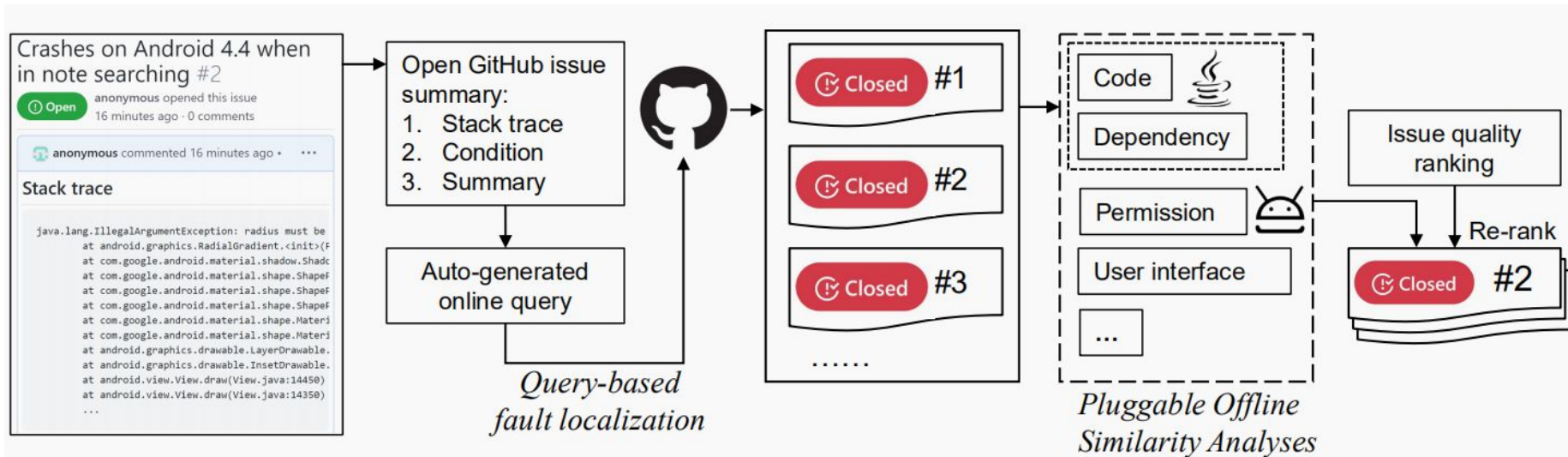


# Using Crossfix

---

- Semi-automated way of fixing bugs

# What is crossfix?



Given your **open GitHub issue** that needs to be fixed, Crossfix gives you a **ranked list of closed GitHub issues** that fixed similar bugs. You can learn from these issues to **fix your bugs!**

# How to use Crossfix

---

## Read the doc before use

Crossfix provides an API interface for searching github issues containing similar bugs. The tool could filter relevant issues which have a similar function or similar UI, so it is more likely to fix bug or find a similar repair path.

The doc is **RUN\_for\_student.md**.

You can access the service by cURL or other HTTP request tools. The doc provides cURL and Python code snips.

The service return JSON in the response body.

# Create query task

## Input:

- `url`: GitHub issue url
- `email`: Email to receive result

```
→ ~ curl -X POST -L "http://lab3.sustech.pub:5000/crossfix" \  
  -F "url= url of your selected GitHub issue" \  
  -F "email= your email address" \  
  {  
    "job_id": "648c756277e111eb8b4e1b38b512bcc2",  
    "msg": "Submit task successfully, the task result will send to the  
submitted email(your_email@gmail.com)."  
  }
```



## Output:

- JSON, including `job_id` and `msg` fields.
- CSV file, which will be sent to the email if successfully finished.

The response status could be:

Status: 400 Bad Request

Status: 200 OK

---

**[Received] Crossfix task 8f87697a774611eb8b4e1b38b512bcc2**

2 封邮件

李子强 <ziquang.li@sustech.pub>

收件人: liziquang199785 <liziquang199785@gmail.com>

2021年2月25日 下午4:50

Email for create query task

Hi, It have received the task 8f87697a774611eb8b4e1b38b512bcc2 for GitHub issue/PR <https://github.com/ankidroid/Anki-Android/issues/6432>.

After the task is completed, the results will be sent to the email, and you can check the progress by the result API.

If you find that the result is abnormal, please forward the result to my email ([lizq2019@mail.sustech.edu.cn](mailto:lizq2019@mail.sustech.edu.cn)).

---

李子强 <ziquang.li@sustech.pub>

收件人: liziquang199785 <liziquang199785@gmail.com>

2021年2月25日 下午4:53

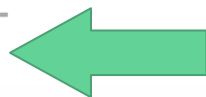
Email for the result

Hi, the result of task 8f87697a774611eb8b4e1b38b512bcc2 for GitHub issue/PR <https://github.com/ankidroid/Anki-Android/issues/6432> is in the attachment.

If you find that the result is abnormal, please forward the result to my email ([lizq2019@mail.sustech.edu.cn](mailto:lizq2019@mail.sustech.edu.cn)).

---

 **similar\_issue(ankidroid\_Anki-Android-6432)-8f8769.csv**  
1K



Result CSV

李子强 <ziquang.li@sustech.pub> **Email for the task error**

2021年2月24日 上午10:16

收件人: liziquang199785 <liziquang199785@gmail.com>

Hi, The task 40e44f5a764611eb9eec20040ff1241c for GitHub issue/PR <https://github.com/ankidroid/Anki-Android/issues/6432> is failed, Admin will check the error log.

## (Optional) Check query status

Input:

- `job_id`: job ID

Output:

- JSON, including:
  - `job_id`: job ID,
  - `job_status`: job status,
  - `enqueued_at`: create task time in ISO format,
  - (Optional) `ended_at`: finish task time in ISO format.

```
→ ~ curl -L "http://lab3.sustech.pub:5000/result?job_id=648c756277e111eb8b4e1b38b512bcc2"
{
  "ended_at": "2021-02-26T03:21:28.791617",
  "enqueued_at": "2021-02-26T03:19:13.650172",
  "job_id": "648c756277e111eb8b4e1b38b512bcc2",
  "job_status": "finished"
}
```



# Evaluate result CSV in the email

query_url	keywords	close_url
<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	crash card browser multi-select mode edit change type in:title	<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>
<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	crash card browser multi-select mode edit change type	<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>
<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	crash card browser multi-select mode edit change type	<a href="https://github.com/ankidroid/Anki-Android/issues/2746">https://github.com/ankidroid/Anki-Android/issues/2746</a>
<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	crash card browser multi-select mode edit change type	<a href="https://github.com/termux/termux-app/issues/1072">https://github.com/termux/termux-app/issues/1072</a>



query issue links, all  
are the same.



keywords and  
filters extract from  
query\_url



corresponding similar  
close issue links

# Evaluate result CSV in the email

query_url	keywords	close_url	usefulness	rank_usefulness	label_usefulness
<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	crash card browser multi-select mode edit change type in:title	<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	Y	1	fix
<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	crash card browser multi-select mode edit change type	<a href="https://github.com/ankidroid/Anki-Android/issues/6432">https://github.com/ankidroid/Anki-Android/issues/6432</a>	N	(left blank)	(left blank)



query issue links, all are the same.



keywords and filters extract from query\_url



corresponding similar close issue links

For each closed issue,

1. please give the short label of usefulness: “Y” (is useful) or “N”,
2. If there are some items labeled with “Y”, give the top 10 ranks from the most useful (1st) to the less useful,
3. corresponding useful (for query issue) level: “fix”, “debug”, “not relevant”, “no result”,

# Automated Program Repair

---

- Fully automated way of fixing bugs

# What is Automated Program Repair (APR)?



# Automated Program Repair

Given a **buggy program** that needs to be fixed and **a set of test cases**, automated program repair tools give you a **patch** that can pass all the test cases. Then the buggy program is **automatically** fixed.

In this project, we use two APR tools: Astor and Prapr. **Note that Astor and Prapr work can be used in Linux or Mac OS. No official support is provided for Windows so you should run them in a virtual machine if you are using a Window system.**

The following slides guide you to use them in example programs.



For Android projects

- Use <https://github.com/I4Soft/Astor4Android>

# Installing PraPR

- If your project use maven for building, PraPR provides maven plugin which can be easily integrated to a buggy project. Read the <https://github.com/prapr/prapr>. Check the example “pom.xml” by <https://github.com/prapr/prapr/blob/master/examples/toy-java-program/pom.xml>!
- If your project use gradle for building, PraPR also has a gradle plugin. Read <https://github.com/prapr/prapr>
- PraPR also provides a pre-configured docker, you can follow this README.md <https://github.com/prapr/prapr> to start with a toy program.





# PraPR

## Output of PraPR

```
> org.mudebug.prapr.mutators.NonVoidMethodCallRemovalMutator_0
>> Generated 2 Killed 2 (100%)
> KILLED 2 SURVIVED 0 TIMED_OUT 0 NON_VIABLE 0
> MEMORY_ERROR 0 NOT_STARTED 0 STARTED 0 RUN_ERROR 0
> NO_COVERAGE 0
-----
> org.pitest.mutationtest.engine.gregor.mutators.ReturnValsMutator
>> Generated 3 Killed 3 (100%)
> KILLED 3 SURVIVED 0 TIMED_OUT 0 NON_VIABLE 0
> MEMORY_ERROR 0 NOT_STARTED 0 STARTED 0 RUN_ERROR 0
> NO_COVERAGE 0
-----
> org.mudebug.prapr.mutators.NonVoidMethodCallRemovalMutator_1
>> Generated 2 Killed 2 (100%)
> KILLED 2 SURVIVED 0 TIMED_OUT 0 NON_VIABLE 0
> MEMORY_ERROR 0 NOT_STARTED 0 STARTED 0 RUN_ERROR 0
> NO_COVERAGE 0
-----
> org.pitest.mutationtest.engine.gregor.mutators.ArgumentPropagationMutator
>> Generated 2 Killed 2 (100%)
> KILLED 2 SURVIVED 0 TIMED_OUT 0 NON_VIABLE 0
> MEMORY_ERROR 0 NOT_STARTED 0 STARTED 0 RUN_ERROR 0
> NO_COVERAGE 0
-----
> org.pitest.mutationtest.engine.gregor.mutators.experimental.RemoveSwitchMutator_0
>> Generated 1 Killed 1 (100%)
> KILLED 1 SURVIVED 0 TIMED_OUT 0 NON_VIABLE 0
> MEMORY_ERROR 0 NOT_STARTED 0 STARTED 0 RUN_ERROR 0
> NO_COVERAGE 0
-----
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 3.555 s
[INFO] Finished at: 2021-03-09T13:15:56Z
[INFO] -----
root@55c1d392df13: ~/prapr/examples/toy-java-program#
```

```
mvn org.mudebug:prapr-plugin:prapr -Dhttps.protocols=TLSv1.2
```

# PraPR Fix Report

## Package Summary

com.example.main

Number of Classes	Line Coverage	Plausible Fixes
1	100% <div><div>11/11</div></div>	3% <div><div>1/33</div></div>

## Breakdown by Class

Name	Line Coverage	Plausible Fixes
<a href="#">Lib.java</a>	100% <div><div>11/11</div></div>	3% <div><div>1/33</div></div>

Report generated by [PIT](#) 2.0.1

## Lib.java

```
1 package com.example.main;
2
3 public class Lib {
4
5     public int factorial(int n) {
6         int res = 1;
7         while (n > 1) {
8             res *= n;
9             n--;
10        }
11        return res;
12    }
13
14    public int fibonacci(int n) {
15        if (n < 1) {
16            return 0;
17        } else {
18            switch (n) {
19                case 1:
20                    return 1;
21                default:
22                    return fibonacci(n - 1) - fibonacci(n - 2); //BUG: integer multiplication should be replaced with addition
23            }
24        }
25    }
26
27 }
```

```
root@55c1d392df13:~/prapr/examples/toy-java-program/target/prapr-reports/202103091315# ls -la
total 32
drwxr-xr-x 4 root root 4096 Mar  9 13:15 .
drwxr-xr-x 4 root root 4096 Mar  9 13:15 ..
drwxr-xr-x 2 root root 4096 Mar  9 13:15 com.example.main
-rw-r--r-- 1 root root 399 Mar  9 13:15 fix-report.log
-rw-r--r-- 1 root root 1558 Mar  9 13:15 index.html
drwxr-xr-x 2 root root 4096 Mar  9 13:15 pool
-rw-r--r-- 1 root root 6076 Mar  9 13:15 style.css
```

## Mutations

- 15
1. changed conditional boundary → KILLED  
2. Substituted 1 with 0 → KILLED  
3. negated conditional → KILLED  
4. removed conditional - replaced comparison check with false → KILLED  
5. removed conditional - replaced comparison check with true → KILLED
- 16
1. Substituted 0 with 1 → KILLED  
2. replaced return of integer sized value with (x == 0 ? 1 : 0) → KILLED
- 18
1. RemoveSwitch 0 mutation → KILLED  
2. Switch mutation → KILLED
- 20
1. Substituted 1 with 0 → KILLED  
2. replaced int return with 0 for com/example/main/Lib::fibonacci → KILLED  
3. replaced return of integer sized value with (x == 0 ? 1 : 0) → KILLED
- 22
1. replaced call to fibonacci with a call to factorial → KILLED  
2. replaced call to fibonacci with a call to factorial → KILLED  
3. the call to com.example.main.Lib::fibonacci(I)I is guarded using default value 0 → KILLED  
4. the call to com.example.main.Lib::fibonacci(I)I is guarded using default value 0 → KILLED  
5. the call to com.example.main.Lib::fibonacci(I)I is replaced with the used of default value 0 → KILLED  
6. the call to com.example.main.Lib::fibonacci(I)I is replaced with the used of default value 0 → KILLED  
7. the call to com.example.main.Lib::fibonacci(I)I is replaced with the used of local n → KILLED  
8. the call to com.example.main.Lib::fibonacci(I)I is replaced with the used of local n → KILLED  
9. the call to fibonacci(I)I is guarded returning default value 0 → KILLED  
10. the call to fibonacci(I)I is guarded returning default value 0 → KILLED  
11. the call to fibonacci(I)I is guarded returning local n → KILLED  
12. the call to fibonacci(I)I is guarded returning local n → KILLED  
13. replaced call to com/example/main/Lib::fibonacci with argument → KILLED  
14. replaced call to com/example/main/Lib::fibonacci with argument → KILLED  
15. Substituted 1 with 0 → KILLED  
16. Substituted 2 with 3 → KILLED  
17. Replaced integer subtraction with addition → KILLED  
18. Replaced integer subtraction with addition → KILLED  
19. Replaced integer subtraction with addition → PLAUSIBLE FIX  
20. replaced int return with 0 for com/example/main/Lib::fibonacci → KILLED  
21. replaced return of integer sized value with (x == 0 ? 1 : 0) → KILLED

# Important: Running Astor and PraPR with timeout

Astor and PraPr could take very long to run for complicated bugs. Set the timeout to be 12 hours.

- For linux, use the timeout command. The syntax for the timeout command is as follows:
  - `timeout [OPTIONS] DURATION COMMAND [ARG]...`
  - e.g., `timeout 5 ping 8.8.8.8`
  - Refer to <https://linuxize.com/post/timeout-command-in-linux/>
- For Mac OS.
  - `brew install coreutils`
  - Use `gtimeout/timeout` command
  - For Mac OS.
- If you don't want to install coreutils, use perl:

```
function timeout() { perl -e 'alarm shift; exec @ARGV' "$@"; }
```

<https://stackoverflow.com/questions/3504945/timeout-command-on-mac-os-x>

# Note

1. Those tools may not have timeout argument, please properly use “timeout ” command in terminal, you should set 12 hours timeout for each fixing attempt
2. To use Astor and Prapr in real large project, please refer to the instruction (MP 1 Part 2).
3. You should specify your Java version based on the buggy project you choose
4. if the java version of target program is under JAVA 7, you need to attach ``-Dhttps.protocols=TLSv1.2`` for every above mvn commands
5. It is possible that Astor and Prapr cannot work on some buggy project, please write the reasons. In the Instruction, we have prepared several possible cases.

# Reminder of Upcoming deadlines

- **Make sure you can run the examples for all tools at the end of this lab! Ask questions about Crossfix, Astor and Prapr on <https://github.com/orgs/cs304-spring2021/teams/all-teams/discussions/2>**
- **Instructions for MP1 have been uploaded in Sakai.** There are two parts of MP1 due at different times. There are two invitation links, one for each part.
  1. MP1 Part 1 (March 24)
  2. MP1 Part 2 (April 14) - Need to run Astor and Prapr **(Each of them may take up to 12 hours to run which sums up to 24 hours!)** . **Do not support Window OS well. Need to run them in virtual machine if you use Window system.**