#ASLI ENGINEERING

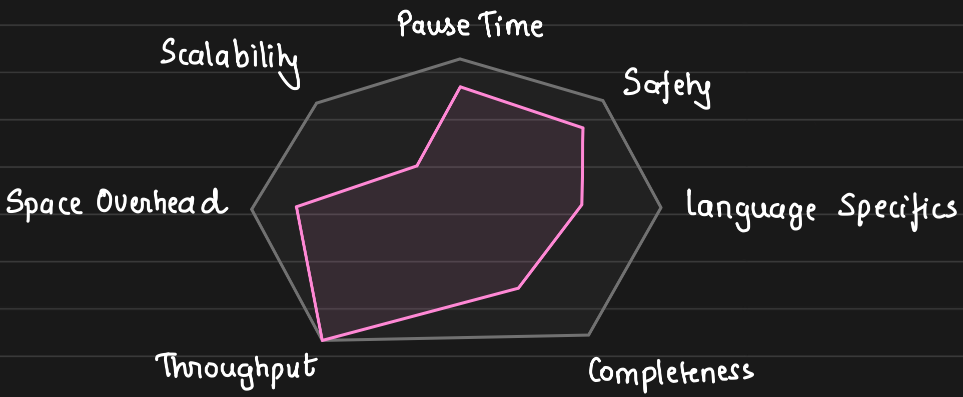
How to pick a Garbage Collector

SWIPE

BY

ARPIT BHAYANI

Metrics of a Garbage Collector



There is no 'best' garbage collector

From a study done on Garbage Collectors in 2000s →

There are many Garbage Collectors and each one is superior than others in atleast one use-case by atleast 15%.

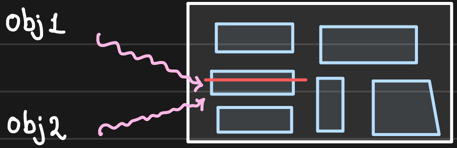
* Most GCs give you a lot of knobs to tune the performance for the load you are handling

- XX: UseSerialGC
- XX: UseParallelGC
- XX: MaxGCPauseMillis
- XX: GCTimeRatio
- XX: MinHeapFreeRatio

After a certain scale you will be spending more time tuning these params than coding.

ARPIT BHAYANI

1. Safety   collector must never reclaim the storage of live objects.

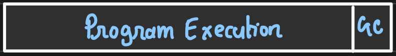


obj1 and obj2 are pointing to the same location in memory. GC should NOT be deleting & relaiming the space

* No Dangling Pointers

2. Throughput   The time spent in garbage collection should be as low as possible.

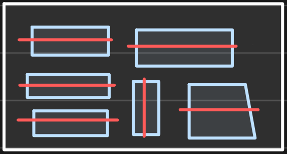
User wants "program" + "garbage collection" to execute in as little time as possible.



Most GC trades its performance and execution time in favour of higher program exec. throughput

eg: Once a while GC will run an expensive defragmentation phase so as to improve on program's memory allocation performance.

3. Completeness   eventually, all garbage in the heap should be reclaimed



Complete cleanup in one shot is not desirable nor always possible
Hence the word Eventual

One cycle v/s many cycles

ARPIT BHAYANI

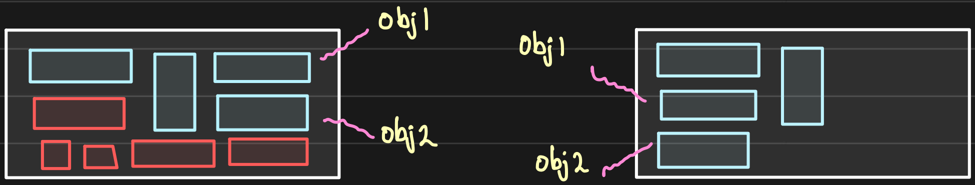
4. Pause Time   Many garbage collectors pause the program execution during cleanup ; this pause should be as low as possible

* One of the most $\boxed{\text{important}}$ and $\boxed{\text{impactful}}$ metric

Most execution of GC do not " stop the world " but some times to maintain the correctness of references it needs to stop the world

$\boxed{\text{Defragmentation}}$

$\boxed{\text{Object Shuffling}}$



Garbage collectors do their best to reduce the Pause Time
but it comes with its own set of challenges & complications

5. Space Overhead   GC may require auxiliary data structures to track objects and decide efficiently
but it puts additional load on memory and consumption

Bitmap Tables → To keep a check on objects already considered
Graphs → To manage & maintain object dependency

ARPIT BHAYANI

6. Language Specific Optimizations A GC may provide language specific optimizations to gain that extra ounce of performance

eg: some languages are pure functional
some languages have only heap allocation
some languages may have explicit de-allocation
some languages have only persistent data structures

A GC exploits its understanding of the language and its constructs to optimize its execution.

* Some GC runs in constant time because of how objects are laid out by the memory manager

7. Scalability GC needs to leverage the modern hardware capabilities to make its execution faster.

Servers are growing... 10s and 100s GB of heap and hence GC will have a lot of work to do going through this massive heap

This would increase the GC time and hence GC that always stop the world become inefficient ↖ Favoured

Some GCs have evolved & become Pause free

ARPIT BHAYANI