

# Introduction



An **operating system** is software that manages a computer’s hardware. It also provides a basis for application programs and acts as an intermediary between the computer user and the computer hardware. An amazing aspect of operating systems is how they vary in accomplishing these tasks in a wide variety of computing environments. Operating systems are everywhere, from cars and home appliances that include “Internet of Things” devices, to smart phones, personal computers, enterprise computers, and cloud computing environments.

In order to explore the role of an operating system in a modern computing environment, it is important first to understand the organization and architecture of computer hardware. This includes the CPU, memory, and I/O devices, as well as storage. A fundamental responsibility of an operating system is to allocate these resources to programs.

Because an operating system is large and complex, it must be created piece by piece. Each of these pieces should be a well-delineated portion of the system, with carefully defined inputs, outputs, and functions. In this chapter, we provide a general overview of the major components of a contemporary computer system as well as the functions provided by the operating system. Additionally, we cover several topics to help set the stage for the remainder of the text: data structures used in operating systems, computing environments, and open-source and free operating systems.

## Bibliographical Notes

Many general textbooks cover operating systems, including [Stallings (2017)] and [Tanenbaum (2014)]. [Hennessy and Patterson (2012)] provide coverage of I/O systems and buses and of system architecture in general. [Kurose and Ross (2017)] provides a general overview of computer networks.

[Russinovich et al. (2017)] give an overview of Microsoft Windows and covers considerable technical detail about the system internals and components. [McDougall and Mauro (2007)] cover the internals of the Solaris operating system. macOS and iOS internals are discussed in [Levin (2013)]. [Levin (2015)] covers the internals of Android. [Love (2010)] provides an overview of the

Linux operating system and great detail about data structures used in the Linux kernel.

The history of open sourcing and its benefits and challenges appears in [Raymond (1999)]. The Free Software Foundation has published its philosophy in <http://www.gnu.org/philosophy/free-software-for-freedom.html>. Free software and open-source software are two different ideas championed by different groups of people, but with a similar net effect of requiring source code to be available (see <http://gnu.org/philosophy/open-source-misses-the-point.html/>

GNU/Linux is the most famous open-source operating system, with some distributions free and others open source (<http://www.gnu.org/distros/>).

The free “Virtualbox” virtualization tool is available from <https://www.virtualbox.org/>. There are pre-built operating system images for virtualbox available at <http://virtualboxes.org/images/>. An alternative to using Virtualbox is to use the free program “Qemu” (<http://wiki.qemu.org/Download/>), which has the `qemu-img` for converting Virtualbox images to Qemu images to easily import them. VMware (<http://www.vmware.com>) provides a free virtual machine “player” for Windows on which hundreds of free “virtual appliances” can run.

The source code of FreeBSD is available for free on line at <https://svnweb.freebsd.org>

Version control systems aid in software development, one common one is subversion: <https://subversion.apache.org/source-code>, and another is git: <http://www.git-scm.com>.

The open source of macOS are available from <http://www.apple.com/open-source/>. Apple also provides extensive developer tools, documentation, and support at <http://connect.apple.com>. For more information, see Appendix C.

The source code for opensolaris is available via a source code browser and for download at <http://src.opensolaris.org/source>. The active fork of OpenSolaris is Illumos and is available at <http://wiki.illumos.org>.

Thousands of open-source projects are available from sites like <http://freshmeat.net/> and <http://distrowatch.com/>.

An extensive but incomplete list of open-source operating-system projects is available from [http://dmoz.org/Computers/Software/Operating\\_Systems/Open\\_Source/](http://dmoz.org/Computers/Software/Operating_Systems/Open_Source/).

## Bibliography

[Hennessy and Patterson (2012)] J. Hennessy and D. Patterson, *Computer Architecture: A Quantitative Approach*, Fifth Edition, Morgan Kaufmann (2012).

[Kurose and Ross (2017)] J. Kurose and K. Ross, *Computer Networking—A Top-Down Approach*, Seventh Edition, Addison-Wesley (2017).

[Levin (2013)] J. Levin, *Mac OS X and iOS Internals to the Apple’s Core*, Wiley (2013).

[Levin (2015)] J. Levin, *Android Internals—A Confectioner’s Cookbook. Volume I* (2015).

- [**Love (2010)**] R. Love, *Linux Kernel Development*, Third Edition, Developer's Library (2010).
- [**McDougall and Mauro (2007)**] R. McDougall and J. Mauro, *Solaris Internals*, Second Edition, Prentice Hall (2007).
- [**Raymond (1999)**] E. S. Raymond, *The Cathedral and the Bazaar*, O'Reilly & Associates (1999).
- [**Russinovich et al. (2017)**] M. Russinovich, D. A. Solomon, and A. Ionescu, *Windows Internals—Part 1*, Seventh Edition, Microsoft Press (2017).
- [**Stallings (2017)**] W. Stallings, *Operating Systems, Internals and Design Principles (9th Edition)* Ninth Edition, Prentice Hall (2017).
- [**Tanenbaum (2014)**] A. S. Tanenbaum, *Modern Operating Systems*, Prentice Hall (2014).

