190031249 OSD Assignment CO-1
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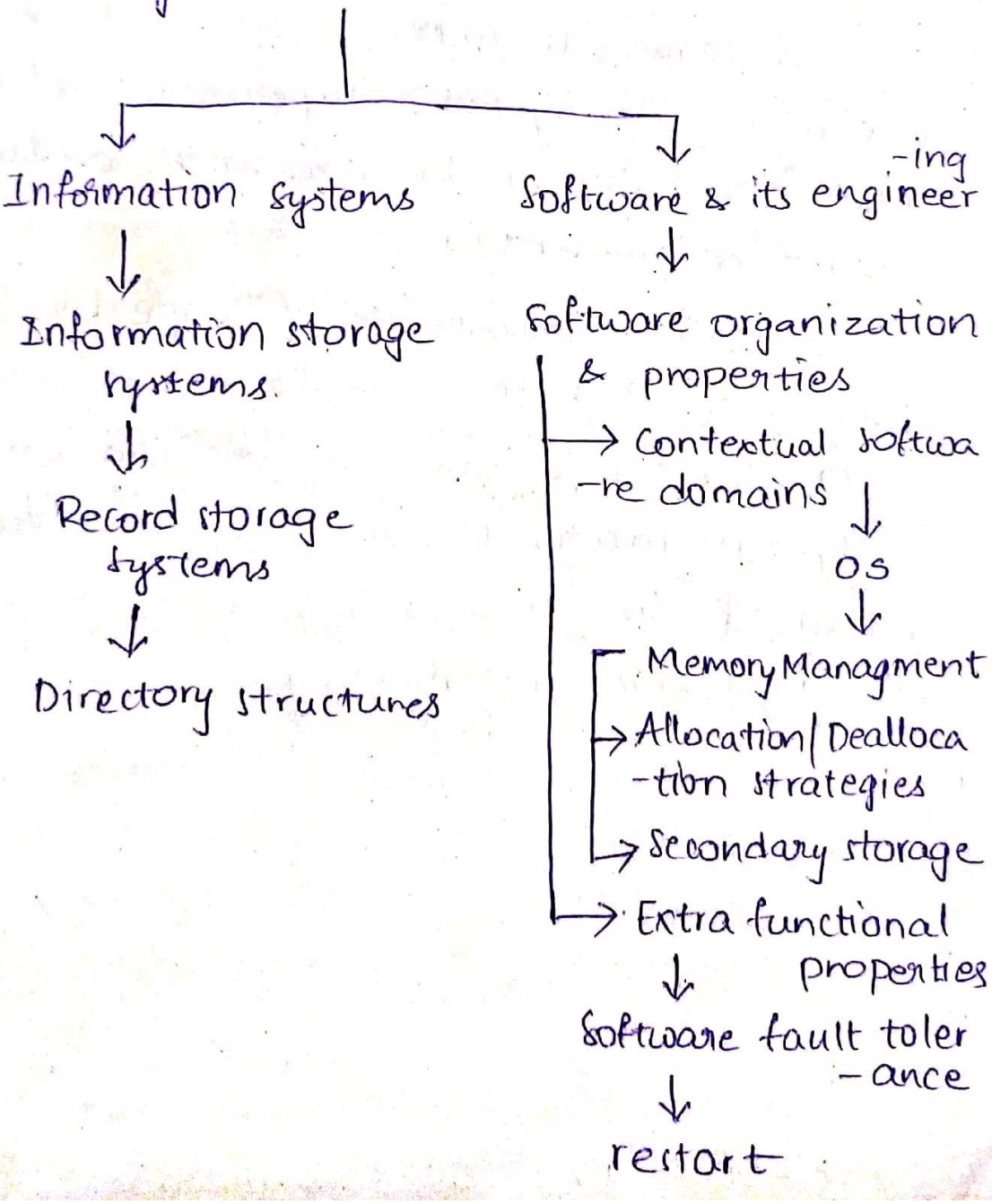
1A) Meta data updates, such as file creator, and block allocation, have consistently been identified as a source of performance integrity, security, & availability problems for file systems.

Log design :-

design & implementation of a log-structure -d file system



→ In case of system crash, the system will be able to determine all metadata updates thats not finish

A superblock is a record of a filesystem, including its size, the block size, the empty or filled blocks their respective counts, the size & location of inode tables, the disk block map & usage information, or size of block groups.

A request to access any file returns access to file systems superblock. If its superblock cannot be accessed, a file system cannot be mounted

Because importance of superblock & because damage to it, could erase crucial data, backup copies are created automatically at intervals on filesystems. for each mounted, linux also maintains a copy of its superblock in Memory.

2A) you are not alloted to create a hard link to a directory. Each directory inode is allowed to appear once in exactly one parent directory & no more. The restriction means that every sub-directory only has one parent directory, thatmeans special name ".." (dot dot) in a sub-directory always refers to its unique parent directory

3A) (i) Directories map file systems names to inode numbers for you. Each inode is identified by a unique inode number that can be shown the opt -i to ls command unix directories are what map file systems names to inode numbers that contains actual data

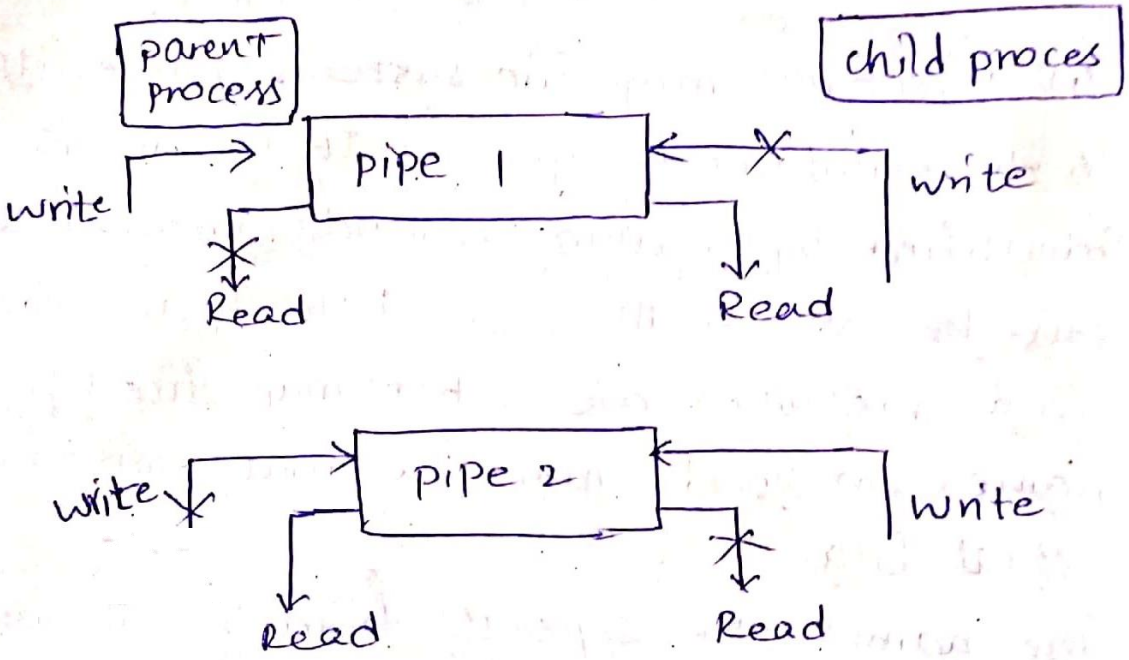
The names are seperate from the things they name when you access program by name, the system finds the programme in a directory, passed with inode num 26632y that holds actual data, & then the system has to go elsewhere on disk to inode numbers 266327 is actually access data for prog name.

File & directory data is actually stored under inode num, not under names.

3A)ii) Reading from small local file (/a/b/c involves 4 seperate disk operations

(1) Reading disk containting root dir/,
2 & 3 reading in disk block containing the directories b and c & reading in disk block containing the file c

4A) pictorial form of two way pipes



program for two way pipe.c

```
# include <stdio.h>
# include <unistd.h>
int main () {
    int pipefds1[2], pipefds2[2];
    int returnstatus1, returnstatus2;
    int pid;
    char pipe1writemessage[20] = "Hi";
    char pipe2writeMessage[20] = "Hello";
```

```
char readmessage[20];
returnstatus1 = pipe(pipefds1);
if (returnstatus1 == -1) {
    printf("unable to create pipe1 \n");
    return 1;
}
returnstatus2 = pipe(pipefds2);
if (returnstatus2 == -1) {
    printf("unable to create pipe2 \n");
    return 1;
}
pid = fork();
if (pid != 0)  //parent process
{ close(pipefds1[0]);
    close(pipefds2[1]);
    printf("In parent: write to pipe 1-
    message is %s \n", pipe1writemessage);
    write(pipefds1[1], pipe1writemessage,
        sizeof(pipe1writemessage));
  read(pipefds2[0], readmessage, sizeof
        (readmessage));
  printf("In parent: Reading from pipe 2-
   message is %s \n", readmessage);
} else { //child process
  close(pipefds1[1]);
  close(pipefds2[0]);
  read(pipefds1[0], readmessage,
                    sizeof(readmessage));
```

```
printf ("In child : Reading from
        pipe message is %s \n", readmessage);
printf ("In child : writing to pipe 2 - message
    is %s \n", pipe2writemessage);
write (pipefds2[1], pipe2writemessage,
        sizeof (pipe2writemessage));
}
return 0;
}
```

compilation : gcc twowaypipe.c

execution/output :

```
In parent : writing to pipe 1 - message is Hi
In child : Reading from pipe 1 - message is Hi
In parent : writing to pipe 2 - message is Hello
In parent : Reading from pipe 2 - message is Hello
```

5A) ~~XV6~~ gives each process its own table of open files, as we saw, each open file is represented by struct file (3650), which is a wrapper around either an inode or a pipe, plus an I/O offset.

```
. $ echo > a
  log write 4 ialloc (44, from create 54)
  log write 4 iupdate (44, from create 54)
  log write 29 writei (47 from dirlink 48,
  log write 2 iupdate from create 54)
```

6A) Algorithm for Allocating Disk block :-

Input : No of filesystem
output : New block buffer

```
{
while (superblock is locked)
{
  sleep (event superblock not locked);
remove block from superblock free list;
if (last block is removed from free list)
{
  lock superblock;
  read block which is just taken from freelist
                                  (algo bread)
copy block number into superblock;
release block buffer (algo brelse);
unlock the superblock;
wakeup processes (event superblock not locked);
}
get buffer from superblock list for removing
zero buffer contents;          block (algo getblk);
Decrement total count of free block;
mention the superblock as modified;
return buffer;
}}
```

7A) (i) The process table entry contains a table, the file descriptor table that gives the mapping b/w the descriptor the process uses to refer to a file connection & and the data structure inside the kernel that represents the actual file connection.

In traditional implementation of UNIX, file descriptors index into a pre-process file descriptor table maintained by kernel, that in turn indexes into a system. wide tables of files opened by all processes called the file-table. This table records mode with which file has been opened: for reading, writing, appending, & possibly other modes. File descriptor Table: There is a file descriptor table per process in U-Area. It contains A pointer to a file table entry:

several file descriptors are opened for every process: (i) stdin, (ii) stdout (iii) stderr It contains OPEN_MAX entries, which must be atleast as big as POSIX_OPEN_MAX.

FileTable :- This is one FileTable in kernel. These entries are pointed to by File descriptor & in turn point to file ID's :-

→ count of no of file Descriptors pointing to this entry
→ accessmode : read or write
→ file ID :- (called inode in UNIX
→ Current offset into the file
→ Access Mode contains one of following:

O_RDONLY : open file with read only access.
O_WRONLY : open file with write only access
O_RDWR : open file with both read, write access

Generally unique to each process, but they can be shared by child processes created with fork subroutine or copied by the fcntl dup and dup2 subroutines.

File descriptors are indexes to file descriptors table in U-block area maintained by kernel for each process. The most common ways for process to obtain file descriptors through open or creat. When fork occurs, the description table occurs copied for child process, which allows child process equal to files used by parent process.

(ii) open("/a/b/c", O_RDWR, O_CREATE)

4851 : sys_open

4801 : create

4807 : nameiparent [4396] is slightly diff : get inode for parent dir, keep name to create

4811 : dirlookup [4212] checks if already exists. sys_open, sys_mknod, sys_mkdir.

4821 : get a fresh inode

4831 : add a name to directory, dirlink [4252]

4838 : if mkdir ("a/b/c"), create "." and ".." entries

4846 : return newly created inode

8 A) Each direct pointer points to 4KB of data, for a total of 10 * 4 KB
The indirect pointer to points to an indirectly block, that contains pointer to data. The indirect block is a 4KB filled with 4-Byte pointers, for a total of 1024 * 4 KB of data

Similarly, the double_indirect pointer points a double-indirect block containing 1024 pointers to indirect block, each of which points to 4KB * 1024 for a total of 1024 * 1024 * 4 KB of data.

Finally, the triple-indirect pointer refer to 1024 * 1024 * 1024 * 4 KB

∴ The total data is thus, 10 * 4KB + 1024 * 4KB + 1024 * 1024 * 4KB + 1024 * 1024 * 1024 * 4 KB

9A) The read system calls takes three arguments (1) file descriptor of file.

(2) Buffer where the read data is to be stored

(3) the no.of bytes to be read from file.

A program needs to access the data from a file stored in a file system uses the read system call. The file is identified by a file descriptor that is normally obtained from a previous call to open read()

read() is used to access data from a file that is stored in file system. The file to read can be identified by its file descriptor & it should opened using open() before it can be read.

(ii) Yes, it is possible to read the desired block directly into user's buffer, & save overhead of copying.

10 A) (i) Most of filesystems have method to assign permissions or access rights to specific users & groups of users. These permissions controlled the ability of users to view, change, Navigate and execute the contents of file systems. Menu options or functions may be made hidden depending on user's permission.

Each file is stored in a directory, & uses a directory entry that describes its characteristics such as it's name, file extension & size If at a dos prompt you type "DIR" to list files in directory by default you will not see any files that have "hidden" attribute set. while use of attributes is strictly "voluntary" They are important in certain circumstances. Deleting a Non-empty directory could work. someway as deleting an empty directory. by remding the pointer to directory's metadata there would be no pointers to item it contained, effectively

deleting all its children recursively.

(ii) dirent [3203]

- name : str
- inum : inode num for file
- empty directory entries : zeroed-Out-inode

naming functions

- namei [4354] does most name-to-inode translation
- skiplem [4314] passes path names
- dirlookup [4242] does name-to-inode lookup in single dir
- dirlink [4252] adds names to a directoly

```
00044 // Directoly is file containing a sequence
                        of dirent structure
00045 # define DIRSIZE 14
00046
00047 struct dirent {
00048   ushort inum;
00049   charname [DIRSIZE]
```