An Easy to Use Infrastructure for Building Static Analysis Tools

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Agenda

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- available for free

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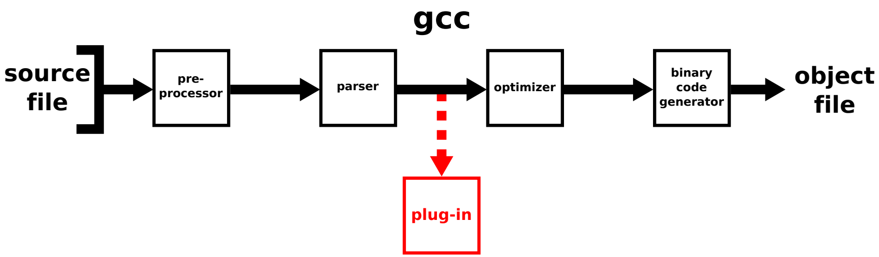
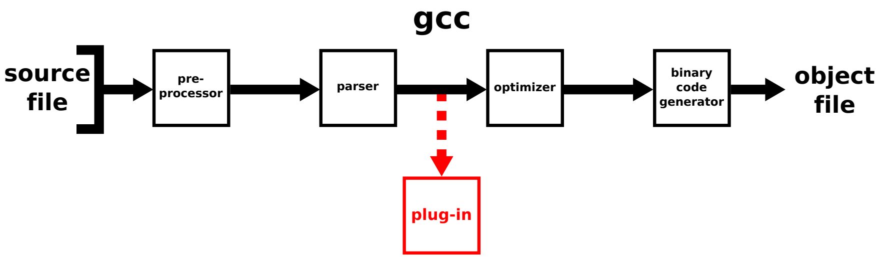
gcc plug-in

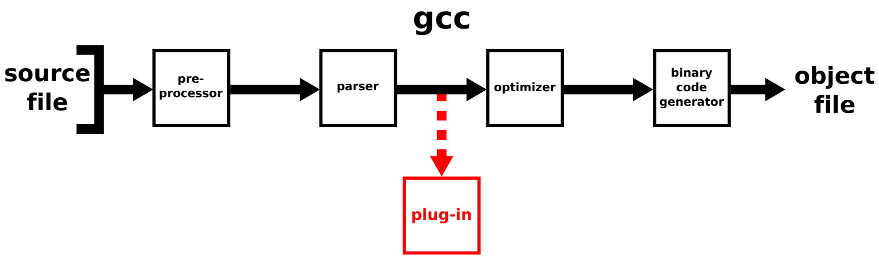

gcc
source file
pre-processor
parser
optimizer
binary code generator
object file
plug-in

gcc plug-in



Why should one build an analysis as a gcc plug-in?

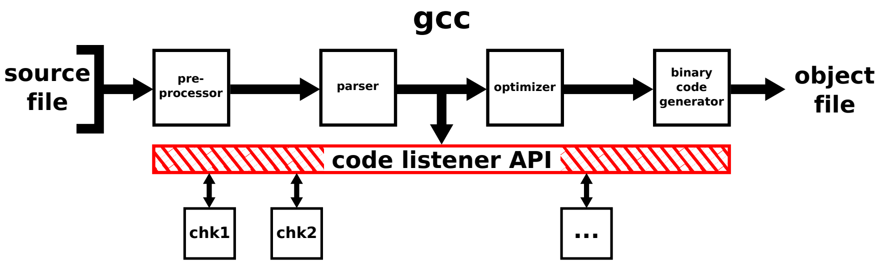
gcc plug-in



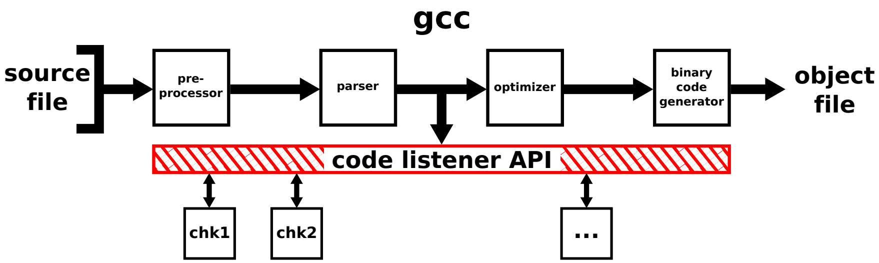
Why should one build an analysis as a gcc plug-in?

- the same code parser is used for both analysis and building
- easy to use for the end users
- ready for `C++` as well as `C`

code listener

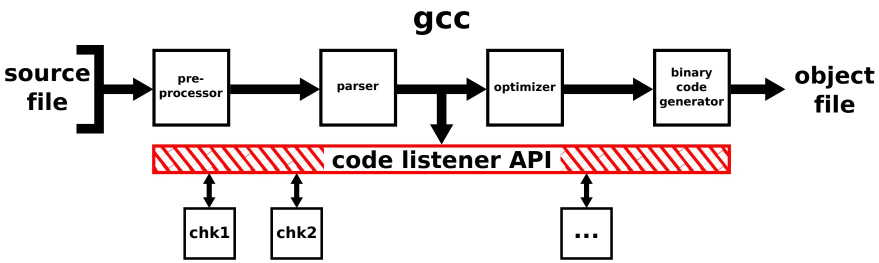


code listener



Why should we bother with an extra layer?

code listener



Why should we bother with an extra layer?

- gcc is complex (about 800 000 lines of code)
- lack of documentation
- we want to be independent of gcc

Consequences

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- `gcc` **`-fplugin=plug.so ...`**
- `make CFLAGS=`**`-fplugin=plug.so`**
- some additional errors and warnings are reported

Consequences

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What does it mean for a developer?

- easy to use `C++` API
- availability of various diagnostic tools
    - CFG plotter
    - intermediate code printer
    - debugging helpers

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What is code listener not suitable for?

- tools that expect AST on their input
- GPL-incompatible projects

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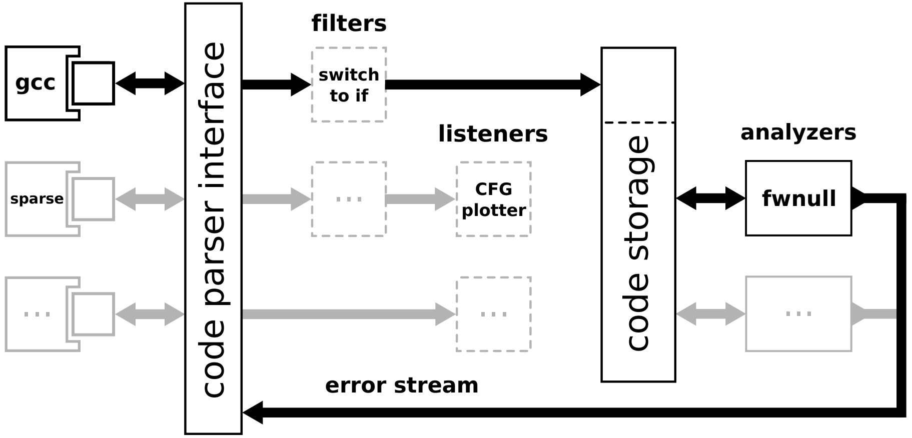
Key Design Constraints

- concise and intuitive API for writing analyzers
- the API should be independent of gcc
- easy migration to other code parsers
  (e.g. from `gcc` to `sparse`)

Block Diagram



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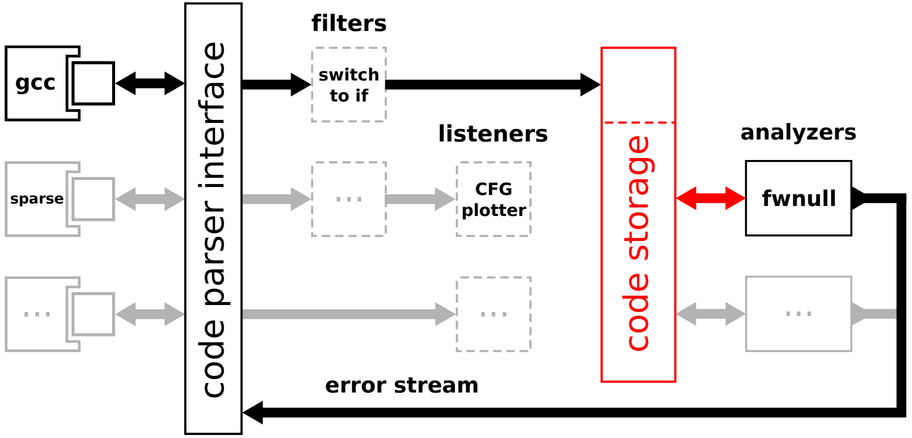
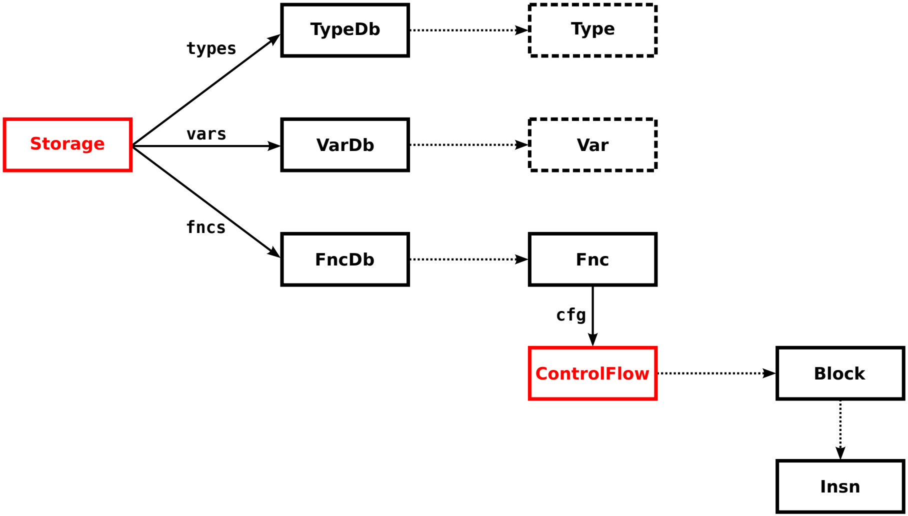


Code Storage API



Instruction Set

1. non-terminal instructions
2. terminal instructions

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unconditional jump	`CL_INSN_JMP`
conditional jump	`CL_INSN_COND`
return	`CL_INSN_RET`

Error Reporting Facility

- location info for each instruction, declaration
- error stream for reporting of code defects
- fully compatible with the code parser's error output

Agenda

Current State

- architecture already implemented and being used
- tools for verification of sequential C programs with dynamic linked data structures

- `predator` – based on separation logic

  `http://www.fit.vutbr.cz/research/groups/verifit/tools/predator`

- `forester` – based on tree automata

  `http://www.fit.vutbr.cz/research/groups/verifit/tools/forester`

Demo (1/2)

- `fwnull` – easy data-flow analyzer (demo)
- simplified `FORWARD_NULL` check used by Coverity
- if a pointer is checked against `NULL`, it should be checked before the pointer is first dereferenced

Demo (2/2)

- `fwnull` found a hidden bug in the `cUrl` project
- `http://github.com/bagder/curl/compare/62ef465...7aea2d5`

```
diff --git a/lib/rtsp.c b/lib/rtsp.c
--- a/lib/rtsp.c
+++ b/lib/rtsp.c
@@ -709,7 +709,7 @@
     while(*start && ISSPACE(*start))
       start++;

-    if(!start) {
+    if(!*start) {
       failf(data, "Got a blank Session ID");
     }
     else if(data->set.str[STRING_RTSP_SESSION_ID]) {
```

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Future Work

- support for `C++` (gcc is ready)
- more front-ends (sparse, LLVM, . . .)
- we are going to build Bi-Abductive analyzer using the infrastructure
- we want to offer the infrastructure to other researchers (implies stabilisation of the API)

Summary

- an easy way to analyze real-world code
- solution based on gcc plug-ins
- compact C++ API
- suitable for tools that expect CFG on their input

- `http://www.fit.vutbr.cz/research/groups/verifit/tools/code-listener`