Unit OS1:
Overview of Operating Systems

1.1. Windows Operating System Internals
Course Overview

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Basic Information

- Windows Operating Systems Internals is a pool of material and resources that explains operating systems (OS) concepts based on the Microsoft Windows XP and Windows Server 2003 operating system family, structured following the ACM/IEEE Operating System Body of Knowledge ("BOK") as defined in Computing Curriculum 2001 project by the Joint IEEE and ACM Task Force ("CC2001").

- This curriculum is based on the book Windows Internals, 4th edition (Microsoft Press, 2004) by Mark Russinovich and David Solomon.

- The experiments, lab descriptions, quizzes, and assignments, which are an integral part of the course materials, have been tested over the last five years in context of an Operating Systems Architecture class taught by Andreas Polze at Humboldt University of Berlin and Hasso-Plattner-Institute at University Potsdam, Germany.

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Roadmap for Section 1.1.

- ACM/IEEE Operating Systems Body of Knowledge - Core units
- ACM/IEEE Operating Systems Body of Knowledge - Elective units
- Supplementary units

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Unit OS1:
Overview of Operating Systems

- 1.1. Windows Operating System Internals Course Overview (Core)
- 1.2. The Evolution of Operating Systems (Core)
- 1.3. Windows Operating System Family – Concepts & Tools (Core)

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Unit OS2:
Operating System Principles

- 2.1. Structuring of the Windows Operating System (Core)
- 2.2. Windows Core System Mechanisms (Core)
- 2.3. Windows on Windows - OS Personalities (Core)
- 2.4. The Windows API – Naming Conventions, Types (Core)
- 2.5. OS Principles labs, quizzes, and assignments

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Unit OS3: Concurrency

- 3.1. Concurrency, Critical Sections, Semaphores (Core)
- 3.2. Windows Trap Dispatching, Interrupts, Synchronization (Core)
- 3.3. Advanced Windows Synchronization (Core/Advanced)
- 3.4. Windows APIs for Synchronization and Inter-Process Communication (Core/Advanced)
- 3.5. Concurrency labs, quizzes, and assignments

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Unit OS4: Scheduling and Dispatch

- 4.1. The Concept of Processes and Threads (Core)
- 4.2. Windows Processes and Threads (Core)
- 4.3. Windows Process and Thread Internals (Core/Advanced)
- 4.4. Windows Thread Scheduling (Core)
- 4.5. Advanced Windows Thread Scheduling (Core/Advanced)
- 4.6. Scheduling and Dispatch labs, quizzes, and assignments

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Unit OS5: Memory Management

- 5.1. Memory Management for Multiprogramming (Core)
- 5.2. Windows Memory Management Fundamentals (Core)
- 5.3. Virtual Address Translation (Core)
- 5.4. Physical Memory Management (Core/Advanced)
- 5.5. Memory Management labs, quizzes, and assignments

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Unit OS6: Device Management - The Input/Output System

- 6.1. Principles of I/O Systems (Elective)
- 6.2. The Windows I/O System Components (Elective)
- 6.3. Windows I/O Processing (Elective/Advanced)
- 6.4. Device Management labs, quizzes, and assignments

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Unit OS7: Protection and Security

- 7.1. The Security Problem (Elective)
- 7.2. Windows Security Components and Concepts (Elective)
- 7.3. Windows Security Descriptors (Elective/Advanced)
- 7.4. Security labs, quizzes, and assignments

Unit OS8: File System

- 8.1. Background: Unix File Systems (Elective)
- 8.2. The Windows File System (NTFS) (Elective)
- 8.3. Encrypting File System Security in Windows OS (Elective/Advanced)
- 8.4. NTFS – Recovery Support (Elective/Advanced)
- 8.5. Windows File and Directory Management (Elective)
- 8.6. File System labs, quizzes, and assignments

Unit OS9:
Real-time and Embedded Systems

- 9.1. Introduction and Vocabulary (Elective)
- 9.2. Real-Time Systems with Windows (Elective)
- 9.3. Embedded Systems with Windows XP Embedded (Elective)

Unit OS10: Fault-tolerance

- 10. Fault-tolerance (Elective) OS10
- 10.1. Fault-tolerance in Windows (Elective)
- 10.2. Fault-tolerance quizzes and assignments

Unit OS11: Performance Evaluation

- 11. System Performance Evaluation and Troubleshooting (Elective) OS11
- 11.1. System Performance
- 11.2. Boot/Startup Troubleshooting
- 11.3. Performance Evaluation labs, quizzes, and assignments

Unit 12: Scripting

- 12. Scripting (Elective) OS12
- 12.1. Windows Management Instrumentation
- 12.2. The Registry
- 12.3. Scripting labs, quizzes and assignments

Supplementary Unit A:
Windows Networking

- A.1. Networking Components in Windows OS (Supplementary/Advanced)

- A.2. Windows Socket Programming (Supplementary/Advanced)

- A.3. Microsoft-specific extensions to Sockets and other Networking APIs (Supplementary/Advanced)

- A.4. Networking labs, quizzes, and assignments

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Supplementary Units B:
Comparing the Linux and Windows Kernels

- B. Comparing the Linux and Windows Kernels (Supplementary/Advanced)

- B.1. Linux and Windows Comparison (Supplementary/Advanced)

- B.2. Linux and Windows Comparison quizzes

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Supplementary Units C: Windows – Unix Interoperability

- C. Windows – Unix Interoperability (Supplementary/Advanced)
- C.1. File and Command Interoperability (Supplementary/Advanced)
- C.2. Programming (Supplementary/Advanced)
- C.3. Interoperability quizzes and assignments

Suggested Reading

- Mark E. Russinovich and David A. Solomon, Microsoft Windows Internals, 4th Edition, Microsoft Press, 2004.
  - (This book is the course's direct companion - required reading).
- Abraham Silberschatz, Peter B. Galvin, Operating System Concepts, John Wiley & Sons, 6th Ed., 2003;
  - (This book gives a platform-neutral overview on operating system design and implementation – suggested reading).
- Jeffrey Richter, Programming Applications for Microsoft Windows, 4th Edition, Microsoft Press, September 1999.
  - (This book provides a comprehensive discussion of the Windows API – suggested reading).

Suggested Reading (contd.)

- Johnson M. Hart, Win32 System Programming: A Windows® 2000 Application Developer's Guide, 2nd Edition, Addison-Wesley, 2000.
  - (This book discusses select Windows programming problems and addresses the problem of portable programming by comparing Windows and Unix approaches).
- Andrew S. Tanenbaum, Distributed Operating Systems, Prentice Hall, 1995.
  - (This text accompanies the course's advanced modules and offers students an explanation of the concepts of distributed operating systems).
- http://www.sysinternals.com
  - (Tools used in labs and experiments)
- http://msdn.microsoft.com
  - (Online resource for information on APIs required during work on assignments).

Source Code References

- Windows Research Kernel (WRK)
  - Subset of Windows kernel source code
  - For more information, see http://www.microsoft.com/resources/sharedsource/Licensing/WindowsAcademic.mspx

- Where source code is available, the last slide in each Powerpoint refers to the relevant directories/files