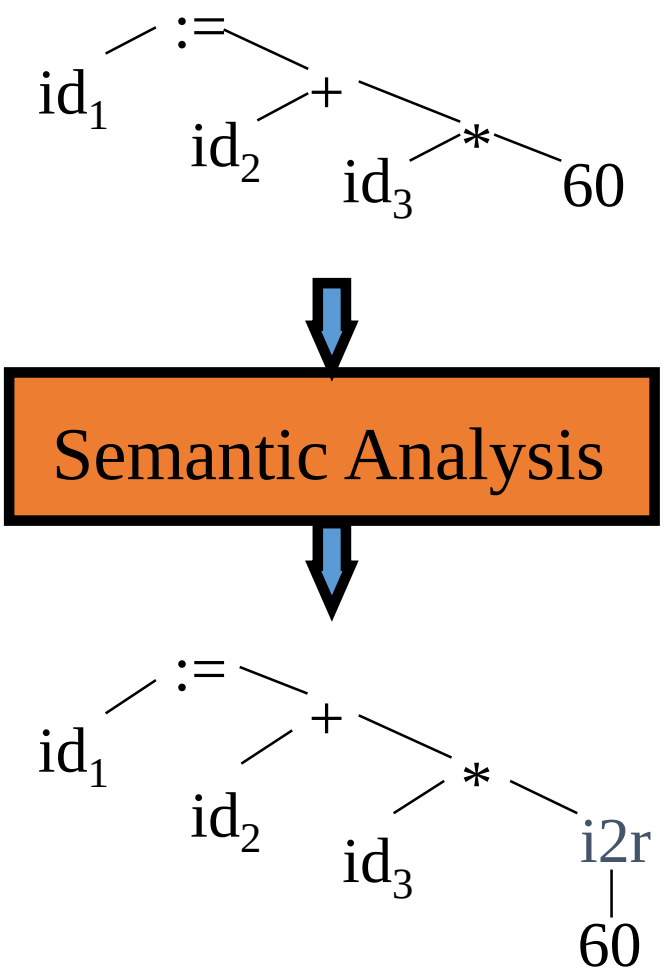
Someone plays the piano

(meaningful)



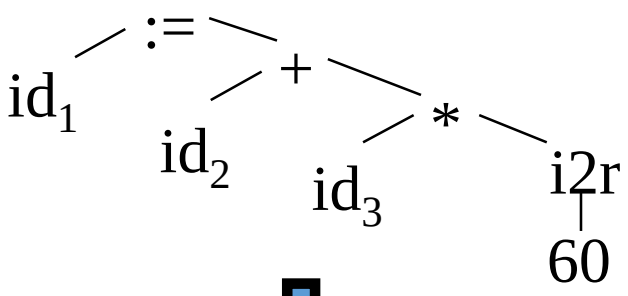
The piano plays someone

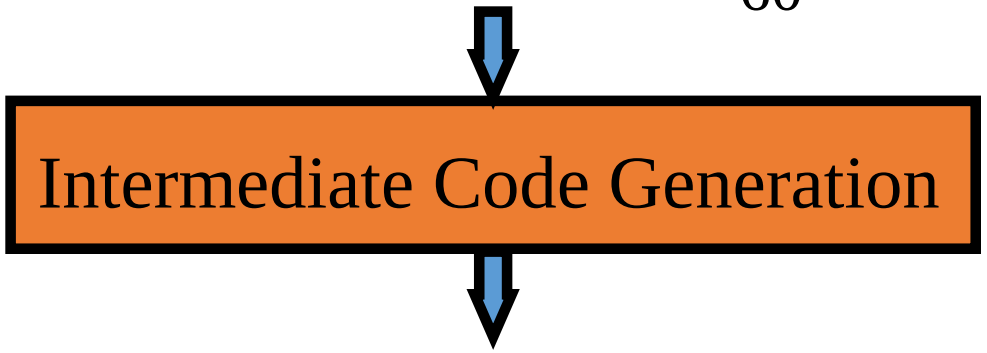
(meaningless)



Intermediate Code Generation

Someone breaks the ice

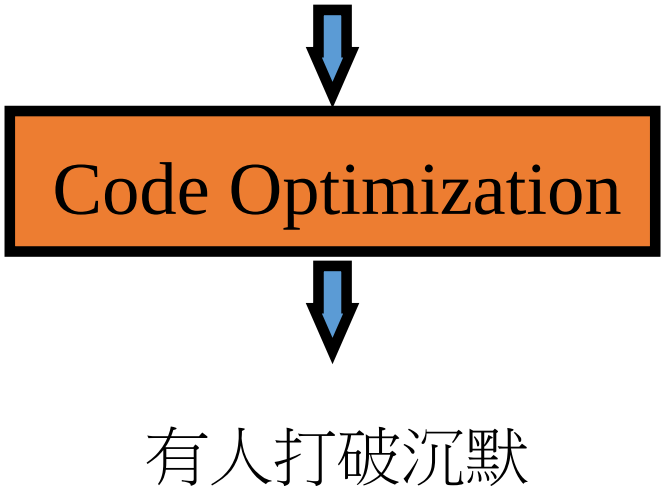


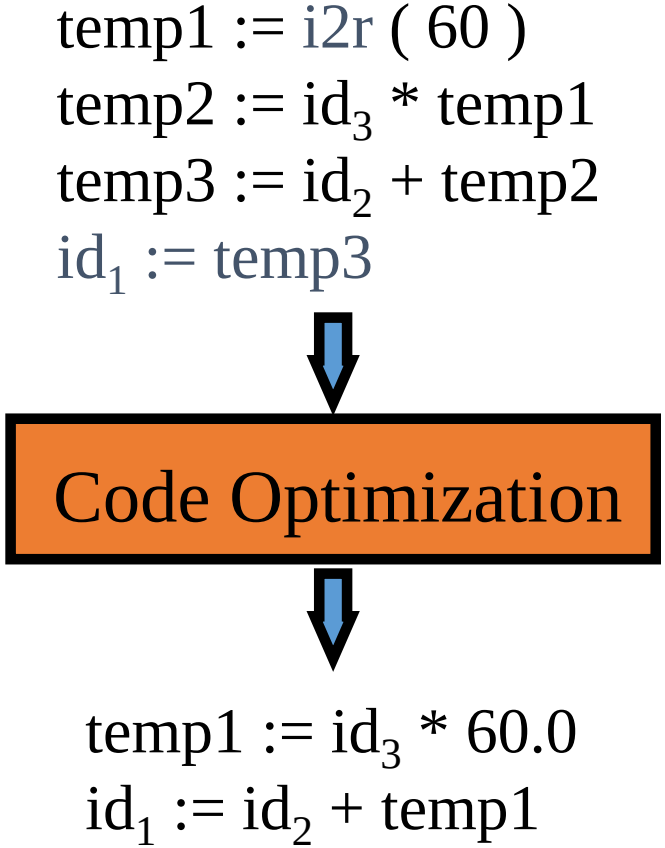


有人打破冰

temp1 := i2r (60)
temp2 := id_3 * temp1
temp3 := id_2 + temp2
id_1 := temp3

Code Optimization



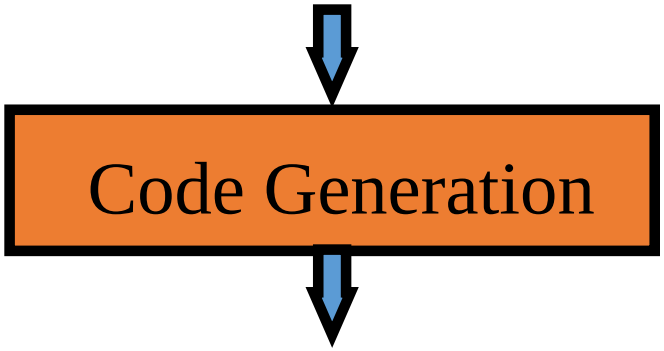


Code Generation

有人打破沉默

有人打破沉默

temp1 := id_3 * 60.0
id_1 := id_2 + temp1



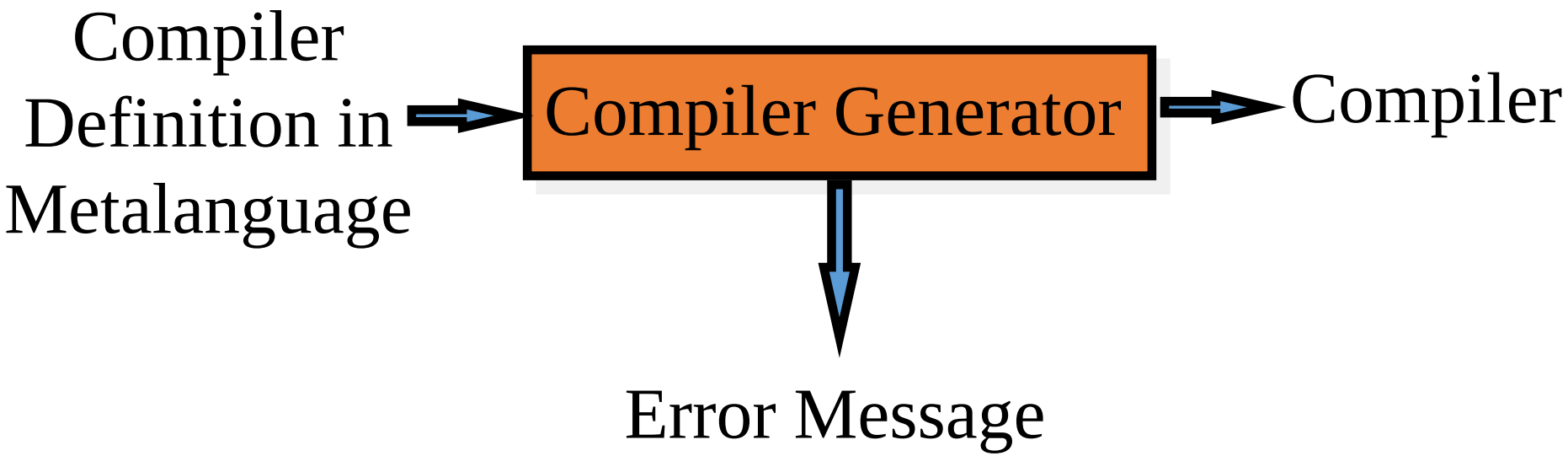

```
movf    id3,   r2
mulf    #60.0, r2
movf    id2,   r1
addf    r2,    r1
movf    r1,    id1
```

Metalanguages

♥**Metalanguage**: *a language used to define another language*

We will use different *metalangauges* to define the various components of a programming language so that these components can be generated automatically

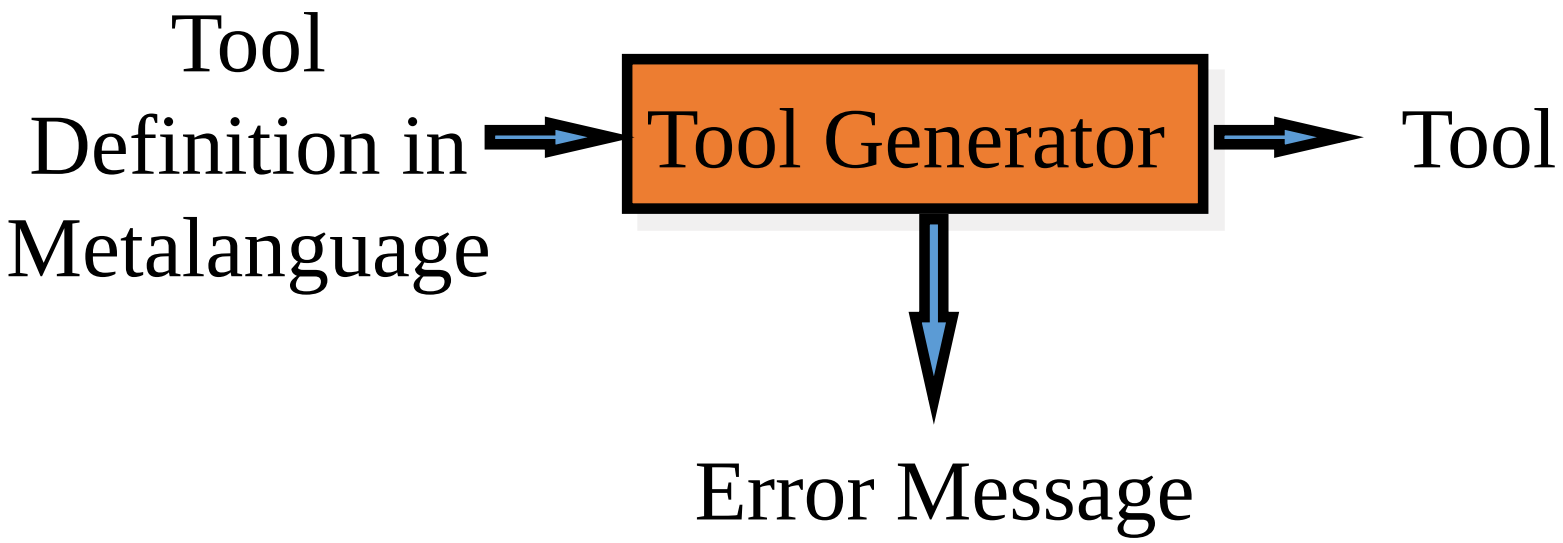
Compiler Generators



Definition of Programming Languages

- *Lexical analysis*: regular expressions
- *Syntax analysis*: context free grammars
- *Semantics analysis*: attribute grammars
- *Intermediate code generation*:
  attribute grammars
- *Code generation*: tree grammars

Automatic Tool Generators



Applications of Compilation Techniques

- ♥Web Browsers (HTML, XML, …)
- ♥Word Processors (postscript, pdf, …)
- ♥Computer-Aided Software Engineering (UML)
- ♥Computer-Aided Design (VHDL, Verilog, …)
- ♥Computer-Aided Manufacturing (APT, G-code)

Outline of This Course

- ♥Lexical analysis
- ♥Syntax analysis
- ♥Semantic analysis
- ♥Intermediate code generation
- ♥Code generation