Meerkat system training

Linux administration

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1. Introduction

- Main aim of the Meerkat system is to provide fast public health surveillance
- 2 days of training:
  - Day 1:
    - Server administration
    - Shell scripting
    - Managing server software
    - Networking servers and network security
    - Server security
  - Day 2:
    - Making changes to ODK forms
    - Using Meerkat APIs to retrieve data
    - Data analysis with Python and spreadsheet calculators

Contents

Exercise 1 a

As a first exercise, let's set up the computers to be able to access the training servers

- Download the PuTTY binary for your computer:

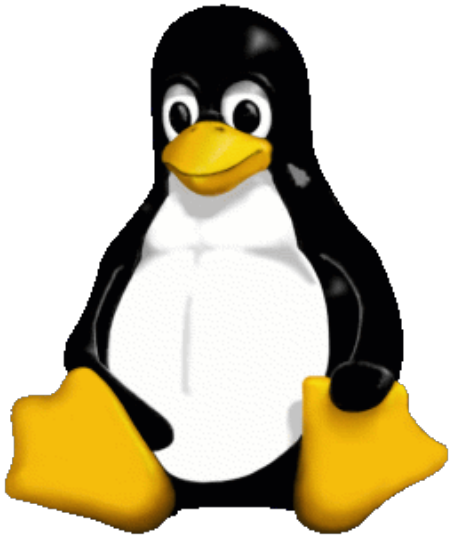
  `http://www.putty.org/`

  - Get the identity file `training.ppk` for the training servers.
  - Use the following guide to get logged in:

    `http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/putty.html`

2. Linux server administration

- 66% of public web sites are on servers that run Linux*
- Linux comes in several distributions that are curated by different institutions
- Linux is open source as are most of its distributions
- Meerkat uses Ubuntu distribution

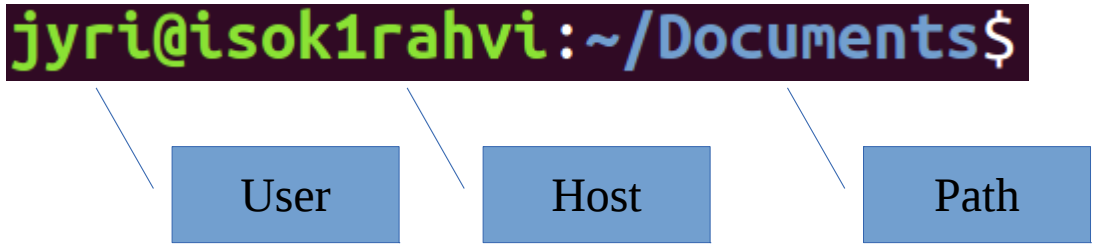


```
jyri@isok1rahvi: ~
jyri@isok1rahvi:~$ df -h
Filesystem            Size  Used Avail Use% Mounted on
udev                  7.8G     0  7.8G   0% /dev
tmpfs                 1.6G  9.7M  1.6G   1% /run
/dev/sdb5             443G   67G  354G  16% /
tmpfs                 7.9G  126M  7.7G   2% /dev/shm
tmpfs                 5.0M  4.0K  5.0M   1% /run/lock
tmpfs                 7.9G     0  7.9G   0% /sys/fs/cgroup
tmpfs                 1.6G   56K  1.6G   1% /run/user/1000
/home/jyri/.Private   443G   67G  354G  16% /home/jyri
jyri@isok1rahvi:~$ free -m
              total        used        free      shared  buff/cache   available
Mem:          15977        3060        9234         167        3682       12303
Swap:         16311           0       16311
jyri@isok1rahvi:~$
```

- Linux servers are used mostly via command line shell
- In case of Ubuntu, the operating system is the same on a server and a PC
- Command line tools have slight differences between distros, this training focuses on Ubuntu

*https://w3techs.com/technologies/overview/operating_system/all

2.1 Basic command line tools



- When using Linux in shell, even the simplest things will be done by commands:
  - `ls` – List contents of current path
  - `cd` – Change current directory: .. for parent directory
  - `cat` – Print file contents to standard output (command line)
  - `man` – Display manual page of command or program
    - Help pages are also often available by `<command> --help`
  - `find` – Find files
  - `grep` – Find row in file
  - `ssh` – Log in to another Linux machine
  - `apt` – Ubuntu package manager for installing software

Exercise 2 a

- Log in to your EC2 virtual server using Putty
- Use Git to download the training material from GitHub:

```
git clone https://github.com/meerkat-code/training.git
```

  - Git is a version control software and a topic of another training, here we use it only to get training material

- Change current directory to

```
training/linux_administration/exercises/demo_locations
```

  The .csv files in this folder include location data for country Demo. A clinic is in a district, which is in a region, which is in a zone.

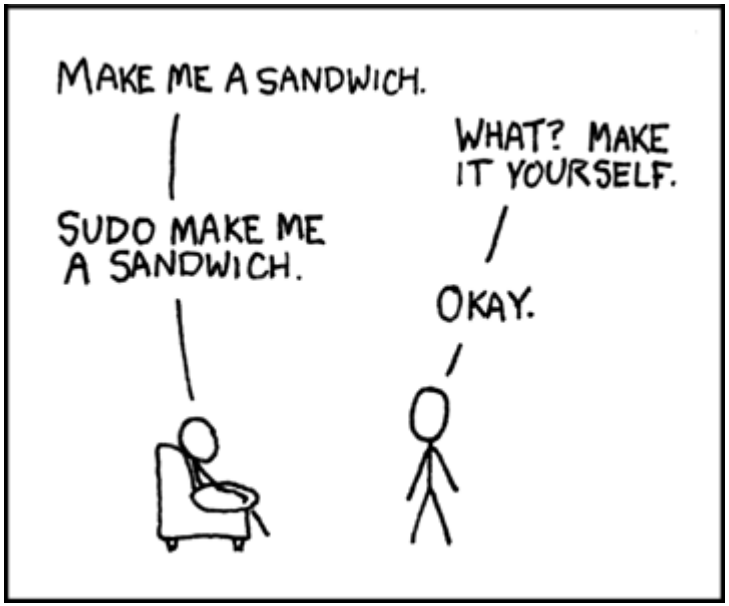
- Print the contents of file `demo_districts.csv` to standard output
- Print all rows in file `demo_clinics.csv` which include the word `Region 1`

2.2 Monitoring server resources

- Monitoring the usage of RAM, disk space, CPU or networking resources are very common tasks in server administration
- Widely available monitoring tools are:
- `df` – Show disk space usage and file systems
- `du` – Calculate the size of files and folders
- `free` – Show memory usage
- `top` – Show statistics on processes and CPU usage
- `netstat` – Show active Internet connections

2.3 User levels and installing software

- Normally you are allowed to performs operations which your user has rights to
  - This includes performing operations on files you have permissions to but not e.g. installing software
- If your user account is an administrator, you can run commands with an elevated access level by preceding a command with `sudo`



https://xkcd.com/149/

Exercise 2 b

- Find out the following about your virtual server:
  - Total amount of RAM installed in server
  - Total amount of disk space available for server
- Try installing the network monitoring tool `bmon` by running

```
apt install bmon
```

- Install bmon by using a command with elevated access
- You can try out the monitoring program with the command `bmon`

3.1 Input and output

Piping

Piping is a technique for forwarding the output of one command to the input of another command. Piping is done with the character |

Example:

```
cat demo_clinics.csv | grep "Clinic 1"
```

Redirecting

Redirecting is a technique for forwarding the output of one command into a file. Redirecting is done with the character >

Redirecting works the other way around too to use a file as command input. This is done with the character <

Examples:

```
cat demo_clinics.csv | grep "Clinic 1" > clinic_1.txt
```

```
grep "Clinic 1" < demo_clinics.csv
```

Exercise 3 a

- Using piping and redirection, perform the following tasks
  - Print *only* the Swap memory statistics on the command line, ignoring other memory statistics
  - Print into a file the size of file `demo_clinics.csv` in the folder

    `training/linux_administration/exercises/demo_locations`

3.1 Input and output

Parameters

It is also possible to pass outputs of commands as parameters to other command. This is done with syntax `<command 1> $(<command 2>)`

Examples:

```
cat $(ls)
```

```
grep "Clinic 1" $(ls)
```

Wild card characters

On command line, you can replace characters with wildcard characters. A full stop `.` will denote any single character and a star `*` will denote any number of any characters. This is done with syntax `<command 1> $(<command 2>)`

Example:

```
grep "Clinic 1" $(find *.csv)
```

Exercise 3 b

- Go to directory

  `training/linux_administration/exercises/demo_locations`

- Using the shell methods described above, perform the following tasks:
  - Print into a new file `demo_district_1_clinics.csv` all rows from file `demo_clinics.csv` that have word “District 1” on them
  - Get all the rows from file `demo_clinics.csv` that have the word `“Clinic 2”` on them. Forward these rows to program `sed` and use `sed` to replace word `“Clinic 2”` with word `“Hospital 1”`. Write the output into a new file `demo_hospital_1.csv`

3.2 Common programs

Nano

There are several shell based text editors such as Vim, Pico and Nano. Nano is relatively easy to use and can be found in standard Ubuntu installations.

Basic commands for using Nano are displayed in the bottom panel. (^ means CONTROL button)

AWK

AWK is a text processing program used from the command line. It is well suited to be used in combination with shell input and output techniques mentioned earlier. It is especially handy for processing column-based data files such as .csv files.

A good AWK tutorial:

http://www.hcs.harvard.edu/~dholland/computers/awk.html

Exercise 3 c

- Go to directory

  `training/linux_administration/exercises/demo_locations`

- Using AWK and methods described above, perform the following tasks:
  - Use AWK on `demo_clinics.csv` to print to output only the columns with clinic names and district names
  - File `demo_clinics.csv` has fields that have commas in them. These might become troublesome, so use AWK to print file `demo_clinics.csv` again as `demo_clinics.psv` using pipe character as a column separator instead of comma.

4 Scripting

- Shell commands can be written into a script file, which you can use to run several commands at the same time.

Anatomy of a shell script:

- First line defines the interpreter to use
- Program flow can be controlled by conditional clauses and loops
- Any command used in the command line can be used in a script file
- A running script file is considered a separate shell. An exit command will not exit the shell that started the script.

```
#!/bin/bash
for csv; do
    psv="${csv%.csv}.psv"
    echo converting "$csv" ...
    sed 's/,/|/g' "$csv" > "$psv"
done
echo all conversions successful
exit 0
```

4.1 When to script?

- Scripts can be a strong tool for automating tasks
- Scripting has some serious shortcomings, however:
  - Writing tests for scripts is not easy
  - The syntax is not as complete and water tight as with most other languages
  - Small errors may end up being very costly,

    e.g. `rm -rf * /` instead of `rm -rf */`

    (Do NOT try the above at home)
- Scripting is fast to implement and often the first step of automating a task
  - Once there's time to invest, scripts can be replaced by programs witten in e.g. Python, Java or C

4.2 Script syntax

- The current user must have execute permissions on the script to be able to run it
- White spaces and line breaks are important syntax elements in shell scripting
- Some bash scripting syntax:

```
# hash is the comment character
var=1 # define a variable, note the lack of white spaces
echo ${var} # call a variable and in this case print its value

for var in val1 val2 valN; do # loop structure
   echo var
done

if [val1 == val2]; then # if statement
   echo True
fi
```

Bash reference manual: https://www.gnu.org/software/bash/manual/bashref.html

Exercise 3 b

- Go to directory

  `training/linux_administration/exercises/demo_locations`

Write a shell script that when run, creates a a single flattened file that has the following columns for each clinic:

Device id, Clinic name, District name, Region name, Zone name