Course Information

Course structure for Fall 2001

This reading seminar covers topics in memory management, with an emphasis on algorithms for automatic dynamic memory management, also known as garbage collection. This is an introductory course; advanced topics, including concurrent, parallel, and distributed algorithms, are left for a future class.

Previous acquaintance with procedural (especially object-oriented) and functional programming languages and their implementation is assumed.

Class will meet twice a week, and participants will make formal oral presentations of assigned reading material.

Assignments

Readings and oral presentations. You must attend all class meetings, read all assigned papers, and participate in class discussion. Each student will present at least three times, depending on the number of participants. Textbook chapters will be prepared by teams of two; research papers will be prepared individually.

Prerequisites

Experience with functional and object-oriented programming languages. Understanding of modern computer architecture.

Meetings

Mondays and Wednesdays, 4:00 - 5:15, in Tapy Hall 217

Instructor

Darko Stefanovic, office FEC 345C, phone 2776561, email darko@cs.unm.edu — office hours Mondays 2:50-3:50 or by appointment

Readings

Textbook

Richard Jones and Rafael Lins: *Garbage Collection: Algorithms for Automatic Dynamic Memory Management* John Wiley, 1996, ISBN 0-471-94148-4.

A comprehensive survey

Paul R. Wilson: Uniprocessor Garbage Collection Techniques, University of Texas, January 1994, ftp://ftp.cs.utexas.edu/pub/garbage/bigsurv.ps.

Detailed Course Plan

- Meeting 1: Organizational meeting. Background material review.
- Meeting 2: Why garbage collection? J&L Ch. 1
- Meeting 3: Overview of “classical” algorithms. J&L Ch. 2
- Meeting 4: Reference counting. J&L Ch. 3
- Meeting 5: Reference counting. J&L Ch. 3
- Meeting 6: Mark-sweep collection. J&L Ch. 4
- Meeting 7: Mark-sweep collection. J&L Ch. 4
- Meeting 8: Mark-compact collection. J&L Ch. 5
- Meeting 9: Mark-compact collection. J&L Ch. 5
- Meeting 10: Copying collection. J&L Ch. 6
- Meeting 11: Copying collection. J&L Ch. 6
- Meeting 12: Generational collection. J&L Ch. 7
- Meeting 13: Cache-conscious collection. J&L Ch. 11
- Meeting 14: Cache-conscious collection. J&L Ch. 11
- Meeting 15: Garbage collection for C and C++. J&L Ch. 9, 10
- Meeting 16: Garbage collection for C and C++. J&L Ch. 9, 10

- (Meetings 17-21: object lifetimes) Meeting 17: Christina Ruggieri and Thomas P. Murtagh: Lifetime Analysis of Dynamically Allocated Objects, POPL88.
- Meeting 18: Henry G. Baker: Thermodynamics of Garbage Collection. Henry G. Baker: 'Infant Mortality' and Generational Garbage Collection
- Meeting 19: David A. Barrett and Benjamin G. Zorn: Using Lifetime Predictors to Improve Memory Allocation Performance.
- Meeting 20: Darko Stefanović and J. E. B. Moss: Characterisation of Object Behaviour in Standard ML of New Jersey.
- Meeting 21: William D. Clinger and Lars T. Hansen: Generational Garbage Collection and the Radioactive Decay Model.
- (Meetings 22-25: Locality effects) Meeting 22: Mark B. Reinhold: Cache Performance of Garbage-Collected Programs.
- Meeting 23: Marcelo J. R. Gonçalves and Andrew W. Appel: Cache Performance of Fast-Allocating Programs.
- Meeting 24: David Tarditi and Amer Diwan: The Full Cost of a Generational Copying Garbage Collection Implementation.
- Meeting 25: Eric Cooper and Scott Nettles and Indira Subramanian: Improving the Performance of SML Garbage Collection using Application-Specific Virtual Memory Management.
- Meeting 26: Anthony L. Hosking and J. Eliot B. Moss and Darko Stefanović: A Comparative Performance Evaluation of Write Barrier Implementations.
- Meeting 27: Urs Hölzle and David Ungar: Do Object-Oriented Languages Need Special Hardware Support?
- Meeting 28: Amer Diwan and J. Eliot B. Moss and Richard L. Hudson: Compiler Support for Garbage Collection in a Statically Typed Language.
- Meeting 29: Andrew W. Appel: Garbage Collection can be Faster than Stack Allocation.
- Meeting 30: Richard L. Hudson, J. Eliot B. Moss, Sreenivas Subramoney, and Weldon Washburn: Cycles to Recycle: Garbage Collection on the IA-64, ISMM 2000