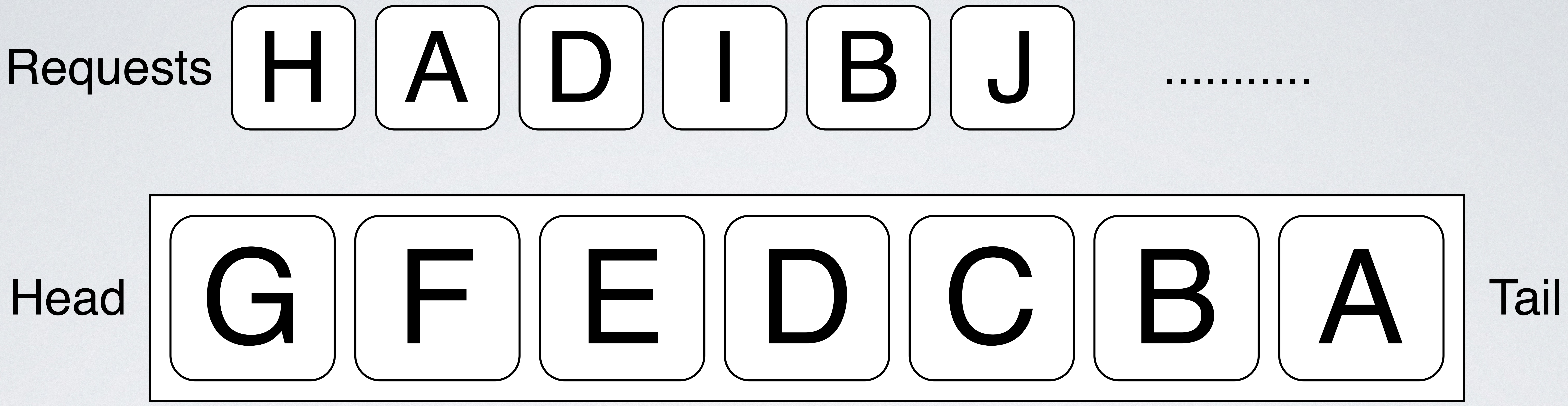
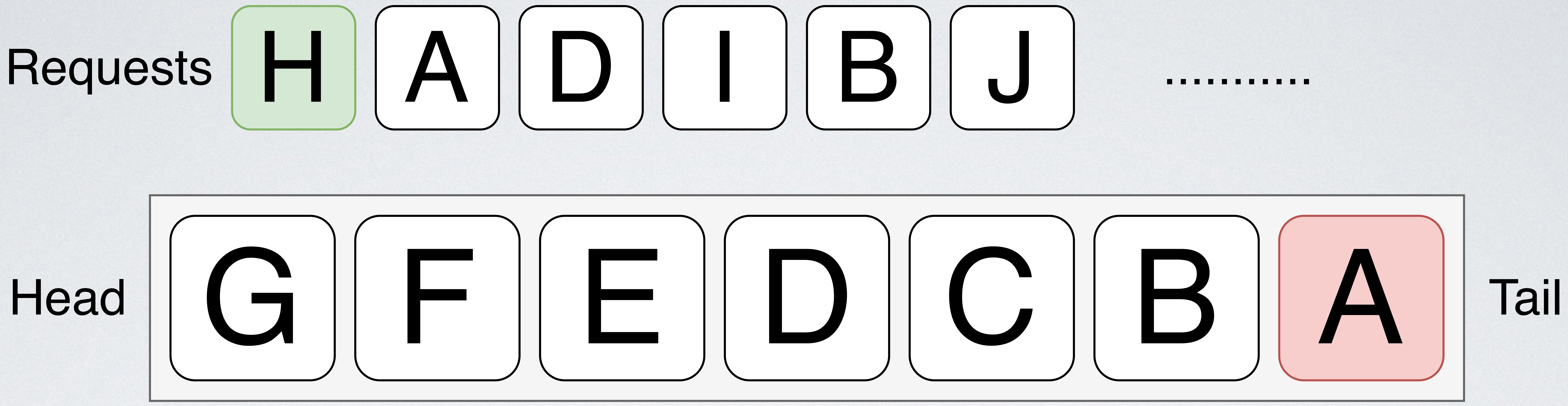
SIEVE

An Eviction Algorithm Simpler than LRU for ~~Web~~ Caches

Ondřej Surý, ISC; IEPG Bangkok; 2025-03-16



HOW DOES LRU WORK



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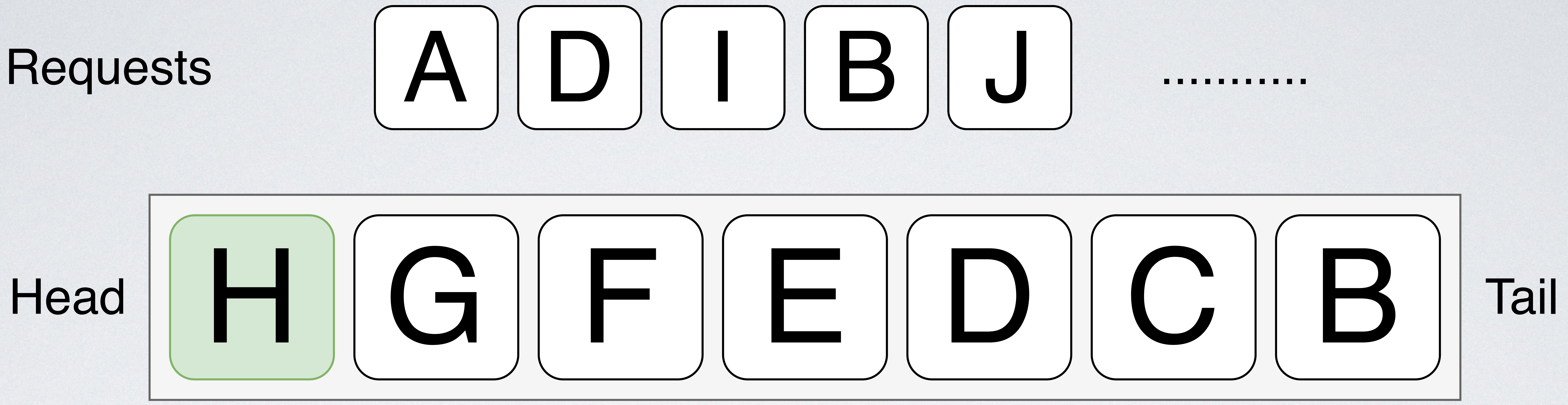

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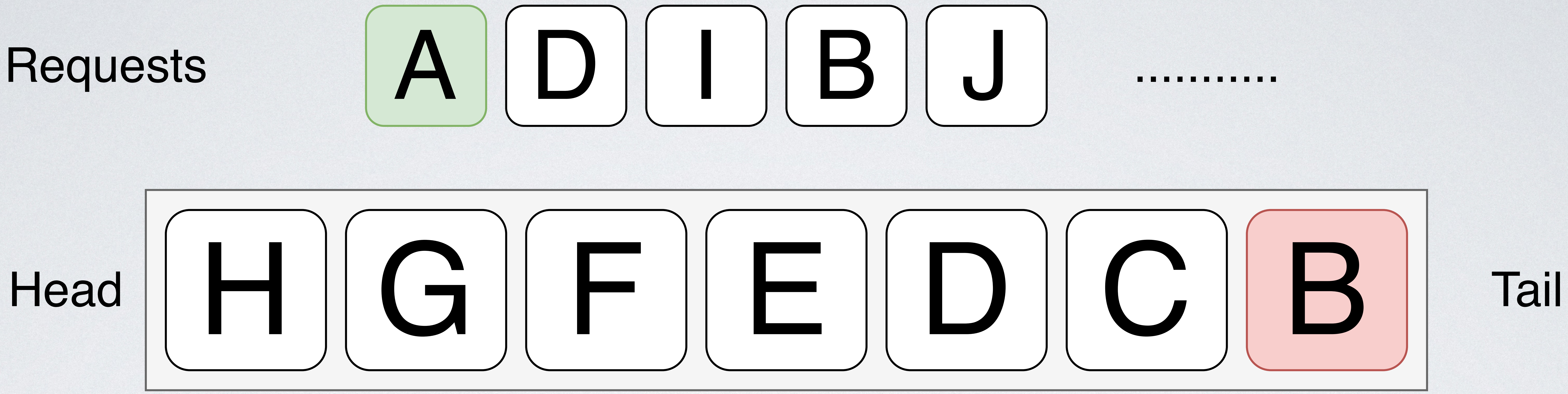

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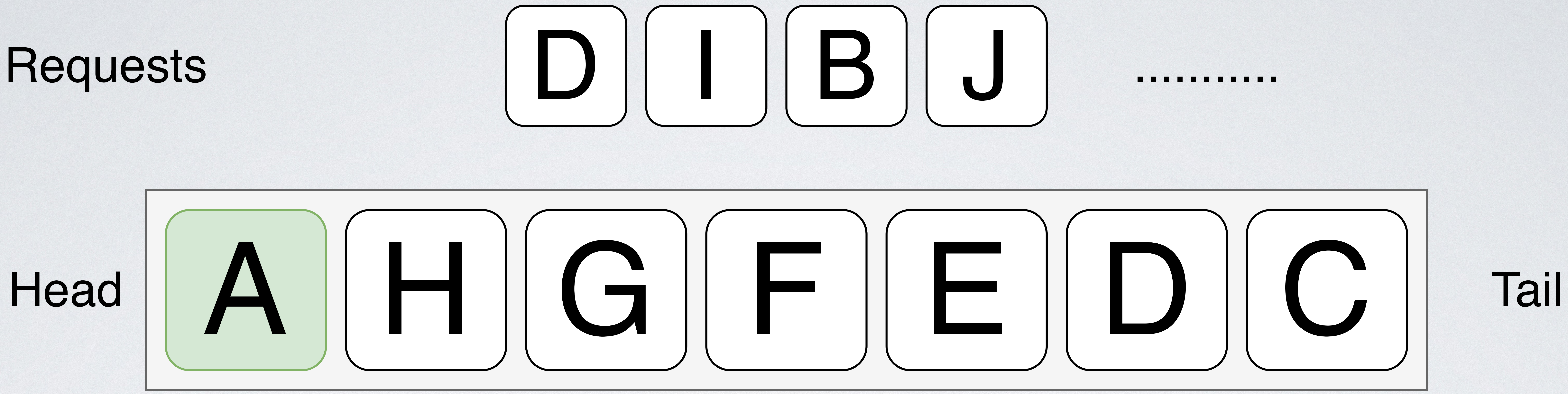

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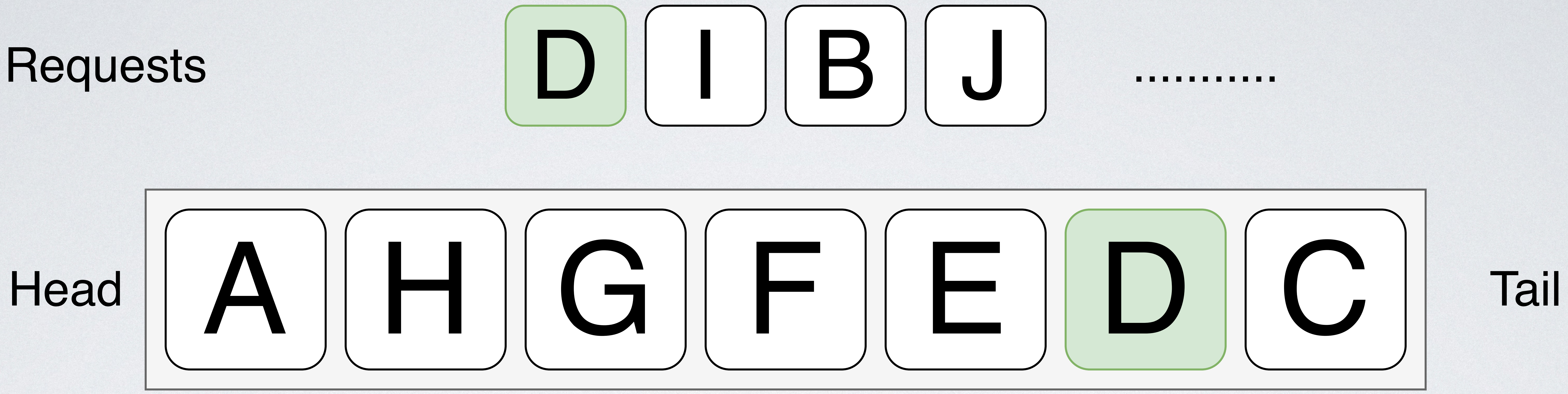

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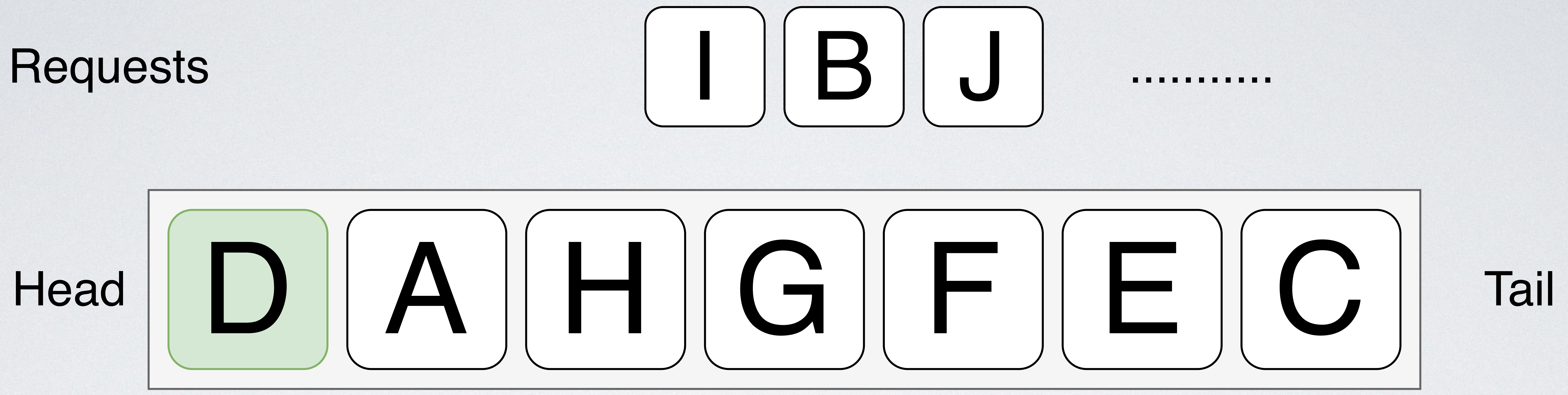

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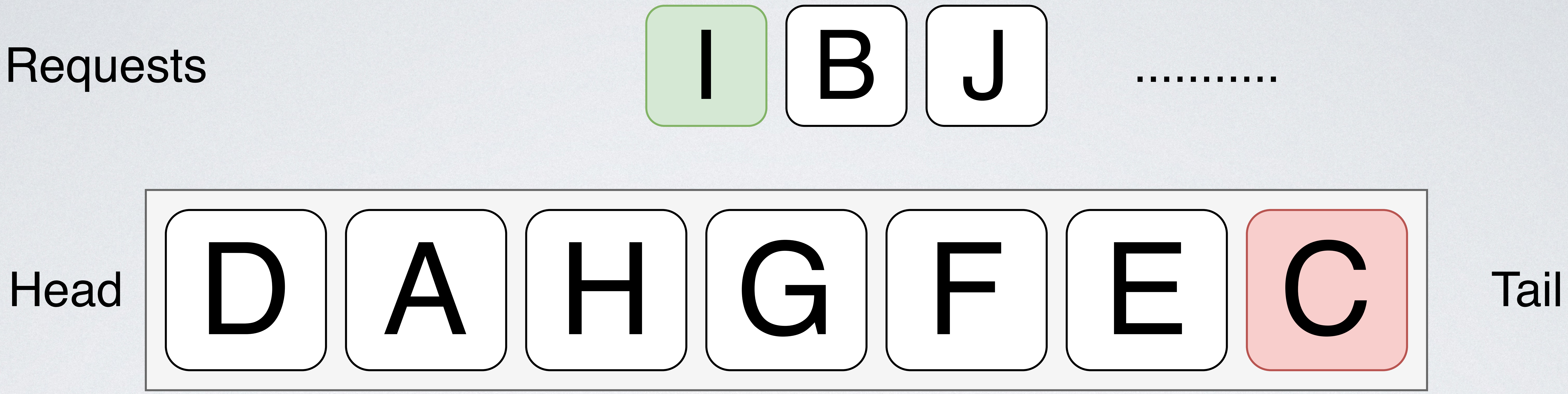

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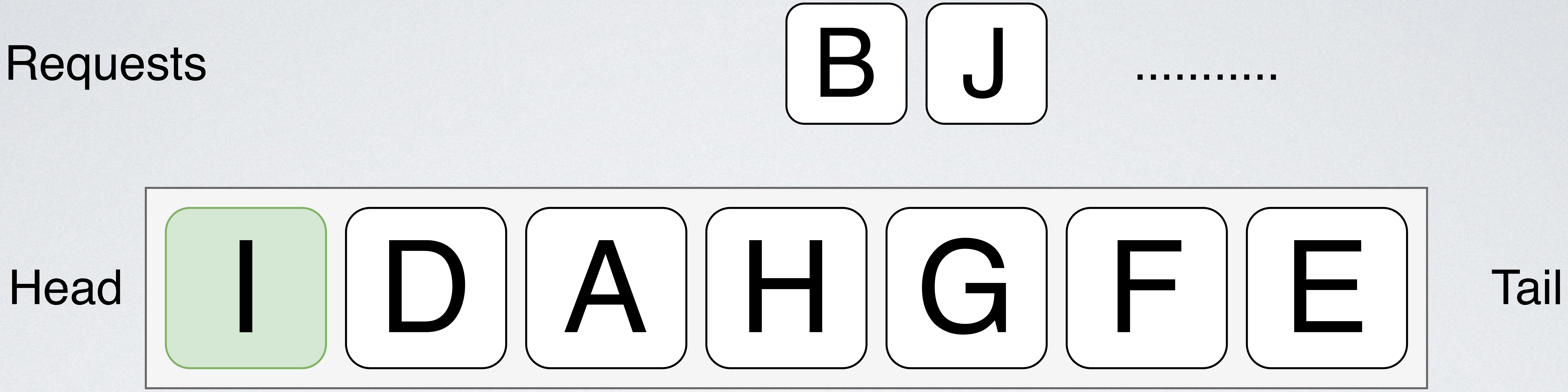

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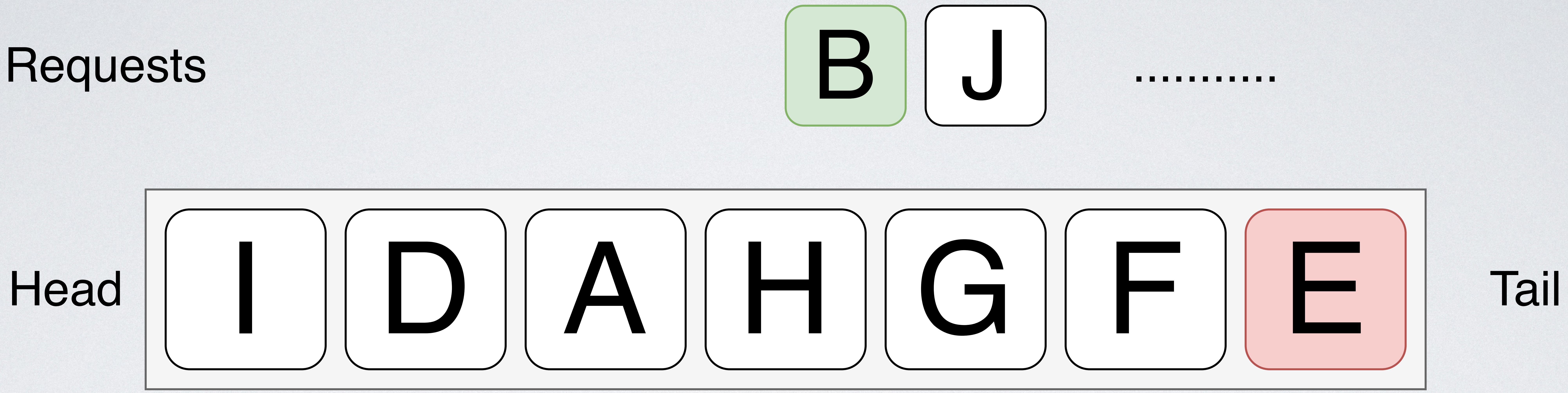

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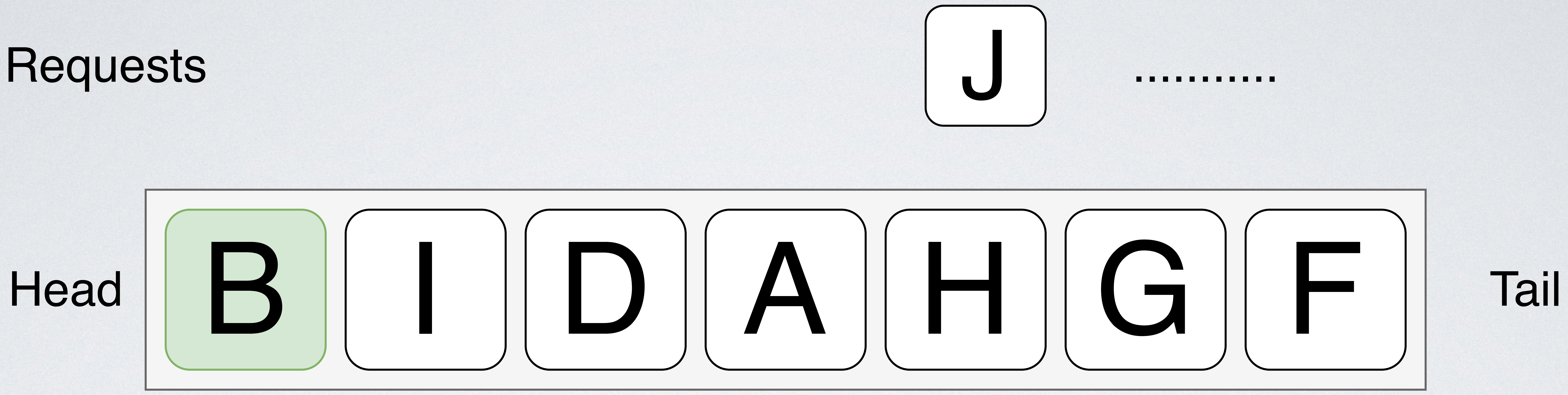

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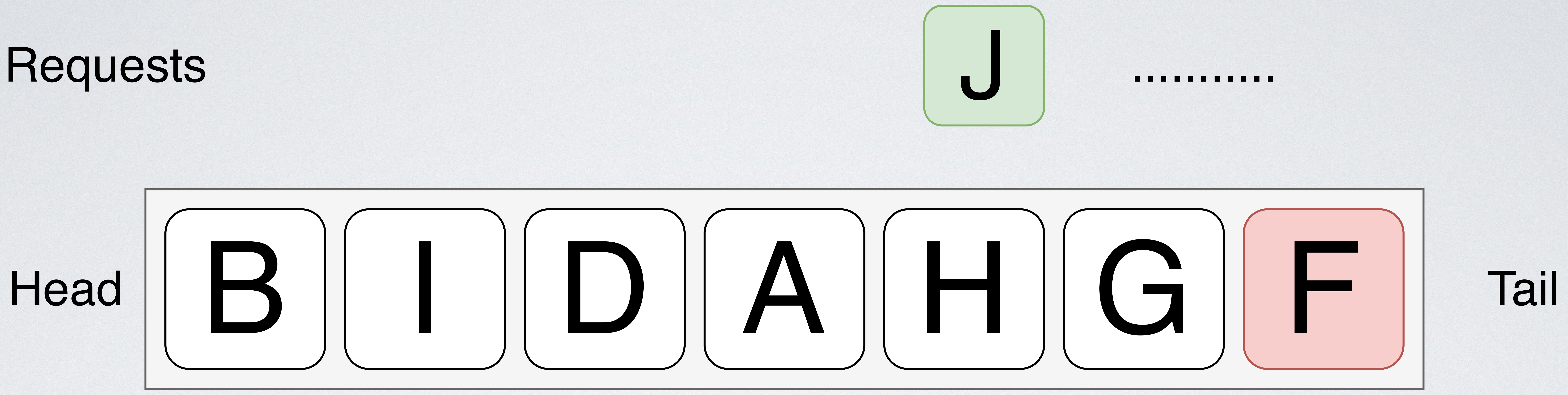

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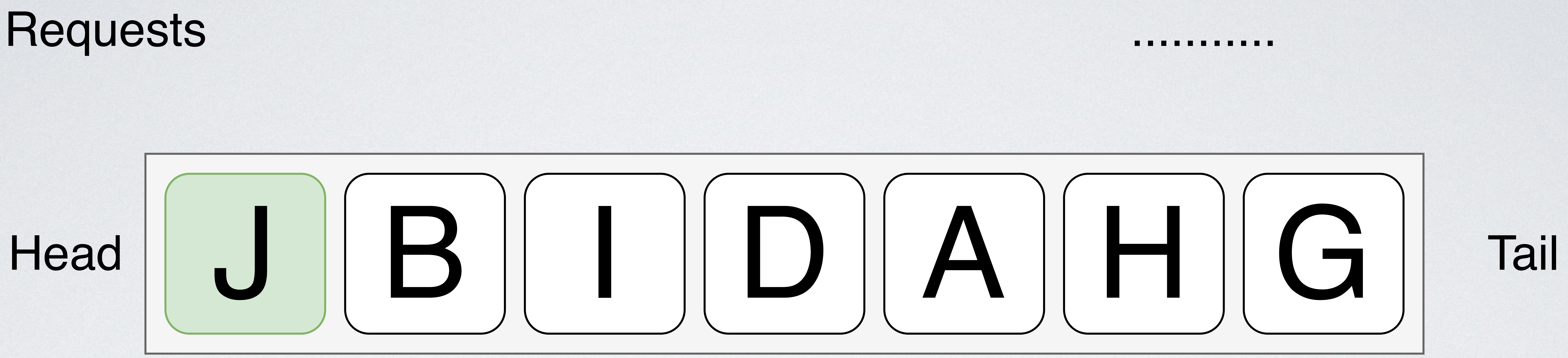
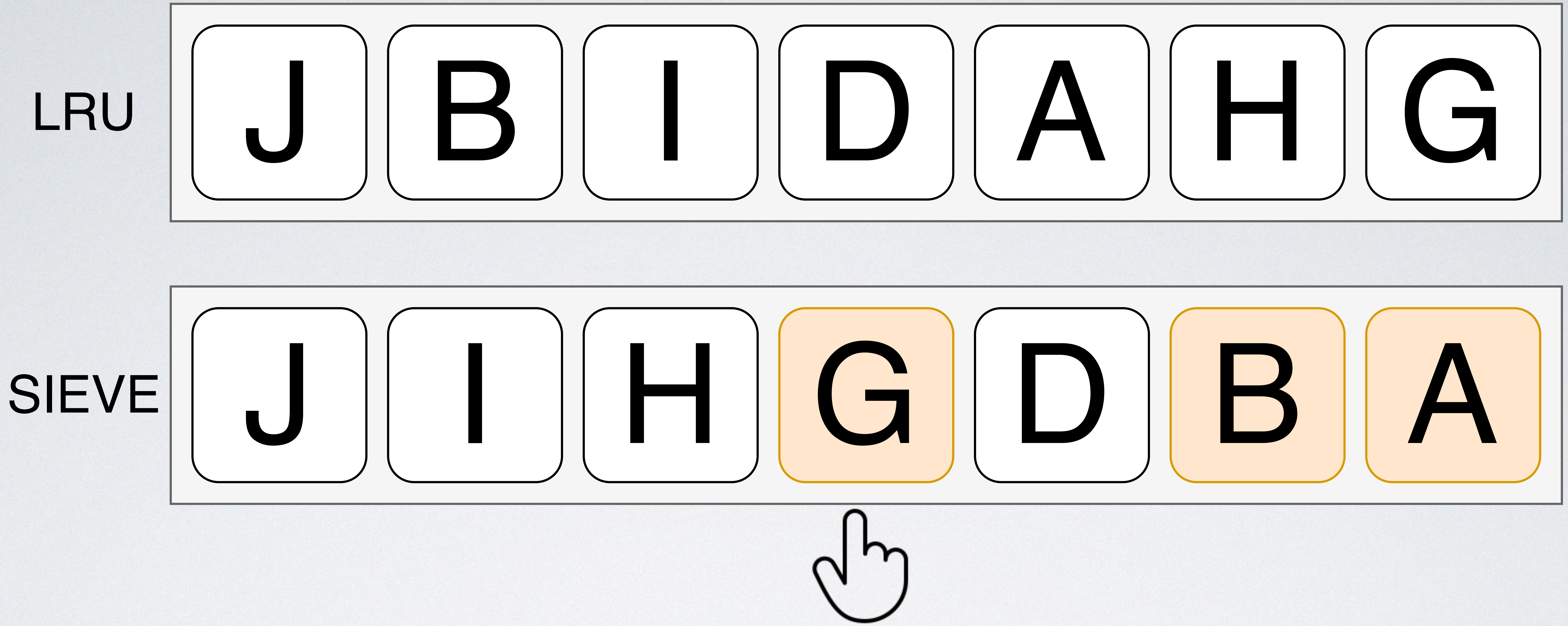


HOW DOES LRU WORK

An Example of SIEVE

HOW DOES SIEVE WORK?



LRU VS SIEVE

SIEVE VS LRU

- CACHE HIT
  - LRU:
    - Moves object to the HEAD
    - Locks the list
  - SIEVE:
    - Mark object (as VISITED)
    - No list-level locking

- CACHE MISS
  - BOTH
    - Insert new item at the list HEAD (both)
    - Locks the list
  - LRU:
    - Evict item from the TAIL
  - SIEVE:
    - If marked, unmark and move the hand
    - If unmarked, evict

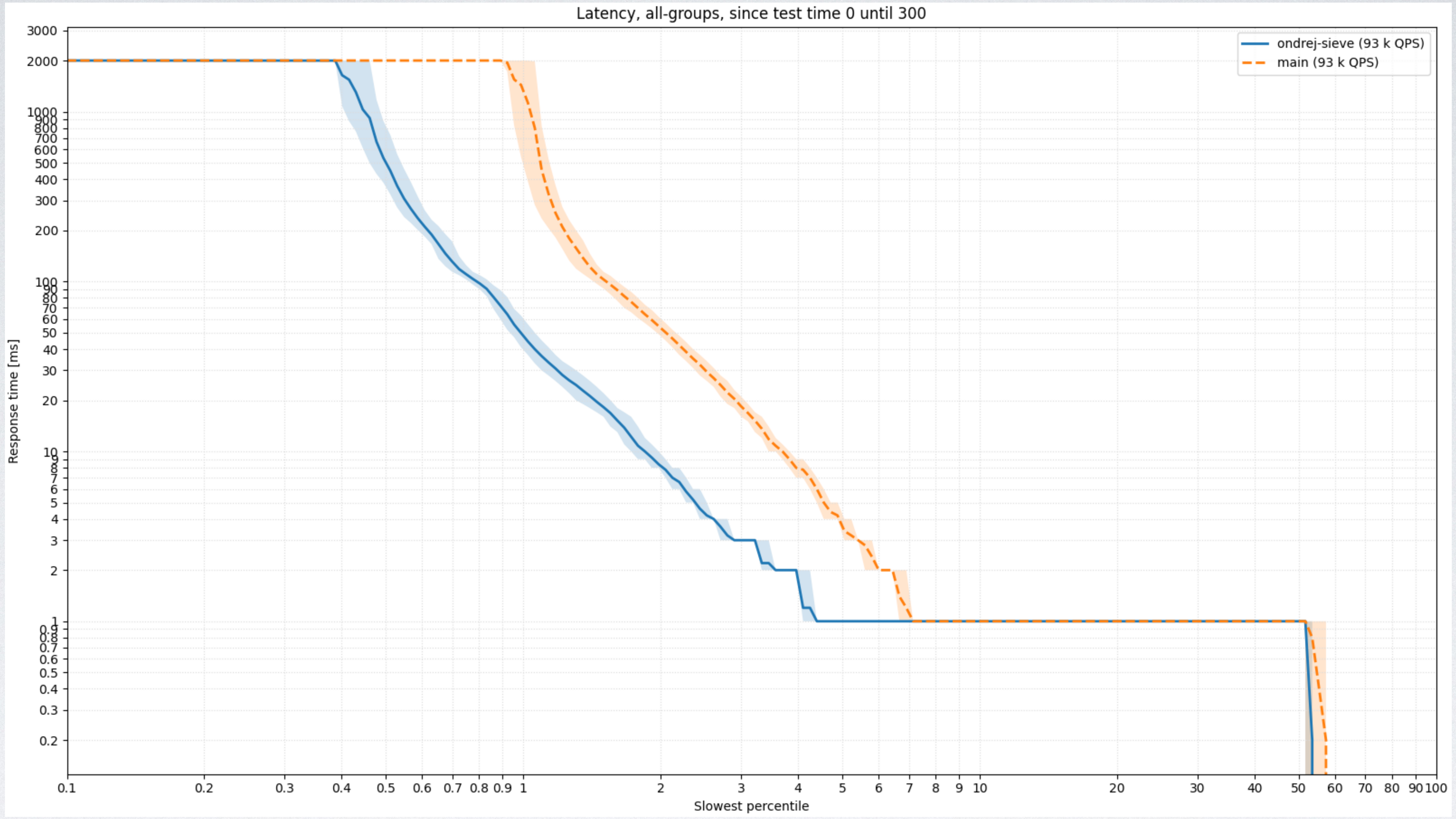
LAZY PROMOTION AND QUICK DEMOTION

- LAZY PROMOTION
  - Only promote the cached objects at the eviction time
- QUICK DEMOTION
  - Remove most objects quickly after insertion

SIEVE IN BIND 9

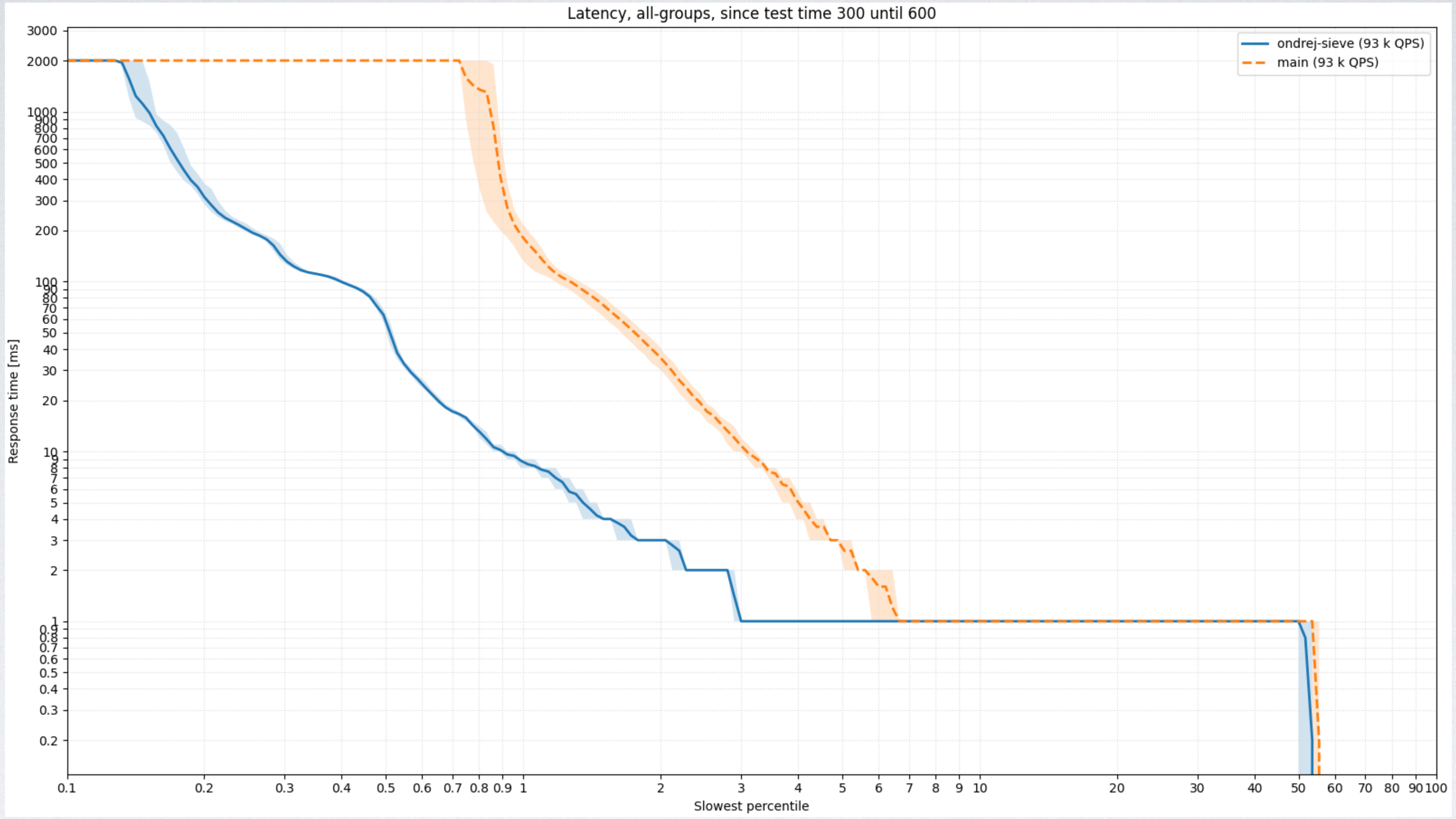
- Replace TTL-based and LRU-based cleaning with SIEVE
- The SIEVE implementation is simpler than the LRU implementation

```
$ git diff --stat origin/main
 lib/dns/include/dns/rdataslab.h |  10 +--
 lib/dns/qpcache.c               | 512 ++++++++++++++++++++
+------------------------------------------------------------------
-----------------------------------------------------------
 lib/isc/Makefile.am             |   1 +
 lib/isc/include/isc/sieve.h     |  62 ++++++++++++++++++
 4 files changed, 144 insertions(+), 441 deletions(-)
```



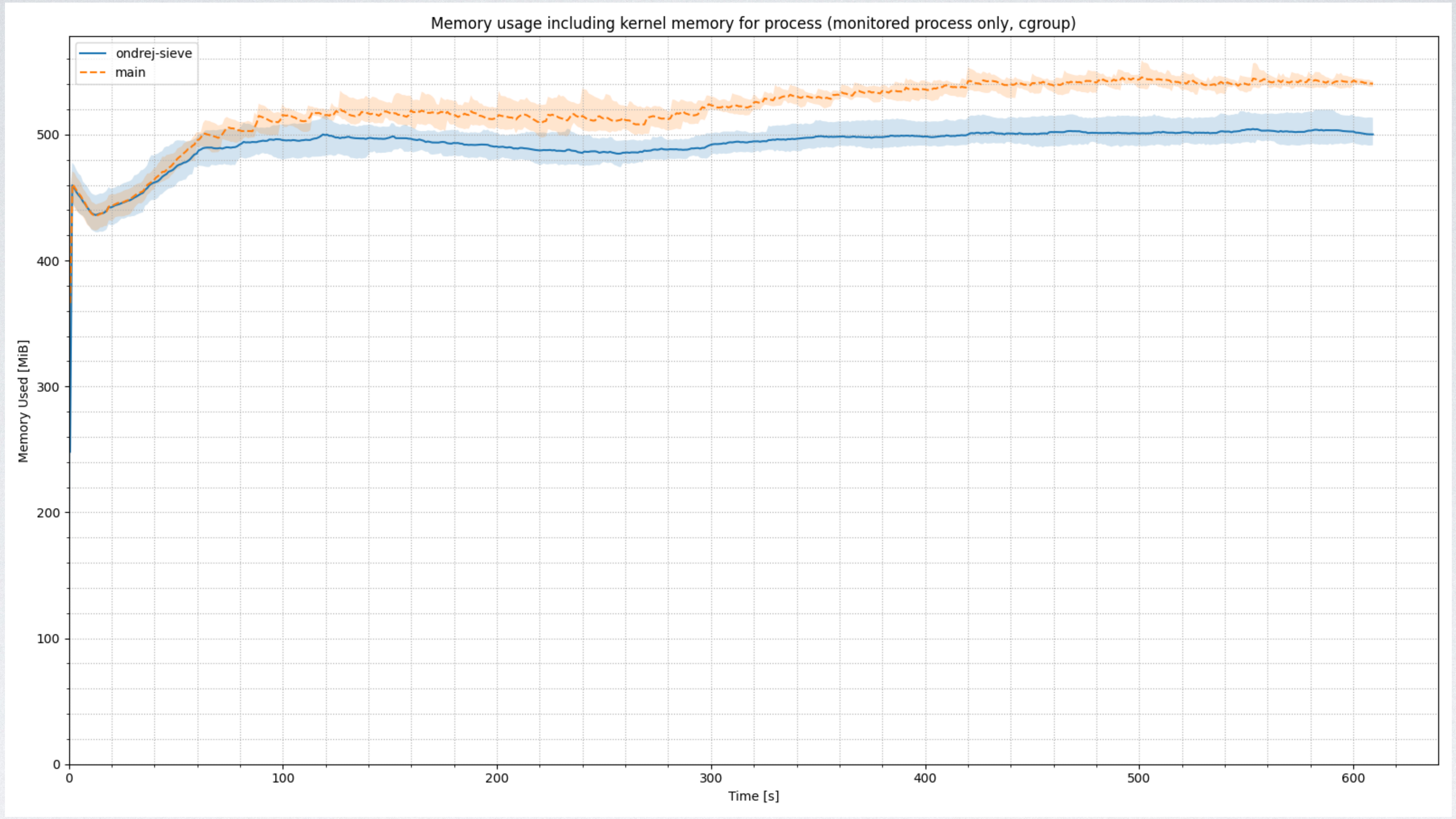
BIND 9 (128MB CACHE)

Latency, Cold-Cache



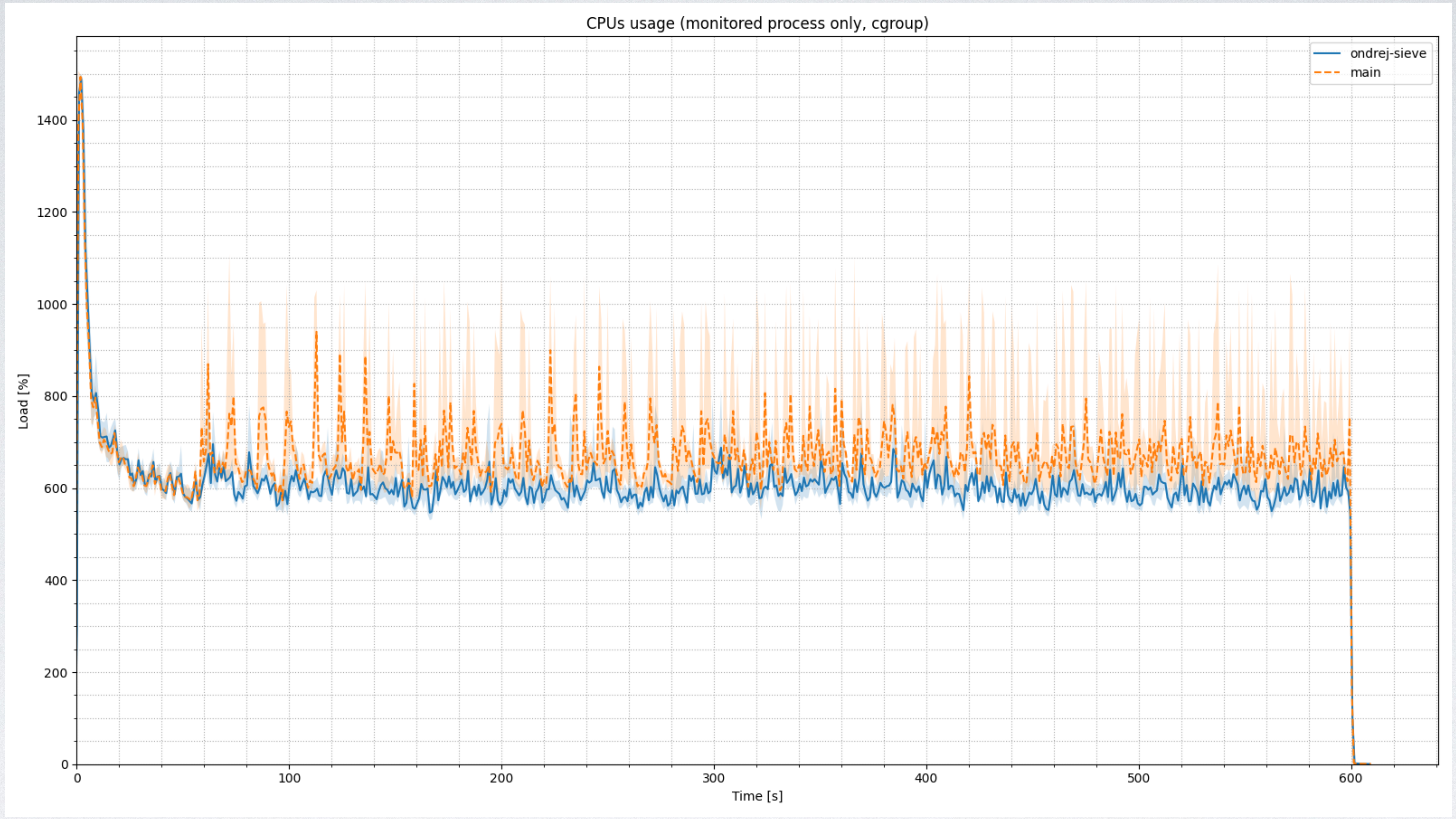
BIND 9 (128MB CACHE)

Latency, Hot-Cache



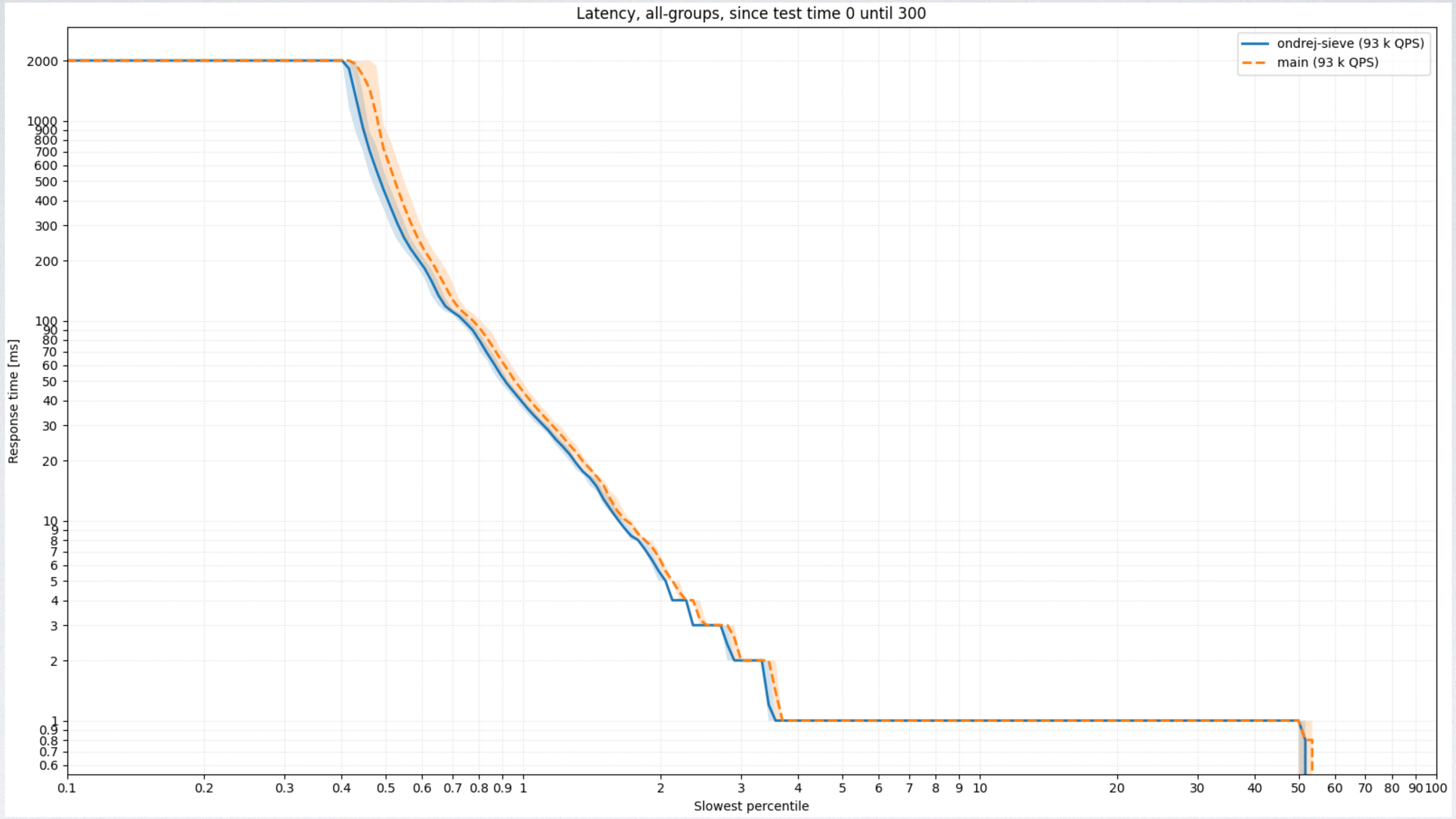
BIND 9 (128MB CACHE)

Memory



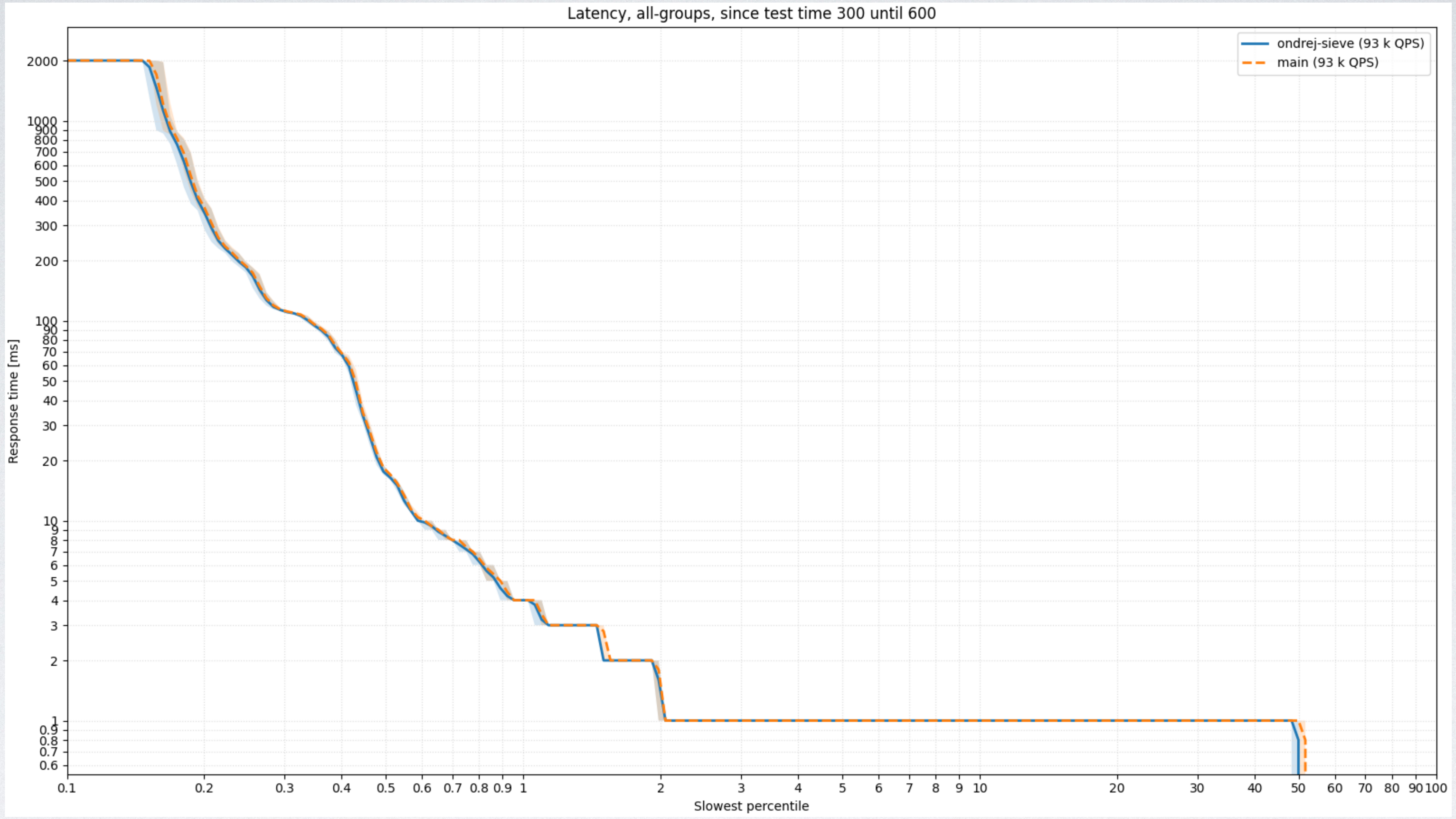
BIND 9 (128MB CACHE)

CPU



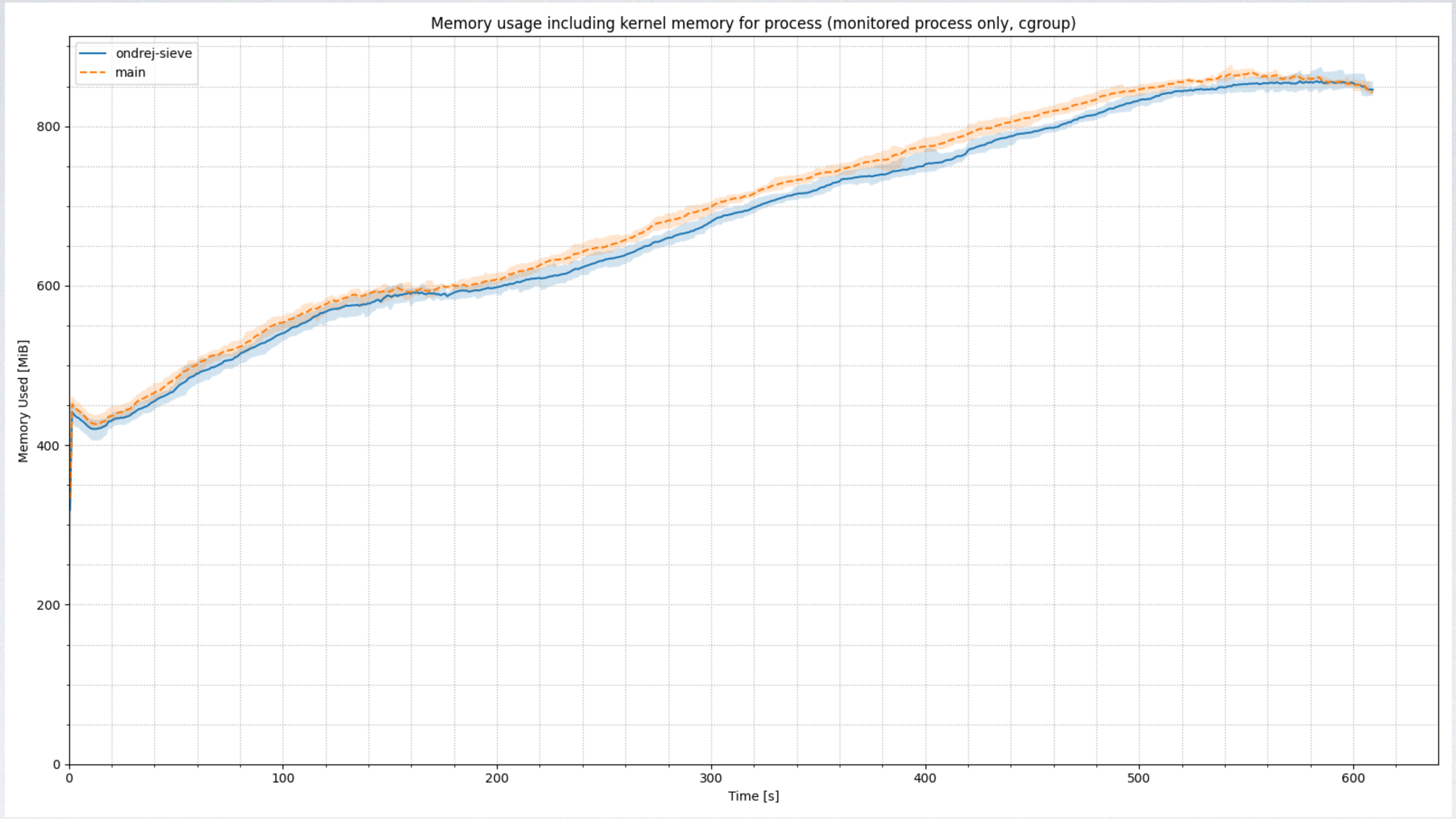
BIND 9 (30GB CACHE)

Latency, Cold-Cache



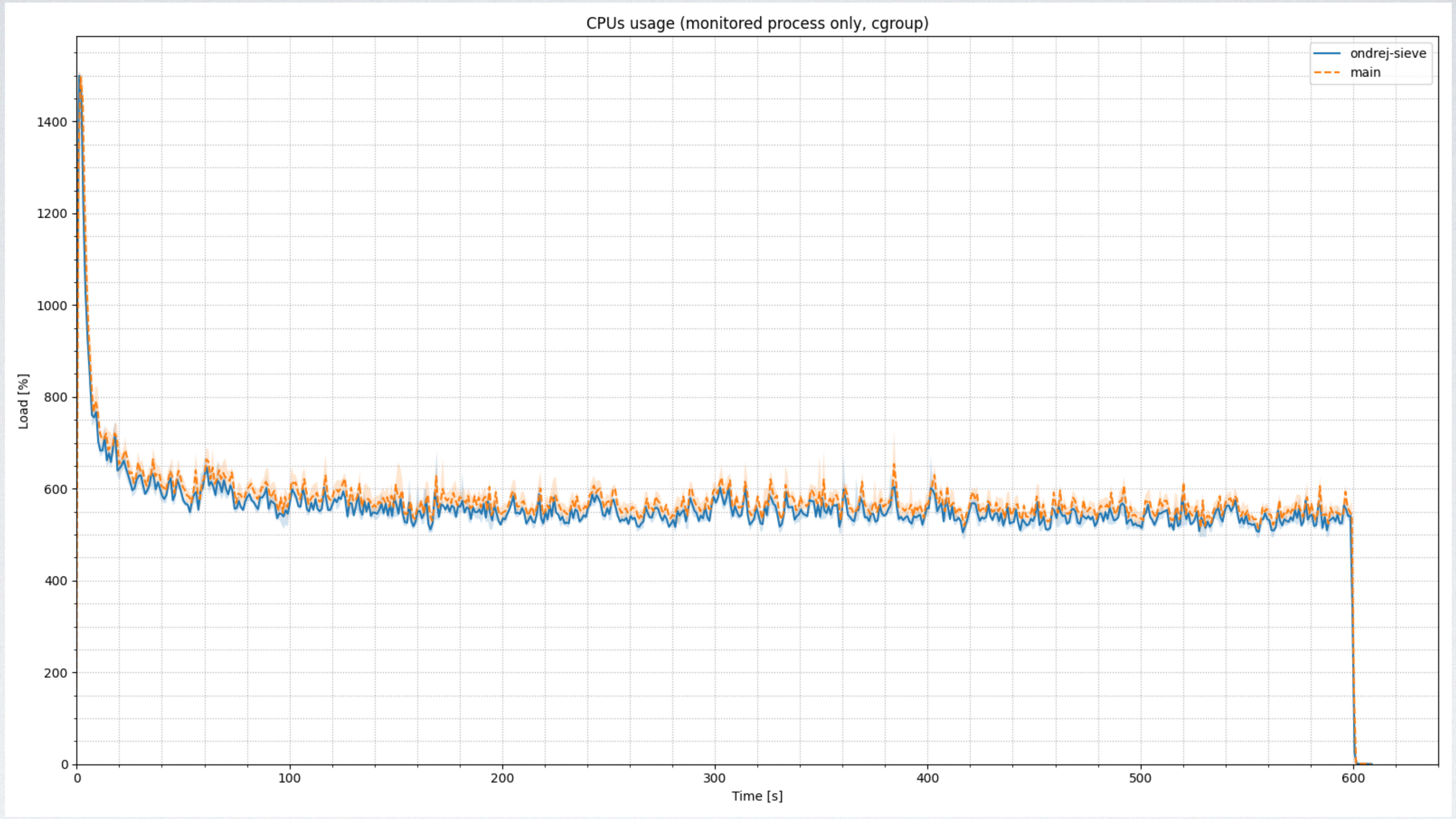
BIND 9 (30GB CACHE)

Latency, Hot-Cache



BIND 9 (30GB CACHE)

Memory



BIND 9 (30GB CACHE)

Memory

SIEVE IN BIND 9

- Implementation in BIND 9.21+ (development version)
- Do we keep TTL-based cleaning?
  - Probably not
- How does the algorithm behave with large caches?
  - More research needed (for BIND 9 and for my dissertation)

THANK YOU

REFERENCES

- https://sievecache.com/
- https://junchengyang.com/publication/nsdi24-SIEVE.pdf
- https://cachemon.github.io/SIEVE-website/blog/2023/12/17/sieve-is-simpler-than-lru/
- https://isc-projects.gitlab-pages.isc.org/-/bind9-shotgun-ci/-/jobs/5392303/artifacts/index.html (30 GB cache)
- https://isc-projects.gitlab-pages.isc.org/-/bind9-shotgun-ci/-/jobs/5392288/artifacts/index.html (128 MB cache)