Compiler Construction: Practical Introduction

Samsung Compiler Bootcamp

Projects

Samsung Research Russia
Moscow 2019

Project List

- **Four "toy" languages**
  For a team of four persons each

  D Dynamic *(like Javascript)*
  O Object-oriented *(like Oberon-2)*
  F Functional *(~CoreLisp; like Lisp & Scheme)*
  I Imperative *(like Pascal/Oberon)*

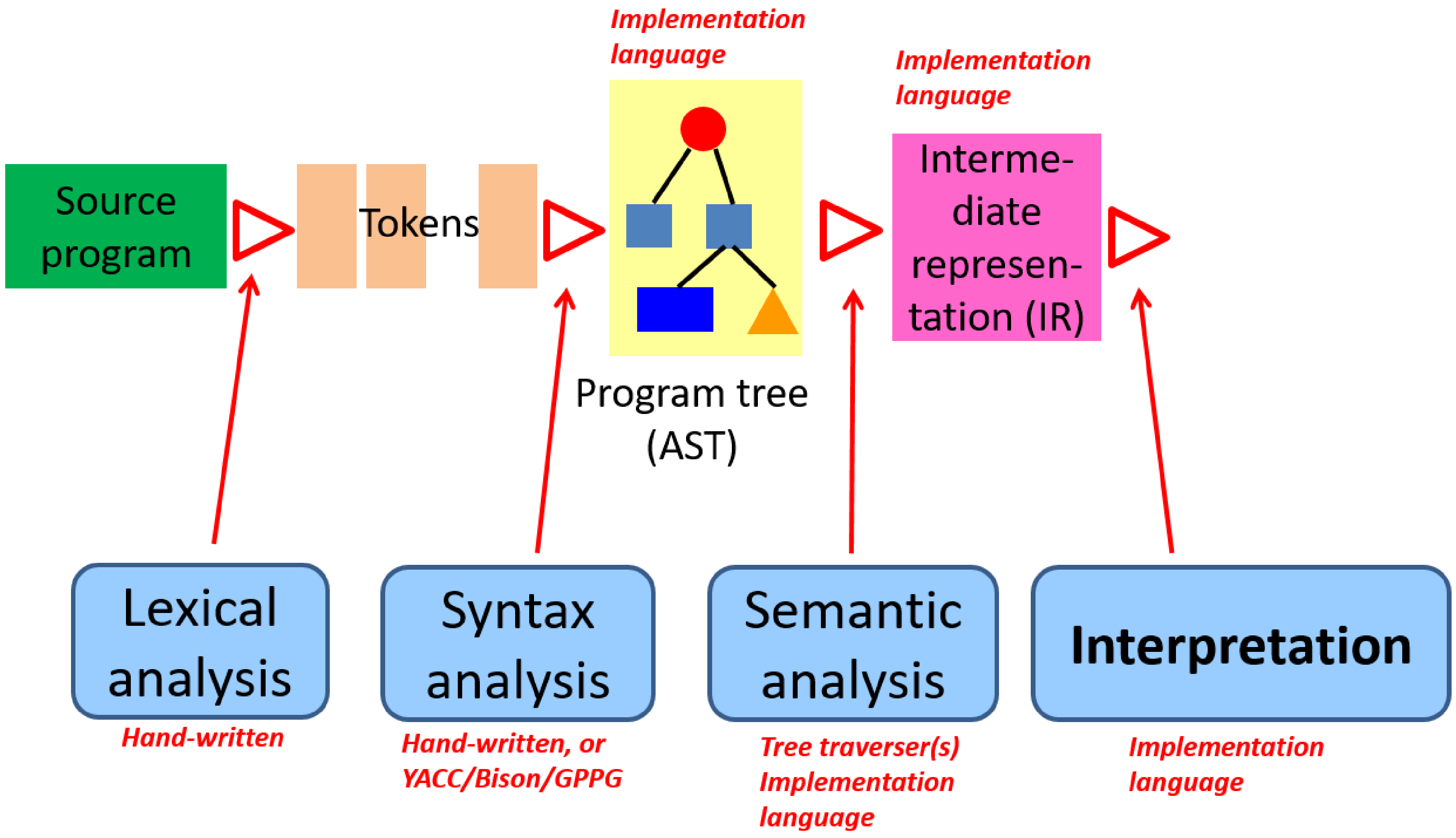
- **Implementation details**
  - Compiler or interpreter
  - Implementation languages: C, C++, C#, Java
  - Tools: yacc/bison, hand-made
  - Target codes & platforms:
    - MSIL
    - Java bytecode
    - LLVM bitcode
    - Own VM ☺

Project D: Dynamic

Short language characteristics

- Object types <u>are not specified</u> and can change while program execution
- The language is **interpreted**
- Major notion: variable & literal (constant)
- Program structure: a sequence of declarations and statements
- Builtin types: built-in: integer, real, boolean, string
  User-defined types: array, tuple, function
- Implicit type conversions
- Statements: assignment, if/while, return, input/output

Project D: Dynamic

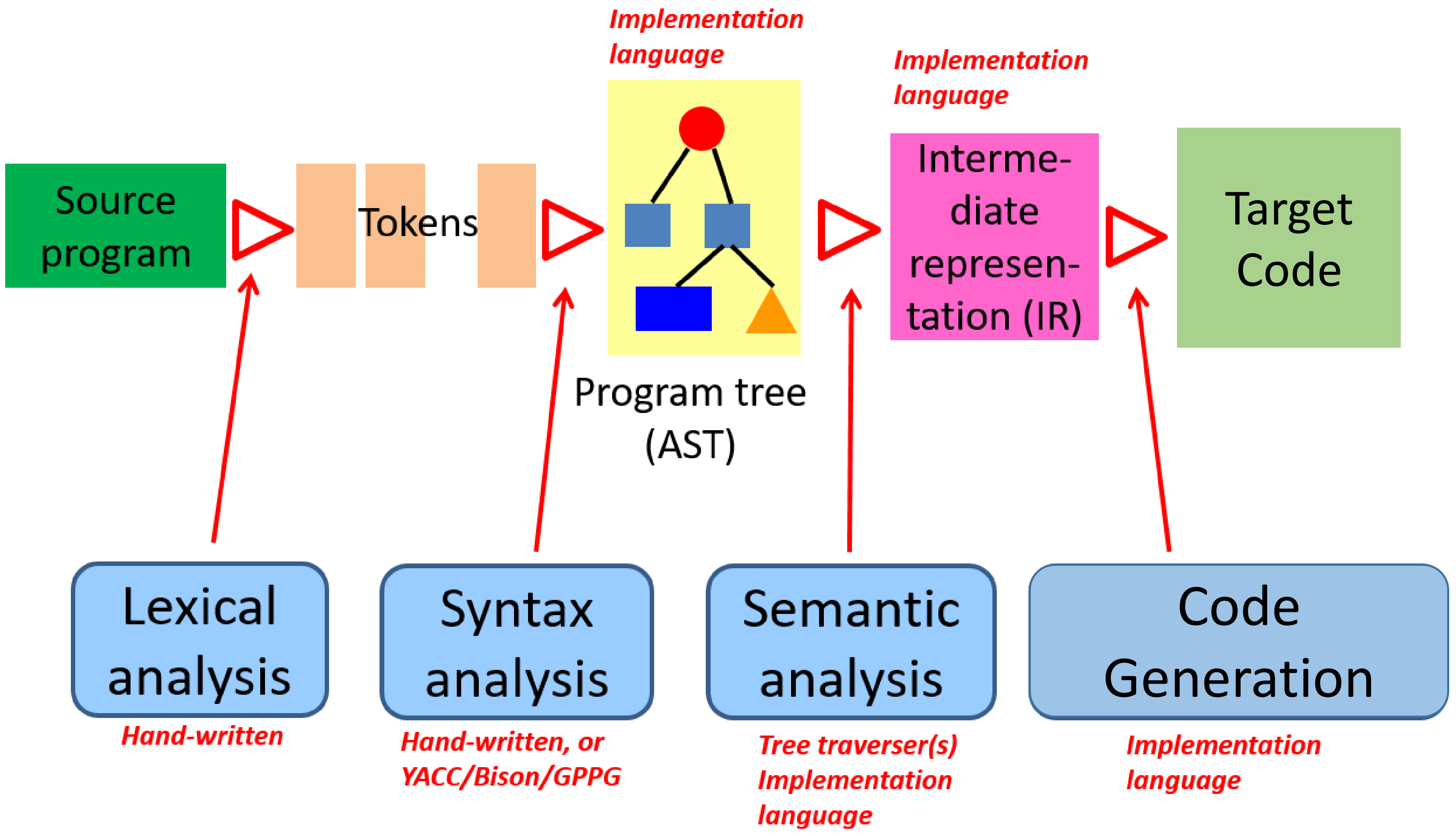


Project O: Object-Oriented

Short language characteristics

- The language is static. Object types are fixed by object declarations and cannot change while program execution.
- Object types <u>are classes</u> – either predefined of user-defined.
- Classes contain data declarations and method declarations.
- The single inheritance and virtual functions are supported.
- No expressions! – only function calls.
- The language is **compiled**. The target code is either an assembly language, of LLVM bitcode, or JVM bytecode, or .NET CIL.
- Program structure: a sequence of classes.
- Statements: a standard set (assignment, if/while, return, input/output)

Project O: Object-Oriented

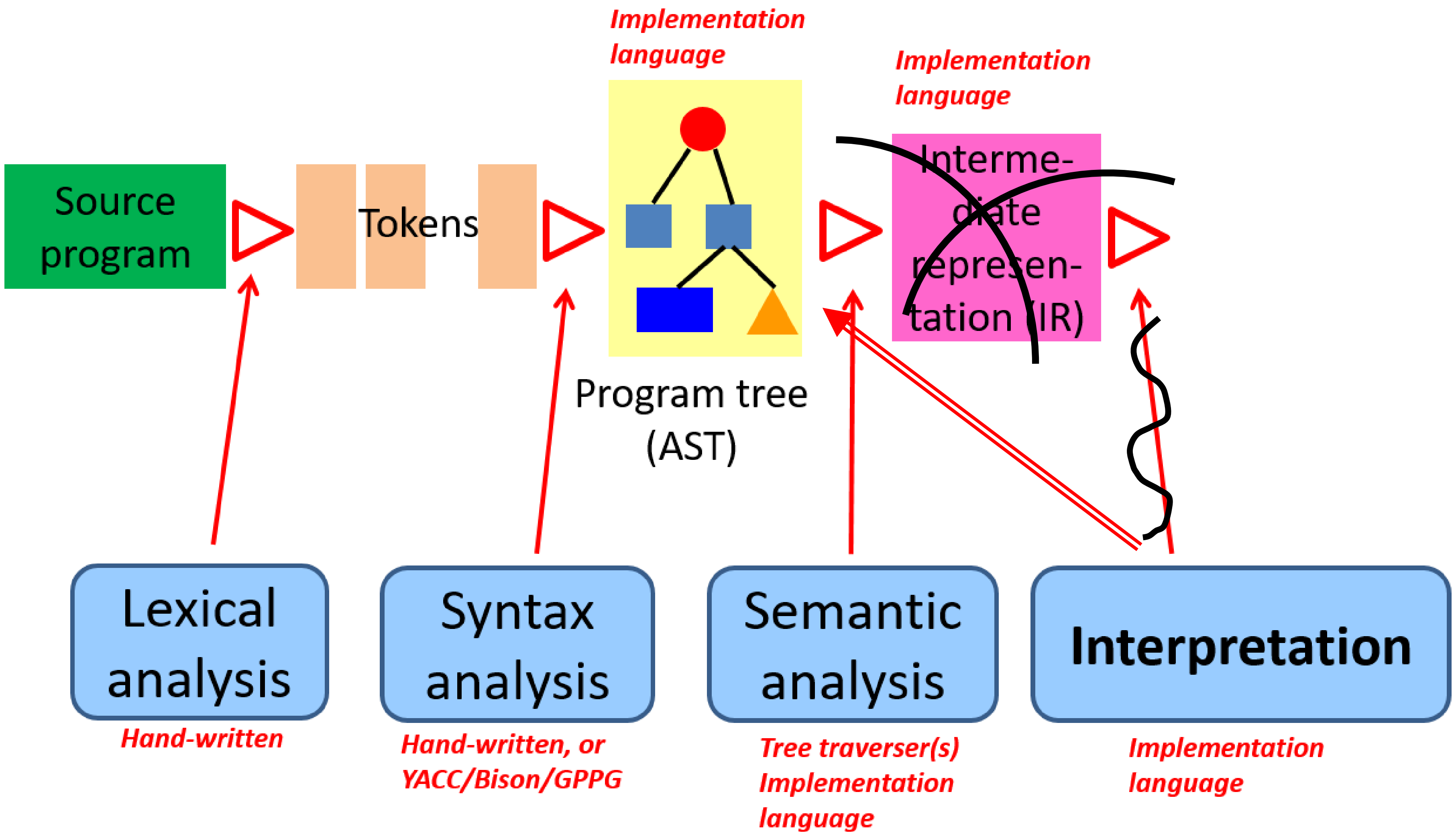


Project F: Functional

Short language characteristics

- There are three atomic predefined types: integers, reals & booleans.
- There are two basic structures: atoms and lists.
  Atom has the name and the value. The atom value can be either of a predefined type, or, or list. In some contexts atom represents itself.
  A list is an ordered sequence of atoms, literals and lists.
- Basic list access rules include taking the head of the list, the "tail" of the list, and constructing a list from its head and the "tail"..
- The language is dynamically typed and **interpreted**.
- Program structure: a sequence of lists and/or atoms
- Special forms (lists): functions, lambdas (unnamed functions), control structures.
- A minimal set of predefined functions: arithmetic, lists operations, etc.

Project F: Functional

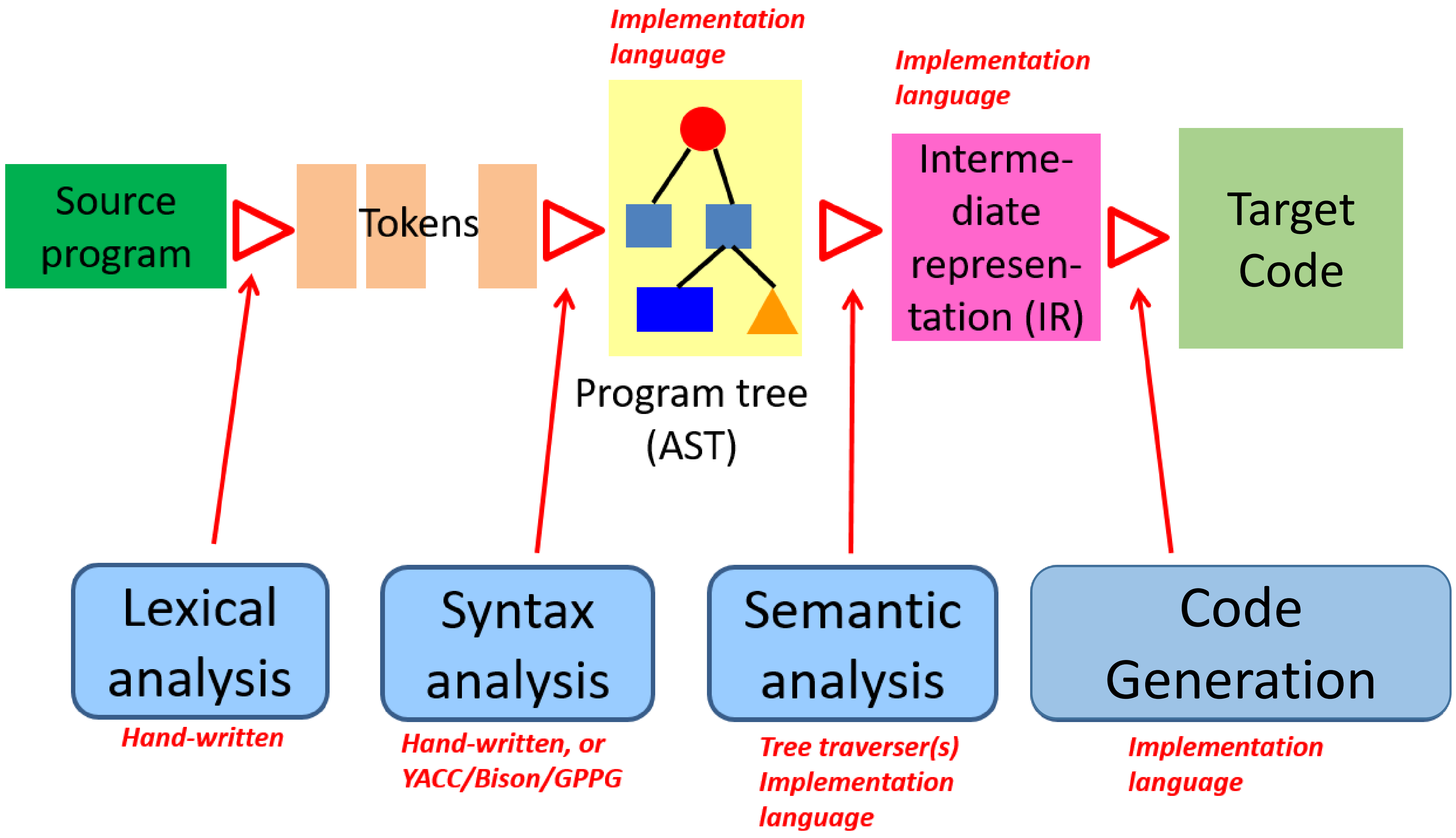


Project I: Imperative

Short language characteristics

- The language is static. Object types are fixed by object declarations and cannot change while program execution.
- There are three predefined data types: integer, real and boolean. There are two predefined data structures: structs and arrays.
- Full expression syntax with usual set of operators.
- The language is **compiled**. The target code is either an assembly language, of LLVM bitcode, or JVM bytecode, or .NET CIL.
- Program structure: a sequence of data and routine declarations.
- Statements: a standard set (assignment, if/while, return, input/output)

Project I: Imperative


Implementation language
Implementation language
Source program
Tokens
Interme-diate represen-tation (IR)
Target Code
Program tree (AST)
Lexical analysis
Hand-written
Syntax analysis
Hand-written, or YACC/Bison/GPPG
Semantic analysis
Tree traverser(s) Implementation language
Code Generation
Implementation language