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

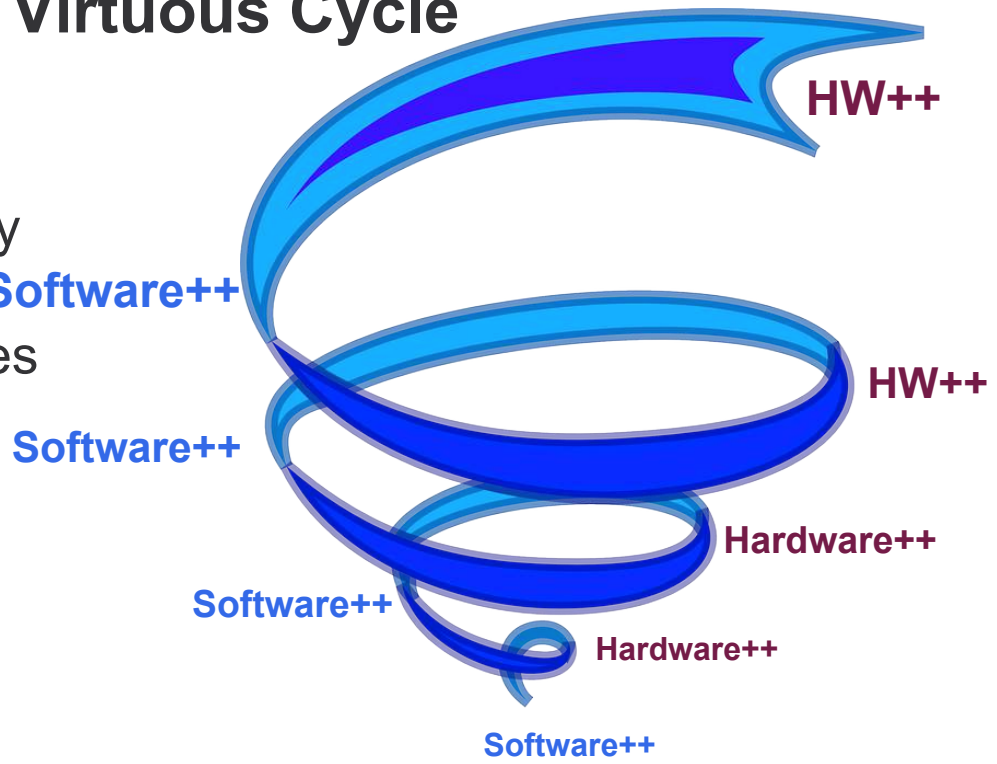
Only if software uses more cores

Long term

Establish a virtuous cycle

Short term

Increase Go Adoption

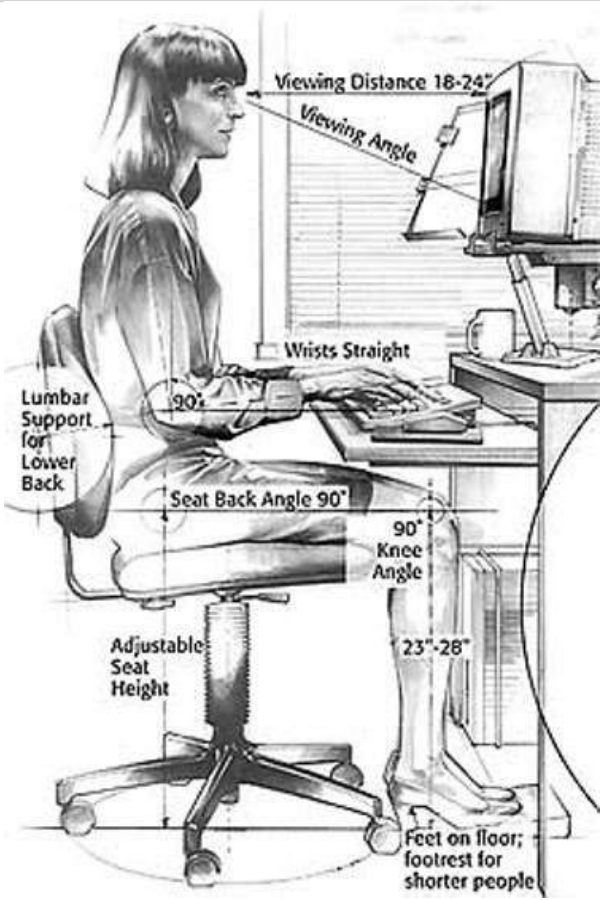


#1 Barrier: GC Latency

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

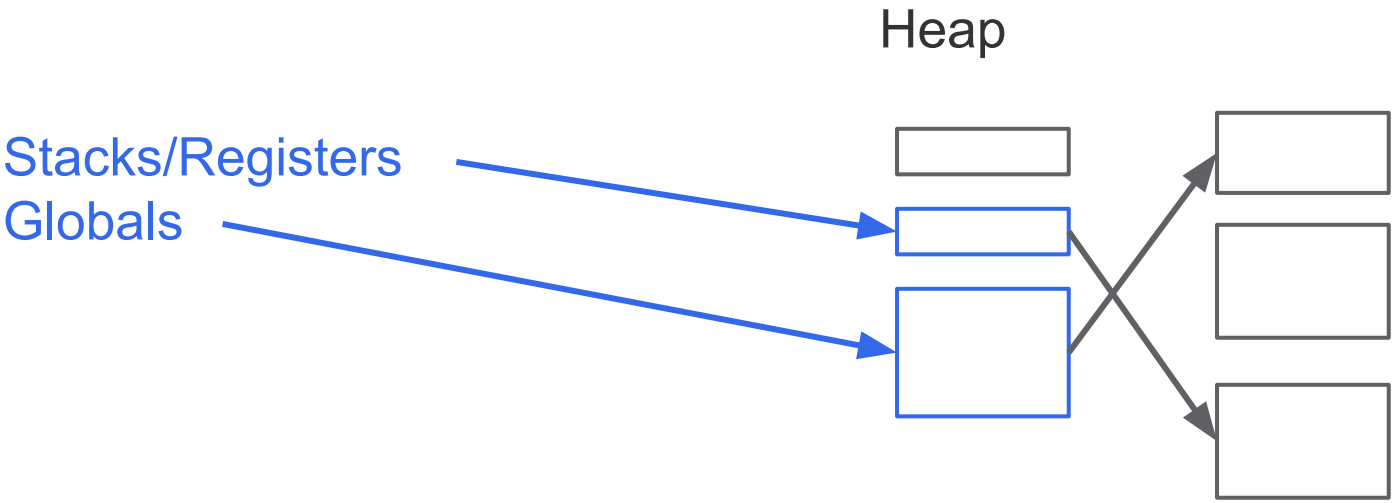
Go isn't Java: GC Related Go Differences

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)	

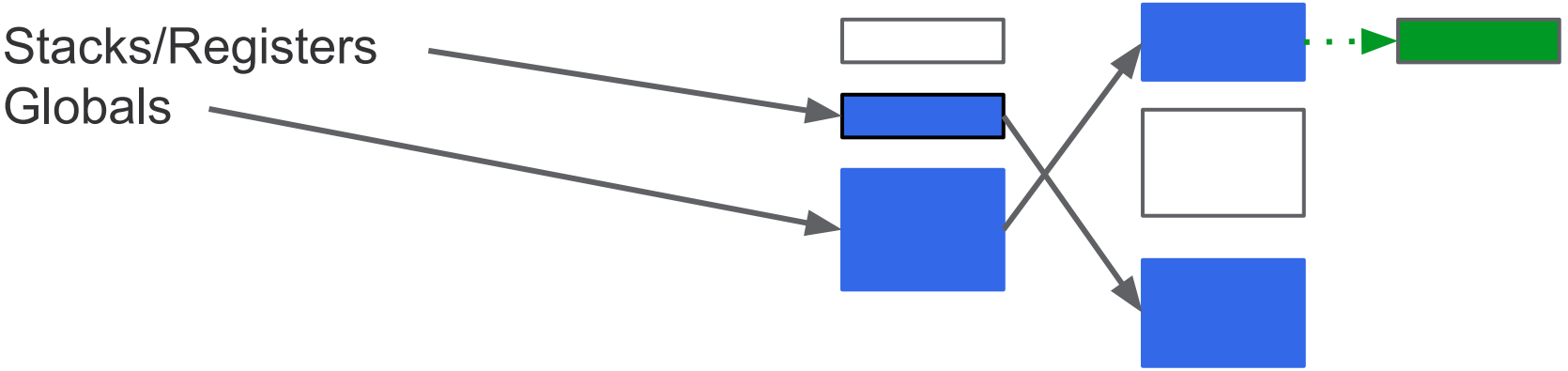
Let's Build a GC for Go

GC 101

Scan Phase



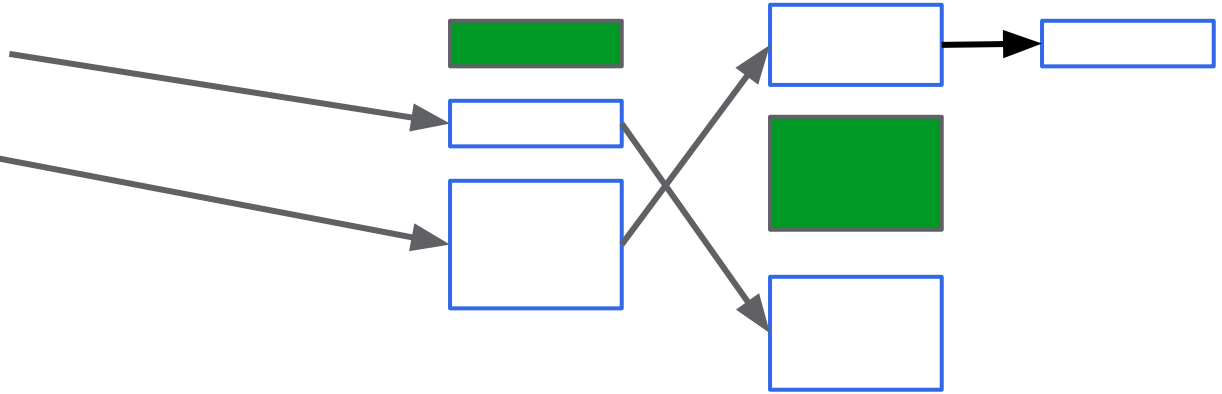
Mark Phase



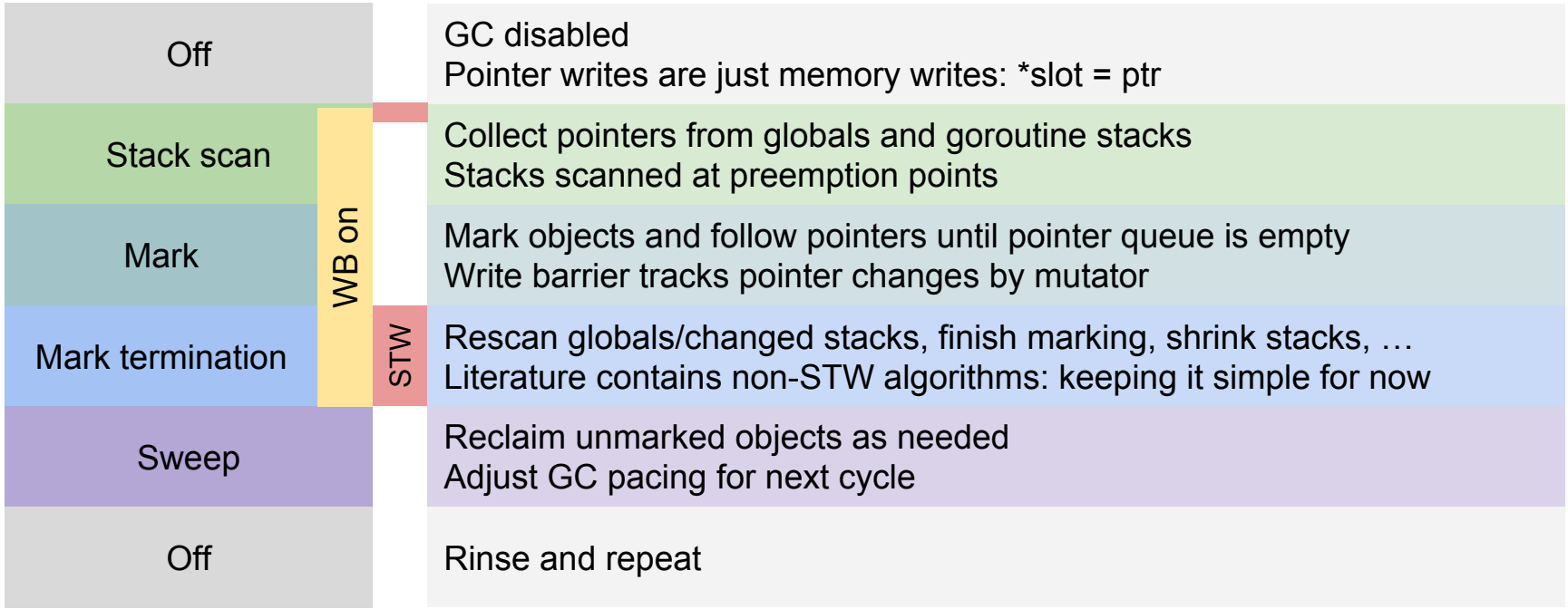
Righteous Concurrent GC struggles with Evil Application changing pointers

Sweep Phase

Stacks/Registers
Globals

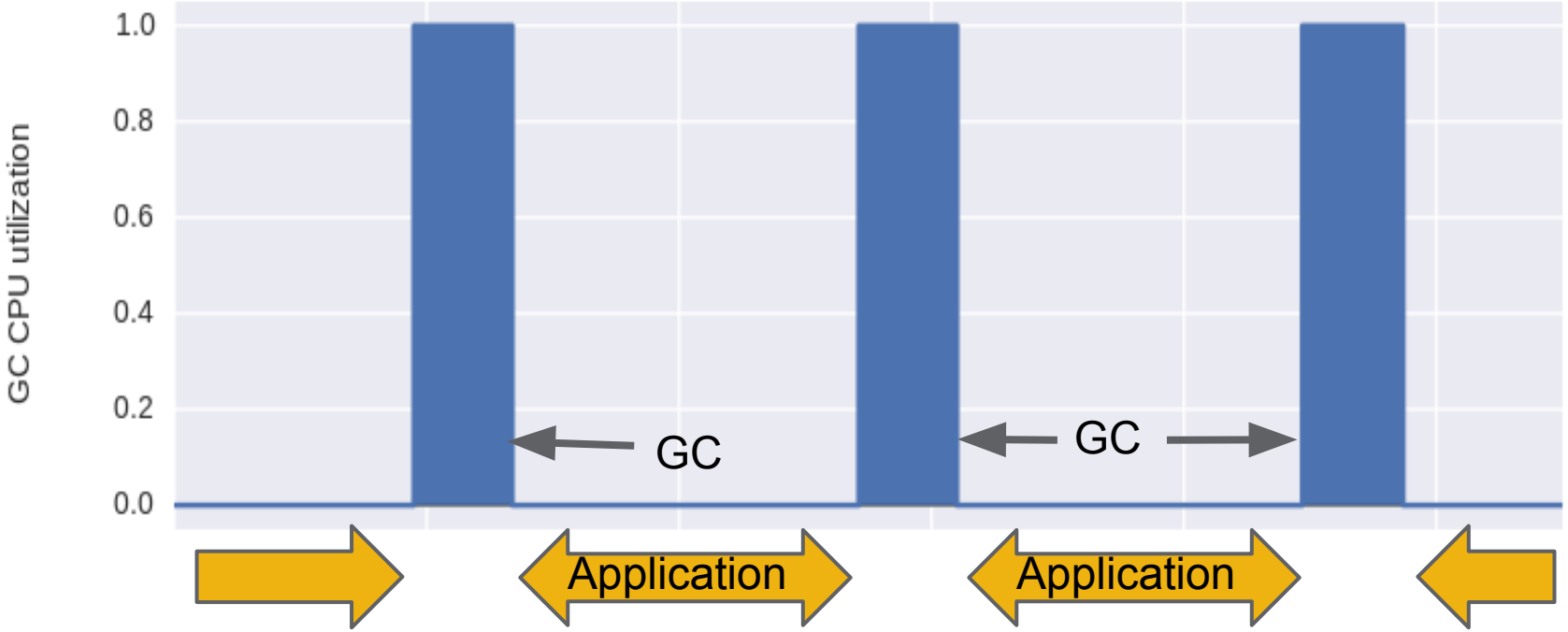


GC Algorithm Phases

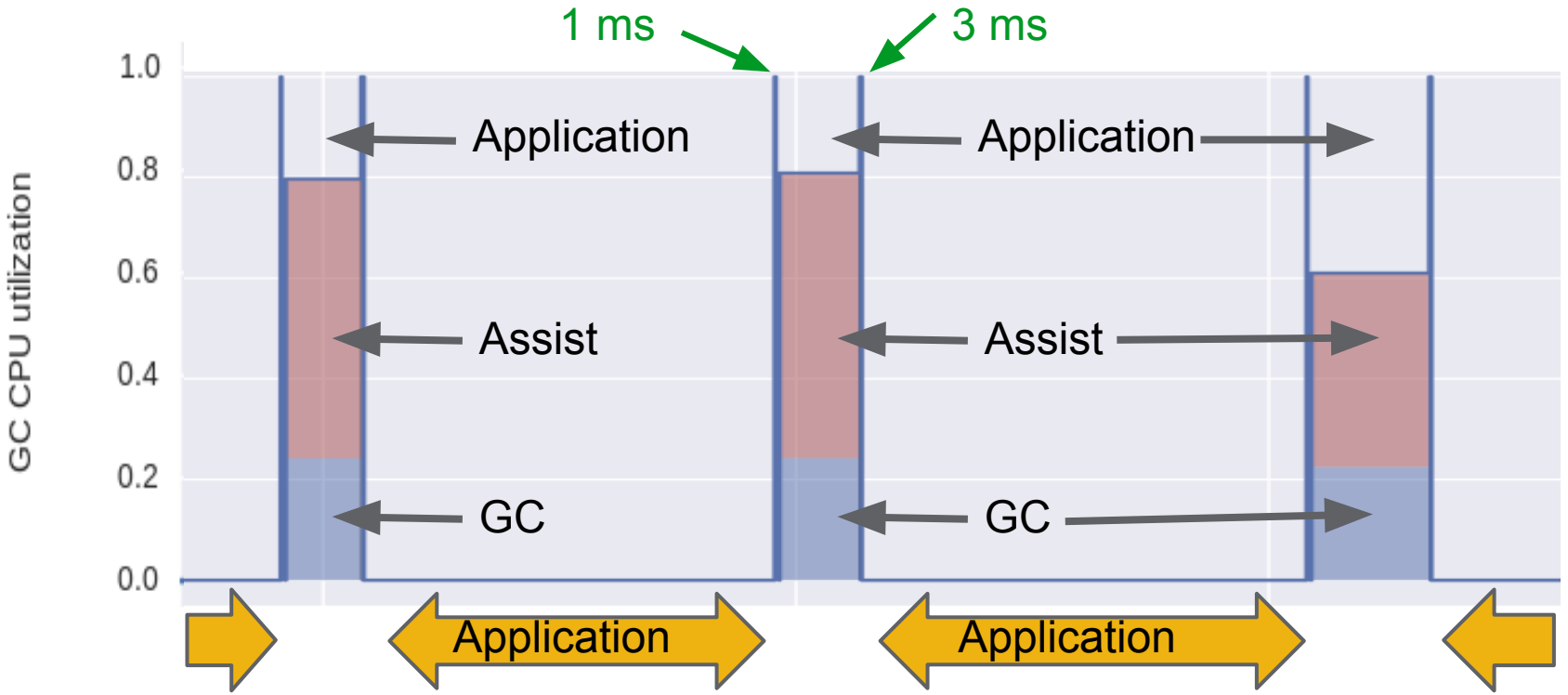


Correctness proofs in literature (see me)

1.4 Stop the World



1.5 Concurrent GC



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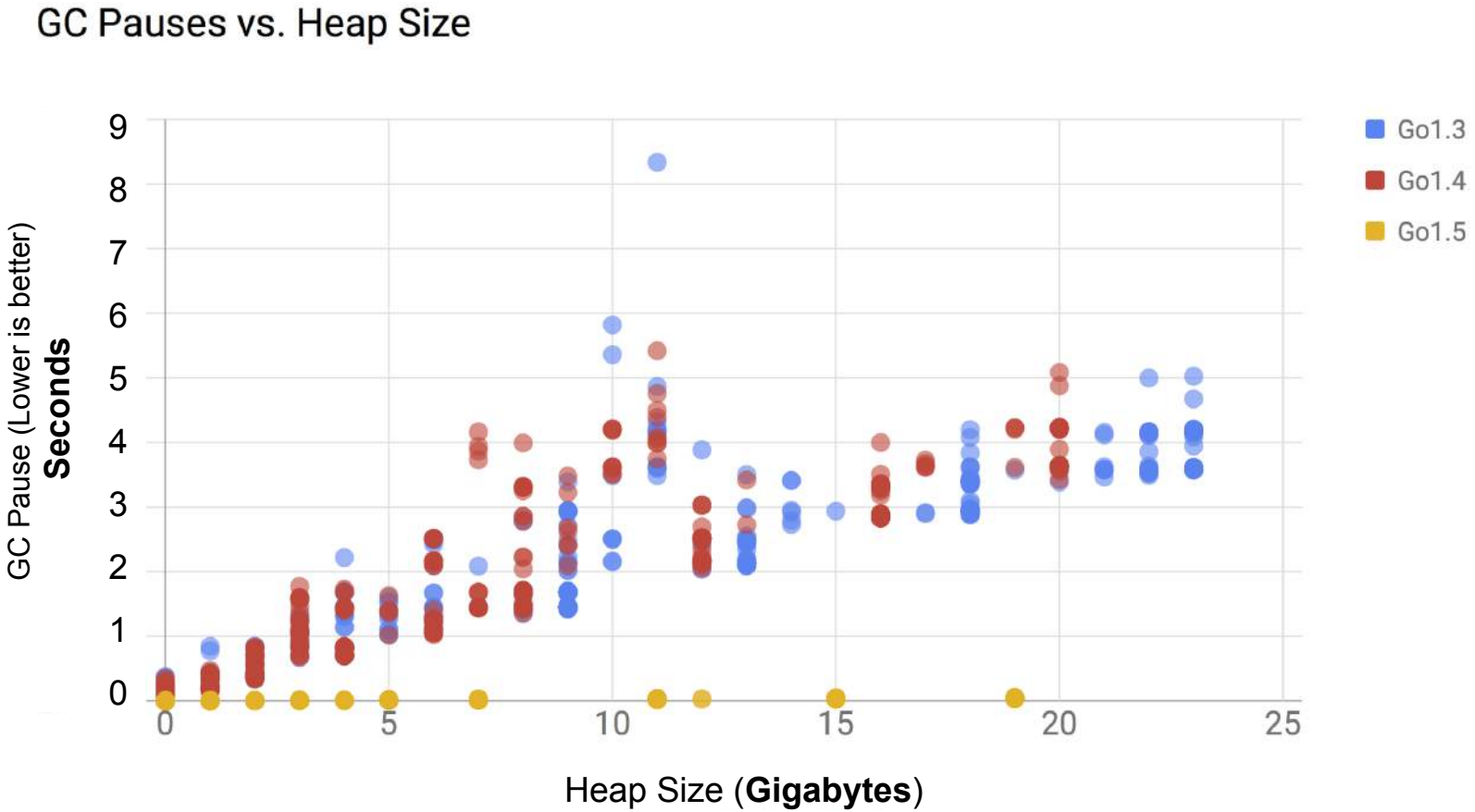
Garbage Benchmark



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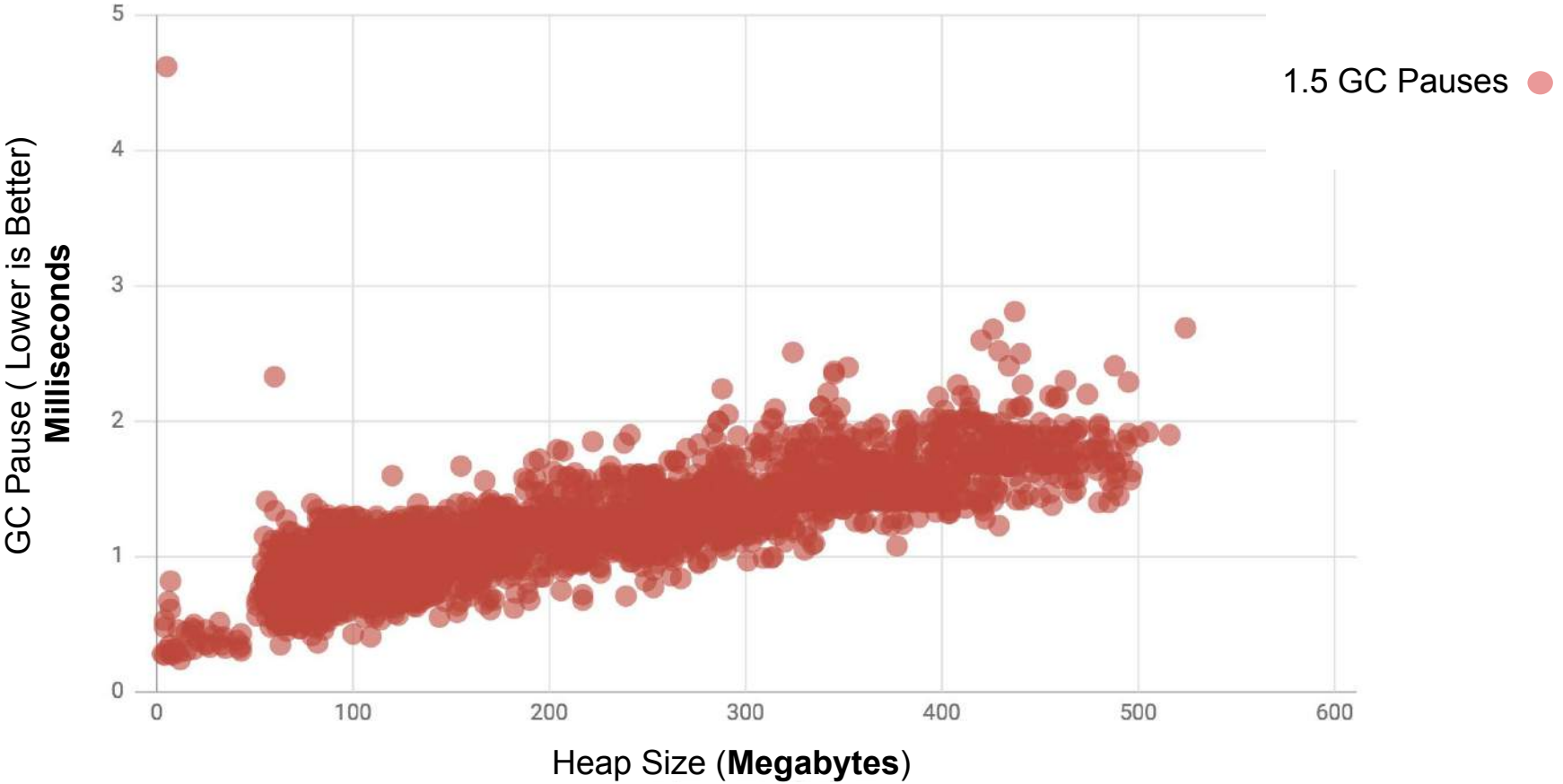
1.5 Garbage Benchmark Latency



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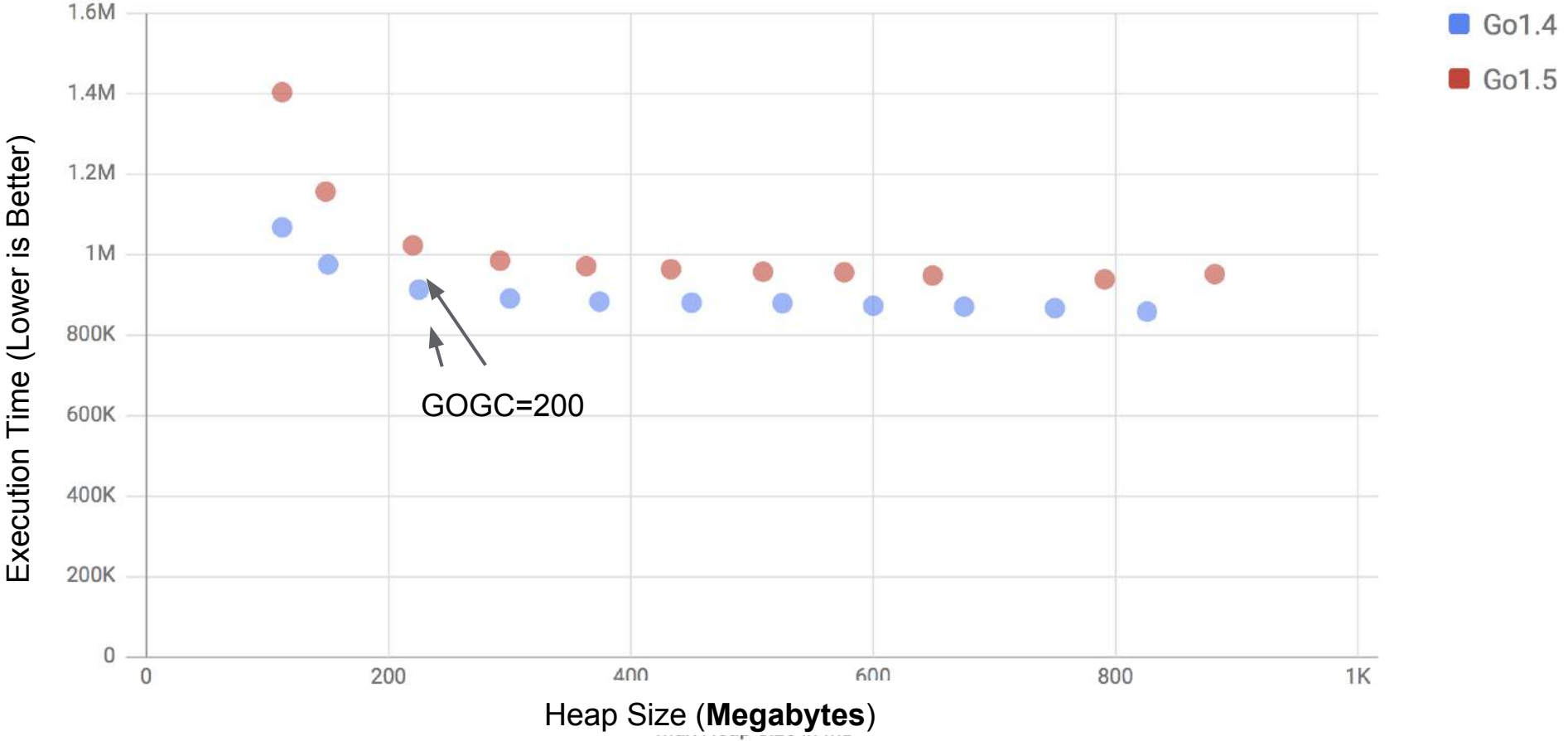
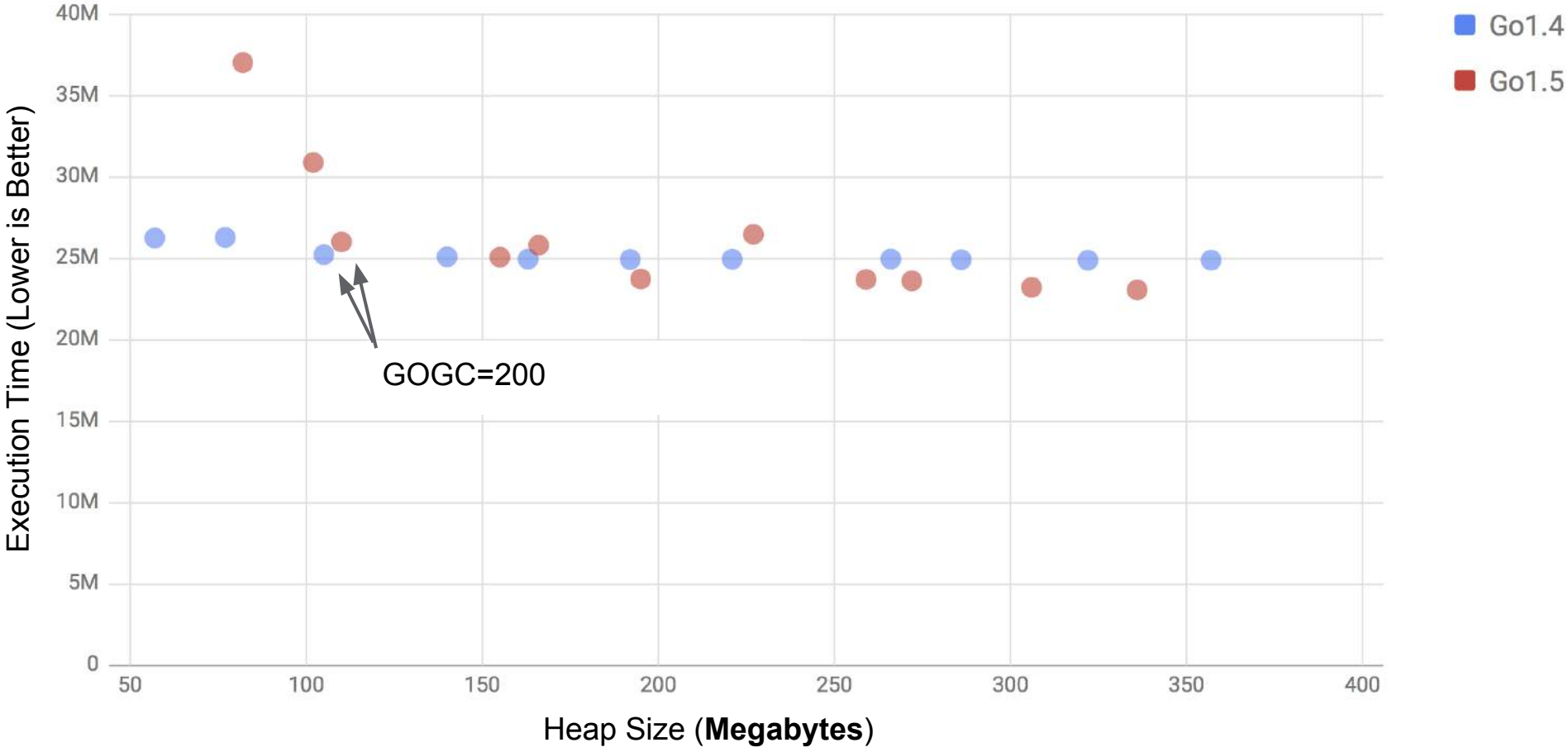
Splay: Increasing Heap Size == Better Performance



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