CS270: Advanced Operating Systems

Course Project on File System Implementation

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Outline

Introduction: Design Goals

- Iterative approach to development
- Encapsulation
- Testable
  - object-oriented design
  - unit test for each object
  - integration test

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Introduction: Design Goals *(Cntd.)*

- General data structures
  - superblock
  - inode table
  - segment manager (LFS)
- Memory mapped files
  - performance gain at the cost of reliability
  - acceptable for high performance system
  - can be seen in Mach[1]

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+ Efficient paging as kernel handles it
– Lesser direct control
– Restricts fine-grained control over writes

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Architecture: Hybrid Log Structured File System (LFS)

- Superblock
  - holds references to all other file system data structures
  - initializes
    - the inode table
    - the segment controller
- Inodes
  - closely resembles inodes from UNIX FFS[2]
  - each inode contains 8 direct, 1 indirect, 1 double indirect, and 1 triple indirect blocks
  - additionally complicated by the need for an algorithm that allows moving both data blocks and indirect pages belonging to an inode

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Beyond Basics

- Segment controller
  - heavy lifting data structure
  - manages a pool of segments
  - tracks segment utilization for efficient GC
- Segment
  - each segment maps its data blocks to the inodes that own them
  - keeps a write head that allows for constant time chunk allocation
  - finding and garbage collecting low utilization chunks can be costly, however
- Experiences with LFS
  - \+ LFS dramatically decreased time to allocate chunks
  - \+ Faster sequential writes due to constant time chunk allocation
  - − Slower updates due to poor utilization of page cache when doing copy on write for updates
  - − Introduces costly GC operation

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Challenges

- Memory mapped interface
- Dropped pointer
- Off by one

Language choice: C++ 11

+ proper exception handling
+ proper memory management

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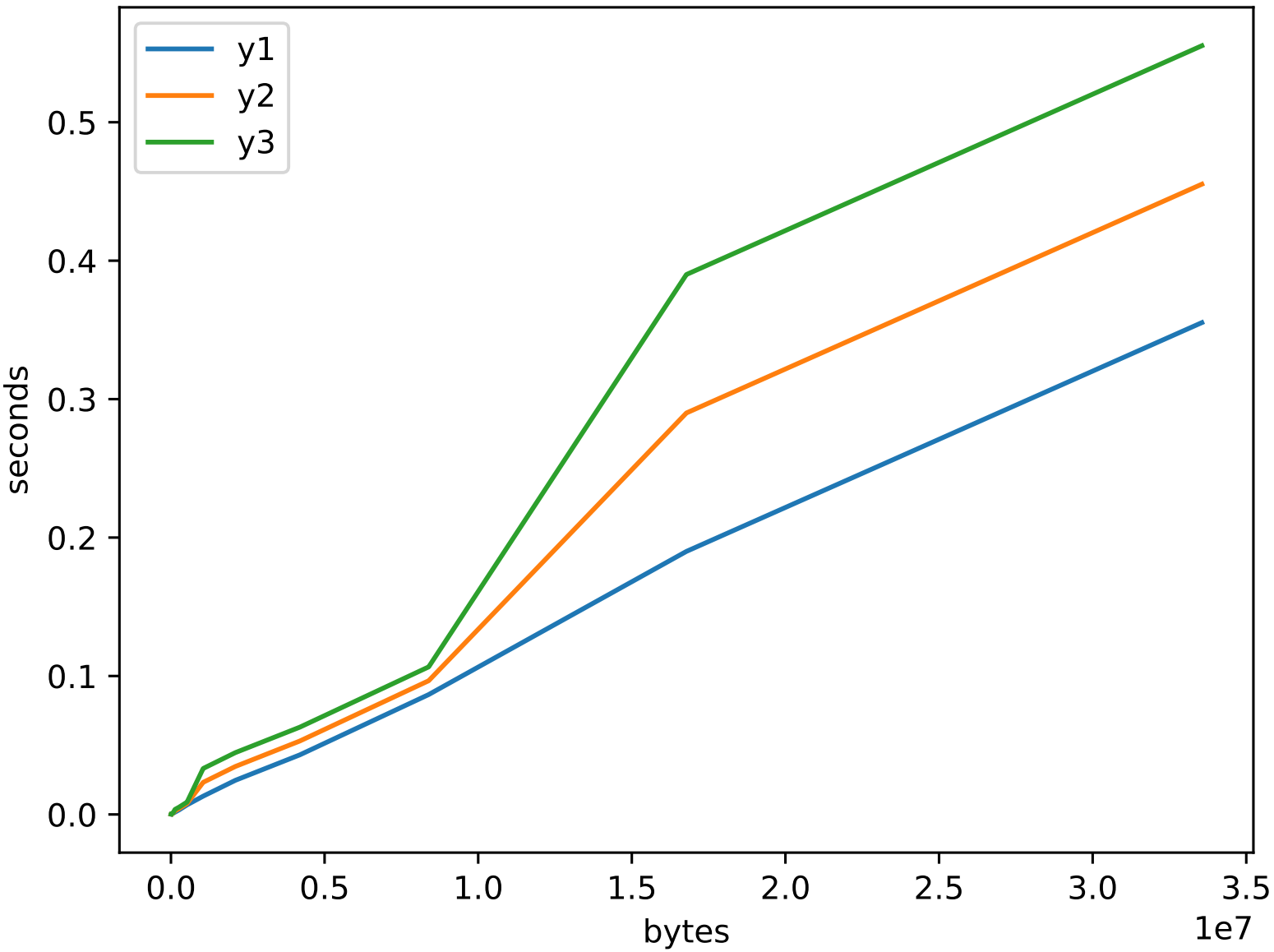
Performance Benchmark



Outline

Conclusion

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Questions?