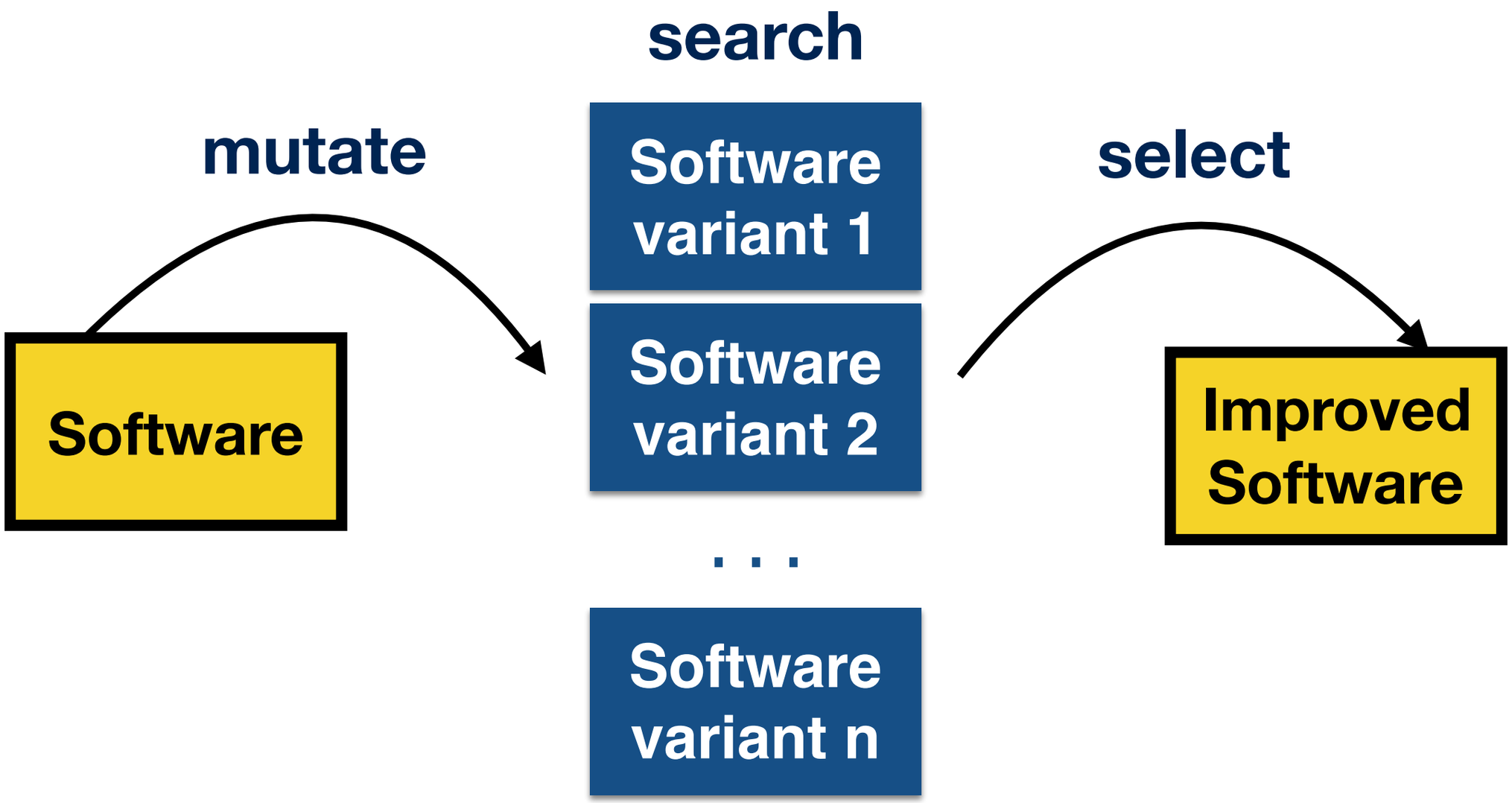
Gin and PyGGI: General Frameworks for Genetic Improvement

Justyna Petke

CREST UCL

EPSRC

Genetic Improvement



Genetic Improvement

Functional Properties

New Feature

Functionality Improvement

Bug Repair

Non-functional Properties

Execution Time

Memory

Bandwidth

Energy

Size

EPSRC

Automated Software Transplantation

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

“Automated Software Transplantation”; Earl T. Barr, Mark Harman, Yue Jia, Alexandru Marginean & Justyna Petke; 24th International Symposium on Software Testing and Analysis (ISSTA 2015)

Genetic Improvement Frameworks

Gin https://github.com/gintool/gin

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)

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Download gin

Demo

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Match test cases to methods

gin.util.Profiler Demo

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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

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Population size?

1

2

3

4

5

6

7

8

9

10

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Number of generations?

2

3

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Let’s generate some patches..

Demo

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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

Alexander E. I. Brownlee, Justyna Petke, Brad Alexander, Earl T. Barr, Markus Wagner, David R. White: “Gin: genetic improvement research made easy”, Genetic and Evolutionary Computation Conference (GECCO 2019)

EPSRC

Gin 

3 options for running tests

Support for Maven & Gradle projects

Automated test case generation & runtime manipulation

Detailed reports on JUnit test results

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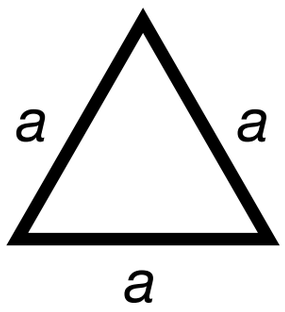
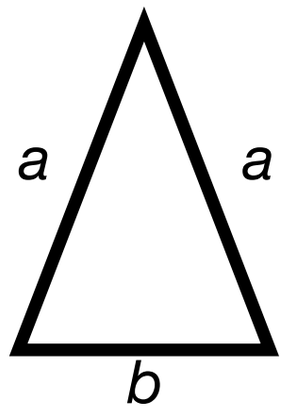
Triangle classification problem

input: *a, b, c*

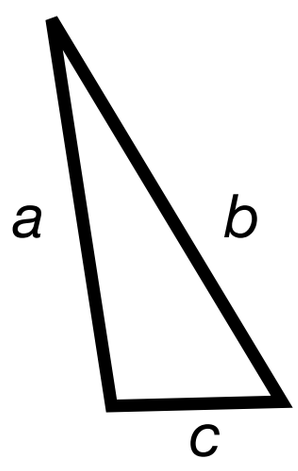
output:



equilateral



isosceles



scalene

$a + b <= c$
&
$a + c <= b$
&
$b + c <= a$

not a triangle

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Triangle Demo

gin.util.DeleteEnumerator Demo

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Gin 

First results:

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

Gin fixed injected bugs

Gin found an edit that improved runtime

Justyna Petke, Alexander E. I. Brownlee: Software Improvement with Gin: A Case Study. Symposium on Search Based Software Engineering (SSBSE 2019)

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PyGGI 

Python General Genetic Improvement Framework

Supports line- & statement-level changes

Copy/delete/replace/move supported

Short scripts needed to run

Gabin An, Aymeric Blot, Justyna Petke, Shin Yoo: "PyGGI 2.0: Language Independent Genetic Improvement Framework”, European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE 2019)

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PyGGI 

XML tree representation

Supports multiple programming languages (inc. Python)

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

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PyGGI 

Demo

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PyGGI 

Bug fixes found

Previous results on runtime improvement replicated

Gabin An, Aymeric Blot, Justyna Petke, Shin Yoo: "PyGGI 2.0: Language Independent Genetic Improvement Framework”, European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE 2019)

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