Infrastructure as Code

Software Architecture

Brae Webb

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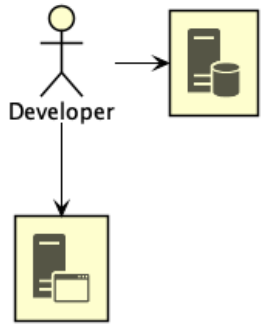
- Do a quick poll.
- Who has heard the term IaC before this course?
- Who has used IaC before this course?

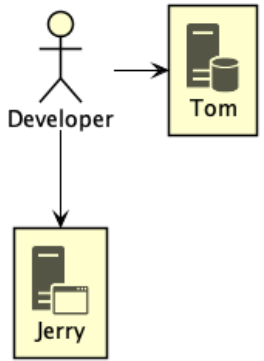
How did we get here?

Pre-2000

The *Iron Age*

Iron Age

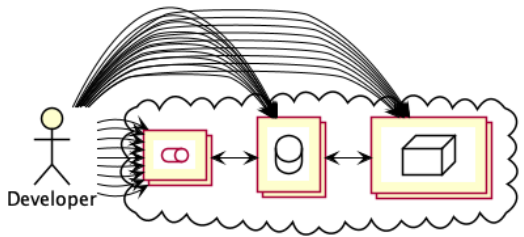




Developer only had a few machines — so few the machines often got fun names.

Introducing...

The *Cloud Age*



- Summarise: things got complicated quickly, we need more hardware and it's easier to provision.
- Largely thanks to virtualization — no physical activity for a new machine.

When faced with complexity

Automate it!

- We have too much to manage to do it manually.
- We're about to start enumerating automation techniques.

The larger story

Server Config Config Management

The larger story

Server Config	Config Management
Application Config	Config Files

The larger story

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Application Config	Config Files
Provisioning	Infrastructure Code

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Specifications	Behaviour Driven Development

Definition 1. Infrastructure Code

Code that provisions and manages *infrastructure resources*.

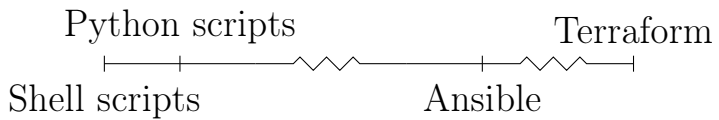
Definition 2. Infrastructure Code

Code that provisions and manages *infrastructure resources*.

Definition 3. Infrastructure Resources

Compute resources, networking resources, and storage resources.

Infrastructure Code



IC often thought of as the right-hand side but includes all.

```
#!/bin/bash

SG=$(aws ec2 create-security-group ...)

aws ec2 authorize-security-group-ingress --group-id "$SG"

INST=$(aws ec2 run-instances --security-group-ids "$SG" \
        --instance-type t2.micro)
```

Using aws CLI to create EC2 access like the practical.

```python
import boto3

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

    data = ec2.authorize_security_group_ingress(...)

    instance = ec2_client.run_instances(
        SecurityGroups=[security_group_id],
        InstanceType="t2.micro",
        ...
    )
```

Using aws python library (boto3).

```
resource "aws_instance" "hextris-server" {
    instance_type = "t2.micro"
    security_groups = [aws_security_group.hextris-server.name]
    ...
}

resource "aws_security_group" "hextris-server" {
    ingress {
        from_port = 80
        to_port = 80
        ...
    }
    ...
}
```

Finally, terraform.

Question

Notice anything different?

- Prompting for declarative.
- Might notice verbosity.

The main difference

Imperative vs. declarative

IC is heading towards a more declarative paradigm.

Infrastructure Code

- Provisions and manages *infrastructure resources*.

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- Only one part of the movement to *automate* the complexities of development.

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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*.

Summarising what we've already covered.

Typo?

Infrastructure Code ≠ Infrastructure *as* Code

- Mention that this distinction is ours.
- Real world unfortunately mixes the two.

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*.

- Code reuse is low.
- Importing existing resources is non-trivial.
- Refactoring is painful.
- State management can be tricky.

Question

What are *good coding practices*?

Ask the class.

Good Coding Practice #1

Everything as code

A practice we do but barely discuss in 'regular' programming because it doesn't make sense not to do it.

```
#!/bin/bash

./download-dependencies
./build-resources
cp -r output/* artifacts/
```

```
#!/bin/bash

./download-dependencies
./build-resources
cp -r output/* artifacts/
```

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

An example of relying on external state in ‘regular’ programming.

```
resource "aws_instance" "hextris-server" {
    instance_type = "t2.micro"
    security_groups = ["sg-6400"]
    ...
}
```

Draw a parallel to the bash example and this, which relies on ‘sg-6400’ existing.

```
resource "aws_instance" "hextris-server" {
    instance_type = "t2.micro"
    security_groups = [aws_security_group.hextris-server.name]
    ...
}

resource "aws_security_group" "hextris-server" {
    ingress {
        from_port = 80
        to_port = 80
        ...
    }
    ...
}
```

The better approach.

Everything as code avoids

Configuration drift

Configuration drift creates

Snowflakes

- Snowflakes: magical machines that 'just work' and everyone is afraid to touch.
- Snowflake because they're unique and easy to break because no one knows how it works.

Benefits

1. Reproducible.

Good Coding Practice #2

Version control

Benefits

1. Restorable.
2. Accountable.

Good Coding Practice #3

Automation

Benefits

1. Consistent.

Automatically applying or checking IC is in sync means the main branch is consistent with reality.

Good Coding Practice #4

Code Reuse

Benefits

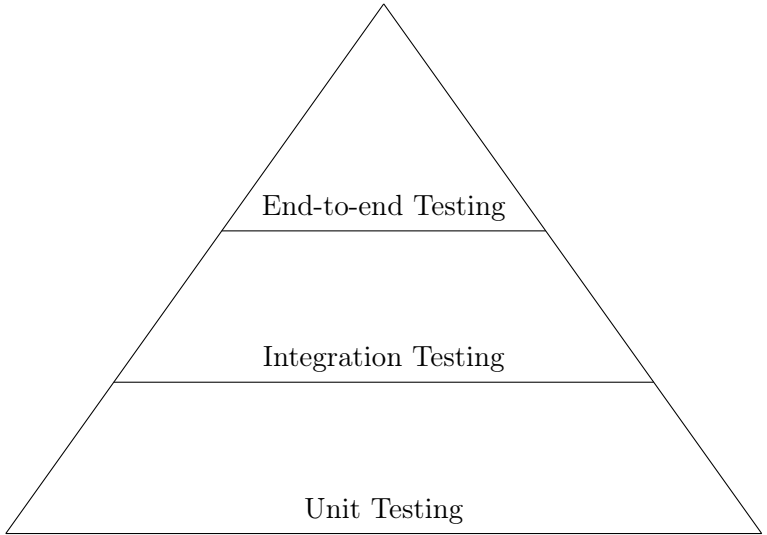
1. Better[1] code.
2. Less work.
3. Only one place to update (or verify).

[1] generally

Good Coding Practice #5

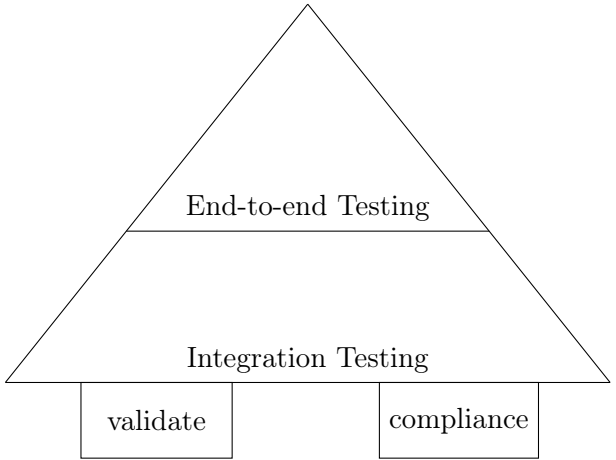
Testing

Test Pyramid



- Traditional test pyramid.
- Unit testing relies of isolated testing.
- But... isolated testing doesn't make *much* sense for IaC.

IaC Test Pyramid



```go
func TestTerraformAwsInstance(t *testing.T) {
    terraformOptions := terraform.WithDefault(t, &terraform.Options{
        TerraformDir: "../week03/",
    })

    defer terraform.Destroy(t, terraformOptions)
    terraform.InitAndApply(t, terraformOptions)

    publicIp := terraform.Output(t, terraformOptions, "public_ip")
    url := fmt.Sprintf("http://%s:8080", publicIp)

    http_helper.HttpGetWithCustomValidation(t, url, nil, 200,
        func(code, resp) { code == 200 &&
                           strings.Contains(resp, "hextris")})
}
```

```
Feature: Define AWS Security Groups

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

An example of compliance testing.

Benefits

1. Trust.