Cif - Information flow in C++

github.com/Teemperor/Cif

Raphael Isemann – Group 26 – 21.05.2018

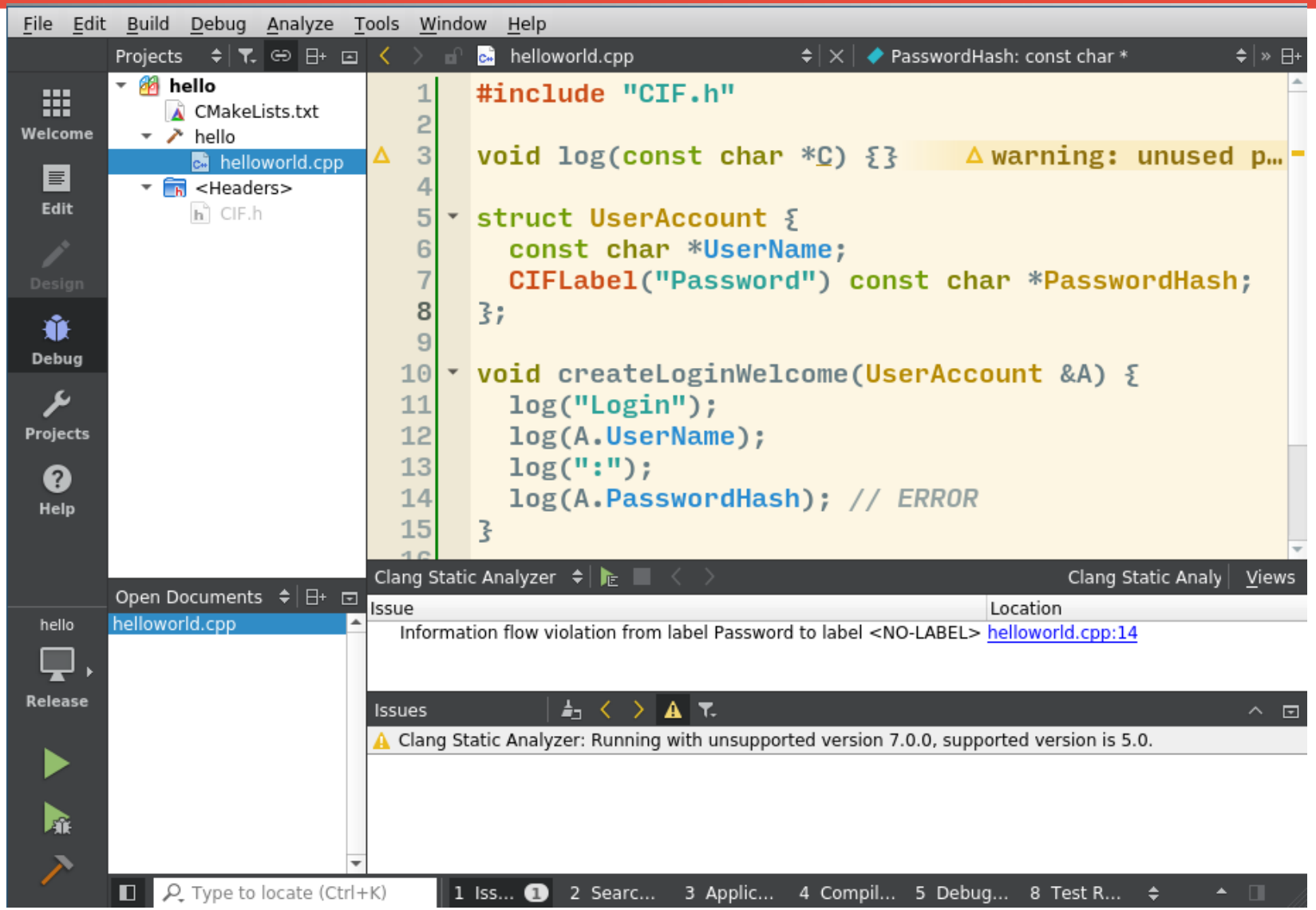
Cif - “Jif for C++”

- **brings information flow security to C++ and other C-languages.**
- **decentral label model + program verifier.**
- **Cif is inspired by Jif for Java, but**
  - is only enforcing information flow in static code, but not during runtime.
  - works with real modern code bases.
  - is actually normal C++, not a dialect like Jif/Java.
  - can be integrated into existing tooling (Qtcreator, Xcode, scan-build reports).
  - Doesn’t separate integrity/confidentiality concerns.

Simple Cif example

```
void log(const char *C);
struct UserAccount {
  const char *UserName;
  CIFLabel("Password") const char *PasswordHash;
};
void logLogin(UserAccount &A) {
  log("Login"); log(A.UserName);
  Log(":"); log(A.PasswordHash); // ERROR
}
```

Simple Cif example (QtCreator)



Using Clang for C-language tooling

- **The Cif verifier is implemented as a Clang static analyzer checker.**
- **Clang is the C-language frontend for LLVM.**
  - Widely used for compiling and analyzing code.
- **Clang supports “C-languages” like C, C++, Obj-C, Obj-C++, OpenCL and their dialects.**
  - Cif could support all of them!
  - But so far C/C++ language features are modelled.
- **Many tools support clang integration, so they also support Cif.**

The Cif verifier

- **Searches for information flow in the AST.**
- **Found flows are verified to follow information flow policy.**
- **Enforces direct flow in all kind of assignments**
  - In assignment operators, function calls, etc.
- **Enforces implicit flow**
  - Branching on a label: if(high) {…}
- **Only checks one translation unit at once.**
- **Analyzes a project while building it.**

Cif rules

- **Declarations can be labelled multiple labels (e.g. “A,B,Foo”)**
- **Flow only allowed if target is classified stronger or equal to the source.**
- **Classes inherit their labels to fields/subclasses.**
  - Class CIFLabel(“Pass”) PasswordManager { … };
- **Structs and “pure” classes can have dynamic labels.**
  - CIFLabel(“A”) std::vector<int> a;
- **Pure functions return combined labels of the passed arguments.**

Cif syntax

- **CIFLabel(“A,B”) int x;**
  - Assigns label to constructs like a variable declarations, parameter, function return parameter, class, struct, etc.
- **CIFDeclassify(“A→B”, x)**
  - Declassifies information in a controlled fashion.
- **CIFPure / CIFPureLIst**
  - Marks functions as pure.
  - Marks classes as containers with dynamic labels.
- **CIFOut**
  - Designates ‘out’ parameter for functions.
- **Implemented as macros, invisible for other CCs.**

Cif in the real world

- **Cif was tested on real projects like OpenSSH, Apache HTTPD, LigHTTPD, nginx.**
- **Didn’t found any vulnerabilities.**
- **But it did find suspicious code like this:**

```
ngx_log_debug3(NGX_LOG_DEBUG_HTTP, r->connection->log, 0,
                    "rc: %i user: \"%V\" salt: \"%s\"",
                    rc, &r->headers_in.user, passwd→data);
```

- **Code:** *github.com/Teemperor/CifExamples*