# Concurrent GCs and Modern Java Workloads: A Cache Perspective

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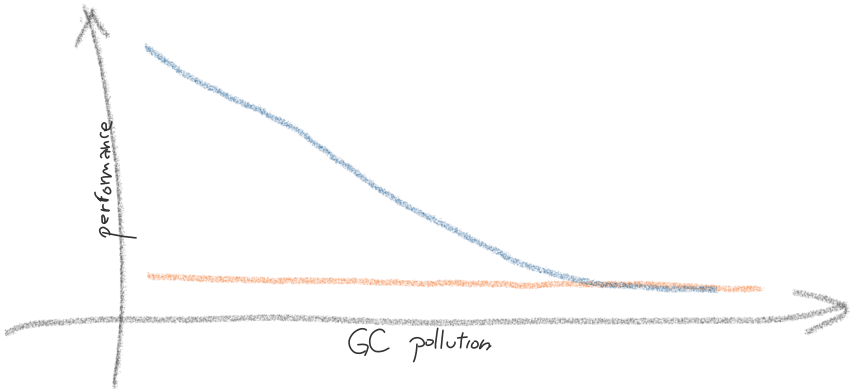

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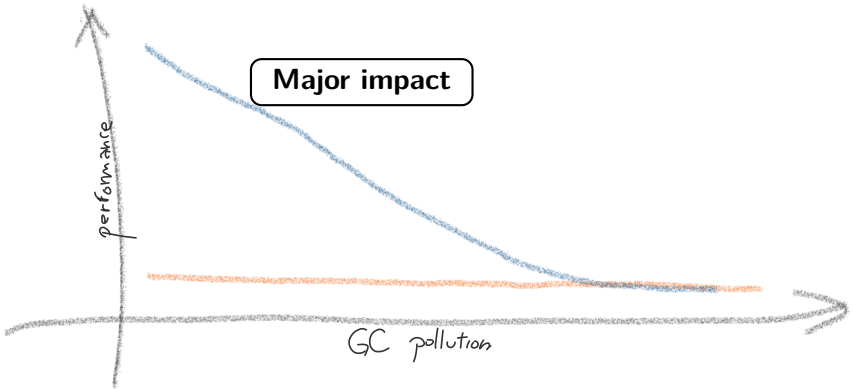

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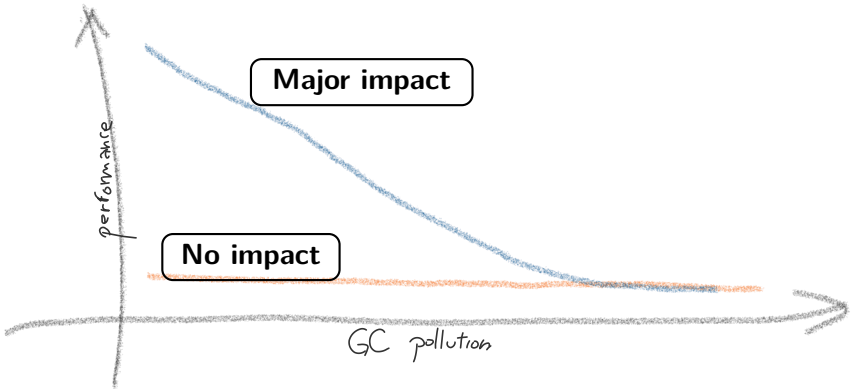

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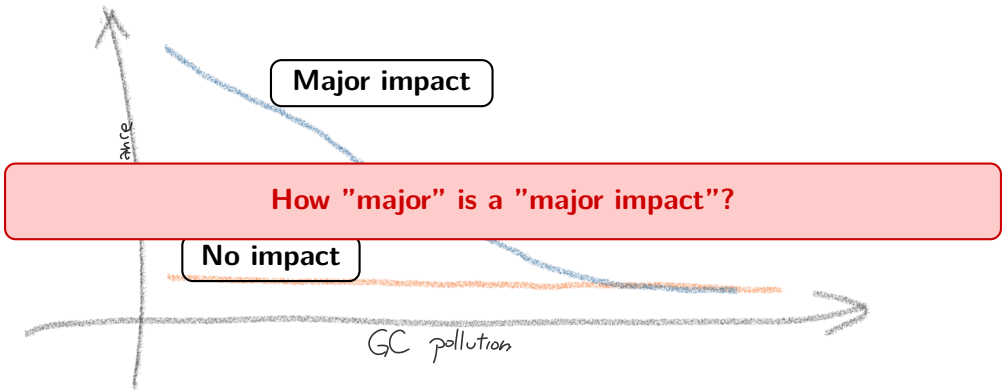

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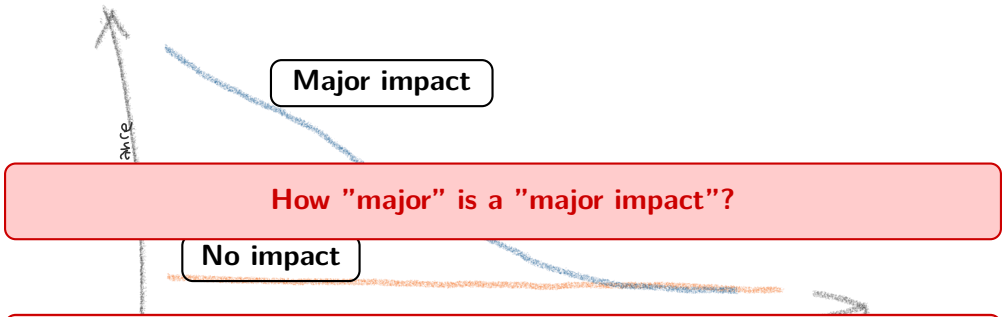

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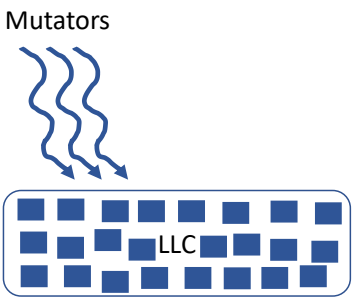


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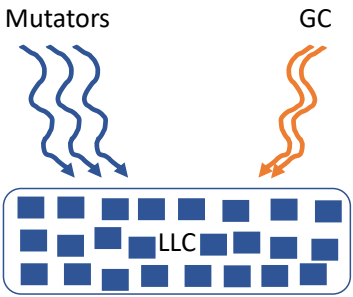


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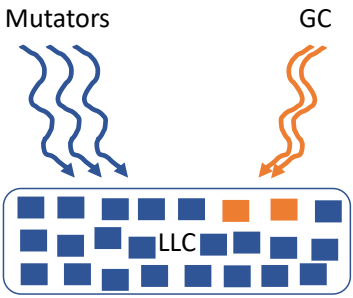


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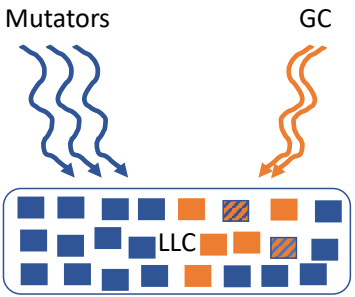


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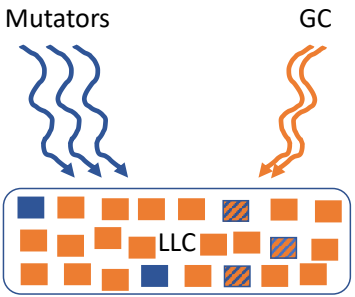


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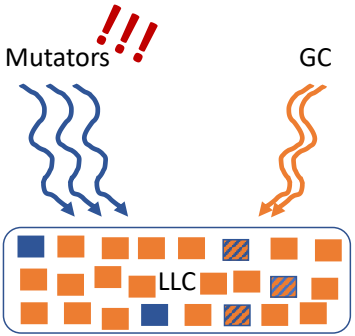


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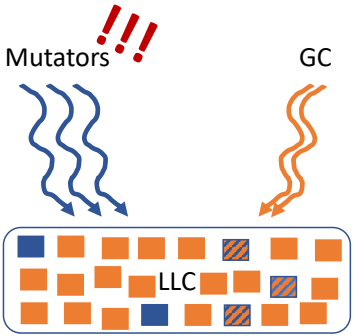


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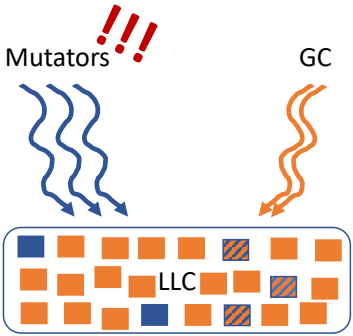


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# Not Easy to Quantify Though

**Challenges**

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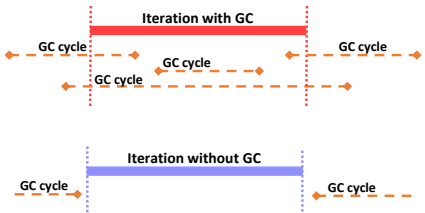

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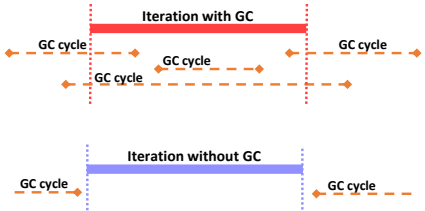
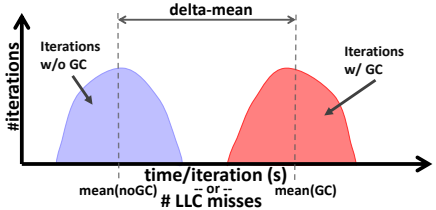



- Quantify based on iteration distribution



# Overview

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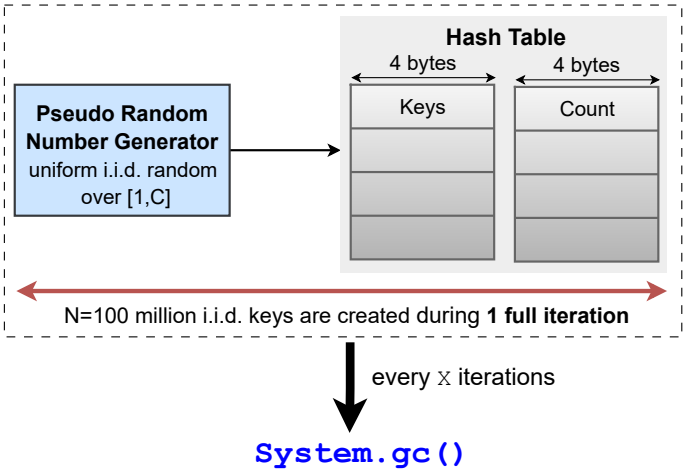

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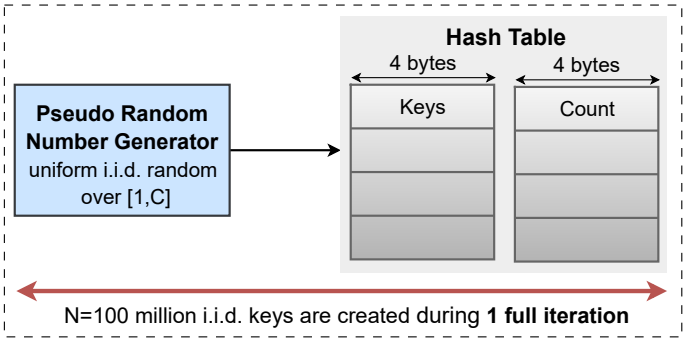


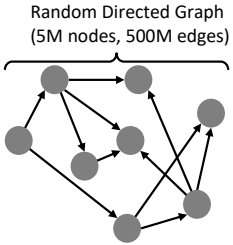

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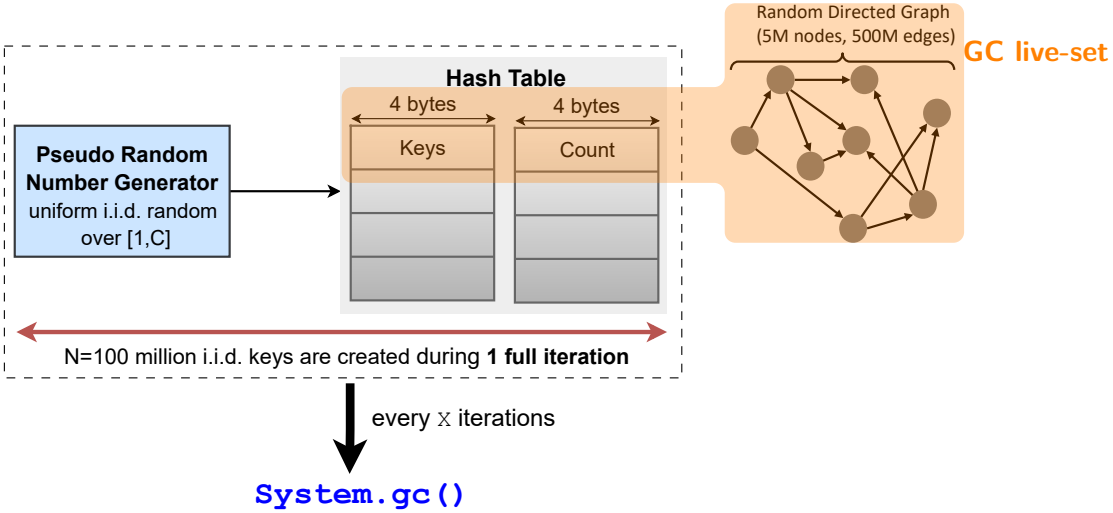

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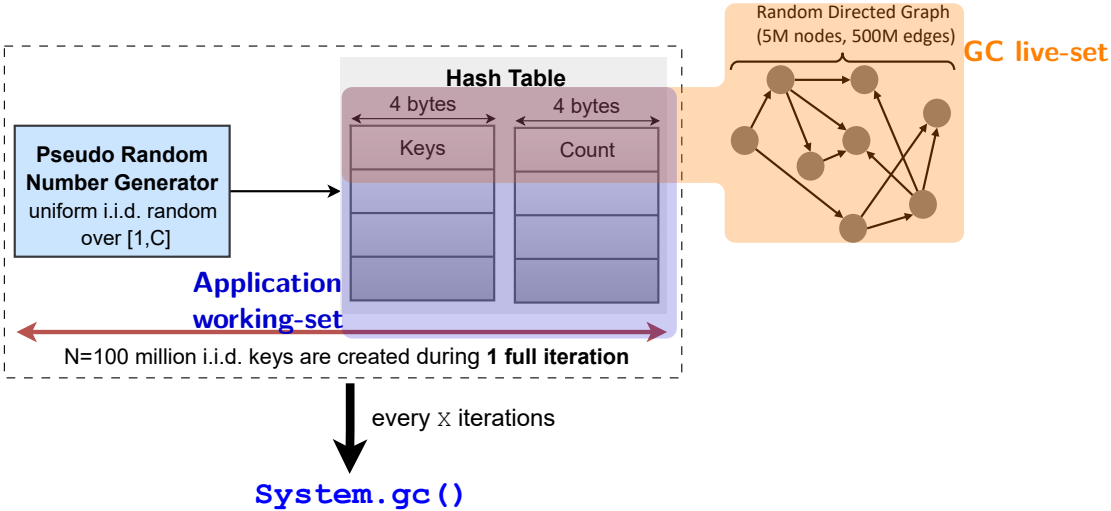

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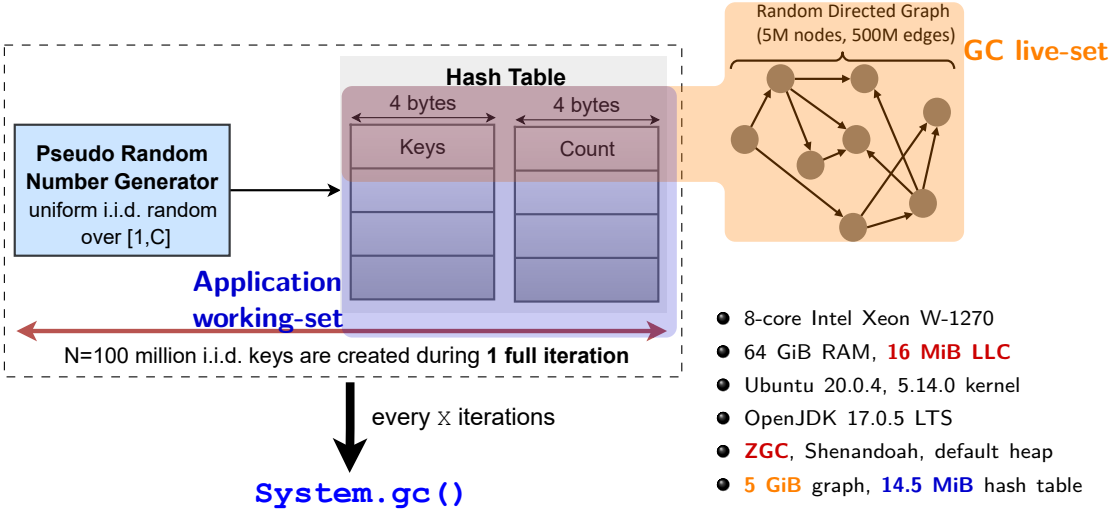
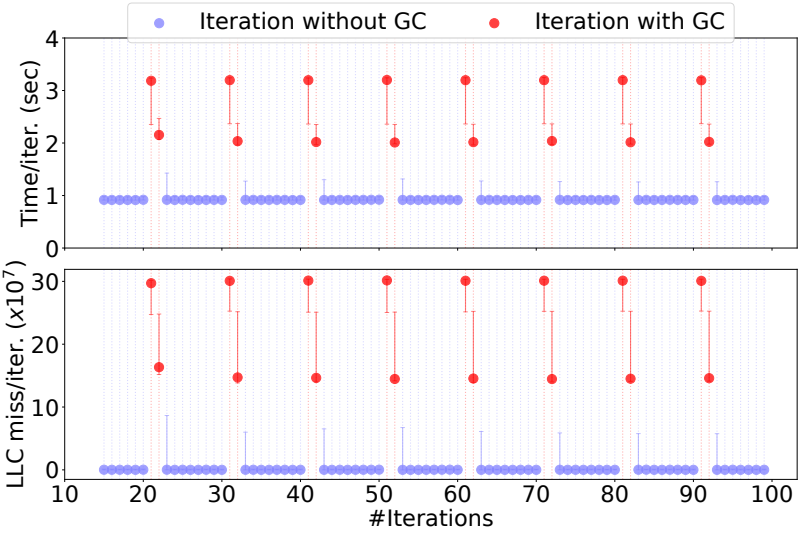



- 8-core Intel Xeon W-1270
- 64 GiB RAM, **16 MiB LLC**
- Ubuntu 20.0.4, 5.14.0 kernel
- OpenJDK 17.0.5 LTS
- **ZGC**, Shenandoah, default heap
- **5 GiB** graph, **14.5 MiB** hash table

# Results


Iteration without GC
Iteration with GC
Time/iter. (sec)
LLC miss/iter. (x10^7)
#Iterations
0
1
2
3
4
10
20
30
40
50
60
70
80
90
100

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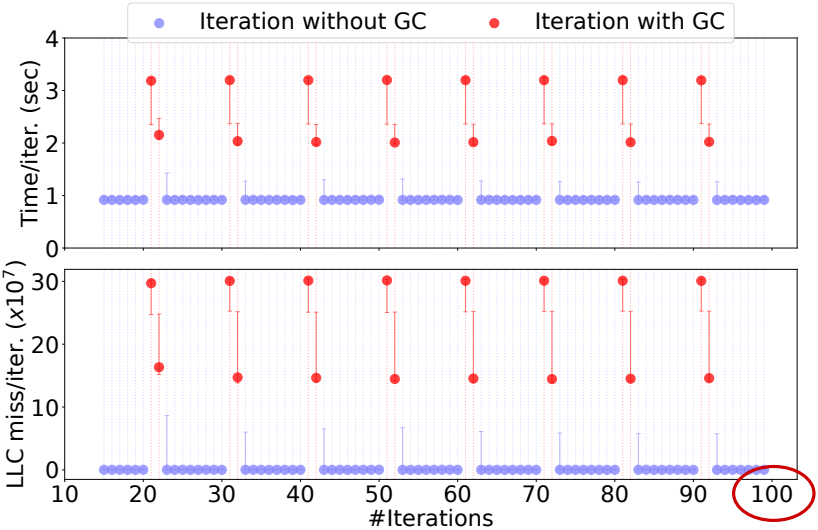
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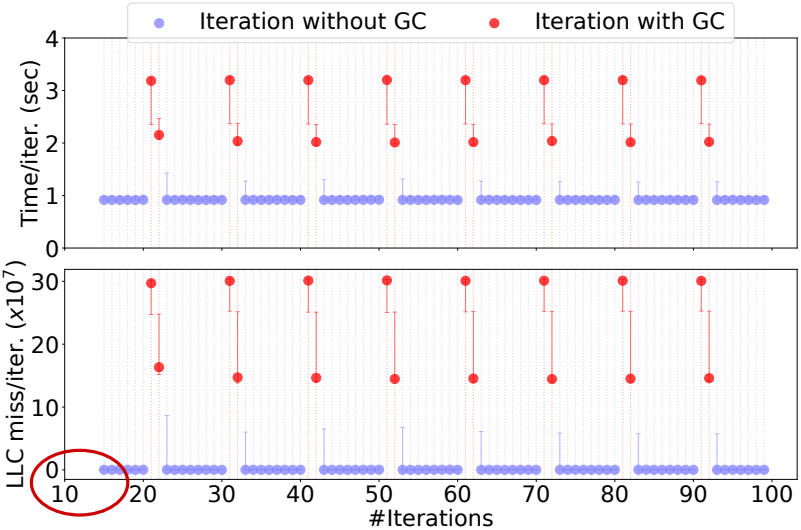
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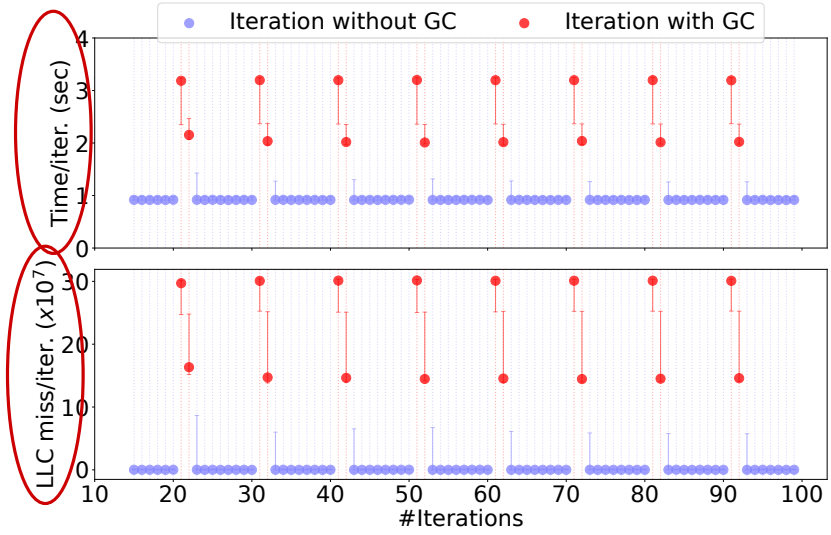
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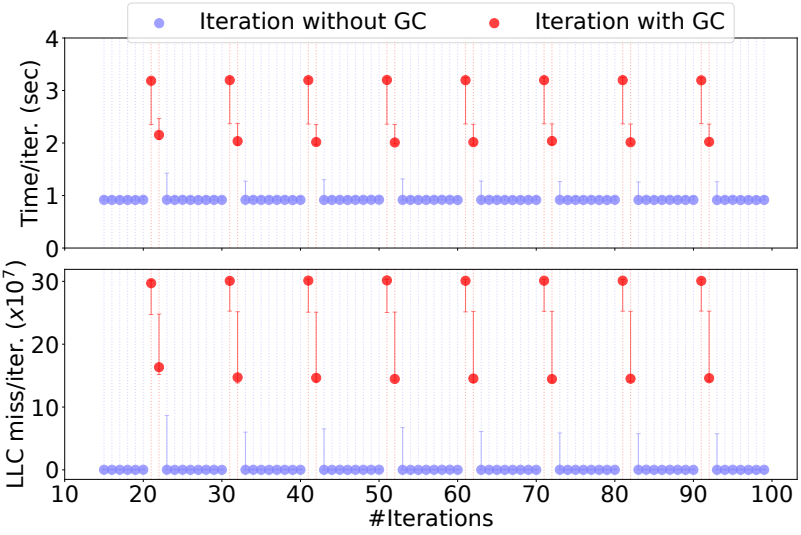
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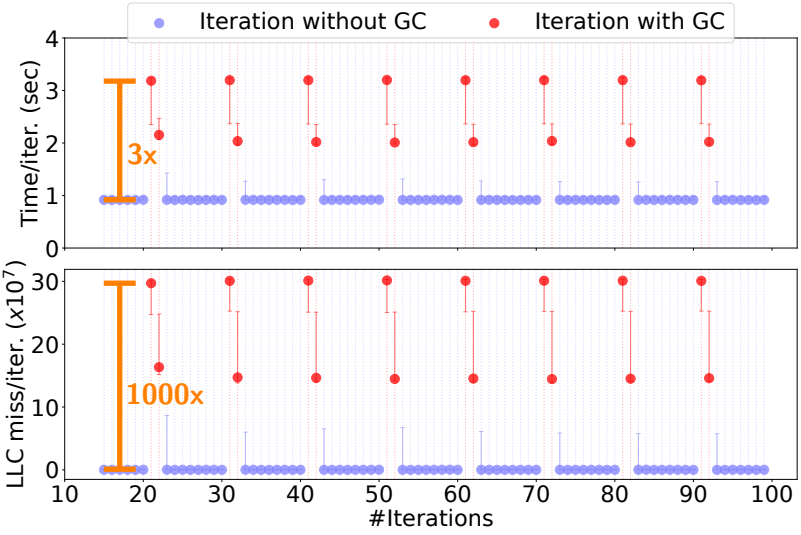
Iteration without GC
Iteration with GC
Time/iter. (sec)
3x
LLC miss/iter. (x10^7)
1000x
#Iterations

# Results


**Major impact on both LLC misses and execution time, consistent across runs.**

# Overview

# Benchmark Selection and Setup

**Renaissance**

- 23 applications
- Representative for modern workloads
- Variety: spark, concurrency, database, functional, scala, web
- Iteration-based benchmarks

**Experimental Setup**

- Disable proactive GC
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**Some stats:**
**3/23** benchmarks: $< 2\%$ of iterations overlap with GC cycles
**2/23** benchmarks: $> 98\%$ of iterations overlap with GC cycles
**5/23** benchmarks: **correlation** between GC cache pollution and performance drop*

*More details on the statistical analysis in the paper.

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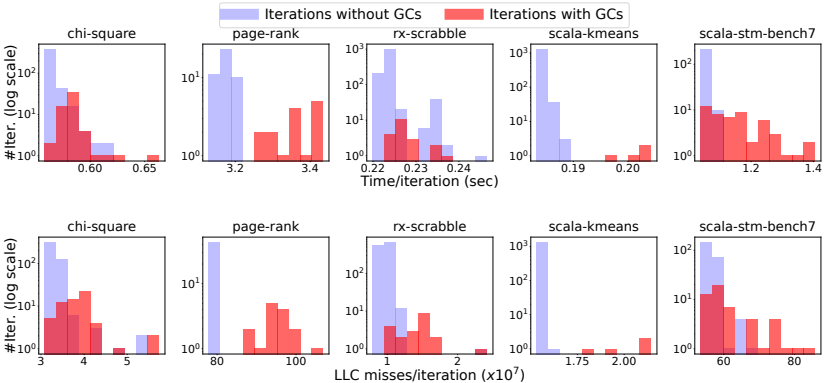

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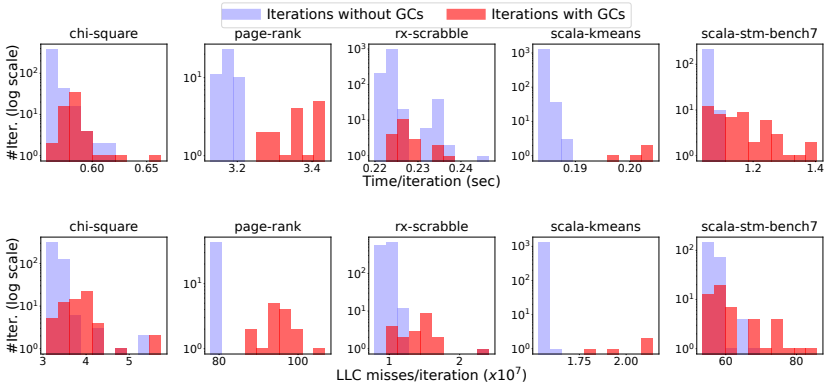


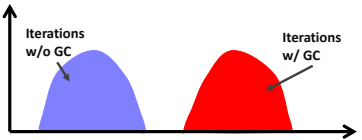

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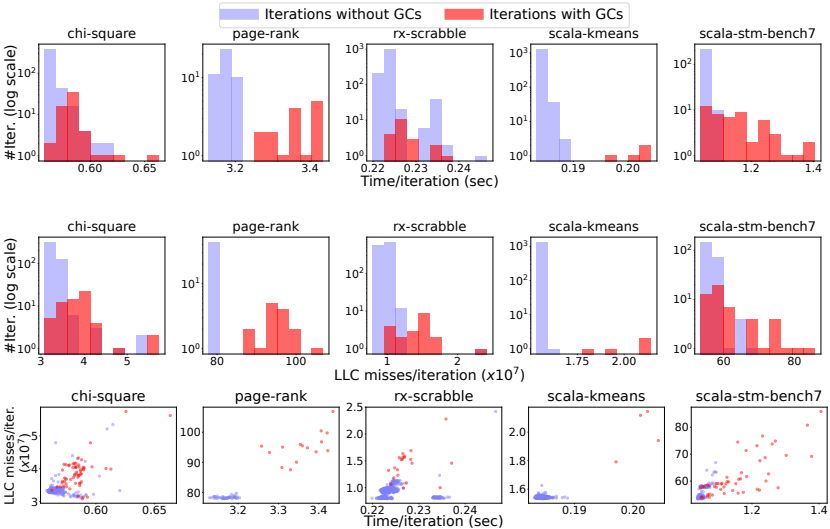

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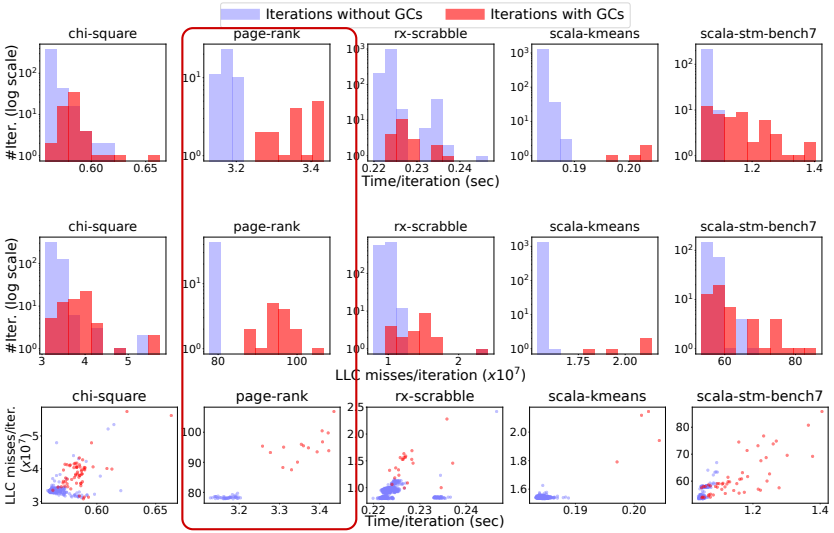

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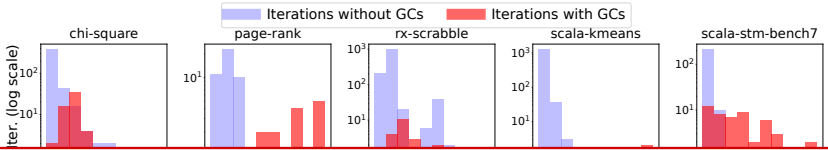


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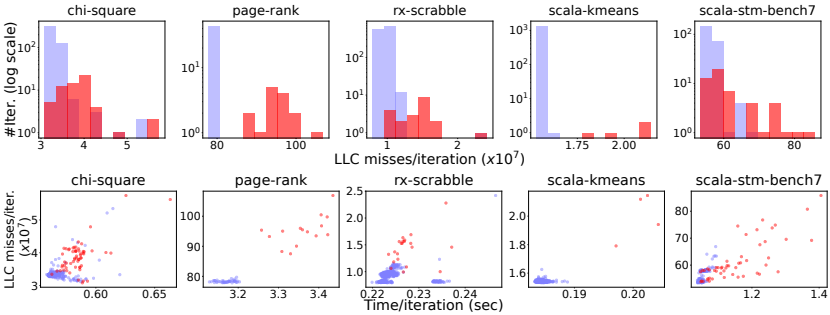

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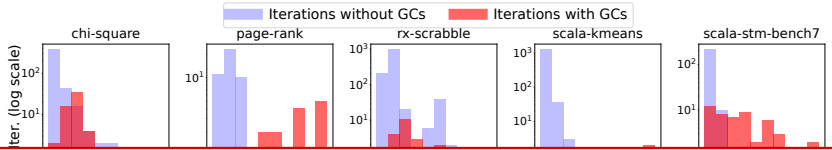


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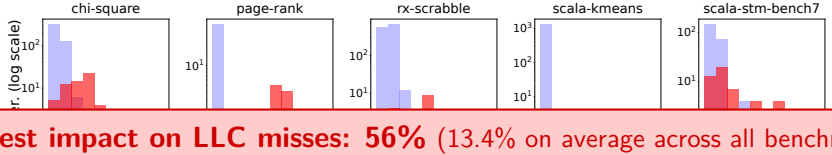
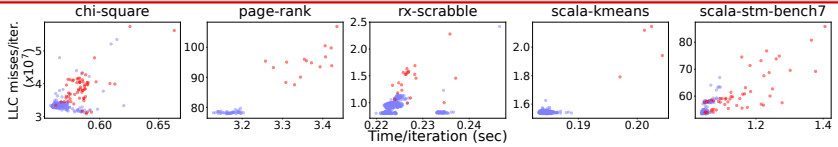



**Highest impact on LLC misses: 56%** (13.4% on average across all benchmarks)



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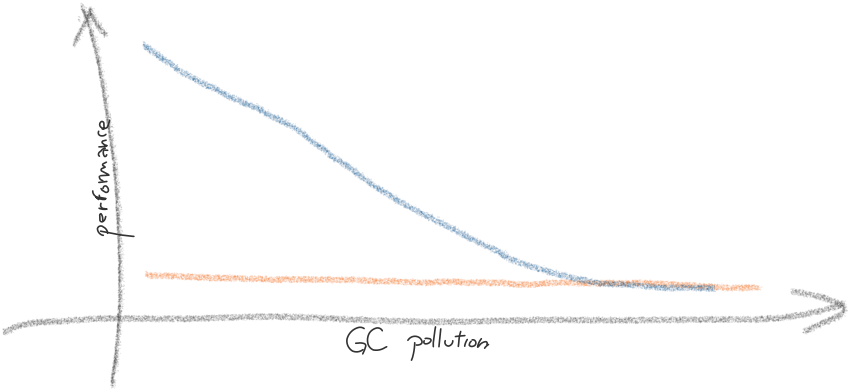

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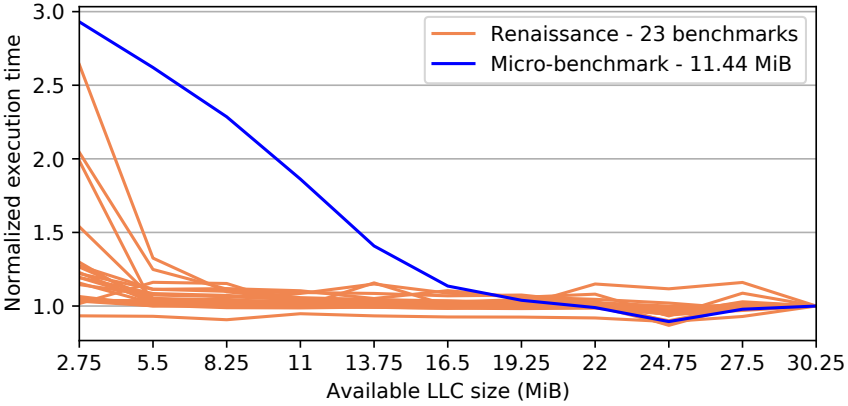

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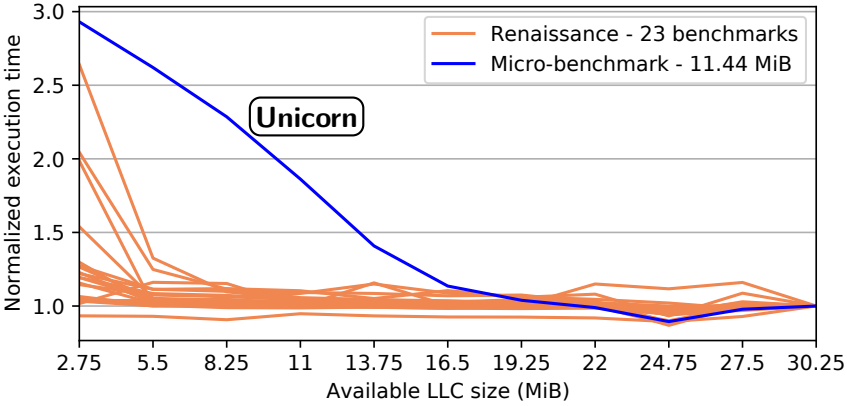

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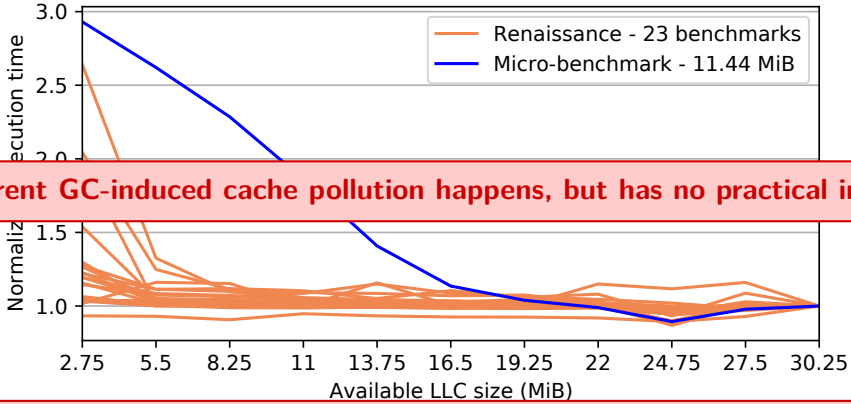
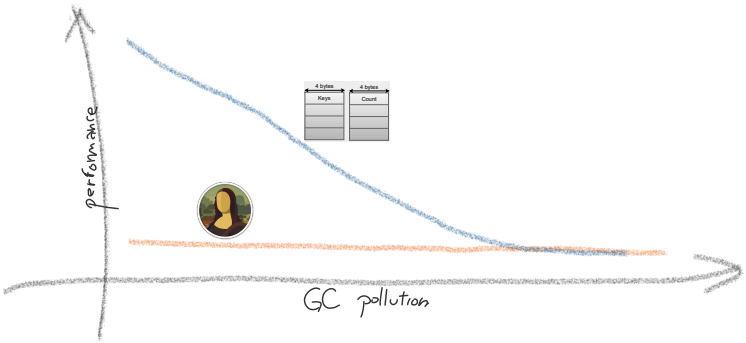



**Concurrent GC-induced cache pollution happens, but has no practical impact...**

**...because real-world Java workloads are typically not cache-sensitive**

# Thank you!




Any questions?