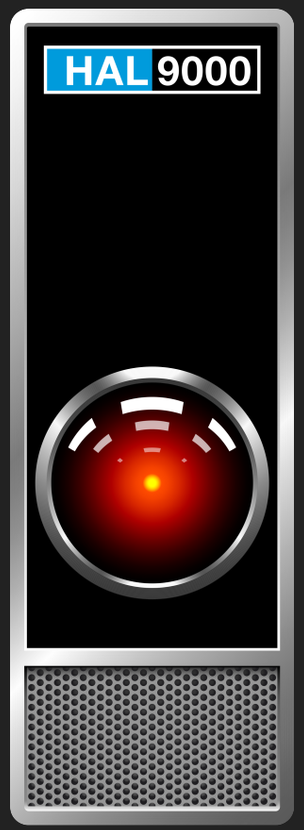
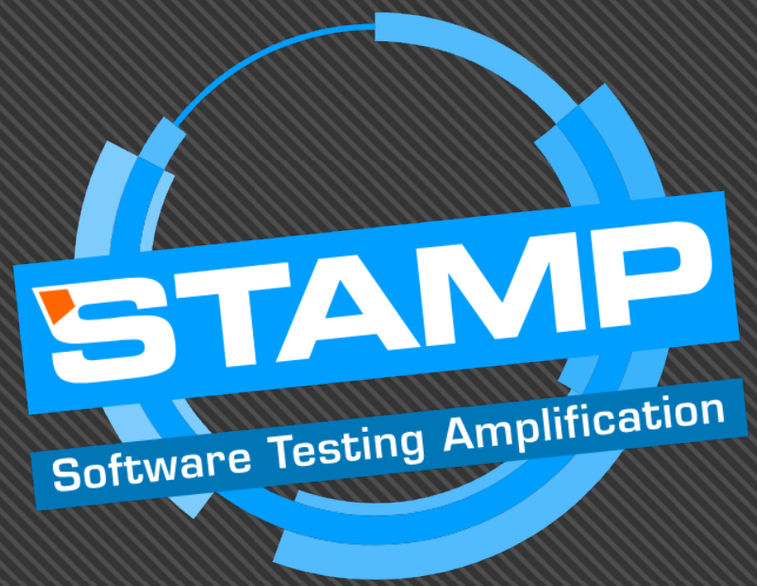


POURIA DERAKHSHANFAR
XAVIER DEVROEY
ANNIBALE PANICHELLA
ANDY ZAIDMAN
ARIE VAN DEURSEN

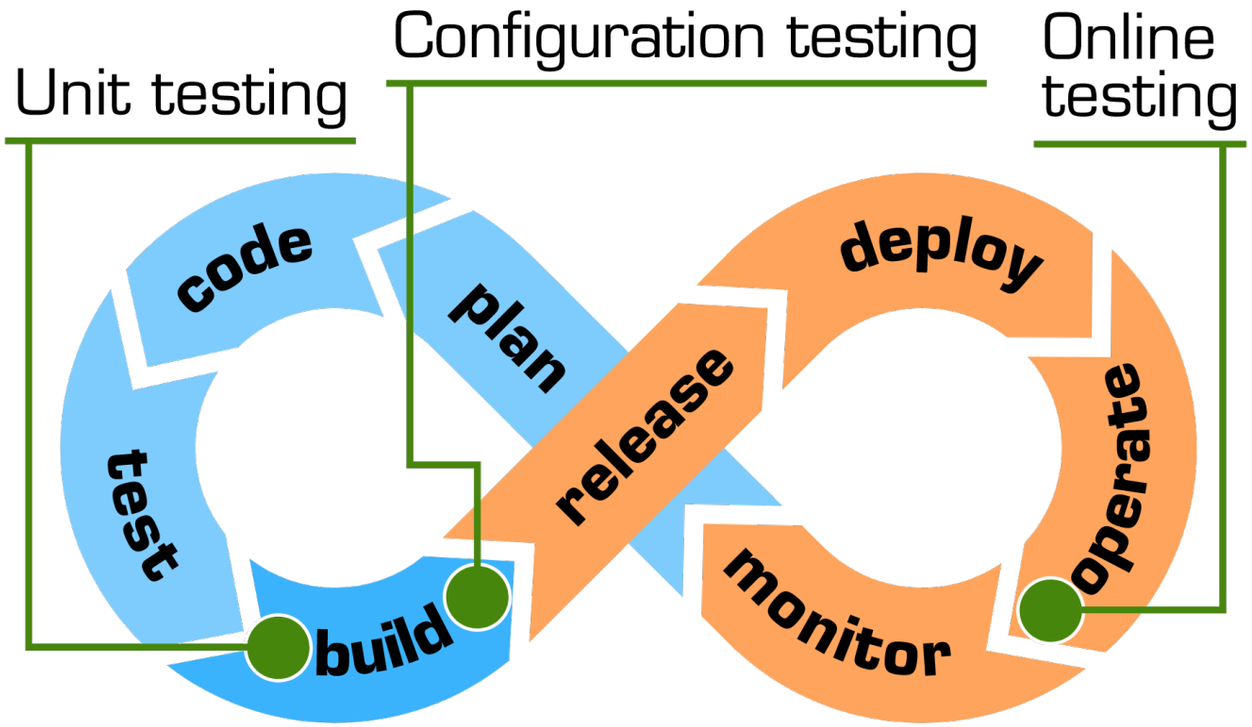
AI FOR TEST GENERATION

STAMP
Software Testing Amplification

TU Delft



European Commission



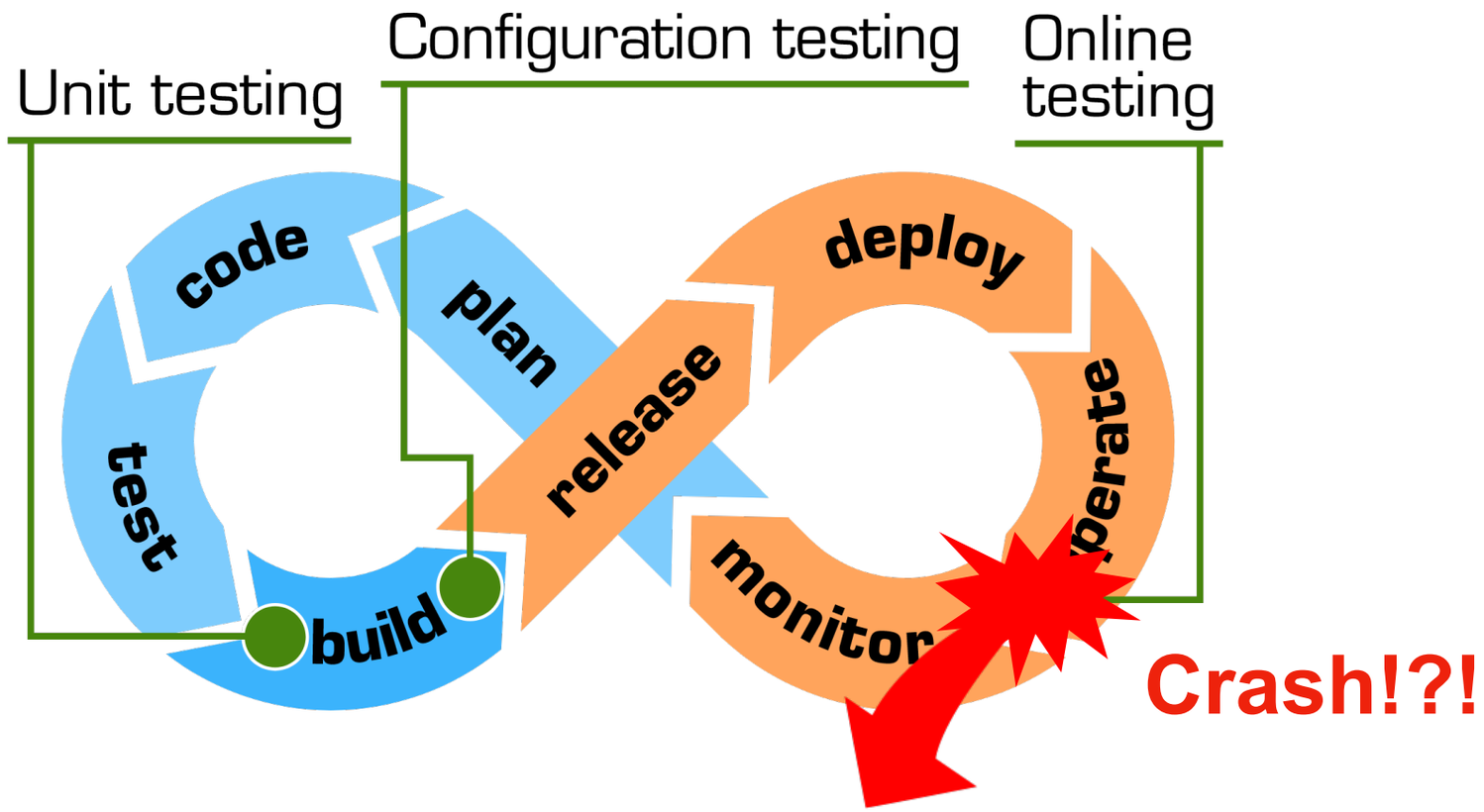
Activeeon SCALE BEYOND LIMITS
Atos
ENGINEERING
Inria INVENTORS FOR THE DIGITAL WORLD
KTH VETENSKAP OCH KONST
OW2
SINTEF
tell.u
TU Delft
X-WIKI THE BEST WAY TO ORGANIZE INFORMATION

TU Delft

GENERATE A CRASH REPRODUCING TEST WITH **BOTSING**

CRASH REPRODUCTION

TU Delft




```
java.lang.ClassCastException: […]
   at org…..SolrEntityReferenceResolver.getWikiReference(....java:93)
   at org…..SolrEntityReferenceResolver.getEntityReference(….java:70)
   at org…..SolrEntityReferenceResolver.resolve(….java:63)
   at org…..SolrDocumentReferenceResolver.resolve(….java:48)
   at …
```

STAMP Software Testing Amplification

TU Delft

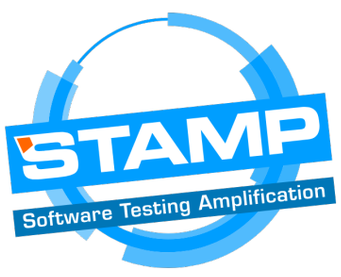
Description

To reproduce:

- start a fresh jetty/hsqldb 7.4
- login with Adim
- go to administration
- enable multilanguag
- put "en, fr" (with the white space) in supported languages property
- save

You end up with the following error in the log:

```
2016-01-25 14:14:32,866 [http://127.0.0.1:8080/xwiki/bin/saveandcontinue/XWiki/XWikiPreferences] ERROR rIndexAvailab
org.apache.solr.client.solrj.SolrServerException: java.lang.RuntimeException: java.lang.ClassCastException: org.apacl
        at org.apache.solr.client.solrj.embedded.EmbeddedSolrServer.request(EmbeddedSolrServer.java:240) ~[solr-core·
        at org.apache.solr.client.solrj.SolrRequest.process(SolrRequest.java:135) ~[solr-solrj-5.3.1.jar:5.3.1 17034·
        at org.apache.solr.client.solrj.SolrClient.queryAndStreamResponse(SolrClient.java:1021) ~[solr-solrj-5.3.1.j
        at org.apache.solr.client.solrj.SolrClient.queryAndStreamResponse(SolrClient.java:1046) ~[solr-solrj-5.3.1.j
        at org.xwiki.search.solr.internal.AbstractSolrInstance.queryAndStreamResponse(AbstractSolrInstance.java:127)
        at org.xwiki.search.solr.internal.SolrIndexAvailableLocalesListener.onEvent(SolrIndexAvailableLocalesListene:
        at org.xwiki.observation.internal.DefaultObservationManager.notify(DefaultObservationManager.java:304) [xwik:
        at org.xwiki.observation.internal.DefaultObservationManager.notify(DefaultObservationManager.java:269) [xwik:
        at com.xpn.xwiki.XWiki.saveDocument(XWiki.java:1586) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at com.xpn.xwiki.web.SaveAction.save(SaveAction.java:181) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at com.xpn.xwiki.web.SaveAndContinueAction.doWrappedAction(SaveAndContinueAction.java:98) [xwiki-platform-le
        at com.xpn.xwiki.web.SaveAndContinueAction.action(SaveAndContinueAction.java:195) [xwiki-platform-legacy-old
        at com.xpn.xwiki.web.XWikiAction.execute(XWikiAction.java:416) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at com.xpn.xwiki.web.XWikiAction.execute(XWikiAction.java:184) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at org.apache.struts.action.RequestProcessor.processActionPerform(RequestProcessor.java:425) [struts-core-1.
        at org.apache.struts.action.RequestProcessor.process(RequestProcessor.java:228) [struts-core-1.3.10.jar:1.3.
        at org.apache.struts.action.ActionServlet.process(ActionServlet.java:1913) [struts-core-1.3.10.jar:1.3.10]
        at org.apache.struts.action.ActionServlet.doPost(ActionServlet.java:462) [struts-core-1.3.10.jar:1.3.10]
        at javax.servlet.http.HttpServlet.service(HttpServlet.java:707) [javax.servlet-api-3.1.0.jar:3.1.0]
        at javax.servlet.http.HttpServlet.service(HttpServlet.java:790) [javax.servlet-api-3.1.0.jar:3.1.0]
        at org.eclipse.jetty.servlet.ServletHolder.handle(ServletHolder.java:808) [jetty-servlet-9.2.13.v20150730.ja
```



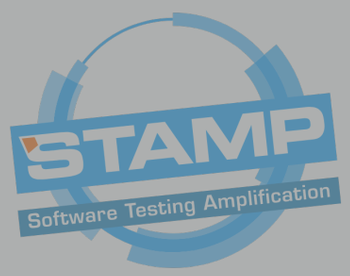
Description

To reproduce:

- start a fresh jetty/hsqldb 7.4
- login with Adim
- go to administration
- enable multilanguag
- put "en, fr" (with the white space) in supported languages property
- save

You end up with the following error in the log:

```
2016-01-25 14:14:32,866 [http://127.0.0.1:8080/xwiki/bin/saveandcontinue/XWiki/XWikiPreferences] ERROR rIndexAvailab
org.apache.solr.client.solrj.SolrServerException: java.lang.RuntimeException: java.lang.ClassCastException: org.apacl
        at org.apache.solr.client.solrj.embedded.EmbeddedSolrServer.request(EmbeddedSolrServer.java:240) ~[solr-core
        at org.apache.solr.client.solrj.SolrRequest.process(SolrRequest.java:135) ~[solr-solrj-5.3.1.jar:5.3.1 17034
at org.apache.solr.client.solrj.SolrClient.queryAndStreamResponse(SolrClient.java:1021) ~[solr-solrj-5.3.1.j
at org.apache.solr.client.solrj.SolrClient.queryAndStreamResponse(SolrClient.java:1046) ~[solr-solrj-5.3.1.j
at org.xwiki.search.solr.internal.AbstractSolrInstance.queryAndStreamResponse(AbstractSolrInstance.java:127)
at org.xwiki.search.solr.internal.SolrIndexAvailableLocalesListener.onEvent(SolrIndexAvailableLocalesListene
at org.xwiki.observation.internal.DefaultObservationManager.notify(DefaultObservationManager.java:304) [xwik
at org.xwiki.observation.internal.DefaultObservationManager.notify(DefaultObservationManager.java:269) [xwik
at com.xpn.xwiki.XWiki.saveDocument(XWiki.java:1586) [xwiki-platform-legacy-oldcore-7.4.jar:na]
at com.xpn.xwiki.web.SaveAction.save(SaveAction.java:181) [xwiki-platform-legacy-oldcore-7.4.jar:na]
at com.xpn.xwiki.web.SaveAndContinueAction.doWrappedAction(SaveAndContinueAction.java:98) [xwiki-platform-le
at com.xpn.xwiki.web.SaveAndContinueAction.action(SaveAndContinueAction.java:195) [xwiki-platform-legacy-old
at com.xpn.xwiki.web.XWikiAction.execute(XWikiAction.java:416) [xwiki-platform-legacy-oldcore-7.4.jar:na]
at com.xpn.xwiki.web.XWikiAction.execute(XWikiAction.java:184) [xwiki-platform-legacy-oldcore-7.4.jar:na]
at org.apache.struts.action.RequestProcessor.processActionPerform(RequestProcessor.java:425) [struts-core-1.
at org.apache.struts.action.RequestProcessor.process(RequestProcessor.java:228) [struts-core-1.3.10.jar:1.3.
at org.apache.struts.action.ActionServlet.process(ActionServlet.java:1913) [struts-core-1.3.10.jar:1.3.10]
at org.apache.struts.action.ActionServlet.doPost(ActionServlet.java:462) [struts-core-1.3.10.jar:1.3.10]
at javax.servlet.http.HttpServlet.service(HttpServlet.java:707) [javax.servlet-api-3.1.0.jar:3.1.0]
at javax.servlet.http.HttpServlet.service(HttpServlet.java:790) [javax.servlet-api-3.1.0.jar:3.1.0]
```



Description

To reproduce:

- start a fresh jetty/hsqldb 7.4
- login with Adim
- go to administration
- enable multilanguag
- put "en, fr" (with the white space) in supported languages property
- save

You end up with the following error in the log:

```
2016-01-25 14:14:32,866 [http://127.0.0.1:8    /xwiki/bin/saveandcontinue/XWiki/XWikiPreferences] ERROR rIndexAvailab
org.apache.solr.client.solrj.SolrServerExce    on: java.lang.RuntimeException: java.lang.ClassCastException: org.apacl
        at org.apache.solr.client.solrj.em     d.EmbeddedSolrServer.request(EmbeddedSolrServer.java:240) ~[solr-core
        at com.xpn.xwiki.web.SaveAction.save(SaveAction.java:181) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at com.xpn.xwiki.web.SaveAndContinueAction.doWrappedAction(SaveAndContinueAction.java:98) [xwiki-platform-le
        at com.xpn.xwiki.web.SaveAndContinueAction.action(SaveAndContinueAction.java:195) [xwiki-platform-legacy-old
        at com.xpn.xwiki.web.XWikiAction.execute(XWikiAction.java:416) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at com.xpn.xwiki.web.XWikiAction.execute(XWikiAction.java:184) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at org.apache.struts.action.RequestProcessor.processActionPerform(RequestProcessor.java:425) [struts-core-1.
        at org.apache.struts.action.RequestProcessor.process(RequestProcessor.java:228) [struts-core-1.3.10.jar:1.3.
        at org.apache.struts.action.ActionServlet.process(ActionServlet.java:1913) [struts-core-1.3.10.jar:1.3.10]
        at org.apache.struts.action.ActionServlet.doPost(ActionServlet.java:462) [struts-core-1.3.10.jar:1.3.10]
        at javax.servlet.http.HttpServlet.service(HttpServlet.java:707) [javax.servlet-api-3.1.0.jar:3.1.0]
        at javax.servlet.http.HttpServlet.service(HttpServlet.java:790) [javax.servlet-api-3.1.0.jar:3.1.0]
```

WRITE A CRASH REPRODUCING TEST

- USEFUL IN DEBUGGING
- REGRESSION TESTING

STAMP Software Testing Amplification

TU Delft

Description

To reproduce:

- start a fresh jetty/hsqldb 7.4
- login with Adim
- go to administration
- enable multilanguag
- put "en, fr" (with the white space) in supported languages property
- save

You end up with the following error in the log:

```
2016-01-25 14:14:32,866 [http://127.0.0.1:8    /xwiki/bin/saveandcontinue/XWiki/XWikiPreferences] ERROR rIndexAvailab
org.apache.solr.client.solrj.SolrServerExce    on: java.lang.RuntimeException: java.lang.ClassCastException: org.apacl
        at org.apache.solr.client.solrj.em    d.EmbeddedSolrServer.request(EmbeddedSolrServer.java:240) ~[solr-core
        at com.xpn.xwiki.web.SaveAction.save    SaveAction.java:181) [xwiki-platform-legacy-oldcore-7.4.jar:na]
        at com.xpn.xwiki.web.SaveAndContinu    tion.doWrappedAction(SaveAndContinueAction.java:98) [xwiki-platform-le
        at com.xpn.xwiki.web.SaveAndContinu    tion.action(SaveAndContinueAction.java:195) [xwiki-platform-legacy-old
        at com.xpn.xwiki.web.XWikiAction.ex    e(XWikiAction.java:416) [xwiki-platform-legacy-oldcore-7.4.jar:na]
```

WRITE A CRASH REPRODUCING TEST

- USEFUL IN DEBUGGING
- REGRESSION TESTING

MANUAL CRASH REPRODUCTION IS HARD

- LABOUR-INTENSIVE AND TIME TAKING TASK
- NEEDS KNOWLEDGABLE DEVELOPERS TO WRITE THE TEST

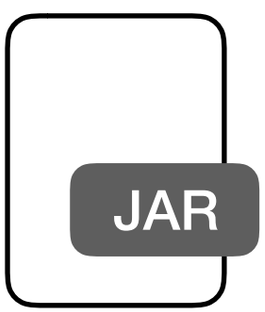
STAMP Software Testing Amplification

TU Delft

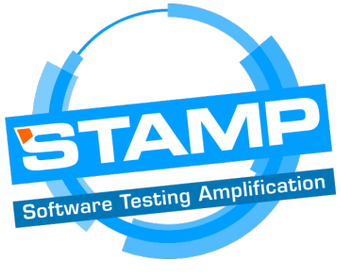
Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application



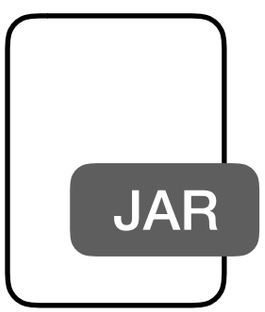
Botsing (Evolutionary-based algorithm)



Stack Trace

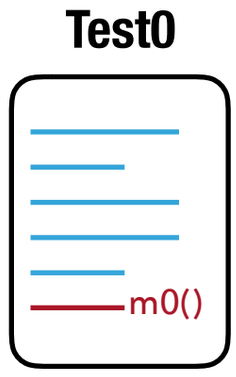
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

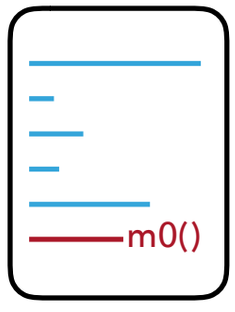
Application

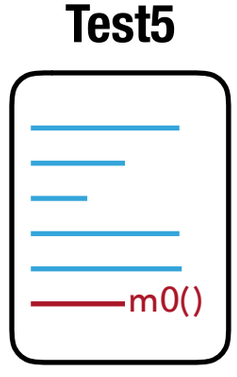


Botsing (Evolutionary-based algorithm)

Random initialization







…

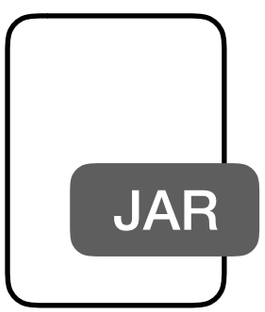
STAMP Software Testing Amplification

TU Delft

Stack Trace

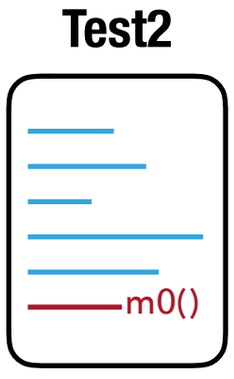
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

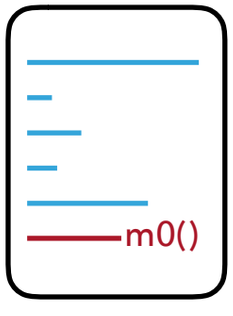
Application

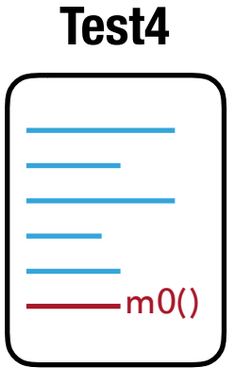


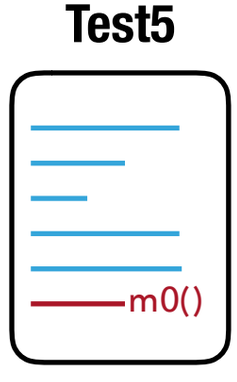
Botsing (Evolutionary-based algorithm)

Random initialization → Evaluate fitness of tests









…

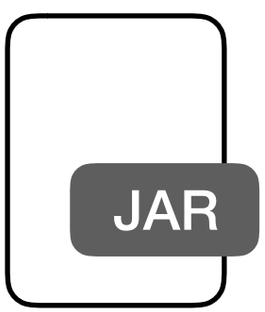
STAMP Software Testing Amplification

TU Delft

Stack Trace

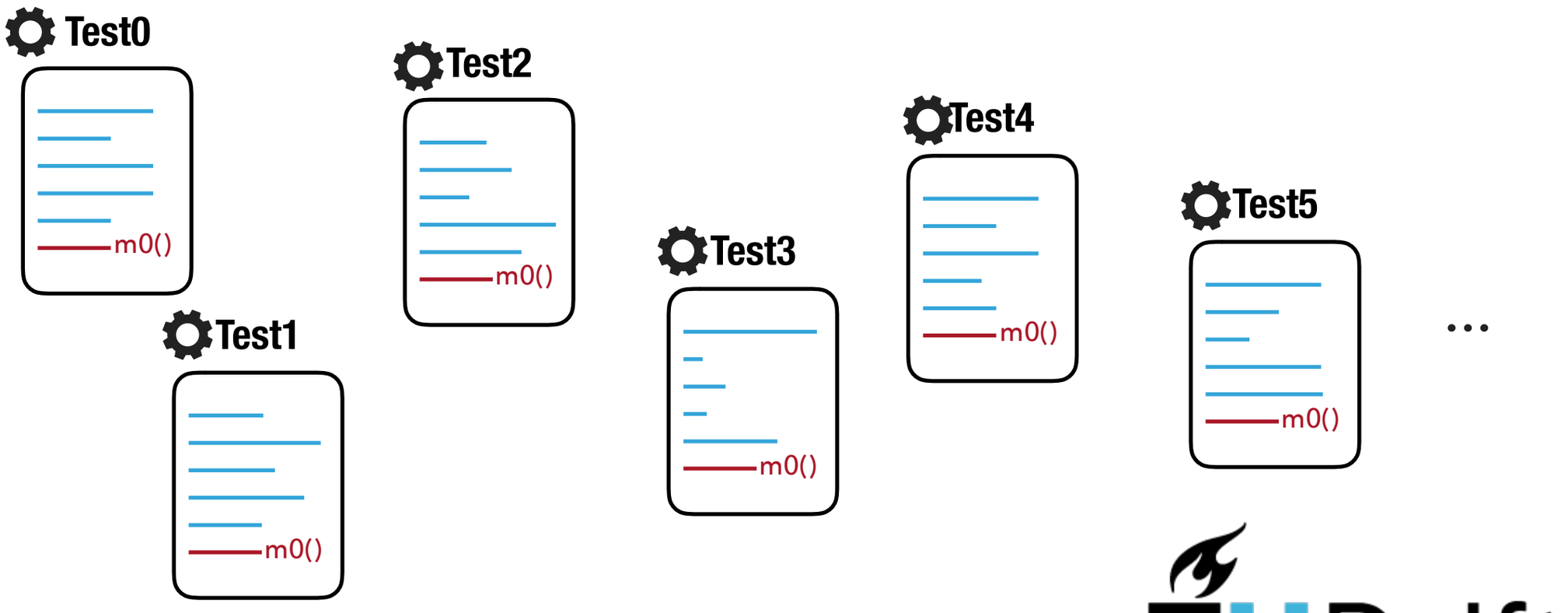
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application



Botsing (Evolutionary-based algorithm)

Random initialization → Evaluate fitness of tests



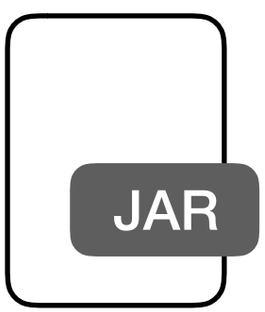
STAMP Software Testing Amplification

TU Delft

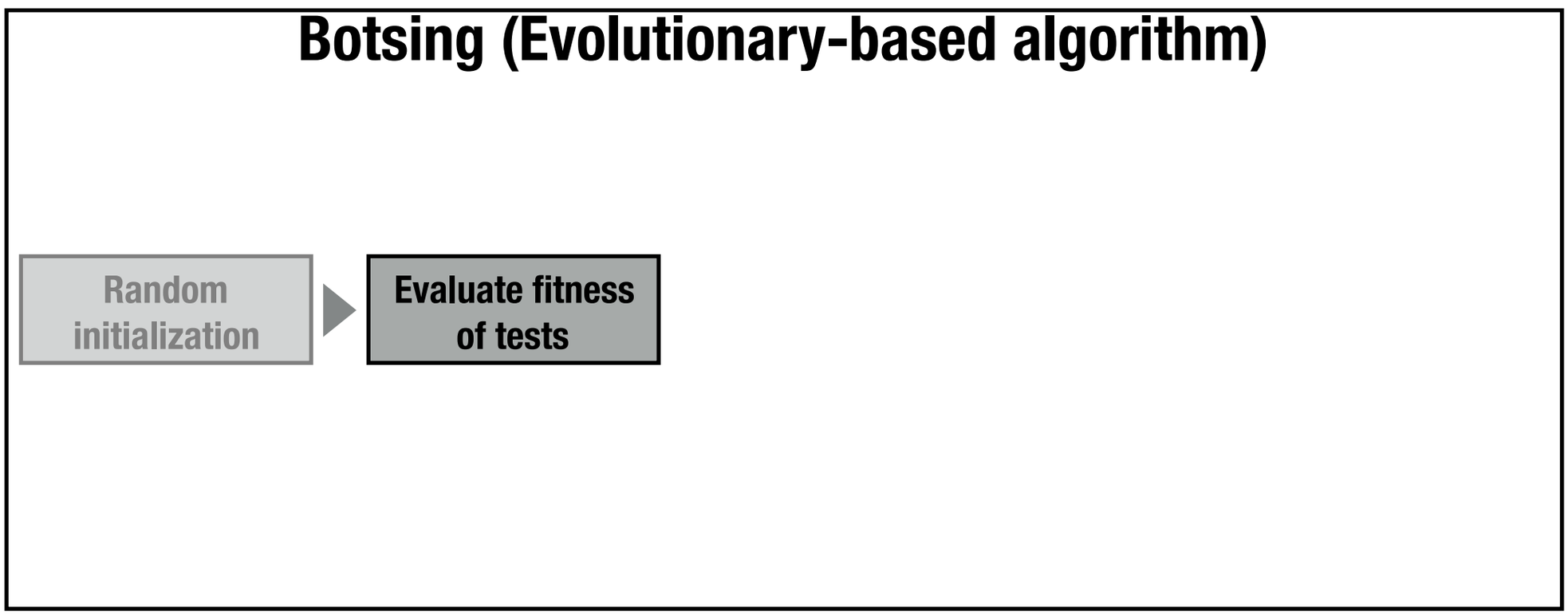
Stack Trace

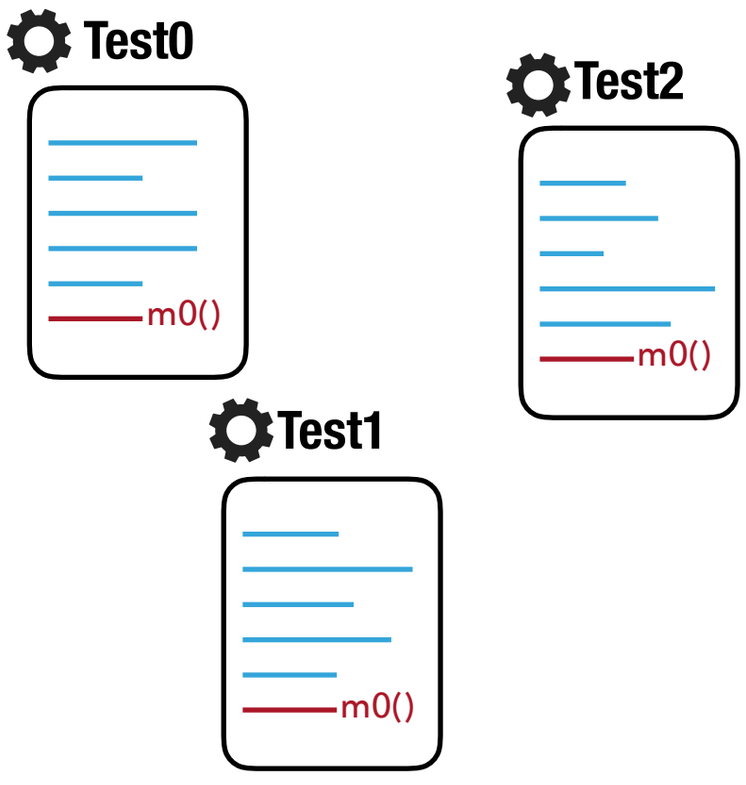
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application



Crash Distance Fitness Function





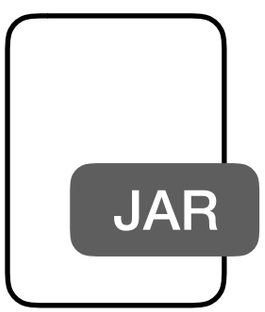
STAMP Software Testing Amplification

TU Delft

Stack Trace

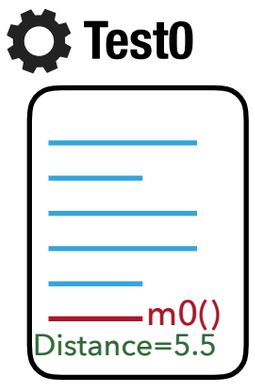
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

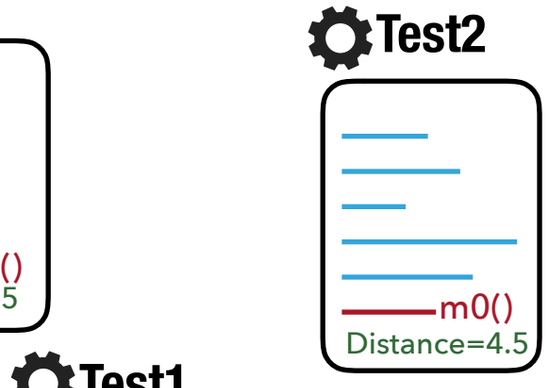
Application

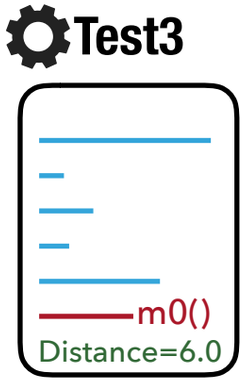


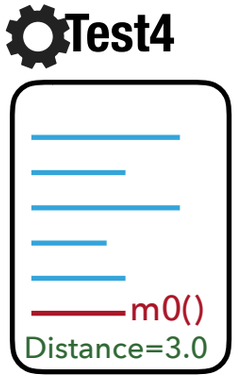
Botsing (Evolutionary-based algorithm)

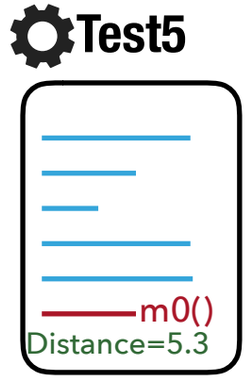
Random initialization → Evaluate fitness of tests



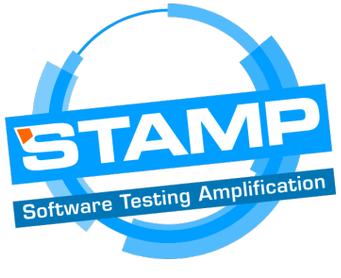








…

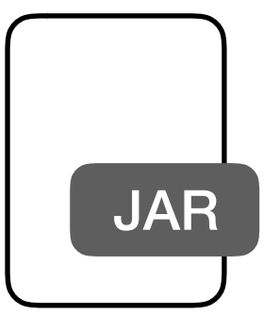


TU Delft

Stack Trace

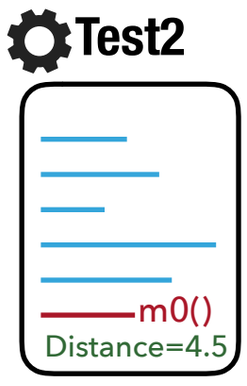
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

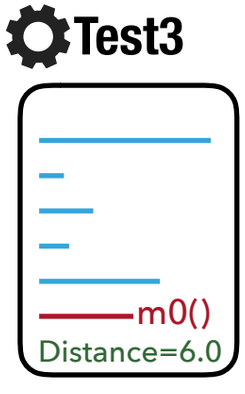
Application

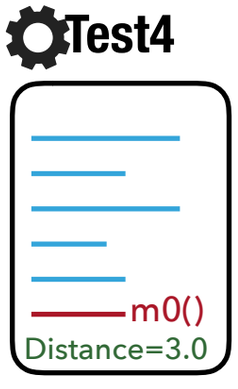


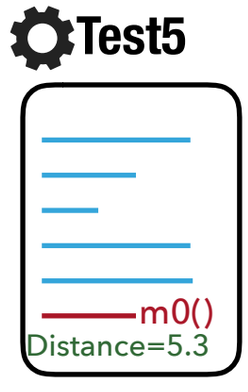
Botsing (Evolutionary-based algorithm)

Random initialization → Evaluate fitness of tests → Selection









…

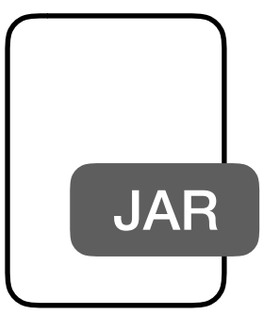
STAMP Software Testing Amplification

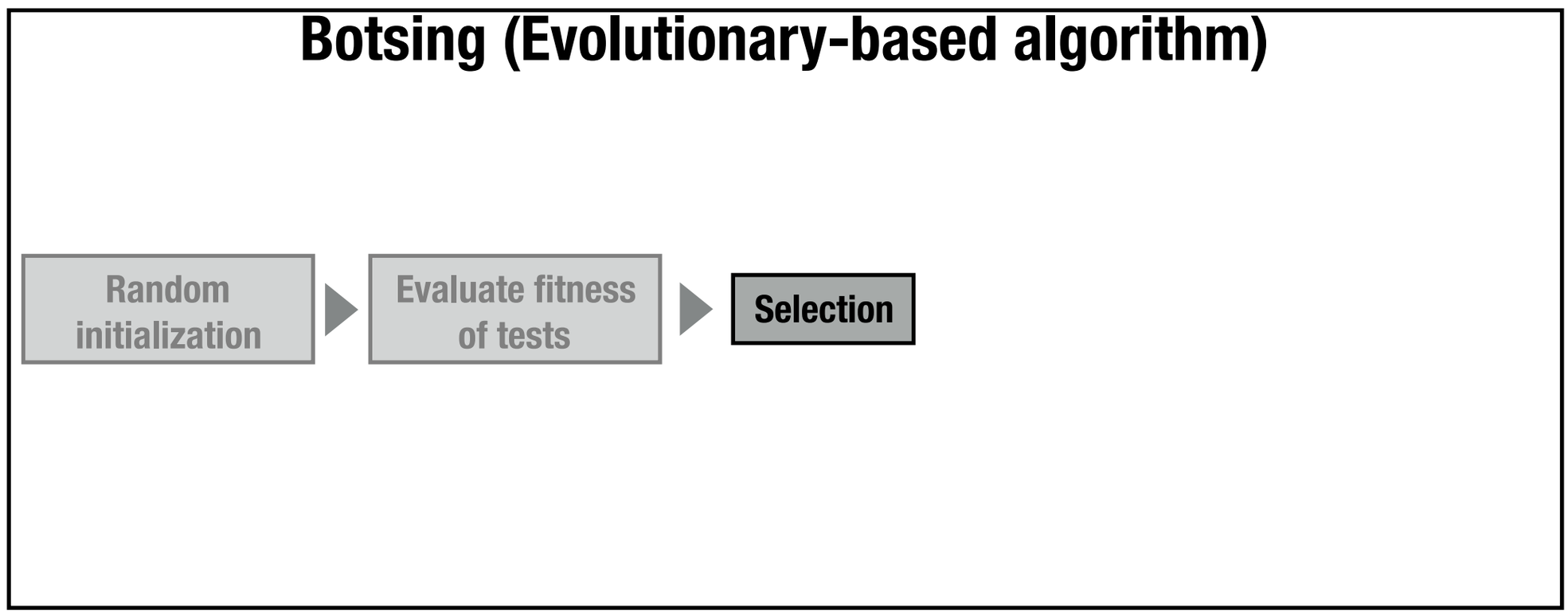
TU Delft

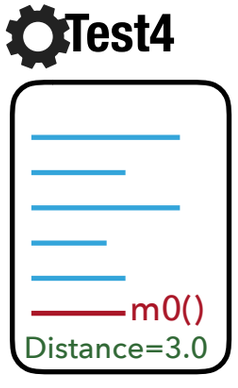
Stack Trace

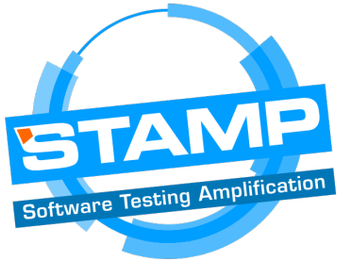
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application







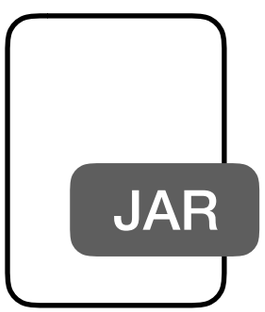


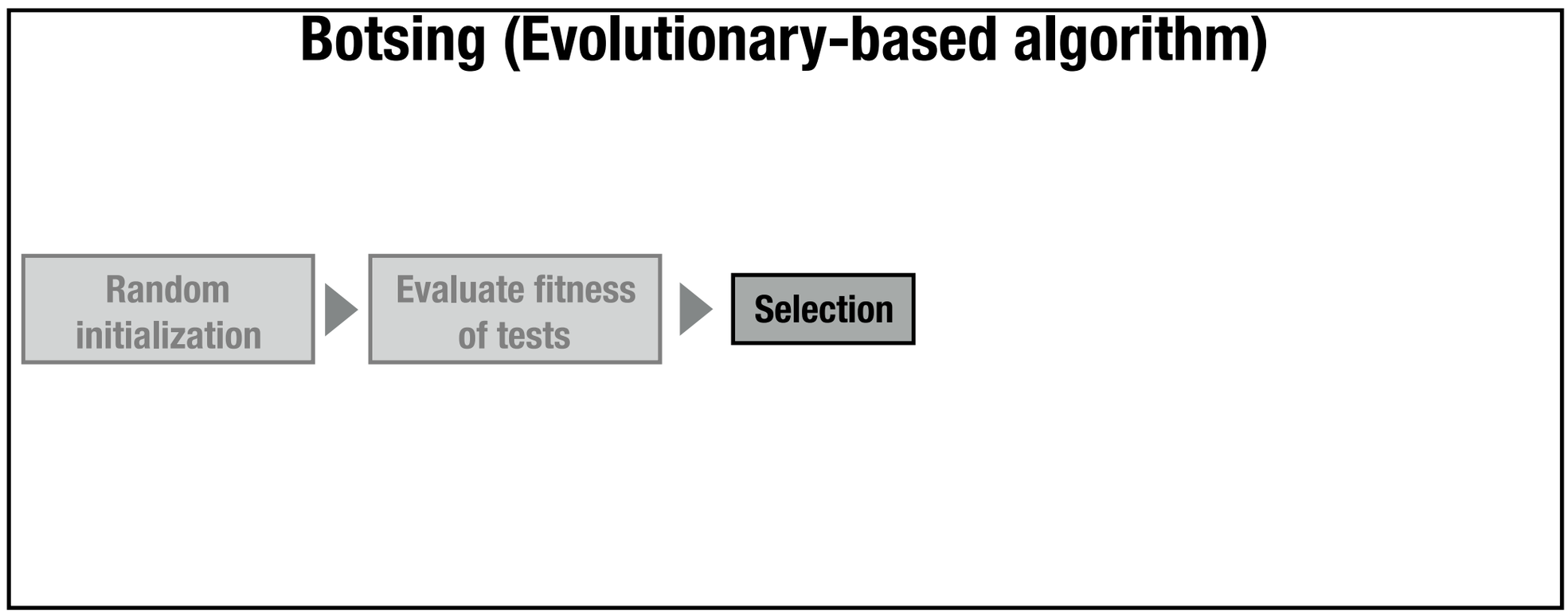
TU Delft

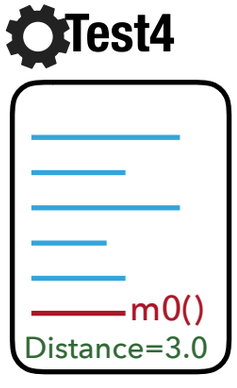
Stack Trace

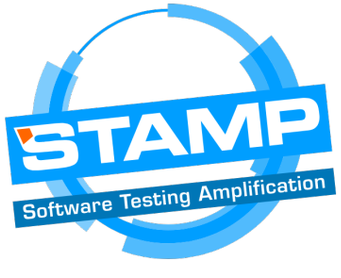
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application







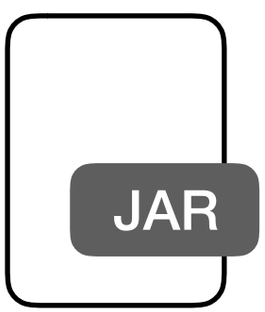


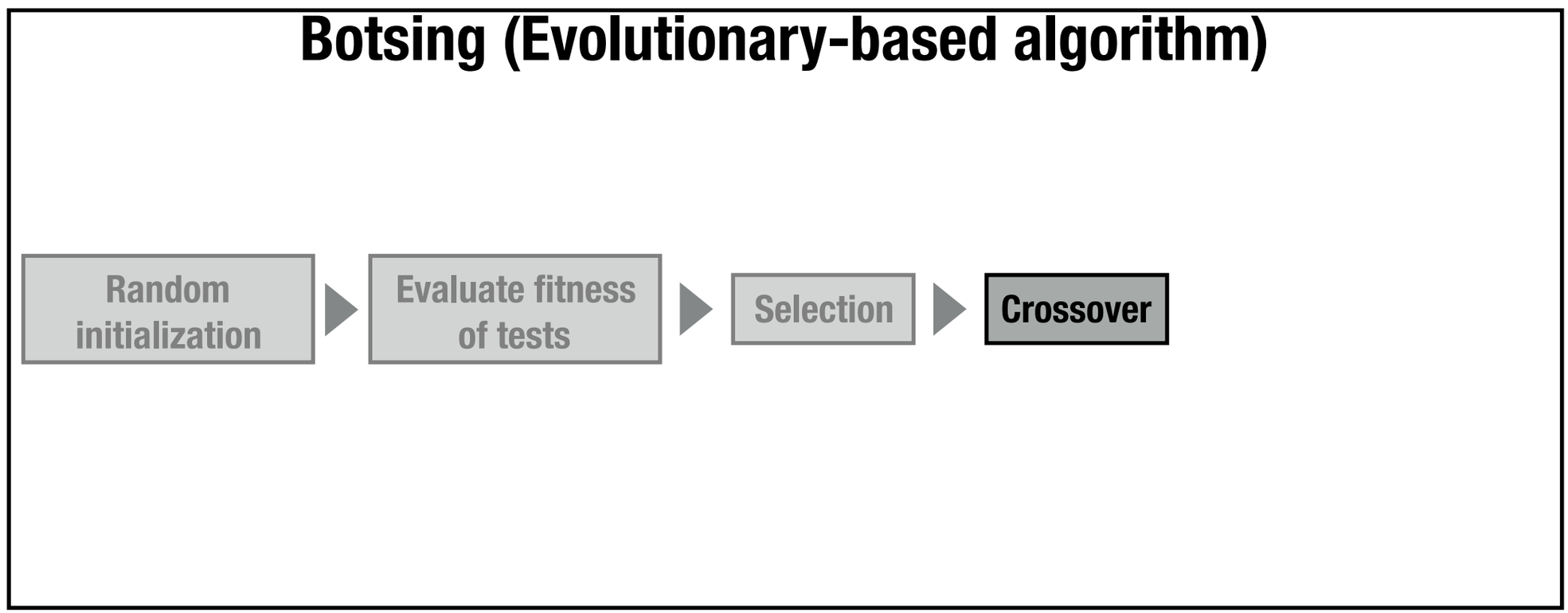
TU Delft

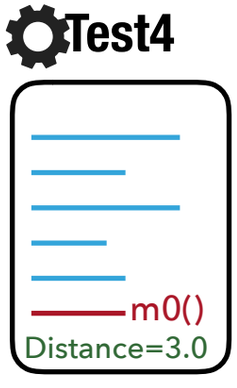
Stack Trace

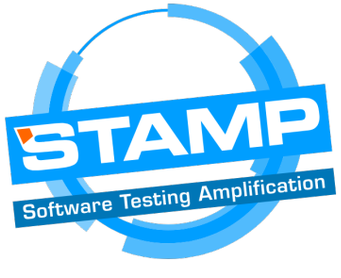
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application









TU Delft

Stack Trace

Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)

Application

JAR

Botsing (Evolutionary-based algorithm)

Random initialization → Evaluate fitness of tests → Selection → Crossover

Test1

m0()
Distance=3.0

Test4

m0()
Distance=3.0

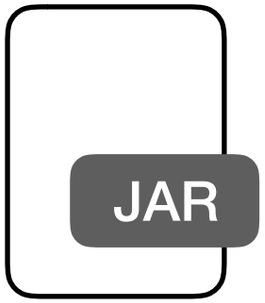
STAMP
Software Testing Amplification

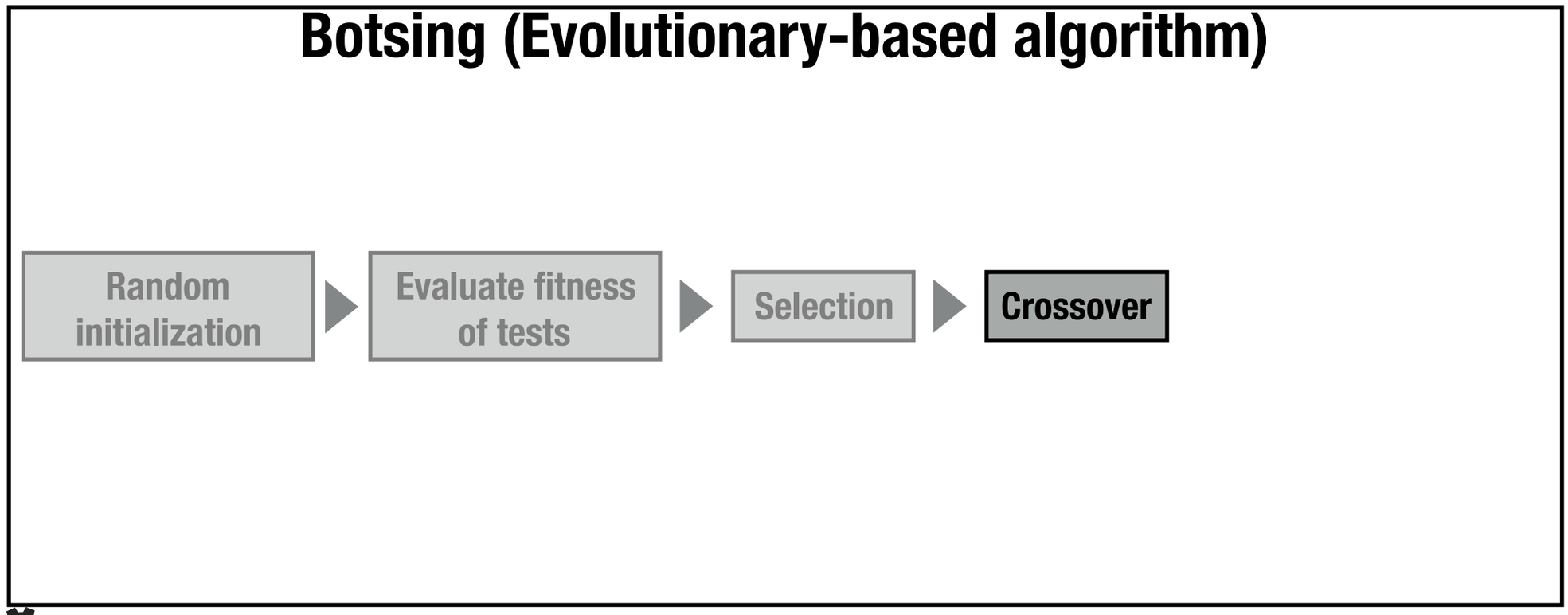
TU Delft

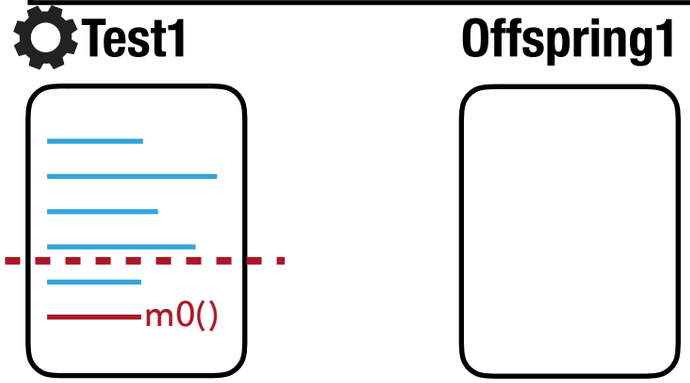
Stack Trace

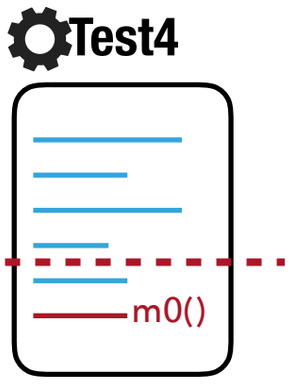
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application









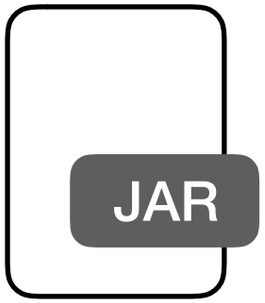
STAMP Software Testing Amplification

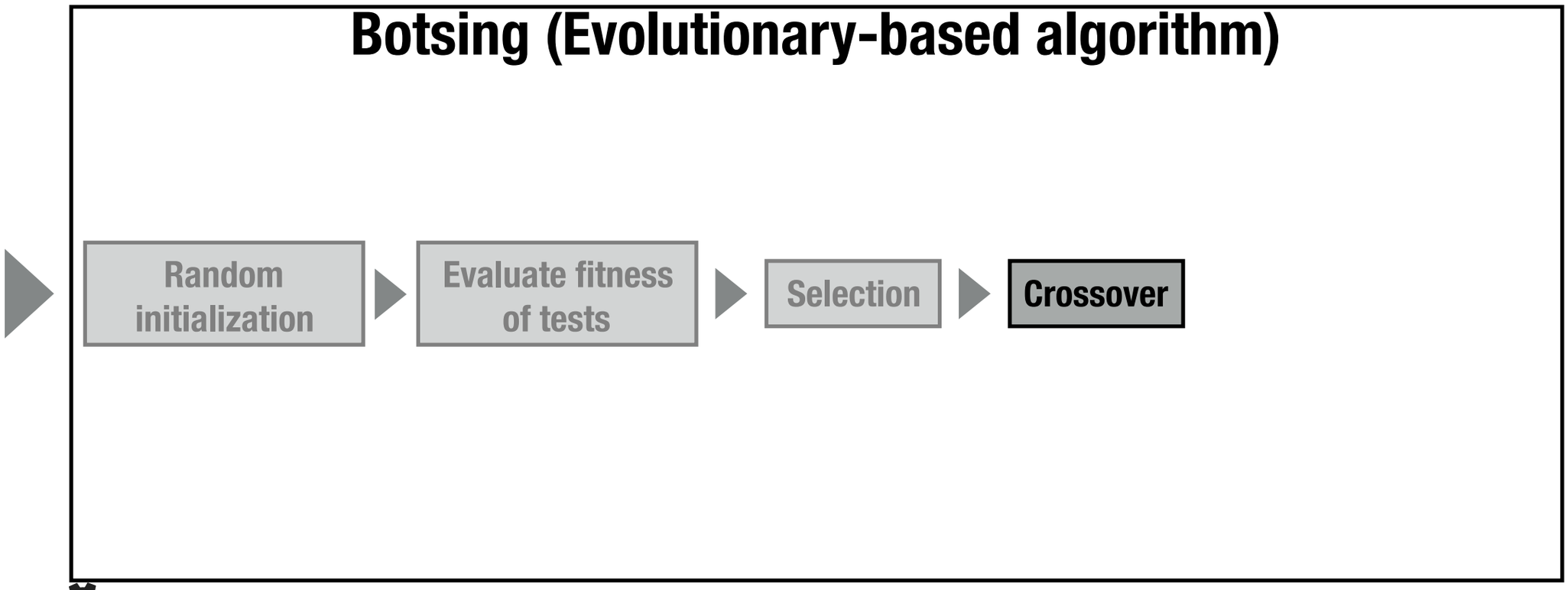
TU Delft

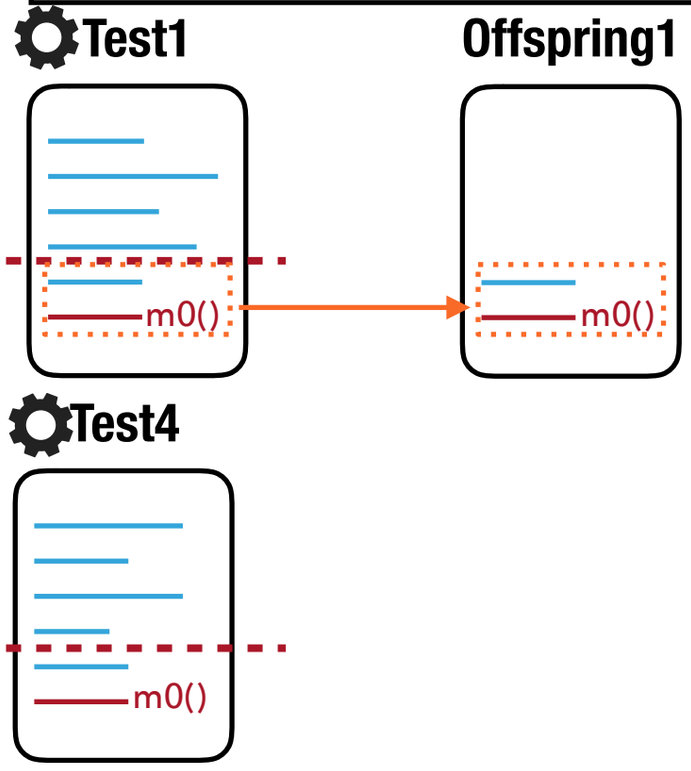
Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application







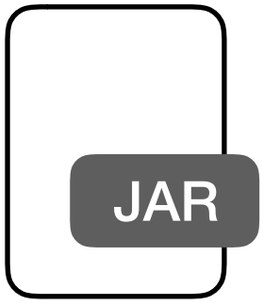
STAMP Software Testing Amplification

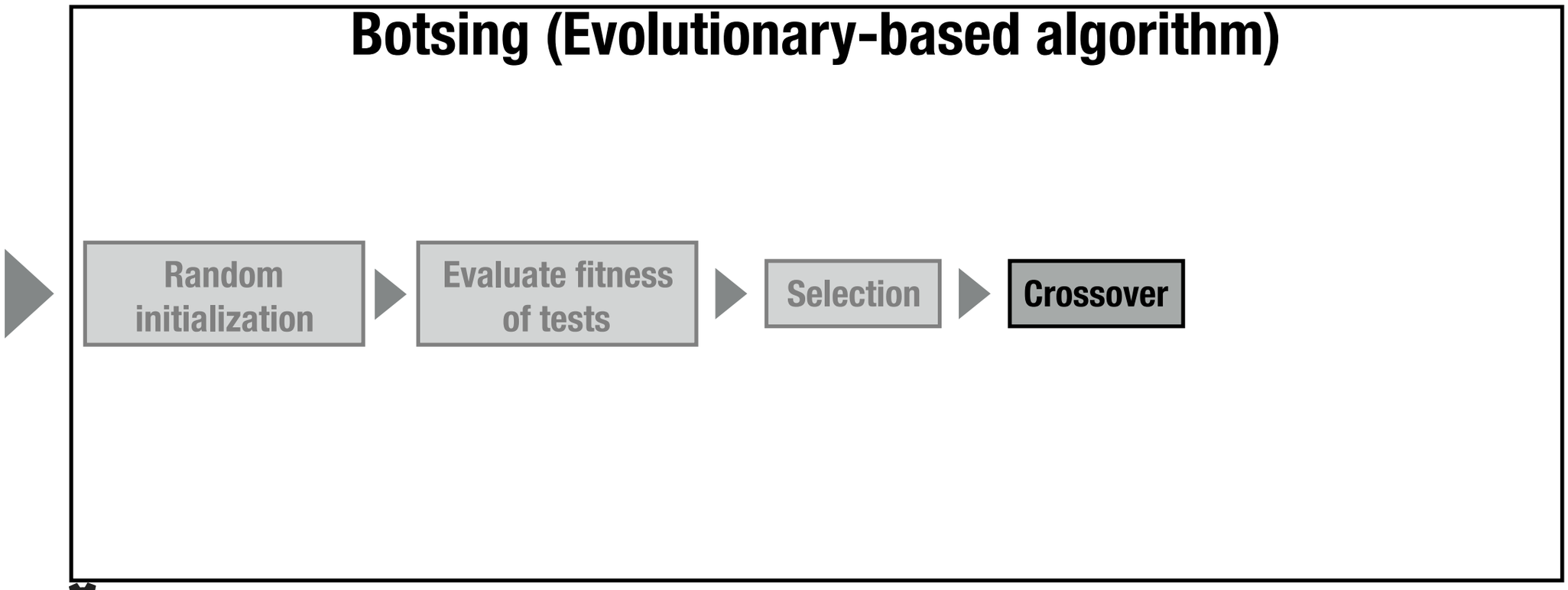
TU Delft

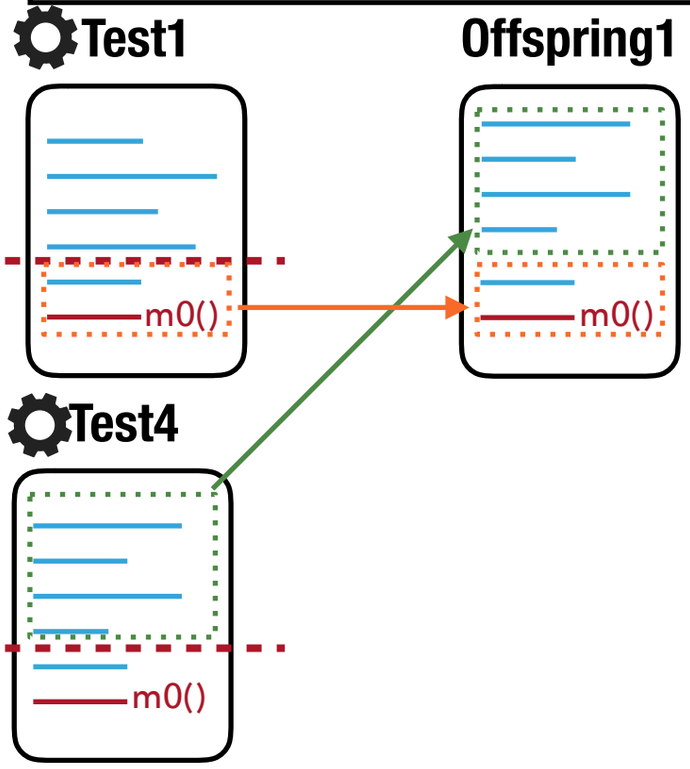
Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application







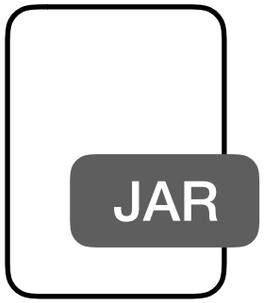
STAMP Software Testing Amplification

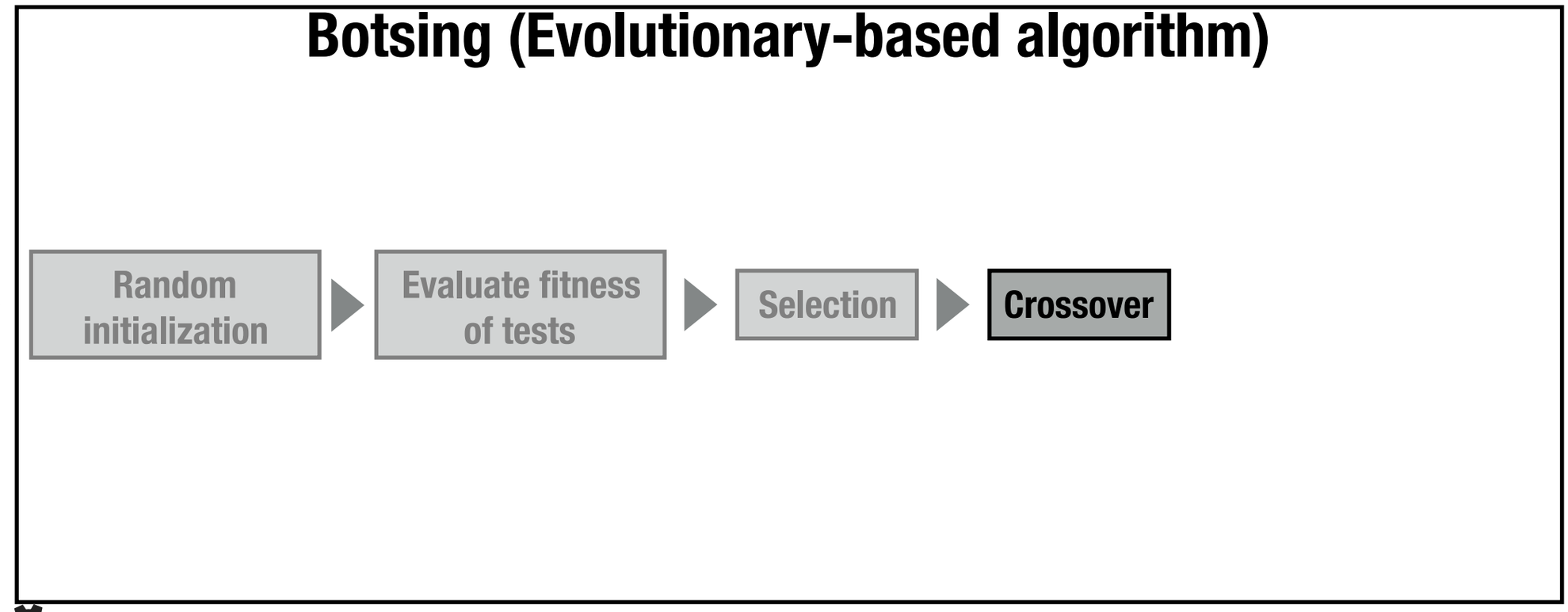
TU Delft

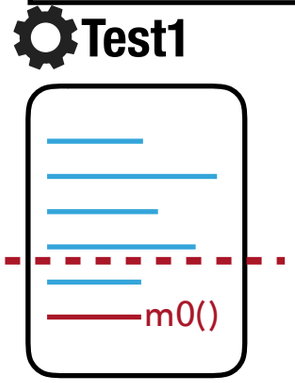
Stack Trace

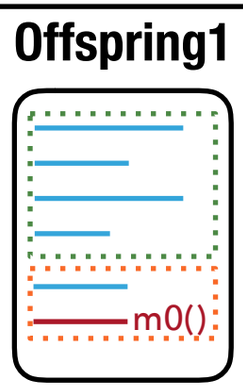
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

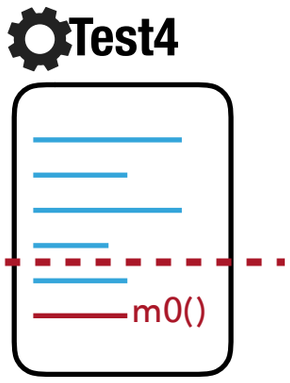
Application

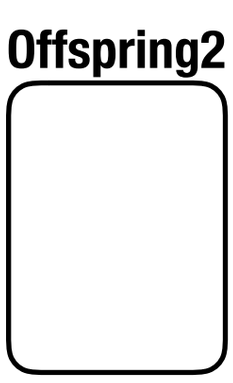






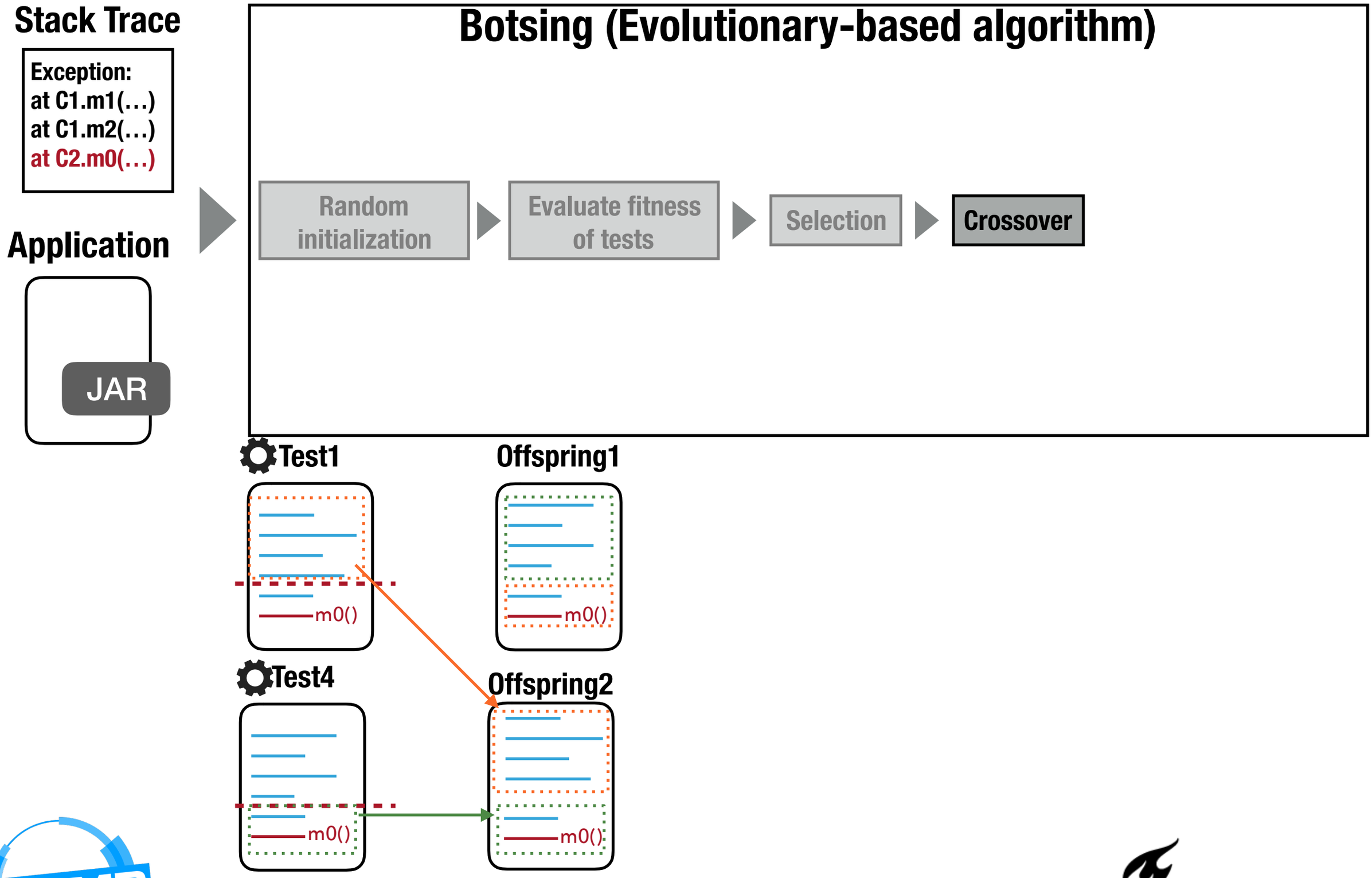






STAMP Software Testing Amplification

TU Delft



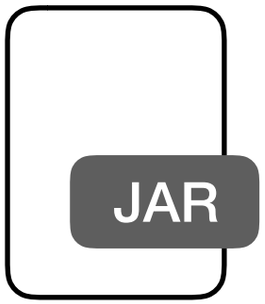
STAMP Software Testing Amplification

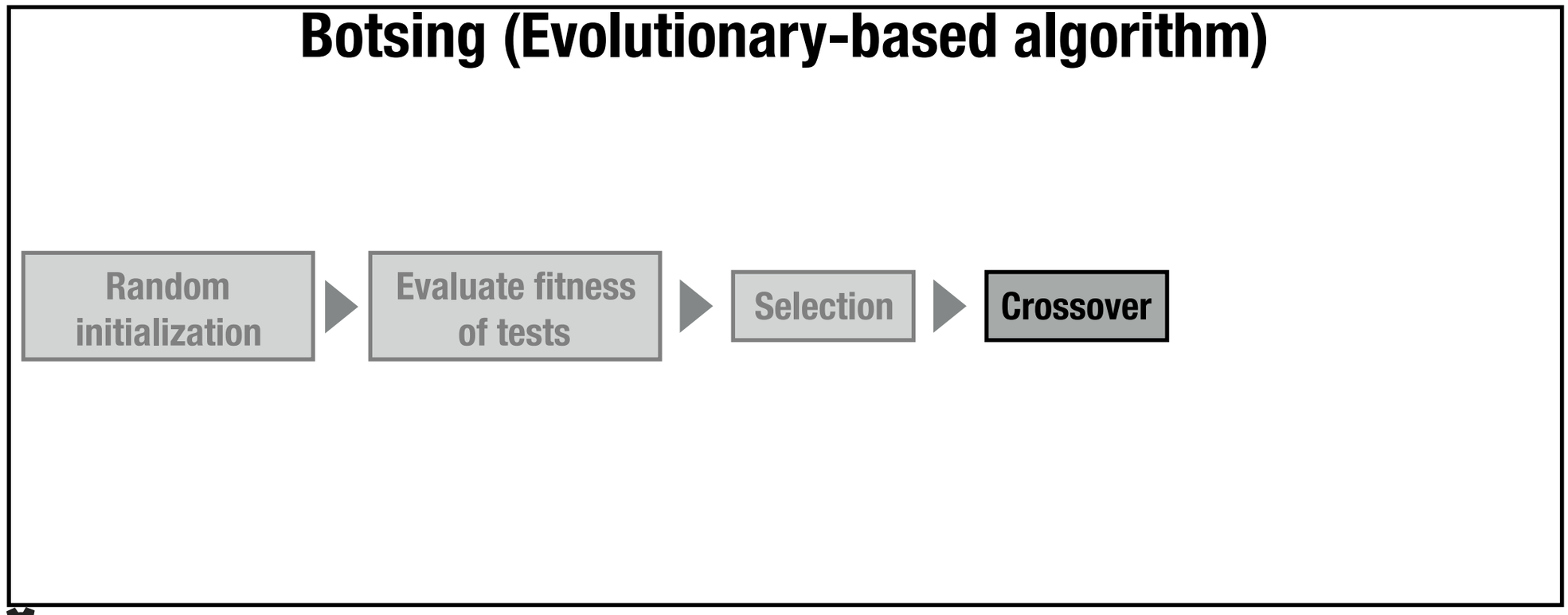
TU Delft

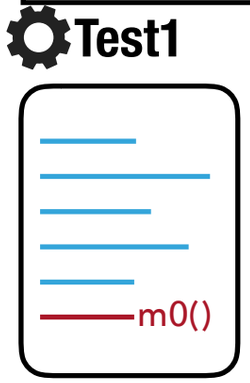
Stack Trace

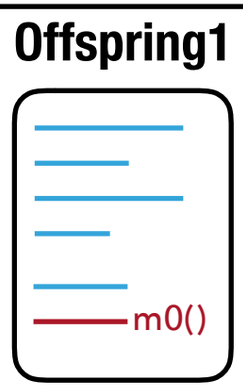
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

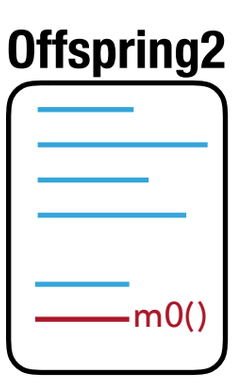
Application

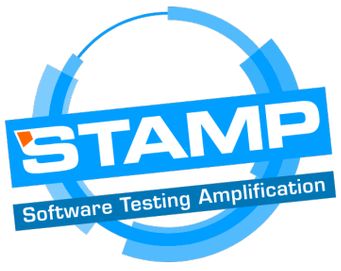










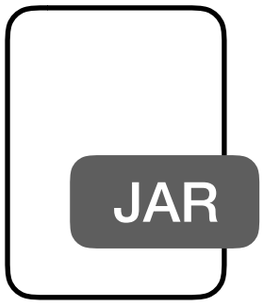


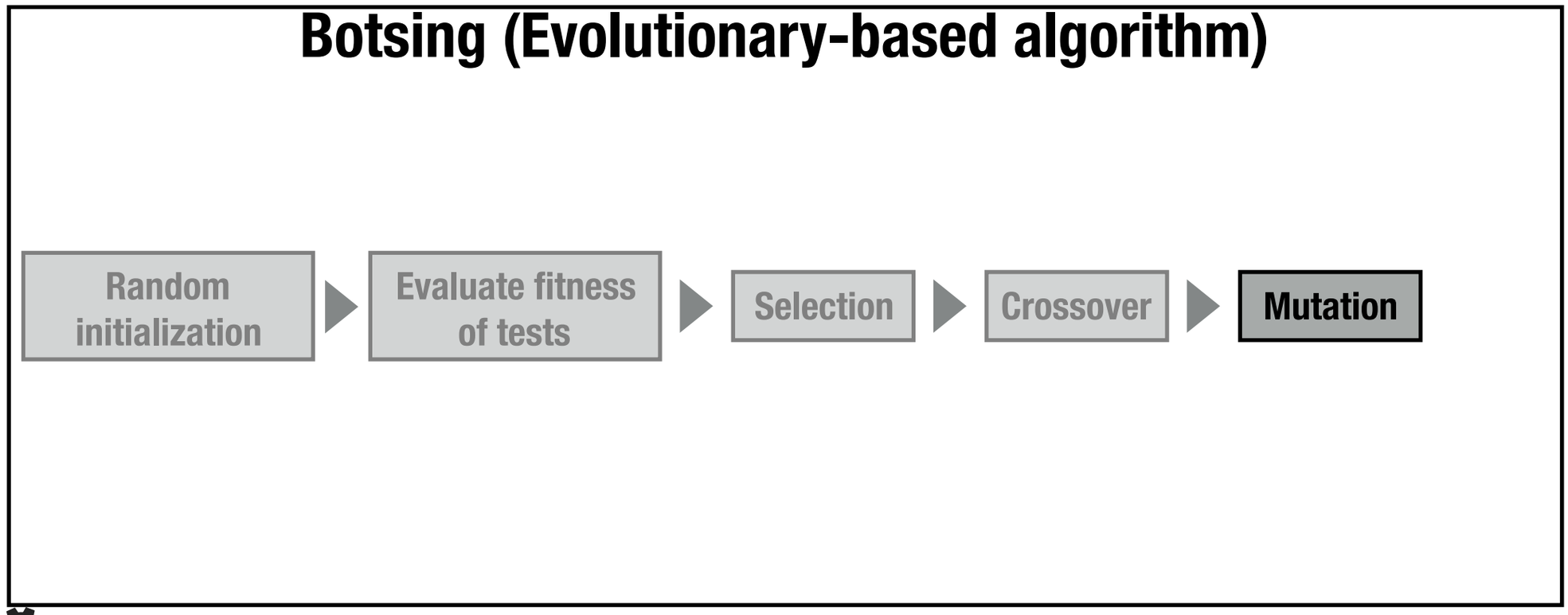
TU Delft

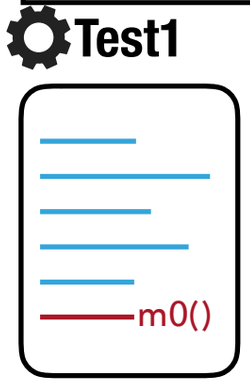
Stack Trace

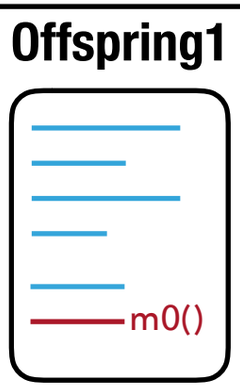
```
Exception:
at C1.m1(...)
at C1.m2(...)
at C2.m0(...)
```

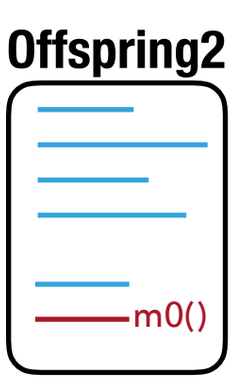
Application











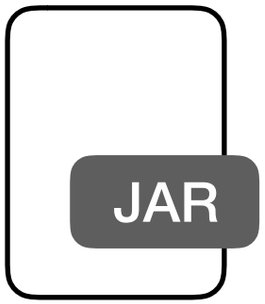
STAMP Software Testing Amplification

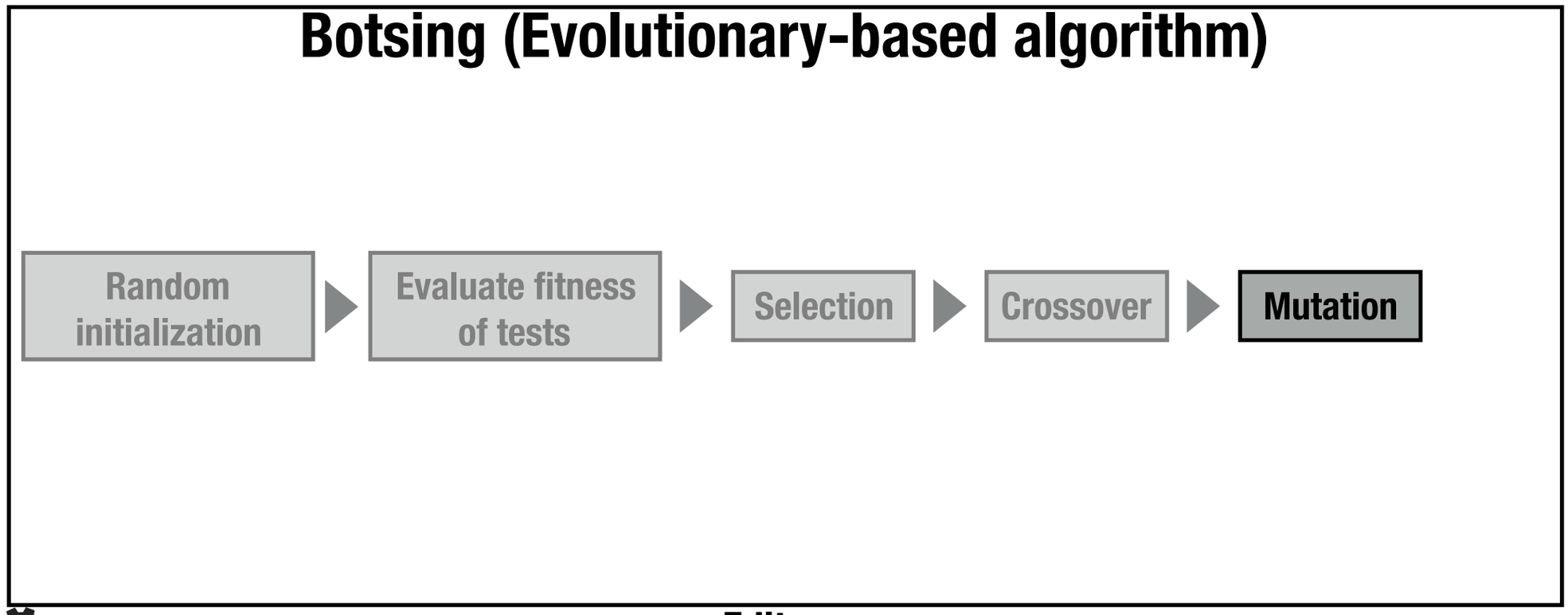
TU Delft

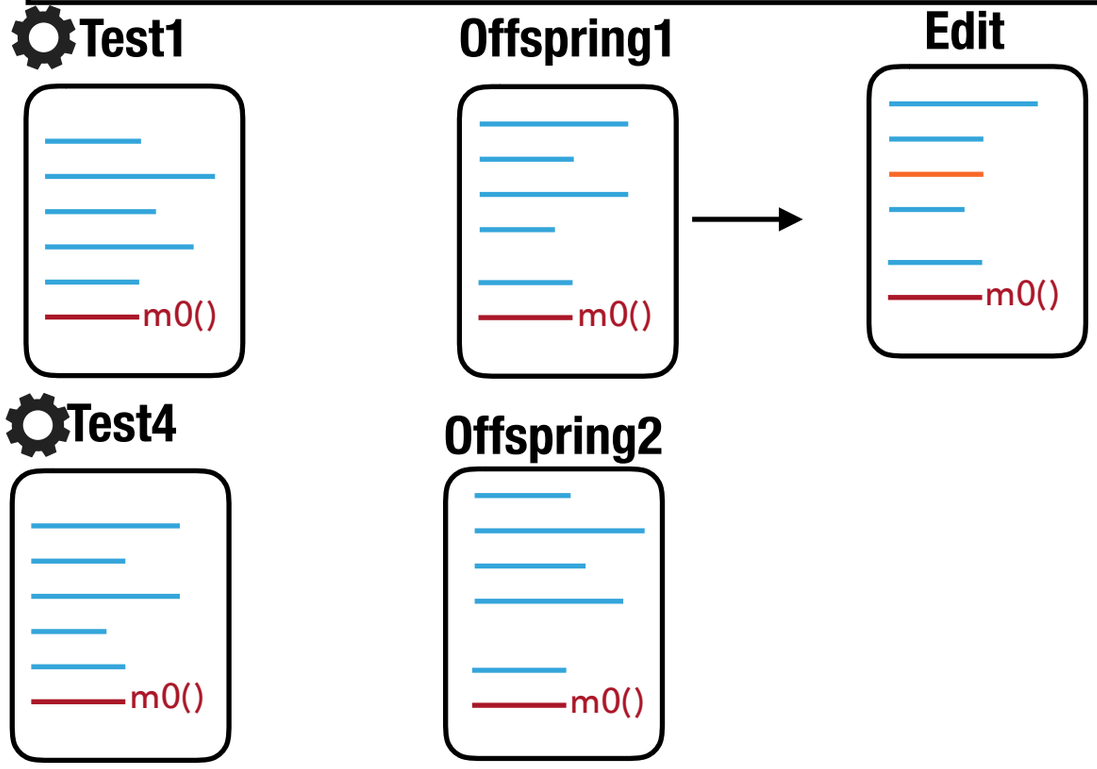
Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application







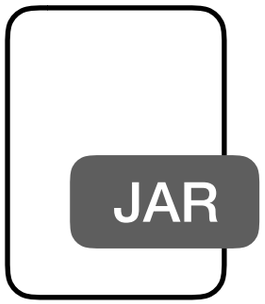
STAMP Software Testing Amplification

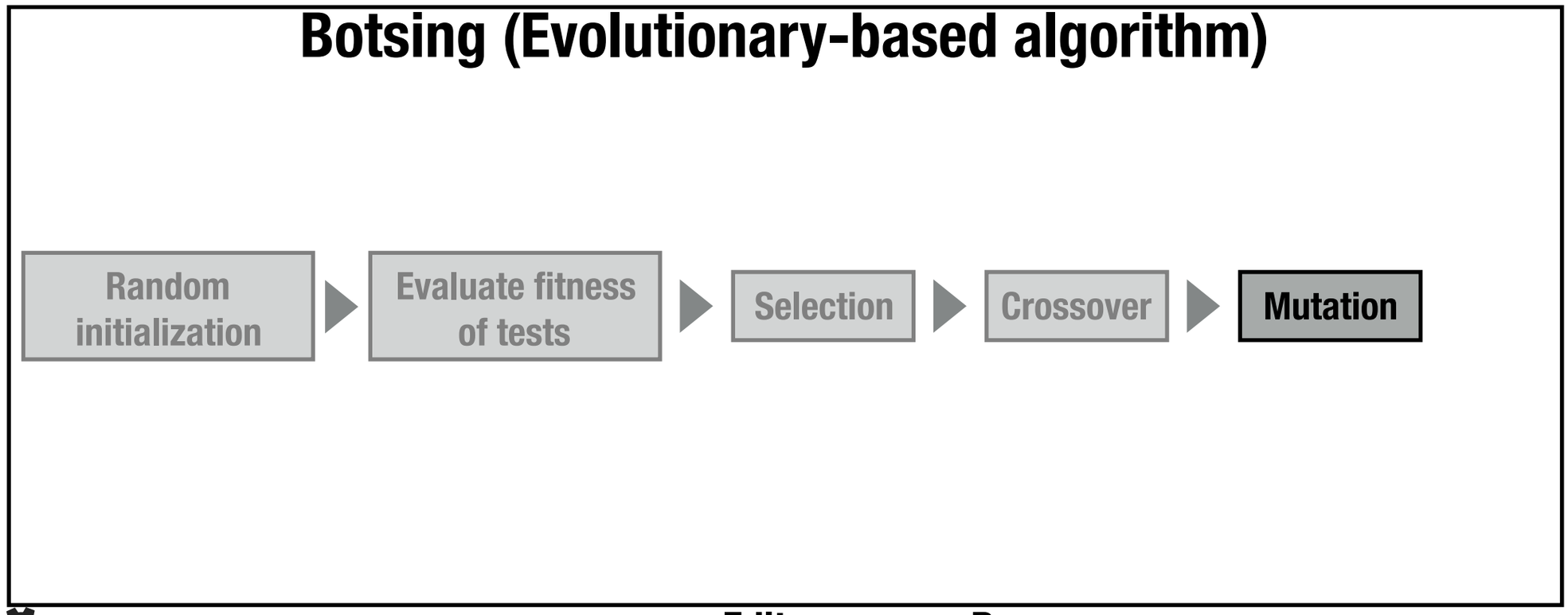
TU Delft

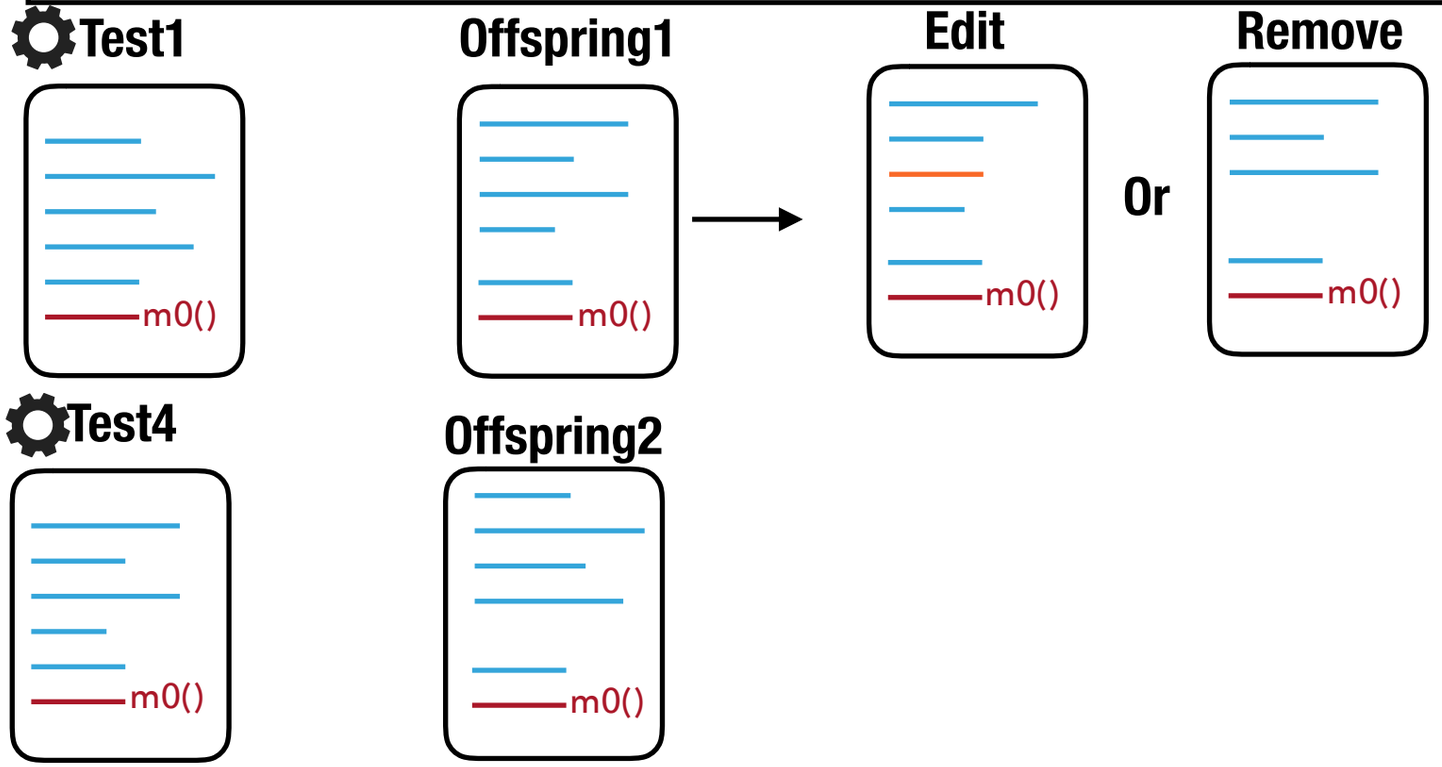
Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application







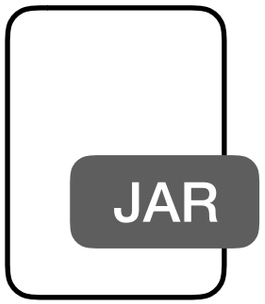
STAMP Software Testing Amplification

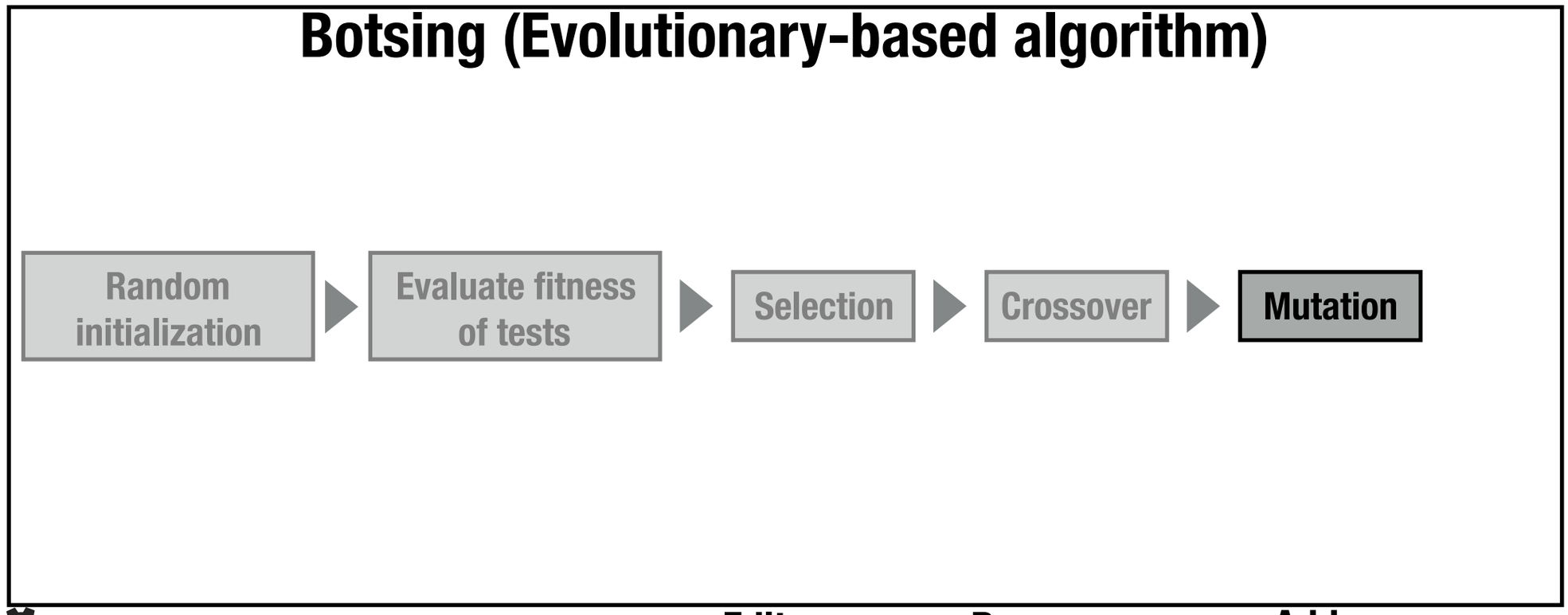
TU Delft

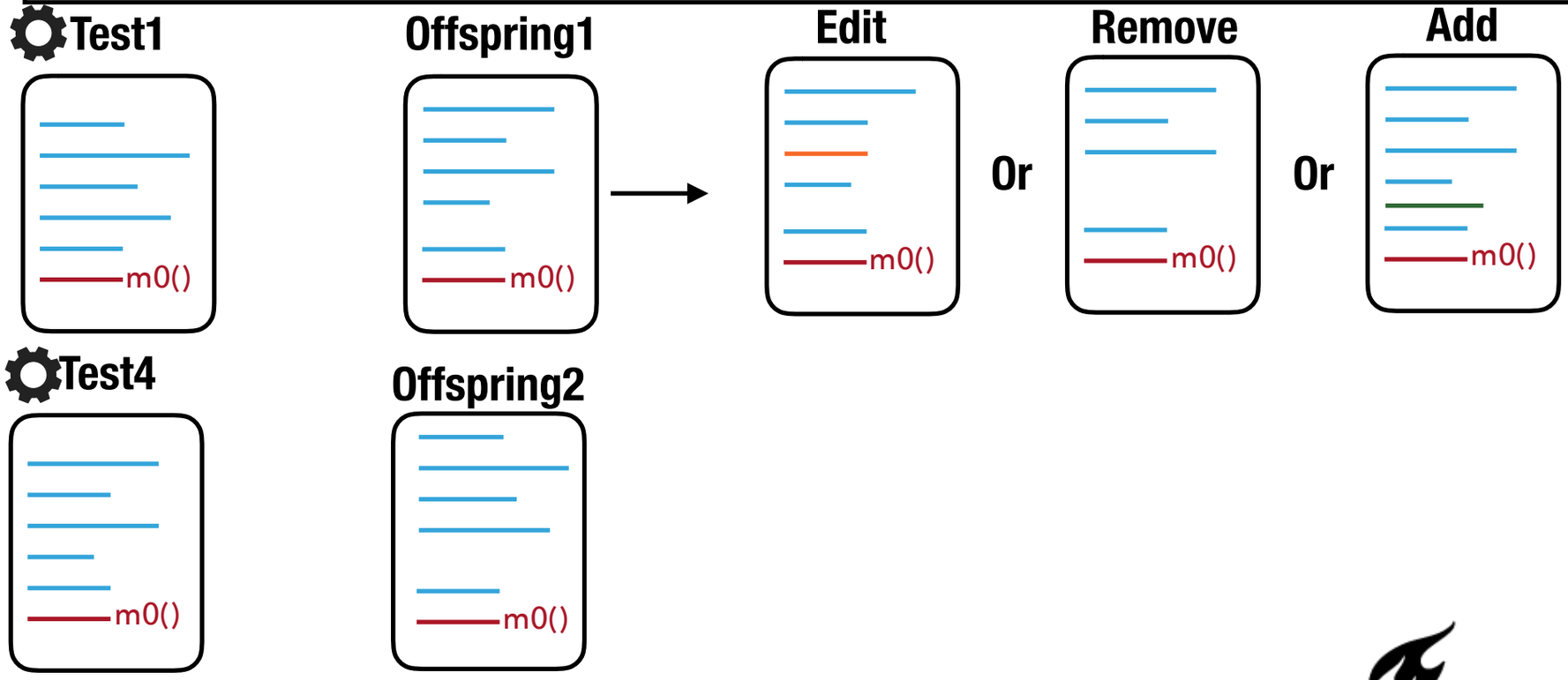
Stack Trace

```
Exception:
at C1.m1(...)
at C1.m2(...)
at C2.m0(...)
```

Application







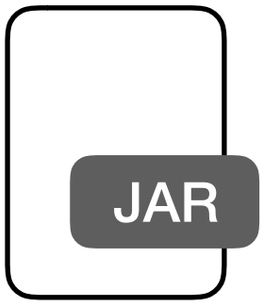
STAMP Software Testing Amplification

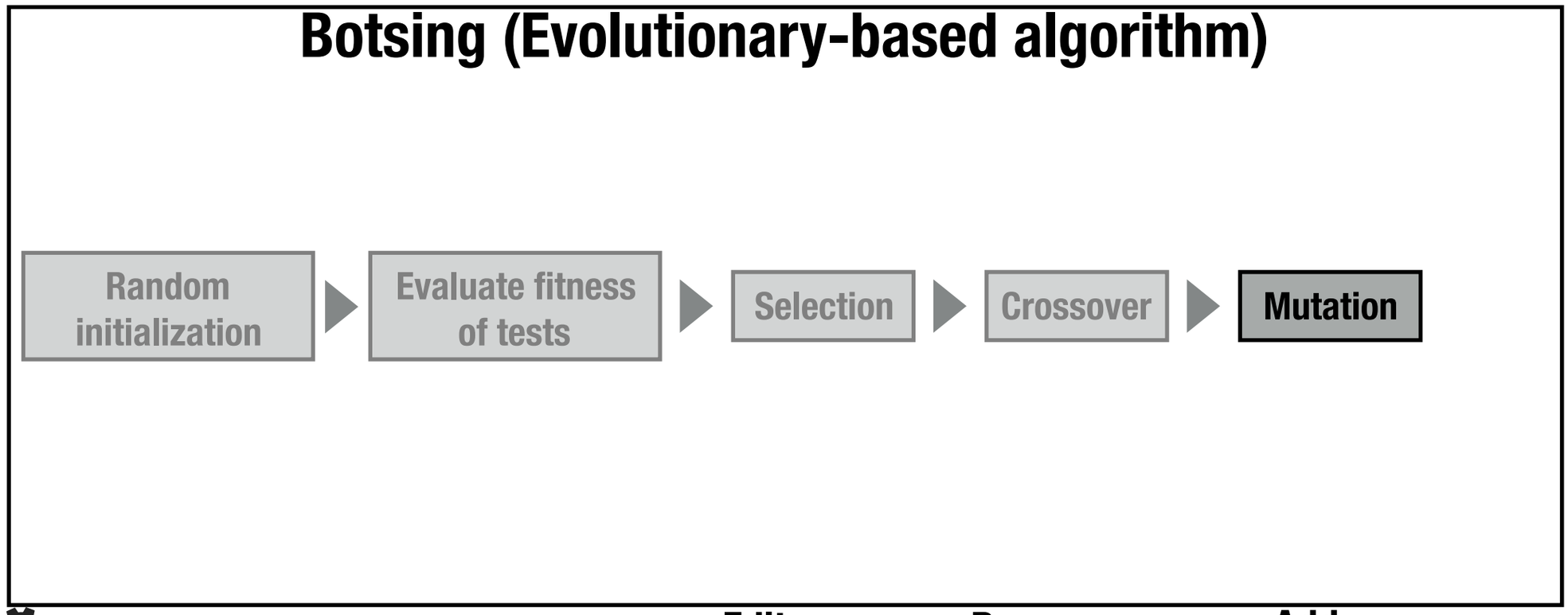
TU Delft

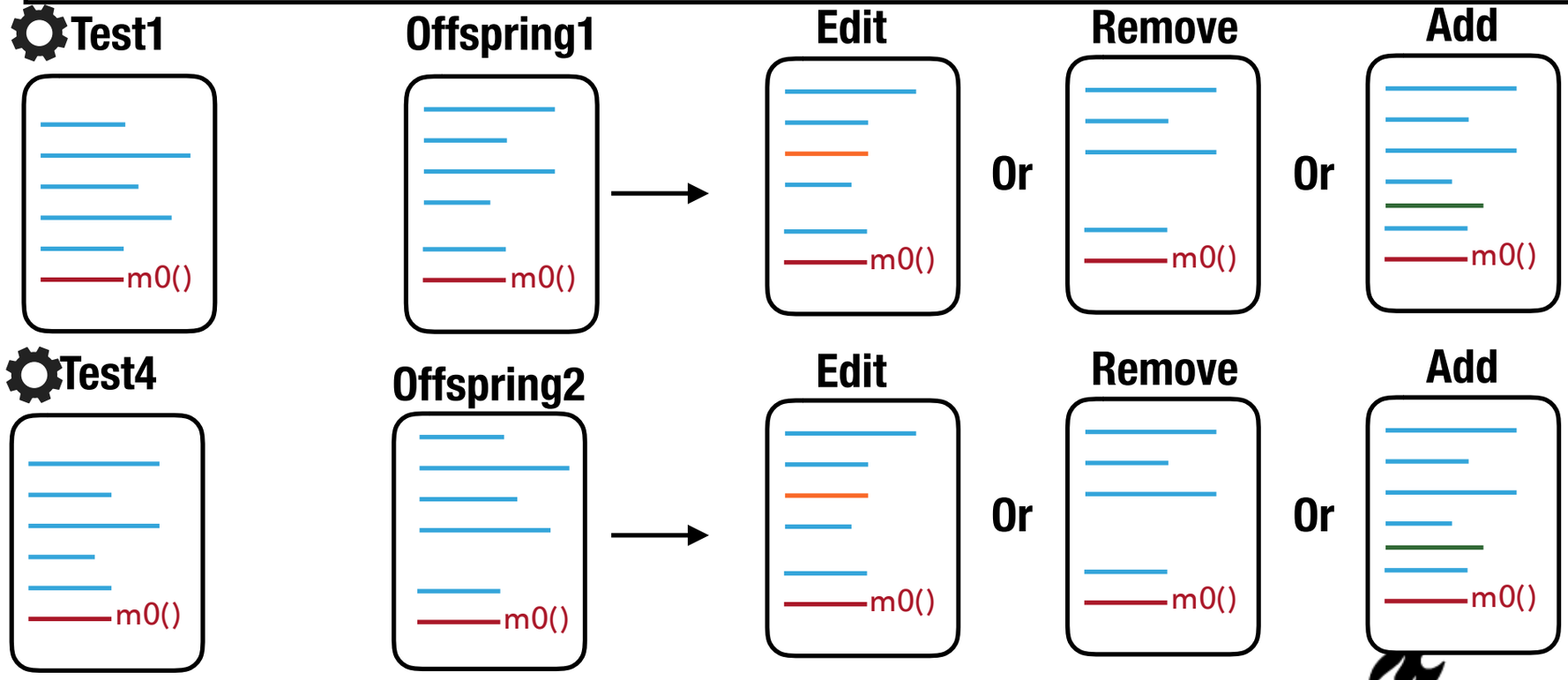
Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application

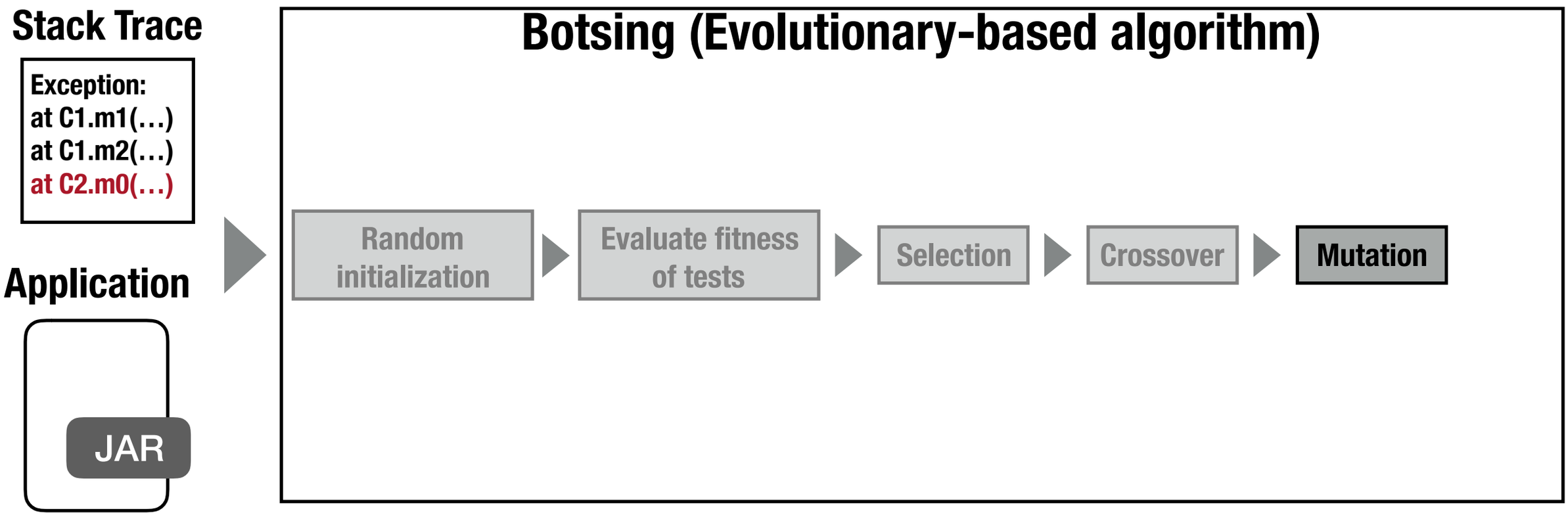


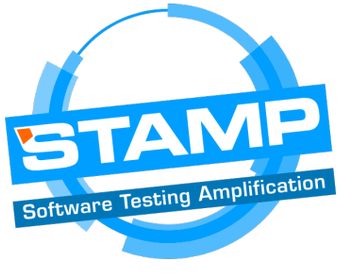




STAMP Software Testing Amplification

TU Delft


Stack Trace
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
Application
JAR
Botsing (Evolutionary-based algorithm)
Random initialization
Evaluate fitness of tests
Selection
Crossover
Mutation

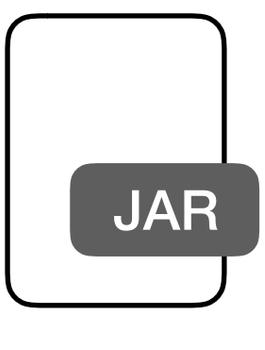

STAMP
Software Testing Amplification

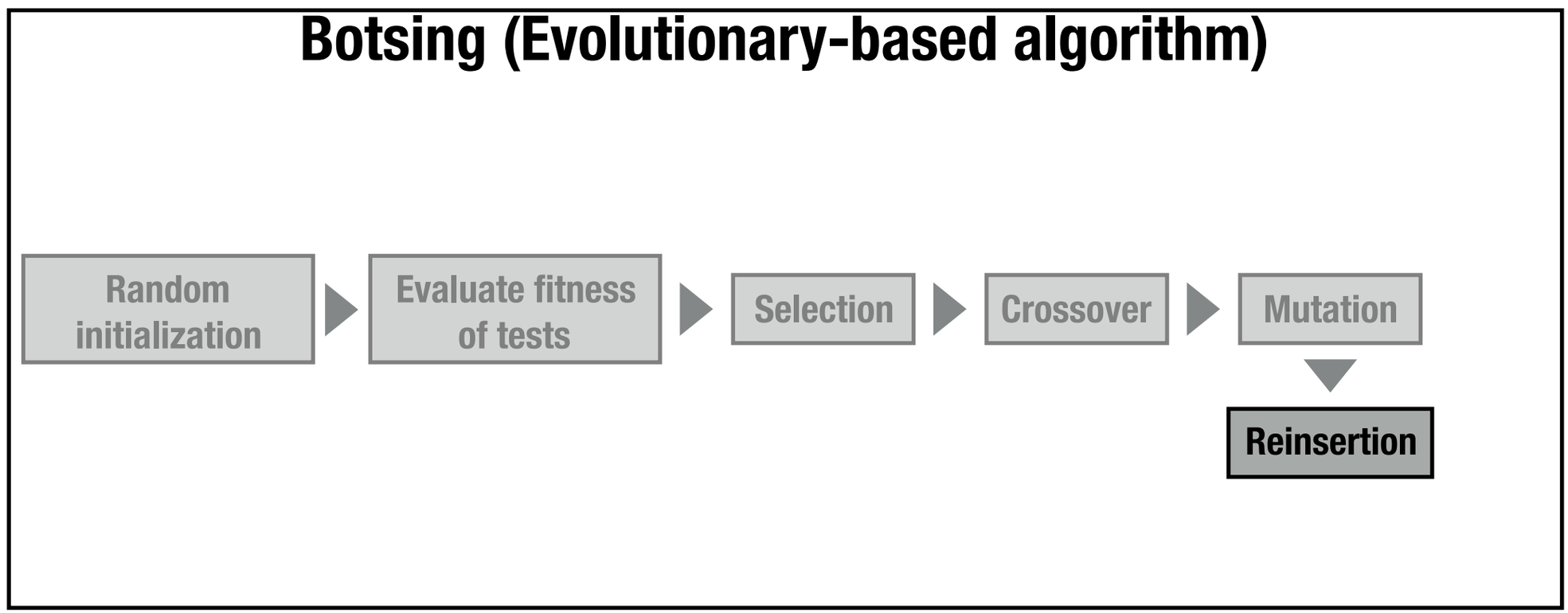

TU Delft

Stack Trace

```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

Application





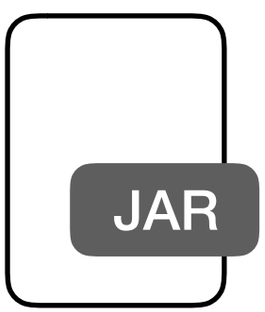
STAMP Software Testing Amplification

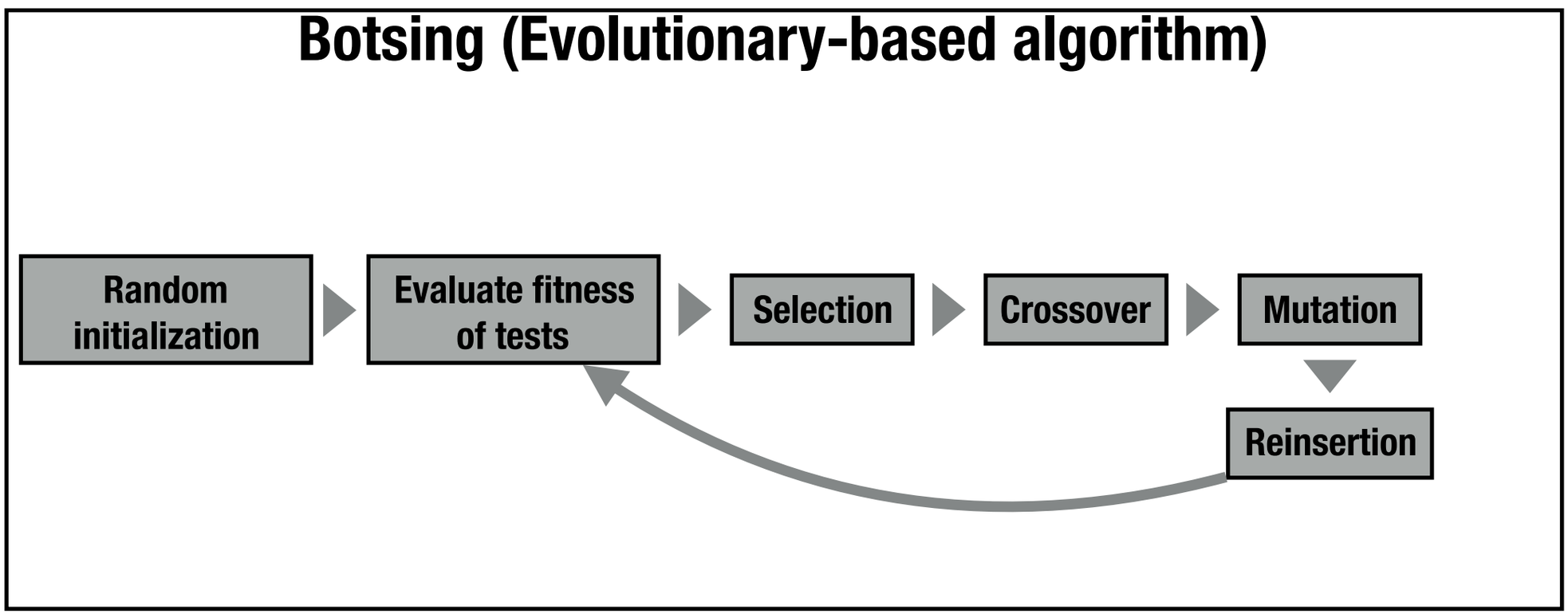
TU Delft

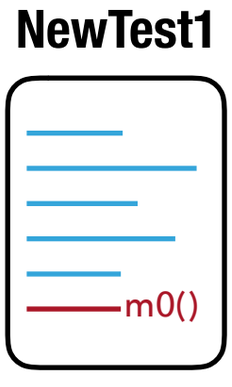
Stack Trace

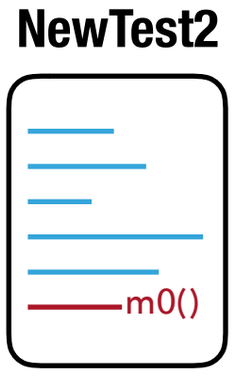
```
Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)
```

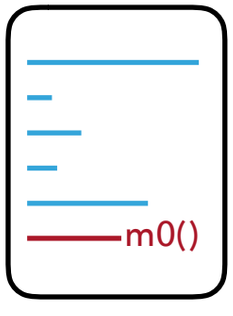
Application

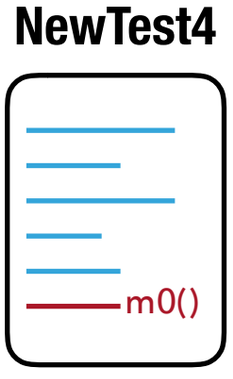


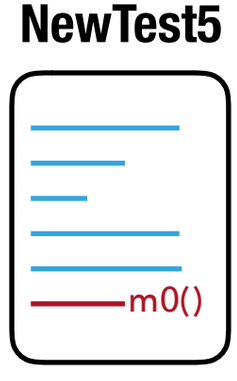




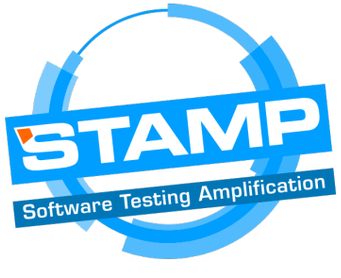








…

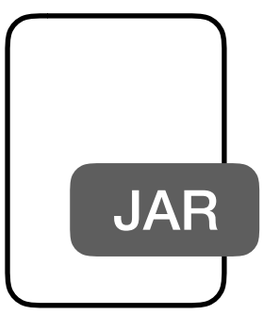


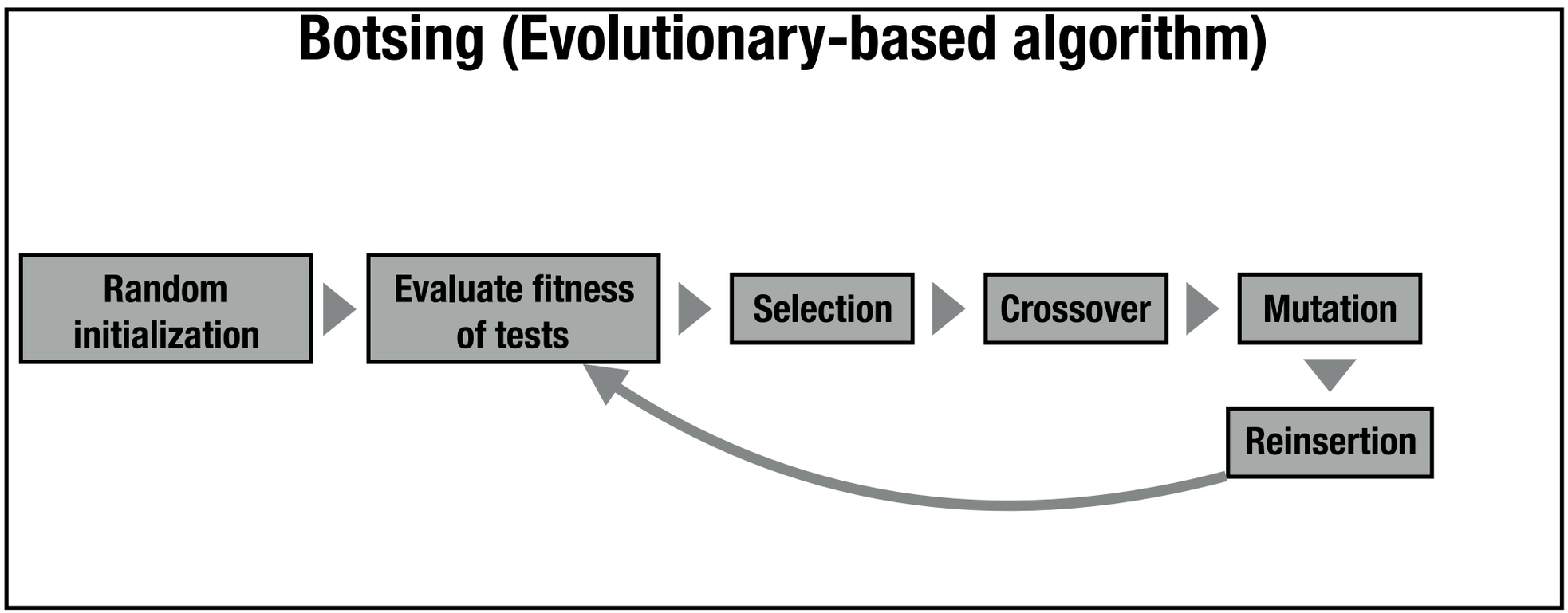
TU Delft

Stack Trace

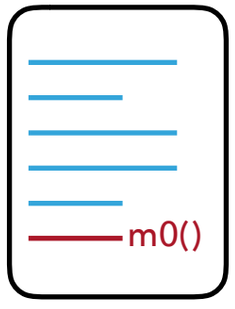
```
Exception:
at C1.m1(...)
at C1.m2(...)
at C2.m0(...)
```

Application





Crash Reproducing TEST



STAMP Software Testing Amplification

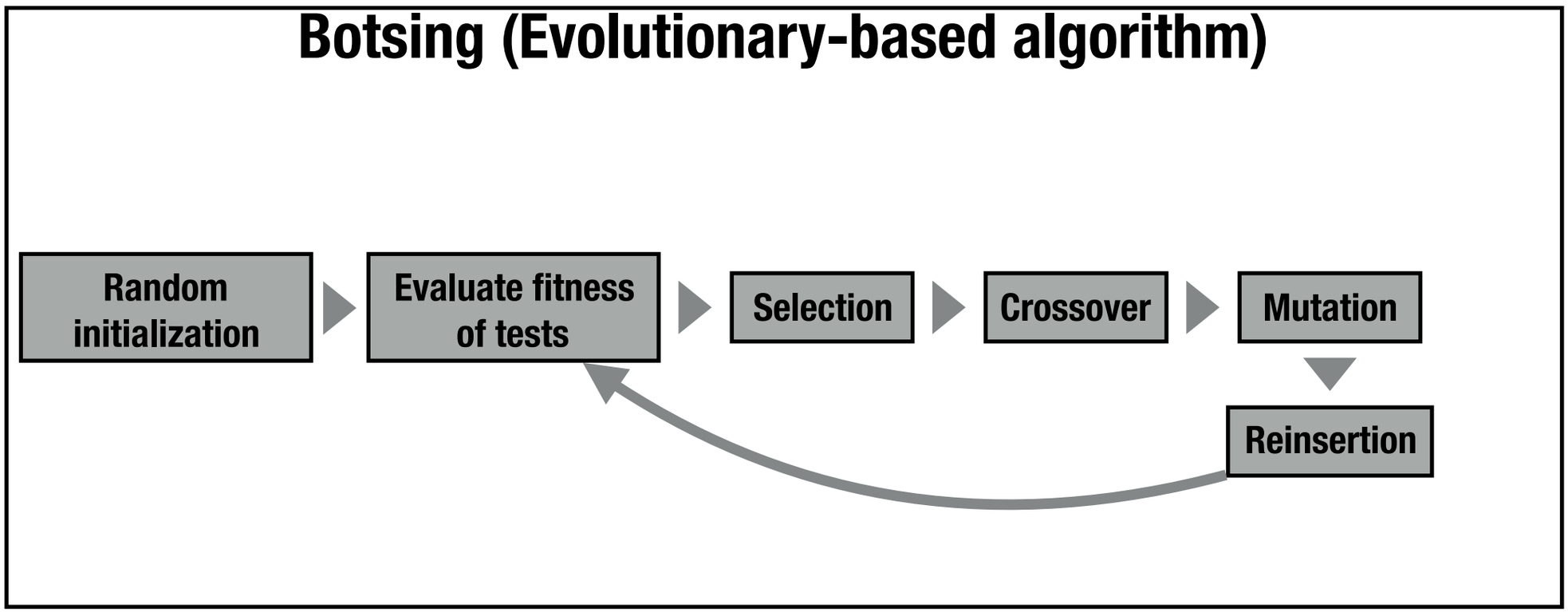
TU Delft

Stack Trace

Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)

Application

JAR



Crash Reproducing TEST

STAMP Software Testing Amplification

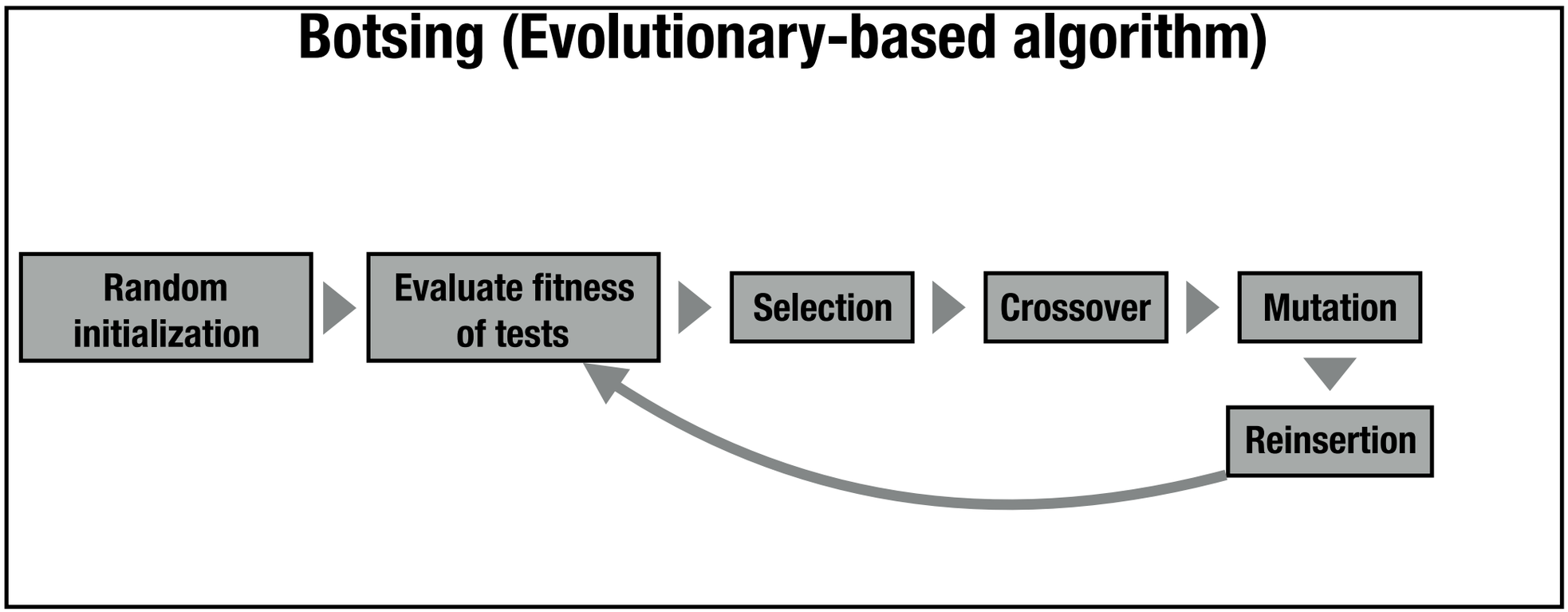
TU Delft

Stack Trace

Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)

Application

JAR

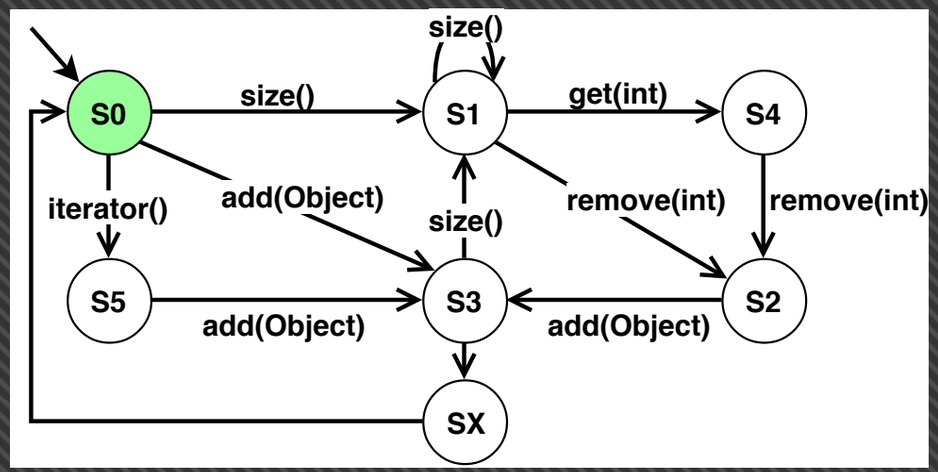


Crash Reproducing TEST

Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)

STAMP Software Testing Amplification

TU Delft



MORE EFFECTIVE CRASH REPRODUCTION
BY MACHINE LEARNING

BEHAVIORAL MODEL SEEDING

TU Delft

Stack Trace

Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)

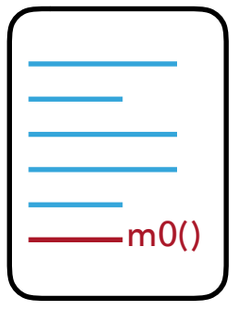
Application

JAR

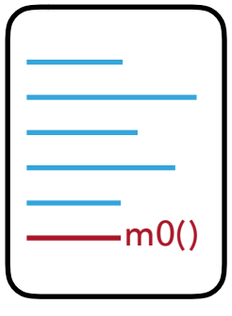
Botsing (Evolutionary-based algorithm)

Random initialization

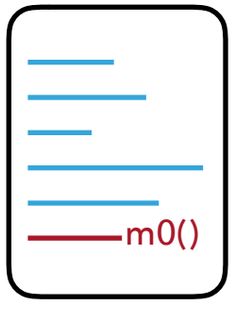
Test0



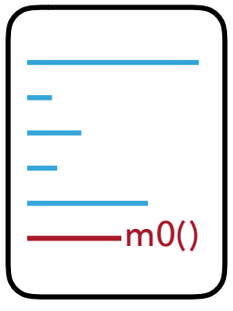
Test1



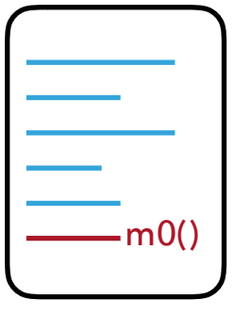
Test2



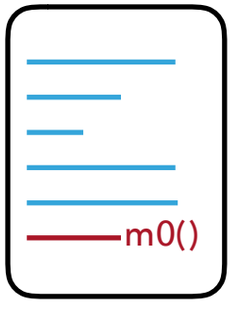
Test3



Test4



Test5



…

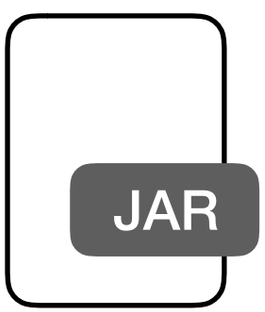
STAMP Software Testing Amplification

TU Delft

Stack Trace

```
Exception:
at C1.m1(...)
at C1.m2(...)
at C2.m0(...)
```

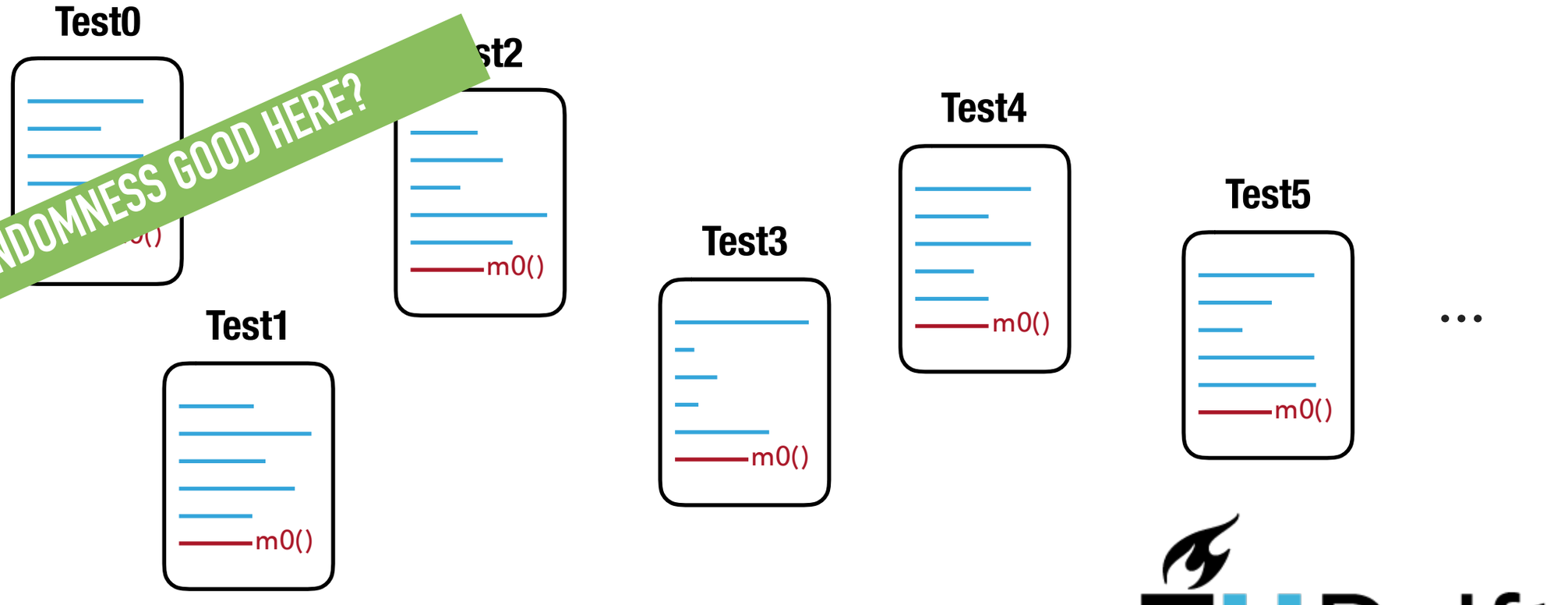
Application



Botsing (Evolutionary-based algorithm)

Random initialization

IS 100% RANDOMNESS GOOD HERE?



STAMP Software Testing Amplification

TU Delft

Stack Trace

Exception:
at C1.m1(…)
at C1.m2(…)
at C2.m0(…)

Application

JAR

Botsing (Evolutionary-based algorithm)

Random initialization

Test0

Test1

Test2

m0()

Test3

m0()

Test4

m0()

Test5

m0()

…

IS 100% RANDOMNESS GOOD HERE?

CAN BOTSING ACTS EVEN SMARTER IN TEST GENERATION

STAMP
Software Testing Amplification

TU Delft

Stack Trace

```
Exception:
at C1.m1(...)
at C1.m2(...)
at C2.m0(...)
```

Application

JAR

Botsing (Evolutionary-based algorithm)

Random initialization

Test0

Test1

Test2

m0()

Test3

Test4

m0()

Test5

m0()

...

IS 100% RANDOMNESS GOOD HERE?

LEARN ABOUT OBJECT USAGES BEFORE START CRASH REPRODUCTION

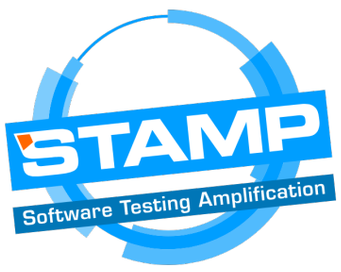
CAN BOTSING ACTS EVEN SMARTER IN TEST GENERATION

STAMP Software Testing Amplification

TU Delft

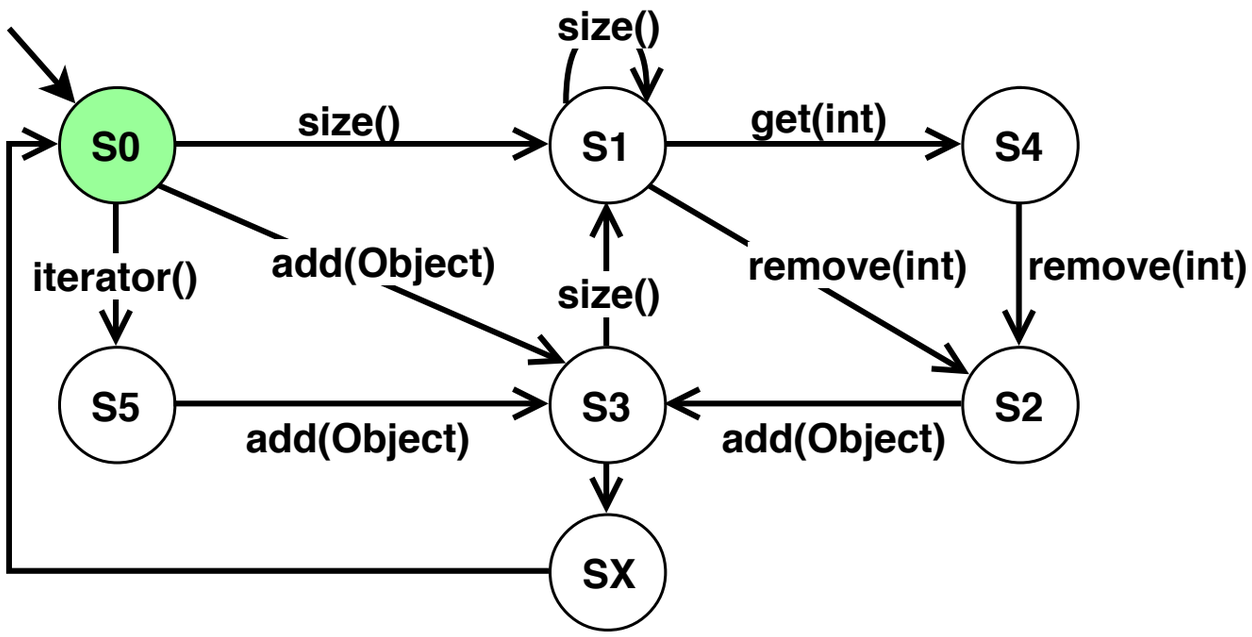
LEARN OBJECTS USAGES BEFORE CRASH REPRODUCTION

- Analyze source code and existing test cases
  - Learn classes usages
  - Abstract the usages in state machines



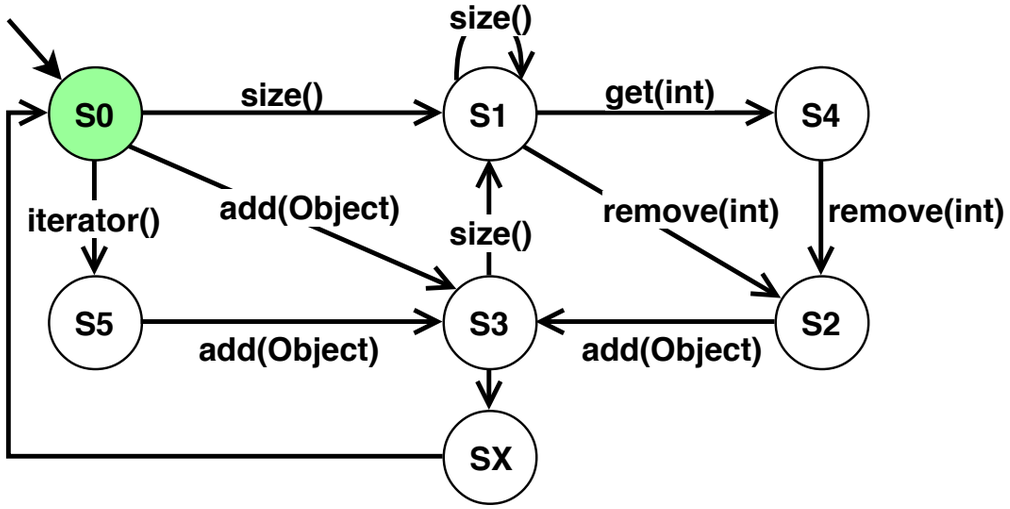
LEARN OBJECTS USAGES BEFORE CRASH REPRODUCTION

- Analyze source code and existing test cases
  - Learn classes usages
  - Abstract the usages in state machines



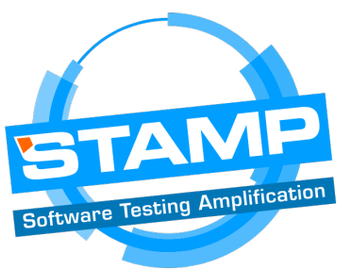
Example: usage of LinkedList in java

LEARN OBJECTS USAGES BEFORE CRASH REPRODUCTION

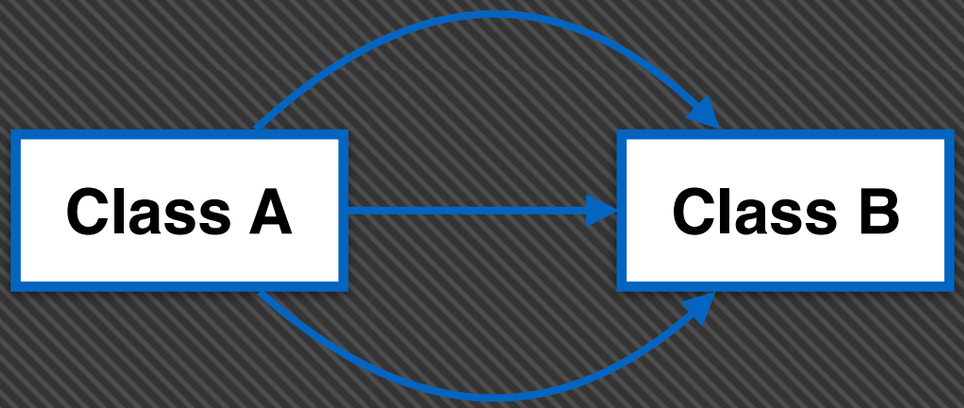


<add(Object), add(Object)>

```
int[] t = new int[7];
t[3] = (-2147483647);
EuclideanIntegerPoint ep = new […](t);
LinkedList<[...]> lst = new LinkedList<>();
lst.add(ep);
lst.add(ep);
```



TU Delft



TEST CLASS INTEGRATIONS

CLING

TU Delft

AUTOMATED TEST GENERATION FOR DIFFERENT LEVELS OF TESTING

Unit Testing	Integration Testing	System-level Testing
EVOSUITE T3		EvoMaster
TARDIS SUSHI		

STAMP Software Testing Amplification

TU Delft

AUTOMATED TEST GENERATION FOR DIFFERENT LEVELS OF TESTING

STAMP
Software Testing Amplification

TU Delft

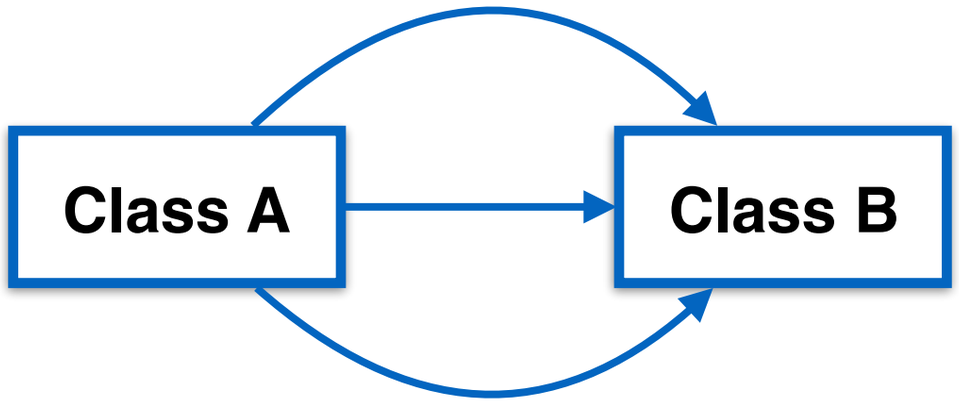
AUTOMATED TEST GENERATION FOR DIFFERENT LEVELS OF TESTING

STAMP
Software Testing Amplification

TU Delft

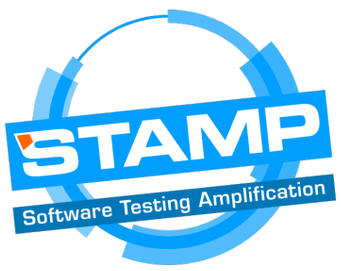
CLASS INTEGRATION TEST GENERATION (CLING)

Unit Testing	Integration Testing	System-level Testing
EVOSUITE T3	Cling	EvoMaster
TARDIS SUSHI		



CLING HELPS IN INTEGRATION-FAULT-DETECTION

- On average, the generated test by cling can improve the fault detection by 10% (mutation testing)
- We manually analyzed the captured crashes by Cling: found some integration level faults not detected by existing automated test generation tools



THANK YOU FOR LISTENING

Botsing
https://github.com/STAMP-project/botsing

Botsing Demo
https://github.com/STAMP-project/botsing-demo

Cling
https://github.com/STAMP-project/botsing/tree/master/cling

STAMP Software Testing Amplification

TU Delft

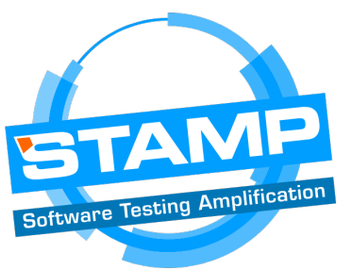
SUPPORTING SLIDES

TU Delft

CRASH DISTANCE FITNESS FUNCTION

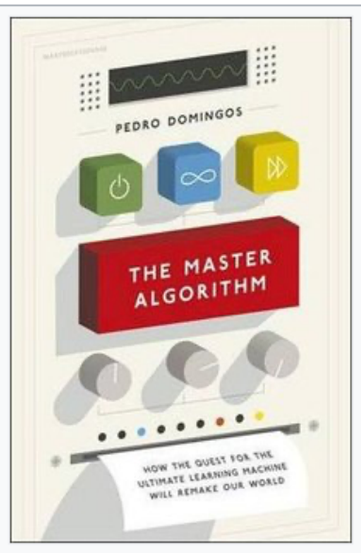
- Line Coverage ($d_s(t)$)
  - How far is the test from the target line
- Exception Coverage ($d_{except}(t)$)
  - Is the Exception thrown
- Stacktrace Similarity ($d_{trace}(t)$)
  - Compares the similarity of the thrown stacktrace compared to the original (given) one

$$f(t) = \begin{cases} 3 \times d_s(t) + 2 \times max(d_{except}) + max(d_{trace}) & \text{if the line is not reached} \\ 3 \times min(d_s) + 2 \times d_{except}(t) + max(d_{trace}) & \text{if the line is reached} \\ 3 \times min(d_s) + 2 \times min(d_{except}) + d_{trace}(t) & \text{if the exception is thrown} \end{cases}$$

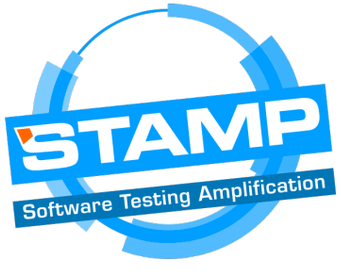


AI ALGORITHMS

The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World



Author	Pedro Domingos
Country	United States
Language	English
Subject	Artificial intelligence
Genre	Philosophy, popular science
Publisher	Basic Books
Publication date	September 22, 2015
Media type	Print, e-book, audiobook
Pages	352 pp.
ISBN	978-0465065707



TU Delft