Modules for C++

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Modules for C++

C++

C++

C++ Libraries

Libraries

```
export MyLib:
public:
  typedef decltype(sizeof(1)) IndexType;
  ...
private:
  int select(IndexType x) {
    ...
  }
```

```
import MyLib;

void select(IndexType x) {
  ...
}
```

```
export M1:
public: typedef int I1;
```

```
export M2:
public: typedef int I2;
```

```
export MM:
public:  import M1;
private: import M2;
```

```
import MM;
I1 i1;  // Okay.
I2 i2;  // Error.  I2 is not declared.
```

```
export MyLib::Basics:
public:
  namespace MyLib {
    typedef decltype(sizeof(1)) IndexType;
  ...
```

```
import MyLib::Basics;

void select(MyLib::IndexType x) {
   ...
}
```

```
export MyLib.basics:
public:
  namespace MyLib {
    typedef decltype(sizeof(1)) IndexType;
private:
    void helper() {
  ...
```

```
export MyLib.select:
  import MyLib.basics;
public:
  namespace MyLib {
    void select(IndexType x) {
      ... helper(); ...
```

```
export MyLib:
public:
  struct S {
    void f(long x) { this->f((long long)x); }
  private:
    void f(long long x);
  };
  void S::f(long long x) { ... }
```

```
import MyLib;

void g(S x) {
  x.f(42);  // Unambiguous.
}
```

```
export MyLib:
public:
  class B {
    virtual void f();
  };
```

```
import MyLib;

struct D: B {
  override void f();  // Does find B::f!
};
```

```
export MyLib:
private:
  import {
    extern "C" int printf(char const*, ...);
  }
public:
  void warning(char const *msg) {
    printf("%s", msg);
  }
```

```
#ifndef MYLIB_H
#define MYLIB_H

import MyLib;

#endif  /* ifndef MYLIB_H */
```

So what?

Macros

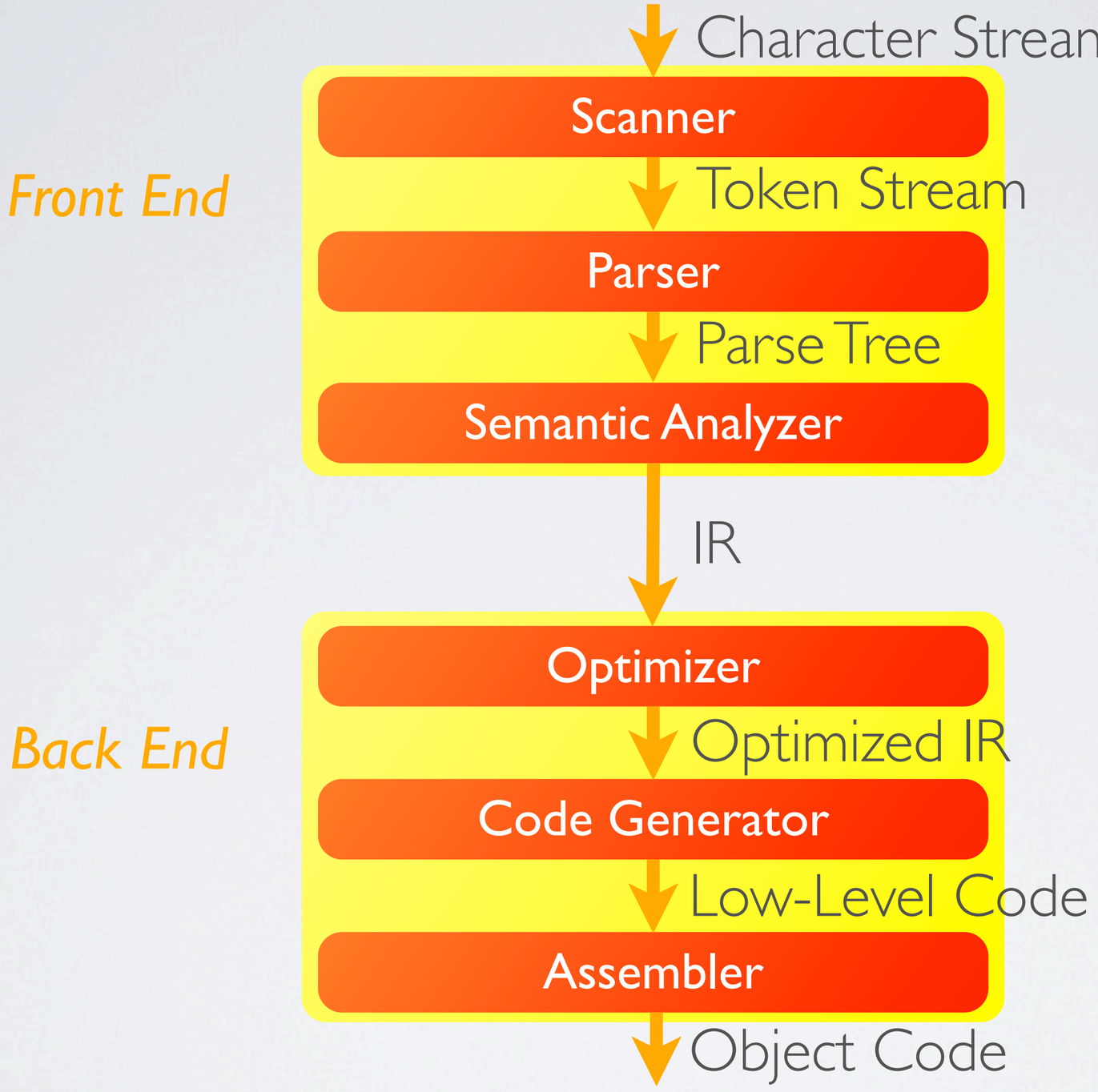

Macros

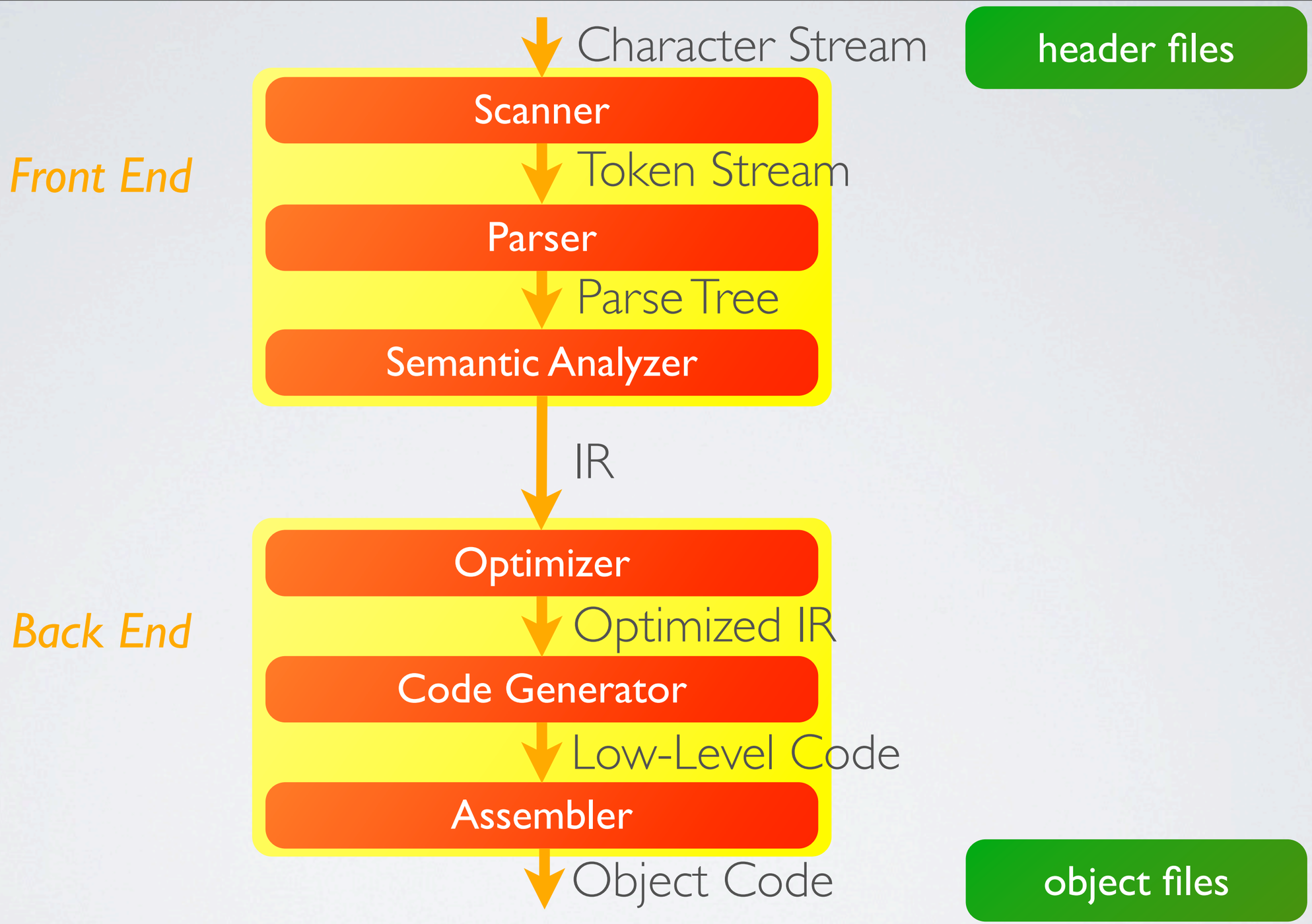
Fast Builds

Explicit Dependencies

Initialization Order

Cross-TU Optimizations


Character Stream
Scanner
Front End
Token Stream
Parser
Parse Tree
Semantic Analyzer
IR
Optimizer
Back End
Optimized IR
Code Generator
Low-Level Code
Assembler
Object Code


Character Stream
header files
Front End
Scanner
Token Stream
Parser
Parse Tree
Semantic Analyzer
IR
Back End
Optimizer
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Code Generator
Low-Level Code
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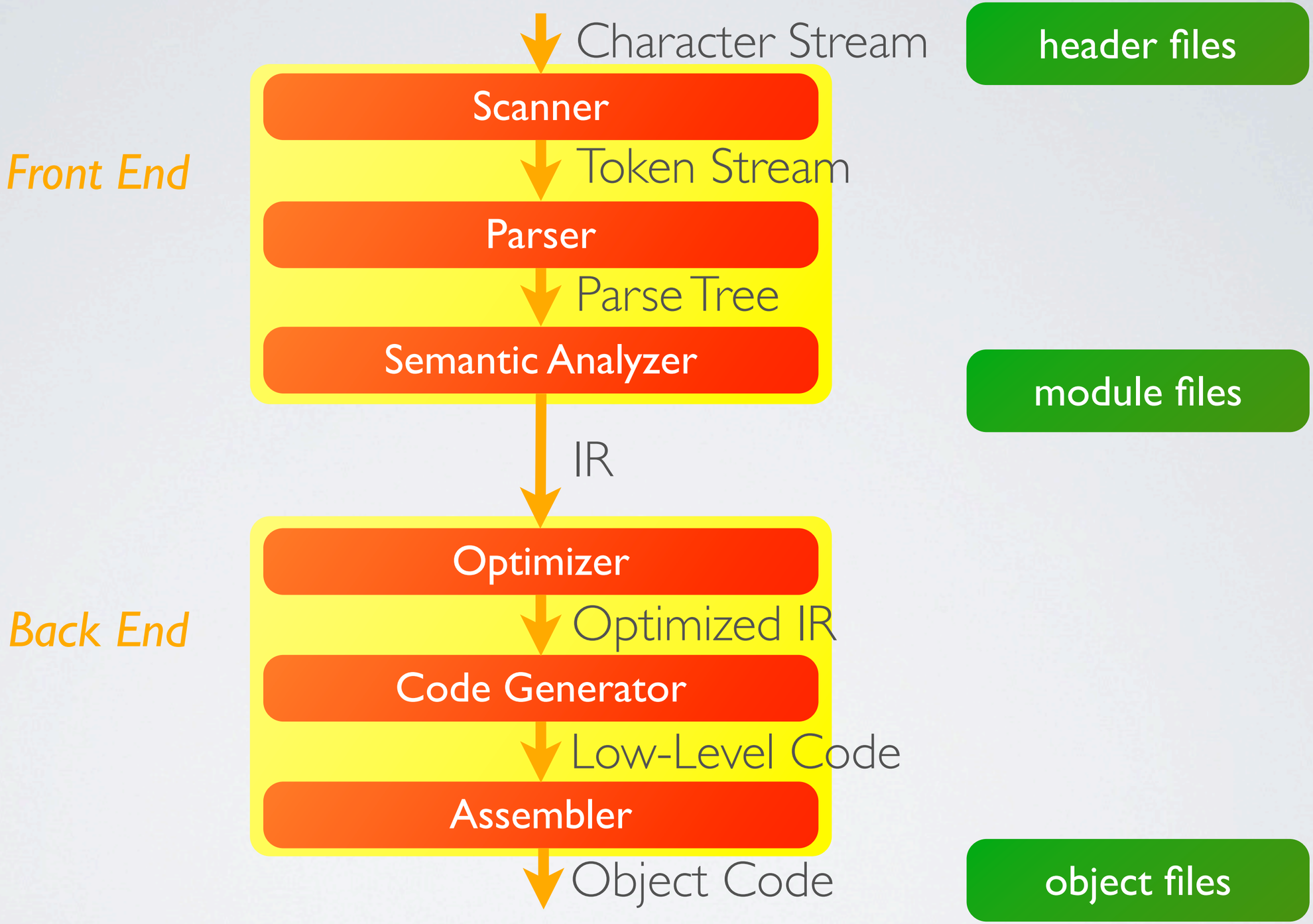
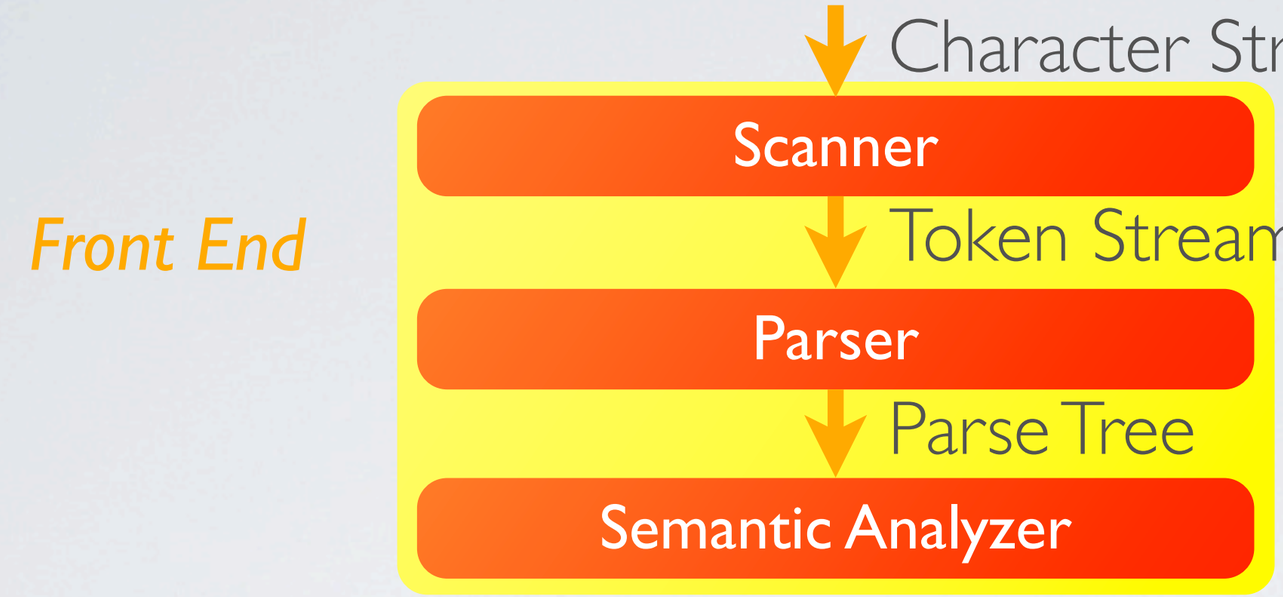
Object Code
object files


Character Stream
header files
Front End
Scanner
Token Stream
Parser
Parse Tree
Semantic Analyzer
module files
IR
Optimizer
Optimized IR
Back End
Code Generator
Low-Level Code
Assembler
Object Code
object files

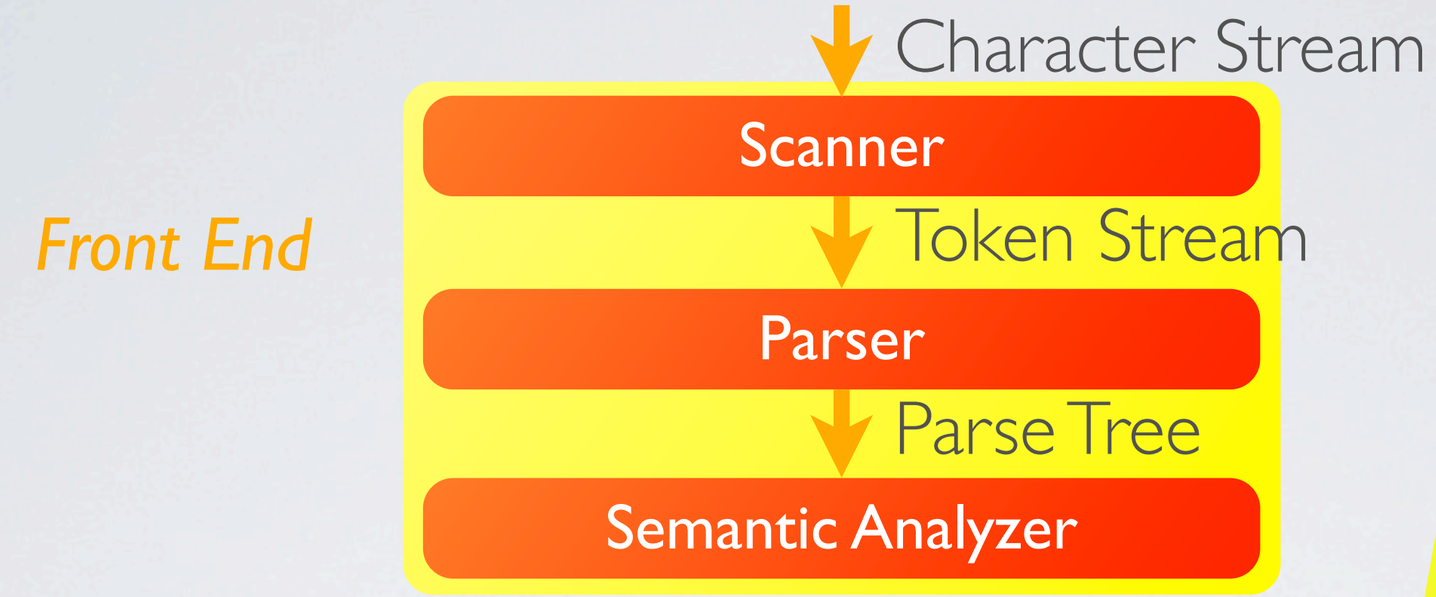


Front End

header files

module files

- *Compiler dependent*
- *Version dependent*
- *Human readable?*



Front End

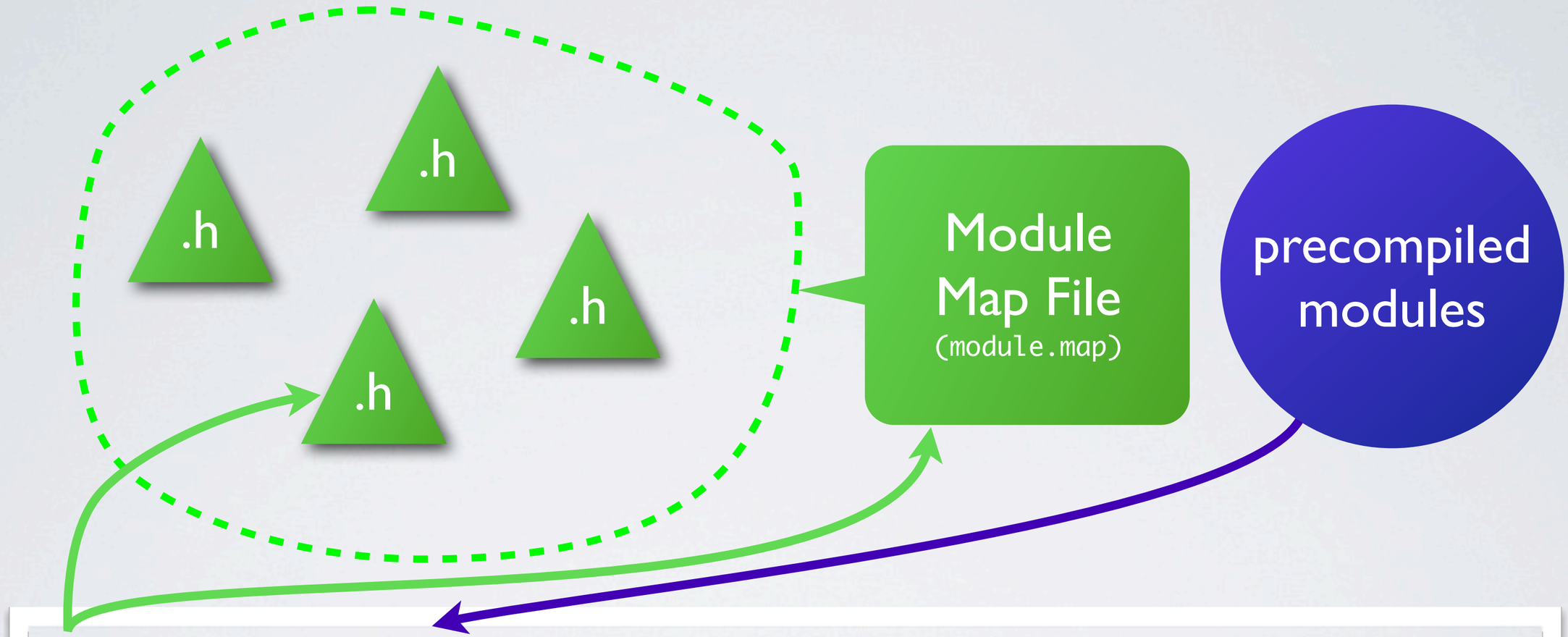
module files

precompiled modules

- *Compiler independent*
- *Version independent*
- *Human readable*

Modules

Clang Modules




```
#include “lib_part.h”

void select(MyLib::IndexType x) {
  ...
}
```

```
// module.map
module std {
  module stdio { header “stdio.h” }
  module vector {
    require cplusplus
    header “vector”
  }
  ...
  explicit module iostream {
    require cplusplus
    header “iostream”
    export std.locale
  }
  ...
}
```

Strengths & Weaknesses

Availability

Ease of Transition

Ease of Programming

Visibility Control

Initialization Ordering

Cross-TU Properties

Unifiable?

```
// module.map
module std {
  module stdio { header “stdio.h” }
  module vector {
    require cplusplus
    header “vector”
  }
  ...
  explicit module iostream {
    require cplusplus
    header “iostream”
    export std.locale
  }
  ...
}
```

```
// std.mpp
export [[mapincludes]] std:
  export [[macros]] .stdio {
#   include "stdio.h"
  }
  export [[cplusplus]] .vector {
#   include "vector"
  }
  ...
  export [[cplusplus, separate]] .iostream {
#   include "iostream"
  public:
    import std.locale;
  }
  ...
}
```

Want more?

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The END