Lesson 1: Intro to AOS

L01a: Principle of Abstraction

1. Principle of Abstraction Introduction
2. Background Material
3. Which is an OS
4. The Hierarchy
5. Which is Not an Abstraction (Quiz)
6. Digging Deeper Into the Power of Abstractions
7. Name the Abstractions (Quiz)
8. Google Earth
9. Principle of Abstraction Conclusion

L01b: Hardware Resources

1. Hardware Resources Introduction
2. Hardware Continuum (Quiz)
3. Hardware Resources in a Computer System
4. Organization With I O Bus
5. The Specifics
6. Hardware Resources Conclusion

L01c: OS Functionality

1. OS Functionality Introduction
2. OS Functionalities (Quiz)
3. What is an OS
4. A Few Examples
5. Mouse Click (Quiz)
6. What Happens When You Click Your Mouse

L01d: Managing the CPU and Memory

1. Managing the CPU and Memory Introduction
2. How is it Possible (Quiz)
3. Catering to Resource Requirements
4. Precious Resources (Quiz)
5. The Modern OS
6. Processor Related OS Abstractions
7. Difference Between Process and Thread
8. Memory Related OS Abstraction
9. Managing the CPU and Memory Conclusion

Lesson 2: OS Structures

L02a: OS Structure Overview

1. OS Structure Overview Introduction
2. OS System Services (Quiz)
3. OS Structure
4. Importance of OS Structure (Quiz)
5. Goals of OS Structure
6. Commercial OS
7. Monolithic Structure
8. DOS-like Structure
9. DOS-like Structure Pros and Cons (Quiz)
10. DOS-like Structure (cont)
11. Loss of Protection in DOS like Structure
12. Opportunities for Customization
13. Microkernel based OS Structure
14. Downside to Microkernel
15. Why Performance Loss
16. Features of Various OS (Quiz)
17. What do we Want

L02b: The SPIN Approach

1. The SPIN Approach Introduction
2. What are we Shooting for in OS Structure
3. Approaches to Extensibility
4. Logical Protection Domains
5. Pointers (Quiz)
6. Spin Mechanisms for Protection Domains
7. Customized OS With Spin
8. Example Extensions
9. Border Crossings (Quiz)
10. Spin Mechanisms for Events
11. Default Core Services in Spin
12. Default Core Service in Spin (cont)
13. The SPIN Approach Conclusion

L02c: The Exokernel Approach

1. Exokernel Approach to Extensibility
2. Examples of Candidate Resources
3. Implementing Secure Bindings
4. Exokernel vs Spin (Quiz)
5. Default Core Services in Exokernel
6. Secure Binding
7. Memory Management Using S TLB
8. Default Core Services in Exokernel (cont)
9. Revocation of Resources
10. Code Usage by Exokernel (Quiz)
11. Putting it all Together
12. Exokernel Data Structures
13. Performance Results of Spin and Exokernel

L02d: The L3 Microkernel Approach

1. The L3 Microkernel Approach Introduction
2. Microkernel-Based OS Structure
3. Potentials for Performance Loss
4. L3 Microkernel
5. Strikes Against Microkernel
6. Debunking User Kernel Border Crossing Myth
7. Cycles (Quiz)
8. Address Space Switches
9. Address Space Switches With As Tagged TLB
10. Liedke's Suggestions for Avoiding TLB Flush
11. Large Protection Domains
12. Upshot for Address Space Switching
13. Thread Switches and IPC
14. Memory Effects
15. Reasons for Mach's Expensive Border Crossing
16. Thesis of L3 for OS Structuring
17. The L3 Microkernel Approach Conclusion

Lesson 3: Virtualization

L03a: Intro to Virtualization

1. Intro to Virtualization Introduction
2. Virtualization (Quiz)
3. Platform Virtualization
4. Utility Computing
5. Hypervisors
6. Connecting the Dots
7. Full Virtualization
8. Para Virtualization
9. Modification of Guest OS Code (Quiz)
10. Para Virtualization (cont)
11. Big Picture

L03b: Memory Virtualization

1. Memory Virtualization Introduction
2. Memory Hierarchy
3. Memory Subsystem Recall
4. Memory Management and Hypervisor
5. Memory Manager Zoomed Out
6. Zooming Back In
7. Who Keeps PPN MPN Mapping (Quiz)
8. Shadow Page Table
9. Efficient Mapping (Full Virtualization)
10. Efficient Mapping (Para Virtualization)
11. Dynamically Increasing Memory
12. Ballooning
13. Sharing Memory Across Virtual Machines
14. VM Oblivious Page Sharing
15. Successful Match
16. Memory Allocation Policies

L03c: CPU & Device Virtualization

1. CPU & Device Virtualization Introduction
2. CPU Virtualization
3. Second Part (Common to Full and Para)
4. Device Virtualization Intro
5. Device Virtualization
6. Control Transfer
7. Data Transfer
8. Control and Data Transfer in Action
9. Disk I O Virtualization
10. Measuring Time
11. Xen and Guests
12. CPU & Device Virtualization Conclusion

Lesson 4: Parallel Systems

L04a: Shared Memory Machines

1. Shared Memory Machine Model
2. Shared Memory and Caches
3. Processes (Quiz)
4. Memory Consistency Model
5. Memory Consistency and Cache Coherence
6. Hardware Cache Coherence
7. Scalability

L04b: Synchronization

1. Lesson Summary
2. Synchronization Primitives
3. Programmer's Intent (Quiz)
4. Programmer's Intent Explanation
5. Atomic Operations
6. Scalability Issues With Synchronization
7. Native Spinlock
8. Problems With Native Spinlock (Quiz)
9. Caching Spinlock
10. Spinlocks With Delay
11. Ticket Lock
12. Spinlock Summary
13. Array Based Queueing Lock
14. Array Based Queueing Lock (cont)
15. Array Based Queueing Lock (cont)
16. Link Based Queueing Lock
17. Link Based Queueing Lock (cont)
18. Link Based Queueing Lock (cont)
19. Link Based Queueing Lock (cont)
20. Link Based Queueing Lock (cont)
21. Link Based Queueing Lock (cont)
22. Link Based Queueing Lock (cont)
23. Link Based Queueing Lock (cont)
24. Algorithm Grading (Quiz)

L04c: Communication

1. Barrier Synchronization
2. Problems With Algorithm (Quiz)
3. Counting Barrier
4. Sense Reversing Barrier
5. Tree Barrier
6. Tree Barrier (cont)
7. Tree Barrier (cont)
8. Tree Barrier (cont)
9. 4 Ary Arrival
10. Binary Wakeup
11. Tournament Barrier
12. Tournament Barrier (cont)
13. Tournament Barrier (cont)
14. Dissemination Barrier
15. Dissemination Barrier (cont)
16. Barrier Completion (Quiz)
17. Dissemination Barrier (cont)
18. Performance Evaluation

L04d: Lightweight RPC

1. RPC and Client Server Systems
2. RPC Vs Simple Procedure Call
3. Kernel Copies (Quiz)
4. Copying Overhead
5. Making RPC Cheap
6. Making RPC Cheap (Binding)
7. Making RPC Cheap (Actual Calls)
8. Making RPC Cheap (Actual Calls) cont
9. Making RPC Cheap (Actual Calls) cont
10. Making RPC Cheap Summary
11. RPC on SMP
12. RPC on SMP Summary

L04e: Scheduling

1. Scheduling First Principles
2. Scheduler (Quiz)
3. Memory Hierarchy Refresher
4. Cache Affinity Scheduling
5. Scheduling Policies
6. Minimum Intervening Policy
7. Minimum Intervening Plue Queue Policy
8. Summarizing Scheduling Policies
9. Scheduling Policy (Quiz)
10. Implementation Issues
11. Performance
12. Performance (cont)
13. Cache Affinity and Multicore
14. Cache Aware Scheduling
15. Scheduling Conclusion

L04f: Shared Memory Multiprocessor OS

1. Shared Memory Multiprocessor OS Introduction
2. OS for Parallel Machines
3. Principles
4. Refresher on Page Fault Service
5. Parallel OS and Page Fault Service
6. Recipe for Scalable Structure in Parallel OS
7. Tornado's Secret Sauce
8. Traditional Structure
9. Objectization of Memory Management
10. Objectized Structure of VM Manager
11. Advantages of Clustered Object
12. Implementation of Clustered Object
13. Non Hierarchical Locking
14. NonHierarchical Locking (cont)
15. Dynamic Memory Allocation
16. IPC
17. Tornado Summary
18. Summary of Ideas in Corey System
19. Virtualization
20. Virtualization to the Rescue
21. Shared Memory Multiprocessor OS Conclusion

Barrier Synchronization

1. Barrier Synchronization Introduction
2. Barrier Semantics
3. Open MP's Interface
4. OS Interface
5. Implement Counter
6. Implement MCS
7. Optimize Tree
8. Analyze SMP Results
9. Distributed Barriers
10. MPI's Interface
11. Implement Dissemination
12. Implement Tournament
13. Optimize Counter
14. Analyze Distributed Results

Lesson 5: Distributed Systems

L05a: Definitions

1. Definitions Introduction
2. What is a Distributed System (Quiz)
3. Distributed Systems Definition
4. A Fun Example
5. Happened Before Relationship
6. Relation (Quiz)
7. Happened Before Relation (cont)
8. Identifying Events (Quiz)
9. Example of Event Ordering

L05b: Lamport Clocks

1. Lamport Clocks Introduction
2. Lamport's Logical Clock
3. Events (Quiz)
4. Logical Clock Conditions
5. Need For a Total Order
6. Lamport's Total Order
7. Total Order (Quiz)
8. Distributed ME Lock Algorithm
9. Distributed ME Lock Algorithm (cont)
10. Messages (Quiz)
11. Message Complexity
12. Real World Scenario
13. Lamport's Physical Clock
14. IPC Time and Clock Dirft
15. Real World Example (cont)
16. Lamport Clocks Conclusion

L05c: Latency Limits

1. Latency Limits Introduction
2. Latency (Quiz)
3. Latency vs Throughput
4. Components of RPC Latency
5. Sources of Overhead on RPC
6. Marshaling and Data Copying
7. Marshaling and Data Copying (cont)
8. Control Transfer
9. Control Transfer (cont)
10. Protocol Processing
11. Protocol Processing (cont)
12. Latency Limits Conclusion

L05d: Active Networks

1. Active Networks Introduction
2. Routing on the Internet
3. Active Networks Example
4. How to Implement the Vision
5. ANTS Toolkit
6. ANTS Capsule and API
7. Capsule Implementation
8. Potential Apps
9. Pros and Cons of Active Networks
10. Roadblocks (Quiz)
11. Feasible
12. Active Networks Conclusion

L05e: Systems from Components

1. Systems from Components Introduction
2. The Big Picture
3. Digging Deeper From Spec to Implementation
4. Digging Deeper From Spec to Implementation (cont)
5. Digging Deeper
6. Putting the Methodology to Work
7. How to Optimize the Protocol Stack
8. NuPrl to the Rescue
9. NuPrl to the Rescue (cont)
10. Systems from Components Conclusion

Lesson 6: Distributed Objects and Middleware

L06a: Spring Operating System

1. Spring Operating System Introduction
2. How to Innovate OS
3. Object based vs Procedural Design
4. Spring Approach
5. Nucleus Microkernel of Spring
6. Object Invocation Across the Network
7. Secure Object Invocation
8. Abstractions (Quiz)
9. Virtual Memory Management in Spring
10. Memory Object Specific Paging
11. Spring System Summary
12. Dynamic Client Server Relationship
13. Subcontract
14. Subcontract Interface for Stubs
15. Spring Operating System Conclusion

L06b: Java RMI

1. Java RMI Introduction
2. Java Language (Quiz)
3. Java History
4. Java Distributed Object Model
5. Bank Account Example
6. Reuse of Local Implementation
7. Reuse of Remote
8. Implementation Preference (Quiz)
9. Java RMI at Work (Server)
10. Java RMI at Work (Client)
11. RMI Implementation (RRL)
12. RMI Implementation Transport
13. Java RMI Conclusion

L06c: Enterprise Java Beans

1. Enterprise Java Beans Introduction
2. Inter Enterprise View
3. Enterprise Java Beans Example
4. N Tier Applications
5. Structuring N Tier Applications
6. Design Alternative (Coarsegrain Session Beans)
7. Design Alternative (Data Access Object)
8. Design Alternative (Session Bean With Entity Bean)
9. Enterprise Java Beans Conclusion

Lesson 7: Distributed Subsystems

L07a: Global Memory Systems

1. Global Memory Systems Introduction
2. Context for Global Memory System
3. GSM Basics
4. Handling Page Faults Case 1
5. Handling Page Faults Case 2
6. Handling Page Faults Case 3
7. Handling Page Faults Case 4
8. Local and Global Boundary (Quiz)
9. Behavior of Algorithm
10. Geriatrics!
11. Geriatrics! (cont)
12. Implementation in Unix
13. Implementation in Unix (cont)
14. Data Structures
15. Data Structures (cont)
16. Putting the Data Structures to Work
17. Putting the Data Structures to Work (cont)
18. Putting the Data Structures to work (cont)
19. Global Memory Systems Conclusion

L07b: Distributed Shared Memory

1. Distributed Shared Memory Introduction
2. Cluster as a Parallel Machine (Sequential Program)
3. Cluster as a Parallel Machine (Message Passing)
4. Cluster as a Parallel Machine (DSM)
5. History of Shared Memory Systems
6. Shared Memory Programming
7. Memory Consistency and Cache Coherence
8. Sequential Consistency
9. SC Memory Model
10. Typical Parallel Program
11. Release Consistency
12. RC Memory Model
13. Distributed Shared Memory Example
14. Advantage of RC over SC
15. Lazy RC
16. Eager vs Lazy RC
17. Pros and Cons of Lazy and Eager (Quiz)
18. Software DSM
19. Software DSM (cont)
20. LRC with Multi Writer Coherence Protocol
21. LRC with Multi Writer Coherence Protocol (cont)
22. LRC with Multi Writer Coherence Protocol
23. Implementation
24. Implementation (cont)
25. Non Page Based DSM
26. Scalability
27. DSM and Speedup

28. Distributed Shared Memory Conclusion

L07c: Distributed File Systems

1. The First NFS (Quiz)
2. NFS
3. DFS
4. Lesson Outline
5. Preliminaries (Striping a File to Multiple Disks)
6. Preliminaries (Log Structured File System)
7. Preliminaries Software (RAID)
8. Putting Them All Together Plus More
9. Dynamic Management
10. Log Based Striping and Stripe Groups
11. Stripe Group
12. Cooperative Caching
13. Log Cleaning
14. Unix File System
15. XFS Data Structures
16. Client Reading a File Own Cache
17. Client Writing a File
18. Distributed File Systems Conclusion

Lesson 8: Failures and Recovery

L08a: Lightweight Recoverable Virtual Memory

1. Lightweight Recoverable Virtual Memory Introduction
2. Persistence
3. Server Design
4. RVM Primitives
5. RVM Primitives (cont)
6. How the Server Uses the Primitives
7. How the Server Uses the Primitives (cont)
8. Transaction Optimizations
9. Implementation
10. Crash Recovery
11. Log Truncation
12. Lightweight Recoverable Virtual Memory Conclusion

L08b: RioVista

1. RioVista Introduction
2. System Crash
3. LRVM Revisited
4. Rio File Cache
5. Vista RVM on Top of Rio
6. Crash Recovery
7. Vista Simplicity
8. RioVista Conclusion

L08c: Quicksilver

1. Cleaning up State Orphan Processes
2. Quicksilver Introduction
3. Quiz Introduction
4. Quicksilver (Quiz)
5. Distributed System Structure
6. Quicksilver System Architecture
7. IPC Fundamental to System Services
8. Bundling Distributed IPC and X Actions
9. Transaction Management
10. Distributed Transaction
11. Commit Initiated by Coordinator
12. Upshot of Bundling IPC and Recovery
13. Implementation Notes
14. Quicksilver Conclusion

Lesson 9: Internet Computing

L09a: Giant Scale Services

1. Giant Scale Services Introduction
2. Giant Scale Services (Quiz)
3. Tablet Introduction
4. Generic Service Model of Giant Scale Services
5. Clusters as Workhorses
6. Load Management Choices
7. Load Management at Network Level
8. DQ Principle
9. DQ Principle (cont)
10. Replication vs Partitioning
11. Graceful Degradation
12. Online Evolution and Growth
13. Online Evolution and Growth (cont)
14. Giant Scale Services Conclusion

L09b: MapReduce

1. MapReduce Introduction
2. MapReduce
3. Why MapReduce
4. Heavy Lifting Done by the Runtime
5. Heavy Lifting Done by the Runtime (cont)
6. Issues to be handled by the Runtime
7. MapReduce Conclusion

L09c: Content Delivery Networks

1. Content Delivery Networks Introduction
2. CDN's (Quiz)
3. DHT
4. DHT Details
5. CDN (An Overlay Network)
6. Overlay Networks in General
7. DHT and CDN's
8. Traditional Approach
9. Greedy Approach Leads to Metadata Server Overload
10. Origin Server Overload
11. Greedy Approach Leads to Tree Saturation
12. Key Based Routing
13. Coral Key Based Routing
14. Key Based Routing in Coral
15. Coral Sloppy DHT
16. Coral Sloppy DHT (cont)
17. Coral in Action
18. Content Delivery Networks Conclusion

Lesson 10: RT and Multimedia

L10a: TS-Linux

1. TS-Linux Introduction
2. Sources of Latency
3. Timers Available
4. Firm Timer Design
5. Firm Timer Implementation
6. Reducing Kernel Preemption Latency
7. TS-Linux Conclusion

L10b: PTS

1. PTS Introduction
2. Programming Paradigms
3. Novel Multimedia Apps
4. Example- Large Scale Situation Awareness
5. Programming Model for Situation Awareness
6. PTS Programming Model
7. Bundling Streams
8. Power of Simplicity
9. PTS Design Principles
10. Persistant Channel Architecture
11. PTS Conclusion

Lesson 11: Security

L11a: Principles of Information Security

1. Principles of Information Security Introduction
2. Firsts from Computing Pioneers
3. Terminologies
4. Levels of Protection
5. Design Principles
6. Principles of Information Security Conclusion

L11b: Security in Andrew

1. Security in Andrew Introduction
2. State of Computing Circa 1988
3. Andrew Architecture
4. Encryption Primer
5. Private Key Encryption System in Action
6. Challenges for Andrew System
7. Andrew Solution
8. Login Process
9. RPC Session Establishment
10. RPC Session Establishment (cont)
11. Sequence Establishment (Quiz)
12. Login is a Special Case of Bind
13. Putting it all together
14. AFS Security Report Card (Quiz)
15. Security in Andrew Conclusion

OS Refresher

Ref Memory Systems

1. Course Introduction
2. Ref Memory Systems Introduction
3. Naive Memory Model
4. Cache Motivation
5. Data Costs (Quiz)
6. Memory Hierarchy
7. Locality and Cache Blocks
8. Direct Mapping
9. Fill in the Table (Quiz)
10. How Many Bits (Quiz)
11. Set Associative Mapping
12. 2 Associative Example
13. 2 Associative Question (Quiz)
14. Fully Associative Mapping
15. Write Policy
16. The Virtual Address Abstraction
17. Address Translation
18. Paging
19. Virtual Page Numbers (Quiz)
20. Page Table Implementation
21. Accelerating Address Translation
22. Page Table Entries
23. Page Fault
24. Putting it all Together
25. Virtually Indexed, Physically Tagged Caches
26. Number of Entries in a Virtually Indexed, Physically Tagged Cache (Quiz)
27. Ref Memory Systems Conclusion

Ref File Systems

1. Ref File Systems Introduction
2. File System Concept
3. Access Rights
4. Permissions Error (Quiz)
5. Developers Interface
6. Sabotage (Quiz)
7. MMap
8. Shuffle (Quiz)
9. Allocation Strategies
10. File Allocation Table
11. Values in the FAT (Quiz)
12. File Allocation Table (cont)
13. Inode Structure
14. Data Blocks
15. Inode Structure
16. Buffer Cache
17. Journaling
18. Direct Memory Access
19. Fill in the Table (Quiz)

20. Ref File Systems Conclusion

Interview With Yousef Khalidi

1. Interview With Yousef 1
2. Interview With Yousef 2