Introduction to GNU/Linux

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The GNU/Linux operating system (History)

- Linux

```
Path: gmdzi!unido!fauern!ira.uka.de!sol.ctr.columbia.edu!zaphod.mps.ohio-state.edu!wupost!uunet!mcsun!ne
From: torva...@klaava.Helsinki.FI (Linus Benedict Torvalds)
Newsgroups: comp.os.minix
Subject: What would you like to see most in minix?
Summary: small poll for my new operating system
Keywords: 386, preferences
Date: 25 Aug 91 20:57:08 GMT
Organization: University of Helsinki

Hello everybody out there using minix -
```

- GNU (GNU's Not Unix)

```
From CSvax:pur-ee:inuxc!ixn5c!ihnp4!houxm!mhuxi!eagle!mit-vax!mit-eddie!RMS@MIT-OZ
From: RMS%MIT-OZ@mit-eddie
Newsgroups: net.unix-wizards,net.usoft
Subject: new Unix implementation
Date: Tue, 27-Sep-83 12:35:59 EST
Organization: MIT AI Lab, Cambridge, MA

Free Unix!
```

The GNU/Linux operating system (Today)

Linux market share[1]

- 1.5% Personal computers
- 35% Servers
- 53% Smart devices
- 97% Supercomputers
- A comprehensive list of distributions `http://distrowatch.com/`
- Five most popular distributions according to DistroWatch: Manjaro, Mint, Ubuntu, elementary and Debian

[1] Source: Wikipedia

Installation alternatives

(a) Full Ubuntu installation on a dedicated partition

(b) Open Virtualization Archive Ubuntu

Casual Linux usage

- nothing to be afraid of :)
- Gnome and Unity "desktop managers"
- Dash menu (equivalent of Start in Windows)
- Web browsing: Firefox
- File browsing: Nautilus
- Text editor: Gedit
- Installing software: Ubuntu Software Center

Exercise: Using Nautilus

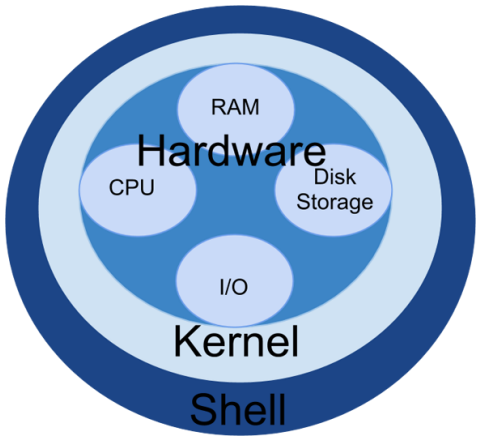
Using the Nautilus file browser, create a folder named `rps` in your home folder.

Power users use the shell (a.k.a command line)

Why use the shell, when we have icons, windows and mice?

- faster
- complex operations via chaining
- batch operations
- in some cases, it's *the only option*

We'll be using the bash shell.



A note on notation

- $ sign signifies a regular user prompt
- # sign signifies a superuser prompt
- Text in "monospace" font is to be entered literally, e.g.

```
user@host:~$ mkdir /tmp/test
```

- Pair of matching less/greater than signs (<>) denotes a "variable":

```
$ cd /home/<username>
```

- Pair of matching brackets denote an optional entry:

```
$ ls [-l]
```

Files and directories (1)

- Where are we?

```
user@host:~$ pwd
```

- What's inside?

```
user@host:~$ ls
```

- Additional options

```
user@host:~$ ls -la
```

- How to move/navigate?

```
user@host:~$ cd rps
```

- Creating a directoy

```
user@host:~/rps$ mkdir tmp
```

- Creating a file

```
user@host:~/rps$ gedit README.rps &
```

Files and directories (2)

(Very) useful tips

- Tab completion
- Command history

- How to list file contents?

```
user@host:~/rps$ less README.rps
```

- Copying a file

```
user@host:~/rps$ cp README.rps tmp/
```

- How to delete a file?

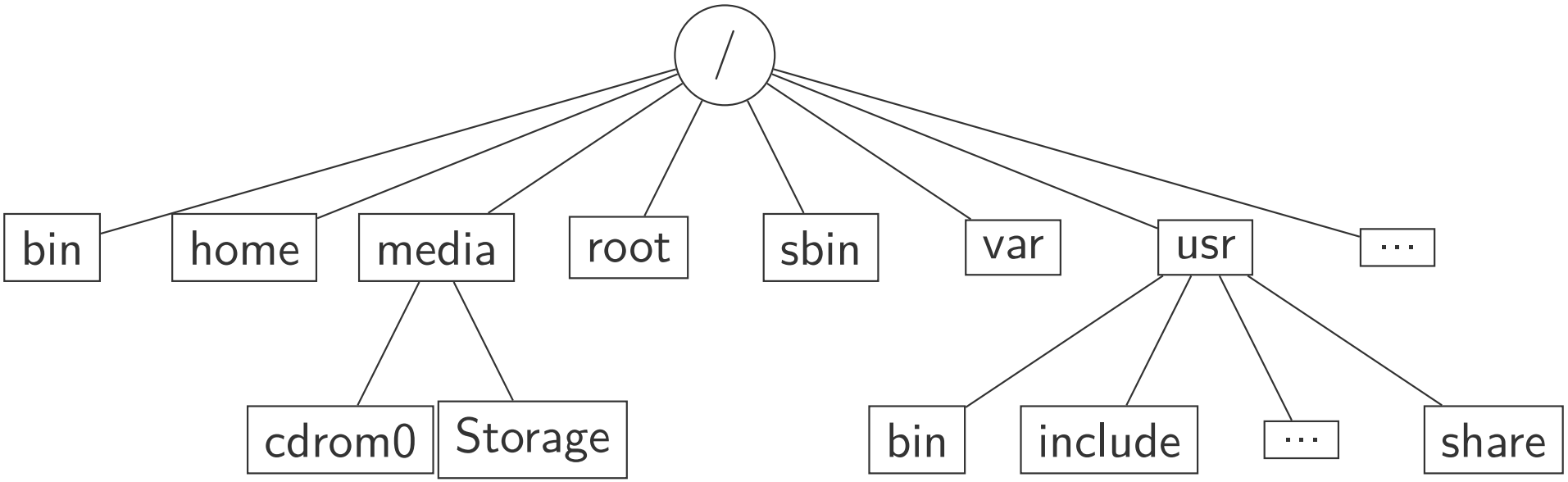
```
user@host:~/rps$ rm tmp/README.rps
```

Tip

Type *q* to get out of interactive programs like `less`.

Filesystem Hierarchy Standard

```
user@host:~/rps$ ls -la /
```



`http://www.pathname.com/fhs/`

Exercise: Removable media

Insert a USB stick into your computer. List its contents in the terminal. Don't forget to eject the USB device before removing it!

Filesystem permissions

- List contents of the `root`[2] user home directory

```
$ ls /root
ls: cannot open directory /root: Permission denied
...
```

- Every file/directory has permissions set for three roles: owner, group and all others.

```
$ ls -ld /root
drwxr-xr-x 34 root root 4096 2012-09-21 17:00 /root
```

- Tools that manipulate ownership and permissions: `chown`, `chgrp` and `chmod`.

[2] This is where the term "to root" an Android device comes from

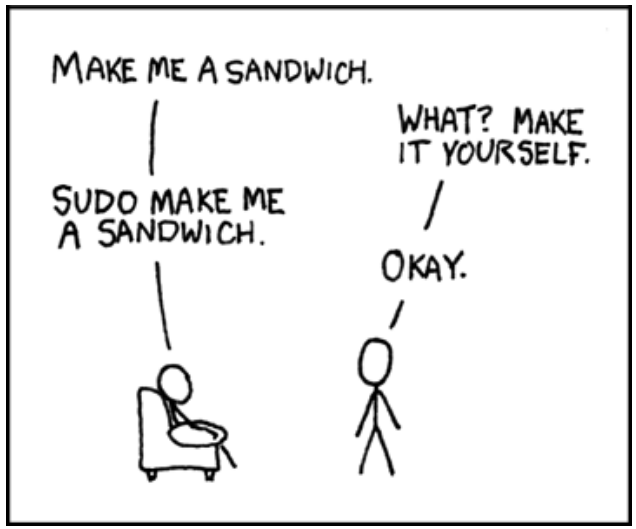
Superuser (root)

- Login disabled for root
- Multiple users can be designated as superusers using sudo[3]
- Executing a command with superuser privileges

```
user@host:~$ sudo ls /root
```

- Gaining a root shell

```
user@host:~$ sudo -i
root@host:~# ...
```



[3] Through the "User Accunts" GUI tool, or by editing (/etc/sudoers)

Command chaining and I/O redirection

- Pass a long output of a command to `less` using pipe |

```
$ ls -la /usr/lib | less
```

- Redirect the output of a command to a file

```
$ echo "Robots rule" > out.txt
$ cat out.txt
$ echo "Neces razbojnice\!" > out.txt
$ ls -la /usr/lib >> out.txt
```

`stdin`, `stdout` (1) and `stderr` (2) streams.

Getting help

- Almost all programs/commands have built-in help

```
$ ls --help
```

- For in–depth help use info...

```
$ info mkdir
```

- ...or man pages.

```
$ man mkdir
```

Exercise: `mkdir` and `ls` options

1. Create a nested folder `tmp2/tmp3/tmp4` inside of your `rps` folder, using only one command (hint: check the options of the 'mkdir' command).
2. Inside of the `tmp4` folder, create a text file containing a list of all files from the `/usr/include` folder, ordered by timestamp.

Searching for files

- Searching for files

```
$ find /home -name README.txt
```

- Indexed searching with *locate*

```
$ locate stdio.h
```

- Find out which executable is run when a command is invoked

```
$ which info
/usr/bin/info
```

Searching inside files

- The *grep* command

```
$ grep <PATTERN> [FILE]
```

- Search for a string in a file

```
$ grep printf /usr/include/stdio.h
$ grep printf /usr/include/*.h
```

- grep can be very useful when combined with other commands using |

```
$ ls /usr/lib | grep python
```

Exercises

Exercise: `locate`

How many stdio.h files are there on your system. (Hint: use the locate command with an additional argument)

Exercise: `grep`

List all directories within the `/usr/lib` directory that have `rwxr-xr-x` permissions. Store this list to a text file. (Hint: Pass the output of `ls` to `grep`).

Advanced Packaging Tool (apt)

- Library with various front-ends:
  - Ubuntu Software Center
  - `apt-get`
- Software repositories in `/etc/apt/sources.list.d`
- Packages are signed and have extensive metadata
- Information is cached
- Updating the cache

```
$ sudo apt-get update
```

- Searching the cache

```
$ apt-cache search terminal | grep -i drop-down
```

- Installing software

```
$ apt-get install guake
$ sudo !!
```

Process management (1)

- Suspending an app with `Ctrl+Z`

```
$ gedit
```

- Moving an app to background

```
$ ^Z
$ jobs
$ bg %1
```

- Killing an app (`Ctrl+C` while the app is in the foreground)

```
$ kill [-9] %1
```

- Starting an app in background

```
$ gedit &
```

- Bringing an app to foreground

```
$ fg %1
```

Process management (2)

- List all processes

```
$ ps [aux]
```

- Monitor processes

```
$ top
```

- Kill a process by PID

```
$ kill -9 <PID>
```

- A fancy kill using `pgrep` and backquote expansion

```
$ kill -9 `pgrep gedit`
```

Environment variables

Variables that affect the behavior of your system and processes.

- List all environment variables

```
$ env
```

- See the contents of a specific variable

```
$ echo $SHELL
```

- Set an environment variable

```
$ [export] PATH=$HOME/scripts:$PATH
```

Environment variables required in every shell session should be exported in `/.bashrc`

Summary

- Navigating the filesystem
- Creating files and folders
- Searching for things
- Installing packages
- Process management
- Environment variables

Useful links

- Basic Use of Linux Operating System at UniZg FER
- Linux tutorial at University of Surrey
- Introdction to Linux edX online course
- Linux System Administration at Rutgers University
- Rute User's Tutorial and Exposition - free Linux usage and administration hanbook (somewhat outdated)
- Ubuntu documentation (official and community wiki)
- Ask Ubuntu (part of StackExchange network)