

Master Thesis

Expiration Classes for Implicit Memory Management

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- Build a real time memory management for Java
- Allow the programmer to improve the system by giving additional information
 - Improve performance
 - Improve predictability
 - Improve correctness

- Java uses garbage collection
 - No predictability
 - No garbage collection algorithm is independent of the amount used memory
- How to use other memory management systems in Java?
 - No deallocation command available
- Which additional information can improve the system?

Expiration Class Analysis

- A concept to analyze memory management systems
 - Reveals costs and their origins

Definition

An **expiration class** is a set of objects which are deallocated at the same time.

Definition

The event which leads to the deallocation of an expiration class is called **expiration event**.

- We used expiration class analysis to identify proper memory management systems

Tracing Garbage Collection

- First implementation of garbage collection [1]

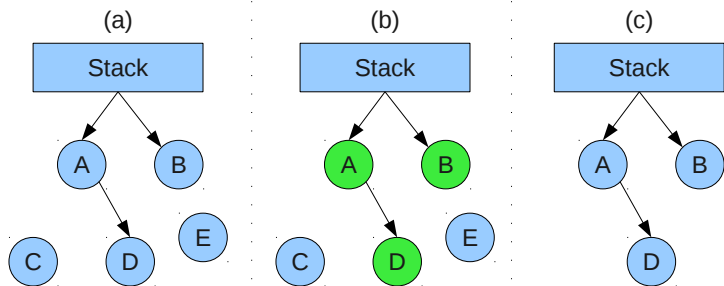


Figure: Example for Tracing

The tracing garbage collector provides the correctness we want to achieve

Cyclic Allocation

Definition

An **allocation site** is the command in the source code which allocates an object.

- Allocates objects of an allocation site into a cyclic buffer. [2]

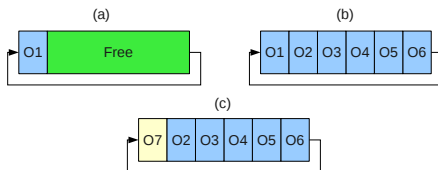


Figure: Cyclic Allocation

Cyclic allocation provides the predictability we want to achieve

- Combination of tracing garbage collection and cyclic allocation

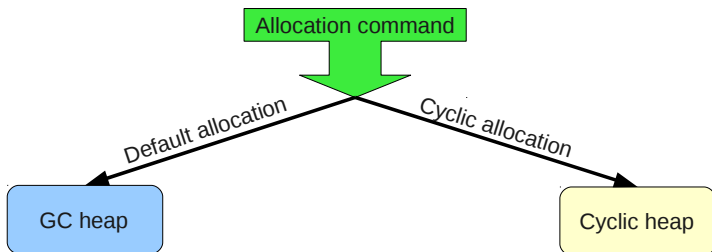


Figure: Allocation in AGC

- Trade-off between Correctness of Garbage Collection and Predictability of Cyclic Allocation
 - Controlled by additional information given by the programmer
 - Predictable allocation time for objects with cyclic allocation
 - Correctness for objects in the garbage collected heap
- The use of cyclic allocation improves the performance of the system
- Overhead
 - Some space overhead because of buffer management
 - Some time overhead because of cross-heap-segment references

Benchmark: Monte Carlo

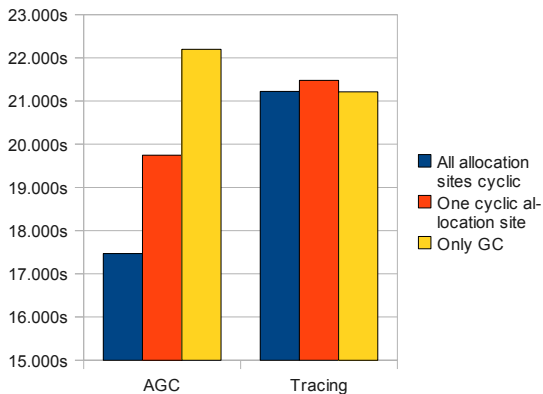


Figure: Monte Carlo: Average Time

Benchmark: JLayer MP3 Encoder

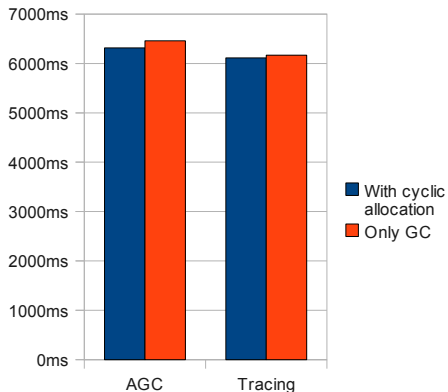


Figure: JLayer: Average Results

Benchmark: Cyclic Allocation Program

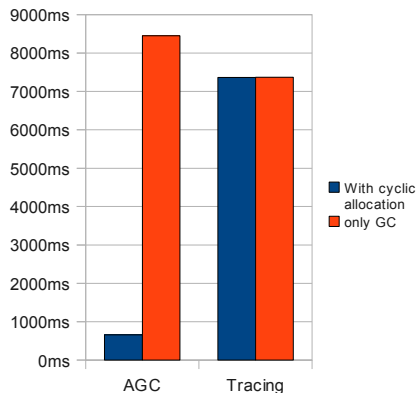


Figure: Cyclic Allocation Program: Average Results

Conclusion

- Expiration Class Analysis is a good help for understanding memory management systems
- Our System AGC either guarantees correctness or predictability for every allocation site
- The performance results justify the use of AGC

Thank you for your attention!
Questions?



J. McCarthy.

Recursive functions of symbolic expressions and their computation by machine, part i.

Commun. ACM, 3(4):184–195, 1960.



H. H. Nguyen and M. Rinard.

Detecting and eliminating memory leaks using cyclic memory allocation.

In *ISMM '07: Proceedings of the 6th international symposium on Memory management*, pages 15–30, New York, NY, USA, 2007. ACM.