Declarative Code Analysis

Existing Solutions, Challenges and Research Directions

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Declarative Code Analysis

What is the goal of analysis?

- **?** Analytics
- **?** Vulnerability detection
- **?** Code smells detection
- **?** ...

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- ? Analysis specification language
- ? Advanced topics
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- Relational database
- Graph database
- Custom problem-specific storage

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- Datalog-like language
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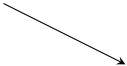

Analysis specification language

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Advanced topics

- Dynamic data analysis (incremental analysis)
- Results analysis
- Query debugging
- ...

Infer (Facebook)

- `https://fbinfer.com/`
- General-purpose static code analysis
- Separation logic + abstract interpretation
  - Modular engine
  - Program API (OCaml)
  - Predefined analysis

CodeQL (GitHub/Microsoft)

- https://codeql.github.com/

NG SAST (ShiftLeft)

- `https://www.shiftleft.io/`
- Static application security testing (vulnerability detection)
- Ocular (Joern) as a graph storage and query engine
  - Custom graph database
  - Custom graph query language

Soufflé (Oracle Labs/The University of Sydney)

- `https://souffle-lang.github.io/index.html`
- General-purpose static code analysis
- Logic programming language inspired by Datalog
  - Translation to C++
  - Can use external storages for relations

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- General-purpose static code analysis
- Logic programming language inspired by Datalog
  - Translation to C++
  - Can use external storages for relations
- Query debugging and results analysis (provenance)
- Incrementalization
- Cloud infrastructure

IncA (Johannes Gutenberg University Mainz)

- `https://github.com/szabta89/IncA`
- Incremental static code analysis framework
- Datalog-like DSL
- Aimed to provide IDE-level incremental analysis

ProgQuery

- `https://github.com/OscarRodriguezPrieto/ProgQuery`
- An Efficient and Scalable Platform for Java Source Code Analysis Using Overlaid Graph Representations (2020)
- Neo4j-based
  - Cypher query language
  - Gremlin API
  - Java native API
- Evaluation shows (see paper above)
  - Can be more expressive than CodeQL and other tools
  - Can demonstrates better performance than CodeQL and other tools

Conclusion

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- Graph database can be an appropriate storage (even Neo4j)
- There is no production ready solutions for IDE-level declarative code analysis
- Incremental analysis is a nontrivial challenge
- Query debugging and results analysis is a nontrivial challenge

Challenges/Research Directions

- Graph databases evaluation
  - Code analysis related scenarios
  - Graph representations comparison
  - Low-level API comparison

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  - Incremental view maintenance
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- Dynamic data analysis
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- Query debugging and results analysis
  - Appropriate data structures
  - Quick fixes
  - ...