OPERATING SYSTEMS

File Management

Suresh Jamadagni

Department of Computer Science

OPERATING SYSTEMS

File-Systems – Case Study: Linux

Suresh Jamadagni
Department of Computer Science

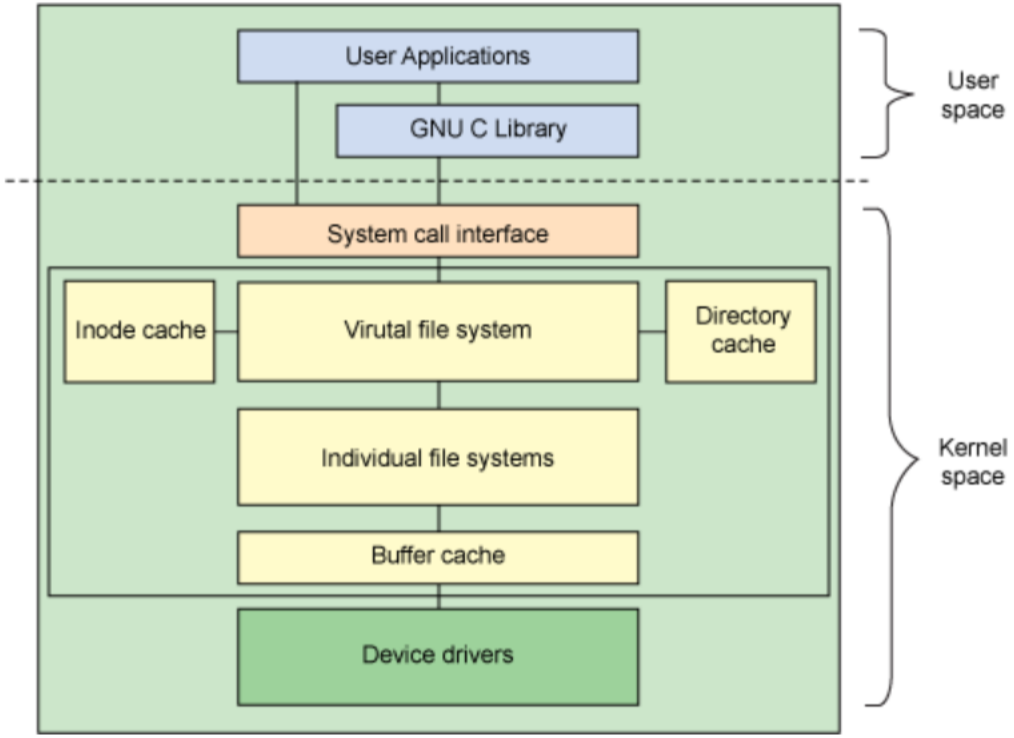
Slides Credits for all the PPTs of this course

- The slides/diagrams in this course are an **adaptation**, **combination**, and **enhancement** of material from the following resources and persons:

1. Slides of Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne - 9th edition 2013 and some slides from 10th edition 2018
2. Some conceptual text and diagram from Operating Systems - Internals and Design Principles, William Stallings, 9th edition 2018
3. Some presentation transcripts from A. Frank – P. Weisberg
4. Some conceptual text from Operating Systems: Three Easy Pieces, Remzi Arpaci-Dusseau, Andrea Arpaci Dusseau

Linux File System - Architecture

- User space contains the applications which provides the user interface for the file system calls (open, read, write, close).
- The system call interface acts as a switch, funneling system calls from user space to the appropriate endpoints in kernel space.
- The VFS is the primary interface to the underlying file systems. This component exports a set of interfaces and then abstracts them to the individual file systems, which may behave very differently from one another.
- Two caches exist for file system objects (inodes and dentries). Each provides a pool of recently-used file system objects.



Reference: https://developer.ibm.com/tutorials/l-linux-filesystem/

Linux File System - Architecture

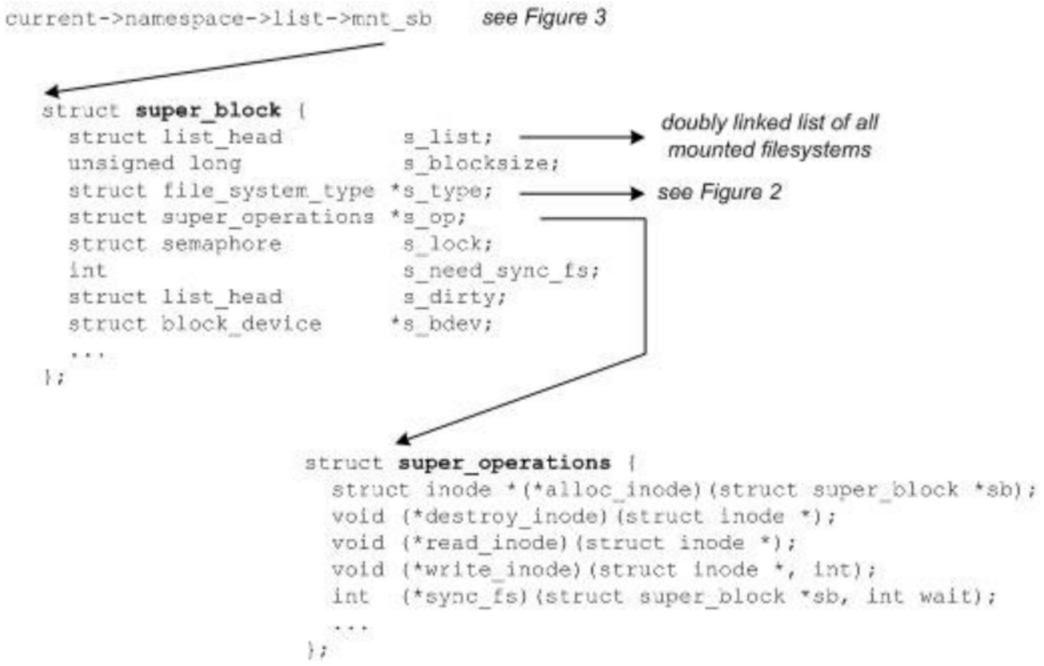
- Each individual file system implementation, such as ext2, JFS, and so on, exports a common set of interfaces that is used by the VFS.
- The buffer cache buffers requests between the file systems and the block devices that they manipulate. For example, read and write requests to the underlying device drivers migrate through the buffer cache. This allows the requests to be cached there for faster access (rather than going back out to the physical device).
- The buffer cache is managed as a set of least recently used (LRU) lists. You can use the sync command to flush the buffer cache out to the storage media (force all unwritten data out to the device drivers and, subsequently, to the storage device).

Linux File System – Common set of objects

- Linux views all file systems from the perspective of a common set of objects.
- These objects are the **superblock, inode, dentry,** and **file**.
- At the root of each file system is the superblock, which describes and maintains state for the file system.
- Every object that is managed within a file system (file or directory) is represented in Linux as an inode.
- The inode contains all the metadata to manage objects in the file system (including the operations that are possible on it).
- Another set of structures, called dentries, is used to translate between names and inodes, for which a directory cache exists to keep the most-recently used around.
- The dentry also maintains relationships between directories and files for traversing file systems.
- A VFS file represents an open file (keeps state for the open file such as the write offset, and so on).

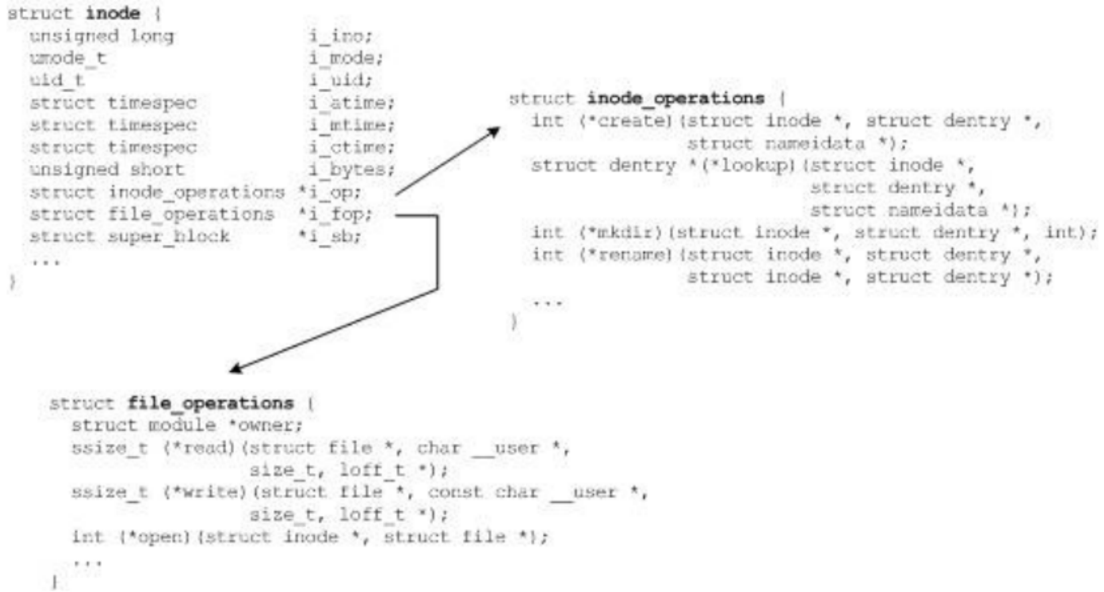
Linux File System – Superblock

- The superblock is a structure that represents a file system.
- It includes the necessary information to manage the file system during operation.
- It includes the file system name (such as ext2), the size of the file system and its state, a reference to the block device, and metadata information (such as free lists and so on).
- The superblock is typically stored on the storage medium
- Superblock structure is available in ./linux/include/linux/fs.h.



Linux File System – inode and dentry

- The inode represents an object in the file system with a unique identifier.
- The individual file systems provide methods for translating a filename into a unique inode identifier and then to an inode reference.
- inode_operations and file_operations structures refers to the individual operations that may be performed on the inode, file and directories



Reference: https://opensource.com/article/18/7/how-check-free-disk-space-linux

Linux File System – Buffer Cache

- Buffer cache keeps track of read and write requests from the individual file system implementations and the physical devices (through the device drivers).
- For efficiency, Linux maintains a cache of the requests to avoid having to go back out to the physical device for all requests. Instead, the most-recently used buffers (pages) are cached here and can be quickly provided back to the individual file systems.
- Linux supports a wide range of file systems such as MINIX, MS-DOS, and ext2. Linux also supports the new journaling file systems such as ext3, JFS, and ReiserFS. Additionally, Linux supports cryptographic file systems such as CFS and virtual file system such as /proc.
- Linux also supports **Filesystem in USErspace** (**FUSE**) filesystem that lets non-privileged users create their own file systems without editing kernel code. This is achieved by running file system code in user space while the FUSE module provides only a bridge to the actual kernel interfaces

THANK YOU

Suresh Jamadagni
Department of Computer Science and Engineering
sureshjamadagni@pes.edu