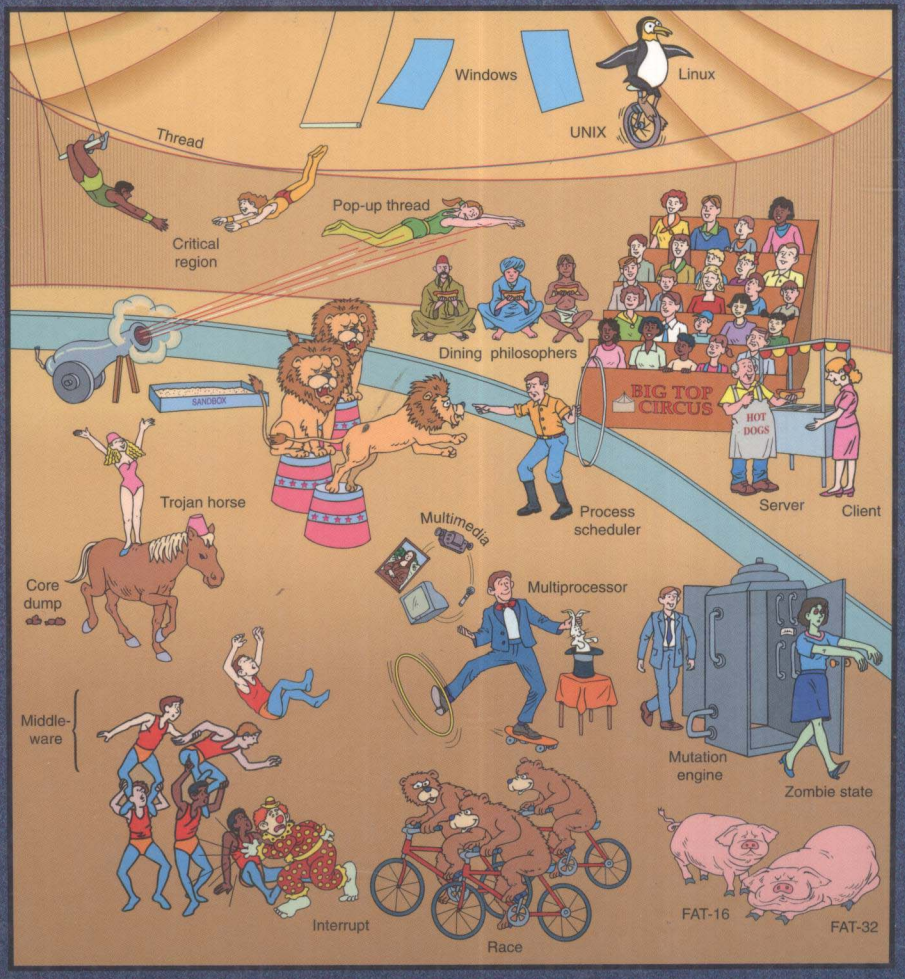
MODERN OPERATING SYSTEMS

SECOND EDITION



Andrew S. Tanenbaum

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SECOND EDITION

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Other bestselling titles by Andrew S. Tanenbaum

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This widely-read classic, now in its fourth edition, provides the ideal introduction to computer architecture. It covers the topic in an easy-to-understand way, bottom up. There is a chapter on digital logic for beginners, followed by chapters on microarchitecture, the instruction set architecture level, operating systems, assembly language, and parallel computer architectures.

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This widely-read classic, now in its third edition, provides the ideal introduction to today's and tomorrow's networks. It explains in detail how modern networks are structured. Starting with the physical layer and working up to the application layer, the book covers a vast number of important topics, including wireless communication, fiber optics, data link protocols, Ethernet, routing algorithms, network performance, security, DNS, electronic mail, USENET news, the World Wide Web, and multimedia. The book has especially thorough coverage of TCP/IP and the Internet.

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Distributed Operating Systems

This text covers the fundamental concepts of distributed operating systems. Key topics include communication and synchronization, processes and processors, distributed shared memory, distributed file systems, and distributed real-time systems. The principles are illustrated using four chapter-long examples.

To Suzanne, Barbara, Marvin, and the memory of Bram and Sweetie π

PREFACE

The world has changed a great deal since the first edition of this book appeared in 1992. Computer networks and distributed systems of all kinds have become very common. Small children now roam the Internet, where previously only computer professionals went. As a consequence, this book has changed a great deal, too.

The most obvious change is that the first edition was about half on single-processor operating systems and half on distributed systems. I chose that format in 1991 because few universities then had courses on distributed systems and whatever students learned about distributed systems had to be put into the operating systems course, for which this book was intended. Now most universities have a separate course on distributed systems, so it is not necessary to try to combine the two subjects into one course and one book. This book is intended for a first course on operating systems, and as such focuses mostly on traditional single-processor systems.

I have coauthored two other books on operating systems. This leads to two possible course sequences.

Practically-oriented sequence:

1. Operating Systems Design and Implementation by Tanenbaum and Woodhull
2. Distributed Systems by Tanenbaum and Van Steen

Traditional sequence:

1. Modern Operating Systems by Tanenbaum
2. Distributed Systems by Tanenbaum and Van Steen

The former sequence uses MINIX and the students are expected to experiment with MINIX in an accompanying laboratory supplementing the first course. The latter sequence does not use MINIX. Instead, some small simulators are available that can be used for student exercises during a first course using this book. These simulators can be found starting on the author's Web page: *www.cs.vu.nl/~ast/* by clicking on Software and supplementary material for my books .

In addition to the major change of switching the emphasis to single-processor operating systems in this book, other major changes include the addition of entire chapters on computer security, multimedia operating systems, and Windows 2000, all important and timely topics. In addition, a new and unique chapter on operating system design has been added.

Another new feature is that many chapters now have a section on research about the topic of the chapter. This is intended to introduce the reader to modern work in processes, memory management, and so on. These sections have numerous references to the current research literature for the interested reader. In addition, Chapter 13 has many introductory and tutorial references.

Finally, numerous topics have been added to this book or heavily revised. These topics include: graphical user intefaces, multiprocessor operating systems, power management for laptops, trusted systems, viruses, network terminals, CD-ROM file systems, mutexes, RAID, soft timers, stable storage, fair-share scheduling, and new paging algorithms. Many new problems have been added and old ones updated. The total number of problems now exceeds 450. A solutions manual is available to professors using this book in a course. They can obtain a copy from their local Prentice Hall representative. In addition, over 250 new references to the current literature have been added to bring the book up to date.

Despite the removal of more than 400 pages of old material, the book has increased in size due to the large amount of new material added. While the book is still suitable for a one-semester or two-quarter course, it is probably too long for a one-quarter or one-trimester course at most universities. For this reason, the book has been designed in a modular way. Any course on operating systems should cover chapters 1 through 6. This is basic material that every student show know.

If additional time is available, additional chapters can be covered. Each of them assumes the reader has finished chapters 1 through 6, but Chaps. 7 through 12 are each self contained, so any desired subset can be used and in any order, depending on the interests of the instructor. In the author's opinion, Chaps. 7 through 12 are much more interesting than the earlier ones. Instructors should tell their students that they have to eat their broccoli before they can have the double chocolate fudge cake dessert.

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Andrew S. Tanenbaum

CONTENTS

4 MEMORY MANAGEMENT 189