Side-Channel Security

Chapter 8: Side-Channel Attacks on The OS Page Cache

Sudheendra Neela

April 3, 2025

Graz University of Technology

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- Attacker and victim: share the CPU cache

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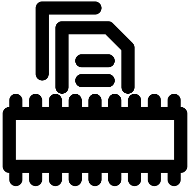

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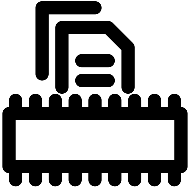

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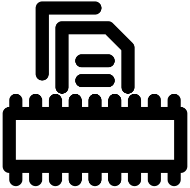

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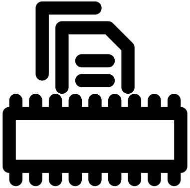

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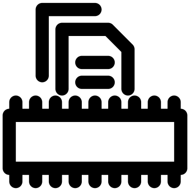

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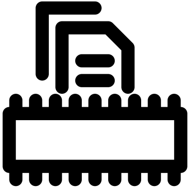

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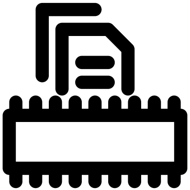

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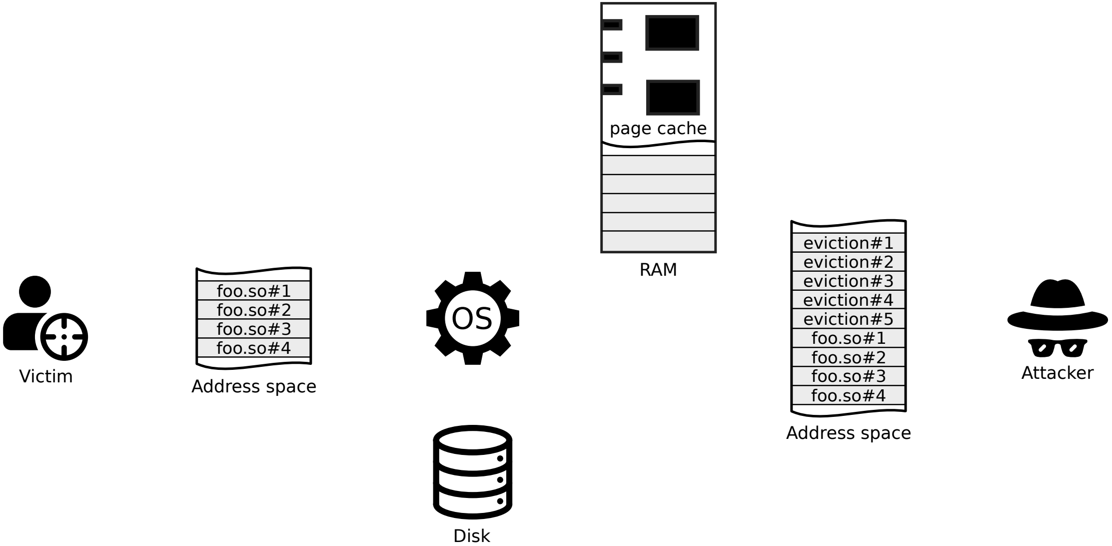
- Implemented by all major operating systems

Page Cache Attacks [4]



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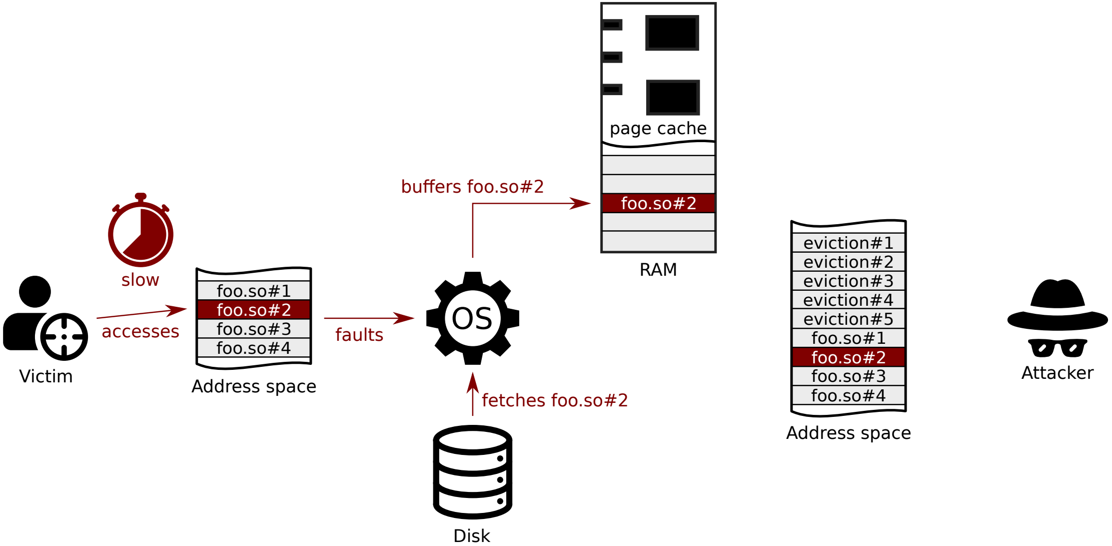

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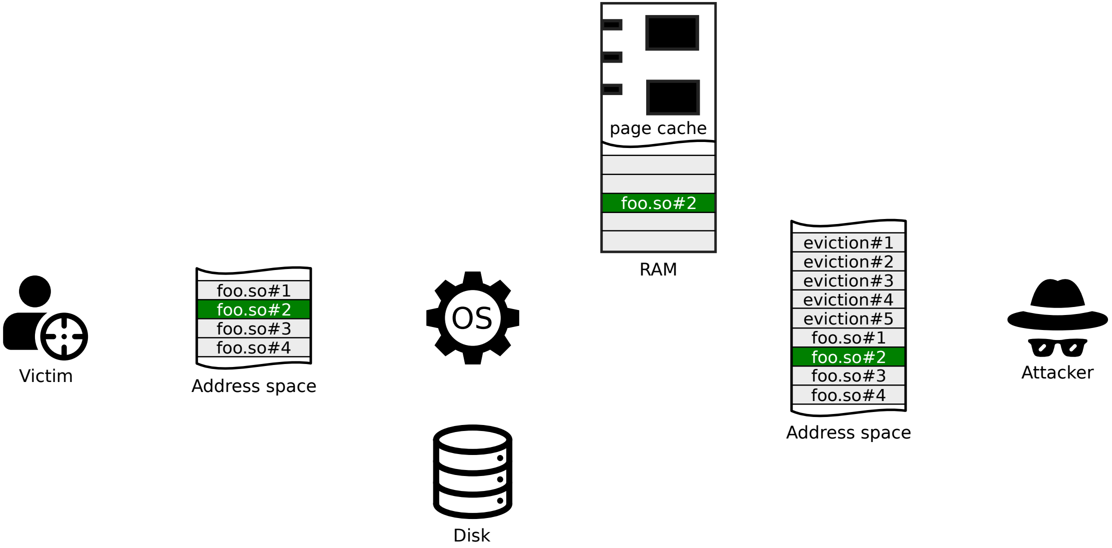

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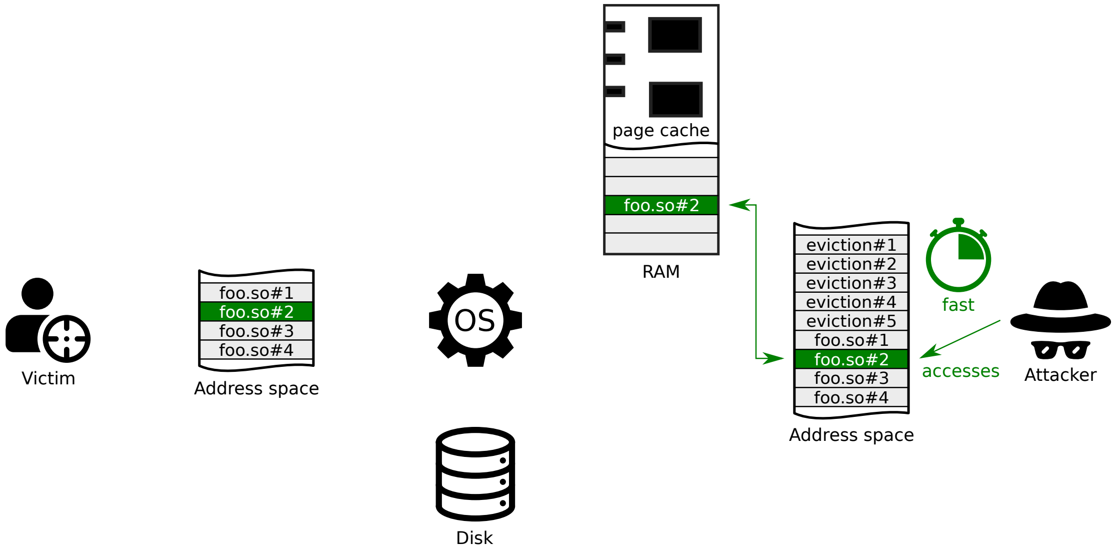

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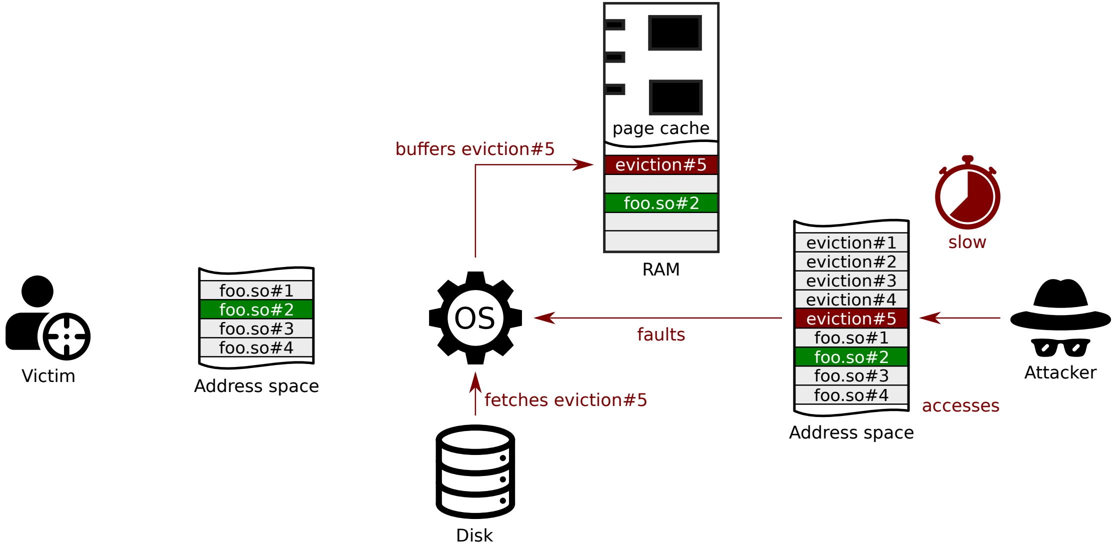

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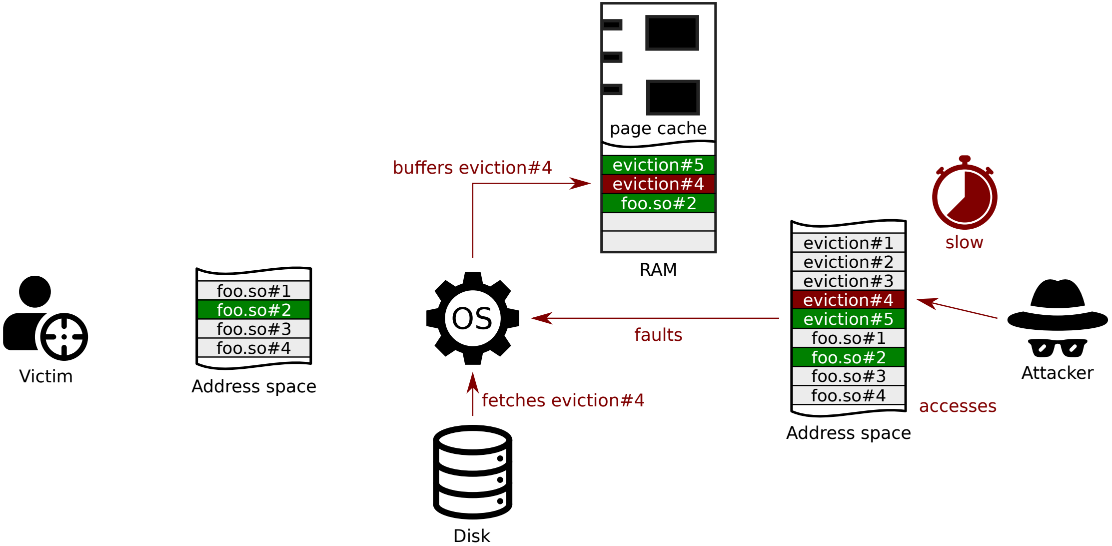

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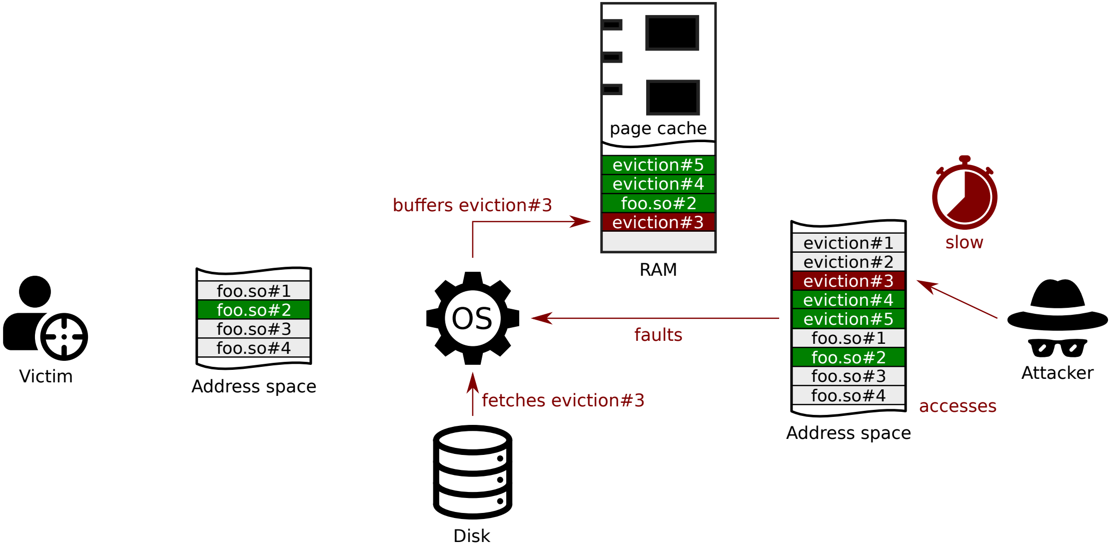

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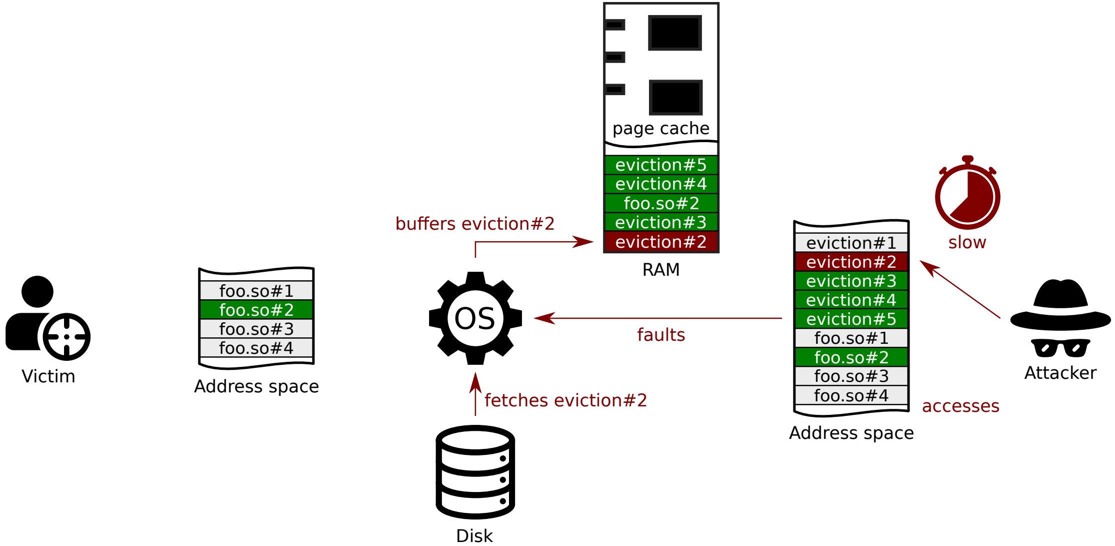

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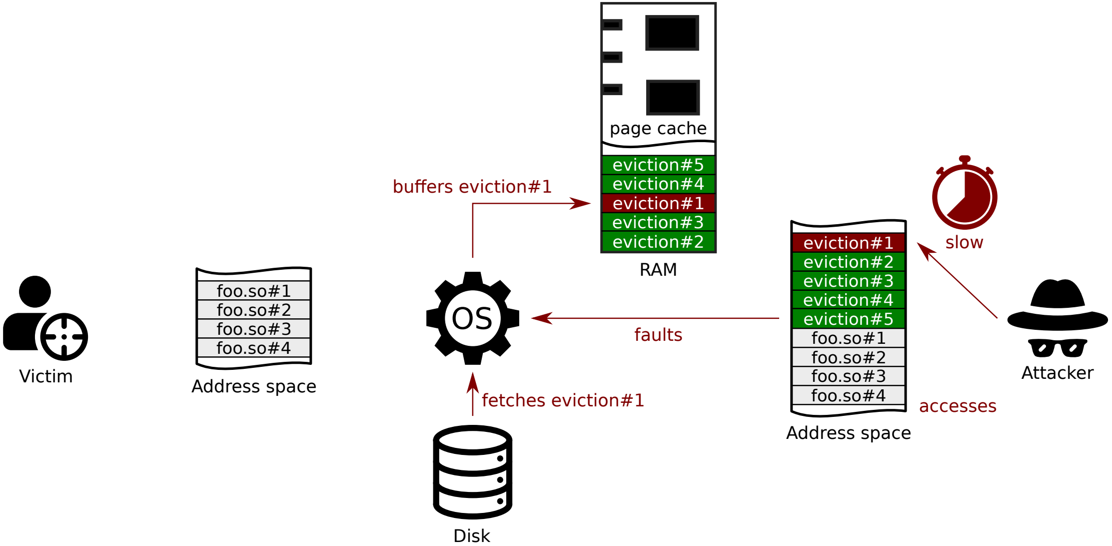

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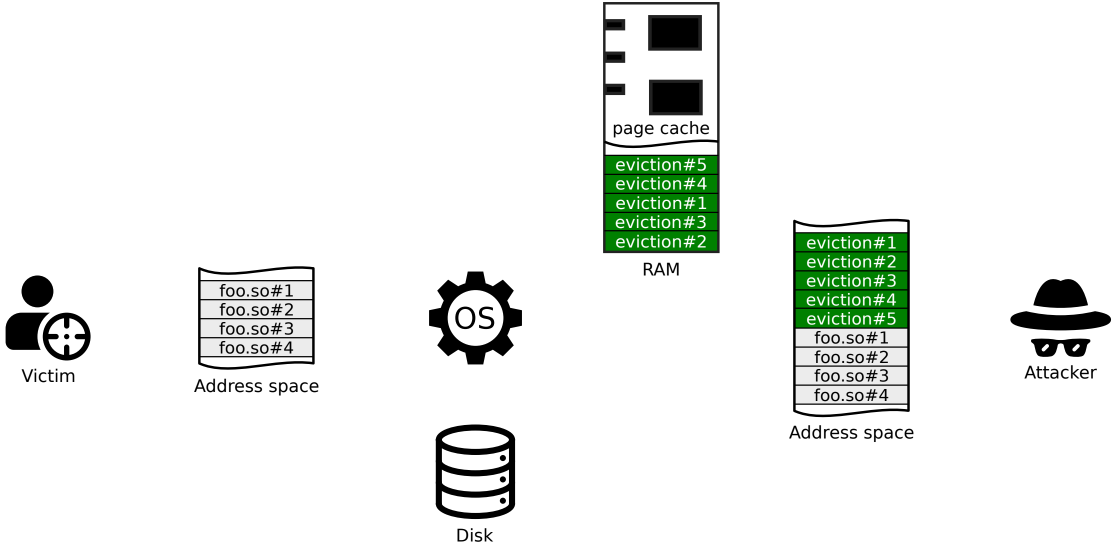

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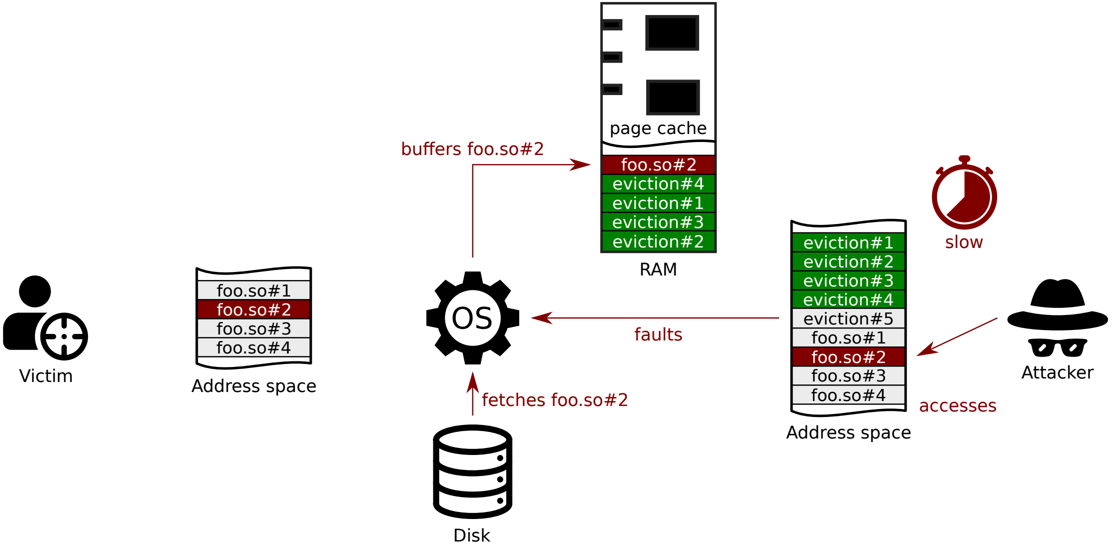

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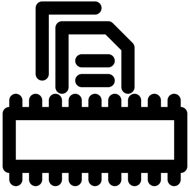

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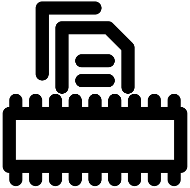

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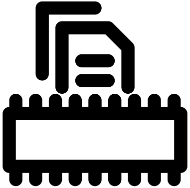

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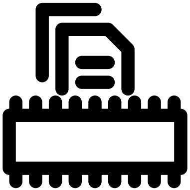

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```
MINCORE(2)                 Linux Programmer's Manual                MINCORE(2)

NAME
       mincore - determine whether pages are resident in memory

SYNOPSIS
       #include <unistd.h>
       #include <sys/mman.h>

       int mincore(void *addr, size_t length, unsigned char *vec);

   Feature Test Macro Requirements for glibc (see feature_test_macros(7)):

       mincore():
           Since glibc 2.19:
               _DEFAULT_SOURCE
           Glibc 2.19 and earlier:
               _BSD_SOURCE || _SVID_SOURCE

DESCRIPTION
       mincore()  returns a vector that indicates whether pages of the calling
       process's virtual memory are resident in core (RAM), and  so  will  not
       cause  a  disk  access  (page fault) if referenced.  The kernel returns
       residency information about the pages starting at the address addr, and
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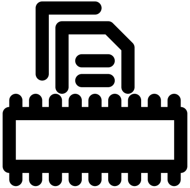

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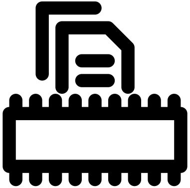

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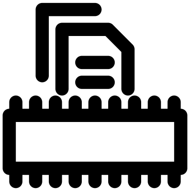

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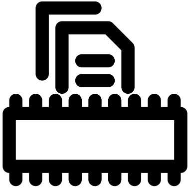

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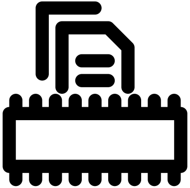

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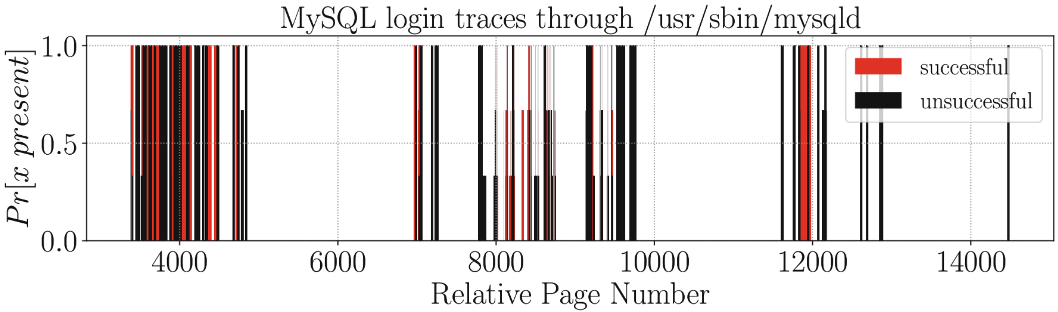

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- Evict target file, use preadv2 to determine keypress

```
DOM_CODE(0x070004, 0x001e, 0x0026, 0x001e, 0x0000, "KeyA", US_A), // aA
DOM_CODE(0x070005, 0x0030, 0x0038, 0x0030, 0x000b, "KeyB", US_B), // bB
DOM_CODE(0x070006, 0x002e, 0x0036, 0x002e, 0x0008, "KeyC", US_C), // cC
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References

[1] Boskov, N., Radami, N., Tiwari, T., and Trachtenberg, A. (2022). Union Buster: A Cross-Container Covert-Channel Exploiting Union Mounting. In *International Symposium on Cyber Security, Cryptology, and Machine Learning*.

[2] Corbet, J. (2019a). Defending against page-cache attacks.

[3] Corbet, J. (2019b). Fixing page-cache side channels, second attempt.

[4] Gruss, D., Kraft, E., Tiwari, T., Schwarz, M., Trachtenberg, A., Hennessey, J., Ionescu, A., and Fogh, A. (2019). Page cache attacks. In *CCS*.

[5] Lever, C. (2000). [patch] madvise() against 2.3.52-3.

[6] Schwarzl, M., Kraft, E., and Gruss, D. (2023). Layered Binary Templating. In *ACNS*.