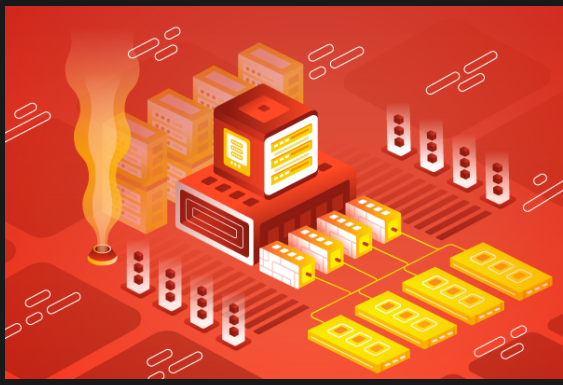
Red Hat Certified Engineer (RHEL 8 RHCE)

Course Navigation



Linux Academy

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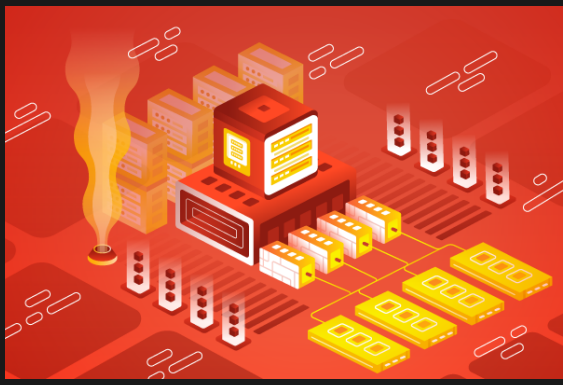

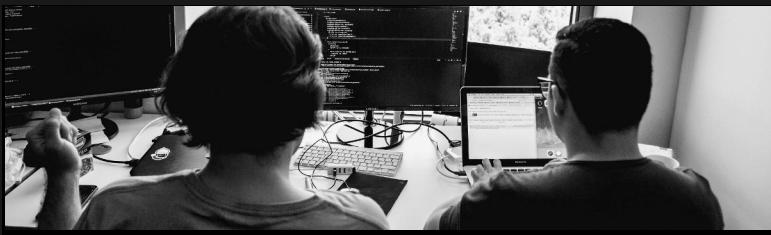

Welcome to the Linux Academy **Red Hat Certified Engineer (RHEL 8 RHCE)** course.

This course is designed to prepare you to sit and pass the Red Hat Certified Engineer exam (EX294).

As of the creation of this course, there are two versions of the Red Hat Certified Engineer exam - one for Red Hat Enterprise Linux 7 (EX300) and one for Red Hat Enterprise Linux 8 (EX294). This course was created based on the objectives of the RHEL 8 version of the exam which is EX294.

This diagram will be used as a reference point throughout the course and can be used as a study guide as you prepare for the exam.

This course was split up, Rob creating all of the labs, and me teaching the lessons. We thank you for taking this course and look forward to working through the material with you!

Matthew Pearson
Rob Marti

Linux Academy Training Architects

Next

Exam Format

- It is a hands-on exam that requires you to perform real-world tasks.
- You will have four hours to complete the exam.
- You will be given multiple systems and must install and configure Ansible in order to perform system administration tasks.
- Your work will be evaluated by running the playbooks created in the exam against fresh systems.
- Internet access will not be provided and candidates are not allowed to bring physical or electronic documentation or notes.
- Exam results are usually reported within 3 days.

The exam objectives can be viewed here:

Exam Objectives

Topics in this section include:

Understanding and using the basic tools for an operating system is essential to administering that system. In this section, we will review these tools and show examples of how to use these on a Red Hat Enterprise Linux 8 host.

- **Log into a Remote Server via SSH**
- **Create Files and Directories**
- **Input/Output Redirection**
- **View and Analyze Text**
- **Archive Files and Directories**
- **Escalate Privileges**
- **File and Directory Permissions**
- **System Documentation**

- **Log into remote server:** `ssh user_name@host`
- **Log out of host:** `exit`

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- **Create directory:** `mkdir <directory_name>`
- **Create file:** `touch file` **or** `vi file`
- **Remove directory:** `rm -r directory` **or** `rmdir (for empty directory)`
- **Remove file:** `rm file`

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- **Standard output (STDOUT):** >, >>
- **Standard input (STDIN):** <, <<
- **Standard error (STDERR):** 2>, 2>>
- **Pipes :** |

Back

- View with text editor: `vi file`
- Print file contents to STDOUT: `cat`
- Print lines matching a pattern: `grep`

Back

- **Compression options: gzip, bzip, xz, etc.**
- **Create archive:**
  `tar -cvzf archive_name file1 file2`
- **Extract archive:**
  `tar -xvzf archive.gz`

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- **Become the** `root` **user:** `sudo -i` **or** `sudo su -`
- **Run command as root user:** `sudo command`

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- **Change ownership:** `chown user:group file`
- **Change permissions (numeric):** `chmod 764 file`
- **Change permission (symbolic):** `chmod u+rw file`
- **Special permissions:** `setuid` (`4` **or** `u+s`), `setgid` (`2` **or** `g+s`), `sticky bit` (`1` **or** `a+t`)

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- **man pages:** `man command` **or** `man section command`
- **info:** `info command`
- `/usr/share/doc`
- **apropos:** `apropos command` **or** `man -k command`

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Shut down and Reboot Systems

- `systemctl poweroff`
- `systemctl reboot`
- `systemctl --help | man systemctl`

Interrupt Boot Process and Change the `root` Password

1. **Edit** the kernel boot parameters by pressing **e**
2. **Go to** the end of the "linux" line by pressing **Ctrl+e**, removing `ro crash` and add `rd.break enforcing=0`
3. **Start** the system by pressing **Ctrl+x**
4. **Remount** the root of the system:
   `mount -o remount,rw /sysroot`
5. **Switch** to `/sysroot`:
   `chroot /sysroot`
6. **Reset** the `root` password:
   `passwd`
7. **Enable** SELinux relabeling:
   `touch /.autorelabel`
8. **Exit** the shell:
   `exit`

Start, Stop, and Check Network Service Status

- Check the status of a service:
  `systemctl status service_name.service`
- Start a service:
  `systemctl start service_name.service`
- Stop a service:
  `systemctl status service_name.service`
- Gain more information:
  `journalctl -xe`

View Processes and Resource Utilization

- Print a list of active process:
  `ps -ef`
- View real-time list of processes and resource utilization:
  `top`
- Terminate a running process:
  `kill -15, kill -9, kill -l`

Copy Files Between Remote Systems

- Secure Copy:
  `scp file_name user_name@server:/path/to/dir`
- Secure FTP:
  `sftp user_name@server`

List Storage Devices:

- `df`
- `lsblk`
- `blkid`
- `fdisk -l`

Create a Partition:

1. Use `fdisk` to manipulate partition table:
   `fdisk /dev/device_name`
2. Use **p** to print the partition table and **o** to create a DOS (MBR) partition table.
3. Use **n** to create a new partition.
4. Set it as a primary partition using **p** and accept the defaults for partition number, first sector, and last sector.
5. List partition types using **l**. Change the partition type to Linux LVM (8e) using **t**.
6. Write the table to disk using **w**.

Create an LVM Logical Volume:

1. Create physical volume:
   ```
   pvcreate /dev/device_name
   ```
2. List physical volumes:
   ```
   pvs
   ```
3. Create volume group:
   ```
   vgcreate vol_group /dev/device_name
   ```
4. List volume groups:
   ```
   vgs
   ```
5. Create logical volume:
   ```
   lvcreate -L 1G -n new_lv vol_group
   ```
6. List logical volumes:
   ```
   lvs
   ```

Delete a Logical Volume, Volume Group, and Physical Volume:

1. Delete logical volume:
   ```
   lvremove vol_group/new_lv
   ```
2. Delete volume group:
   ```
   vgremove vol_group
   ```
3. Delete physical volume:
   ```
   pvremove /dev/device_name
   ```

Creating and Mounting File Systems

1. Create a file system on a logical volume: `mkfs.ext4 /path/to/lv`
2. Mount a file system: `mount /path/to/lv /path/to/dir`
3. List mounted file systems: `df -h`
4. Add mount information to `/etc/fstab` for boot persistence:
   ```
   UUID=UUID_NUMBER /mount/point
   fs_type defaults 0 0
   ```

Extend Logical Volumes

1. Increase underlying logical volume: `lvextend -L +500M /dev/vol_grp/log_vol`
2. Unmount filesystem: `umount /path/to/mount`
3. Run file system check: `e2fsck -f /dev/vol_grp/log_vol`
4. Resize file system: `resize2fs /dev/vol_grp/log_vol`
5. List mounted file systems: `df -h`

Mount a Network File Systems

1. Install required packages:
   `yum install nfs-utils`
2. Start required services:
   `systemctl start rpcbind`
3. Show file system exports on the client:
   `showmount -e SERVER_IP`
4. Mount a network file system: `mount -t nfs SERVER_IP:/server/dir /client/dir`

Create Collaborative Directories with set-GID

1. Create directory: `mkdir /new/dir`
2. Configure set-GID on directory:
   `chmod g+s /new/dir`
3. Create file in new directory:
   `touch /new/dir/newFile`

Working with Virtual Data Optimizer (VDO)

1. Install required packages: yum install vdo
2. Create a vdo volume: `vdo create --name=vdo_vol --device=/dev/devName --vdoLogicalSize=vol_size`
3. View information on vdo volumes:
   `vdostats --hu`

Start, Stop, and Enable Services

- View yum repositories:
  `ls -a /etc/yum.repos.d`
- Install packages: `yum install packageName`
- Start a service:
  `systemctl start name.service`
- Enable a service:
  `systemctl enable name.service`
- Stop a service: `systemctl stop name.service`

Schedule Tasks Using `at` and `cron`

- View the crontab: `cat /etc/crontab`
- Add a task to a user crontab: `crontab -e`
- List tasks in a user's crontab: `crontab -l`
- Schedule a task using the at command: `at time`
- List the scheduled jobs: `atq`
- Delete a job: `atrm job_num`

Configure Systems to Boot into Specific Target Automatically

- Check the current configuration:
  `systemctl get-default`
- Change the current target:
  `systemctl isolate name.target`
- Set the default configuration:
  `systemctl set-default name.target`
- Change target to rescue mode:
  `systemctl rescue`

Configure Time Service Client

1. Install required packages: `yum install chrony`
2. Start and enable the chronyd service:
   `systemctl start chronyd && systemctl enable chronyd`
3. Add the NTP server (server SERVER_IP) address to /etc/chrony: `vi /etc/chrony`
4. Restart the chronyd service:
   `systemctl restart chronyd`

Create, Delete, and Modify Local Users

- View user information:
  ```
  id username
  groups username
  /etc/passwd
  /etc/shadow
  /etc/group
  ```
- Create a user: `useradd username`
- Modify a user: `usermod -d -aG -L -U`
- Delete a user: `userdel username`

Change Passwords

- Change a password: `passwd username`
- View password expiry information:
  `chage -l username`
- Set password expiration by max days:
  `chage -M days username`
- Set password expiration by date:
  `chage -E YYYY-MM-DD username`

Create, Delete, and Modify Groups

- View group information:
  ```
  id username
  groups username
  /etc/passwd
  /etc/shadow
  /etc/group
  ```

- Create a group: `groupadd groupname`
- Add user to a group: `usermod -g -aG`
- Modify a group: `groupmod -n -g`
- Delete a group: `groupdel groupname`

Configure Superuser Access

- View the `sudoers` file: `vi /etc/sudoers`
- Edit the `sudoers` file: `visudo`
- Grant a user `sudo` access by adding the following line to `/etc/sudoers`:
  ```
  username    ALL=(ALL)    ALL
  ```
- Grant members of a group `sudo` access by adding the following line to `/etc/sudoers`:
  ```
  %groupname    ALL=(ALL)    ALL
  ```

Configure Firewall Settings

- Install firewalld: `yum install firewalld`
- Start and enable firewalld:
  `systemctl start firewalld && systemctl enable firewalld`
- View `firewall-cmd` options:
  `firewall-cmd -h | man firewall-cmd`
- List zones: `firewall-cmd --get-zones (--get-default-zone)`
- List everything added for or enabled in a zone:
  `firewall-cmd --list-all --zone=public`
- Add a service for a zone:
  `firewall-cmd --add-service=service (--permanent)`
- Add a port for a zone:
  `firewall-cmd --add-port=port/protocol (--permanent)`
- Reload firewall rules: `firewall-cmd --reload`

Configure Key Based Authentication for SSH

- Generate public and private key pair: `ssh-keygen`
- Copy a public key to a remote server:
  `ssh-copy-id username@remote_host`
- Default public/private key location:
  `/home/username/.ssh/`

Working with SELinux

- View SELinux modes: `getenforce`
- Set mode to permissive or enforcing:
  `setenforce 0 | 1`
- List booleans: `getsebool -a`
- Turn booleans on or off:
  `setsebool boolean on | off`
  `(-P for permanent)`
- List SELinux contexts: `semanage fcontext -l`
- View context on files and process:
  `ls -Z | ps -axZ`
- Change SELinux context:
  `semanage fcontext -a -t context_type '/directory(/.*)?'`
- Restore default contexts:
  `restorecon -R /directory`
- View SELinux policy violations:
  `sealert -a /var/log/audit/audit.log`

Inventories are what Ansible uses to locate and run against multiple hosts.

- Default location of the hosts file: `/etc/ansible/hosts`
- The default location of the hosts file can be set in `/etc/ansible/ansible.cfg`.
- It can be specified using the `-i` option when running `ansible`.
- The file can contain individual hosts, groups of hosts, groups of groups, and host and group level variables.
- It can also Can contain variables that determine how you connect to a host.

INI-based inventory file:

```
mail.example.com

[webservers]
web01.example.com
web02.example.com

[dbservers]
db[01:04].example.com
```

Understand Core Components of Ansible

Inventories

YAML-based inventory file:

```
all:
  hosts:
    mail.example.com
  children:
    webservers:
      hosts:
        web01.example.com
        web02.example.com
    dbservers:
      hosts:
        db[01:04].example.com
```

Understanding Modules

- Modules are essentially tools for particular tasks.
- Modules can take, and usually do take, parameters.
- Modules return JSON.
- Run modules from the command line or within a playbook.
- Ansible ships with a significant amount of modules by default.
- Custom modules can be written.

Understanding Variables in Ansible

- Variables names should only contain letters, numbers, and underscores.
- Variables should always start with a letter.
- There are three main scopes for variables:
  - Global
  - Host
  - Play

- They are typically used for configuration values and various parameters.
- Variables can store the return value of executed commands.
- Variables may also be dictionaries.
- Ansible provides a number of predefined variables.

Example of Host Level Variables:

```
INI format:

[webservers]
host1 http_port=80 maxRequestsPerChild=500
host2 http_port=305 maxRequestsPerChild=600

YAML format:

webservers:
  host1:
    http_port: 80
    maxRequestsPerChild: 500
  host2:
    http_port: 305
    maxRequestsPerChild: 600
```

Understanding Ansible Facts

- Facts provide certain information about a given target host.
- Facts are automatically discovered by Ansible when it reaches out to a host.
- Facts can be disabled.
- Facts can be cached for use in playbook executions.

```
[cloud_user@mspearson4c ansible]$ ansible -i inv.ini
mspearson2c -m setup

mspearson2c | SUCCESS => {
    "ansible_facts": {
        "ansible_all_ipv4_addresses": [
            "172.31.101.166",
            "192.168.122.1"
        ],
        "ansible_all_ipv6_addresses": [
            "2600:1f18:502:2f01:a37b:b7b5:61a6:3659",
            "fe80::835:c7ff:fe1d:f35e"
        ],
        "ansible_apparmor": {
            "status": "disabled"
        },
        "ansible_architecture": "x86_64",
        "ansible_bios_date": "10/16/2017",
        "ansible_bios_version": "1.0",
        "ansible_cmdline": {
            "BOOT_IMAGE":
"(hd0,msdos2)/boot/vmlinuz-4.18.0-80.7.2.el8_0.x86_64",
            "console": "tty0",
```

Understanding Plays and Playbooks

- The goal of a play is to map a group of hosts to some well-defined roles.
- A play can consist of one or more tasks which make calls to Ansible modules.
- A playbook is a series of plays.

Example of an Ansible Playbook:

```
---
- hosts: webservers
  become: yes
  tasks:
  - name: ensure apache is at the latest version
    yum:
      name: httpd
      state: latest
  - name: write our custom apache config file
    template:
      src: /srv/httpd.j2
      dest: /etc/httpd/conf/httpd.conf
  - name: ensure that apache is started
    service:
      name: httpd
      state: started
- hosts: dbservers
  become: yes
  tasks:
  - name: ensure postgresql is at the latest version
    yum:
      name: postgresql
      state: latest
  - name: ensure that postgresql is started
    service:
      name: postgresql
      state: started
```

The Ansible Configuration File

- Possible locations of Ansible configuration files (in order processed):
  - `ANSIBLE_CONFIG` (environment variable)
  - `ansible.cfg` (in the current directory)
  - `~/.ansible.cfg` (in the home directory)
  - `/etc/ansible/ansible.cfg`
- A configuration file will not automatically load if it is in a world-writable directory.
- Configuration can be set in environment variables.

Common Ansible Configurations

- The `ansible-config` command can be used to view configurations:
  - `list` - Prints all configuration options
  - `dump` - Dumps configuration
  - `view` - View the configuration file
- Commonly used settings:
  - `inventory` - Specifies the default inventory file
  - `roles_path` - Sets paths to search in for roles
  - `forks` - Specifies the amount of hosts configured by Ansible at the same time (Parallelism):
  - `ansible_managed` - Text inserted into templates which indicate that file is managed by Ansible and changes will be overwritten.

Install Ansible Using YUM

- `sudo subscription-manager repos --enable ansible-2.8-for-rhel-8-x86_64-rpms` (if needed)

- `sudo yum install ansible`

Install Ansible from Source

1. `sudo yum install git`
2. `git clone --single-branch --branch stable-2.8 https://github.com/ansible/ansible.git`
3. `cd ansible/`
4. `source ./hacking/env-setup`
5. `pip2.7 install --user -r ./requirements.txt`

Test the installation:

```
ansible 127.0.0.1 -m ping
```

A Inventory Files

Ansible Inventory An inventory is a list of hosts that Ansible manages.

- Inventory files may contain hosts, patterns, groups and variables.
- Multiple inventory files may be specified using a directory.
- Inventory files may be specified in INI or YAML format.

Inventory Locations:

Default:
```
/etc/ansible/hosts
```

Specified by CLI:
```
ansible -i <filename>
```

Can be set in:
```
ansible.cfg
```

B Example Inventory Files

INI-based inventory file:

```
mail.example.com ansible_port=5556
ansible_host=192.168.0.20

[webservers]
web01.example.com
web02.example.com

[webservers:vars]
http_port=8080

[dbservers]
db[01:99].example.com
```

Inventory Variables Best Practices

1. Variables should be stored in YAML files located relative to the inventory file.
2. Host and group variables should be stored in the `host_vars` and `group_vars` directories respectively (directories must be created).
3. Variable files should be named after the host or group for which they contain variables (files may end in `.yml` or `.yaml`).

C Example Inventory Files

YAML-based inventory file:

```
---
all:
  hosts:
    mail.example.com
      ansible_port: 5556
      ansible_port: 192.168.0.20
  children:
    webservers:
      hosts:
        web01.example.com
        web02.example.com
      vars:
        http_port: 8080
    dbservers:
      hosts:
        db[01:99].example.com
```

D Groups of Groups

INI-based inventory file:

```
[east]
host1
host2

[west]
host3
host4

[usa:children]
east
west
```

YAML-based inventory file:

```
all:
  children:
    usa:
      children:
        east:
          hosts:
            host1:
            host2:
        west:
          hosts:
            host3:
            host4:
```

Default `ansible.cfg`

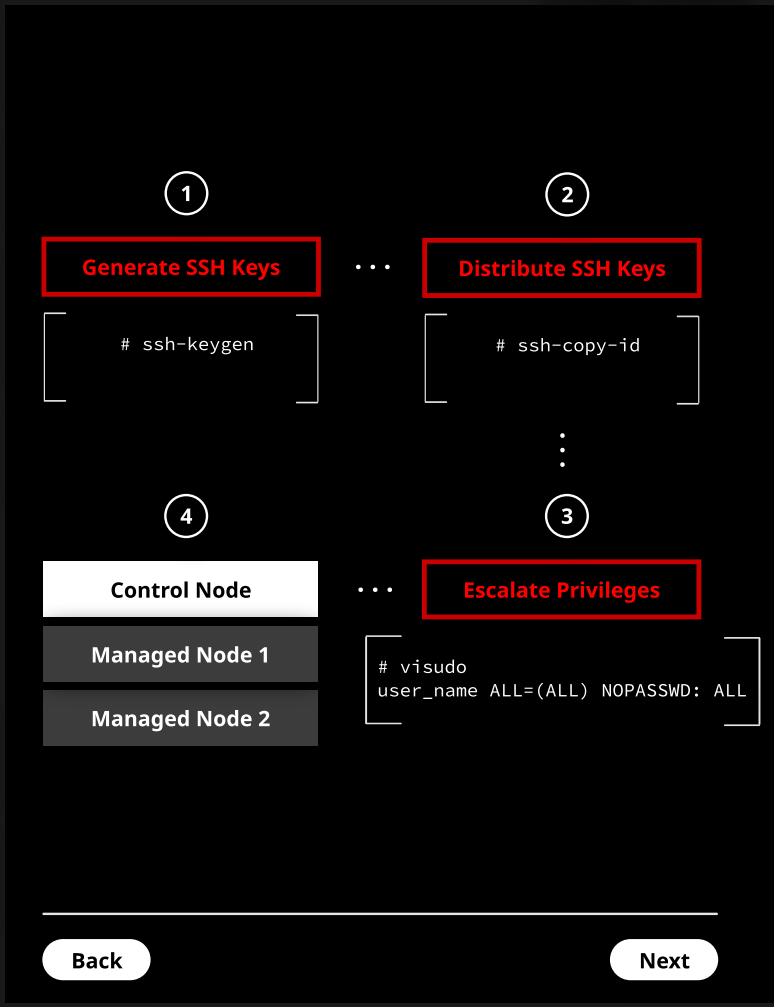
```
# config file for ansible -- https://ansible.com/
# ===============================================
# nearly all parameters can be overridden in
ansible-playbook
# or with command line flags. ansible will read
ANSIBLE_CONFIG,
# ansible.cfg in the current working directory,
.ansible.cfg in
# the home directory or /etc/ansible/ansible.cfg,
whichever it
# finds first
[defaults]
# some basic default values...
#inventory      = /etc/ansible/hosts
#library        = /usr/share/my_modules/
#module_utils   = /usr/share/my_module_utils/
#remote_tmp     = ~/.ansible/tmp
#local_tmp      = ~/.ansible/tmp
#plugin_filters_cfg = /etc/ansible/plugin_filters.yml
#forks          = 5
#poll_interval  = 15
#sudo_user      = root
#ask_sudo_pass = True
....
```

Order of preference for `ansible.cfg`:

- `ANSIBLE_CONFIG` (environment variable)
- `ansible.cfg` (in the current directory)
- `~/.ansible.cfg` (in the home directory)
- `/etc/ansible/ansible.cfg`

Configure Ansible Managed Nodes

Create and Distribute SSH Keys to Manage Nodes and Configure Privilege Escalation



Back to Main

Ansible Ad Hoc Command

Syntax:

```
ansible host -i inventory_file -m module
-a "arguments"
```

- They are used to execute quick one liners.
- They are useful for non-routine tasks.
- Execute them using the `ansible` command (`ansible-playbook` is used to execute playbooks).
- Arguments require double quotes and are space delimited.
- Commands are executed as the user running Ansible.
- Use the `-b` option to execute commands as the `root` user.
- The `-a` option may be used without the `-m` option to run shell commands.

Common Uses

- File transfer
- Package management
- User and group management
- Managing services
- Fact gathering
- General system information
- Software deployment from Git
- Playbook creation testing

Shell Scripts

- The first line must include `#!/bin/bash`.
- Comments can be added by using the # symbol.
- Execute permission needs to be added to the script.
- Execute the script using the absolute path or `./script.sh` (if the script is in your current directory).

Simple echo Script:

```
#!/bin/bash
# hello world script

echo “Hello world!!”
```

A for Loop:

```
#!/bin/bash

for i in {1..5}
do
   echo "Hello $i times!"
done
```

A case Statement

```
#!/bin/bash

echo -n "Enter the name of a state: "

read STATE

echo -n "The capital city of $STATE is "

case $STATE in
  Georgia)
    echo "Atlanta"
    ;;
  Virginia)
    echo "Richmond"
    ;;
  Texas)
    echo "Austin"
    ;;
  Maine)
    echo "Augusta"
    ;;
  *)
    echo "not in the database"
    ;;
esac
```

Shell Script with Ad Hoc Ansible Commands

```
#!/bin/bash

# Create the user matt

ansible mspearson3c.mylabserver.com -i inv -b -m
user -a "name=matt"

# Create the demo directory in matt's home
directory

ansible mspearson3c.mylabserver.com -i inv -b -m
file -a "path=/home/matt/demo state=directory
owner=matt group=matt mode=0755"

# Copy testFile to matt's home directory

ansible mspearson3c.mylabserver.com -i inv -b -m
copy -a "src=/home/cloud_user/ansible/testFile
dest=/home/matt/testFile mode=0644 owner=matt
group=matt"

# Install httpd to the webservers group, then start
and enable the httpd service

ansible webservers -i inv -b -m yum -a "name=httpd
state=latest"

ansible webservers -i inv -b -m service -a
"name=httpd state=started enabled=yes"
```

Common Modules

- Ping
  - Validates a server is running and reachable
  - No required parameters
- Setup
  - Gather Ansible facts
  - No required parameters
- Yum
  - Manage packages with the YUM package manager
  - Common parameters (not required):
    - `name` and `state`
- Service
  - Control services on remote hosts
  - Common parameters:
    - `name` (required), `state`, and `enabled`
- User
  - Manage user accounts and attributes
  - Common parameters:
    - `name` (required), `state`, `group`, and `groups`

Common Modules (cont.)

- Copy
  - Copy files to a remote host
  - Common parameters:
    src, dest (required), owner, group, and mode
- File
  - Manage files and directories
  - Common parameters:
    path (required), state, owner, group, and mode
- Git
  - Interact with git repositories
  - Common parameters:
    `repo` (required), `dest` (required), and `clone`

Register the Results of Running a Command

- Use the `register` keyword to store the results of running a command as a variable.
- Variables can be referenced by other tasks in the playbook.
- Registered variables are only valid on the host for the current playbook run.
- Return values differ from module to module.

Use `register` in a playbook

```
---
- hosts: hostname
  tasks:
    - name: create a file
      file:
        path: /tmp/testFile
        state: touch
      register: variable
    - name: display debug message
      debug: msg="Register output is
{{ variable }}"
```

Handlers

- Handlers take action when called.
- Handlers are called when a change is made.
- Handlers are called using the notify keyword.
- More than one handler can be defined for a playbook or play.
- Multiple handlers can be specified in the notify section.
- Handlers can have multiple tasks.
- Regardless of how many tasks notify a handler, it will only run once.

Example of a Handler in a Playbook

```
---
- hosts: mspearson2c
  become: yes
  tasks:
    - name: update httpd.conf
      replace:
        path:
/etc/httpd/conf/httpd.conf
        regexp: '^ServerAdmin.*$'
        replace: 'ServerAdmin
cloud_user@localhost'
        backup: yes
      notify: "restart web server"
  handlers:
    - name: "restart apache"
      service:
        name: httpd
        state: restarted
      listen: "restart web server"
```

The when Statement

- Allows a task to run or be skipped if certain conditions are met.
- Parentheses can be used to group conditions.
- Multiple conditions can be specified as a list.
- Mathematical operation comparisons can be used.

Example of a when statement in a Playbook

```
---
- hosts: webservers
  become: yes
  tasks:
    - name: copy file
      copy:
        src:
/home/cloud_user/index.html
        dest: /var/www/html/index.html
      when: ansible_hostname ==
"mspearson3c"
```

Loops

- May be performed using the `loop` or `with_<lookup>` keywords
- Standard loop usage
  - Iterate over a simple list
  - Iterate over a list of hashes
  - Iterate over a dictionary
- When statements are processed separately for each item in a loop

Example of a `loop` in a Playbook

```
---
- hosts: webservers
  become: yes
  tasks:
    - name: create a list of users
      user:
        name: “{{ item }}”
        state: present
        groups: wheel
      loop:
        - violet
        - graham
        - bethany
```

Error Handling

- Ignore errors by using the `ignore_errors` keyword.
- Force previously notified handler to run using the `force_handlers` keyword.
- Define failure conditions using the `failed_when` keyword.
- Override the “changed” status result using the `changed_when` keyword.
- Abort an entire play if any task fails using the `any_errors_fatal` keyword.
- Implement a block in order to logically group tasks and provide error handling using the following keywords:
  - `block`
  - `rescue`
  - `always`

Using ignore_errors keyword:

```
---
- hosts: labservers
  tasks:
    - name: copy remote files
      fetch:
        src: /tmp/errorFile
        dest: /tmp
      ignore_errors: yes
```

Using a block to handle errors:

```
---
- hosts: labservers
  tasks:
    - name: copy remote files
      block:
        - fetch:
            src: /tmp/blockFile
            dest: /tmp
      rescue:
        - debug:
            msg: "The file doesn't
exist on {{ ansible_hostname }}."
      always:
        - debug:
            msg: "Playbook is
finished!"
```

Create Playbooks to Configure Systems to a Specified State

Example Playbook

```
---
- hosts: webservers
  become: yes
  tasks:
    - name: install apache
      yum:
        name: httpd
        state: latest
    - name: create user and add them to the
apache group
      user:
        name: "{{ item }}"
        groups: apache
      loop:
        - will
        - myles
    - name: create index.html
      template:
        src:
/home/cloud_user/ansible/templates/index.j2
        dest: /var/www/html/index.html
        owner: apache
        group: apache
        mode: 0644
    - name: start and enable httpd
      service:
        name: httpd
        state: started
        enabled: yes
```

Example Playbook (cont.):

```
- hosts: dbservers
  become: yes
  tasks:
    - name: install postresql
      yum:
        name: postgresql-server
        state: latest
    - name: initialize db cluster
      command: /usr/bin/postgresql-setup
--initdb
    - name: create users
      user:
        name: "{{ item }}"
        groups: postgres
      loop:
        - corey
        - aaron
    - name: start and enable postgres
      service:
        name: postgresql
        state: started
        enabled: yes
```

The `yum` Module - Use the `yum` package manager to install, upgrade, downgrade, remove, and list packages and groups.

Examples of the yum module:

```
- name: install a package
  yum:
    name: package_name
    state: latest

- name: Install a list of packages
  yum:
    name:
      - package_name
      - package_name
    state: latest

- name: Install rpm from a remote repo
  yum:
    name: http://website.com/path/to/rpm
    state: present

- name: Install rpm from a local file
  yum:
    name: /path/to/file.rpm
    state: present

- name: Remove a package
  yum:
    name: package_name
    state: absent
```

The yum_repository module - Add or remove a yum repository.

Examples of the yum_repository module:

```
- name: Add a repository
  yum_repository:
    name: repo_name
    description: Description of repo
    baseurl:
https://website.com/full/path/of/base/url
    gpgcheck: no

- name: Remove a repository from a repo file
  yum_repository:
    name: repo_name
    file: repo_file_name (without the
“.repo” extension)
    state: absent
```

The service module - This controls services on a remote host. The supported init systems are BSD init, OpenRC, SysV, Solaris SMF, systemd, and upstart.

Example of the `service` module:

```
- name: Show options for service module
  service:
    name: service_name
    state:
started|stopped|restarted|reloaded
    enabled: yes|no
    args: additional arguments provided on
the command line
```

The `systemd` module - This controls `systemd` services on a remote host.

Example of the `systemd` module:

```
- name: Show options for systemd module
  service:
    name: service_name
    state:
started|stopped|restarted|reloaded
    enabled: yes|no
    daemon_reload: yes|no
    force: yes|no
```

The `firewalld` module - Allows for the addition or deletion of running or permanent firewall rules by services or ports (TCP or UDP)

Example of the `firewalld` module:

```
- name: add firewall rules by service
  firewalld:
    zone: public|dmz|internal|external|trusted|etc.
    service: service_name
    permanent: yes|no
    immediate: yes|no
    state: enabled|disabled|present|absent

- name: add firewall rules by port(s)
  firewalld:
    zone: public|dmz|internal|external|trusted|etc.
    port: 8080/tcp|170-179/udp
    permanent: yes|no
    immediate: yes|no
    state: enabled|disabled|present|absent

- name: add firewall rules using a Rich Rule
  firewalld:
    zone: public|dmz|internal|external|trusted|etc.
    rich_rule: rule family=ipv4 forward-port
port=443 protocol=tcp to-port=8443
    permanent: yes|no
    immediate: yes|no
    state: enabled|disabled|present|absent
```

Create Partitions

The `parted` module - Uses the parted command line tool in order to configure block device partitions.

Example of the `parted` module:

```
- name: Show options for parted module
  parted:
    device: /dev/sdc|/dev/nvme1n1
    number: 1
    state: present|absent|info
    part_end: 1GiB|100%
    label: msdos|gpt
    flags: [ lvm ]
```

Create Logical Volumes

The `lvg` module - Create, remove, and resize volume groups

Example of the lvg module:

```
- name: show options for lvg module
  lvg:
    force: no|yes
    pesize: 8
    pvs: /dev/nvme1n1p1,/dev/nvme2n1p1
    vg: vg_name
    state: present|absent
```

The `lvol` module - Create, remove, and resize logical volumes

Example of the lvol module:

```
- name: show options for lvol module
  lvol:
    vg: vg_name
    lv: lv_name
    size: 512m|1g|100%FREE
    state: present|absent
    shrink: yes|no
    resizefs: no|yes
    force: no|yes
    opts: free form options passed to the
lvcreate command
```

Manage File Content

The `file` module - Manage files and file properties.

Example of the `file` module:

```
- name: create a file
  file:
    path: /path/to/file
    state: touch
```

The `copy` module - Copy files to remote locations.

Example of the `copy` module:

```
- name: add content to specific file
  copy:
    content: file_content
    dest: /path/to/file
```

The `lineinfile` module - Manage lines in text files.

Example of the `lineinfile` module:

```
- name: replace a line
  lineinfile:
    path: /path/to/file
    regexp: 'regular_expression'
    line: line to insert/replace in the file
```

Create Files and and Replace Strings (cont.)

The `replace` module - Replace all instances of a particular string within a file.

Example of the `replace` module:

```
- name: replace strings within a file
  replace:
    path: /path/to/file
    regexp: regular_expression
    replace: 'string that replaces regexp
matches'
```

The `template` module - Template a file out to a remote server.

Example of the `template` module:

```
- name: show template options
  template:
    src: /path/to/template.j2
    dest: /path/to/dest
    owner: owner_name
    group: group_name
    mode: file_permissions
```

Create Files and and Replace Strings (cont.)

Example of a template file:

```
Hostname = {{ ansible_hostname }}
Operating System = {{ ansible_distribution }} {{
ansible_distribution_version }}
IPV4 Address  = {{ ansible_default_ipv4.address }}
IPV6 Address  = {{ ansible_default_ipv6.address }}
Interfaces = {{ ansible_interfaces|join(', ') }}
Block Devices = {{ ansible_devices|join(', ') }}
```

Create a Filesystem

The `filesystem` module - Create a filesystem.

Example of the `filesystem` module:

```
- name: options for filesystem module
  filesystem:
    fstype: fs_type
    dev: /path/to/device
    force: no|yes
    resizefs: no|yes
    opts: options to pass to the mkfs command
```

Mount a Filesystem

The `mount` module - Control and configure mount points.

Example of the `mount` module:

```
- name: option for the mount module
  mount:
    path: /path/to/mount/point
    src: /path/to/device
    fstype: fs_type
    state: mounted|absent|present|unmounted
    opts: mount options
    backup: no|yes
```

Create an Archive

The `archive` module - Creates a compressed archive on one or more files or directories.

Example of the `archive` module:

```
- name: show options for archive module
  archive:
    path:
      - /path/to/file
      - /path/to/file
      - /path/to/dir
      - /globbed/path/using/*
    exclude_path:
      - /file/to/exclude
      - /dir/to/exclude
      - /glob/to/exclude/ex*
    format: gz|bz2|tar|xz|zip
    dest: /name/of/archive.tgz
```

Unpack an Archive

The `unarchive` **module -** Copy (optional) and unpack an archive.

Example of the `unarchive` module:

```
- name: show options for unarchive module
  unarchive:
    src:
/path/to/file.zip|www.website.com/path/to/file.zip
    dest: /path/to/unpack/in
    remote_src: no|yes
```

Schedule Tasks using `cron` and `at`

The `cron` module - Manage `cron.d` and `crontab` entries.

Example of the `cron` module:

```
- name: show options for the cron module
  cron:
    name: “job_name”
    special_time: reboot|daily|weekly|etc.
    minute: 0-59|*|*/2
    hour: 0-23|*|*/2
    day: 1-31|*|*/2
    month: 1-12|*|*/2
    weekday: 0-6 for Sunday to Saturday|*
    user: user_name
    cron_file: file_name
    state: present|absent
    job: command
```

Schedule Tasks using `cron` and `at` (cont.)

The `at` module - Schedule the execution of a command or script with the `at` command.

Example of the `at` module:

```
- name: show options for the at module
  at:
    command: command_to_run
    script_file: /path/to/script.sh
    count: count of units in the future to
execute the command or script
    unit: minutes|hours|days|weeks
    state: present|absent
```

The `selinux` module - Change the policy and state of SELinux.

Example of the `selinux` module:

```
- name: show options for selinux module
  selinux:
    configfile: /path/to/config
    policy: targeted
    state: enforcing|permissive|disabled
```

The `seboolean` module - Toggle SELinux booleans.

Example of the `seboolean` module:

```
- name: show options for seboolean module
  seboolean:
    name: boolean_name
    state: no|yes
    persistent: no|yes
```

The `sefcontext` module - Manage SELinux file context mappings definitions.

Example of the `sefcontext` module:

```
- name: show options for sefcontext module
  sefcontext:
    ftype: a|d|etc.
    reload: yes|no
    target: '/path/to/dir(/.*)?'
    setype: selinux_type
    state: present|absent
- name: apply new SELinux context to the filesystem
  command: restorecon -irv /path/to/dir
```

Manage Users

The `user` module - Manage user accounts and user attributes.

Example of the `user` module:

```
- name: show options for user module
  user:
    name: user_name
    shell: /bin/bash|/bin/zsh|etc.
    home: /path/to/home/dir
    comment: user_description
    uid: set the uid of the user
    group: set the user's primary group
    groups: list of groups to add the user to
    append: no|yes
    state: present|absent
```

Manage Groups

The `group` module - Add or remove groups.

Example of the `group` module:

```
- name: show options for the group module
  group:
    name: group_name
    gid: set the gid for the group
    system: no|yes
    state: present|absent
```

Understanding Variables

- Can contain letters numbers and underscores
- Must begin with a letter
- Can be stored as dictionaries, which map keys to values
  - Dictionary variables can be referenced using bracket notation or dot notation:
    - Example: `dictionary_name['field1']` or `dictionary.field1`
- Variables stored as a list (array) may be accessed by putting the element number in brackets:
  - Example (first element of an array): {{ array_name[0] }}
- Variables may be defined or set in the following locations:
  - Inventories (also in `host_vars` and `group_vars` directories)
  - Playbooks (i.e., `vars`, `vars_files`, and `vars_prompt`)
  - Roles (i.e., set in `roles/role_name/vars/main.yml`)
  - The command line (i.e., `-e or --extra-vars`)

Understanding Variables (cont.)

- Referenced defined variables using the Jinja2 templating system.
  - example: This is my `{{ variable }}`
    - Note: YAML requires values starting with a variable to be quoted.
- Transform variable values using Jinja2 filters (i.e. join, capitalize, etc.)
- Ansible stores information about remote hosts in variables known as Ansible facts.
- Ansible provides special, reserved variables known as magic variables.
  - Examples: `hostvars`, `groups`, `group_names`, and `inventory_hostname`
- Custom facts (AKA local facts) can be added to the remote system by the user:
  - Defined in files that end with `.fact`
  - Local fact files are stored in `/etc/ansible/facts.d`
  - Fact file directory can be changed using the `fact_path` keyword
  - Local facts can be viewed by running the following: `ansible <hostname> -m setup -a "filter=ansible_local"`

Understanding Templates

- Templates are files that contain both static values and dynamic values, through the use of variables.
- Ansible processes templates using jinja2.
- Templates are designated with the .j2 extension.
- Templates are often used for configuration file management.
- Templates have access to the same variables as the plays that call them.

The `template` module - Process a template and push it out to a remote server.

Example of the `template` module:

```
- name: show template options
  template:
    src: /path/to/template.j2
    dest: /path/to/dest
    owner: owner_name
    group: group_name
    mode: file_permissions
    validate: validation_command %s
    backup: no|yes
```

`httpd.conf` Template

```
# This is the main Apache HTTP server configuration
file.
#
# {{ ansible_managed }}

ServerRoot "/etc/httpd"

Listen {{ http_port }}

Include conf.modules.d/*.conf

User apache
Group apache

ServerAdmin {{ admin }}@{{ ansible_hostname }}

<Directory />
    AllowOverride none
    Require all denied
</Directory>

DocumentRoot "{{ content_dir }}"
...
```

`index.html` Template

```
Welcome to {{ ansible_hostname }}!

-The ipv4 address is {{ ansible_default_ipv4['address'] }}

-The current memory usage is {{
ansible_memory_mb['real']['used'] }}mb out of {{
ansible_memory_mb['real']['total'] }}mb

-The {{ ansible_devices| first }} block device has the
following partitions:
 -{{ ansible_devices['nvme0n1']['partitions']|join('\n -') }}
```

Playbook Example

```
---
- hosts: webservers
  become: yes
  vars:
    content_dir: /webcontent
    http_port: 8080
    admin: cloud_user
  tasks:
    - name: push config template
      template:
        src: /home/cloud_user/ansible/templates/httpd.conf.j2
        dest: /etc/httpd/conf/httpd.conf
        backup: yes
      notify: "restart apache"
    - name: push index.html template
      template:
        src: /home/cloud_user/ansible/templates/index.html.j2
        dest: /webcontent/index.html
  handlers:
    - name: restart web servers
      service:
        name: httpd
        state: restarted
      listen: "restart apache"
```

Roles Overview

- The default location for roles is `/etc/ansible/roles`.
- Roles provide a way to automatically load certain vars_files, tasks, and handlers based on a known file structure.
- Roles expect a particular directory structure.
- Directories not being used may be excluded.
- Each directory in use most contain a `main.yml` with relevant content.

```
[cloud_user@mspearson1c roles]$ tree -A common/
common/
├── defaults
│   └── main.yml
├── files
├── handlers
│   └── main.yml
├── meta
│   └── main.yml
├── README.md
├── tasks
│   └── main.yml
├── templates
├── tests
│   ├── inventory
│   └── test.yml
└── vars
    └── main.yml
```

Roles Directories

- tasks - This directory contains the main list of tasks to be executed by this role.
- `handlers` - This directory contains handlers, which may be used by this role or even anywhere outside this role.
- `defaults` - This directory contains default variables for the role and is meant to provide a value to a variable if no other value is given. (low precedence)
- `vars` - This directory contains variables used within the role. (high precedence)
- `files` - This directory contains files which can be deployed via this role.
- `templates` - This directory contains templates which can be deployed via this role.
- `meta` - This directory defines some of the meta data for this role.

Red Hat Enterprise Linux (RHEL) System Roles

- Provided by the RHEL Extras repository.
- Requires the **rhel-system-roles** package to be installed.
- Can be used by Ansible Engine and Ansible Tower to manage RHEL systems.
- Needs to be installed on the Ansible control node(s) which can then be used to manage and configure the client nodes.
- Supported system roles include: `kdump`, `network`, `selinux`, `timesync`, and `postfix` (tech preview)
- The documentation can be found in the following location:

`/usr/share/doc/rhel-system-roles-<version>/SUBSYSTEM/`

- The Ansible roles may be found in the following location:

`/usr/share/ansible/roles/rhel-system-roles.SUBSYSTEM/`

Role Variables (`timesync` role):

```
# List of NTP servers
timesync_ntp_servers:
  - hostname: foo.example.com   # Hostname or address of the server
    minpoll: 4                  # Minimum polling interval (default 6)
    maxpoll: 8                  # Maximum polling interval (default 10)
    iburst: yes                 # Flag enabling fast initial synchronization
                                # (default no)
    pool: no                    # Flag indicating that each resolved address
                                # of the hostname is a separate NTP server
                                # (default no)

# List of PTP domains
timesync_ptp_domains:
  - number: 0                   # PTP domain number
    interfaces: [ eth0 ]        # List of interfaces in the domain
    delay: 0.000010             # Assumed maximum network delay to the
                                # grandmaster in seconds
                                # (default 100 microsecond)
    transport: UDPv4            # Network transport: UDPv4, UDPv6, L2
                                # (default UDPv4)
    udp_ttl: 1                  # TTL for UDPv4 and UDPv6 transports
                                # (default 1)
```

Example Playbook (`timesync` role):

```
- hosts: targets
  vars:
    timesync_ntp_servers:
      - hostname: foo.example.com
        iburst: yes
      - hostname: bar.example.com
        iburst: yes
      - hostname: baz.example.com
        iburst: yes
  roles:
    - rhel-system-roles.timesync
```

Create the Directory Structure for Roles: `ansible-galaxy init role_name`

Create tasks:

```
---
# tasks file for apache
- name: create webcontent directory
  file:
    path: "{{ apache_content_dir }}"
    state: directory
    mode: '0755'
- name: set secontext on webcontent directory
  sefcontext:
    target: '{{ apache_content_dir }}(/.*)?'
    setype: httpd_sys_content_t
    state: present
- name: run restorecon on webcontent
  command: restorecon -irv {{ apache_content_dir }}
- name: install apache
  yum:
    name: httpd
    state: latest
- name: deploy httpd.conf template
  template:
    src: httpd.conf.j2
    dest: /etc/httpd/conf/httpd.conf
    backup: yes
  notify: "restart apache"
- name: deploy index.html template
  template:
    src: index.html.j2
    dest: "{{ apache_content_dir }}/index.html"
    backup: yes
- name: start and enable httpd service
  service:
    name: httpd
    enabled: yes
    state: started
```

Create variables:

```
---
# defaults file for apache
apache_content_dir: /webcontent
apache_http_port: 8080
apache_admin: cloud_user
```

Create templates (index.html.j2):

```
Welcome to {{ ansible_hostname }}!

-The ipv4 address is {{
ansible_default_ipv4['address'] }}
-The current memory usage is {{
ansible_memory_mb['real']['used'] }}mb out of {{
ansible_memory_mb['real']['total'] }}mb
-The {{ ansible_devices| first }} block device has
the following partitions:
 -{{
ansible_devices['nvme0n1']['partitions']|join('\n
-') }}
```

Create templates (httpd.conf.j2):

```
# This is the main Apache HTTP server
configuration file.
#
# {{ ansible_managed }}

ServerRoot "/etc/httpd"

Listen {{ apache_http_port }}

Include conf.modules.d/*.conf

User apache
Group apache

ServerAdmin {{ apache_admin }}@{{ ansible_hostname
}}

<Directory />
    AllowOverride none
    Require all denied
</Directory>

DocumentRoot "{{ apache_content_dir }}"
…
```

Create handlers:

```
---
# handlers file for apache
- name: restart web servers
  service:
    name: httpd
    state: restarted
  listen: "restart apache"
```

Create playbook (examples):

```
---
- hosts: webservers
  become: yes
  roles:
    - role_name
    - role: role_name
      vars:
        var_name: value

---
- hosts: webservers
  become: yes
  tasks:
    - include_role:
        name: role_name
      vars:
        var_name: value
```

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Understanding Ansible Galaxy

Ansible Galaxy - A large public repository for downloading and sharing community developed roles.

The `ansible-galaxy` utility - Create and remove roles or install roles from Ansible Galaxy or a Git-based SCM (software configuration management).

Syntax: `ansible-galaxy [delete|import|info|init|install| list|login|remove|search|setup] [--help] [options] ...`

Ansible Galaxy Commands

Create roles directory structure:

```
ansible-galaxy init role_name
```

Search Galaxy for roles:

```
ansible-galaxy search keyword --author
authorname
```

Install a role:

```
(from galaxy) ansible-galaxy install
role_name
(from a file) ansible-galaxy install -r
file.yml
```

List installed roles:

```
ansible-galaxy list
```

Print information about installed roles:

```
ansible-galaxy info role_name
```

Remove a role:

```
ansible-galaxy remove role_name
```

Understanding Parallelism

- Parallelism is the word used for Ansible's default ability to interact with multiple hosts at the same time.
- The parallel processes spawned by Ansible are known as forks.
- The default number of forks in Ansible is **5**.
- The default number of forks can be changed by editing the forks parameter in `ansible.cfg`.
- The number of forks can be changed on a per command basis by using the `-f` flag.
- Ansible allows for rolling updates using the serial keyword.

Change default forks value in `ansible.cfg`:

```
forks = desired_number
```

Change forks value in the command line:

```
ansible host  -f desired_number -m module -a
“arguments”
ansible-playbook -f desired_number
playbook.yml
```

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Use the `serial` keyword to perform rolling update:

```
---
- hosts: labservers
  serial:
    - 1
    - 2
    - 50%
  tasks:
  - name: create new file
    file:
      path: /tmp/serialFile
      state: touch
```

Understanding Ansible Vault

- Can be used to encrypt any structured data file used by Ansible:
  - Variable files in `group_vars` and `host_vars` directories
  - Variable files loaded by `include_vars` and vars_files in playbooks
  - Variable files passed on the command line using `-e @var_file.yml`
- Passwords on an encrypted file can be updated using the `ansible-vault rekey` command.
- Can be used to encrypt individual variables inside a YAML file using the `!vault` tag
- Uses vault IDs to support multiple vault passwords (labels are used to distinguish between the individual passwords):
  - example: `--vault-id label@source`

The Ansible Vault Command

- Create an encrypted file: `ansible-vault create file.yml`
- Create an encrypted file with a vault ID:
  `ansible-vault create --vault-id label@source file.yml`
- Edit an encrypted file: `ansible-vault edit file.yml`
- Edit an encrypted file with a vault ID:
  `ansible-vault edit --vault-id label@source file.yml`
- Rekey encrypted files: `ansible-vault rekey file1.yml file2.yml`
- Rekey encrypted files a vault ID:
  `ansible-vault rekey --vault-id label@source file1.yml file2.yml`
- Encrypt an existing file: `ansible-vault encrypt file.yml`
- Encrypt an existing file with a vault ID:
  `ansible-vault encrypt --vault-id label@source file.yml`
- Decrypt a file: `ansible-vault decrypt file.yml`
- View an encrypted file: ansible-vault view file.yml
- Encrypt a string to be used as a variable in a YAML file:
  `ansible-vault encrypt_string --ask-vault-pass 'string_value' --name 'secret_var'`
- Output of encrypted variable:

```
New Vault password:
Confirm New Vault password:
secret_var: !vault |
          $ANSIBLE_VAULT;1.1;AES256
          63373266643938616266333164383266353966333962623631363936323138366231303830633461
          35343238666539626132613561636437666639373139316 40a3135646439636664346330623731 33
          38656632303264346630373036363961616337363235326561336638653565303436363864653135
          64336366313234373304643065134363062666139363531373536656632613837353465353630313
          3030
Encryption successful
```

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Providing Vault Passwords

- Use password stored in a text file: `ansible-playbook --vault-password-file /path/to/password/file playbook.yml`
- Use password stored in a text file with a vault ID: `ansible-playbook --vault-id label@password_file playbook.yml`
- Prompt for a password: `ansible-playbook --ask-vault-pass playbook.yml`
- Prompt for a password with a vault ID: `ansible-playbook --vault-id label@prompt playbook.yml`
- Use multiple passwords with vault ID: `ansible-playbook --vault-id label1@password_file --vault-id label2@prompt playbook.yml`

Using Ansible Vault in a Playbook

Create an encrypted file:

```
ansible-vault create file.yml
```

Encrypt an already existing file:

```
ansible-vault encrypt file.yml
```

Edit an encrypted file:

```
ansible-vault edit file.yml
```

Run playbook with encrypted variables file:

- Using password prompt:
  - `ansible-playbook --ask-vault-pass playbook.yml`
- Using password file:
  - `ansible-playboook --vault-password-file /path/to/password/file playbook.yml`

Rekey an encrypted file:

```
ansible-vault rekey file.yml
```

Decrypt an encrypted file:

```
ansible-vault decrypt file.yml
```

The `ansible-doc` Command - Documentation Tool for Plugins and Modules

Command syntax:

```
ansible-doc [-l|-F|-s] [options] [-t <plugin type> ] [plugin]
```

List modules:

```
ansible-doc -l
```

Show documentation for a module:

```
ansible-doc module_name
```

Show documentation snippet of a module:

```
ansible-doc -s module_name
```

Example `ansible-doc` Command Output:

```
# ansible-doc service
...
        Controls services on remote hosts. Supported
init systems include BSD init, OpenRC, SysV, Solaris
SMF, systemd, upstart. For Windows targets, use the
[win_service] module instead.

  * This module is maintained by The Ansible Core Team
  * note: This module has a corresponding action
plugin.

OPTIONS (= is mandatory):
- arguments
        Additional arguments provided on the command
line.
        (Aliases: args)[Default: (null)]
        type: str
- enabled
        Whether the service should start on boot.
        *At least one of state and enabled are
required.*
        [Default: (null)]
        type: bool
= name
        Name of the service.
        type: str

EXAMPLES:
- name: Start service httpd, if not started
  service:
    name: httpd
    state: started
...
```

Documentation on the Web

Ansible Documenation:
https://docs.ansible.com/

Ansible Galaxy Documentation:
https://galaxy.ansible.com/docs/

Points of interest:

- Ansible Documentation
- Installation | Installation Guide
- User Guide
- Playbooks | Working With Playbooks
- Module Index
- Ansible Galaxy | Galaxy Documentation

Recommendations for Your Next Course

- Red Hat Certified Architect
  - Red Hat Certified Specialist in Virtualization (ex318)
  - Red Hat Certified Specialist in Ansible Automation (ex407)
  - Red Hat Certified Specialist in OpenShift Administration (ex280)
  - Red Hat Certified Specialist in Server Hardening (ex413)
  - Red Hat Certified Specialist in Security (ex415)
  - Red Hat Certified Specialist in Linux Diagnostics and Troubleshooting (ex342)
- Cloud platforms
  - AWS
  - Azure
  - Google Cloud
- DevOps
  - Chef
  - Puppet
  - Saltstack
  - Kubernetes
- Big Data
  - Elastic
  - Splunk
  - Hadoop

Exam Preparation

Preparing for the Exam

- Make sure you have completed all the lessons and hands-on labs.
- Make use of the instructor-provided flash cards and create your own.
- Use the interactive diagram as a study guide reference.
- Go back over any topic multiple times to help with retention (labs and lessons).
- Reach out to the Linux Academy community for any additional questions.
- Join a study group.
- Be sure to get some good sleep the night before the exam.
- Eat a modest meal before taking the exam and be sure that you are reasonably hydrated.
- Arrive at the testing center with plenty of time before the exam starts.

Signing up for the Exam

- Visit the website for the exam: https://www.redhat.com/en/services/training/ex294-red-hat-certified-engineer- rhce-exam-red-hat-enterprise-linux-8
- Register for your desired format: classroom or individual.
- Follow the email instructions from Red Hat to schedule the location and time of your exam (for individuals).