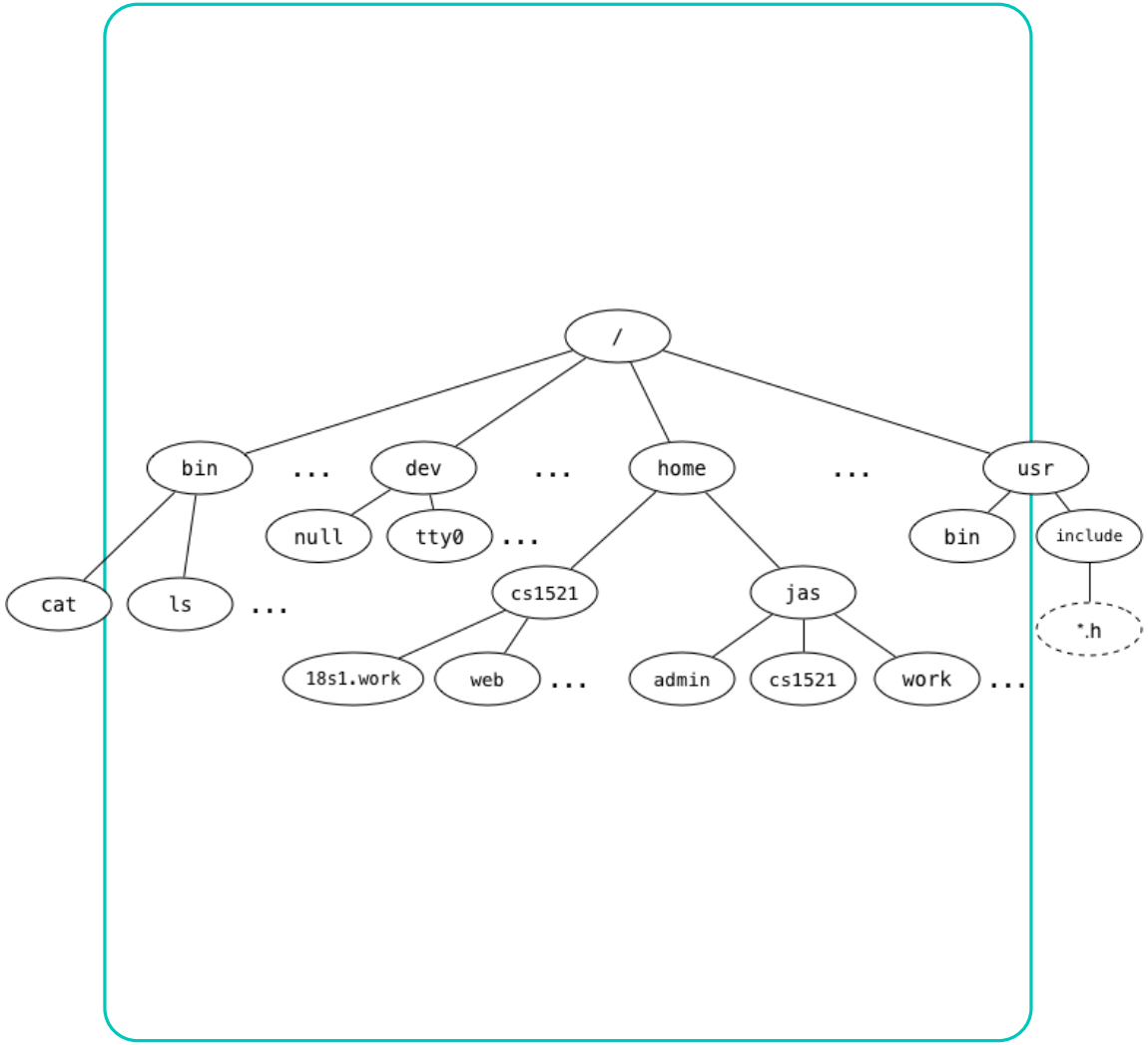
COMP1521 Tutorial 06

Unix filesystem

- What is the full pathname of COMP1521's web directory?
- Which directory is ~jas/../..?
- Links to the children of a given directory are stored as entries in the directory structure. Where is the link to the parent directory stored?
- What kind of filesystem object is cat?
- What kind of filesystem object is home?
- What kind of filesystem object is tty0?
- What kind of filesystem object is a symbolic link? What value does it contain?
- Symbolic links change the filesystem from a tree structure to a graph structure. How do they do this?



Filesystems cont.

- Filesystems typically stored on a spinning disk device
  - Contains magnetic storage medium of tracks
    - Each track has sectors
  - Disks are block-based devices
    - Each block is a logical entity made up of data stored in a collection of sectors
  - Information moved to/from via read/write head
    - Moves physically to required track and waits for head to spin whilst reading

Why does accessing data from a disk take significantly longer than accessing data from RAM?

System Calls

- Special functions defined by the Operating System
- Has privileged access to do things we can't we normal functions we make or written by others in libraries
  - E.g. any kind of I/O must use the open() syscall even if it's higher level implementation does the same thing e.g.(fopen())
- Examples
  - Open()
  - Write()
  - Read()
  - Close()

fopen() -> open()

Give equivalent open() syscall for each of these fopen() calls

- fopen(FilePath, "r")
- fopen(FilePath, "a")
- fopen(FilePath, "w")
- fopen(FilePath, "r+")
- fopen(FilePath, "w+")

Using syscalls

Assume that all of the relevant #include's are done.

How many calls with be made to the read() function, and what is the value of nb after each call?

```
 1. int fd; // open file descriptor
 2. int nb; // # bytes read
 3. int ns = 0; // # spaces
 4. char buf[BUFSIZ]; // input buffer
 5.
 6. fd = open("xyz",O_RDONLY);
 7. assert(fd >= 0);
 8. while ((nb = read(fd, buf, 1000)) > 0) {
 9.     for (int i = 0; i < nb; i++)
10.         if (isspace(buf[i])) ns++;
11. }
12. close(fd);
```

Reading binary files with syscalls

Write a main() function that scans a file containing a list of Graphics records and displays them using a function:

void display(int device, Graphics item)

where device is a file descriptor for a graphics display that is opened via open() at the start of the program using the file name /dev/display. Assume that the file of Graphics data is called "Picture".

```
typedef struct _graphics {
   int   x;  // x coordinate
   int   y;  // y coordinate
   char  r;  // red level
   char  g;  // green level
   char  b;  // blue level
} Graphics;
```

Understanding stat() and lstat()

- The stat() and lstat() functions both take an argument which is a pointer to a struct stat object, and fill it with the meta-data for a named file.

```
struct stat {
    ino_t     st_ino;     /* inode number */
    mode_t    st_mode;    /* protection */
    uid_t     st_uid;     /* user ID of owner */
    gid_t     st_gid;     /* group ID of owner */
    off_t     st_size;    /* total size, in bytes */
    blksize_t st_blksize; /* blocksize for filesystem I/O */
    blkcnt_t  st_blocks;  /* number of 512B blocks allocated */
    time_t    st_atime;   /* time of last access */
    time_t    st_mtime;   /* time of last modification */
    time_t    st_ctime;   /* time of last status change */
};
```

- What do each of these fields represent? (Assume jas has user id 501 and group id 70)

```
$ ls -ls stat.c
8 -rw-r--r--  1 jas  users  1855  9 Sep 14:24 stat.c
```

Understanding directories in UNIX

- Who can access the 17s2.work directory?
- What operations can a typical user perform on the public_html directory?
- What is the file web?
- What is the difference between stat("web",&info) and lstat("web",&info)?
- (where info is an object of type (struct stat))

```
drwxr-x--- 11 cs1521 cs1521 4096 Aug 27 11:59 17s2.work
drwxr-xr-x  2 cs1521 cs1521 4096 Aug 20 13:20 bin
-rw-r-----  1 cs1521 cs1521   38 Jul 20 14:28 give.spec
drwxr-xr-x  3 cs1521 cs1521 4096 Aug 20 13:20 lib
drwxr-x--x  3 cs1521 cs1521 4096 Jul 20 10:58 public_html
drwxr-xr-x 12 cs1521 cs1521 4096 Aug 13 17:31 spim
drwxr-x---  2 cs1521 cs1521 4096 Sep  4 15:18 tmp
lrwxrwxrwx  1 cs1521 cs1521   11 Jul 16 18:33 web -> public_html
```