Ansible Automation:

Ansible is a powerful automation tool that can replace many Bash scripts with more maintainable and scalable solutions. Ansible is an automation tool used for configuration management, application deployment, and task automation.

Key Ansible concepts:

1. Playbooks: YAML files containing a set of tasks to be executed on remote hosts.
2. Tasks: Individual units of work in a playbook.
3. Modules: Pieces of code Ansible executes to perform specific operations.
4. Inventory: A list of managed nodes that Ansible can work with.

Ansible Playbook Structure

```
---
- name: Playbook Name
  hosts: target_hosts
  become: yes/no
  vars:
    variable1: value1
  tasks:
    - name: Task 1 Name
      module_name:
        param1: value1
        param2: value2
```

- `name`: A description of what the playbook or task does.
- `hosts`: Specifies which hosts from the inventory this play applies to.
- `become`: Whether to escalate privileges (like sudo).
- `vars`: Define variables used in the playbook.
- `tasks`: A list of tasks to be executed.

Ansible configuration file:

When we install ansible by default configuration files will get created in the following location:

/etc/ansible/ansible.cfg

This configuration file contains several sections, they are:

1. Defaults
2. Inventory
3. Privilege_escalation
4. SSH_connection
5. Paramiko_connection
6. Persist_connection
7. Colors

Here are some frequently used configuration options:

1. In the [defaults] section:
    - inventory: Specifies the default inventory file
    - remote_user: Default username for SSH connections
    - host_key_checking: Whether to check SSH host keys
    - roles_path: Where to look for roles
    - forks: Number of parallel processes to use
2. In the [privilege_escalation] section:
    - become: Whether to use privilege escalation by default
    - become_method: Default method for privilege escalation (e.g., sudo, su)
    - become_user: Default user to become when using privilege escalation
3. In the [ssh_connection] section:
    - ssh_args: Additional SSH arguments
    - control_path: Location of ControlPath sockets

Environment Variable:

`ANSIBLE_CONFIG` = `/opt/ansible_web.cfg`

Copy of Default Config File in current directory:

`/opt/web_playbooks/ansible.cfg`

Config file in home directory:

`.ansible.cfg`

Default Config File:

`/etc/ansible/ansible.cfg`

If we have all types of configuration files then it follows the priority:

1. Environmental variable: 1st priority is always to the parameters configured in the file specified through an environmental variable

   `ANSIBLE_CONFIG` = `/opt/ansible_web.cfg`

2. Current directory config file: 2nd priority **ansible.cfg** file in the current directory
3. Home directory config file: **.ansible.cfg** file 3rd priority in users home directory
4. Default config file

Example of ansible.cfg:

```
[defaults]
inventory = ./inventory
Log_path = /var/log/ansible.log
library= /usr/share/my_modules
roles_path=atc/ansible/roles
action_plugins=/usr/share/ansible/plugins/action
remote_user = ansible
host_key_checking = False
gathering= implicit
timeout=10
forks = 5

[privilege_escalation]
become = True
become_method = sudo
become_user = root

[ssh_connection]
ssh_args = -o ControlMaster=auto -o ControlPersist=60s
```

Ansible configuration variables:

There are different ways to pass the environmental variables in

1. For single playbook:

   ANSIBLE_GATHERING= explicit ansible-playbook playbook.yml

2. If we want throughout the shell session, up to we exit from the shell:

   export ANSIBLE_GATHERING= explicit
   Ansible-playbook playbook.yml

3. If we want to change on different shells, on different users on different systems is to create a local copy of configuration file in playbooks directory and update the parameter:

   /opt/web-playbooks/ansible.cfg
   gathering =explicit

To find the different configuration options, what are the corresponding environmental variables are and what they mean

View configuration:

- To find the different configuration options, what are the corresponding environmental variables are and what they mean

  ansible -config list ⇒ list all the configurations

- We have different config files in the system in default /etc/ansible.ansible.cfg , one in present directory , one in home directory, to see which config file is in active, we use

  ansible-config view ⇒shows the current active config file details

- Shows as comprehensive list of current settings picked up, and where it is picked up
  ansible-config dump ⇒ shows the current settings

Eg:
export ANSIBLE_GATHERING=explicit
ansible-config dump | grep GATHERING
DEFAULT_GATHERING(env:ANSIBLE_GATHERING)=explicit

- **Version Control**: Keep your ansible.cfg in version control along with your playbooks.
- **Project-Specific Configurations**: Use project-specific ansible.cfg files in your project directories for settings that should apply only to that project.
- **Comment Your Configurations**: Use comments (lines starting with ';' or '#') to explain non-obvious settings.
- **Security**: Be cautious with settings like host_key_checking = False. While convenient for testing, it can be a security risk in production environments.
- **Use Environment Variables**: For sensitive information, use environment variables instead of hardcoding values in ansible.cfg.
- **Regular Review**: Periodically review and update your configuration to ensure it aligns with current best practices and your project needs.

If we want to change only one parameter in the config file , we dont need to copy the whole default config file , instead of copying the whole config file, we can override the single parameter using environment variables

What the environment variable should be?

Change the parameter in to uppercase and add the ansible word as prefix to it in uppercase

gathering =implicit ANSIBLE_GATHERING=explicit ⇒ this environmental variables have highest precedence

YAML:

- Ansible playbooks or text file or config files are written in YAML
- YAML is used to represent config data
- Key value pair, separated by colon
- Space should be mandatory in between colon and value
- Number of spaces in front of each property should be same

Key value pair:

Fruit: Apple
Vegetable: Carrot
Liquid: Water

Array/list:

Fruits:
- Oranges
- Apple
- Banana

Vegetables:
- Carrot
- tomato

Dictionary/map:

Banana:
    Calories: 104 #here the space up to calories and space up to fat should be same
    Fat: 0.4g
Grapes:
    Calories: 62
    Fat: 0.3g

Dictionary vs list vs list of dictionaries:

Dictionary: if we want to display the all details of the single item/product we use dictionary
List: stores multiple items of same type of object

eg:

- red carer
- blue car
- Black car

List of dictionary:

Stores all info about each car:

- Color: blue
- Model:
    - Name: Corvette
    - Model: 1995
- transmission: manual
- Color: black
- Model:
    - Name: Corvette
    - Model: 1996
- transmission: manual
- Color: grey
- Model:
    - Name: Corvette
    - Model: 1997
- transmission: manual

Dictionary: unordered
List: ordered

Eg:
Dictionary:

1. Banana:
    Calories: 105
    Fat: 0.4g
2. Banana:
    Fat: 0.4g
    Calories: 105

Both 1 and 2 dictionaries are equal, but list:

1. Fruits:
- Oranges
- Grapes
- Banana
- Apple

2. Fruits:
- Banana
- Apples
- Grapes
- oranges

Both 1 and 2 list are not same because of their order

List of directories:

Ansible inventory:

- Ansible can connect to multiple servers by using ssh in linux, powershell in windows
- Agentless: to work with ansible we no need to install any other software on target machines.
- Information of target machines is stored in inventory file, if we don't create that file, the ansible uses the default inventory file to store the information about the target machines(.: etc/Ansible/hosts location)
- Inventory file is in ini format, simply displays n no. of servers one after the other.
- Way 1:
  server1.company.com
  server2.company.com
  server3.company.com

- way2:

  [Mail]

  server1.company.com
  server2.company.com

  [db]

  server3.company.com
  server4.company.com

For giving alias name:

1. Alias name is given in beginning of line, and then address is assigned to ansible_host parameter
2. **Ansible_host** is an **inventory parameter** used to specify the ip address of a server
3. Another inventory parameters:
   a. **ansible_connection-ssh/winrm/localhost # defines how ansible connects to the server, like through windows or linux , etc**
   b. **ansible_port-22/5986 # default it is set to 22**
   c. **ansible_user-root/administrator # defines user who is creating the connection like root or admin**

d. **Ansible_ssh_pass- password #display like text format which is not safe**
e. **Ansible_password for windows password**

Example:

web ansible_host=server1.company.com ansible_connection=ssh ansible_user=root

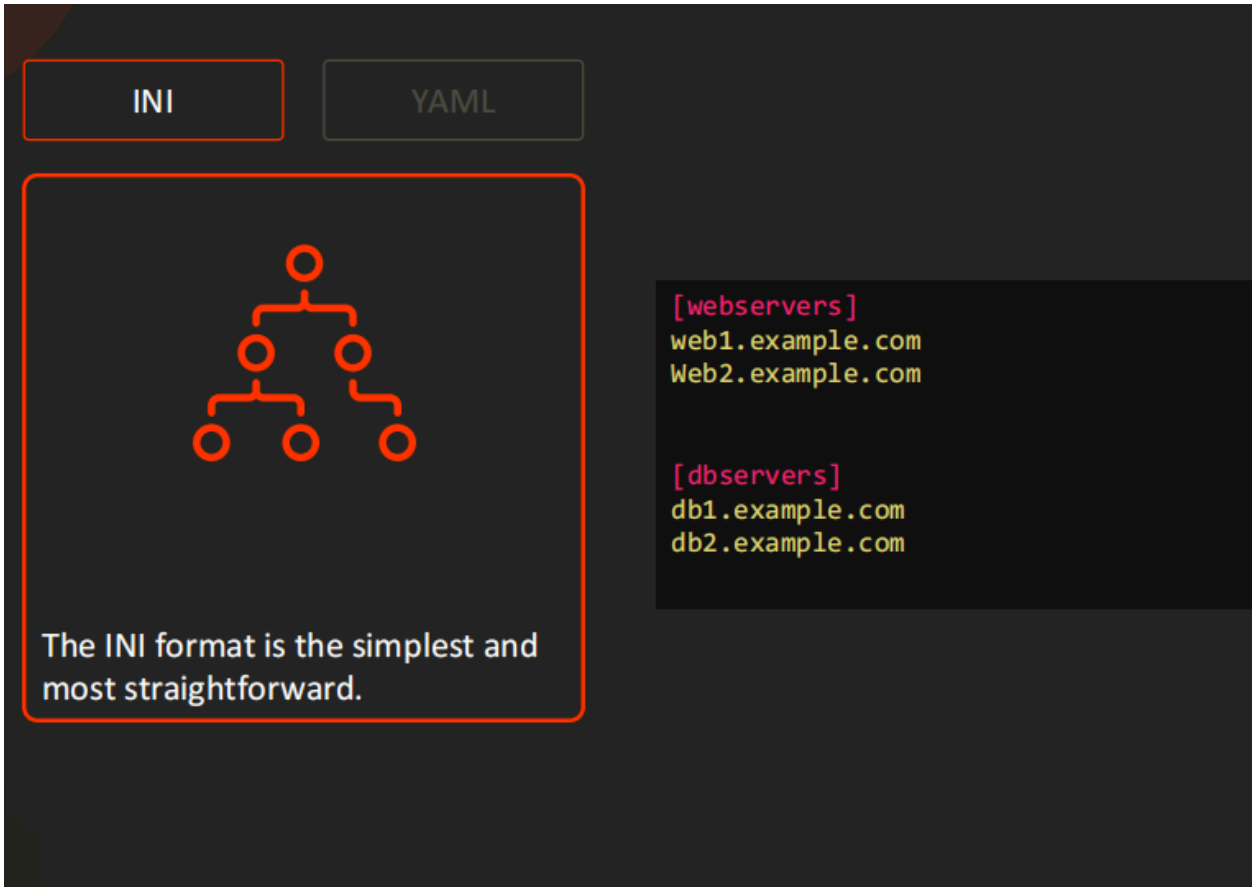
db ansible_host=server2.company.com ansible_connection=winrm ansible_user=admin

mail ansible_host=server3.company.com ansible_connection= ssh ansible_ssh_pass = p!2s#

localhost ansible_connection=localhost

Inventory formats:

1. INI
2. YAML



INI:
Basic that follows in start up, they does only less number of tasks, like managing db, web.

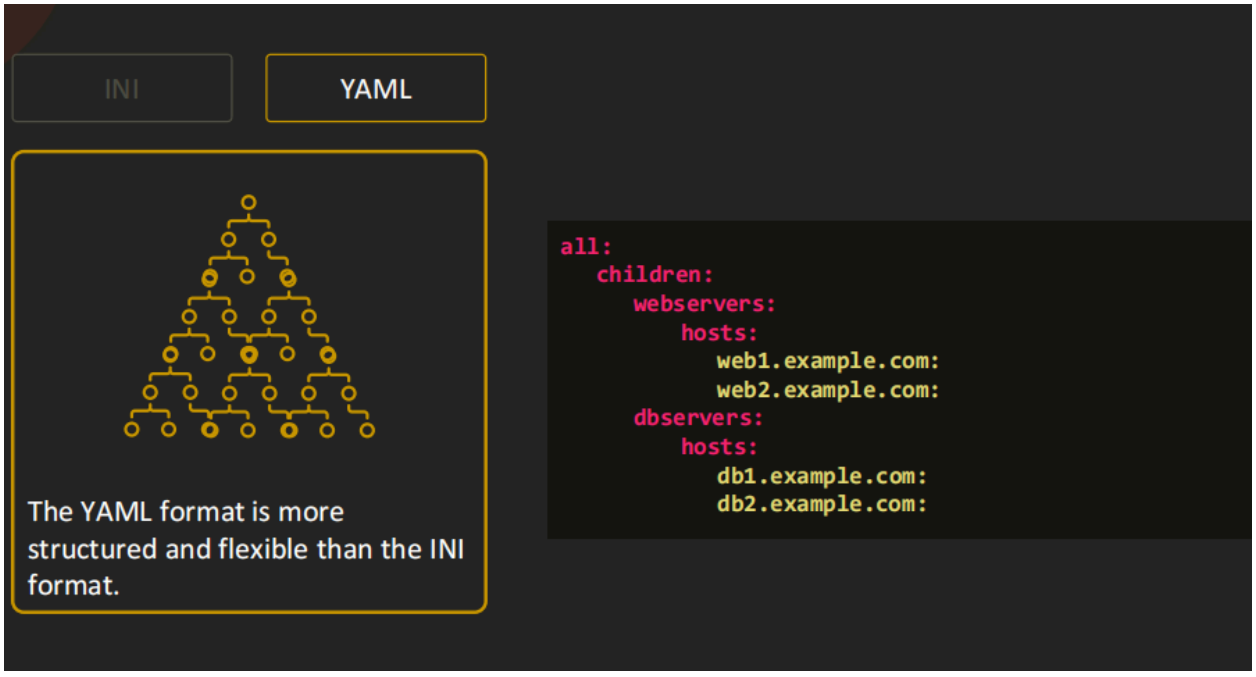
Example:

[Mail]
server1.company.com
server2.company.com

[db]
server3.company.com
server4.company.com

[web]
server5.company.com
server6.company.com

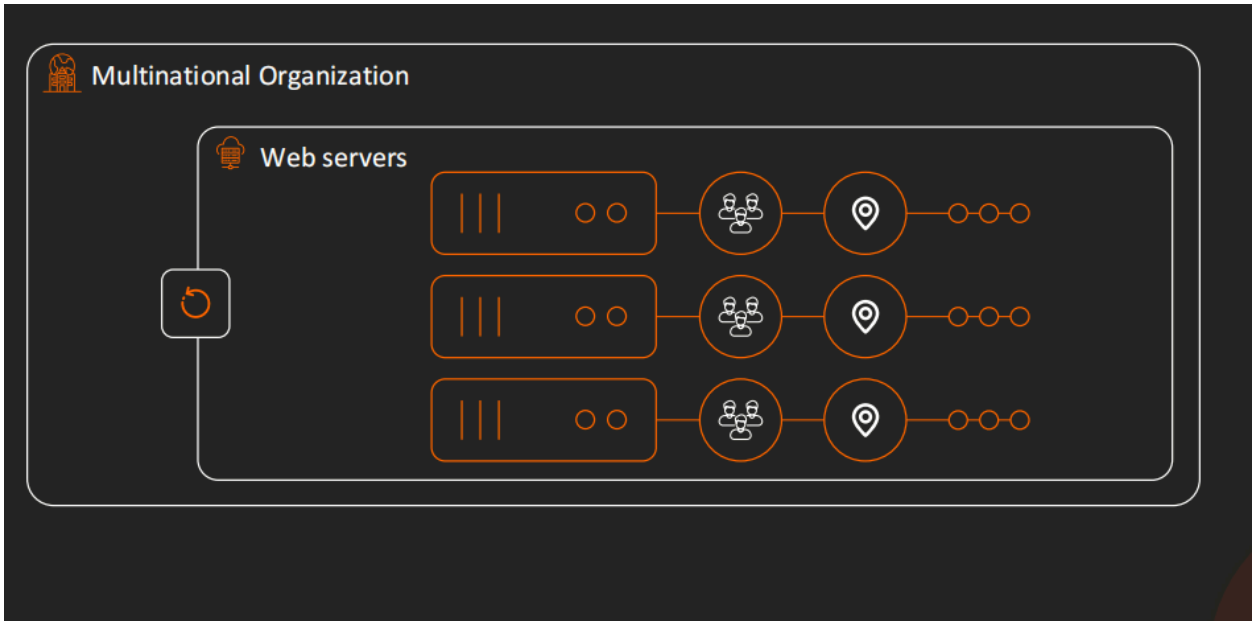
YAML:



Uses in multinational companies like to maintain multiple tasks, supports multiple apps etc
Example:

```
All:
  children:
        webserver:
              hosts:
                    web1.example.com
                    web2.example .com
```

Grouping:

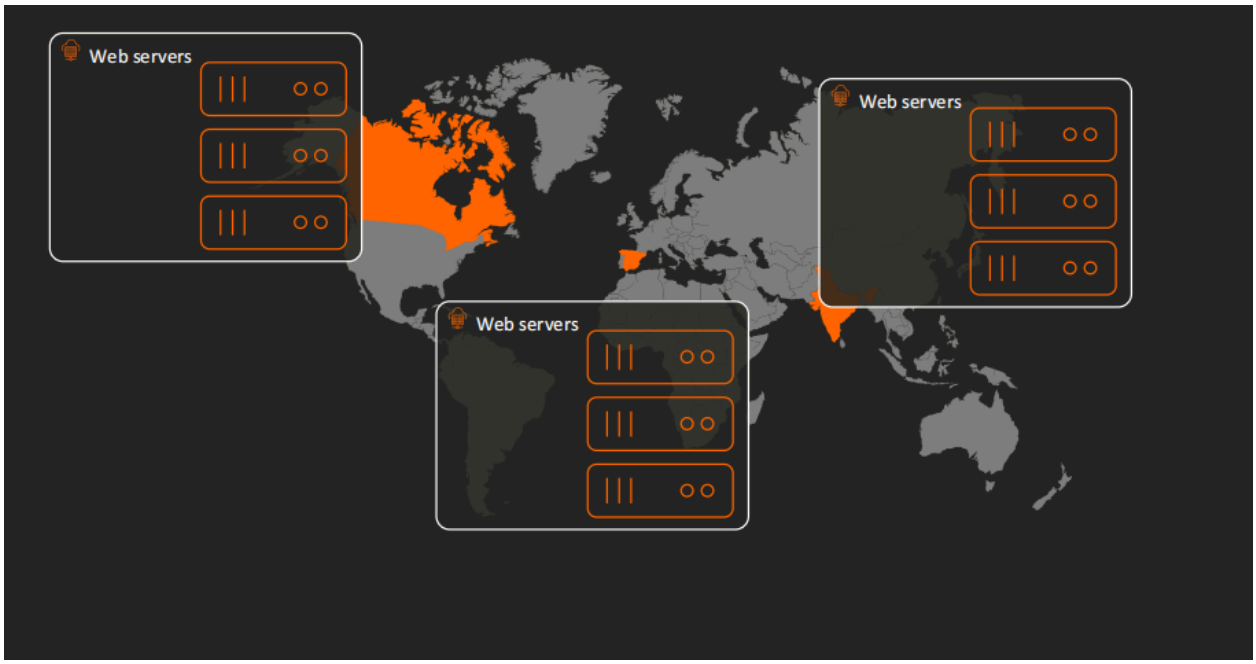


we categorize the servers based roles or locations or any other criteria is called grouping

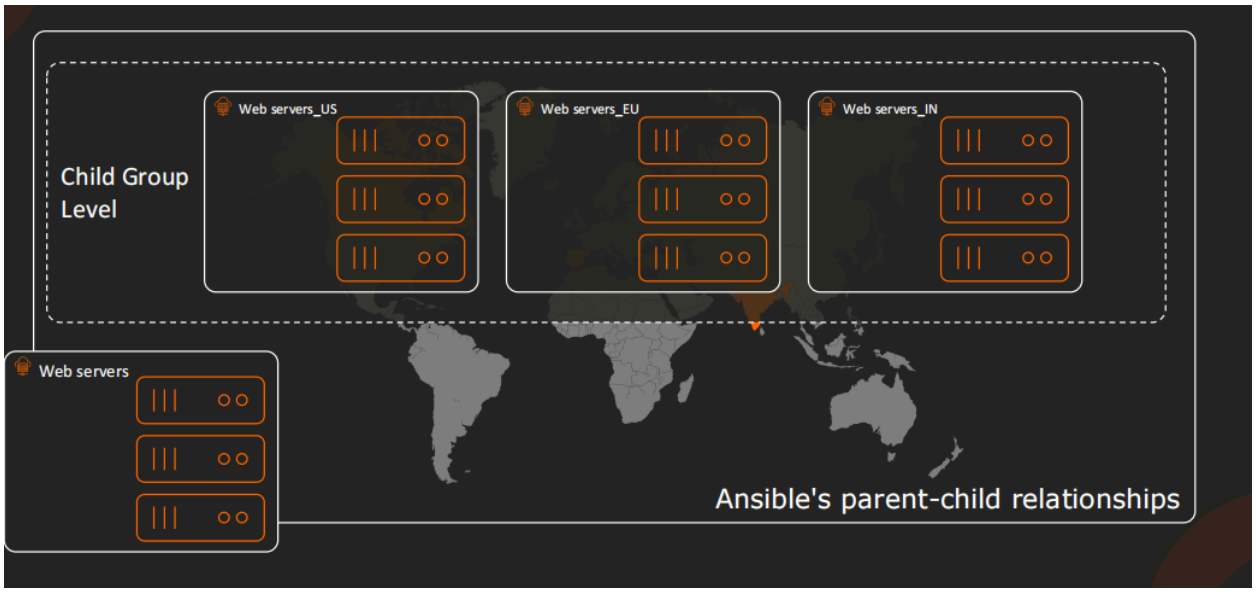
Collectively identify all the web servers under a common label named webservers
If we want to update the webservers , instead of mentioning each server we can mention/target the label name webservers then changes will apply to the all servers in that label this is called grouping this is done by ansible.

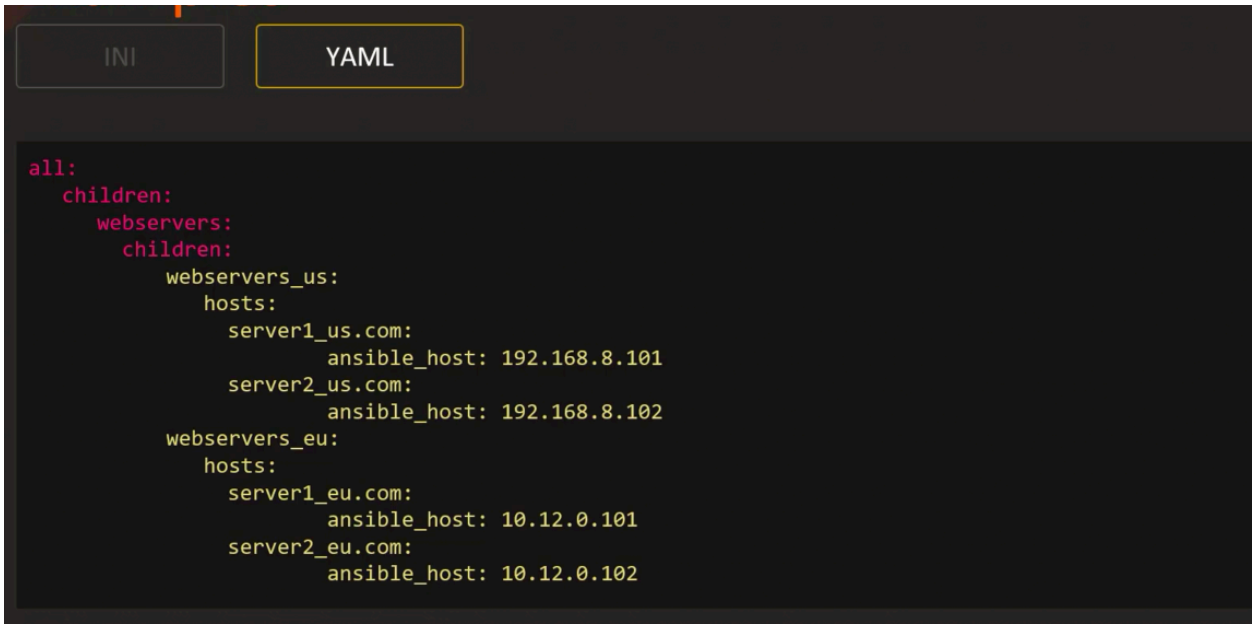
Parent -child relationship:

If we have multiple webservers in different location:



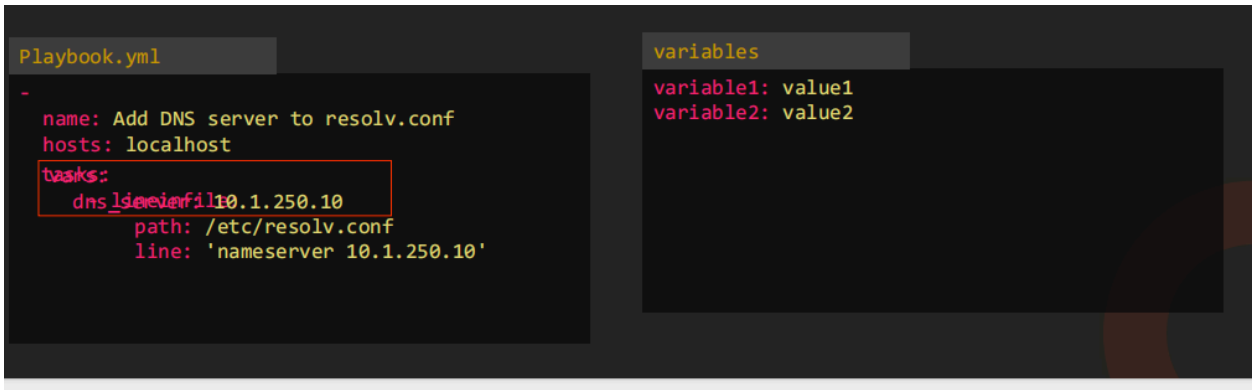
If we are having the webservers in different locations, then we create a webservers label as a parent label and listing webservers according to the location as a childs of that parent label





Ansible variables:

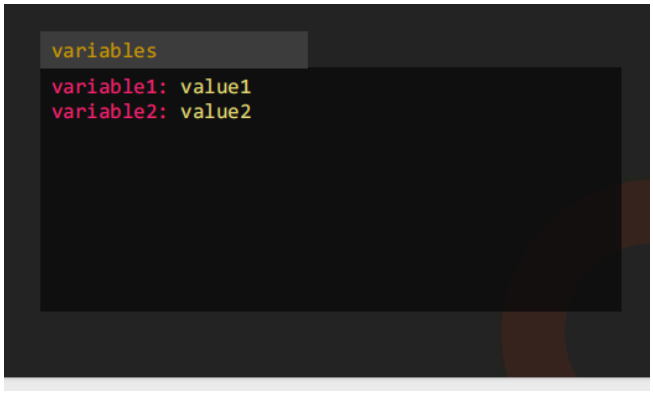
Variable stores, hostnames, username, password info

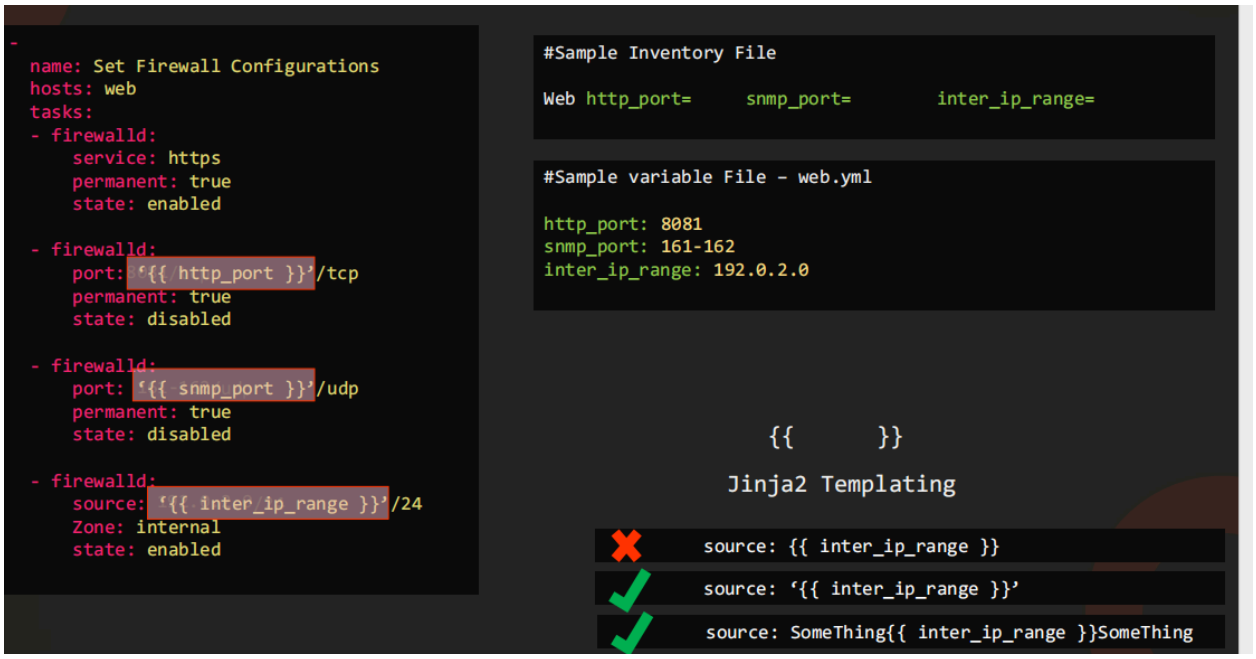


We can add vars in playbook like:

Name: Add DNS server to resolv.config
hosts:.....
Vars :
dns_server=10.1.250.10
tasks:
……..

Or we can add an another variables file separately and add variables into it:





1. We can add the variables in the inventory file and can fetch it to our playbook
2. We can also create a variable file -web.yml and add all the variables and values to that variables into that file as shown in above picture

This format of using variables in play books is called jinja2 templating.
In jinja2 technique we use :

'{{variable_name}}' ⇒ correct
{{variable_nme}} ⇒ wrong

If we mention the variable in between the sentence:

{{variable_name}} ⇒ correct

Variable types:

1. String: sequence of chars
2. Number variables: integer, float
3. Boolean: true or false
4. list
5. Dictionary

Variable presidency;

What if variable defined in two different places like a group variable in inventory file and as host variable

Example:this is the **inventory file**

```
Web1 ansible_host=172.20.1.100
Web1 ansible_host=172.20.1.102   dns_server=11.2.3.2   # declaring the dns server at the host
Web1 ansible_host=172.20.1.103

[web_servers]
web1
web2
web3

[web_servers:vars]    #group variable
dns_server=10.5.5.3
```

Defining Inside the Playbook:

```
—
  - name: configuring dns
    host: all
    var:
        dns_server:10.5.5
    tasks:
    - nsupdate:
          Server: '{{dns_server}}'
```

Precedency:

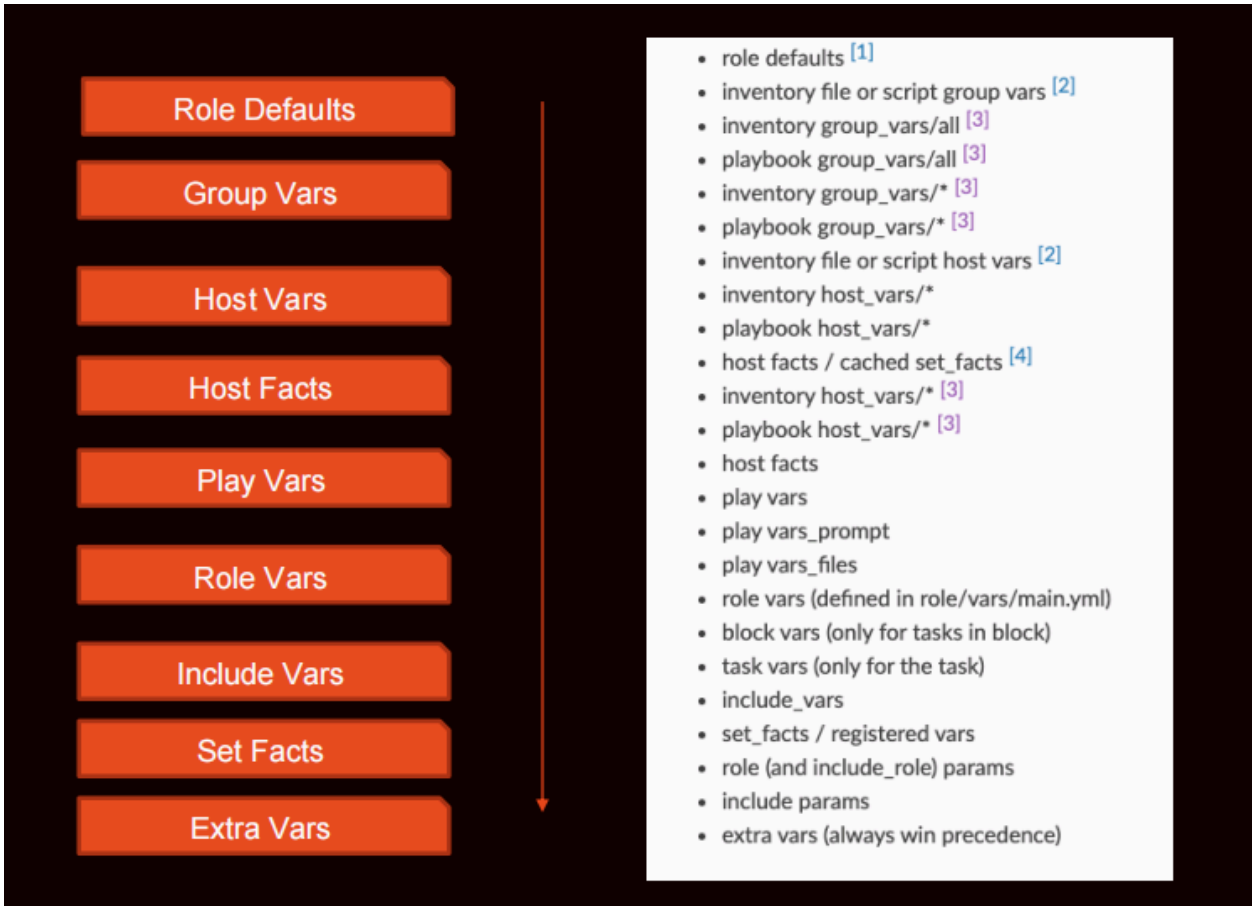
1. Group vars
2. Host vars
3. Play level
4. Extra vars option

Group var has lowest precedence
Extra var has highest precedence

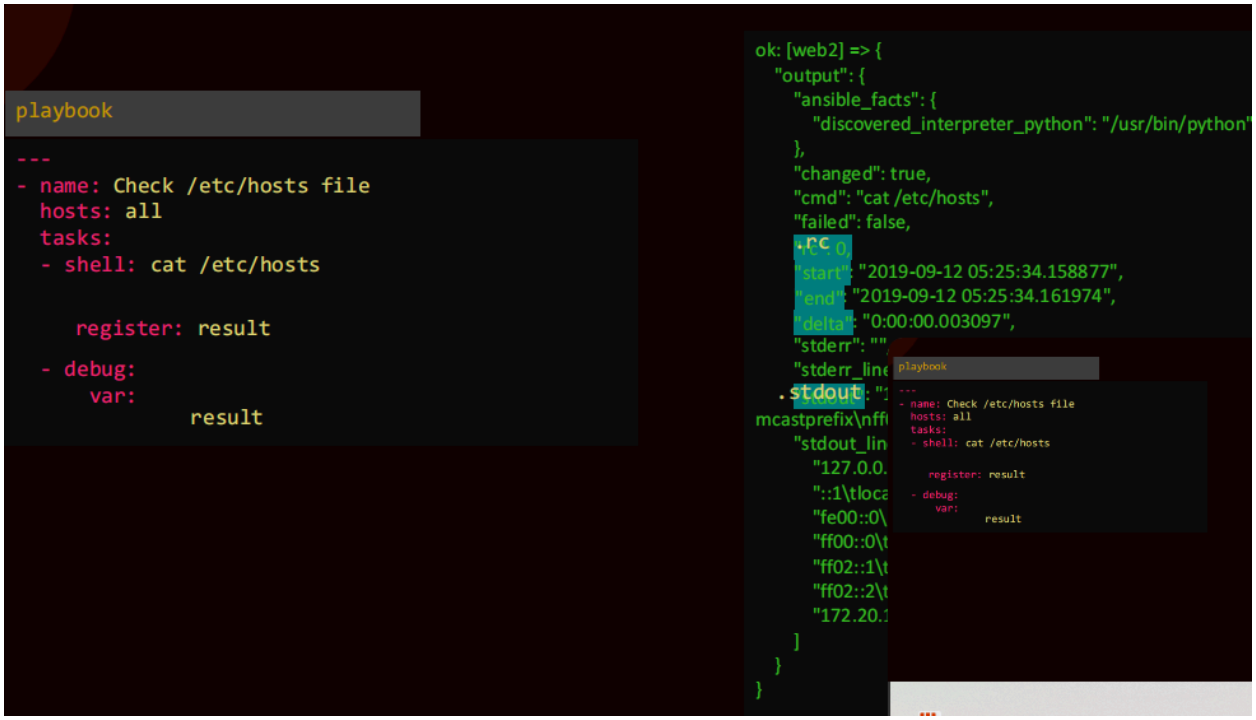
Priority increases from top to bottom, 1st it checks group var and take the value of group var if there is host var then that values is replaced with host var values and so on

Extra vars:

ansible-playbook playbook.yml –extra-vars “dns_server=10.5.5.6”



Register variable:



By using a register variable we can store the output of one task as a result and we can use that result later.

- debug:
  var: result

Result shows:

1. Here return code specified by rc , will be zero if command run successfully, if command does not run successfully then rc value will be other than zero.
2. It also shows start time and end time of command

If we want to view the task in another method without debug module , then we can pass -v option while running playbook:

Ansible-playbook -i inventory playbook.yml -v

<u>Variable scoping:</u>

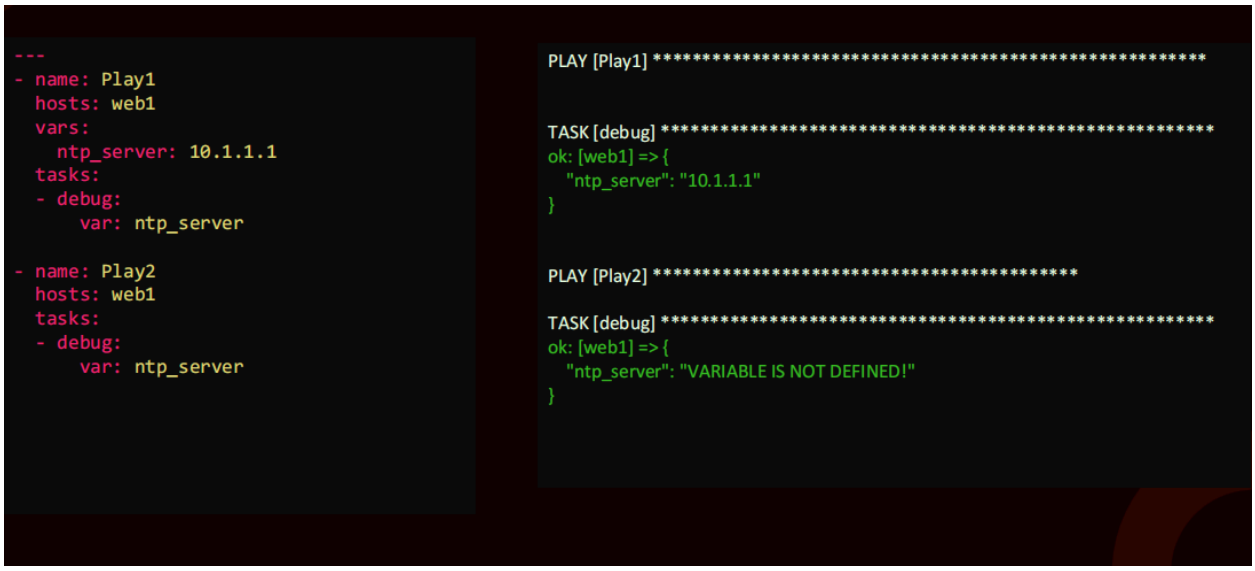
Accessibility or visibility of that variable

1. **Host scope:** if variable is defined at that host line that is accessed by that one host , not other hosts:

Eg:
web1 ansible_host=123.23.2.100
web2 ansible_host=123.23.2.102 dns_server=10.5.5.4

Here dns_server variable is applicable for only web2 host, dns_server here is a host variable.

2. **Play scope : Group variable or group of group variable**
   Here ntp_server is defined in play 1 not in play 2 so that, that ntp_server variable value does not applicable to play2



3. **Global variable**: that can be accessed throughout the playbook execution.

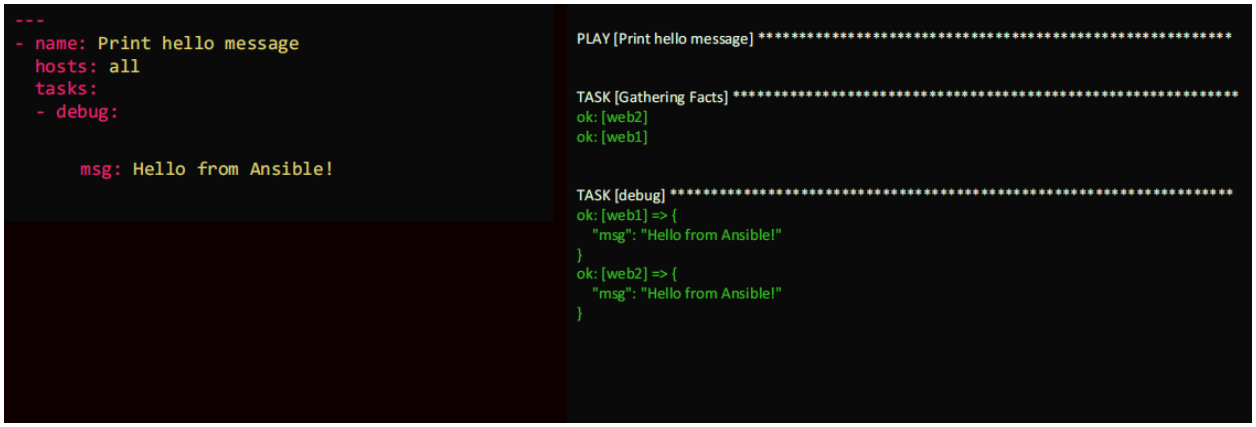
   ansible-playbook playbook.yml -- extra-vars “ntp_server=10.1.1.1.”

Ansible facts:

When ansible connects to the target machine, it first collects the information about the machine about its system information, architecture, os, processor details, host network connectivity, ip address, mac address these all information is called as **facts**.

Ansible gathers all this facts by using setup module, setup module is runned automatically by ansible, it gather facts of that hosts when you run the playbook, even if u not use this module in the playbook

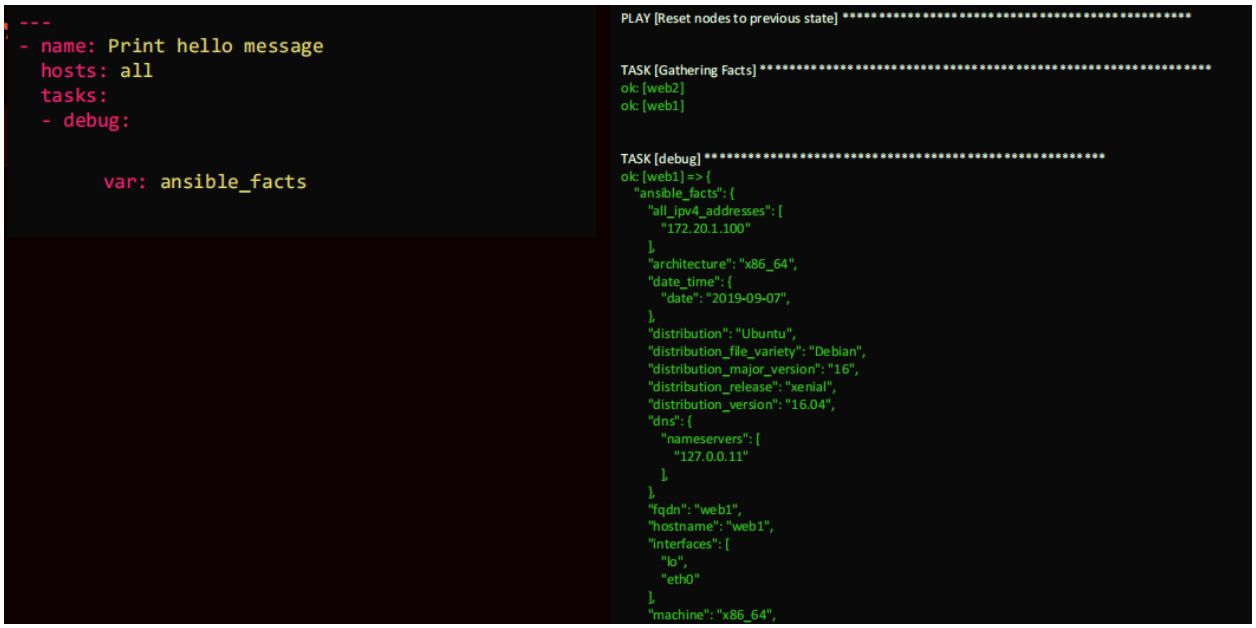
Below is a playbook to print a hello message by using debug. It does 2 tasks , 1st task is to gather the facts this gathering is done by setup module, 2nd task is to print that message



```
---
- name: Print hello message
  hosts: all
  tasks:
  - debug:

      msg: Hello from Ansible!
```

```
PLAY [Print hello message] ***************************************************

TASK [Gathering Facts] *******************************************************
ok: [web2]
ok: [web1]

TASK [debug] *****************************************************************
ok: [web1] => {
    "msg": "Hello from Ansible!"
}
ok: [web2] => {
    "msg": "Hello from Ansible!"
}
```

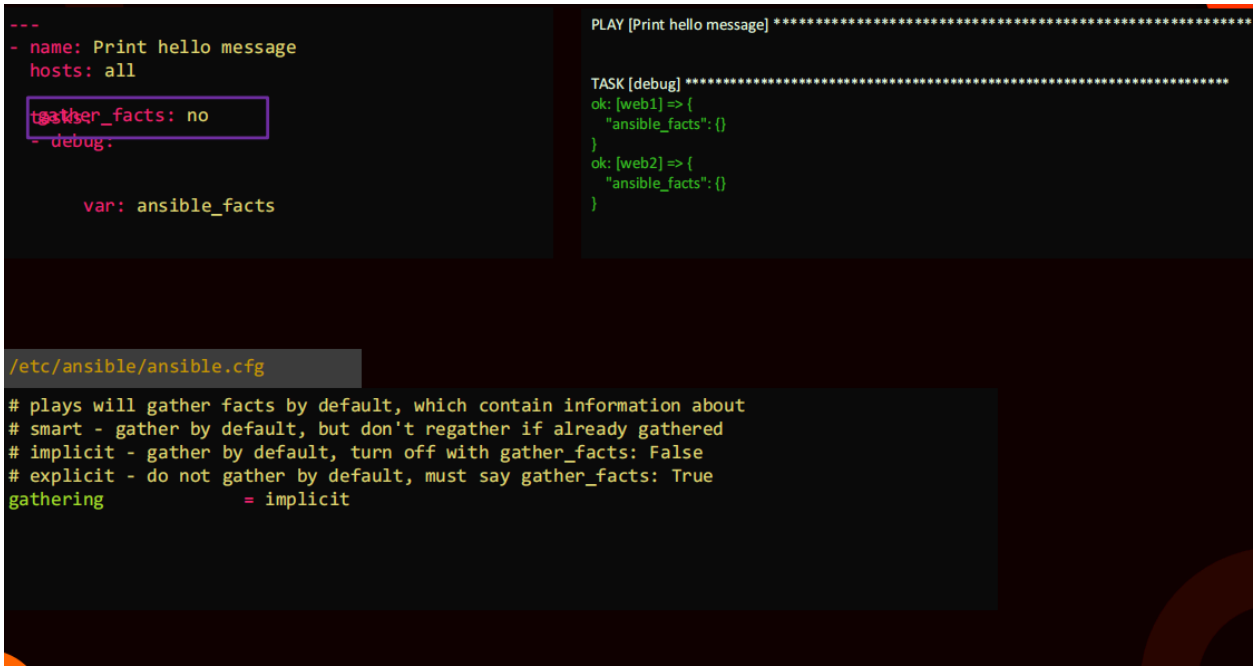
Ansible stores all the facts in **ansible_facts** variable, for displaying what are the facts gathered by ansible_facts we display that ansible_facts by using debug as follows:



```
---
- name: Print hello message
  hosts: all
  tasks:
  - debug:

      var: ansible_facts
```

```
PLAY [Reset nodes to previous state] *****************************************

TASK [Gathering Facts] *******************************************************
ok: [web2]
ok: [web1]

TASK [debug] *****************************************************************
ok: [web1] => {
    "ansible_facts": {
        "all_ipv4_addresses": [
            "172.20.1.100"
        ],
        "architecture": "x86_64",
        "date_time": {
            "date": "2019-09-07",
        },
        "distribution": "Ubuntu",
        "distribution_file_variety": "Debian",
        "distribution_major_version": "16",
        "distribution_release": "xenial",
        "distribution_version": "16.04",
        "dns": {
            "nameservers": [
                "127.0.0.11"
            ],
        },
        "fqdn": "web1",
        "hostname": "web1",
        "interfaces": [
            "lo",
            "eth0"
        ],
        "machine": "x86_64",
```

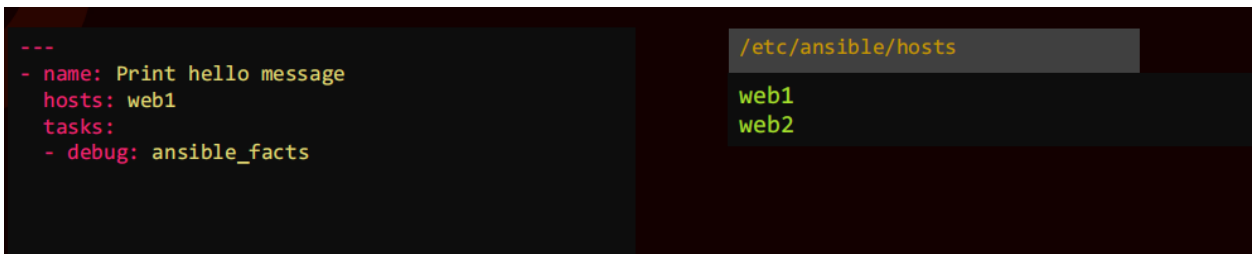
If we dont want to gather the facts by ansible_facts we can turn it off by using **gather_facts : no** in the playbook, by default it is said to implicit , means to gather info automatically, we are turning off now.



Above playbook code:

name:...
hosts:...
gather_facts:no
tasks:
- debug:
var: …

⇒ Ansible only gathers the facts against the hosts that are part of playbook, if we have an inventory file with 2 hosts web1 and web2 and in ansible playbook that targets only on the web1 then the ansible only gathers the facts of only web1 not web2.
⇒ If we don't have facts of host, then in that case that host is not targeted in the playbook so that ansible not gathered that host facts



Precedence:
What if changing the value of variable in two places in playbook and in config file, then playbook take the precedency

==========

Practice sessions:

Q: Adding servers into the list in the inventory file:

Ans:
server1.company.com
server2.company.com
server3.company.com
==========
Q: Adding alias names to db servers and web servers:

Sample Inventory File

web1 ansible_host=server1.company.com
web2 ansible_host=server2.company.com
web3 ansible_host=server3.company.com
db1 ansible_host=server4.company.com
~
Q: adding a server alias name and host details, connection details etc as follows:

```
-------------------------------------------------------------------------------------------
|  Alias |        HOST         | Connection | User          | Password     |
-------------------------------------------------------------------------
|  web1  | server1.company.com |    ssh     | root          | Password123! |
-------------------------------------------------------------------------
|  web2  | server2.company.com |    ssh     | root          | Password123! |
-------------------------------------------------------------------------
|  web3  | server3.company.com |    ssh     | root          | Password123! |
-------------------------------------------------------------------------
|  db1   | server4.company.com |    winrm   | administrator | Dbp@ss123!   |
-------------------------------------------------------------------------------------------
```

Ans:

Sample Inventory File

Web Servers
web1 ansible_host=server1.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
web2 ansible_host=server2.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
web3 ansible_host=server3.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
db1 ansible_host=server4.company.com ansible_connection=winrm ansible_user=administrator ansible_password=Dbp@ss123!

==========

Q: adding a group for web servers as web_servers and similarly add an another group db_servers that contains list of database servers:

Ans: # Sample Inventory File

Web Servers
web1 ansible_host=server1.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
web2 ansible_host=server2.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
web3 ansible_host=server3.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!

Database Servers
db1 ansible_host=server4.company.com ansible_connection=winrm ansible_user=administrator ansible_password=Password123!

[web_servers]
web1
web2
web3

[db_servers]
db1

==========
Q: Create a new group called `all_servers` and add the previously created groups `web_servers` and `db_servers` under it.

[parent_group:children]
child_group1
child_group2

Ans: # Sample Inventory File

Web Servers
web1 ansible_host=server1.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
web2 ansible_host=server2.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!
web3 ansible_host=server3.company.com ansible_connection=ssh ansible_user=root ansible_ssh_pass=Password123!

Database Servers
db1 ansible_host=server4.company.com ansible_connection=winrm ansible_user=administrator ansible_password=Password123!

[web_servers]
web1
web2
web3

[db_servers]
db1

[all_servers:children]
web_servers
db_servers

==========

Q: Update the `/home/bob/playbooks/inventory` file to represent the data given in the below table in Ansible Inventory format.

Server Alias	Server Name	OS	User	Password
sql_db1	sql01.xyz.com	Linux	root	Lin$Pass
sql_db2	sql02.xyz.com	Linux	root	Lin$Pass
web_node1	web01.xyz.com	Win	administrator	Win$Pass
web_node2	web02.xyz.com	Win	administrator	Win$Pass
web_node3	web03.xyz.com	Win	administrator	Win$Pass

Group the servers together based on this table:

Group	Members
db_nodes	sql_db1, sql_db2
web_nodes	web_node1, web_node2, web_node3
boston_nodes	sql_db1, web_node1
dallas_nodes	sql_db2, web_node2, web_node3
us_nodes	boston_nodes, dallas_nodes

Ans:

Sample Inventory File

Web Servers

```
web_node1 ansible_host=web01.xyz.com ansible_connection=winrm
ansible_user=administrator ansible_password=Win$Pass
web_node2 ansible_host=web02.xyz.com ansible_connection=winrm
ansible_user=administrator ansible_password=Win$Pass
web_node3 ansible_host=web03.xyz.com ansible_connection=winrm
ansible_user=administrator ansible_password=Win$Pass

# DB Servers
sql_db1 ansible_host=sql01.xyz.com ansible_connection=ssh ansible_user=root
ansible_ssh_pass=Lin$Pass
sql_db2 ansible_host=sql02.xyz.com ansible_connection=ssh ansible_user=root
ansible_ssh_pass=Lin$Pass

[db_nodes]
sql_db1
sql_db2

[web_nodes]
web_node1
web_node2
web_node3

[boston_nodes]
sql_db1
web_node1

[dallas_nodes]
sql_db2
web_node2
web_node3

[us_nodes:children]
boston_nodes
dallas_nodes
```

==========

Magic variables:

1. **hostvars**
2. **Groups**

3. **Group_names**
4. **inventory_hostname**

Hostvars - magic variable:

1. When we write the alias to some hosts, ansible 1st creates the sub process to each host
2. Undergoes variable interpolation where it picks the variables from different sources and associates to their respective hosts
3. Here the dns server is defined only for web2 ,not defined for web1 and web3

4. How can web1 and web3 get the dns server ip address specified to web2 host, it is done by using **magic variables**

   '{{hostvars['web2'].dns_server}}'

5. To get the hostname or ip address of other host then use ansible_host:

   '{{hostvars['web2'].ansible_host}}'

6. If we want to access the facts(like architecture,devices,mounts) of other hosts we use the following:

‘{{hostvars[‘web2’].ansible_facts.architecture}}’

‘{{hostvars[‘web2’].ansible_facts.devices}}’

‘{{hostvars[‘web2’].ansible_facts.mounts}}’

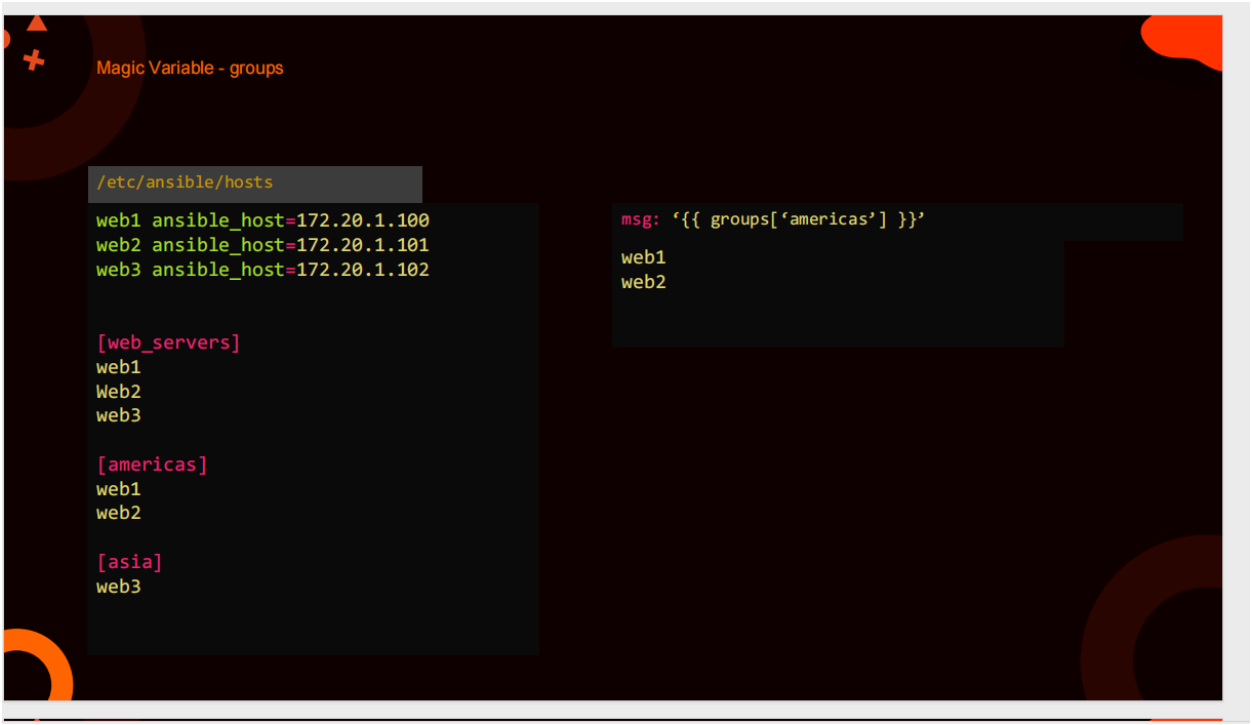
‘{{hostvars[‘web2’].ansible_facts.processor}}’

7. Instead of above line we can also write as follows :

   ‘{{hostvars[‘web2’][‘ansible_facts’][processor’]}}’

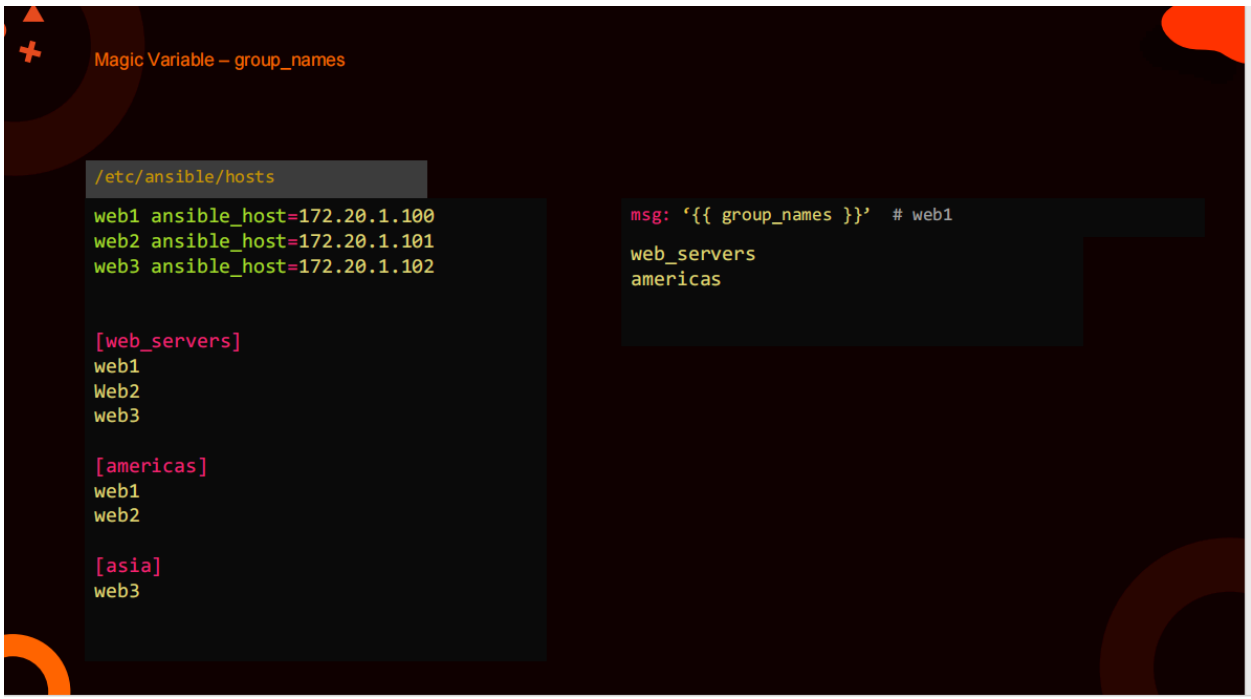
Groups - magic variable:

1. Groups return all the hosts under the given group.



Group_names - magic variable:

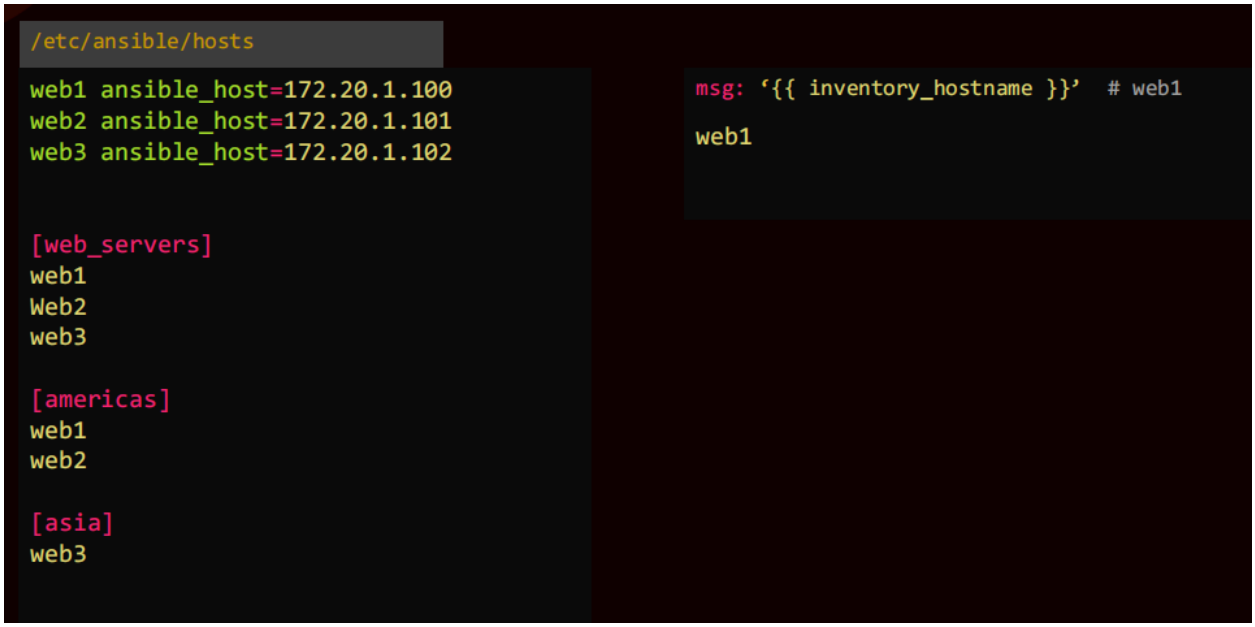
It displays all group names where the particular host is part of(or)
It returns all the group names the current host is part of



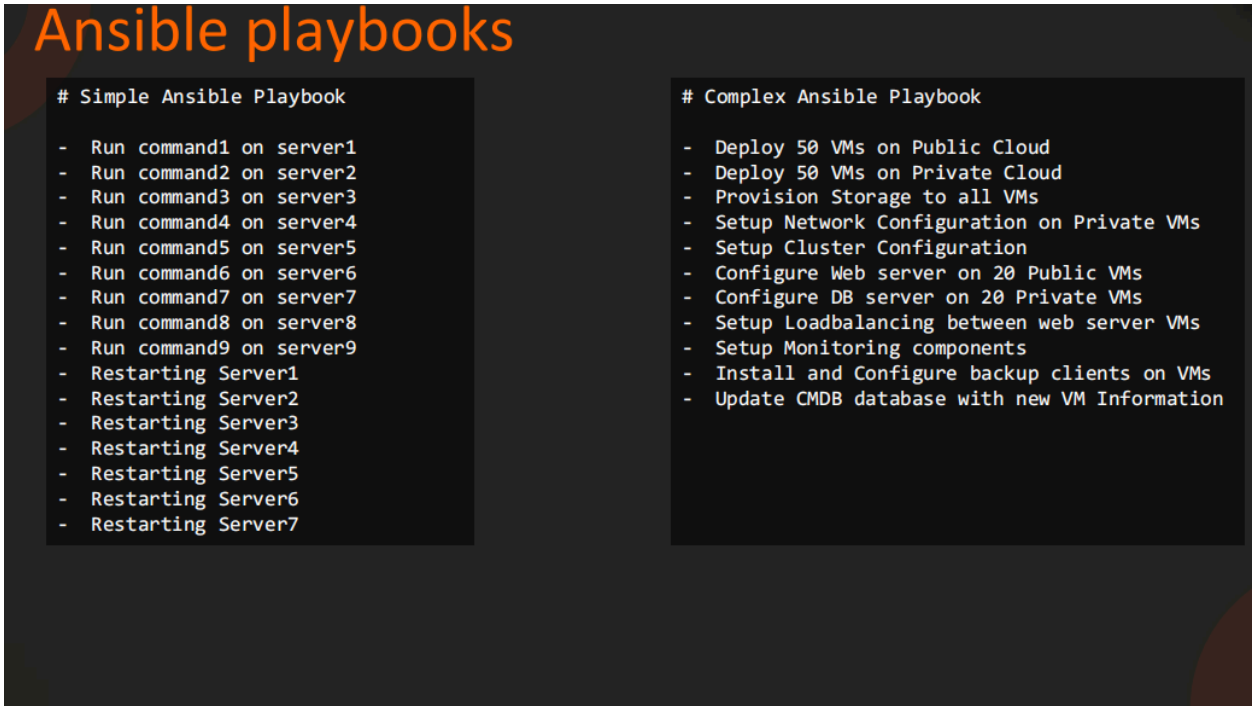
Here the above picture shows that, displaying the group names where the host1 is present

Inventory_hostname - magic variable:

It gives you the name configured for the host in the inventory file and not the hostname or SQDN



Ansible playbooks: It is set of instruction to the ansible what to do



1. Playbooks are written YAML format
2. A playbook is a single YAML file that contains set of plays
3. A play is the set of tasks to be done on the hosts
4. Task is the action like execute the command, run the script, install a package, shutdown/restart

Here are some sample playbooks contains:

Name, host, tasks are properties of dictionary and order of it doesn't matter , we can swap name and host

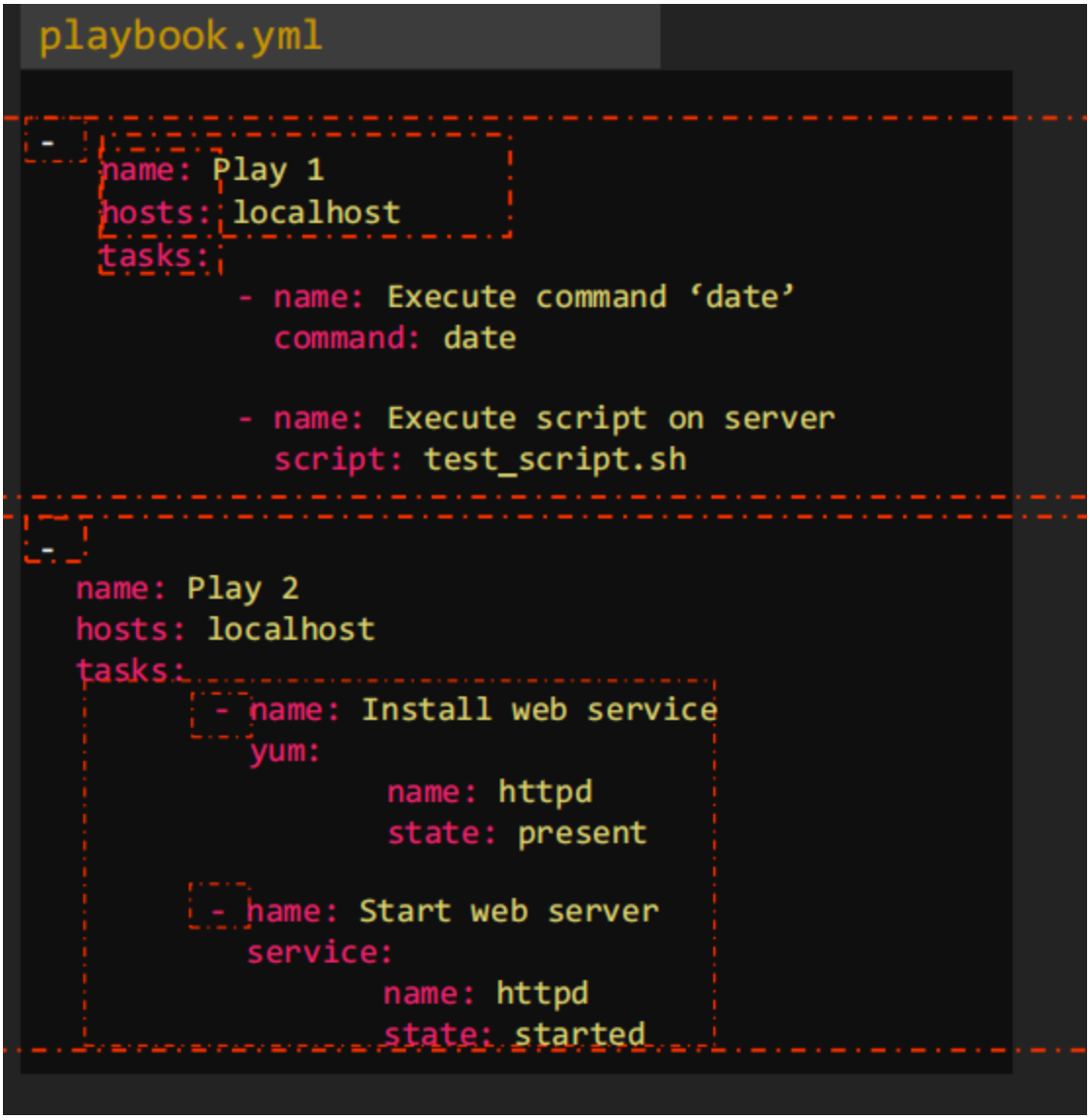
Name: contains play,
hosts: tells where the task should be done like in which server,
Tasks: we should write the actions that to be performed

1. playbook.yml

```
-
  name: Play 1
  hosts: localhost
  tasks:
   - name: Execute command 'date'
     command: date

   - name: Execute script on server
     script: test_script.sh

   - name: Install httpd service
     yum:
      name: httpd
      state: present

   - name: Start web server
     service:
      name: httpd
      state: started
```

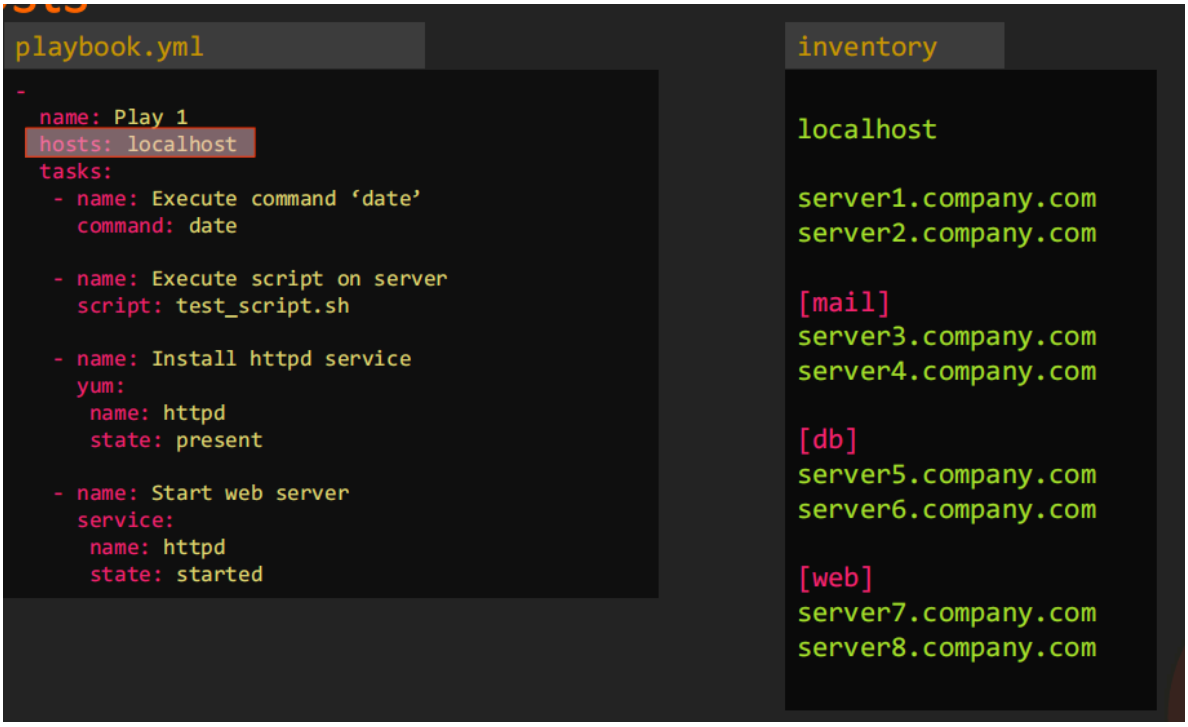
Above playbook contains only one play, the tasks should be done in the local host and tasks are displaying date, executing the test_script.sh and installing the httpd service and restarting the server

2. playbook.yml



In the 2nd YAML file it contains 2 plays, written as a list, so that the playbook is list dictionaries, each play is a dictionary and set of properties like name, host, tasks.

Order of hosts and name can be swapped
But order of the list cant be swapped

3. 

In above playbook and inventory file, it is mandatorily to specify the host where we need to perform the tasks, in inventory file 1st we have to mention the host name where we need to perform tasks in the first line

Before mentioning the host in playbook , we should ensure that the hosts should present in the inventory file we created earlier

hosts defined in the inventory file must match the host used in the playbook and all connection information can be retrieved from the inventory file

Modules:

Different actions run by tasks is called as modules

In the above case like in 3rd playbook, we can say the following as the modules: Command, script, yum, service

There are so many modules: to know about all modules we use following command **ansible-doc-l**

To execute the playbook

Syntax:
ansible-playbook <playbook file name>
Eg: ansible-playbook playbook.yml
ansible-playbook --help

Verifying the playbooks:
Why?

Verifying the playbook is a critical step before deploying updates to production, ensuring that the Ansible automation functions correctly. If it doesn't run properly, it could lead to serious consequences such as system shutdowns and data loss, which may be irreversible.

How:

1. Check mode
2. Diff mode