

Programmierpraktikum

Claudius Gros, SS2012

Institut für theoretische Physik
Goethe-University Frankfurt a.M.

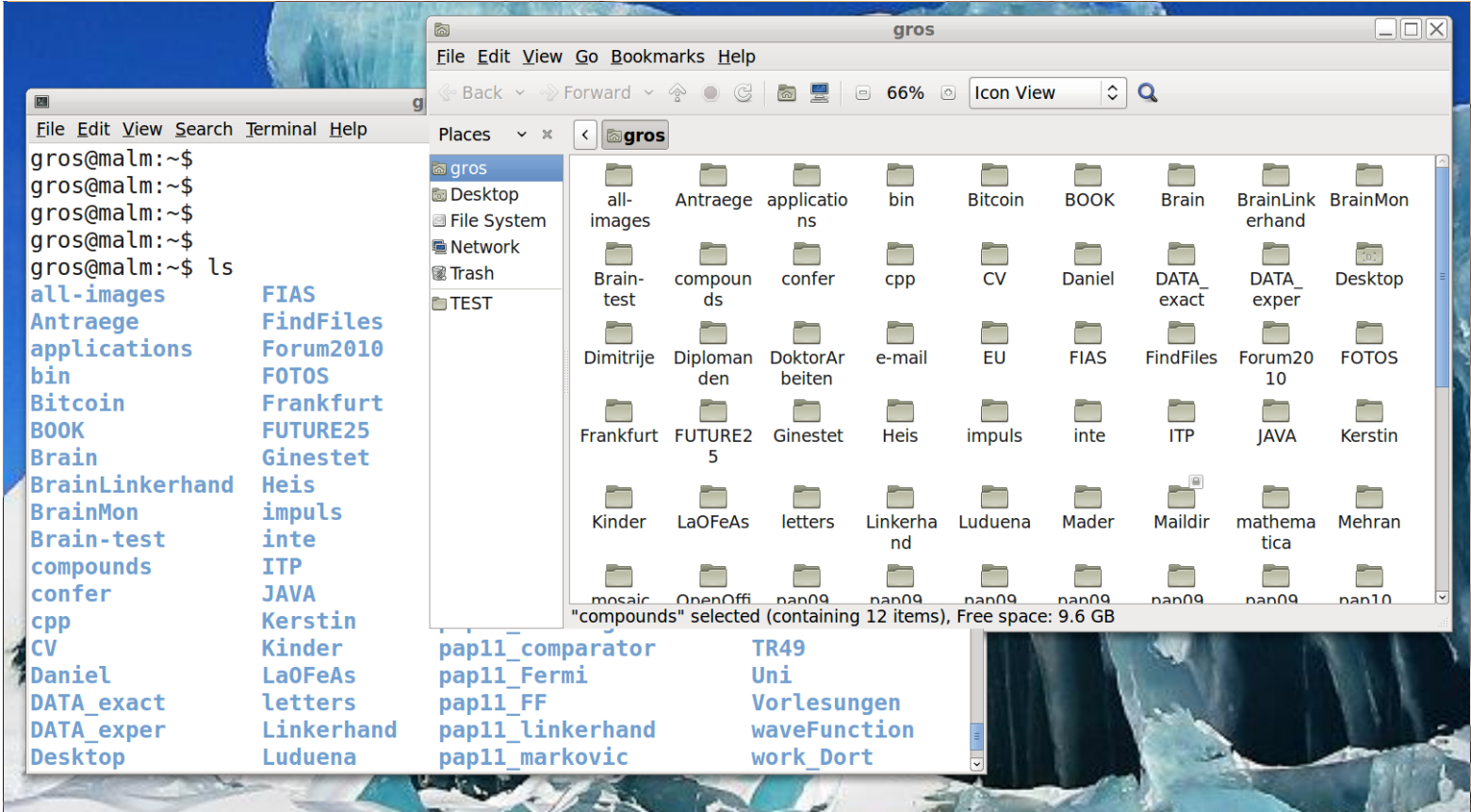
Linux - Basics

what is Linux

Unix by Linus Torvalds

- multi-user
- multi-process: foreground, background, ...
- scripts
- open source
- one-click installation on Windows
[Ubuntu Windows installer](#)

Linux: console commands vs. icon clicking



Linux commands - overview

Directory Operations

- `cd` Change into the given directory ("`.`" present directory, "`..`" one level up, "`/`" top (root) directory)
 - `ls` Show (list) the content of the given directory (`-a` all, `-l` long, `-h` human readable)
 - `mkdir` Create (make) a new directory
 - `pwd` Show path to the present directory
 - `rmdir` Delete (remove) given directory when empty
-

Editors

- `emacs` Windowed editor with a large palette of functions
 - `vi / vim` Standard in-console Unix-editors with full keyboard control
-

File Operations

- `chmod` For changing access rights for `-r` reading, `-w` writing and `-x` executing
 - `cp` Copy files and directory (`-r` recursively)
 - `file` Shows file type and information
-
- `more` Prints a text (file) on screen consecutively

File Manipulation

- `cat` Combines (concatenates) several files into a single file
- `grep` Search in a output for a string or expression (`more test.txt | grep "information"`)
- `kprinter` Sending file to a printer
- `okular` Universal viewer for documents, images and graphics
- `sort` Sorting an output or a file (`-r` reverse, `-u` unique, `-g` numerical)
- `split` Splitting a given file into parts
- `wc` Counting lines, words and chars in an output or file (`-l` only)

lines)

Info and Documentation

- `apropos` Gives a list of man-pages for a given subject
- `man` Prints man pages (documentation) for a given command or program to screen

Data Compression

- `gzip / bzip2` For compression of files and data
- `tar` For compression and decompression (with `-x`) of archives and multiple files

- `zip / unzip` Compression and decompression WinZip (DOS/Win) files
-

Miscellaneous

- `↑ / ↓` Tabbing through previous commands
 - `date` Prints current data to screen
 - `env` Prints a list of all environment variables
 - `expr` Evaluation of symbolic mathematical expressions, mostly for scripts
 - `find` Searching for files, starting from current directory.
-
- `history` History of previous shell commands

Process Management

- `&` Process running in the background (used at the end of a command line)
- `^C` Terminates (kills) the current process (running in current console)
- `kill` Terminates (kills) a process with a given ID (*PID*)
- `nice` Setting the priority of a given process, mostly in order not to disturb other users
- `nohup` Starting a program which will continue to run after the user logs out (no hangup)
- `ps` Lists processes started by the user in present console (*-a* all, *-l* long)

- `time` Measuring the time needed to execute a given process or program
 - `top` Shows all running processes with real-time updating of active processes and their respective CPU and memory consumption
-

System Infos

- `df` Disc use of all partitions
 - `du` Disc use of current and child directories
 - `uptime` Time since last reboot
-

Remote Connections

- `ftp` Data transfer to and from a remote host with line commands (file transfer protocol)
 - `ping` Sending pings to remote host
 - `scp` Copy data to and from remote host (secure copy)
 - `ssh` Connect to remote host and log in
-

Linux commands: man

man - show manual

- **man** *command*: show manual of *command*
- **man** *man*: show manual of command *man*

NAME

man - an interface to the on-line reference manuals

SYNOPSIS

```
man [-c|-w|-tZ] [-H[browser]] [-T[device]] [-X[dpi]] [-adhu7V] [-i|-I] [-m system[,...]] [-L locale] [-p string]
pager] [-r prompt] [-S list] [-e extension] [--warnings [warnings]] [[section] page ...] ...
man -l [-7] [-tZ] [-H[browser]] [-T[device]] [-X[dpi]] [-p string] [-P pager] [-r prompt] [--warnings[warnings]] ...
man -k [apropos options] regexp ...
man -f [whatis options] page ...
```

DESCRIPTION

man is the system's manual pager. Each page argument given to man is normally the name of a program, utility or file associated with each of these arguments is then found and displayed. A section, if provided, will direct man to a specific section of the manual. The default action is to search in all of the available sections, following a pre-defined order and displaying the first page found, even if page exists in several sections.

Linux commands: ls

ls - list directory contents




- **ls -l**: long listing format
- **ls -a**: list all files
- **ls -h**: human readable

```

user@pc:/$ ls -l
total 91
drwxr-xr-x  2 root root  4096 Mar 19 08:46 bin
drwxr-xr-x  4 root root  3072 Feb 20 14:49 boot
drwxr-xr-x 14 root root 14240 Apr  6 13:45 dev
drwxr-xr-x 192 root root 12288 Apr 24 09:18 etc
drwxr-xr-x  3 root root     0 Apr 24 09:18 home
drwxr-xr-x  2 root root     6 Aug 14  2008 initrd
drwxr-xr-x 17 root root  8192 Jan 29 09:53 lib
drwxr-xr-x  2 root root     6 Apr 15  2008 mnt
drwxr-xr-x  8 root root  4096 Apr 21 13:50 opt
dr-xr-xr-x 181 root root     0 Feb 20 10:25 proc
drwxr-xr-x  9 root root  4096 Jan 29 09:57 root
drwxr-xr-x  2 root root  8192 Feb 20 14:48 sbin
drwxr-xr-x 12 root root     0 Feb 20 10:25 sys
drwxrwxrwt 132 root root 12288 Apr 24 09:20 tmp
drwxr-xr-x 12 root root   133 Aug 14  2008 usr
drwxr-xr-x 17 root root  4096 Aug 14  2008 var
user@pc:/$
    
```

Linux commands: more

more - show file on screen

- **more** *file*: show *file* on screen
- move with  and 
- exit with 

Linux commands: pwd

pwd - print working directory

- **pwd**: print full path name of current directory

```
user@pc:~$ pwd  
/home/user  
user@pc:~$
```


Linux commands: cd

cd - change directory

- **cd** *directory*: change to *directory*
- **cd** /: change to root
- **cd** ~: change to home
- **cd** ..: one up

```
user@pc:~$ cd /  
user@pc:/$ cd var  
user@pc:/var$
```

Linux commands: mkdir

mkdir - make directory

- **mkdir** *directory*: create *directory*
- **mkdir -p** *foo/test/abc/123/bar*:
create directory *foo/test/abc/123/bar* and all parents if necessary

```
user@pc:~$ mkdir test
user@pc:~$
```

Linux commands: rmdir

rmdir - remove directory

- **rmdir** *directory*: delete *directory*
- only works on empty directories

```
user@pc:~$ rmdir test
user@pc:~$ rmdir downloads
rmdir: failed to remove `downloads': Directory not empty
user@pc:~$
```

Linux commands: mv

mv - move/rename files

- **mv** *file1 file2*: rename *file1* to *file2*
- **mv** *file directory*: move *file* to *directory*
- **mv** *myImages/*.jpg /home/user/otherUser/yourImages/*:
move all *jpg* files in the directory *myImages/*
to the directory */home/user/otherUser/yourImages/*

```
user@pc:~$ mv foo.txt bar.txt
user@pc:~$ mv bar.txt downloads
user@pc:~$
```

Linux commands: rm

rm - remove files or directories

- **rm** *file*: delete *file*
- **rm** *directory*: delete *directory*
- **rm -r** *directory*: recursive delete *directory* and all containing files
- **rm** *image**: delete all files starting with *image*

```
user@pc:~$ rm downloads/bar.txt
user@pc:~$
```

Linux commands: cat

cat - concatenate files and print to standard output

- **cat** *file*: print contents of *file*
- **cat** *file1 file2 > file3*: concatenate the files *file1* and *file2* and print output to *file3*
- **cat** *aaa** **>** *aaa.all*: concatenate all files starting with *aaa*

```
user@pc:~$ cat file1
first line of file1
second line of file1

user@pc:~$ cat file2
first line of file2
second line of file2

user@pc:~$ cat file* > all
user@pc:~$ cat all
first line of file1
second line of file1
first line of file2
second line of file2
```

Linux commands: ps

ps - report a snapshot of the current processes

- **ps**: list current processes
- **ps aux**: list all processes

```

user@pc:~$ ps aux
USER      PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1  0.0  0.0   4020   476 ?        Ss   Feb20    1:08 /sbin/init
root         2  0.0  0.0     0     0 ?        S    Feb20    0:00 [kthreadd]
root         3  0.0  0.0     0     0 ?        S    Feb20    0:02 [migration/0]
root         4  0.0  0.0     0     0 ?        S    Feb20    0:23 [ksoftirqd/0]
root         5  0.0  0.0     0     0 ?        S    Feb20    0:00 [watchdog/0]
root         6  0.0  0.0     0     0 ?        S    Feb20    0:04 [migration/1]
root         7  0.0  0.0     0     0 ?        S    Feb20    1:04 [ksoftirqd/1]
1635      4650  0.0  0.0   92248   2752 ?        S    Apr21    0:00 /usr/lib/eclipse/eclipse -vm /usr/lib/jvm/java-gcj/bin/j
1635      4656  0.7  9.4 1021416 381456 ?        Sl   Apr21   29:27 /usr/lib/jvm/java-gcj/bin/java -Djava.library.path=/usr
daemon    4715  0.0  0.0    8084    524 ?        Ss   Feb20    0:00 /sbin/portmap
root     4776  0.0  0.0     740     36 ?        Ss   Feb20    0:37 /usr/local/bin/netbeep eth0
statd    4813  0.0  0.0   14416    816 ?        Ss   Feb20    0:00 /sbin/rpc.statd -p 2051 -o 2052
1635     17246  0.0  0.1   17052   7332 pts/1    Ss   09:13    0:00 bash
user@pc:~$
    
```

Linux commands: kill

kill - send a signal to a process

- **kill** *pid*: send signal TERM to process with id *pid*
- **kill -9** *pid*: kill process with id *pid*

```

user@pc:~$ ps -l
F S  UID  PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1467  8100  8095  0  80   0 -  8641 wait  pts/0      00:00:02 bash
0 S  1467 16732  8100  1  80   0 - 133912 poll_s pts/0      00:00:00 kwrite
0 R  1467 16797  8100  0  80   0 -  5796 -      pts/0      00:00:00 ps
0 S  1467 26446   1  0  80   0 - 221014 futex_ pts/0      00:02:11 soffice.bin
user@pc:~$ kill 16732
    
```


piping of Linux commands

| - output of one command as input of next

- **sort** *filename*: sort the file *filename*
- **grep** *expression*: extract all lines containing the *expression* from output

```
user@pc:~$ more names.txt
Ralph Junghans
Anna Rosenkranz
Joachim Neumayer
Anna Furlger

user@pc:~$ more names.txt | grep "Anna" | sort > names.anna

user@pc:~$ more names.anna
Anna Furlger
Anna Rosenkranz
```

Linux editors

use the editor you feel at ease with

- **vi/vim**: standard editor
- keyboard controlled - no need to use the mouse
 - `i` start inserting modus
 - `R` start replacing modus
 - `o` start insert in next line
 - `a` start inserting at end of current line
 - `esc` exit editing modi
 - `u` undo last insertion or change

 - `r` replace current char
 - `x` delete char
 - `7x` delete seven chars

- `dd` delete line
- `8dd` delete eight line
- `y` copy (yank) current line to buffer
- `9y` copy (yank) nine lines to buffer
- `p` insert buffer

- `j` move cursor a line down
- `k` move cursor a line up
- `h` move cursor to the left
- `l` move cursor to the right

- `:w` save (write) file
- `:q` exit (quit) *vi*
- `:wq` write and exit

- `:111` goto line 111
- `:1,11d` delete lines 1 through 11

`:1,$s/error/correct/`

substitute *error* by *correct* through the entire file

`:10,20s/yes/no/g`

substitution from line 10 to twenty, also multiple times per line (*g*)

hidden files

files starting with a `.` are hidden

- used for setting user preferences/configuration for applications
- `.vimrc` settings for **vi/vim** editor
- `.eclipse` settings for the **Eclipse** development environment
- ...

```

user@pc:~/TEST$ ls -l
total 32
-rw-rw-r-- 1 user user 1775 2012-03-09 17:58 HashMapMapDemo.class
-rw-rw-r-- 1 user user 2019 2012-03-09 17:59 HashMapMapDemo.java
-rw-rw-r-- 1 user user 20961 2012-03-09 15:45 hashMap.svg
user@pc:~/TEST$ ls -la
total 56
drwxrwxr-x  2 user user 4096 2012-03-12 09:57 .
drwxr-xr-x 153 user user 12288 2012-03-12 09:56 ..
-rw-rw-r--  1 user user 1775 2012-03-09 17:58 HashMapMapDemo.class
-rw-rw-r--  1 user user 2019 2012-03-09 17:59 HashMapMapDemo.java
-rw-rw-r--  1 user user 20961 2012-03-09 15:45 hashMap.svg
-rw-rw-r--  1 user user  3 2012-03-12 09:56 .I-am-a-hidden-file
    
```

connection to remote hosts

using university computers from home

- **ssh** *remote-host*: establish a connection to remote host
itp.uni-frankfurt.de
th.physik.uni-frankfurt.de
- **scp** *remote-host-path* . : transfer data from remote host to current directory
- **scp** ./filename *remote-host-path* : transfer data from current directory to remote host
- **javac** / **java** : compile / execute a Java program
- **time...** : measuring the time needed to execute a program
- **nohup** ... & : starting a program which runs in the background (&) and which continues to be executed after logging-out (**nohup**)

```
user@pc:~$ ssh -l gros karlstad.th.physik.uni-frankfurt.de
gros@karlstad.th.physik.uni-frankfurt.de's password:

gros@karlstad:~$ cd TEST/
gros@karlstad:~$ javac Test.java
gros@karlstad:~$ nohup time java Test test.old test.new &
[1] 2176
```

```

gros@karlstad:~$ nohup: ignoring input and appending output to `nohup.out'

gros@karlstad:~$ exit
logout
Connection to karlstad.th.physik.uni-frankfurt.de closed.

user@pc:~$ scp gros@karlstad.th.physik.uni-frankfurt.de:TEST/nohup.out .
gros@karlstad.th.physik.uni-frankfurt.de's password:
nohup.out                               100% 326      0.3KB/s   00:00

user@pc:~$ more nohup.out
# starting Test.main()
# scanning the file test.old
# scanning the file test.new
    1000 lines in test.old
    1000 lines in test.new
     84 lines in test.output
0.15user 0.02system 0:00.21elapsed 77%CPU (0avgtext+0avgdata 77248maxresident)k
888inputs+80outputs (6major+5261minor)pagefaults 0swaps

```

- **ping** *remote-host*: checking availability and connection quality

```

user@pc:~$ ping 141.2.247.163
PING 141.2.247.163 (141.2.247.163) 56(84) bytes of data.
64 bytes from 141.2.247.163: icmp_req=1 ttl=64 time=4.99 ms
64 bytes from 141.2.247.163: icmp_req=2 ttl=64 time=0.132 ms
64 bytes from 141.2.247.163: icmp_req=3 ttl=64 time=0.263 ms
64 bytes from 141.2.247.163: icmp_req=4 ttl=64 time=0.299 ms

user@pc:~$ ping findfiles.net
PING findfiles.net (85.10.210.3) 56(84) bytes of data.
64 bytes from findfiles.net (85.10.210.3): icmp_req=1 ttl=55 time=6.51 ms
64 bytes from findfiles.net (85.10.210.3): icmp_req=2 ttl=55 time=6.16 ms
64 bytes from findfiles.net (85.10.210.3): icmp_req=3 ttl=55 time=6.28 ms

```

Linux - shell scripts

automated execution of commands

- **chmod** **+x**: make file executable (**x**)

```
user@pc:~$ vi test.sh
user@pc:~$ chmod -x test.sh
```

- **echo** : print message to screen
- **sleep** **8**: sleep for **8** seconds

```
#!/bin/bash
i=0
N=2
while test $i -le $N
do
a=`expr 50 \\* $i`
b=`expr $a + 1`
more "inputFile_$i.dat" | grep "Anna" > "outFile_$b.out"
echo "ich gehe jetzt für $i Sekunden schlafen " $i
sleep $i;
i=`expr $i + 1`
done
cat outFile_*.out > outFile.all
```

```
user@pc:~$ ls
inputFile_0.dat inputFile_1.dat inputFile_2.dat test.sh
```



```
user@pc:~$ ./test.sh
ich gehe jetzt für 0 Sekunden schlafen 0
ich gehe jetzt für 1 Sekunden schlafen 1
ich gehe jetzt für 2 Sekunden schlafen 2

user@pc:~$ ls
inputFile_0.dat  inputFile_2.dat  outFile_1.out  outFile.all
inputFile_1.dat  outFile_101.out outFile_51.out  test.sh
```

```
user@pc:~$ more inputFile_*.dat
::::::::::::
inputFile_0.dat
::::::::::::
Ralph Junghans
Anna Rosenkranz
Joachim Neumayer
Anna Furlger
::::::::::::
inputFile_1.dat
::::::::::::
Keine Anna hier,
oder etwa doch?
::::::::::::
inputFile_2.dat
::::::::::::
Hier ist nun wirklich
keine anna zu finden.

user@pc:~$ more outFile.all
Anna Rosenkranz
Anna Furlger
Keine Anna hier,
```

Linux open-source utilities

a very large selection of free utilities

- **gnuplot** *datafile*
`fast and dirty' visualization of xy, xyz or multicolumn data files
- **xmgrace** *datafile*
more elaborate plotting of xy, xyz or multicolumn data files
- **gimp**
advanced editor for bitmap images
- **inkscape**
advanced editor for scalable vector graphics
- **alpine**
console mail program
- **ooffice**
OpenOffice (LibreOffice) package