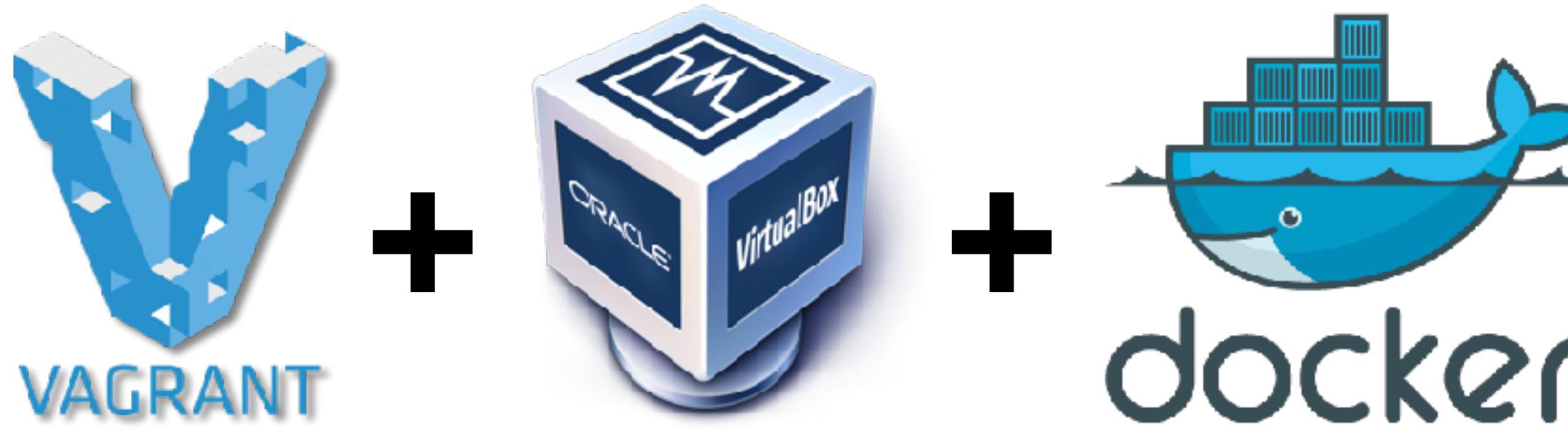


Making Developers More Productive with Vagrant, VirtualBox, and Docker



John J. Rofrano

Senior Technical Staff Member, IBM T.J. Watson Research

DevOps Principle of the Day: **“AUTOMATE EVERYTHING!”**

Even the Development Team !!!

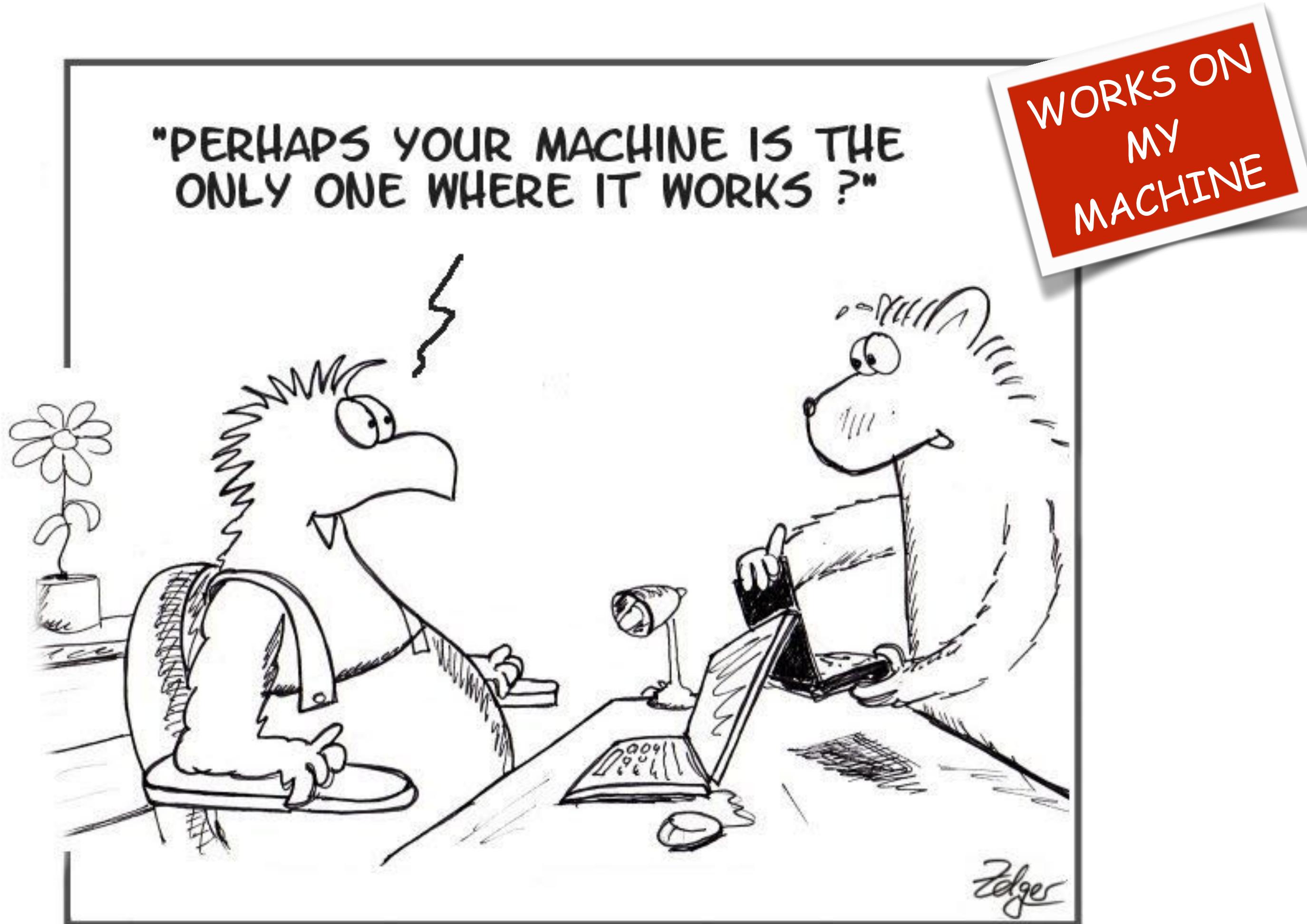
What We Will Cover?

- How to create customized development environments with Vagrant and VirtualBox that can be created and destroyed and created again in a consistent fashion
- How to leverage Docker containers for middleware deployment
- How to make your DevOps team more productive with just a single command: > vagrant up

The Problem

- Manually creating local environments for developers to work in is:
 - Time consuming
 - Error prone
 - Inconsistent at best
 - Unreproducible at worst!

The Goal is to Avoid This



It works on my machine

The Wrong Solution

- Carefully and painstakingly create documentation in the form of “runbooks” that give step-by-step instructions on how to recreate the development environment via cut-n-paste
- NOT VERY AGILE !!!
 - *We value: Working software over comprehensive documentation*

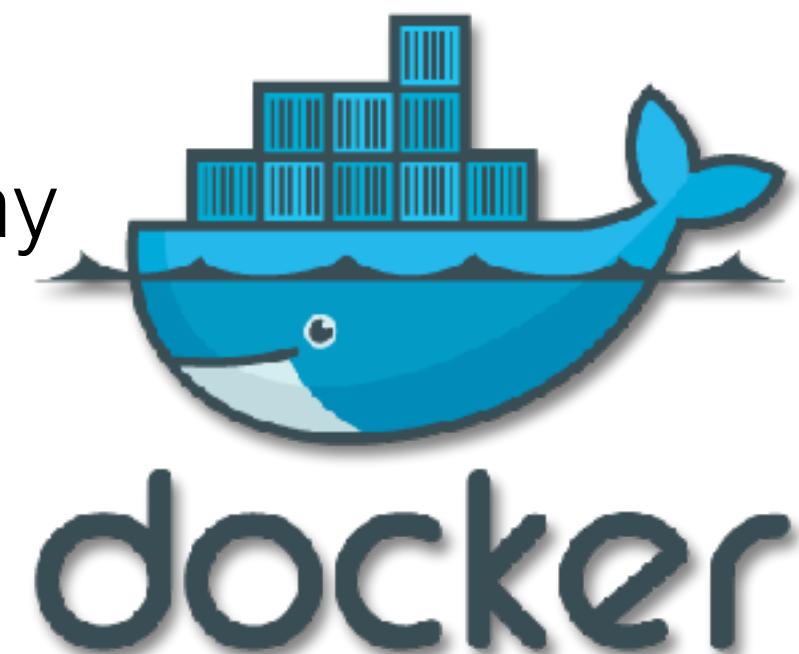
The Right Solution

- Automate the creation of local development environments right on your laptop or desktop



Use Vagrant to quickly provision complex configurations consistently with repeatability

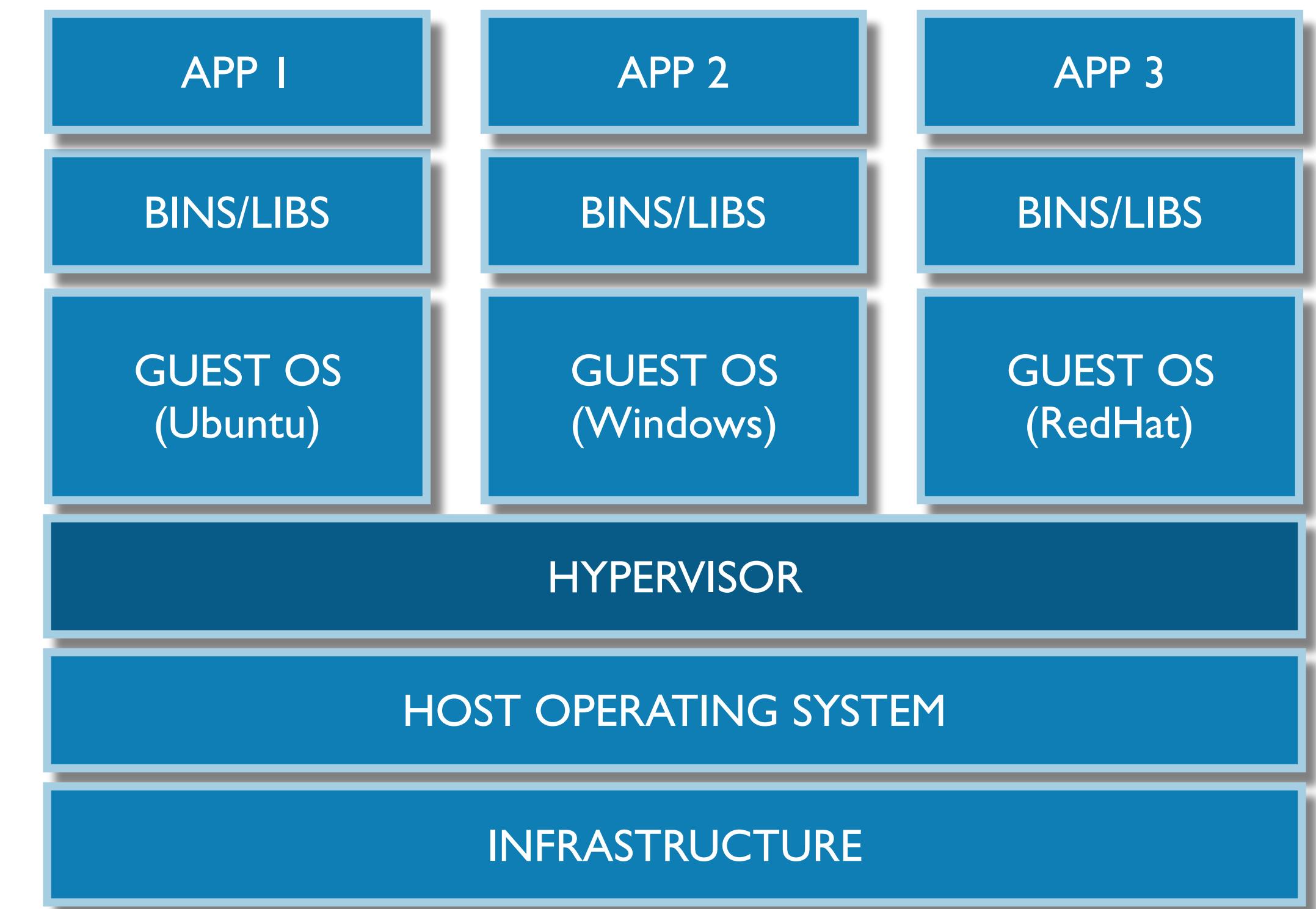
Use Docker to handle middleware without any installation



Use VirtualBox to create Virtual Machines to develop in

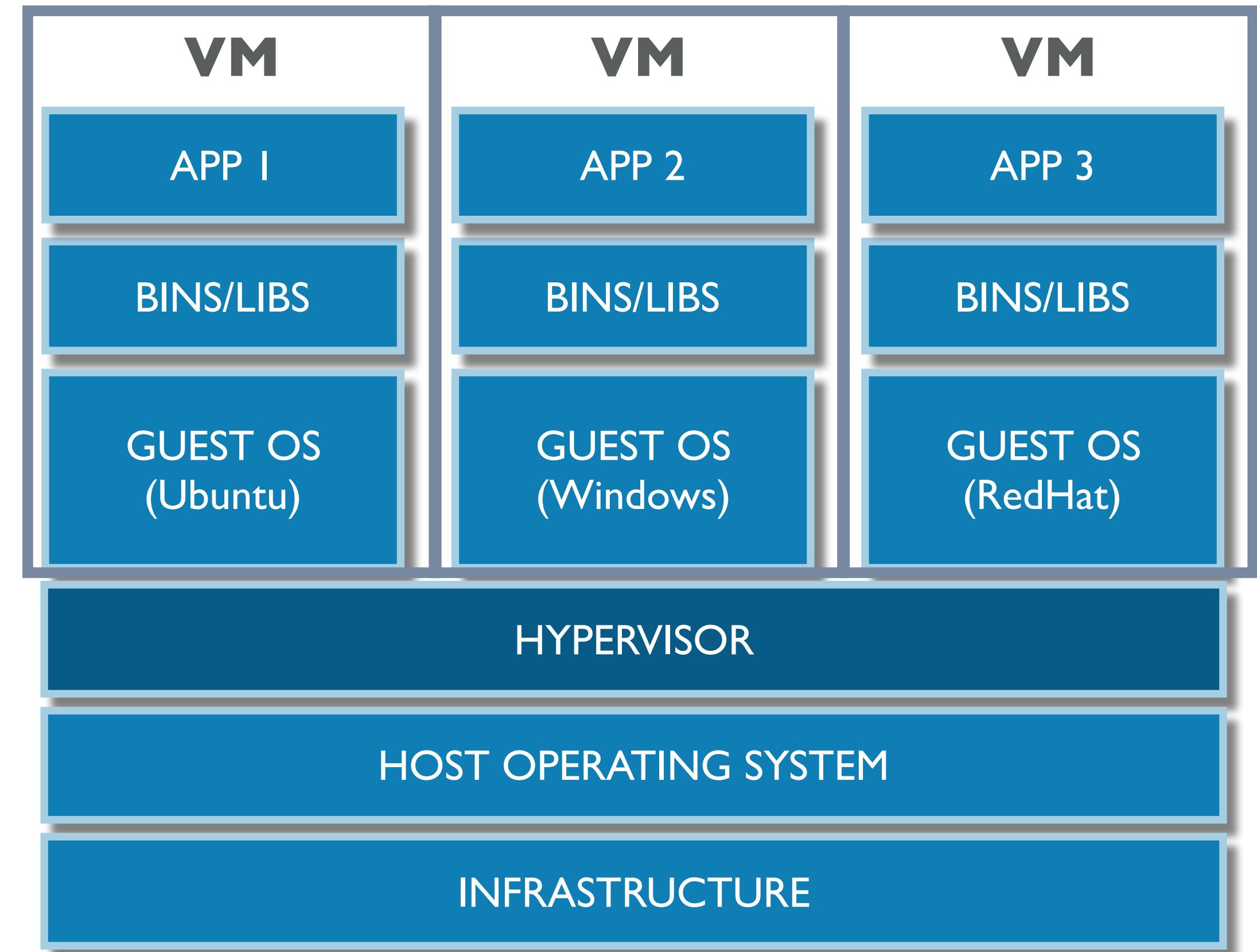
Virtual Machines

- **Virtual Machines** (VM) are created by emulating computer hardware in software
- The emulation is provided by software called a **Hypervisor**
- Each **Guest OS** thinks it's talking to dedicated computer hardware but it is really talking to the hypervisor that is sharing a much larger system



Virtual Machines

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What is VirtualBox?

- VirtualBox is a free Hypervisor that runs on OS X, Windows, and Linux
- Similar to VMware Workstation on a PC, or VMware Fusions and Parallels Desktop on a Mac
- Allows you to run your code in a Virtual Machine



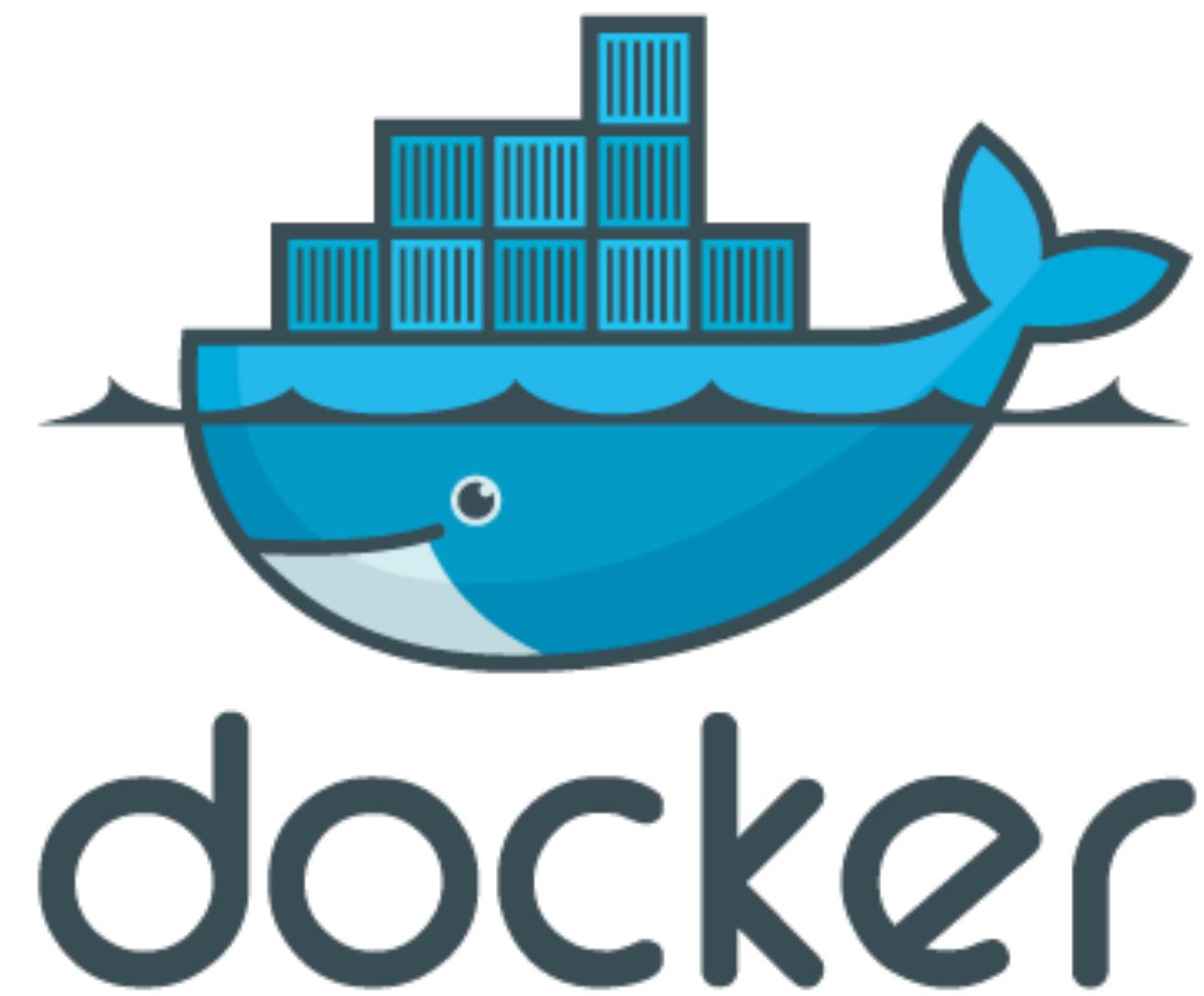
What is Vagrant?

- Vagrant is a developer's tool for creating lightweight, reproducible and portable virtual environments via command-line
- It supports VirtualBox, VMware, SoftLayer, Amazon AWS and Digital Ocean
- It supports configuration management utilities like Puppet, Chef, etc.
- It supports Docker natively which makes it easy to use Docker containers in VMs



What is Docker?

- Docker packages applications into Containers that include all of their dependencies, but share the kernel with other containers
- Containers run as an isolated process in userspace on the host operating system
- Containers are not tied to any specific infrastructure – Docker containers run on any computer, on any infrastructure and in any cloud.
- This guarantees that it will always run the same, regardless of the environment it is running in.



Baked vs. Fried

- Do you Bake software into the image?
- Or do you Fry it up fresh when you need it?
- I like to Fry!



Today's Focus

- Installing Vagrant and VirtualBox
- Create a simply Vagrantfile that spins up a Web Server in a VM
- Create a more complex Vagrantfile that leverages Docker

Hands-On

“live session”

Some Assembly Required

- Tools you will need to complete this lab:
 - Computer running OS X, Linux, or Windows*
 - Internet Access to download boxes
 - Text Editor (...i like Atom)
 - GitHub Account
 - PC users must have "*VT-x/AMD-V hardware acceleration*" turned on in your BIOS for VirtualBox to work.



* Windows users may need an ssh client

Installing VirtualBox

<https://www.virtualbox.org/wiki/Downloads>

The screenshot shows the VirtualBox download page. At the top left is the Oracle VM VirtualBox logo. The main title is "VirtualBox". Below it is a section titled "Download VirtualBox" with the sub-instruction "Here, you will find links to VirtualBox binaries and its source code." A green callout box with the text "Select the appropriate download for your OS" has an arrow pointing to the "VirtualBox platform packages" section. This section contains a bulleted list of download links:

- **VirtualBox platform packages.** The binaries are released under the terms of the GPL version 2.
 - [VirtualBox 5.0.20 for Windows hosts ↗x86/amd64](#)
 - [VirtualBox 5.0.20 for OS X hosts ↗amd64](#)
 - [VirtualBox 5.0.20 for Linux hosts ↗](#)
 - [VirtualBox 5.0.20 for Solaris hosts ↗amd64](#)
- **VirtualBox 5.0.20 Oracle VM VirtualBox Extension Pack ↗All supported platforms**

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP and PXE boot for Intel cards. See [this chapter from the User Manual](#). The Extension Pack binaries are released under the [VirtualBox Personal Use and Evaluation License \(PUEL\)](#).
Please install the extension pack with the same version as your installed version of VirtualBox!
If you are using [VirtualBox 4.3.36](#), please download the extension pack ↗here.
- **VirtualBox 5.0.20 Software Developer Kit (SDK) ↗All platforms**

At the bottom, there's a note about the changelog and checksums:

See the [changelog](#) for what has changed.
You might want to compare the

- [SHA256 checksums or the](#)
- [MD5 checksums](#)

Installing Vagrant

<https://www.vagrantup.com/downloads.html>

The screenshot shows the 'DOWNLOAD VAGRANT' section of the Vagrant website. It features three download links:

- MAC OS X**: Universal (32 and 64-bit) with an Apple logo icon.
- WINDOWS**: Universal (32 and 64-bit) with a Windows logo icon.
- DEBIAN**: 32-bit | 64-bit with a Debian logo icon.

A green callout box with a curved arrow points to the MAC OS X link, containing the text: "Select the appropriate download for your OS".

Below the main content, there is a note about SHA256 checksums, verifying signatures, and older versions of Vagrant.

ARCHIVES

DOWNLOADS

Below are the available downloads for the latest version of Vagrant (1.8.3). Please download the proper package for your operating system and architecture.

You can find the [SHA256 checksums for Vagrant 1.8.3](#) here. You can also [verify the checksums signature file](#) which has been signed with HashiCorp's GPG key. You can also [download older versions of Vagrant](#) from the releases service.

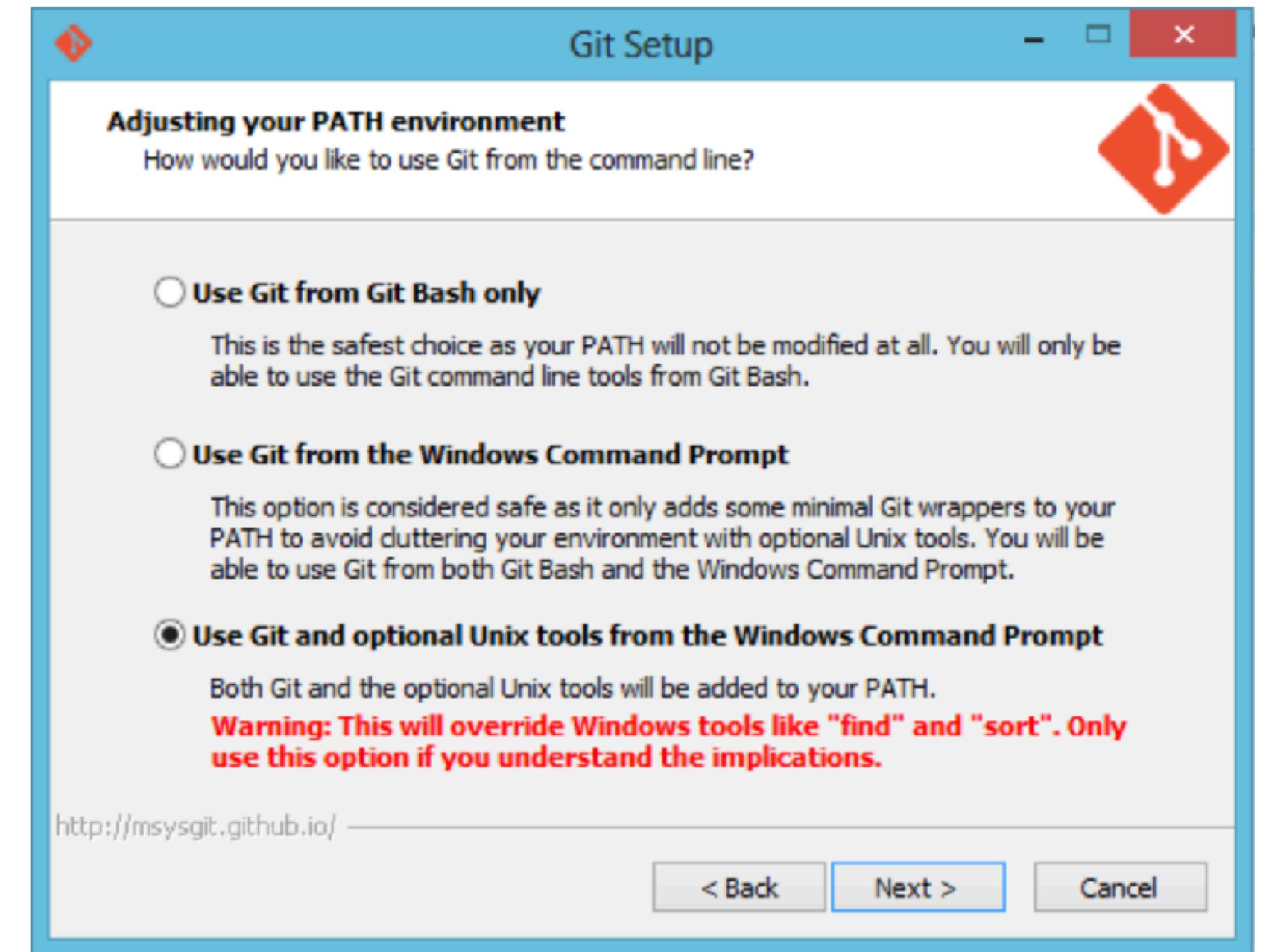
Select the appropriate download for your OS



Windows SSH

- Vagrant requires an SSH client which Windows doesn't have by default
- The easiest way to solve this is to install git with the optional unix tools
- Here is a tutorial:

<http://tech.osteel.me/posts/2015/01/25/how-to-use-vagrant-on-windows.html>



Create Your First Vagrant VM

- Create a folder to work in:

```
$ mkdir lab-vagrant-demo  
$ cd lab-vagrant-demo
```

- Go from Zero to running Ubuntu Trusty 64 with these 2 commands:

```
$ vagrant init ubuntu/trusty64  
$ vagrant up
```

- That's it! 😊

What Did “init” do?

- It created a default Vagrantfile that you can customize
- The Vagrantfile controls how the VM will be provisioned
- By editing the Vagrantfile we can change the VM’s behavior
- The Vagrantfile will be what you check-in to GitHub

Default Vagrantfile

```
Vagrant.configure(2) do |config|  
  config.vm.box = "ubuntu/trusty64"  
  
  # config.vm.box_check_update = false  
  
  # config.vm.network "forwarded_port", guest: 80, host: 8080  
  
  # config.vm.network "private_network", ip: "192.168.33.10"  
  
  # config.vm.network "public_network"  
  
  # config.vm.synced_folder "../data", "/vagrant_data"  
  
  # config.vm.provider "virtualbox" do |vb|  
  #   vb.gui = true  
  #   vb.memory = "1024"  
  # end  
  
  # config.push.define "atlas" do |push|  
  #   push.app = "YOUR_ATLAS_USERNAME/YOUR_APPLICATION_NAME"  
  # end  
  
  # config.vm.provision "shell", inline: <<-SHELL  
  #   sudo apt-get update  
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This is a Ruby file that uses Ruby syntax

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Selects the box to use as a base

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  # SHELL  
end
```

This is a Ruby file that uses Ruby syntax

Selects the box to use as a base

Everything else is commented out

What Did “up” Do?

- Vagrant downloaded the ubuntu/trusty64 box from atlas.hashicorp.com
- VirtualBox was called to create a VM from that box
- Installed VirtualBox tools and setup the network and shared your current folder as /vagrant
- Ran provisioning scripts to prepare the VM (more on that later)
- Set up SSH keys to logon to the VM

Initial Vagrant Run

```
iotia:lab-vagrant-demo rofrano$ vagrant up
Bringing machine 'default' up with 'virtualbox' provider...
==> default: Importing base box 'ubuntu/trusty64'...
==> default: Matching MAC address for NAT networking...
==> default: Checking if box 'ubuntu/trusty64' is up to date...
==> default: Setting the name of the VM: lab-vagrant-demo_default_1466018224850_26496
==> default: Clearing any previously set forwarded ports...
==> default: Couldn't find Cheffile at ./Cheffile.
==> default: Clearing any previously set network interfaces...
==> default: Preparing network interfaces based on configuration...
    default: Adapter 1: nat
==> default: Forwarding ports...
    default: 22 (guest) => 2222 (host) (adapter 1)
==> default: Booting VM...
==> default: Waiting for machine to boot. This may take a few minutes...
    default: SSH address: 127.0.0.1:2222
    default: SSH username: vagrant
    default: SSH auth method: private key
    default: Warning: Remote connection disconnect. Retrying...
    default:
    default: Vagrant insecure key detected. Vagrant will automatically replace
    default: this with a newly generated keypair for better security.
    default:
    default: Inserting generated public key within guest...
    default: Removing insecure key from the guest if it's present...
    default: Key inserted! Disconnecting and reconnecting using new SSH key...
==> default: Machine booted and ready!
```

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Creates the
VM

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Creates the VM

Setup Network/Port Forwarding

Initial Vagrant Run

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Creates the VM

Setup Network/Port Forwarding

Setup SSH keys

Where did Ubuntu/Trusty64 Come From?

Atlas

Discover Vagrant Boxes <https://atlas.hashicorp.com/search>

This page lets you discover and use Vagrant Boxes created by the community. You can search by operating system, architecture or provider.

Provider filter: virtualbox, vmware_desktop, aws, digitalocean, docker, google, hyperv, rackspace, parallels

Sort by: Downloads, Recently Created, Recently Updated

| Box Name | Description | Downloads | Last Release |
|--|---|------------|--|
| ubuntu/trusty64 | Official Ubuntu Server 14.04 LTS (Trusty Tahr) builds | 16,683,267 | 20160602.0.0 last release 9 days ago |
| laravel/homestead | Official Laravel local development box. | 6,278,356 | 0.4.4 last release 2 months ago |
| hashicorp/precise64 | A standard Ubuntu 12.04 LTS 64-bit box. | 5,218,258 | 1.1.0 last release 2 years ago |
| hashicorp/precise32 | A standard Ubuntu 12.04 LTS 32-bit box. | 1,980,023 | 1.0.0 last release 2 years ago |
| puphpet/ubuntu1404-x64 | Ubuntu Trusty 14.04 LTS x64 | 1,655,910 | 20151201 last release 7 months ago |
| ubuntu/trusty32 | Official Ubuntu Server 14.04 LTS (Trusty Tahr) builds | 1,149,417 | 20160606.0.0 last release 5 days ago |
| puphpet/debian75-x64 | Debian Wheezy 7.5 x64 | 1,040,837 | 20151201 last release 7 months ago |
| debian/jessie64 | Vanilla Debian 8 "Jessie" | 919,640 | 8.5.1 last release 5 days ago |
| scotch/box | Just a dead-simple local LAMP stack for developers that just works. | 899,937 | 2.5 last release 7 months ago |

Sign in | Atlas Documentation | All Systems Operational | HashiCorp

What Other Boxes Are There?

Vagrantbox.es

<http://www.vagrantbox.es/>

Fork me on GitHub

Vagrant is an amazing tool for managing virtual machines via a simple to use command line interface. With a simple `vagrant up` you can be working in a clean environment based on a standard template.

These standard templates are called [base boxes](#), and this website is simply a list of boxes people have been nice enough to make publicly available.

Suggest a Box

Do you know of another base box? [Send a pull request](#) and we'll add it to the list below.

Available Boxes

To use the available boxes just replace {title} and {url} with the information in the table below.

```
$ vagrant box add {title} {url}
$ vagrant init {title}
$ vagrant up
```

Search:

| Name | Provider | URL | Size (MB) |
|---|------------|--|-----------|
| Virtuozzo 7 x64 (Guest Additions 4.3.26) | VirtualBox | Copy https://atlas.hashicorp.com/OpenVZ/boxes/Virtuozzo-7b2 | 912 |
| Debian Jessie 8.1.0 Release x64 (Minimal, Guest Additions 4.3.26) | VirtualBox | Copy https://atlas.hashicorp.com/ARTACK/boxes/debian-jessie | 692 |
| CentOS 7.0 x64 (Minimal, VirtualBox Guest Additions 4.3.28, Puppet 3.8.1 - see here for more infos) | VirtualBox | Copy https://github.com/tommy-muehle/puppet-vagrant-boxes/releases/download/1.1.0/centos-7.0-x86_64.box | 475 |
| CentOS 6.6 x64 (Minimal, VirtualBox Guest Additions, Puppet 3.7.5 - see here for more infos) | VirtualBox | Copy https://github.com/tommy-muehle/puppet-vagrant-boxes/releases/download/1.0.0/centos-6.6-x86_64.box | 348 |
| CentOS 7 x64 (Minimal, Shrunked, Guest Additions 4.3.26) (Monthly updates) | VirtualBox | Copy https://github.com/holms/vagrant-centos7-box/releases/download/7.1.1503.001/CentOS-7.1.1503-x86_64-netboot.box | 437 |
| CentOS 7.1 x64 (Minimal, Puppet 4.2.3, Guest Additions 4.3.30)[notes] | VirtualBox | Copy https://github.com/CommanderK5/packer-centos-template/releases/download/0.7.1/vagrant-centos-7.1.box | 576 |
| CentOS 6.7 x64 (Minimal, Puppet 4.2.3, Guest Additions 4.3.30)[notes] | VirtualBox | Copy https://github.com/CommanderK5/packer-centos-template/releases/download/0.6.7/vagrant-centos-6.7.box | 577 |
| Debian Jessie 8.0 Release x64 (Minimal, Shrunked, Guest Additions 4.3.26) | VirtualBox | Copy https://github.com/holms/vagrant-jessie-box/releases/download/Jessie-v0.1/Debian-jessie-amd64-netboot.box | 437 |
| Debian 8.1 x64 (LXC, Puppet 3.7.2, Guest Additions 4.3.28) | VirtualBox | Copy https://dl.dropboxusercontent.com/u/3523744/boxes/debian-8.1-amd64-lxc-puppet/debian-8.1-lxc-puppet.box | 594 |
| Debian Jessie 8.0 RC2 64-bit (Minimal, Shrunked + Guest Additions 4.3.24 + Puppet 3.7.2) | VirtualBox | Copy http://static.gender-api.com/debian-8-jessie-rc2-x64-slim.box | 328 |

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$ vagrant up
```

This is one way to add these boxes

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| Debian Jessie 8.1.0 Release x64 (Minimal, Guest Additions 4.3.26) | VirtualBox | Copy https://atlas.hashicorp.com/ARTACK/boxes/debian-jessie | 692 |
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| CentOS 6.7 x64 (Minimal, Puppet 4.2.3, Guest Additions 4.3.30)[notes] | VirtualBox | Copy https://github.com/CommanderK5/packer-centos-template/releases/download/0.6.7/vagrant-centos-6.7.box | 577 |
| Debian Jessie 8.0 Release x64 (Minimal, Shrunked, Guest Additions 4.3.26) | VirtualBox | Copy https://github.com/holms/vagrant-jessie-box/releases/download/Jessie-v0.1/Debian-jessie-amd64-netboot.box | 437 |
| Debian 8.1 x64 (LXC, Puppet 3.7.2, Guest Additions 4.3.28) | VirtualBox | Copy https://dl.dropboxusercontent.com/u/3523744/boxes/debian-8.1-amd64-lxc-puppet/debian-8.1-lxc-puppet.box | 594 |
| Debian Jessie 8.0 RC2 64-bit (Minimal, Shrunked + Guest Additions 4.3.24 + Puppet 3.7.2) | VirtualBox | Copy http://static.gender-api.com/debian-8-jessie-rc2-x64-slim.box | 328 |

Getting In and Out of your VM

- Just like any remote server that you ssh into, you use exit to leave

```
$ exit  
iotia:lab-vagrant rofrano$
```

- To get back in you just ssh again

```
iotia:lab-vagrant rofrano$ vagrant ssh  
$
```

How To Use A Different Box?

- To use a different box, specify a name in config.vm.box and the url in config.vm.box_url

```
Vagrant.configure(2) do |config|  
  config.vm.box = "centos64-x86_64"  
  config.vm.box_url = "https://github.com/2creatives/vagrant-centos/releases/  
download/v6.4.2/centos64-x86_64-20140116.box"  
end
```

Accessing Your VM

- Use SSH client to access your VM

```
$ vagrant ssh
```

- /vagrant folder holds your current directory on the host OS

```
$ cd /vagrant
```

Vagrant SSH

```
$ vagrant ssh
```

Vagrant SSH

```
$ vagrant ssh
```

ssh into the vm

Vagrant SSH

```
$ vagrant ssh
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 3.13.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com/

System information as of Wed Jun 15 19:17:28 UTC 2016

System load:  0.91          Processes:      81
Usage of /:   3.5% of 39.34GB  Users logged in:  0
Memory usage: 25%
Swap usage:   0%

Graph this data and manage this system at:
https://landscape.canonical.com/

Get cloud support with Ubuntu Advantage Cloud Guest:
http://www.ubuntu.com/business/services/cloud

0 packages can be updated.
0 updates are security updates.

$
```

Vagrant SSH

```
$ vagrant ssh
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 3.13.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com/

System information as of Wed Jun 15 19:17:28 UTC 2016

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Get cloud support with Ubuntu Advantage Cloud Guest:
http://www.ubuntu.com/business/services/cloud

0 packages can be updated.
0 updates are security updates.

$ cd /vagrant
$ ls -l
```

Vagrant SSH

```
$ vagrant ssh
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 3.13.0-87-generic x86_64)

 * Documentation: https://help.ubuntu.com/

System information as of Wed Jun 15 19:17:28 UTC 2016

System load:  0.91          Processes:      81
Usage of /:   3.5% of 39.34GB  Users logged in:  0
Memory usage: 25%           IP address for eth0: 10.0.2.15
Swap usage:   0%

Graph this data and manage this system at:
https://landscape.canonical.com/

Get cloud support with Ubuntu Advantage Cloud Guest:
http://www.ubuntu.com/business/services/cloud

0 packages can be updated.
0 updates are security updates
```

```
$ cd /vagrant
$ ls -l
```

access to local filesystem via the /vagrant folder

Vagrant SSH

```
$ vagrant ssh
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 3.13.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com/

System information as of Wed Jun 15 19:17:28 UTC 2016

System load:  0.91          Processes:      81
Usage of /:   3.5% of 39.34GB  Users logged in:  0
Memory usage: 25%
Swap usage:   0%

Graph this data and manage this system at:
https://landscape.canonical.com/

Get cloud support with Ubuntu Advantage Cloud Guest:
http://www.ubuntu.com/business/services/cloud

0 packages can be updated.
0 updates are security updates.

$ cd /vagrant
$ ls -l
total 4
-rw-r--r-- 1 vagrant vagrant 1928 Jun 15 19:12 Vagrantfile
$
```

Vagrant SSH

```
$ vagrant ssh
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 3.13.0-87-generic x86_64)

 * Documentation: https://help.ubuntu.com/

System information as of Wed Jun 15 19:17:28 UTC 2016

System load:  0.91           Processes:      81
Usage of /:   3.5% of 39.34GB  Users logged in:  0
Memory usage: 25%
Swap usage:   0%

Graph this data and manage this system at:
https://landscape.canonical.com/

Get cloud support with Ubuntu Advantage Cloud Guest:
http://www.ubuntu.com/business/services/cloud

0 packages can be updated.
0 updates are security updates.

$ cd /vagrant
$ ls -l
total 4
-rw-r--r-- 1 vagrant vagrant 1928 Jun 15 19:12 Vagrantfile
```

This is your Vagrantfile from
inside the VM

Vagrant file sharing

- Vagrant is sharing the host folder it was invoked from within the vm as /vagrant
- This means that you can edit files with your native Mac or Windows editor
- ...and still be able to run the code on your Linux VM

Install Apache

- We can install software using Chef, Ansible, Puppet, Salt, Shell, etc.
- Let's use the “shell” provisioner to add apache2 (*just uncomment the code*)

```
Vagrant.configure(2) do |config|  
  config.vm.box = "ubuntu/trusty64"  
  
  config.vm.provision "shell", inline: <<-SHELL  
    sudo apt-get update  
    sudo apt-get install -y apache2  
  SHELL  
  
end
```

Install Apache

- We can install software using Chef, Ansible, Puppet, Salt, Shell, etc.
- Let's use the “shell” provisioner to add apache2 (*just uncomment the code*)

```
Vagrant.configure(2) do |config|  
  config.vm.box = "ubuntu/trusty64"  
  
  config.vm.provision "shell", inline: <<-SHELL  
    sudo apt-get update  
    sudo apt-get install -y apache2  
  SHELL  
end
```

Uncomment this code
from the bottom of the Vagrantfile
It uses shell syntax for the
OS (Ubuntu in this case)

Re-provision the VM after Updates

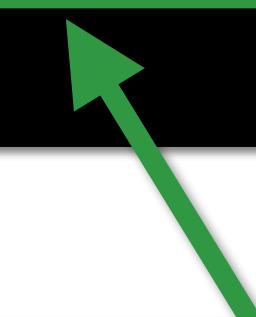
- After making changes to a Vagrantfile in any of the provisioning sections, you must re-provision the VM

```
$ exit  
  
$ vagrant reload --provision
```

Re-provision the VM after Updates

- After making changes to a Vagrantfile in any of the provisioning sections, you must re-provision the VM

```
$ exit  
  
$ vagrant reload --provision
```



Reload alone will only reboot the VM and run non-provisioning blocks but the --provision parameter forces the provision blocks to be re-evaluated and run

Testing the Web Server

- Use SSH client to access your VM and CURL to access Apache

```
$ vagrant ssh  
$ curl 127.0.0.1
```

- You should see HTML returned
- But if you access it from your browser it will fail! Why?

Let's Forward The Web Port

- We must forward the ports that we want to access from outside the VM. Let's add a private IP Address for direct access too:

```
Vagrant.configure(2) do |config|  
  
  config.vm.box = "ubuntu/trusty64"  
  
  # accessing "localhost:8080" will access port 80 on the guest machine.  
  config.vm.network "forwarded_port", guest: 80, host: 8080  
  
  config.vm.network "private_network", ip: "192.168.33.10"  
  
  config.vm.provision "shell", inline: <<-SHELL  
    sudo apt-get update  
    sudo apt-get install -y apache2  
  SHELL  
  
end
```

Let's Forward The Web Port

- We must forward the ports that we want to access from outside the VM. Let's add a private IP Address for direct access too:

```
Vagrant.configure(2) do |config|  
  
  config.vm.box = "ubuntu/trusty64"  
  
  # accessing "localhost:8080" will access port 80 on the guest machine.  
  config.vm.network "forwarded_port", guest: 80, host: 8080  
  
  config.vm.network "private_network", ip: "192.168.33.10"  
  
  config.vm.provision "shell", inline: <<-SHELL  
    sudo apt-get update  
    sudo apt-get install -y apache2  
  SHELL  
  
end
```

We should use ports higher than 1024 if we are not root

Reload the VM after Updates

- Since we didn't change any of the provisioning blocks in the Vagrantfile, we can just reload the VM and the port forwarding will be picked up

```
$ exit  
$ vagrant reload
```

New Vagrant Run

```
iotia:lab-vagrant-demo rofrano$ vagrant reload
==> default: Attempting graceful shutdown of VM...
==> default: Checking if box 'ubuntu/trusty64' is up to date...
==> default: Clearing any previously set forwarded ports...
==> default: Couldn't find Cheffile at ./Cheffile.
==> default: Clearing any previously set network interfaces...
==> default: Preparing network interfaces based on configuration...
    default: Adapter 1: nat
    default: Adapter 2: hostonly
==> default: Forwarding ports...
    default: 80 (guest) => 8080 (host) (adapter 1)
    default: 22 (guest) => 2222 (host) (adapter 1)
==> default: Booting VM...
==> default: Waiting for machine to boot. This may take a few minutes...
    default: SSH address: 127.0.0.1:2222
    default: SSH username: vagrant
    default: SSH auth method: private key
    default: Warning: Remote connection disconnect. Retrying...
    default: Warning: Remote connection disconnect. Retrying...
==> default: Machine booted and ready!
GuestAdditions 5.0.20 running --- OK.
==> default: Checking for guest additions in VM...
==> default: Configuring and enabling network interfaces...
==> default: Mounting shared folders...
    default: /vagrant => /Users/rofrano/github/Demo/lab-vagrant-demo
==> default: Machine already provisioned. Run `vagrant provision` or use the `--provision` flag to force provisioning. Provisioners marked to run always will still run.
iotia:lab-vagrant-demo rofrano$
```

New Vagrant Run

```
iotia:lab-vagrant-demo rofrano$ vagrant reload
==> default: Attempting graceful shutdown of VM...
==> default: Checking if box 'ubuntu/trusty64' is up to date...
==> default: Clearing any previously set forwarded ports...
==> default: Couldn't find Cheffile at ./Cheffile.
==> default: Clearing any previously set network interfaces...
==> default: Preparing network interfaces based on configuration...
    default: Adapter 1: nat
    default: Adapter 2: hostonly
==> default: Forwarding ports...
    default: 80 (guest) => 8080 (host) (adapter 1)
    default: 22 (guest) => 2222 (host) (adapter 1)
==> default: Booting VM...
==> default: Waiting for machine to boot. This may take a few minutes...
    default: SSH address: 127.0.0.1:2222
    default: SSH username: vagrant
    default: SSH auth method: private key
    default: Warning: Remote connection disconnect. Retrying...
    default: Warning: Remote connection disconnect. Retrying...
==> default: Machine booted and ready!
GuestAdditions 5.0.20 running --- OK.
==> default: Checking for guest additions in VM...
==> default: Configuring and enabling network interfaces...
==> default: Mounting shared folders...
    default: /vagrant => /Users/rofrano/github/Demo/lab-vagrant-demo
==> default: Machine already provisioned. Run `vagrant provision` or use the `--provision` flag to force provisioning. Provisioners marked to run always will still run.
iotia:lab-vagrant-demo rofrano$
```

Our port got forwarded from 80 inside the VM
to 8080 outside the VM (on the host)

Test It In Your Browser

The screenshot shows a web browser window with the URL "localhost:8080" in the address bar. The page title is "Apache2 Ubuntu Default Page". It features the Ubuntu logo and the word "ubuntu". A red banner at the top right says "It works!". Below it, a message states: "This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server." Another message below says: "If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator." A "Configuration Overview" section explains the configuration layout: "Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server." It also describes the configuration layout: "The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:"

```
/etc/apache2/
|-- apache2.conf
|   |-- ports.conf
|-- mods-enabled
|   |-- *.load
|   |-- *.conf
|-- conf-enabled
|   |-- *.conf
|-- sites-enabled
|   |-- *.conf
```

- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this file can be customized anytime.
- Configuration files in the `mods-enabled/`, `conf-enabled/` and `sites-enabled/` directories contain particular configuration snippets which manage modules, global configuration fragments, or virtual host configurations, respectively.

Display a menu They are activated by symlinking available configuration files from their respective *-available/

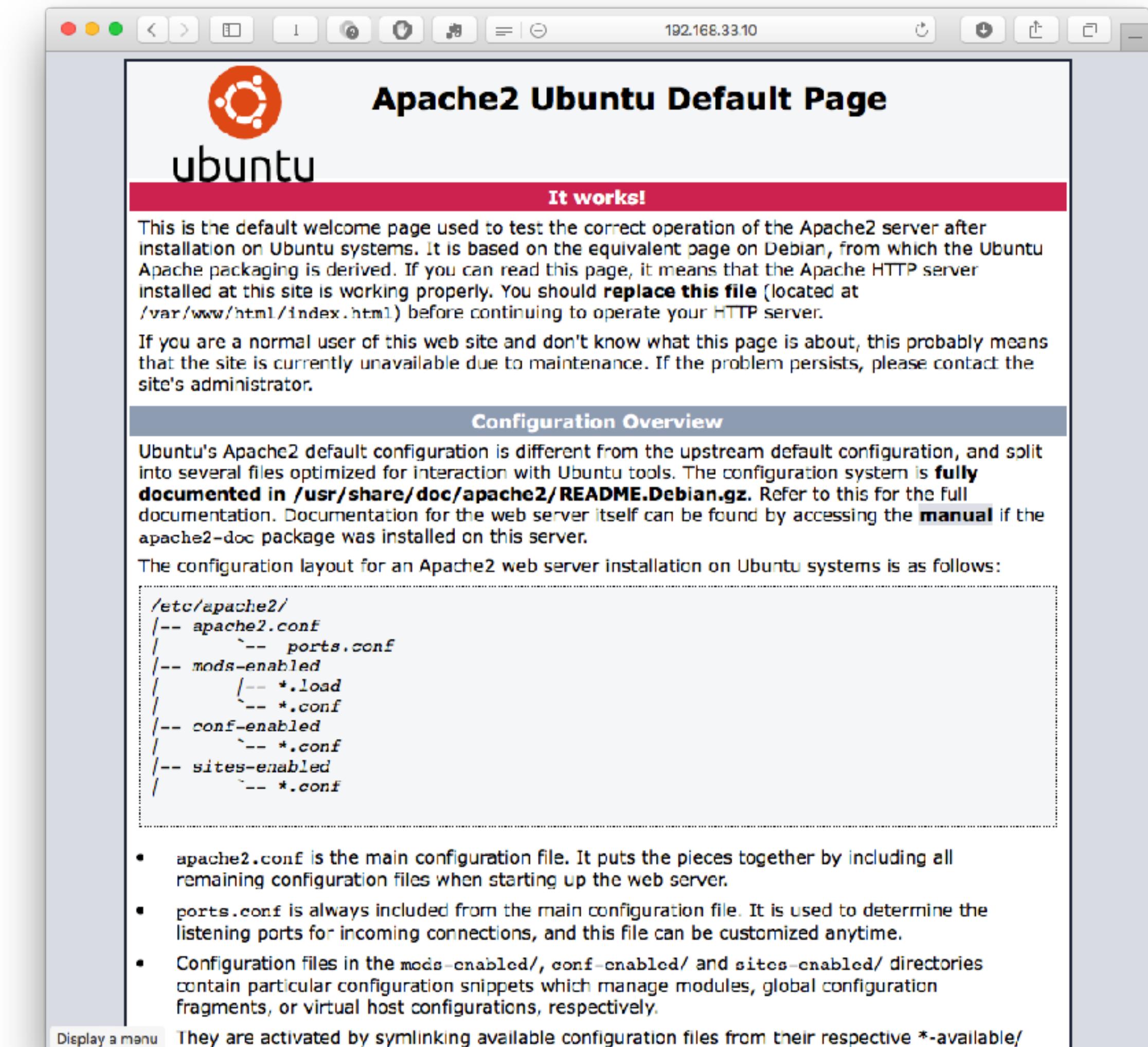
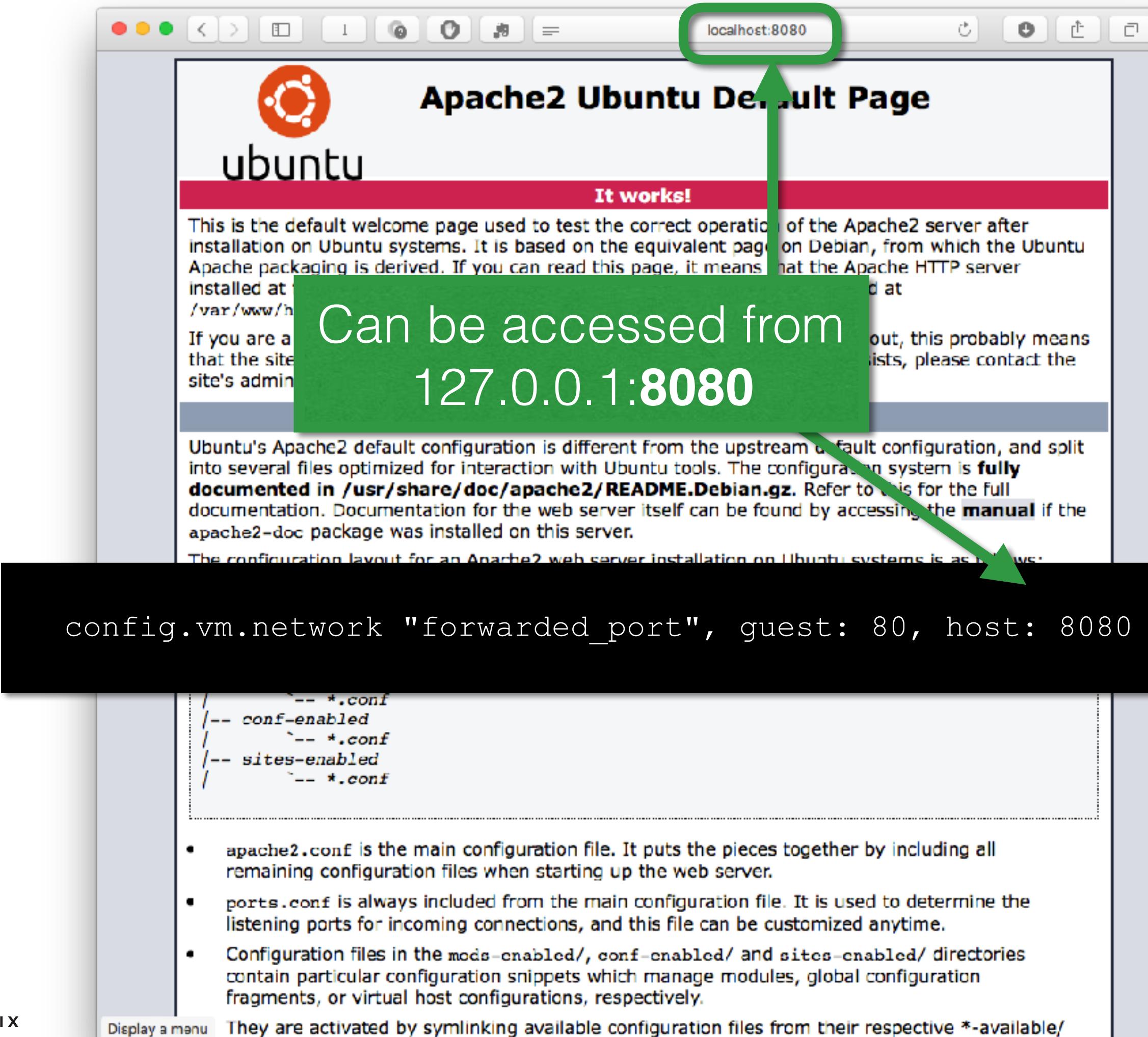
The screenshot shows a web browser window with the URL "192.168.33.10" in the address bar. The page title is "Apache2 Ubuntu Default Page". It features the Ubuntu logo and the word "ubuntu". A red banner at the top right says "It works!". Below it, a message states: "This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server." Another message below says: "If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator." A "Configuration Overview" section explains the configuration layout: "Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server." It also describes the configuration layout: "The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:"

```
/etc/apache2/
|-- apache2.conf
|   |-- ports.conf
|-- mods-enabled
|   |-- *.load
|   |-- *.conf
|-- conf-enabled
|   |-- *.conf
|-- sites-enabled
|   |-- *.conf
```

- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this file can be customized anytime.
- Configuration files in the `mods-enabled/`, `conf-enabled/` and `sites-enabled/` directories contain particular configuration snippets which manage modules, global configuration fragments, or virtual host configurations, respectively.

Display a menu They are activated by symlinking available configuration files from their respective *-available/

Test It In Your Browser



Test It In Your Browser

localhost:8080

Apache2 Ubuntu Default Page

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at `/var/www/html` is working correctly. If you are a system administrator and expect this page to be different, please contact the site's administrator.

If you are a user and you see this page, this probably means that the site's configuration is broken. If you are a developer, please contact the site's administrator.

Can be accessed from
127.0.0.1:8080

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```
config.vm.network "forwarded_port", guest: 80, host: 8080
```

/etc/apache2/

```
-- *.conf
|-- conf-enabled
|   |-- *.conf
|-- sites-enabled
|   |-- *.conf
```

- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this file can be customized anytime.
- Configuration files in the `mods-enabled/`, `conf-enabled/` and `sites-enabled/` directories contain particular configuration snippets which manage modules, global configuration fragments, or virtual host configurations, respectively.

Display a menu They are activated by symlinking available configuration files from their respective `*-available/`

192.168.33.10

Apache2 Ubuntu Default Page

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at `/var/www/html` is working correctly. If you are a system administrator and expect this page to be different, please contact the site's administrator.

If you are a user and you see this page, this probably means that the site's configuration is broken. If you are a developer, please contact the site's administrator.

Can be also accessed from
192.168.33.10:80

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```
config.vm.network "private_network", ip: "192.168.33.10"
```

/etc/apache2/

```
-- *.conf
|-- conf-enabled
|   |-- *.conf
|-- sites-enabled
|   |-- *.conf
```

- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this file can be customized anytime.
- Configuration files in the `mods-enabled/`, `conf-enabled/` and `sites-enabled/` directories contain particular configuration snippets which manage modules, global configuration fragments, or virtual host configurations, respectively.

Display a menu They are activated by symlinking available configuration files from their respective `*-available/`

More Port Forwarding Examples

```
# Forward RAILS port
config.vm.network :forwarded_port, guest: 3000, host: 3000, auto_correct: true

# Forward Python Flask port
config.vm.network :forwarded_port, guest: 5000, host: 5000, auto_correct: true

# Forward PostgreSQL port
config.vm.network :forwarded_port, guest: 5432, host: 5432, auto_correct: true

# Forward MySQL port
config.vm.network :forwarded_port, guest: 3306, host: 5432, auto_correct: true

# Forward Redis port
config.vm.network :forwarded_port, guest: 6379, host: 6379, auto_correct: true

# Forward RabbitMQ Ports
config.vm.network :forwarded_port, guest: 15672, host: 15672, auto_correct: true
config.vm.network :forwarded_port, guest: 4369, host: 4369, auto_correct: true
config.vm.network :forwarded_port, guest: 5672, host: 5672, auto_correct: true
```

Adding Your Own Content

- We can link a local folder to the html root to serve up our own content (remember our local folder is shared with the VM!)
- First lets create a new ./html folder and add index.html:

```
$ mkdir html  
$ cd html  
$ echo '<html><h1>Hello World!</h1></html>' > index.html
```

Link Our HTML Folder

- We can point `/var/www/html` to our host folder `/vagrant/html`

```
Vagrant.configure(2) do |config|  
  
  config.vm.box = "ubuntu/trusty64"  
  
  # accessing "localhost:8080" will access port 80 on the guest machine.  
  config.vm.network "forwarded_port", guest: 80, host: 8080  
  
  config.vm.network "private_network", ip: "192.168.33.10"  
  
  config.vm.provision "shell", inline: <<-SHELL  
    sudo apt-get update  
    sudo apt-get install -y apache2  
    sudo rm -rf /var/www/html  
    sudo ln -s /vagrant/html /var/www/html  
  SHELL  
  
end
```

Link Our HTML Folder

- We can point `/var/www/html` to our host folder `/vagrant/html`

```
Vagrant.configure(2) do |config|  
  
  config.vm.box = "ubuntu/trusty64"  
  
  # accessing "localhost:8080" will access port 80 on the guest machine.  
  config.vm.network "forwarded_port", guest: 80, host: 8080  
  
  config.vm.network "private_network", ip: "192.168.33.10"  
  
  config.vm.provision "shell", inline: <<-SHELL  
    sudo apt-get update  
    sudo apt-get install -y apache2  
    sudo rm -rf /var/www/html  
    sudo ln -s /vagrant/html /var/www/html  
  SHELL  
  
end
```

Remove the `/var/www/html` folder
and link to our host's `./html` folder

Add 'rm' and 'ln' Commands

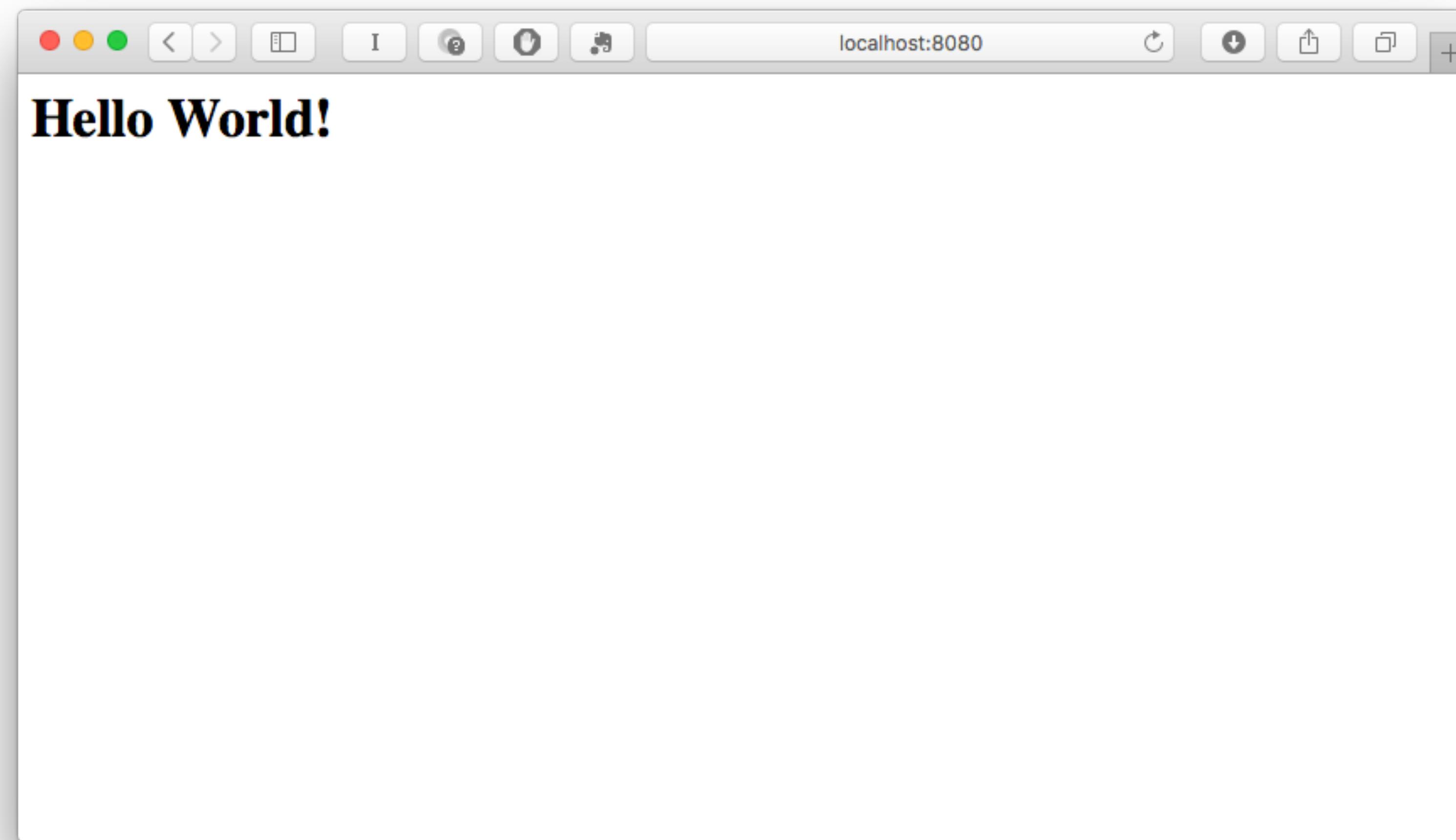
```
config.vm.provision "shell", inline: <<-SHELL  
  sudo apt-get update  
  sudo apt-get install -y apache2  
  sudo rm -rf /var/www/html  
  sudo ln -s /vagrant/html /var/www/html  
SHELL
```

Re-provision the VM after Updates

- Since we changed a provision block in the Vagrantfile we must reload and provision

```
$ vagrant reload --provision
```

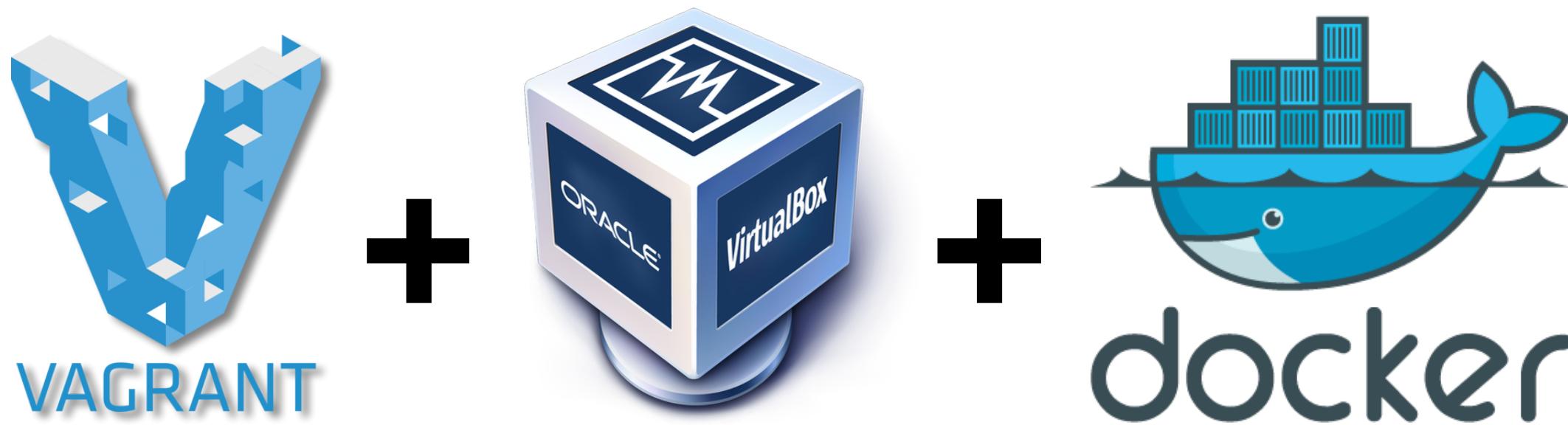
Apache is Serving Our Page



What Just Happened?

- We are serving up local files from our laptop inside of the VM
- That means we can develop locally with our favorite IDE tools
- And we can run the code in a Linux VM just like a production server!
- Very Cool ! ! ! 

Lets Add Docker To The Mix



- We want to create an environment to run a Python / Flask microservice that uses a Redis database to store a hit counter
- We will use Docker to run Redis without having to install anything
- Vagrant supports a Docker provisioner that we can leverage

Clone the Project from GitHub

- You are a new developer to the project and you want to get up and running quickly so that you can start developing:

```
$ git clone git@github.com:rofrano/lab-vagrant.git  
$ cd lab-vagrant  
$ vagrant up
```

Complete Vagrantfile

```
Vagrant.configure(2) do |config|
  config.vm.box = "ubuntu/trusty64"
  config.vm.network "forwarded_port", guest: 5000, host: 5000
  config.vm.network "private_network", ip: "192.168.33.10"

  config.vm.provider "virtualbox" do |vb|
    vb.memory = "1024"
    vb.cpus = 1
  end

  config.vm.provision "shell", inline: <<-SHELL
    sudo apt-get update
    sudo apt-get install -y git python-pip python-dev build-essential
    sudo apt-get -y autoremove
    # Install app dependencies
    cd /vagrant
    sudo pip install -r requirements.txt
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
    # Make vi look nice
    echo "colorscheme desert" > ~/.vimrc
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

Complete Vagrantfile

```
Vagrant.configure(2) do |config|
  config.vm.box = "ubuntu/trusty64"
  config.vm.network "forwarded_port", guest: 5000, host: 5000
  config.vm.network "private_network", ip: "192.168.33.10"

  config.vm.provider "virtualbox" do |vb|
    vb.memory = "1024"
    vb.cpus = 1
  end

  config.vm.provision "shell", inline: <<-SHELL
    sudo apt-get update
    sudo apt-get install -y git python-pip python-dev build-essential
    sudo apt-get -y autoremove
    # Install app dependencies
    cd /vagrant
    sudo pip install -r requirements.txt
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
    # Make vi look nice
    echo "colorscheme desert" > ~/.vimrc
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

Create an Ubuntu VM and
Forward the ports you need

Complete Vagrantfile

```
Vagrant.configure(2) do |config|
  config.vm.box = "ubuntu/trusty64"
  config.vm.network "forwarded_port", guest: 5000, host: 5000
  config.vm.network "private_network", ip: "192.168.33.10"

  config.vm.provider "virtualbox" do |vb|
    vb.memory = "1024"
    vb.cpus = 1
  end

  config.vm.provision "shell", inline: <<-SHELL
    sudo apt-get update
    sudo apt-get install -y git python-pip python-dev build-essential
    sudo apt-get -y autoremove
    # Install app dependencies
    cd /vagrant
    sudo pip install -r requirements.txt
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
    # Make vi look nice
    echo "colorscheme desert" > ~/.vimrc
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

Create an Ubuntu VM and
Forward the ports you need

Allocate the VM resources

Complete Vagrantfile

```
Vagrant.configure(2) do |config|
  config.vm.box = "ubuntu/trusty64"
  config.vm.network "forwarded_port", guest: 5000, host: 5000
  config.vm.network "private_network", ip: "192.168.33.10"

  config.vm.provider "virtualbox" do |vb|
    vb.memory = "1024"
    vb.cpus = 1
  end

  config.vm.provision "shell", inline: <<-SHELL
    sudo apt-get update
    sudo apt-get install -y git python-pip python-dev build-essential
    sudo apt-get -y autoremove
    # Install app dependencies
    cd /vagrant
    sudo pip install -r requirements.txt
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
    # Make vi look nice
    echo "colorscheme desert" > ~/.vimrc
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

Create an Ubuntu VM and Forward the ports you need

Allocate the VM resources

Provision the development environment

Complete Vagrantfile

```
Vagrant.configure(2) do |config|
  config.vm.box = "ubuntu/trusty64"
  config.vm.network "forwarded_port", guest: 5000, host: 5000
  config.vm.network "private_network", ip: "192.168.33.10"

  config.vm.provider "virtualbox" do |vb|
    vb.memory = "1024"
    vb.cpus = 1
  end

  config.vm.provision "shell", inline: <<-SHELL
    sudo apt-get update
    sudo apt-get install -y git python-pip python-dev build-essential
    sudo apt-get -y autoremove
    # Install app dependencies
    cd /vagrant
    sudo pip install -r requirements.txt
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
    # Make vi look nice
    echo "colorscheme desert" > ~/.vimrc
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

The diagram illustrates the structure of a Vagrantfile with five green callout boxes and arrows pointing to specific sections:

- Create an Ubuntu VM and Forward the ports you need**: Points to the first section of the Vagrantfile, which defines the VM box and port forwarding.
- Allocate the VM resources**: Points to the provider configuration section.
- Provision the development environment**: Points to the shell provisioning block.
- Add Docker Containers for middleware**: Points to the Docker provisioner configuration for adding a Redis container.

Application Code

```
app.py

1 import os
2 import redis
3 from flask import Flask, jsonify
4
5 port = os.getenv('PORT', '5000')
6 hostname = os.getenv('HOSTNAME', '127.0.0.1')
7 redis_port = os.getenv('REDIS_PORT', '6379')
8
9 app = Flask(__name__)
10
11 # Application Routes
12 @app.route('/')
13 def index():
14     return jsonify(name='Hit Me Service', version='1.0', url='/hits'), 200
15
16 @app.route('/hits')
17 def hits():
18     redis_server.incr('hit_counter')
19     count = redis_server.get('hit_counter')
20     return jsonify(hits=count), 200
21
22
23 if __name__ == "__main__":
24
25     redis_server = redis.Redis(host=hostname, port=int(redis_port))
26     app.run(host='0.0.0.0', port=int(port))
27
```

Application Code

```
app.py  
1 import os  
2 import redis  
3 from flask import Flask, jsonify  
4  
5 port = os.getenv('PORT', '5000')  
6 hostname = os.getenv('HOSTNAME', '127.0.0.1')  
7 redis_port = os.getenv('REDIS_PORT', '6379')  
8  
9 app = Flask(__name__)  
10  
11 # Application Routes  
12 @app.route('/')  
13 def index():  
14     return jsonify(name='Hit Me Service', version='1.0', url='/hits'), 200  
15  
16 @app.route('/hits')  
17 def hits():  
18     redis_server.incr('hit_counter')  
19     count = redis_server.get('hit_counter')  
20     return jsonify(hits=count), 200  
21  
22  
23 if __name__ == "__main__":  
24  
25     redis_server = redis.Redis(host=hostname, port=int(redis_port))  
26     app.run(host='0.0.0.0', port=int(port))  
27
```

Pull runtime data from the environment

Application Code

```
app.py  
1 import os  
2 import redis  
3 from flask import Flask, jsonify  
4  
5 port = os.getenv('PORT', '5000')  
6 hostname = os.getenv('HOSTNAME', '127.0.0.1')  
7 redis_port = os.getenv('REDIS_PORT', '6379')  
8  
9 app = Flask(__name__)  
10  
11 # Application Routes  
12 @app.route('/')  
13 def index():  
14     return jsonify(name='Hit Me Service', version='1.0', url='/hits'), 200  
15  
16 @app.route('/hits')  
17 def hits():  
18     redis_server.incr('hit_counter')  
19     count = redis_server.get('hit_counter')  
20     return jsonify(hits=count), 200  
21  
22  
23 if __name__ == "__main__":  
24     redis_server = redis.Redis(host=hostname, port=int(redis_port))  
25     app.run(host='0.0.0.0', port=int(port))  
26  
27
```

Pull runtime data from the environment

Connect to Redis and run Flask Server

Application Code

```
app.py  
1 import os  
2 import redis  
3 from flask import Flask, jsonify  
4  
5 port = os.getenv('PORT', '5000')  
6 hostname = os.getenv('HOSTNAME', '127.0.0.1')  
7 redis_port = os.getenv('REDIS_PORT', '6379')  
8  
9 app = Flask(__name__)  
10  
11 # Application Routes  
12 @app.route('/')  
13 def index():  
14     return jsonify(name='Hit Me Service', version='1.0', url='/hits'), 200  
15  
16 @app.route('/hits')  
17 def hits():  
18     redis_server.incr('hit_counter')  
19     count = redis_server.get('hit_counter')  
20     return jsonify(hits=count), 200  
21  
22  
23 if __name__ == "__main__":  
24     redis_server = redis.Redis(host=hostname, port=int(redis_port))  
25     app.run(host='0.0.0.0', port=int(port))  
26  
27
```

Pull runtime data from the environment

/ returns info

Connect to Redis and run Flask Server

Application Code

```
app.py

1 import os
2 import redis
3 from flask import Flask, jsonify
4
5 port = os.getenv('PORT', '5000')
6 hostname = os.getenv('HOSTNAME', '127.0.0.1')
7 redis_port = os.getenv('REDIS_PORT', '6379')

8
9 app = Flask(__name__)
10
11 # Application Routes
12 @app.route('/')
13 def index():
14     return jsonify(name='Hit Me Service', version='1.0', url='/hits'), 200

15
16 @app.route('/hits')
17 def hits():
18     redis_server.incr('hit_counter')
19     count = redis_server.get('hit_counter')
20     return jsonify(hits=count), 200

21
22
23 if __name__ == "__main__":
24     redis_server = redis.Redis(host=hostname, port=int(redis_port))
25     app.run(host='0.0.0.0', port=int(port))

26
27
```

Pull runtime data from the environment

/ returns info

/hits calls Redis to increment counter and return it

Connect to Redis and run Flask Server

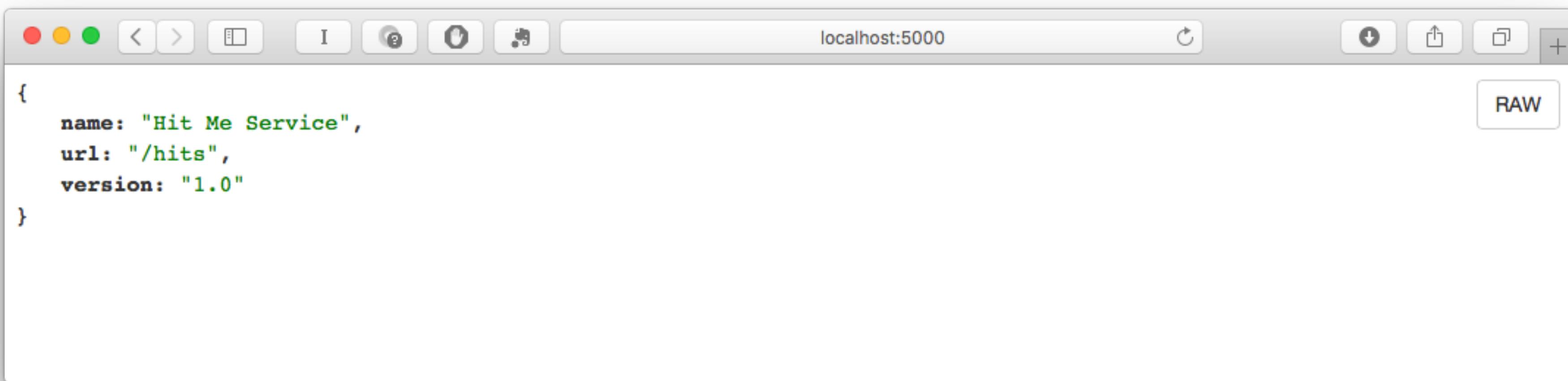
Start the Application

- Once the Vagrant VM has been provisioned we can ssh into it and start the Python Flask application

```
$ vagrant ssh  
$ cd /vagrant  
$ python app.py
```

```
* Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
```

Flask is Serving Our Application



A screenshot of a web browser window titled "localhost:5000". The address bar shows "localhost:5000". The content area displays the following JSON response:

```
{  
    name: "Hit Me Service",  
    url: "/hits",  
    version: "1.0"  
}
```

The "RAW" button is visible in the top right corner of the browser window.

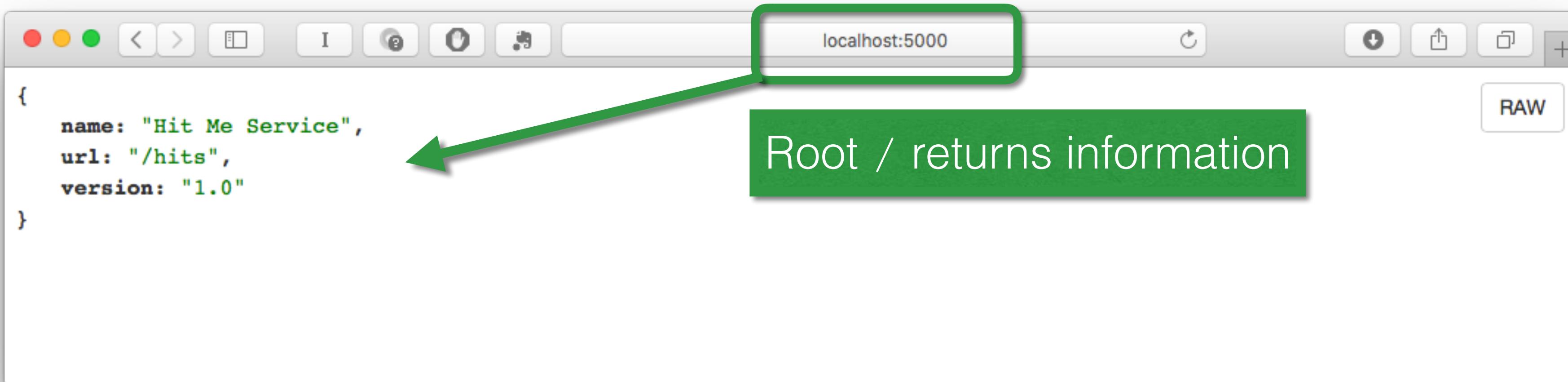


A screenshot of a web browser window titled "localhost:5000/hits". The address bar shows "localhost:5000/hits". The content area displays the following JSON response:

```
{  
    hits: "3"  
}
```

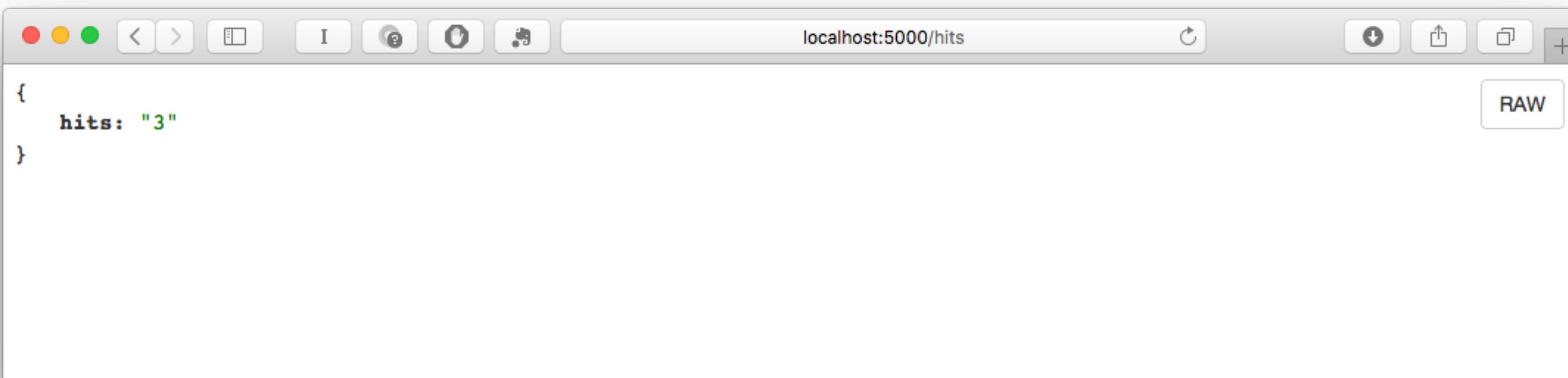
The "RAW" button is visible in the top right corner of the browser window.

Flask is Serving Our Application



A screenshot of a web browser window titled "localhost:5000". The address bar is highlighted with a green box. A green arrow points from a callout box containing the text "Root / returns information" to the word "Root" in the browser's title bar. The main content area shows a JSON response:

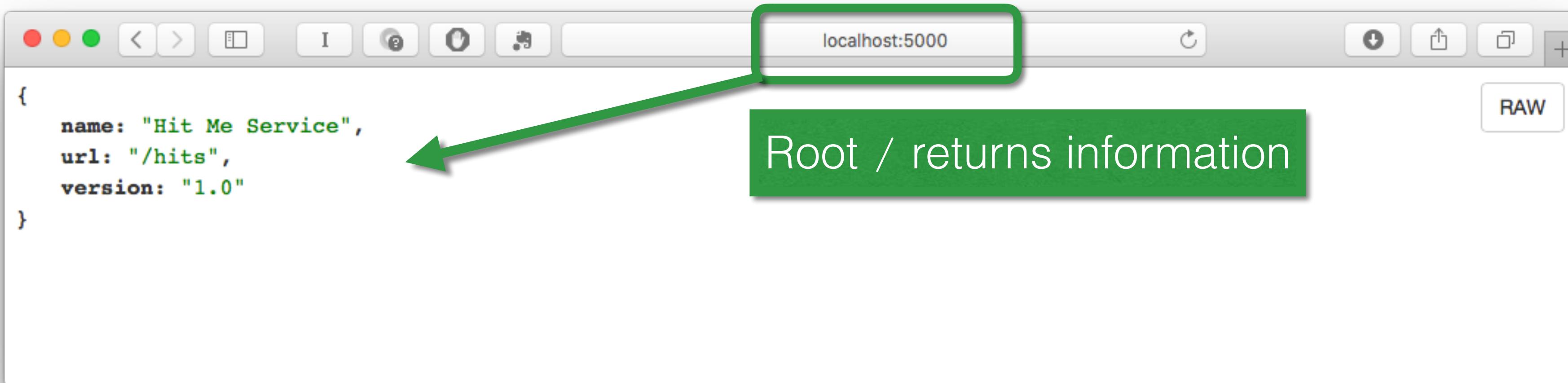
```
{  
    name: "Hit Me Service",  
    url: "/hits",  
    version: "1.0"  
}
```



A screenshot of a web browser window titled "localhost:5000/hits". The address bar is highlighted with a green box. The main content area shows a JSON response:

```
{  
    hits: "3"  
}
```

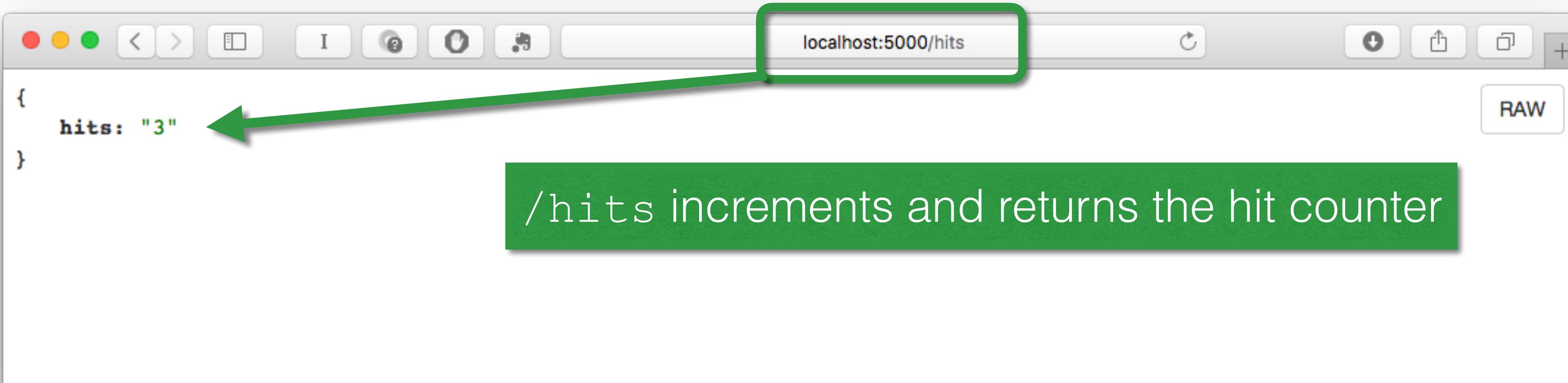
Flask is Serving Our Application



A screenshot of a web browser window titled "localhost:5000". The address bar is highlighted with a green box. The page content shows a JSON response:

```
{  
    name: "Hit Me Service",  
    url: "/hits",  
    version: "1.0"  
}
```

A green arrow points from a callout box containing the text "Root / returns information" to the "name" field in the JSON response.



A screenshot of a web browser window titled "localhost:5000/hits". The address bar is highlighted with a green box. The page content shows a JSON response:

```
{  
    hits: "3"  
}
```

A green arrow points from a callout box containing the text "/hits increments and returns the hit counter" to the "hits" field in the JSON response.

What Just Happened?

- A developer (you) who possibly never worked with Python, Flask, or Redis before
- Just cloned a git repo and provisioned a working development environment
- With one command: `vagrant up`

Vagrant Python Environment

```
# Forward Python Flask port
config.vm.network :forwarded_port, guest: 5000, host: 5000, auto_correct: true

# Setup a Python development environment
config.vm.provision "shell", inline: <<-SHELL
    sudo apt-get update
    sudo apt-get install -y git python-pip python-dev build-essential
    sudo apt-get -y autoremove
    # Install app dependencies
    cd /vagrant
    sudo pip install -r requirements.txt
SHELL
```

Vagrant Ruby on Rails Environment

```
# Forward RAILS port
config.vm.network :forwarded_port, guest: 3000, host: 3000, auto_correct: true

# Setup a Ruby on Rails development environment
config.vm.provision :shell, privileged: false, inline: <<-SHELL
  sudo apt-get update
  sudo apt-get -y install git libsqlite3-dev libpq-dev nodejs
  sudo apt-get -y autoremove

# disable docs during gem install
echo "gem: --no-document" >> ~/.gemrc
gem update --no-rdoc --no-ri
gpg --keyserver hkp://keys.gnupg.net --recv-keys 409B6B1796C275462A1703113804BB82D39DC0E3
# use RVM to install Ruby and Rails
curl -sSL https://get.rvm.io | bash -s stable --rails

# Add Heroku toolbelt
sudo wget -O- https://toolbelt.heroku.com/install-ubuntu.sh | sh
SHELL
```

Working With Docker In The VM

- We can run any Docker commands inside the VM to get the current status of any Docker containers

```
$ docker images
```

| REPOSITORY | TAG | IMAGE ID | CREATED | SIZE |
|------------|--------|--------------|------------|----------|
| redis | alpine | 8a8bdae38335 | 7 days ago | 29.07 MB |

Working With Docker In The VM

- We can run any Docker commands inside the VM to get the current status of any Docker containers

List Image Inventory

```
$ docker images
```

| REPOSITORY | TAG | IMAGE ID | CREATED | SIZE |
|------------|--------|--------------|------------|----------|
| redis | alpine | 8a8bdae38335 | 7 days ago | 29.07 MB |

Working With Docker In The VM

- We can run any Docker commands inside the VM to get the current status of any Docker containers

```
$ docker images
```

| REPOSITORY | TAG | IMAGE ID | CREATED | SIZE |
|------------|--------|--------------|------------|----------|
| redis | alpine | 8a8bdae38335 | 7 days ago | 29.07 MB |

```
$ docker ps
```

| CONTAINER ID | IMAGE | COMMAND | CREATED | STATUS | PORTS | NAMES |
|--------------|--------------|------------------------|--------------|---------------|------------------------|-------|
| 8ef040bad484 | redis:alpine | "docker-entrypoint.sh" | 25 hours ago | Up 16 minutes | 0.0.0.0:6379->6379/tcp | redis |

Working With Docker In The VM

- We can run any Docker commands inside the VM to get the current status of any Docker containers

```
$ docker images
```

| REPOSITORY | TAG | IMAGE ID | CREATED | SIZE |
|------------|--------|--------------|------------|----------|
| redis | alpine | 8a8bdae38335 | 7 days ago | 29.07 MB |

List Running Containers

```
$ docker ps
```

| CONTAINER ID | IMAGE | COMMAND | CREATED | STATUS | PORTS | NAMES |
|--------------|--------------|------------------------|--------------|---------------|------------------------|-------|
| 8ef040bad484 | redis:alpine | "docker-entrypoint.sh" | 25 hours ago | Up 16 minutes | 0.0.0.0:6379->6379/tcp | redis |

Vagrantfile to Docker Mapping

- This is the mapping from the Vagrantfile to the Docker containers:

Vagrantfile

```
config.vm.provision "docker" do |d|
  d.pull_images "redis:alpine"
  d.run "redis:alpine",
    args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
end
```

```
$ docker ps
CONTAINER ID        IMAGE               COMMAND                  CREATED             STATUS              PORTS                 NAMES
8ef040bad484        redis:alpine       "docker-entrypoint.sh"   25 hours ago      Up 16 minutes   0.0.0.0:6379->6379/tcp   redis
```

Vagrantfile to Docker Mapping

- This is the mapping from the Vagrantfile to the Docker containers:

Vagrantfile

```
config.vm.provision "docker" do |d|
  d.pull_images "redis:alpine"
  d.run "redis:alpine",
    args: "--restart-always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
end
```

Image to run

```
$ docker ps
CONTAINER ID        IMAGE               COMMAND
8ef040bad484        redis:alpine      "docker-entrypoint.sh"
```

Vagrantfile to Docker Mapping

- This is the mapping from the Vagrantfile to the Docker containers:

Vagrantfile

```
config.vm.provision "docker" do |d|
  d.pull_images "redis:alpine"
  d.run "redis:alpine",
    args: "--restart-always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
end
```

Image to run

Port to listen on

```
$ docker ps
CONTAINER ID        IMAGE
8ef040bad484        redis:alpine
```

| COMMAND | CREATED | STATUS | PORTS | NAMES |
|------------------------|--------------|---------------|------------------------|-------|
| "docker-entrypoint.sh" | 25 hours ago | Up 16 minutes | 0.0.0.0:6379->6379/tcp | redis |

Vagrantfile to Docker Mapping

- This is the mapping from the Vagrantfile to the Docker containers:

Vagrantfile

```
config.vm.provision "docker" do |d|
  d.pull_images "redis:alpine"
  d.run "redis:alpine",
    args: "--restart-always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
end
```

Image to run

Port to listen on

```
$ docker ps
CONTAINER ID
8ef040bad484
```

IMAGE
redis:alpine

name of container

| COMMAND | CREATED | STATUS | PORTS | NAMES |
|------------------------|--------------|---------------|------------------------|-------|
| "docker-entrypoint.sh" | 25 hours ago | Up 16 minutes | 0.0.0.0:6379->6379/tcp | redis |

What about data persistence?

- Map a Volume in the VM to persist data cross Docker containers

```
Vagrant.configure(2) do |config|
  config.vm.provision "shell", inline: <<-SHELL
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

What about data persistence?

- Map a Volume in the VM to persist data cross Docker containers

```
Vagrant.configure(2) do |config|
  config.vm.provision "shell", inline: <<-SHELL
    # Prepare Redis data share
    sudo mkdir -p /var/lib/redis/data
    sudo chown vagrant:vagrant /var/lib/redis/data
  SHELL

  # Add Redis docker container
  config.vm.provision "docker" do |d|
    d.pull_images "redis:alpine"
    d.run "redis:alpine",
      args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
  end
end
```

Persist container data in the VM

Data Volumes for PostgreSQL

```
#####
# Add PostgreSQL docker container
#####
config.vm.provision "shell", inline: <<-SHELL
  # Prepare PostgreSQL data share
  sudo mkdir -p /var/lib/postgresql/data
  sudo chown vagrant:vagrant /var/lib/postgresql/data
SHELL

# Add PostgreSQL docker container
config.vm.provision "docker" do |dl|
  d.pull_images "postgres"
  d.run "postgres",
    args: "-d --name postgres -p 5432:5432 -v /var/lib/postgresql/data:/var/lib/postgresql/data"
end
```

Data Volumes for PostgreSQL

```
#####
# Add PostgreSQL docker container
#####
config.vm.provision "shell", inline: <<-SHELL
  # Prepare PostgreSQL data share
  sudo mkdir -p /var/lib/postgresql/data
  sudo chown vagrant:vagrant /var/lib/postgresql/data
SHELL

# Add PostgreSQL docker container
config.vm.provision "docker" do |d|
  d.pull_images "postgres"
  d.run "postgres",
    args: "-d --name postgres -p 5432:5432 -v /var/lib/postgresql/data:/var/lib/postgresql/data"
end
```

A green arrow points from a green box containing the text "volume on the host" to a green box highlighting the path "/var/lib/postgresql/data" in the Docker command "args: "-v /var/lib/postgresql/data:/var/lib/postgresql/data"".

Data Volumes for PostgreSQL

```
#####
# Add PostgreSQL docker container
#####
config.vm.provision "shell", inline: <<-SHELL
  # Prepare PostgreSQL data share
  sudo mkdir -p /var/lib/postgresql/data
  sudo chown vagrant:vagrant /var/lib/postgresql/data
SHELL

# Add PostgreSQL docker container
config.vm.provision "docker" do |d|
  d.pull_images "postgres"
  d.run "postgres",
    args: "-d --name postgres -p 5432:5432 -v /var/lib/postgresql/data:/var/lib/postgresql/data"
end
```

volume on the host

Volume in container

Data Volumes for MySQL

```
#####
# Add MySQL docker container
#####
config.vm.provision "shell", inline: <<-SHELL
  # Prepare MySQL data share
  sudo mkdir -p /var/lib/mysql
  sudo chown vagrant:vagrant /var/lib/mysql
SHELL

# Add MySQL docker container
config.vm.provision "docker" do |dl|
  d.pull_images "mariadb"
  d.run "mariadb",
    args: "--restart=always -d --name mariadb -p 3306:3306 -v /var/lib/mysql:/var/lib/mysql -e
MySQL_ROOT_PASSWORD=passw0rd"
end
```

Data Volumes for Redis

```
#####
# Add Redis docker container
#####
config.vm.provision "shell", inline: <<-SHELL
  # Prepare Redis data share
  sudo mkdir -p /var/lib/redis/data
  sudo chown vagrant:vagrant /var/lib/redis/data
SHELL

# Add Redis docker container
config.vm.provision "docker" do |d|
  d.pull_images "redis:alpine"
  d.run "redis:alpine",
    args: "--restart=always -d --name redis -h redis -p 6379:6379 -v /var/lib/redis/data:/data"
end
```

Data Volumes for CouchDB

```
#####
# Add CouchDB docker container
#####
config.vm.provision "shell", inline: <<-SHELL
  # Prepare CouchDB data share
  sudo mkdir -p /usr/local/var/lib/couchdb
  sudo chown vagrant:vagrant /usr/local/var/lib/couchdb
SHELL

# Add CouchDB docker container
config.vm.provision "docker" do |d|
  d.pull_images "couchdb"
  d.run "couchdb",
    args: "--restart=always -d --name couchdb -p 5984:5984 -v /usr/local/var/lib/couchdb:/usr/local/
var/lib/couchdb"
end
```

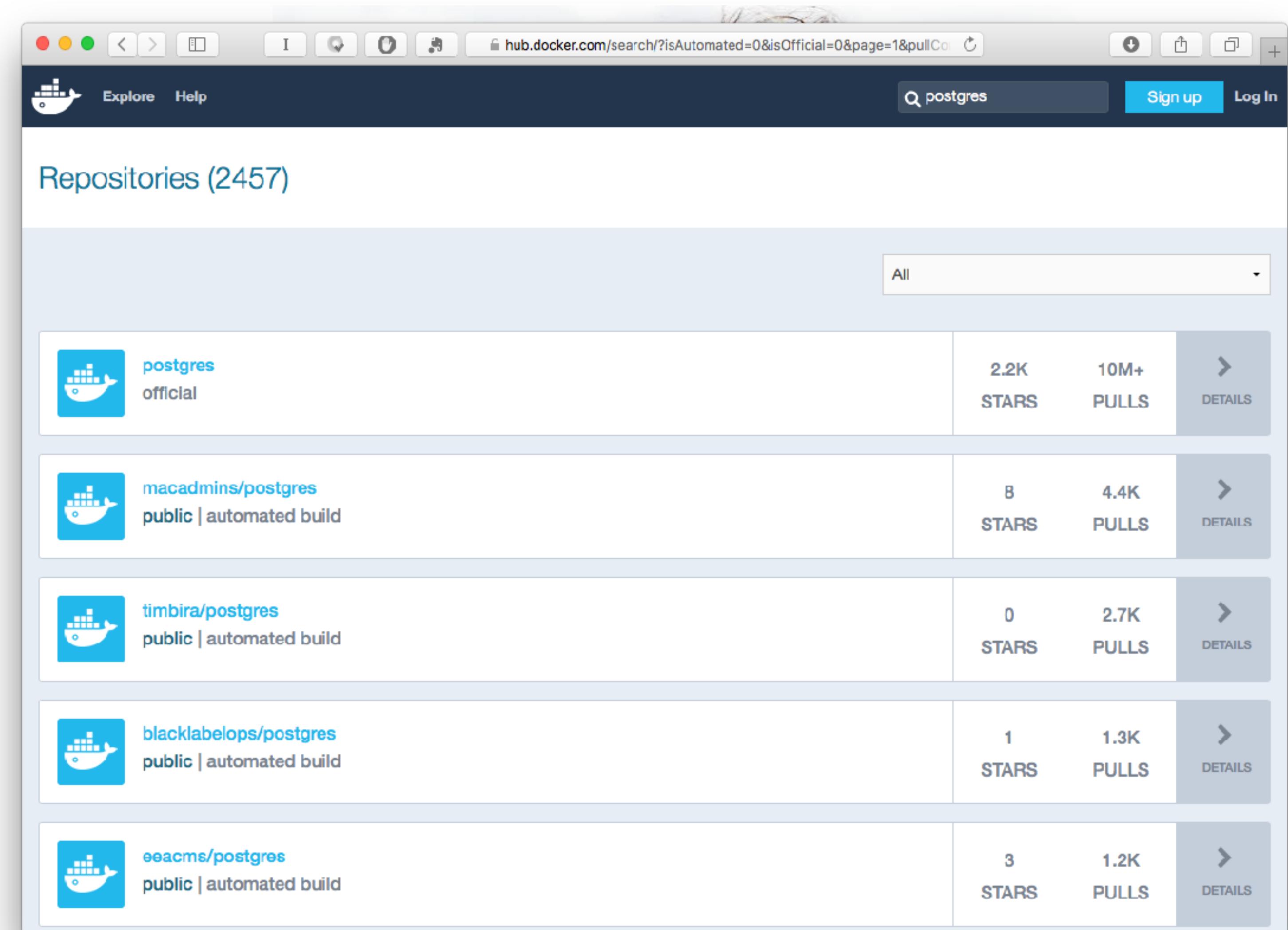
Handy Docker Startup Args

- **--restart=always** <— if it stops, restart it
- **-d** <— run as a daemon process (background)
- **--name <name>** <— name of running container in docker ps
- **-p <host>:<cont>** <— forward host port to container port
- **-v </host/folder>:<container/folder>** <— map volume
- **-e MY_ENV_VAR=<value>** <— inject environment variable

Where To Get More Containers?

hub.docker.com

- Contains 1000's of Docker images with almost every software you can imagine
- Usually “official” images come from the creator of the software
- Most have documentation on how to best use them



Ending Your Vagrant Session

- When you are done for the day, it's a good idea to shutdown your VM.
- This is accomplished with the halt command

```
$ exit  
iotia:lab-vagrant rofrano$ vagrant halt  
==> default: Attempting graceful shutdown of VM...
```

Removing a VM Permanently

- When you no longer need a VM you can delete it from your computer
- This is accomplished with the `destroy` command

```
$ vagrant destroy  
    default: Are you sure you want to destroy the 'default' VM? [y/N]  
==> default: Destroying VM and associated drives...
```

Handy Vagrant Commands

- `vagrant up` — bring up the vm
- `vagrant ssh` — open a shell inside the vm
- `exit` — exit out of the vm shell back to your host computer
- `vagrant halt` — shutdown the vm to return later with `vagrant up`
- `vagrant suspend | resume` — suspend vm and resume it later
- `vagrant reload --provision` — restarts vagrant machine, loads new Vagrantfile configuration and reprovisions shell scripts
- `vagrant destroy` — delete the vm for good
- `vagrant status` — see the status of all the current Vagrantfile's VM
- `vagrant global-status` — see the status of all Vagrant VM's

Summary

- You just deployed your first Vagrant environment
- You learned how to automatically install additional software
- You added Docker containers to supply needed middleware
- You can now check your `Vagrantfile` into github so that others can create the perfect development environment when working on your project.

QUESTIONS?

THANK YOU!