ECE 598 – Advanced Operating Systems
Lecture 15

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Announcements

- Homework #7 was posted
  Took all weekend to get get memory protection working.
  Something is up with the cache part, if it crashes on you
  right away, just report that in your HW assignment.

- Project topics due Thursday
  Be sure to e-mail. This is worth points!

- Hand back midterms

- HW#6 not graded yet

Devices – Review

- Character devices – read a sequence of characters incoming, like a serial connection
open/read/write

- Block devices – read chunks of data with random access, can seek back and forth
open/read/write/lseek
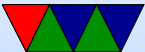
Creating Devices

- On Linux, looks like a file under /dev/, open/read/write as per normal
- Traditionally use `mknod sda b 123 45` or similar to make it
- This had issues; needed someone to maintain master list, would hit limits (only 16 hard drive partitions?), need to either manually create when new hardware added, or have dev entry for every possible device
- Linux has udev and hotplugging which detects new

hardware and auto-creates entry in /dev for you

Filesystems

- Why use a filesystem?
  - Why not just open a disk raw, and remember that your senior project is at offset 1,000,000 and your jpegs all start at offset 4,005,434?
  - A good use of abstraction. Naming is useful.
- What is a file?
  - In Unix is just a stream of bytes. That's not necessarily the only possibility
  - Old systems files were just 80-column punch card

images.
- How do you store a file?
  - In a "file"?

  - Everything in root directory?
  - Hierarchical?
  - Database?
- Why not just load everything into memory?
  - Too big? Share with other processes?
  - Persistent across reboots?

Filesystem File Types

- Regular files
- Directories
- Char devices, block devices
- Links (hard, soft)
- FIFOs

Filesystems metadata – Filenames

- UNIX – anything that is not / or NUL.
  What about "-rf" or * or ?
  What about foreign chars? Emoji?
- Windows, more restrictions. Thins like CON and COM and PTR. Can cause problems. Uses backslash for directory separation (why?)
- DOS famously had 8.3 filenames.
- Mac used to use : as directory separator.
- Case sensitive? Bob or bob or BoB?

What does it mean to be capital/lowercase? i18n

Filesystems metadata – attributes

- Permissions (read, write, execute)
- Owner (user, group)
- Access time (atime, ctime, mtime)
- Current size
- Locks
- Hidden
- Immutable / System
- Extended attributes / capabilities

Brief File Review

File Related Operations / System Calls

- Create
- Delete (Unlink)
- Open
- Close
- Read
- Write
- Append
- Seek
- Get attributes

- Set attributes
- Rename/move
- mmap() Memory Map

File Descriptors

- On Linux/Unix "everything is a file"

- When open a file or object, get a number that indexes into a table, each referring to a file.

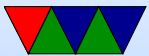- Low-level syscalls mostly operate on file descriptors

Directories/Folders

- Root directory
- Hierarchical
- Path names. /, ., ..
- Operations
  - create
  - delete
  - opendir
  - closedir
  - readdir

- rename
- link
- unlink

Filesystems

- Often a MBR (master boot record) and partition table

- Disks divided into partitions

  - Why partitions?
  - Split up system (/, /boot, /usr, /home)
  - Why is boot separate? Smaller so boot loader can access, maybe a different fs type.
  - Dual-booting operating systems
  - Swap partitions

- Then individual filesystems