Unix-like Operating Systems

Introduction to Unix

Jan Trdlička

Czech Technical University in Prague, Faculty of Information Technology
Department of Computer Systems

Contents

Module Structure

- Module consists of lectures, tutorials and homeworks (5 ECTS credits $\sim$ 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, oral interview and tasks.
  - Graded assessment (no exam).
- You are automaticaly 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 (`lscpu`).
- 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 systemis 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 `CRTL 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
```

Secure Shell

- 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
```

UNIX manual

- 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`