Shell Programming

A Necessity for all Programmers

Introduction to Linux and Shell

Nagesh Karmali | Firuza Karmali

IITBX
Infinite Learning

Department of Computer Science and Engineering
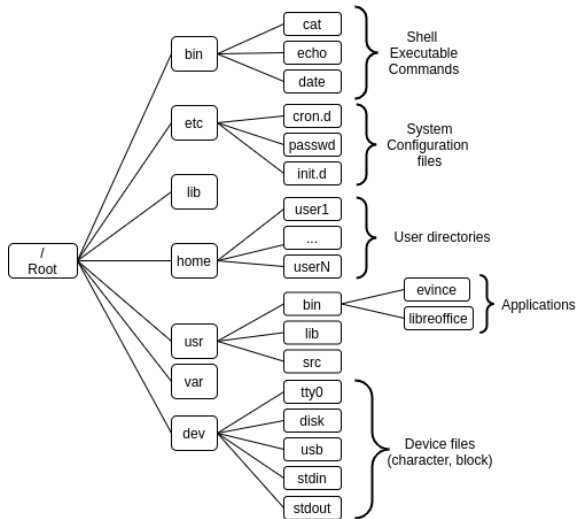IIT Bombay

You will learn to ...

- File system
- Architecture of Linux system
- Internal file representation
- Shell
- Applications

- Birth: 1970s – AT&T Labs, led by Ken Thompson and Dennis Ritchie
- Written in high level language, typically C
- Easy to read and understand
- Power to provide services in a simple way
- Build complex programs from simpler ones
- Hierarchical file system with efficient implementation
- Support for different file systems
- Every device is treaed as a file
- Multi-user, Multiprocess system

Birth of GNU/Linux

- GNU is a recursive acronym for "GNU's Not Unix!"
- Open Source System
- Developed from scratch, using the same principles of Unix
- GNU open source development started in 1984, Free Software Foundation (FSF) by Richard Matthew Stallman
- Developed central components, forming the largest single contribution to the whole system
- Linus Torvalds wrote Linux in 1991 and contributed to the Free Software Community
- Many distributions/flavors
  - Ubuntu
  - Debian
  - Fedora

File System

- Organized hierarchically as a tree
- Ability to create and delete files
- Grow dynamically
- Devices/Directories/Files are all treated as files
- Protection of data

Internal Representation of File – Inode

- Block size = 512 bytes
- Block number address = 32 bits (4 bytes)
- Direct addressing = $12 \times 512 = 6KB$
- Single indirect = $128 \times 512 = 64KB$
- Double indirect = $128 \times 128 \times 512 = 8MB$
- Triple indirect = $128 \times 128 \times 128 \times 512 = 1GB$

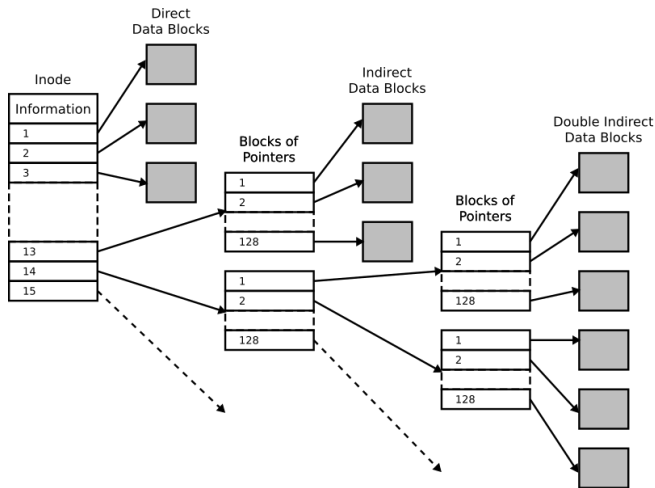**Question**: What is the maximum file size if the block size is 1KB, 2KB, etc.?

Figure: ext2 Inode [2]
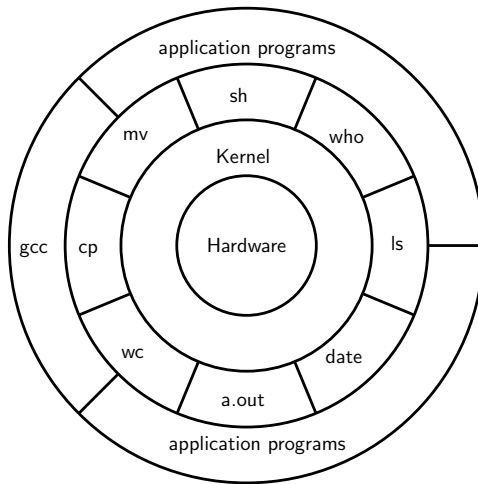
Architecture of Linux System

Figure: Architecture [1]

IITBX
Infinite Learning

- Command line interpreter
- Uses terminal/console
- Interacts with the Kernel
- Execute commands and scripts
- Navigating directories, opening files, etc.

Types of Shell

- Bourne: First shell 1970
    - sh
    - bash
    - ksh
    - zsh
- C
    - csh
    - tcsh

Note: The course uses Ubuntu OS and bash terminal

Applications

- Day to day usage
- Cron jobs (automating tasks) - backup data every night
- Package installation
- Cloud automation and cloning systems
- Creating system images in the cloud
- Database migrations

- System monitoring
- Automating the build process
- Running files in batch mode
- Linking various programs using pipes and filters
- Scheduling and executing system tasks

- Users
- Programmers
- System Administrators

First look at the terminal

- Terminal
- Command execution

Demo

IITBX
Infinite Learning

- File system
- Internal file representation
- Architecture of Linux system
- Shell
- Applications

References

[1] Maurice J Bach et al.
    The design of the UNIX operating system.
    Prentice-Hall Englewood Cliffs, 1986.

[2] timtjtim.
    An ext2 inode with indirect and double indirect data blocks visualised.
    `https://commons.wikimedia.org/wiki/File:Ext2-inode.svg`, CC BY-SA 4.0, via
    Wikimedia Commons, 2019.

Thank you