

Get ready for the cloud!

A new paradigm in scientific computing

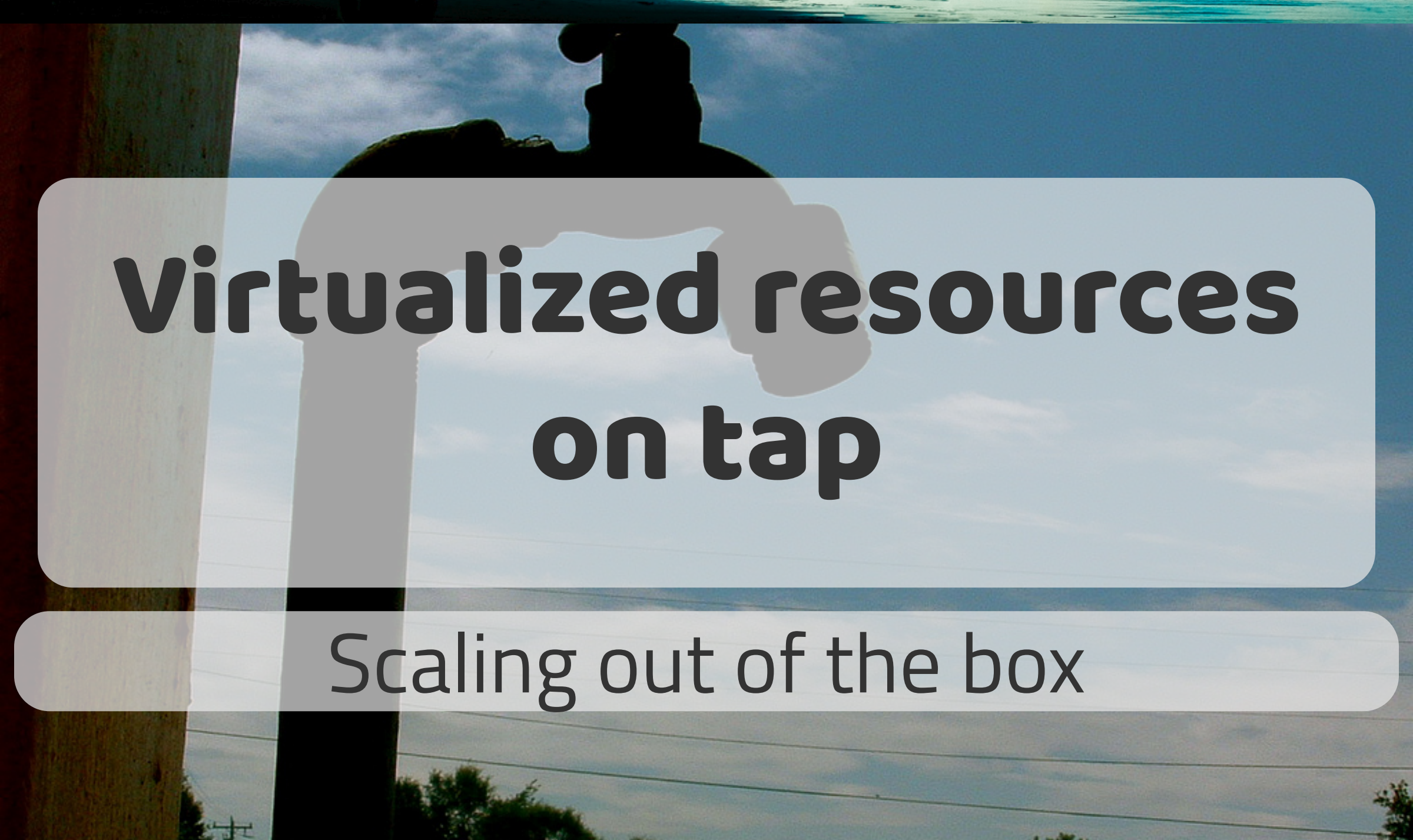
@jjmere1o



What is the cloud?



**Cloud is where you
run your programs**



Virtualized resources on tap

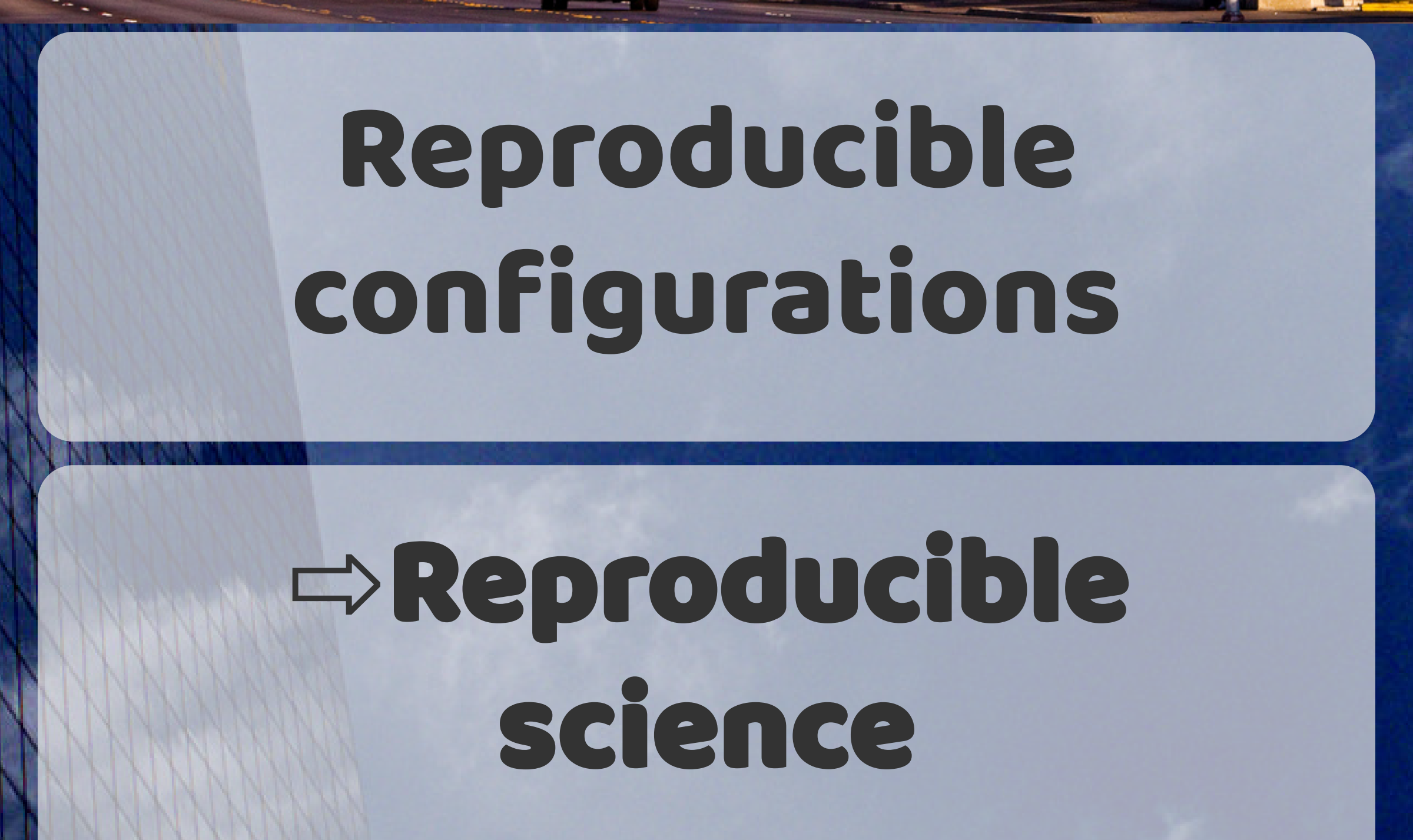
Scaling out of the box

A photograph of a car manufacturing assembly line. Two workers, a man and a woman, are shown in blue uniforms and safety glasses. The man is on the left, and the woman is on the right, both focused on their work. They are working on a car chassis that is mounted on a conveyor belt. The background shows the industrial setting with bright overhead lights and other parts of the factory.

Infrastructure as code

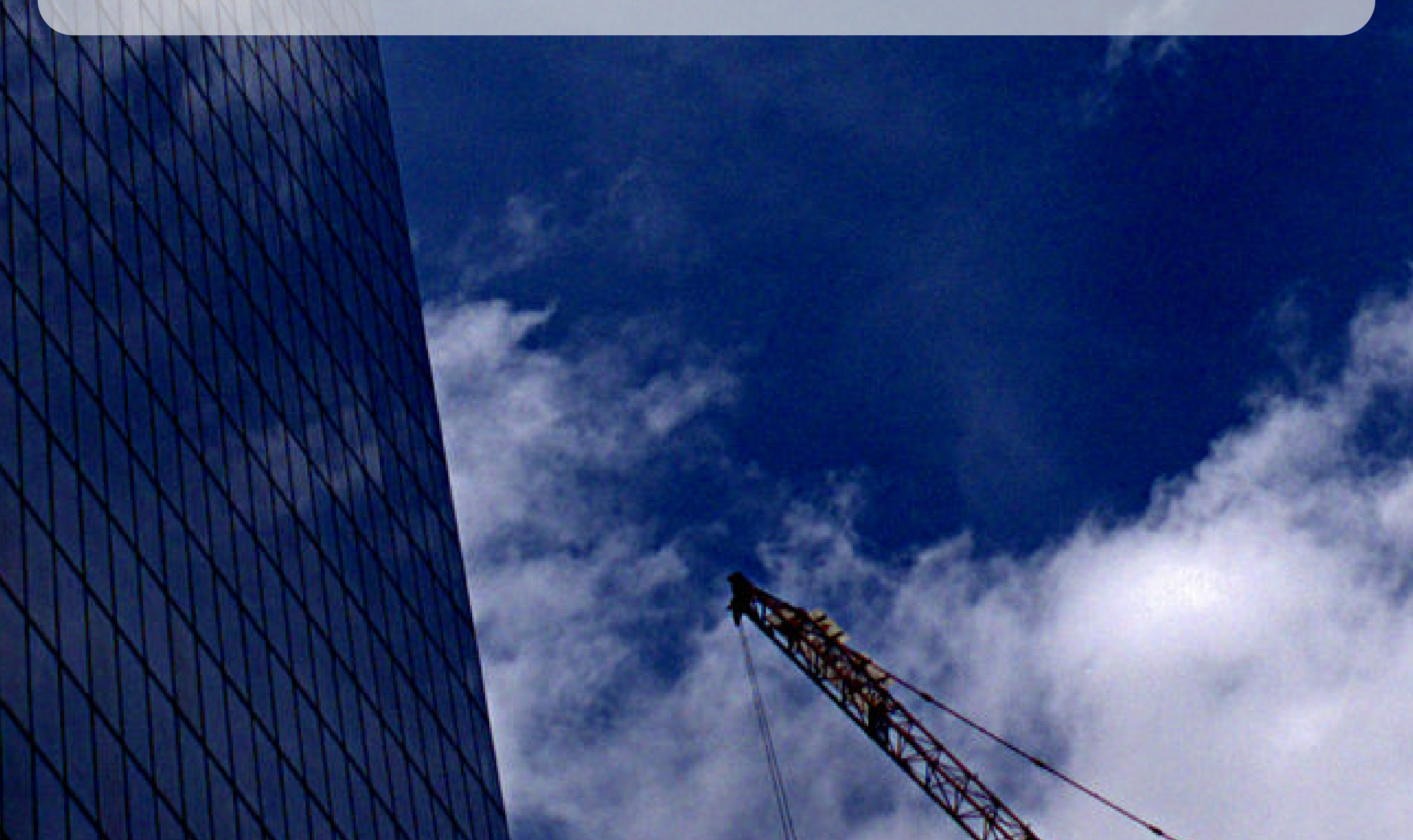
Distributed, multi- vendor, computing





**Reproducible
configurations**

⇒ **Reproducible
science**



The background of the image is a photograph of a city skyline during a sunset or sunrise. The sky is filled with soft, colorful clouds in shades of orange, yellow, and blue. The city buildings are silhouetted against the bright horizon. A semi-transparent white rectangular box with rounded corners is centered over the image, containing the text.

A new application development and deployment paradigm

The background is a photograph of a brick wall. The bricks are light-colored and arranged in a standard pattern. There are some faint, blue, hand-drawn markings on the wall, which appear to be graffiti or a technical diagram. These markings include lines and shapes that could represent a network or a structural layout. A semi-transparent white rounded rectangle is overlaid on the center of the image, containing the text.

**.. designed around
scaling**

**Why use the cloud in
scientific computing?**

✓ **It's new!**

✓ **No sunk costs!**

✓ **It scales!**

**→ It changes the
algorithmic paradigm**



**Let Nature be your
guide**

The background of the slide is a photograph of a sunset or sunrise. The sky is filled with soft, colorful clouds in shades of blue, orange, and yellow. A faint rainbow is visible in the upper center of the sky. In the foreground, the silhouettes of buildings and structures are visible against the bright horizon.

Cloud is about reproducible
infrastructure

A stack of three clear plastic storage bins is placed on a wooden desk. The bins are filled with various items, including what appears to be a laptop in the top bin and some papers or small objects in the middle bin. The bottom bin is partially visible and contains some dark, indistinct items. In the background, several people are seated at desks, suggesting a classroom or workshop environment. A semi-transparent grey box with rounded corners is overlaid on the middle bin, containing the text "Let's containerize".

Let's containerize

Describe infrastructure:

package.json

```
{
  "name": "hiffeitor",
  "scripts": {
    "test": "mocha",
    "start": "./callback-ea-HIFF.js"
  },
  "dependencies": {
    "nodeo": "^0.2.1",
    "winston": "^2.2.0",
    "winston-logstash": "^0.2.11",
    "winston-papertrail": "^1.0.2"
  },
  "devDependencies": {
    "flightplan": "^0.6.14"
  }
}
```

Introducing **docker**

Lightweight virtualization

***Portable* infrastructure**

Using docker

```
docker pull jjmerelo/cloudy-ga
```


Containerizing through

Dockerfile

```
FROM phusion/baseimage
MAINTAINER JJ Merelo "jjmerelo@gmail.com"
RUN echo "Building a docker environment for NodeO"
ENV DEBIAN_FRONTEND=noninteractive
RUN apt-get update && apt-get upgrade -y
RUN apt-get install apt-utils -y
[... more stuff ... ]
ADD https://github.com/JJ/cloudy-ga/raw/master/app/hiff.json app
WORKDIR /app
RUN npm i
RUN chmod +x callback-ea-HIFF.js
```

```
CMD npm start
```

```
sudo docker build .
```

```
to Docker daemon 8.341 MB
```

```
6.04
```

```
brary/ubuntu
```

```
plete
```

```
plete
```

```
plete
```

```
plete
```

```
ec34f66d8a7ff5b42e6971625d8232c72bf0e38ad06
```

**Bring your own
container**

```
cc34100da71f3b42e0971023da0232c72b10e30ad0c  
er image for ubuntu:16.04  
sudo docker build
```

```
Mereto "jjmereto@gmail.com"  
df5c497  
--no-cache -t
```

```
container 8df5ddf5c497  
lding a docker environment for Node0"  
27556f6  
jjmereto/cloudy-
```

```
ronment for Node0  
ga:0.0.1  
container 39beb27556f6  
ca89e56a9
```


... and run it

```
sudo docker run -t jjmerelo/cloudy-ga:0.0.1  
  -e "PAPERTRAIL_PORT=7777"  
  -e "PAPERTRAIL_HOST=logs77.papertrailapp.com"
```

Logging matters

[illegible]

**It's not programming as
usual**

Reactive programming

**Algorithm + stream =
application in the cloud**

Decoupled processing and data structures

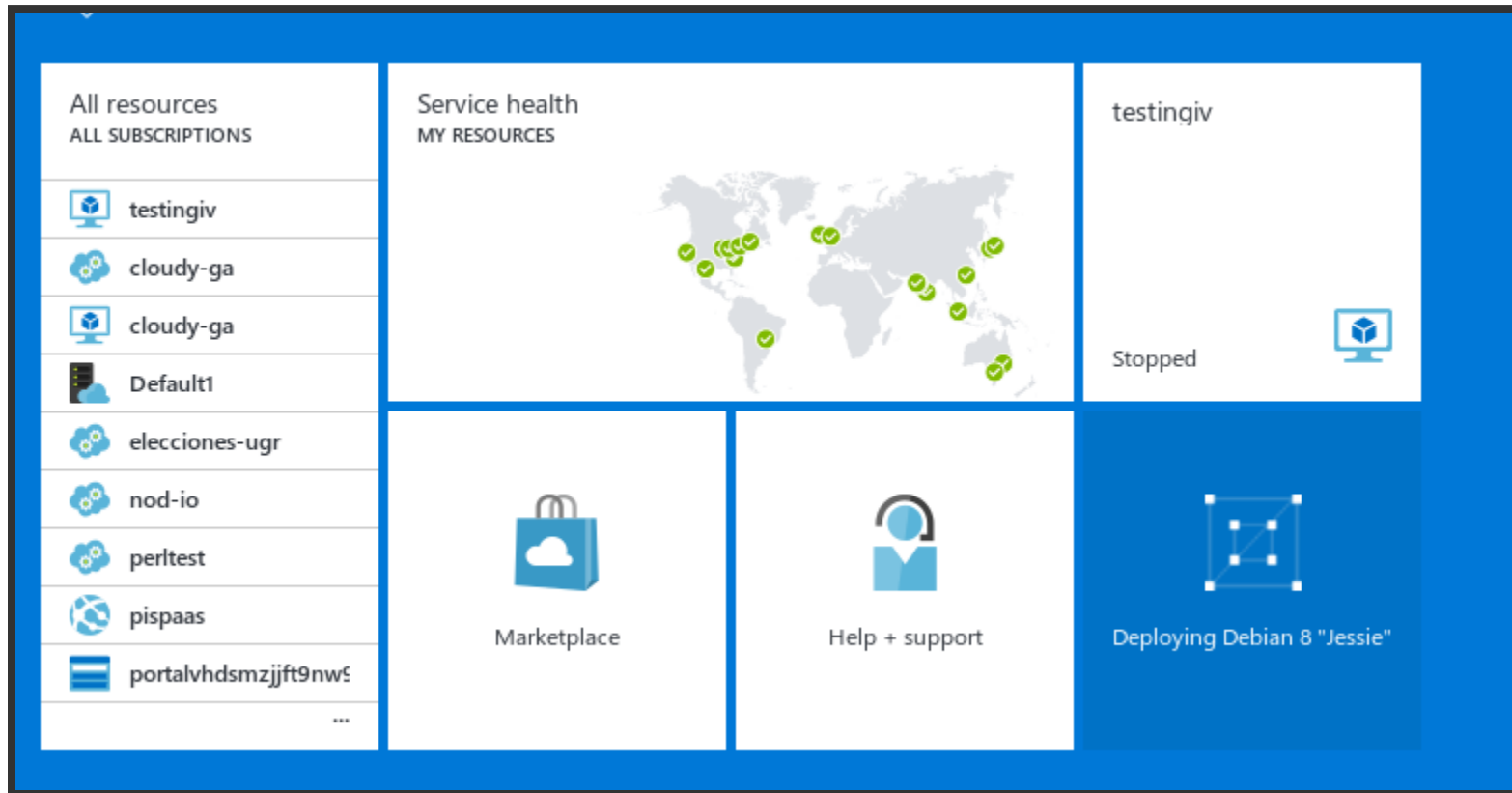
An aerial photograph showing a thick, white layer of clouds covering a vast landscape. Below the clouds, dark, rugged mountain ranges are visible. The sky above the clouds is a clear, pale blue. In the bottom right corner, a portion of an aircraft's wing or fuselage is visible, suggesting the photo was taken from a high altitude.

Running in the cloud

A photograph of a wooden sandbox in a backyard. Inside the sandbox, there is a white wire mesh chair and a small green and blue toy car. The text "Infrastructure as a service" is overlaid in a large, bold, black font on a semi-transparent white rectangular background.

Infrastructure as a service

Create instance



Set up with Ansible

```
- hosts: "{{target}}"
  tasks:
    - name: install prerequisites
      command: apt-get update -y && apt-get upgrade -y
    - name: install packages
      apt: pkg={{ item }}
      with_items:
        - git
        - npm
    - name: Create profile
  copy: content="export PAPERTRAIL_PORT={{ PAPERTRAIL_PORT }}"
      dest=/home/cloudy/.profile
```

Run the *playbook*

PLAY [all] *****

GATHERING FACTS *****

ok: [default]

TASK: [install prerequisites] *****

changed: [default]

TASK: [install packages] *****

changed: [default] => (item=language-pack-en,language-pack-es,git,curl,build-essential,libssl-dev,nodejs,npm)

PLAY RECAP *****

default : ok=3 changed=2 unreachable=0 failed=0

=> default: Running provisioner: code (ansible)...

default: Running ansible-playbook...

PLAY [all] *****

GATHERING FACTS *****

ok: [default]

TASK: [clone repo] *****

changed: [default]

PLAY RECAP *****

default : ok=2 changed=1 unreachable=0 failed=0

Ready to run ✓

[illegible]

**But there's
something missing
here**



Deploying to the cloud

The background of the slide features a person's hands holding a laptop, with the laptop screen displaying a scenic view of a mountain range under a clear blue sky. The person's hands are visible from the wrists up, and the laptop is held horizontally. The overall image has a soft, slightly blurred quality, giving it a professional yet approachable feel.

Let's use **FlightPlan**

```
plan.target('azure', {
  host: 'cloudy-ga.cloudapp.net',
  username: 'azureuser',
  agent: process.env.SSH_AUTH_SOCK
});
// Local
plan.local(function(local) {
  local.echo('Plan local: push changes');
  local.exec('git push');
});
```


... And after setup

```
plan.remote(function(remote) {  
  remote.log('Pull');  
  remote.with('cd cloudy-ga',function() {  
    remote.exec('git pull');  
    remote.exec('cd app;npm install .');  
  });  
  remote.with('cd /home/azureuser/cloudy-ga/app',function() {  
    remote.exec('npm start');  
  });  
});
```

The background of the slide is a photograph of a person jumping over waves. The person is in silhouette, with their arms raised in the air. The sky is blue with white, fluffy clouds, and the sun is shining from the upper right, creating a lens flare. The water is dark blue with white foam from the waves.

IaaS have free *tiers*

But it generally is pay-as-you-go

Great if you do small amounts of computation



**Make do without a
server**



Platform as a service

There's *freemium* PaaS

Heroku, OpenShift, IBM's BlueMix and Google AppSpot

 Applications1 of 3 Available in domain [jmerelo](#)**objiv**

Node.js 0.10



1

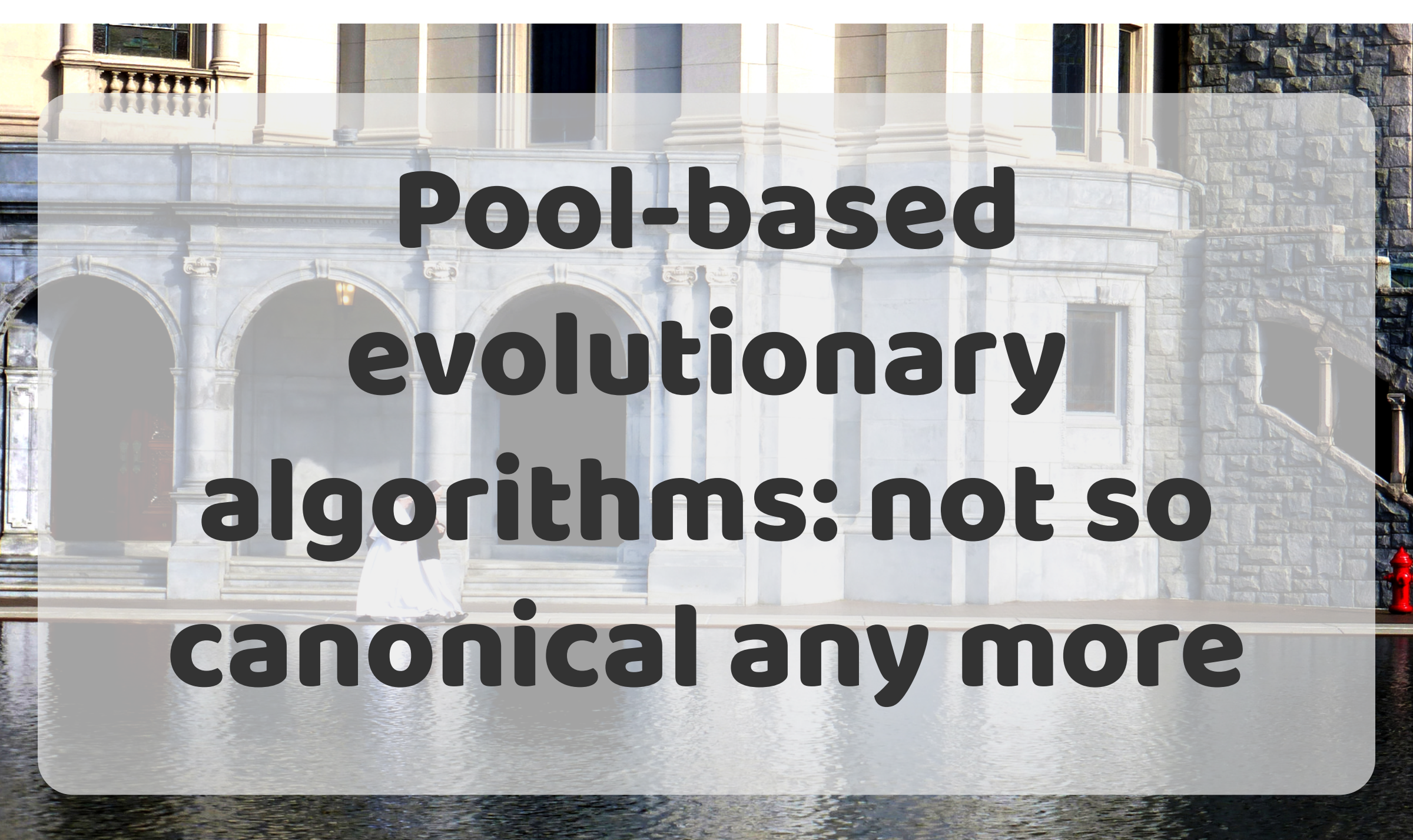
[Add Application...](#)

You may want to...

[Add a database to an app](#) [Add a collaborator](#) [Use your own domain name](#) [Create a scalable application](#) 

From the command line

The `rhc` client lets you:[Access logs](#) [Save and restore backups](#) [Connect directly to internal services](#) 

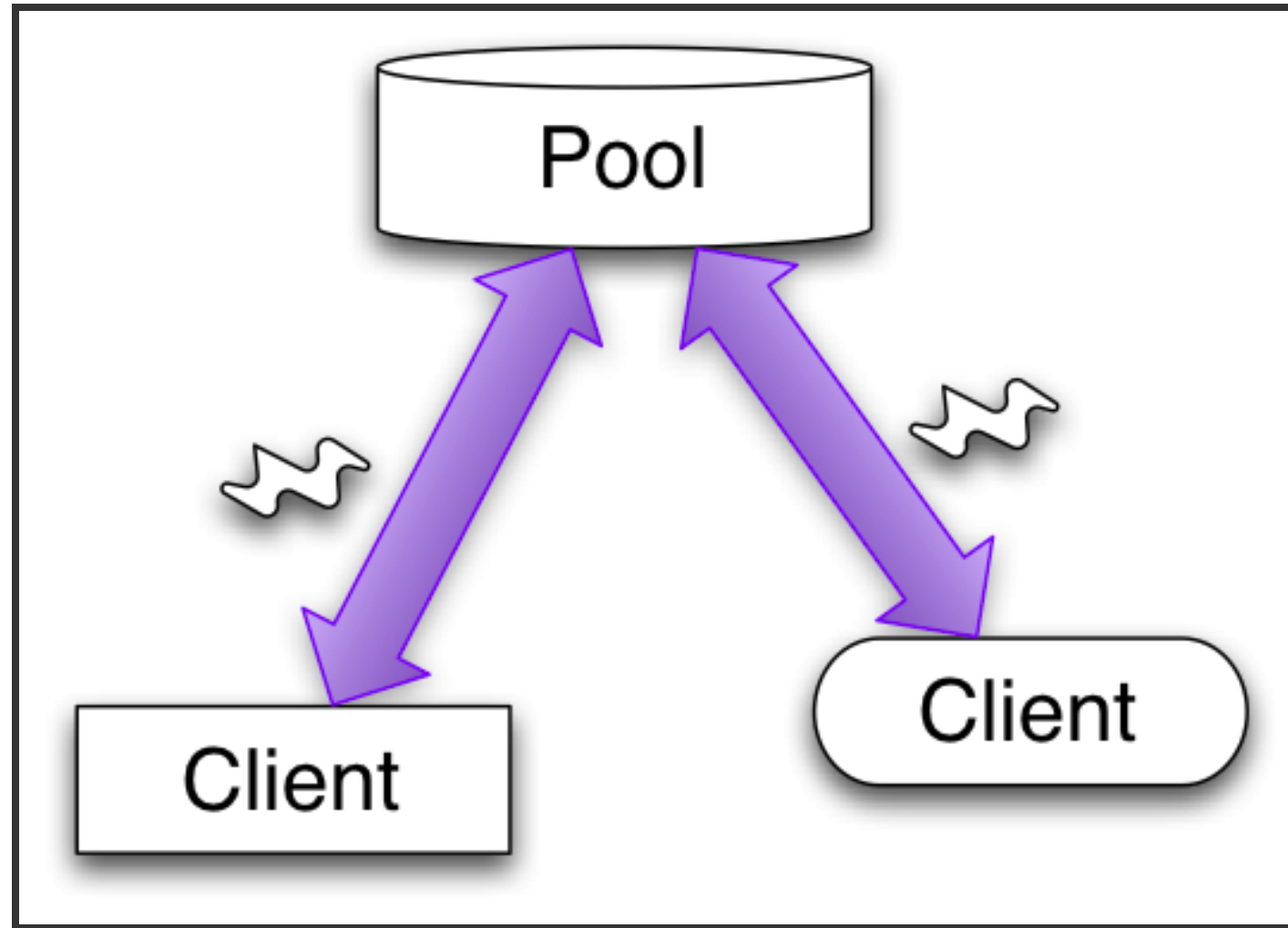


**Pool-based
evolutionary
algorithms: not so
canonical any more**



Detaching population from operations

→ **Reactive
programming.**





Three good things about pool-based EAs

- 1. Self-organizing clients**
- 2. Fully asynchronous**
- 3. Persistent population**



**Island models can be
used too**

Deploy server to PaaS ✓

Deploy clients to IaaS ✓

→ And do science!


```
y-ga1029.cloudapp.net > info:  chromosome=01010010110101001011011001001110000100110001111011001110010001000000001110001011000
```

Come together now!

Vagrant for orchestration

```
Vagrant.configure("2") do |config|
  config.vm.box = "ubuntu/xenial64"
  config.vm.provision "shell", inline: <<-SHELL
    apt-get update
    apt-get upgrade -y
  SHELL
  config.vm.provision "main", type: "ansible" do |ansible|
    ansible.extra_vars = { target: "all" }
    ansible.playbook = "playbook.yml"
  end
  # and the rest...
end
```

All together

✓ Get servers → PaaS, Loggers

✓ Create/provision boxes → Vagrant + Ansible

✓ Deploy/run → FlightPlan

Take this home

1. **Cloud** is the new (grid|cluster)
2. There is an (almost) **free** lunch
3. **Reactive** programming
4. We should ♥ **logs**



Questions?

Tweet out (of follow) [@jjmere10](https://twitter.com/jjmere10)

Credits

- Running and clouds by Hernán Piñera
- Car assembly by Chrysler group
- Faucet on the sky by Kristin Nador
- Strip mall by Thomas Hawk
- Mobiles, Flickr image by Kai Hendry [flic.kr/p/50mH5r](https://www.flickr.com/photos/50mH5r/)
- People in room from Adriaan Bloem [flic.kr/p/8NDCRh](https://www.flickr.com/photos/8NDCRh/)
- Shooting at clouds by Charles Prithvi Raj
- Sandbox, Flickr image by Gil Garcia [flic.kr/p/5Pa7ZJ](https://www.flickr.com/photos/5Pa7ZJ/)

B&W sandbox, Flickr image by Stefani Woods

[flic.kr/p/4QiGQV](https://www.flickr.com/photos/4QiGQV/)

HTTP codes, Image by Paul Downey [flic.kr/p/8yZyBF](https://www.flickr.com/photos/8yZyBF/)

Data center in cave, from Antony Antony [flic.kr/p/6K3ZAG](https://www.flickr.com/photos/6K3ZAG/)

Nuns and pool, Flickr image by Lorianne diSabato

[@flic.kr/p/nXfbQ6](https://www.flickr.com/photos/nXfbQ6/)

3 fingers, Flickr image by Mutiara Karina

[https://flic.kr/p/a955m3](https://www.flickr.com/photos/a955m3/).

Freedom by Gonzalo Baeza