Operating Systems Programming Assignment #5

Page Cache Simulation: FIFO and LRU

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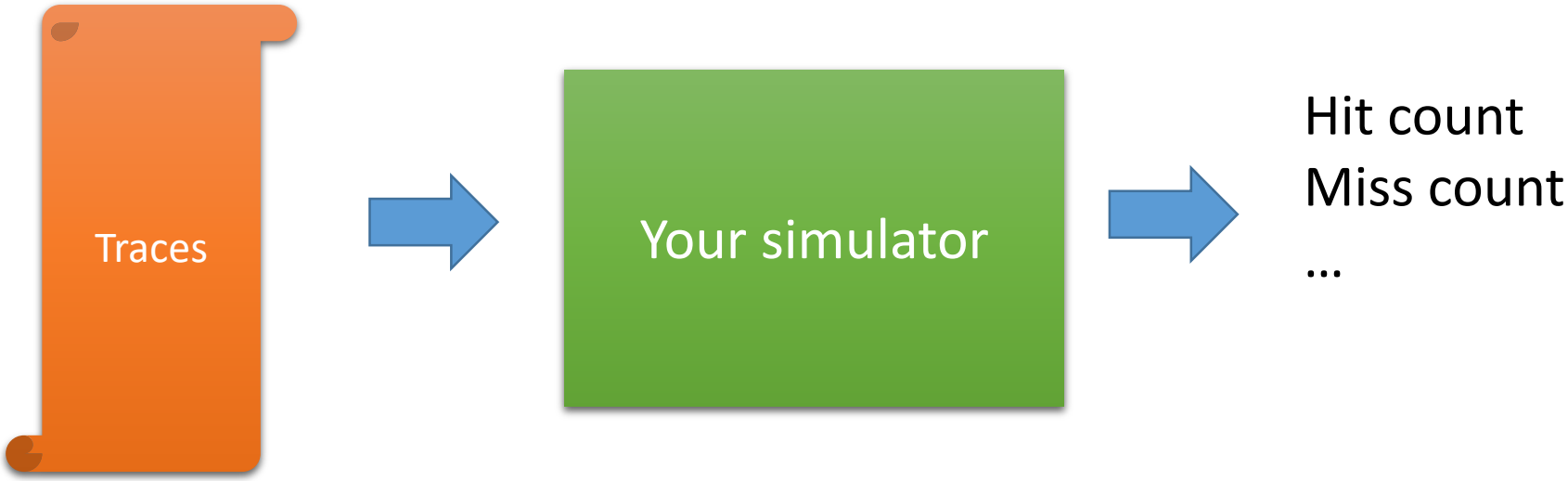
Simulation



Memory traces were collected from a sorting program using Valgrind
http://valgrind.org

Trace File Format (trace.txt)

- There are 4 types of memory access:

<op> <address> <size>

```
I  0400a878,6
 L 04021538,4
I  0400a87e,8
 M 04021044,4
I  0400a886,6
 S 04021b88,4
```

//instruction read at 0400a878 of size 6
//data load at 04021538 of size 4
//data modified at 04021044 of size 4
//data store at 04021b88 of size 4

Trace File Format

- Ignore op and size for simplicity

```
0400a878
04021538
0400a87e
04021044
0400a886
04021b88
```

Page Reference Pattern

- Page size: 4 KB

  040011a0 → 04001

  040011a2 → 04001

  be96260c → be962

  04004b80 → 04004

Page Replacement(FIFO)

- Example: Frame #=2

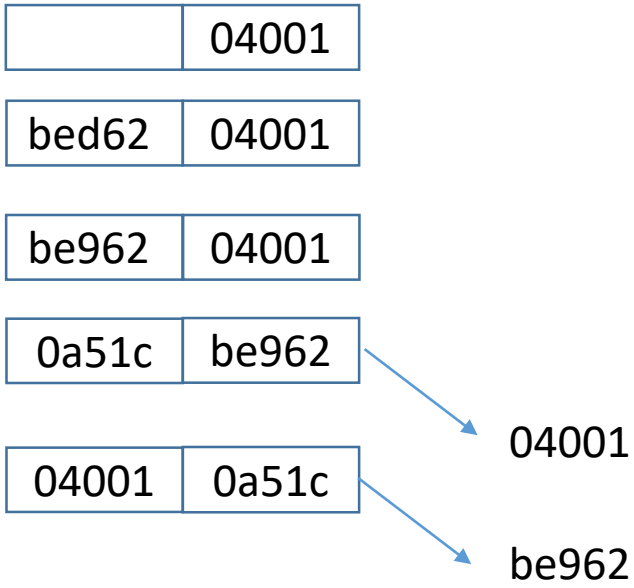
04001 (miss)

be962 (miss)

04001 (hit)

0a51c (miss)

04001 (miss)



Page Replacement(LRU)

- Example: Frame #=2

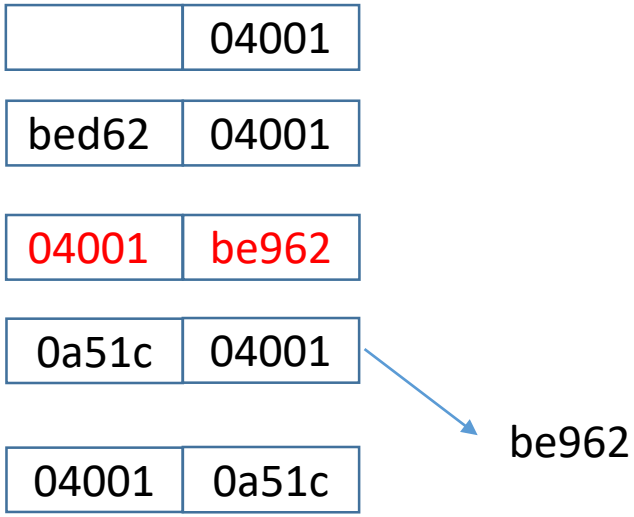
04001 (miss)

be962 (miss)

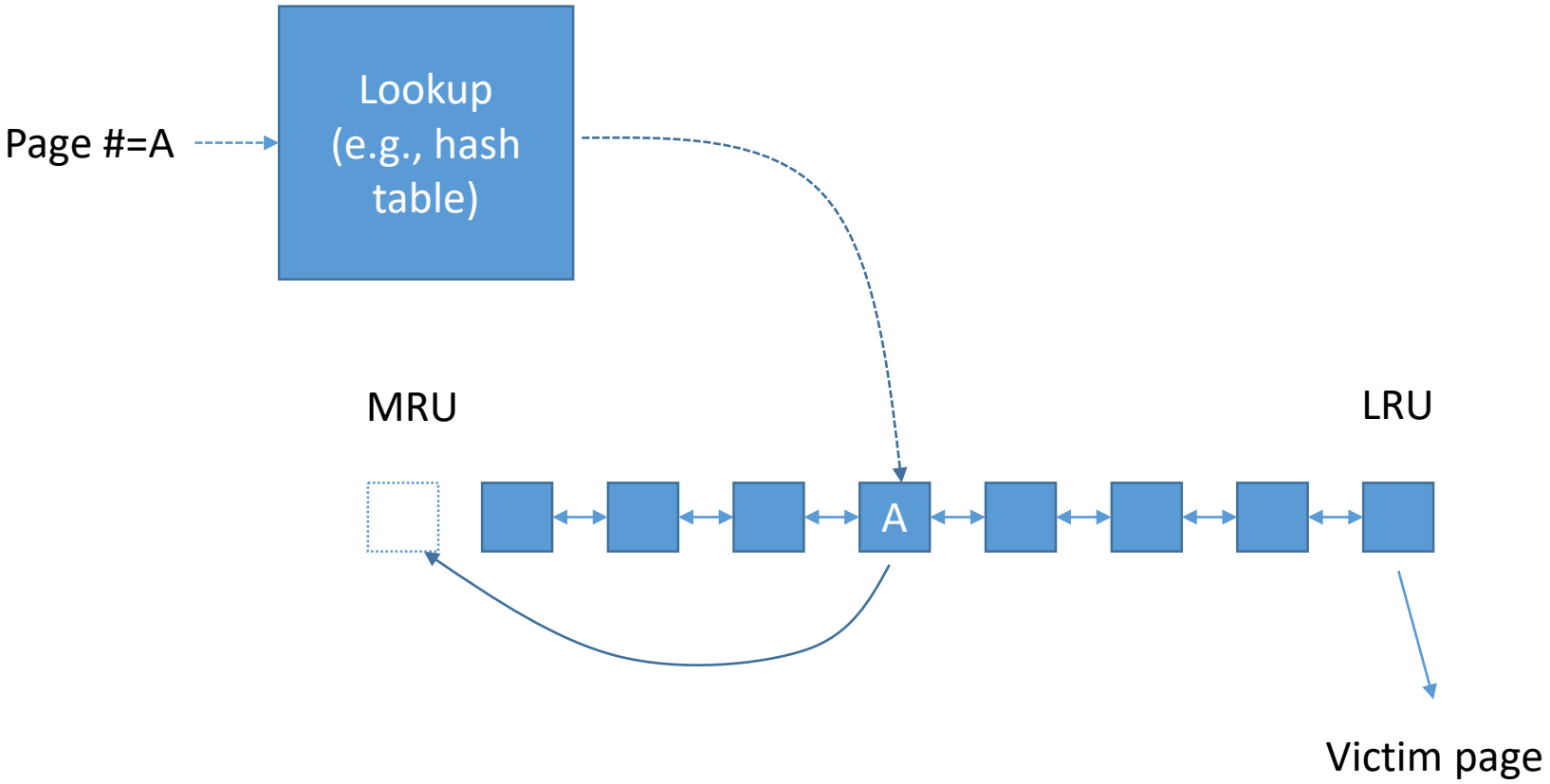
04001 (hit)

0a51c (miss)

04001 (hit)



Simulator Structure (LRU)



Page Cache Operations

- Page lookup
  - Check whether or a new reference is a hit or a miss
  - Hash tables, binary search trees, skip lists….

- Do not use linear search!!!
  - You will receive a grade penalty if you do
  - Implement your own search, or reuse any existing libraries/classes for searching
  - TAs will read your code
  - Duplication in this part does not count

Page Cache Operations

- Victim selection
  - FIFO
    - The oldest page
  - LRU
    - The least recently used page

Procedure

1. Algorithm=FIFO
2. For (Frame #=64; <=512; *=2)
   - Read the trace file “trace.txt”
   - Run simulation
   - Print out the miss count, hit count, page fault ratio
3. Algorithm=LRU
4. For (Frame #=64; <=512; *=2)
   - Read the trace file “trace.txt”
   - Run simulation
   - Print out the miss count, hit count, page fault ratio

Output Format

FIFO---

size	miss	hit	page fault ratio
64	15370	10038814	0.001528717
128			
256	2033	10052151	0.000202204
512			

LRU---

size	miss	hit	page fault ratio
64	8440	10045744	0.000839452
128			
256	1434	10052750	0.000142627
512			

Correctness

- Your results must be exactly the same as ours
- You must not use linear search

Testing OS Environment

- Ubuntu 16.04, Ubuntu 14.04 or CS linux work station
  - Your code should compile successfully in one of the above environments