Cvičení:

- Otevřít terminál
- Otevřít www browser se slidy: https://kfa.mff.cuni.cz/linux
- V terminálu vytvořit adresář **`cviceni`**, a v něm soubor **`test.txt`**
- Zkontrolovat, jaká jsou defaultní práva a vlastnictví adresáře a souboru výše
- Zjistit, v jakých skupinách jako uživatelé jsme
- Změnit vlastnictví souboru **`test.txt`** na některou ze skupiny, ve které jako uživatel jsme
- Kouknout se na další skupiny v systému v souboru **`/etc/groups`** a zkusit „dát“ soubor **`test.txt`** některé ze skupin, ve které jako uživatel nejsme
- Podobně zkusit „dát“ soubor **`test.txt`** administrátorovi (root)
- Nastavit plná **`rwx`** práva souboru **`test.txt`** pro uživatele a skupinu, ale žádná práva pro ostatní uživatele systému (others)
  - pomocí písmenných přepínačů i osmičkového kódu
- Vypnout práva **`x`** a/nebo **`r`** pro adresář **`cviceni`**. Co to dělá a (ne)umožní za operace v adresáři? (Lze si obsah adresáře vypsat? Lze si soubory v adresáři přečíst? Lze v adresáři spustit skript?)

Introduction to the Linux OS

Peter Huszár
KFA: Department of Atmospheric Physics

Pavel Řezníček
ÚČJF: Institute of particle and nuclear physics

October 5, 2026

Overview and Organization

Introduction to the Operation system Linux, focus on the command line, scripting, basic services and tools used in (not only) physics: tasks automation in data processing and modeling

Organization

- Graded Assessment (KZ): attendance to the lectures, worked out homeworks

Literature

- C. Herborth: Unix a Linux - Názorný průvodce, Computer Press, Praha, 2006
- D. J. Barrett: Linux - Kapesní přehled, Computer Press, Praha, 2006
- M. Sobell: Mistrovství v RedHat a Fedora Linux, Computer Press, Praha, 2006
- M. Sobell: Linux - praktický průvodce, Computer Press, Praha, 2002
- E. Siever: Linux v kostce, Computer Press, Praha, 1999
- Number of online sources...

Study materials and homeworks

- http://kfa.mff.cuni.cz/linux

KFA MFF UK

ÚČJF MFF UK

Syllabus

1. UNIX systems, history, installation, basic applications
2. Structure of the Linux OS, file systems, hierarchy of the file system
3. Command line, shells, remote access (ssh, ftp)
4. Processes and their administration, basic system commands, packages, printing
5. Users, file and directory permissions
6. Work with files and directories, file compression, links, partition
7. Text-file processing commands, redirection, pipeline
8. Regular expressions
9. Command line based text editors
10. User and system variables, output processing
11. Scripts: basic construction, conditionals, loops, functions, automation
12. Networking, server-client services: http, (s)ftp, scp, ssh, sshfs, nfs
13. Programming in Linux (examples of Fortran, C/C++, Python), version control systems, documents in Latex

Processes in Linux

Running applications and system processes can be inspected, killed, ... (aka TaskManager in Windows)

- `ps axuf | less`: inspect currently running processes (one-time)
- `top`, `htop`: online inspection of processes
  - Frequency of update
  - Search
  - Sort by memory usage instead of CPU
  - Can kill or change priority of a process
- `kill, killall, xkill`: kill process or application
- `nice`, `renice`: change application priority (0 by default, only root can increase it)
  - Priorities: -20 ... 19
  - `nice -12 large-job`: run large-job with priority 12
  - `nice --12 large-job`: run large-job with priority -12
  - `renice 17 -p 1134`: change priority of process with id 1134 to 17
- `cpulimit`: limit cpu usage of a process
- `ulimit`, `unlimit`: limit resources for a process (resp. in active shell): e.g. memory, number of opened files, ...
  - User can't override defaults in `/etc/security/limits.conf`
  - `ulimit -a`: see current limits
  - `unlimit`: set limits to the system defaults (not further limits for user)
  - `ulimit -Sv`: limit memory usage in kilobytes

KFA MFF UK

ÚČJF MFF UK

GUI processes

- `xrestop`: GUI processes
- `xkill`: GUI kill
- `wmctrl`: Change GUI window position, size, etc.
- `xev`: Monitor / debug key press (special keys)
- `xprop`: Properties of GUI window
- `xdotool`: Properties of GUI window, including emulation of keyboard/mouse

Other resources monitoring

- `iotop`: Disk usage per process
- `jnettop`: Network usage

Administration

In general: search for solutions of problems e.g. at *stackoverflow.com*, but be careful advices include modification of system files (configs are OK; reshufling binaries, libraries etc. NOT)

- `shutdown`, `poweroff`, `halt`, `reboot`,
- `hibernate`, `hibernate-ram`, `hibernate-disk`, `s2disk`, `s2ram`
- `systemctl` command:
  - `list-units`: list running system services
  - `stop`, `start`, `restart`: handle given service, only works till restart
  - `disable`, `enable`: enable/disable service completely (even after restart)

System configuration:

- in `/etc` directory
- most common default options in `/etc/default` directory

Logging of system events: in `/var/log` directory

- `syslog`, `daemon.log`, `messages`, `kern.log`, `debug`: system messages
- `auth.log`: info about logging of users (including virtual ones)
- `Xorg.0.log`: log of the GUI system
- Log files are usually backuped per month and started freshly again (`/etc/logrotate.conf`, `/etc/logrotate.d`)

KFA MFF UK
ÚČJF MFF UK

Handled by the Linux Kernel (includes HW drivers)

- Info about HW in pseudofiles: `/dev/*`, `/sys/*`, `/proc`
- Commands to list HW:
  - `lspci`: HW connected to the PCI bus
  - `lshw`: detailed info about all HW
  - `lsusb`: USB devices
  - `lsblk`: Block devices (disks)
  - `lsscsi`: SCSI devices (CD/DVD)
- Adding removing driver (= kernel module):
  - `lsmod`: list loaded kernel modules
  - `modinfo`: detailed info about kernel module
  - `modprobe`: add, or remove (`-r`) from kernel
  - `insmod`, rmmod: simple add / remove module from kernel
  - PS: Not all drivers are as separated modules, but can be builtin in the kernel =¿ the only way to disable them is via kernel option in GRUB boot loader
- Configuring kernel modules:
  - `/etc/modules`: force load of kernel modules not picked up automatically (special HW, very new HW, ...)
  - `/etc/modprobe.d`: add options to drivers, blacklist drivers

Network

Nowadays most systems use *NetworkManager* (NM) application to handle the net connection

- `/sbin/ifconfig`: Show info about network devices and connection (IP address, MAC address)
- NM allows complex configuration, including scripts
- NM recently generates random WiFi MAC address for security on public sites: might need to be disabled in corporate networks through `/etc/NetworkManager` settings

Useful commands:

- `ping`: Check remote host is online
- `traceroute`: Show full communication path to remote host
- `ssh`: connect to remote host via Secure Shell
- `ftp, sftp, scp, nfs`: copy files from/to remote host (see later lectures)
- `netstat`: info about connections, opened ports etc. (`netstat -natulp | less`)

Print

The linux system mostly rely on CUPS printing system:

- `/etc/cups`: configuration of the print client and server
- `localhost:631` in web-browser: WEB-based configuration of CUPS

However, recently some GUI applications can ignore CUPS settings and search for available printers by themselves...

Automatic tasks in background

CRON system:

- /etc/crontab: basic file to run tasks per hour/day/week/month
- /etc/cron.hourly
- /etc/cron.daily
- /etc/cron.weekly
- /etc/cron.monthly
- /etc/cron.d: more complicated rules

```
# /etc/cron.d/renew_prak0x: crontab entries for reweval of the prak0x user home directories
# Execute only during the period of the exercises (01.Oct - 20.Jan)
# TODO ?: Add entry in between day in case of 2 excercises per single day

SHELL=/bin/bash

# m  h   dom   mon              dow  user  command
32   01   *    OCT,NOV,DEC,JAN  SUN  root  /home/prak_template/bin/reboot.cron.sh
# NO!!! (studenti by po rebootu nenasli sva data !)
#@reboot                            root  /home/prak_template/bin/renew_prak0x.cron.sh
12   03   *    OCT,NOV,DEC       *   root  /home/prak_template/bin/renew_prak0x.cron.sh
12   03  1-20  JAN               *   root  /home/prak_template/bin/renew_prak0x.cron.sh
```

Linux on net is also target of attacks, especially through the ssh connection

- `sshguard`: service that stops ssh login after several failed attempts
- `rkhunter`: complex check of the most important system utilities
- `chkrootkit`: simple check of most known "viruses" in the system utilities
- `logcheck`: scans log files and reports suspicious activities

Many of these commands are set to run regularly and send reports by e-mail to the system admin (see `/etc/aliases` file)