## Chapter 1

## Table of contents

- 1 Introduction
  - 1.1 Motivation
    - \* 1.1.1 Problem Definition
  - 1.2 Research Questions
  - 1.3 Non-Goals
  - 1.4 Research Methodology
  - 1.5 Structure of the thesis
- 2 Background
  - 2.1 Language Server Protocol
    - \* 2.1.1 JSON-RPC
    - \* 2.1.2 Commands and Notifications
      - $\cdot$  2.1.2.1 Code Completion
      - · 2.1.2.2 Hover
      - · 2.1.2.3 File Notification
      - · 2.1.2.4 Hover
      - $\cdot$  2.1.2.5 Completion
      - · 2.1.2.6 Go-To-\*
      - · 2.1.2.7 Symbols
      - · 2.1.2.8 code lenses
    - \* 2.1.3 Shortcomings
  - 2.2 Configuration programming languages
    - \* 2.2.1 Infrastructure as Code
    - \* 2.2.2 Nickel
      - $\cdot$  2.2.2.1 Gradual typing
      - $\cdot$  2.2.2.2 Contracts
      - $\cdot$  2.2.2.3 Nickel AST
- 3 Related work
  - 3.1 Previous Approaches
    - $* \ 3.1.1 \ \mathrm{IDEs}$
    - \* 3.1.2 IDE Abstraction
      - · 3.1.2.1 Monto
      - $\cdot$  3.1.2.2 Merlin
  - 3.2 Language Servers

- \* 3.2.1 Considerable dimensions
- \* 3.2.2 Representative LSP Projects
  - · 3.2.2.1 Integrating with the Compiler/Runtime
  - $\cdot~3.2.2.2$  Runtime independent LSP implementations
  - · 3.2.2.3 Language Server as an Interface to CLI tools
  - $\cdot\,$  3.2.2.4 Language Servers generation for Domain Specific Languages
- 3.3 Alternative approaches
  - \* 3.3.1 LSP Extensions
  - \* 3.3.2 Language Server Index Format
  - \* 3.3.3 \*SP, Abstracting software development processes
- 4 Design and Implementation
  - 4.1 Key Objectives
    - \* 4.1.1 Performance
    - \* 4.1.2 Capability
    - \* 4.1.3 Flexibility
    - \* 4.1.4 Generalizability
  - 4.2 Design Decisions
    - \* 4.2.1 Programming language
    - \* 4.2.2 File processing
    - \* 4.2.3 Code Analysis
  - 4.3 High-Level Architecture
  - 4.4 Illustrative example
  - 4.5 Linearization
    - \* 4.5.1 States
    - \* 4.5.2 Transfer from AST
      - $\cdot$  4.5.2.1 Usage Graph
      - · 4.5.2.2 Scopes
      - $\cdot$  4.5.2.3 Linearizer
      - · 4.5.2.4 Linearization Process
    - \* 4.5.3 Post-Processing
      - · 4.5.3.1 Sorting
      - · 4.5.3.2 Resolving deferred access
      - · 4.5.3.3 Resolving types
    - \* 4.5.4 Resolving Elements
      - · 4.5.4.1 Resolving by position
      - · 4.5.4.2 Resolving by ID
      - · 4.5.4.3 Resolving by scope
  - 4.6 LSP Server Implementation
    - \* 4.6.1 Server Interface
    - $\ast$  4.6.2 Diagnostics and Caching
    - \* 4.6.3 Commands
      - · 4.6.3.1 Hover
      - · 4.6.3.2 Jump to Definition and Show references
      - $\cdot$  4.6.3.3 Completion
      - $\cdot$  4.6.3.4 Document Symbols
- 5 Evaluation
  - 5.1 Evaluation Considerations
  - 5.2 Methods
    - \* 5.2.1 Objectives

- \* 5.2.2 Qualitative
  - $\cdot~$  5.2.2.1 Pre-Evaluation
  - $\cdot~$  5.2.2.2 Experience Survey
- \* 5.2.3 Quantitative
- 5.3 Process
- 5.4 Results
  - \* 5.4.1 Qualitative
  - \* 5.4.2 Quantitative
- 6 Discussion

  - $\begin{array}{l} -\ 6.1\ \mathrm{Project\ results} \\ -\ 6.2\ \mathrm{Project\ shortcomings} \end{array}$
  - 6.3 Future Work