CS 447/647

Configuration Management

Overview

What is configuration management?

What programming paradigm does configuration management use?

What are the elements of configuration management?

What are some common configuration management tasks?

Configuration Management

- Changes should be
    - Structured
    - Automated
    - Consistent
- Difficult when dealing with heterogeneity
    - Debian, Ubuntu, CentOS
    - Windows: 10, Server 2012, Server 2019

Configuration Management (CM)

- Automates the management of Operating Systems
  - Eliminate toil
- Network-based
  - SSH - **ansible**
  - Client - Salt, Puppet, Chef
- Text File Configurations
  - Ansible, Salt - Yet Another Markup Language (YAML)
  - Puppet - Ruby syntax
  - Chef - IDK
- Developer Operations
  - Agile-like development process
  - Less hardware
  - More software engineering
  - Managing cloud resources
  - CLAMS - Culture, Lean, Automation, Measurement, Sharing

Configuration Management in a Nutshell

- Tradition Method
  - Shell scripts
  - Chaos - (Less time and micromanagey)
  - Procedural - violates a core Unix programming principle
- Configuration Management Method
  - Capture state in code
  - Track changes in revision control (git)
  - Declarative - Describe the state
  - Task - create user, install package, copy files, modify configuration.

Dangers of Configuration Management

- No standardization
  - Lexicons differ
    - Puppet - Agent node
    - Ansible - Host
  - Knowledge doesn’t transfer
- Don’t mix CM with ad-hoc
  - Snowflake systems
- Steep learning curves
  - Especially with large “code” bases
- Test in production
- Slows down development initially

Elements of Configuration Management

- Operations and Parameters
    - Small-scale tasks and checks
    - Out-of-the-box tasks
        - Create or remove users
        - Copy files
        - Render templates
        - Add lines to config files
        - Restart services
        - Run shell commands
    - Applied repeatedly without causing problems
    - Detect state
    - Cross-platform

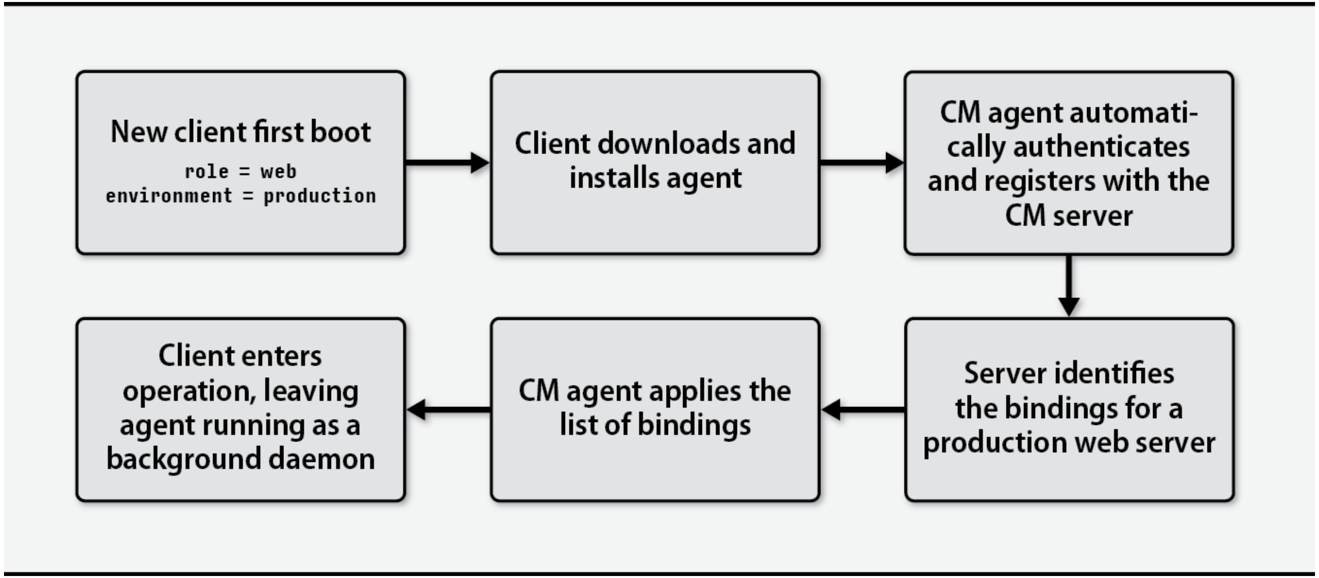
Elements of Configuration Management

- Variables
  - Used in configuration templates
  - Different scopes
  - Types
    - Scalars
    - Arrays
    - Dictionaries
- Facts
  - Discovers descriptive facts of client
    - IP
    - OS
  - Extensible

Elements of Configuration Management

- Change Handlers
  - Operations to perform after a change
    - Restart web server after config change
- Bindings
  - Associate tasks to specific Hosts
- Bundles
  - Collection of operations
    - Setting up WWW server
- Client Inventory and registration
  - Client daemon - Pull
  - Server - Push
  - Authentication

Setup



New client first boot

```
role = web
environment = production
```

Client downloads and installs agent

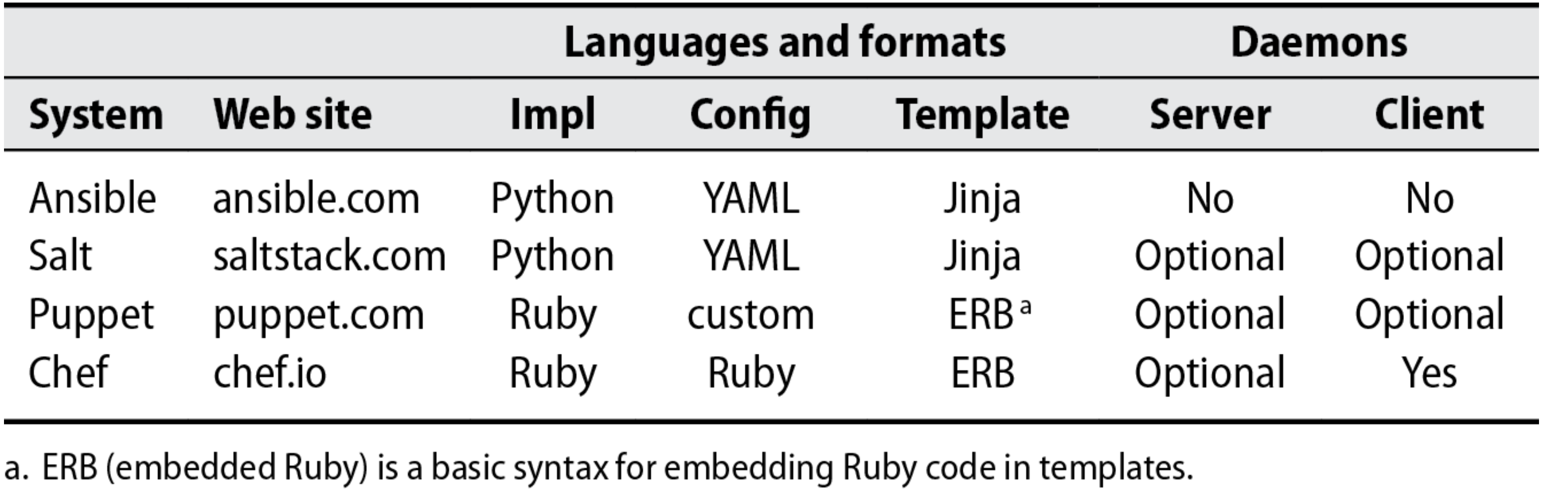
CM agent automatically authenticates and registers with the CM server

Server identifies the bindings for a production web server

CM agent applies the list of bindings

Client enters operation, leaving agent running as a background daemon

CM Systems



		Languages and formats			Daemons	
System	Web site	Impl	Config	Template	Server	Client
Ansible	ansible.com	Python	YAML	Jinja	No	No
Salt	saltstack.com	Python	YAML	Jinja	Optional	Optional
Puppet	puppet.com	Ruby	custom	ERB [a]	Optional	Optional
Chef	chef.io	Ruby	Ruby	ERB	Optional	Yes

[a] ERB (embedded Ruby) is a basic syntax for embedding Ruby code in templates.

Microsoft Configuration Management (CM) - Windows GUI, Point and click.

Why YAML?

- Simple Serialization Format
  - Encode an object as string
- Not executable
- Human readable
  - Whitespace delimited
- Broad support for languages
- Types
  - Integers, Floats, Timestamps, Collections, Strings, Dictionary (key:value)
- Defines two functions
  - Dump (Present) and Load (Construct)

https://yaml.org/

Example 2.27. Invoice

```
--- !<tag:clarkevans.com,2002:invoice>
invoice: 34843
date   : 2001-01-23
bill-to: &id001
    given  : Chris
    family : Dumars
    address:
        lines: |
            458 Walkman Dr.
            Suite #292
        city    : Royal Oak
        state   : MI
        postal  : 48046
ship-to: *id001
product:
    - sku         : BL394D
      quantity    : 4
      description : Basketball
      price       : 450.00
    - sku         : BL4438H
      quantity    : 1
      description : Super Hoop
      price       : 2392.00
tax  : 251.42
total: 4443.52
comments:
    Late afternoon is best.
    Backup contact is Nancy
    Billsmer @ 338-4338.
```

Example 2.28. Log File

```
---
Time: 2001-11-23 15:01:42 -5
User: ed
Warning:
  This is an error message
  for the log file
---
Time: 2001-11-23 15:02:31 -5
User: ed
Warning:
  A slightly different error
  message.
---
Date: 2001-11-23 15:03:17 -5
User: ed
Fatal:
  Unknown variable "bar"
Stack:
  - file: TopClass.py
    line: 23
    code: |
      x = MoreObject("345\n")
  - file: MoreClass.py
    line: 58
    code: |-
      foo = bar
```

Our term	Ansible	Salt	Puppet	Chef
operation	task	state	resource	resource
op type	module	function	resource type, provider	provider
op list	tasks	states	class, manifest	recipe
parameter	parameter	parameter	property, attribute	attribute
binding	play(book)	top file	classification, declaration	run list
master host	control	master	master	server
client host	host	minion	agent, node	node
client group	group	nodegroup	node group	role
variable	variable	variable	parameter, variable	attribute
fact	fact	grain	fact	automatic attribute
notification	notification	requisite	notify	notifies
handler	handler	state	subscribe	subscribes
bundle	role	formula	module	cookbook
bundle repo	galaxy	GitHub	forge	supermarket

Introduction to Ansible

- Configuring Ansible
  - Default configuration - `/etc/ansible/ansible.cfg`
  - User configuration - `~/.ansible.cfg`

```
Example
```

```
1. Install sudo
2. Copy a sudoers file to server
3. Correct permissions
4. Add group named sudo
5. Add users to sudo group
```

pip and virtualenv

- pip is a tool for installing and managing Python packages
  - ansible
  - psycopg2 - PostgreSQL database driver
  - Bundled with Python >=3.4
- PyPi (Python Package Index) is a software repository
  - 221,549 projects
- virtualenv is a tool to isolate your Python environment
  - Separates libraries from the system

Virtual Environments

- What if different applications require conflicting versions of a package?
- Can’t install everything to `/usr/lib/python3.6/site-packages`
- Virtual environments have their own installation directories
- Work on different projects or use different applications within their own virtual environments

virtualenv

- `apt install virtualenv python3-virtualenv`
- `virtualenv -p python3 path/env_name` — create environment
- `source path/env_name/bin/activate` — activate environment (Unix)
- pip is installed into the environment