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Basic Principles of Hardening – Tutorial

PA211 Advanced Topics of Cyber Security

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Sandbox preparation

1. Run **`pa211_setup`** command – only on school computers (nymfe).
2. Clone a new repository with the target (hardening sandbox):

   https://gitlab.fi.muni.cz/cybersec/pa211/hardening.git
3. Change directory to **hardening/intro**. This directory contains **`Vagrantfile`**.
4. Run **`vagrant up`**.

Goals of this seminar

- Test your system against CIS Benchmark
- Create *security templates* for UFW
- Hands-on activities with other supportive tools

- This tutorial focuses primarily on **check of your system.** The actual configuration comes after.

Standards

CIS Benchmarks

Open Source Initiative

- Tools performing audit/hardening based on **CIS Benchmark**
  - As source **e.g., GitHub**
  - Be careful, it is security risk to run any random script!
  - Help at the beginnings, can't rely on them for 100%
- **Awesome Open Source**
  - Open-Source application catalog, 56 categories, more than 370,000 projects
  - Currently Top 56 CIS Benchmark Open-Source Projects (search for "CIS Benchmark")
  - Examples:
    - CIS Ubuntu 20.04 Ansible role
    - Prowler for AWS security assessment
    - CIS Kubernetes Benchmark
    - CIS Benchmark for CentOS

Task 1 – Check System Against CIS

- Introduce yourself with debian-cis tool
- Work on **server VM** (`vagrant ssh server`)
- QuickStart:
  - `$ git clone https://github.com/ovh/debian-cis.git`
  - `$ cd debian-cis`
  - `$ sudo cp debian/default /etc/default/cis-hardening`
  - `$ sudo sed -i "s#CIS_ROOT_DIR=.*#CIS_ROOT_DIR='$(pwd)'#" /etc/default/cis-hardening`
- Run **ONLY audit**, do **not apply changes** to the system (--*apply* vs. --*audit*) `$ bin/hardening.sh --audit-all --sudo`

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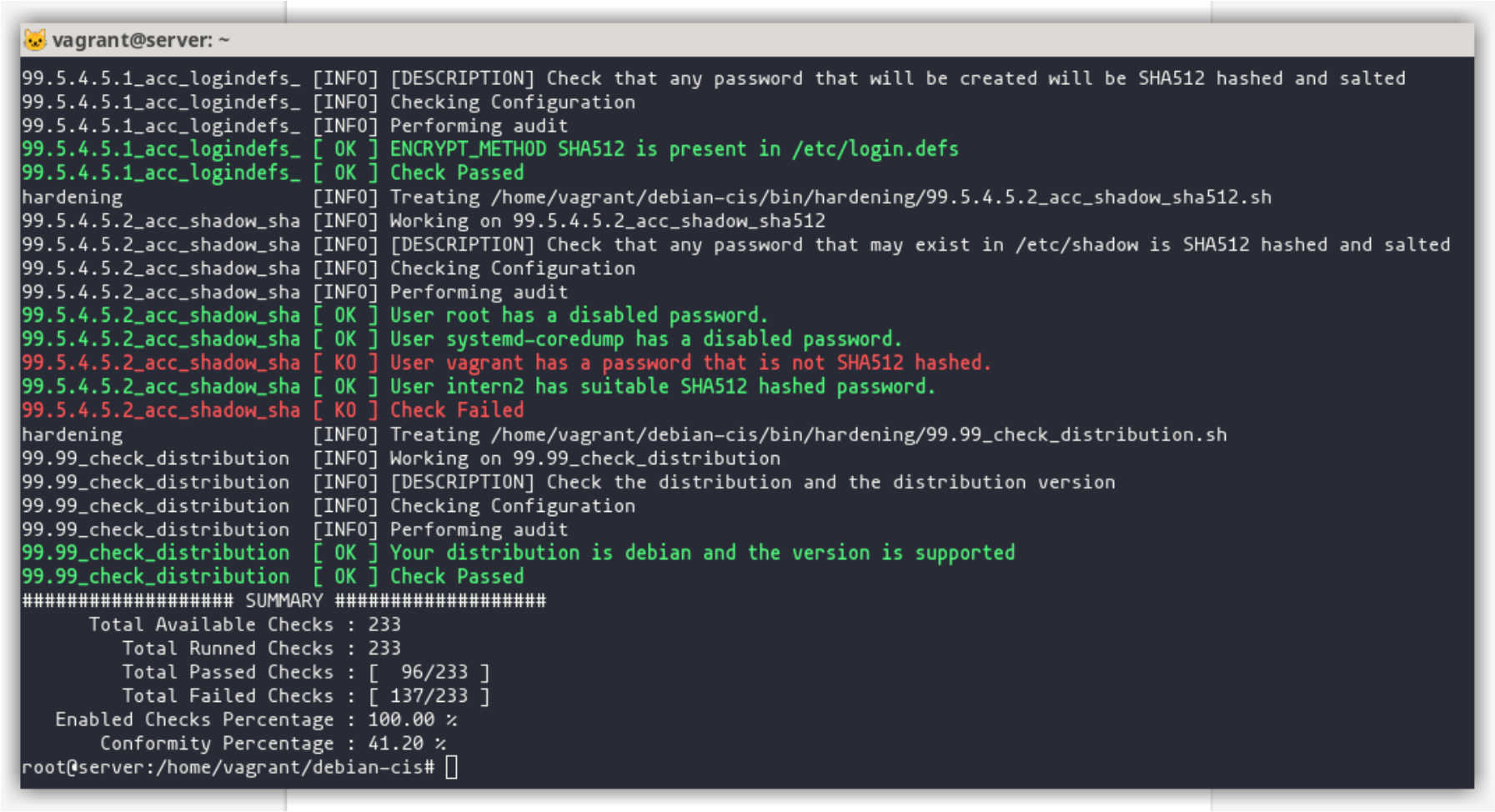
Task 1 – Check System Against CIS

1. How many checks passed/failed?
2. Use ***grep*** command and filter key words ***time_sync, firewall, ...***
   a. Which time synchronization packages/services are recommended by CIS Benchmarks for Debian 10 to be install/enabled? Are they? Which is/isn't?
   b. Which of time sync packages are so-called "full featured" for CIS? What does it mean ?
   c. Is some firewall enabled? Which one(s)?
   d. (optional) Does CIS Benchmark for Debian 10 specify whether/which firewall you can/should choose?

Solution Q1



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Solution Q2

a. Packages *ntp*, *chrony* are not installed, *systemd-timesyncd* is enabled
   - CIS Debian Linux 10 Benchmark, v1.0.0 - 02-13-2020, p. 135

b. Packages *chrony* and *NTP* are NTP implementations
   - *systemd-timesyncd* implements only SNTP (Simple NTP) client-side, therefore can't be time server and it is less accurate then NTP

c. Ufw, iptables

d. No, one of those provided is OK

Best Practices

Other Approaches and Tools

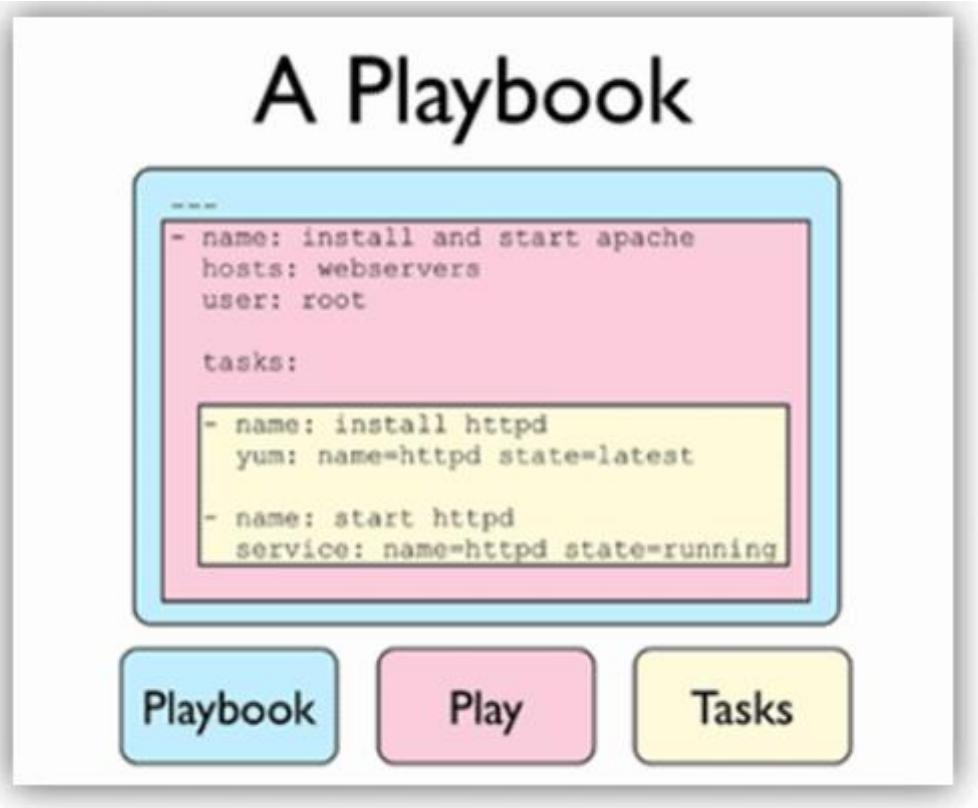
Security Templates

- Goal: To create **a configuration file** that sets all required settings for your server, database, tool, firewall, etc., **automatically** and can be **reused** on other (virtual) machines to provide the same functionality (and level of security).
- Automated configuration with *BASH scripts*?
  - You want to **describe the desired state**, **not how to get there**
  - What happen if you run commands more times than you want/should?
- Configuration management tools: **Ansible**, Puppet, CFEngine, etc.

Ansible crash course

- Ansible – automation of systems configuration
- Keywords:
  - **Playbooks** – yaml file, consists of play(s)
  - **Play –** executes part of the overall goal of the playbook, running one or more **tasks**
  - **Hosts –** the play's target (all, server, localhost)
  - **Modules** – Ansible main building blocks
  - More in documentation

Note: Ansible doesn't like **tabs**



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Task 1 - Run "Hello world!" playbook

- Create *helloworld.yml* playbook
  - Playbook will print debug message "Hello world!"
  - Use Ansible Debug module
  - As hosts use localhost (127.0.0.1)
  - Run the command `ansible-playbook` *helloworld.yml*

```
vagrant@server: ~
vagrant@server:~$ ansible-playbook helloworld.yml
[WARNING]: No inventory was parsed, only implicit localhost is available
[WARNING]: provided hosts list is empty, only localhost is available. Note that the implicit localhost does not match 'all'

PLAY [Just execute Hello world! message] ***************************************************************************

TASK [Gathering Facts] *********************************************************************************************
ok: [127.0.0.1]

TASK [Print debug message] *****************************************************************************************
ok: [127.0.0.1] => {
    "msg": "Hello world!"
}

PLAY RECAP *********************************************************************************************************
127.0.0.1                  : ok=2    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```


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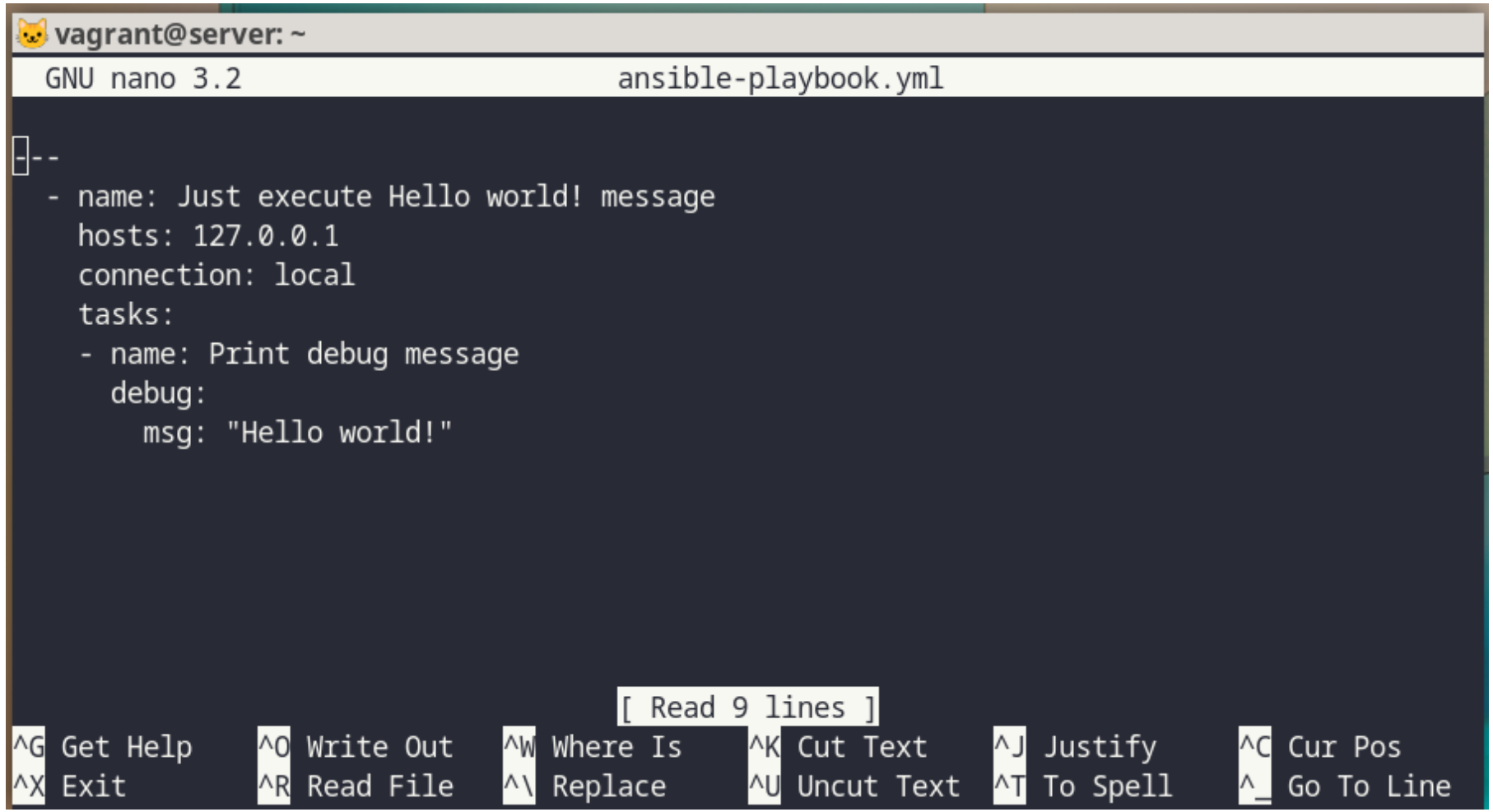
Solution 1



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Task 2 – Configure UFW to follow CIS

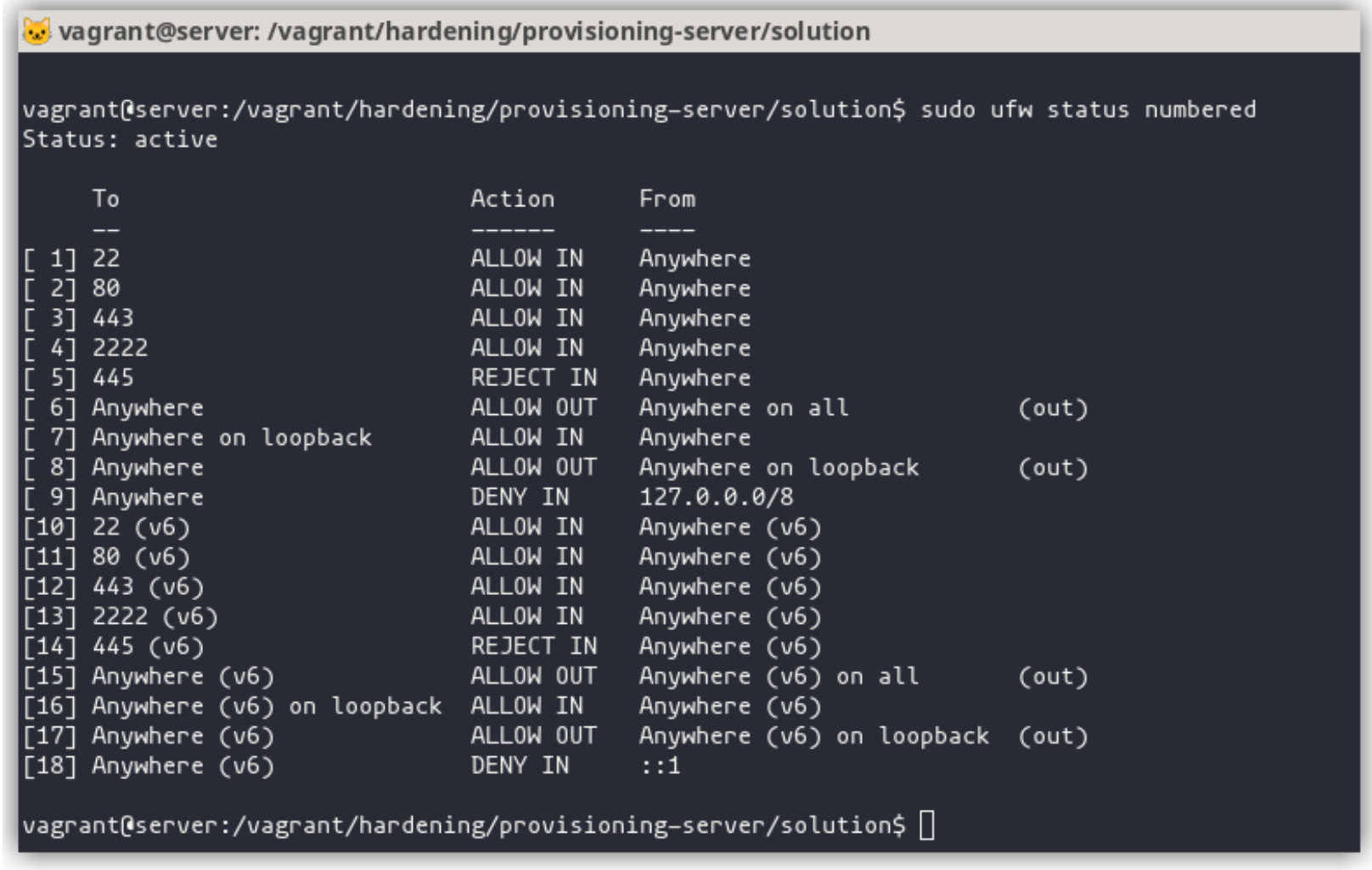
1. Check current settings of UFW
   - Run **`sudo ufw status numbered`**
   - Ansible playbook for this setup is in ***/vagrant/hardening/provisioning-server/ufw.yml***
2. Configure UFW to follow CIS Benchmark for Debian 10 server
   - **Modify the provided playbook ufw.yml**
   - Use Ansible UFW module, which requires `community.general` collection – it is already present, you can check it by running `ansible-galaxy collection list`

Task 2 – Configure UFW to follow CIS

- Create playbook that follows CIS Benchmark for Debian 10
  - Sections 3.5.2.1 - 3.5.2.5 of Debian 10 Guide

1. Ensure **default deny firewall policy** (Be careful, do not close your door!)
   - Deny incoming, outgoing, routed
2. Ensure **firewall rules exist for all open ports**
   - Non-loopback TCP open ports, NOT LOOPBACK
3. Ensure **outbound connections** are configured
   - No special requirements
4. Ensure **loopback traffic** is configured
   - The loopback interface is the only place that loopback network traffic should be seen. All other interfaces should ignore traffic on this network as an anti-spoofing measure.
5. Ensure **ufw service is enabled**
6. (not CIS) **Reject port** for Active Directory Microsoft service (SMB)
   - Do you know what is difference between reject/drop?

Solution 2



Solution in ***/vagrant/hardening/provisioning-server/solution/ufw-cis.yml***

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Ansible Role as Security Template

- What we have already done, but more complex
- Roles automatically load related *vars, files, tasks, handlers*, and other Ansible artifacts based on a known file structure
- Can be easily **reused** and **shared**
  - Minimize the risk of introducing mistake, once prepared "to be secure"
- Examples:
  - Role to set iptable rules and make them persistent
  - Open Source Initiative - CIS Ubuntu 20.04 Ansible Role

Bonus: Other Tools

Monitoring

Build your own arsenal

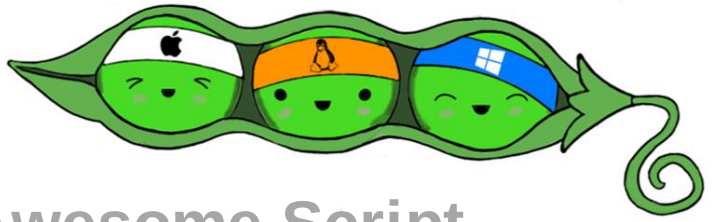
- No magic tools exist automatically solving hardening
- Do **NOT** use random tools changing your system settings!!!
  - They usually need `sudo` escalation to read/write specific files
- Build your own set of helping (trusted) tools + knowledge

Sandbox Preparation

- Return sandbox into useable form after playing with ufw
- Run **`sudo ufw disable`** and continue with following tasks

LinPEAS

Linux Privilege Escalation Awesome Script



- Check whether your system is vulnerable to **privileges escalation**
- Linux/Unix*/MacOS hosts
- LinPEAS is often used for penetration testing
- Overview of individual checks and explanation

LinPEAS – Generating report

- Access server VM `vagrant ssh server`
- Get LinPEAS
  - `wget https://github.com/carlospolop/PEASS-ng/releases/latest/download/linpeas.sh`
  - `chmod +x linpeas.sh`
- Run LinPEAS and view report
  - `./linpeas.sh > report.txt`
  - `less -r report.txt`

Task – Get to know the LinPEAS

1. Are there some recognized CVEs?
2. Can you find information about current *sudo* version?
3. Are there some *SUID/SGID binaries?*
4. Did LinPEAS find some forgotten passwords?

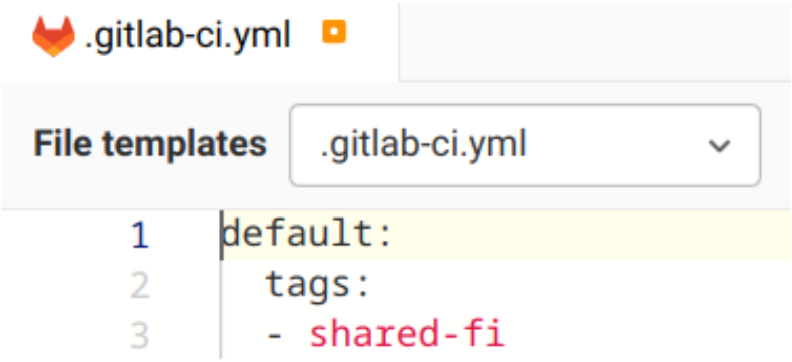
Solution

1. Sections **CVEs Check** (CVE-2022-2588) and **Executing Linux Exploit Suggester** (CVE-2019-13272, CVE-2021-3156, etc.)
2. In section **Sudo version** == 1.8.27 is potentially critical (red color), in Interesting Files -> SUID LinPEAS suggests to check if */usr/bin/sudo* is vulnerable
3. Sections **SUID, SGID**
4. Not really, e.g., section **Searching passwords in history files** reference legit code without forgotten passwords. In following sections, most of the files are legit ones which usually does not contain passwords --> but you would need to do closer look to be sure.

Gitlab Security

- Offers many **analyzers** (including open source)
  - You can integrate them into CI pipeline (e.g. merge to main)
- **SAST** – Static Application Security Testing
  - Checks your **source code** for known vulnerabilities
  - Other features - **dependency** scanning, **container** scanning, **secret** detection, **fuzz** testing
- **D(ynamic)AST** – automated web app security testing using OWASP ZAP (Zed Attack Proxy), i.e., attacking your application

SAST – Test your repository



1. Create *.gitlab-ci.yml* in repository root with following tag if using gitlab.fi.muni.cz:
2. In the repo, go to *Security & Compliance* -> *Configuration* -> *Enable SAST* and merge it with default settings into main
3. After completing pipeline, check results in *Vulnerability report*

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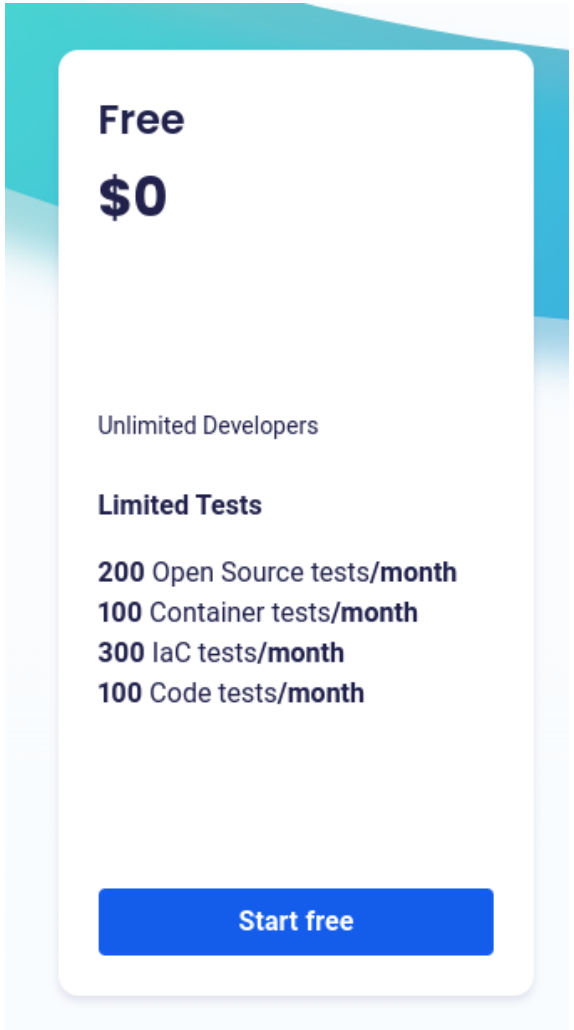
Snyk

- Security tool which **scans your code**, dependencies, containers, etc. **for vulnerabilities**
- Supports integration with various tools: *GitHub/GitLab*, *Kubernetes*, *Docker Hub*, *IntelliJ*, *PyCharm*, *RubyMine*, …
- Free version is limited in number of tests per months
- Requires registration (Google/GitHub)
  - Then set integration with your favorite tools, import repos and run scanning...voila!



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Snyk – Scan your repository

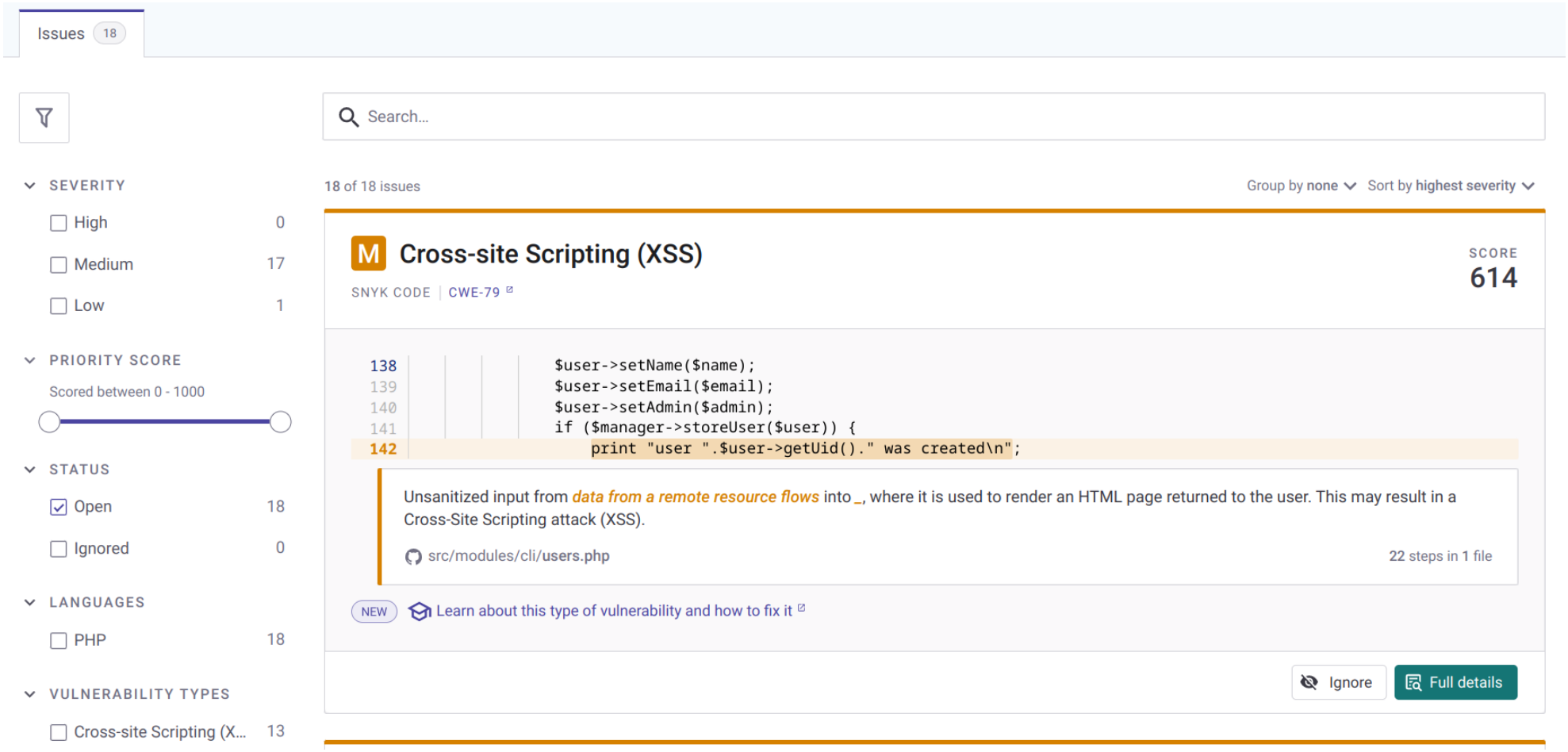

Figure: Fork of Pakiti-CESNET

Bonus: Pakiti

- Another example of **Ansible role**
- Pakiti: monitoring the patching status of Linux systems
  - Client/server model
  - Client on monitored machines regularly sends reports to Pakiti server
  - Pakiti server checks version against its database and collected information
  - Detection of vulnerabilities based on CVE identifiers
- Developed by CESNET
- Current version is almost 2 years old

Bonus: Grafana and Prometheus

- Prometheus (open-source)
  - Monitoring and alerting tool
  - Recording any numeric time series (metrics recorded over times), e.g. CPU usage
- Prometheus supports Grafana integration
  - Open-source analytics & visualization web application for databases
  - Integration also with other monitoring solutions: Elasticsearch, MySWL, Graphite, ...
- Grafana provides freely available demo
  - Use data source, e.g., 'Prometheus – Demo Dashboard'

How was it today?

And how was this part of the course?

Please fill in an **anonymous** exit ticket:

https://muni.cz/go/pa211-22-09

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