STARTS:
STAtic Regression Test Selection

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Regression Testing

• Rerun tests after every change to check that existing functionality is not broken

• RetestAll: run all tests after each change

Problem: RetestAll can be slow especially when there are many tests!
Regression Test Selection (RTS)

• RTS speeds up regression testing by rerunning only tests that are affected by the code changes.
• End-to-end time for RTS steps must be less than time to rerun all tests.
STARTS

• STARTS is an RTS tool that finds dependencies \textit{statically}
  • Dynamic may be too slow, or infeasible in some settings

• We implemented STARTS as a Maven plugin

• STARTS source code is publicly-available on GitHub:
  • https://github.com/TestingResearchIllinois/starts
STARTS Architecture

Old Checksums
Old Dependencies

New classfiles

List of all test classes

Old Checksums
Old Dependencies

Checksum Comparator

Changed Types

Checksum Finder

New Checksums

Impacted Test Finder

Impacted Tests

Test Runner

mvn starts:select

mvn starts:starts

jdeps

Type-level Dependencies

Dependency Updater

New Checksums
New Dependencies

yasgl

Type-Dependency Graph

mvn starts:diff
STARTS: Finding Changes

mvn starts:diff
Find changes since last time STARTS was run

Old Checksums
Old Dependencies

Old Checksums
Old Dependencies

New Classfiles

Checksum Comparator
Changed Types

Checksum Finder
New Checksums

New Checksums

New Checksums
STARTS: Selecting Impacted Tests

mvn starts:select
Select impacted tests without running them

```
Old Checksums
Old Dependencies
List of all Test Classes
Changed Types
Impacted Test Finder
```

```
Impacted Tests
```

```
T1

T2

T3

T4

A
B
C
D
E
F
```
STARTS: Running Impacted Tests

mvn starts:starts
Select and run impacted tests

Old Checksums
Old Dependencies
List of all Test Classes

Changed Types

Impacted Test Finder

Impacted Tests

Test Runner

T1
T2
T3
T4
STARTS: Updating for the Next Run

**jdeps** is part of the standard JDK and quickly finds direct class dependencies.

**yasgl** is our custom graph library for computing the transitive closure.
Results on 840 versions of 32 GitHub projects

<table>
<thead>
<tr>
<th></th>
<th>Tests (#)</th>
<th>Selected Tests (#)</th>
<th>Selected Tests (%)</th>
<th>RetestAll Time (s)</th>
<th>STARTS Time (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg (SHORT)</td>
<td>58.0</td>
<td>16.4</td>
<td>32.4</td>
<td>17.6</td>
<td>87.8</td>
</tr>
<tr>
<td>Avg (LONG)</td>
<td>155.9</td>
<td>54.1</td>
<td>40.5</td>
<td>236.8</td>
<td>68.2</td>
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<tr>
<td>Avg (OVERALL)</td>
<td>91.7</td>
<td>29.4</td>
<td>35.2</td>
<td>93.0</td>
<td>81.0</td>
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</tbody>
</table>

STARTS is more effective for longer-running projects

<table>
<thead>
<tr>
<th></th>
<th>STARTS Breakdown (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>analysis</td>
</tr>
<tr>
<td>Avg (SHORT)</td>
<td>1.0</td>
</tr>
<tr>
<td>Avg (LONG)</td>
<td>0.8</td>
</tr>
<tr>
<td>Avg (OVERALL)</td>
<td>0.9</td>
</tr>
</tbody>
</table>

STARTS analysis and graph construction time is relatively efficient
Conclusions

• STARTS is a publicly-available, purely static, class-level regression test selection tool
• We are investigating ways to make STARTS safer
  • Maybe also more precise?
• STARTS is available on GitHub
  • https://github.com/TestingResearchIllinois/starts