Gin and PyGGI: General Frameworks for Genetic Improvement

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CREST
Genetic Improvement

- Software
- Software variant 1
- Software variant 2
- Software variant n
- Improver Software

- Mutate
- Search
- Select
Genetic Improvement

Functional Properties
- New Feature
- Functionality Improvement
- Bug Repair

Non-functional Properties
- Execution Time
- Memory
- Bandwidth
- Energy
- Size
Automated Software Transplantation

Idea: add a new feature to the software by transplanting it from a different piece of software

Genetic Improvement Frameworks

**Gin** [https://github.com/gintool/gin](https://github.com/gintool/gin)

**PyGGI** [https://github.com/coinse/pyggi](https://github.com/coinse/pyggi)
Select a program

**jcodec**: a library implementing a set of popular video and audio codecs” (98k LoC)

**junit4**: a framework to write repeatable tests (11k LoC)
Download gin

Demo
Match test cases to methods

gin.util.Profiler Demo
Select improvement objective

improve runtime

repair
Select edit type

line

statement

matched_statement (restrict to AST nodes of the same type)
modify_statement (Binary and Unary operator replacement)
Search Strategy

Genetic Programming
Population size?
Number of generations?

2

3
Let’s generate some patches..

Demo
Gin 🍹

An extensible and modifiable toolbox for GI experimentation

Automatically transforms, builds, and tests Java projects

Supports automated test-generation & source code profiling

Scales to large real-world projects

3 options for running tests

Support for Maven & Gradle projects

Automated test case generation & runtime manipulation

Detailed reports on JUnit test results
Triangle classification problem

input: $a, b, c$

output:

equilateral

isosceles

scalene

not a triangle

$a + b \leq c$

$a + c \leq b$

$b + c \leq a$
Triangle Demo

gin.util.DeleteEnumerator Demo
First results:

**Gson**: a java library that converts Java objects to JSON and vice-versa

Gin fixed injected bugs

Gin found an edit that improved runtime

PyGGI

Python General Genetic Improvement Framework

Supports line- & statement-level changes

Copy/delete/replace/move supported

Short scripts needed to run

PyGGI 🐖

XML tree representation

Supports multiple programming languages (inc. Python)

Build-in support for srcML (C++, C, C#, Java)
PyGGI

Demo
Bug fixes found

Previous results on runtime improvement replicated

Genetic Improvement Frameworks

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