Automation with Ansible

Hands on workshop

Delivered by :

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Prerequisites

1. A PC/Laptop with Linux/MAC/Windows
2. Internet Connected
3. SSH Client e.g, Putty, Terminal
4. Web browser
5. Basic knowledge of Linux and command line
6. Functional knowledge of a Linux text editor

Agenda

1. Introduction to Ansible
2. Installing Ansible
3. Ansible Components
4. Real world deployment I
5. Ansible advance topics
6. Real world deployment II
7. Ansible Roles
8. Real world deployment III

Introduction to Ansible

What is Ansible?

- Automation
- Change Management
- Provisioning
- Orchestration

Automation

- Core of Ansible
- Run tasks
  - Update a software package
  - Create a user
  - Open/Close ports
- Conditions
- Scale

Change Management

- System State
  - Define
  - Enforce
  - Example
    - Apache web server version 2.4.x installed
    - PHP 5.4.x installed
    - Apache web server started
    - webadmin user exist with authorized key
  - Deviation from the state would warrant a change
  - Ansible operations are Idempotent

Provisioning

- Built on top of Automation and Change Management
- Preparing a system
- Installing, updating, configuring software
- For Example:
  - Start with a basic installation of OS
  - Update the operating system
  - Install the web server
  - Deploy the application
  - Configure the application
  - Start the web server

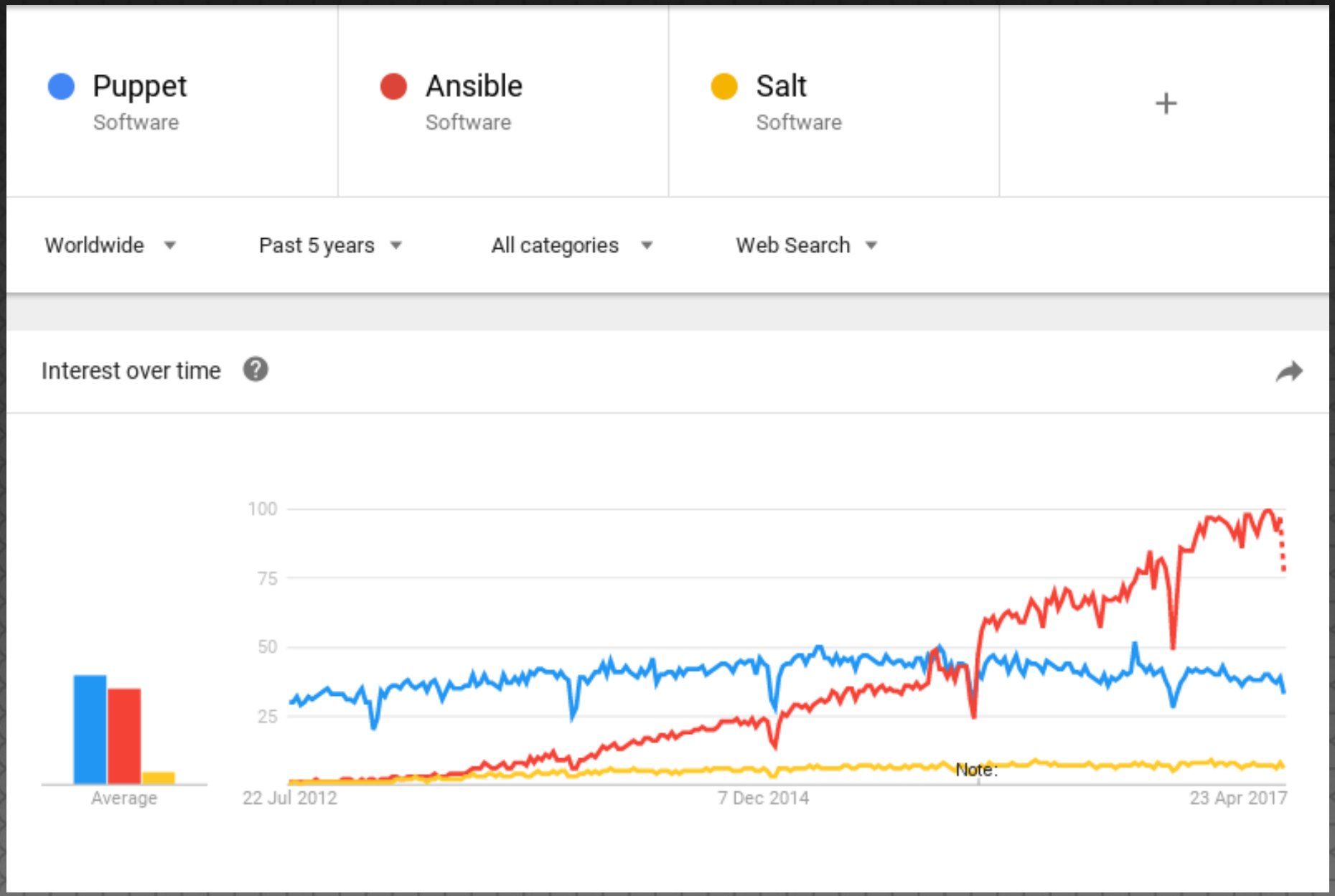
Orchestration

- Orchestration is not Automation
- Coordination between systems
- Order sensitive tasks
- For example:
  - Remove web1 from LB
  - Run tasks on web1
  - Add web1 to LB
  - ....

Why Ansible?

- Simple and Lightweight
  - No Agents
  - No database
- Multi-platform
  - Windows, Linux, Unix, Mac ..
- YAML
- Built-in Security
- Extendable

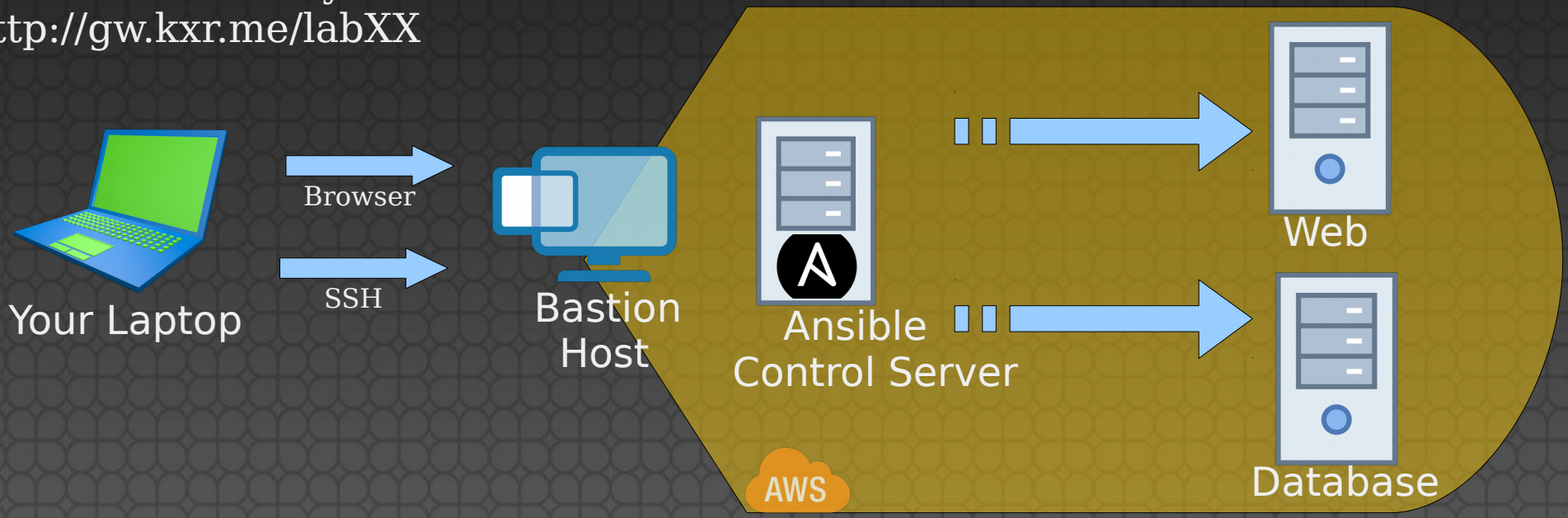
Why Ansible?


Puppet
Software
Ansible
Software
Salt
Software
+
Worldwide
Past 5 years
All categories
Web Search
Interest over time
100
75
50
25
Note:
Average
22 Jul 2012
7 Dec 2014
23 Apr 2017

Installing Ansible

Lab Environment

- You will be assigned a lab number. 10 – 99
- Substitute your lab number with XX in the table below
- SSH into the bastion host to access your environment
- You can also access your webserver:
  - http://gw.kxr.me/labXX



Server	IP Address	User	Password
Bastion Host	gw.kxr.me	labXX	Lab3nvXX
acs.labXX	10.0.XX.10	root	ansibleXX
webserver.labXX	10.0.XX.11	root	webserverXX
database.labXX	10.0.XX.12	root	databaseXX

Setup your laptop

- Your laptop should be connected to the internet
- Use your favorite SSH client on you laptop (e.g. Putty)
- Create 3 separate connections to the bastion host for each node: acs, webserver, database
- Each node is having a basic installation of CentOS 7
- Make sure you are on the correct nodes
- The color of the prompt should help you identify each node:

```
[root@acs ~]
[root@webserver ~]
[root@database ~]
```

Installing Ansible

On the Control Server `[root@acs ~]`

```
yum -y update
yum -y install epel-release
yum -y install ansible
```

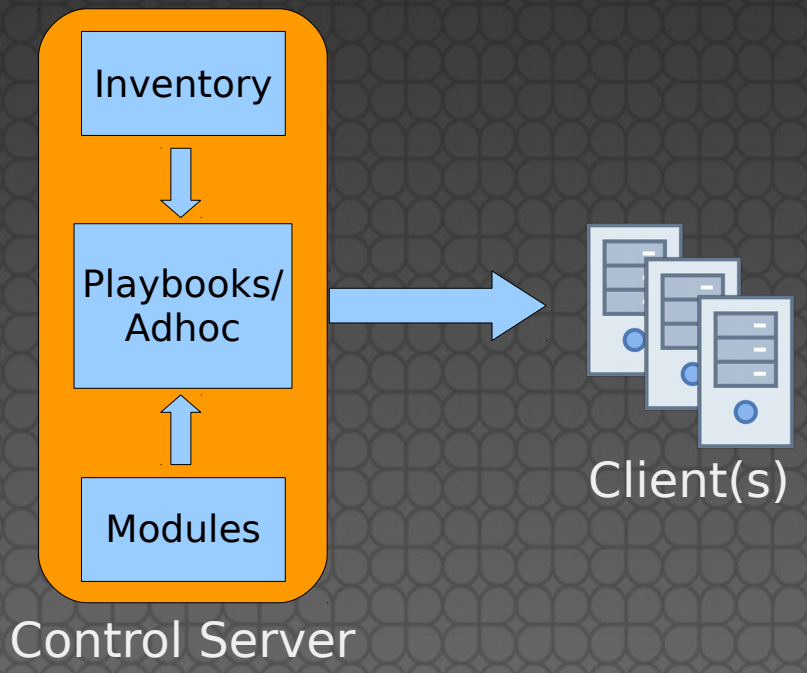
- Ansible is installed (that simple!)
- Ansible Configuration: /etc/ansible/ansible.cfg
- Default inventory: /etc/ansible/host
- Easily refer to the documentation:

```
ansible-doc -l
ansible-doc <module>
ansible-doc -s <module>
```

Ansible Components

Ansible Components

- Architecture
  - Control Server → Client
  - Gather facts from clients
- Control Server
  - Inventory
  - Modules
  - Playbooks
- Client
  - SSH
  - WinRM



Inventory

- Default: /etc/ansible/hosts
- Custom inventory using -i switch
  - Use custom inventories to isolate environments e.g. Prod, dev, US
- Hosts, Groups, Variables
- Default Groups: all, ungrouped
- For example:

```
mail.example.com

[webservers]
one.example.com
alpha.example.com ansible_host=192.0.2.50

[dbservers]
one.example.com
two.example.com
three.example.com ansible_host=192.0.2.99
```

Setup inventory

- /etc/ansible/hosts
- Make sure the hostnames are reachable

```
yum -y install nano vim emacs
cd /etc/ansible
<editor> hosts
```

```
[app]
webserver.labXX
database.labXX

[webservers]
webserver.labXX

[dbservers]
database.labXX
```

Modules

- Ansible ships with ~500 Modules
  - You can write your own!
- Each modules is automating a task for you.
- Modules for configuring network devices.
- Module Support (Read the docs)
  - Core
  - Curated
  - Community
- Lets see some in action

Ansible Ad-hoc commands

- Running quick task
- Inventory, Module, Arguments
  - `ansible <inventory> -m <module> -a <arguments>`
- Examples:
  - add client finger prints to known_hosts
  - Use `-k` or `--ask-pass` to be prompted for password

```
ansible webserver.labXX -m ping
ansible webserver.labXX -a “ip addr”
ansible webserver.labXX -a “w”
ansible webserver.labXX -m yum -a “name=vim state=present”
```

Authorize ssh

- Lets generate our ssh key:

```
ssh-keygen
```

- Authorize our key:

```
ssh-copy-id webserver.labXX
```

```
ssh-copy-id webserver.labXX
```

- We can use ansible :)

```
ansible webserver.labXX -m authorized_key  -a \
"user=root key={{lookup('file', '/root/.ssh/id_rsa.pub')}}" -k
```

```
ansible database.labXX -m authorized_key  -a \
"user=root key={{lookup('file', '/root/.ssh/id_rsa.pub')}}" -k
```

Commonly used Modules

- setup

```
ansible webserver.labXX -m setup
-a “filter=ansible_eth*”
```

- yum, apt
- copy, fetch
- hostname, timzone, service
- user, authorized_key
- template, file, lineinfile

Targeting hosts and groups

- OR group1:group2

```
ansible webservers:dbservers -m ping
```

- AND group1:&group2

```
ansible 'app:&dbservers' -m ping
```

- NOT !group1

```
ansible 'app:!dbservers' -m ping
```

- Combination group1:&group2:!group3
- Wildcard and Regex

```
ansible *.lab* -m ping
```

```
~web[0-9]+
```

Playbooks

- Written in YAML
  - Watch the whitespaces!
- Playbooks: Collection of Plays
  - Plays: Collection of tasks
    - Tasks: Collection of modules
- Sequential order of execution
- Stops further execution on failure
  - ignore_errors: yes
  - retry file for failed hosts
- You can include other playbooks

Playbooks – Example

```
---
- hosts: webservers

  tasks:
  - name: Install Apache Webserver
    yum: name=httpd state=present

  - name: Start Apache Webserver
    service: name=httpd state=started enabled: yes

- hosts: dbservers

  tasks:
  - name: Install MariaDB Server
    yum: name=mariadb-server state=present

  - name: Start MariaDB Server
    service: name=mariadb-server state=started enabled: yes
```

Playbooks – Example

```
---
- hosts: webservers

  tasks:
  - name: Install Apache Webserver
    yum: name=httpd state=present

  - name: Start Apache Webserver
    service: name=httpd state=started enabled: yes

- hosts: dbservers

  tasks:
  - name: Install MariaDB Server
    yum: name=mariadb-server state=present

  - name: Start MariaDB Server
    service: name=mariadb-server state=started enabled: yes
```

Playbooks – Example

```
---
- hosts: webservers

  tasks:
  - name: Install Apache Webserver
    yum: name=httpd state=present

  - name: Start Apache Webserver
    service: name=httpd state=started enabled: yes

- hosts: dbservers

  tasks:
  - name: Install MariaDB Server
    yum: name=mariadb-server state=present

  - name: Start MariaDB Server
    service: name=mariadb-server state=started enabled: yes
```

Playbooks – Example

```
---
- hosts: all

  tasks:

  - name: Disable SELinux
    selinux:
      state: disabled

  - name: Reboot
    command: /sbin/reboot
```

```
cd /etc/ansible
cp /opt/workshop/examples/disable_selinux_reboot.yml .
ansible-playbook disable_selinux_reboot.yml --check
```

Real World Deployment I

Deployment Objectives

- Common
  - Disable selinux
  - Create a standard directory
  - Install vim
- Webserver
  - Install apache webserver
  - create webadmin user
- Database
  - Install mariadb database server
  - create dbadmin user

Deployment I – Play 1

```
- hosts: all
  tasks:
  - name: Disable SELinux
    selinux:
      state: disabled
  - name: Create MyFiles Directory
    file:
      path: /root/MyFiles
      state: directory
      owner: root
      group: root
      mode: 0755
  - name: Install Vim
    yum:
      name: vim
      state: present
```

Deployment I – Play 2

```
- hosts: webservers
  tasks:
  - name: Install Apache Webserver
    yum:
      name: httpd
      state: present

  - name: Start Apache Webserver
    service:
      name: httpd
      state: started
      enabled: yes
  - name: Create webadmin user
    user:
      name: webadmin
      comment: "Web Admin User"
      groups: apache
```

Deployment I – Play 3

```
- hosts: dbservers
  tasks:
  - name: Install MariaDB Server
    yum:
      name: mariadb-server
      state: present

  - name: Start MariaDB Server
    service:
      name: mariadb-server
      state: started
      enabled: yes
  - name: Create dbadmin user
    user:
      name: dbadmin
      comment: "DB Admin User"
      groups: mysql
```

Deployment I

- Copy and run the playbook from /opt/workshop/rwd1

```
[root@acs ~]
cd /etc/ansible
cp /opt/workshop/rwd1/playbook1.yml .
ansible-playbook playbook1.yml --check
ansible-playbook playbook1.yml
```

- Test services on both nodes
- Run the playbook again

Playbook Output

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

TASK [Gathering Facts] ********************************************************
ok: [webserver.lab10]
ok: [database.lab10]

TASK [Disable SELinux] ********************************************************
changed: [webserver.lab10]
changed: [database.lab10]
                              .. .. .. ..

PLAY [webservers] *************************************************************

TASK [Gathering Facts] ********************************************************
ok: [webserver.lab10]

TASK [Install Apache Webserver] ***********************************************
changed: [webserver.lab10]

                              .. .. .. ..

PLAY RECAP ********************************************************************
database.lab10             : ok=8    changed=6    unreachable=0    failed=0
webserver.lab10            : ok=8    changed=6    unreachable=0    failed=0
```

[Break]
Questions?

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Ansible Advance Topics

Ansible Advance Topics

- Variables
- Conditions
- Handlers
- Loops
- Templates
- Includes

Variables

- Facts

```
ansible webservers -m setup
```

- Magic Variables
  - hostvars, group_names, groups
- Variables Defined in:
  - Inventory
  - Playbook
  - Include files
  - Roles

Variables

- Variables in inventory

```
webserver.labXX ansible_port=2992 ansible_host=1.2.3.4

webserver.labXX http_port=80 maxRequestsPerChild=100
```

```
[app]
webserver.labXX
database.labXX

[webservers]
webserver.labXX

[dbservers]
database.labXX

...
```

```
...
[app:vars]
ntp_server=1.2.3.4

[webservers:vars]
http_port=80
htdocs=/var/www/html

[dbservers:vars]
mariadb_port=3306
db_user = dbadmin
```

- Inventory variables in files:
  - /etc/ansible/host_vars/webserver.labXX.yml
  - /etc/ansible/group_vars/app.yml

Variables

- Variables in playbook

```
- hosts: webservers

  vars:
    http_port: 80
    htdocs: /var/www/html

  tasks:
    - name: Blah blah
      module:
        ...
```

Variables

- Register variables

```
- hosts: webservers

  tasks:
    - name: Run shell script
      shell: /root/script.sh
      register: script_output
    ...
```

Conditions

- When Statement

```
- hosts: webservers

  tasks:
    - name: Run shell script
      yum: name=httpd state=present
      when: ansible_os_family == "RedHat"

    - name: Run shell script
      apt: name=apache2 state=present
      when: ansible_os_family == "Debian"

    ...
```

Conditions

- “When” on Register variables

```
- hosts: all

  tasks:
      - name: Check apache vhost conf file
        stat:
            path: /etc/httpd/conf.d/app.conf
        register: appconf

      - name: Copy appconf file
           copy:
             src: /opt/application/apache/app.conf
             dest: /etc/httpd/conf.d/app.conf
        when: not appconf.stat.exists

      - name: Restart Apache
        service:
          name: httpd
          state: restarted
```

Handlers

- Running Operations On Change

```
- hosts: all

  tasks:
      - name: Check apache vhost conf file
        stat:
            path: /etc/httpd/conf.d/app.conf
        register: appconf

      - name: Copy appconf file
          copy:
            src: /opt/application/apache/app.conf
            dest: /etc/httpd/conf.d/app.conf
        when: not appconf.stat.exists
        notify: Restart Apache

  handlers:
      - name: Restart Apache
        service:
          name: httpd
          state: restarted
```

Loops

- Standard Loops using “with_items:”

```
- hosts: all

  tasks:
    - name: Add user user1
      user:
        name: "user1"
        state: present
        groups: "wheel"

    - name: Add user user2
      user:
        name: "user2"
        state: present
        groups: "wheel"
```

```
- hosts: all

  tasks:
    - name: add users user1 and 2
      user:
        name: "{{ item }}"
        state: present
        groups: "wheel"
      with_items:
        - user1
        - user2
```

Loops

- File iteration using “with_file”

```
- hosts: all

  tasks:
    - name: Copy app.php
      copy:
        src: /opt/app/app.php
        dest: /var/www/html/
        owner: apache
        mode: 600

    - name: Copy config.php
      copy:
        src: /opt/app/config.php
        dest: /var/www/html/
        owner: apache
        mode: 600
```

```
- hosts: all

  tasks:
    - name: Copy app files
      copy:
        src: “{{ item }}”
        dest: /var/www/html/
        owner: apache
        mode: 600
      with_file:
        - “/opt/app/app.php”
        - “/opt/app/config.php”
```

Loops

- File iteration using “with_fileglob”

```
- hosts: all

  tasks:
    - name: Copy app.php
      copy:
        src: /opt/app/app.php
        dest: /var/www/html/
        owner: apache
        mode: 600

    - name: Copy config.php
      copy:
        src: /opt/app/config.php
        dest: /var/www/html/
        owner: apache
        mode: 600
```

```
- hosts: all

  tasks:
    - name: Copy app files
      copy:
        src: “{{ item }}”
        dest: /var/www/html/
        owner: apache
        mode: 600
      with_fileglob:
        - “/opt/app/*.php”
```

Templates

- Ansible uses jinja2 templating engine
- Template modules
  - Similar to copy module
  - Replaces the variables
  - Can contain loops and conditions
- Check the official Jinja2 docs:

  `http://jinja.pocoo.org/docs/2.9/`

Templates

- Jinja2 Basics
  - `{% ... %}` for Statements
  - `{{ ... }}` for Expressions
  - `{# ... #}` for Comments
- Variables
  - `{{ foo.bar }}`
- Filters
  - `{{ htmldata | striptags | title }}`
  - `{{ list | join(', ') }}`

Templates

- Example: ntp.conf.j2

```
driftfile /var/lib/ntp/drift

restrict 127.0.0.1
restrict -6 ::1

server {{ ntpserver }}

includefile /etc/ntp/crypto/pw

keys /etc/ntp/keys
```

Templates

- Example: my.cnf.j2

```
[mysqld]
datadir=/var/lib/mysql
socket=/var/lib/mysql/mysql.sock
user=mysql
# Disabling symbolic-links is recommended to
prevent assorted security risks
symbolic-links=0
port={{ mysql_port }}

[mysqld_safe]
log-error=/var/log/mysqld.log
pid-file=/var/run/mysqld/mysqld.pid
```

Templates

- Using the templates

```
...
- name: Configure ntp file
  template:
    src: ntp.conf.j2
    dest: /etc/ntp.conf
  notify: Restart ntp

...

- name: Configure MariaDB
  template:
    src: my.cnf.j2
    dest: /etc/my.cnf
  notify: restart mariadb
...
```

Includes

- Break up bits of configuration policy into smaller files
- Simplify, organize and reuse plays
- Task includes
  - Inclusions under the “tasks” directive
- Play includes
  - Inclusions along the same level of tasks
- You can pass variables when calling the include statement
  - One “template” playbook with variables can be used multiple times with different variables
- Example:

Includes

```
# tasks/common.yml

- name: Disable SELinux
  selinux:
    state: disabled

- name: Install Vim
  yum:
    name: vim
    state: present
```

```
# tasks/httpd.yml
- name: Install httpd
  yum:
    name: httpd
    state: present

- name: Start httpd
  service:
    name: httpd
    state: started
    enabled: yes
```

```
# tasks/mariadb.yml
- name: Install mariadb
  yum:
    name: mariadb-server
    state: present

- name: Start mariadb
  service:
    name: mariadb
    state: started
    enabled: yes
```

```
- hosts: all
  tasks:
    - include tasks/common.yml

- hosts: webservers
  tasks:
    - include: tasks/httpd.yml

- hosts: dbservers
  tasks:
    - include: tasks/httpd.yml
```

Real World Deployment – II

Deployment Objectives

- Common
  - Disable selinux
  - Create some standard directories
  - Setup NTP service and timezone
  - Install vim, screen, tcpdump, mysql, wget
- Webserver
  - Install apache webserver, with vhost configuration
  - create webadmin user
  - Deploy a simple one page application
- Database
  - Install mariadb database server, with configuration
  - create dbadmin user
  - Configure database for the application

Deployment

```
cd /etc/ansible
cp -r /opt/workshop/rwd2 .
cd rwd2
```

- Templates
  - index.php.j2: A simple web app
  - my.cnf.j2: mariadb configuration
  - ntp.cnf.j2: ntp server configuration
  - vhost.conf.j2: Apache configuration
- Includes
  - common.yml, webserver.yml, database.yml
- Playbook2.yml
  - `ansible-playbook playbook2.yml --check`
  - `ansible-playbook playbook2.yml`

```
rwd2/
├── templates/
│   ├── index.php.j2
│   ├── my.cnf.j2
│   ├── ntp.conf.j2
│   └── vhost.conf.j2
├── common.yml
├── database.yml
├── playbook2.yml
└── webserver.yml
```

[Break]
Questions?

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Ansible Roles

Ansible Roles

- Best way to organize your playbooks
- Includes on steroids
  - no additional magic except directory structure and search path handling
- Special directory structure
  - You don’t need to have all the directories
  - Only what you need
  - A simple role will only have tasks/main.yml
- main.yml
  - can have include files beside it

```
examplerole/
├── defaults/
│   └── main.yml
├── files/
│   └── app.zip
├── handlers/
│   └── main.yml
├── meta/
│   └── main.yml
├── tasks/
│   └── main.yml
├── templates/
│   └── conf.ini.j2
└── vars/
    └── main.yml
```

Ansible Roles – Rules

- If tasks/main.yml exists, tasks listed therein will be added to the play.
- If handlers/main.yml exists, handlers listed therein will be added to the play.
- If vars/main.yml exists, variables listed therein will be added to the play.
- If defaults/main.yml exists, variables listed therein will be added to the play.
- If meta/main.yml exists, any role dependencies listed therein will be added.
- Any copy, script, template or include tasks in the role can reference files in: files, templates, tasks without having to path them relatively or absolutely

```
examplerole/
├── defaults/
│   └── main.yml
├── files/
│   └── app.zip
├── handlers/
│   └── main.yml
├── meta/
│   └── main.yml
├── tasks/
│   └── main.yml
├── templates/
│   └── conf.ini.j2
└── vars/
    └── main.yml
```

Ansible Roles – Example

```
# roles/memcached/tasks/main.yml
- name: Install memcacahed
  yum:
        name: memcached
        state: present

- name: Enable memecached service
  service:
        name: memcached
        state: started
```

```
# roles/httpd/tasks/main.yml
- name: Install httpd
  yum:
        name: httpd
        state: present

- name: Enable httpd service
  service:
        name: httpd
        state: started
```

```
# playbook.yml

- hosts: webservers

  roles:
    - memcached
    - httpd
```

```
roles/
├── httpd/
│   └── tasks/
│       └── main.yml
└── memcached/
    └── tasks
        └── main.yml
```

Ansible Roles – Example

```
# roles/apache2/tasks/main.yml
- name: Install apache2
  apt:
        name: apache2
        state: present

- name: Enable apache2 service
  service:
        name: apache2
        state: started
```

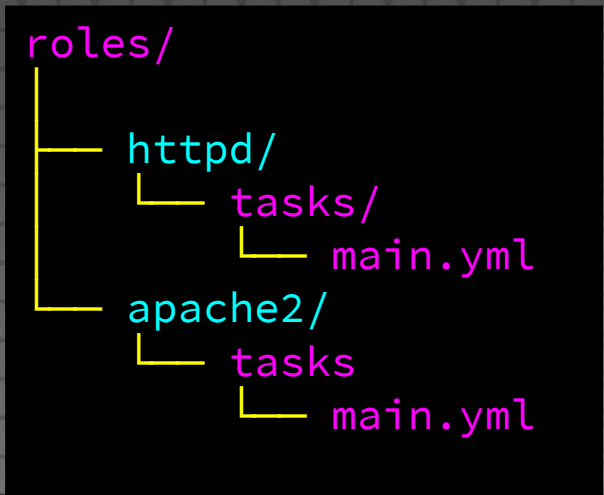
```
# roles/httpd/tasks/main.yml
- name: Install httpd
  yum:
        name: httpd
        state: present

- name: Enable httpd service
  service:
        name: httpd
        state: started
```

```
# playbook.yml

- hosts: webservers

 roles:
  - { role: httpd,  when: ansible_distribution == 'RedHat' }
  - { role: apache2,  when: ansible_distribution == 'Debian' }
```



Ansible Galaxy

- Free repository of community developed roles
- You can also use the site to share roles that you create
- Uses github authentication
- You can deploy your own internal Galaxy server
- Installing Roles

```
ansible-galaxy install username.role_name
```

- By default installs to `/etc/ansible/roles`
- A good reference point for writing your own

Ansible Roles

- Let us do the same deployment again, this time with roles
- Hardly any change in the code
- Three Roles
  - common
  - webserver
  - database
- Variable appname set in playbook
- Variables set in roles

Real World Deployment – III

Deployment

- Roles and Playbook are available:

  /opt/workshop/rwd3/common

  /opt/workshop/rwd3/webserver

  /opt/workshop/rwd3/database

  /opt/workshop/rwd3/playbook3.yml

- Copy the three roles
  - `cd /etc/ansible`
  - `cp -r /opt/workshop/rwd3/common roles/`
  - `cp -r /opt/workshop/rwd3/webserver roles/`
  - `cp -r /opt/workshop/rwd3/database roles/`
- Copy and execute the playbook
  - `cp /opt/workshop/rwd3/playbook3.yml .`
  - `ansible-playbook playbook3.yml`

```
roles/
├── common
│   ├── tasks
│   │   └── main.yml
│   ├── templates
│   │   └── ntp.conf.j2
│   └── vars
│       └── main.yml
├── database
│   ├── handlers
│   │   └── main.yml
│   ├── tasks
│   │   └── main.yml
│   ├── templates
│   │   └── my.cnf.j2
│   └── vars
│       └── main.yml
└── webserver
    ├── handlers
    │   └── main.yml
    ├── tasks
    │   └── main.yml
    ├── templates
    │   ├── index.php.j2
    │   └── vhost.conf.j2
    └── vars
        └── main.yml
```

The End

Questions?

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Workshop Material:
https://github.com/kxr/ansible-workshop