缺陷修复技术

熊英飞

北京大学软件工程研究所

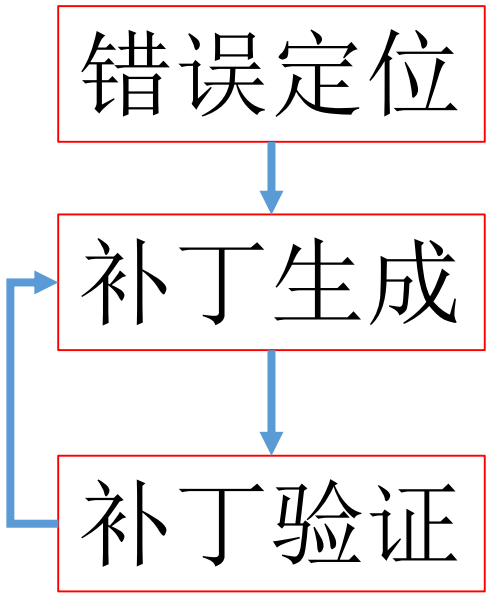
报告人介绍 – 熊英飞

- 2000~2004，电子科技大学本科
- 2004~2006，北京大学研究生
  - 导师：梅宏、杨芙清
- 2006~2009，日本东京大学博士
  - 导师：胡振江、武市正人
- 2009~2011，加拿大滑铁卢大学博士后
  - 导师：Krzysztof Czarnecki
- 2012~，北京大学“百人计划”研究员（Tenure-Track）
- 研究方向：软件分析、编程语言设计

缘起

- 人和Bug的斗争从来没有停止过
- 缺陷检测：到底有没有Bug
  - 从上世纪60年代开始
  - 代表技术：软件测试、软件验证
- 缺陷定位：Bug在哪里
  - 从上世纪90年代开始
  - 代表技术：统计性调试
- 缺陷修复：自动消除Bug
  - 约从2000年之后开始
  - 代表技术：生成-验证缺陷修复技术

“生成-验证”缺陷修复



代表性工作

- GenProg
  - [Westley Weimer: ICSE'09, GECCO'09, CACM'10, ICSE'12]
  - 错误定位：采用统计性调试
  - 补丁生成：
    - 基本操作：复制其他语句/删除语句
    - 采用遗传算法从基本操作合成补丁
  - 补丁验证：运行程序中的测试验证补丁
  - 实证研究：55/105，8$/bug
- 引发一系列相关工作
  - AutoFiix, Nopol, RSRepair, MintHint, AutoRepair, SemFix, DirectFix, SPR…
- 程序员的前景一片光明，“躺着也能把钱挣了”的时代眼看就要到来

转折

- [Qi-ISSTA'15]
  - GenProg被认为修复的55个缺陷中，只有2个是正确的
  - 根本原因：通过测试并不代表是正确的修复
- [Le Goues-FSE'15]
  - 详细实验了GenProg，AE等多个主流修复方法，采用了更大的数据集，更多的测试集
  - 结果基本一致
- 其他后续工作
  - Prophet, Angelix
  - 补丁的正确率最好也只有30%左右

原因分析

- 软件中的规约通常是不充分的
- 已有缺陷修复技术仅已满足规约为目标，但通过规约并不意味着是正确的修复

我们的方法

- 获取领域知识来修复缺陷
  - 有经验的程序员在不知道软件规约的情况下也能修复很多缺陷
  - 获取有经验的程序员的领域知识，利用领域知识修复特定类型的缺陷
- 我们小组的工作
  - 设计编程语言编码领域知识
  - 从已有数据自动获取领域知识
  - 针对重要缺陷类型设计专门修复算法

基于问答网站分析的复发崩溃缺陷的自动修复

高庆，张汉生，王杰，
熊英飞，张路，梅宏

北京大学软件工程研究所

发表于ASE'15

示例


```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33        switch (action) {
...           ...
51        }
52    }
```

context: Context

应该为

context.getApplicationContext() : ApplicationContext

java.lang.RuntimeException: Unable to start receiver : android.conten

Web Videos News Images More Search tools

8 results (0.52 seconds)

android - "IntentReceiver components are not allowed to ...
stackoverflow.com/.../**intentreceiver-components-are-not-allowed-to-regi**...
Jul 24, 2014 - "**IntentReceiver components** are **not allowed** to **register** to **receive** ... ACTION_BATTERY_CHANGED); **Intent** batteryStatus = c. ... **RuntimeException**: **Unable** to **start receiver** ... ActivityThread.main(ActivityThread.java:4627) at **java**.**lang**.reflect. ... NativeStart.main(Native Method) Caused by: **android**.**content**.

android - Battery changed broadcast receiver crashing app ...
stackoverflow.com/.../battery-changed-broadcast-**receiver**-crashing-app-...
Feb 27, 2013 - Battery changed broadcast **receiver** crashing app on some phones. **No** ... **PowerConnectionReceiver**"> <**intent**-filter> <action **android**:name="**android**.**intent**.action. ... **RuntimeException**: **Unable** to **start receiver** com.doublep.wakey. .... **ReceiverCallNotAllowedException**: **IntentReceiver components** are **not** ...

android - Want app to execute some code when phone is ...
stackoverflow.com/.../want-app-to-execute-some-code-when-phone-is-pl...
Jun 29, 2012 - ACTION_BATTERY_CHANGED)); int plugged = **intent**. ... The code errors out with: *FATAL EXCEPTION: main:: **java**.**lang**.**RuntimeException**: **Unable** to **start receiver** com.example.**ChargingOnReceiver**: **android**.**content**. ... **IntentReceiver components** are **not allowed** to **register** to **receive intents** *. I kind of ...

push notification - Unable to start receiver com.parse ...
stackoverflow.com/.../**unable-to-start-receiver**-com-parse-parsebroadcastr...
Feb 11, 2013 - **ParseBroadcastReceiver** on Trigger.io **Android** app. **No** problem. ...

stackoverflow Questions Tags Users Badge

Stack Overflow is a community of 4.7 million programmers, just like you, helping each o
only takes a minute:

"IntentReceiver components are not allowed to register to receive int
determine Battery level

2

I am trying to get Battery info from my Application following the guidelines at http://developer.android.com/training/monitoring-device-state/battery-monitoring.html

This is the method is came up with to check the battery level:

2

```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY_
    Intent batteryStatus = c.registerReceiver(null, iFilter);
```

4

Instead of:

```
context.registerReceiver(null, new IntentFilter(Intent.ACTION_BATTERY_CHANGED));
```

use:

```
context.getApplicationContext().registerReceiver(null, new IntentFilter(Intent.ACTION_BATTE
```

This is annoying -- `registerReceiver()` should be smarter than this -- but it's the workaround for this particular case.

share improve this answer

answered Jun 29 '12 at 19:57
CommonsWare
510k • 60 • 1155 • 1221

示例

```
29    public void onReceive (final Context context, final Intent intent) {
30       final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31       final float bl = BatteryHelper.level(context);
32       LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33       switch (action) {
...         ...
51       }
52    }
```

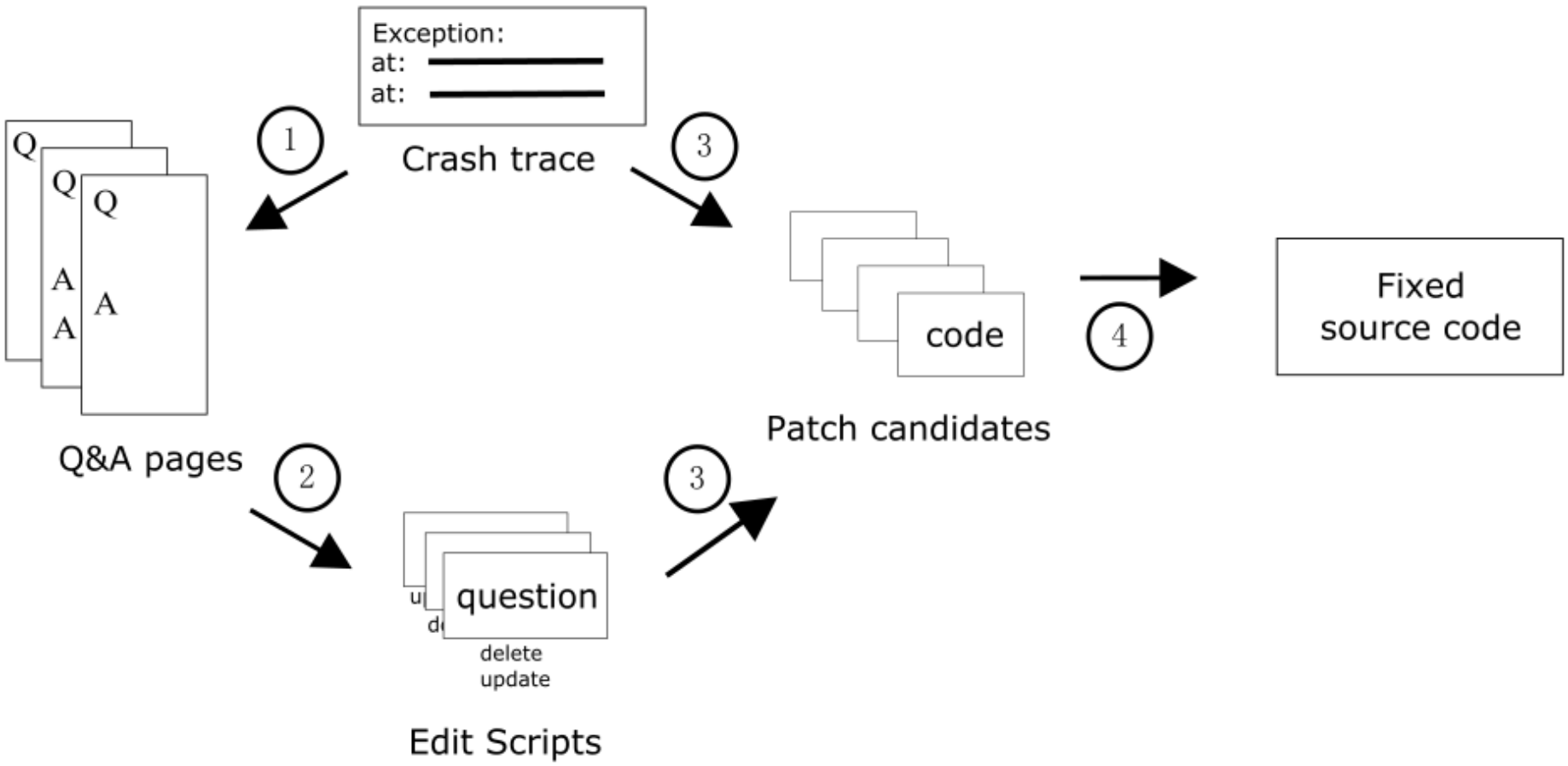
```
final float bl=BatteryHelper.level(
                    context.getApplicationContext());
```

✓ 修复

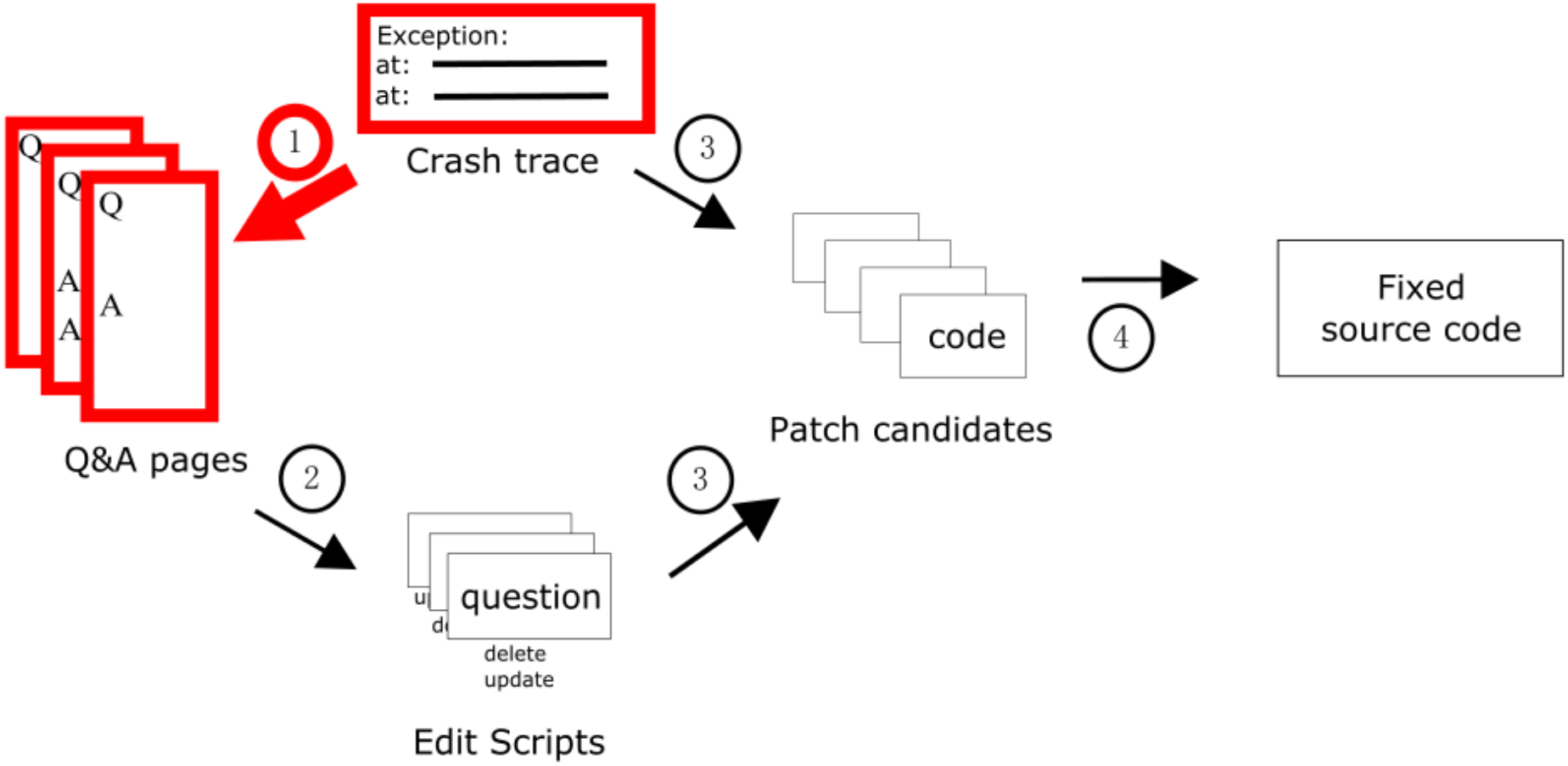
我们的工作

- 主要思想
  - 自动化这个过程
  - 使用因特网资源（问答网站）来修复崩溃缺陷
- 核心
  - 使用代码分析而不是复杂的自然语言处理

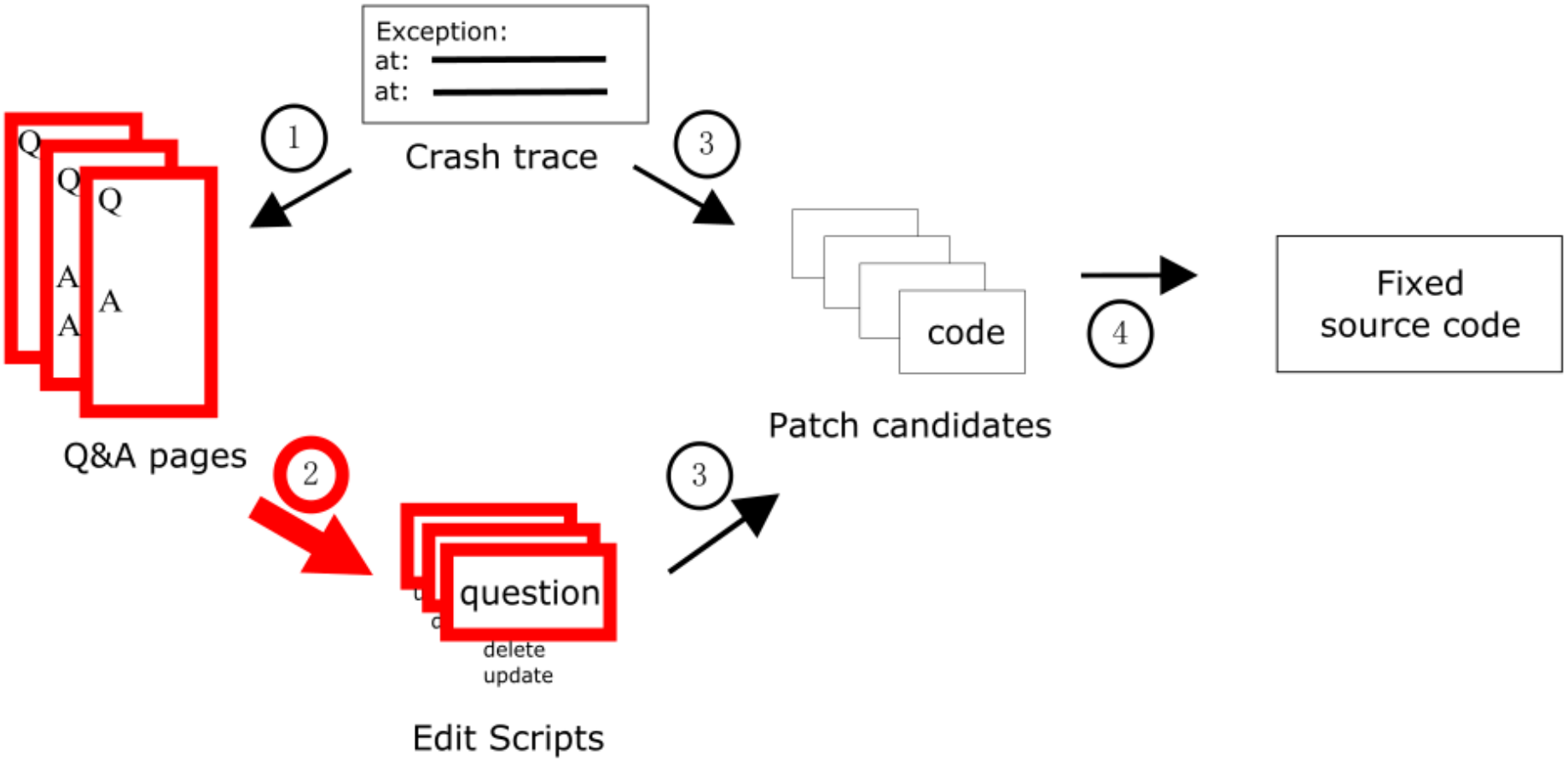
方法概览


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
code
Patch candidates
4
Fixed
source code
2
3
question
delete
update
Edit Scripts

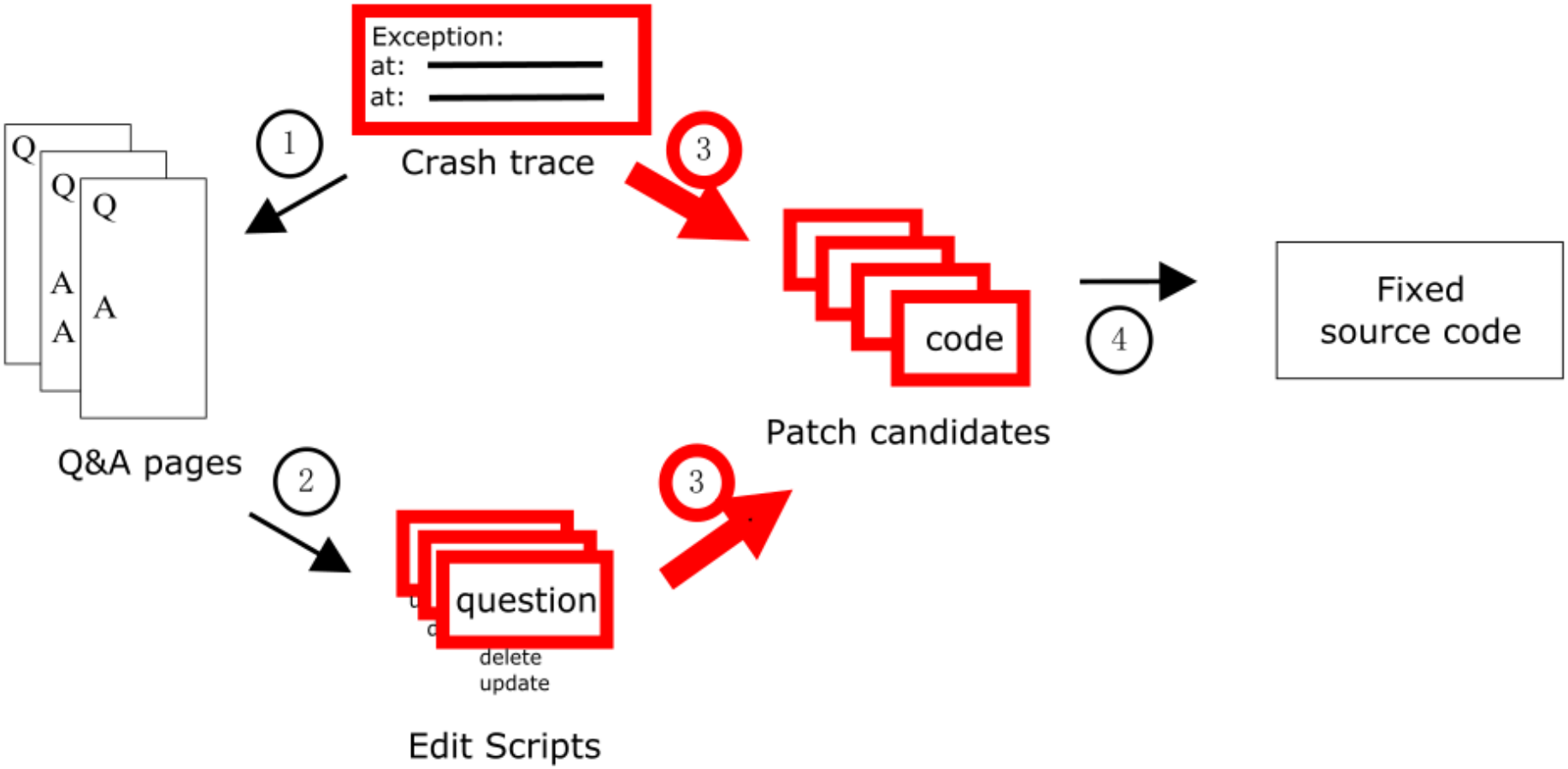
方法概览


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
code
Patch candidates
4
Fixed
source code
2
3
question
delete
update
Edit Scripts

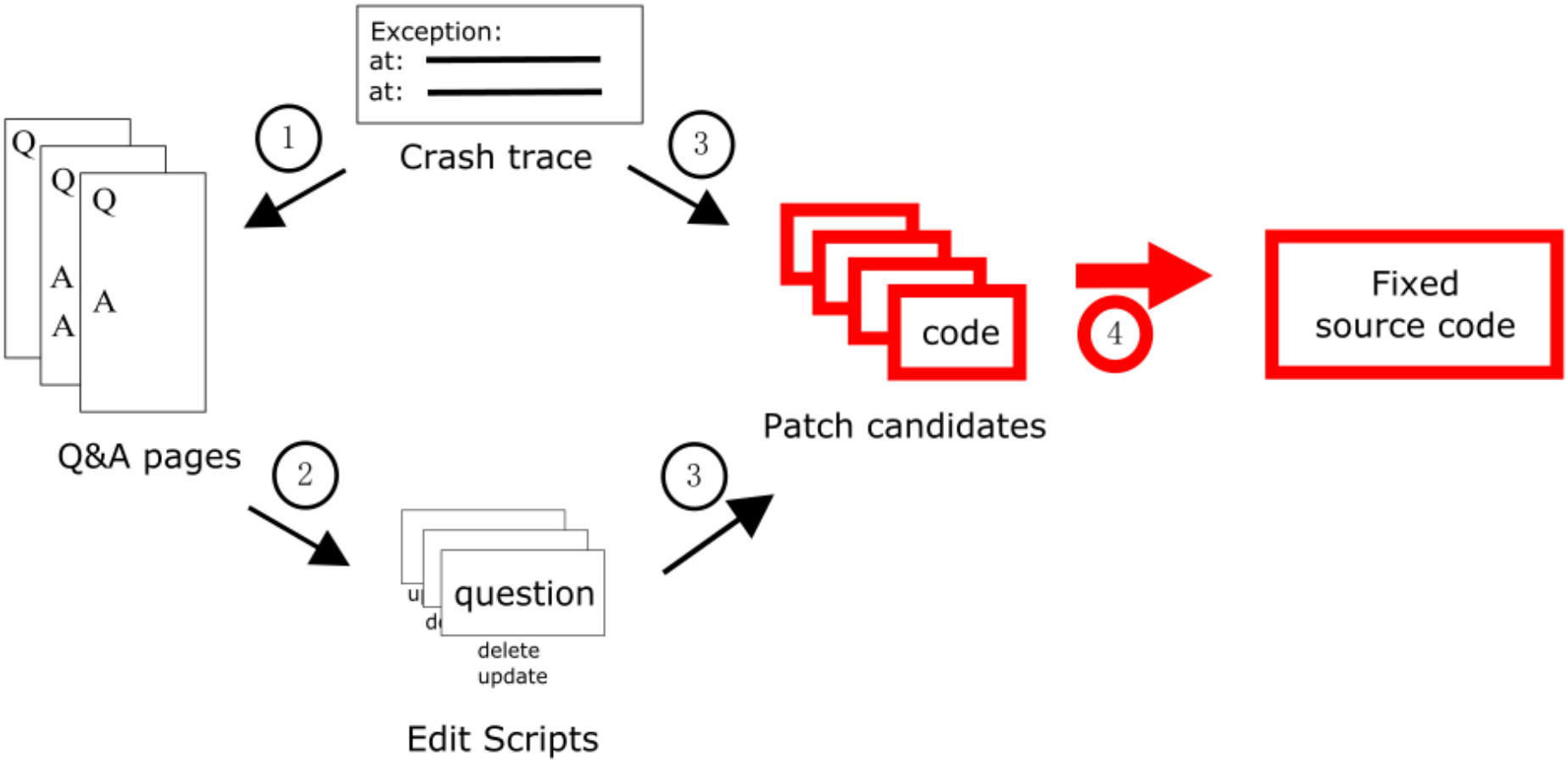
方法概览


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
code
Patch candidates
4
Fixed
source code
2
3
question
delete
update
Edit Scripts

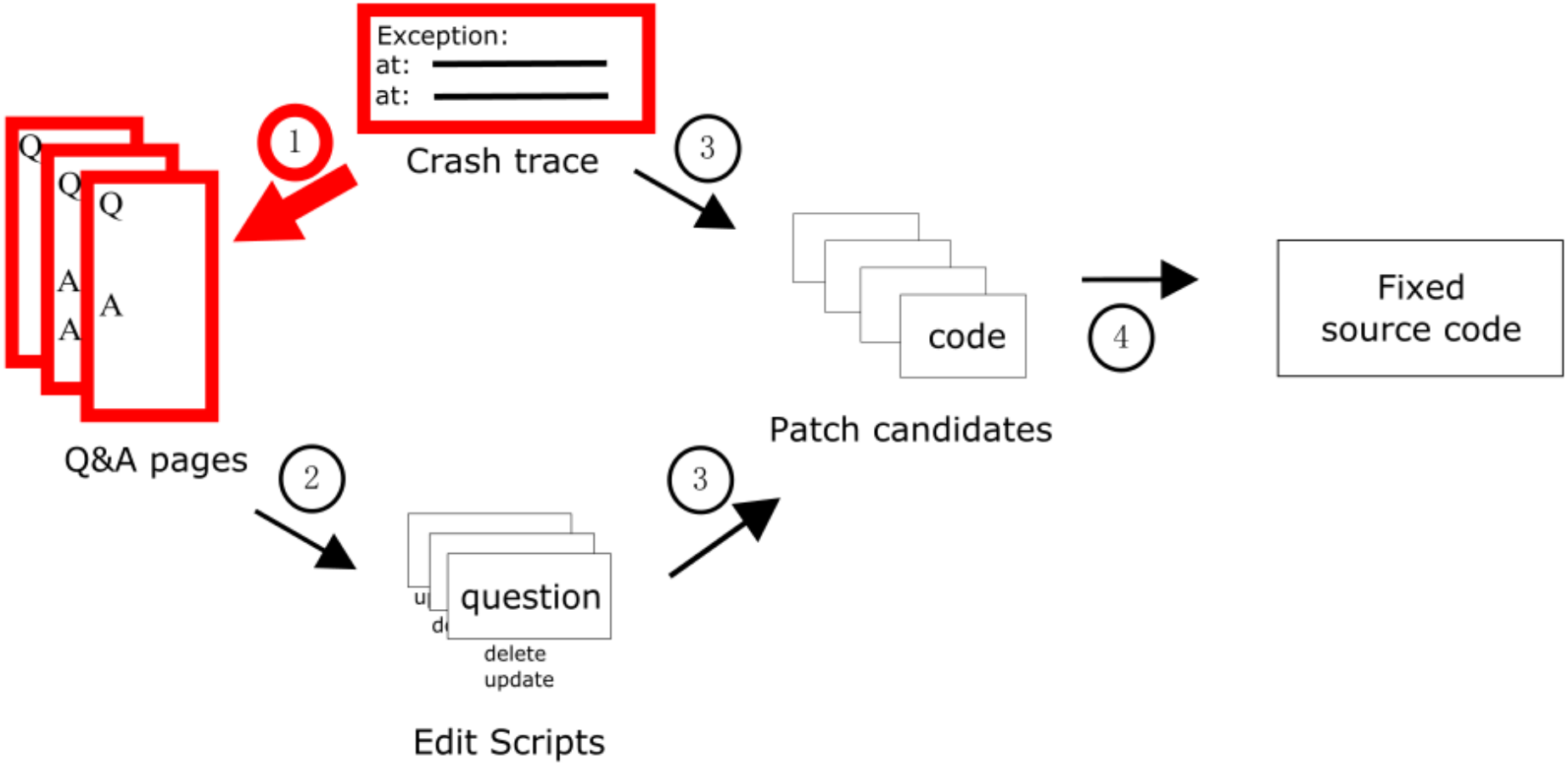
方法概览


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
code
Patch candidates
4
Fixed
source code
2
3
question
delete
update
Edit Scripts

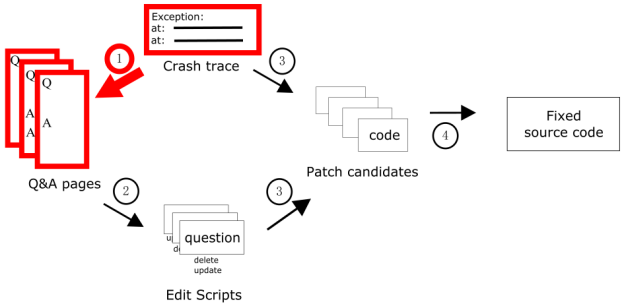
方法概览


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
2
code
4
Fixed
source code
Patch candidates
3
question
delete
update
Edit Scripts

步骤1:
提取问答网页


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
2
code
Patch candidates
4
Fixed
source code
question
delete
update
3
Edit Scripts

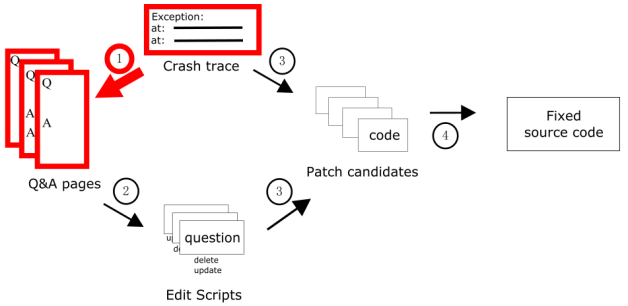
步骤1:
提取问答网页




```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
```

```
1  java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver:
   android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents
2  at android.app.ActivityThread.handleReceiver(ActivityThread.java:2126)
3  at android.app.ActivityThread.access$1500(ActivityThread.java:123)
4  at android.app.ActivityThread$H.handleMessage(ActivityThread.java:1197)
5  at android.os.Handler.dispatchMessage(Handler.java:99)
6  at android.os.Looper.loop(Looper.java:137)
7  at android.app.ActivityThread.main(ActivityThread.java:4424)
8  at java.lang.reflect.Method.invokeNative(Native Method)
9  at java.lang.reflect.Method.invoke(Method.java:511)
10 at com.android.internal.os.ZygoteInit$MethodAndArgsCaller.run(ZygoteInit.java:784)
11 at com.android.internal.os.ZygoteInit.main(ZygoteInit.java:551)
12 at dalvik.system.NativeStart.main(Native Method)
13 Caused by: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to rece
14 at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:118)
15 at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:112)
16 at com.vaguehope.onosendai.update.AlarmReceiver.onReceive(AlarmReceiver.java:31)
17 at android.app.ActivityThread.handleReceiver(ActivityThread.java:2119)
18 ... 10 more
```

步骤1:
提取问答网页



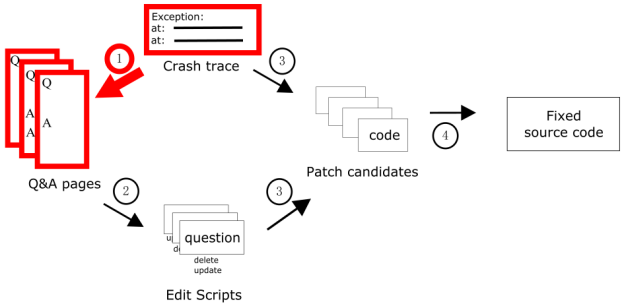

```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
```

```
1  java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver:
   android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents
2  at android.app.ActivityThread.handleReceiver(ActivityThread.java:2126)
3  at android.app.ActivityThread.access$1500(ActivityThread.java:123)
4  at android.app.ActivityThread$H.handleM
5  at android.os.Handler.dispatchMessage(Ha
6  at android.os.Looper.loop(Looper.java:137
7  at android.app.ActivityThread.main(Activ
8  at java.lang.reflect.Method.invokeNative(N
9  at java.lang.reflect.Method.invoke(Method
10 at com.android.internal.os.ZygoteInit$Met
11 at com.android.internal.os.ZygoteInit.mai
12 at dalvik.system.NativeStart.main(Native Method)
13 Caused by: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to rece
14 at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:118)
15 at android.app.ReceiverRestrictedContext.registerReceiv
16 at com.vaguehope.onosendai.update.AlarmReceiver.onR
17 at android.app.ActivityThread.handleReceiver(ActivityT
18 ... 10 more
```

java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents

搜索引擎

步骤1:
提取问答网页



Google java.lang.RuntimeException: Unable to start receiver com.vaguehope.ono SafeSearch on

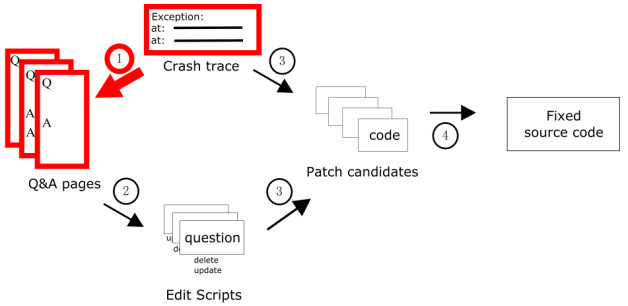
Web News Videos Images More Search tools

Your search - **java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update ...** - did not match any documents.

Suggestions:

- Make sure that all words are spelled correctly.
- Try different keywords.
- Try more general keywords.
- Try fewer keywords.

步骤1:
提取问答网页



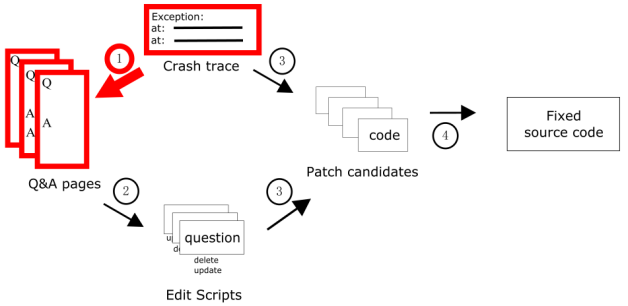

```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33        switch (action) {
```

```
1  java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver:
   android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents
2  at android.app.ActivityThread.handleReceiver(ActivityThread.java:2126)
3  at android.app.ActivityThread.access$1500(ActivityThread.java:123)
4  at android.app.ActivityThread$H.handleM
5  at android.os.Handler.dispatchMessage(Ha
6  at android.os.Looper.loop(Looper.java:137
7  at android.app.ActivityThread.main(Activ
8  at java.lang.reflect.Method.invokeNative(N
9  at java.lang.reflect.Method.invoke(Method
10 at com.android.internal.os.ZygoteInit$Met
11 at com.android.internal.os.ZygoteInit.mai
12 at dalvik.system.NativeStart.main(Native Method)
13 Caused by: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to rece
14 at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:1118)
15 at android.app.ReceiverRestrictedContext.registerReceiv
16 at com.vaguehope.onosendai.update.AlarmReceiver.onR
17 at android.app.ActivityThread.handleReceiver(ActivityT
18 ... 10 more
```

java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents

搜索引擎

步骤1:
提取问答网页



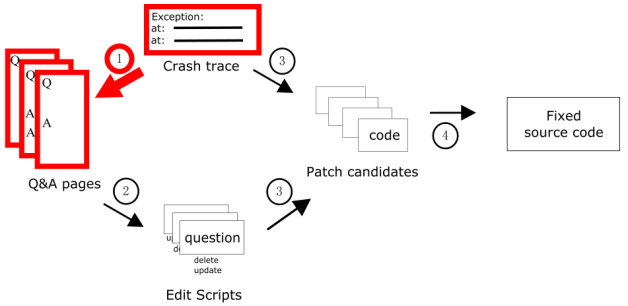

```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33        switch (action) {
```

```
1  java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver:
   android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents
2  at android.app.ActivityThread.handleReceiver(ActivityThread.java:2126)
3  at android.app.ActivityThread.access$1500(ActivityThread.java:123)
4  at android.app.ActivityThread$H.handleM
5  at android.os.Handler.dispatchMessage(Ha
6  at android.os.Looper.loop(Looper.java:137
7  at android.app.ActivityThread.main(Activ
8  at java.lang.reflect.Method.invokeNative(N
9  at java.lang.reflect.Method.invoke(Method
10 at com.android.internal.os.ZygoteInit$Met
11 at com.android.internal.os.ZygoteInit.mai
12 at dalvik.system.NativeStart.main(Native Method)
13 Caused by: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to rece
14 at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:1118)
15 at android.app.ReceiverRestrictedContext.registerReceiv
16 at com.vaguehope.onosendai.update.AlarmReceiver.onR
17 at android.app.ActivityThread.handleReceiver(ActivityT
18 ... 10 more
```

java.lang.RuntimeException: Unable to start receiver
com.vaguehope.onosendai.update.AlarmReceiver:
android.content.ReceiverCallNotAllowedException:
IntentReceiver components
are not allowed to register to receive intents

搜索引擎

步骤1:
提取问答网页




```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33        switch (action) {
```

```
1  java.lang.RuntimeException: Unable to start receiver com.vaguehope.onosendai.update.AlarmReceiver:
   android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to receive intents
2  at android.app.ActivityThread.handleReceiver(ActivityThread.java:2126)
3  at android.app.ActivityThread.access$1500(ActivityThread.java:123)
4  at android.app.ActivityThread$H.handleM
5  at android.os.Handler.dispatchMessage(Ha
6  at android.os.Looper.loop(Looper.java:137
7  at android.app.ActivityThread.main(Activ
8  at java.lang.reflect.Method.invokeNative(N
9  at java.lang.reflect.Method.invoke(Method
10 at com.android.internal.os.ZygoteInit$Met
11 at com.android.internal.os.ZygoteInit.mai
12 at dalvik.system.NativeStart.main(Native Method)
13 Caused by: android.content.ReceiverCallNotAllowedException: IntentReceiver components are not allowed to register to rece
14 at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:1118)
15 at android.app.ReceiverRestrictedContext.registerReceiv
16 at com.vaguehope.onosendai.update.AlarmReceiver.onR
17 at android.app.ActivityThread.handleReceiver(ActivityT
18 ... 10 more
```

java.lang.RuntimeException: Unable to start receiver
~~com.vaguehope.onosendai.update.AlarmReceiver:~~
android.content.ReceiverCallNotAllowedException:
IntentReceiver components
are not allowed to register to receive intents

搜索引擎

java.lang.RuntimeException: Unable to start receiver : android.conten

Web Videos News Images More Search tools

8 results (0.52 seconds)

android - "IntentReceiver components are not allowed to ...
stackoverflow.com/.../**intentreceiver-components-are-not-allowed-to-regi**...
Jul 24, 2014 - "**IntentReceiver components** are **not allowed** to **register** to receive ... ACTION_BATTERY_CHANGED); **Intent** batteryStatus = c. ... **RuntimeException**: **Unable** to **start receiver** ... ActivityThread.main(ActivityThread.java:4627) at **java**.**lang**.reflect. ... NativeStart.main(Native Method) Caused by: **android**.**content**.

android - Battery changed broadcast receiver crashing app ...
stackoverflow.com/.../battery-changed-broadcast-**receiver**-crashing-app-...
Feb 27, 2013 - Battery changed broadcast **receiver** crashing app on some phones. **No** ... **PowerConnectionReceiver**"> <**intent**-filter> <action **android**:name="**android**.**intent**.action. ... **RuntimeException**: **Unable** to **start receiver** com.doublep.wakey. .... **ReceiverCallNotAllowedException**: **IntentReceiver components** are **not** ...

android - Want app to execute some code when phone is ...
stackoverflow.com/.../want-app-to-execute-some-code-when-phone-is-pl...
Jun 29, 2012 - ACTION_BATTERY_CHANGED)); int plugged = **intent**. ... The code errors out with: *FATAL EXCEPTION: main:: **java**.**lang**.**RuntimeException**: **Unable** to **start receiver** com.example.**ChargingOnReceiver**: **android**.**content**. ... **IntentReceiver components** are **not allowed** to **register** to **receive intents** *. I kind of ...

push notification - Unable to start receiver com.parse ...
stackoverflow.com/.../**unable-to-start-receiver**-com-parse-parsebroadcastr...
Feb 11, 2013 - **ParseBroadcastReceiver** on Trigger.io **Android** app. **No** problem. ...

stackoverflow Questions Tags Users Badg

Stack Overflow is a community of 4.7 million programmers, just like you, helping each o
only takes a minute:

"IntentReceiver components are not allowed to register to receive in
determine Battery level

2

I am trying to get Battery info from my Application following the guidelines at http://developer.android.com/training/monitoring-device-state/battery-monitoring.html

2

This is the method is came up with to check the battery level:

```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY
    Intent batteryStatus = c.registerReceiver(null, iFilter);
```

• • • • • •

```
java.lang.RuntimeException: Unable to start receiver wifi.myapp.sudara.lk.sudara_app.Sm
        at android.app.ActivityThread.handleReceiver(ActivityThread.java:2821)
        at android.app.ActivityThread.access$3200(ActivityThread.java:125)
        at android.app.ActivityThread$H.handleMessage(ActivityThread.java:2083)
        at android.os.Handler.dispatchMessage(Handler.java:99)
        at android.os.Looper.loop(Looper.java:123)
        at android.app.ActivityThread.main(ActivityThread.java:4627)
```

• • • • • •

4

Instead of:

```
context.registerReceiver(null, new IntentFilter(Intent.ACTION_BATTERY_CHANGED));
```

use:

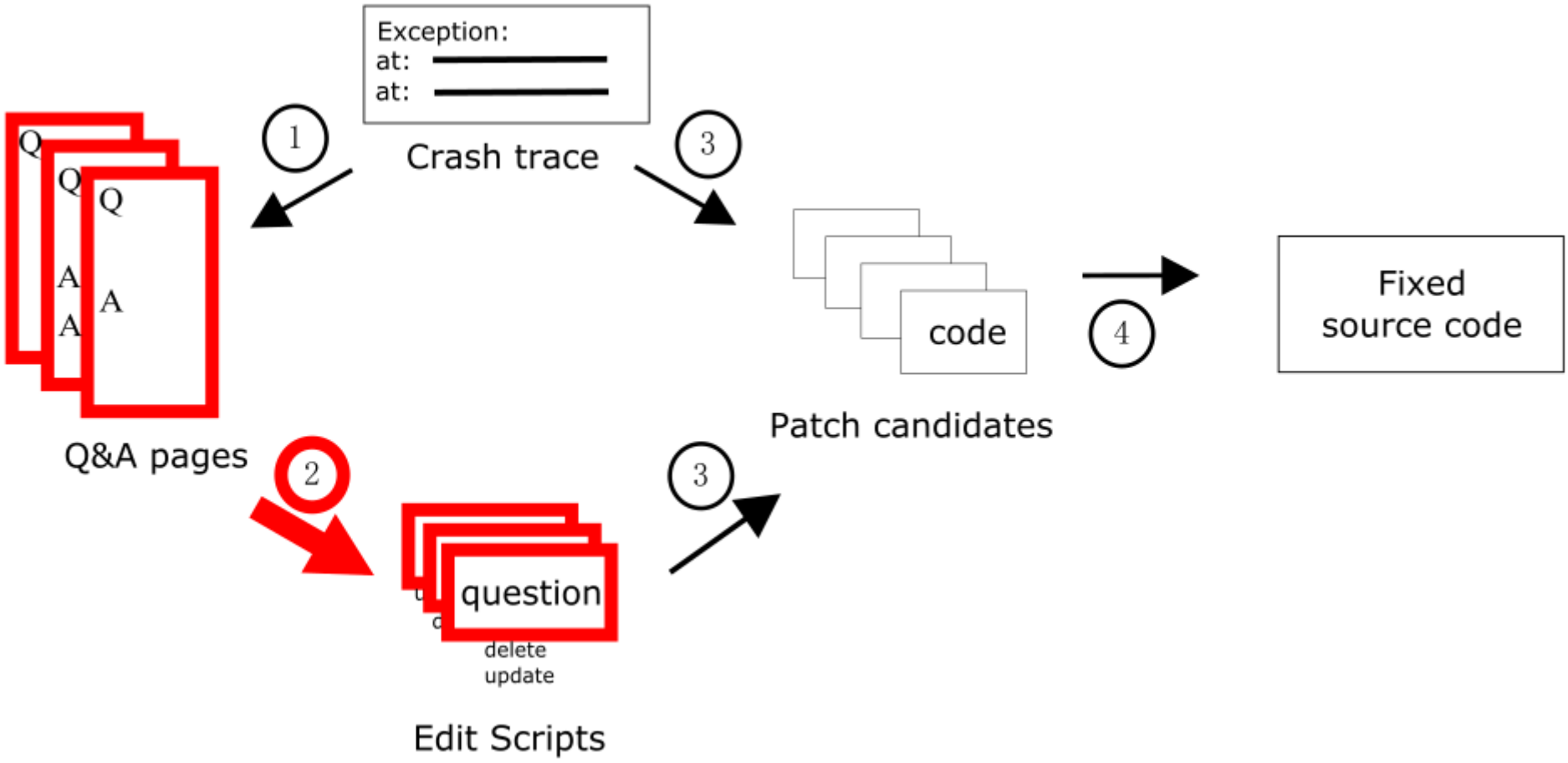
```
context.getApplicationContext().registerReceiver(null, new IntentFilter(Intent.ACTION_BATT
```

This is annoying -- `registerReceiver()` should be smarter than this -- but it's the workaround for this particular case.

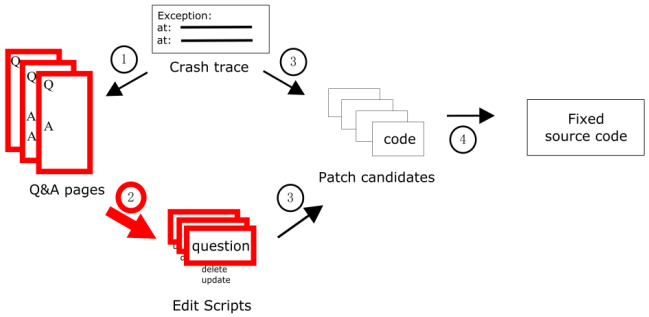
share improve this answer

answered Jun 29 '12 at 19:57

步骤2:
生成编辑脚本

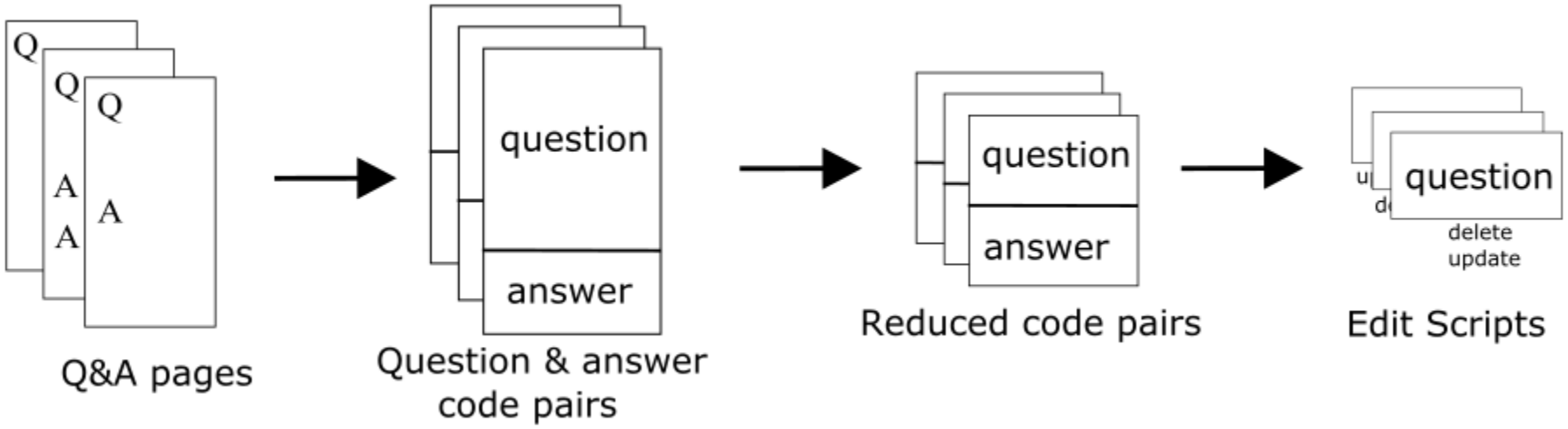

Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
2
question
delete
update
Edit Scripts
3
code
Patch candidates
4
Fixed
source code

步骤2:
生成编辑脚本

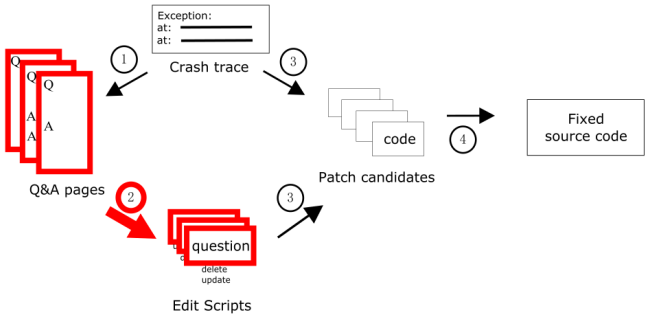


- 核心组件
  - 代码对

问题代码：问答网站中的错误代码
答案代码：问答网站中的修复代码

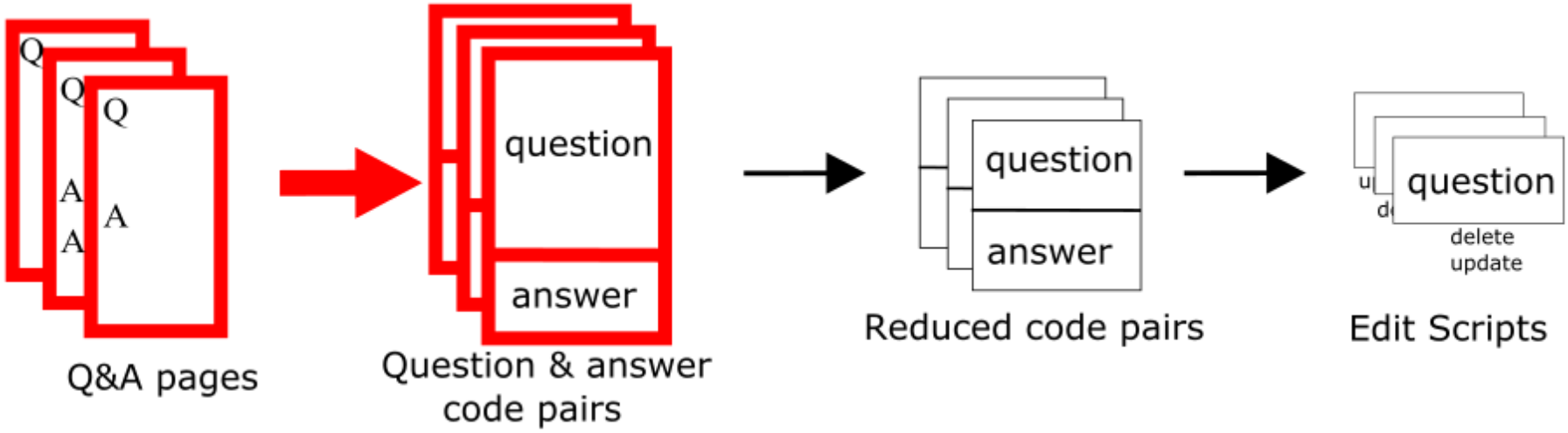


步骤2:
生成编辑脚本



- 核心组件
  - 代码对

问题代码：问答网站中的错误代码
答案代码：问答网站中的修复代码



stackoverflow

Questions Tags Users Badges

Stack Overflow is a community of 4.7 million programmers, just like you, helping each othe
only takes a minute:

"IntentReceiver components are not allowed to register to receive inter
determine Battery level

2

I am trying to get Battery info from my Application following the guidelines at http://developer.android.com/training/monitoring-device-state/battery-monitoring.html

This is the method is came up with to check the battery level:

2

```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY_
    Intent batteryStatus = c.registerReceiver(null, iFilter);
```

A

• • • • • •

4

Instead of:

```
context.registerReceiver(null, new IntentFilter(Intent.ACTION_BATTERY_CHANGED));
```

B

use:

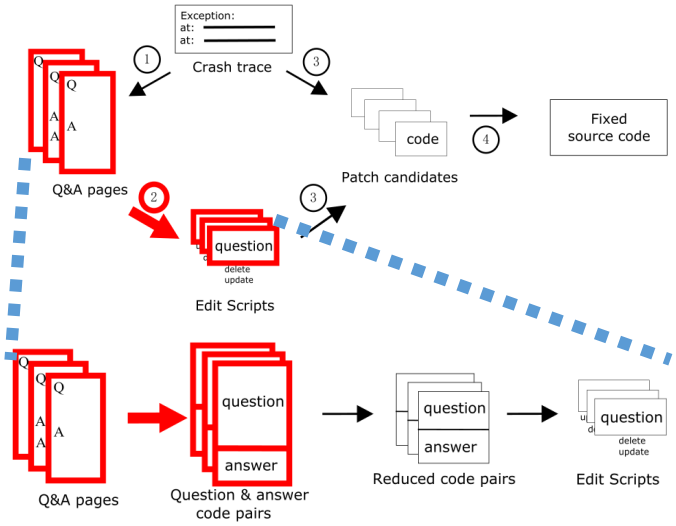
```
context.getApplicationContext().registerReceiver(null, new IntentFilter(Intent.ACTION_BATTER
```

C

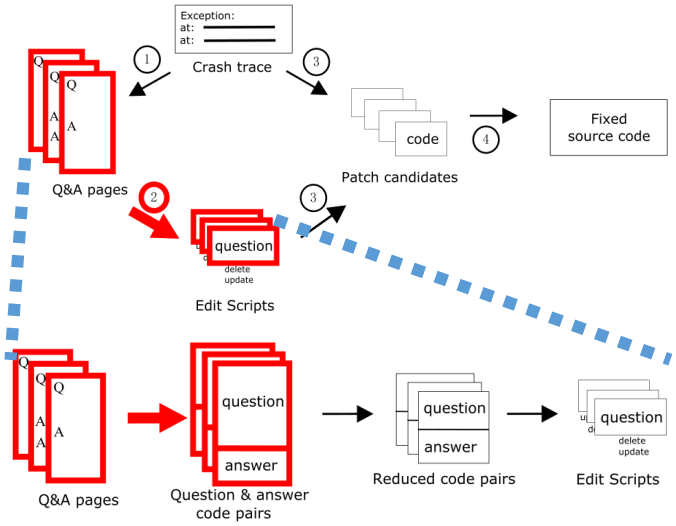
This is annoying -- `registerReceiver()` should be smarter than this -- but it's the workaround for this particular case.

share improve this answer

answered Jun 29 '12 at 19:57
CommonsWare
510k • 60 • 1155 • 1221



把代码片段组合为代码对



- 两段代码都从答案帖中提取

Instead of:

```
4   context.registerReceiver(null, new IntentFilter(Intent
```

B

use:

```
context.getApplicationContext().registerReceiver(null,
```

C

- 分别从问题帖和答案帖中提取

```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY_CHANGED);
    Intent batteryStatus = c.registerReceiver(null, iFilter);

    int status = batteryStatus.getIntExtra(BatteryManager.EXTRA_STATUS, -1);
    boolean isCharging = status == BatteryManager.BATTERY_STATUS_CHARGING || status == Batte

    int chargePlug = batteryStatus.getIntExtra(BatteryManager.EXTRA_PLUGGED, -1);
    boolean isUsbCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_USB;
    boolean isAcCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_AC;

    int batteryLevel = batteryStatus.getIntExtra(BatteryManager.EXTRA_LEVEL, -1);
    int scale = batteryStatus.getIntExtra(BatteryManager.EXTRA_SCALE, -1);

    float batteryPct = batteryLevel / (float) scale;

}
```

A

```
context.registerReceiver(null, new IntentFilter(Intent.AC
```

B

A

```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY_CHANGED);
    Intent batteryStatus = c.registerReceiver(null, iFilter);

    int status = batteryStatus.getIntExtra(BatteryManager.EXTRA_STATUS, -1);
    boolean isCharging = status == BatteryManager.BATTERY_STATUS_CHARGING || status == Batte

    int chargePlug = batteryStatus.getIntExtra(BatteryManager.EXTRA_PLUGGED, -1);
    boolean isUsbCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_USB;
    boolean isAcCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_AC;

    int batteryLevel = batteryStatus.getIntExtra(BatteryManager.EXTRA_LEVEL, -1);
    int scale = batteryStatus.getIntExtra(BatteryManager.EXTRA_SCALE, -1);

    float batteryPct = batteryLevel / (float) scale;

}
```

C

```
context.getApplicationContext().registerReceiver(nu
```

stackoverflow

Questions | Tags | Users | Badges

Stack Overflow is a community of 4.7 million programmers, just like you, helping each othe
only takes a minute:

"IntentReceiver components are not allowed to register to receive inter
determine Battery level

2

I am trying to get Battery info from my Application following the guidelines at http://developer.android.com/training/monitoring-device-state/battery-monitoring.html

This is the method is came up with to check the battery level:

2

```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY_
    Intent batteryStatus = c.registerReceiver(null, iFilter);
```

A

• • • • • •

4

Instead of:

```
context.registerReceiver(null, new IntentFilter(Intent.ACTION_BATTERY_CHANGED));
```

B

use:

```
context.getApplicationContext().registerReceiver(null, new IntentFilter(Intent.ACTION_BATTER
```

C

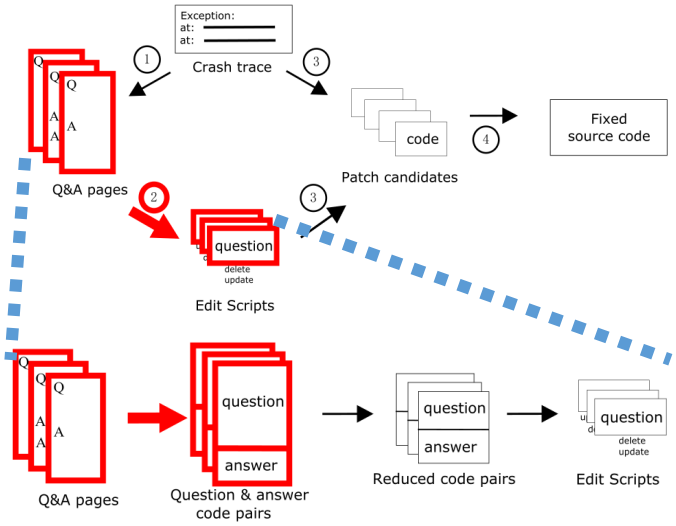
This is annoying -- `registerReceiver()` should be smarter than this -- but it's the workaround for this particular case.

share improve this answer

answered Jun 29 '12 at 19:57

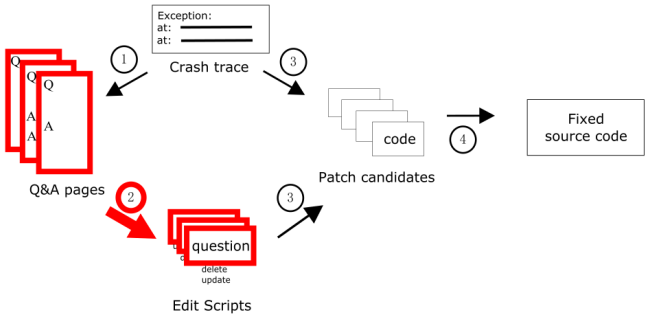
CommonsWare

510k • 60 • 1155 • 1221

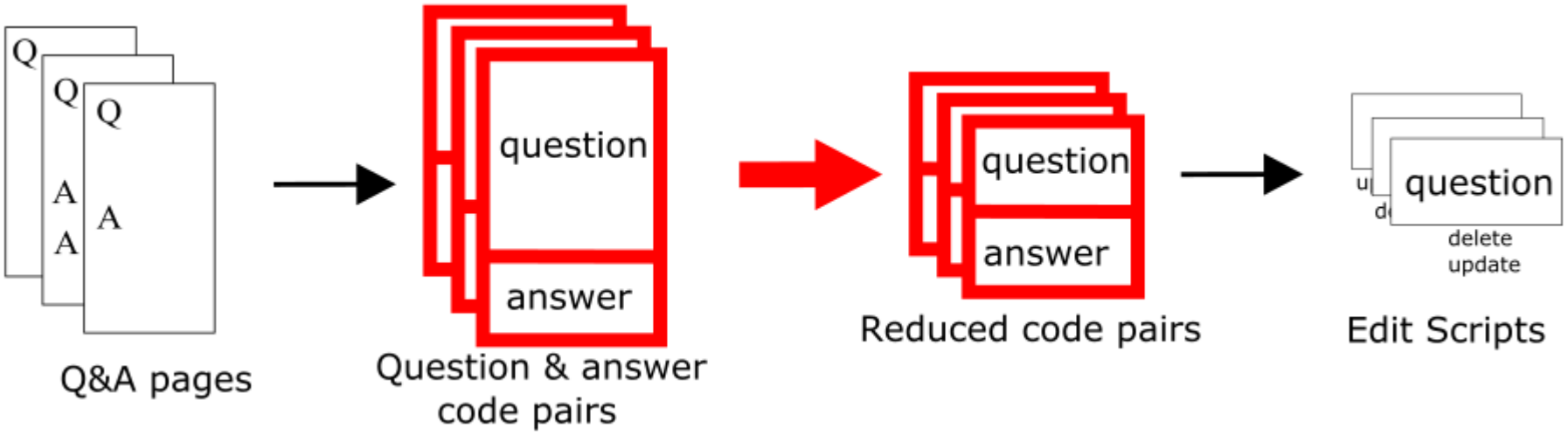


- B | C
- A | B
- A | C

步骤2:
生成编辑脚本

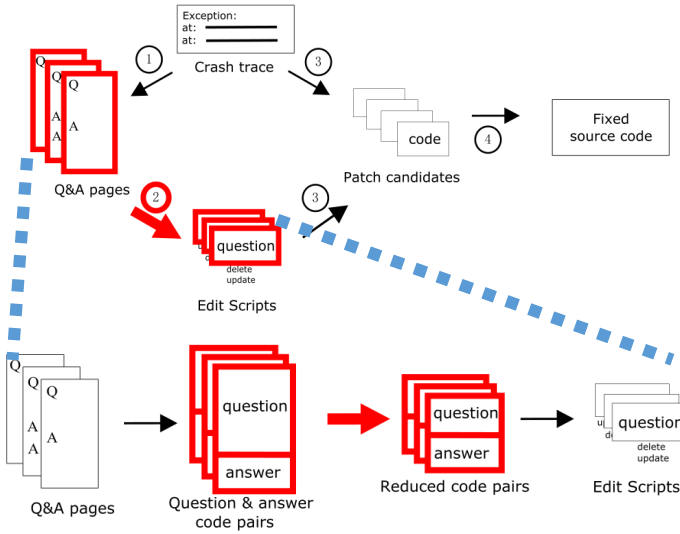


- 核心组件
  - 代码对



消除冗余代码:

- 文本相似度
- 结构相似度



A

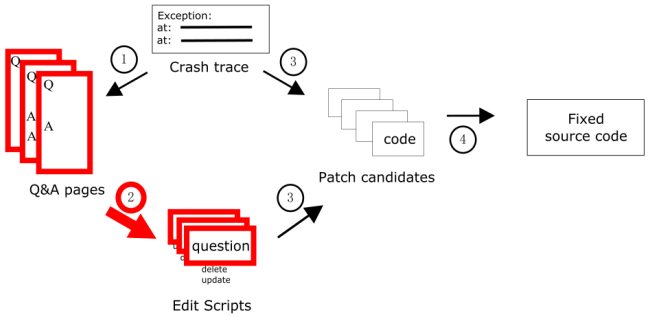
```
public void sendBatteryInfoMessage(){

    IntentFilter iFilter = new IntentFilter(Intent.ACTION_BATTERY_CHANGED);
    Intent batteryStatus = c.registerReceiver(null, iFilter);

    int status = batteryStatus.getIntExtra(BatteryManager.EXTRA_STATUS, -1);
    boolean isCharging = status == BatteryManager.BATTERY_STATUS_CHARGING || status == Batte

    int chargePlug = batteryStatus.getIntExtra(BatteryManager.EXTRA_PLUGGED, -1);
    boolean isUsbCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_USB;
    boolean isAcCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_AC;

    int batteryLevel = batteryStatus.getIntExtra(BatteryManager.EXTRA_LEVEL, -1);
    int scale = batteryStatus.getIntExtra(BatteryManager.EXTRA_SCALE, -1);

    float batteryPct = batteryLevel / (float) scale;

}
```

B

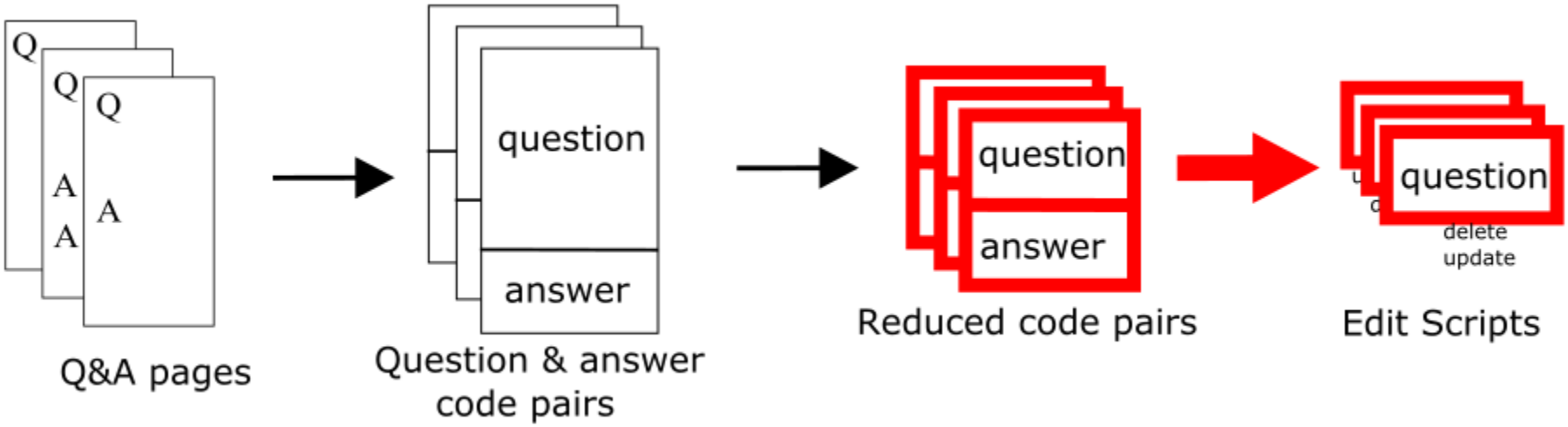
```
context.getApplicationContext().registerReceiver(nu
```

$$\frac{\text{Intent intent = context.registerReceiver(...);}}{\text{context.getApplicationContext().registerReceiver(...);}}$$

步骤2:
生成编辑脚本



- 核心组件
  - 代码对

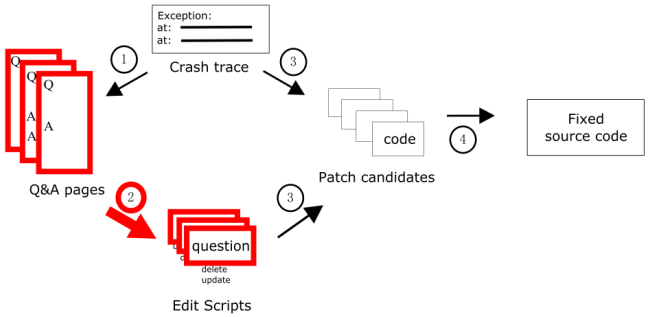


- 现有的编辑脚本生成算法- GumTree

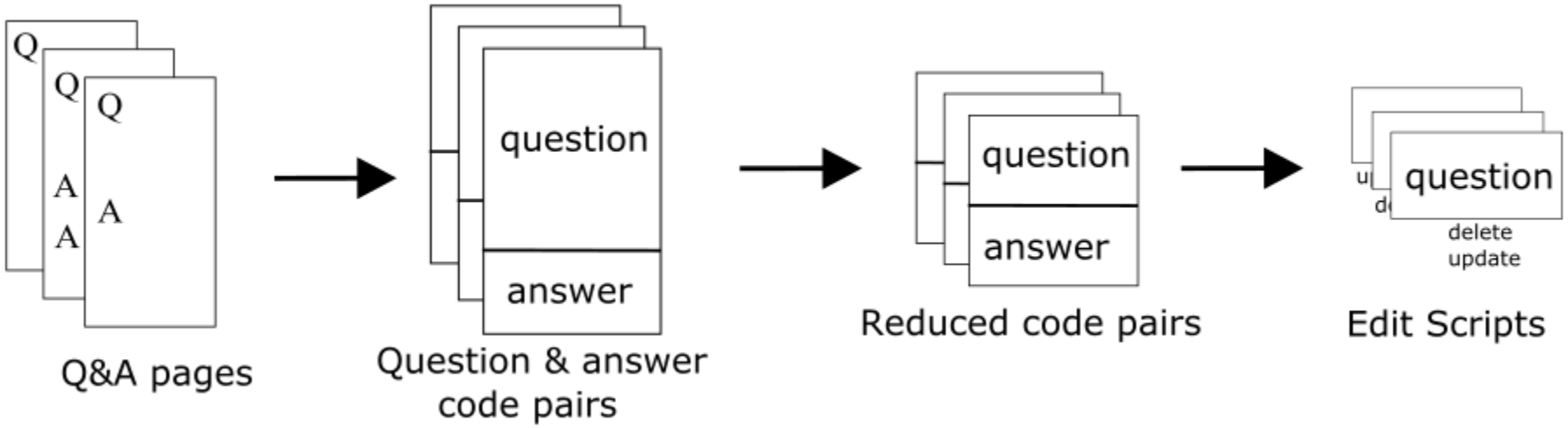
1st position **Insert getApplicationContext() after 1st position**

```
context.registerReceiver(...);
context.getApplicationContext().registerReceiver(...);
```

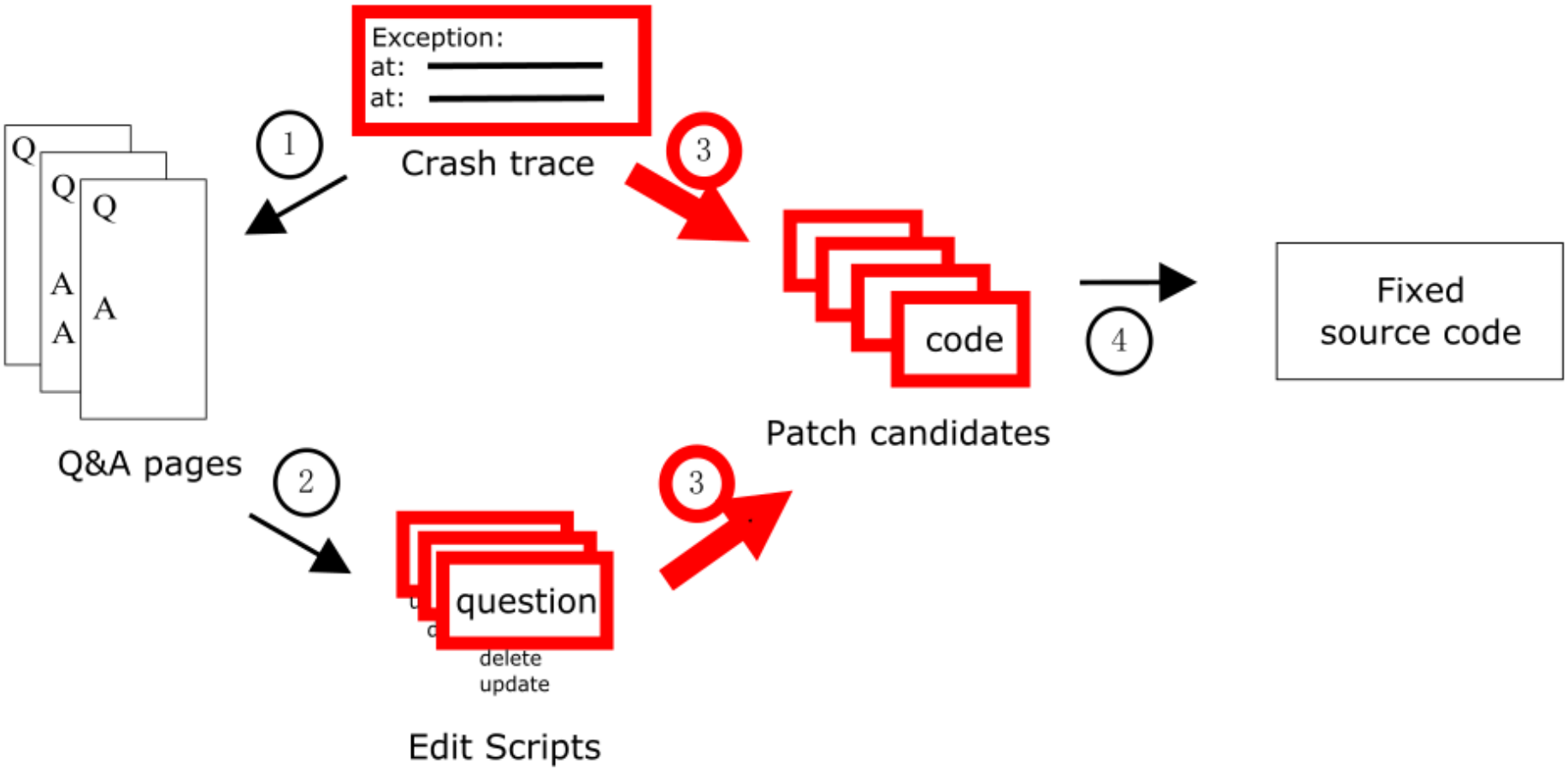
步骤2:
生成编辑脚本



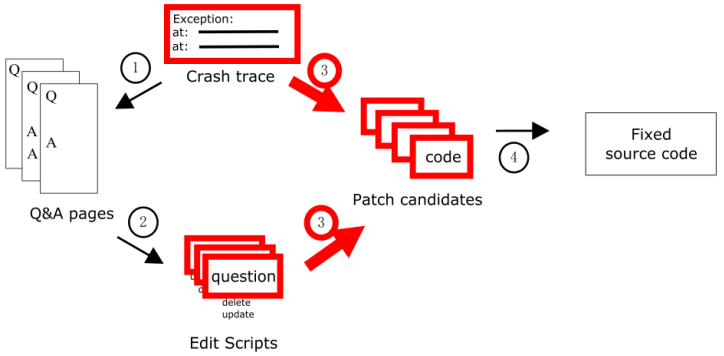
- 核心组件
  - 代码对



步骤3:
生成补丁


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
2
code
4
Fixed
source code
Patch candidates
3
question
delete
update
Edit Scripts

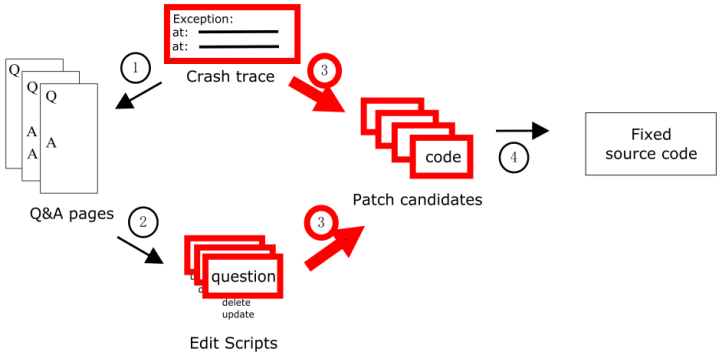
步骤3:
生成补丁




```
10    at com.android.internal.os.ZygoteInit$MethodAndArgsCaller.run(ZygoteInit.java:784)
11    at com.android.internal.os.ZygoteInit.main(ZygoteInit.java:551)
12    at dalvik.system.NativeStart.main(Native Method)
13    Caused by: android.content.ReceiverCallNotAllowedException: IntentReceiver compor
14    at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:118)
15    at android.app.ReceiverRestrictedContext.registerReceiver(ContextImpl.java:112)
16    at com.vaguehope.onosendai.update.AlarmReceiver.onReceive(AlarmReceiver.java:31)
17    at android.app.ActivityThread.handleReceiver(ActivityThread.java:2119)
18    ... 10 more
```

```
29    public void onReceive (final Context context, final Intent intent) {
30       final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31       final float bl = BatteryHelper.level(context);
32       LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33       switch (action) {
...         ...
51       }
52    }
```

步骤3:
生成补丁




```
t.ReceiverCallNotAllowedException: IntentReceiver compo
strictedContext.registerReceiver(ContextImpl.java:118)
strictedContext.registerReceiver(ContextImpl.java:112)
ai.update.AlarmReceiver.onReceive(AlarmReceiver.java:31)
ad.handleReceiver(ActivityThread.java:2119)
```

```
context.registerReceiver(null, new I
```

```
29    public void onReceive (final Context context, final Intent intent) {
30        final int action = intent.getExtras().getInt(KEY_ACTION, -1);
31        final float bl = BatteryHelper.level(context);
32        LOG.i("AlarmReceiver invoked: action=%s bl=%s.", action, bl);
33        switch (action) {
...           ...
51        }
52    }
```

步骤3:
生成补丁

- 编辑脚本
  - 把一个代码片段变换为另一个代码片段

- 绝对位置=>相对位置
- 绝对变量名=>相对变量名

绝对位置=>相对位置

问题代码

```
context.registerReceiver(...);
```

1st position

编辑脚本：
Insert getApplicationContext()
after 1st position

答案代码

```
context.getApplicationContext().registerReceiver(...);
```

缺陷代码

```
BatteryHelper.level(context);
```

3rd position

1st position　2nd position

编辑脚本：
Insert getApplicationContext()
after 3rd position

```
BatteryHelper.level(co  .getApplicationContext());
```

绝对变量名=>相对变量名

问题代码

```
a = 1;
```

编辑脚本：
Insert ‘a’ and ‘+’

答案代码

```
a = a + 1;
```

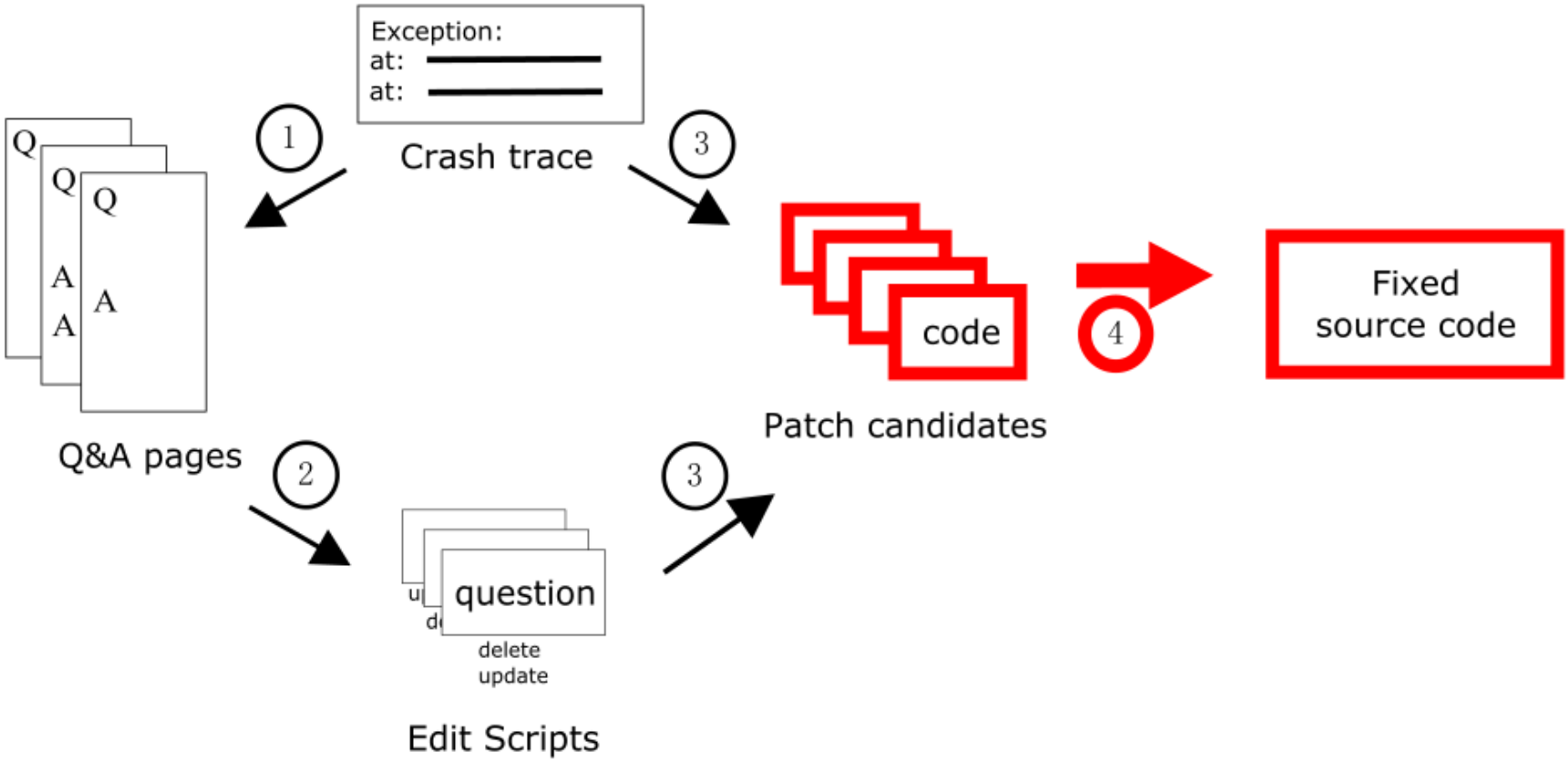
缺陷代码

```
c = 1;
```

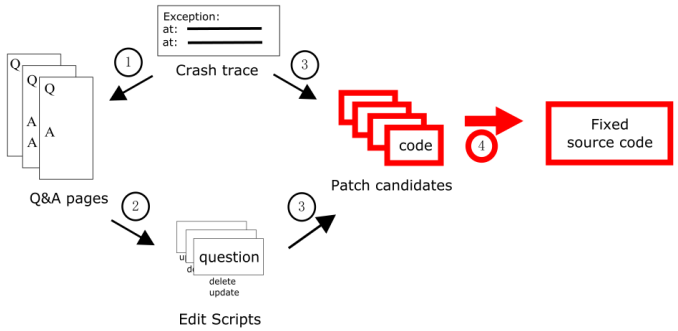
编辑脚本：
Insert ‘c’ and ‘+’

```
c = c + 1;
```

步骤4:
过滤补丁


Exception:
at:
at:
Crash trace
1
3
Q
Q
Q
A
A
A
Q&A pages
2
question
delete
update
Edit Scripts
3
code
Patch candidates
4
Fixed
source code

步骤4:
过滤补丁



- 合并等价补丁
- 过滤掉不能通过编译的补丁
- 取出前k个补丁
  - k=1

实验

- RQ1:有效性
  - 我们的方法在修复真实世界的复发缺陷上有效性有多高？？
- RQ2:有用性
  - 我们的方法是否能补充现有的修复方法？

实验

- 实验对象: GitHub项目
- 复发缺陷: 24
  - Android工程
  - 崩溃踪迹
  - 人工写出的补丁
  - 解决方案在因特网中已经存在
- 开源工具
  - http://sei.pku.edu.cn/~gaoqing11/qacrashfix

RQ1 – 有效性

- 24个缺陷中产生了10个(第一个)补丁，其中8个正确

Project	Issue No.	Loc	#Edit Scripts	#Patches				
				Initial	Equivalent	Compile Error	Remaining	Correct
Calligraphy	41	406	0	0	0	0	0	–
screen-notifications	23	846	6	1	0	1	0	–
TuCanMobile	27	2,849	8	20	2	12	6	Y
OpenIAB	62	7,053	8	1	0	0	1	Y
Android-Universal-Image-Loader	660	11,829	8	0	0	0	0	–
couchbase-lite-android	292	12,004	5	9	0	9	0	–
Onosendai	100	17,821	6	12	2	3	7	Y
LNReader-Android	62	21,276	3	1	0	0	1	Y
the-blue-alliance-android	252	24,094	5	1	0	1	0	–
open-keychain	217	31,038	9	9	1	6	2	Y
Ushahidi_Android	100	33,574	9	2	0	2	0	–
cgeo	457	36,963	8	11	1	3	7	N
cgeo	887	42,814	8	13	5	6	2	Y
TextSecure	1397	46,469	9	40	0	40	0	–
cgeo	2537	54,765	6	0	0	0	0	–
WordPress-Android	688	62,344	9	8	0	8	0	–
WordPress-Android	780	62,455	0	0	0	0	0	–
WordPress-Android	1320	62,895	9	5	1	3	1	Y
WordPress-Android	1484	65,307	1	0	0	0	0	–
WordPress-Android	1122	65,539	6	0	0	0	0	–
gnucash-android	221	68,158	11	0	0	0	0	–
cgeo	3991	68,202	12	8	0	3	5	Y
WordPress-Android	1928	71,485	8	1	0	0	1	N
calabash-android	149	93,146	10	30	0	30	0	–
Total	–	963,332	164	172	12	127	33	8

RQ1 – 时间开销

- 平均时间：
  62.2 s/bug
- 编译时间：
  68.5%
- 得到第一个补丁的平均时间：
  37.5 s/bug

Project	Issue No.	Loc	Time (sec)		
			First	Total	Compilation
Calligraphy	41	406	0.001	0.001	0
screen-notifications	23	846	30.205	30.205	12.187
TuCanMobile	27	2,849	10.619	83.447	54.866
OpenIAB	62	7,053	37.106	53.433	35.905
Android-Universal-Image-Loader	660	11,829	12.629	12.629	0
couchbase-lite-android	292	12,004	71.361	71.361	52.914
Onosendai	100	17,821	6.845	70.080	62.945
LNReader-Android	62	21,276	13.136	25.987	10.496
the-blue-alliance-android	252	24,094	15.949	15.949	7.099
open-keychain	217	31,038	9.409	106.799	65.869
Ushahidi_Android	100	33,574	54.665	54.665	29.888
cgeo	457	36,963	15.500	93.372	62.235
cgeo	887	42,814	5.729	43.697	34.343
TextSecure	1397	46,469	229.263	229.263	211.488
cgeo	2537	54,765	24.537	24.537	0
WordPress-Android	688	62,344	106.533	106.533	66.409
WordPress-Android	780	62,455	0.001	0.001	0
WordPress-Android	1320	62,895	18.209	74.008	36.374
WordPress-Android	1484	65,307	9.133	9.133	0
WordPress-Android	1122	65,539	27.392	27.392	0
gnucash-android	221	68,158	7.146	7.146	0
cgeo	3991	68,202	18.411	155.640	122.389
WordPress-Android	1928	71,485	14.122	35.444	12.891
calabash-android	149	93,146	161.855	161.855	143.842
Total	–	963,332	899.756	1492.577	1022.140

I5双核处理器，8GB内存，Win7

RQ2 – 有用性

- 定性分析
  - 源代码搜索 [GenProg/RSRepair]
  - 模板/转换模式分析 [PAR/SPR]

Issue	Grep Command	Result
TuCanMobile #27	grep ”isShowing” -R .	N
OpenIAB #62	grep ”super.onDestroy” -R .	N
Onosendai #100	grep ”context.getApplicationContext” -R .	N
open-keychain #217	grep ”dismissAllowing” -R .	N
cgeo #887	grep ”image/jpeg” -R .	N
cgeo #887	grep ”image/*” -R .	N
LNReader-Android #62	grep ”super.onDestroy” -R .	N
Wordpress-Android #1320	grep ”commitAllowingStateLoss” -R .	N
cgeo #3991	grep ”isFinishing” -R .	N
cgeo #3991	grep ”\btry\b” -R .	Y
cgeo #3991	grep ”\bcatch\b” -R .	Y

修复示例


```
24      @Override
25      protected void onDestroy() {
  +         super.onDestroy();
26          OpenIAB.instance().unbindService();
            //If there is something wrong with coordinates
27      }
```

```
    +       try {
562             finish();
    +       }
    +       catch ( Exception e) {
    +           e.printStackTrace();
    +       }
563         return;
```

摘要

- 使用因特网资源（问答网站）修复崩溃缺陷

- 使用崩溃踪迹中的文本可以帮助提取web网页
- 分析问答网页中的代码能有效帮助缺陷修复

- 在复发的崩溃缺陷中，精度80%，召回率 30%

谢谢！

C语言内存泄漏的自动修复

高庆，熊英飞，米亚晴，张路，
杨纬坤， 周钊平，谢冰，梅宏

北京大学软件工程研究所

发表于ICSE’15

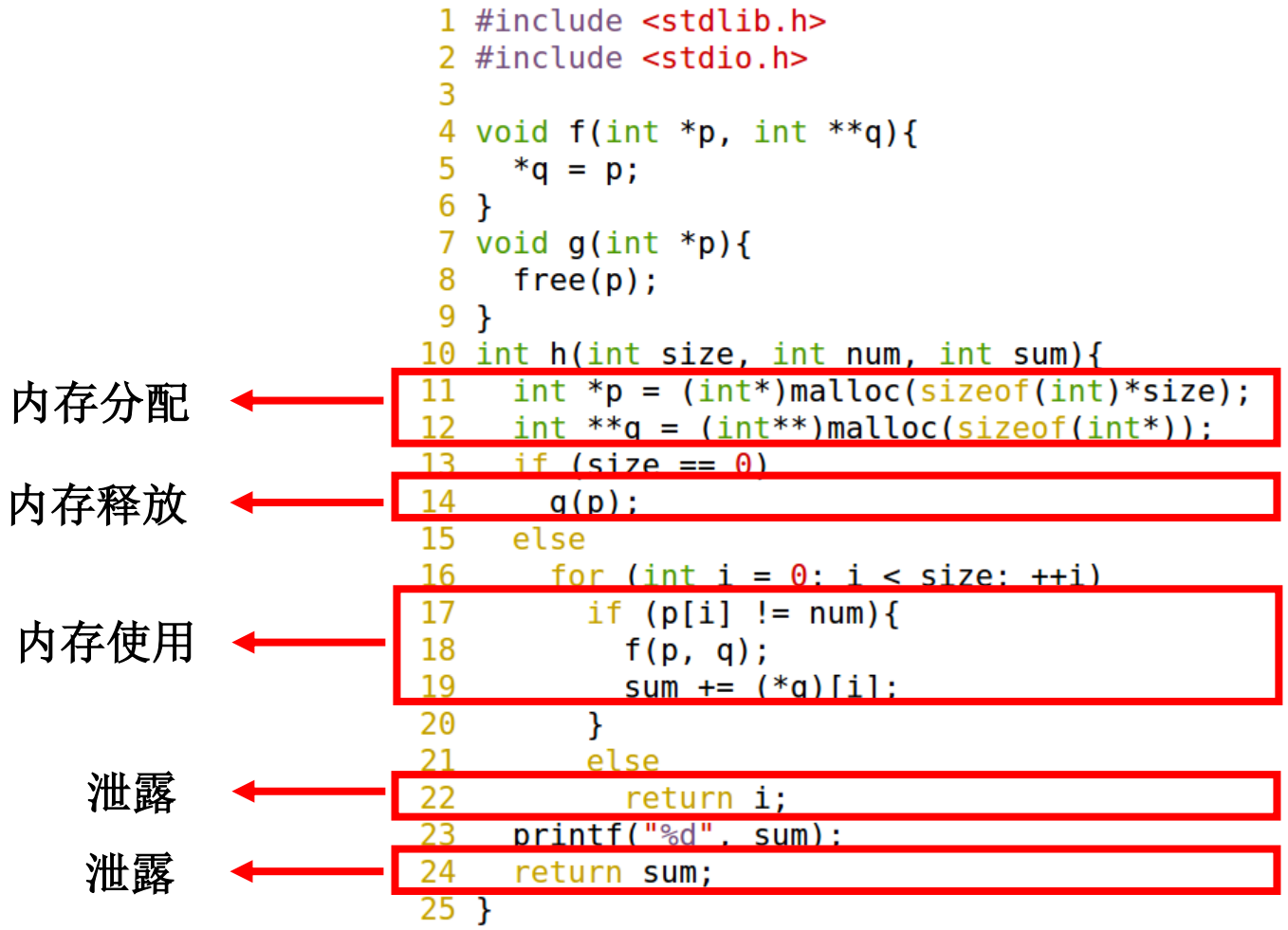
内存管理

- 软件工程经典问题，数千篇论文
- 垃圾回收
  - 广泛用于Java, Go等大量新语言
  - 通过动态扫描内存发现需要回收的内存

垃圾回收 vs 安全攸关软件

- 大量系统资源无法通过垃圾回收管理
  - 文件句柄、线程锁等
- 特定类型的软件无法使用垃圾回收管理
  - 实时嵌入式系统，运行资源有限
  - 大数据处理系统，垃圾收集耗时过长
    - 处理数据量达到10G时，垃圾收集运行时间占程序运行总时间一半以上

内存泄露的例子




```c
#include <stdlib.h>
#include <stdio.h>

void f(int *p, int **q){
  *q = p;
}
void g(int *p){
  free(p);
}
int h(int size, int num, int sum){
  int *p = (int*)malloc(sizeof(int)*size);
  int **q = (int**)malloc(sizeof(int*));
  if (size == 0)
    g(p);
  else
    for (int i = 0; i < size; ++i)
      if (p[i] != num){
        f(p, q);
        sum += (*q)[i];
      }
      else
        return i;
  printf("%d", sum);
  return sum;
}
```

内存泄露的例子


```
1  #include <stdlib.h>
2  #include <stdio.h>
3
4  void f(int *p, int **q){
5    *q = p;
6  }
7  void g(int *p){
8    free(p);
9  }
10 int h(int size, int num, int sum){
11   int *p = (int*)malloc(sizeof(int)*size);
12   int **q = (int**)malloc(sizeof(int*));
13   if (size == 0)
14     g(p);
15   else
16     for (int i = 0; i < size; ++i)
17       if (p[i] != num){
18         f(p, q);
19         sum += (*q)[i];
20       }
21       else
22         return i;
23   printf("%d", sum);
24   return sum;
25 }
```

free(q);

free(p);

free(q);

free(p);

free(q);

修复内存泄露仍是难题

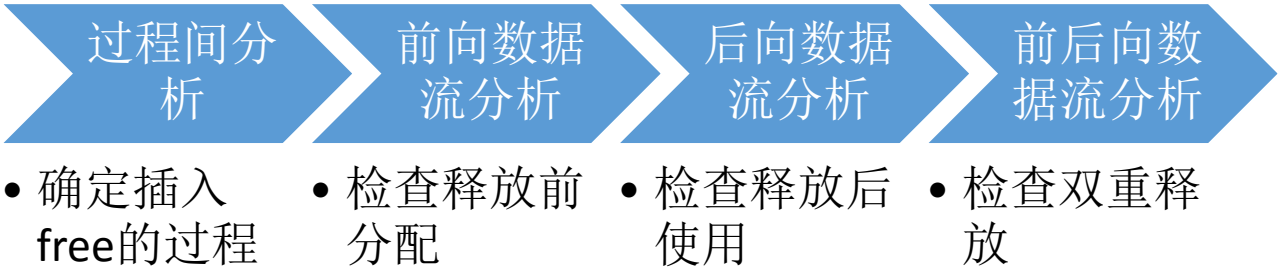
- 需要考虑多个条件
  - 内存释放前必须已分配
  - 内存释放时必须有能从栈上访问的路径
  - 在任意路径上，内存不能被释放两次
  - 在任意路径上，内存使用前不能被释放
- 漏掉任何一条都将导致致命错误
- 实践中，常常出现发现内存泄露但不敢修改的情况

研究成果：自动内存修复技术

- 通过对C程序代码的分析，自动查找内存泄露并修复
- 保证修复的正确性
  - 对于任意插入的free语句和任意执行路径
    - 释放前分配：在执行到free之前所指的内存已经分配
    - 无双重释放：在该路径上没有任何其他free语句释放同一块内存
    - 无释放后使用：在该free之后所释放内存不能再被使用
- 能在较短时间内完成对大型程序的分析工作
  - 10万行量级的程序约2分钟完成分析
- 能自动修复一定数量的内存泄露
  - 自动修复了SPEC2000上约30%的内存泄露

技术路线和创新

- 反复使用数据流分析



- 处理各种复杂情况
  - 循环、全局变量、多重分配、空指针判断等问题

- 在一定程度上，用数据流分析的效率达到了较高精度分析的效果

软件配置的交互式修复

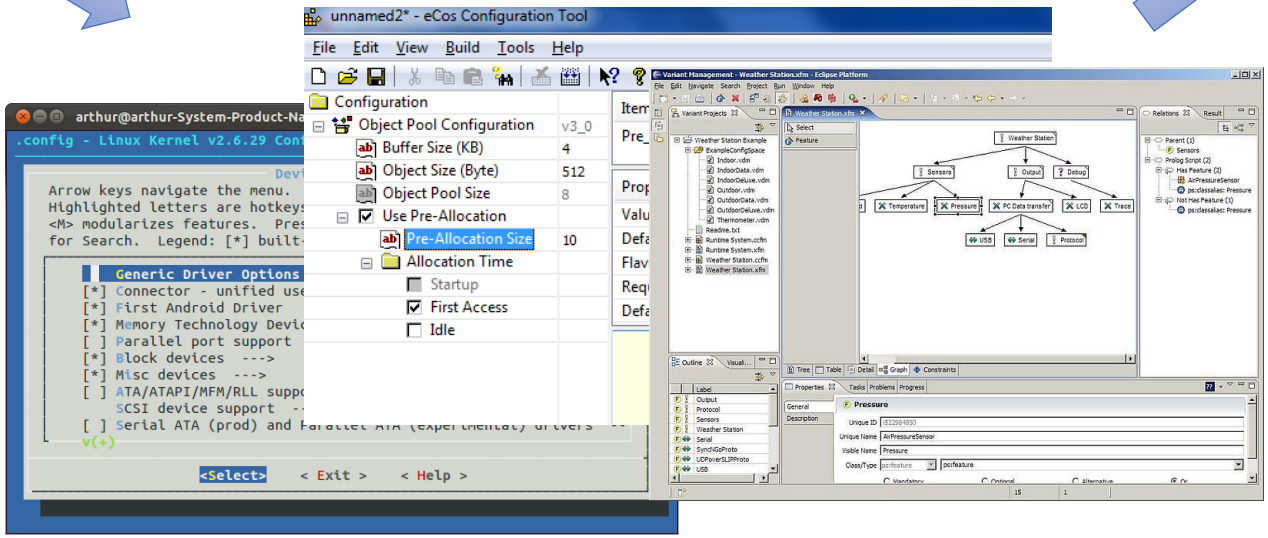
北京大学 熊英飞

合作者

北京大学	王波、张汉生、王杰、赵海燕、张伟
University of Waterloo	Leonardo Passos, Steven She, Krzysztof Czarnecki
University of Namur	Arnaud Hubaux

Variability Models & Configurators

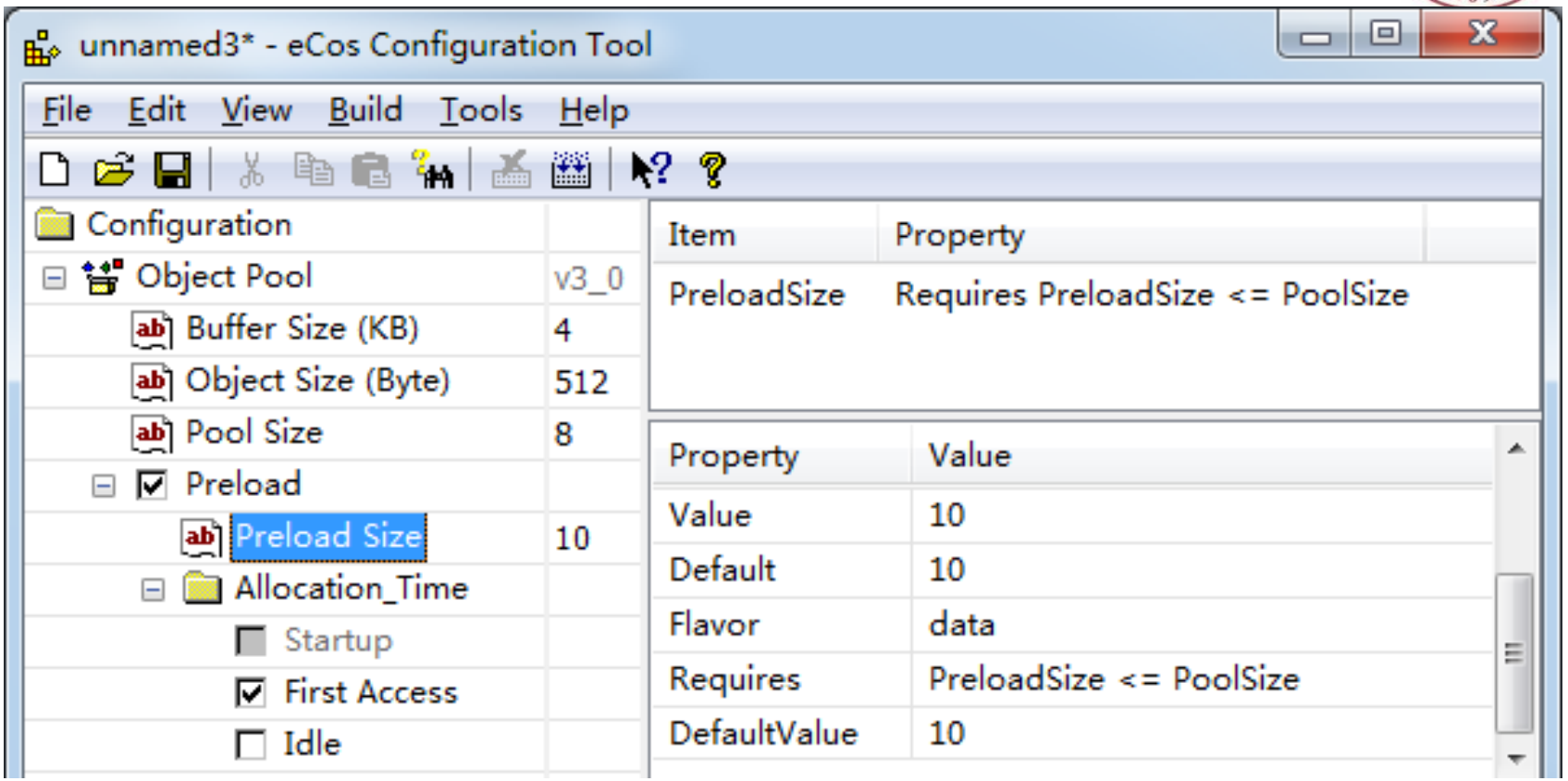
Configuration



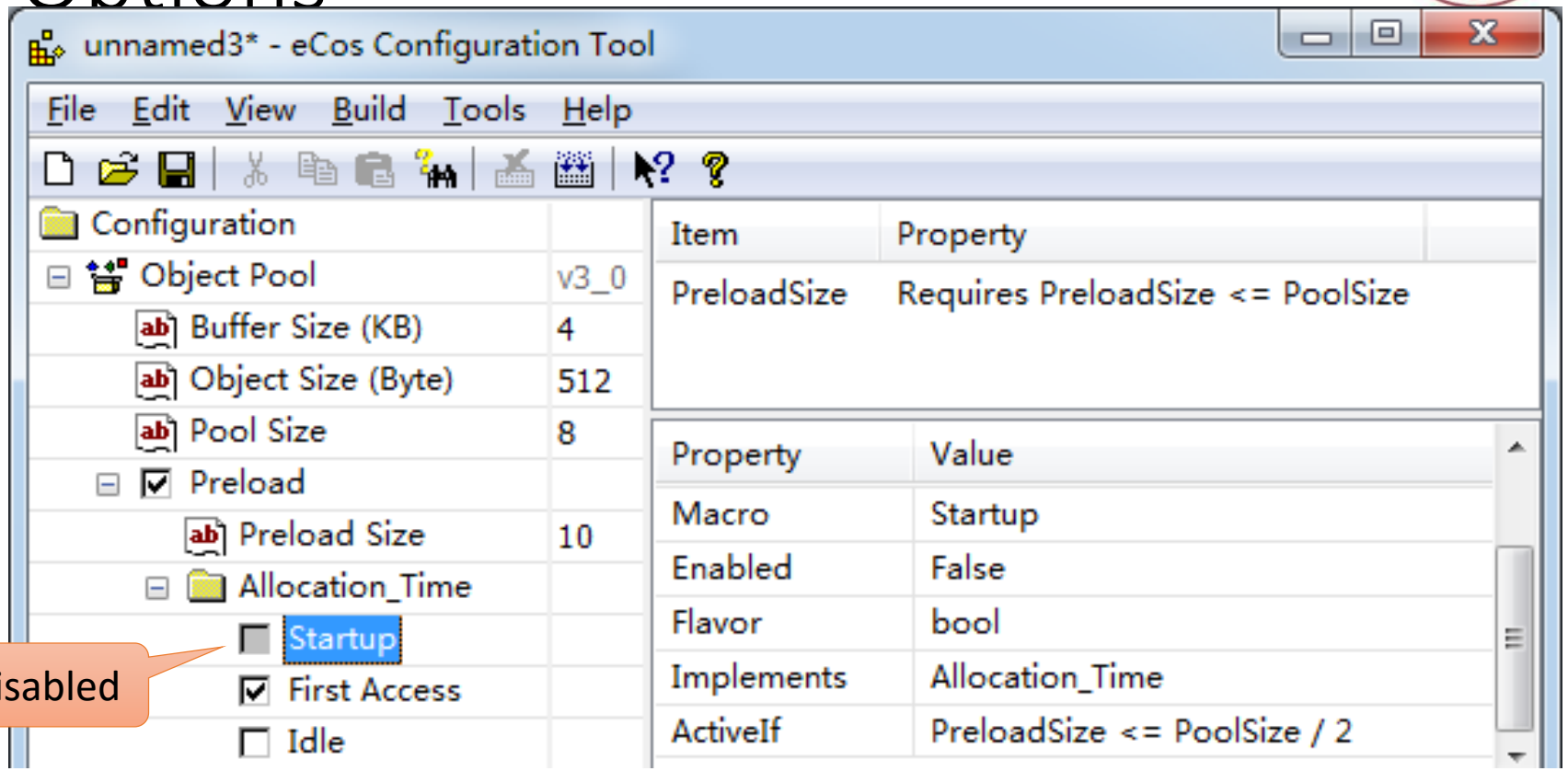
Linux Kconfig,
eCos CDL,
pure::variants,
…

Variability Models

eCos Configurator - Errors



eCos Configurator - Inactive Options

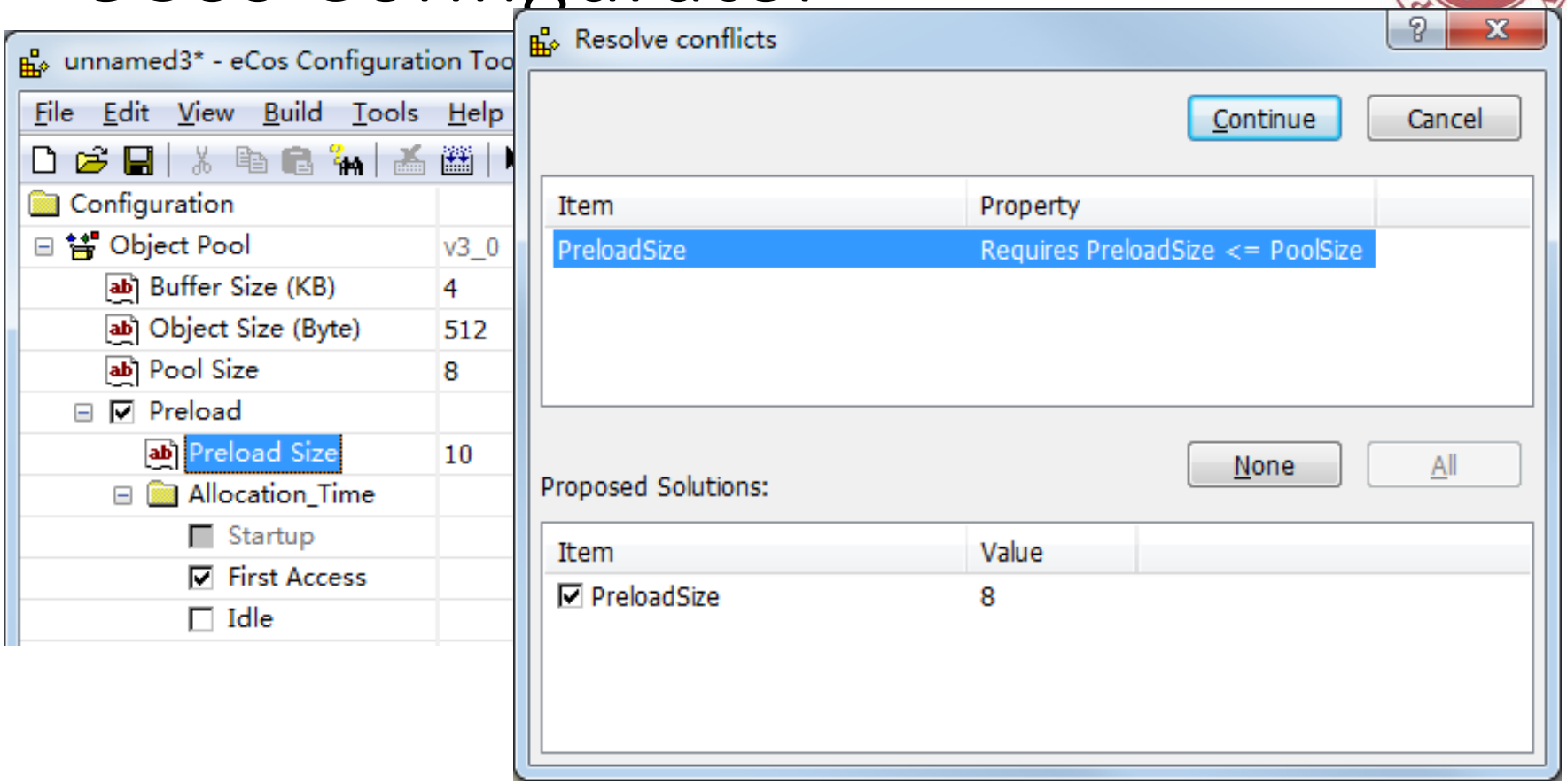


Error resolution and option activation both need to resolve violation of constraint.

Survey

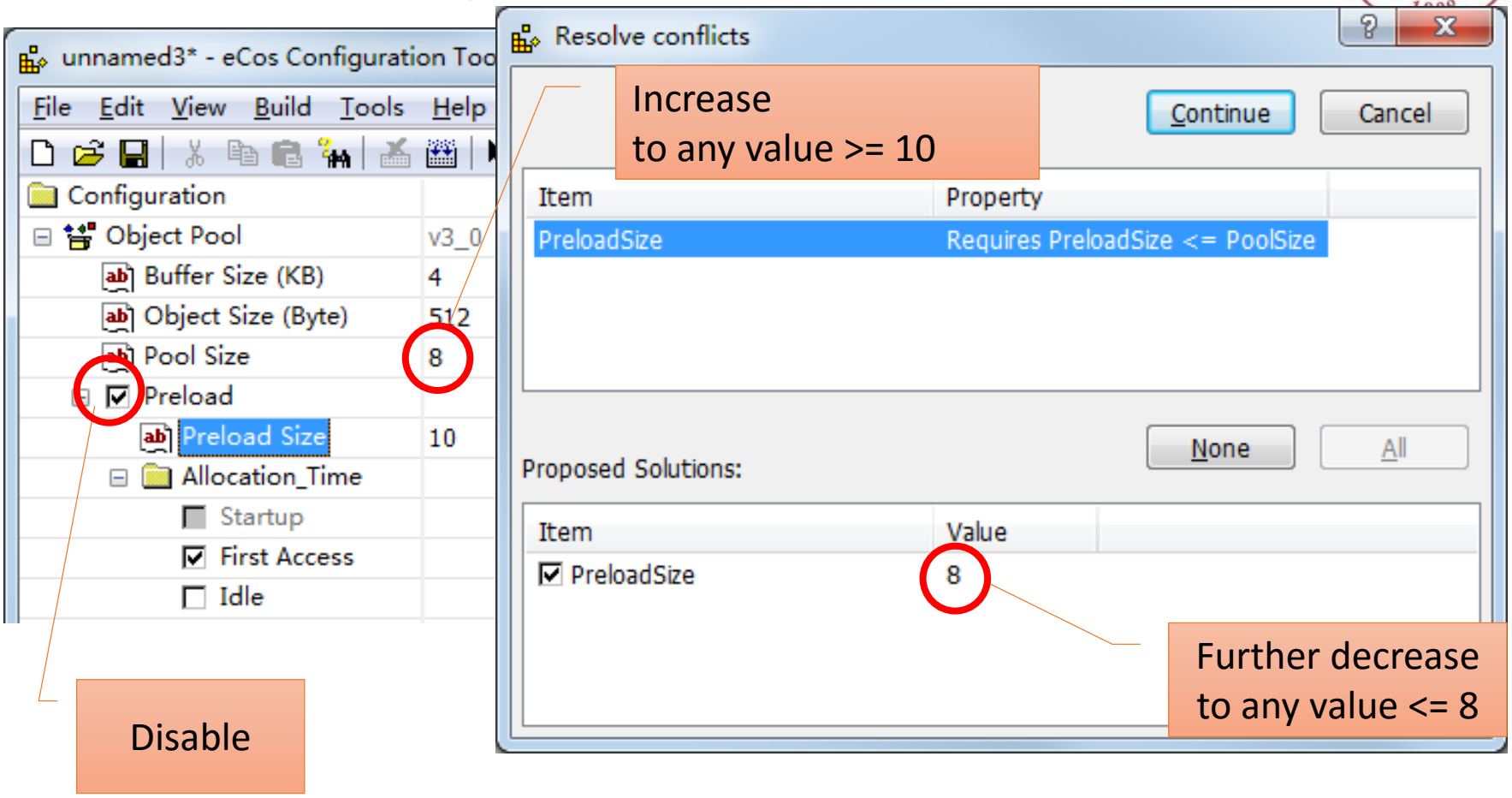
- 97 Linux users and 9 eCos users
- Resolving a violation is hard
  - 20% Linux users need "a few dozen minutes" to activate an option in average
  - 56% eCos users consider activation to be a problem

eCos Configurator



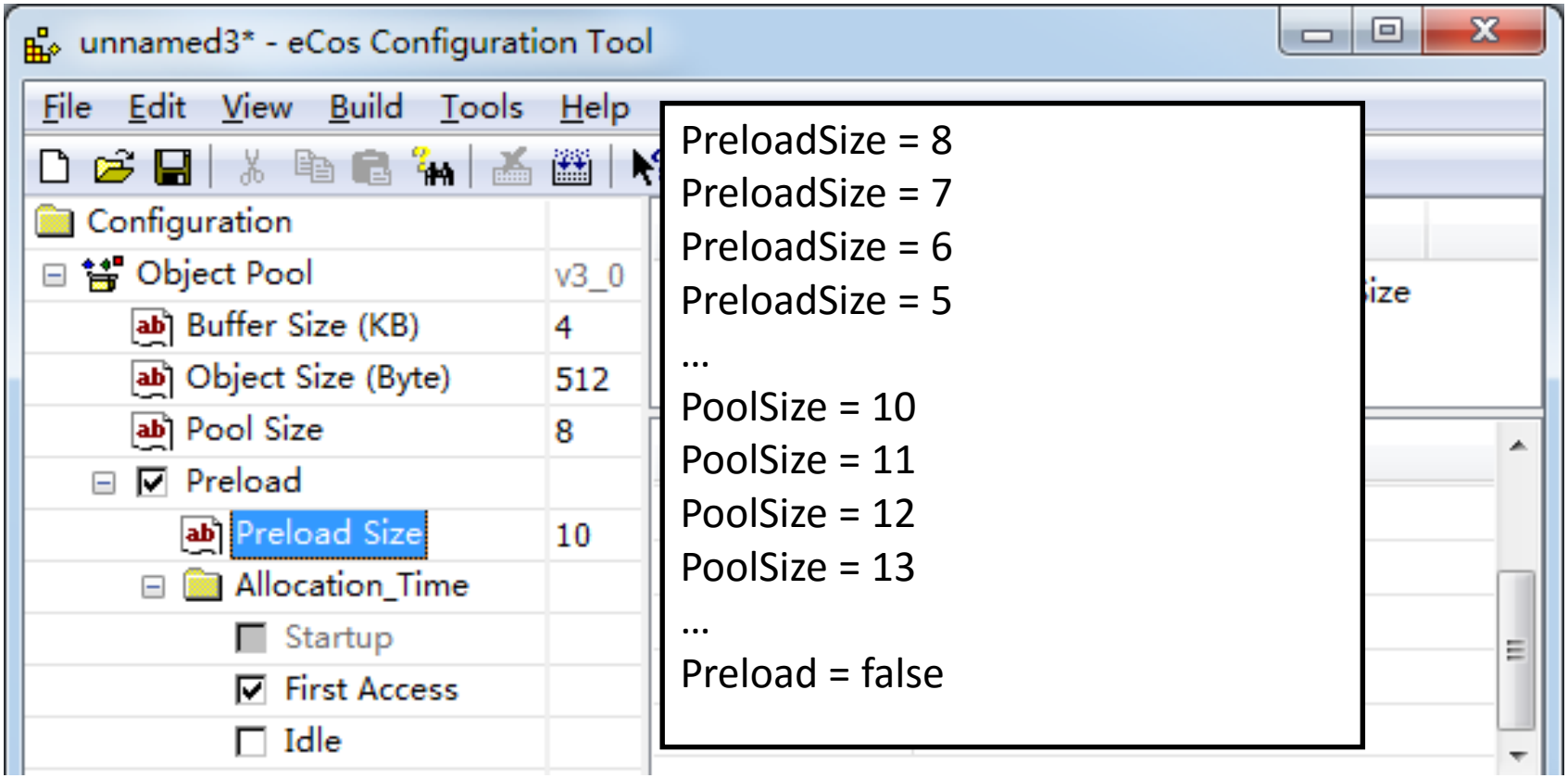
Essentially, fixes work for both resolving errors and activating options

Fix Incompleteness

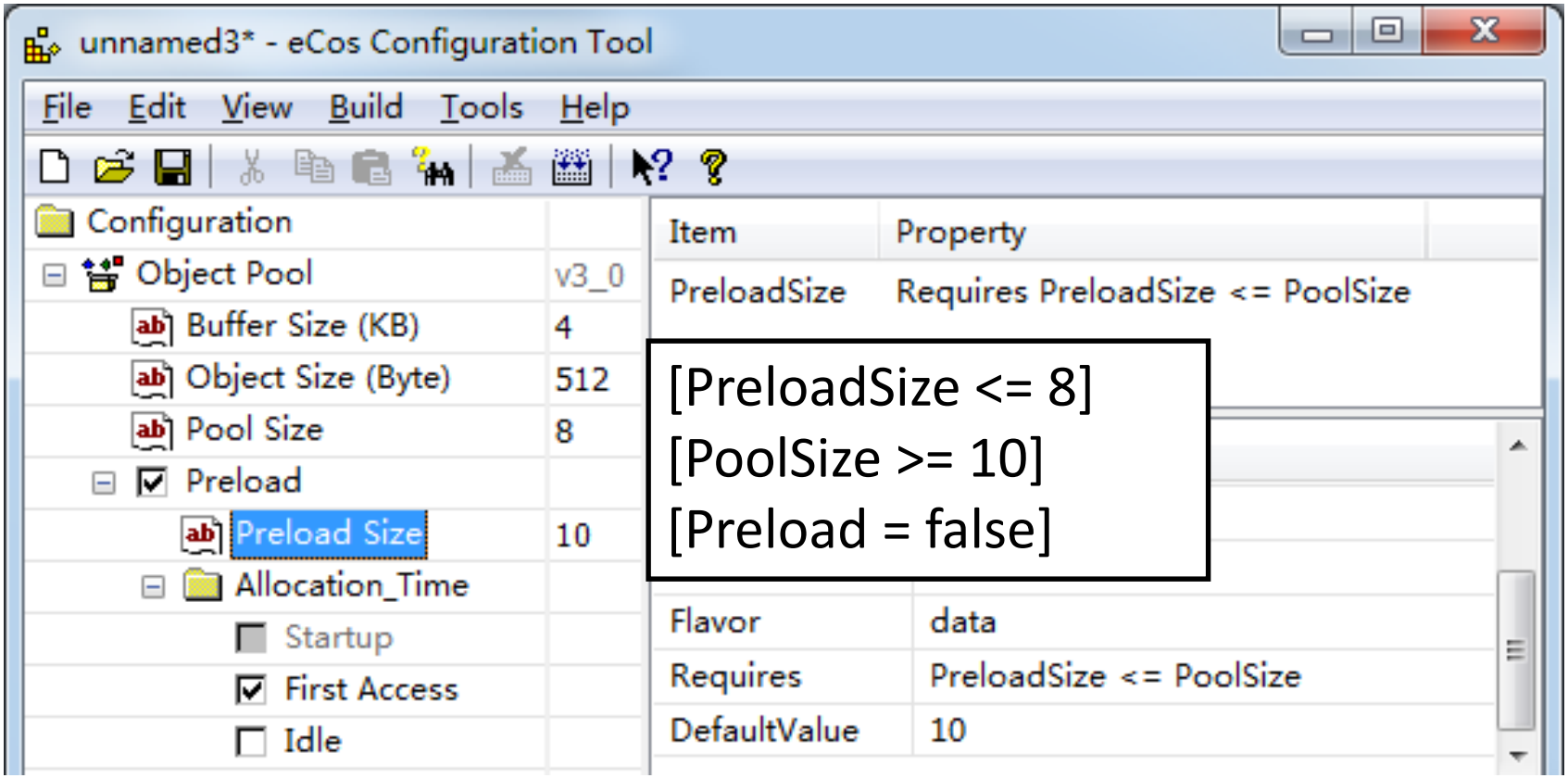


78% eCos users have ecountered situations where the proposed fix is not useful

How to complete fixes



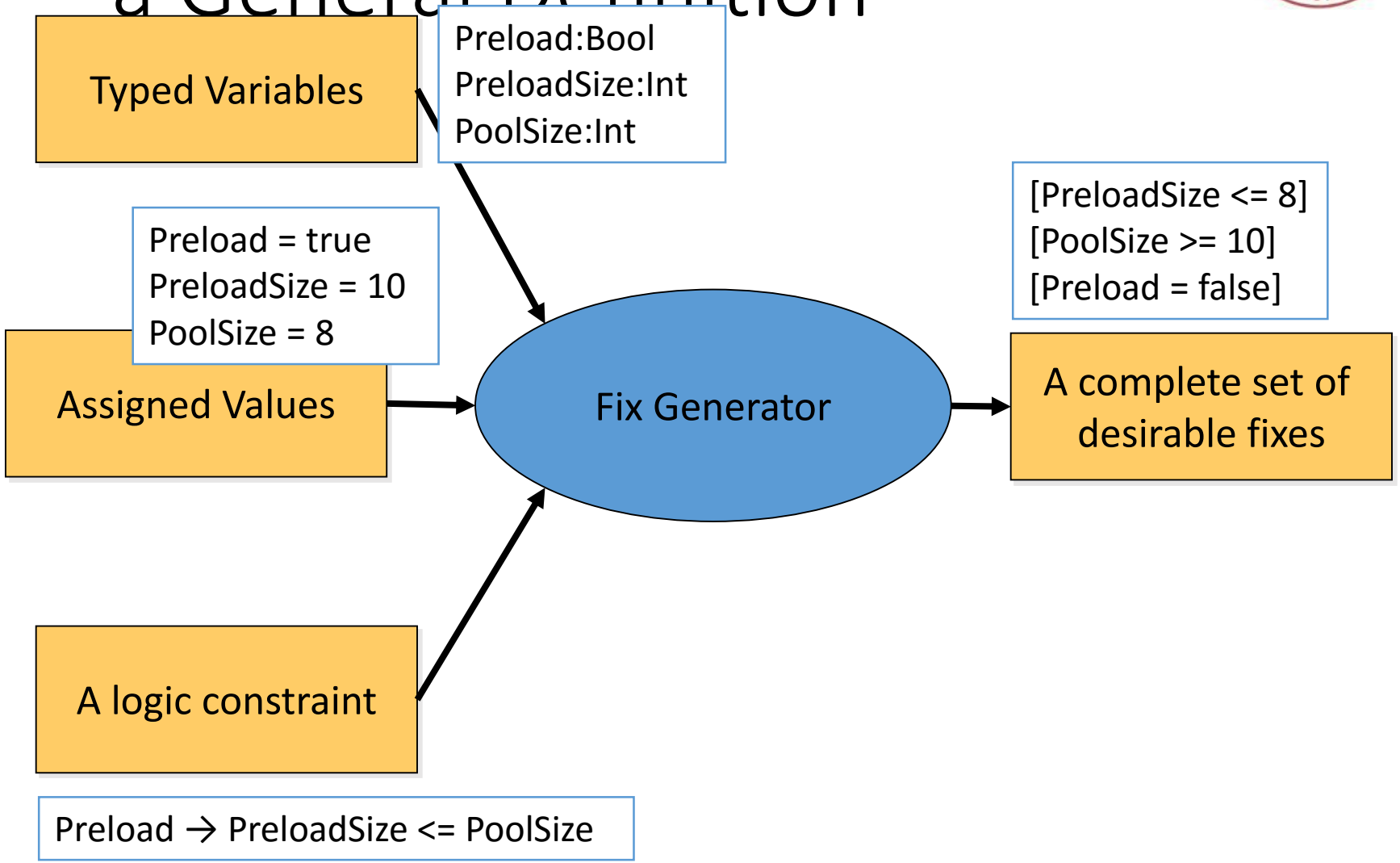
Our Solution – Range Fixes



Our Contributions

- Defining the range fix generation problem
  - Three desirable properties of range fixes
- Proposing a range fix generation algorithm
- Exploring the constraint interaction problem
  - Summarizing and adapting three strategies used in existing work
  - Comparing the strategies empirically

Fix Generation Problem – a General Definition



Desired Properties of Fixes

Correctness	Minimality of variables	Maximality of ranges
Any change represented by a range fix will satisfy the constraint	There is no way to change a subset of variables to satisfy the constraint	A range fix represents the maximal ranges over the variables
A desirable one: [PreloadSize <=8]		
Undesirable ones		
[PreloadSize <= 9]	[PreloadSize <=8, Preload = false]	[PreloadSize <=7]

Algorithm Outline

- Step 1: find the variables to change
  - Basic idea: translating to an SMT problem
    - ① treat configurations also as soft constraints
      1. [soft] Preload = true
      2. [soft] PreloadSize = 10
      3. [soft] PoolSize = 8
      4. [hard] Preload → PreloadSize <= PoolSize
    - ② ask an SMT solver for unsatisfiable cores
      - (1, 2, 3)
    - ③ pick one variable from each core
      - {Preload}, {PreloadSize}, {PoolSize}

Algorithm Outline

- Step 2: find the range of the variables
  - Basic idea: simplify the constraint
    - Example: {PreloadSize}

① replace unchangeable variables with their current values
    - true → PreloadSize <= 8

② simplify the constraint and convert to CNF
    - [PreloadSize <= 8]

Experiments

- Source
  - Version histories from 5 open source projects
  - 535~933 variables, 85~330 constraints
- Steps
  - Compare each pair of consecutive versions
  - Replay the user changes in different orders
  - Generate fixes for the violations and compare with user changes

Results

- Generation Time
  - Average: 50ms
  - Maximum: 250ms
- Complexity of Fix
  - Measured by the number of variables per fix
  - Max:58
  - Median:2
  - 83% of the fix lists contain less than 10 variables

谢谢！