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Master's Thesis

The Heap of the Living Dead: Post-Mortem Memory Profiling for Java Applications

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Managed memory, i.e., garbage collected memory, has gained wide-spread use because it relieves the programmer from freeing heap objects manually and allows for fast allocations. However, these advantages come at the cost of a difficult to understand memory manager and garbage collector. Therefore, searching for memory-related performance degradations is a tedious task because the reasons for slow allocations, a large garbage collection pause, or a high garbage collection frequency might not be obvious.

The goal of this thesis is to extend the Hotspot Java Virtual Machine (VM) with an object tracing mechanism. It should be able to report every single object allocation including information about the object as well as the allocation process itself, i.e., type, size, address as well as the allocation thread, allocation site, allocator (VM, interpreter, compiler), and mode (slow and fast path). Furthermore, the interpreter, the compiler, and the garbage collector (GC) must be extended to track pointer updates and object movements respectively. Finally, a tool should be developed to debug the trace step-by-step, to visualize the heap and object movements, and potentially compare traces of two different runs.

As already existing tracing mechanisms aim for genericity among different VMs and GCs, this implementation should exploit VM-internal knowledge as much as possible in favor of performance. For simplification, the implementation may be limited to one compiler and garbage collector.

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