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LINUX TERMINAL

Beginner Tutorial

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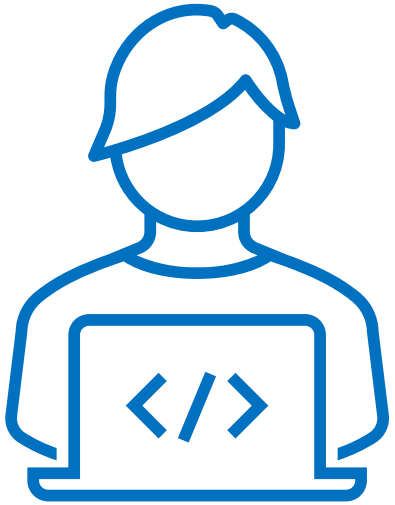
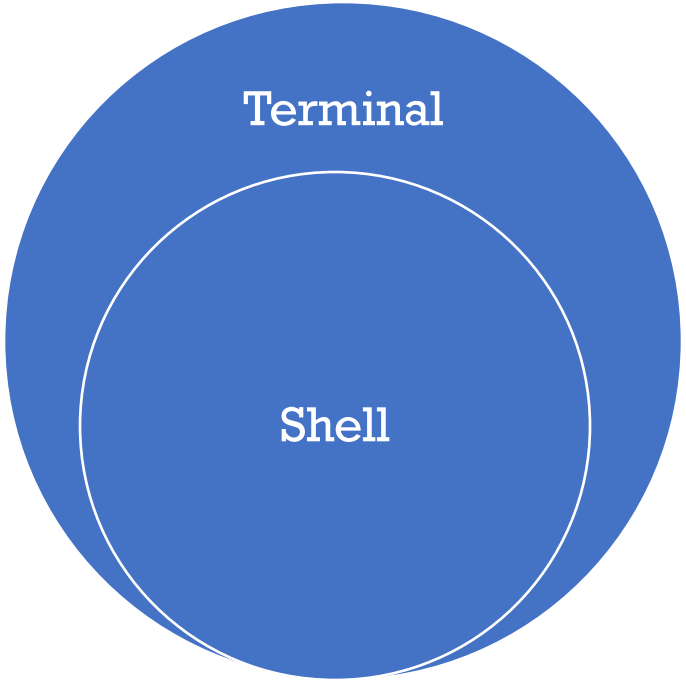


TABLE OF CONTENTS

1. INTRO: WHAT IS THE COMMAND LINE?

- Text-based tool to control the computer
- Terminal: interface to enter text commands
- Shell: program that evaluates the commands
  - **bash** or **sh** on Linux
  - **zsh** or **bash** on Mac
  - **Powershell** or **Command Prompt** on Windows
  - Other shells with various functions available



1. INTRO: WHY COMMAND LINE?

Advantages over GUI (Graphical User Unterface):

- Available on every computer
- Easy development of software (no design experts necessary)
- Requires less resources (CPU, mem)
- Automation using scripts
- No mouse and searching for buttons needed

Disadvantages:

- Unintuitive for beginners

1. INTRO: WHY LINUX?

- Free usage
- Open source: Flexible and independent
- Higher performance than e.g. Windows
- Full control over updates and system state
- Many open source software are targeted on Linux

-> Basic knowledge important for computer scientists

1. INTRO: LAB SETUP

- Course material at **www.github.com/Jonas-Wessner/linux-beginner-lab**
- Install Docker from **www.docker.com/products/docker-desktop/**
- Docker allows running a "mini-linux" on your PC.
- We have created a preconfigured environment that contains exercises

QUESTIONS?

2. NAVIGATION: APPEARANCE

```
myuser@8a1bc344a6ba:~$ pwd
/home/myuser
```

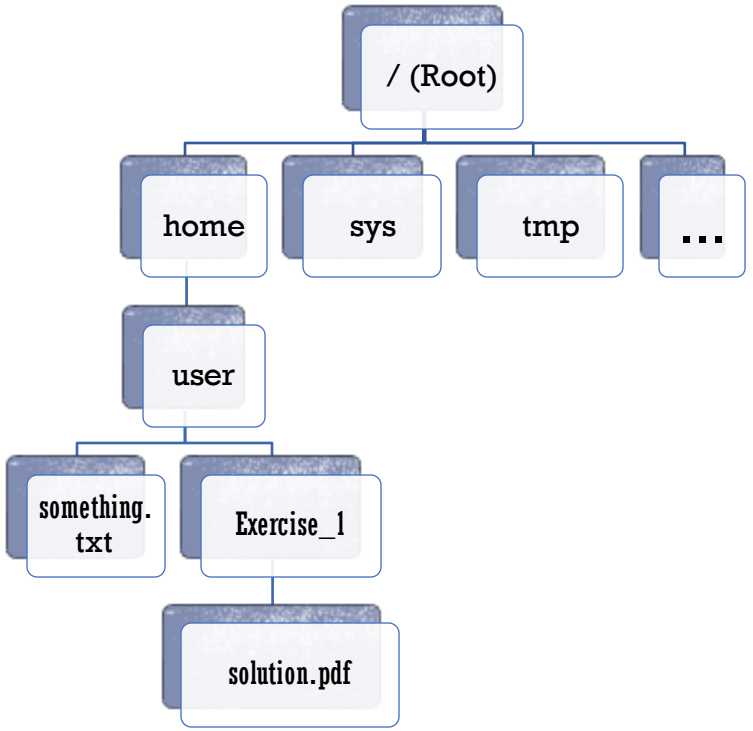
- "**myuser**": user name, priveliged user is called "root"
- "**8a1bc344a6ba**": computer name
- Start position is user's home directory a.k.a. **~**
- Show current position: pwd (Print Working Directory)

2. NAVIGATION: DIRECTORY TREE

- "/": root directory
- "..": upwards one directory
- "~": shortcut for /home/user
- Specify location as path:
  - Absolute (starting from root)

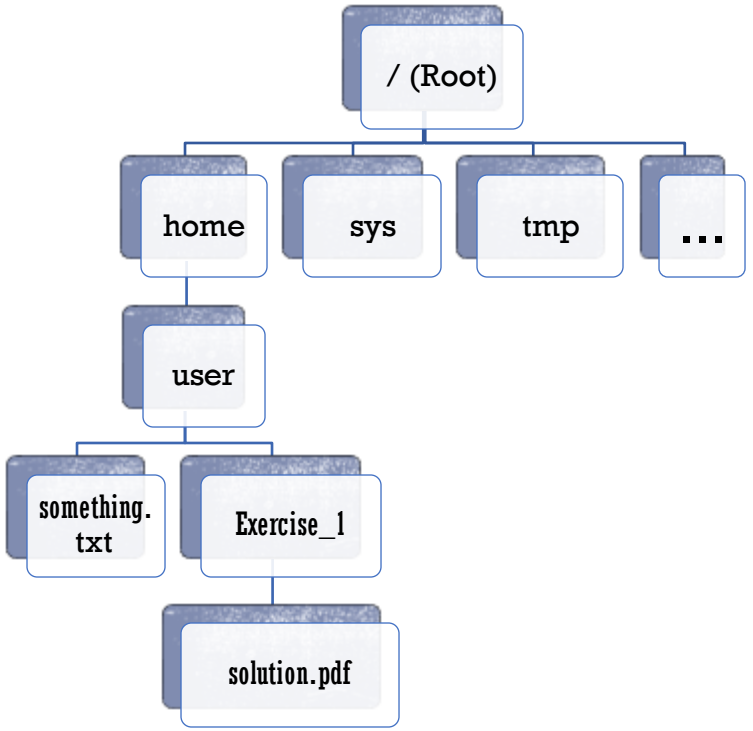
    e.g. /home/user/Aufgabe1/loesung.txt
  - Relative (starting from working directory

    e.g. ./Aufgabe1/loesung.txt oder Aufgabe1/loesung.txt
- Change directory: cd <destination_path>



2. NAVIGATION: LINUX-DATEISYSTEM

- Print contents of directory:
  - ls <options> (details in chapter 3)
- Tips:
  - Tab key for auto completion
  - Arrow up and down to use previous commands
  - history shows all previously used commands



QUESTIONS?

2. NAVIGATION: EXERCISE

- Exercise at home/myuser/2_navigation/task.txt
- Solution at home/myuser/2_navigation/solution.txt

```
myuser@8a1bc344a6ba:~/2_navigation$ cat task.txt
1. Show all contents of this directory
2. Find the file called 'passwort.secret' and look at its content. It
is located somewhere in this directory and its subdirectories.
3. Navigate to the root of the directory tree.
4. Show all home directories on the machine
5. Show the contents of the directory /bin. What do you see?
6. Change to your home directory using the '~' syntax
7. Navigate to locations of your own choice using absolute and relativ
e paths.
8. Use the command history (arrow up and down) to execute some of the
commands, which you have used previously once again.
9. Print your current location in the directory tree

NOTE: Try to use Tab-completion for all of the exercises.
```

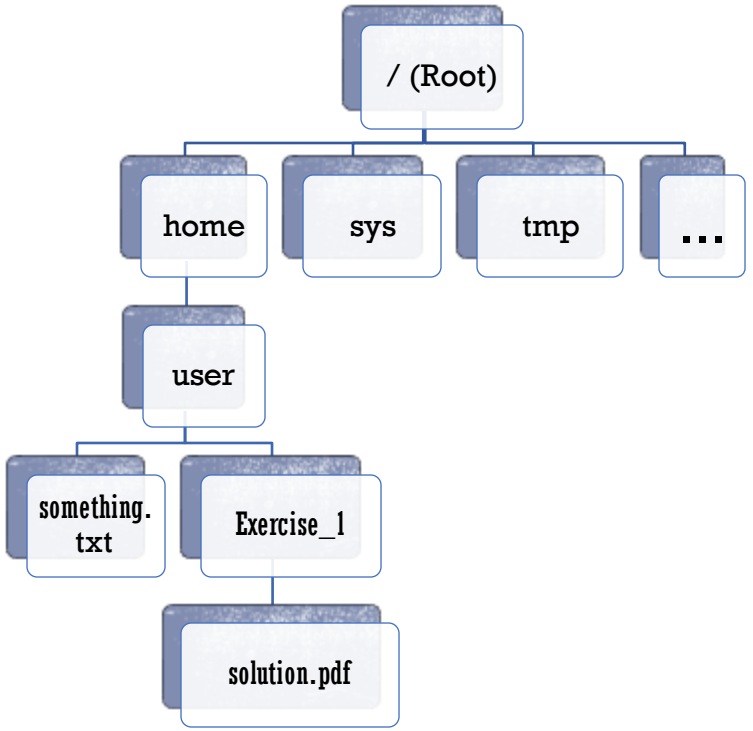
3. FILES AND DIRECTORIES

- ls -1 shows every entry in new line (one column)
- ls -l shows a "long listing" with more details, e.g.:

  -rw-rw-r-- 1 user user 0 Oct 10 10:22 Test.txt

  drwxr-xr-x 2 user user 4096 Oct 10 10:22 Aufgabe1

- Organized as:
  - directory, read, write, execute
  - [type] [access permissions: user (owner), group (owner), others] [hard link] [user] [group] [size] [date] [name]



3. CHANGING ACCESS PERMISSIONS

- chmod <opt> <Dateiname>
- <opt> specifies the permissions to be changed:

  +x grants permission to execution for everyone

  -x removes permission to execute for everyone

  u+x grants permission to execute for user **u**

  u-x removes permission to execute for user **u**

  •Analogously for groups and other users (**g**roup), andere Nutzer (**o**thers)

  •And for other types of permissions (**r**ead, **w**rite)

3. FILES AND DIRECTORIES

- File names are globally unique
- Files starting with a dot (**.**) are hidden
- File name extension does not matter (e.g. with extension .pptx could contain PDF contents)
- cat <file> prints contents of a file
- touch <file> creates a new empty file
- mkdir <directory> creates a new directory
- rm <file> deletes a file, **-r** (recursive) option for directories
- cp <source> <dest> copies a file, **-r** (recursive) option for directories
- mv <source> <dest> copies a file or directory, also used for renaming

3. WILDCARDS

- Select more than one file or directory e.g.:

  rm –r *.pdf

-> removes all files or directories ending with .pdf

- Wildcards do not match hidden files (starting with dot)

3. FILES AND DIRECTORIES: EXERCISE

```
myuser@8a1bc344a6ba:~/3_files_and_dirs$ cat task.txt
 1. Show all contents of this directory
 2. Show all contents of this directory in separate lines including hi
dden files
 3. Show all contents of this directory with their permissions
 4. Create a new file called `my_file.txt`
 5. Delete the file called `useless.json`
 6. Create a directory with the name `new_files`
 7. Move all files with the suffix `.new` to the directory `new_files`
 8. Remove all files with the suffix `.old?`
 9. Rename the file `weird_name.txt` to `good_name.txt`
10. Clear all contents of the directory `trash`
11. Use the command './check.sh' in this directory to verify your resu
lts

NOTE 1: Wildcards (*) can be helpful
NOTE 2: Watch out for hidden files
```

QUESTIONS?

4. EDITING FILES WITH VIM

- Vim is a command line editor that is usually available on Linux machines
- vim <filename> opens existing file in vim
- Different modes:
  - Command mode (ESC key) : initial mode
  - Insert mode (i key): edit text
  - 2x d delete whole line
  - :q (quit) exit document (if no changes made)
  - :q! exit document and discard changes
  - :wq (write, quit) save changes and exit document

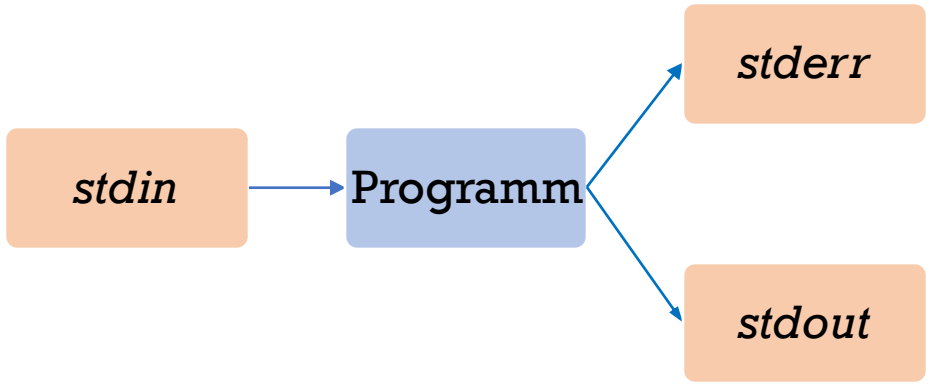
4. VIM: EXERCISE

```
myuser@8a1bc344a6ba:~/4_vim$ cat task.txt
1. Create a file called 'lets_go_vim.txt'
2. Use vim to edit the file 'lets_go_vim.txt' and change its contents
to 'Hello Vim!'
3. Look at the modified file using the cat command
4. Use Vim to replace all numbers with dots in the file 'shopping_list
.txt' by hyphens (-). E.g. the first line should look like this '- Wat
er'.
5. Delete the entry with cream in the file 'shopping_list.txt'
6. Use the command './check.sh' in this directory to verify your resul
ts

NOTE: Do not add any extra white spaces in the files for the check com
mand to work properly.
```

5. STREAMS AND REDIRECTION

- Programs have 3 data streams
  - Datandard input: ***stdin***
  - Standard output: ***stdout***
  - Standard error: ***stderr***



5. STREAMS AND REDIRECTION

> redirects standard output to a file and overwrites contents

E.g.: pwd > verzeichnis.txt

>> same but appends to file

< reads from a file and sends to standard in of process

e.g.: egrep "subway" < input_file.txt

| connects stdout of process 1 to stdin of process 2

e.g: ls | egrep ".txt"

QUESTIONS?

5. STREAMS: EXERCISE

```
myuser@8a1bc344a6ba:~/5_pipes_redirection_search$ cat task.txt
1. Copy the files 'best_recipe.txt.new' and 'morning_routine.txt.new'
from exercise '3_files_and_dirs' to this directory
2. Append the contents of 'best_recipe.txt.new' to the file 'morning_r
outine.txt.new' using output stream redirection
3. Create a file called 'search_results.txt'
4. Search for all lines containing the substring ',Q' in the file 'tit
anic_train.csv' using egrep and append the search result to the file '
search_results.txt'
5. Create a file called 'count.txt'
6. Use the 'egrep' command and the command 'wc -l' to count the number
 of lines in the 'titanic_train.csv' containing the substring ',S'. Wr
ite the result to the file 'count.txt'.
7. Use the command './check.sh' in this directory to verify your resul
ts

NOTE: The 'wc' command reads from its standard input stream
```

6. SUBSHELLS

- Execute a command inside of another command using $(subcommand)
  - E.g.:

```
myuser@99ac344ce626:~/3_cde$ echo "Your current directory is $(pwd)"
Your current directory is /home/myuser/3_cde
```

- Execution from inside out

QUESTIONS?

6. SUBSHELLS: EXERCISE

```
myuser@8a1bc344a6ba:~/6_subshells$ cat task.txt
1. Use the echo command, a subshell and the date command to print the
text 'It is now <date>', where 'date' is the current date and time. Re
direct the output to a file called 'date.txt'
2. Use a subshell and the 'date +%y_%m_%d_%H' command to automatically
 create a file with the name '<year>_<month>_<day>_<hour>.log', where
the in brackets encapsulated variables equal the attributes of the cur
rent point in time.
3. Check whether the entries with the ID 121 are equal for the file 't
itanic_train_1.csv' and the file 'titanic_train_2.csv' using the egrep
 command and a subshell. Before you start, use the cat command to get
an impression of the data in the files in order to decide how to searc
h for the entry with this ID.
4. Repeat the third task with id 122
5. Use the command './check.sh' in this directory to verify your resul
ts for tasks 1 and 2
6. Compare your results for exercises 3 and 4 with those of the person
 next to you or check the file 'solution.txt'
```

7. PROCESS MANAGEMENT

- Process = running program instance
  - Processes are independent
  - Multiple processes of on program possible e.g. multiple firefox windows open
- In the terminal, processes can run in the foreground or background
  - Foreground (default): blocks shell, shell is busy until program exits
  - Background: are disconnected from shell (asynchronous)

7. BACKGROUND PROCESSES

- **&** after a command executes it as background process

  e.g.: **sleep 60 &**

```
myuser@99ac344ce626:~/3_cde$ sleep 60 &
[1] 325
myuser@99ac344ce626:~/3_cde$ jobs
[1]+  Running                 sleep 60 &
myuser@99ac344ce626:~/3_cde$
```

- jobs shows background processes started from this shell
- fg <jobID> pulls a process to the foreground
- bg <jobID> resumes a process in the background
- Ctrl + Z pauses a foreground process
- Ctrl + C stops a foreground process

QUESTIONS?

AUFGABE 7: PROZESSMANAGEMENT

```
myuser@8a1bc344a6ba:~/7_process_management$ cat task.txt
1. execute the command '$(sleep 180 ; echo "finished at $(date)" > fin
ished.txt)' as a background process
2. Save the current output of the command 'jobs' to a file called 'run
ning.txt'
3. Pull the process started earlier into the foreground
4. Stop the process (Do not cancel it but stop it temporarily!
5. Save the current output of the command 'jobs' to a file called 'sto
pped.txt'
6. Resume the process in the background
7. Wait until the background process has finished and try to understan
d what happened.
8. Use the command './check.sh' in this directory to verify your resul
ts for tasks 1-6
9. Discuss your results of task 7 with the person next to you or verif
y your hypothesis using the file 'solutions.txt'

NOTE: Unfortunately the Ctrl+Z does not work correctly with Docker on
Windows. Therefore, if you are running Windows, you cannot fully compl
ete this exercise.
```

8. INSTALL PROGRAMS WITH APT

- There are many preinstalled programs: ls, pwd, cat …
- apt is a possibility to install new programs from the CL
  - Packet manager
  - Maintains a list of all installed and installable programs on the computer
  - apt update updates program lists (recommended before each install!)
  - apt upgrade updates all installed programs
  - apt install <package> installes a program
  - apt remove <package> deinstalls a program
- Allows automatic installation of programs
- apt requires sudo command (SuperUserDo)
- Not all programs are available to install with apt

QUESTIONS?

8. INSTALL PROGRAMS WITH APT: EXERCISE

```
myuser@8a1bc344a6ba:~/8_apt$ cat task.txt
1. Install the program 'unzip' using apt
2. Unzip the zip-archive 'big_data.zip' using the program unzip
3. Uninstall the program 'unzip' using apt
4. Use the command './check.sh' in this directory to verify your resul
ts

NOTE 1: Installing and uninstalling requires administrator rights (sud
o)
NOTE 2: The password for the super user (sudo) ist 'secret'
```

9. AUTOMATION WITH SCRIPTS

- A script is a non-compiled program (i.e. just-in-time interpreted code)
  - Bash defines its own programming language
  - Simple programs only contain commands, but loops, conditions … are possible
  - Allows automating repetetive tasks
  - Skripts must have the execute permission set (remember chapter 3)

QUESTIONS?

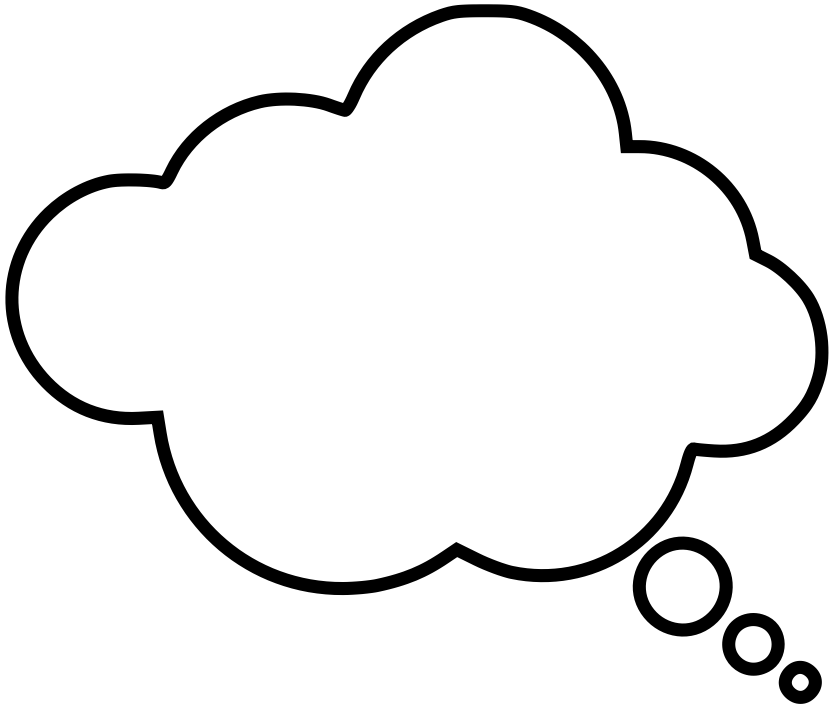
9. AUTOMATION WITH SCRIPTS EXERCISE

```
myuser@8a1bc344a6ba:~/9_scripting$ cat task.txt
This directory is an exact copy of the directory '3_files_and_dirs'.
This time it is your task to create a script, which completes the exercise for you.
As a reminder, the tasks of exercise 3, which should be automated in this exercise, ar
e:

- Show all contents of this directory
- Show all contents of this directory in separate lines including hidden files
- Show all contents of this directory with their permissions
- Create a new file called `my_file.txt`
- Delete the file called `useless.json`
- Create a directory with the name `new_files`
- Move all files with the suffix `.new` to the directory `new_files`
- Remove all files with the suffix `.old?`
- Rename the file `weird_name.txt` to `good_name.txt`
- Clear all contents of the directory `trash`


Bonus: If that is fun, implement another script for one of the other exercises.

NOTE: If you need to reset the directory to test your script multiple times, then use
the './reset 9_scripting' command in your home directory. If you do that you might wan
t to backup your script somewhere outside of this directory, so it will not get delete
d during the reset process.
```



FEEDBACK

Help us improving this seminar
by sharing your opinion.