Master Thesis
Expiration Classes for Implicit Memory Management

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Intention

- 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
Challenges

- 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
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]

![Cyclic Allocation](image)

**Figure**: Cyclic Allocation

Cyclic allocation provides the predictability we want to achieve
Combination of tracing garbage collection and cyclic allocation

Figure: Allocation in AGC
Properties of 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
Figure: Monte Carlo: Average Time
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?
References
