Go GC:
Latency Problem Solved

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Google

My Codefendants: The Cambridge Runtime Gang

https://upload.wikimedia.org/wikipedia/commons/thumb/2/2f/Sato_Tadanobu_with_a_goban.jpeg/500px-Sato_Tadanobu_with_a_goban.jpeg

Making Go Go: Establish A Virtuous Cycle

News Flash:

2X Transistors != 2X Frequency

More transistors == more cores

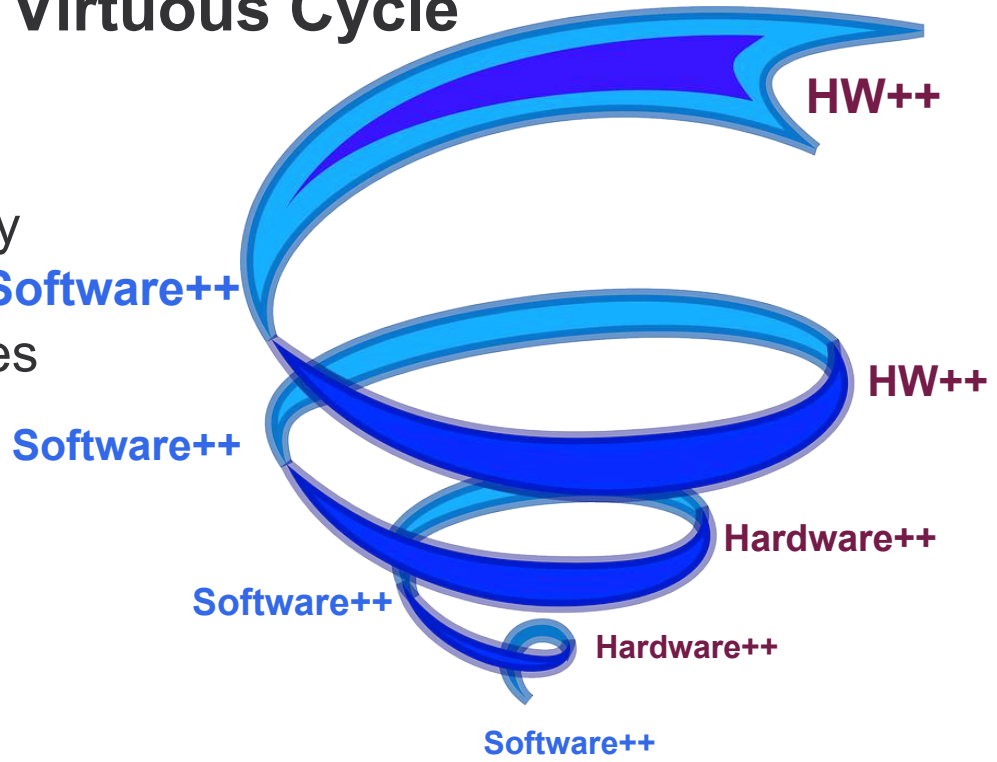
Only if software uses more cores

Long term

Establish a virtuous cycle

Short term

Increase Go Adoption

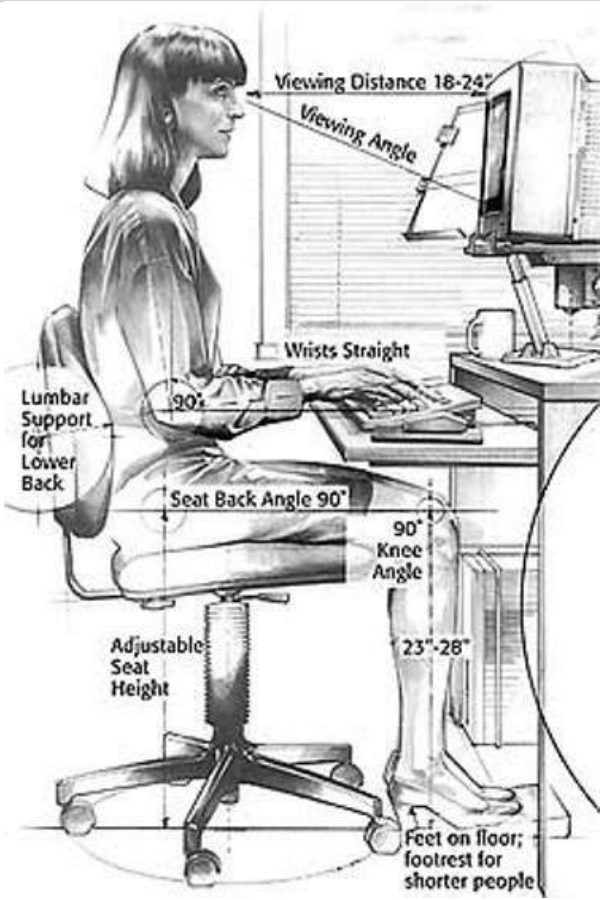


#1 Barrier: GC Latency

When is the best time to do a GC?

When nobody is looking.

Using camera to track eye movement
When subject looks away do a GC.



https://upload.wikimedia.org/wikipedia/commons/3/35/Computer_Workstation_Variables.jpg

Pop up a network wait icon

https://commons.wikimedia.org/wiki/File:WIFI_icon.svg#globalusage

Or
Trade Throughput for Reduced GC Latency

Latency

Nanosecond
- 1: Grace Hopper Nanosecond 11.8 inches

Microsecond
- 5.4: Time light travels 1 mile in vacuum

Millisecond
- 1: Read 1 MB sequentially from SSD
- 20: Read 1 MB from disk
- 50: Perceptual Causality (cursor response threshold)
- 50+: Various network delays
- 300: Eye blink

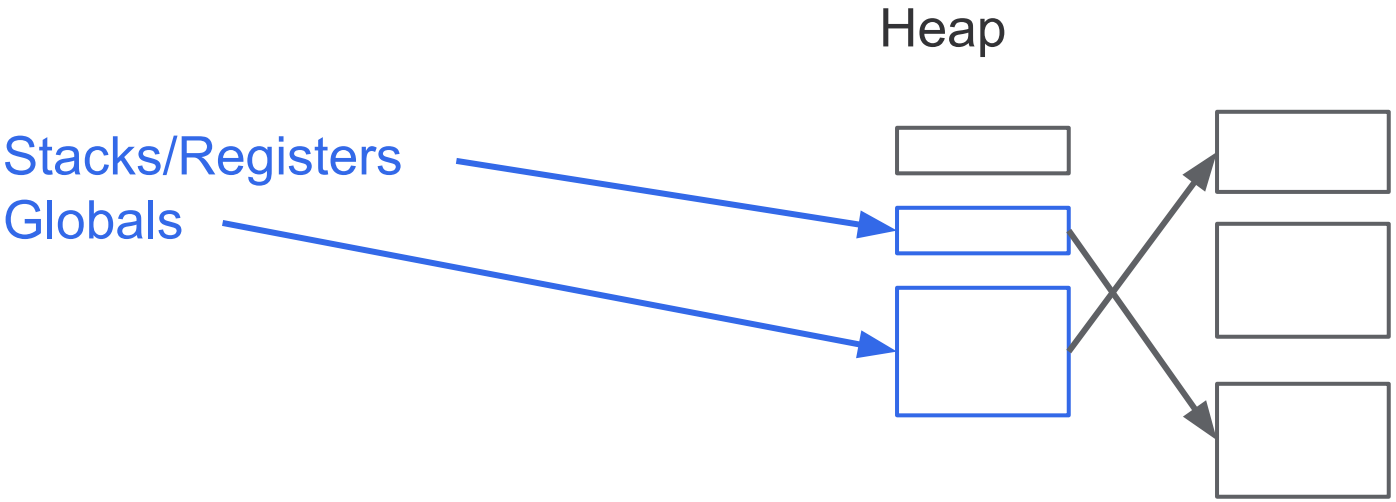
Go isn't Java: GC Related Go Differences

Go	Java
Thousands of Goroutines	Tens of Java Threads
Synchronization via channels	Synchronization via objects/locks
Runtime written in Go	Runtime written in C
Leverages Go same as users	
Control of spatial locality	Objects linked with pointers
Objects can be embedded	
Interior pointers (&foo.field)	

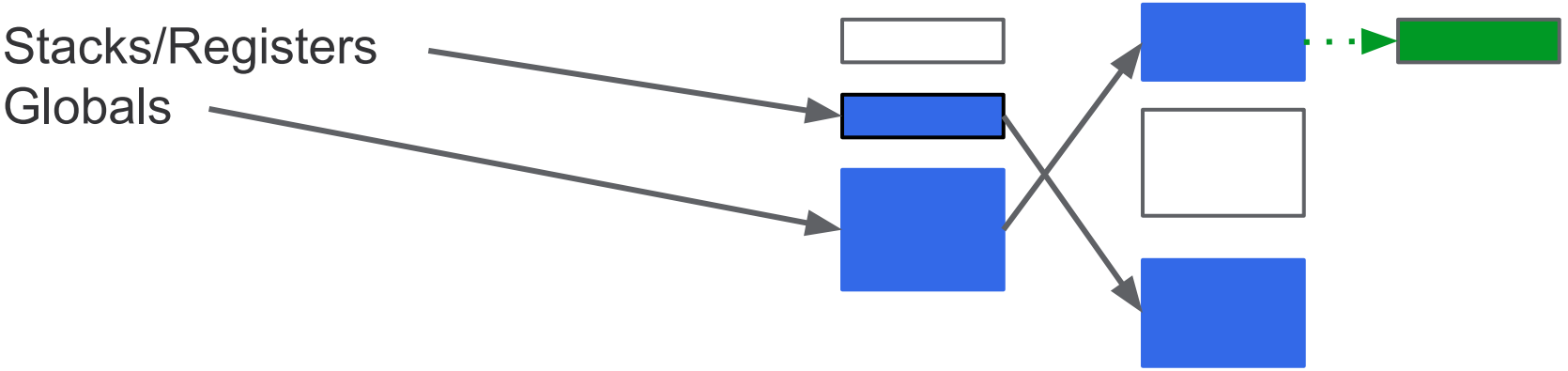
Let's Build a GC for Go

GC 101

Scan Phase

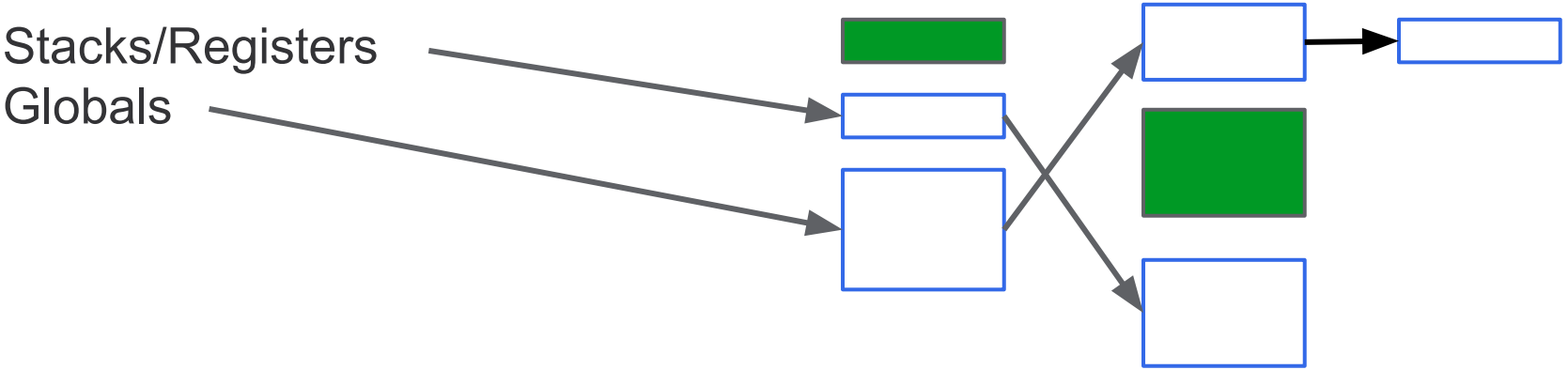


Mark Phase

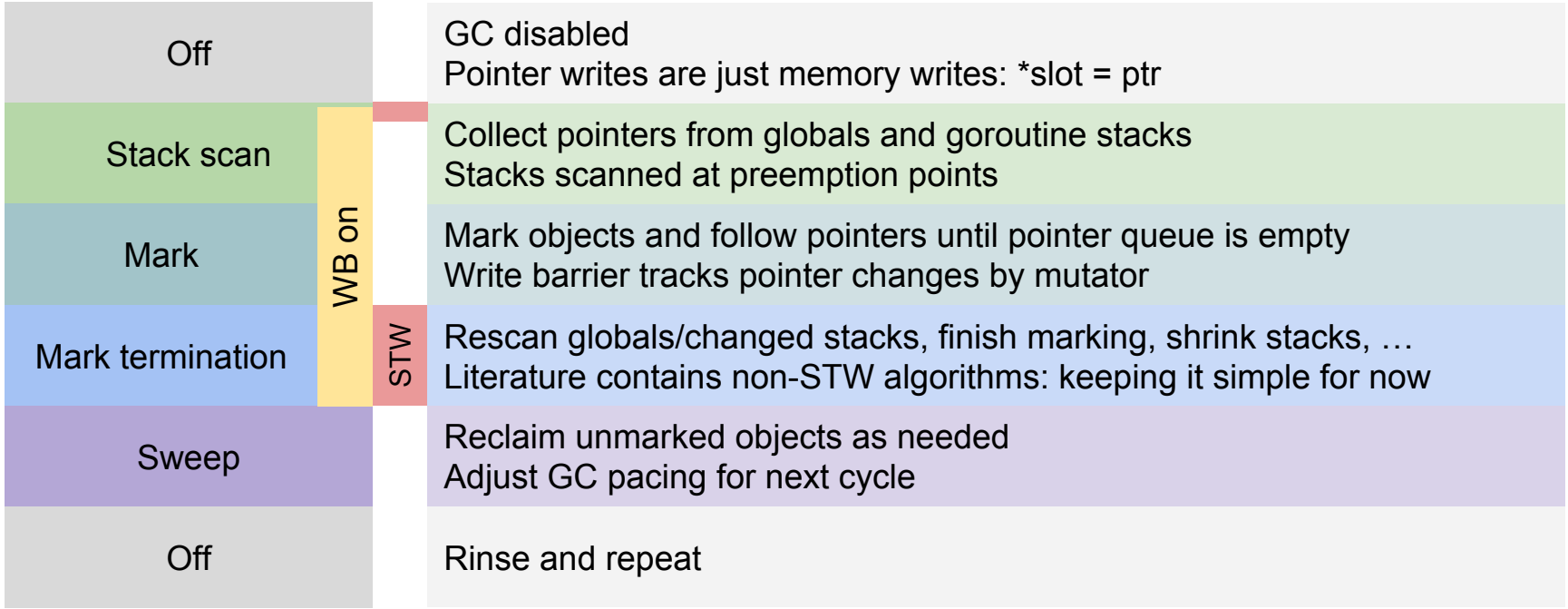


Righteous Concurrent GC struggles with Evil Application changing pointers

Sweep Phase

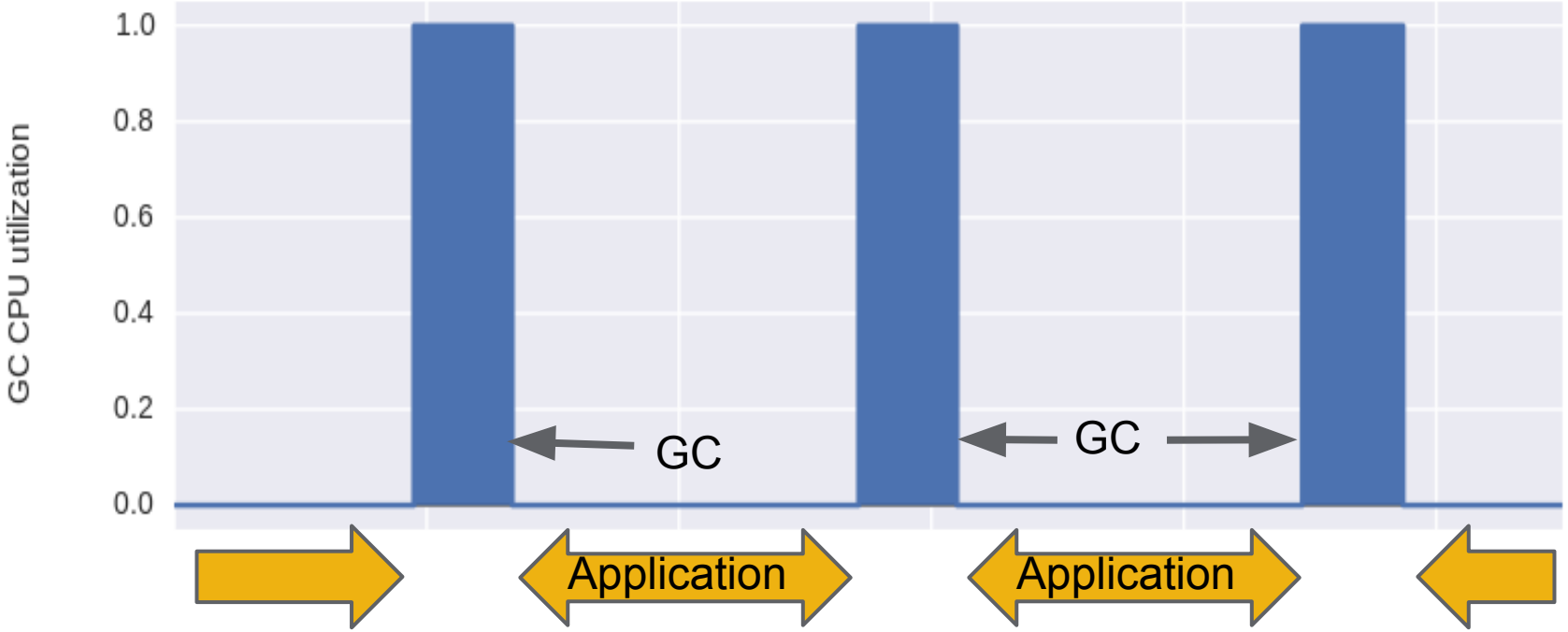


GC Algorithm Phases

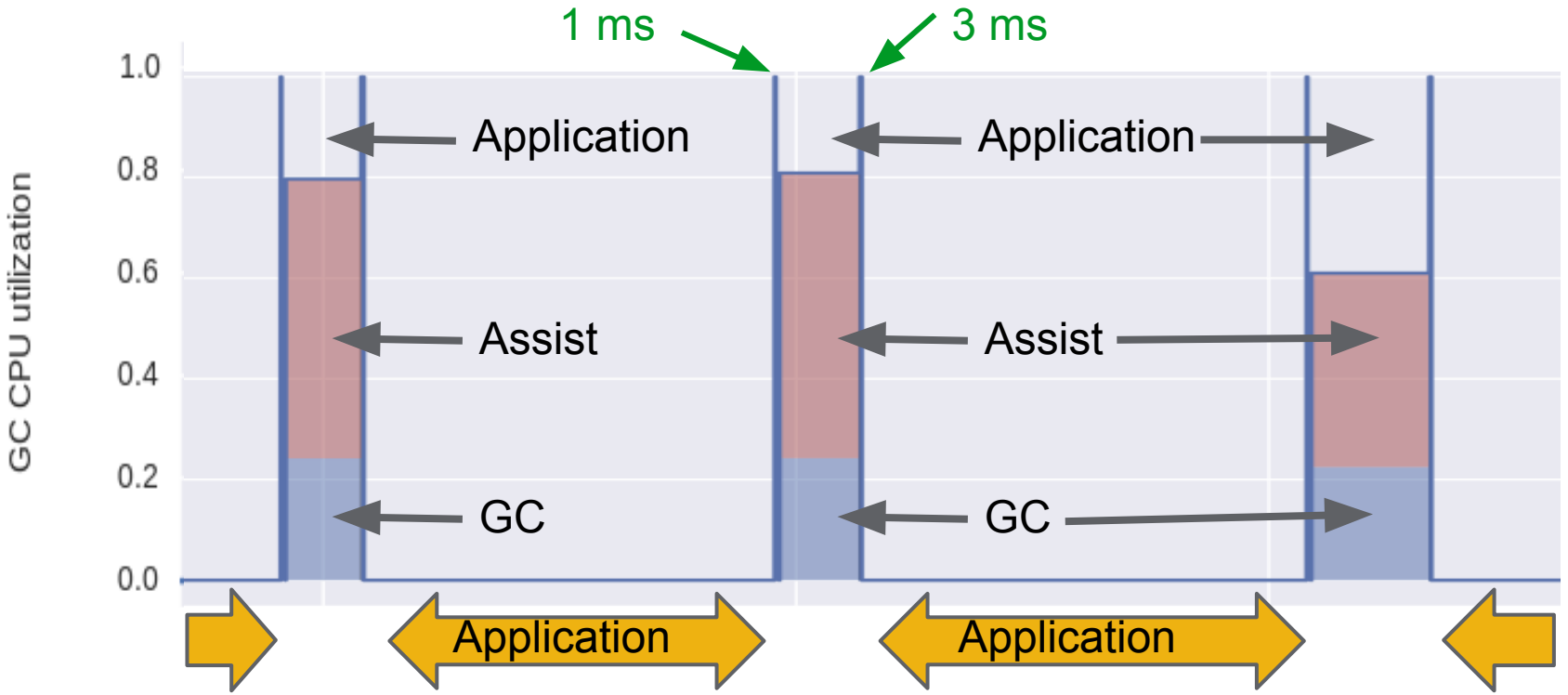


Correctness proofs in literature (see me)

1.4 Stop the World



1.5 Concurrent GC



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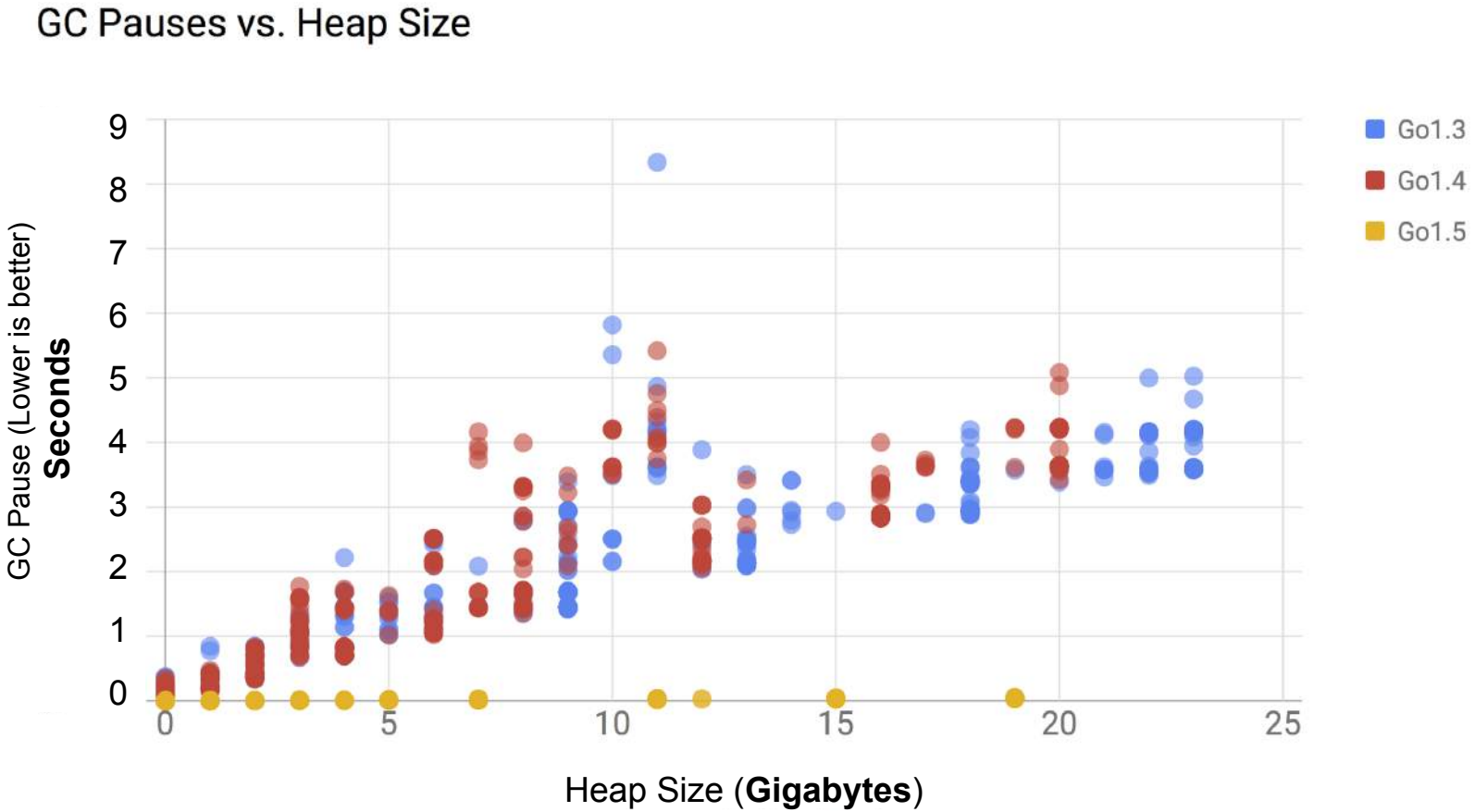
Garbage Benchmark



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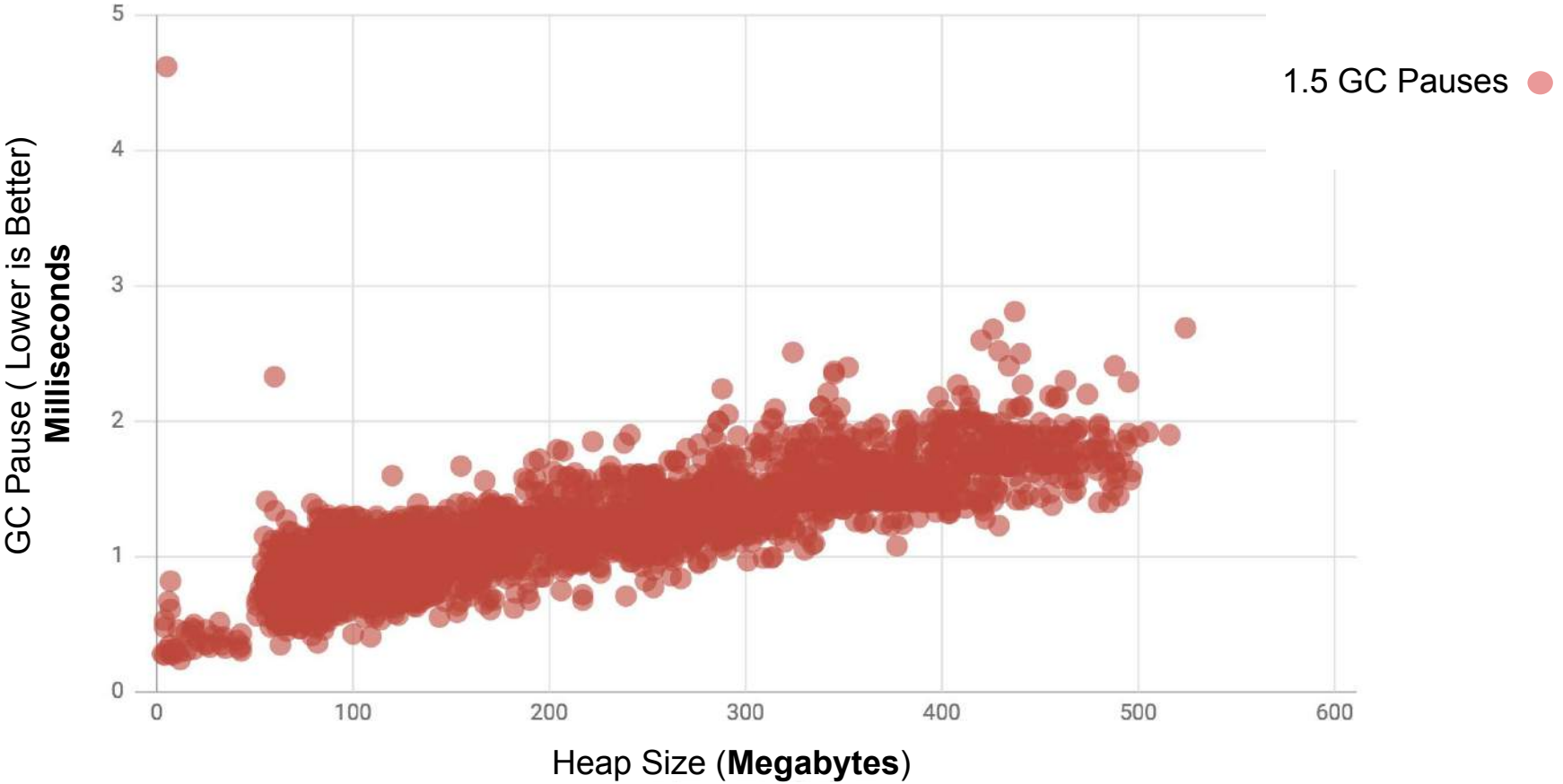
1.5 Garbage Benchmark Latency



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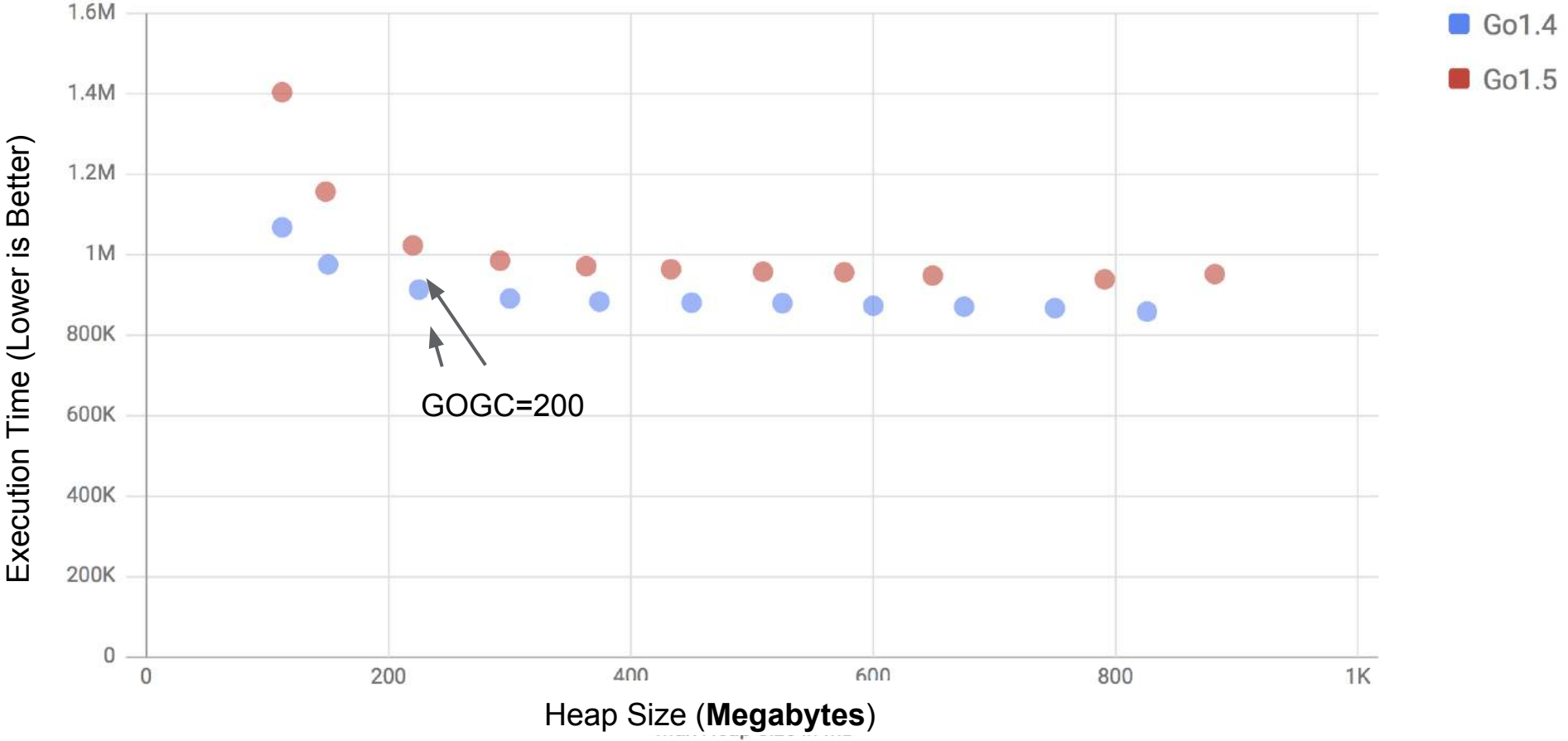
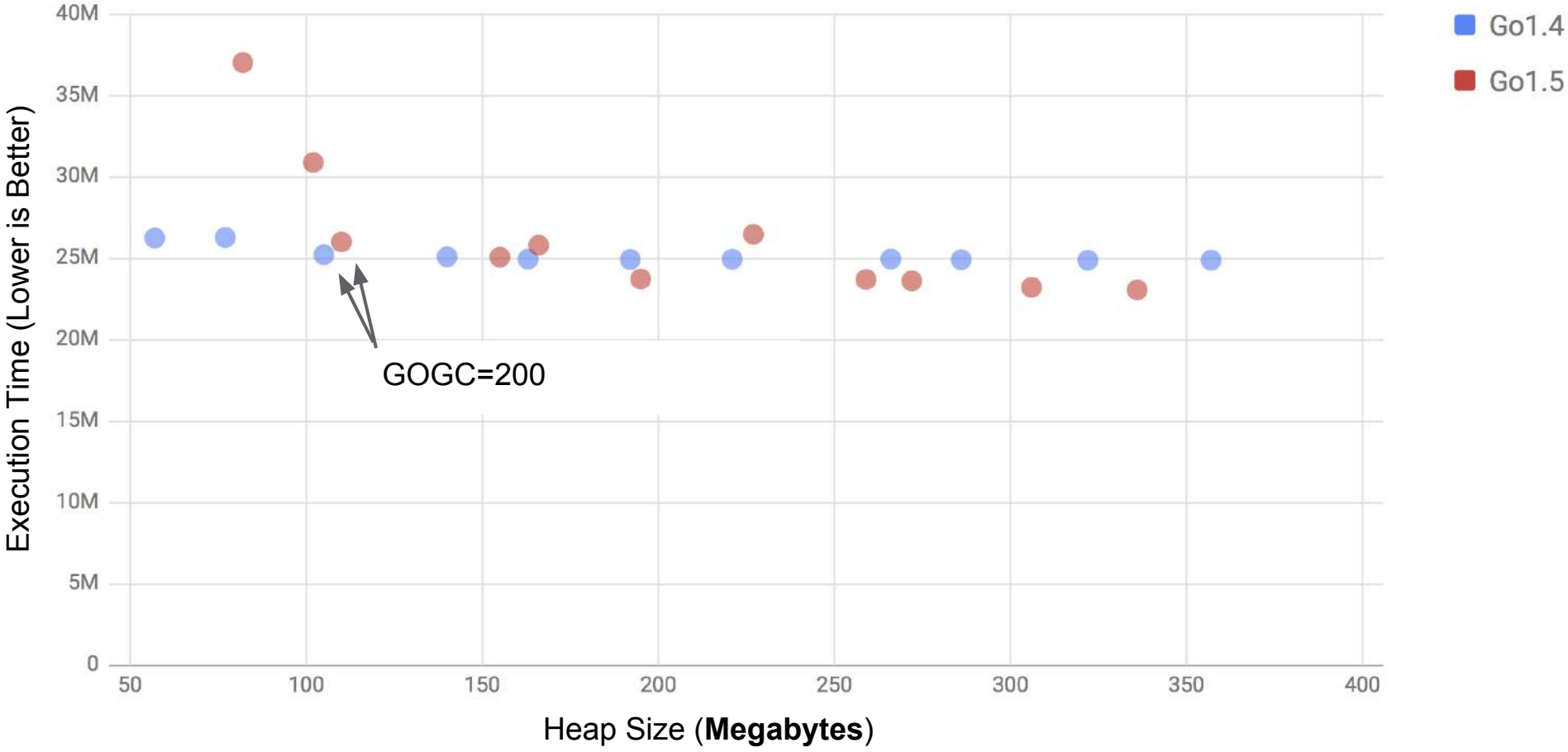
Splay: Increasing Heap Size == Better Performance



Google JSON: Increasing Heap Size == Better Performance



Onward

Tell people that GC is not a barrier with Go's low latency GC

Tune for even lower latency, higher throughput, more predictability
    Find the sweet spot.

1.6 work will be use case driven:
    Let's talk.

Increase Go Adoption
Establish Virtuous Cycle

Questions