malloc() & free() in Scoped Memory

Adding Manual Memory Management to the Fiji™ VM

Prepared For:

CSE 605 - Advanced Concepts in Programming Languages
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Index

Recap of Checkpoint 1

- 100% Fragmentation-tolerant Allocation
  - Avoids need for cleanup
- Region for dynamic memory allocation
- Sets as Tracking Structure (Linked Lists)
- C Structures cast into Primitive and Array Blocks

Recap of Checkpoint 2

- Wrapper Classes for hooking up Java to C
- Methods available to programmer
- Added Primitive allocation/ deallocation
  - Interface methods for primitives
- Added Array allocation/ deallocation
  - Interface methods for arrays

Primitive Tests

- Primitive Tests
  - Correctness
  - Benchmarking

	Heap (CMR)	Heap (HF)	Unmanaged Memory
Integer Creation	59,447 ns	15,933 ns	62,461 ns
Integer Access	3456 ns	3140 ns	2140 ns
Total	425,380 ns	351,447 ns	876,881 ns

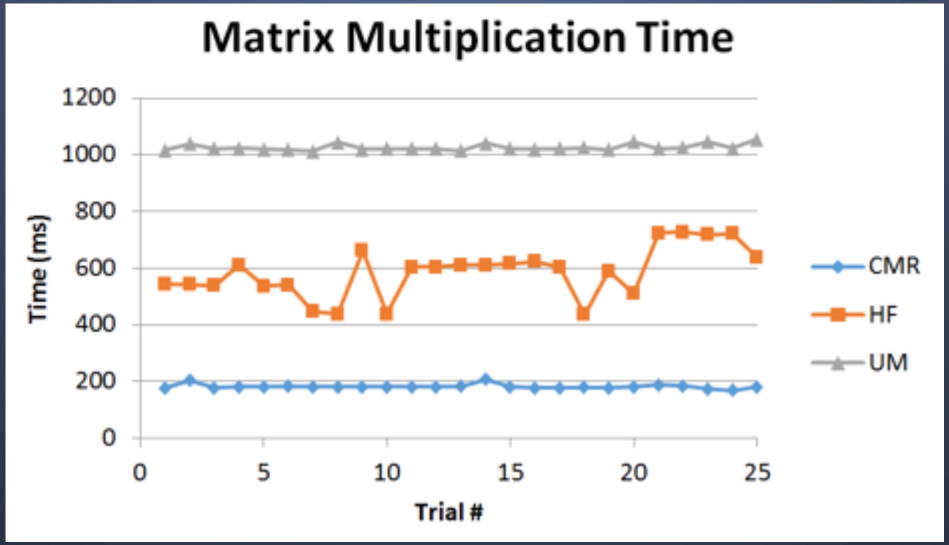
Array Correctness Testing

- Proper exception handling
- Proper invalid argument handling
- Memory Usage
- Memory Contents
- Expected behavior of existing Fiji APIs

Array Benchmarking

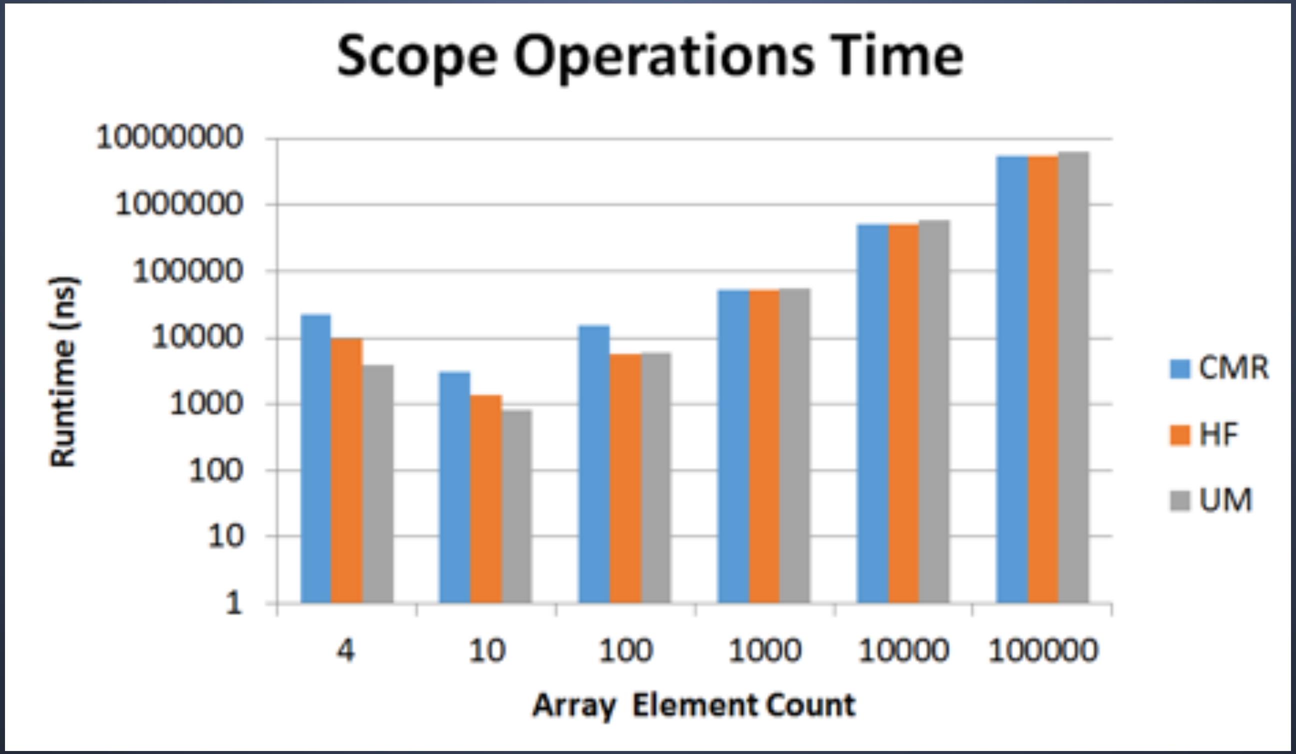
- Matrix Multiplication:

	Heap (CMR)	Heap (HF)	Unmanaged Memory	JVM (64-bit JRockit 7)
Array Allocation	537,608 ns	736,555 ns	382,308 ns	4,760,240 ns
Array Element Access	296,589 ns	676,489 ns	1,183,968 ns	196,622 ns
Array Element Mutation	8,665,398 ns	6,382,481 ns	6,456,606 ns	8,985,866 ns
Matrix Multiplication	182 ms	585 ms	1026 ms	107 ms



Array Benchmarking

- Scope Allocation:
  - Calculation involving a high amount of scope allocation/deallocation



Conclusion and Future scope

- Reduce overhead on array accesses
- Compiler integration
- Framework has been for object allocation/deallocation

- Multithreading
- Possibly completely avoid memory waste in arrays