How a Translator Works

CS 222: Programming Languages

Translators

The job of a translator is to convert data in a source language to an equivalent form in a target language.

- Assemblers

	Assembly language →	Machine code
Decrement the B processor register by one:	`DEC B`	`00000101`
Load AL register with 61 hexadecimal value:	`MOV AL, 61h`	`10110000 01100001`

More Translators

- Compilers High-level language → Machine code of physical processor
  - Programs in the source language are **compiled**.
  - Produces executable program
  - Ex: GCC is a compiler for C, C++, Objective-C, Fortran, Ada

- Interpreters High-level language → Machine code of virtual machine
  - Programs in the source language are **interpreted**.
  - Parses the source code into intermediate representation which is immediately executed
  - Ex: Thonny is an interpreter for Python

- Combination thereof
  - Ex: **Just-in-time (JIT) compilation**
  - Java compiler translates source code to byte code to be executed by JVM
  - JVM can compile byte code to machine code

Four Translator Design Principles

1. Correctness Principle

The runtime behavior of a translated form must be that described by the input being translated.

2. Early-warning Principle

Both syntax (form) and semantic (use) errors should be identified and reported at the earliest possible point in the translation process.

- Type errors are identified via **type checking**.
- Statically typed languages type check at translation time
  - Ex: Java, C, C++
- Dynamically typed languages type check at execution time
  - Ex: Python, Ruby, Lisp

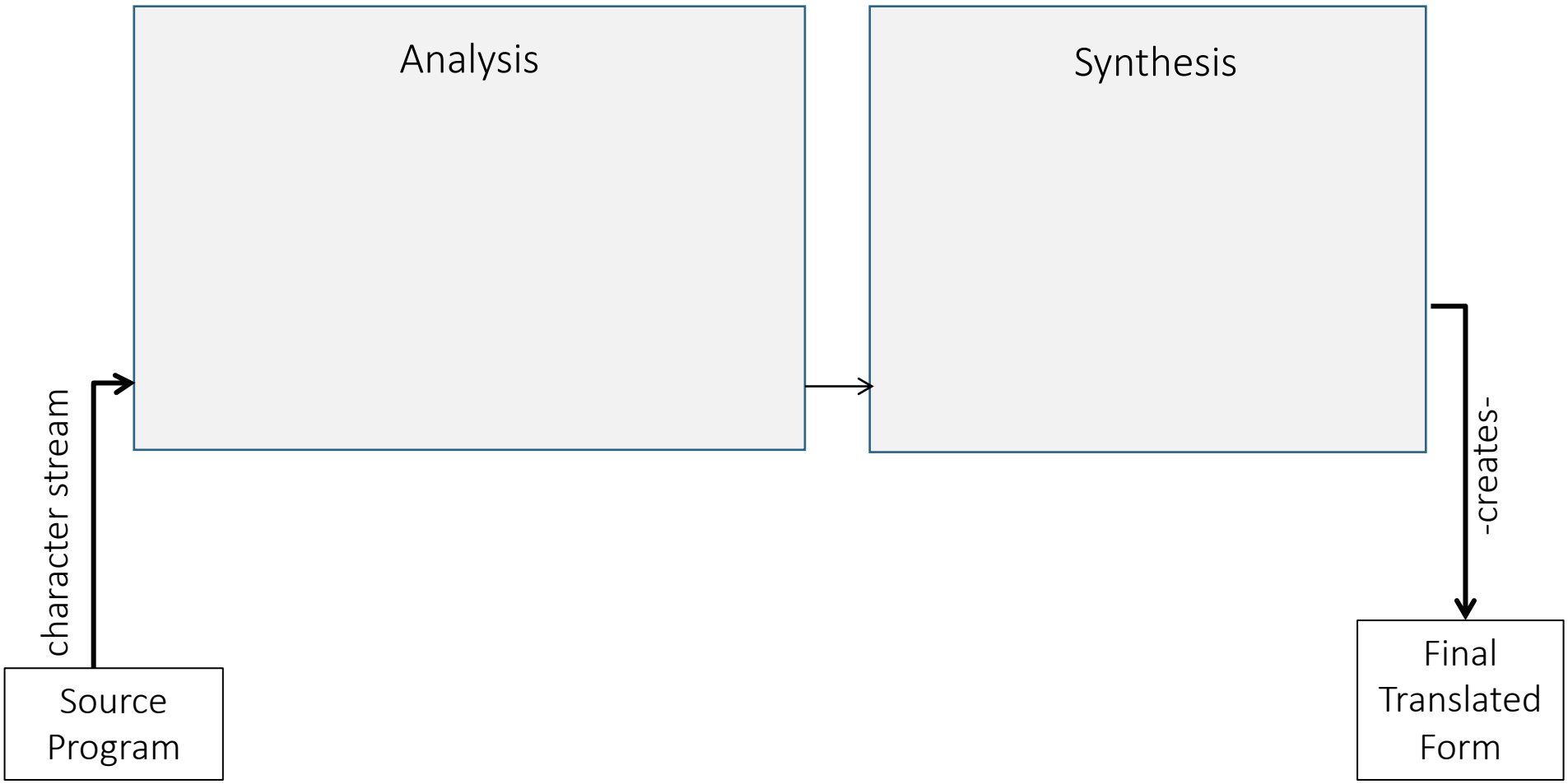
3. Efficiency Principle

A translator must ensure that a translated form makes sensible and efficient use of the computational resources in the execution environment.

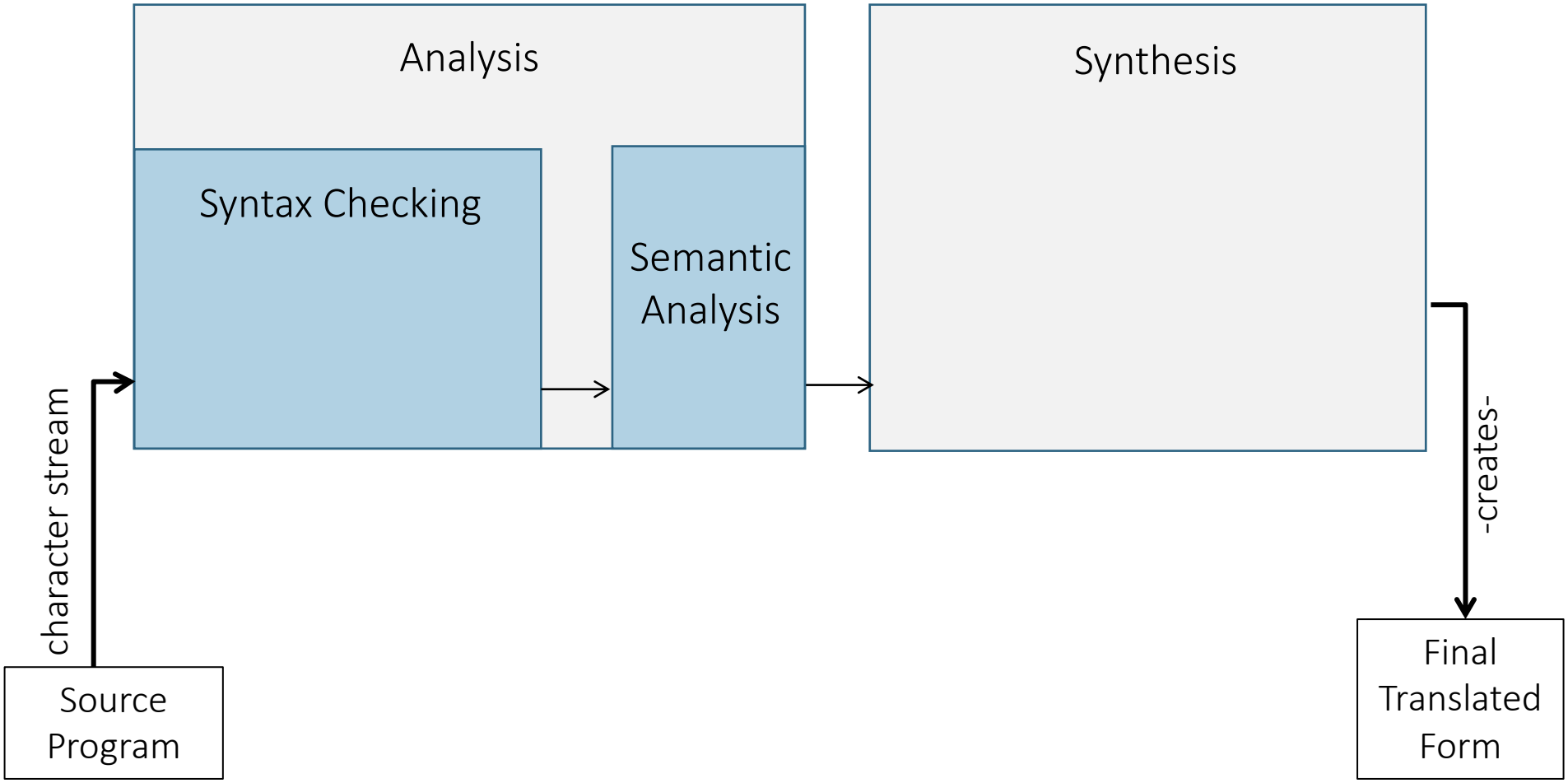
4. Portability Principle

A translator should be designed so that it can be ported to a new execution environment with a minimum of effort.

Phases of Translation



Phases of Translation



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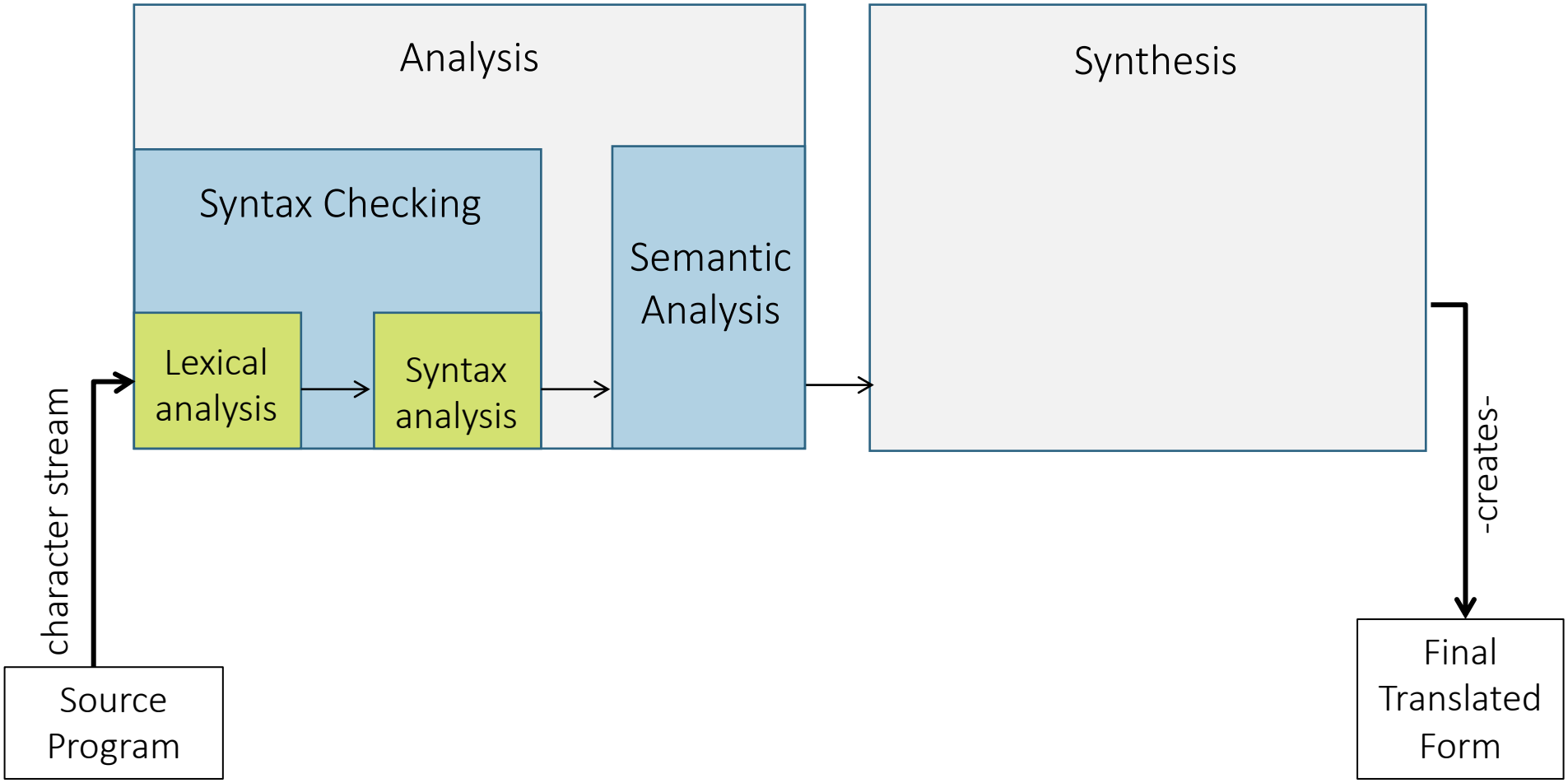

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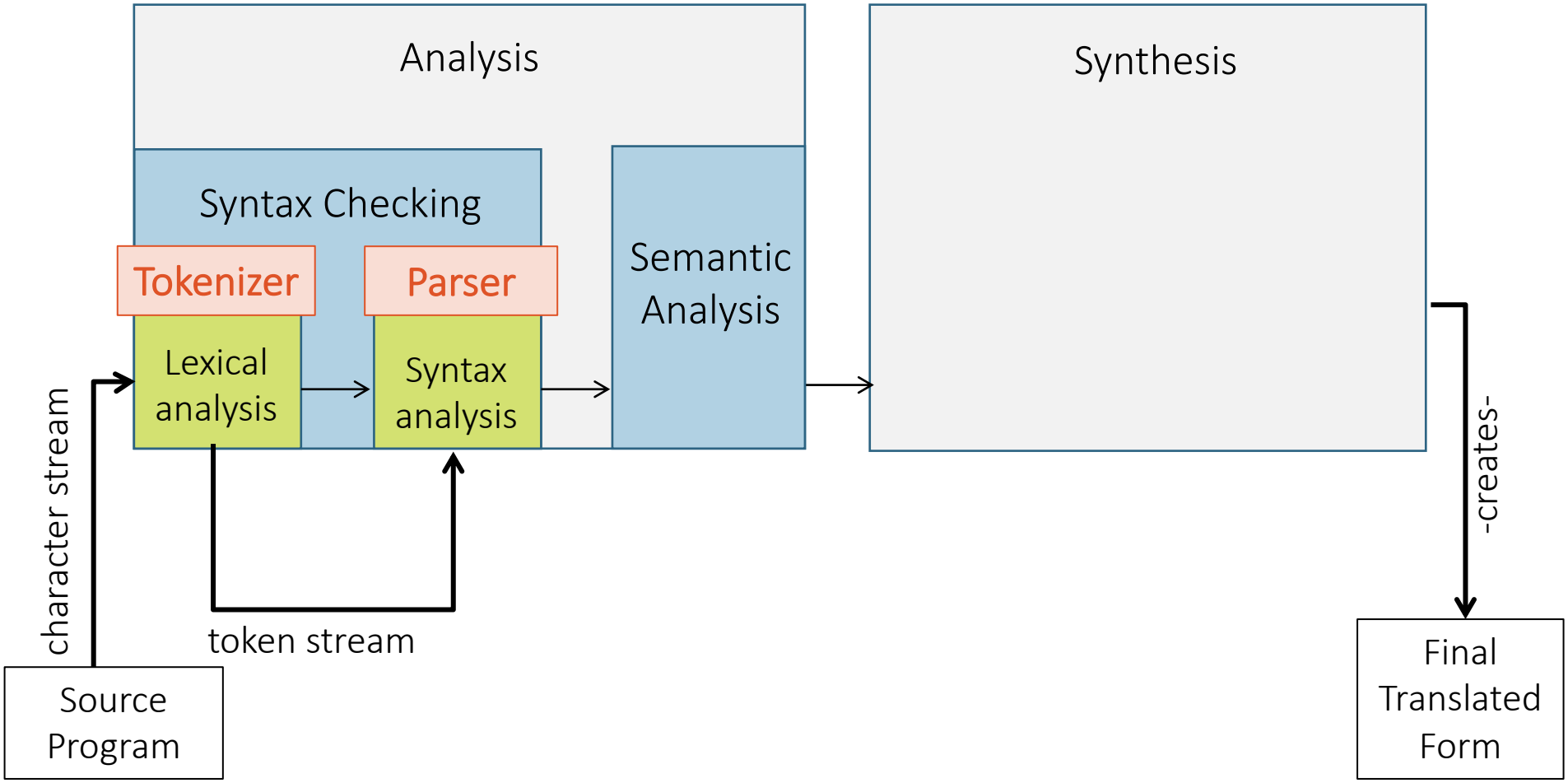

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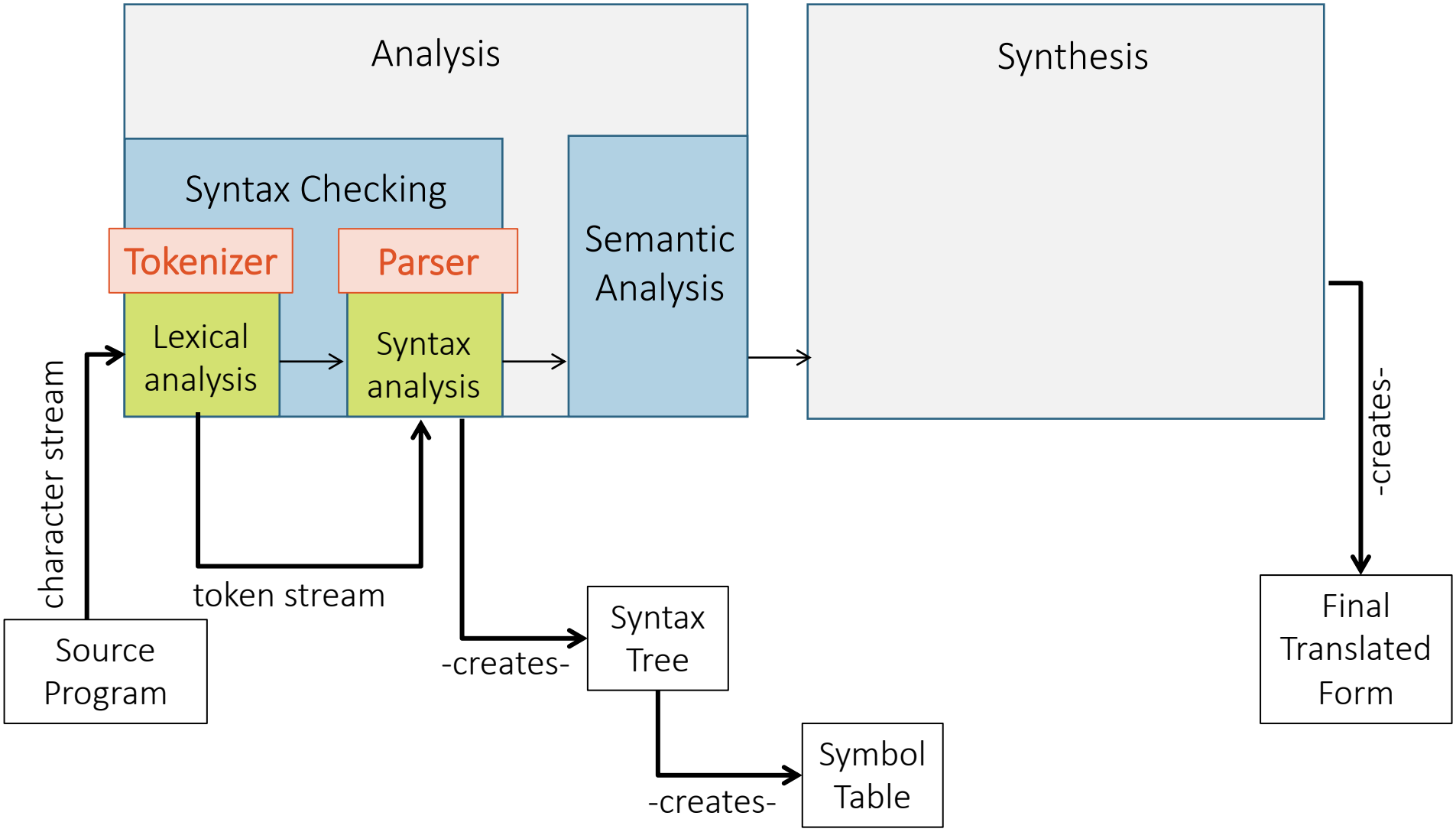

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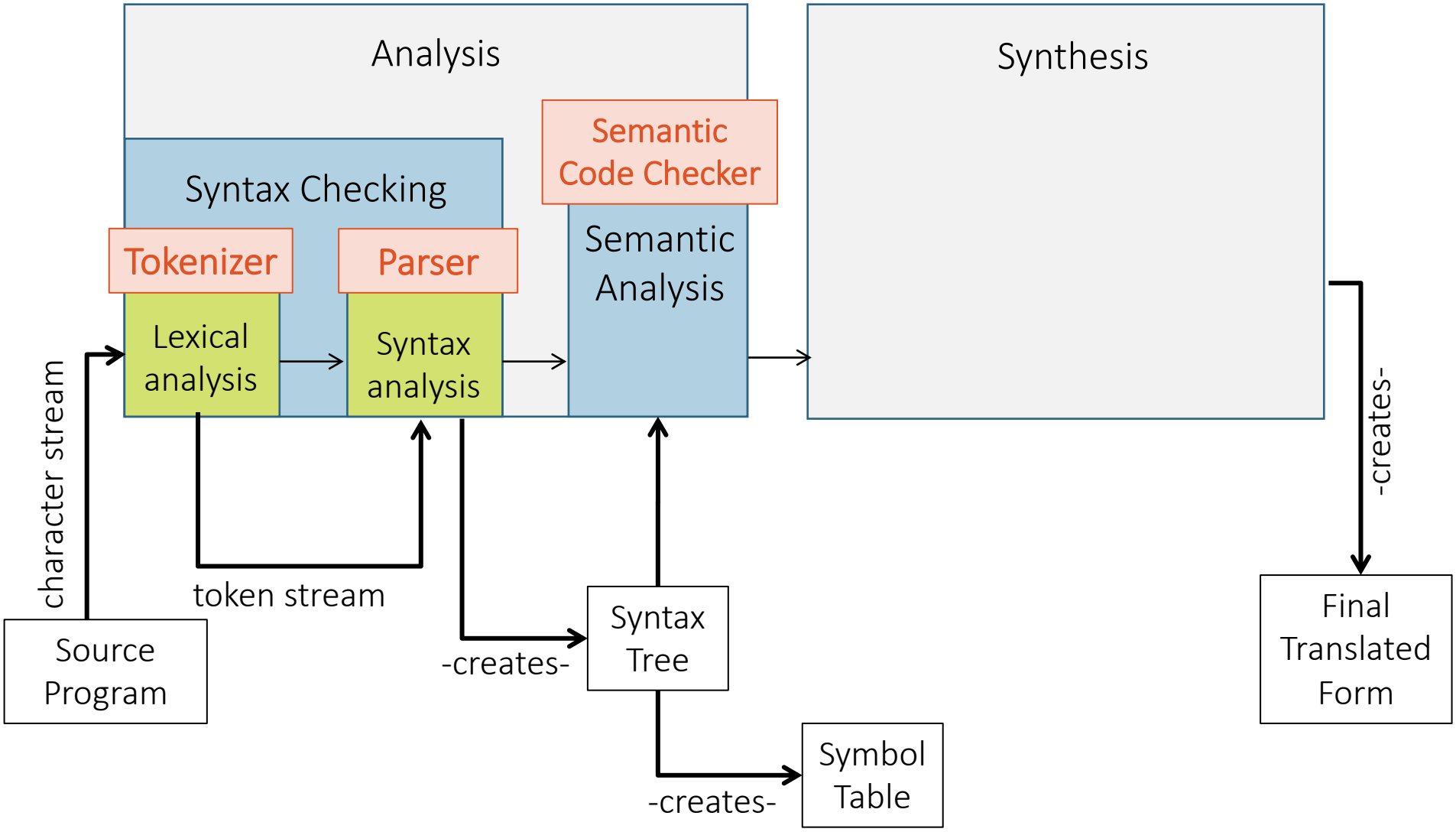

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