Green Advisor

Karan Aggarwal
Department of Computing Science

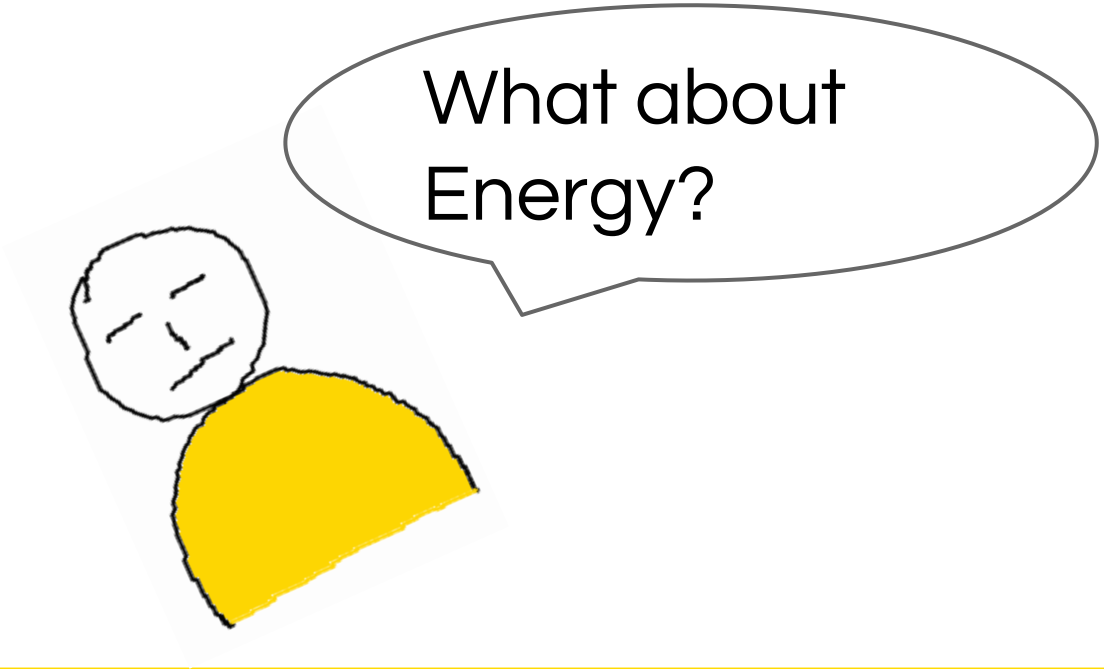
kaggarwa@ualberta.ca

UNIVERSITY OF ALBERTA

Introduction

- □ Unaware of energy consumption profile of apps
- □ Expensive instrumentation for estimation of energy.
- □ Relate change in system call counts of application with the change in energy consumption profile.

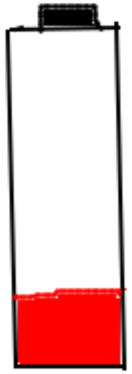
```
$ git commit
```



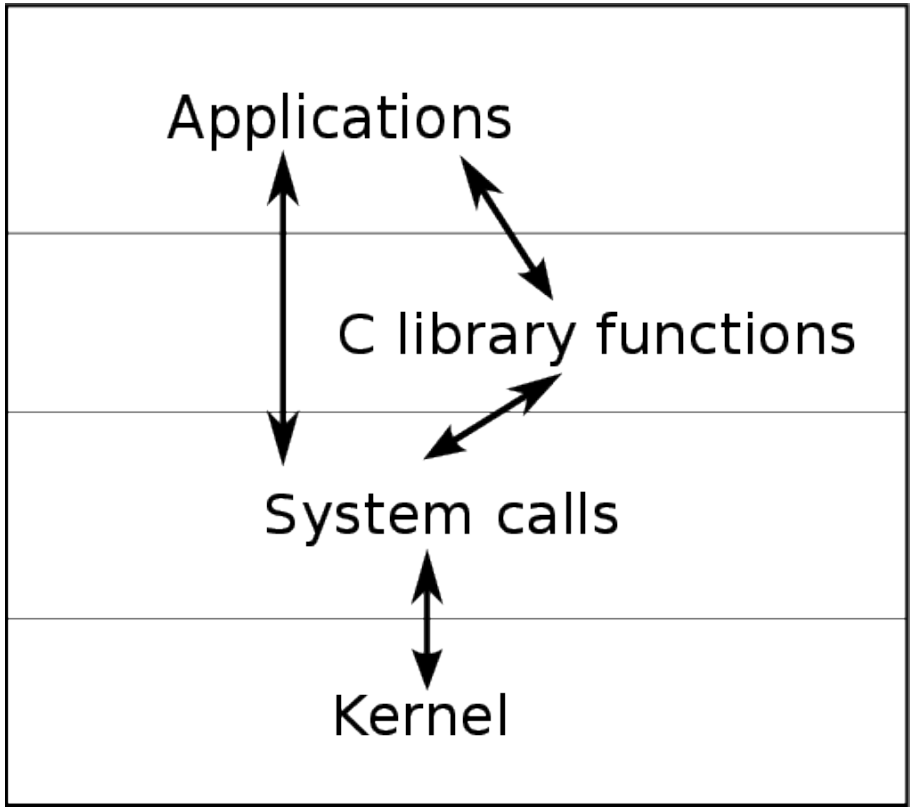
Why care about application energy consumption?

□ Prolonging Battery life

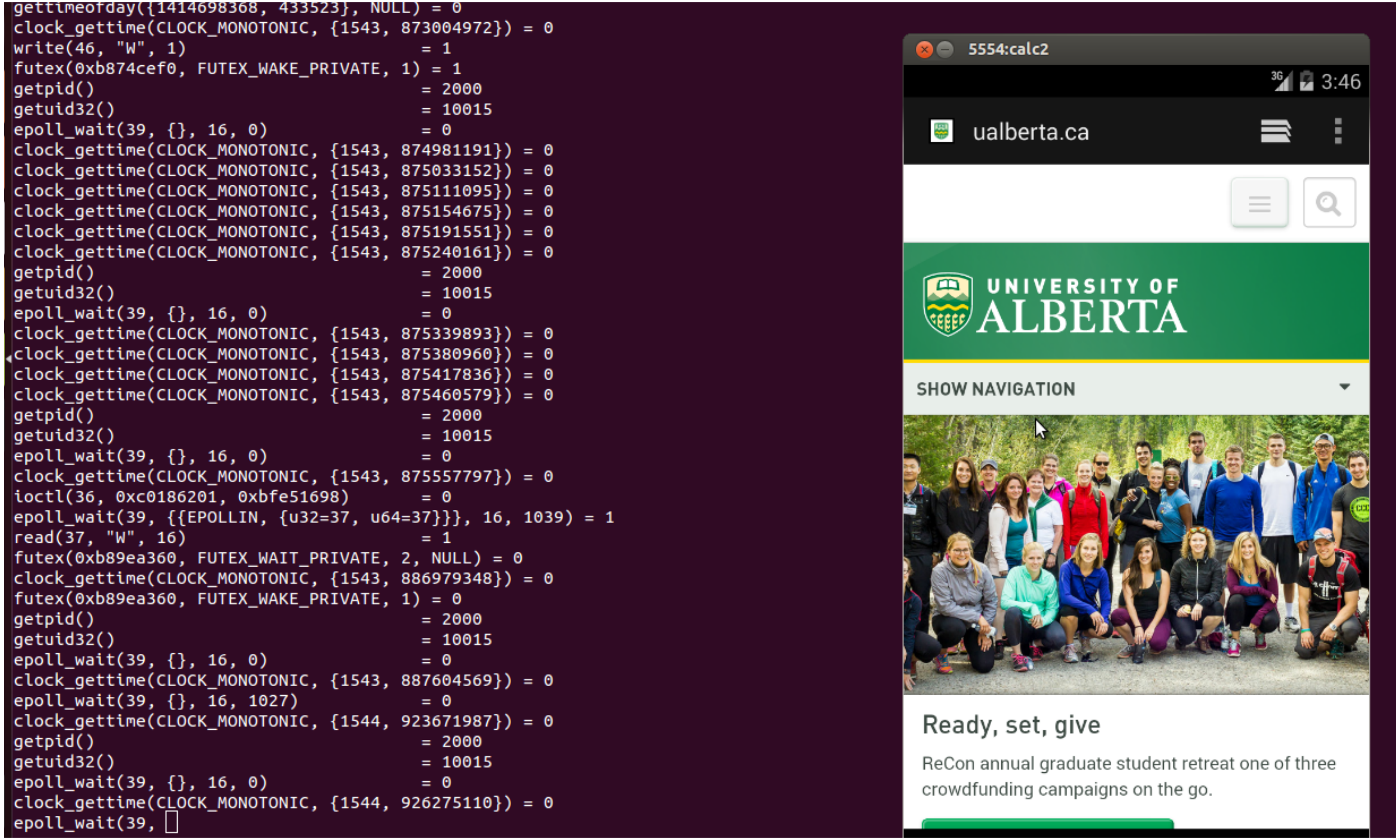
□ Reducing Carbon emissions



System Calls



System Calls



```
gettimeofday({1414698368, 433523}, NULL) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 873004972}) = 0
write(46, "W", 1)                       = 1
futex(0xb874cef0, FUTEX_WAKE_PRIVATE, 1) = 1
getpid()                                = 2000
getuid32()                              = 10015
epoll_wait(39, {}, 16, 0)               = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 874981191}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875033152}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875111095}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875154675}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875191551}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875240161}) = 0
getpid()                                = 2000
getuid32()                              = 10015
epoll_wait(39, {}, 16, 0)               = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875339893}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875380960}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875417836}) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875460579}) = 0
getpid()                                = 2000
getuid32()                              = 10015
epoll_wait(39, {}, 16, 0)               = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 875557797}) = 0
ioctl(36, 0xc0186201, 0xbfe51698)       = 0
epoll_wait(39, {{EPOLLIN, {u32=37, u64=37}}}, 16, 1039) = 1
read(37, "W", 16)                       = 1
futex(0xb89ea360, FUTEX_WAIT_PRIVATE, 2, NULL) = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 886979348}) = 0
futex(0xb89ea360, FUTEX_WAKE_PRIVATE, 1) = 0
getpid()                                = 2000
getuid32()                              = 10015
epoll_wait(39, {}, 16, 0)               = 0
clock_gettime(CLOCK_MONOTONIC, {1543, 887604569}) = 0
epoll_wait(39, {}, 16, 1027)            = 0
clock_gettime(CLOCK_MONOTONIC, {1544, 923671987}) = 0
getpid()                                = 2000
getuid32()                              = 10015
epoll_wait(39, {}, 16, 0)               = 0
clock_gettime(CLOCK_MONOTONIC, {1544, 926275110}) = 0
epoll_wait(39, 
```

Ready, set, give

ReCon annual graduate student retreat one of three crowdfunding campaigns on the go.

Demo Requirements

Please clone the tool from github using:

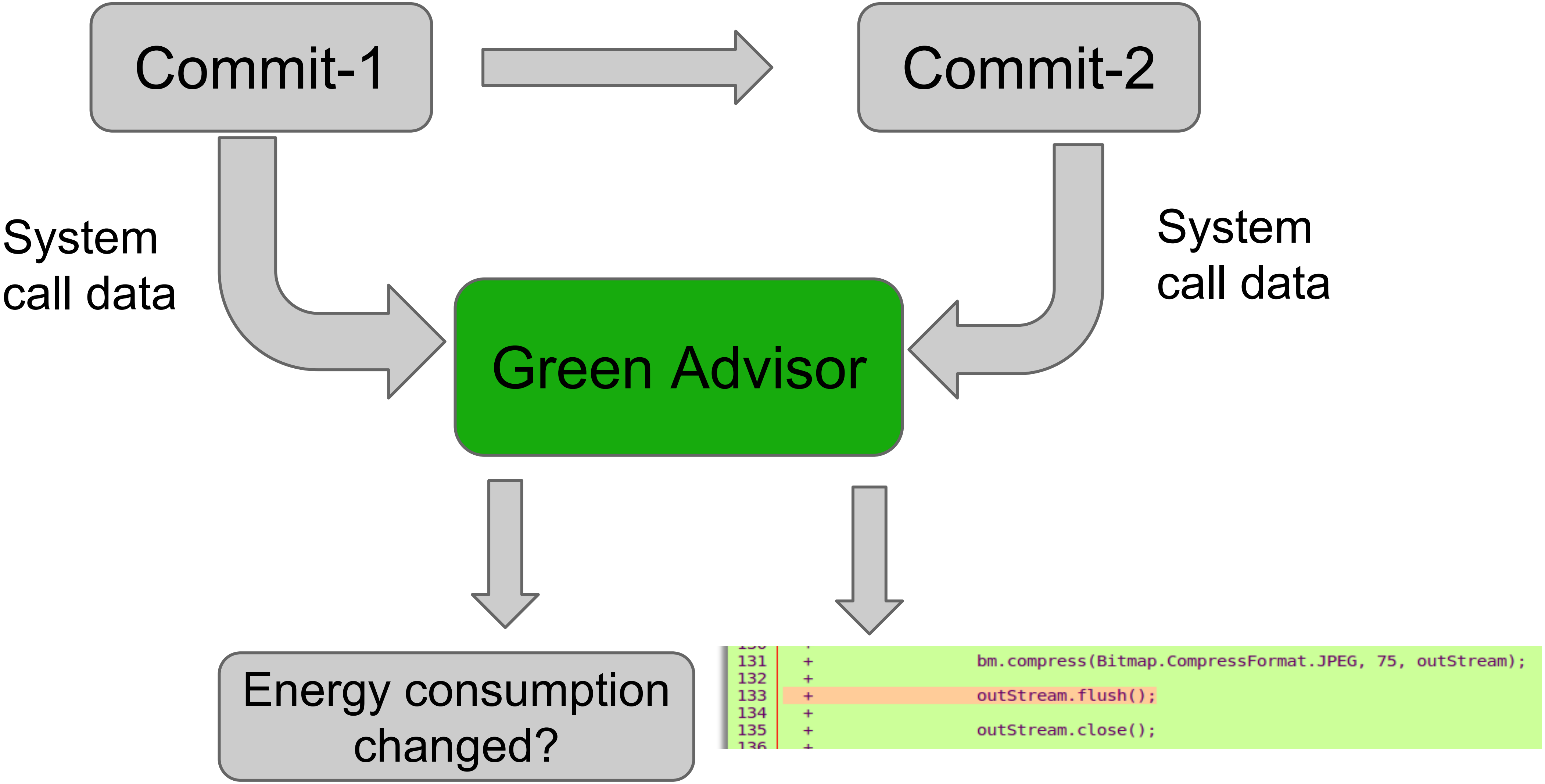
```
git clone https://github.com/kaggarwal/GreenAdvisor.git
```

LonelyTwitter Repo clone:

```
git clone https://github.com/aewilson-ua/lonelyTwitter.git
```

Open Eclipse and have your emulator running.

Workflow



Commit-1

Commit-2

System call data

System call data

Green Advisor

Energy consumption changed?

```
+
+                bm.compress(Bitmap.CompressFormat.JPEG, 75, outStream);
+
+                outStream.flush();
+
+                outStream.close();
+
```

Tool Structure

- setVariables
- README
- LICENSE
- jar
  - tool.jar
  - database.db
- stracing

Initialising the tool : setVariables

1. adbPath: The path to ADB(Android Debug Bridge) that comes with your adt bundle and would be Android SDK folder's platform tools.

For the lab machines:

adbPath= /usr/local/share/android-sdk-linux/platform-tools/adb

Initialising the tool : setVariables

2. **gitDir**: This is the path to your Github directory you are using for the storing your Android Application projects.

For the lonely twitter app:

gitDir= /<path-to-git-repo>/lonelyTwitter/

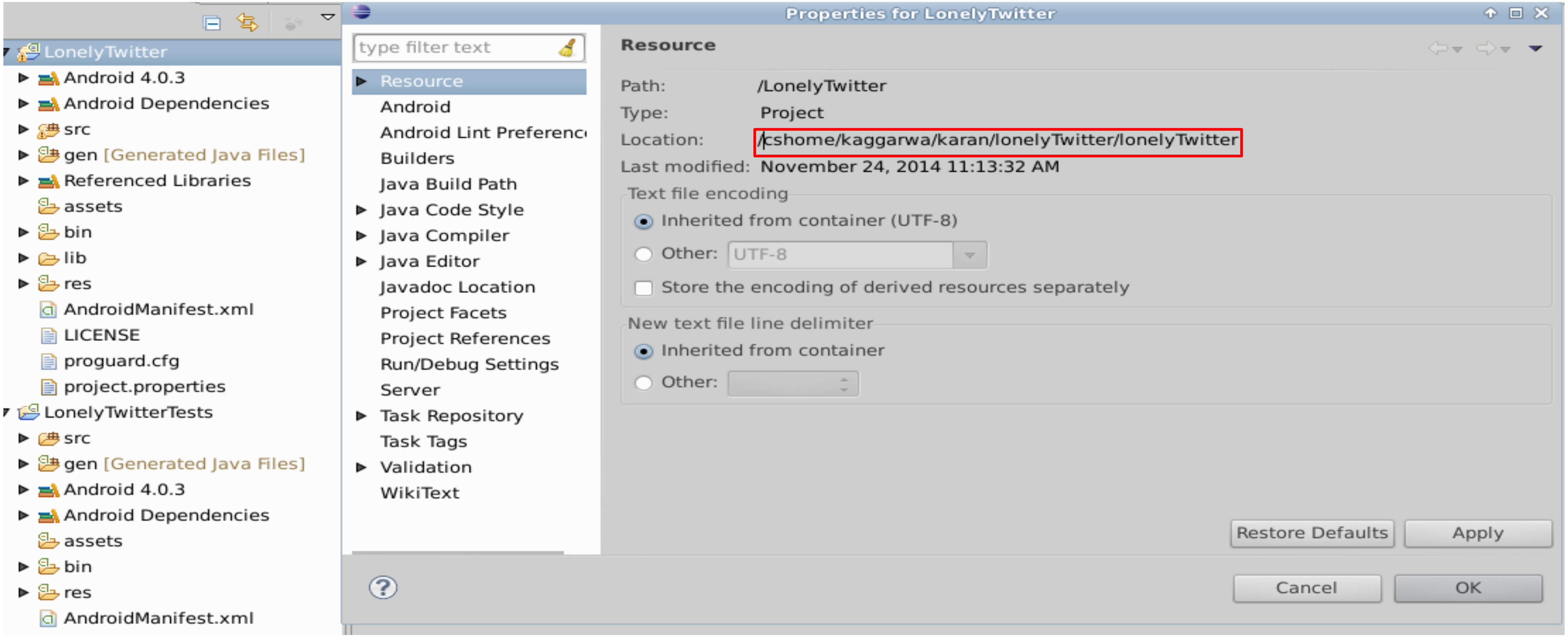
Initialising the tool : setVariables

3. **appCodeDir**: This is the path to the directory containing your Application code(i.e. where your App's AndroidManifest.xml is stored)

For the lonely twitter app:

appCodeDir= /<path-to-git-repo>/lonelyTwitter/lonelyTwitter/

Initialising the tool : setVariables



Resource

Path: /LonelyTwitter

Type: Project

Location: /cshome/kaggarwa/karan/lonelyTwitter/lonelyTwitter

Last modified: November 24, 2014 11:13:32 AM

Text file encoding

● Inherited from container (UTF-8)

○ Other: UTF-8

□ Store the encoding of derived resources separately

New text file line delimiter

● Inherited from container

○ Other:

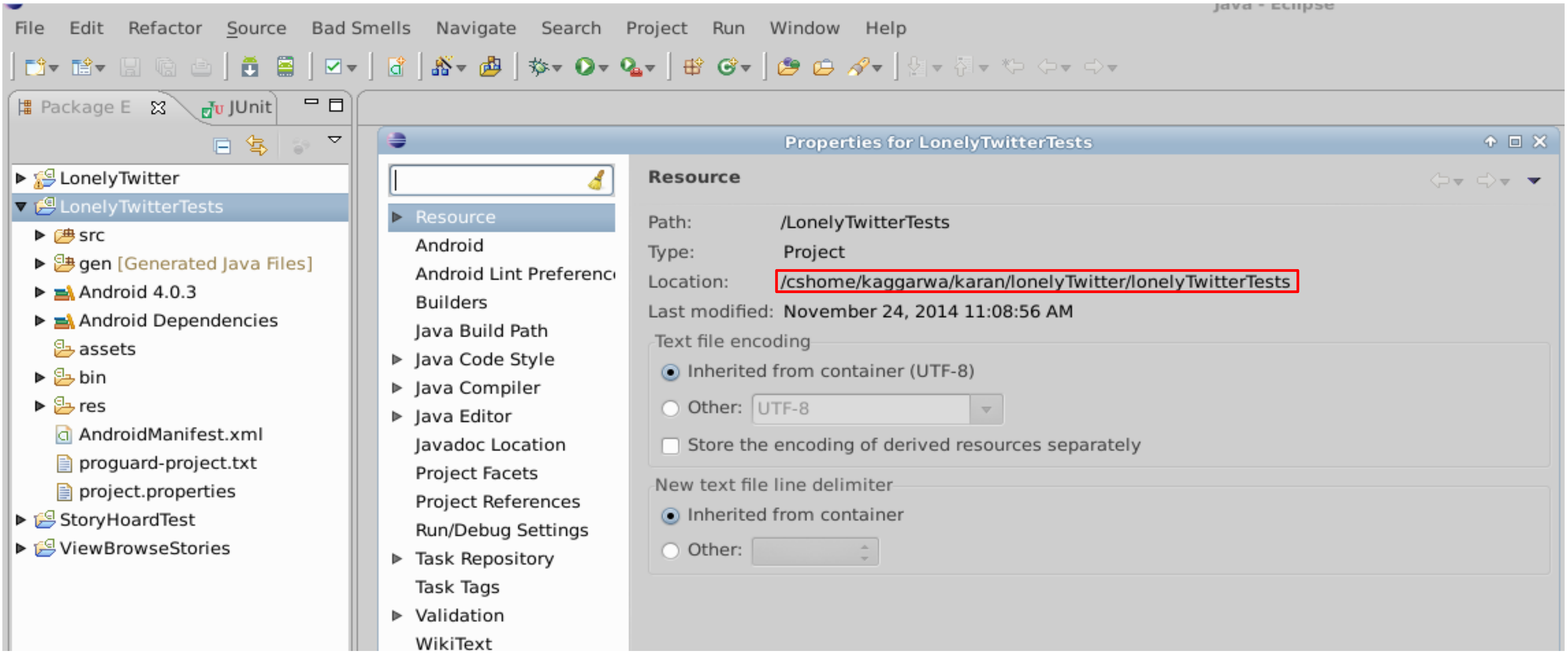
Initialising the tool : setVariables

4. **testCodeDir**: This is the path to the directory containing your Android Junit tests code(i.e. where your Jnuit test's AndroidManifest.xml is stored).

For the lonely twitter app:

appCodeDir= /<path-to-git-repo>/lonelyTwitter/lonelyTwitterTests/

Initialising the tool : setVariables



Resource

Path: /LonelyTwitterTests

Type: Project

Location: /cshome/kaggarwa/karan/lonelyTwitter/lonelyTwitterTests

Last modified: November 24, 2014 11:08:56 AM

Text file encoding

● Inherited from container (UTF-8)

○ Other: UTF-8

□ Store the encoding of derived resources separately

New text file line delimiter

● Inherited from container

○ Other:

Initialising the tool : setVariables

```
adbPath = /usr/local/share/android-sdk-linux/platform-tools/adb
gitDir = /cshome/kaggarwa/karan/lonelyTwitter/
appCodeDir = /cshome/kaggarwa/karan/lonelyTwitter/lonelyTwitter/
testCodeDir = /cshome/kaggarwa/karan/lonelyTwitter/lonelyTwitterTests/
```

Demo

Go to LonelyTwitter Directory:

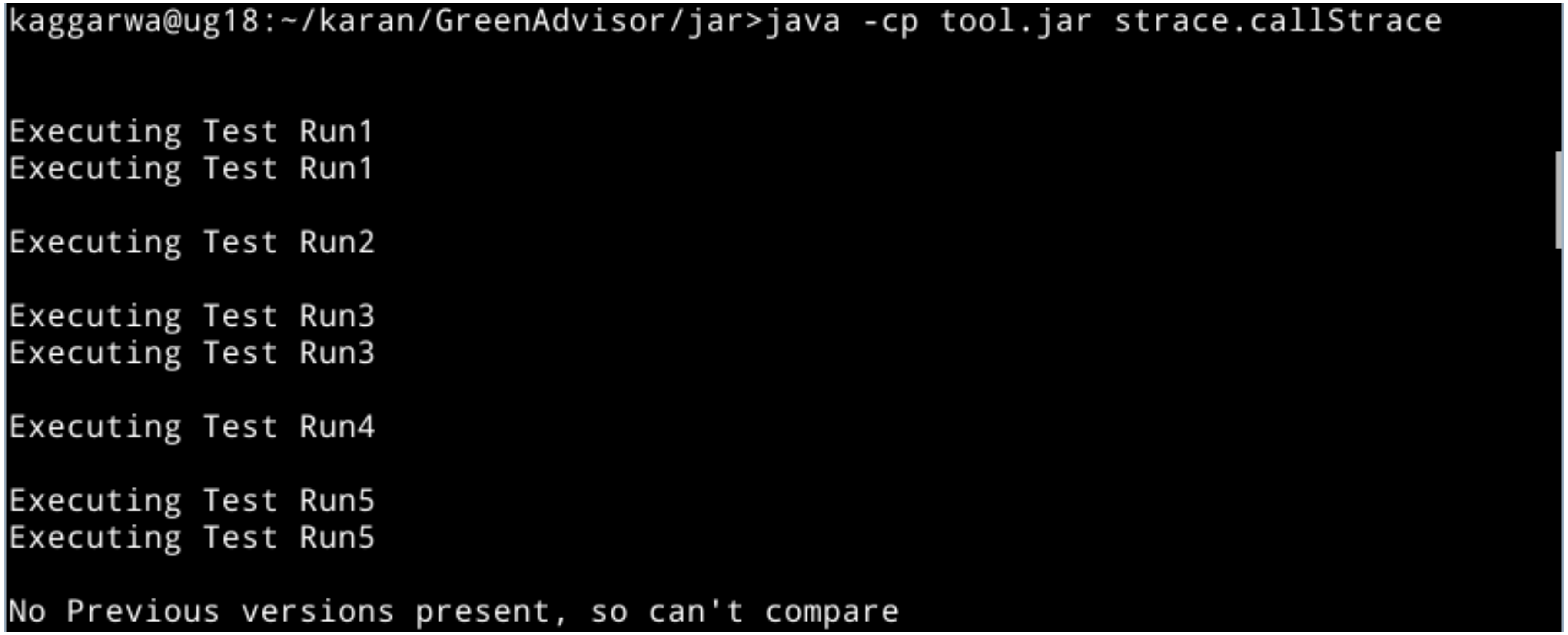
```
git checkout  5c160a082778af3a40386c4b3b2ab33bc688ae23
```

Running the tool

- Run your Junit tests so that .apk files for your tests are created.
- Open another terminal window
- Go to GreenAdvisor directory
- Run the following command:

```
sh run.sh
```

Demo on lonelyTwitter



```
kaggarwa@ug18:~/karan/GreenAdvisor/jar>java -cp tool.jar strace.callStrace


Executing Test Run1
Executing Test Run1

Executing Test Run2

Executing Test Run3
Executing Test Run3

Executing Test Run4

Executing Test Run5
Executing Test Run5

No Previous versions present, so can't compare
```

In the terminal window with LonelyTwitter repo open enter:

```
git checkout f700a60f8fc0c6279583226da2dbbe2e1144eb38
```

Remember!

Before running the tool, make sure that you have run the junit test for that particular commit.

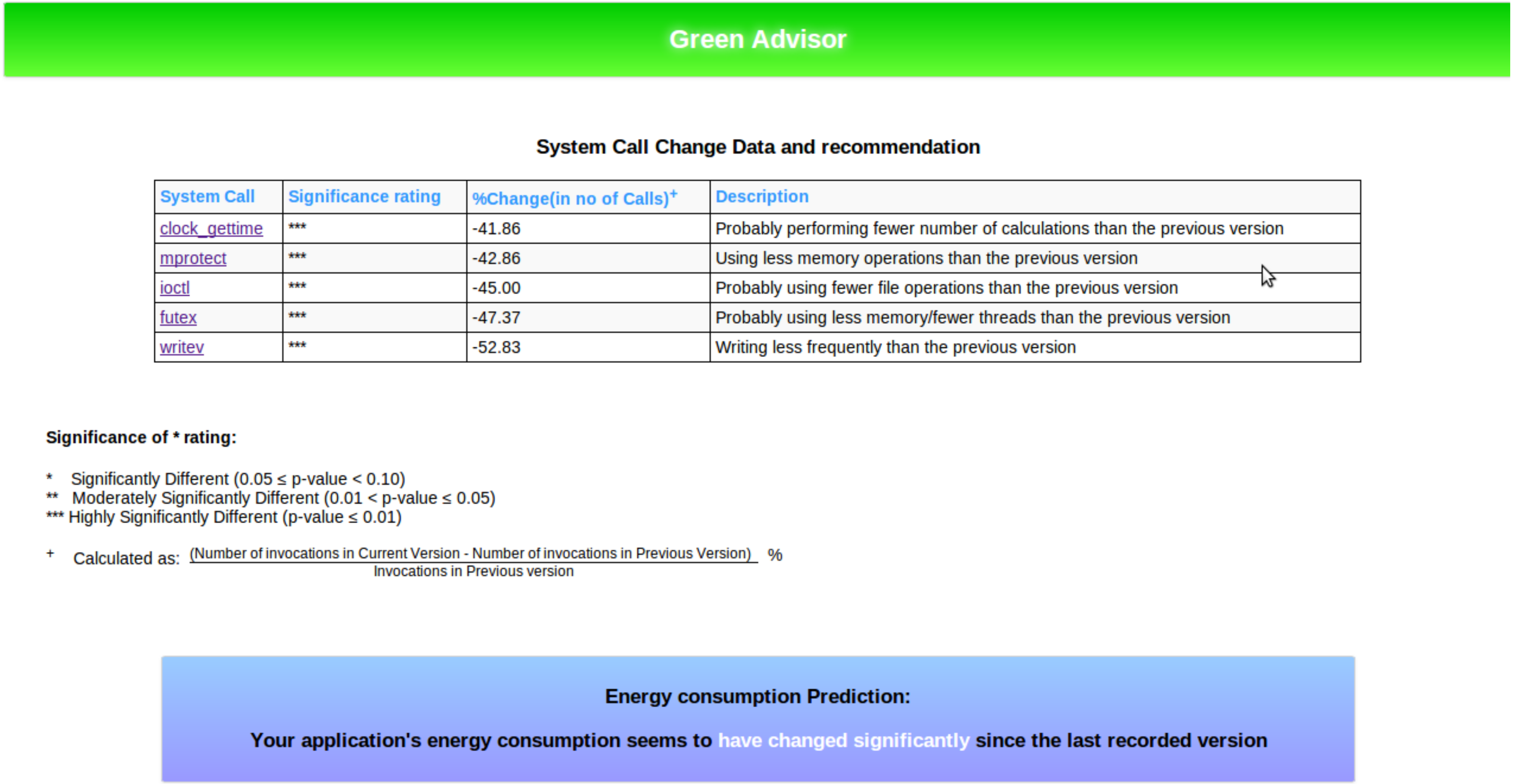
The emulator should be running before starting the tool.

Running the tool

- After making a commit, run the Junit tests on Eclipse again so that apk's are generated
- Make sure you are in the GreenAdvisor directory
- Run the following command:

```
sh run.sh
```

Report



Green Advisor

System Call Change Data and recommendation

System Call	Significance rating	%Change(in no of Calls)+	Description
clock_gettime	***	-41.86	Probably performing fewer number of calculations than the previous version
mprotect	***	-42.86	Using less memory operations than the previous version
ioctl	***	-45.00	Probably using fewer file operations than the previous version
futex	***	-47.37	Probably using less memory/fewer threads than the previous version
writev	***	-52.83	Writing less frequently than the previous version

Significance of * rating:

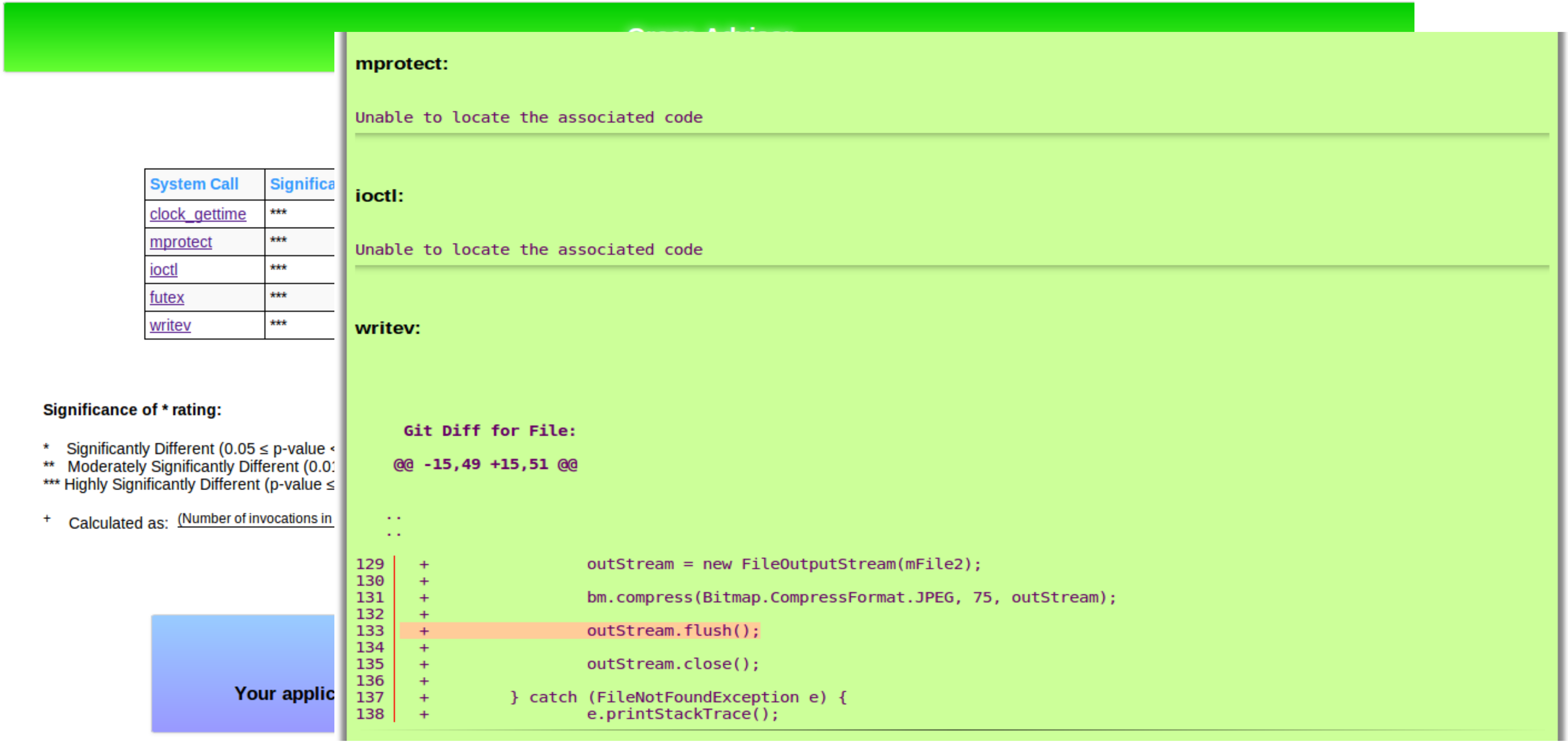
* Significantly Different ($0.05 \le$ p-value < 0.10)
** Moderately Significantly Different ($0.01 <$ p-value ≤ 0.05)
*** Highly Significantly Different (p-value ≤ 0.01)

+ Calculated as: $\frac{\text{(Number of invocations in Current Version - Number of invocations in Previous Version)}}{\text{Invocations in Previous version}}$ %

Energy consumption Prediction:

Your application's energy consumption seems to have changed significantly since the last recorded version

Report



System Call	Significa
clock_gettime	***
mprotect	***
ioctl	***
futex	***
writev	***

Significance of * rating:

* Significantly Different (0.05 ≤ p-value <

** Moderately Significant Different (0.0

*** Highly Significantly Different (p-value ≤

+ Calculated as: (Number of invocations in

Your applic

mprotect:

Unable to locate the associated code

ioctl:

Unable to locate the associated code

writev:

Git Diff for File:

@@ -15,49 +15,51 @@

```
..
..
+                  outStream = new FileOutputStream(mFile2);
+
+                  bm.compress(Bitmap.CompressFormat.JPEG, 75, outStream);
+
+                  outStream.flush();
+
+                  outStream.close();
+
+          } catch (FileNotFoundException e) {
+                  e.printStackTrace();
```

Energy Consumption Demo

Please refer to: https://github.com/kaggarwal/GreenAdvisor/blob/master/EnergyDemo.md

You will get a URL at the end of the tests where you can view your graphs for energy consumption.

Remember!

Before running the tool, make sure that you have run the junit test for that particular commit.

The emulator should be running before starting the tool.

Deliverables

Run the tool on commits you suspect to have changed your energy consumption and then complete these:

- Feedback Questionnaire sheet
- Make a GreenAdvisor directory in your project repo, and push database.db and Report(s) files under it.

THANK YOU!