File System creation

Unix Fundamentals

User

Shell

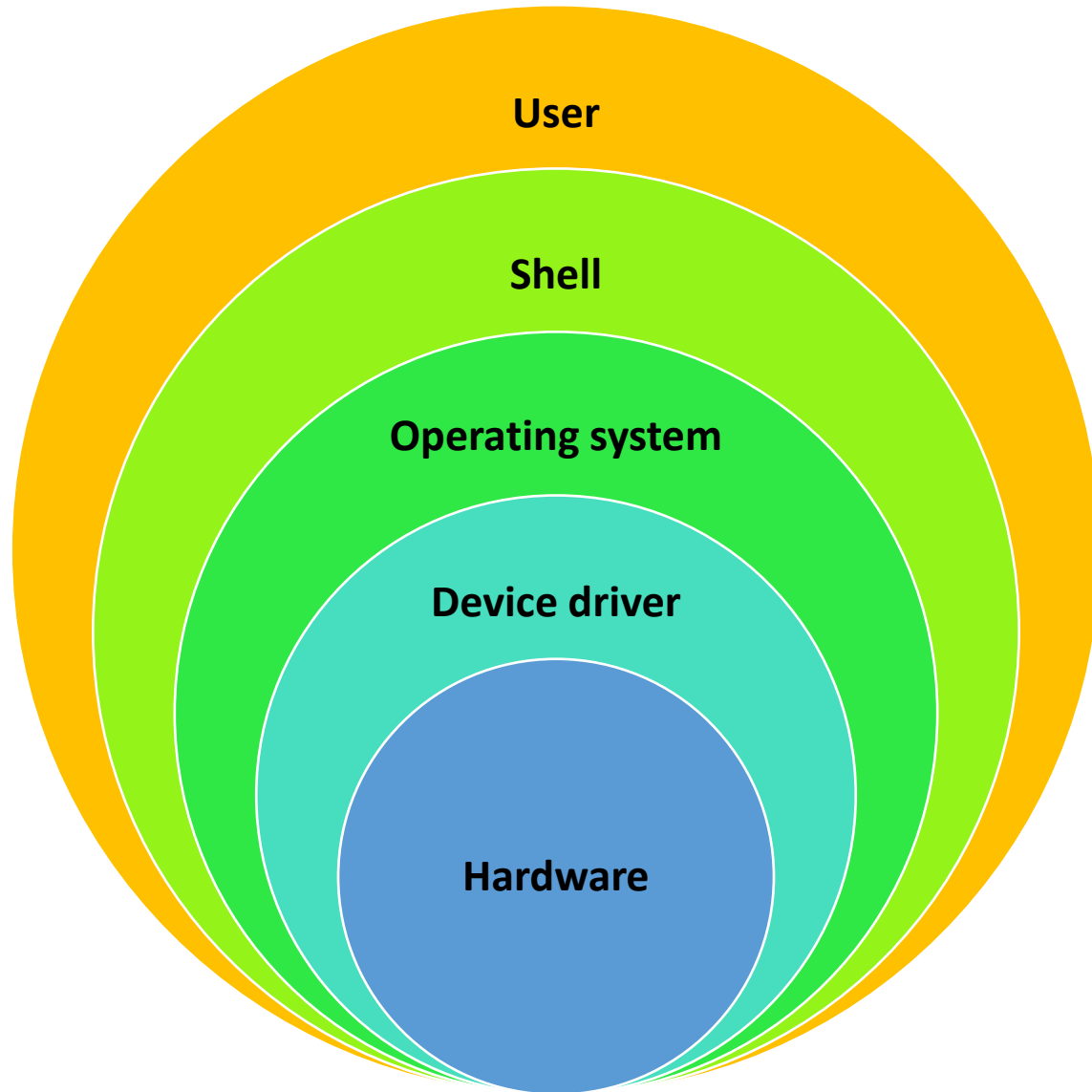Operating system

Device driver

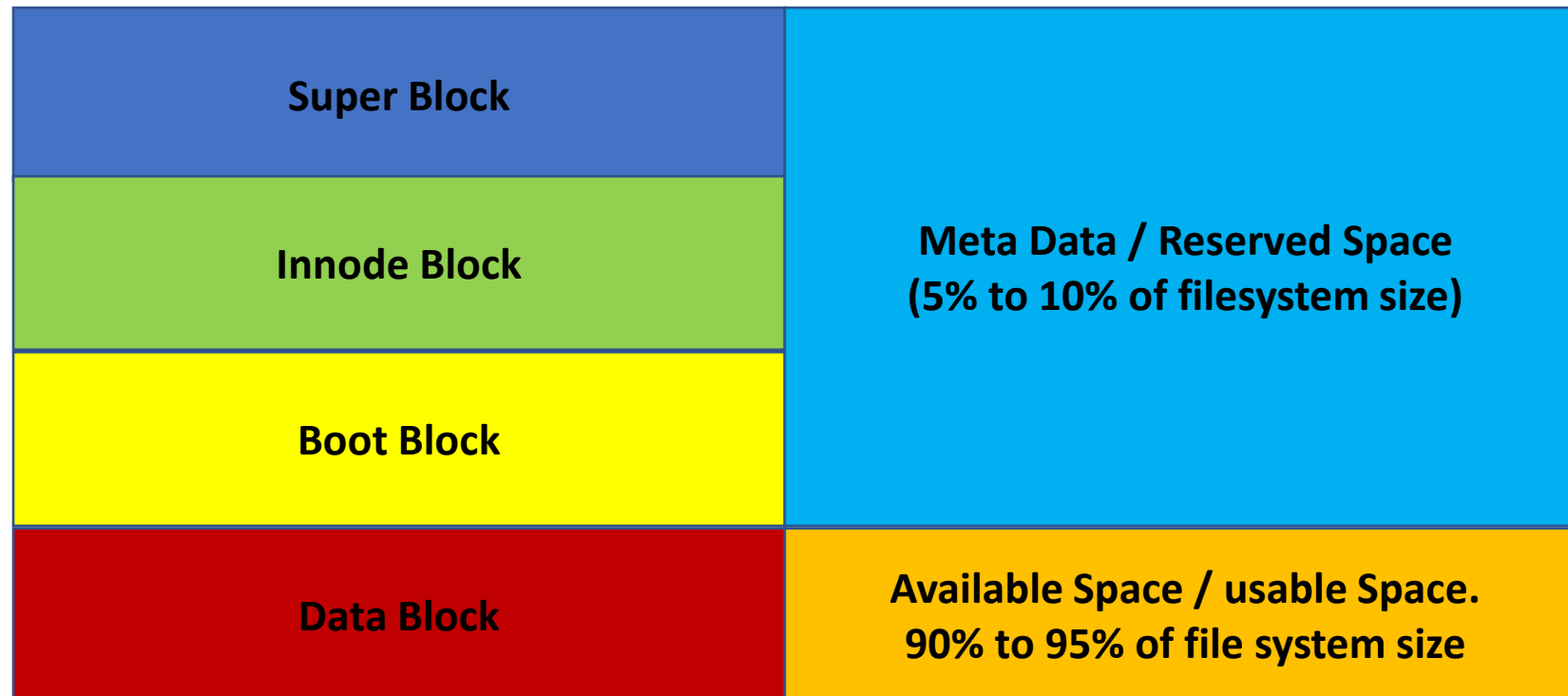Hardware

- Device driver:
  - It is a software that can perform I/O (input/output) with one type of hardware

- Major number:
  - Points to the Name of device driver loaded in the kernel

- Minor number:
  - Points to the instance of a device associated with a particular device driver

- File system is used to control how data is stored and retrieved.

- File systems can be used on numerous different types of storage devices that use different kinds of media.
  - The most common storage device in use today is a hard disk drive
- The file system manages access to both the content of files and the metadata about those files. It is responsible for arranging storage space

Filesystem structure

- When you create a filesystem, the available space is broken into an allocation unit. The allocation units are categorized in Four sets that form the meta data and usable space in a filesystem.

- Anything between 5% to 10% of space is reserved for meta-data

Super Block	**Meta Data / Reserved Space**
Innode Block	**(5% to 10% of filesystem size)**
Boot Block	
Data Block	**Available Space / usable Space.** **90% to 95% of file system size**

Filesystem structure

Super Block

- Holds the information related to used-list, free-list, recycle-list (optional) of data blocks
- Used list and recycle list has pair of values (Innode-num and name of file)
- Free list has (Innode number)
- Multiple copies of super block are stored while creating a file system. These location are shown when you create a file system

Boot Block

- Boot block (master boot record related information)

Innode Block

- This holds information related to properties of the files stored in data block. Example
    - File permissions (rwx/s, Mode of file)
    - Owner, group, link count, time stamp
    - size of file, type of file (d, -, s, p, l)

Data Block

- User save data.
- Modifiable Content

Types of file system

- File system takes advantages of the ability of disk storage media to randomly address data in a short amount of time.

- Below are default file system in unix
  - Ext2(Second extended filesystem is a file system for the Linux kernel)
  - Ext3(Third extended filesystem, journaled file system that is commonly used by the Linux kernel)
  - Ext4(Fourth extended filesystem ,is a journaling file system for Linux)

Creation of file system

- We can create the file system on disk and on tape. We are going to discuss about disk file system

- For creating file system we must create partition on disk first

- Command used for creating the partition as below

    1) Fdisk is used for creating partition on disk

    2) mkfs for file system creation

    3) mount -for mounting file system.

(For creation of partition and file system refer next slide)

Creation of File system

Creation of file system

```
Applications  Places  System                          Tue Jan 31, 3:42 AM   Prathamesh

                              pratham@localhost:/

File  Edit  View  Search  Terminal  Help

[root@localhost /]# fdisk /dev/sdb

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
         switch off the mode (command 'c') and change display units to
         sectors (command 'u').

Command (m for help): m
Command action
   a   toggle a bootable flag
   b   edit bsd disklabel
   c   toggle the dos compatibility flag
   d   delete a partition
   l   list known partition types
   m   print this menu
   n   add a new partition
   o   create a new empty DOS partition table
   p   print the partition table
   q   quit without saving changes
   s   create a new empty Sun disklabel
   t   change a partition's system id
   u   change display/entry units
   v   verify the partition table
   w   write table to disk and exit
   x   extra functionality (experts only)

Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-1827, default 1): 1
Last cylinder, +cylinders or +size{K,M,G} (1-1827, default 1827): 1827

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.

     pratham@localhost:/
```

Creation of file system

```
pratham@localhost:/

File  Edit  View  Search  Terminal  Help

[root@localhost /]# mkfs -t ext2 /dev/sdb1
mke2fs 1.41.12 (17-May-2010)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
917504 inodes, 3668836 blocks
183441 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=3758096384
112 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Writing inode tables: done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 26 mounts or
180 days, whichever comes first.  Use tune2fs -c or -i to override.
```

Creation of file system

SOFTENGER
Strive to Excel

pratham@localhost:/

File Edit View Search Terminal Help

```
[root@localhost /]# mkdir /aap
mkdir: cannot create directory `/aap': File exists
[root@localhost /]# mkdir /aaa
[root@localhost /]# ls
aaa  aap  boot  etc  home  lib64     media  mnt  proc  sbin     srv  tmp  var
aam  bin  dev   FSD  lib   lost+found  mmm    opt  root  selinux  sys  usr
[root@localhost /]# mount /dev/sdb1 /aaa
[root@localhost /]# df -k
Filesystem      1K-blocks      Used Available Use% Mounted on
/dev/sda2        20271996   2597628  16637928  14% /
tmpfs              506144       560    505584   1% /dev/shm
/dev/sda1          289293     28472    245461  11% /boot
.host:/         307199996  19856604 287343392   7% /mnt/hgfs
/dev/sdb1        14444992     35824  13675404   1% /aaa
```

Creation of file system

File   Edit   View   Search   Terminal   Help

```
[root@localhost /]# mkdir /aap
mkdir: cannot create directory `/aap': File exists
[root@localhost /]# mkdir /aaa
[root@localhost /]# ls
aaa  aap  boot  etc  home  lib64     media  mnt  proc  sbin     srv  tmp  var
aam  bin  dev   FSD  lib   lost+found  mmm    opt  root  selinux  sys  usr
[root@localhost /]# mount /dev/sdb1 /aaa
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/dev/sdb1         14444992      35824  13675404   1% /aaa
```

Mount command

- *Mount command is used to attach the disk/partition with the OS, so that an access point can be created for users to get into that particular device.*

- *To create a unique access-point / entry-point into device, create a **NEW** directory on the OS level*

- *When mount command completes successful, 'cd' into this directory will take the user into the new device / disk / partition*

- *Syntax:*
  - *mount [mount options] device name*

- *Example:*
  - *mount –o rw /dev/sdc2 /u8*

Unmount command

- *To remove the access to the device simply run unmount command.*

- *unmount command first check if the mount-point is in use, i.e. is any user accessing this directory or any underlying part of this directory.*

- *If yes, then mount will throw an error and stop*

- *If no, the mount, will flush all the data currently in RAM back to the disk and then remove detach this device from the directory.*

- *Once unmount is done, the directory remains on the machine as an ordinary directory*

- *Syntax:*
  - *umount /u8; --or unmount /dev/sdc2*

- *FSTAB file is referred by the operating system, during the boot/startup of the machine.*

- *Boot process will automatically mount all filesystems that are actively defined in the /etc/fstab file.*

- *In case of mount failure, the system will continue mounting other file systems.*

- *In case of mount of '/' itself fails, then the system will throw relevant error message on the CONSOLE and stop the boot sequence.*

FSTAB: Structure

Device to be mounted	Mount point	Type of file system	mount options	FS dump required (1/0)	FSCK pass number (0/1/2)
/dev/sda2	/	Ext4	Defaults	1	1
/dev/sda1	/boot	Ext4	Defaults	1	2
UUID=19245658-510a-43cb-a7ad-075853a1267a	swap	Swap	Defaults	0	0

- **Instead of giving a device name, we can also give Label and UUID number**
- **UUID number for a device can be found if you run the command, blkid device-name**
- **Example:**
  - **$ blkid /dev/sdc1**
  - **/dev/sdc1: UUID="623f3b98-be14-4578-8804-c9ddd43742a1" TYPE="ext2"**

FSCK: File system consistency Check

- Some of the meta-data associate with a filesystem is maintained in RAM, to improve the performance of filesystem.

- Similarly, when you open a new file and start putting data into it, a Innode number is allocated to the file.

- Similarly, when you open an existing file, you get access to a copy of that file and not the original file.

- While these things are happening, if the machine is powered-off by pulling the power-supply cable, then it is possible that the latest data from the RAM is not copied to DISK. Thus there will be inconsistency in data within the meta-data for a given file systems:

- Example: for the new file, Innode number is allocated, however as the file is not saved, there is no entry in the Innode block for this particular file. i.e. properties of the file are not defined.

FSCK: File system consistency Check

- These inconsistencies will occur ONLY when there is abrupt disconnection of the DISK/PARTITION.

- FSCK is the command that checks the consistency of meta-data. In case any inconsistencies are found, the relevant data is moved to a directory called as "lost+found"

- Following are the stages of fsck:
  - Phase 1 – Check Blocks and Sizes.
  - Phase 2a – Check Duplicated Names.
  - Phase 2b – Check Pathnames.
  - Phase 3 – Check Connectivity.
  - Phase 3b – Verify Shadows/ACLs.
  - Phase 4 – Check Reference Counts.
  - Phase 5 – Check Cylinder Groups.