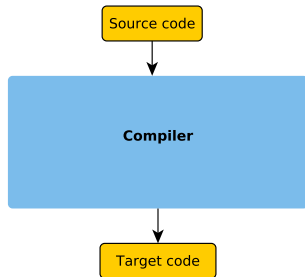


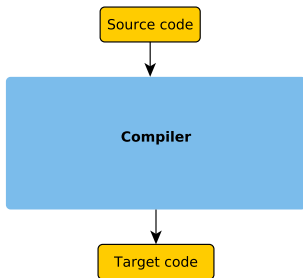
What are Formal Languages and Compilers?

Petr Zemek

Brno University of Technology, Faculty of Information Technology
Božetěchova 2, 612 00 Brno, CZ
<http://www.fit.vutbr.cz/~izemek>

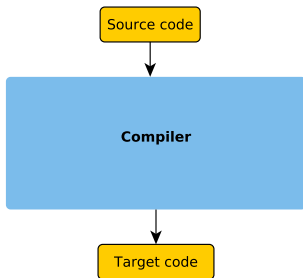




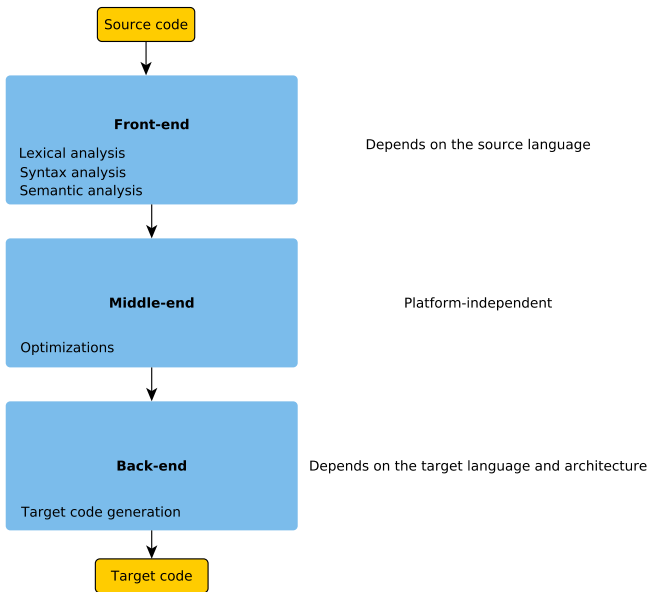


- Examples:

- gcc: `.c` file → binary executable file
- javac: `.java` file → `.class` file



- Examples:
 - gcc: `.c` file → binary executable file
 - javac: `.java` file → `.class` file
- typically high-level code → low-level code





- A **language** is a set of “legal” sentences.



- A **language** is a set of “legal” sentences.
- A **sentence** is a sequence of symbols.



- A **language** is a set of “legal” sentences.
- A **sentence** is a sequence of symbols.
- The **symbols** can be characters, words, punctuation, hieroglyphs, dots and dashes (Morse code), etc.



- A **language** is a set of “legal” sentences.
- A **sentence** is a sequence of symbols.
- The **symbols** can be characters, words, punctuation, hieroglyphs, dots and dashes (Morse code), etc.
- A **formal language** is a language defined by a finite set of unambiguous rules delimiting the legal sentences from the illegal ones.



- A **language** is a set of “legal” sentences.
- A **sentence** is a sequence of symbols.
- The **symbols** can be characters, words, punctuation, hieroglyphs, dots and dashes (Morse code), etc.
- A **formal language** is a language defined by a finite set of unambiguous rules delimiting the legal sentences from the illegal ones.

Example

Rules: $S \rightarrow aSb, S \rightarrow ab$

Starting symbol: S

Terminal symbols: a, b



- A **language** is a set of “legal” sentences.
- A **sentence** is a sequence of symbols.
- The **symbols** can be characters, words, punctuation, hieroglyphs, dots and dashes (Morse code), etc.
- A **formal language** is a language defined by a finite set of unambiguous rules delimiting the legal sentences from the illegal ones.

Example

Rules: $S \rightarrow aSb, S \rightarrow ab$

Starting symbol: S

Terminal symbols: a, b

The formal language: $\{a^n b^n : n \geq 1\}$



- A **language** is a set of “legal” sentences.
- A **sentence** is a sequence of symbols.
- The **symbols** can be characters, words, punctuation, hieroglyphs, dots and dashes (Morse code), etc.
- A **formal language** is a language defined by a finite set of unambiguous rules delimiting the legal sentences from the illegal ones.

Example

Rules: $S \rightarrow aSb, S \rightarrow ab$

Starting symbol: S

Terminal symbols: a, b

The formal language: $\{a^n b^n : n \geq 1\}$

- there are various models for describing formal languages



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)
- modeling and simulation of biological organisms (plant development)



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)
- modeling and simulation of biological organisms (plant development)
- molecular genetics



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)
- modeling and simulation of biological organisms (plant development)
- molecular genetics
- coding theory and cryptography



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)
- modeling and simulation of biological organisms (plant development)
- molecular genetics
- coding theory and cryptography
- natural language processing



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)
- modeling and simulation of biological organisms (plant development)
- molecular genetics
- coding theory and cryptography
- natural language processing
- design of embedded systems



Theoretical viewpoint:

- underly many areas of theoretical computer science (mathematical logic, complexity theory, automata theory, graph theory, etc.)
- provide **formal models** for describing formal languages

Practical viewpoint: they have applications in many areas, like

- description of programming languages, compilers
- computer-aided art (turtle graphics, fractals)
- modeling and simulation of biological organisms (plant development)
- molecular genetics
- coding theory and cryptography
- natural language processing
- design of embedded systems
- ... and many other application areas



- introduction to formal languages and compiler construction
- models for describing formal languages (grammars, automata)
- using these models in compiler construction
- studying properties of these models



- getting five credits :) oh yeah!



- getting five credits :) oh yeah!
- introduce you to formal languages



- getting five credits :) oh yeah!
- introduce you to formal languages
- introduce you to compiler construction



- getting five credits :) oh yeah!
- introduce you to formal languages
- introduce you to compiler construction
- see applications of mathematics in computer science



- getting five credits :) oh yeah!
- introduce you to formal languages
- introduce you to compiler construction
- see applications of mathematics in computer science
- improve your English skills

That's all folks.