Fog and Cloud Computing

Lab

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RiSING (Robust and Secure Distributed Computing)
Fondazione Bruno Kessler (FBK)

Trento, April 8th 2022

Lab Resources

- Shared Etherpad: https://annuel2.framapad.org/p/6s5u416vo7-9t4b

- White Board: https://tinyurl.com/2p8j7yra

- Interaction:
  - Etherpad
    - *Exercises check, Share Troubleshooting, Questions and Logs*
  - Zoom Chat (for those remotely connected)
    - *Discuss with your colleagues during exercises or directly/privately with me*
  - Rise your Hand (also via Zoom)
    - *If you need my attention or want to speak, don't be shy !!!*
  - Course Forum: https://tinyurl.com/27vmd9pj
    - *Questions and answers could be useful to others, be collaborative*

Lab Resources

- Slides
  - Uploaded before any lesson in Moodle

- Repositories of exercises
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022

- Lab Virtual Machine:
  - **Lab VM on Azure (reference for exercises)**
  - Vagrant and VirtualBox on your laptop (possible choice)
    - https://www.virtualbox.org/, https://www.vagrantup.com/ and https://gitlab.fbk.eu/dsantoro/fcc-lab-2022

Today Lesson & Disclaimer

- New Lab Environment
- New Lab Environment Setup & Access
- Exercises
  - SSH
  - Check e03 from last lesson on new Lab VM
  - Socks Proxy using SSH
  - Provisioning of repeatable environments
  - Configuration Management Systems
- IaaS and OpenStack Intro

New Lab Environment

- Based on Microsoft Azure Cloud
- Offered and Setup by DISI
- Each student has its own environment
- Admin privileges
- Can be recreated (in case unrecoverable/crash)
- Big VM
  - 16GB RAM
  - 8vCPU
- Managed by YOU

Microsoft Azure

Only one RULE

ON

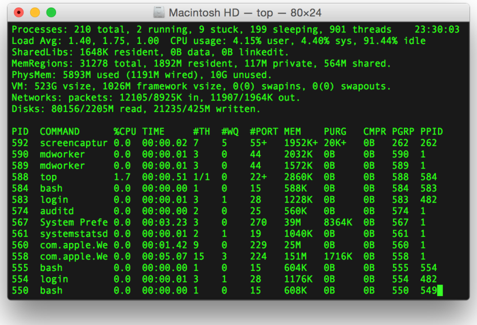
OFF

Saves

New Lab Environment

- Minimal requirements
  - OpenSSH Client
  - Unix Terminal
  - Web browser

- Remote support
  - We can access your VM
  - We need to know upfront:
    - URL
    - PORT
  - If you need support just share them with us

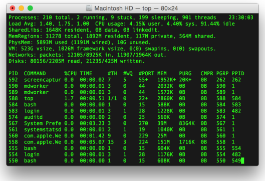


```
Processes: 210 total, 2 running, 9 stuck, 199 sleeping, 901 threads    23:30:03
Load Avg: 1.40, 1.75, 1.00  CPU usage: 4.15% user, 4.40% sys, 91.44% idle
SharedLibs: 1648K resident, 0B data, 0B linkedit.
MemRegions: 31278 total, 1892M resident, 117M private, 564M shared.
PhysMem: 5893M used (1191M wired), 10G unused.
VM: 523G vsize, 1026M framework vsize, 0(0) swapins, 0(0) swapouts.
Networks: packets: 12105/8925K in, 11907/1964K out.
Disks: 80156/2205M read, 21235/425M written.

PID  COMMAND      %CPU TIME     #TH  #WQ  #PORT MEM    PURG   CMPR PGRP PPID
592  screencaptur 0.0  00:00.02 7    5    55+   1952K+ 20K+   0B   262  262
590  mdworker     0.0  00:00.01 3    0    44    2032K  0B     0B   590  1
589  mdworker     0.0  00:00.01 3    0    44    1572K  0B     0B   589  1
588  top          1.7  00:00.51 1/1  0    22+   2860K  0B     0B   588  584
584  bash         0.0  00:00.00 1    0    15    588K   0B     0B   584  583
583  login        0.0  00:00.01 3    1    28    1228K  0B     0B   583  482
574  auditd       0.0  00:00.00 2    0    25    560K   0B     0B   574  1
567  System Prefe 0.0  00:03.23 3    0    270   39M    8364K  0B   567  1
561  systemstatsd 0.0  00:00.01 2    1    19    1040K  0B     0B   561  1
560  com.apple.We 0.0  00:01.42 9    0    229   25M    0B     0B   560  1
558  com.apple.We 0.0  00:05.07 15   3    224   151M   1716K  0B   558  1
555  bash         0.0  00:00.00 1    0    15    604K   0B     0B   555  554
554  login        0.0  00:00.01 3    1    28    1176K  0B     0B   554  482
550  bash         0.0  00:00.00 1    0    15    608K   0B     0B   550  549
```

New Lab Environment

- Access from your laptop
- Access from remote
- Access via OpenSSH
  - SSH Socks Tunnel
  - Bypass Firewalling
  - More secure



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589  mdworker     0.0  00:00.01 3    0    44    1572K  0B     0B   589  1
588  top          1.7  00:00.51 1/1  0    22+   2860K  0B     0B   588  584
584  bash         0.0  00:00.00 1    0    15    588K   0B     0B   584  583
583  login        0.0  00:00.01 3    1    28    1228K  0B     0B   583  482
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567  System Prefe 0.0  00:03.23 3    0    270   39M    8364K  0B   567  1
561  systemstatsd 0.0  00:00.01 2    1    19    1040K  0B     0B   561  1
560  com.apple.We 0.0  00:01.42 9    0    229   25M    0B     0B   560  1
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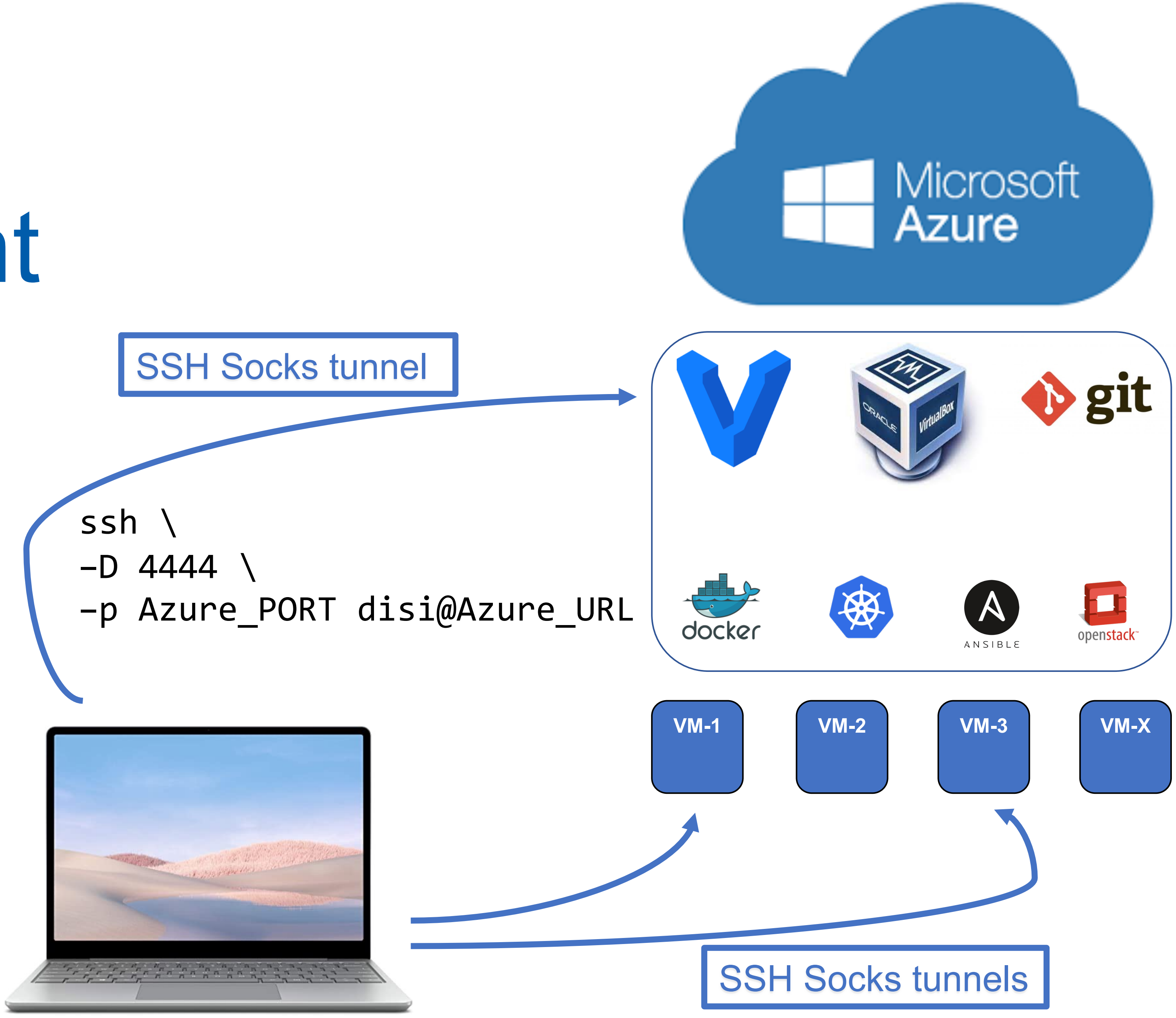
555  bash         0.0  00:00.00 1    0    15    604K   0B     0B   555  554
554  login        0.0  00:00.01 3    1    28    1176K  0B     0B   554  482
550  bash         0.0  00:00.00 1    0    15    608K   0B     0B   550  549
```



SSH Socks tunnel

```
ssh \
-D 4444 \
-p Azure_PORT disi@Azure_URL
```

VM-1

VM-2

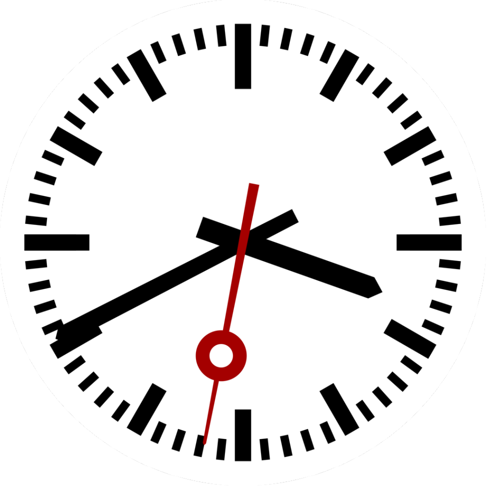
VM-3

VM-X

SSH Socks tunnels

New Lab Environment- Lab Check

- Register for “Fog and cloud computing - Domenico Siracusa”
  - See email and follow link
- Set a password for your VM
- Turn on the VM
- Follow setup instructions:
  - https://docs.microsoft.com/en-us/azure/lab-services/how-to-use-remote-desktop-linux-student
- Access the server via OpenSSH
  - Using password
- Clone the repository using git
  - `git clone https://gitlab.fbk.eu/dsantoro/fcc-lab-2022.git`
- Give me an ack here:
  - https://annuel2.framapad.org/p/6s5u416vo7-9t4b

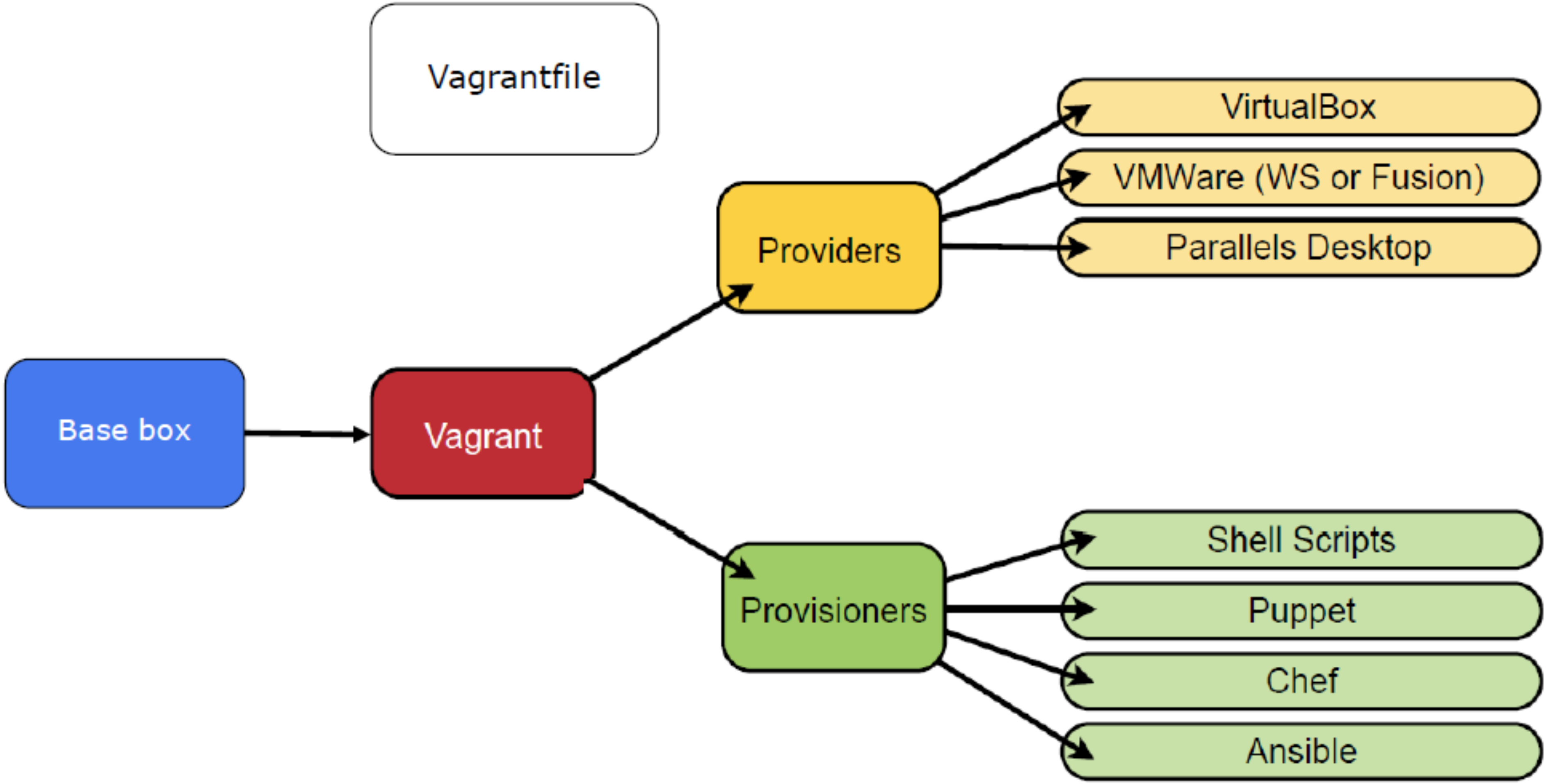


10 minutes

Exercise 4 – Generate and upload your SSH key

- **Time:** ~10 minutes
  - Try by yourself and ask for support
  - Give an ack when completed succesfully
- **Description:**
  - If you do not have already one, generate an ssh key and save it on your laptop. Then move the key on the lab virtual-machine in order to use public/private authentication. Check that you are able to login on the lab VM without typing your password.
- **Instructions:**
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022/-/tree/master/e04

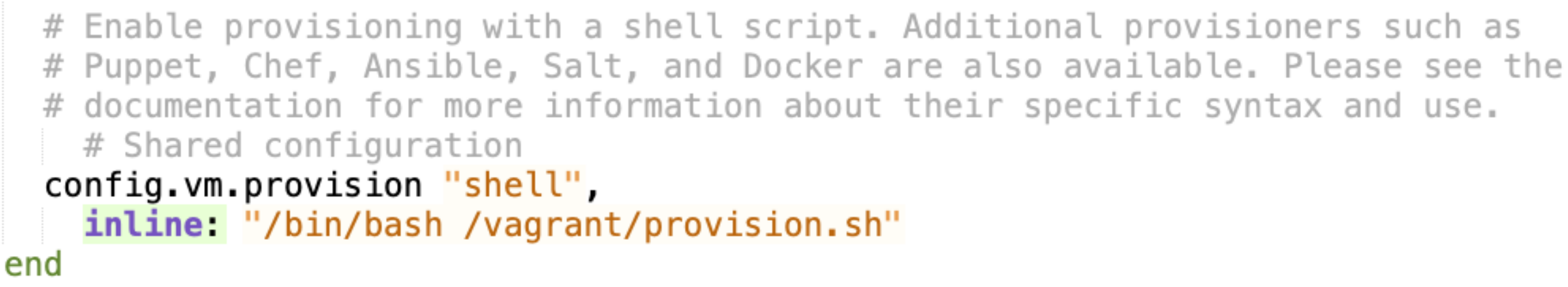
1^{st} Lesson Recap 1/2



1st Lesson Recap 2/2

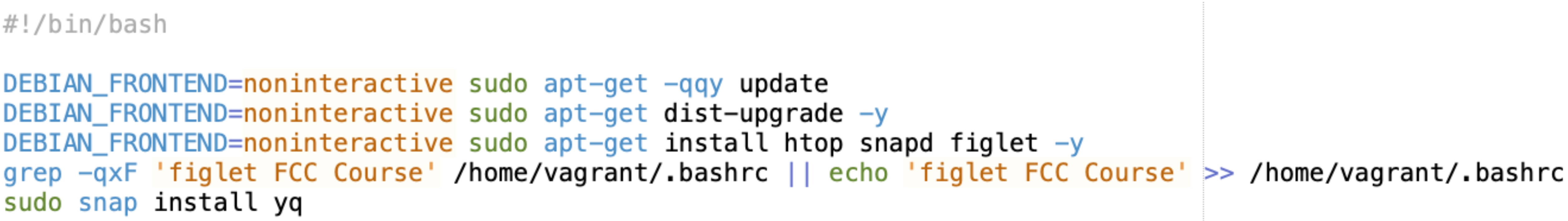
Vagrantfile

set as provisioning script



```
# Enable provisioning with a shell script. Additional provisioners such as
# Puppet, Chef, Ansible, Salt, and Docker are also available. Please see the
# documentation for more information about their specific syntax and use.
  # Shared configuration
config.vm.provision "shell",
  inline: "/bin/bash /vagrant/provision.sh"
end
```

provision.sh

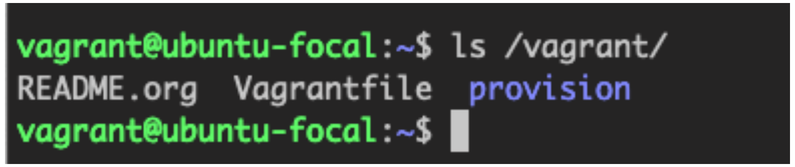


```
#!/bin/bash

DEBIAN_FRONTEND=noninteractive sudo apt-get -qqy update
DEBIAN_FRONTEND=noninteractive sudo apt-get dist-upgrade -y
DEBIAN_FRONTEND=noninteractive sudo apt-get install htop snapd figlet -y
grep -qxF 'figlet FCC Course' /home/vagrant/.bashrc || echo 'figlet FCC Course' >> /home/vagrant/.bashrc
sudo snap install yq
```

shared using synced folder

/vagrant



```
vagrant@ubuntu-focal:~$ ls /vagrant/
README.org  Vagrantfile  provision
vagrant@ubuntu-focal:~$ 
```

Vagrant HowTo 2/2

- `vagrant help`
  - Get info on all commands
- `vagrant COMMAND -h`
  - Get help for COMMAND
- `vagrant init [box]`
  - Create a Vagrantfile
- `vagrant up`
  - Create and provision the VM
- `vagrant provision`
  - Only provision the VM
- `vagrant ssh`
  - Enter the VM via SSH
- `vagrant status`
  - Get VM status
- `vagrant global-status`
  - Get all VM status
- `vagrant plugin list`
  - List all plugins
- `vagrant box list`
  - List all boxes

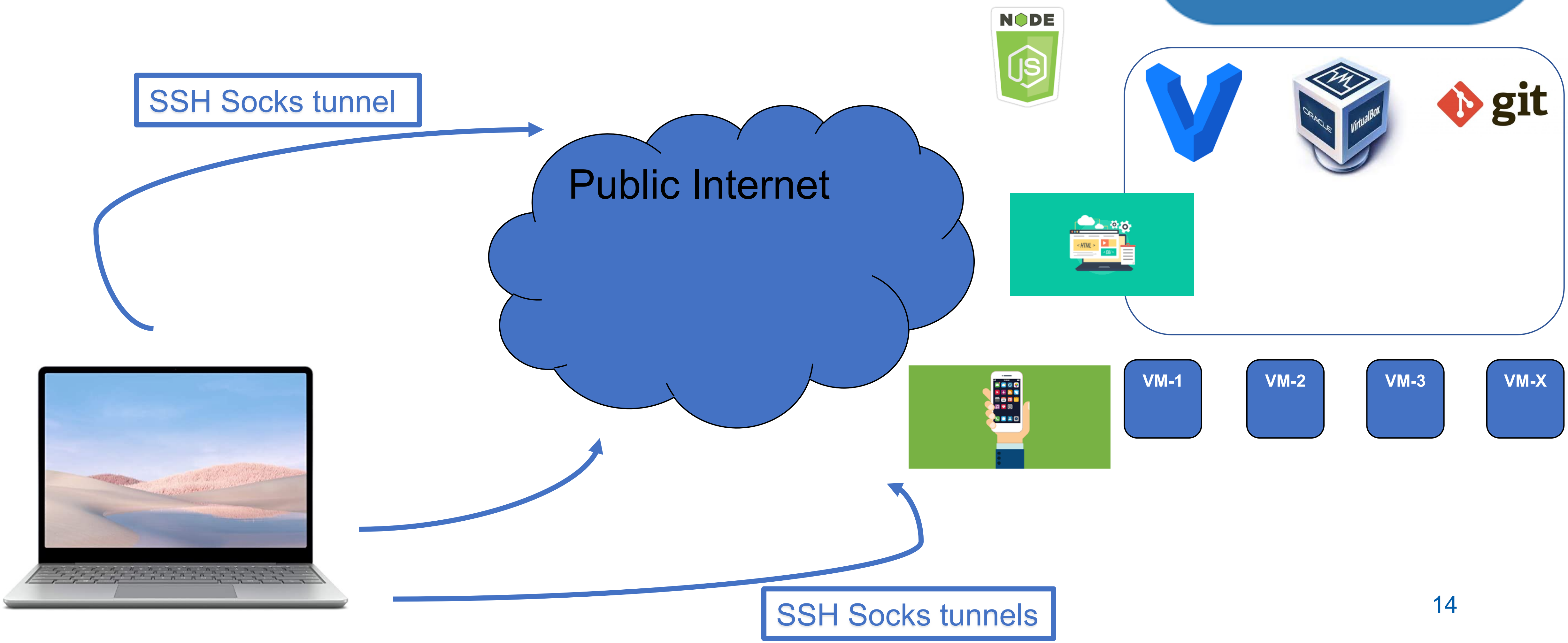
Back to Exercise 3 on the New Lab VM Customise and Share the Environment

- **Time:** ~10 minutes
  - *Check and Verify*
  - *Anyone has a modified Vagrantfile to share with me ???*

- **Description:**
  - Destroy the previous Virtual Machine. Modify the provisioning script and create a customized new Virtual Machine. Share the environment with your teammate (different OS preferred) and test if the environment is portable as expected.

- **Instructions:**
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022/-/tree/master/e03

Should we expose app on Internet ?



SSH Socks tunnel

Public Internet

VM-1

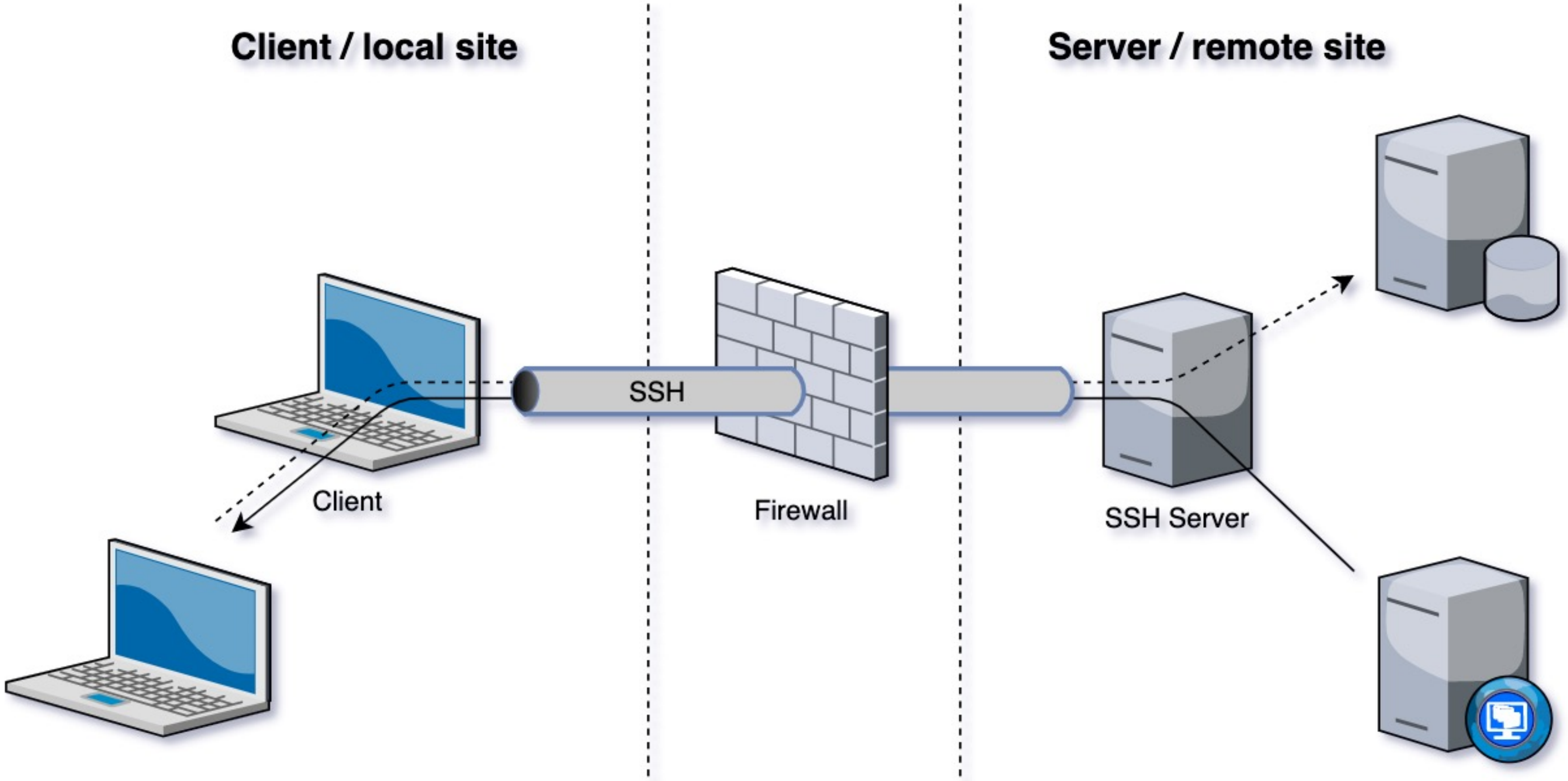
VM-2

VM-3

VM-X

SSH Socks tunnels

SSH Socks Proxy Tunnel

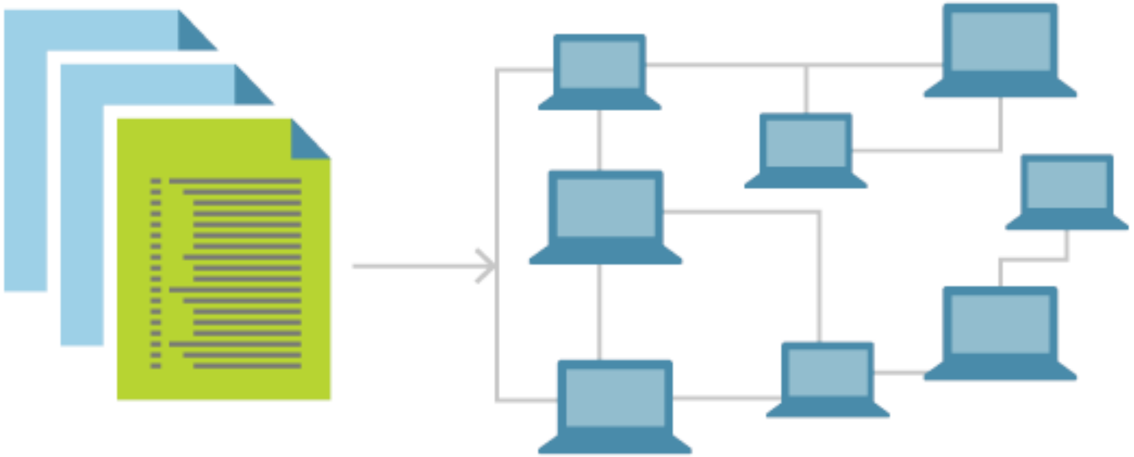


Exercise 5 – Setup an SSH tunnel and use it as a socks proxy in a web Browser

- **Time:** 15 minutes
  - 10 minutes: *Try by yourself and ask for support*
    - Give an ack when completed succesfully
  - 5 minutes: *Cross check and Verify*
- **Description:**
  - Setup a browser to use SSH based Socks Proxy tunnel. Create a tunnel from your laptop to the Lan VM. Finally verify that you, and only you, are able to reach your VM behind the firewall using this setup.
- **Instructions:**
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022/-/tree/master/e05

Configuration Management Systems

- In DevOps, permits to maintain OS configuration files
  - **Configuration management (CM)** is a systems engineering process for establishing and maintaining consistency of a product
- Used with IaC
  - **Infrastructure as code** (**IaC**) is the process of managing and provisioning computer data centers through machine-readable definition files
- Track changes in VCS, like git



SALTSTACK

CHEF™

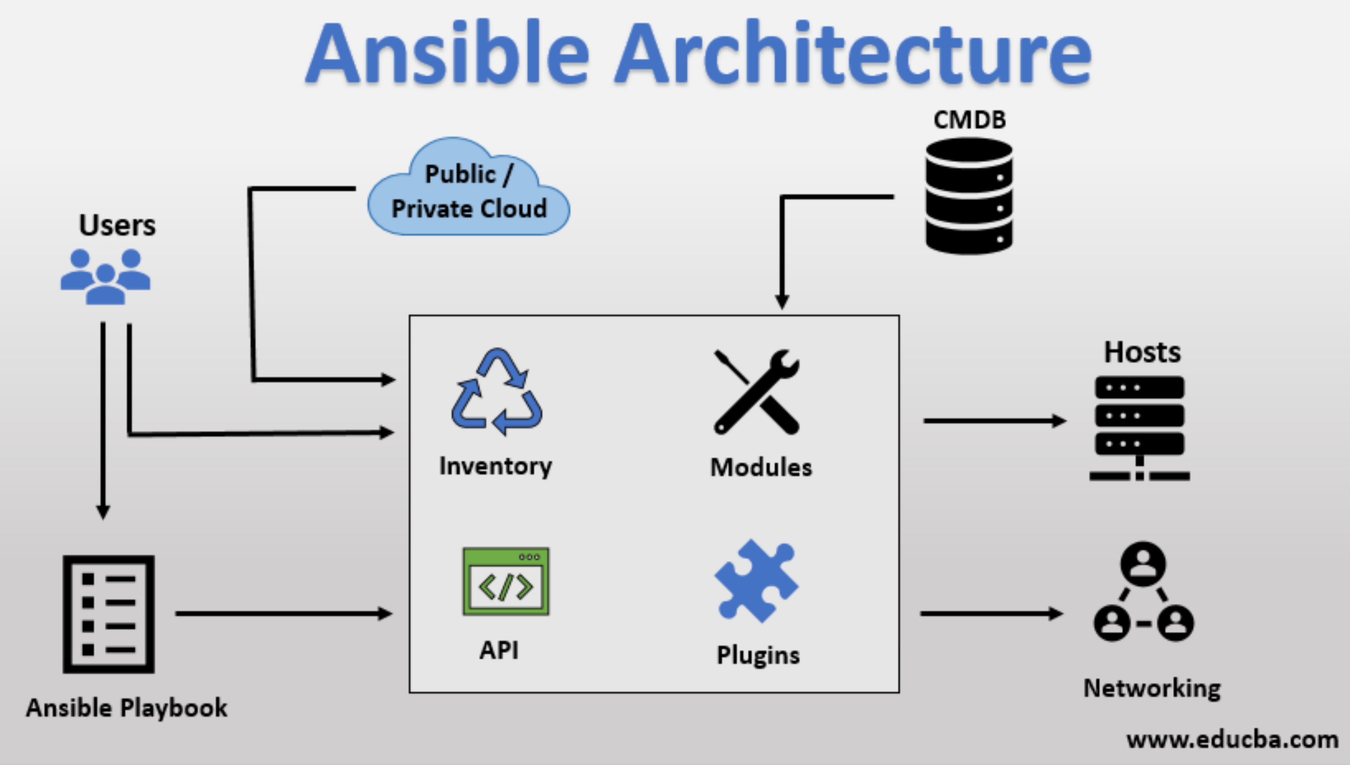
ANSIBLE

CFEngine

puppet

Ansible

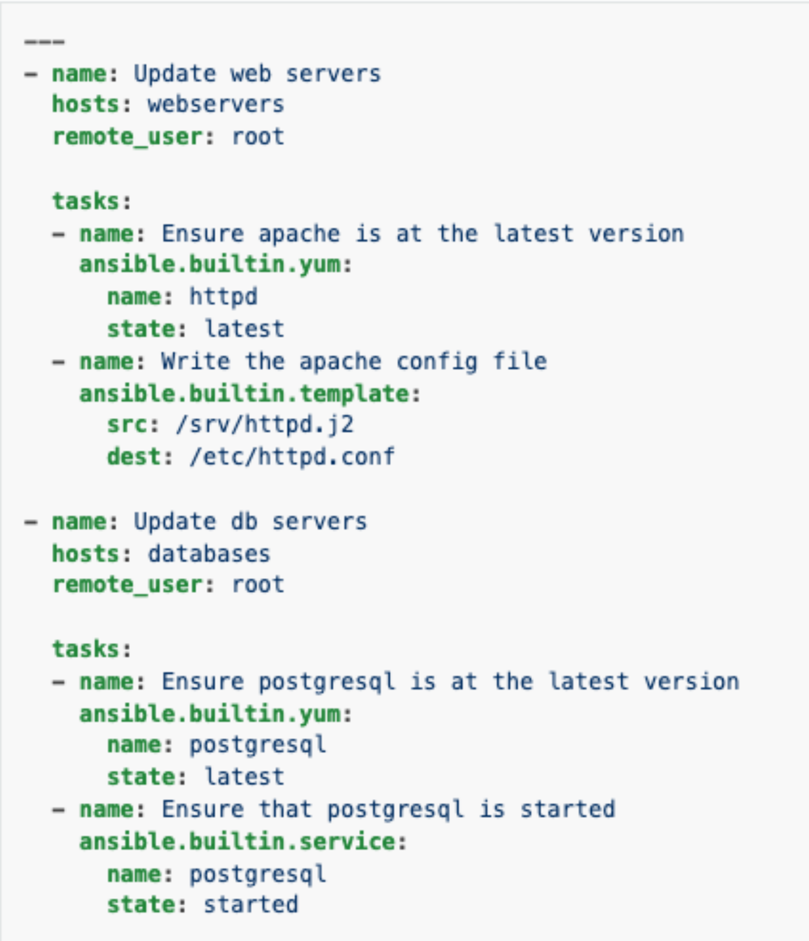
(https://www.ansible.com)



- Proprietary / GNU GPL
- Huge docs and community
- Idempotent
- Extensible
- Mostly used for CM
- Can do also IaC
- YAML syntax
- Written in Python
- agent-less
- Based on SSH

Quick look at the Ansible Playbook and Inventory

Ansible playbook [ref]



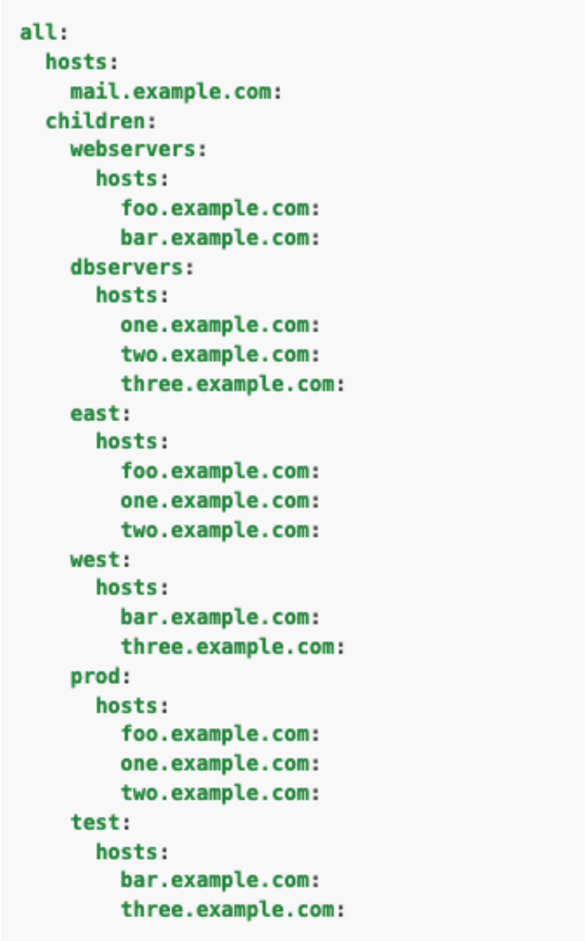
```
---
- name: Update web servers
  hosts: webservers
  remote_user: root

  tasks:
  - name: Ensure apache is at the latest version
    ansible.builtin.yum:
      name: httpd
      state: latest
  - name: Write the apache config file
    ansible.builtin.template:
      src: /srv/httpd.j2
      dest: /etc/httpd.conf

- name: Update db servers
  hosts: databases
  remote_user: root

  tasks:
  - name: Ensure postgresql is at the latest version
    ansible.builtin.yum:
      name: postgresql
      state: latest
  - name: Ensure that postgresql is started
    ansible.builtin.service:
      name: postgresql
      state: started
```

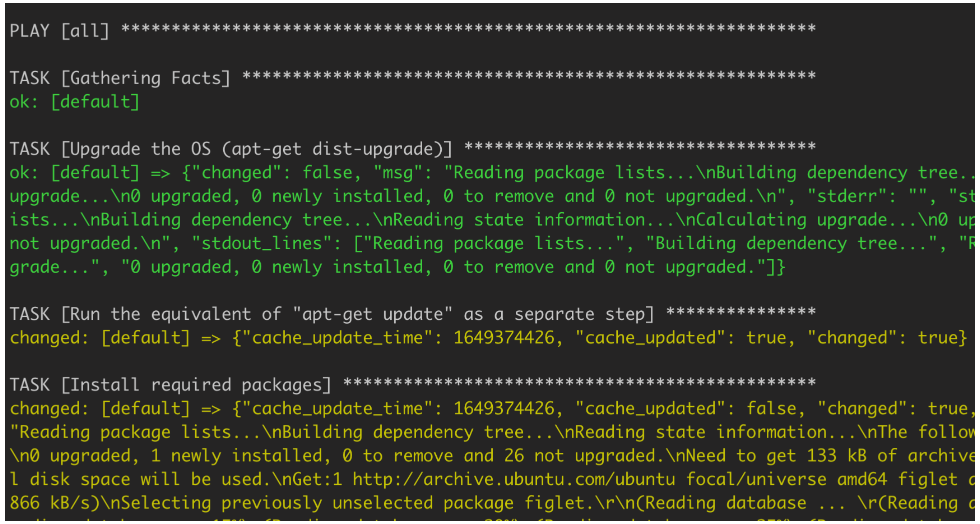
Ansible inventory [ref]



```
all:
  hosts:
    mail.example.com:
  children:
    webservers:
      hosts:
        foo.example.com:
        bar.example.com:
    dbservers:
      hosts:
        one.example.com:
        two.example.com:
        three.example.com:
    east:
      hosts:
        foo.example.com:
        one.example.com:
        two.example.com:
    west:
      hosts:
        bar.example.com:
        three.example.com:
    prod:
      hosts:
        foo.example.com:
        one.example.com:
        two.example.com:
    test:
      hosts:
        bar.example.com:
        three.example.com:
```

```
ansible-playbook playbook.yml \
-f 10
```

```
ansible-playbook -i inventory \
playbook.yml \
-f 10
```



```
PLAY [all] *********************************************************************

TASK [Gathering Facts] *********************************************************
ok: [default]

TASK [Upgrade the OS (apt-get dist-upgrade)] ***********************************
ok: [default] => {"changed": false, "msg": "Reading package lists...\nBuilding dependency tree..
upgrade...\n0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.\n", "stderr": "", "st
ists...\nBuilding dependency tree...\nReading state information...\nCalculating upgrade...\n0 up
not upgraded.\n", "stdout_lines": ["Reading package lists...", "Building dependency tree...", "R
grade...", "0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded."]}

TASK [Run the equivalent of "apt-get update" as a separate step] ***************
changed: [default] => {"cache_update_time": 1649374426, "cache_updated": true, "changed": true}

TASK [Install required packages] ***********************************************
changed: [default] => {"cache_update_time": 1649374426, "cache_updated": false, "changed": true,
"Reading package lists...\nBuilding dependency tree...\nReading state information...\nThe follow
\n0 upgraded, 1 newly installed, 0 to remove and 26 not upgraded.\nNeed to get 133 kB of archive
l disk space will be used.\nGet:1 http://archive.ubuntu.com/ubuntu focal/universe amd64 figlet a
866 kB/s)\nSelecting previously unselected package figlet.\r\n(Reading database ... \r(Reading d
```

Exercise 6 – Advanced deployment: Provision with Vagrant and Configure with Ansible

- **Time:** 20 minutes
  - 10 minutes: *Try by yourself and ask for support*
    - Give an ack when completed succesfully
  - 10 minutes: *Cross check and Verify*

- **Description:**
  - Provision a Virtual Machine using Vagrant as you did in e02. This time the provisioner in not of type shell but of type Ansible, so first look at the Vagrantfile and then at the provision.yml file and try to understand what is going on this time. Provision the VM using this new system multiple times, check the VM and inspect virtualbox VMs using CLI.

- **Instructions:**
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022/-/tree/master/e06

Exercise 7 – Deploy a webserver and access the main page via a browser

- **Time:** ~20 minutes
  - 20 minutes 10 minutes: *Try by yourself and ask for support*
    - Give an ack when completed succesfully
  - 10 mintues: *Cross check and Verify*

- **Description:**
  - Provision a Virtual Machine using Vagrant as you did in e06. This time you should install an Apache2 Web Server on the VM. Moreover, once the new service is installed you must check it is working: first via CLI inside the VM and then using a browser from your laptop. Is the laptop allopwed to reach the VM using the SSH Socks Proxy configured so far?

- **Instructions:**
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022/-/tree/master/e07