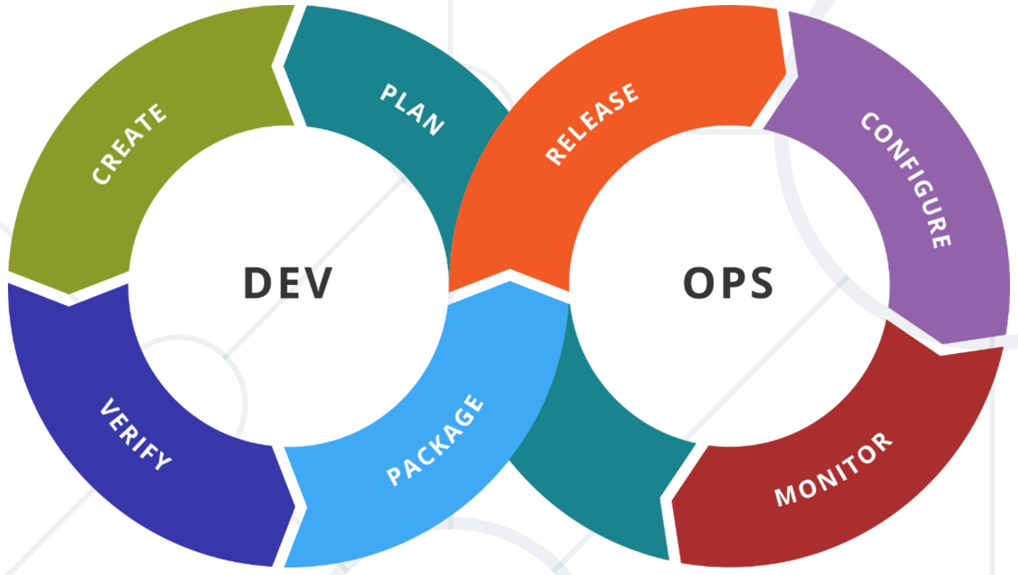
Ansible

Introduction and Basic Techniques



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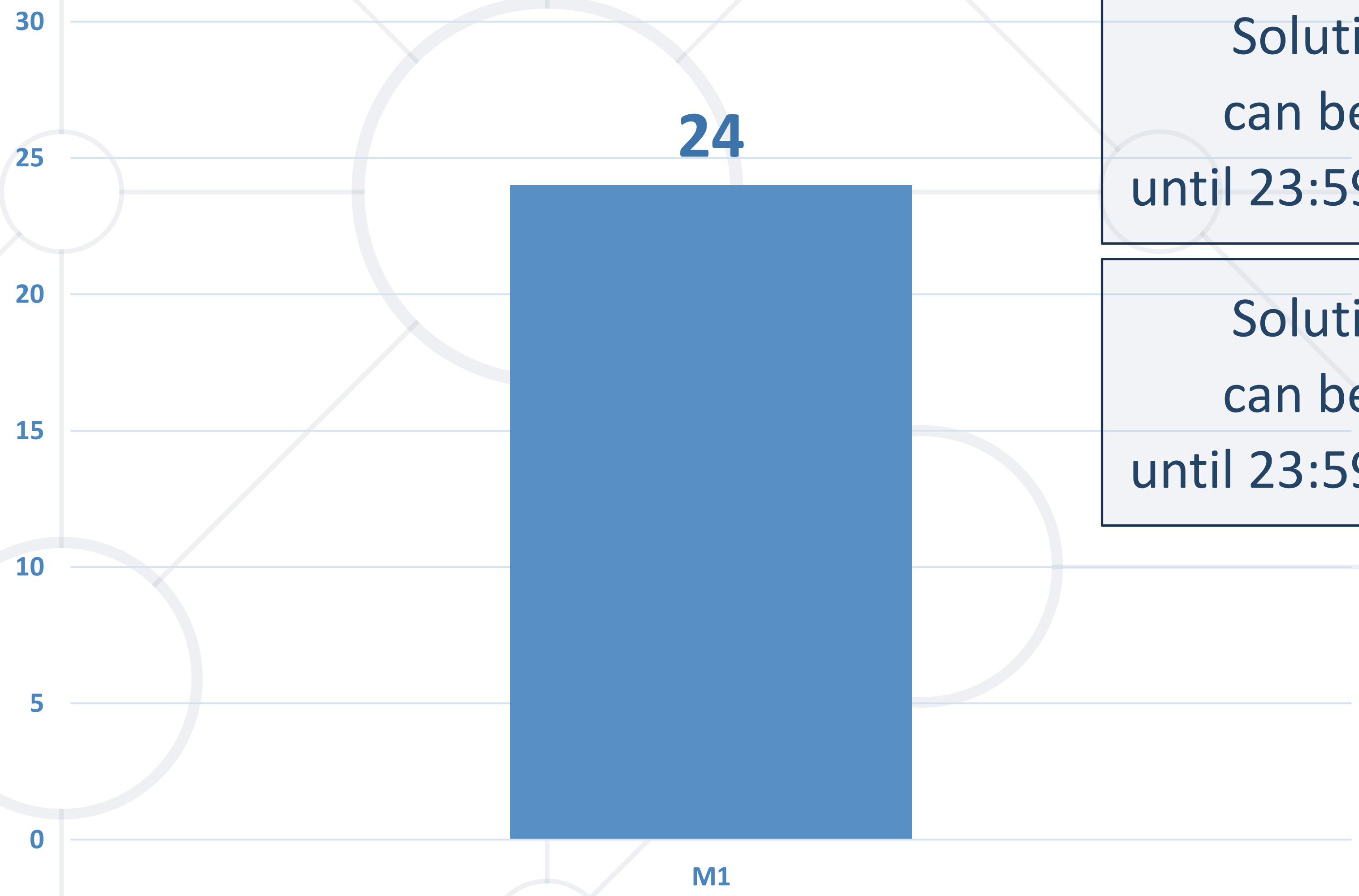
Homework Progress



Solutions for M1
can be submitted
until 23:59 on 12.04.2023

Solutions for M2
can be submitted
until 23:59 on 19.04.2023

Previous Module (M1)

Quick Overview

What We Covered

1. Infrastructure as Code
   - Introduction
   - Terraform Basics
2. Terraform and Docker
3. Terraform and AWS

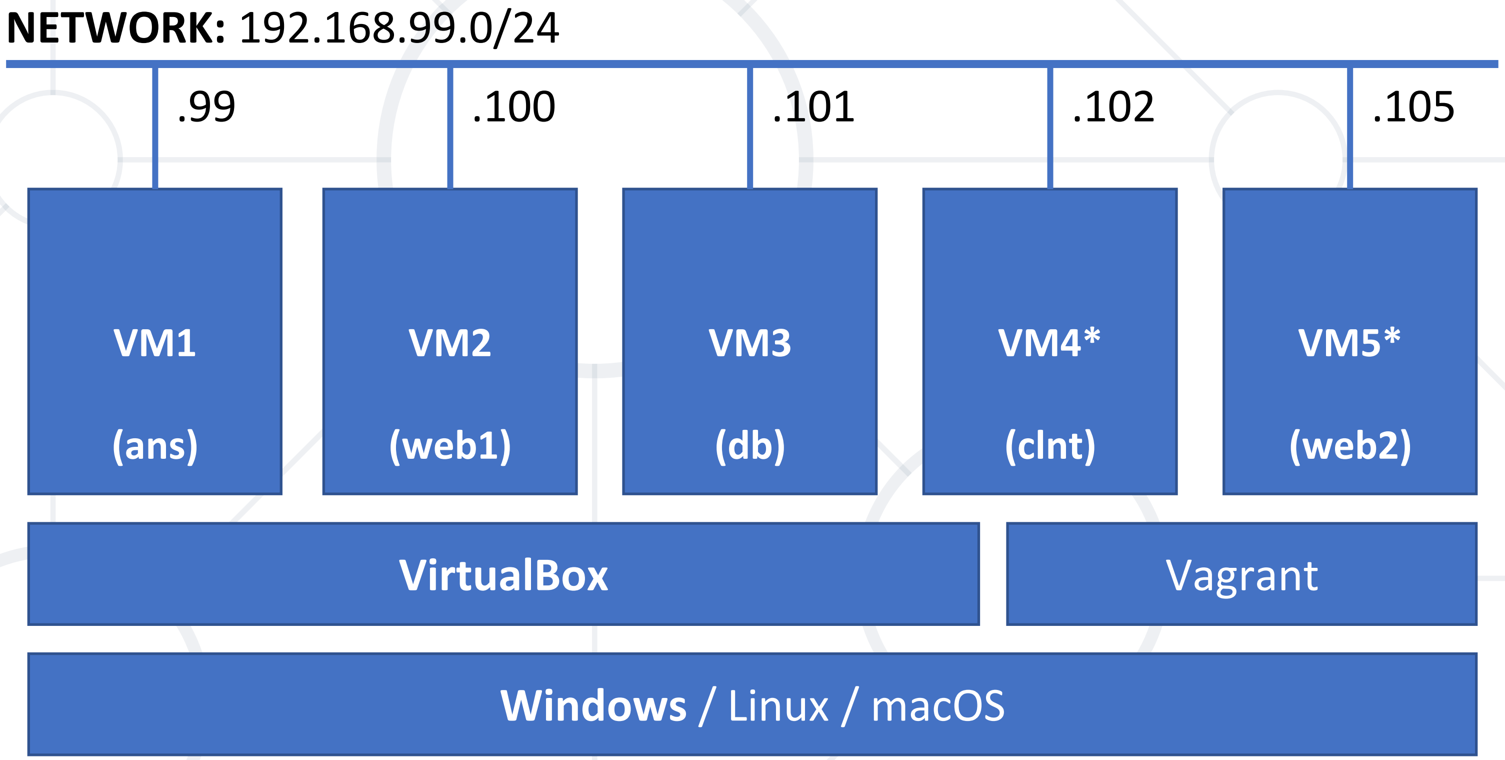
This Module (M2)

Topics and Lab Infrastructure

Table of Contents

1. Introduction to Ansible
   - Other solutions
   - Ansible architecture
2. Working with Ansible
   - Work with Inventories and Configurations
   - Using Modules
3. Advanced Ansible
   - Playbooks and Roles

Lab Infrastructure



* VM4 and VM5 can be skipped. Of course, the exercises should be adjusted accordingly

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Available Solutions

For Provisioning, Configuration, and etc.

The Need

- Manage efficiently large-scale infrastructures
- Replicated environments
- Avoid the so-called Snowflake servers
- Version control for the environment
- Quick provisioning
- Quick recovery

Solutions (1)

- **Chef** by Chef (now Progress)
  - Recipes are written in Ruby DSL
  - Master-agent model, pull-based approach
  - Supports Windows both as server and node
- **Puppet** by Puppet
  - Recipes are written in Ruby DSL and Embedded Ruby
  - Master-agent model
  - Supports agents on Linux, OS X, and Windows

Solutions (2)

- **Salt** by SaltStack
  - Recipes are written in YAML
  - Two modes – with or without agents (Salt Minions)
  - Supports Windows both as host and remote system
- **Ansible** by Ansible Inc (now Red Hat)
  - Recipes are written in YAML
  - Agentless
  - Windows is only supported as remote system

Introduction to Ansible

Architecture. Components. Installation

What is Ansible*?

"… An **ansible** is a category of fictional device or technology capable of instantaneous or faster-than-light communication…"

* https://en.wikipedia.org/wiki/Ansible

What is/does Ansible?

- **Change Management**
  - Define and track system state. Idempotence
- **Provisioning**
  - Transition ***form a State A to a State B***
- **Automation**
  - Automatic execution of tasks on a system
- **Orchestration**
  - Coordination of automation between systems

Key Characteristics

- No extra components, just the bare minimum
  - There are no agents, repositories, etc.
- Easy to learn and program
  - Uses YAML, structured, easy to read and write
- Secure by design
  - Uses ***OpenSSH*** and ***WinRM***, ***root*** and ***sudo***
- Open and extendable
  - Shell commands, Library (Ansible-Galaxy) with tons of modules

Requirements

- Ansible Control Server
  - Python 2.7+ / 3.5+
  - Linux/Unix/Mac
  - Windows is not supported
- Remote Server
  - Linux/Unix/Mac – Python 2.6+ / 3.5+, SSH
  - Windows – Remote PowerShell

Current version
2.9.xx
(Red Hat release)

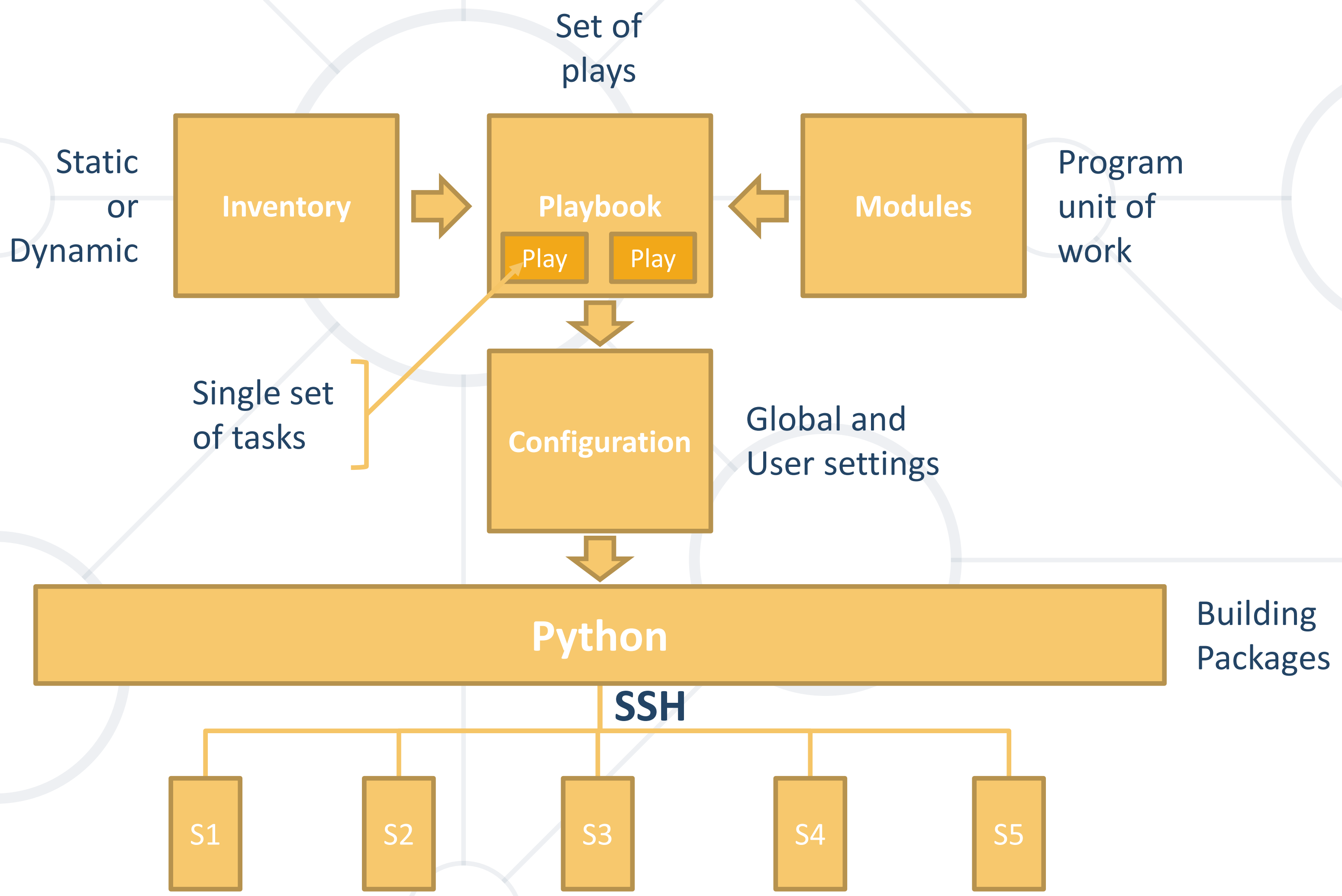
Red Hat Release vs Community Release

- Starting from version 2.10 we have two artifacts
- Community package called **ansible** (current version is **7.x**)
    - If contains the Ansible language and runtime + range of community curated collections
    - It is based and expands on what was included in Ansible 2.9
- Minimalist package called **ansible-core** (current version is **2.14.x**)
    - In version 2.10 was called **ansible-base**
    - It contains the Ansible language, runtime and a short list of core modules and plugins
- Both can be installed via OS **package manager** or with **pip**

Availability

- Compilation from source
- Installation from the official repositories
  - Supports all major distributions
  - Usually, additional repository have to be added
    - RedHat 6.x – **EPEL** / RedHat 7.x – **Extras**
    - SUSE Enterprise Linux 12.x/15.x – **Package Hub** Repository
    - Older versions of Ubuntu – **Ansible PPA** (ppa:ansible/ansible)
- Installation via pip (Python package manager)

Architecture and Components



Practice: Installation. Environment Setup

Live Demonstration in Class

Inventory

Manage Your Hosts

Inventory

- Define and describe the environment
  - Reflect our interpretation of the environment
- Can be stored anywhere on the system
  - Locally for a project, user, etc.
- Can have more than one inventory file
  - We can choose at run-time or use a configuration file

Inventory Features

- Behavioral Parameters
- Groups
- Groups of Groups
- Assign Variable
- Scale out
- Either Static or Dynamic

Two default groups – **all** and **ungrouped**

Sample Inventory File

```
web ansible_host=192.168.82.100
clnt ansible_host=192.168.82.102 ansible_user=vagrant ansible_ssh_pass=vagrant
```

Behavioral Parameters

```
[servers]
web

[stations]
clnt
```

Groups

```
[machines:children]
servers
stations
```

Groups of Groups

```
[machines:vars]
ansible_user=vagrant
ansible_ssh_pass=vagrant
```

Variables

Inventory Two Ways

- The **INI Way**

```
host.dob.lab

[web]
w1.dob.lab
w2.dob.lab

[db]
db1.dob.lab
```

- The **YAML Way**

```
all:
  hosts:
    host.dob.lab:
  children:
    web:
      hosts:
        w1.dob.lab:
        w2.dob.lab:
    db:
      hosts:
        db1.dob.lab:
```

Scale Out

- Split the inventory file
  - On smaller more manageable pieces
  - Chose a criteria – location, environment, role
  - Store the files in the same directory – shared variables
  - Store the files in separate directories
- Once split the files it is difficult to merge them

Variable Precedence and Files

- Order of precedence
  - Group Variables (**group_vars**) All
  - Group Variables (**group_vars**) GroupName
  - Host Variables (**host_vars**) HostName
- Variable Files

YAML file indication

Comment

Variables

```
---
# file: host_vars/web01
username: user01
userdir: /home/user01
```

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Configuration

Variables and Settings

Configuration Storage and Order

- Configuration Files
  - **$ANSIBLE_CONFIG**
  - **./ansible.cfg**
  - **~/.ansible.cfg**
  - **/etc/ansible/ansible.cfg** ⇨ Not created if built from source

- They are **not merged**, the **first found** is taken into account
- **Override** by prefixing the name with **$ANSIBLE_<setting>**

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Modules

Modules

- Modules do the **actual work**
- They can be executed
  - Manually using the **ansible** command
  - In batches with **ansible-playbook**

- They are known as **task plugins** or **library plugins**
- Two major types – **Core** and **Extras**
- Organized in categories – **Command**, **Files**, **System**, etc.

Modules Help

- List all available modules

```
$ ansible-doc -l
```

- Get detailed information for a module

```
$ ansible-doc service
```

- Show playbook snippet for a module

```
$ ansible-doc -s service
```

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Practice: See It in Action

Live Demonstration in Class

Plays and Playbooks

Fundamentals

Plays

- Plays map hosts to tasks
- Each play can have multiple tasks
- Tasks call modules
- Tasks run sequentially

Play Declaration

```
- hosts: webservers
  become: true
```

Global Play Declaration

```
  tasks:
    - name: Copy new index.html
      copy: src=html/index.html dest=/var/www/html/
```

Module

Task Declaration

Playbooks

- A playbook contain **one** or **more plays**
- Stored in **YAML files**
- Two ways of declaration – **list** and **dictionary**
- Can be used to **build** entire **application environment**

Playbook File

```
---
- hosts: webservers
  become: true
  tasks:
    - name: Install Apache HTTP Server
      dnf: name=httpd state=present
    - name: Start Apache HTTP Server and Enable it
      service: name=httpd state=started enabled=true
```

Play One

```
- hosts: databases
  become: true
  tasks:
    - name: Install MariaDB Server
      dnf: name=mariadb,mariadb-server state=present
    - name: Start and enable MariaDB
      service: name=mariadb state=started enabled=true
```

Play Two

Playbook Two Ways

- The **List Way**

```
---
- hosts: web
  become: true
  tasks:
    - name: Install WEB
      dnf: name=httpd state=present
    - name: Start WEB
      service: name=httpd state=started
```

- The **Dictionary Way**

```
---
- hosts: web
  become: true
  tasks:
    - name: Install WEB
      dnf:
        name: httpd
        state: present
    - name: Start WEB
      service:
        name: httpd
        state: started
```

Playbooks Execution

- Execute with default inventory

```
$ ansible-playbook playbook_name.yml
```

- Execute with specified inventory

```
$ ansible-playbook -i inventory playbook_name.yml
```

- On host failure it is excluded from further tasks execution
- Failed hosts are stored in a file
- Retry execution only for failed hosts

```
$ ansible-playbook book.yml --limit @/path/to/file
```

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Roles

Fundamentals

Roles

- Allow **easy sharing** of content
- Way of automatic loading of tasks, vars, and handlers
- Described via **YAML files** in certain directory structure
- Search for roles
  - A **roles/** directory relative to the playbook file
  - By default, in **/etc/ansible/roles**

Roles Directory Structure

- **tasks** – main list of tasks to be executed
- **handlers** – handlers, that may be executed
- **defaults** – default variables for the role
- **vars** – other variables for the role
- **files** – files, that can be deployed
- **templates** – templates, that can be deployed
- **meta** – meta data (parameters and dependencies)

* **main.yml** is expected in each folder
** **Other** task specific **files** can be **included**, like ***redhat.yml***
*** **At least one** of the folders must be included

Role Example

- Definition (main.yml)

```
---
  - name: Firewall | Open HTTP port
    firewalld:
      service: http
      permanent: true
      state: enabled
      immediate: true
```

- Usage (playbook.yml)

```
---
- hosts: web
  roles:
    - firewall-8080
```

```
.
├── ansible.cfg
├── hosts
├── playbook.yml
└── roles
    ├── firewall-8080
    │   └── tasks
    │       └── main.yml
    └── firewall-http
        └── tasks
            └── main.yml
```

Ansible Galaxy

- Free site for **finding**, **downloading**, and **sharing** roles
- We can **develop** and **share** our own roles. **GitHub account** is needed
- Galaxy can be run **on-premise** as well
- Command line tool **ansible-galaxy** is included

```
$ ansible-galaxy install username.role
```

- Default storage is configured via **roles_path** variable
- Install a role to a **custom path**

```
$ ansible-galaxy install --roles-path . username.role
```

- Install roles included in requirements file

```
$ ansible-galaxy install -r requirements.yml
```

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Additional Techniques

Include Files

- Easier playbook management – smaller playbooks
- Reuse other playbooks – common/repeatable plays
- Can load external variable

```
tasks:
  - include_vars: ext_var_file.yml
  - include: web-server.yml
  - include: db-server.yml
```

Register Task

- Link tasks – data from one task is passed to another
- Can be used for error catching

```
tasks:
  - shell: /usr/bin/whoami
    register: username
  - file: path=/path/to/folder/readme.txt
          owner={{ username }}
```

Debug Module

- Display output during execution
- Easier problem identification
- Two ways for execution

```
tasks:
  - debug: msg="Host: {{ inventory_hostname }}"

  - shell: /usr/bin/uptime
    register: result
  - debug:
      var: result
      verbosity: 2
```

Playbook Handlers

- Runs when notified
- It is notified only when state=changed
- Runs last

```
tasks:
  - copy: src=files/httpd.conf dest=/etc/httpd/conf/
    notify:
      - Web Server Restart

handlers:
  - name: Web Server Restart
    service: name=apache2 state=restarted
```

Conditional Clause - When

- Evaluate should a task execute

```
tasks:
  - apt: name=apache2 state=present
    when: ansible_os_family == "Debian"

  - dnf: name=httpd state=present
    when: ansible_os_family == "RedHat"
```

- Use APT module if Debian or use DNF/YUM if RedHat

Conditional Clause - Result

- Track execution status of the previous task
- Status options – **success**, **failed**, **skipped**
- Should add **ignore_errors** or the playbook will fail

```
tasks:
  - command: /bin/false
    register: result
    ignore_errors: True

  - command: /bin/some_command
    when: result|failed
```

Templates

- Jinja2 Engine
- Create and copy dynamic files

```
- name: Deploy index.j2 on RedHat
  vars:
    v_host_type: RedHat
  template: src=templates/index.j2
            dest=/var/www/html/index.html
  when: ansible_os_family == "RedHat"
```

- **templates/index.j2**

```
<h2>Hello from Ansible on {{ v_host_type }}!</h2>
```

Practice: Playbooks in Action

Live Demonstration in Class

Summary

- Ansible is a powerful solution for **configuration** and **provisio ning**
  - It can be installed from **source**, **repository**, or **PIP**
  - It is driven by a set of configuration files
- **One** or **more inventories** can be used simultaneously
- Actual executable parts are called **modules**
- Modules can be combined in **plays**
- Plays can be combined in **playbooks**
- Plays can go one step further with **Jinja2 templates**

Resources

- Ansible Documentation
  http://docs.ansible.com/
- Ansible Modules
  http://docs.ansible.com/ansible/latest/list_of_all_modules.html
- Ansible Galaxy
  https://galaxy.ansible.com/
- Ansible Galaxy Documentation
  https://galaxy.ansible.com/docs/
- Ansible Examples Repository
  https://github.com/ansible/ansible-examples
- Short Ansible Tutorial
  https://www.codereviewvideos.com/course/ansible-tutorial

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