

Arugula



A Programming Language for Describing Human Errors

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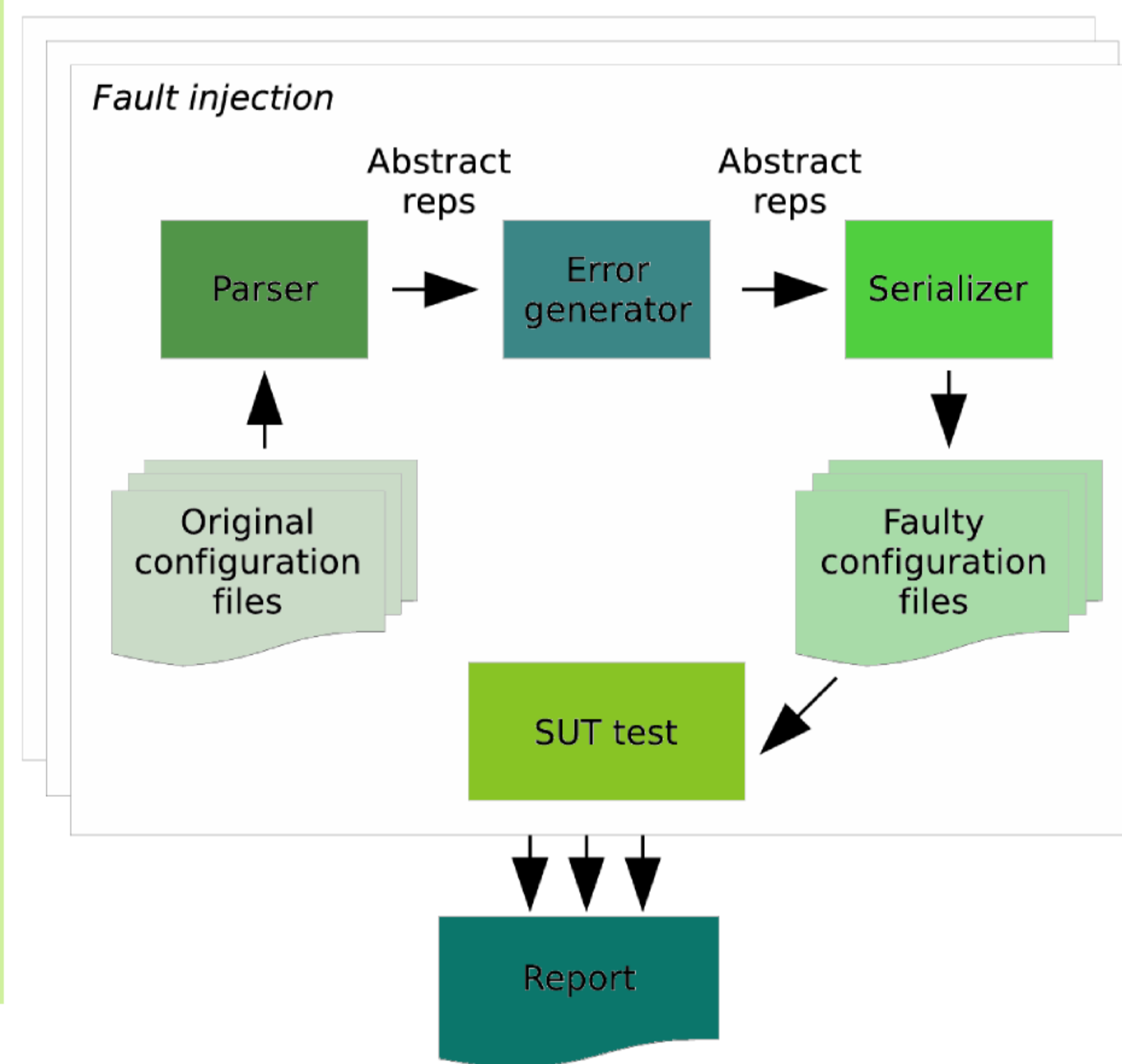
Abstract

ConfErr is a tool for testing and quantifying the reaction of software systems to **human-induced configuration mutations**.

Configuration mutations are the result of human error. ConfErr uses **human error models** rooted in psychology and linguistics to generate realistic configuration mistakes.

ConfErr injects these mistakes and measures their effects, producing a **resilience profile** of the system under test (i.e., how sensitive the program is).

ConfErr Design



How People Err

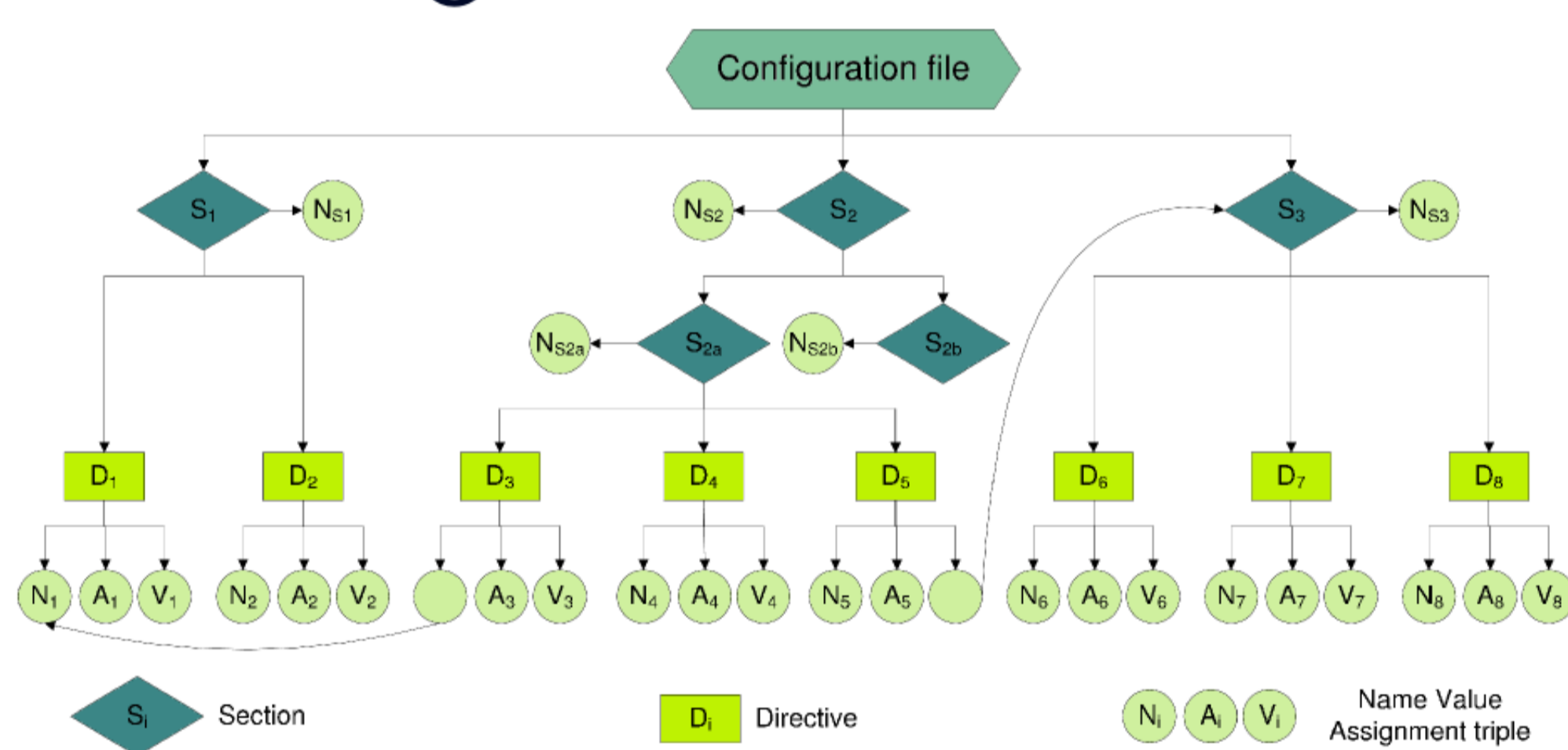
There are **3 types** of configuration errors.

Typing mistakes: typos (letter omissions, insertions, substitutions, transpositions), false concept ("yes" instead of "true"), and false knowledge ("colour" vs "color").

Structural errors: inattention-errors (wrong copy-paste, forgotten sections), similarity errors (borrowing configuration parts from other systems).

Semantic errors: misunderstanding how the system works (e-mail field contains the wrong person's address)

Configuration Files

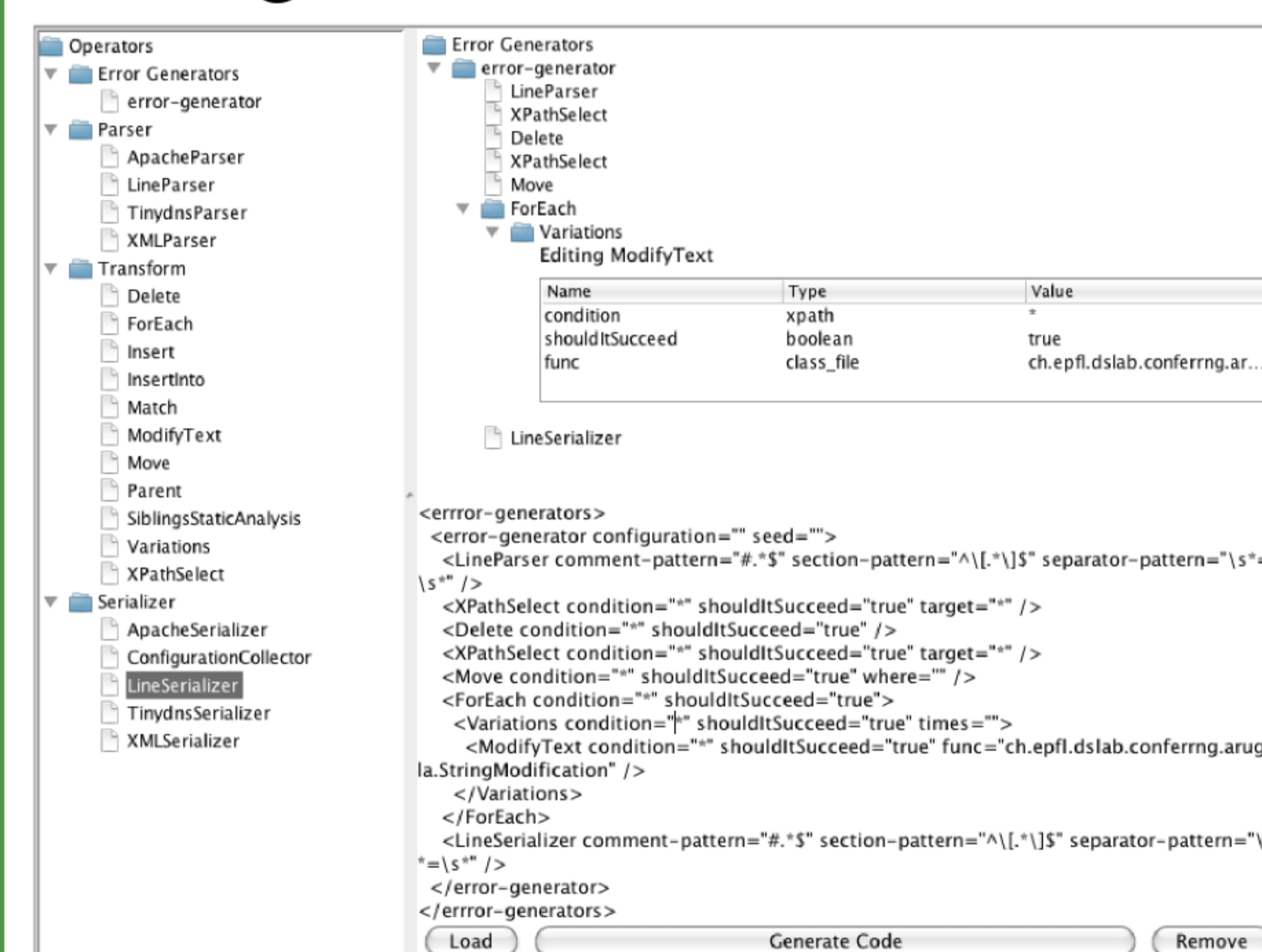


ConfErr represents a configuration file as a **Directed Acyclic Graph (DAG)**.

Leaves contain text information; **inner nodes** describe configuration structure.

A **directive** is a triple {name, separator, value}, while a **section** is a collection of directives.

Arugula



Easy to write *human error generators*.
Error generators are *program independent*.
Makes human errors *reproducible*.
A basis for *resilience benchmarks*.

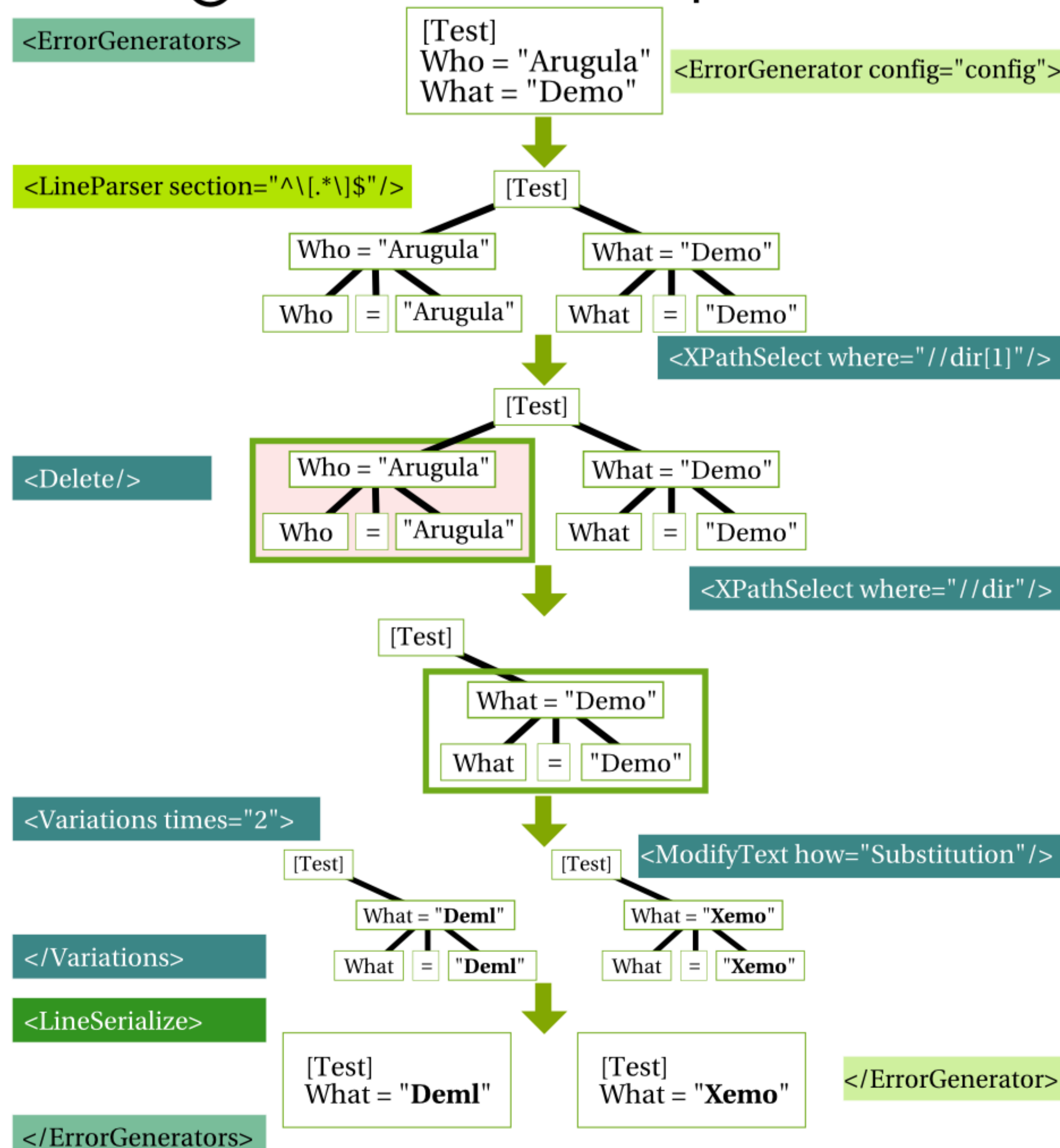
Arugula Operators

An Arugula Operator → →



Operator	Description
Parse	Generate abstract representation
XPathSelect	Select nodes based on XPath expr.
Match	Select nodes based on reg. expr.
Delete	Remove nodes from input
InsertInto	Copy nodes
Insert	Add children to input nodes
ModifyText	Transform text representation
ForEach	Transform each node separately
Variations	Transform multiple times
Serialize	Generate concrete config. files

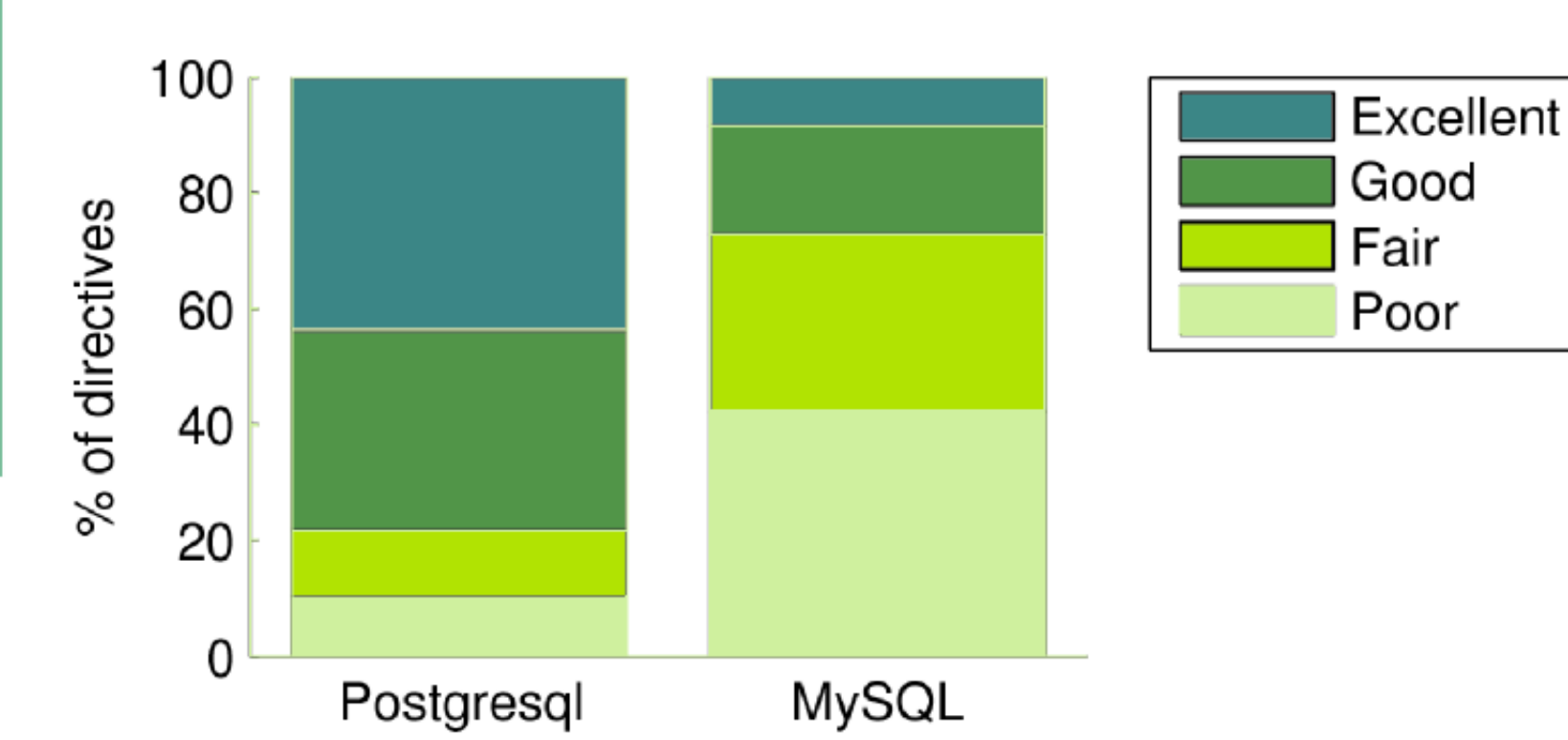
Arugula Example



Results

Experiment	MySQL	Postgres	Apache
# Errors	327	98	120
Detected at start-up	270 (83%)	76 (78%)	46 (38%)
Detected by tests	1 (<0.1%)	0 (0%)	6 (5%)
Total	271 (83%)	76 (78%)	52 (43%)

Resilience to typos. Comparison



Special Features

Generic error injection. Arugula can inject a category of errors to inject. To inject all typos, the parameter to *ModifyText* will be *StringModification* (ancestor of all typos). Whenever new typos are added, they will **automatically** be used by ConfErr.

Detect new directives/section names. Arugula provides an operator that searches through a program to find **siblings of known directives**.

