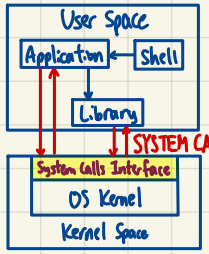
UNIT 2: UNIX+OS CONCEPTS

OVERALL STRUCTURE — SYSTEM VS FUNCTION CALLS



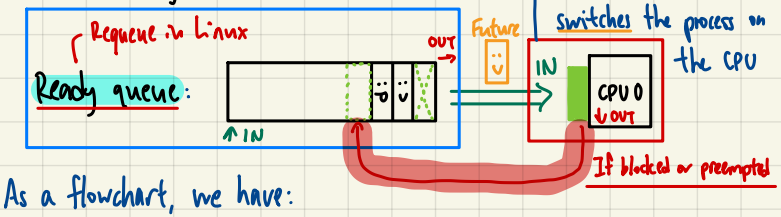
	System Call	Function Call
Description	Application calls to functions provided by OS kernel	Program calls to predefined functions (eg: defined in library)
Behavior	Causes switches from user to kernel (space/mode)	Cause no space/mode switches
Speed	Slow	Fast

PROCESS MANAGEMENT (Time-sharing: Processes ran "share" CPU time)

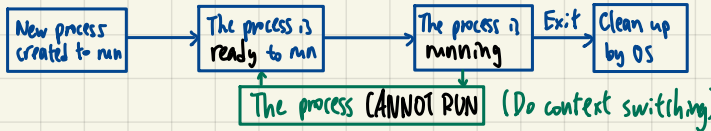
Context-switch: The process of storing the execution context of a process, and restoring the execution context of a new process

Context-switching causes overload.

The scheduler context switches the process on the CPU



As a flowchart, we have:



FILE/DIRECTORY MANAGEMENT

In Unix, everything is a file.

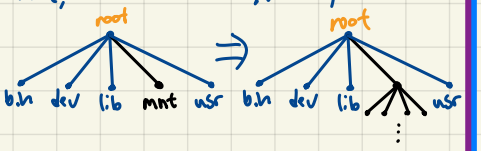
Root directory: Top-most dir. "/"

Home directory: Directory when you log in

Absolute path: /x/y/z (begin at root) Relative path: x/y/z

THE MOUNT COMMAND

Here, we mount in "/mnt",



SYNTAX

s=mkdir(name, code) create dir

s=rmdir(name) remove dir

s=link(name1, name2) create new name2→name1

s=unlink(name) remove dir entry

s=mount(special, name, flag) mount

s=umount(special) unmount

Remark:

Pipe ("|") sends the output of one process as the input for another.

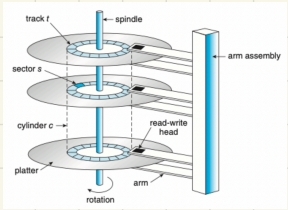
UNIT 3: FILE I/O (PART 1)

WEEK 2

Shun/翔海 (@shun4midx)

FILE I/O (BUFFERED VS UNBUFFERED)

Disk structure:



Buffered (Standard) I/Os: Functions accumulate results in intermediate buffers (within a process), not making system calls each time (e.g. fread/fwrite)

Unbuffered I/Os: Functions invoke system calls to the kernel each time (e.g. read(), write() in Unix)

Of course, buffered is faster due to no system calls. Unbuffered would require updating process, OS kernel, and storage as needed. Even with buffer cache in OS kernel, it takes a long time. Besides, buffer cache needs to be maintained carefully alongside storage when write() is called.

SYNTAX — FILE DESCRIPTORS

File descriptor: A nonnegative integer ∈ [0, OPEN_MAX−1], where OPEN_MAX = max files a process can open at once

↳ They are per-process, so diff processes may share file descriptors

In <unistd.h>, we have 0=STDIN_FILENO, 1=STDOUT_FILENO, 2=STDERR_FILENO by POSIX.1 standard. More are stored in a file table.

```
char buf[100];
E.g. while (n=read(STDIN_FILENO, buf, 100))!=0) {
       write(STDOUT, buf, n); }
```

FILE I/O CODE SYNTAX (Can end w/ exit(0);)

```
#include <fcntl.h>   (absolute path ⇒ susceptible to TOCTTOU attack)
int open(const char* path, int oflag, .../*mode_t mode*/);
int openat(int fd, const char* path, int oflag,.../*mode_t mode*/);
int close(int fd);
```

(base of relative path (file dir); If AT_FDCWD, then fd is the curr working dir)

(Rmk: obsolete but creat(const char* path, mode_t mode); exists)

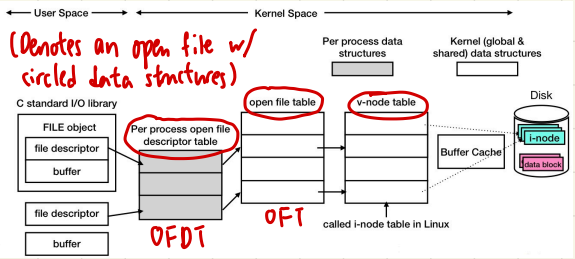
DIFFERENT OFLAGS

Must: O_RDONLY, O_WRONLY, O_RDWR (RD=read, WR=write)

Optional: O_APPEND (append at EOF), O_TRUNC (truncate file size to 0), O_CREAT (create if DNE), O_NONBLOCK, O_SYNC, (Can OR w/ mult) O_DSYNC (data sync), O_RSYNC

Mode: S_I [4 char] ← order: R(read), W(write), X(execute) ← choose 1 or all three + USR, GRP, OTH (other) ← abbrev to fit length

UNIX KERNEL SUPPORT FOR FILE/IO



OFDT: One entry per file descriptor (file desc flag, ptr to OFT entry)

OFT: File status flag, curr file offset, ptr to V-node table

V-node (i-node table): V-node info, ptr to i-node

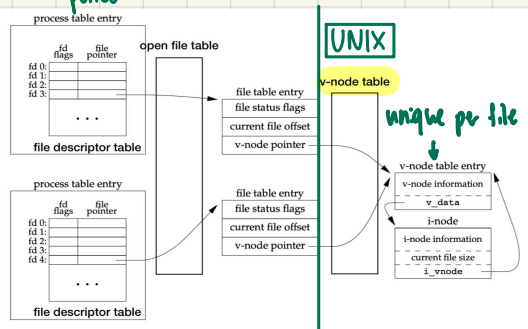
V-node: In-memory data structure for each open file

↳ Info: File type, ptr to func that operate the file

i-node: Stored physically on storage device and in memory

↳ Contains metadata (owner, size, device, protection info, ...)

↳ OS kernel reads i-node from disk to memory when file is opened



Rmk: Linux has i-node but no v-node