

Weekly Seminar

Haonan, Wenxuan, Xueying

COMPASS

Jan 26, 2021

The plan

Wenxuan & Xueying

- Sync

Haonan

- 1 Read a paper: “iReplayer: In-situ and Identical Record-and-Replay for Multithreaded Applications”

Wenxuan's work

Replayer Impl

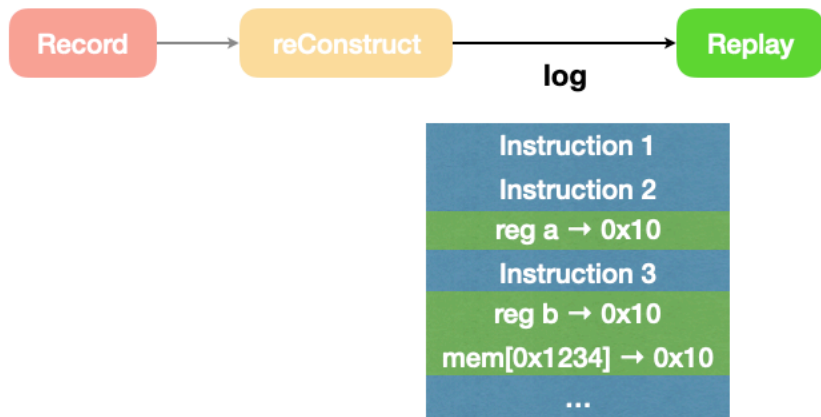
Discuss in next slides

read the paper “REPT”

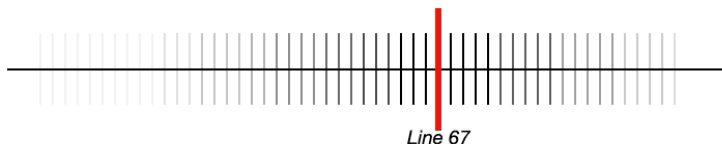
Wrote a blog, [My notes on REPT:Reverse Debugging of Failures in Deployed Software](#)

Input

Record and reConstruct provide log (including every instruction and data change) to **replayer**.



Replayer == Browser



Last instruction: mov x0, x1

Reg x0	Reg x1	...	Reg x30
0x0001	0xffff		0xbeef

MEM [#0]	MEM [#4]	...	MEM [#80]
0x0005	0xfffe		0xdead

Next instruction: mov x1, x2

Functionality

All registers and memories are **immutable** during debugging.

Provide developers filters, searching tools to understand how program goes.

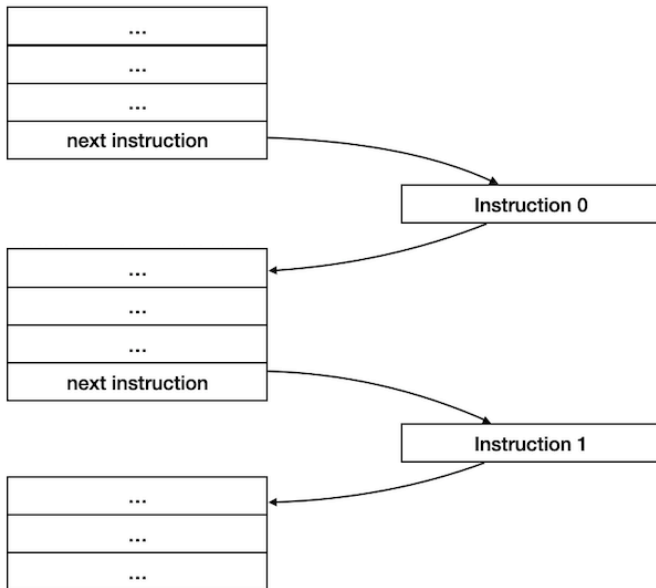
The workload is almost none!

Replayer version 2

- The instructions actually **run** in the processors.
- Developers can manipulate replay.

Replay Controller

Reconstructed "Program"



Challenges of version 2

Say, we want to have a replayer written in C/C++.

- 1 Analyse the record log
- 2 Read user input commands (continue, reverse, goto, ...)
- 3 Dynamically run assembly

Notice we are writing a replayer running as a normal program, the hard parts are:

- 1 Assembly are **run-time** determined, rather than determined during compiling.
- 2 We don't know what assembly will do, it may do something harmful, like modify a register we used in the replayer, or override stack in the memory.

Challenges of version 2 - Cont'd

Challenge 1

Q: Assembly are **run-time** determined, rather than determined during compiling.

A: We might need to modify PC register in some hacky ways.

Challenges of version 2 - Cont'd

Challenge 2

Q: Assembly may do something harmful.

A: We need a good isolation. Maybe a virtual machine?

Challenge 3

Q: If running in actual host, how to manage the context?

A: context switch! Can OS help? Let one thread (replay controller) to control another thread (assembly)? How?

Challenge 4

Q: If OS can't help, switch context by our own, **language-level**?

A: Associated with the C++ Coroutine. Coroutine needs to store and restore the scene.

Replay Design

TO BE DECIDED.

Paper Introduction

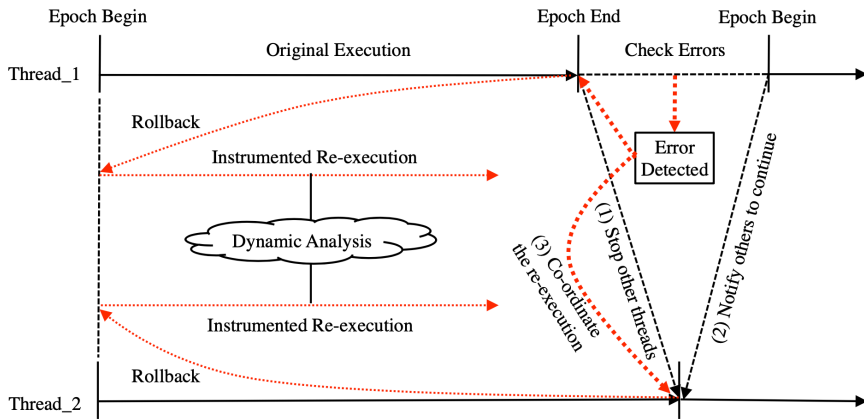
- Hongyu Liu, Tongping Liu et al. “iReplayer: In-situ and Identical Record-and-Replay for Multithreaded Applications”, PLDI'18
- University of Texas at San Antonio, Huawei US Lab
- Only replay the execution **if necessary**
- ~~This paper was rejected 7 times~~

Types of Replay

- *Lawful*: replay is re-execution (ReVirt)
- *Neutral*: capture/snapshot is also replay (TTD, REPT)
- *Chaotic*: rollback is also replay (iReplayer)

iReplayer

Design goal: in-situ, identical, efficient



Syscalls in Different Types

Category	Syscall Examples
Repeatable	getpid, getcwd
Recordable	gettimeofday, mmap, open
Revocable	file read/write
Deferrable	close, munmap, (thread exits)
Irrevocable	fork, lseek

About REPT: OSDI'18

- “Reverse Debugging of Failures in Deployed Software”
- They adapted and deployed in WinDbg (see: https://youtu.be/0VUy4mqA_Lk)
- An improvement of *Time Travel Debugging*

Plan

Haonan

- For these categories of syscalls, to find some ways to record

Wenxuan

- Understand the design graph
- Find ways to replay.