ELTE

Thematic Excellence Program

Industry and Digitalisation

Application Domain Specific Highly Reliable IT Solutions

# Static source code analysis and manipulation of Erlang programs

Melinda Tóth and István Bozó

Department of Programming Languages and Compilers,
Eötvös Loránd University (ELTE)
{toth_m, bozo_i}@inf.elte.hu

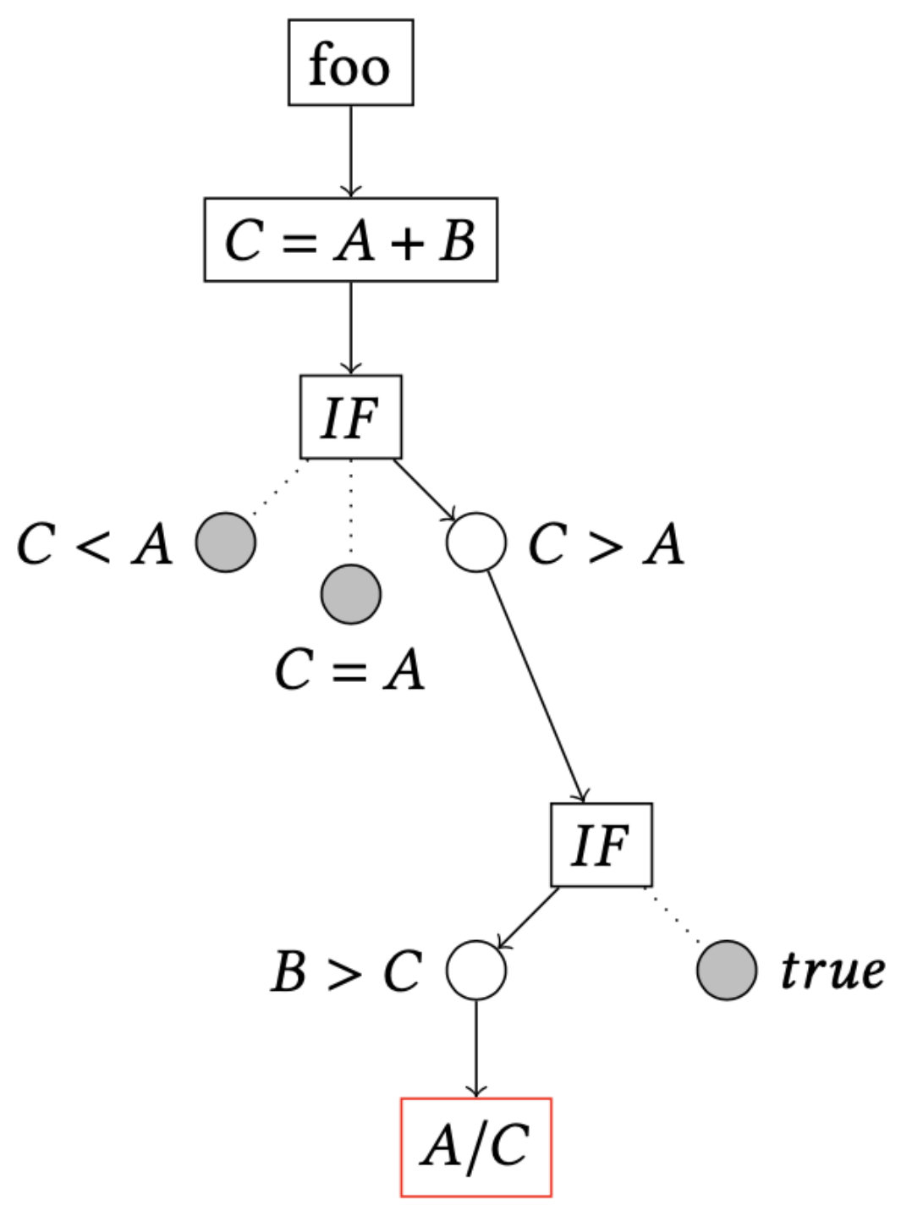
## RefactorErl

- Compile-time analyses designed for Erlang:
  - Lifetime, scope, visibility, reference analyses for semantic entities (functions, records, variables, etc.)
  - Side-effects, hidden dependencies
  - Data-flow, control-flow, dynamic function call
- Main features are
  - Understanding legacy code
  - Refactoring/Application restructuring
  - Code checking: complexity, quality, style, vulnerability, custom properties

## Code Checking with RefactorErl

Secure coding

- Find non-intentional software vulnerabilities in Erlang
  - Interoperability mechanism related vulnerabilities
  - Concurrent programming related issues
  - Distributed programming related issues
  - Injection
  - Memory overload related attacks
- How it works?
  - Determines the function call locations which are associated with unsecure operations.
  - Selects the functions parameters that can be associated with potential vulnerabilities.
  - Runs data-flow analysis on the sensitive parameters.
  - Flags parameters with unknown source.
  - Filters out functions provided by the users for input validation.
- Next improvements:
  - Optimizations and selection heuristics
  - False positive result reductions
  - New checkers

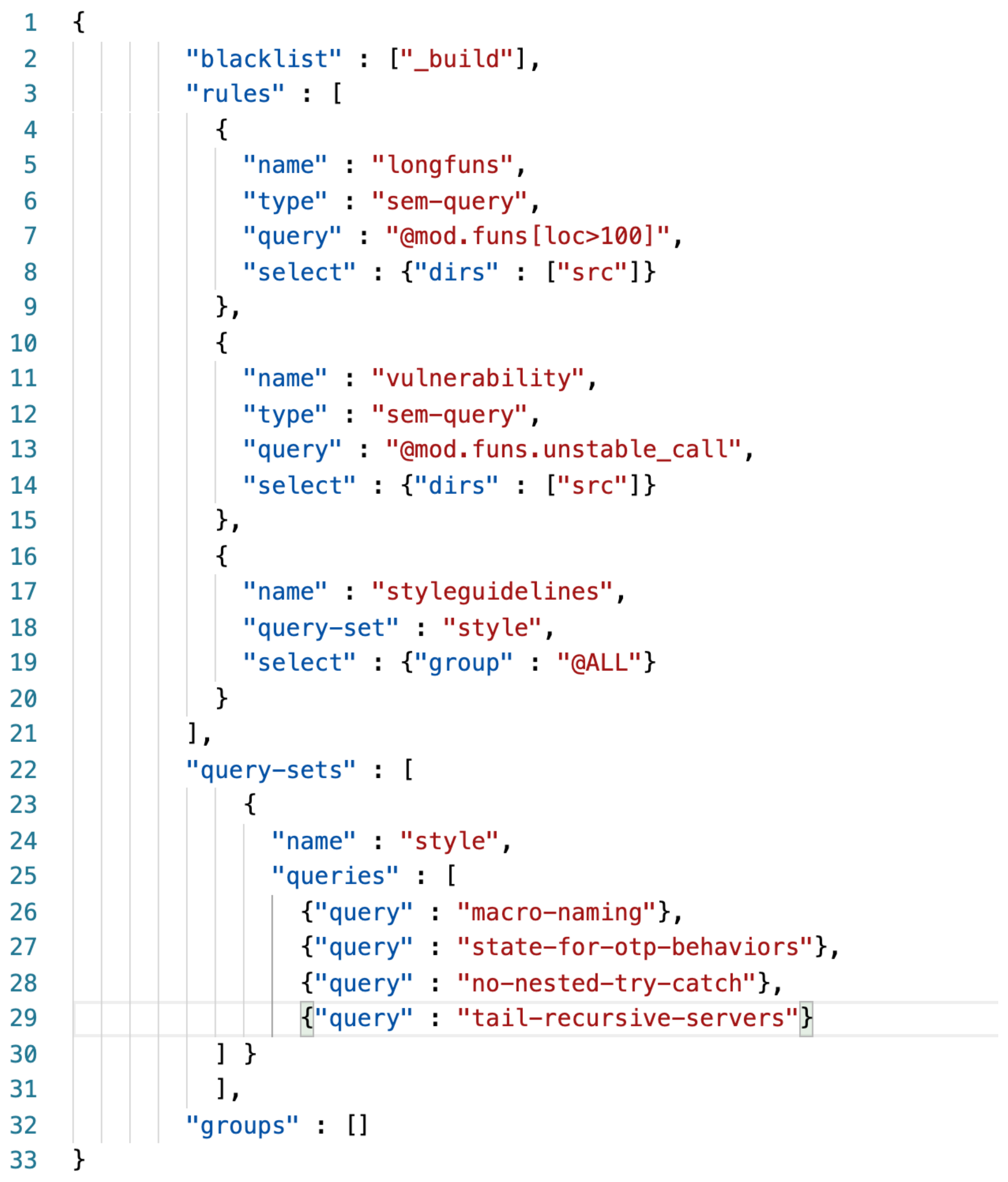


Code checking

- Through the Semantic Query Language
  - Helps also in debugging, grokking, learning
  - Built-in + custom
  - Works with the units of the language
  - `mods.funs.unstable_calls`
  - `mods.funs.unsecure_compile_operations`
- New DRC client
  - Focuses on automatic code checking
  - Easy to integrate and use
  - Input config
  - Connects to a running RefactorErl server
  - Custom output

Finding sources of runtime errors

- Control-flow based static execution paths selection
- Combined with direct symbolic execution
- Using the Z3 SMT solver on the generated constraints
- The runtime error compiled to a constraint
- Suggests execution path that leads to a runtime error



```
{
        "blacklist" : ["_build"],
        "rules" : [
          {
            "name" : "longfuns",
            "type" : "sem-query",
            "query" : "@mod.funs[loc>100]",
            "select" : {"dirs" : ["src"]}
          },
          {
            "name" : "vulnerability",
            "type" : "sem-query",
            "query" : "@mod.funs.unstable_call",
            "select" : {"dirs" : ["src"]}
          },
          {
            "name" : "styleguidelines",
            "query-set" : "style",
            "select" : {"group" : "@ALL"}
          }
        ],
        "query-sets" : [
            {
              "name" : "style",
              "queries" : [
                {"query" : "macro-naming"},
                {"query" : "state-for-otp-behaviors"},
                {"query" : "no-nested-try-catch"},
                {"query" : "tail-recursive-servers"}
          ] }
          ],
        "groups" : []
}
```

## Topics

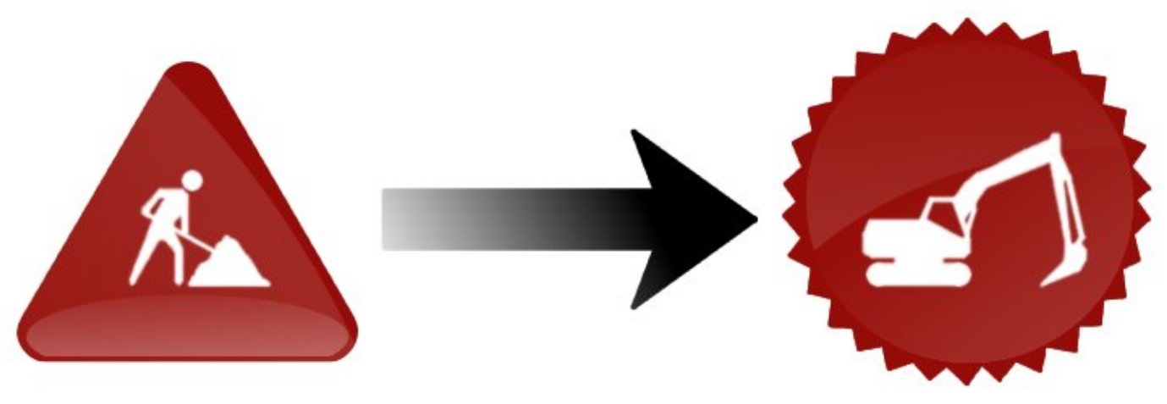
- Semantic queries
- Software complexity metrics
- Bad smell detection
- Duplicated code detection and elimination
- Clustering - software restructuring
- Dependency visualisation
- Secure programming
- Communication/process analyses
- Decompilation
- Pattern candidate discovery and parallelisation
- Program slicing for test case selection
- OTP behaviour analyses
- Distributed software analysis and manipulation
- Improving the “functional style” of the code
- Merging static and dynamic analyses
- Green computing

## Why to use it?

Key benefits for industrial partners

- Shorten learning term of a newcomer
- Shorten bug report solution time
- Make the possibility of a better team work
- Support software delivery product line
- Increase code quality through reducing faults
- Shorten time-consuming daily jobs, such as the source code checking
- Supports secure coding

Effective software maintenance



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