

Lecture 4: File management starting from /

Hands-on Unix System Administration DeCal

2012-01-30

Review

- ❖ Shell expansion
- ❖ Standard streams
- ❖ Useful commands
- ❖ In a nutshell
- ❖ Philosophy

Users

File hierarchy

Filesystems

Files

Review

Shell expansion

Review

❖ Shell expansion

❖ Standard streams

❖ Useful commands

❖ In a nutshell

❖ Philosophy

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- variables (`$PATH`, environment variables)
- aliases
- tilde
- globbing
- backticks
- single vs. double quotes

Standard streams

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❖ Shell expansion

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- stdin, stdout, stderr
- redirection: $>$, $>>$, $<$
- pipes: $|$
- tee, xargs

Useful commands

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- ❖ Useful commands

- ❖ In a nutshell
- ❖ Philosophy

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- `find`
- `tr, sort, head, tail, wc`
- `for index in $array; do
command; done`
- `while expression; do command;
done`
- `regex with grep, sed, awk`

In a nutshell

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❖ **In a nutshell**

❖ Philosophy

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- RTFM: `man`, `--help` command line option
- **input**: command line options, `stdin`
- **output**: `stdout`, `stderr`
- **manipulate** with pipes (`|`), redirection (`>`, `>>`), and substitution (`\``)

Philosophy

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- ❖ Useful commands
- ❖ In a nutshell

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The highest achievement of the Unix-aesthetic is to have a command that does precisely one function, and does it well. Purists object that, after freshman programmers at Berkeley got through with it, the program “cat” which concatenates multiple files to its output now has OPTIONS. . . “Cat came back from Berkeley waving flags,” in the words of Rob Pike, perhaps the ultimate Unix minimalist. —The Unix-Haters Handbook

This is the Unix philosophy. Write programs that do one thing and do it well. Write programs to work together. Write programs to handle text streams, because that is a universal interface. —Doug McIlroy

Review

Users

❖ Types of users

❖ Groups

❖ NSS databases

❖ What's a user

❖ Who's logged in

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Types of users

Review

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❖ Types of users

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❖ NSS databases

❖ What's a user

❖ Who's logged in

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Files

- **root**: superuser, virtually unlimited control
- system user accounts
 - ◆ typically low UIDs, `/bin/false` shell
- real user accounts
 - ◆ typically higher UIDs, real shell like `/bin/bash`

Groups

Review

Users

❖ Types of users

❖ **Groups**

❖ NSS databases

❖ What's a user

❖ Who's logged in

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Files

- every user has a primary group and optionally secondary group(s)
- important for file permissions

NSS databases

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Users

❖ Types of users

❖ Groups

❖ **NSS databases**

❖ What's a user

❖ Who's logged in

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- **passwd**: user information, public
 - ◆ `useradd, usermod, chsh, userdel`
- **shadow**: “encrypted” (hashed) passwords, only readable by root
 - ◆ `passwd`
- **group**: groups
 - ◆ `groupadd, groupmod, groupdel`

What's a user

Review

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❖ Types of users

❖ Groups

❖ NSS databases

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```
$ getent passwd daradib
daradib:x:1000:1000:Dara Adib,, :/home/daradib:/bin/bash
```

- login name
- password hash
- numerical user ID
- numerical group ID
- finger info (name, phone, office, etc.)
- home directory
- shell

Who's logged in

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❖ What's a user

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- `who, w`: print currently logged in users
- `last`: print login-logout log from `/var/log/wtmp`, `/var/log/utmp`, or similar
- for more details, use process accounting

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- ❖ Windows
- ❖ *nix concept
- ❖ Looking under /
- ❖ Looking under / more

Filesystems

Files

File hierarchy

Windows

Review

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File hierarchy

❖ **Windows**

❖ *nix concept

❖ Looking under /

❖ Looking under / more

Filesystems

Files

- each storage device has a drive letter, e.g. `A: \` for floppy, `C: \` for hard disk, etc.
- important directories
 - ◆ `C:\Windows`
 - ◆ `"C:\Program Files"`
 - ◆ `C:\Users`

*nix concept

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❖ Windows

❖ *nix concept

❖ Looking
under /

❖ Looking
under / more

Filesystems

Files

- “simplicity through expression”
- everything starts from the root¹: /
- excessive (but productive) abbreviation

- case sensitive

¹(not to be confused with /root)

Looking under /

/bin/ core **bin**aries

/dev/ **dev**ice files

/etc/ systemwide *configuration* files

/home/ **home** *directories* (user data)

/lib/ core **lib**raries

/proc/ **proc**fs interface to kernel

Looking under / more

/root/ **root**'s home directory²

/sbin/ to **system binaries**

/tmp/ **temporary** files

/usr/ non-core binaries, libraries, etc.

/var/ **varying** files: logs, user inboxes, running program data, etc.

²(not to be confused with the root /)

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- ❖ What is a filesystem?
- ❖ Examples
- ❖ Non-disk/flash filesystems
- ❖ RAID
- ❖ RAID examples
- ❖ Mounting

Files

Filesystems

What is a filesystem?

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❖ What is a filesystem?

❖ Examples

❖ Non-disk/flash filesystems

❖ RAID

❖ RAID examples

❖ Mounting

Files

- Each local hard disk can have one or more partitions which contain files managed by a filesystem
 - ◆ e.g., `/dev/sda`, `/dev/sda1`

Examples

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Filesystems

❖ What is a filesystem?

❖ **Examples**

❖ Non-disk/flash filesystems

❖ RAID

❖ RAID examples

❖ Mounting

Files

- Windows (and flash drives) filesystems: FAT32, NTFS
- Linux: ext3, ext4, btrfs
- Other Unix: UFS, XFS, ZFS, ReiserFS

Non-disk/flash filesystems

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❖ What is a filesystem?

❖ Examples

❖ Non-disk/flash filesystems

❖ RAID

❖ RAID examples

❖ Mounting

Files

- RAM: tmpfs
- network: NFS, SMB
- FUSE: GmailFS, WikipediaFS

RAID

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❖ What is a filesystem?

❖ Examples

❖ Non-disk/flash filesystems

❖ RAID

❖ RAID examples

❖ Mounting

Files

- Redundant Array of Independent (Inexpensive) Disks
- combine multiple hard drives for speed (striping), capacity, reliability (mirroring, parity)

RAID examples

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❖ What is a filesystem?

❖ Examples

❖ Non-disk/flash filesystems

❖ RAID

❖ RAID examples

❖ Mounting

Files

- common examples: RAID 0 (striping), RAID1 (mirror), RAID5 (parity), RAID 6 (two parity)
- nested, e.g., RAID 10

Mounting

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❖ What is a filesystem?

❖ Examples

❖ Non-disk/flash filesystems

❖ RAID

❖ RAID examples

❖ Mounting

Files

- file hierarchy crosses filesystem boundaries
- use `mount` to mount local or networked *stuff* on a directory (mount point)
 - ◆ can mount regular files too

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- ❖ ls options
- ❖ ls -l
- ❖ Regular files
- ❖ Other file types
- ❖ File permissions
- ❖ Changing file permissions

Files

ls options

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❖ ls options

❖ ls -l

❖ Regular files

❖ Other file types

❖ File permissions

❖ Changing file permissions

- -l: long listing format
- -h: human-readable file sizes
- -d: show directories themselves, not contents
- -F: classify files with indicators
 - ◆ e.g., directory / , symlink @ , executable *

ls -l

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❖ ls options

❖ **ls -l**

❖ Regular files

❖ Other file types

❖ File permissions

❖ Changing file permissions

```
$ ls -l lec04.lyx
```

```
-rw-r--r-- 1 daradib daradib  
15K Sep 24 16:38 lec04.lyx
```

- file type
- permissions: user, group, other
- number of hard links
- owner, group, size, mtime, name

Regular files

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❖ ls options

❖ ls -l

❖ **Regular files**

❖ Other file types

❖ File permissions

❖ Changing file permissions

- Windows: filetype extensions
 - ◆ .exe
 - ◆ .doc
- Unix: magic tests
 - ◆ man file

Other file types

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❖ ls options

❖ ls -l

❖ Regular files

❖ **Other file types**

❖ File permissions

❖ Changing file permissions

- `ls -l`
 - ◆ **directories** (dir)
 - ◆ **symbolic links** (symlink)
 - ◆ **devices: character, block**
 - ◆ **sockets, named pipes** (FIFOs)

File permissions

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```
-rw-r--r-- 1 root root 1.5K Sep 2 10:58 /etc/passwd
-rw-r----- 1 root shadow 947 Sep 2 10:58 /etc/shadow
```

- permissions (`chmod`)

- ◆ **r**ead (+4)
- ◆ **w**rite (+2)
- ◆ **x**ecute (+1)

- owners (`chown`, `chgrp`)

- ◆ **u**ser (first digit)
- ◆ **g**roup (second digit)
- ◆ **o**ther (third digit)

Changing file permissions

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❖ ls options

❖ ls -l

❖ Regular files

❖ Other file types

❖ File permissions

❖ **Changing file permissions**

These commands are equivalent:

- `chown daradib:root file`
- `chown daradib file; chgrp root file`

These commands are equivalent:

- `chmod u=rwx,g+w,o-rwx file`
- `chmod 720 file`