

# Infrastructure as Code

CSSE6400

Brae Webb

March 21, 2022

Infrastructure as Code

# How did we get here?

Pre-2000

# The *Iron Age*

## Iron Age



## Iron Age



Introducing...

# The *Cloud Age*

## The Cloud Age



When faced with complexity

**Automate it!**



# The larger story

Server Config Config Management

# The larger story

Server Config   Config Management  
Application Config   Config Files

# The larger story

Server Config   Config Management  
Application Config   Config Files  
Provisioning   Infrastructure Code

# The larger story

Server Config   Config Management  
Application Config   Config Files  
Provisioning   Infrastructure Code  
Building   Continuous Integration

# The larger story

|                    |                        |
|--------------------|------------------------|
| Server Config      | Config Management      |
| Application Config | Config Files           |
| Provisioning       | Infrastructure Code    |
| Building           | Continuous Integration |
| Deployment         | Continuous Deployment  |

# The larger story

|                    |                        |
|--------------------|------------------------|
| Server Config      | Config Management      |
| Application Config | Config Files           |
| Provisioning       | Infrastructure Code    |
| Building           | Continuous Integration |
| Deployment         | Continuous Deployment  |
| Testing            | Automated Tests        |

# The larger story

Server Config   Config Management

Application Config   Config Files

Provisioning   Infrastructure Code

Building   Continuous Integration

Deployment   Continuous Deployment

Testing   Automated Tests

Database Administration   Schema Migration

# The larger story

Server Config   Config Management

Application Config   Config Files

Provisioning   Infrastructure Code

Building   Continuous Integration

Deployment   Continuous Deployment

Testing   Automated Tests

Database Administration   Schema Migration

Specifications   Behaviour Driven Development



### Definition 1. Infrastructure Code

Code that provisions and manages *infrastructure resources*.

## Definition 2. Infrastructure Code

Code that provisions and manages *infrastructure resources*.

## Definition 3. Infrastructure Resources

Compute resources, networking resources, and storage resources.

## Infrastructure Code



```
1  #!/bin/bash
3  SG=$(aws ec2 create-security-group ...)
5  aws ec2 authorize-security-group-ingress --group-id "$SG"
7  INST=$(aws ec2 run-instances --security-group-ids "$SG" \
8      --instance-type t2.micro)
```

```
1 import boto3

3 def create_instance():
4     ec2_client = boto3.client("ec2", region_name="us-east-1")
5     response = ec2.create_security_group(...)
6     security_group_id = response['GroupId']

8     data = ec2.authorize_security_group_ingress(...)

10     instance = ec2_client.run_instances(
11         SecurityGroups=[security_group_id],
12         InstanceType="t2.micro",
13         ...
14     )
```

```
1 resource "aws_instance" "hextris-server" {
2     instance_type = "t2.micro"
3     security_groups = [aws_security_group.hextris-server.name]
4     ...
5 }

7 resource "aws_security_group" "hextris-server" {
8     ingress {
9         from_port = 80
10        to_port = 80
11        ...
12    }
13    ...
14 }
```

Question

Notice anything different?

The *main* difference

# Imperative vs. declarative



## Infrastructure Code

- Provisions and manages *infrastructure resources*.

## Infrastructure Code

- Provisions and manages *infrastructure resources*.
- Only one part of the movement to *automate* the complexities of development.

## Infrastructure Code

- Provisions and manages *infrastructure resources*.
- Only one part of the movement to *automate* the complexities of development.
- Ranges from simple shell scripts up to...?

## Infrastructure Code

- Provisions and manages *infrastructure resources*.
- Only one part of the movement to *automate* the complexities of development.
- Ranges from simple shell scripts up to...?
- Tendancy to be *declarative*.

Typo?

Infrastructure Code  $\neq$  Infrastructure *as* Code

## Definition 4. Infrastructure as Code

Following the same *good coding practices* to manage Infrastructure Code as standard code.

Warning!

Infrastructure as Code still *early* and quite *bad*.

Question

What are *good coding practices*?



Good Coding Practice #1

*Everything* as code

```
1  #!/bin/bash
3  ./download-dependencies
4  ./build-resources
5  cp -r output/* artifacts/
```

```
1  #!/bin/bash
3  ./download-dependencies
4  ./build-resources
5  cp -r output/* artifacts/
```

```
1  $ cp: directory artifacts does not exist
```

```
1 resource "aws_instance" "hextris-server" {  
2     instance_type = "t2.micro"  
3     security_groups = ["sg-6400"]  
4     ...  
5 }
```

```
1 resource "aws_instance" "hextris-server" {
2     instance_type = "t2.micro"
3     security_groups = [aws_security_group.hextris-server.name]
4     ...
5 }

7 resource "aws_security_group" "hextris-server" {
8     ingress {
9         from_port = 80
10        to_port = 80
11        ...
12    }
13    ...
14 }
```

Everything as code avoids

# Configuration drift

Configuration drift creates

# Snowflakes

## Benefits

1. Reproducible.



Good Coding Practice #2

# Version control

## Benefits

1. Restorable.
2. Accountable.

Good Coding Practice #3

# Automation

## Benefits

### 1. Consistent.

Good Coding Practice #4

# Code Reuse

## Benefits

1. Better<sup>1</sup> code.
2. Less work.
3. Only one place to update (or verify).

---

<sup>1</sup>generally

Good Coding Practice #5

# Testing

# Test Pyramid





# laC Test Pyramid



```
1 func TestTerraformAwsInstance(t *testing.T) {
2     terraformOptions := terraform.WithDefault(t, &terraform.Options{
3         TerraformDir: "../week03/",
4     })
5
6     defer terraform.Destroy(t, terraformOptions)
7     terraform.InitAndApply(t, terraformOptions)
8
9     publicIp := terraform.Output(t, terraformOptions, "public_ip")
10    url := fmt.Sprintf("http://%s:8080", publicIp)
11
12    http_helper.HttpGetWithCustomValidation(t, url, nil, 200,
13        func(code, resp) { code == 200 &&
14            strings.Contains(resp, "hextris")})
15 }
```

```
1 Feature: Define AWS Security Groups

3 Scenario: Only selected ports should be publicly open
4     Given I have AWS Security Group defined
5     When it contains ingress
6     Then it must only have tcp protocol and port 22,443 for 0.0.0.0/0
```

## Benefits

### 1. Trust.