

Advanced Operating Systems – Course Overview

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Course Goal

- What is Operating System?
- You all took the Operating Systems course. Any topic(s) you wish to have deeper exploration?
- This course looks at advanced topics
 - some already quite mature while others are topics of current research.
 - relate directly to real-world computer systems and practical problems.

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Topic #1 - Network Servers

- Online applications and concurrency management
- Performance modeling of network servers
- Request tracking and workload monitoring
- Replication and consistency management
- Server infrastructure at Google
 - Google file system, mapreduce, ...

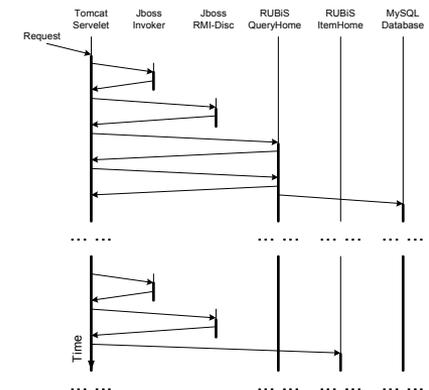
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Topic #1 Example

- Server request propagation [work with Chris Stewart]



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Topic #2 - I/O and storage systems

- Storage device characterization
- Concurrent I/O
- Data consistency with journaling
- Data persistence for delayed writes

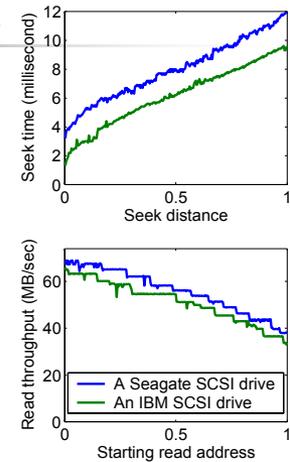
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Topic #2 Example

- Characterization of two SCSI disk drives



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Topic #3 - Performance measurement

- Measurement of concurrent servers
 - target measure: response time, throughput, ...
 - measurement stability/scalability
- Measurement confidence
 - confidence intervals, hypothesis testing, t-test, ...
- Regression-based modeling
 - linear/polynomial fitting, exponential fitting, double-exponential/power-law fitting, ...
- Workload characterization and benchmarking

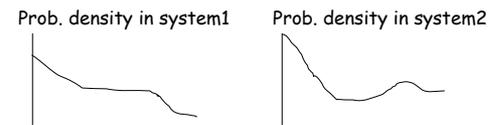
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Topic #3 Example - System Metric Comparison

- A metric (latency of a system call, number of outstanding I/O requests) is represented as a distribution of samples



- How to diff two distributions?
 - difference on expected means
 - earth mover's distance (difference in shape)

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Topic #4 - Virtualization

- Virtual machine overview
- Virtual machine I/O processing
- Virtual machine memory management
- Virtual machine for manageability, reliability, data durability, ...

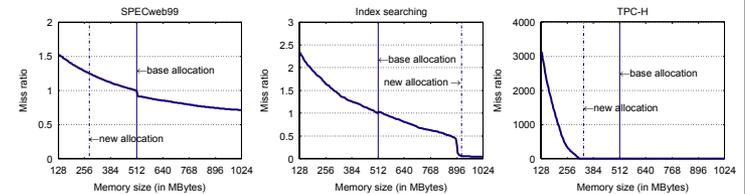
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Topic #4 Example

- Virtual machine adjustment of memory allocation [work with Pin Lu]



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Topic #5 - System dependability

- Scalable model checking
- Anomaly detection and characterization
- Comprehensive anomaly depiction
- Error monitoring

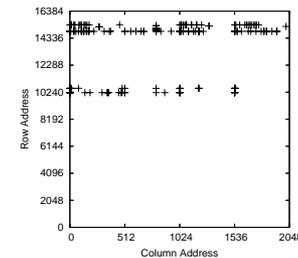
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Topic #5 Example

- Memory hardware errors [work with Xin Li and Michael Huang]



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Topic #6 - Hardware-related issues

- OS utilization of processor hardware counters
- OS issues with multi-core processors
 - CPU scheduling
 - Cache space allocation



Assignments and the final project

- Probable assignments
 - computer system performance measurement
 - analysis of real system traces
 - some OS kernel work – likely related to the I/O system
- Final project
 - encouraged to do something you are interested (something directly related to your AI/theory research)
 - there will be some fallback options
- System programming (C/C++) and data processing (Perl)
- Turn in written reports
- No exams