Weekly Seminar

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COMPASS

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The plan

Wenxuan & Xueying

- Sync

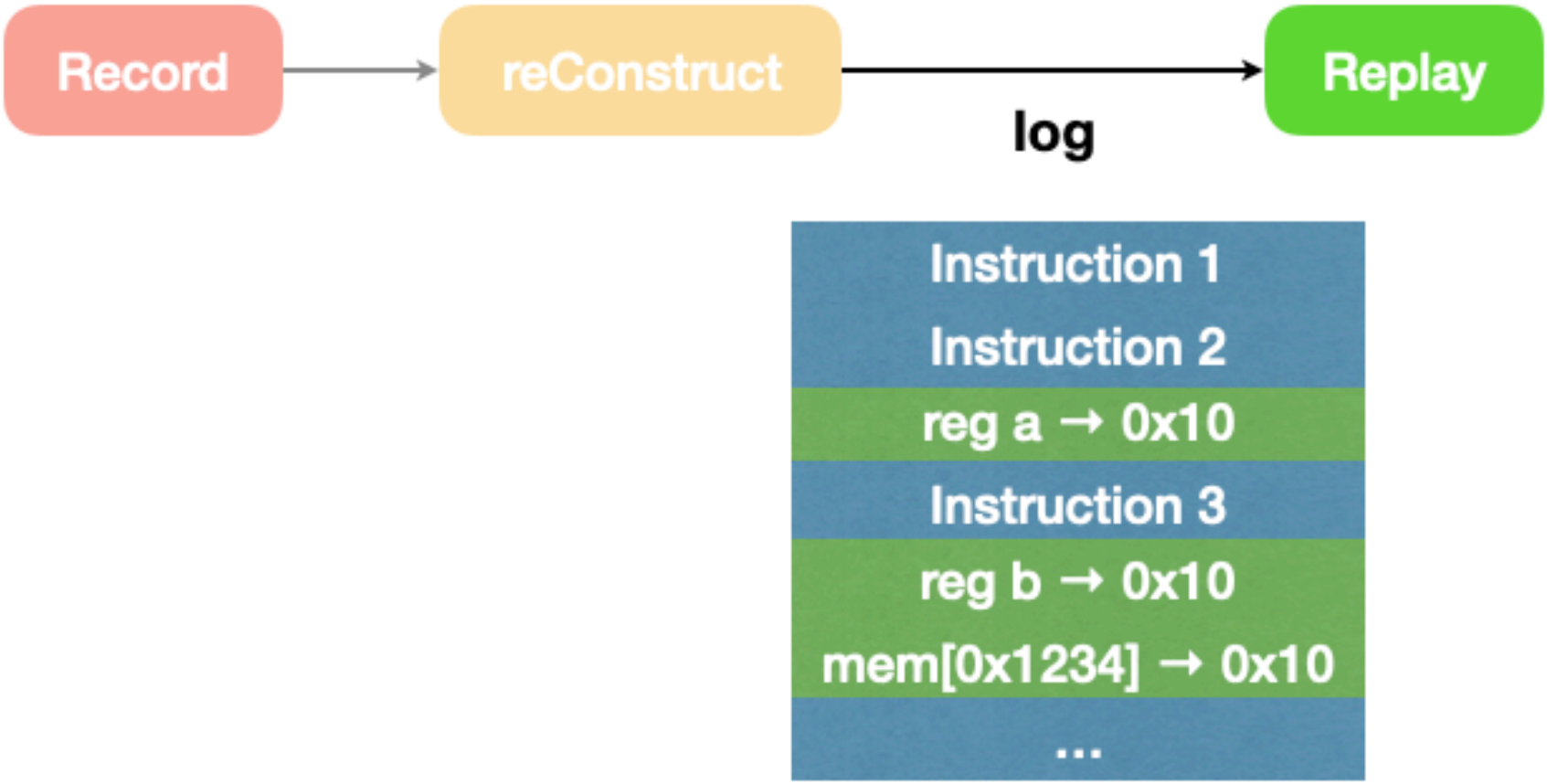
Haonan

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

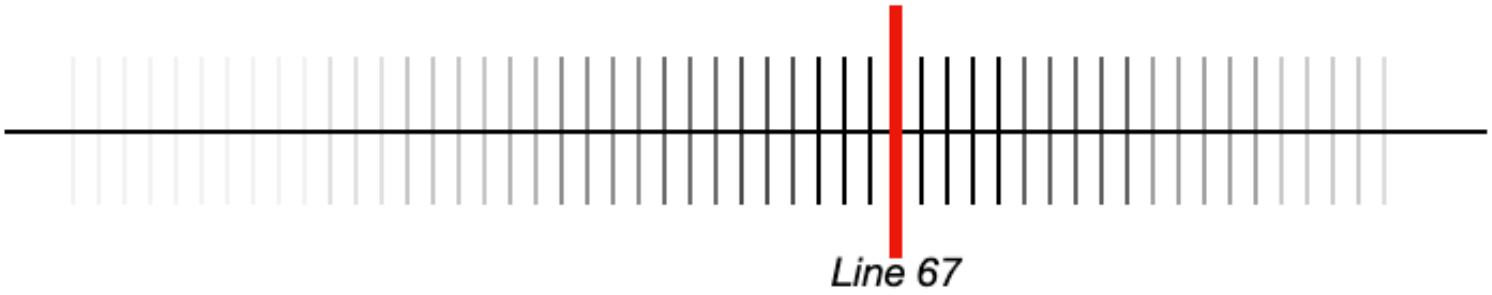
Replayer Impl

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

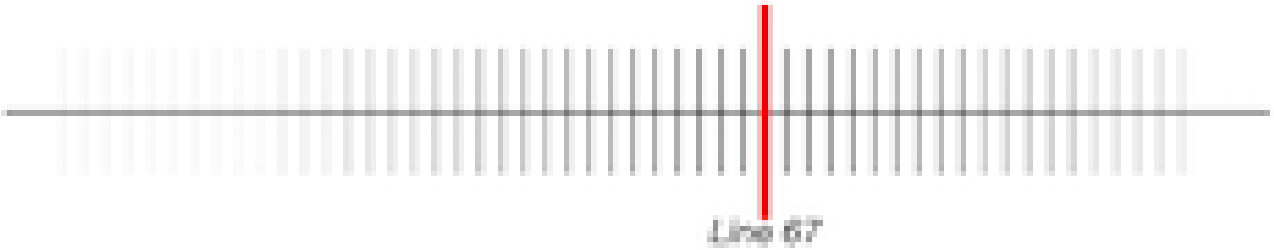
MEM [#0]	MEM [#4]	...	MEM [#80]
0x0005	0xfffe		0xdead

Next instruction: mov x1, x2

Functionality

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

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



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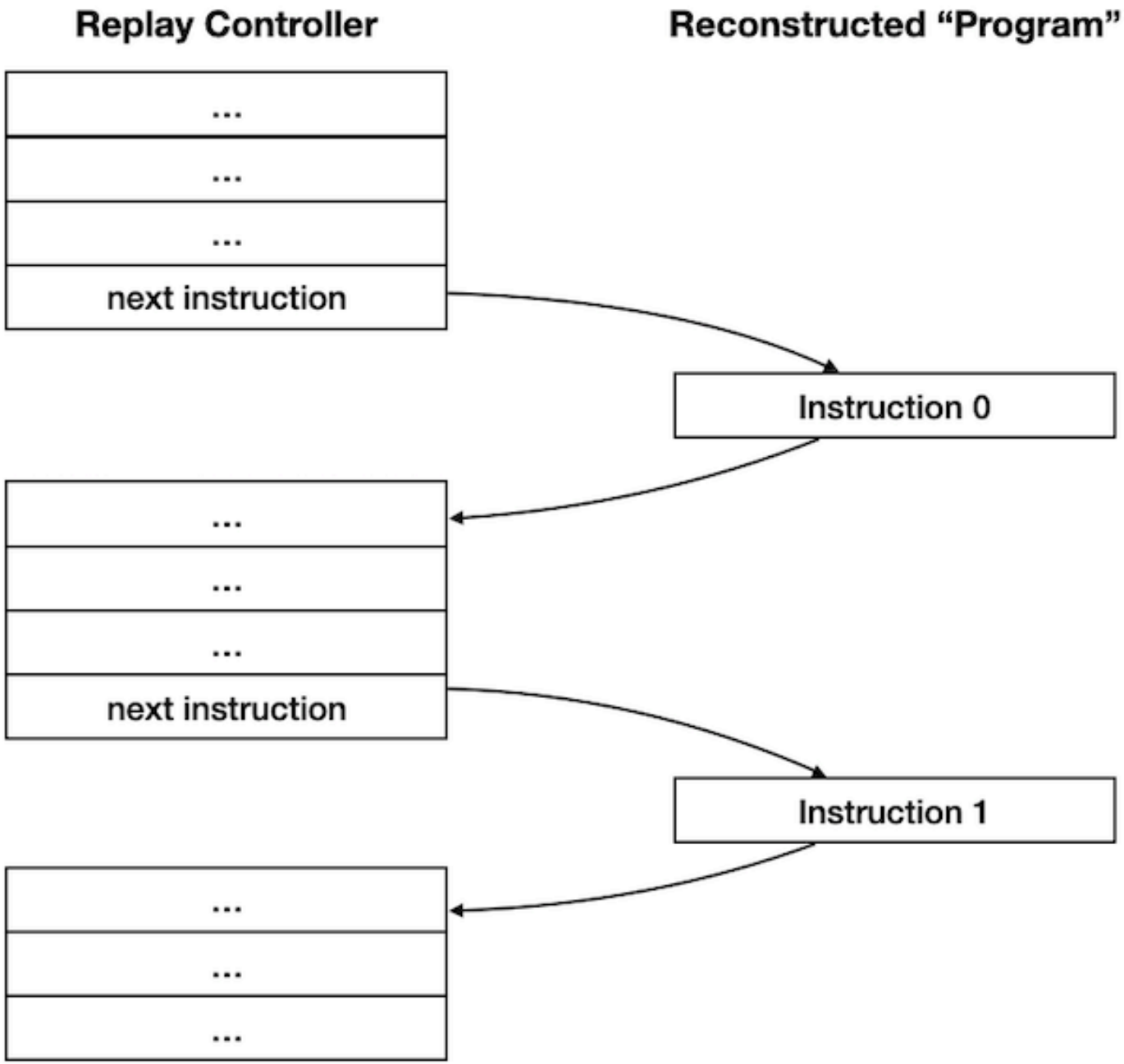
Next instruction: mov x1, x2

Replayer version 2

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


Replay Controller
Reconstructed "Program"
...
...
...
next instruction
Instruction 0
...
...
...
next instruction
Instruction 1
...
...
...

Challanges 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 writting 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.

Challanges of version 2 - Cont'd

Challange 1

Q: Assembly are **run-time** determined, rather than determined during compiling.
A: We might need to modify PC register in some hacky ways.

Challanges of version 2 - Cont'd

Challange 2

Q: Assembly may do something harmful.
A: We need a good isolation. Maybe a virtual machine?

Challange 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?

Challange 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.

Paper Introduction

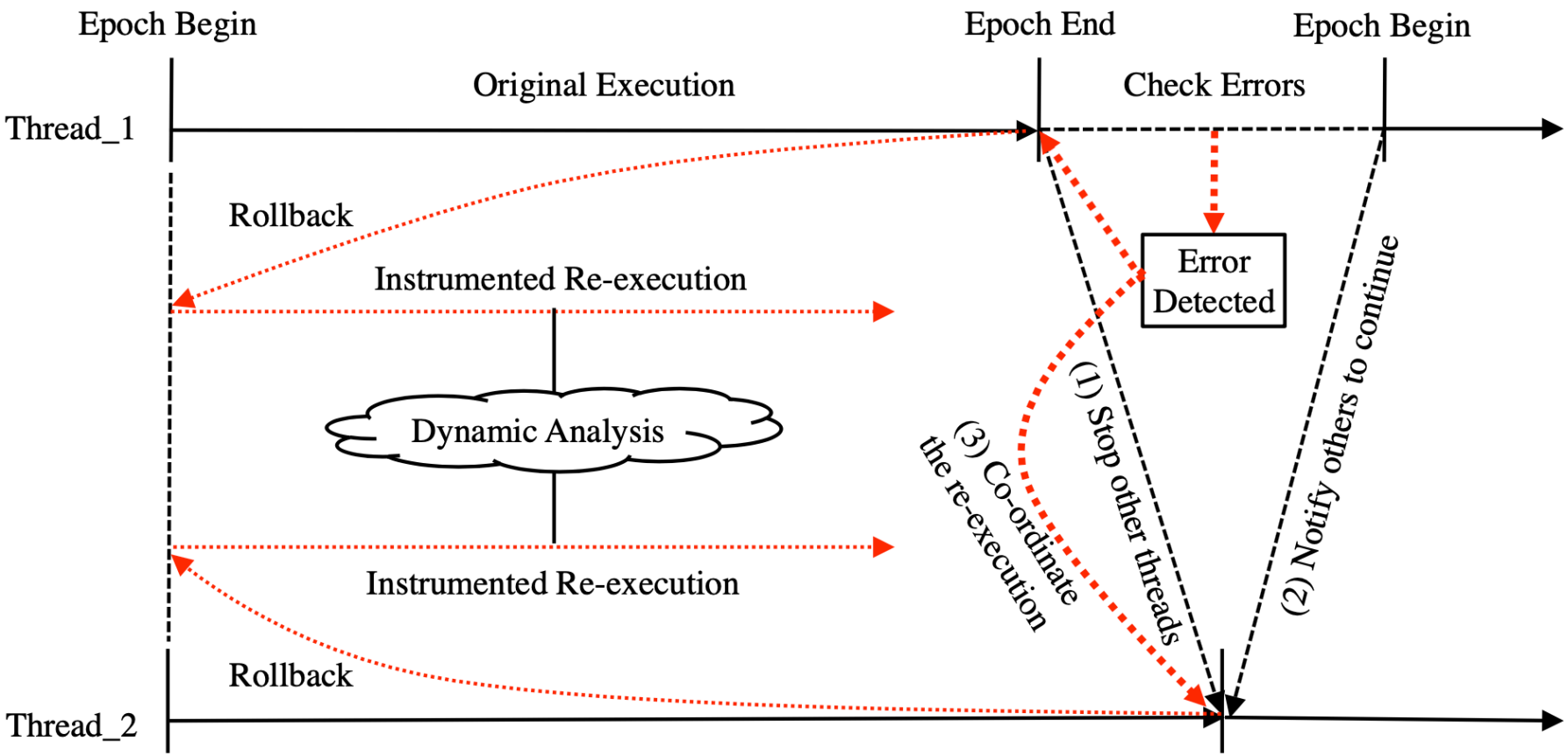
- Hongyu Liu, Tongping Liu et al. “iReplayer: In-situ and Identical Record-and-Replay for Multithreaded Applications”, PLDI’18
- University of Texas at San Antonio, Huawei US Lab
- Only replay the execution **if necessary**
- ~~This paper was rejected 7 times~~

Types of Replay

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

iReplayer

Desgin 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 Travle Debugging*

Plan

Haonan

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

Wenxuan

- Understand the design graph
- Find ways to replay.