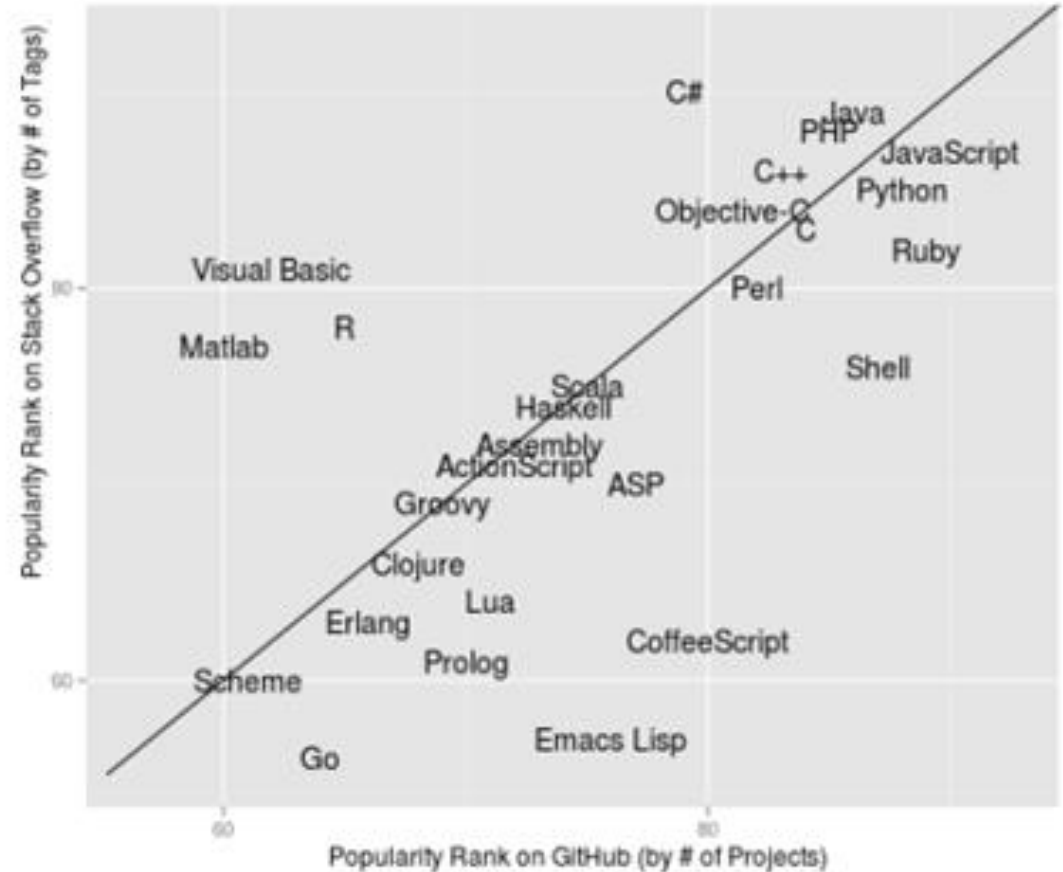


Programming Languages

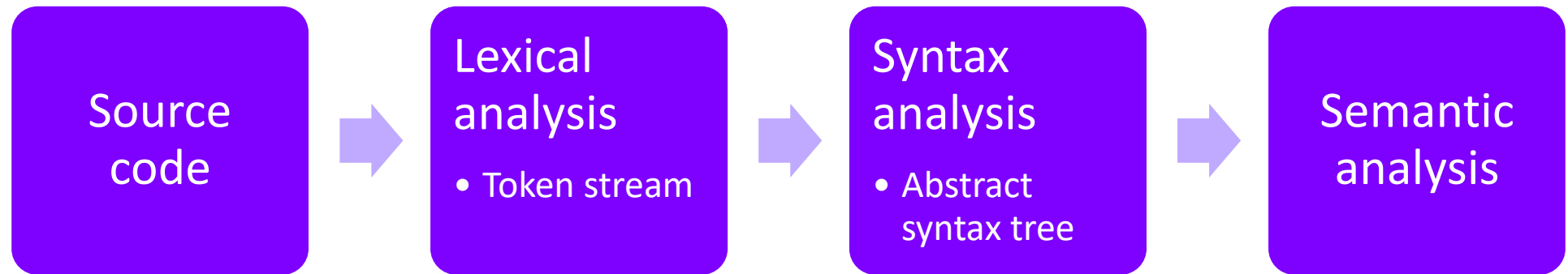
Shaun C. D'Souza

Compilers and translators

- Compilers translate information from one representation to another.
- Most commonly, the information is a program
- Compilers translate from high-level source code to low-level code
- Translators transform representations at the same level of abstraction
- Windows – 50 million LOC
- Google internet services – 2 billion LOC



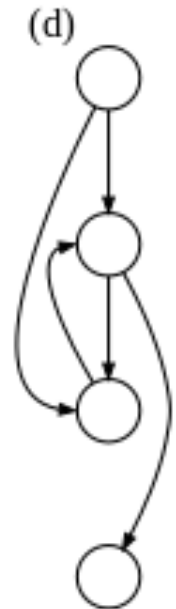
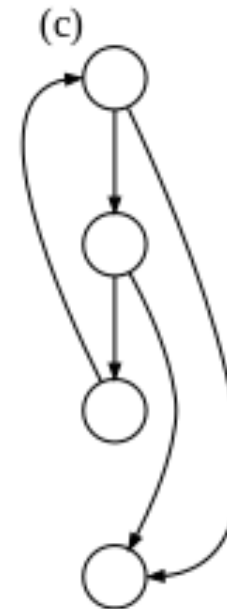
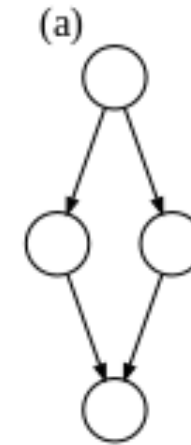
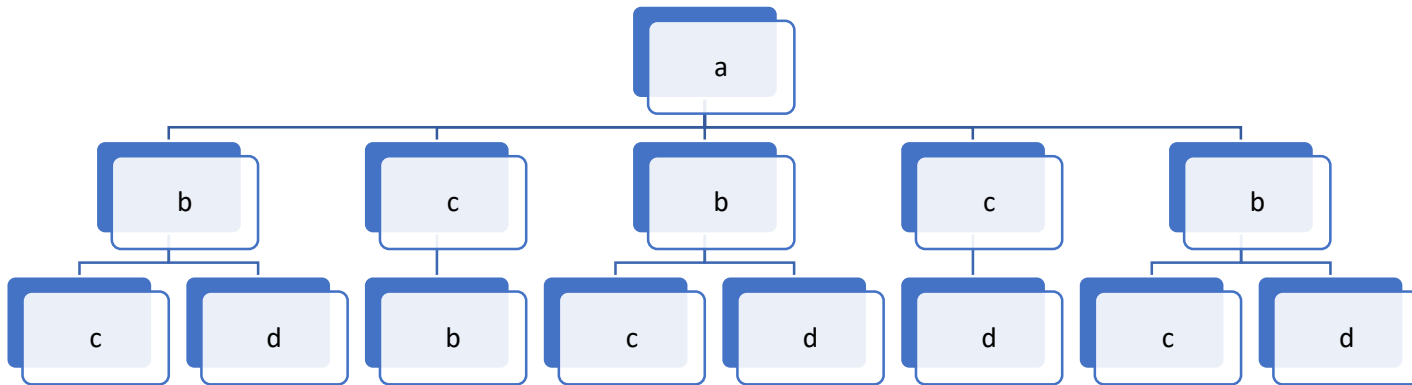
Stages of compilation



Abstract syntax trees

- AST representation?
 - encodes order of evaluation
 - allows divide and conquer recursive evaluation
- parser turns flat text into a tree
 - so that programmers need no enter trees
- source language vs target language
 - for interpreters, we usually talk about host languages
- AST is a kind of a program intermediate form (IR).

Control flow graph



Source code

- Optimize for human readability
- Lexical analysis
 - Natural language: “He wrote the program”

He	wrote	the	program
----	-------	-----	---------

- Programming language “if (b == 0) a = b”

if	(	b	==	0	)	a	=	b
----	---	---	----	---	---	---	---	---

- tokens: “if” “(” “b” “==” “0” “)” “a” “=” “b”

Syntactic analysis

Natural language

He	wrote	the	program
noun	verb	article	noun
subject	predicate	object	
sentence			

Programming language

if (b == 0)	a = b
test	assignment
if-statement	

Semantic analysis

- Natural language:

He	wrote	the	computer
noun	verb	article	noun

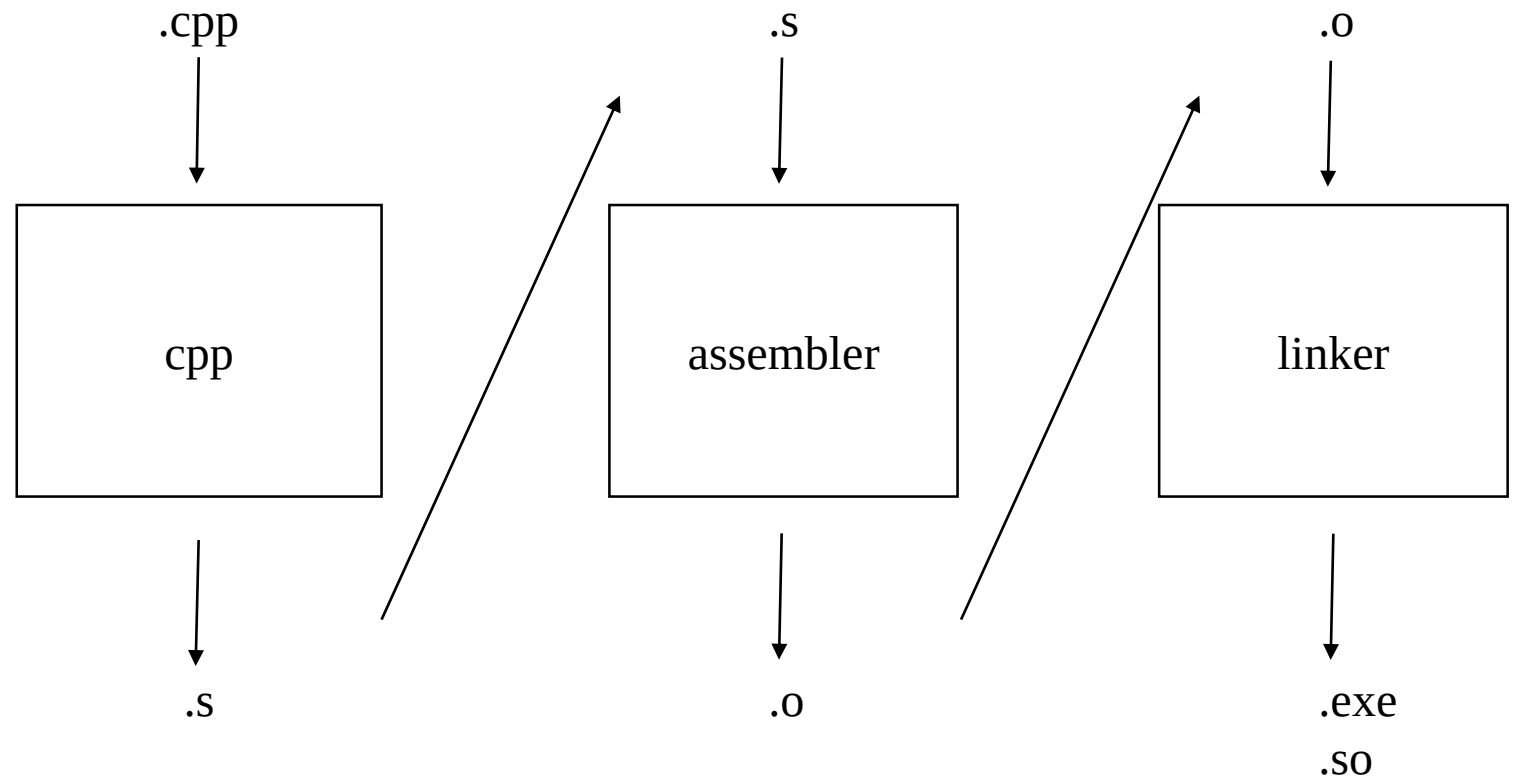
- Syntax is correct; semantics is wrong!
- Programming language

if (b == 0)	a = foo
test	assignment

- semantic analysis will report an error

Gcc compiler

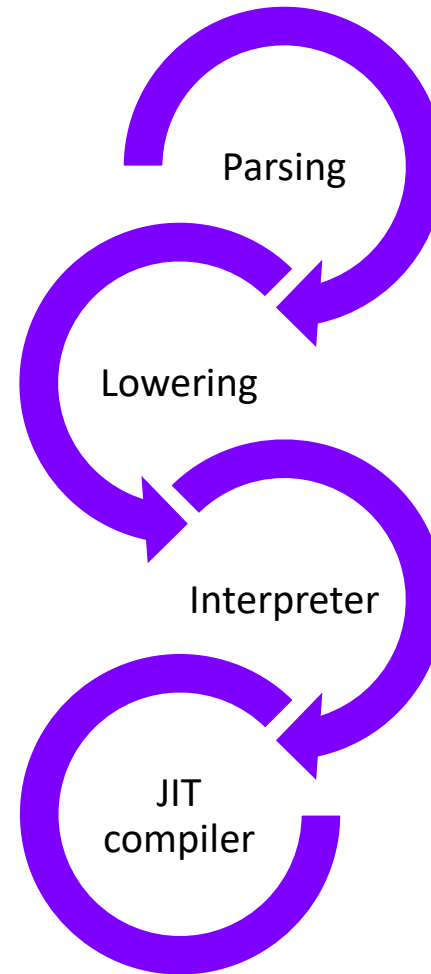
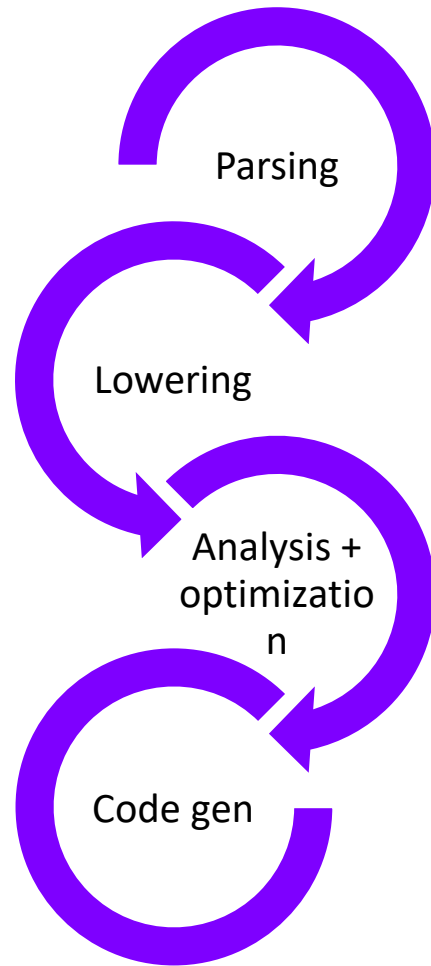
- `g++ -c -save-temps foo.cpp`
- `G++ -E`
- `G++ -S`
- `G++ -c`



Gcc generic AST

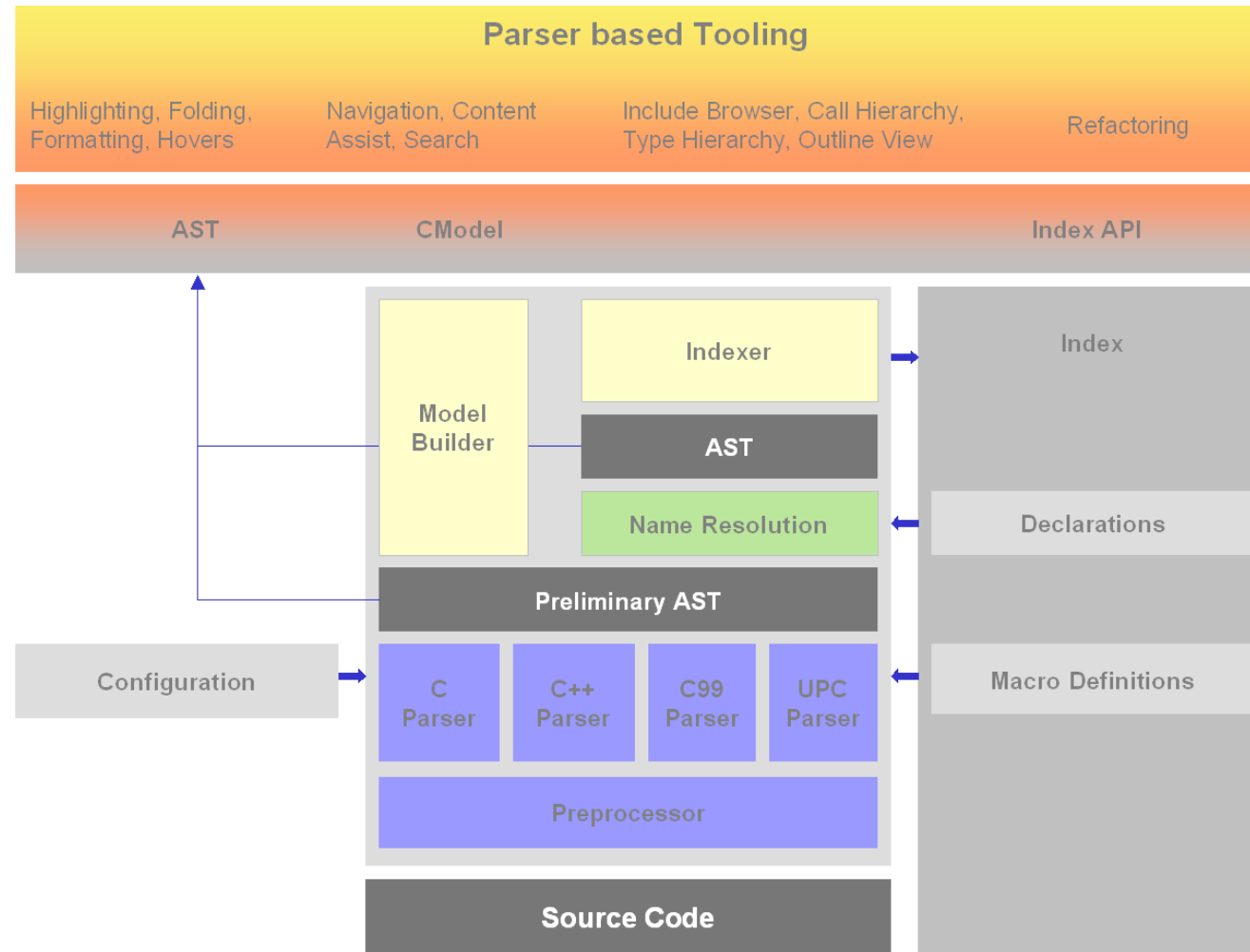
- `g++ -fdump-translation-unit foo.cpp`
- `G++ -fdump-tree-original`

Interpreter and compiler



Example systems: g++ compiler, V8 JS

Eclipse parsing



References

- <http://gcc.gnu.org/>
- http://wiki.eclipse.org/CDT/designs/Overview_of_Parsing
- API for C/C++ AST -
<http://help.eclipse.org/luna/index.jsp?topic=%2Forg.eclipse.cdt.doc.isv%2Fguide%2Fdom%2Findex.html>