

Unit OS1: Overview of Operating Systems

1.1. Windows Operating System Internals Course Overview

Windows Operating System Internals - by David A. Solomon and Mark E. Russinovich with Andreas Polze

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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”).
- The CDK 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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3

For each of the units, there are basic and advanced modules. The units are scalable to multiple academic levels and can be used by faculty staff in whole or in part for teaching OS courses in academic institutions.

The basic modules provide materials to incorporate into a complete undergraduate level OS course of one semester in length. This covers the Windows operating system specific topics in the core and elective units at minimum (or basic) level of coverage of BOK as defined in CC2001.

The advanced modules provide materials to incorporate into an advanced (undergraduate or graduate) level OS course of one semester in length. The module covers the Windows operating system specific topics in the core and elective units of CC2001 (extended level of coverage).

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

A lecturer may choose to use the basic course materials in order to augment an existing (undergraduate) OS course with information regarding the Windows operating system family. However, by combining the basic and advanced sections of the materials supplied herein, a potential lecturer may give a fully featured one semester (undergraduate) operating system course. Another option would be the usage of the advanced sections only in order to give a special (graduate) lecture or seminar on operating system internals and a comparison of architectural and design decisions and their impact for a number of different operating systems.

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)
- 1.4. Microsoft Windows Roadmap

The “Operating Systems Internals Course” focuses on general-purpose operating systems technology and discusses techniques and approaches taken by the Microsoft Windows operating system family. Those techniques are compared to solutions found in Linux/UNIX systems.

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. History of the Windows NT/2000/XP/2003 operating system (Core)
- 2.6. OS Principles labs, quizzes, and assignments

Some Lab assignments are discussed throughout the Sections of the Curriculum module. Additional assignments may be found in the accompanying Lab manual.

Unit OS3: Concurrency

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

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

Unit OS5: Memory Management

- 5.1. Memory Management for Multiprogramming (Core)
- 5.2. Windows Memory Management Internals (Core)
- 5.3. Windows Memory Structures (Core)
- 5.4. Advanced Windows Memory Management (Core/Advanced)
- 5.5. Memory Management labs, quizzes, and assignments

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

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, OS11, OS12: System Analysis and Scripting

- 10. Fault-tolerance (Elective) OS10
- 11. System Performance Evaluation and Troubleshooting (Elective) OS11
- 12. Scripting (Elective) OS12

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

Supplementary Units B & C: Comparison and Interoperability

- B. Comparing the Linux and Windows Kernels (Supplementary/Advanced)
- C. Windows – Unix Interoperability (Supplementary/Advanced)
 - C.1. File and Command Interoperability (Supplementary/Advanced)
 - C.2. Programming (Supplementary/Advanced)

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).