

Unix-like Operating Systems

Introduction

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Module Structure

- Module consists of lectures, seminars and homeworks (5 ECTS credits ~ 150 hours per semester).

- **Course materials**

<https://courses.fit.cvut.cz/BIE-UOS>

- **Tutorials**

- Tests.
- Discussion about described examples.
- Solving task.

- **Classification**

- Points from tests and tasks.
- Graded assessment (no exam).

- You are automatically subscribed to e-learning module BI-ULI (Introduction to Linux, 2 credits).

Local Linux systems at labs

- Not visible from the Internet (private IP address).
- CPU architecture is Intel (1scpu).
- Operating system is GNU Linux - **Ubuntu 20.04** (less /etc/*release*).
- Home directories /home/USER are shared among local lab computers (GNU Linux and Windows).
- How to login to this system?
 - Use the CTU password.
- How to change CTU password?
 - Go to the page <https://usermap.cvut.cz>.
- How to run applications?
 - From GUI (Graphical User Interface).

```
Panel -> Menu -> Terminal
```

- From CLI (Command-Line Interface) – terminal.

```
firefox &
```

Public Solaris Servers fray1 and fray2

- Visible from the Internet (public IP address).
- Fully qualified domain names
 - `fray1.fit.cvut.cz` or `fray2.fit.cvut.cz`.
- CPU architecture is Sparc (`psrinfo -pv`).
- Operating system is **Solaris** (`less /etc/*release*`).
- Home directories `/home/stud/USER` are shared only between `fray1` and `fray2`.
- How to login to this systems?
 - Use the initial system password.
- What is your initial system password?
 - Go to the page <https://profile.fit.cvut.cz/en/syspassword>.
- How to change this password only on these servers?
 - Use command `passwd`.
- You can connect to these servers by Secure Shell Protocol (SSH).
 - Use command `ssh` for remote connection.
 - Use command `scp` for data transfer.

Shell

- SHELL = command line interpreter.
- There are different shells (programs):
 - Bourne Shell – sh,
 - Korn Shell – ksh,
 - C Shell – csh,
 - Bourne Again Shell – bash.
- What shell is running in the terminal?

```
ps
```

```
echo $0
```

- Parts of command are separated by one or more spaces/TABs.

```
ls -la / /usr
```

- Commands can be separated by semicolon, ampersand, pipe, or by new line.

```
date -u ; who am i
```

- UNIX is case sensitive!!!

Command line syntax

- *Command name* defines which command will be executed (what).
- *Options* modify behaviour of command (how).
- *Arguments* specify data (with).
- Example

```
ls -l -R /usr/bin /tmp
```

- list (*ls*)
 - long (*-l*) and recursively (*-R*)
 - directories */usr/bin* and */tmp*
- Some (typically GNU) commands allow you to mix options and arguments.

```
ls /usr/bin -lR /tmp
```

- The word *--* means the end of options, then everything else is considered like arguments.

```
ls -- -l # list the file/directory -l
```

Command line syntax – command name

- The first word in the command line.
 - Without path.

```
date
```

- With the path.

```
/usr/bin/date  
../script.sh  
./program
```

- If the shell can not find the command, shell returns
Command not found.
- If the user has not permission to run the command, the shell returns
Permission denied.
- The command type indicates how each name would be interpreted by
the shell if it is used as a command name.

```
type date
```

```
type echo
```


Command line syntax – options and arguments

- There can be no, one or more options or arguments.

```
ls  
ls -a  
ls -a -l /etc /home /tmp
```

- *Short options*

- They start with character "-" and contain just one character.
- They can be written separately or together

```
ls -a -l /etc  
ls -la /etc
```

- *Long options*

- They start with characters "--" and contain the whole words (or more words).
- They are written separately. The option and its argument can be separated by "=".

```
ls --color=never
```

Basic commands

- Run the application *Terminal*.
- What information contains the prompt?
- Who is working in the terminal?

```
echo $USER  
whoami
```

- What is the name of the system where the terminal is running?

```
hostname
```

- How to get information about the system?

```
uname -a  
cat /etc/*release*      # in Solaris and Linux
```

- How to print string to the standard output?

```
echo "Hello word."  
printf "Hello word.\n"  
printf "%s = %5d\n" "sum" "11"
```

Basic commands

- Where is my home directory?

```
echo $HOME
```

- What is the current working directory?

```
echo $PWD  
pwd
```

- How to change the current working directory to the directory /etc?

```
cd /etc
```

- How to list the contents of the current working directory?

```
ls
```

- How to list the contents of the directory /usr/bin?

```
ls /usr/bin
```

```
cd /usr/bin  
ls
```

Key shortcuts in bash

- Key TAB ... command/filename/username/hostname completion.
- Keys CTRL v TAB ... insert a tab character.
- Command history ... display the command history list.
- Keys ↑ and ↓ ... enable to go through the command history list.
- Keys CTRL r ... search backward in command history list.
- Keys CTRL c ... stop the last foreground process.
- Keys CTRL d ... EOF (End Of File).
- Keys CTRL a ... move to the start of the current line.
- Keys CTRL e ... move to the end of the current line.
- Keys CTRL l ... clear the screen.
- Keys CTRL d ... delete the character at point.
- Keys CTRL k ... kill the text from point to the end of the line.
- Keys CTRL u ... kill backward from point to the beginning of the line.

Secure Shell

- Run the application *Terminal*.
- How to connect to the remote server `fray1.fit.cvut.cz` like user with login name `USER`?

```
ssh USER@fray1.fit.cvut.cz
```

- How to execute comand *hostname* on the remote server `fray1.fit.cvut.cz`?

```
ssh USER@fray1.fit.cvut.cz hostname
```

- Which users are logged on to the server
 - Solution 1

```
ssh USER@fray1.fit.cvut.cz finger
```

- Solution 2

```
ssh USER@fray1.fit.cvut.cz  
finger  
exit
```

- How to copy local file `/etc/group` to home directory on the server `fray1.fit.cvut.cz` like user with login name `USER`?

```
scp /etc/group USER@fray1.fit.cvut.cz:
```

- How to copy local file `/etc/group` to the directory `/tmp` on the server `fray1.fit.cvut.cz`?

```
scp /etc/group USER@fray1.fit.cvut.cz:/tmp
```

- How to copy the directory `/etc` on the server `fray1.fit.cvut.cz` to the local directory `/tmp`?

```
scp -r USER@fray1.fit.cvut.cz:/etc /tmp
```

UNIX manual

- It consists of several sections.
- Search by keyword.
- Uniform manual page structure.
- Web documentation (system dependent)!
- Access to UNIX manual by command `man`.

```
man man
man ls                # press key H to get help

man printf
man printf.3          # Linux
man printf.3c         # Solaris

man -k printf
man -a printf
```

- What pager (program) is used to display manual pages?

```
echo $PAGER
```

- How to change the pager temporarily?

```
export PAGER=less
```

- How to change the pager permanently?

```
# in Linux
echo "export PAGER=less" >> $HOME/.bash_profile

# in Solaris
echo "export PAGER=less" >> $HOME/.profile
```


Information about builtin commands

- Builtin commands are implemented inside the shell.
- They are interpreted directly by the shell (no binary file/script is executed).
- How to get information about builtin commands?
 - See section "SHELL BUILTIN COMMANDS" in manual page of shell.

```
man bash      # and search for pattern "^SHELL B"
```

- Use builtin command help.

```
help help
```

- What options can be used with the builtin command printf?

```
help printf
```

```
man bash      # and search for pattern "^ *printf"
```

Setting the locale

- Keyboard layout and its switching.
- The locale define langue, date formats, alphabetic idiosyncrasies, and other locale-specific standards (see `locale(1)` and `locale(5)`).
- What is the current locale?

```
locale
```

- What locales are available in the system?

```
locale -a
```

- How to change the current locale?

```
export LANG=C  
export LC_ALL=C
```

Homework

- Read info about **Secure Shell (ssh)** and **Public-key cryptography**
- Set SSH login without password
 - 1 Create private and public keys.

```
ssh-keygen
```

- 2 Copy the public key to remote-host under user with the login name USER.

```
ssh-copy-id -i ~/.ssh/id_rsa.pub USER@fray1.fit.cvut.cz
```

- 3 Verify the login to remote-host without entering the password.

```
ssh USER@fray1.fit.cvut.cz
```

- Will the following command work now? Why yes or no?

```
ssh USER@fray2.fit.cvut.cz
```

Homework

- Connect to the server `fray1.fit.cvut.cz` and study structure of manual pages of the following commands
 - `man(1)`
 - `date(1)`
 - `ssh(1)`
- Use only one command `date` to print the current date and the current time on the standard output in the following format

```
Today is Thursday, 05.10.2017 (week 40).  
The time is 14:13:57 [CEST].
```

Hint

- `man date`
- `export LC_ALL=C`