AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

OPN201

How Apache Lucene's community built merge-on-refresh

Michael Sokolov (he/him)
Principal Engineer
Amazon.com

Michael Froh (he/him)
Software Development Engineer
Amazon.com

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Who are we?

- Mike Sokolov
  - Lucene Project Management Committee chair
  - Principal Engineer on Amazon Product Search

- Mike Froh
  - Amazon Software Development Engineer
  - Previously worked on AWS Search Services and Amazon CloudWatch

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Agenda

Background

Problem

Solution

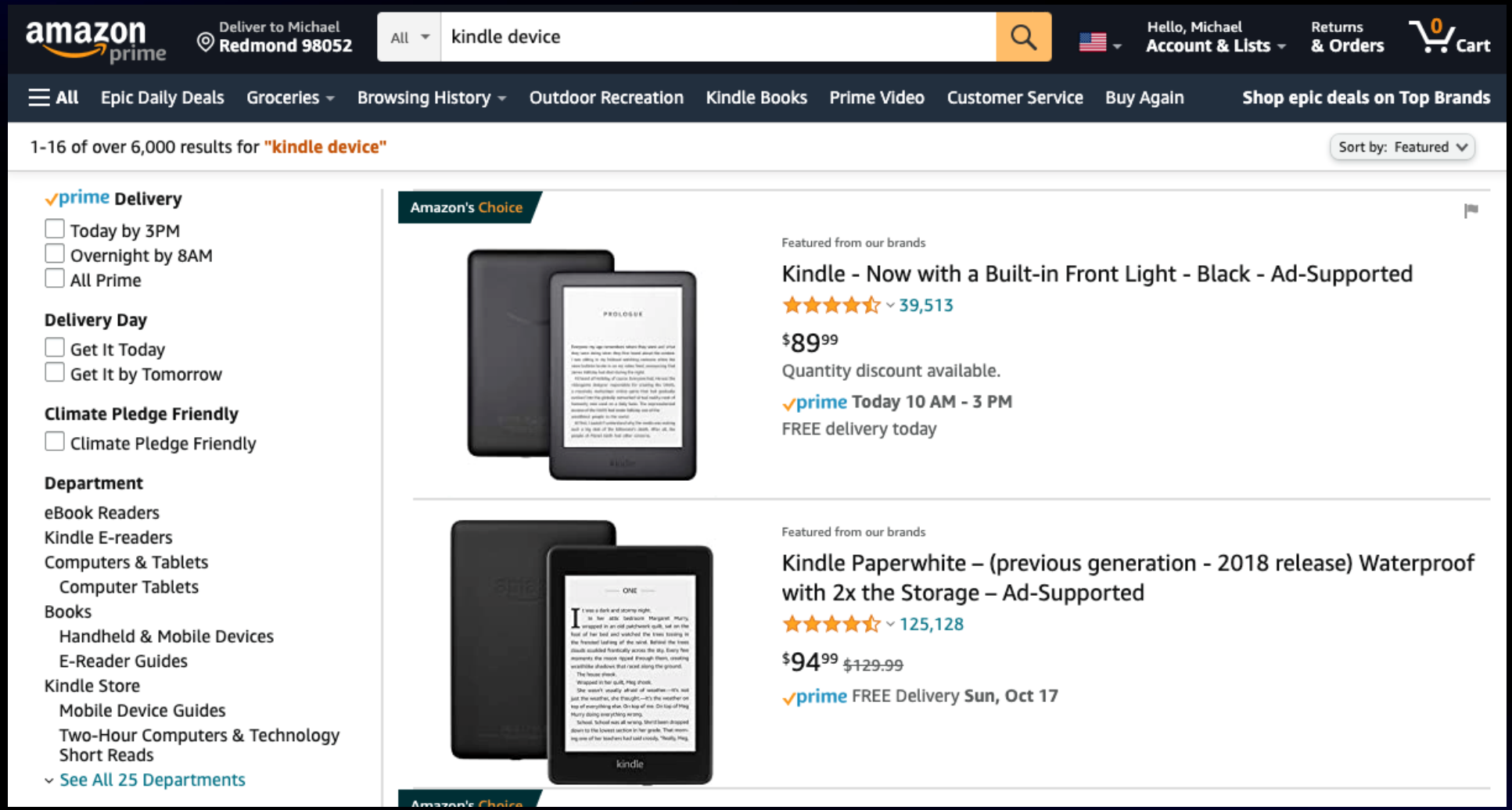
Community > Code



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Amazon product search



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Apache Lucene

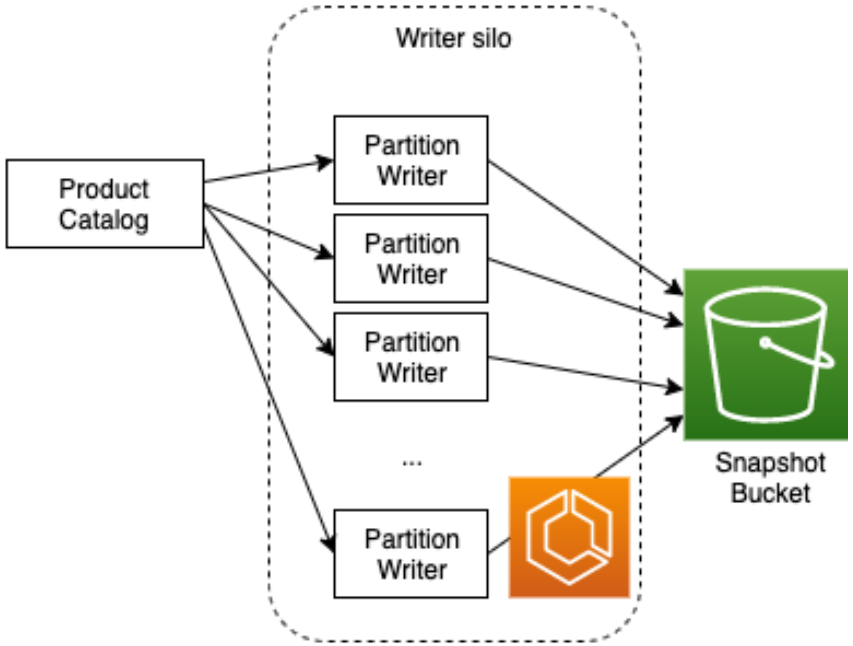
Open-source search library

Used in Elasticsearch, Apache Solr, Amazon product search, many other Amazon services, and all over the world

Seven committers and 20+ contributors at Amazon

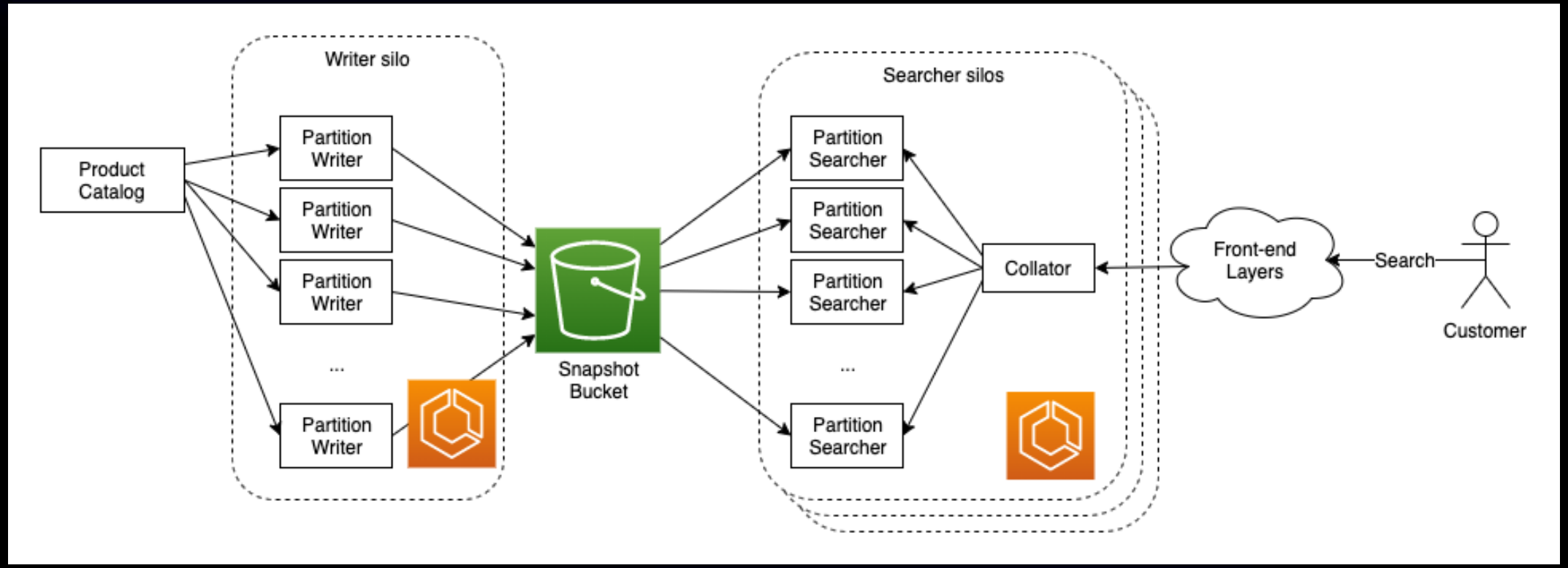
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Amazon product search architecture



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Amazon product search architecture



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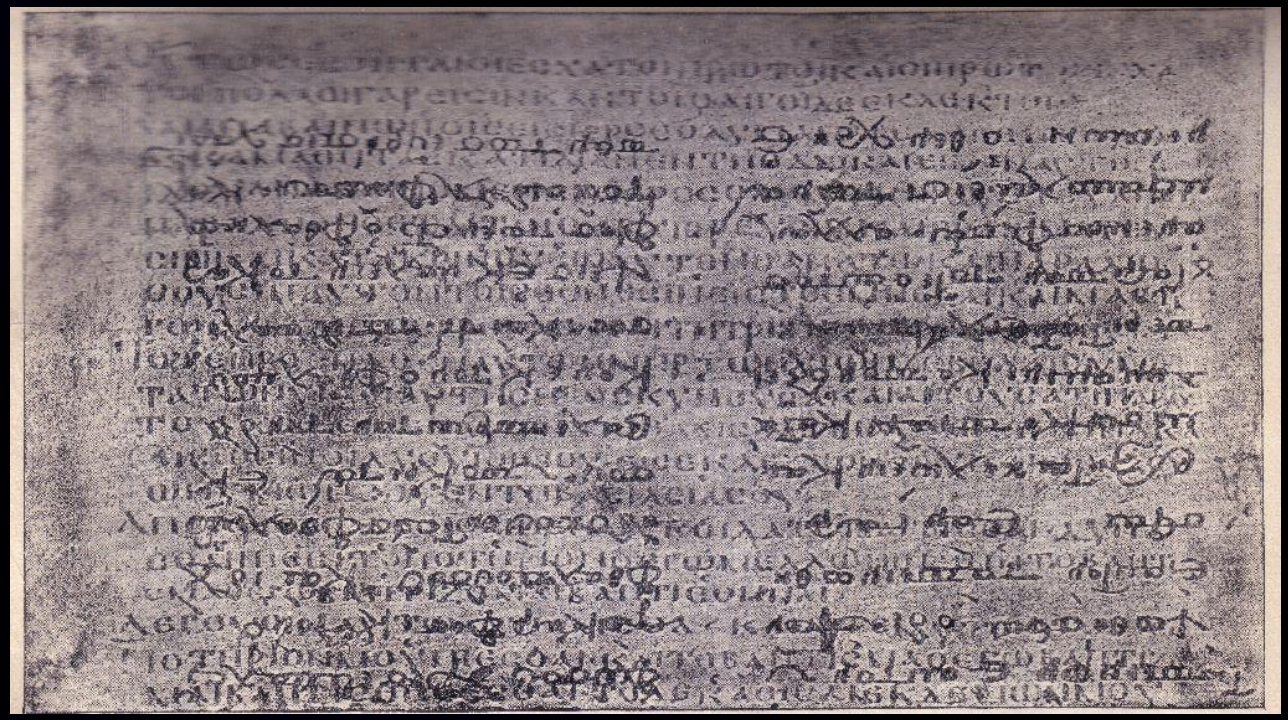
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Search basics



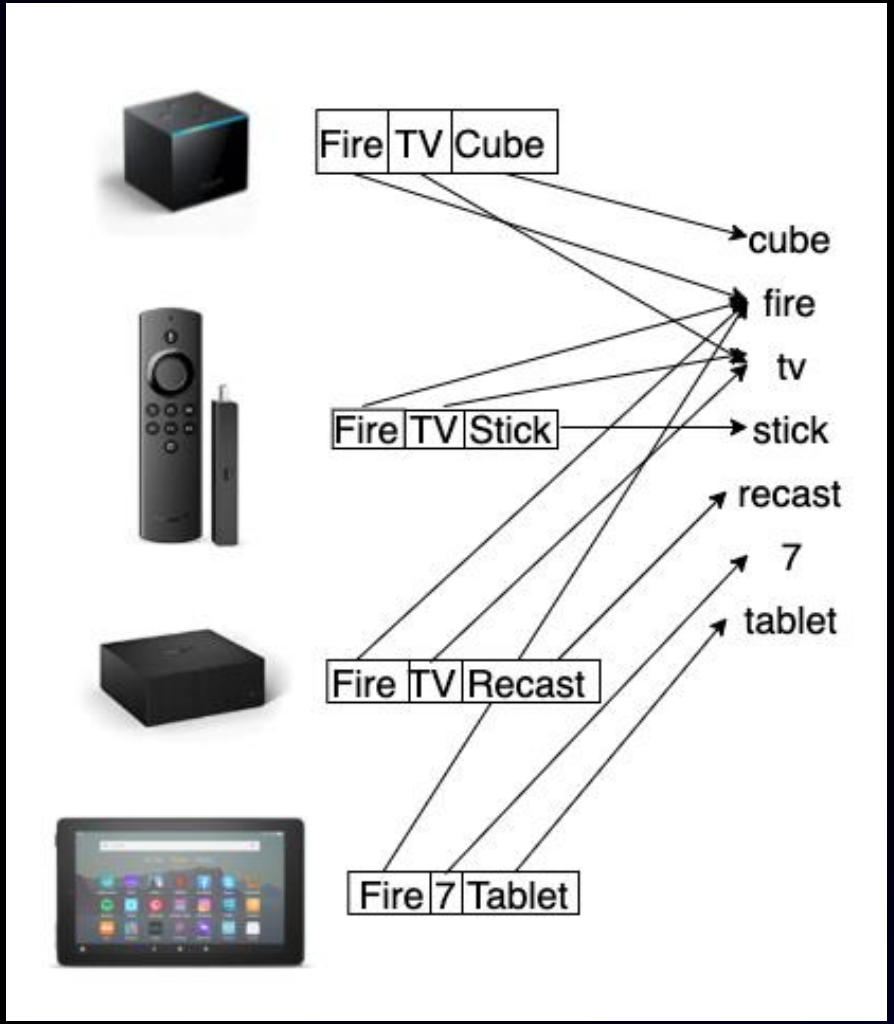
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Search basics



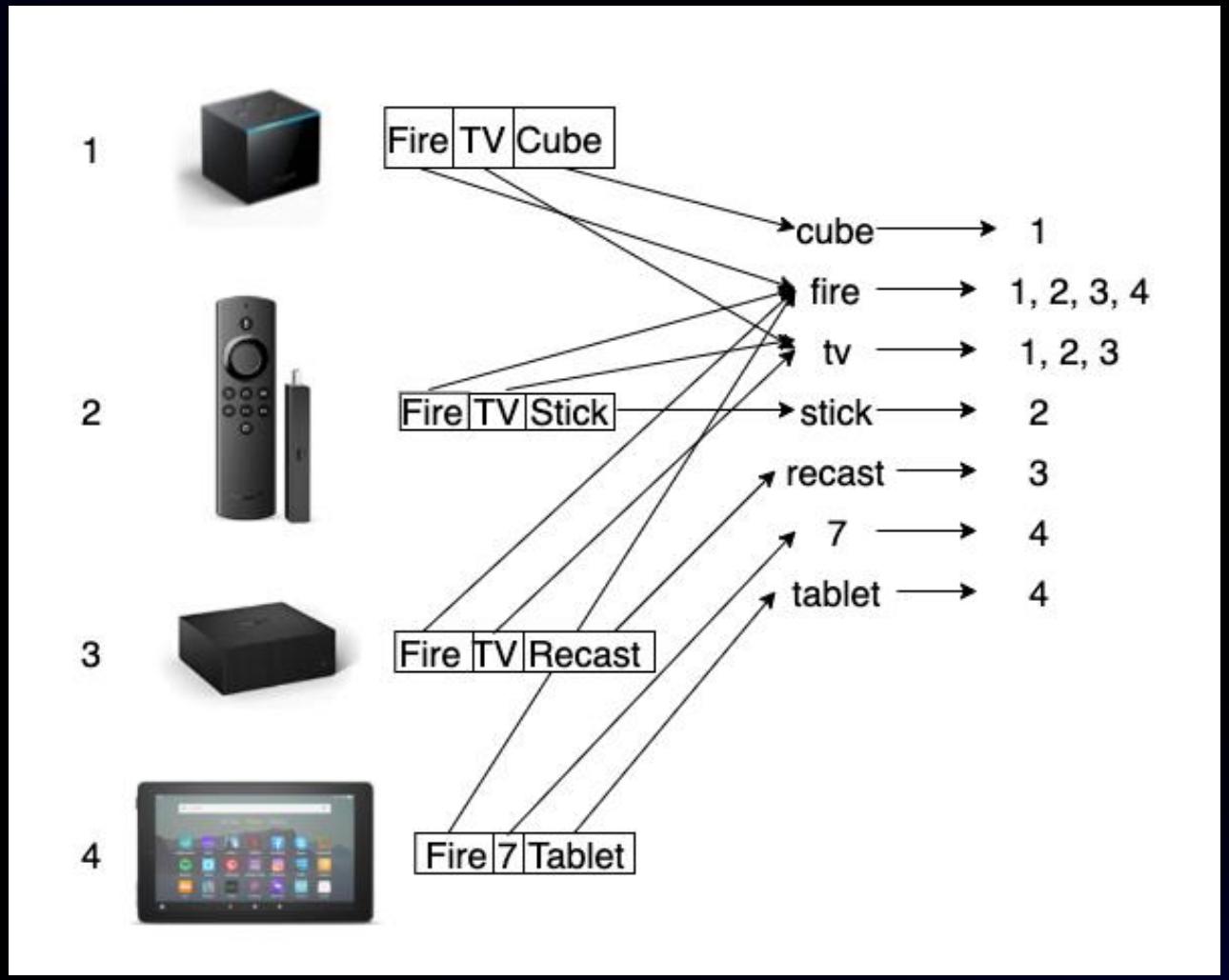
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Search basics



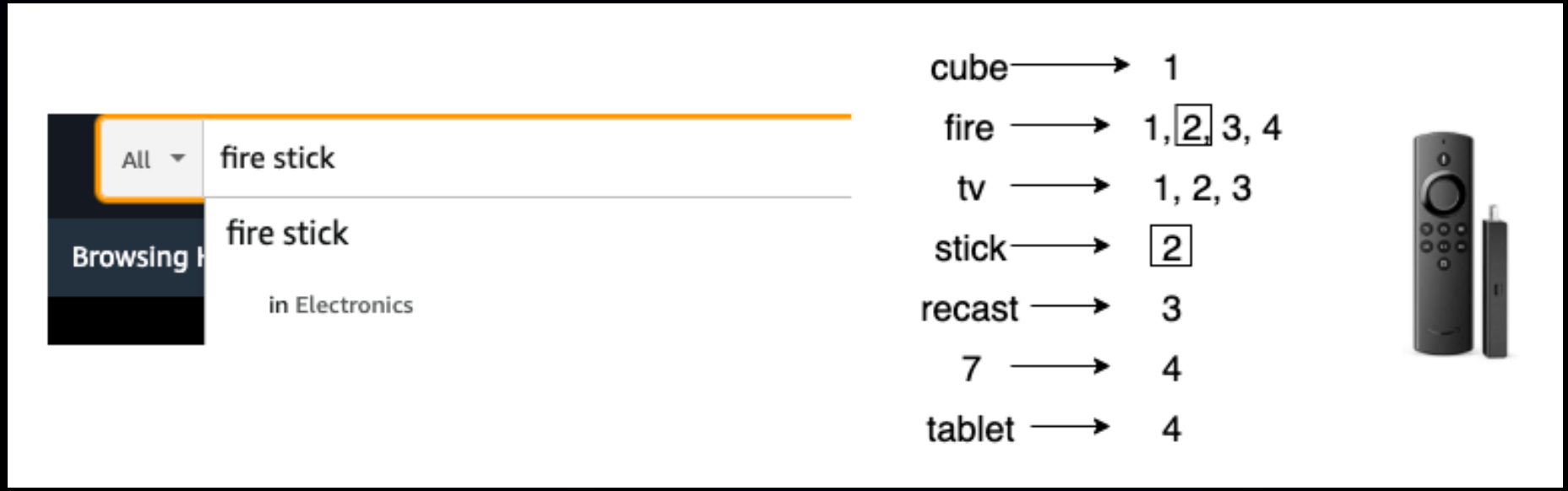
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Search basics



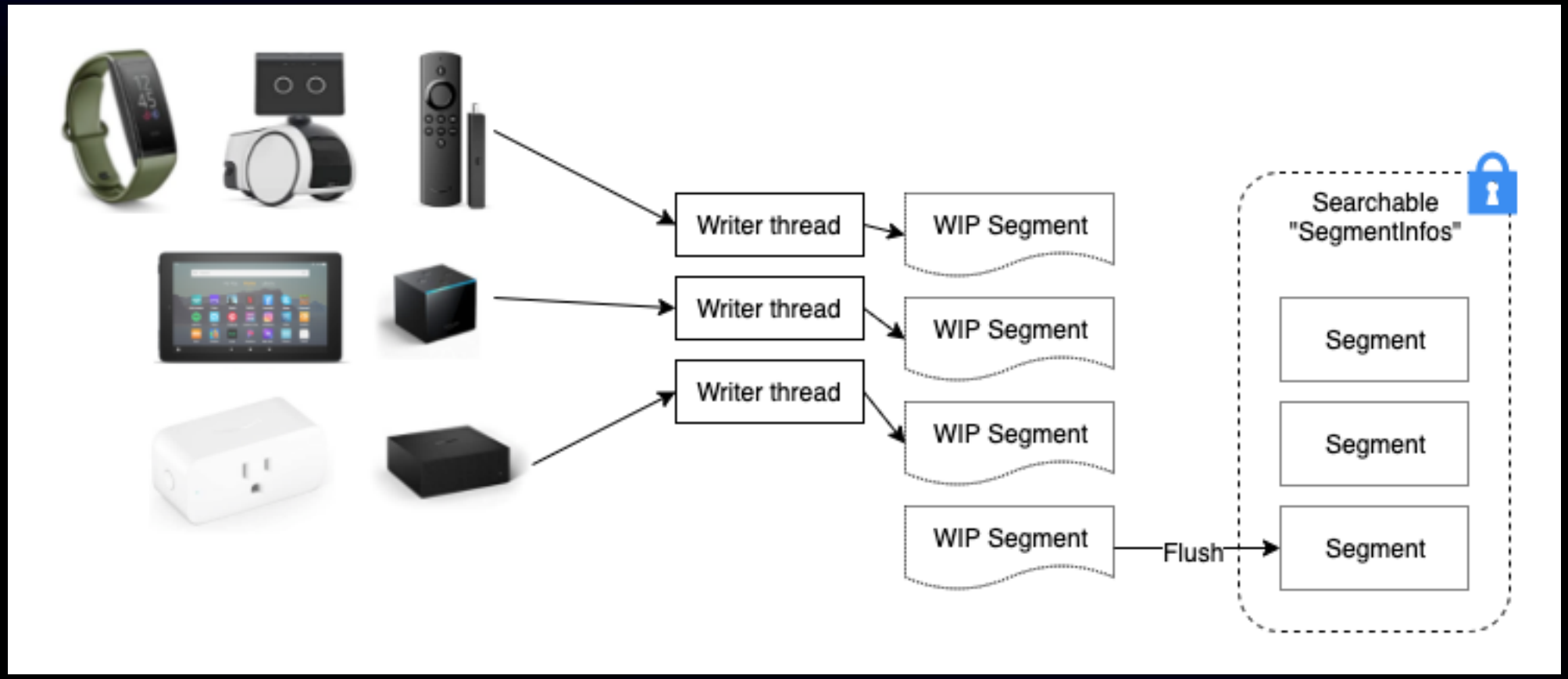
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Search basics



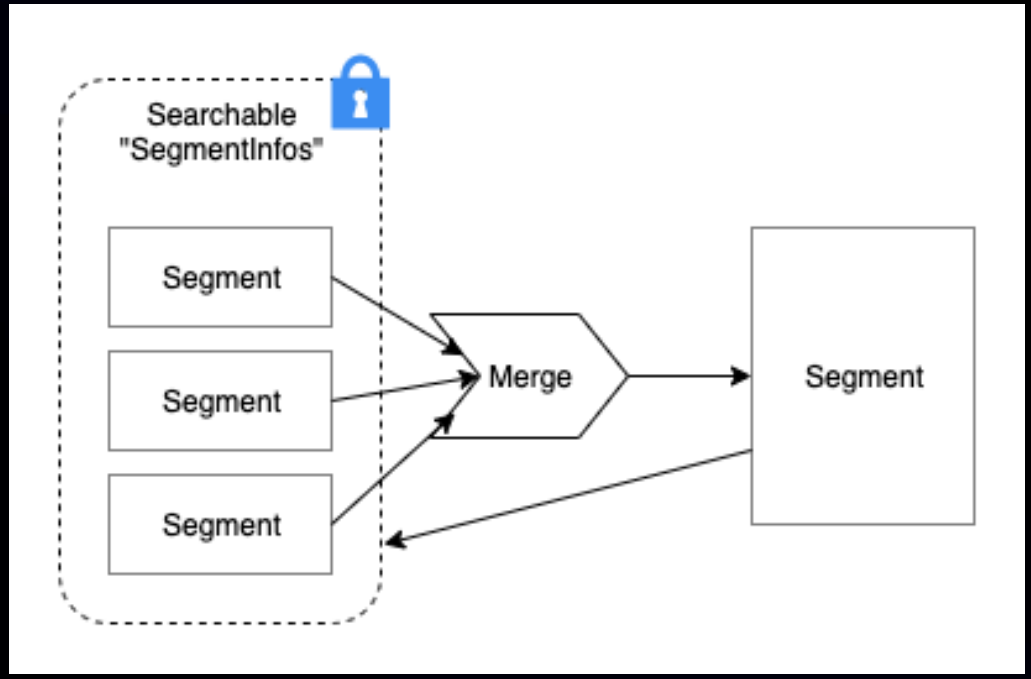
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How Apache Lucene writes an index



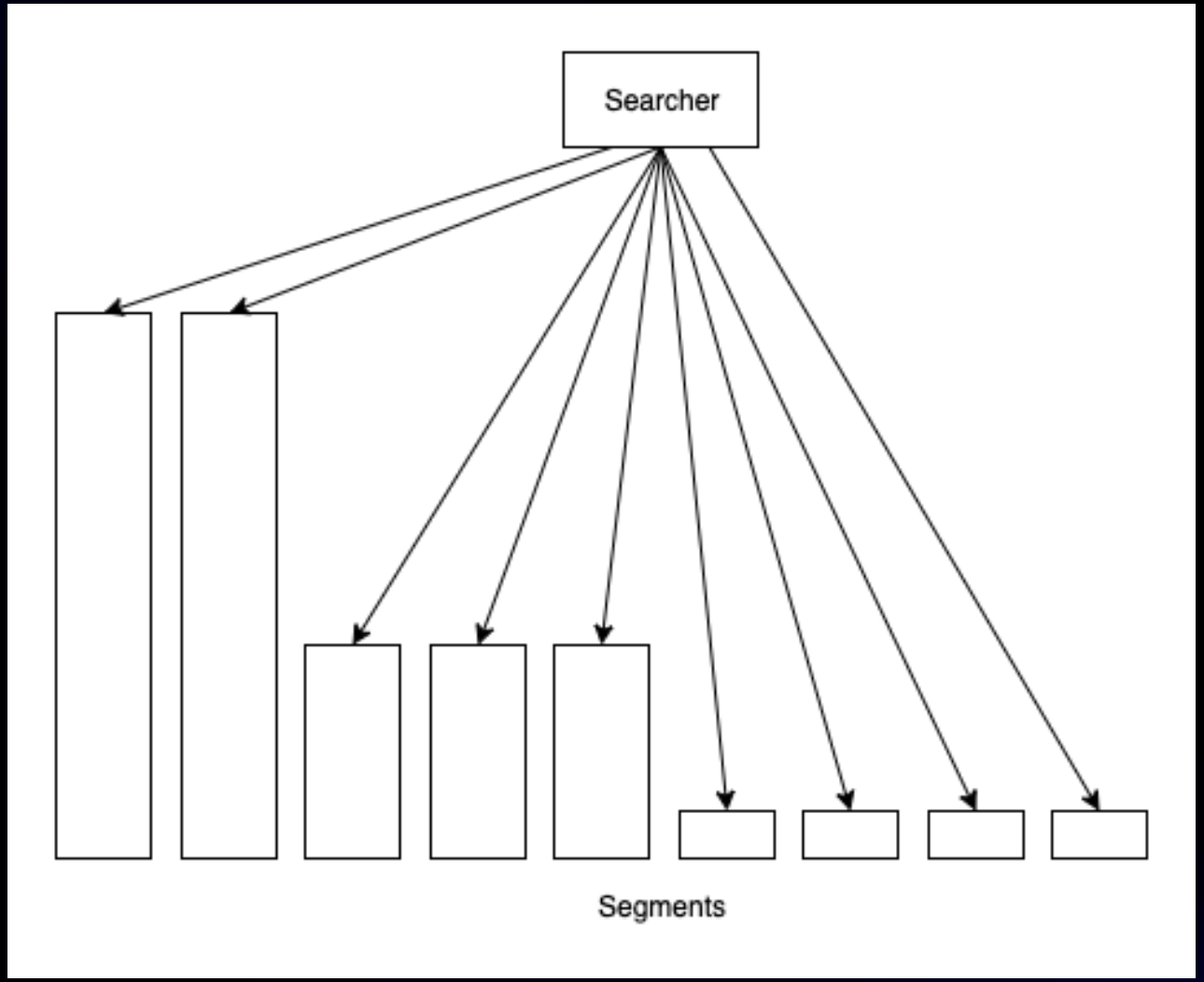
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Merging segments



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Concurrent search



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Too many small segments

- Commit flushes many tiny segments
- Per-segment overhead
- Constantly applying new updates
- Want to merge before searchers see lots of segments

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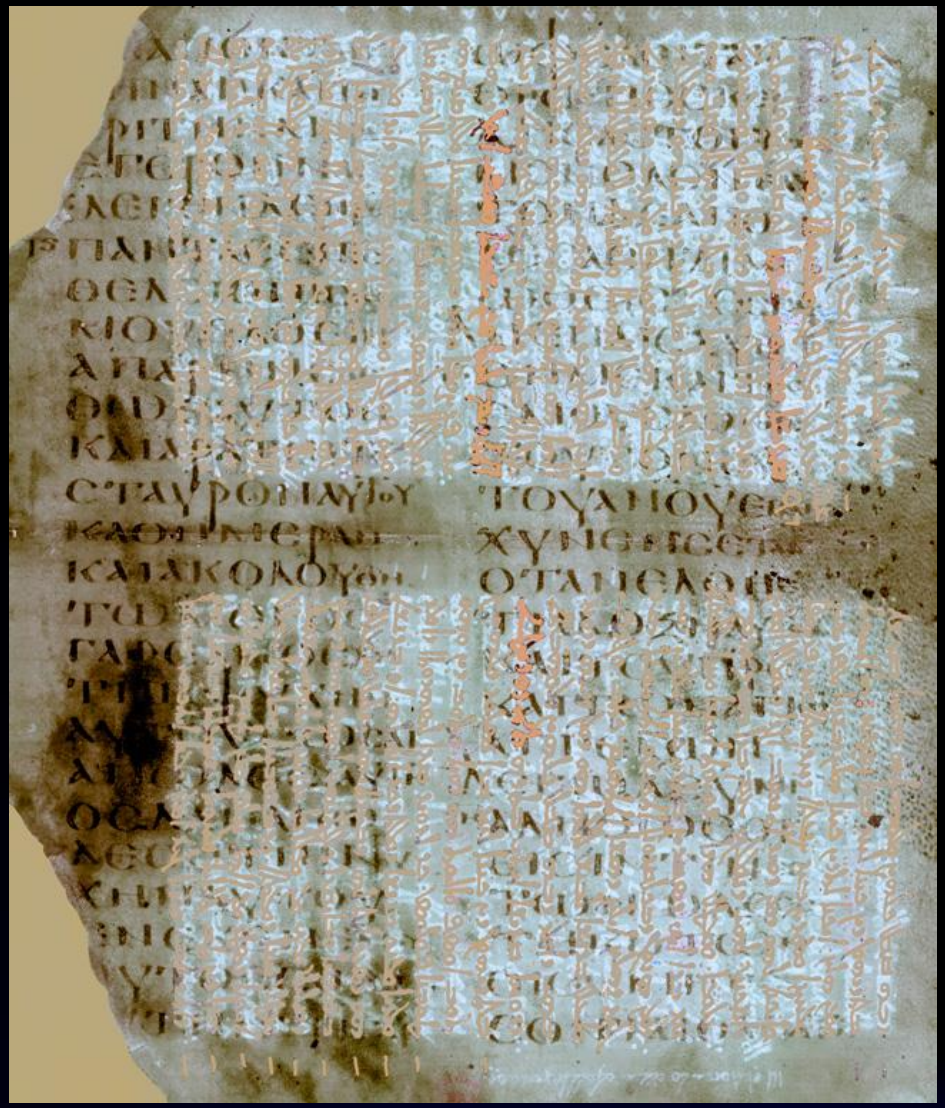
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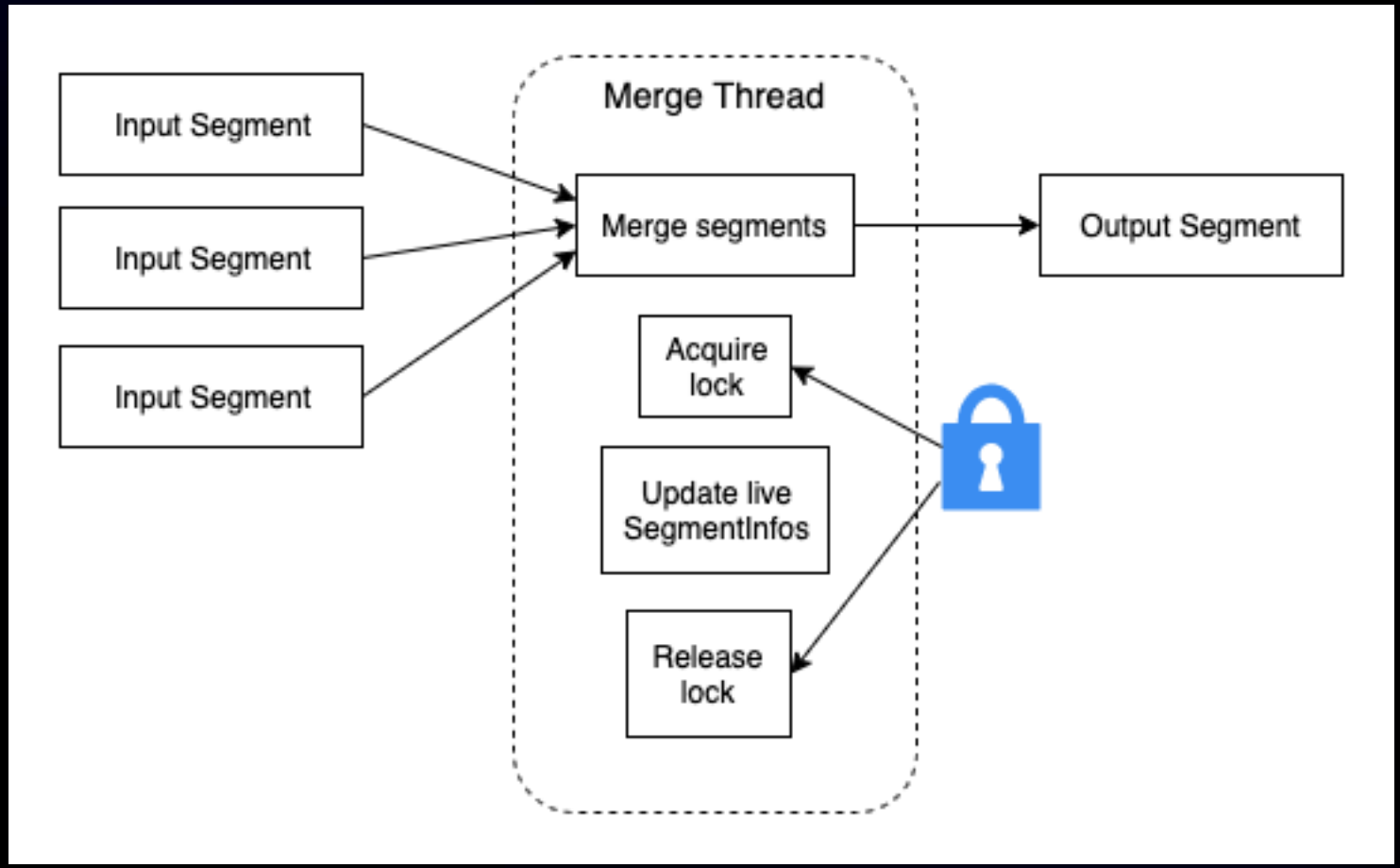
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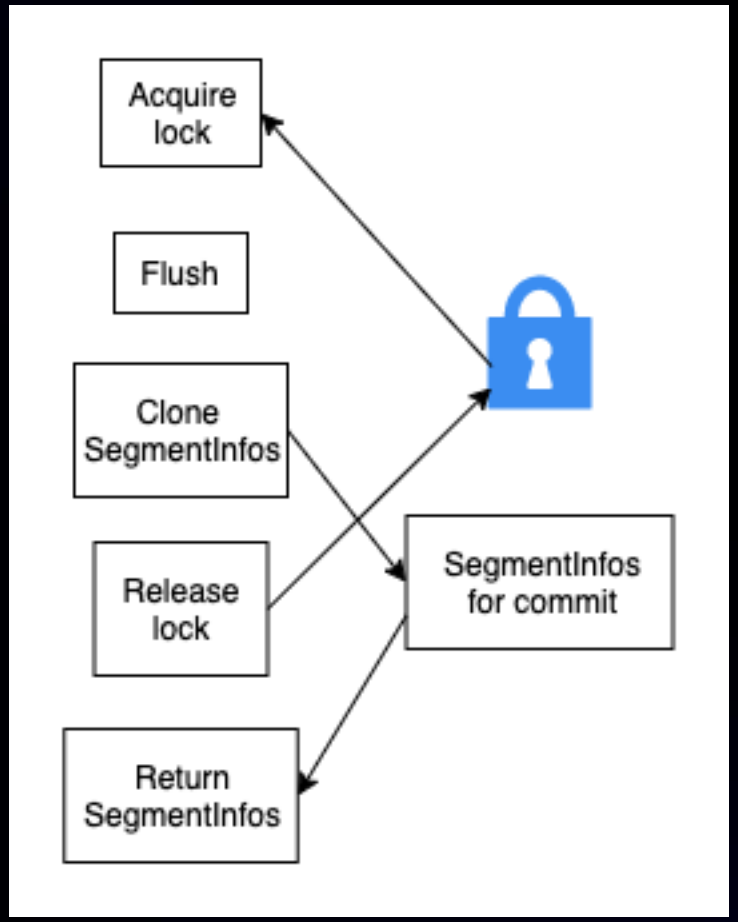
How do Lucene merges work?



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Anatomy of a Lucene commit



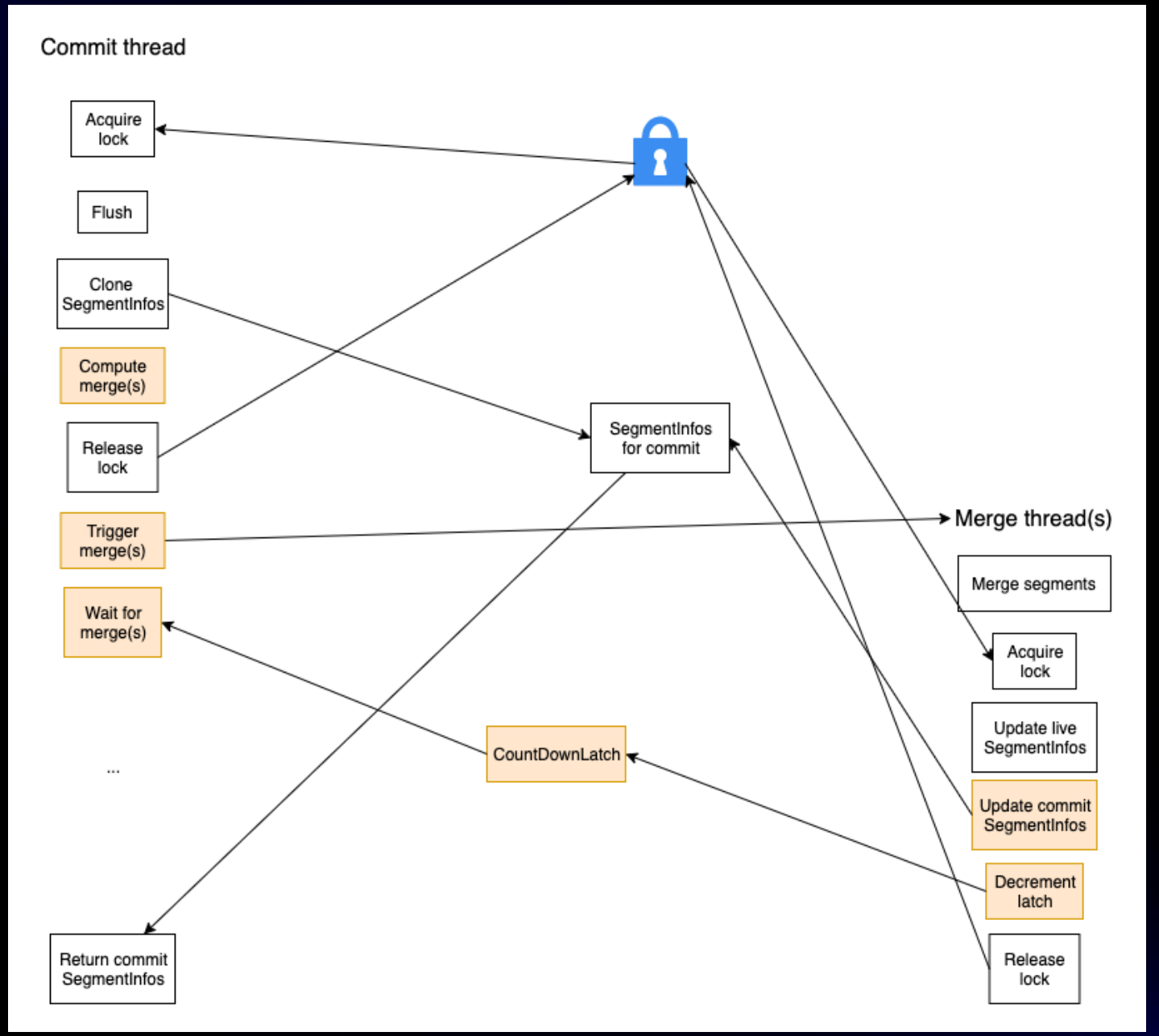
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Put the merge in the commit

- What we commit is what we replicate (is what we search)
- Compute merge(s) while we still hold the flush lock
- Don’t hold lock while the merge runs
- Return SegmentInfos that reflect merge(s)

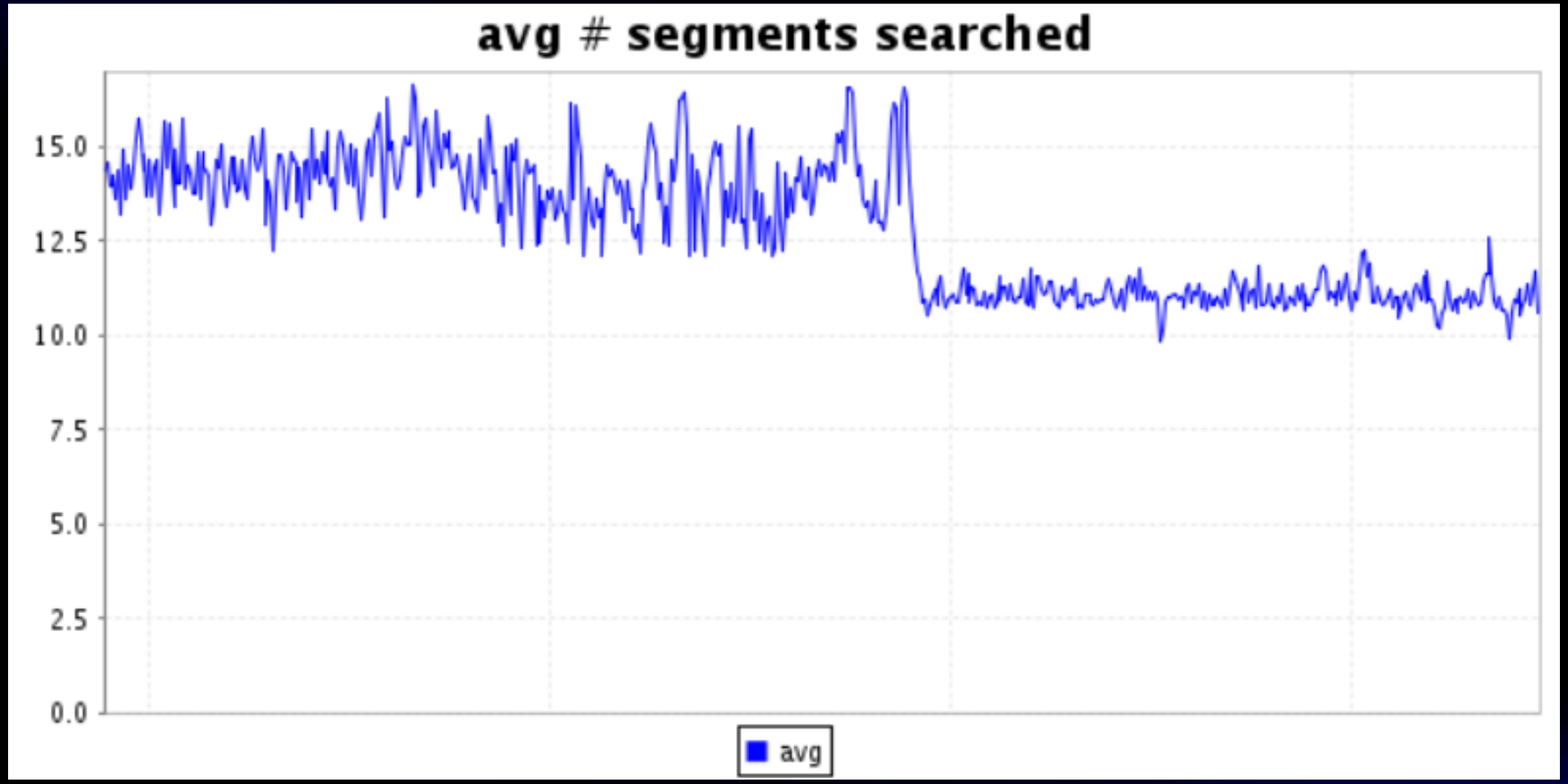
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Success!



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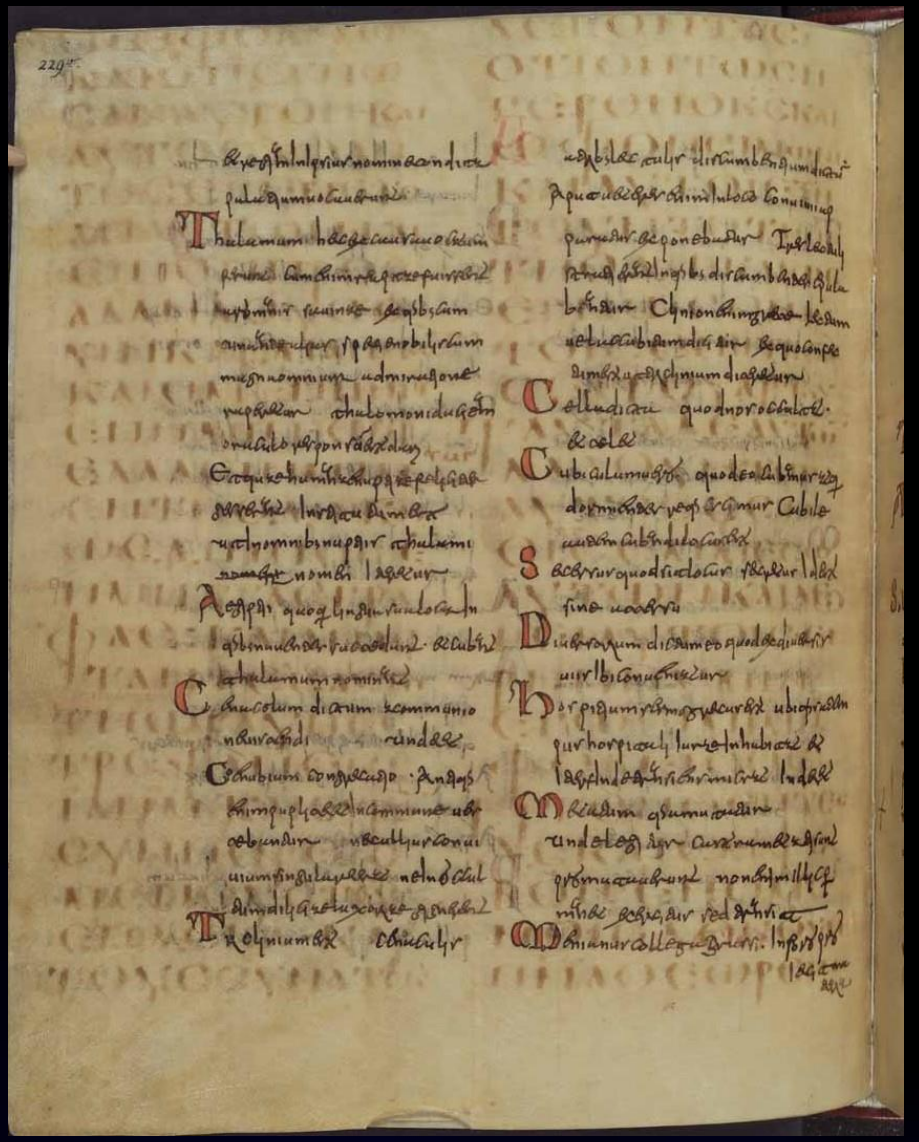
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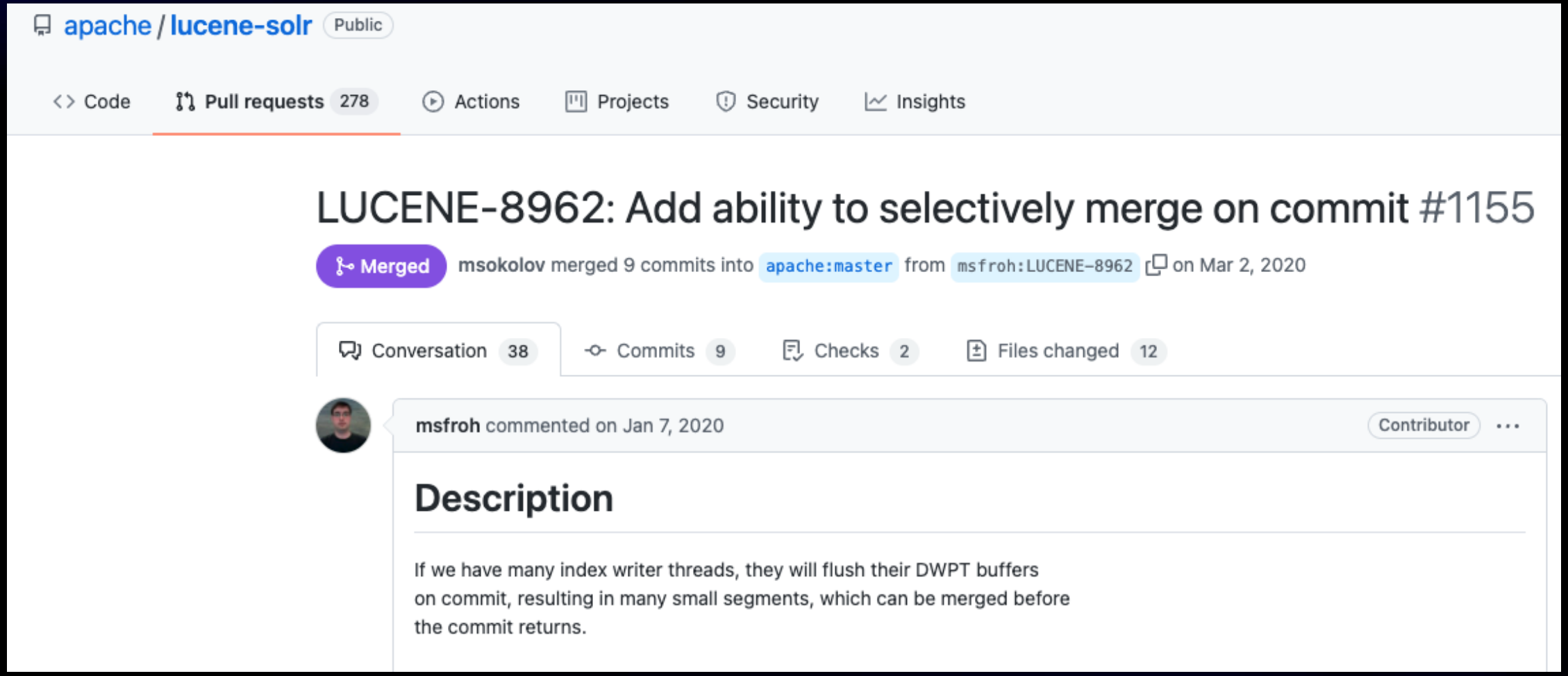
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An issue is born (in Lucene JIRA)



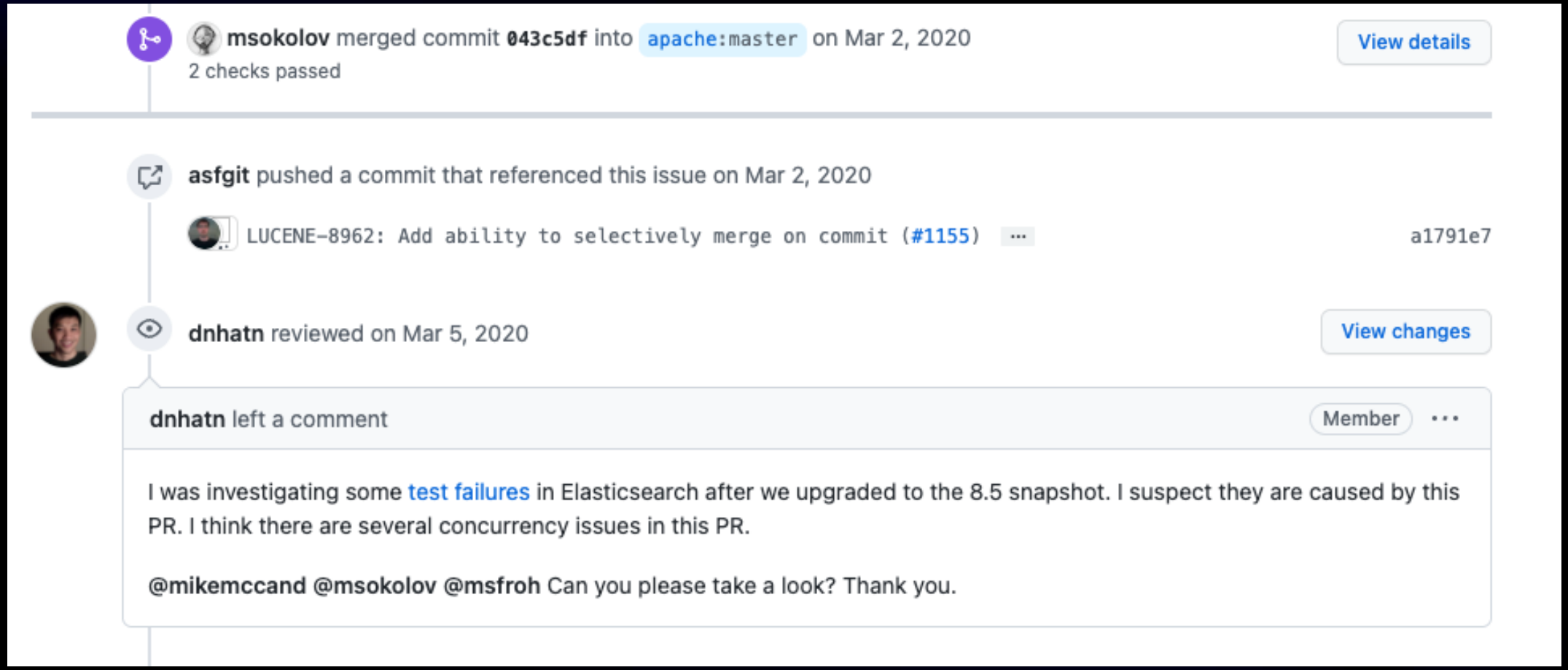
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First GitHub PR (of 10!)



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Things break



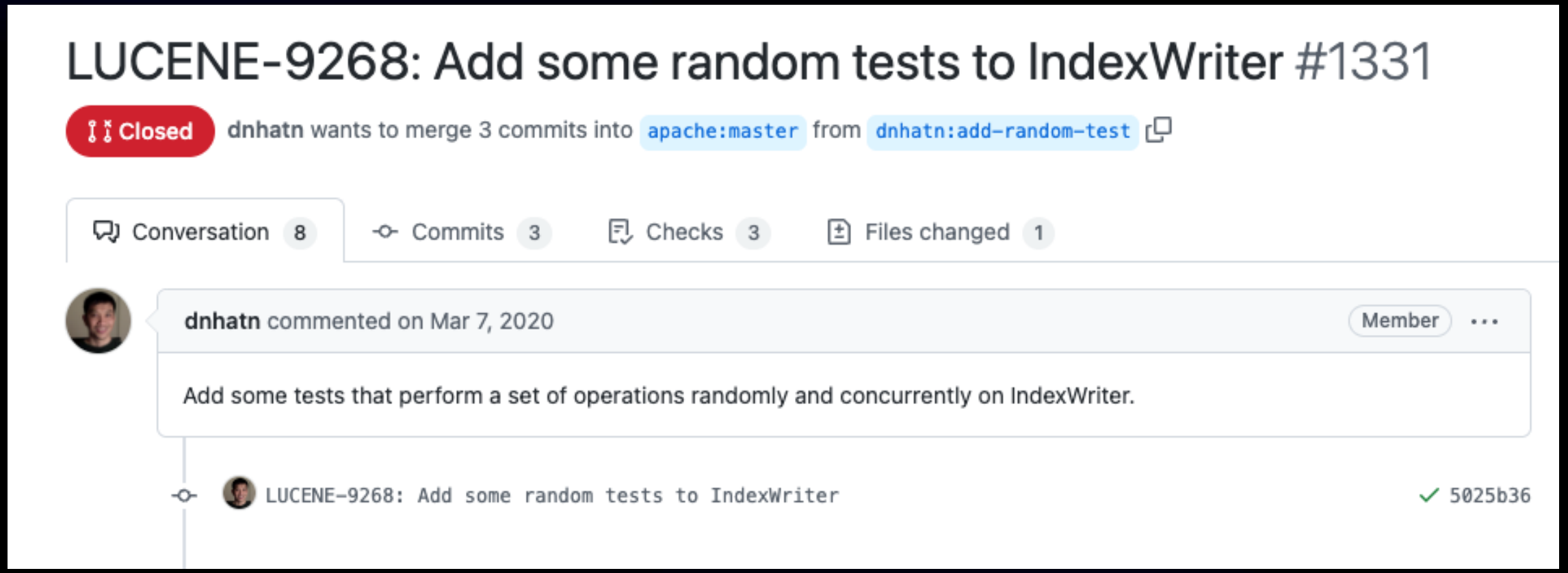
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Randomized testing

- Varies event sequences like commit, refresh, add/delete document
- Unearths rare cases
- Captures seed for repeatability (usually!)
- randomizedtesting spun out as a standalone project

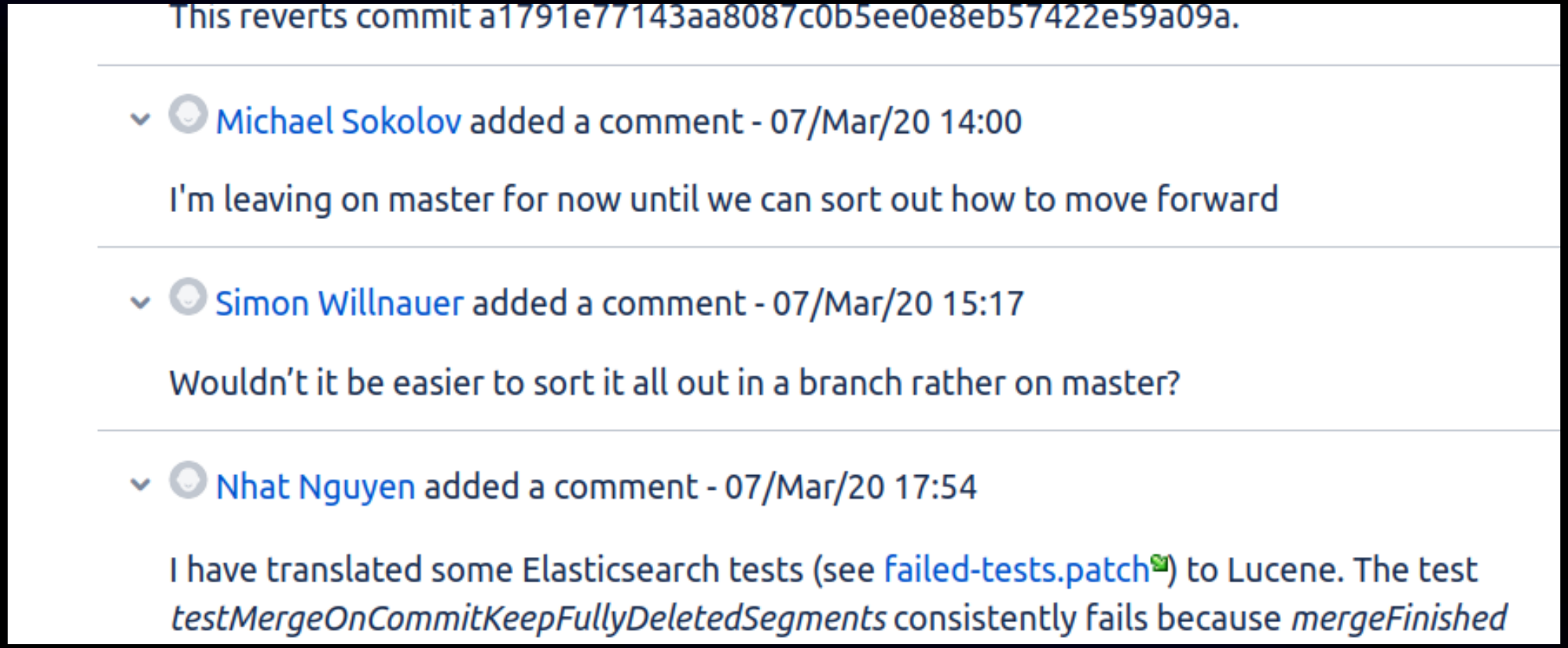
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Powerful test contributed



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Revert (: won’t be the last either :)



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PR 1552 – Another try

LUCENE-8962: merge small segments on commit #1552

Merged **msokolov** merged 15 commits into `master` from `jira/lucene-8962` on Jun 18, 2020

Conversation 50 | Commits 15 | Checks 2 | Files changed 13



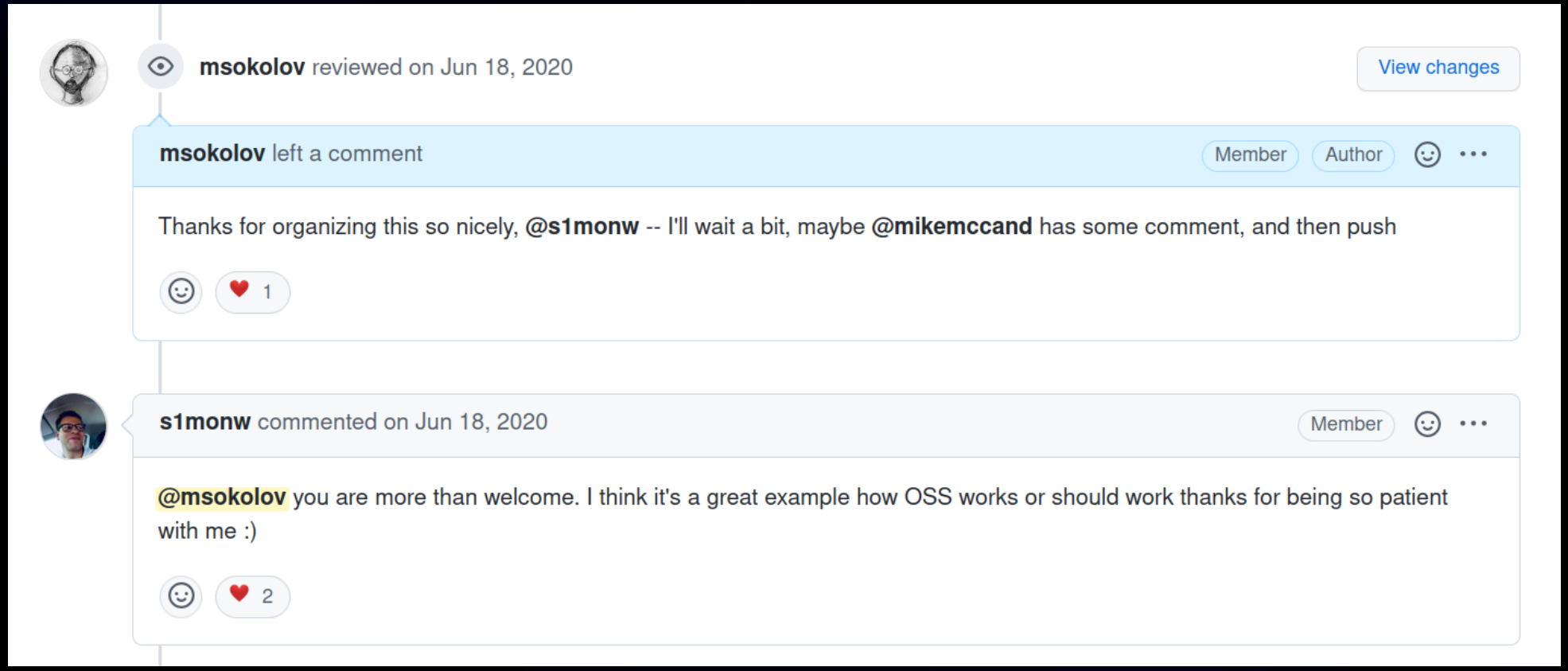
msokolov commented on Jun 3, 2020 • edited — Contributor

LUCENE-8962: This PR revisits the merge-on-commit patch submitted by **@msfroh** a little while ago. The only change from that earlier PR is a fix for failures uncovered by TestIndexWriter.testRandomOperations, some whitespace cleanups, and a rebase on the current master branch. The problem was that updateSegmentInfosOnMergeFinish would incorrectly decRef a merged segments' files if that segment was modified by deletions (or updates) while it was being merged.

With this fix, I ran the failing test case several thousands of times with no failures, whereas before it would routinely fail after a few hundred test runs.

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Simplified implementation



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But wait

Simon Willnauer added a comment - 22/Jun/20 20:20

Mike Sokolov I think I have bad news for you. I think we forgot about an important guarantee that we have from updateDocument that is now with this feature enabled not holding up anymore. During a merge we carry over deletes that are made concurrently to

There's more!



s1monw commented on Jun 26, 2020 Member Author

> Wow! I didn't realize that capturing/cloning live docs at a point in time would be so complicated. I learned a lot from this PR about how deletes are handled. Thanks, Simon!

@msfroh I didn't either :) it's been a while that I digged into merging code and I think the same is true for **@mikemccand** - I am impressed how far you got in this pretty complex class. I'd love to see you digging more and coming up with more stuff like this. Thank you for contributing this. I am always happy to help. This entire process from the first patch to the feature being integrated is a great example of how amazing OSS is.

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Contributing to open source

- Exposed our change more widely
- Led to a better solution
- Builds bridges connecting a worldwide community

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Thank you!

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