

# File-System Internals



As we saw in Chapter 13, the file system provides the mechanism for on-line storage and access to file contents, including data and programs. This chapter is primarily concerned with the internal structures and operations of file systems. We explore in detail ways to structure file use, to allocate storage space, to recover freed space, to track the locations of data, and to interface other parts of the operating system to secondary storage.

## Bibliographical Notes

The MS-DOS FAT system is explained in [Norton and Wilton (1988)]. The internals of the BSD UNIX system are covered in full in [McKusick and Neville-Neil (2005)]. Details concerning file systems for Linux can be found in [Love (2010)]. The Google file system is described in [Ghemawat et al. (2003)]. FUSE can be found at <http://fuse.sourceforge.net>.

Algorithms such as balanced trees (and much more) are covered by [Knuth (1998)] and [Cormen et al. (2009)]. [Silvers (2000)] discusses implementing the page cache in the NetBSD operating system. The ZFS source code for space maps can be found at [http://src.opensolaris.org/source/xref/onnv/onnv-gate/usr/src/uts/common/fs/zfs/space\\_map.c](http://src.opensolaris.org/source/xref/onnv/onnv-gate/usr/src/uts/common/fs/zfs/space_map.c).

The network file system (NFS) is discussed in [Callaghan (2000)]. NFS Version 4 is a standard described at <http://www.ietf.org/rfc/rfc3530.txt>. [Ousterhout (1991)] discusses the role of distributed state in networked file systems. Log-structured designs for networked file systems are proposed in [Hartman and Ousterhout (1995)] and [Thekkath et al. (1997)]. NFS and the UNIX file system (UFS) are described in [Vahalia (1996)] and [Mauro and McDougall (2007)]. The NTFS file system is explained in [Solomon (1998)].

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