# Computer Systems and Architecture

## Introduction to UNIX

Bart Meyers

University of Antwerp

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# Outline

# UNIX

- Operating system
- Servers, desktops, laptops
- Different types
  - Sun Solaris
  - FreeBSD
  - GNU/Linux (Ubuntu, OpenSUSE, Debian, CentOS, ...)
  - MacOS X

# UNIX Shell

- Three parts:
  - Kernel
    - Central component, manages the computer's hardware (CPU, memory, filestore...)
  - Shell
    - Interface between user and kernel
    - Command Line Interpreter (CLI)
  - Programs

# UNIX Shell

- Interprets commands
- Commands are themselves programs
- Filename completion (use the [tab] key)
- History (use the cursor keys)

# Files and processes

- Everything in UNIX is a file or a process
  - A process is an executing program (unique PID)
  - A file is a collection of data
- Directory structure
  - Root: `/`
  - Home dir: `~/`
  - Current dir: `./`
  - Parent dir: `../`
  - Absolute path: `/home/p10/p101234/oefeningen.html`
  - Relative path: `./oefeningen.html`

# File permissions

- Users
  - Unique username
  - Member of one or more groups
  - `/etc/passwd` and `/etc/group`
- Files
  - Owner (and associated group)
  - Set of permission flags: `r` (+4), `w` (+2), `x` (+1) for owner, group, other
  - Change with `chmod`, `chown`, `chgrp`
- Examples:
  - `chmod 755` *`file`* Owner can do everything, group and others can read/execute
  - `chmod 777` *`file`* Everyone can read, write and execute
  - `chmod 600` *`privatefile`* Owner can read/write, others can't do anything
  - `chmod 664` *`file`* Owner and group can read/write, others can only read
  - `chmod +x` *`file`* Add execute permissions for everyone

# Basic UNIX commando's - browsing

| | |
|---|---|
| `ls` | list files and directories |
| `ls -a` | list all files and directories |
| `mkdir` | make a directory |
| `cd` *`directory`* | change to named directory |
| `cd` | change to home directory |
| `cd ~` | change to home directory |
| `cd ..` | change to parent directory |
| `pwd` | display the path of the current directory |
| `find` | search through directory tree |

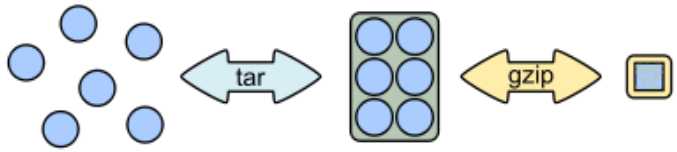
# Basic UNIX commando's - files

| | |
|---|---|
| `cp` *file1 file2* | copy file1 and call it file2 |
| `mv` *file1 file2* | move or rename file1 to file2 |
| `touch` *file* | update the date of an existing file or create a new file |
| `rm` *file* | remove a file |
| `rmdir` *directory* | remove a directory |
| `cat` *file* | display a file |
| `less` *file* | display a file a page at a time |
| `head` *file* | display the first few lines of a file |
| `tail` *file* | display the last few lines of a file |
| `grep 'keyword'` *file* | search a file for keywords |
| `wc` *file* | count number of metrics in file |
| `ln -s` *from to* | make softlink from to |
| `uniq` | report or filter out repeated lines in a file |
| `file` *file* | show the file type of a file |
| `du` *file* | show the disk size of a file or directory |

# Basic UNIX commando's - Varia

| | |
|---|---|
| `man` *`command`* | display manual pages for a command |
| `date` | display date and time |
| `who` | info on all currently logged on users |
| `whoami` | info about yourself |
| `echo` *`hello world!`* | display characters in the terminal |
| `sort text` | sort its input |
| `finger` | Lookup user info |
| `passwd` | Change your password |

# Archiving




- Tar: Uncompressed
  - Create: `tar -cvf` *`tarball.tar files`*
  - Extract: `tar -xvf` *`tarball.tar`*
  - List files: `tar -tf` *`tarball.tgz`*
  - Update files: `tar -uf` *`tarball.tgz files`*
- Gzip: Compression
  - Create: `gzip` *`tarball.tar`*
  - Extract: `gunzip` *`tarball.tar.gz`*
- `tar.gz` or `tgz`?
  - Tar + compression
  - Create: `tar -cvzf` *`tarball.tgz files`*
  - Extract: `tar -xvzf` *`tarball.tgz`*
  - List files: `tar -tzf` *`tarball.tgz`*

# Processes

- Jobs are connected to terminal which started them
- Foreground or background
- `Ctrl+C`: kill current job

| | |
|---|---|
| `kill [-9]` *process_id* | Kill job with pid process_id |
| `pkill` *process_name* | Kill job with name process_name |
| *command* `&` | Run command in the background |
| `ps [-ef]` | Display process info |
| `top` | Display process info interactively |
| `jobs` | Display user's jobs |
| `fg` *pid* | Bring process to the foreground |
| `bg` *pid* | Bring process to the background |

# Basic UNIX commando's - Network

| | |
|---|---|
| `ssh` *`username@host`* | Login with a remote shell |
| `scp` *`from username@host:to`* | copy files over network |
| `wget` *`http://url/file.jpg`* | download files from the web |

# Standard in- and output

- Processes write to the standard output, and take their input from the standard input.
- Keyboard and terminal
- Standard error (terminal)
- Redirection is possible
  - >, >>, <, 2>

# Redirection

- `ls -alrF > listing.txt` : store ls output in listing.txt
- `sort < listing.txt` : feed listing.txt to sort program
- `echo HOI >> listing.txt` : append string HOI to listing.txt
- `echo hello > /dev/null` : suppress output
- `who 2> errors.txt` : store errors in file

# Pipes

- Pipes redirect output from one process to the following one
- Without pipes:

```
who > names.txt
sort < names.txt
```

- With pipes:

```
who | sort
```

# Exercises

- http://msdl.cs.mcgill.ca/people/hv/teaching/ComputerSystemsArchitecture/#CS1