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# Vagga Documentation

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Vagga is a tool to create development environments. In particular it is able to:

- Build container and run program with single command, right after `git pull`
- Automatically rebuild container if project dependencies change
- Run multiple processes (e.g. application and database) with single command
- Execute network tolerance tests

All this seamlessly works using linux namespaces (or containers).

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**Hint:** While vagga is perfect for development environments and to build containers, it should not be the tool of choice to run your software in production environments. For example, it does not offer features to automatically restart your services when those fail. For these purposes, you could build the containers with vagga and then transfer them into your production environment and start them with tools like: [docker](#), [rocket](#), [lxc](#), [lxd](#), [runc](#), [systemd-nspawn](#), [lithos](#) or even [chroot](#).

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# CHAPTER 1

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## Links

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- [Managing Dependencies with Vagga](#) shows basic concepts of using vagga and what problems it solves
- [The Higher Level Package Manager](#) – discussion of vagga goals and future
- [Evaluating Mesos](#) discuss how to run network tolerance tests
- [Container-only Linux Distribution](#)
- [Containerized PHP Development Environments with Vagga](#)
- [The story behind vagga \(in russian\)](#)



## 2.1 About Vagga

Contents:

### 2.1.1 Entry Point

Vagga is a tool to create development environments. In particular it is able to:

- Build container and run program with single command, right after “git pull”
- Automatically rebuild container if project dependencies change
- Run multiple processes (e.g. application and database) with single command
- Execute network tolerance tests

All this seamlessly works using linux namespaces (or containers).

### Example

Let’s make config for hello-world flask application. To start you need to put following in `vagga.yaml`:

```
containers:
  flask:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [python3-flask]
commands:
  py3: !Command
    container: flask
    run: python3
```

- – create a container “flask”
- – install base image of ubuntu
- – enable the universe repository in ubuntu
- – install flask from package (from ubuntu universe)
- – create a simple command “py3”
- – run command in container “flask”
- – the command-line is “python3”

To run command just run `vagga command_name`:

```
$ vagga py3
[ .. snipped container build log .. ]
Python 3.5.1+ (default, Mar 30 2016, 22:46:26)
[GCC 5.3.1 20160330] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import flask
>>>
```

This is just a lazy example. Once your project starts to mature you want to use some specific version of flask and some other dependencies:

```
containers:
  flask:
    setup:
      - !Ubuntu xenial
      - !Py3Install
      - werkzeug==0.9.4
      - MarkupSafe==0.23
      - itsdangerous==0.22
      - jinja2==2.7.2
      - Flask==0.10.1
      - sqlalchemy==0.9.8
```

And if another developer does `git pull` and gets this config, running `vagga py3` next time will rebuild container and run command in the new environment without any additional effort:

```
$ vagga py3
[ .. snipped container build log .. ]
Python 3.5.1+ (default, Mar 30 2016, 22:46:26)
[GCC 5.3.1 20160330] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import flask, sqlalchemy
>>>
```

---

**Note:** Container is rebuilt from scratch on each change. So *removing* package works well. Vagga also uses smart caching of packages to make rebuilds fast.

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You probably want to move python dependencies into `requirements.txt`:

```
containers:
  flask:
    setup:
```

```
- !Ubuntu xenial
- !Py3Requirements "requirements.txt"
```

And vagga is smart enough to rebuild if `requirements.txt` change.

In case you've just cloned the project you might want to run bare `vagga` to see which commands are available. For example, here are some commands available in vagga project itself:

```
$ vagga
Available commands:
  make           Build vagga
  build-docs     Build vagga documentation
  test          Run self tests
```

(the descriptions on the right are added using `description` key in command)

## More Reading

- [Managing Dependencies with Vagga](#) shows basic concepts of using vagga and what problems it solves.
- [The Higher Level Package Manager](#) – discussion of vagga goals and future
- [Evaluating Mesos](#) discuss how to run network tolerance tests.

## 2.1.2 What Makes Vagga Different?

There are four prominent features of vagga:

- Command-centric workflow instead of container-centric
- Lazy creation of containers
- Containers are versioned and automatically rebuilt
- Running multiple processes without headache

Let's discuss them in details

### Command-Centric Workflow

When you start working on project, you don't need to know anything about virtual machines, dependencies, paths whatever. You just need to know what you can do with it.

Consider we have an imaginary web application. Let's see what we can do:

```
$ git clone git@git.git:somewebapp.git somewebapp
$ cd somewebapp
$ vagga
Available commands:
  build-js      build javascript files needed to run application
  serve        serve a program on a localhost
```

Ok, now we know that we probably expected to build javascript files and that we can run a server. We now just do:

```
$ vagga build-js
# container created, dependencies populated, javascripts are built
$ vagga serve
Now you can go to http://localhost:8000 to see site in action
```

Compare that to vagrant:

```
$ vagrant up
# some machine(s) created
$ vagrant ssh
# now you are in new shell. What to do?
$ make
# ok probably something is built (if project uses make), what now?
$ less README
# long reading follows
```

Or compare that to docker:

```
$ docker pull someuser/somewebapp
$ docker run --rm --it someuser/somewebapp
# if you are lucky something is run, but how to build it?
# let's see the README
```

## Lazy Container Creation

There are few interesting cases where lazy containers help.

### Application Requires Multiple Environments

In our imaginary web application described above we might have very different environments to build javascript files, and to run the application. For example javascripts are usually built and compressed using Node.js. But if our server is written in python we don't need Node.js to run application. So it's often desirable to run application in a container without build dependencies, at least to be sure that you don't miss some dependency.

Let's declare that with vagga. Just define two containers:

```
containers:
  build:
    setup:
      - !Ubuntu xenial
      - !Install [make, nodejs, node-uglify]
  serve:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [python-django]
```

One for each command:

```
commands:
  build-js: !Command
    container: build
```

```

run: "make build-js"

serve: !Command
  container: serve
  run: "python manage.py runserver"

```

Similarly might be defined test container and command:

```

containers:

  testing:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [make, nodejs, node-uglify, python-django, python-nose]

commands:

  test:
    container: testing
    run: [nosetests]

```

And your user never care how many containers are there. User only runs whatever commands he needs.

How is it done in vagrant?

```

$ vagrant up
# two containers are up at this point
$ vagrant ssh build -- make
# built, now we don't want to waste memory for build virtual machine
$ vagrant halt build
$ vagrant ssh serve -- python manage.py runserver

```

## Project With Examples

Many open-source projects and many proprietary libraries have some examples. Often samples have additional dependencies. If you developing a markdown parser library, you might have a tiny example web application using flask that converts markdown to html on the fly:

```

$ vagga
Available commands:
  md2html      convert markdown to html without installation
  tests        run tests
  example-web  run live demo (flask app)
  example-plugin example of plugin for markdown parser
$ vagga example-web
Now go to http://localhost:8000 to see the demo

```

How would you achieve the same with vagrant?

```

$ ls -R examples
examples/web:
Vagrantfile README flask-app.py

examples/plugin:
Vagrantfile README main.py plugin.py

```

```
$ cd examples/web
$ vagrant up && vagrant ssh -- python main.py --help
$ vagrant ssh -- python main.py --port 8000
# ok got it, let's stop it
$ vagrant halt && vagrant destroy
```

I.e. a Vagrantfile per example. Then user must keep track of what containers he have done `vagrant up` in, and do not forget to shutdown and destroy them.

---

**Note:** example with Vagrant is very imaginary, because unless you insert files in container on provision stage, your project root is inaccessible in container of `examples/web`. So you need some hacks to make it work.

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Docker case is very similar to Vagrant one.

### Container Versioning and Rebuilding

What if the project dependencies are changed by upstream? No problem:

```
$ git pull
$ vagga serve
# vagga notes that dependencies changed, and rebuilds container
$ git checkout stable
# moving to stable branch, to fix some critical bug
$ vagga serve
# vagga uses old container that is probably still around
```

Vagga hashes dependencies, and if the hash changed creates new container. Old ones are kept around for a while, just in case you revert to some older commit or switch to another branch.

---

**Note:** For all backends except `nix`, version hash is derived from parameters of a builder. For `nix` we use hash of `nix` derivations that is used to build container, so change in `.nix` file or its dependencies trigger rebuild too (unless it's non-significant change, like whitespace change or swapping lines).

---

How you do this with Vagrant:

```
$ git pull
$ vagrant ssh -- python manage.py runserver
ImportError
$ vagrant reload
$ vagrant ssh -- python manage.py runserver
ImportError
$ vagrant reload --provision
# If you are lucky and your provision script is good, dependency installed
$ vagrant ssh -- python manage.py runserver
# Ok it works
$ git checkout stable
$ vagrant ssh -- python manage.py runserver
# Wow, we still running dependencies from "master", since we added
# a dependency it works for now, but may crash when deploying
$ vagrant restart --provision
# We used ``pip install requirements.txt`` in provision
# and it doesn't delete dependencies
```

```
$ vagrant halt
$ vagrant destroy
$ vagrant up
# let's wait ... it sooo long.
$ vagrant ssh -- python manage.py runserver
# now we are safe
$ git checkout master
# Oh no, need to rebuild container again?!?!
```

Using Docker? Let's see:

```
$ git pull
$ docker run --rm -it me/somewebapp python manage.py runserver
ImportError
$ docker tag me/somewebapp:latest me/somewebapp:old
$ docker build -t me/somewebapp .
$ docker run --rm -it me/somewebapp python manage.py runserver
# Oh, that was simple
$ git checkout stable
$ docker run --rm -it me/somewebapp python manage.py runserver
# Oh, crap, I forgot to downgrade container
# We were smart to tag old one, so don't need to rebuild:
$ docker run --rm -it me/somewebapp:old python manage.py runserver
# Let's also rebuild dependencies
$ ./build.sh
Running: docker run --rm me/somewebapp_build python manage.py runserver
# Oh crap, we have hard-coded container name in build script?!?!
```

Well, docker is kinda easier because we can have multiple containers around, but still hard to get right.

## Running Multiple Processes

Many projects require multiple processes around. E.g. when running web application on development machine there are at least two components: database and app itself. Usually developers run database as a system process and a process in a shell.

When running in production one usually need also a cache and a webserver. And developers are very lazy to run those components on development system, just because it's complex to manage. E.g. if you have a startup script like this:

```
#!/bin/sh
redis-server ./config/redis.conf &
python manage.py runserver
```

You are going to loose `redis-server` running in background when python process dead or interrupted. Running them in different tabs of your terminal works while there are two or three services. But today more and more projects adopt service-oriented architecture. Which means there are many services in your project (e.g. in our real-life example we had 11 services written by ourselves and we also run two mysql and two redis nodes to emulate clustering).

This means either production setup and development are too diverse, or we need better tools to manage processes.

How vagrant helps? Almost in no way. You can run some services as a system services inside a vagrant. And you can also have multiple virtual machines with services, but this doesn't solve core problem.

How docker helps? It only makes situation worse, because now you need to follow logs of many containers, and remember to `docker stop` and `docker rm` the processes on every occasion.

Vagga's way:

```
commands:
  run_full_app: !Supervise
  children:
    web: !Command
      container: python
      run: "python manage.py runserver"
    redis: !Command
      container: redis
      run: "redis-server ./config/redis.conf"
    celery: !Command
      container: python
      run: "python manage.py celery worker"
```

Now just run:

```
$ vagga run_full_app
# two python processes and a redis started here
```

It not only allows you to start processes in multiple containers, it also does meaningful monitoring of them. The `stop-on-failure` mode means if any process failed to start or terminated, terminate all processes. It's opposite to the usual meaning of supervising, but it's super-useful development tool.

Let's see how it's helpful. In example above celery may crash (for example because of misconfiguration, or OOM, or whatever). Usually when running many services you have many-many messages on startup, so you may miss it. Or it may crash later. So you click on some task in web app, and wait when the task is done. After some time, you think that it *may* be too long, and start looking in logs here and there. And after some tinkering around you see that celery is just down. Now, you lost so much time just waiting. Wouldn't it be nice if everything is just crashed and you notice it immediately? Yes it's what `stop-on-failure` does.

Then if you want to stop it, you just press `Ctrl+C` and wait for it to shut down. If it hangs for some reason (may be you created a bug), you repeat or press `Ctrl+/` (which is `SIGQUIT`), or just do `kill -9` from another shell. In any case vagga will not exit until all processes are shut down and no hanging processes are left ever (Yes, even with `kill -9`).

### 2.1.3 Vagga vs Docker

Both products use linux namespaces (a/k/a linux containers) to the work. However, docker requires root privileges to run, and doesn't allow to make development environments as easy as vagga.

#### User Namespaces

As you might noticed that adding user to `docker` group (if your docker socket is accessed by `docker` group), is just like giving him a passwordless `sudo`. This is because root user in docker container is same root that one on host. Also user that can start docker container can mount arbitrary folder in host filesystem into the container (So he can just mount `/etc` and change `/etc/passwd`).

Vagga is different as it uses a user namespaces and don't need any programs running as root or `setuid` programs or `sudo` (except systems' builtin `newuidmap/newgidmap` if you want more that one user inside a container, but `newuidmap` `setuid` binary is very small functionally and safe).

#### No Central Daemon

Vagga keeps your containers in `.vagga` dir inside your project. And runs them just like any other command from your shell. I.e. command run with vagga is child of your shell, and if that process is finished or killed, its just done.

No need to delete container in some central daemon like docker has (i.e. docker doesn't always remove containers even when using `--rm`).

Docker also shares some daemon configuration between different containers even run by different users. There is no such sharing in vagga.

Also not having central daemon shared between users allows us to have a user-defined settings file in `$HOME/.config/vagga/`.

## Children Processes

Running processes as children of current shell has following advantages:

- You can monitor process and restart when dead (needs polling in docker), in fact there a command type `supervise` that does it for you)
- File descriptors may be passed to process
- Processes/containers may be socket-activated (e.g. using `systemd --user`)
- Stdout and stderr streams are just inherited file descriptors, and they are separate (docker mixes the two; it also does expensive copying of the stream from the container to the client using HTTP api)

## Filesystems

All files in vagga is kept in `.vagga/container_name/` so you can inspect all *persistent* filesystems easily, without finding cryptic names in some system location, and without `sudo`

## Filesystem Permissions

Docker by default runs programs in container as root. And it's also a root on the host system. So usually in your development project you get files with root owner. While it's possible to specify your uid as a user for running a process in container, it's not possible to do it portable. I.e. your uid in docker container should have `passwd` entry. And somebody else may have another uid so must have a different entry in `/etc/passwd`. Also if some process really needs to be root inside the container (e.g. it must spawn processes by different users) you just can't fix it.

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**Note:** In fact you can specify `uid` without adding a `passwd` entry, and that works most of the time. Up to the point some utility needs to lookup info about user.

---

With help of user namespaces Vagga runs programs as a root inside a container, but it looks like your user outside. So all your files in project dir are still owned by you.

## Security

While docker has enterprise support, including security updates. Vagga doesn't have such (yet).

However, Vagga runs nothing with root privileges. So even running root process in guest system is at least as secure as running any unprivileged program in host system. It also uses `chroot` and linux namespaces for more isolation. Compare it to docker which doesn't consider running as root inside a container secure.

You can apply `selinux` or `apparmor` rules for both.

## Filesystem Redundancy

Vagga creates each container in `.vagga` as a separate directory. So theoretically it uses more space than layered containers in docker. But if you put that dir on `btrfs` filesystem you can use `bedup` to achieve much better redundancy than what docker provides.

### 2.1.4 Vagga vs Vagrant

Both products do development environments easy to setup. However, there is a big difference on how they do their work.

#### Containers

While vagrant emulates full virtual machine, vagga uses linux containers. So you don't need hardware virtualization and a supervisor. So usually vagga is more light on resources.

Also comparing to vagrant where you run project inside a virtual machine, vagga is suited to run commands inside a container, not a full virtual machine with SSH. In fact many vagga virtual machines don't have a shell and/or a package manager inside.

#### Commands

While vagrant is concentrated around `vagrant up` and VM boot process. Light containers allows you to test your project in multiple environments in fraction of second without waiting for boot or having many huge processes hanging around.

So instead of having `vagrant up` and `vagrant ssh` we have user-defined commands like `vagga build` or `vagga run` or `vagga build-a-release-tarball`.

#### Linux-only

While vagrant works everywhere, vagga only works on linux systems with recent kernel and userspace utilities.

If you use a mac, just run vagga inside a vagrant container, just like you used to run docker :)

#### Half-isolation

Being only a container allows vagga to share memory with host system, which is usually a good thing.

Memory and CPU usage limits can be enforced on vagga programs using `cgroups`, just like on any other process in linux. Vagga runs only on quite recent linux kernels, which has much more limit capabilities than previous ones.

Also while vagrant allows to forward selected network ports, vagga by default shares network interface with the host system. Isolating and forwarding ports will be implemented soon.

## 2.2 Installation

Contents
----------

- *Binary Installation*
- *Runtime Dependencies*
- *Ubuntu*
- *Ubuntu: Old Releases (precise, 12.04)*
- *Debian 8*
- *Arch Linux*
- *Building From Source*
- *OS X / Windows*
- *Raspbian Stretch (Debian 9)*

## 2.2.1 Binary Installation

**Note:** If you're ubuntu user you should use package. See *instructions below*.

Visit <https://files.zerogw.com/vagga/latest.html> to find out latest tarball version. Then run the following:

```
$ wget https://files.zerogw.com/vagga/vagga-0.8.0.tar.xz
$ tar -xJf vagga-0.8.0.tar.xz
$ cd vagga
$ sudo ./install.sh
```

Or you may try more obscure way:

```
$ curl -sSf https://files.zerogw.com/vagga/vagga-install.sh | sh
```

**Note:** Similarly we have a *-testing* variant of both ways:

- <https://files.zerogw.com/vagga/latest-testing.html>

```
$ curl -sSf https://files.zerogw.com/vagga/vagga-install-testing.sh | sh
```

## 2.2.2 Runtime Dependencies

Vagga is compiled as static binary, so it doesn't have many runtime dependencies. It does require user namespaces to be properly set up, which allows Vagga to create and administer containers without having root privilege. This is increasingly available in modern distributions but may need to be enabled manually.

- the `newuidmap`, `newgidmap` binaries are required (either from `shadow` or `uidmap` package)
- known exception for Arch Linux: ensure `CONFIG_USER_NS=y` enabled in kernel. Default kernel doesn't contain it, you can check it with:

```
$ zgrep CONFIG_USER_NS /proc/config.gz
```

See *Arch Linux*

- known exception for Debian and Fedora: some distributions disable unprivileged user namespaces by default. You can check with:

```
$ sysctl kernel.unprivileged_usersns_clone
kernel.unprivileged_usersns_clone = 1
```

or you may get:

```
$ sysctl kernel.unprivileged_usersns_clone
sysctl: cannot stat /proc/sys/kernel/unprivileged_usersns_clone: No such file or_
↪directory
```

**Either one** is a valid outcome.

In case you've got `kernel.unprivileged_usersns_clone = 0`, use something along the lines of:

```
$ sudo sysctl -w kernel.unprivileged_usersns_clone=1
kernel.unprivileged_usersns_clone = 1
# make available on reboot
$ echo kernel.unprivileged_usersns_clone=1 | \
  sudo tee /etc/sysctl.d/50-unprivileged-usersns-clone.conf
kernel.unprivileged_usersns_clone=1
```

- `/etc/subuid` and `/etc/subgid` should be set up. Usually you need at least 65536 subusers. This will be setup automatically by `useradd` in new distributions. See `man subuid` if not. To check:

```
$ grep -w $(whoami) /etc/sub[ug]id
/etc/subgid:<you>:689824:65536
/etc/subuid:<you>:689824:65536
```

The only other optional dependency is `iptables` in case you will be doing *network tolerance testing*.

See instructions specific for your distribution below.

### 2.2.3 Ubuntu

To install from vagga's repository just add the following to `sources.list` (see actual command below):

```
deb [arch=amd64 trusted=yes] https://ubuntu.zerogw.com vagga main
```

The process of installation looks like the following:

```
$ echo 'deb [arch=amd64 trusted=yes] https://ubuntu.zerogw.com vagga main' | sudo tee_
↪/etc/apt/sources.list.d/vagga.list
deb https://ubuntu.zerogw.com vagga main
$ sudo apt-get update
[.. snip ..]
Get:10 https://ubuntu.zerogw.com vagga/main amd64 Packages [365 B]
[.. snip ..]
Fetched 9,215 kB in 17s (532 kB/s)
Reading package lists... Done
$ sudo apt-get install vagga
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  vagga
0 upgraded, 1 newly installed, 0 to remove and 113 not upgraded.
```

```

Need to get 873 kB of archives.
After this operation, 4,415 kB of additional disk space will be used.
WARNING: The following packages cannot be authenticated!
  vagga
Install these packages without verification? [y/N] y
Get:1 https://ubuntu.zerogw.com/ vagga/main vagga amd64 0.1.0-2-g8b8c454-1 [873 kB]
Fetched 873 kB in 2s (343 kB/s)
Selecting previously unselected package vagga.
(Reading database ... 60919 files and directories currently installed.)
Preparing to unpack .../vagga_0.1.0-2-g8b8c454-1_amd64.deb ...
Unpacking vagga (0.1.0-2-g8b8c454-1) ...
Setting up vagga (0.1.0-2-g8b8c454-1) ...

```

Now vagga is ready to go.

**Note:** If you are courageous enough, you may try to use `vagga-testing` repository to get new versions faster:

```
deb [arch=amd64 trusted=yes] https://ubuntu.zerogw.com vagga-testing main
```

It's build right from git "master" branch and we are trying to keep "master" branch stable.

## 2.2.4 Ubuntu: Old Releases (precise, 12.04)

For old ubuntu you need `uidmap`. It has no dependencies. So if your ubuntu release doesn't have `uidmap` package (as 12.04 does), just fetch it from newer ubuntu release:

```

$ wget http://gr.archive.ubuntu.com/ubuntu/pool/main/s/shadow/uidmap_4.1.5.1-1ubuntu9_
→amd64.deb
$ sudo dpkg -i uidmap_4.1.5.1-1ubuntu9_amd64.deb

```

Then run same sequence of commands, you run for more recent releases:

```

$ echo 'deb [arch=amd64 trusted=yes] https://ubuntu.zerogw.com vagga main' | sudo tee_
→/etc/apt/sources.list.d/vagga.list
$ sudo apt-get update
$ sudo apt-get install vagga

```

If your ubuntu is older, or you upgraded it without recreating a user, you need to fill in `/etc/subuid` and `/etc/subgid`. Command should be similar to the following:

```

$ echo "$ (id -un):100000:65536" | sudo tee /etc/subuid
$ echo "$ (id -un):100000:65536" | sudo tee /etc/subgid

```

Or alternatively you may edit files by hand.

Now your vagga is ready to go.

## 2.2.5 Debian 8

Install Vagga like in Ubuntu:

```
$ echo 'deb [arch=amd64 trusted=yes] https://ubuntu.zerogw.com vagga main' | sudo tee _  
↪ /etc/apt/sources.list.d/vagga.list  
$ sudo apt-get update  
$ sudo apt-get install vagga
```

Then fix runtime dependencies:

```
$ echo 'kernel.unprivileged_userns_clone = 1' | sudo tee --append /etc/sysctl.conf  
$ sudo sysctl -p
```

Now your vagga is ready to go.

### 2.2.6 Arch Linux

Since 4.14.5-1 Arch Linux kernel has enabled CONFIG\_USER\_NS option, you can check it with:

```
$ zgrep CONFIG_USER_NS /proc/config.gz
```

The only thing you should to do with new kernel is to turn on sysctl flag:

```
sysctl kernel.unprivileged_userns_clone=1
```

To preserve the flag between reboots just execute:

```
echo kernel.unprivileged_userns_clone=1 | sudo tee -a /etc/sysctl.d/99-sysctl.conf
```

Installing vagga from binary archive using [AUR package](#) (please note that vagga-bin located in new AUR4 repository so it should be activated in your system):

```
$ yaourt -S vagga-bin
```

If your shadow package is older than 4.1.5, or you upgraded it without recreating a user, after installation you may need to fill in /etc/subuid and /etc/subgid. You can check if you need it with:

```
$ grep $(id -un) /etc/sub[ug]id
```

If output is empty, you have to modify these files. Command should be similar to the following:

```
$ echo "$(id -un):100000:65536" | sudo tee -a /etc/subuid  
$ echo "$(id -un):100000:65536" | sudo tee -a /etc/subgid
```

### 2.2.7 Building From Source

The recommended way to is to build with vagga. It's as easy as installing vagga and running `vagga make` inside the the clone of a vagga repository.

There is also a `vagga build-packages` command which builds ubuntu and binary package and puts them into `dist/`.

To install run:

```
$ make install
```

or just (in case you don't have make in host system):

```
$ ./install.sh
```

Both support PREFIX and DESTDIR environment variables.

You can also build vagga out-of-container by using rustup.rs. Make sure you have the musl target installed:

```
$ rustup target add x86_64-unknown-linux-musl
```

Also make sure you have musl-gcc in your path:

```
$ which musl-gcc
/usr/bin/musl-gcc
```

Then just build using cargo and the appropriate target:

```
$ cargo build --target x86_64-unknown-linux-musl
```

## 2.2.8 OS X / Windows

We have two proof of concept wrappers around vagga:

- [vagga-docker](#) which leverages docker for mac to run vagga on OS X
- [vagga-box](#) a wrapper around VirtualBox (tested on OS X only so far)

If you'd like something more stable, try:

- [vagrant-vagga](#) (recommended)
- [vagga-barge](#)
- Or just your own vagrant config (but see [this FAQ entry](#))

## 2.2.9 Raspbian Stretch (Debian 9)

Either compile on Raspberry Pi (be patient as it needs quite a while; take care not to run out of memory):

```
$ git clone https://github.com/tailhook/vagga.git
$ cd vagga
$ VAGGA_VERSION=$(git describe) CFLAGS=-I/usr/include/arm-linux-musleabihf cargo_
↳ build --target=arm-unknown-linux-musleabihf
```

Or cross compile (recommended):

```
$ git clone https://github.com/tailhook/vagga.git
$ cd vagga
$ vagga make-arm
$ scp target/arm-unknown-linux-musleabihf/debug/vagga <user@pi>:<path to vagga repo>
```

Installation needs to be run from inside cloned vagga repo on Raspberry Pi.

```
$ ./fetch_binaries.sh armhf
$ sudo ./install.sh
$ vagga -V
$ sudo apt install uidmap
```

Run container with Alpine should be fine on all Pi models whereas Ubuntu is only confirmed for “Pi 2 model B” <https://wiki.ubuntu.com/ARM/RaspberryPi>

To run container with Ubuntu add `ubuntu-mirror` to your vagga settings file

```
$ echo 'ubuntu-mirror: http://ports.ubuntu.com/ubuntu-ports' >> ~/.vagga.yaml
$ # if you get error because of failed 'apt-get update' try different mirror, e.g.
$ echo 'ubuntu-mirror: http://ftp.tu-chemnitz.de/pub/linux/ubuntu-ports/' >> ~/.vagga.
→yaml
```

In your `vagga.yaml` select proper architecture:

```
setup:
- !UbuntuRelease { codename: xenial, arch: armhf }
```

## 2.3 Configuration

Main vagga configuration file is `vagga.yaml`. It's usually in the root of the project dir.

Configuration format basics.

### 2.3.1 Overview

The `vagga.yaml` has two sections:

- `containers` – description of the containers
- `commands` – a set of commands defined for the project

There is also two top-level options:

#### **mixins**

**\*\*This functionality is experimental\*\*. Some details can change in future.**

This is a list of vagga configs that will be “mixed in” into current config. This basically means that we import all the commands and containers from them literally.

When adding mixins, latter one overrides commands and containers in the former configs. And the ones in `vagga.yaml` override all the mixins.

There are a few use-cases for mixins:

1. Splitting config into several groups of things, while putting together containers and commands (latter contrasts to using `includes`).
2. Use a generated parts of configs. Because non-existing or invalid mixins are ignored (with a warning) you can generate or update mixins by vagga commands without risk of making defunct vagga config.
3. Use vagga config from a subproject (but be aware that paths resolve to original `vagga.yaml`, not the included one)
4. Override things from git-commited `vagga.yaml` to custom one (note the latter requires not to commit `vagga.yaml` itself, but only mixed in things)

New in version 0.7.1.

Changed in version 0.8.1: There are implicit mixins:

1. `vagga.local.yaml`
2. `.vagga.local.yaml` (hidden)

### 3. `.vagga/local.yaml` (in vagga dir)

They should be used to add or override local commands which shouldn't be committed to a central repository. They work similarly as normal mixins and can contain additional mixins themselves.

#### **minimum-vagga**

(default is no limit) Defines minimum version to run the configuration file. If you put:

```
minimum-vagga: v0.5.0
```

Into `vagga.yaml` other users will see the following error:

```
Please upgrade vagga to at least "v0.5.0"
```

This is definitely optional, but useful if you start using new features, and want to communicate the version number to a team. Versions from testing work as well. To see your current version use:

```
$ vagga --version
```

## Containers

Example of one container defined:

```
containers:
  sphinx:
    setup:
      - !Ubuntu xenial
      - !Install [python3-sphinx, make]
```

The YAML above defines a container named `sphinx`, which is built with two steps: download and unpack ubuntu xenial base image, and install packages name `python-sphinx`, `make` inside the container.

## Commands

Example of command defined:

```
commands:
  build-docs: !Command
    description: Build vagga documentation using sphinx
    container: sphinx
    work-dir: docs
    run: [make]
```

The YAML above defines a command named `build-docs`, which is run in container named `sphinx`, that is run in `docs/` sub dir of project, and will run command `make` in container. So running:

```
$ vagga build-docs html
```

Builds html docs using sphinx inside a container.

See [commands](#) for comprehensive description of how to define commands.

## 2.3.2 Container Parameters

### setup

List of steps that is executed to build container. See *Container Building Guide* and *Build Steps (The Reference)* for more info.

### environ-file

The file with environment definitions. Path inside the container. The file consists of line per value, where key and value delimited by equals = sign. (Its similar to `/etc/environment` in ubuntu or `EnvironmentFile` in systemd, but doesn't support commands quoting and line wrapping yet)

### environ

The mapping, that constitutes environment variables set in container. This overrides `environ-file` on value by value basis.

### uids

List of ranges of user ids that need to be mapped when the container runs. User must have some ranges in `/etc/subuid` to run this container, and the total size of all allowed ranges must be larger or equal to the sum of sizes of all the ranges specified in `uids` parameter. Currently vagga applies ranges found in `/etc/subuid` one by one until all ranges are satisfied. It's not always optimal or desirable, we will allow to customize mapping in later versions.

Default value is `[0-65535]` which is usually good enough. Unless you have a smaller number of uids available or run container in container.

### gids

List of ranges of group ids that need to be mapped when the container runs. User must have some ranges in `/etc/subgid` to run this container, and the total size of all allowed ranges must be larger or equal to the sum of sizes of all the ranges specified in `gids` parameter. Currently vagga applies ranges found in `/etc/subgid` one by one until all ranges are satisfied. It's not always optimal or desirable, we will allow to customize mapping in later versions.

Default value is `[0-65535]` which is usually good enough. Unless you have a smaller number of gids available or run container in container.

### volumes

The mapping of mount points to the definition of volume. Allows to mount some additional filesystems inside the container. See *Volumes* for more info. Default is:

```
volumes:
  /tmp: !Tmpfs { size: 100Mi, mode: 0o1777 }
```

---

**Note:** You must create a folder for each volume. See *Container Building Guide* for documentation.

---

### resolv-conf-path

The path in container where to copy `resolv.conf` from host. If the value is `null`, no file is copied. Default is `/etc/resolv.conf`. Its useful if you symlink `/etc/resolv.conf` to some `tmpfs` directory in `setup` and point `resolv-conf-path` to the directory.

---

**Note:** The default behavior for vagga is to overwrite `/etc/resolv.conf` inside the container at the start. It's violation of read-only nature of container images (and visible for all containers). But as we are doing only single-machine development environments, it's bearable. We are seeking for a better way without too much hassle for the user. But you can use the symlink if it bothers you.

---

**hosts-file-path**

The path in container where to copy `/etc/hosts` from host. If the value is `null`, no file is copied. Default is `/etc/hosts`. The setting intention is very similar to `resolv-conf-path`, so the same considerations must be applied.

**auto-clean**

(experimental) Do not leave multiple versions of the container lying around. Removes the old container version after the new one is successfully build. This is mostly useful for containers which depend on binaries locally built (i.e. the ones that are never reproduced in future because of timestamp). For most containers it's a bad idea because it doesn't allow to switch between branches using source-control quickly. Better use `vagga _clean --old` if possible.

**image-cache-url**

If there is no locally cached image and it is going to be built, first check for the cached image in the specified URL.

Example:

```
image-cache-url: http://example.org/${container_name}.${short_hash}.tar.xz
```

To find out how to upload an image see `push-image-cmd`.

**Warning:** The url must contain at least `short_hash` substitution, or otherwise it will ruin the vagga's container versioning.

**Note:** Similarly to `Tar` command we allow paths starting with `.` and `/volumes/` here. It's of limited usage. And we still consider this experimental. This may be useful for keeping image cache on network file system, presumably on non-public projects.

**data-dirs**

List of directories and files that only should remain in the container. All other directories and files will be removed after container is build. Useful to create data containers that can be used as volumes inside normal containers.

Example:

```
data-dirs: [/var/lib/postgres]
```

**default-shell**

(default `[/bin/sh, -c, $cmdline, "--"]`) Alternative shell to run commands with. This shell is only used to run commands which have `run` argument as a string. If `run` is a list then default shell is **not** used.

You can use any command, not only sh-compatible, for example `python`, but that may be unexpected o user so use your best judgement. Also take closer look on the default invocation, in particular:

1. `$cmdline` is replaced with the contents of `run`
2. **-- is a common convention to prevent user command's arguments** conflicting with shell's arguments (this is useful if `accepts-arguments` is enabled)

## 2.3.3 Commands

Every command under `commands` in `vagga.yaml` is mapped with a tag that denotes the command type. There are two command types `!Command` and `!Supervise` illustrated by the following example:

```
containers: {ubuntu: ... }
commands:
  bash: !Command
    description: Run bash shell inside the container
    container: ubuntu
    run: /bin/bash
  download: !Supervise
    description: Download two files simultaneously
    children:
      amd64: !Command
        container: ubuntu
        run: wget https://partner-images.canonical.com/core/xenial/current/ubuntu-
↪xenial-core-cloudimg-amd64-root.tar.gz
      i386: !Command
        container: ubuntu
        run: wget https://partner-images.canonical.com/core/xenial/current/ubuntu-
↪xenial-core-cloudimg-i386-root.tar.gz
```

Since 0.7.1 there is a third *experimental* kind which is !CapsuleCommand.

## Common Parameters

These parameters work for both kinds of commands:

### description

Description that is printed in when vagga is run without arguments

### banner

The message that is printed before running process(es). Useful for documenting command behavior.

### banner-delay

The seconds to sleep before printing banner. For example if commands run a web service, banner may provide a URL for accessing the service. The delay is used so that banner is printed after service startup messages not before. Note that currently vagga sleeps this amount of seconds even if service is failed immediately.

### epilog

The message printed after command is run. It's printed only if command returned zero exit status. Useful to print further instructions, e.g. to display names of build artifacts produced by command.

### aliases

The list of names that might be used to refer to a command. For example:

```
commands:
  test: !Command
    aliases: [check, run-tests]
    container: py3
    run: [pytest]
```

Note if there is a command with the same name it overrides an alias. When multiple commands have single alias the result is deemed **undefined** for now, we may turn it into an error/warning later or run both commands.

Overriding works also across the mixins. So command imported earlier overrides alias defined later. Aliases aren't merged on encountering a mixin, but rather being overridden like other settings.

Another trick is that bare vagga and vagga `_list` (without `--hidden`) show command only if main name does not start with underscore. I.e. this is a way to hide non-underscored command by naming it `_something` and adding non-underscored alias.

**group**

(no default) Which group to print command under. It's actual title of the group printed when running bare *vagga*. For example:

```
commands:
  build: !Command # ...
  example-app1: !Command
    group: "Example applications"
    # ...
  example-app2: !Command
    group: "Example applications"
    # ...
```

Might be listed as:

```
$ vagga
Available commands:
  build          Build the library

Example applications:
  example-app1   Run simple example application
  example-app2   Run a more comprehensive example applications
```

By default command is listed in the first section named “Available commands”, if all commands have a “group”, then aforementioned title is not printed.

**prerequisites**

The list of commands to run before the command, each time it is started.

Example:

```
commands:
  make:
    container: build
    run: "make prog"
  run:
    container: build
    prerequisites: [make]
    run: "./prog"
```

The sequence of running of command with `prerequisites` is following:

1. Container is built if needed for each prerequisite
2. Container is built if needed for main command
3. Each prerequisite is run in sequence
4. Command is started

If any step fails, neither next step nor the command is run.

The *prerequisites* are recursive. If any of the prerequisite has prerequisites itself, they will be called. But each named command will be run only once. We use topology sort to ensure prerequisite commands are started before dependent commands. For cyclic dependencies, we ensure that command specified in the command line is run later, otherwise order of cyclic dependencies is unspecified.

The supervise command's `--only` and `--except` influences neither running prerequisites itself nor commands inside the prerequisite if the latter happens to be supervise command. But there is a global flag `--no-prerequisites`.

The *prerequisites* is not (yet) supported in the any of children of a `!Supervise` command, but you can write prerequisites for the whole command group.

### expect-inotify-limit

Check the `sysctl fs.inotify.max_user_watches` and print a warning or set it automatically if *auto-apply-sysctl* is enabled. *More info about max\_user\_watches*

### options

This is a `docopt` definition for the options that this command accepts. Example:

```
commands:
  test: !Supervise
    options: |
      Usage: vagga test [--redis-port=<n>] [options] [<tests>...]

      Options:
      -R, --redis-port <n>  Port to run redis on [default: 6379]
      <tests> ...           Name of the tests to run. By default all
                           tests are run

    children:
      redis: !Command
        container: redis
        run: |
          redis-server --daemonize no --port "$VAGGAOPT_REDIS_PORT"
      first-line: !Command
        container: busybox
        run: |
          py.test --redis-port "$VAGGAOPT_REDIS_PORT" $VAGGAOPT_TESTS
```

As you might have noticed, options are passed in environment variables prefixed with `VAGGAOPT_` and `VAGGACLI_` (see below). Your scripts are free to use them however makes sense for your application.

---

### Note:

- You should include `[options]` at least in one of the usage examples, to have `-h`, `--help` working as well as other built-in options (`--only`, `--except` in supervise commands)
  - This setting overrides *accepts-arguments*
- 

Every argument is translated into two variables:

- `VAGGAOPT_ARG` – has the raw value of the argument, for boolean flags it contains either `true` or `nothing`, for repeatable flags it contains a number of occurrences
- `VAGGACLI_ARG` – has a canonical representation of an argument, this includes option name and all needed escaping to represent multiple command line arguments

The `ARG` is usually a long name of the option if exists, or short name otherwise. For positional arguments it's argument name. It's always uppercased and has `-` replaced with `_`

There are few shortcomings of both kinds:

1. `VAGGAOPT_` can't represent list of arguments that can contain spaces. So it can't be used for list of file names in the general case.
2. `VAGGACLI_` contains escaped versions of arguments so requires using `eval` to make proper argument list from it

Some shell patterns using `VAGGAOPT_`:

1. To propagate a flag, use either one:

```
somecmd ${VAGGAOPT_FLAG:++flag}
somecmd $VAGGACLI_FLAG
```

2. To optionally pass a value to a command, use either one (note the implications of eval in the second command):

```
somecmd ${VAGGAOPT_VALUE:++value} $VAGGAOPT_VALUE
eval somecmd $VAGGACLI_VALUE
```

To overcome limitations of eval, for example if you need to expand \$(hostname) in the command, you can use the following snippet:

```
eval printf "%s\0" $VAGGACLI_VALUE | xargs -0 somecmd -H$(hostname)
```

3. To pass a list of commands each prefixed with a --test=, use either one:

```
# any shell (but ugly)
eval printf "%s\0" $VAGGACLI_TESTS | sed -z 's/^/--test=/' | xargs -0_
↪somecmd
```

```
# bash only
eval "tests=($VAGGACLI_TESTS) "
somecmd "${tests[@]/#/--test=}"
```

(Note for some sed implementations you need to omit -z flag)

This works if you have argument like vagga test <tests>... However, if your vagga command-line is vagga test --test=<name>... use the following instead:

```
eval somecmd $VAGGACLI_TEST
```

### symlink-name

This functionality is experimental. Some details can change in future.

If parameter is set to some name, then vagga \_update\_symlinks will add a symlink to a vagga binary with this name. This should be used for commands that you want to run from your shell without vagga\_ prefix. See \_update\_symlinks command for more info.

New in version 0.7.1.

## Parameters of !Command

### container

The container to run command in.

### tags

The list of tags for this command. Tags are used for processes filtering (with --only and --exclude) when running any !Supervise command.

Simple example:

```
commands:
  run: !Supervise
  children:
    postgres: !Command
    tags: [service]
```

```
run: ...
redis: !Command
tags: [service]
run: ...
app: !Command
tags: [app]
run: ...
```

```
$ vagga run --only service # will start only postgres and redis processes
```

### run

The command to run. It can be:

- either a string encompassing a shell command line (which is feeded to `/bin/sh -c`)
- or a list containing first the full path to the executable to run and then possibly static arguments.

### work-dir

The working directory to run in. Path relative to project root. By default command is run in the same directory where vagga started (sans the it's mounted as `/work` so the output of `pwd` would seem to be different)

### accepts-arguments

Denotes whether command accepts additional arguments. Defaults to:

- `false` for a shell command line (if `run` is a string);
- `true` if command is an executable (if `run` is a list).

NB: If command is a shell command line - even if it's composed of only one call to an executable -, arguments are given to its executing context, not appended to it.

---

**Note:** This setting is ignored when `options` is set.

---

### environ

The mapping of environment to pass to command. This overrides environment specified in container on value by value basis.

### volumes

The mapping of mount points to the definition of volume. Allows to mount some additional filesystems inside the container. See [Volumes](#) for more info.

The volumes defined here override `volumes` specified in the container definition (each volume name is considered separately).

---

**Note:** You must create a folder for each volume. See [Container Building Guide](#) for documentation.

---

### pidlmode

This denotes what is run as pid 1 in container. It may be `wait`, `wait-all-children` or `exec`. The default `wait` is okay for most regular processes. See [What's Special With Pid 1?](#) for more info.

### write-mode

The parameter specifies how container's base file system is used. By default container is immutable (corresponds to the `read-only` value of the parameter), which means you can only write to the `/tmp` or to the `/work` (which is your project directory).

Another option is `transient-hard-link-copy`, which means that whenever command is run, create a copy of the container, consisting of hard-links to the original files, and remove the container after running

command. Should be used with care as hard-linking doesn't prevent original files to be modified. Still very useful to try package installation in the system. Use `vagga _build --force container_name` to fix base container if that was modified.

#### **user-id**

The user id to run command as. If the `external-user-id` is omitted this has same effect like using `sudo -u` inside container (except it's user id instead of user name)

#### **external-user-id**

**(experimental)** This option allows to map the `user-id` as seen by command itself to some other user id inside container namespace (the namespace which is used to build container). To make things a little less confusing, the following two configuration lines:

```
user-id: 1
external-user-id: 0
```

Will make your command run as user id 1 visible inside the container (which is "daemon" or "bin" depending on distribution). But outside the container it will be visible as your user (i.e. user running vagga). Which effectively means you can create/modify files in project directory without permission errors, but `tar` and other commands which have different behaviour when running as root would think they are not root (but has user id 1)

#### **group-id**

The group id to run command as. Default is 0.

#### **supplementary-gids**

The list of group ids of the supplementary groups. By default it's empty list.

#### **pass-tcp-socket**

Binds a TCP to the specified address and passes it to the application as a file descriptor #3.

Example:

```
nginx:
  container: nginx
  run: nginx
  pass-tcp-socket: 8080
  environ:
    NGINX: "3;" # inform nginx not to listen on its own
```

You may specify what to listen to with the following formats:

- `8080` – just a port number – listens on 127.0.0.1
- `*:8080` – wildcard pattern for host – listens on every host
- `0.0.0.0:8080` – same as `*:8080`
- `192.0.2.1:8080` – listen on specified IPv4 host
- `[2001:db8::1]:8080` – listen on specified IPv6 host
- `localhost:8080` – resolve a name and listen that host (note: name must resolve to a single address)

This is better then listening by the application itself in the following cases:

1. If you want to test systemd socket activation
2. If you prepare your application to a powerful supervisor like `lithos` (lithos can run multiple processes on the same port using the feature)
3. To declare (document) that your application listens specified port (otherwise it may be hidden somewhere deeply in config)

4. To listen port in the **host** network namespace when applying network isolation (as an alternate to `public-ports`)

### Parameters of *!Supervise*

#### **mode**

The set of processes to supervise and mode. See *Supervision* for more info

#### **children**

A mapping of name to child definition of children to run. All children are started simultaneously.

#### **kill-unresponsive-after**

(default 2 seconds) If some process exits (in `stop-on-failure` mode), vagga will send TERM signal to all the other processes. If they don't finish in the specified number of seconds, vagga will kill them with KILL signal (so they finish without being able to intercept signal unconditionally). If you don't like this behavior set the parameter to some large value.

#### **isolate-network**

Run all processes within isolated network namespace. Isolated network will have only a loopback device, so processes won't have access to the internet. For example, it is possible to run several test suites each start service that binds the same port. Also you can run arbitrary command inside isolated network using `--isolate-network` commandline option.

### Parameters of *!CapsuleCommand*

**This functionality is experimental.** Some details can change in future.

It's generally not recommended to use, unless you know what are you doing.

#### **uids**

#### **gids**

If you need to build container non-standard uid/gid mapping, you might want to configure these to match container's settings.

Note: all containers built in this *CapsuleCommand* must match uids/gids with these. Defaults are usually okay.

#### **work-dir**

The working directory to run in. Path relative to project root. By default command is run in the same directory where vagga started (sans the it's mounted as `/work` so the output of `pwd` would seem to be different)

#### **environ**

The mapping of environment to pass to command. This overrides environment specified in container on value by value basis.

This is also a good way to pass some variables to a script that bootstraps a capsule.

#### **run**

The command to run. Rules are the same as in normal command, but usually this option either specifies a local script to run (committed in repository) or a single pattern like `vagga _capsule script https://some/location.sh`. See *Capsule Commands* for more info.

## 2.3.4 Container Building Guide

Build commands are tagged values in your container definition. For example:

```
containers:
  ubuntu:
    setup:
      - !Ubuntu xenial
      - !Install [python]
```

This contains two build commands `!Ubuntu` and `!Install`. They mostly run sequentially, but some of them are interesting, for example `!BuildDeps` installs package right now, but also removes package at the end of the build to keep container smaller and cleaner.

See *Build Steps (The Reference)* for additional details on specific commands. There is also an `genindex`

## Generic Installers

To run arbitrary shell command use `!Sh`:

```
setup:
- !Ubuntu xenial
- !Sh "apt-get update && apt-get install -y python"
```

If you have more than one-liner you may use `YAML` *literal* syntax for it:

```
setup:
- !Ubuntu xenial
- !Sh |
  wget somepackage.tar.gz
  tar -xzf somepackage.tar.gz
  cd somepackage
  make && make install
```

**Warning:** The `!Sh` command is run by `/bin/sh -exc`. With the flags meaning `-e` – exit if any command fails, `-x` – print command before executing, `-c` – execute command. You may undo `-ex` by inserting `set +ex` at the start of the script. But it's not recommended.

To run `!Sh` you need `/bin/sh`. If you don't have shell in container you may use `!Cmd` that runs command directly:

```
setup:
# ...
- !Cmd [ /usr/bin/python, '-c', 'print "hello from build" ]
```

To install a package of any (supported) linux distribution just use `!Install` command:

```
containers:

  ubuntu:
    setup:
      - !Ubuntu xenial
      - !Install [python]

  ubuntu-trusty:
    setup:
      - !Ubuntu trusty
      - !Install [python]
```

```
alpine:
  setup:
    - !Alpine v3.5
    - !Install [python]
```

Occasionally you need some additional packages to use for container building, but not on final machine. Use `!BuildDeps` for them:

```
setup:
- !Ubuntu xenial
- !Install [python]
- !BuildDeps [python-dev, gcc]
- !Sh "make && make install"
```

The `python-dev` and `gcc` packages from above will be removed after building whole container.

To add some environment arguments to subsequent build commands use `!Env`:

```
setup:
# ...
- !Env
  VAR1: value1
  VAR2: value2
- !Sh "echo $VAR1 / $VAR2"
```

---

**Note:** The `!Env` command doesn't add environment variables for processes run after build. Use `environ` setting for that.

---

Sometimes you want to rebuild container when some file changes. For example if you have used the file in the build. There is a `!Depends` command which does nothing per se, but add a dependency. The path must be relative to your project directory (the dir where `vagga.yaml` is). For example:

```
setup:
# ...
- !Depends requirements.txt
- !Sh "pip install -r requirements.txt"
```

To download and unpack tar archive use `!Tar` command:

```
setup:
- !Tar
  url: http://something.example.com/some-project-1.0.tar.gz
  sha256: acd1234...
  path: /
  subdir: some-project-1.0
```

Only `url` field is mandatory. If `url` starts with dot `.` it's treated as filename inside project directory. The `path` is target path to unpack into, and `subdir` is a dir inside tar file. By default `path` is root of new filesystem. The `subdir` is a dir inside the tar file, if omitted whole tar archive will be unpacked.

You *can* use `!Tar` command to download and unpack the root filesystem from scratch.

There is a shortcut to download tar file and build and install from there, which is `!TarInstall`:

```
setup:
- !TarInstall
```

```
url: https://static.rust-lang.org/dist/rust-1.10.0-x86_64-unknown-linux-gnu.tar.gz
sha256: abcd1234...
subdir: rust-1.10.0-x86_64-unknown-linux-gnu
script: ./install.sh --prefix=/usr
```

Only the `url` is mandatory here too. Similarly, if `url` starts with dot `.` it's treated as filename inside project directory. The script is by default `./configure --prefix=/usr; make; make install`. It's run in `subdir` of unpacked archive. If `subdir` is omitted it's run in the *only* subdirectory of the archive. If archive contains more than one directory and `subdir` is empty, it's an error, however you may use `.` as `subdir`.

To remove some data from the image after building use `!Remove` command:

```
setup:
# ...
- !Remove /var/cache/something
```

To clean directory but ensure that directory exists use `!EmptyDir` command:

```
setup:
# ...
- !EmptyDir /tmp
```

---

**Note:** The `/tmp` directory is declared as `!EmptyDir` implicitly for all containers.

---

To ensure that directory exists use `!EnsureDir` command. It's very often used for future mount points:

```
setup:
# ...
- !EnsureDir /sys
- !EnsureDir /dev
- !EnsureDir /proc
```

---

**Note:** The `/sys`, `/dev` and `/proc` directories are created automatically for all containers.

---

Sometimes you want to keep some cache between builds of container or similar containers. Use `!CacheDirs` for that:

```
setup:
# ...
- !CacheDirs { "/var/cache/apt": "apt-cache" }
```

Multiple directories may be specified at once.

**Warning:** In this example, “apt-cache” is the name of the directory on your host. Unless changed in the *Settings*, the directory can be found in `.vagga/.cache/apt-cache`. It is shared both between all the containers and all the different builders (not only same versions of the single container). In case the user enabled `shared-cache`, the folder will also be shared between containers of different projects.

Sometimes you just want to write a file in target system:

```
setup:
# ...
```

```
- !Text
  /etc/locale.conf: |
    LANG=en_US.UTF-8
    LC_TIME=uk_UA.UTF-8
```

---

**Note:** You can use any YAML’y syntax for file body just the “literal” one which starts with a pipe | character is the most handy one

---

## Ubuntu

To install base ubuntu system use:

```
setup:
- !Ubuntu xenial
```

Potentially any ubuntu long term support release instead of `xenial` should work. To install a non LTS release, use:

```
setup:
- !UbuntuRelease { codename: wily }
```

To install any ubuntu package use generic `!Install` command:

```
setup:
- !Ubuntu xenial
- !Install python
```

Many interesting ubuntu packages are in the “universe” repository, you may add it by series of `!UbuntuRepo` commands (see below), but there is shortcut `!UbuntuUniverse`:

```
setup:
- !Ubuntu xenial
- !UbuntuUniverse
- !Install [checkinstall]
```

The `!UbuntuRepo` command adds additional repository. For example, to add `marathon` repository you may write:

```
setup:
- !Ubuntu xenial
- !UbuntuRepo
  url: http://repos.mesosphere.io/ubuntu
  suite: xenial
  components: [main]
- !Install [mesos, marathon]
```

This effectively adds the repository and installs `mesos` and `marathon` packages.

---

**Note:** Probably the key for repository should be added to be able to install packages.

---

## Alpine

To install base alpine system use:

```
setup:
- !Alpine v3.5
```

Potentially any alpine version instead of v3.4 should work.

To install any alpine package use generic !Install command:

```
setup:
- !Alpine v3.5
- !Install [python]
```

## Npm Installer

You can build somewhat default nodejs environment using !NpmInstall command. For example:

```
setup:
- !Ubuntu xenial
- !NpmInstall [babel]
```

All node packages are installed as --global which should be expected. If no distribution is specified before the !NpmInstall command, the implicit !Alpine v3.5 (in fact the latest version) will be executed.

```
setup:
- !NpmInstall [babel]
```

So above should just work as expected if you don't need any special needs. E.g. it's usually perfectly okay if you only use node to build static scripts.

The following npm features are supported:

- Specify `package@version` to install specific version (**recommended**)
- Use `git:// url` for the package. In this case git will be installed for the duration of the build automatically
- Bare `package_name` (should be used only for one-off environments)

Other forms may work, but are unsupported for now.

---

**Note:** The npm and additional utilities (like `build-essential` and `git`) will be removed after end of container building. You must !Install them explicitly if you rely on them later.

---

## Python Installer

There are two separate commands for installing packages for python2 and python3. Here is a brief example:

```
setup:
- !Ubuntu xenial
- !Py2Install [sphinx]
```

We always fetch latest pip for installing dependencies. The `python-dev` headers are installed for the time of the build too. Both `python-dev` and `pip` are removed when installation is finished.

The following pip package specification formats are supported:

- The `package_name==version` to install specific version (**recommended**)

- Bare `package_name` (should be used only for one-off environments)
- The `git+` and `hg+` links (the `git` and `mercurial` are installed as build dependency automatically), since vagga 0.4 `git+https` and `hg+https` are supported too (required installing `ca-certificates` manually before)

All other forms may work but not supported. Specifying command-line arguments instead of package names is not supported. To configure pip use `!PipConfig` directive. In the example there are full list of parameters:

```
setup:
- !Ubuntu xenial
- !PipConfig
  index-urls: ["http://internal.pypi.local"]
  find-links: ["http://internal.additional-packages.local"]
  dependencies: true
- !Py2Install [sphinx]
```

They should be self-descriptive. Note unlike in pip command line we use single list both for primary and “extra” indexes. See pip documentation for more info about options

---

**Note:** By default `dependencies` is `false`. Which means pip is run with `--no-deps` option. Which is recommended way for setting up isolated environments anyway. Even `setuptools` are not installed by default. To see list of dependencies and their versions you may use `pip freeze` command.

---

Better way to specify python dependencies is to use “requirements.txt”:

```
setup:
- !Ubuntu xenial
- !Py3Requirements "requirements.txt"
```

This works the same as `Py3Install` including auto-installing of version control packages and changes tracking. I.e. It will rebuild container when “requirements.txt” change. So ideally in python projects you may use two lines above and that’s it.

The `Py2Requirements` command exists too.

---

**Note:** The “requirements.txt” is checked semantically. I.e. empty lines and comments are ignored. In current implementation the order of items is significant but we might remove this restriction in the future.

---

## PHP/Composer Installer

Composer packages can be installed either explicitly or from `composer.json`. For example:

```
setup:
- !Ubuntu xenial
- !ComposerInstall [laravel/installer]
```

The packages will be installed using Composer’s global require at `/usr/local/lib/composer/vendor`. This is only useful for installing packages that provide binaries used to bootstrap your project (like the Laravel installer, for instance):

```
setup:
- !Ubuntu xenial
- !ComposerInstall [laravel/installer]
- !Sh laravel new src
```

Alternatively, you can use Composer's `crate-project` command:

```
setup:
- !Ubuntu xenial
- !ComposerInstall # just to have composer available
- !Sh composer create-project --prefer-dist laravel/laravel src
```

**Note:** In the examples above, it is used `src (/work/src)` instead of `.` (`/work`) because Composer only accepts creating a new project in an empty directory.

For your project dependencies, you should install packages from your `composer.json`. For example:

```
setup:
- !Ubuntu xenial
- !ComposerDependencies
```

This command will install packages (including dev) from `composer.json` into `/usr/local/lib/composer/vendor` using Composer's `install` command.

**Note:** The `/usr/local/lib/composer` directory will be automatically added to PHP's `include_path`.

**Warning:** Most PHP frameworks expect to find the `vendor` directory at the same path as your project in order to require `autoload.php`, so you may need to fix your application entry point (in a Laravel 5 project, for example, you should edit `bootstrap/autoload.php` and change the line `require __DIR__.'../../vendor/autoload.php'`; to `require 'vendor/autoload.php'`;

You can also specify some options available from Composer command line, for example:

```
setup:
- !Ubuntu xenial
- !ComposerDependencies
  working_dir: src # run command inside src directory
  dev: false # do not install dev dependencies
  optimize_autoloader: true
```

If you want to use `hhvm`, you can disable the installation of the `php` runtime:

```
setup:
- !Ubuntu xenial
- !ComposerConfig
  install_runtime: false
  runtime_exe: /usr/bin/hhvm
```

**Note:** When setting the `runtime_exe` option, be sure to specify the full path of the binary (e.g `/usr/bin/hhvm`).

**Note:** Vagga will try to create a symlink from `runtime_exe` into `/usr/bin/php`. If that location already exists, Vagga will **not** overwrite it.

Note that you will have to manually `install hhvm` and set the `include_path`:

```
setup:
- !Ubuntu xenial
- !Repo universe
- !Install [hhvm]
- !ComposerConfig
  install_runtime: false
  runtime_exe: /usr/bin/hhvm
- !Sh echo 'include_path=./usr/local/lib/composer' >> /etc/hhvm/php.ini
environ:
  HHVM_REPO_CENTRAL_PATH: /run/hhvm.hhbc
```

- – setup `include_path` in hhvm config
- – tell hhvm to store the build cache database in a writeable directory

Alpine v3.5 added support for php7 in their “community” repository while keeping php5 as the default runtime. In order to use php7, you have to specify all the packages required by composer (and any other php packages you may need):

```
setup:
- !Alpine v3.5
- !Repo community
- !Install
  - php7
  - php7-openssl
  - php7-phar
  - php7-json
  - php7-pdo
  - php7-dom
  - php7-zip
- !ComposerConfig
  install_runtime: false
  runtime_exe: /usr/bin/php7
```

---

**Note:** Composer executable and additional utilities (like `build-essential` and `git`) will be removed after end of container building. You must `!Download` or `!Install` them explicitly if you rely on them later.

---

**Warning:** PHP/Composer support was recently added to vagga, some things may change as we gain experience with the tool.

## Ruby Installer

Ruby gems can be installed either by providing a list of gems or from a Gemfile using `bundler`. For example:

```
setup:
- !Ubuntu xenial
- !GemInstall [rake]
```

We will update `gem` to the latest version (unless specified not to) for installing gems. The `ruby-dev` headers are installed for the time of the build too and are removed when installation is finished.

The following `gem` package specification formats are supported:

- The `package_name:version` to install specific version (**recommended**)

- Bare `package_name` (should be used only for one-off environments)

```

setup:
- !Ubuntu xenial
- !Install [zlib1g]
- !BuildDeps [zlib1g-dev]
- !Env
  HOME: /tmp
- !GemInstall [rails]
- !Sh rails new . --skip-bundle

```

Bundler is also available for installing gems from Gemfile. For example:

```

setup:
- !Ubuntu xenial
- !GemBundle

```

You can also specify some options to Bundler, for example:

```

setup:
- !Ubuntu xenial
- !GemBundle
  gemfile: src/Gemfile # use this Gemfile
  without: [development, test] # groups to exclude when installing gems
  trust_policy: HighSecurity

```

It is possible to avoid installing ruby if you are providing it yourself:

```

setup:
- !Ubuntu xenial
- !GemSettings
  install_ruby: false
  gem_exe: /usr/bin/gem

```

**Warning:** Ruby/Gem support was recently added to vagga, some things may change as we gain experience with the tool.

## Dependent Containers

Sometimes you want to build on top of another container. For example, container for running tests might be based on production container, but it might add some test utils. Use `!Container` command for that:

```

containers:
  base:
    setup:
      - !Ubuntu xenial
      - !Py3Install [django]
  test:
    setup:
      - !Container base
      - !Py3Install [nose]

```

It's also sometimes useful to freeze some part of container and test next build steps on top of it. For example:

```
containers:
  temporary:
    setup:
      - !Ubuntu xenial
      - !TarInstall
        url: http://download.zeromq.org/zeromq-4.1.4.tar.gz
    web:
      setup:
        - !Container temporary
        - !Py3Install [pyzmq]
```

In this case when you try multiple different versions of pyzmq, the zeromq itself will not be rebuilt. When you're done, you can append build steps and remove the temporary container.

Sometimes you need to generate (part of) vagga.yaml itself. For some things you may just use shell scripting. For example:

```
container:
  setup:
    - !Ubuntu xenial
    - !Env { VERSION: 0.1.0 }
    - !Sh "apt-get install somepackage==$VERSION"
```

---

**Note:** Environment of user building container is always ignored during build process (but may be used when running command).

---

In more complex scenarios you may want to generate real vagga.yaml. You may use that with ancillary container and !SubConfig command. For example, here is how we use a [docker2vagga](#) script to transform Dockerfile to vagga config:

```
docker-parser:
  setup:
    - !Alpine v3.5
    - !Install [python]
    - !Depends Dockerfile
    - !Depends docker2vagga.py
    - !Sh 'python ./docker2vagga.py > /docker.yaml'

somecontainer:
  setup:
    - !SubConfig
      source: !Container docker-parser
      path: docker.yaml
      container: docker-smart
```

Few comments:

- – container used for build, it's rebuilt automatically as a dependency for “somecontainer”
- – normal dependency rules apply, so you must add external files that are used to generate the container and vagga file in it
- – put generated vagga file inside a container
- – the “path” is relative to the source if the latter is set
- – name of the container used *inside* a “docker.yaml”

**Warning:** The functionality of `!SubConfig` is experimental and is a subject to change in future. In particular currently the `/work` mount point and current directory used to build container are those of initial `vagga.yaml` file. It may change in future.

The `!SubConfig` command may be used to include some commands from another file without building container. Just omit `source` command:

```
subdir:
  setup:
    - !SubConfig
    path: subdir/vagga.yaml
    container: containername
```

The YAML file used may be a partial container, i.e. it may contain just few commands, installing needed packages. The other things (including the name of the base distribution) can be set by original container:

```
# vagga.yaml
containers:
  ubuntu:
    setup:
      - !Ubuntu xenial
      - !SubConfig
      path: packages.yaml
      container: packages
  alpine:
    setup:
      - !Alpine v3.5
      - !SubConfig
      path: packages.yaml
      container: packages

# packages.yaml
containers:
  packages:
    setup:
      - !Install [redis, bash, make]
```

### 2.3.5 Build Steps (The Reference)

This is work in progress reference of build steps. See *Container Building Guide* for help until this document is done. There is also an alphabetic genindex

All of the following build steps may be used as an item in `setup` setting.

#### Container Bootstrap

Command that can be used to bootstrap a container (i.e. may work on top of empty container):

- *Alpine*
- *Ubuntu*
- *UbuntuRelease*
- *SubConfig*

- *Container*
- *Tar*

### Ubuntu Commands

#### Ubuntu

Simple and straightforward way to install Ubuntu release.

Example:

```
setup:  
- !Ubuntu xenial
```

The value is single string having the codename of release *xenial*, *trusty* and *precise* known to work at the time of writing.

The Ubuntu images are updated on daily basis. But vagga downloads and caches the image. To update the image that was downloaded by vagga you need to clean the cache.

---

**Note:** This is shortcut install that enables all the default that are enabled in *UbuntuRelease*. You can switch to *UbuntuRelease* if you need fine-grained control of things.

---

#### UbuntuRelease

This is more exensible but more cumbersome way to setup ubuntu (comparing to *Ubuntu*). For example to install *trusty* you need:

```
- !UbuntuRelease { codename: trusty }
```

(note this works since vagga 0.6, previous versions required *version* field which is now deprecated).

You can also setup non-LTS release of different architecture:

```
- !UbuntuRelease { codename: vivid, arch: i386 }
```

All options:

**codename** Name of the ubuntu release. Like *xenial* or *trusty*. Either this field or *url* field must be specified. If both are specified *url* take precedence.

**url** Url to specific ubuntu image to download. May be any image, including *server* and *desktop* versions, but *cloudimg* is recommended. This must be filesystem image (i.e usually ending with *root.tar.gz*) not *.iso* image.

Example: `http://cloud-images.ubuntu.com/xenial/current/xenial-server-cloudimg-amd64-root.tar.gz`

**arch** The architecture to install. Defaults to *amd64*.

**keep-chfn-command** (default *false*) This may be set to *true* to enable `/usr/bin/chfn` command in the container. This often doesn't work on different host systems (see [#52](#) as an example). The command is very rarely useful, so the option here is for completeness only.

**eatmydata** (default *true*) Install and enable `libeatmydata`. This does **not** literally eat your data, but disables all `fsync` and `fdatasync` operations during container build. This works only on distributions where we have tested it: *xenial*, *trusty*, *precise*. On other distributions the option is ignored (but may be implemented in future).

The `fsync` system calls are used by ubuntu package management tools to secure installing each package, so that on subsequent power failure your system can boot. When building containers it's both the risk is much smaller and build starts from scratch on any kind of failure anyway, so partially written files and directories do not matter.

I.e. don't disable this flag unless you really want slow processing, or you have some issues with `LD_PRELOAD`'ing the library.

---

**Note:** On `trusty` and `precise` this also enables universe repository by default.

---

**version** The version of ubuntu to install. This must be digital `YY.MM` form, not a code name.

**Deprecated.** Supported versions: `12.04`, `14.04`, `14.10`, `15.10`, `16.04`. Other version will not work. This field will also be removed at some point in future.

### AptTrust

This command fetches keys with `apt-key` and adds them to trusted keychain for package signatures. The following trusts a key for `fkrull/deadsnakes` repository:

```
- !AptTrust keys: [5BB92C09DB82666C]
```

By default this uses `hkps://keyserver.ubuntu.com:443`, but you can specify alternative:

```
- !AptTrust
  server: hkp://pgp.mit.edu
  keys: [1572C52609D]
```

This is used to get rid of the error similar to the following:

```
WARNING: The following packages cannot be authenticated!
 libpython3.5-minimal python3.5-minimal libpython3.5-stdlib python3.5
E: There are problems and -y was used without --force-yes
```

Options:

**server** (default `hkps://keyserver.ubuntu.com:443`) Server to fetch keys from. May be a hostname like `keyserver.ubuntu.com` or in `hkp://hostname:port` or `hkps://hostname:port` form.

**keys** (default `[]`) List of keys to fetch and add to trusted keyring. Keys can include full fingerprint or **suffix** of the fingerprint. The most common is the 8 hex digits form.

### UbuntuRepo

Adds arbitrary debian repo to ubuntu configuration. For example to add newer python:

```
- !UbuntuRepo
  url: http://ppa.launchpad.net/fkrull/deadsnakes/ubuntu
  suite: xenial
  components: [main]
- !Install [python3.5]
```

See [UbuntuPPA](#) for easier way for dealing specifically with PPAs.

Options:

**url** Url to the repository. Default is the mirror url from the current ubuntu distribution.

**suite** Suite of the repository. The common practice is that the suite is named just like the codename of the ubuntu release. For example `xenial`. Default is the codename of the current distribution.

**components** List of the components to fetch packages from. Common practice to have a `main` component. So usually this setting contains just single element `components: [main]`. **Required.**

**trusted** Marks repository as trusted. Usually useful for installing unsigned packages from local repository. Default is `false`.

### UbuntuPPA

A shortcut to `UbuntuRepo` that adds named PPA. For example, the following:

```
- !Ubuntu xenial
- !AptTrust keys: [5BB92C09DB82666C]
- !UbuntuPPA fkrull/deadsnakes
- !Install [python3.5]
```

Is equivalent to:

```
- !Ubuntu xenial
- !UbuntuRepo
  url: http://ppa.launchpad.net/fkrull/deadsnakes/ubuntu
  suite: xenial
  components: [main]
- !Install [python3.5]
```

### UbuntuUniverse

The singleton step. Just enables an “universe” repository:

```
- !Ubuntu xenial
- !UbuntuUniverse
- !Install [checkinstall]
```

## Alpine Commands

### Alpine

```
setup:
- !Alpine v3.5
```

### AlpineRepo

Adds arbitrary alpine repository. For example to add testing repository:

```
- !AlpineRepo
  url: http://nl.alpinelinux.org/alpine/
  branch: edge
  repo: testing
  tag: testing
- !Install [app@testing]
```

Options:

**url** Url to the repository. Default is the mirror url from the current alpine distribution.

**branch** Branch of the repository. For example `v3.4`, `edge`. Default is the version of the current alpine distribution.

**repo** Repository to fetch packages from. For example `main`, `community`, `testing`. **Required.**

**tag** Tag for this repository. Alpine package manager will now by default only use the untagged repositories. Adding a tag to specific package will prefer the repository with that tag. To add a tag just put `@tag` after the package name. For example:

```

- !AlpineRepo
  branch: edge
  repo: testing
  tag: testing
- !Install [graphicsmagick@testing]

```

## Distribution Commands

These commands work for any linux distributions as long as distribution is detected by vagga. Latter basically means you used *Alpine*, *Ubuntu*, *UbuntuRelease* in container config (or in parent config if you use *SubConfig* or *Container*)

### Repo

Adds official repository to the supported linux distribution. For example:

```

setup:
- !Ubuntu xenial
- !Repo xenial/universe
- !Repo xenial-security/universe
- !Repo xenial-updates/universe

setup:
- !Ubuntu xenial
- !Repo universe # The same as "xenial/universe"

setup:
- !Alpine v3.5
- !Repo edge/testing

setup:
- !Alpine v3.5
- !Repo community # The same as "v3.5/community"

```

### Install

```

setup:
- !Ubuntu xenial
- !Install [gcc, gdb] # On Ubuntu, equivalent to `apt-get install gcc gdb -y`
- !Install [build-essential] # `apt-get install build-essential -y`
# Note that `apt-get install` is run 2 times in this example

```

### BuildDeps

```

setup:
- !Ubuntu xenial
- !BuildDeps [wget]
- !Sh echo "We can use wget here, but no curl"
- !BuildDeps [curl]
- !Sh echo "We can use wget and curl here"
# Container built. Now, everything in BuildDeps(wget and curl) is removed from the
↳ container.

```

## Generic Commands

### Sh

Runs arbitrary shell command, for example:

```
- !Ubuntu xenial
- !Sh "apt-get install -y package"
```

If you have more than one-liner you may use *YAMLy literal* syntax for it:

```
setup:
- !Alpine v3.5
- !Sh |
  if [ ! -z "$(which apk)" ] && [ ! -z "$(which lbu)" ]; then
    echo "Alpine"
  fi
- !Sh echo "Finished building the Alpine container"
```

**Warning:** To run !Sh you need /bin/sh in the container. See *Cmd* for more generic command runner.

**Note:** The !Sh command is run by /bin/sh -exc. With the flags meaning -e - exit if any command fails, -x - print command before executing, -c - execute command. You may undo -ex by inserting set +ex at the start of the script. But it's not recommended.

### Cmd

Runs arbitrary command in the container. The argument provided must be a YAML list. For example:

```
setup:
- !Ubuntu xenial
- !Cmd ["apt-get", "install", "-y", "python"]
```

You may use *YAMLy* features to get complex things. To run complex python code you may use:

```
setup:
- !Cmd
  - python
  - -c
  - |
    import socket
    print("Builder host", socket.gethostname())
```

Or to get behavior similar to *Sh* command, but with different shell:

```
setup:
- !Cmd
  - /bin/bash
  - -exc
  - |
    echo this is a bash script
```

### RunAs

Runs arbitrary shell command as specified user (and/or group), for example:

```
- !Ubuntu xenial
- !RunAs
  user-id: 1
  script: |
    python -c "import os; print(os.getuid())"
```

Options:

**script** (required) Shell command or script to run

**user-id** (default 0) User ID to run command as. If the `external-user-id` is omitted this has same effect like using `sudo -u`.

**external-user-id** (optional) See *explanation of external-user-id* for `!Command` as it does the same.

**group-id** (default 0) Group ID to run command as.

**supplementary-gids** (optional) The list of group ids of the supplementary groups. By default it's an empty list.

**work-dir** (default `/work`) Directory to run script in.

**isolate-network** (default `false`) See *explanation of isolate-network* for `!Supervise` command type.

### Download

Downloads file and puts it somewhere in the file system.

Example:

```
- !Download
  url: https://jdbc.postgresql.org/download/postgresql-9.4-1201.jdbc41.jar
  path: /opt/spark/lib/postgresql-9.4-1201.jdbc41.jar
```

---

**Note:** This step does not require any download tool to be installed in the container. So may be used to put static binaries into container without a need to install the system.

---

Options:

**url** (required) URL to download file from

**path** (required) Path where to put file. Should include the file name (vagga doesn't try to guess it for now). Path may be in `/tmp` to be used only during container build process.

**mode** (default `'0o644'`) Mode (permissions) of the file. May be used to make executable bit enabled for downloaded script

**sha256** (optional) Sha256 hashsum of the file. If real hashsum is different this step will fail.

New in version 0.8.0.

**Warning:** The download is cached similarly to other commands. Currently there is no way to control the caching. But it's common practice to publish every new version of archive with different URL (i.e. include version number in the url itself)

### Tar

Unpacks Tar archive into container's filesystem.

Example:

```
- !Tar
  url: http://something.example.com/some-project-1.0.tar.gz
  path: /
  subdir: some-project-1.0
```

Downloaded file is stored in the cache and reused indefinitely. It's expected that the new version of archive will have a new url. But occasionally you may need to clean the cache to get the file fetched again.

**url Required.** The url or a path of the archive to fetch. If the url starts with dot `.` it's treated as a file name relative to the project directory. Otherwise it's a url of the file to download.

---

**Note:** Since vagga 0.6 we allow to unpack local paths starting with `/volumes/` as file on one of the volumes configured in settings (*external-volumes*). This is experimental, and requires every user to update their settings before building a container. Still may be useful for building company-internal things.

---

**path** (default `/`). Target path where archive should be unpacked to. By default it's a root of the filesystem.

**subdir** (default `.`) Subdirectory inside the archive to extract. `.` extracts the root of the archive.

**sha256** (optional) Sha256 hashsum of the archive. If real hashsum is different this step will fail.

**This command may be used to populate the container from scratch**

### TarInstall

Similar to *Tar* but unpacks archive into a temporary directory and runs installation script.

Example:

```
setup:
- !TarInstall
  url: https://static.rust-lang.org/dist/rust-1.10.0-x86_64-unknown-linux-gnu.tar.
  ↪gz
  script: ./install.sh --prefix=/usr
```

**url Required.** The url or a path of the archive to fetch. If the url starts with dot `.` it's treated as a file name relative to the project directory. Otherwise it's a url of the file to download.

**subdir** (optional) Subdirectory which command is run in. May be `.` to run command inside the root of the archive.

The common case is having a single directory in the archive, and that directory is used as a working directory for script by default.

**sha256** (optional) Sha256 hashsum of the archive. If real hashsum is different this step will fail.

**script** The command to use for installation of the archive. Default is effectively a `./configure --prefix=/usr && make && make install`.

The script is run with `/bin/sh -exc`, to have better error handling and display. Also this means that dash/bash-compatible shell should be installed in the previous steps under path `/bin/sh`.

### Unzip

Unpacks zip archive into container's filesystem.

All options are the same as for *Tar* step.

Example:

```

- !Unzip
  url: https://services.gradle.org/distributions/gradle-3.1-bin.zip
  path: /opt/gradle
  subdir: gradle-3.1

```

**Git**

Check out a git repository into a container. This command doesn't require git to be installed in the container.

Example:

```

setup:
- !Alpine v3.5
- !Install [python3]
- !Git
  url: git://github.com/tailhook/injections
  path: /usr/lib/python3.5/site-packages/injections

```

(the example above is actually a bad idea, many python packages will work just from source dir, but you may get improvements at least by precompiling \*.pyc files, see [GitInstall](#))

Options:

**url** (required) The git URL to use for cloning the repository

**revision** (optional) Revision to checkout from repository. Note if you don't specify a revision, the latest one will be checked out on the first build and then cached indefinitely

**branch** (optional) A branch to check out. Usually only useful if revision is not specified

**path** (required) A path where to store the repository.

**GitInstall**

Check out a git repository to a temporary directory and run script. This command doesn't require git to be installed in the container.

Example:

```

setup:
- !Alpine v3.5
- !Install [python, py-setuptools]
- !GitInstall
  url: git://github.com/tailhook/injections
  script: python setup.py install

```

Options:

**url** (required) The git URL to use for cloning the repository

**revision** (optional) Revision to checkout from repository. Note if you don't specify a revision, the latest one will be checked out on the first build and then cached indefinitely

**branch** (optional) A branch to check out. Usually only useful if revision is not specified

**subdir** (default root of the repository) A subdirectory of the repository to run script in

**script** (required) A script to run inside the repository. It's expected that script does compile/install the software into the container. The script is run using `/bin/sh -exc`

**GitDescribe**

Finds the most recent tag for the given git repository, takes it into account when calculating container's hash and writes it into a file if the last is specified.

Examples:

```
setup:
# Only put tag information into the container's hash
- !GitDescribe
# Also write the most recent tag into the file
- !GitDescribe /version.txt
# Specify another path to the git repository
- !GitDescribe
  repo: /work/subrepo
  output-file: /version.txt
```

Options:

**repo** (default /work) Path to the git repository.

**output-file** (optional) Writes the most recent tag into the file.

New in version 0.8.0.

## Files and Directories

### Text

Writes a number of text files into the container file system. Useful for writing short configuration files (use external files and file copy or symlinks for writing larger configs)

Example:

```
setup:
- !Text
  /etc/locale.conf: |
    LANG=en_US.UTF-8
    LC_TIME=uk_UA.UTF-8
```

### Copy

Copy file or directory into the container. Useful either to put build artifacts from temporary location into permanent one, or to copy files from the project directory into the container.

Example:

```
setup:
- !Copy
  source: /work/config/nginx.conf
  path: /etc/nginx/nginx.conf
```

For directories you might also specify regular expression to ignore:

```
setup:
- !Copy
  source: /work/mypkg
  path: /usr/lib/python3.4/site-packages/mypkg
  ignore-regex: "(~|.py[co])$"
```

Symlinks are copied as-is. Path translation is done neither for relative nor for absolute symlinks. Hint: relative symlinks pointing inside the copied directory work well, as well as absolute symlinks that point to system locations.

---

**Note:** The command fails if any file name has non-utf-8 decodable names. This is intentional. If you really

need bad filenames use traditional `cp` or `rsync` commands.

Options:

**source** (required) Absolute to directory or file to copy. If path starts with `/work` files are checksummed to get the version of the container.

**path** (required) Destination path

**ignore-regex** (default `(^|/)\.(git|hg|svn|vagga)($|/)|~$|\.\bak$|\.\orig$|^#.*#`) Regular expression of paths to ignore. Default regex ignores common revision control folders and editor backup files.

**include-regex** (default `None`) Regular expression of paths to include. When path matches both ignore and include expressions it will be ignored. Also note that if `include-regex` matches only the folder, no contents will be included. For example `patches/.*\.sql$` will copy all `patches` directories with all `.sql` files inside them.

**owner-uid, owner-gid** (preserved by default) Override uid and gid of files and directories when copying. It's expected that most useful case is `owner-uid: 0` and `owner-gid: 0` but we try to preserve the owner by default. Note that unmapped users (the ones that don't belong to user's subuid/subgid range), will be set to `nobody` (65535).

**preserve-permissions** (default `false`) Whether to preserve permissions of the copied files. If `false` `umask` option is taken into account.

**preserve-times** (default `false`) If `true` preserves modification times of the copied files. By default modification times set to the first second from the unix epoch. This behaviour is useful for reproducible builds. Before 0.8.0 modification times were set to the current time.

New in version 0.8.0.

**umask** (default `0o002`) When `preserve-permissions` is disabled (set to `false`) `umask` determines how permissions are calculated. For directories and executable files it is `0o777 & !umask`, for other files `-0o666 & !umask`. Do not forget to use `0o` prefix for octal notation.

**rules** Leverages glob patterns instead of regular expressions to match paths. This option conflicts with `ignore-regex` and `include-regex` options.

The rules are similar to those which is used in `.gitignore` file but meaning of include/exclude rules is opposite. Also there are several differences:

- Include patterns **must** be absolute so they have to start with a leading slash. This is done for performance reasons to exclude unknown directories from traversing. If you really want to match relative paths you can prepend pattern with a slash followed by two consecutive asterisks. Thus `/**/*.py` pattern will match `test.py`, `dir/main.py`, `dir/subdir/test.py` paths and so on.
- `!` prefix negates the pattern. Negative patterns can be relative. Unlike `.gitignore` patterns it is possible to include a file when its parent directory was excluded. For instance rules `["!dir", "/dir/*.py"]` will match all python files inside the `dir` directory.
- If there is no matched files inside a directory the directory itself won't be copied.
- If the pattern ends with a slash, it will match only with a directory and paths underneath it. Also `/dir/` pattern will copy `dir` directory even if it is empty.
- Empty rules will match all underneath paths. But if you add only exclude rules no path will be matched. So you should explicitly add at least one include rule:

[ ] will match all paths

["!dir/"] will match nothing

["!dir/", "/"] will match all paths except `dir` directories

By default there are some ignore rules that correspond `ignore-regex` expression:

```
["!.git/", "!.hg/", "!.svn/", "!.vagga/", "!*.bak", "!*.orig",  
"!*~", "!##", "!.#*"]
```

New in version 0.8.0.

**no-default-rules** Disables default ignore rules which are given above. The option only works in pair with `rules` option.

New in version 0.8.0.

**Warning:** If the source directory starts with `/work` all the files are read and checksummed on each run of the application in the container. So copying large directories for this case may influence container startup time even if rebuild is not needed.

This command is useful for making deployment containers (i.e. to put application code to the container file system). For this case checksumming issue above doesn't apply. It's also useful to enable `auto-clean` for such containers.

### Remove

Remove file or a directory from the container and **keep it clean on the end of container build**. Useful for removing cache directories.

This is also inherited by subcontainers. So if you know that some installer leaves temporary (or other unneeded files) after a build you may add this entry instead of using shell `rm` command. The `/tmp` directory is cleaned by default. But you may also add man pages which are not used in container.

Example:

```
setup:  
- !Remove /var/cache/something
```

For directories consider use `EmptyDir` if you need to keep cleaned directory in the container.

### EnsureDir

```
setup:  
#...  
- !EnsureDir /var/cache/downloads  
- !Sh if [ -d "/var/cache/downloads" ]; then echo "Directory created"; fi;  
- !EnsureDir /creates/parent/directories
```

### EmptyDir

Cleans up a directory. It's similar to the `Remove` but keeps directory created.

### CacheDirs

Adds build cache directories. Example:

```
- !CacheDirs  
  /tmp/pip-cache/http: pip-cache-http  
  /tmp/npm-cache: npm-cache
```

This maps `/tmp/pip-cache/http` into the cache directory of the vagga, by default it's `~/.vagga/.cache/pip-cache-http`. This allows to reuse same download cache by multiple rebuilds of the container. And if shared cache is used also reuses the cache between multiple projects.

Be picky on the cache names, if file conflicts there may lead to unexpected build results.

---

**Note:** Vagga uses a lot of cache dirs for built-in commands. For example the ones described above are used whenever you use `Py*` and `Npm*` commands respectively. You don't need to do anything special to use cache.

---

## Meta Data

### Env

Set environment variables for the build.

Example:

```
setup:
- !Env HOME: /root
```

---

**Note:** The variables are used only for following build steps, and are inherited on the `Container` directive. But they are *not used when running* the container.

---

### Depends

Rebuild the container when a file changes. For example:

```
setup:
# ...
- !Depends requirements.txt
- !Sh "pip install -r requirements.txt"
```

The example is not the best one, you could use `Py3Requirements` for the same task.

Only the hash of the contents of a file is used in versioning the container not an owner or permissions. Consider adding the `auto-clean` option if it's temporary container that depends on some generated file (sometimes useful for tests).

Options:

**path** (required) Relative path to directory or file inside `/work` directory. Matched files and directories will be checksummed to get the version of the container.

**ignore-regex** See `ignore-regex`

**include-regex** See `include-regex`

**rules** See `rules`

**no-default-rules** See `no-default-rules`

## Sub-Containers

### Container

Build a container based on another container:

```
container:
  base:
    setup:
      - !Ubuntu xenial
      - !Py3Install [django]
    test:
      setup:
        - !Container base
        - !Py3Install [nose]
```

There two known use cases of functionality:

1. Build test/deploy containers on top of base container (example above)
2. Cache container build partially if you have to rebuild last commands of the container frequently

In theory, the container should behave identically as if the commands would be copy-pasted to the *setup* fo dependent container, but sometimes things doesn't work. Known things:

1. The packages in a *BuildDeps* are removed
2. *Remove* and *EmptyDir* will empty the directory
3. *Build* with *temporary-mount* is not mounted

If you have any other bugs with container nesting report in the bugtracker.

---

**Note:** *Container* step doesn't influence *environ* and *volumes* as all other options of the container in any way. It only somewhat replicate *setup* sequence. We require whole environment be declared manually (you you can use YAMLY aliases)

---

### SubConfig

This feature allows to generate (parts of) *vagga.yaml* for the container. For example, here is how we use a *docker2vagga* script to transform *Dockerfile* into vagga config:

```
docker-parser:
  setup:
    - !Alpine v3.5
    - !Install [python]
    - !Depends Dockerfile
    - !Depends docker2vagga.py
    - !Sh 'python ./docker2vagga.py > /docker.yaml'

somecontainer:
  setup:
    - !SubConfig
      source: !Container docker-parser
      path: docker.yaml
      container: docker-smart
```

Few comments:

- – container used for build, it's rebuilt automatically as a dependency for “somecontainer”
- – normal dependency rules apply, so you must add external files that are used to generate the container and vagga file in it
- – put generated vagga file inside a container
- – the “path” is relative to the source if the latter is set

- – name of the container used *inside* a “docker.yaml”

**Warning:** The functionality of `!SubConfig` is experimental and is a subject to change in future. In particular currently the `/work` mount point and current directory used to build container are those of initial `vagga.yaml` file. It may change in future.

The `!SubConfig` command may be used to include some commands from another file without building container. Just omit `generator` command:

```
subdir:
  setup:
  - !SubConfig
    path: subdir/vagga.yaml
    container: containername
```

The YAML file used may be a partial container, i.e. it may contain just few commands, installing needed packages. The other things (including the name of the base distribution) can be set by original container:

```
# vagga.yaml
containers:
  ubuntu:
    setup:
    - !Ubuntu xenial
    - !SubConfig
      path: packages.yaml
      container: packages
  alpine:
    setup:
    - !Alpine v3.5
    - !SubConfig
      path: packages.yaml
      container: packages

# packages.yaml
containers:
  packages:
    setup:
    - !Install [redis, bash, make]
```

## Build

This command is used to build some parts of the container in another one. For example:

```
containers:
  webpack:
    setup:
    - !NpmInstall [webpack]
    - !NpmDependencies
  jsstatic:
    setup:
    - !Container webpack
    - !Copy
      source: /work/frontend
      path: /tmp/js
    - !Sh |
      cd /tmp/js
      webpack --output-path /var/javascripts
```

```
  auto-clean: true
  nginx:
    setup:
      - !Alpine v3.5
      - !Install [nginx]
      - !Build
      container: jsstatic
      source: /var/javascripts
      path: /srv/www
```

Note the following things:

- – We use separate container for npm *dependencies* so we don't have to rebuild it on each change of the sources
- – We copy javascript sources into our temporary container. The important part of copying operation is that all the sources are hashed and versioned when copying. So container will be rebuild on source changes. Since we don't need sources in the container we just put them in temporary folder.
- – The temporary container is cleaned automatically (there is low chance that it will ever be reused)

Technically it works similar to `!Container` except it doesn't apply configuration from the source container and allows to fetch only parts of the resulting container.

Another motivating example is building a package:

```
containers:
  pkg:
    setup:
      - !Ubuntu xenial
      - !Install [build-essential]
      - !EnsureDir /packages
      - !Sh |
        checkinstall --pkgname=myapp --pakdir=/packages make
    auto-clean: true
  nginx:
    setup:
      - !Ubuntu xenial
      - !Build
      container: pkg
      source: /packages
      temporary-mount: /tmp/packages
      - !Sh dpkg -i /tmp/packages/mypkg_0.1.deb
```

Normal versioning of the containers apply. This leads to the following consequences:

- Putting multiple *Build* steps with the same `container` will build container only once (this way you may extract multiple folders from the single container).
- Despite the name *Build* dependencies are not rebuilt.
- The *Build* command itself depends only on the container but on on the individual files. You need to ensure that the source container is versioned well (sometimes you need *Copy* or *Depends* for the task)

Options:

**container** (required) Name of the container to build and to extract data from

**source** (default /) Source directory (absolute path inside the source container) to copy files from

**path** Target directory (absolute path inside the resulting container) to copy (either `path` or `temporary-mount` required)

**temporary-mount** A directory to mount `source` into. This is useful if you don't want to copy files, but rather want to use files from there. The directory is created automatically if not exists, but not parent directories. It's probably good idea to use a subdirectory of the temporary dir, like `/tmp/package`. The mount is **read-only** and persists until the end of the container build and is not propagated through `Container` step.

**content-hash** (default `false`) If `true` this container will depend on source container by the hash of the files copied.

We keep it `false` by default for two reasons:

1. `true` doesn't work for `temporary-mount`
2. `false` means dependent container is always built, even if current container is up to date and doesn't need to be rebuilt.

We still recommend to have it `false` for the reasons above as this is how everything else in vagga works. But here is the use case for `true`:

1. We build a data-only container with content-addressing (i.e. every file is accesses by a path derived from checksum of that file)
2. The list of checksums is imported into another container (i.e. it produces links to the files in first container)
3. The container in (1) is not binary reproducible (i.e. every build could possibly produce different checksums)
4. Container are then deployed independently

Note: the (3) in the list above is the main culprit of the feature. If you can force binary reproducibility you can ignore this discussion.

## Node.JS Commands

### NpmInstall

Example:

```
setup:
- !NpmInstall [babel-loader@6.0, webpack]
```

Install a list of node.js packages. If no linux distributions were used yet `!NpmInstall` installs the latest Alpine distribution. Node is installed automatically and analog of the `node-dev` package is also added as a build dependency.

**Note:** Packages installed this way (as well as those installed by `!NpmDependencies` are located under `/usr/lib/node_modules`. In order for node.js to find them, one should set the environment variable `NODE_PATH`, making the example become

Example:

```
setup:
- !NpmInstall [babel-loader@6.0, webpack]
environ:
  NODE_PATH: /usr/lib/node_modules
```

### NpmDependencies

Works similarly to `NpmInstall` but installs packages from `package.json`. For example:

```
- !NpmDependencies
```

This installs dependencies and devDependencies from package.json into a container (with --global flag).

You may also customize package.json and install other kinds of dependencies:

```
- !NpmDependencies
  file: frontend/package.json
  peer: true
  optional: true
  dev: false
```

---

**Note:** Since npm supports a whole lot of different versioning schemes and package sources, some features may not work or may not version properly. You may send a pull request for some unsupported scheme. But we are going to support only the popular ones. Generally, it's safe to assume that we support a npmjs.org packages and git repositories with full url.

---

**Note:** We don't use `npm install .` to execute this command but rather use a command-line to specify every package there. It works better because `npm install --global .` tries to install this specific package to the system, which is usually not what you want.

---

Options:

**file** (default package.json) A file to get dependencies from

**package** (default true) Whether to install package dependencies (i.e. the ones specified in dependencies key)

**dev** (default true) Whether to install devDependencies (we assume that vagga is mostly used for development environments so dev dependencies should be on by default)

**peer** (default false) Whether to install peerDependencies

**bundled** (default true) Whether to install bundledDependencies (and bundleDependencies too)

**optional** (default false) Whether to install optionalDependencies. *By default npm tries to install them, but don't fail if it can't install. Vagga tries its best to guarantee that environment is the same, so dependencies should either install everywhere or not at all. Additionally because we don't use "npm install package.json" as described earlier we can't reproduce npm's behavior exactly. But optional dependencies of dependencies will probably try to install.*

**Warning:** This is a new command. We can change default flags used, if that will be more intuitive for most users.

### NpmConfig

The directive configures various settings of npm commands above. For example, you may want to turn off automatic nodejs installation so you can use custom overversion of it:

```
- !NpmConfig
  install_node: false
  npm_exe: /usr/local/bin/npm
- !NpmInstall [webpack]
```

---

**Note:** Every time *NpmConfig* is specified, options are **replaced** rather than *augmented*. In other words, if you start a block of `npm` commands with *NpmConfig*, all subsequent commands will be executed with the same options, no matter which *NpmConfig* settings were before.

---

All options:

**npm-exe** (default is `npm`) The `npm` command to use for installation of packages.

**install-node** (default `true`) Whether to install `nodejs` and `npm` automatically. Setting the option to `false` is useful for setting up custom version of the `node.js`.

**install-yarn** (default `true`) Whether to install `yarn` package automatically (even if `install-node` is `false`). `Yarn` only installed if `!Yarn*` commands are used.

New in version v0.8.0.

**yarn-exe** (default is `/usr/bin/yarn`) The `yarn` command to use for installation of packages if `!Yarn*` commands are used.

The reason we have full path here is because `vagga`'s own search mechanisms for executables doesn't resolve absolute symlinks well. (I.e. bare executable name will work here as long as it's not an absolute symlink). We may fix this in the future releases.

New in version v0.8.0.

**yarn-version** (default is `latest`) The `yarn` version to install for the `!Yarn*` commands. Only useful if `install-yarn` is enabled.

Example:

```
.. code-block:: yaml
```

- `!NpmInstall yarn-version: 1.0.1`

New in version v0.8.0.

### YarnDependencies

Works similarly to *NpmDependencies* but installs packages using `yarn` and For example:

```
- !YarnDependencies
```

This installs `dependencies` and `devDependencies` from `package.json` into a container's `/usr/lib/node_modules`. It also links all the binaries from `node_modules/.bin` directory installed by `yarn` into `/usr/bin` directory for easier access.

The settings in *NpmConfig* do affect this command.

Options:

**production** (default `false`) If set to `true` does not install `devDependencies` (corresponds to `--production` flag for `yarn`)

**optional** (default `false`) If set to `true` install optional dependencies

**dir** (default `.`) Base directory where `package.json` is. Note: unlike in `!setup:NpmDependencies` we don't specify the path to the file, but to the directory because we track both `package.json` and `yarn.lock` files in there.

New in version v0.8.0.

## Python Commands

### PipConfig

The directive configures various settings of pythonic commands below. The mostly used option is dependencies:

```
- !PipConfig
  dependencies: true
- !Py3Install [flask]
```

Most options directly correspond to the pip command line options so refer to [pip help](#) for more info.

---

**Note:** Every time *PipConfig* is specified, options are **replaced** rather than *augmented*. In other words, if you start a block of pythonic commands with *PipConfig*, all subsequent commands will be executed with the same options, no matter which *PipConfig* settings were before.

---

All options:

**dependencies** (default `false`) allow to install dependencies. If the option is `false` (by default) pip is run with `pip --no-deps`

**index-urls** (default `[]`) List of indexes to search for packages. This corresponds to `--index-url` (for the first element) and `--extra-index-url` (for all subsequent elements) options on the pip command-line.

When the list is empty (default) the `pypi.python.org` is used.

**find-links** (default `[]`) List of URLs to HTML files that need to be parsed for links that indicate the packages to be downloaded.

**trusted-hosts** (default `[]`) List of hosts that are trusted to download packages from.

**cache-wheels** (default `true`) Cache wheels between different rebuilds of the container. The downloads are always cached. Only binary wheels are toggled with the option. It's useful to turn this off if you build many containers with different dependencies.

Starting with vagga v0.4.1 cache is namespaced by linux distribution and version. It was single shared cache in vagga <= v0.4.0

**install-python** (default `true`) Install python automatically. This will install either python2 or python3 with a default version of your selected linux distribution. You may set this parameter to `false` and install python yourself. This flag doesn't disable automatic installation of pip itself and version control packages. Note that by default `python-dev` style packages are as build dependencies installed too.

**allow\_pre\_releases** (default `false`) Allow install pre-release and development versions. By default, pip only finds stable versions.

**python-exe** (default is either `python2` or `python3` depending on which command is called, e.g. `Py2Install` or `Py3Install`) This allows to change executable of python. It may be either just name of the specific python interpreter (`python3.5`) or full path. Note, when this is set, the command will be called both for `Py2*` commands and `Py3*` commands.

### Py2Install

Installs python package for Python 2.7 using pip. Example:

```
setup:
- !Ubuntu xenial
- !Py2Install [sphinx]
```

We always fetch latest pip for installing dependencies. The `python-dev` headers are installed for the time of the build too. Both `python-dev` and `pip` are removed when installation is finished.

The following pip package specification formats are supported:

- The `package_name==version` to install specific version (**recommended**)
- Bare `package_name` (should be used only for one-off environments)
- The `git+` and `hg+` links (the `git` and `mercurial` are installed as build dependency automatically), since `vagga 0.4` `git+https` and `hg+https` are supported too (required installing `ca-certificates` manually before)

All other forms may work but not supported. Specifying command-line arguments instead of package names is not supported.

See *Py2Requirements* for the form that is both more convenient and supports non-vagga installations better.

---

**Note:** If you configure `python-exe` in *PipConfig* there is no difference between *Py2Install* and *Py3Install*.

---

### Py2Requirements

This command is similar to *Py2Install* but gets package names from the file. Example:

```
setup:
- !Ubuntu xenial
- !Py2Requirements "requirements.txt"
```

See *Py2Install* for more details on package installation and *PipConfig* for more configuration.

### Py3Install

Same as *Py2Install* but installs for Python 3.x by default.

```
setup:
- !Alpine v3.5
- !Py3Install [sphinx]
```

See *Py2Install* for more details on package installation and *PipConfig* for more configuration.

### Py3Requirements

This command is similar to *Py3Install* but gets package names from the file. Example:

```
setup:
- !Alpine v3.5
- !Py3Requirements "requirements.txt"
```

See *Py2Install* for more details on package installation and *PipConfig* for more configuration.

## PHP/Composer Commands

---

**Note:** PHP/Composer support was recently added to vagga, some things may change as we gain experience with the tool.

---

### ComposerInstall

Example:

```
setup:
- !Alpine v3.5
- !ComposerInstall ["phpunit/phpunit:~5.2.0"]
```

Install a list of php packages using `composer global require --prefer-dist --update-no-dev`. Packages are installed in `/usr/local/lib/composer/vendor`.

Binaries are automatically installed to `/usr/local/bin` by Composer so they are available in your `PATH`.

Composer itself is located at `/usr/local/bin/composer` and available in your `PATH` as well. After container is built, the Composer executable is no longer available.

### ComposerDependencies

Install packages from `composer.json` using `composer install`. For example:

```
- !ComposerDependencies
```

Similarly to `ComposerInstall`, packages are installed at `/usr/local/lib/composer/vendor`, including those listed at `require-dev`, as Composer default behavior.

Options correspond to the ones available to the `composer install` command line so refer to [composer cli docs](#) for detailed info.

Options:

**working\_dir** (default `None`) Use the given directory as working directory

**dev** (default `true`) Whether to install `require-dev` (this is Composer default behavior).

**prefer** (default `None`) Preferred way to download packages. Can be either `source` or `dist`. If no specified, will use Composer default behavior (use `dist` for stable).

**ignore\_platform\_reqs** (default `false`) Ignore `php`, `hhvm`, `lib-*` and `ext-*` requirements.

**no\_autoloader** (default `false`) Skips autoloader generation.

**no\_scripts** (default `false`) Skips execution of scripts defined in `composer.json`.

**no\_plugins** (default `false`) Disables plugins.

**optimize\_autoloader** (default `false`) Convert PSR-0/4 autoloading to classmap to get a faster autoloader.

**classmap\_authoritative** (default `false`) Autoload classes from the classmap only. Implicitly enables `optimize_autoloader`.

### ComposerConfig

The directive configures various settings of composer commands above. For example, you may want to use `hhvm` instead of `php`:

```
- !ComposerConfig
  install_runtime: false
  runtime_exe: /usr/bin/hhvm
- !ComposerInstall [phpunit/phpunit]
```

---

**Note:** Every time `ComposerConfig` is specified, options are **replaced** rather than *augmented*. In other words, if you start a block of composer commands with `ComposerConfig`, all subsequent commands will be executed with the same options, no matter which `ComposerConfig` settings were before.

---

All options:

**runtime\_exe** (default `/usr/bin/php`) The command to use for running Composer. When setting this option, be sure to specify the full path for the binary. A symlink to the provided value will be created at `/usr/bin/php` if it not exists, otherwise, `/usr/bin/php` will remain the same.

**install\_runtime** (default `true`) Whether to install the default runtime (php) automatically. Setting the option to `false` is useful when using hhvm, for example.

**install\_dev** (default `false`) Whether to install development packages (php-dev). Defaults to `false` since it is rare for php projects to build modules and it may require manual configuration.

**include\_path** (default `./usr/local/lib/composer`) Set `include_path`. This option overrides the default `include_path` instead of appending to it.

**keep\_composer** (default `false`) If set to `true`, the composer binary will not be removed after build.

**vendor\_dir** (default `/usr/local/lib/composer/vendor`) The directory where composer dependencies will be installed.

---

**Note:** Setting `install_runtime` to `false` still installs Composer.

---

## Ruby Commands

---

**Note:** Ruby support is recently added to the vagga some things may change as we gain experience with the tool.

---

### GemInstall

Example:

```
setup:
- !Ubuntu xenial
- !GemInstall [rake]
```

Install a list of ruby gems using `gem install --bindir /usr/local/bin --no-document`.

The `--bindir` option instructs `gem` to install binaries in `/usr/local/bin` so they are available in your `PATH`.

### GemBundle

Install gems from Gemfile using `bundle install --system --binstubs /usr/local/bin`. For example:

```
- !GemBundle
```

Options correspond to the ones available to the `bundle install` command line, so refer to [bundler documentation](#) for detailed info.

Options:

**gemfile** (default `Gemfile`) Use the specified gemfile instead of Gemfile.

**without** (default `[]`) Exclude gems that are part of the specified named group.

**trust\_policy** (default `None`) Sets level of security when dealing with signed gems. Accepts *LowSecurity*, *MediumSecurity* and *HighSecurity* as values.

### GemConfig

The directive configures various settings of ruby commands above:

```
- !GemConfig
  install_ruby: true
  gem_exe: gem
  update_gem: true
- !GemInstall [rake]
```

---

**Note:** Every time *GemConfig* is specified, options are **replaced** rather than *augmented*. In other words, if you start a block of ruby commands with *GemConfig*, all subsequent commands will be executed with the same options, no matter which *GemConfig* settings were before.

---

All options:

**install\_ruby** (default `true`) Whether to install ruby.

**gem\_exe** (default `/usr/bin/gem`) The rubygems executable.

**update\_gem** (default `true`) Whether to update rubygems itself.

---

**Note:** If you set `install_ruby` to false you will also have to provide rubygems if needed.

---

**Note:** If you set `gem_exe`, vagga will no try to update rubygems.

---

### 2.3.6 Volumes

Volumes define some additional filesystems to mount inside container. The default configuration is similar to the following:

```
volumes:
  /tmp: !Tmpfs
    size: 100Mi
    mode: 0o1777
  /run: !Tmpfs
    size: 100Mi
    mode: 0o766
    subdirs:
      shm: { mode: 0o1777 }
```

**Warning:** Volumes are **not** mounted during container build, only when some command is run.

Available volume types:

#### **Tmpfs**

Mounts a `tmpfs` filesystem.

Options:

**size** Limit for filesystem size in bytes. You may use suffixes `k`, `M`, `G`, `ki`, `Mi`, `Gi` for bigger units. The ones with `i` are for power of two units, the other ones are for power of ten

**mode** The mode (permission bits) of the root directory for a new filesystem

**subdirs** A mapping for subdirectories to create inside tmpfs, for example:

```
volumes:
  /var: !Tmpfs
    mode: 0o766
    subdirs:
      lib: # default mode is 0o766
      lib/tmp: { mode: 0o1777 }
      lib/postgres: { mode: 0o700 }
```

The only property currently supported on a directory is mode

**files** A mapping of a file to its contents to write into tmpfs filesystem. This is similar to *Text* build step. Directories for files are not created automatically. Use *subdirs* to create one.

Example:

```
volumes:
  /run: !Tmpfs
    size: 100Mi
    files:
      docker.sock: ""
  /run/docker.sock: !BindRO /volumes/docker.sock
```

Both *subdirs* and *files* are often used as mountpoints for some *BindRW* and *BindRO* directories.

### VaggaBin

Mounts vagga binary directory inside the container (usually it's contained in `/usr/lib/vagga` in host system). This may be needed for *Network Testing* or may be for vagga in vagga (i.e. container in container) use cases.

### BindRW

Binds some folder inside a container to another folder. Essentially it's bind mount (the RW part means read-writeable). The path must be absolute (inside the container). This directive can't be used to expose some directories not already visible. This is often used to put some temporary directory in development into well-defined production location.

For example:

```
volumes:
  /var/lib/mysql: !BindRW /work/tmp/mysql
```

There are currently two prefixes for *BindRW*:

- */work* – which uses directory inside the project directory
- */volumes* – which uses one of the volumes defined in settings (*external-volumes*)

The behavior of vagga when using any other prefix is undefined.

### BindRO

Read-only bind mount of a folder inside a container to another folder. See *BindRW* for more info.

### CacheDir

Mounts a directory cached by vagga. Useful if you need access to the cache during container run.

For example:

```
setup:
# ...
- !CacheDirs
  /root/.m2/repository: maven-cache
```

```
# ...
volumes:
  /root/.m2/repoistory: !CacheDir maven-cache
```

### Empty

Mounts an empty read-only directory. Technically mounts a new *Tmpfs* system with minimal size and makes it read-only. Useful if you want to hide some built-in directory or subdirectory of `/work` from the container. For example:

```
volumes:
  /tmp: !Empty
```

Note, that hiding `/work` itself is not supported. You may hide a subdirectory though:

```
volumes:
  /work/src: !Empty
```

### Snapshot

Create a `tmpfs` volume, copy contents of the original folder to the volume. And then mount the filesystem in place of the original directory.

This allows to pre-seed the volume at the container build time, but make it writeable and throwable.

Example:

```
volumes:
  /var/lib/mysql: !Snapshot
```

---

**Note:** Every start of the container will get it's own copy. Even every process in *!Supervise* mode will get own copy. It's advised to keep container having a snapshot volume only for single purpose (i.e. do not use same container both for postgresql and python), because otherwise excessive memory will be used.

---

Parameters:

**size** (default 100Mi) Size of the allocated `tmpfs` volume. Including the size of the original contents. This is the limit of how much data you can write on the volume.

**container** Copy contents of the folder of another container. Path to the source folder is the same as the mount-point.

**owner-uid, owner-gid** (default is to preserve) The user id of the owner of the directory. If not specified the ownership will be copied from the original

Additional properties, like the source directory will be added to the later versions of vagga

### Container

Mount a root file system of other container as a volume.

Example:

```
containers:
  app:
    setup:
      - !Ubuntu xenial
      ...
  deploy-tools:
    setup:
      - !Alpine v3.5
```

```
- !Install [rsync]
volumes:
  /mnt: !Container app
```

This may be useful to deploy the container without installing anything to the host file system. E.g. you can `rsync` the container's file system to remote host. Or `tar` it (but better use `_pack_image` or `_push_image` for that). Or do other fancy things.

Unless you know what are you doing both containers should share same `uids` and `gids`.

---

**Note:** Nothing is mounted on top of container's file system. I.e. `/dev`, `/proc` and `/sys` directories are empty. So you probably can't chroot into the filesystem in any sensible way. But having that folders empty is actually what is useful for use cases like deploying.

---

### Persistent

Makes a writable directory just for this container. It's similar to `BindRW` but creates a volume inside `.vagga/volumes`

Example:

```
commands:
  postgres: !Command
    volumes:
      /var/lib/postgres: !Persistent { name: "postgres" }
  run: ...
```

Or the shorter form:

```
volumes:
  /var/lib/postgres: !Persistent "postgres"
```

There are a few reasons to use `Persistent` over `BindRW`:

1. User don't need to create the directories
2. When running vagga in VM it's a common practice to use more efficient (or more featureful, like supporting hardlinks) filesystem for `.vagga`
3. It may be a little bit clearer than throwing all that writable stuff into `workdir` (for example your `.vagga` is already in `.gitignore`)

Options:

**name (required)** Name of the volume. Multiple containers using same name will mount same volume (same instance of volume). Multiple volumes in single container may reference same volume too. We currently don't support mounting subvolumes but we may do in future.

**owner-uid, owner-gid** User id and group id to set for the new volume. The are only set when volume is first created.

**init-command** The name of the command that is used for initializing volume. Technically command is inserted into the prerequisites of every other command that uses this volume. The command must have this volume either in container or in command definition. When command is first run, it has an empty directory at the mount point of the volume. If command fails we immediately stop running dependent commands, which effectively means no other command can run with the volume mounted.

It's usually good idea to name the command starting with underscore, so it doesn't show in the list of commands to use for daily work.

If volume is already initialized and command is run in a normal way (using `vagga xx` or as a prerequisite), it's run as any other command. But if the volume is not initialized it will be run with the temporary directory at a volume mount point which will be committed to a volume on success. Basically this allows to debug the command easily.

If the same `init-command` is repeated in multiple volumes it is run only once (so you must initialize all the volumes that depend on it). Multiple volumes that have different `init-command` values can only be used in the command definition (not in container), because otherwise it's impossible to establish an initialization order.

Currently `!Supervise` commands can't be used to initialize a volume, but we may lift this limitation in the future.

To remove volumes that were created but had been removed since than run:

```
vagga _clean --unused-volumes
```

To remove all volumes (they will be created on the next run):

```
vagga _clean --volumes
```

### 2.3.7 Upgrading

#### Upgrading 0.7.x -> 0.8.0

- `!Copy` now resets timestamps when copying, if you need timestamps add `preserve-times`. By default it sets timestamp to first second after epoch. This means timestamp is non-zero, but stable whenever you build container, meaning it improves reproducibility.
- The `/etc/resolv.conf` and `/etc/hosts` files are now cleaned after container build and mounted over by system files. This may slightly tweak behavior when running concurrent containers. Also, if you sync containers to remote hosts they will not contain `resolv.conf` from build machine (which is a good thing), but will be empty if not populated afterwards.

For most users upgrade should be seamless.

#### Upgrading 0.6.x -> 0.7.0

This release only introduces minor incompatibilities and also changes hashes of the containers (so all containers will be rebuild after vagga upgrades).

- `Py2/Py3Requirements` now properly hashes files containing `-r` (basically includes). This means if you had previously `!Depends` commands for that files, you may now remove them. But it also means that included files should exist when running vagga (i.e. before containers are built).
- `vagga _run` now searches in the following precedence if no `PATH` was set in container `/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin`. Previously the precedence was reversed. This may influence you if you have commands with the same names both in `/usr` and `/usr/local`
- `Copy` and `Depends` do not respect file permissions. Most of the time this means that on machines with different `umask` you still have same container hash. But it also means that if you change permissions on the file container does not get rebuilt (executable bit is still versioned).
- `!Snapshot` respects the owner and permissions of the source directory rather than using defaults from `tmpfs` volume. We consider this a bugfix, but it may break some things if you relied on old behavior
- *Environment variable precedence* changed to be more intuitive

- `resolv.conf` and `hosts` files are replaced again after `Tar`, `Ubuntu`, `Container`, `SubConfig`. It's a bugfix in most cases (i.e. some stalled files may be unpacked/copied in old vagga). But it may clobber your files if you expected old behavior.
- `eatmydata` is enabled for built-in commands only, if you relied on fast fsyncs earlier, your builds may be slow. You may use `!Env { LD_PRELOAD: "/usr/lib/x86_64-linux-gnu/libeatmydata.so" }` to restore old behavior (for xenial, for other distros path may be different).
- Previously we have ignored the error when we couldn't remount root file system as read-only (e.g. on `tmpfs` or when otherwise some options like `nosuid` were enabled), this is no longer the case (we learned how to make those volumes readonly). In some scenarios it may mean that previously writable folders are now read-only.
- If you relied on a symlink to `/tmp/vagga/hosts`, we have removed it because it was rarely useful and sometimes imposed issues (for example when `/tmp` is readonly). We are working on a more long term solution. In the meantime you must either rely on hosts from the host system (by default) or create a file yourself (luckily IP addresses are static so it's easy, although may be boring).

### Upgrading 0.5.0 -> 0.6.0

This release doesn't introduce any severe incompatibilities. The bump of version is motivated mostly by the change of container hashes because of refactoring internals.

Minor incompatibilities are:

- Vagga now uses images from `partner-images.ubuntu.com` rather than `cdimage.ubuntu.com`
- Vagga now uses single level of uid mappings and doesn't use the actual mapping as part of container hash. This allows to use `mount` in container more easily and also means we have reproducible containers hashes across machines
- `!Copy` command now uses paths inside the container as the `source`, previously was inside the capsule (because of a mistake), however using source outside of the `/work` has not been documented
- Checksum checking in `!Tar` and `!TarInstall` now works (previously you could use an archive with wrong `sha256` parameter)
- Vagga now uses `tar-rs` library for unpacking archives instead of `busybox`, this may mean some features are new, and some archives could fail (please report if you find one)
- Vagga now runs `id -u -n` for finding out username, previously was using long names which aren't supported by some distributions (alpine == `busybox`).
- Commands with name starting with underscore are not listed in `vagga` and `vagga _list` by default (like built-in ones)
- Ubuntu commands now use `libeatmydata` by default, which makes installing packages about 3x faster
- We remove `/var/spool/rsyslog` in `ubuntu`, this is only folder that makes issues when rsyncing image because of permissions (it's not useful in container anyway)
- Updated `quire` requires you need to write `!*Unpack` instead of `!Unpack`
- Remove `change-dir` option from `SubConfig` that never worked and was never documented

### Upgrading 0.4.1 -> 0.5.0

This release doesn't introduce any severe incompatibilities. Except in the networking support:

- Change gateway network from `172.18.0.0/16` to `172.23.0.0/16`, hopefully this will have less collisions

The following are minor changes during the container build:

- The `stdin` redirected from `/dev/null` and `stdout` is redirected to `stderr` during the build. If you really need asking a user (which is an antipattern) you may open a `/dev/tty`.
- The `.vagga/.mnt` is now unmounted during build (fixes bugs with bad tools)
- `!Depends` doesn't resolve symlinks but depends on the link itself
- `!Remove` removes files when encountered (previously removed only when container already built), also the command works with files (not only dirs)

The following are bugfixes in container runtime:

- The `TERM` and `*_proxy` env vars are now propagated for supervise commands in the same way as with normal commands (previously was absent)
- Pseudo-terminals in vagga containers now work
- Improved SIGINT handling, now Ctrl+C in interactive processes such as `python` (without arguments) works as expected
- The signal messages (“Received SIGINT...”) are now printed into `stderr` rather than `stdout` (for `!Supervise` type of commands)
- Killing vagga supervise with `TERM` mistakenly reported SIGINT on exit, fixed

And the following changes the hash of containers (this should not cause a headache, just will trigger a container rebuild):

- Add support for `arch` parameter in `!UbuntuRelease` this changes hash sum of all containers built using `!UbuntuRelease`

See [Release Notes](#) and [Github](#) for all changes.

### Upgrading 0.4.0 -> 0.4.1

This is minor release so it doesn't introduce any severe incompatibilities. The pip cache in this release is namespaced over distro and version. So old cache will be inactive now. And should be removed manually by cleaning `.vagga/.cache/pip-cache` directory. You may do that at any time

See [Release Notes](#) and [Github](#) for all changes.

### Upgrading 0.3.x -> 0.4.x

The release is focused on migrating from small amount of C code to “unshare” crate and many usability fixes, including ones which have small changes in semantics of configuration. The most important changes:

- The `!Sh` command now runs shell with `-ex` this allows better error reporting (but may change semantics of script for some obscure cases)
- There is now `kill-unresponsive-after` setting for `!Supervise` commands with default value of 2. This means that processes will shut down unconditionally two seconds after Ctrl+C.

See [Release Notes](#) and [Github](#) for all changes.

### Upgrading 0.2.x -> 0.3.x

This upgrade should be seamless. The release is focused on migrating code from pre-1.0 Rust to... well... rust 1.2.0.

Other aspect of code migration is that it uses `musl` libc. So building vagga from sources is more complex now. (However it's as easy as previous version if you build with vagga itself, except you need to wait until rust builds for the first time).

## Upgrading 0.1.x -> 0.2.x

There are basically two things changed:

1. The way how containers (images) are built
2. Differentiation of commands

## Building Images

Previously images was build by two parts: `builder` and `provision`:

```
rust:
  builder: ubuntu
  parameters:
    repos: universe
    packages: make checkinstall wget git uidmap
  provision: |
    wget https://static.rust-lang.org/dist/rust-0.12.0-x86_64-unknown-linux-gnu.tar.gz
    tar -xf rust-0.12.0-x86_64-unknown-linux-gnu.tar.gz
    cd rust-0.12.0-x86_64-unknown-linux-gnu
    ./install.sh --prefix=/usr
```

Now we have a sequence of steps which perform work as a `setup` setting:

```
rust:
  setup:
    - !Ubuntu trusty
    - !UbuntuUniverse ~
    - !TarInstall
      url: http://static.rust-lang.org/dist/rust-1.0.0-alpha-x86_64-unknown-linux-gnu.
      ↪tar.gz
      script: " ./install.sh --prefix=/usr"
    - !Install [make, checkinstall, git, uidmap]
    - !Sh "echo Done"
```

Note the following things:

- Downloading and unpacking base os is just a step. Usually the first one.
- Steps are executed sequentially
- The amount of work at each step is different as well as different level of abstractions
- The `provision` thing may be split into several `!Sh` steps in new vagga

The description of each step is in [Reference](#).

By default `uids` and `gids` are set to `[0-65535]`. This default should be used for all containers unless you have specific needs.

The `tmpfs-volumes` key changed for the generic `volumes` key, see [Volumes](#) for more info.

The `ensure-dirs` feature is now achieved as `- !EnsureDir dirname build step`.

### Commands

Previously type of *command* was differentiated by existence of `supervise` and `command/run` key.

Now first kind of command is marked by `!Command` yml tag. The `command` and `run` differentiation is removed. When `run` is a list it's treated as a command with arguments, if `run` is a string then it's run by shell.

The `!Supervise` command contains the processes to run in `children` key.

See *reference* for more info.

### Missing Features

The following features of vagga 0.1 are missing in vagga 0.2. We expect that they were used rarely of at all.

- Building images by host package manager (builders: `debian-debootstrap`, `debian-simple`, `arch-simple`). The feature is considered too hard to use and depends on the host system too much.
- Arch and Nix builders. Will be added later. We are not sure if we'll keep a way to use host-system nix to build nix container.
- Docker builder. It was simplistic and just PoC. The builder will be added later.
- Building images without `uidmap` and properly set `/etc/subuid` and `/etc/subgid`. We believe that all systems having `CONFIG_USER_NS` enabled have subuids either already set up or easy to do.
- The `mutable-dirs` settings. Will be replaced by better mechanism.

### 2.3.8 Supervision

Vagga may supervise multiple processes with single command. This is very useful for running multiple-component and/or networking systems.

By supervision we mean running multiple processes and watching until all of them exit. Each process is run in it's own container. Even if two processes share the key named "container", which means they share same root filesystem, they run in different namespaces, so they don't share `/tmp`, `/proc` and so on.

### Supervision Modes

There are three basic modes of operation:

- `stop-on-failure` – stops all processes as soon as any single one is dead (default)
- `wait-all-successful` – waits until all successful processes finish

In any mode of operation supervisor itself never exits until all the children are dead. Even when you kill supervisor with `kill -9` or `kill -KILL` all children will be killed with `-KILL` signal too. I.e. with the help of namespaces and good old `PR_SET_PDEATHSIG` we ensure that no process left when supervisor killed, no one is reparented to `init`, all traces of running containers are cleared. Seriously. It's very often a problem with many other ways to run things on development machine.

### Stop on Failure

It's not coincidence that `stop-on-failure` mode is default. It's very useful mode of operation for running on development machine.

Let me show an example:

```

commands:
  run_full_app: !Supervise
    mode: stop-on-failure
    children:
      web: !Command
        container: python
        run: "python manage.py runserver"
      celery: !Command
        container: python
        run: "python manage.py celery worker"

```

Imagine this is a web application written in python (*web* process), with a work queue (*celery*), which runs some long-running tasks in background.

When you start both processes `vagga run_full_app`, often many log messages with various levels of severity appear, so it's easy to miss something. Imagine you missed that *celery* is not started (or dead shortly after start). You go to the web app do some testing, start some background task, and wait for it to finish. After waiting for a while, you start suspect that something is wrong. But *celery* is dead long ago, so skimming over recent logs doesn't show up anything. Then you look at processes: "Oh, crap, there is no *celery*". This is time-wasting.

With `stop-on-failure` you'll notice that some service is down immediately.

In this mode *vagga* returns exit code of first process exited. And an `128+signal` code when any other signal was sent to supervisor (and propagated to other processes).

### Wait All Successful

In `wait-all-successful` mode *vagga* works same as in `stop-on-failure` mode, except processes that exit with exit code 0 (which is known as successful error code) do not trigger failure condition, so other processes continue to work. If any process exits on signal or with non-zero exit code "failure" mode is switched on and *vagga* exits the same as in `stop-on-failure` mode.

This mode is intended for running some batch processing of multiple commands in multiple containers. All processes are run in parallel, like with other modes.

In this mode *vagga* returns exit code zero if all processes exited successfully and exit code of the first failing process (or `128+signal` if it was dead by signal) otherwise.

### Tips

#### Restarting a Subset Of Processes

Sometimes you may work only on one component, and don't want to restart the whole bunch of processes to test just one thing. You may run two supervisors, in different tabs of a terminal. E.g:

```

# run everything, except the web process we are debugging
$ vagga run_full_app --exclude web
# then in another tab
$ vagga run_full_app --only web

```

Then you can restart *web* many times, without restarting everything.

### 2.3.9 What's Special With Pid 1?

The first process started by the linux kernel gets PID 1. Similarly when new PID namespace is created first process started in that namespace gets PID 1 (the PID as seen by the processes in that namespace, in the parent namespace it gets assigned other PID).

The process with PID 1 differs from the other processes in the following ways:

1. When the process with pid 1 die for any reason, all other processes are killed with `KILL` signal
2. When any process having children dies for any reason, its children are reparented to process with PID 1
3. Many signals which have default action of `Term` do not have one for PID 1.

At a glance, first issue looks like the most annoying. But in practice the most inconvenient one is the last one. For development purposes it effectively means you can't stop process by sending `SIGTERM` or `SIGINT`, if process have not installed a signal handler.

At the end of the day, all above means most processes that were not explicitly designed to run as PID 1 (which are all applications except supervisors), do not run well. Vagga fixes that by not running process as PID 1.

---

#### Outdated

The following text is outdated. Vagga doesn't support any pid modes since version 0.2.0. This may be fixed in future. We consider this as mostly useless feature for development purposes. If you have a good use case please [let us know](#).

---

In fact there are three modes of operation of PID 1 supported by vagga (set by `pidlmode`).

- `wait` – (default) run command (usually it gets PID 2) and wait until it exits
- `wait-all-children` – run command, then wait all processes in namespace to finish
- `exec` – run the command as PID 1, useful only if command itself is process supervisor like `upstart`, `systemd` or `supervisord`

Note that in `wait` and `exec` modes, when you kill vagga itself with a signal, it will propagate the signal to the command itself. In `wait-all-children` mode, signal will be propagated to all processes in the container (even if it's some supplementary command run as a child of some intermediary process). This is rarely the problem.

### 2.3.10 Capsule Commands

**This functionality is experimental.** Some details can change in future.

New in version 0.7.1.

It's generally not recommended to use `CapsuleCommand`, unless you know what are you doing.

This kind of command doesn't require container to be built. It operates in intermediate container that we call **capsule**. Capsule is a container that provides same level of isolation as normal container but has neither config nor version, on the other hand it provides tools to build create and start other containers.

This feature is both: more powerful, as it provides a way to build/run different containers based on dynamic parameters and even change `vagga.yaml`. On the other hand it starts with bare shell, and it's your job to bootstrap needed utilities and do all process supervision.

All the tools officially supported by vagga in capsule are prefixed with `vagga _capsule`, namely:

- `vagga _capsule build <container_name>` – builds container, similar to `vagga _build <container_name>`

- `vagga _capsule run <container> <cmd>` – runs command in a container. Container will be (re)built if required.
- `vagga _capsule script <url>` – fetches a script from the url, caches it and runs from cache
- `vagga _capsule download <url>` – fetches a file from the url and caches printing file path to stdout

There are few limitations of the capsule:

1. All containers must have same uid/gid maps (which is often the case)
2. `vagga _clean` doesn't work in capsule yet
3. Volume init commands do not work
4. Supervise commands can't be run in capsule (actually any commands configured in yml can't be run from the inside capsule, but most of them can be emulated with `vagga _capsule run`)

## 2.4 Running

Usually running vagga is as simple as:

```
$ vagga run
```

To find out commands you may run bare vagga:

```
$ vagga
Available commands:
  run           Run mysample project
  build-docs    Build documentation using sphinx
```

### 2.4.1 Command Line

When running `vagga`, it finds the `vagga.yml` file in current working directory or any of its parents and uses that as a project root directory (alternative files are supported too, see below).

When running `vagga` without arguments it displays a short summary of which commands are defined by `vagga.yml`, like this:

```
$ vagga
Available commands:
  run           Run mysample project
  build-docs    Build documentation using sphinx
```

Refer to [Commands](#) for more information of how to define commands for `vagga`.

There are also builtin commands. All builtin commands start with underscore `_` character to be clearly distinguished from user-defined commands.

Full list of files that mark directory as `vagga`'s project:

1. `vagga.yml` primary and preferred one
2. `.vagga/vagga.yml` as an alternative to `vagga.yml` (useful if you don't want to commit it to a git)
3. `vagga.local.yml` or `.vagga.local.yml` or `.vagga/local.yml` which contain additional *mixins* also mark project directory even if no `vagga.yml` is present (since `vagga 0.8.1`)

### Multiple Commands

Since vagga 0.6 there is a way to run multiple commands at once:

```
$ vagga -m cmd1 cmd2
```

This is similar to running:

```
$ vagga cmd1 && vagga cmd2
```

But there is one key difference: **containers needed to run all the commands are built beforehand**. This has two consequences:

1. When containers need to be rebuilt, they are rebuilt first, then you see the output of both commands in sequence (no container build log in-between)
2. If container for command 2 depends on side-effects of running command 1 (i.e. container contains a binary built by command 1), you will get wrong results. In that case you should rely on shell to do the work (for example in the repository of vagga itself `vagga -m make test` is **not** the right way, the right is `vagga make && vagga test`)

Obviously you can't pass any arguments to either of commands when running `vagga -m`, this is also the biggest reason of why you can't run built-in commands (those starting with underscore) using the option. But you can use global options, and they influence all the commands, for example:

```
$ vagga --environ DISPLAY:0 -m clean_profile run_firefox
```

### Builtin Commands

All commands have `--help`, so we don't duplicate all command-line flags here

**vagga \_run CONTAINER CMD ARG...** run arbitrary command in container defined in `vagga.yaml`

**vagga \_build CONTAINER** Builds container without running a command.

More useful in the form:

```
$ vagga _build --force container_name
```

To rebuild a container that has previously been built.

**vagga \_clean** Removes images and temporary files created by vagga.

The following command removes containers that are not used by current vagga config (considering the state of all files that `vagga.yaml` depends on):

```
$ vagga _clean --unused
```

Another for removes containers which were not uses for some time:

```
$ vagga _clean --unused --at-least 10days
```

This is faster as it only checks timestamps of the containers. Each time any command in a container is run, we update timestamp. This is generally more useful than bare `--unused`, because it allows to keep multiple versions of same container, which means you can switch between branches rapidly.

There an old and deprecated option for removing unused containers:

```
$ vagga _clean --old
```

This is different because it only looks at symlinks in `.vagga/*`. So may be wrong (if you changed `vagga.yaml` and did not run the command(s)). It's faster because it doesn't calculate the hashsums. But the difference in speed usually not larger than a few seconds (on large configs). The existence of the two commands should probably be treated as a historical accident and `--unused` variant preferred.

For other operations and parameters see `vagga _clean --help`

**vagga \_list** List of commands (similar to running vagga without command)

**vagga \_version\_hash CONTAINER** Prints version hash for the container. In case the image has not been built (or config has been updated since) it should return new hash. But sometimes it's not possible to determine the hash in advance. In this case command returns an error.

Might be used in some automation scripts.

**vagga \_init\_storage\_dir** **Deprecated.** Use `storage-subdir-from-env-var` instead.

If you have configured a `storage-dir` in settings, say `/vagga-storage`, when you run `vagga _init_storage_dir abc` will create a `/vagga-storage/abc` and `.vagga` with `.vagga/.lnk` pointing to the directory. The command ensures that the storage dir is not used for any other folder (unless `--allow-multiple` is specified).

This is created for buildbots which tend to clean `.vagga` directory on every build (like gitlab-ci) or just very often.

Since vagga 0.6 there is `--allow-multiple` flag, that allows to keep shared subdirectory for multiple source directories. This is useful for CI systems which use different build directories for different builds.

**Warning:** While simultaneous builds of different source directories, with the same subdirectory should work most of the time, this functionality still considered experimental and may have some edge cases.

**vagga \_pack\_image IMAGE\_NAME** Pack image into the tar archive, optionally compressing and output it into stdout (use shell redirection `> file.tar` to store it into the file).

It's very similar to `tar -cC .vagga/IMAGE_NAME/root` except it deals with file owners and permissions correctly. And similar to running `vagga _run IMAGE_NAME tar -c /` except it ignores mounted file systems.

**vagga \_push\_image IMAGE\_NAME** Push container image `IMAGE_NAME` into the image cache.

Actually it boils down to packing an image into tar (`vagga _pack_image`) and running `push-image-script`, see the documentation of the setting to find out how to configure image cache.

**vagga \_base\_dir** Displays (writes to stdout) directory where active `vagga.yaml` is.

**vagga \_relative\_work\_dir** Displays (writes to stdout) current working directory relative to the base directory. Basically, this means that `$(vagga _base_dir)/$(vagga _relative_work_dir)` is current working directory.

When current working directory contains `vagga.yaml` this command returns empty string (output still contains a newline), not a single dot, as one may expect.

**vagga \_update\_symlinks** **This functionality is experimental.** Some details can change in future.

Creates a set of symlinks in your home directory (`~/vagga/cmd`) and in current vagga directory (`.vagga/cmd`) which point to commands named in vagga. Symlinks are created to the current vagga binary (which is resolved using `readlink /proc/self/exe` not, `argv[0]`).

These directories can be added to `PATH` either in your shell or in your text editor, IDE, or any other kind of shell. Or you can pass them to scripts which allow customization (`make RSYNC=/myproj/.vagga/.cmd/rsync`).

Only commands which have `symlink-name` are linked with the name specified in the parameter. So you make create a hidden (underscored) name for some public command.

There are two directories, so basically two modes of operation:

1. User home directory `~/ .vagga/cmd`. It meant to use for utilities you're going to use in multiple projects. When running such a command in some project dir, exact command from this project dir will be invoked. So if you run `flake8` (a linter for python), correct version of linter for this project will be run. If you `cd` to another project, correct version of the tool with specific plugins and python interpreter will be picked there immediately.
2. Project directory `proj/.vagga/.cmd`. This directory may be used to specify utility directly or to point your IDE to in project settings. It's not recommended to add this directory to your search `PATH`.

Note: for (1) it's expected that single version of vagga is used for all of the projects, which is usually the case.

New in version 0.7.1.

## Normal Commands

If *command* declared as `!Command` you get a command with the following usage:

```
Usage:
  vagga [OPTIONS] some_command [ARGS ...]

Runs a command in container, optionally builds container if that does not
exists or outdated. Run `vagga` without arguments to see the list of
commands.

positional arguments:
  some_command      Your defined command
  args              Arguments for the command

optional arguments:
  -h, --help                show this help message and exit
  -E, --env, --environ NAME=VALUE
                           Set environment variable for running command
  -e, --use-env VAR         Propagate variable VAR into command environment
  --no-build                Do not build container even if it is out of date.
                           Return error code 29 if it's out of date.
  --no-version-check       Do not run versioning code, just pick whatever
                           container version with the name was run last (or
                           actually whatever is symlinked under
                           `./vagga/container_name`). Implies `--no-build`
```

All the `ARGS` that follow command are passed to the command even if they start with dash `-`.

## Supervise Commands

If *command* declared as `!Supervise` you get a command with the following usage:

```
Usage:
  vagga run [OPTIONS]
```

```

Run full server stack

optional arguments:
  -h, --help            show this help message and exit
  --only PROCESS_NAME [...]
                        Only run specified processes
  --exclude PROCESS_NAME [...]
                        Don't run specified processes
  --no-build            Do not build container even if it is out of date.
                        Return error code 29 if it's out of date.
  --no-version-check   Do not run versioning code, just pick whatever
                        container version with the name was run last (or
                        actually whatever is symlinked under
                        `./vagga/container_name`). Implies `--no-build`

```

Currently there is no way to provide additional arguments to commands declared with `!Supervise`.

The `--only` and `--exclude` arguments are useful for isolating some single app to a separate console. For example, if you have `vagga run` that runs full application stack including a database, cache, web-server and your little django application, you might do the following:

```
$ vagga run --exclude django
```

Then in another console:

```
$ vagga run --only django
```

Now you have just a django app that you can observe logs from and restart independently of other applications.

## 2.4.2 Environment

There are a few ways to pass environment variables from the runner's environment into a container.

Firstly, any environment variable that starts with `VAGGAENV_` will have its prefix stripped, and exposed in the container's environment:

```
$ VAGGAENV_FOO=BAR vagga _run container printenv FOO
BAR
```

The `-e` or `--use-env` command line option can be used to mark environment variables from the runner's environment that should be passed to container:

```
$ FOO=BAR vagga --use-env=FOO _run container printenv FOO
BAR
```

And finally the `-E`, `--env` or `--environ` command line option can be used to assign an environment variable that will be passed to the container:

```
$ vagga --environ FOO=BAR _run container printenv FOO
BAR
```

The order of precedence for environment variables from the highest priority to the lowest:

1. Options `-E`/`--environ` in the command-line
2. Options `-e`/`--use-env` in the command-line
3. `VAGGAENV_*` variables

4. Variables set inside one of the settings files: `environ` option
5. Variables set via `propagate-environ` setting
6. Variables set in command: `environ` option
7. Variables set in container: `environ` option
8. Variables set in container: `environ-file` option
9. Variables that are auto-propagated: `*_proxy`, `TERM`

## 2.4.3 Settings

### Global Settings

Settings are searched for in one of the following files:

- `$HOME/.config/vagga/settings.yaml`
- `$HOME/.vagga/settings.yaml`
- `$HOME/.vagga.yaml`

Supported settings:

#### **storage-dir**

Directory where to put images build by vagga. Usually they are stored in `.vagga` subdirectory of the project dir. It's mostly useful when the `storage-dir` points to a directory on a separate partition. Path may start with `~/` which means path is inside the user's home directory.

#### **storage-subdir-from-env-var**

This options is designed specifically for Continuous Integration (CI) systems. When this option is set it identifies an environment variable that is used to specify the name of a subdirectory of the storage dir used for current project. It's only useful if `storage-dir` is set.

For example, for gitlab you may want to set:

```
storage-subdir-from-env-var: CI_PROJECT_NAME
```

Or or alternatively:

```
storage-subdir-from-env-var: CI_PROJECT_NAMESPACE
```

Note: only dash, underscore, and alphanumeric chars are allowed in the name, all other characters will be replaced by dash (so technically clashes of names are possible). If this environment variable is empty, then vagga will fail.

Note 2: already set symlink in `.vagga/lnk` overrides this setting. This also means that `_init_storage_dir` overrides the setting. Which means you may not get immediate result when migrating from old system. You may remove the link though, if your CI system does not do that by default.

New in version 0.7.2.

#### **cache-dir**

Directory where to put cache files during the build. This is used to speed up the build process. By default cache is put into `.vagga/.cache` in project directory but this setting allows to have cache directory shared between multiple projects. Path may start with `~/` which means path is inside the user's home directory.

**site-settings**

The mapping of project paths to settings for this specific project.

Example:

```
site-settings:
  /home/myuser/myproject:
    cache-dir: /home/myuser/.cache/myproject
```

**proxy-env-vars**

Enable forwarding for proxy environment variables. Default `true`. Environment variables currently that this setting influence currently: `http_proxy`, `https_proxy`, `ftp_proxy`, `all_proxy`, `no_proxy`.

**propagate-environ**

A list of variables and patterns that are propagated into the container by default. Example:

```
propagate-environ:
- "GIT_BRANCH"
- "JENKINS_*"
- "CI_*
```

This is intended to use on CI system where parameters of build job is safe to propagate.

While technically you can specify "\*" it's very dangerous and error-prone option to enable.

**external-volumes**

A mapping of volume names to the directories inside the host file system.

---

**Note:** The directories must exist even if unused in any `vagga.yaml`.

---

For example, here is how you might export home:

```
external-volumes:
  home: /home/user
```

Then in `vagga.yaml` you use it as follows (prepend with `/volumes`):

```
volumes:
  /root: !BindRW /volumes/home
```

See [Volumes](#) for more info about defining mount points.

**Warning:**

1. Usage of volume is usually a subject for filesystem permissions. I.e. your user becomes `root` inside the container, and many system users are not mapped (not present) in container at all. This means that mounting `/var/lib/mysql` or something like that is useless, unless you `chown` the directory
2. Any vagga project may use the volume if it's defined in global config. You may specify the volume in `site-settings` if you care about security (and you should).

**push-image-script**

A script to use for uploading a container image when you run `vagga _push_image`.

To push image using webdav:

```
push-image-script: "curl -T ${image_path} \  
http://example.org/${container_name}.${short_hash}.tar.xz"
```

To push image using *scp* utility (SFTP protocol):

```
push-image-script: "scp ${image_path} \  
user@example.org:/target/path/${container_name}.${short_hash}.tar.xz"
```

The FTP(s) (for example, using *lftp* utility) or S3 (using *s3cmd*) are also valid choices.

---

**Note:** This is that rare case where command is run by vagga in your host filesystem. This allows you to use your credentials in home directory, and ssh-agent's socket. But also this means that utility to upload images must be installed in host system.

---

Variables:

**container\_name** The name of the container as declared in *vagga.yaml*

**short\_hash** The short hash of container setup. This is the same hash that is used to detect whether container configuration changed and is needed to be rebuilt. And the same hash used in directory name *.vagga/roots*.

#### **auto-apply-sysctl**

Set sysctls required by command. We do our best to only apply "safe" sysctls by vagga automatically. Still it may exhaust resources of your system, so use this option on your own risk.

We apply settings with `sudo -k` which means it will prompt for password each time setting is tuned (probably only after system reboot).

Settings currently exists:

Key in vagga.yaml	Sysctl Name	Hardcoded Limit
<i>expect-inotify-limit</i>	fs.inotify.max_user_watches	524288

All project-local settings are also allowed here.

## **Project-Local Settings**

Project-local settings may be in the project dir in:

- *.vagga.settings.yaml*
- *.vagga/settings.yaml*

All project-local settings are also allowed in global config.

While settings can potentially be checked-in to version control it's advised not to do so.

#### **version-check**

If set to `true` (default) vagga will check if the container that is already built is up to date with config. If set to `false` vagga will use any container with same name already built. It's only useful for scripts for performance reasons or if you don't have internet and containers are not too outdated.

#### **ubuntu-mirror**

Set to your preferred ubuntu mirror. Default is currently a special url `mirror://mirrors.ubuntu.com/mirrors.txt` which choses local mirror for you. But it sometimes fails. Therefore we reserve an option to change the default later.

The best value for this settings is probably `http://<COUNTRY_CODE>.archive.ubuntu.com/ubuntu/`.

**ubuntu-skip-locking**

Enables `-o Debug::NoLocking=yes`. This is *super-experimental*, but allows to build multiple ubuntu images in parallel even when they use the same cache (i.e. in the same project, or when using `cache-dir`)

**alpine-mirror**

Set to your preferred alpine mirror. By default it's the random one is picked from the list.

---

**Note:** Alpine package manager is used not only for building *Alpine* distribution, but also internally for fetching tools that are outside of the container filesystem (for example to fetch `git` for *Git* or *GitInstall* command(s))

---

**build-lock-wait**

By default (`build-lock-wait: false`) vagga stops current command and prints a message when some other process have already started to build the image. When this flag is set to `true` vagga will wait instead. This is mostly useful for CI systems.

**environ**

The mapping, that overrides environment variables set in container or command.

**run-symlinks-as-commands**

(default `true`) If the setting is true, when there is a symlink named `yyy` that points to a vagga, and vagga is run by calling the name of that symlink vagga finds a command with `symlink-name` which equals to this command and runs it directly, passing all the arguments to that command (i.e. vagga doesn't try to parse command-line itself).

New in version 0.7.1.

**index-all-images**

(default `false`) When the setting is `true` then vagga will hash all the files inside the containers and will create a special signature file.

New in version 0.7.1.

**hard-link-identical-files**

**This functionality is experimental.** Use at your own risk.

(default `false`) This setting is paired with `index-all-images`. When both settings are `true` vagga will search identical files inside other containers and will replace the same files with hard links. This can significantly reduce a disk space occupied by the containers.

There are two precautions about this setting:

1. Date modified, date created and most other metadata is ignored
2. If you edit file directly in `.vagga/<container-name>` you may edit files in multiple containers at the same time (this is similar to `transient-hard-link-copy` in a some way)

New in version 0.7.2.

**disable-auto-clean**

Disables `auto-clean` option in all containers. This is useful on CI systems where multiple parallel builds should work.

## 2.4.4 Errors

The document describes errors when running vagga on various systems. The manual only includes errors which need more detailed explanation and troubleshooting. Most errors should be self-descriptive.

### Could not read /etc/subuid or /etc/subgid

The full error might look like:

```
ERROR:vagga::container::uidmap: Error reading uidmap: Can't open /etc/subuid: No such
↳file or directory (os error 2)
WARN:vagga::container::uidmap: Could not read /etc/subuid or /etc/subgid (see http://
↳bit.ly/err_subuid)
error setting uid/gid mappings: Operation not permitted (os error 1)
```

Or it might look like:

```
WARN:vagga::container::uidmap: Could not find the user "your_user_name" in /etc/
↳subuid or /etc/subgid (see http://bit.ly/err_subuid)
Command <Command "/proc/self/exe" ("vagga_wrapper") "_build" "rust-musl"; environ: {
↳"RUST_LOG"="warn", "TERM"="screen", "_VAGGA_HOME"="/var/empty", }; uid_map=[UidMap {
↳inside_uid: 65534, outside_uid: 0, count: 1 }]; gid_map=[GidMap { inside_gid: 65534,
↳outside_gid: 0, count: 1 }]>: error setting uid/gid mappings: Operation not
↳permitted (os error 1)
```

The first message above means there is no /etc/subuid file. It probably means you need to create one. The second option means there is a /etc/subuid file but your user is absent in the file.

The recommended contents of /etc/subuid are following:

```
your_user_name:100000:65536
```

You should **also** check /etc/subgid, add presumably the same contents to /etc/subgid (In subgid file the first field still contains your user name not a group name).

You may get another similar error:

```
ERROR:vagga::container::uidmap: Error reading uidmap: /etc/subuid:2: Bad syntax:
↳"user:100000:1000"
WARN:vagga::container::uidmap: Could not read /etc/subuid or /etc/subgid (see http://
↳bit.ly/err_subuid)
error setting uid/gid mappings: Operation not permitted (os error 1)
```

This means somebody has edited /etc/subuid and made an error. Just open the file (note it's owned by root) and fix the issue (in the example the last character should be zero, but it's a letter "O").

### Can't find newuidmap or newgidmap

Full error usually looks like:

```
WARN:vagga::process_util: Can't find `newuidmap` or `newgidmap` (see http://bit.ly/
↳err_idmap)
error setting uid/gid mappings: No such file or directory (os error 2)
```

There might be two reasons for this:

1. The binaries are not installed (see below)
2. The commands are not in `PATH`

In the latter case you should fix your `PATH`.

The packages for Ubuntu  $\geq$  14.04:

```
$ sudo apt-get install uidmap
```

The Ubuntu 12.04 does not have the package. But you may use the package from newer release (the following version works fine on 12.04):

```
$ wget http://gr.archive.ubuntu.com/ubuntu/pool/main/s/shadow/uidmap_4.1.5.1-1ubuntu9_
↳amd64.deb
$ sudo dpkg -i uidmap_4.1.5.1-1ubuntu9_amd64.deb
```

Most distributions (known: Nix, Arch Linux, Fedora) have binaries as part of “shadow” package, so have them installed on every system.

### You should not run vagga as root

Well, sometimes users get some `permission denied` errors and try to run `vagga` with `sudo`. Running as root is **never** an answer.

Here is a quick check list on permission checks:

- Check owner (and permission bits) of `.vagga` subdirectory if it exists, otherwise the directory where `vagga.yaml` is (project dir). In case you have already run `vagga` as root just do `sudo rm -rf .vagga`
- *Could not read /etc/subuid or /etc/subgid*
- *Can't find newuidmap or newgidmap*
- Check `uname -r` to have version of 3.9 or greater
- Check `sysctl kernel.unprivileged_usersns_clone` the setting must either *not exist* at all or have value of 1
- Check `zgrep CONFIG_USER_NS /proc/config.gz` or `grep CONFIG_USER_NS "/boot/config-`uname -r`"` (ubuntu) the setting should equal to `y`

The error message might look like:

```
You should not run vagga as root (see http://bit.ly/err\_root)
```

Or it might look like a warning:

```
WARN:vagga::launcher: You are running vagga as a user different from the owner of project directory. You may not have needed permissions (see http://bit.ly/err\_root)
```

Both show that you don't run `vagga` with the user that owns the project. The legitimate reasons to run `vagga` as root are:

- If you run `vagga` in container (i.e. in `vagga` itself) and the root is not a real root
- If your project dir is owned by root (for whatever crazy reason)

Both cases should inhibit the warning automatically, but as a last resort you may try `vagga --ignore-owner-check`. If you have good case where this works, please file an issue and we might make the check better.

## Don't run vagga on shared folders

If you are testing or using vagga using an OS X machine, you might be tempted to set up a Linux virtual machine and share your definitions into the machine. Sadly, this leads to the shared folder implementation lying to you: it pretends all files are owned by the user you use on the guest system, but this is not fully true. This manifests in errors such as this:

```
vagrant@vagrant-ubuntu-trusty-64:/vagrant/vagga$ vagga doc (1/1) Installing alpine-keys (1.1-r0) OK: 0
MiB in 1 packages fetch http://dl-2.alpinelinux.org/alpine/v3.2/main/x86_64/APKINDEX.tar.gz (1/15)
Installing musl (1.1.11-r2) (2/15) Installing busybox (1.23.2-r0) ERROR: Failed to set ownership on
bin/bbsuid.apk-new: Operation not permitted ERROR: Failed to set file permissions on bin/bbsuid.apk-
new: Operation not permitted ERROR: Failed to preserve modification time on bin/bbsuid.apk-new: Op-
eration not permitted Executing busybox-1.23.2-r0.post-install
```

and subsequent errors, including vagga not being allowed to clean up after itself.

Don't use shared folders as your cache dir or storage dir, see [Settings](#) for ways to change them.

## Out of Shared Memory

We use 100MiB for shared memory by default, to increase it add the following to the volumes of your container (or command):

```
containers:
  some-container:
    volumes:
      /run: !Tmpfs
        size: 1Gi # your new size of shared memory
      subdirs:
        shm: # create shm directory
```

## Known scenarios

Facebook's [flow](#) requires a lot of shared memory. The error that can be seen in the log is as follows:

```
[2016-08-11 06:59:40] We've run out of filesystems to use for shared memory
SharedMem.Out_of_shared_memory
```

The amount of memory needed probably depends on an application that is being compiled by flow.

## 2.4.5 System Settings

Vagga sometimes hints and if permitted can tune few options on a host system. This is the reference of the options that vagga can fix.

See [auto-apply-sysctl](#) for a table of options and limits.

### Sysctl `fs.inotify.max_user_watches`

The `inotify` is used to notify user processes that some file or directory is changed by another process. It's tweaked by `expect-inotify-limit`.

It's very useful for the following things:

1. Run processes with automatic restart on reload
2. Run build system and automatically rebuild on file change
3. Start unit tests on each file change

Unfortunately on some systems (namely ubuntu xenial, docker on mac) it's very common to have a limit of 8192 inotify watches. Which is too slow on some systems.

The error is manifested as:

- `inotify watch limit reached`
- `ENOSPC/No space left on device (yes, this is not a typo)`
- `Internal watch failed: watch ENOSPC`
- Some programs just crash (see #291)

Tuning it is usually harmless unless the value is too large. Each user watch takes up to 1080 bytes. So values up to 512K are fine on most current systems.

To tune it (temporarily) you need to run:

```
sudo sysctl fs.inotify.max_user_watches=524288
```

To store for the next reboot you may try to add `-w`:

```
sudo sysctl -w fs.inotify.max_user_watches=524288
```

But it doesn't work for some linux distributions (hello, NixOS)

Alternatively, you may set `auto-apply-sysctl`. This tells vagga to automatically run `sudo -k sysctl ...` on your behalf (probably asking for a password).

## 2.4.6 OverlayFS

This page documents `overlayfs` support for vagga. This is currently a work in progress.

Since `unprivileged overlayfs` is unsupported in mainline kernel, you may need some setup. Anyway, **ubuntu**'s stock kernel has the patch applied.

### The Plan

1. Make of use of overlayfs in `Snapshot` volume. This will be enabled by a volume-level setting initially. In perspective the setting will be default on systems that support it.
2. Use overlayfs for `_run --writable` and transient copies
3. Use overlayfs for `Container` step. This will be enabled by a container-level setting. Which, presumably, will always be disabled by default.
4. Add `vagga _build container --cache-each-step` to ease debugging of container builds (actually to be able to continue failing build from any failed step)

Smaller things:

- `vagga _check_overlayfs_support`

We need a little bit more explanation about why we would keep overlays disabled by default. The first thing to know, is that while we will mount overlays for filesystems inside the container, we can't mount overlays outside of the container.

So we want to have first class IDE support by default (so you can point to one folder for project dependencies, not variable list of layered folders)

For `--cache-each-step` the main reason is performance. From experience with [Docker](#) we know that snapshotting each step is not zero-cost.

### Setup

This section describes quirks on various systems that are needed to enable this feature.

To check this run:

```
$ vagga _check_overlayfs_support
supported
$ uname -r -v
4.5.0 #1-NixOS SMP Mon Mar 14 04:28:54 UTC 2016
```

If first command reports `supported` please report your value of `uname -rv` so we can add it to the lists below.

The *original patch* made by Canonical's employee is just one line, and has pretty extensive documentation about why it's safe enough.

### Ubuntu

It works by default on [Ubuntu](#) trusty 14.04. It's reported successfully on the following systems:

```
3.19.0-42-generic #48~14.04.1-Ubuntu SMP Fri Dec 18 10:24:49 UTC 2015
```

### Arch Linux

Since you already use custom kernel, you just need another patch. If you use the package recommended in *installation page*<archlinux> your kernel **already supports** overlays too.

The [AUR package](#) has the feature enabled too, this is where you can find the PKGBUILD to build the kernel yourself.

### NixOS

On [NixOS](#) you need to add a patch and rebuild the kernel. Since the patch is already in the nixos source tree, you need just the following in your `/etc/nixos/configuration.nix`:

```
nixpkgs.config.packageOverrides = pkgs: {
  linux_4_5 = pkgs.linux_4_5.override { kernelPatches = [
    pkgs.kernelPatches.ubuntu_unprivileged_overlayfs
  ]; };
};
```

Adjust kernel version as needed.

## 2.5 Network Testing

Usually vagga runs processes in host network namespace. But there is a mode for network testing.

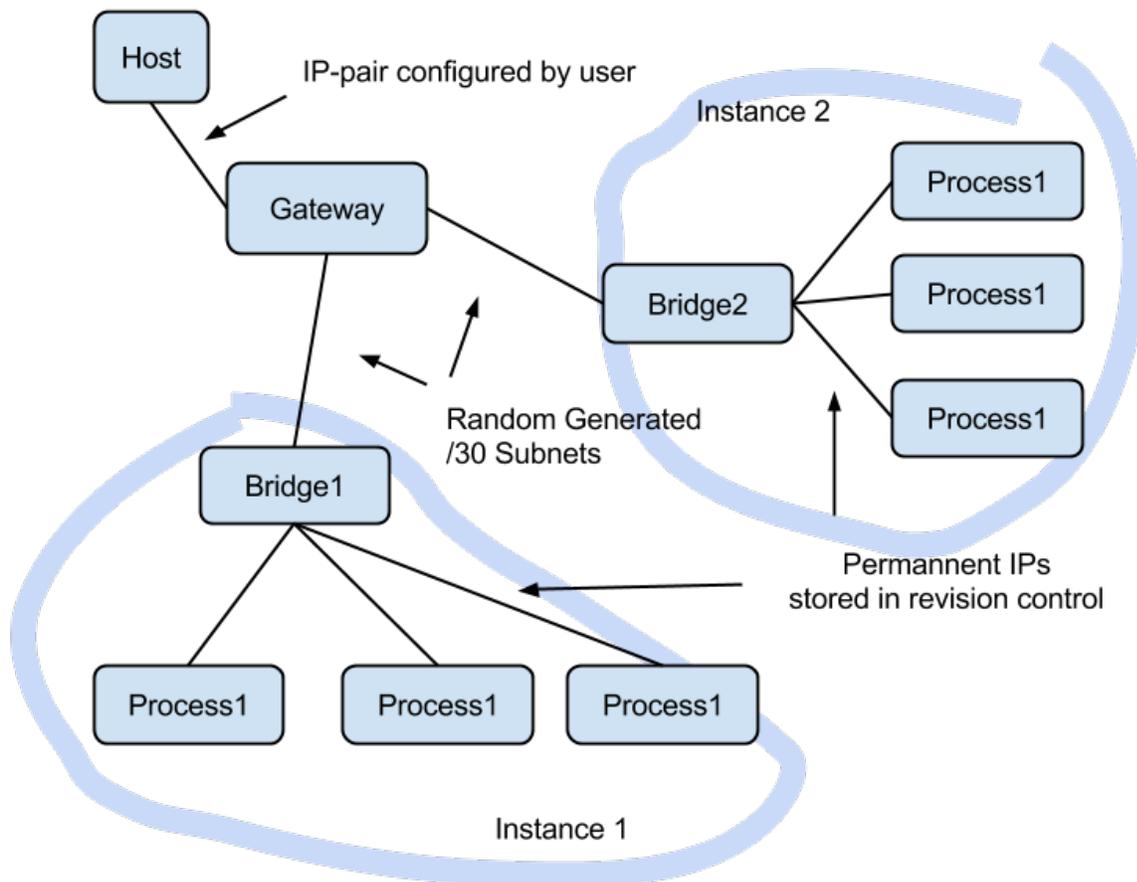
**Warning:** This documentation is awfully incomplete. There is a good [article](#) in the meantime. Except `vagga_network` command is replaced by `vagga _network` subcommand (note the space after vagga)

### 2.5.1 Overview

For testing complex networks we leverage `!Supervise` type of commands to run multiple nodes. But we also need a way to setup network. What we need in particular:

1. The IPs should be hard-coded (i.e. checked in into version control)
2. Multiple different projects running simultaneously (and multiple instances of same project as a special case of it)
3. Containers should be able to access internet if needed

So we use “double-bridging” to get this working, as illustrated below:



The *Setup* section describes how to setup a gateway in the host system, and *Containers* section describes how to configure containers in `vagga.yaml`. And *Partitioning* section describes how to implement tests which break network and create network partitions of various kinds.

### 2.5.2 Setup

Unfortunately we can't setup network in fully non-privileged way. So you need to do some preliminary setup. To setup a bridge run:

```
$ vagga _create_netns
```

Running this will show what commands are going to run:

```
We will run network setup commands with sudo.
You may need to enter your password.
```

```
The following commands will be run:
```

```
sudo 'ip' 'link' 'add' 'vagga_guest' 'type' 'veth' 'peer' 'name' 'vagga'
sudo 'ip' 'link' 'set' 'vagga_guest' 'netns' '16508'
sudo 'ip' 'addr' 'add' '172.23.255.1/30' 'dev' 'vagga'
sudo 'sysctl' 'net.ipv4.conf.vagga.route_localnet=1'
sudo 'mount' '--bind' '/proc/16508/ns/net' '/run/user/1000/vagga/netns'
sudo 'mount' '--bind' '/proc/16508/ns/user' '/run/user/1000/vagga/usersns'
```

```
The following iptables rules will be established:
```

```
["-I", "INPUT", "-i", "vagga", "-d", "127.0.0.1", "-j", "ACCEPT"]
["-t", "nat", "-I", "PREROUTING", "-p", "tcp", "-i", "vagga", "-d", "172.23.255.1
↔", "--dport", "53", "-j", "DNAT", "--to-destination", "127.0.0.1"]
["-t", "nat", "-I", "PREROUTING", "-p", "udp", "-i", "vagga", "-d", "172.23.255.1
↔", "--dport", "53", "-j", "DNAT", "--to-destination", "127.0.0.1"]
["-t", "nat", "-A", "POSTROUTING", "-s", "172.23.255.0/30", "-j", "MASQUERADE"]
```

Then immediately the commands are run, this will probably request your password by `sudo` command. The `iptables` commands may depend on DNS server settings in your `resolv.conf`.

---

**Note:** you can't just copy these commands and run (or push exact these commands to `/etc/sudoers`), merely because the pid of the process in mount commands is different each time.

---

You may see the commands that will be run without running them with `--dry-run` option:

```
$ vagga _create_netns --dry-run
```

To destroy the created network you can run:

```
$ vagga _destroy_netns
```

This uses `sudo` too

**Warning:** if you have `172.23.0.0/16` network attached to your machine, the `_create_netns` and `_destroy_netns` may break that network. We will allow to customize the network in future versions of `vagga`.

## 2.5.3 Containers

Here is a quick example of how to run network tests: `vagga.yaml`

The configuration runs `flask` application with `nginx` and periodically stops network between processes. For example here is test for normal connection:

```
$ vagga run-normal &
$ vagga wrk http://172.23.255.2:8000 --latency
Running 10s test @ http://172.23.255.2:8000
 2 threads and 10 connections
Thread Stats   Avg      Stdev     Max    +/-  Stdev
  Latency    6.07ms   1.05ms  20.21ms  94.69%
  Req/Sec   827.65   78.83   0.92k    86.00%
Latency Distribution
 50%    5.82ms
 75%    6.11ms
 90%    6.54ms
 99%   11.62ms
16485 requests in 10.00s, 2.86MB read
Requests/sec:  1647.73
Transfer/sec:   292.78KB
```

Here is the same test with bad network connection:

```
$ vagga run-flaky &
$ vagga wrk http://172.23.255.2:8000 --latency
Running 10s test @ http://172.23.255.2:8000
 2 threads and 10 connections
Thread Stats   Avg      Stdev     Max    +/-  Stdev
  Latency   241.69ms 407.98ms  1.41s   81.67%
  Req/Sec   631.83  299.12   1.14k   71.05%
Latency Distribution
 50%    7.27ms
 75%   355.09ms
 90%   991.64ms
 99%    1.37s
 5032 requests in 10.01s, 0.87MB read
Requests/sec:   502.64
Transfer/sec:    89.32KB
```

The `run-flaky` works as follows:

- Stop networking packets going between `nginx` and `flask` (`iptables .. -j DROP`)
- Sleep for a second
- Restore network
- Sleep for a second
- Repeat

The respective part of the configuration looks like:

```
interrupt: !BridgeCommand
container: test
run: |
  set -x
  while true; do
    vagga _network isolate flask
```

```
sleep 1
vagga _network fullmesh
sleep 1
done
```

As you can see in the test there are interesting differences:

- average latency is 241ms vs 5ms
- median latency is about the same
- 99 percentile of latency is 1.37s vs 11.62ms (i.e. 100x bigger)
- request rate 502 vs 1647

The absolute scale doesn't matter. But intuitively we could think that if network doesn't work 50% of the time it should be 3x slower. But it isn't. Different metrics are influenced in very different way.

### 2.5.4 Partitioning

# TBD

---

There is an [article](#) on how the network interface was designed and why.

## 2.6 Tips And Tricks

### 2.6.1 Faster Builds

There are *Settings* which allow to set common directory for cache for all projects that use vagga. I.e. you might add the following to `$HOME/.config/vagga/settings.yaml`:

```
cache-dir: ~/.cache/vagga/cache
```

Currently you must create directory by hand.

### 2.6.2 Multiple Build Attempts

Despite of all the caching vagga does, it's usually to slow to rebuild a big container when trying to install even a single package. You might try something like this:

```
$ vagga _run --writeable container_name pip install pyzmq
```

Note that the flag `--writeable` or shorter `-W` doesn't write into the container itself, but creates a (hard-linked) copy, which is destructed on exit. To run multiple commands you might use bash:

```
host-shell$ vagga _run -W container bash
root@localhost:/work# apt-get update
root@localhost:/work# apt-get install -y something
```

---

**Note:** We delete package indexes of ubuntu after the container is built. This is done to keep the image smaller. So, if you need for example to run `apt-get install` you would always need to run `apt-get update` first.

---

Another technique is to use *PHP/Composer Installer*.

### 2.6.3 Debug Logging

You can enable additional debug logging by setting the environment variable `RUST_LOG=debug`. For example:

```
$ RUST_LOG=debug vagga _build container
```

### 2.6.4 I'm Getting "permission denied" Errors

When starting vagga, if you see the following error:

```
ERROR:container::monitor: Can't run container wrapper: Error executing: permission_
↪denied
```

Then you might not have the appropriate kernel option enabled. You may try:

```
$ sysctl -w kernel.unprivileged_users_clone=1
```

If that works, you should add it to your system startup. If it doesn't, unfortunately it may mean that you need to recompile the kernel. It's not that complex nowadays, but still disturbing.

Anyway, if you didn't find specific instructions for your system on the *Installation* page, please [report an issue](#) with the information of your distribution (at least `uname` and `/etc/os-release`), so I can add instructions.

### 2.6.5 Fix "insufficient permissions" for USB device

To allow access on a USB device from inside the container, the device permissions need to be set properly on the host system.

Either you use 'chown' to set the owner of the device under `/dev/bus/usb/...` to `<your_host_user>` or you define a `udev` rule on your host system to grant access to the USB device.

A simple rule which grants access to all users for all devices of a vendor may look like this:

```
ATTRS{idVendor}=="04b8", ATTRS{idProduct}=="*", MODE="0777"
```

`MODE="0777"` in your `udev` rule will allow access for every user, while `OWNER="your_host_user"` will only grant access to your user.

To list your device attributes, use e.g.:

```
$ udevadm info -a -n /dev/bus/usb/001/003
```

### 2.6.6 How to Debug Slow Build?

There is a log with timings for each step, in container's metadata folder. The easiest way to view it:

```
$ cat .vagga/<container_name>/../timings.log
0.000 0.000 Start 1425502860.147834
0.000 0.000 Prepare
0.375 0.374 Step: Alpine("v3.1")
1.199 0.824 Step: Install(["alpine-base", "py-sphinx", "make"])
1.358 0.159 Finish
```

**Note:** Note the `../` part. It works because `.vagga/<container_name>` is a symlink. Real path is something like `.vagga/.roots/<container_name>.<hash>/timings.log`

---

First column displays time in seconds since container started building. Second column is a time of this specific step.

You should also run `build` at least twice to see the impact of package caching. To rebuild container run:

```
$ vagga _build --force <container_name>
```

### 2.6.7 How to Find Out Versions of Installed Packages?

You can use typical `dpkg -l` or similar command. But since we usually `deinstall npm` and `pip` after setting up container for space efficiency we put package list in container metadata. In particular there are following lists:

- `alpine-packages.txt` – list of packages for Alpine linux
- `debian-packages.txt` – list of packages for Ubuntu/Debian linux
- `pip2-freeze.txt/pip3-freeze.txt` – list of python packages, in a format directly usable for `requirements.txt`
- `npm-list.txt` – a tree of npm packages

The files contain list of all packages including ones installed implicitly or as a dependency. All packages have version. Unfortunately format of files differ.

The files are at parent directory of the container's filesystem, so can be looked like this:

```
$ cat .vagga/<container_name>/../pip3-freeze.txt
```

Or specific version can be looked:

```
$ cat .vagga/.roots/<container_name>.<hash>/pip3-freeze.txt
```

The latter form is useful to compare with older versions of the same container.

## 2.7 Conventions

This document describes the conventions for writing vagga files. You are free to use only ones that makes sense for your project.

### 2.7.1 Motivation

Establishing conventions for vagga file have the following benefits:

- Easy to get into your project for new developers
- Avoid common mistakes when creating vagga file

## 2.7.2 Command Naming

### run

To run a project you should just start:

```
$ vagga run
```

This should obey following rules:

1. Run all the dependencies: i.e. database, memcache, queues, whatever
2. Run in host network namespace, so user can access database from host without any issues
3. You shouldn't need to configure anything before running the app, all defaults should be out of the box

### test

To run all automated tests you should start:

```
$ vagga test
```

The rules for the command:

1. Run all the test suites that may be run locally
2. Should not include tests that require external resources
3. If that's possible, should include ability to run individual tests and *-help*
4. Should run all needed dependencies (databases, caches,..), presumably on different ports from ones used for `vagga run`

It's expected that exact parameters depend on the underlying project. I.e. for python project this would be a thin wrapper around *nosetests*

### test-whatever

Runs individual test suite. Named `whatever`. This may be used for two purposes:

1. Test suite requires some external dependencies, say a huge database with real-life products for an e-commerce site.
2. There are multiple test suites with different runners, for example you have a *nosetests* runner and *cunit* runner that require different command-line to choose individual test to run

Otherwise it's similar to `run` and may contain part of that test suite

### doc

Builds documentation:

```
$ vagga doc
[.. snip ..]
-----
Documentation is built under docs/_build/html/index.html
```

The important points about the command:

1. Build HTML documentation
2. Use *epilog* to show where the documentation is after build
3. Use *work-dir* if your documentation build runs in a subdirectory

If you don't have HTML documentation at all, just ignore rule #1 and put whatever documentation format that makes sense for your project.

Additional documentation builders (different formats) may be provided by other commands. But main `vagga doc` command should be enough to validate all the docs written before the commit.

The documentation may be built by the same container that application runs or different one, or even just inherit from application's one (useful when some of the documentation is extracted from the code).

## 2.8 Examples and Tutorials

### 2.8.1 Tutorials

#### Building a Django project

This example will show how to create a simple Django project using vagga.

- *Creating the project structure*
- *Freezing dependencies*
- *Let's add a dependency*
- *Adding some code*
- *Trying out memcached*
- *Why not Postgres?*

#### Creating the project structure

In order to create the initial project structure, we will need a container with Django installed. First, let's create a directory for our project:

```
$ mkdir -p ~/projects/vagga-django-tutorial && cd ~/projects/vagga-django-tutorial
```

Now create the `vagga.yaml` file and add the following to it:

```
containers:
  django:
    setup:
      - !Alpine v3.5
      - !Py3Install ['Django >=1.10,<1.11']
```

and then run:

```
$ vagga _run django django-admin startproject MyProject .
```

This will create a project named `MyProject` in the current directory. It will look like:

```
~/projects/vagga-django-tutorial
├── MyProject
│   ├── __init__.py
│   ├── settings.py
│   ├── urls.py
│   └── wsgi.py
├── manage.py
└── vagga.yaml
```

Notice that we used `'Django >=1.10, <1.11'` instead of just `Django`. It is a good practice to always specify the major and minor versions of a dependency. This prevents an update to an incompatible version of a library breaking your project. You can change the Django version if there is a newer version available (`'Django >=1.11, <1.12'` for instance).

## Freezing dependencies

It is a common practice for python projects to have a `requirements.txt` file that will hold the exact versions of the project dependencies. This way, any developer working on the project will have the same dependencies.

In order to generate the `requirements.txt` file, we will create another container called `app-freezer`, which will list our project's dependencies and output the requirements file.

```
containers:
  app-freezer:
    setup:
      - !Alpine v3.5
      - !Py3Install
        - 'Django >=1.10, <1.11'
      - !Sh python3 -m pip freeze > requirements.txt
  django:
    setup:
      - !Alpine v3.5
      - !Py3Requirements requirements.txt
```

- – our new container
- – call `pip trough python3 -m` to generate the requirements file
- – just reference the requirements file from `django` container

Every time we add a new dependency, we need to rebuild the `app-freezer` container to generate the updated `requirements.txt`.

Now, build the `app-freezer` container:

```
$ vagga _build app-freezer
```

You will notice the new `requirements.txt` file holding a content similar to:

```
Django==1.10.5
```

And now let's run our project. Edit `vagga.yaml` to add the run command:

```
containers:
  # same as before
commands:
  run: !Command
    description: Start the django development server
    container: django
    run: python3 manage.py runserver
```

and then run:

```
$ vagga run
```

If everything went right, visiting `localhost:8000` will display Django's welcome page saying 'It worked!'.

### Let's add a dependency

By default, Django is configured to use `sqlite` as its database, but we want to use a database url from an environment variable, since it's more flexible. However, Django does not understand database urls, so we need `django-environ` to parse configuration urls into the format Django understands.

Add `django-environ` to our `app-freezer` container:

```
containers:
  app-freezer:
    setup:
      - !Alpine v3.5
      - !PipConfig
      dependencies: true
      - !Py3Install
      - 'Django >=1.10,<1.11'
      - 'django-environ >=0.4,<0.5'
      - !Sh python3 -m pip freeze > requirements.txt
```

- `django-environ` have a dependency on the package `six` which would not be installed unless we tell pip to do so

Rebuild the `app-freezer` container to update `requirements.txt`:

```
$ vagga _build app-freezer
```

Set the environment variable:

```
containers:
  #...
  django:
    environ:
      DATABASE_URL: sqlite:///db.sqlite3
    setup:
      - !Alpine v3.5
      - !Py3Requirements requirements.txt
```

- `env` will point to `/work/db.sqlite3`

Now let's change our project's settings by editing `MyProject/settings.py`:

```
# MyProject/settings.py
import os
import environ
env = environ.Env()

# other settings

DATABASES = {
    # will read DATABASE_URL from environment
    'default': env.db()
}
```

Let's add a shortcut command for `manage.py`:

```
commands:
  # ...
  manage.py: !Command
    description: Shortcut to manage.py
```

```
container: django
run: [python3, manage.py]
```

**Note:** This command accept arguments by default, so instead of writing it long `vagga _run django python3 manage.py runserver` we will be able to shorten it to `vagga manage.py runserver`

To see if it worked, let's run the migrations from the default Django apps and create a superuser:

```
$ vagga manage.py migrate
$ vagga manage.py createsuperuser
```

After creating the superuser, run our project:

```
$ vagga run
```

visit `localhost:8000/admin` and log into the Django admin.

## Adding some code

Before going any further, let's add a simple app to our project.

First, start an app called 'blog':

```
$ vagga manage.py startapp blog
```

Add it to `INSTALLED_APPS`:

```
# MyProject/settings.py
INSTALLED_APPS = [
    # ...
    'blog',
]
```

Create a model:

```
# blog/models.py
from django.db import models

class Article(models.Model):
    title = models.CharField(max_length=100)
    body = models.TextField()
```

Create the admin for our model:

```
# blog/admin.py
from django.contrib import admin
from .models import Article

@admin.register(Article)
class ArticleAdmin(admin.ModelAdmin):
    list_display = ('title',)
```

Create and run the migration:

```
$ vagga manage.py makemigrations
$ vagga manage.py migrate
```

Run our project:

```
$ vagga run
```

And visit `localhost:8000/admin` to see our new model in action.

Now create a couple views:

```
# blog/views.py
from django.views import generic
from .models import Article

class ArticleList(generic.ListView):
    model = Article
    paginate_by = 10

class ArticleDetail(generic.DetailView):
    model = Article
```

Create the templates:

```
{# blog/templates/blog/article_list.html #}
<!DOCTYPE html>
<html>
<head>
  <title>Article List</title>
</head>
<body>
  <h1>Article List</h1>
  <ul>
    {% for article in article_list %}
      <li><a href="{% url 'blog:article_detail' article.id %}">{{ article.title }}</a></li>
    {% endfor %}
  </ul>
</body>
</html>
```

```
{# blog/templates/blog/article_detail.html #}
<!DOCTYPE html>
<html>
<head>
  <title>Article List</title>
</head>
<body>
  <h1>{{ article.title }}</h1>
  <p>
    {{ article.body }}
  </p>
</body>
</html>
```

Set the urls:

```
# blog/urls.py
from django.conf.urls import url
from . import views

urlpatterns = [
    url(r'^$', views.ArticleList.as_view(), name='article_list'),
    url(r'^(?P<pk>\d+)?$', views.ArticleDetail.as_view(), name='article_detail'),
]
```

```
# MyProject/urls.py
from django.conf.urls import url, include
from django.contrib import admin

urlpatterns = [
    url(r'^$', include('blog.urls', namespace='blog')),
    url(r'^admin/', admin.site.urls),
]
```

---

**Note:** Remember to import include at the first line

---

Now run our project:

```
$ vagga run
```

and visit localhost:8000. Try adding some articles through the admin to see the result.

## Trying out memcached

Many projects use `memcached` to speed up things, so let's try it out.

Add `pylibmc` to our app-freezer, as well as its build dependencies:

```
containers:
  app-freezer:
    setup:
      - !Alpine v3.5
      - &build_deps !BuildDeps
      - libmemcached-dev
      - zlib-dev
      - cyrus-sasl-dev
      - !PipConfig
      dependencies: true
      - !Py3Install
      - 'Django >=1.10,<1.11'
      - 'django-environ >=0.4,<0.5'
      - 'pylibmc >=1.5,<1.6'
      - !Sh python3 -m pip freeze > requirements.txt
  django:
    environ:
      DATABASE_URL: sqlite:///db.sqlite3
    setup:
      - !Alpine v3.5
      - *build_deps
      - !Py3Requirements requirements.txt
```

- – we used an YAML anchor (&build\_deps) to avoid repetition of the build dependencies
- – libraries needed to build pylibmc
- – the YAML alias \*build\_deps references the anchor declared in the app-freezer container, so we don't need to repeat the build dependencies on both containers

And rebuild the container:

```
$ vagga _build app-freezer
```

Add the pylibmc runtime dependencies to our django container:

```
containers:
  # ...
  django:
    setup:
      - !Alpine v3.5
      - *build_deps
      - !Install
      - libmemcached
      - zlib
      - libsasl
      - !Py3Requirements requirements.txt
    environ:
      DATABASE_URL: sqlite:///db.sqlite3
```

- – libraries needed by pylibmc at runtime

Crate a new container called memcached:

```
containers:
  # ...
  memcached:
    setup:
      - !Alpine v3.5
      - !Install [memcached]
```

Create the command to run with caching:

```
commands:
  # ...
  run-cached: !Supervise
    description: Start the django development server alongside memcached
    children:
      cache: !Command
        container: memcached
        run: memcached -u memcached -vv
      app: !Command
        container: django
        environ:
          CACHE_URL: pymemcache://127.0.0.1:11211
        run: python3 manage.py runserver
```

- – run memcached as verbose so we see can see the cache working
- – set the cache url

Change MyProject/settings.py to use our memcached container:

```
import os
import environ
env = environ.Env()

# other settings

CACHES = {
    # will read CACHE_URL from environment
    # defaults to memory cache if environment is not set
    'default': env.cache(default='locmemcache://')
}
```

Configure our view to cache its response:

```
# blog/urls.py
from django.conf.urls import url
from django.views.decorators.cache import cache_page
from . import views

cache_15m = cache_page(60 * 15)

urlpatterns = [
    url(r'^$', views.ArticleList.as_view(), name='article_list'),
    url(r'^(?P<pk>\d+)$', cache_15m(views.ArticleDetail.as_view()), name='article_
↪detail'),
]
```

Now, run our project with memcached:

```
$ vagga run-cached
```

And visit any article detail page, hit `Ctrl+r` to avoid browser cache and watch the memcached output on the terminal.

## Why not Postgres?

We can test our project against a Postgres database, which is probably what we will use in production.

First add `psycopg2` and its build dependencies to `app-freezer`:

```
containers:
  app-freezer:
    setup:
      - !Alpine v3.5
      - !BuildDeps
        - libmemcached-dev
        - zlib-dev
        - cyrus-sasl-dev
        - postgresql-dev
      - !PipConfig
      dependencies: true
      - !Py3Install
        - 'Django >=1.10,<1.11'
        - 'django-environ >=0.4,<0.5'
        - 'pylibmc >=1.5,<1.6'
        - 'psycopg2 >=2.6,<2.7'
      - !Sh python3 -m pip freeze > requirements.txt
```

- – library needed to build psycopg2
- – psycopg2 dependency

Rebuild the container:

```
$ vagga _build app-freezer
```

Add the runtime dependencies of psycopg2:

```
containers:
  django:
    setup:
      - !Alpine v3.5
      - *build_deps
      - !Install
        - libmemcached
        - zlib
        - libsasl
        - libpq
      - !Py3Requirements requirements.txt
    environ:
      DATABASE_URL: sqlite:///db.sqlite3
```

- – library needed by psycopg2 at runtime

Before running our project, we need a way to automatically create our superuser. We can create a migration to do this. First, create an app called `common`:

```
$ vagga manage.py startapp common
```

Add it to `INSTALLED_APPS`:

```
INSTALLED_APPS = [
    # ...
    'common',
    'blog',
]
```

Create the migration for adding the admin user:

```
$ vagga manage.py makemigrations -n create_superuser --empty common
```

Change the migration to add our admin user:

```
# common/migrations/0001_create_superuser.py
from django.db import migrations
from django.contrib.auth.hashers import make_password

def create_superuser(apps, schema_editor):
    User = apps.get_model("auth", "User")
    User.objects.create(username='admin',
                        email='admin@example.com',
                        password=make_password('change_me'),
                        is_superuser=True,
                        is_staff=True,
                        is_active=True)
```

```
class Migration(migrations.Migration):

    dependencies = [
        ('auth', '__latest__')
    ]

    operations = [
        migrations.RunPython(create_superuser)
    ]
```

Create the database container:

```
containers:
# ...
postgres:
  setup:
  - !Ubuntu xenial
  - !EnsureDir /data
  - !Sh |
      addgroup --system --gid 200 postgres
      adduser --uid 200 --system --home /data --no-create-home \
        --shell /bin/bash --group --gecos "PostgreSQL administrator" \
        postgres
  - !Install [postgresql-9.5]
  environ:
    PGDATA: /data
    PG_PORT: 5433
    PG_DB: test
    PG_USER: vagga
    PG_PASSWORD: vagga
    PG_BIN: /usr/lib/postgresql/9.5/bin
  volumes:
    /data: !Persistent
      name: postgres
      owner-uid: 200
      owner-gid: 200
      init-command: _pg-init
    /run: !Tmpfs
      subdirs:
        postgresql: { mode: 0o777 }
```

- – Use fixed user id and group id for postgres
- – Vagga command to initialize the volume

---

**Note:** The database will be persisted in `.vagga/.volumes/postgres`.

---

Now add the command to initialize the database:

```
commands:
# ...
_pg-init: !Command
  description: Init postgres database
  container: postgres
  user-id: 200
  group-id: 200
```

```
run: |
  set -ex
  ls -la /data
  $PG_BIN/pg_ctl initdb
  $PG_BIN/pg_ctl -w -o '-F --port=$PG_PORT -k /tmp' start
  $PG_BIN/createuser -h 127.0.0.1 -p $PG_PORT $PG_USER
  $PG_BIN/createdb -h 127.0.0.1 -p $PG_PORT $PG_DB -O $PG_USER
  $PG_BIN/psql -h 127.0.0.1 -p $PG_PORT -c "ALTER ROLE $PG_USER WITH ENCRYPTED_
↪PASSWORD '$PG_PASSWORD';"
  $PG_BIN/pg_ctl stop
```

And then add the command to run with Postgres:

```
commands:
# ...
run-postgres: !Supervise
  description: Start the django development server using Postgres database
  children:
    app: !Command
      container: django
      environ:
        DATABASE_URL: postgresql://vagga:vagga@127.0.0.1:5433/test
      run: |
        python3 manage.py migrate
        python3 manage.py runserver
    db: !Command
      container: postgres
      user-id: 200
      group-id: 200
      run: exec $PG_BIN/postgres -F --port=$PG_PORT
```

Now run:

```
$ vagga run-postgres
```

Visit `localhost:8000/admin` and try to log in with the user and password we defined in the migration.

## Building a Laravel project

This tutorial will show how to create a simple [Laravel](#) project on Alpine using PHP7, MySQL and Redis.

- *Create the project*
- *Setup the database*
- *Inspecting the database*
- *Adding some code*
- *Setup Redis*

### Create the project

In order to create the initial project structure, we will need a container with the Laravel installer. First, let's create a directory for our project:

```
$ mkdir -p ~/projects/vagga-laravel-tutorial && cd ~/projects/vagga-laravel-tutorial
```

Create the `vagga.yaml` file and add the following to it:

```
containers:
  app:
    setup:
      - !Alpine v3.5
      - !Repo community
      - !Install
        - ca-certificates
        - php7
        - php7-openssl
        - php7-mbstring
        - php7-phar
        - php7-json
      - !ComposerConfig
        install-runtime: false
        runtime-exe: /usr/bin/php7
        keep-composer: true
      - !ComposerInstall
    environ:
      HOME: /tmp
```

Here we are building a container from Alpine v3.5 and telling it to install PHP7 and everything needed to run Composer. Now let's create our new project:

```
$ vagga _run app composer create-project \
  --prefer-dist --no-install --no-scripts \
  laravel/laravel src 5.4.*
$ mv src/* src/.* .
$ rmdir src
```

The first command is quite big! It tells composer to create a new project from `laravel/laravel` version 5.4 and place it into the `src` directory. The three flags tell composer to:

- `--prefer-dist` install packages from distribution source when available;
- `--no-install` do not run composer `install` after creating the project;
- `--no-scripts` do not run scripts defined in the root package.

We want our project's files to be in the current directory (the one containing `vagga.yaml`) but Composer only accepts an empty directory, so we tell it to create the project into `src`, move its contents into the current directory and remove `src`.

Now that we have our project created, change our container as follows:

```
containers:
  app-base:
    setup:
      - !Alpine v3.5
      - !Repo community
      - !Install
        - ca-certificates
        - php7
        - php7-openssl
        - php7-pdo_mysql
        - php7-mbstring
```

```

- php7-xml
- php7-session
- php7-dom
- php7-phar
- php7-json
- php7-posix
- php7-ctype
- !Sh ln -s /usr/bin/php7 /usr/bin/php
app:
  environ: &env
    APP_ENV: development
    APP_DEBUG: true
    APP_KEY: YourRandomGeneratedEncryptionKey
  setup:
- !Container app-base
- !Env { <<: *env }
- !ComposerConfig
  install-runtime: false
  runtime-exe: /usr/bin/php7
  keep-composer: true
- !EnsureDir /work/vendor
- !EnsureDir /usr/local/lib/composer/vendor
- !Sh mount --bind,ro /usr/local/lib/composer/vendor /work/vendor
- !ComposerDependencies
- !Sh umount /work/vendor
  volumes:
    /work/vendor: !BindRO /vagga/root/usr/local/lib/composer/vendor

```

This might look complex, but let's break it down:

```

app-base:
  setup:
- !Alpine v3.5
- !Repo community
- !Install
- ca-certificates
- php7
- php7-openssl
- php7-pdo_mysql
- php7-mbstring
- php7-xml
- php7-session
- php7-dom
- php7-phar
- php7-json
- php7-posix
- php7-ctype
- !Sh ln -s /usr/bin/php7 /usr/bin/php

```

The container for our application is based on Alpine linux v3.5 and we will use PHP7, so we need to enable the “community” repository from Alpine and install php7 and the modules needed for both Laravel and Composer.

We also link the php7 executable into /usr/bin/php to make it available as just php.

This container will be used as the base for the app container in order to speed up builds.

```

environ: &env
  APP_ENV: development

```

```
APP_DEBUG: true
APP_KEY: YourRandomGeneratedEncryptionKey
```

Here we are configuring our application. Laravel comes out of the box with its configuration done through environment variables, so we are setting these to what we need to a development environment. The default project template uses `dotenv` to load configuration into environment automatically from a `.env` file, but we won't use that. Instead, we tell vagga to set the environment for us.

We are also setting and yml anchor (`&env`) so we can reference it later.

```
setup:
- !Container app-base
- !Env { <<: *env }
```

We are extending the `app-base` container and referencing the yml anchor we defined earlier to make the environment available during build.

```
- !ComposerConfig
  install-runtime: false
  runtime-exe: /usr/bin/php7
  keep-composer: true
```

Since we installed `php` by ourselves, we tell vagga to use version we installed instead of the default version from Alpine.

```
- !EnsureDir /work/vendor
- !EnsureDir /usr/local/lib/composer/vendor
- !Sh mount --bind,ro /usr/local/lib/composer/vendor /work/vendor
- !ComposerDependencies
- !Sh umount /work/vendor
```

The `composer.json` created by Laravel has some post install hooks that expect the `vendor` directory to be available at the project root, but vagga installs composer dependencies under `/usr/local/lib/composer`. To make it available to our application during the build, we mount that directory into `/work/vendor` and `umount` afterwards.

To test if everything is ok, let's add a command to run our project:

```
containers:
# ...
commands:
  run: !Command
    container: app
    description: run the laravel development server
    run: |
      php artisan cache:clear
      php artisan config:clear
      php artisan serve
```

- – clear application cache to prevent previous runs from interfering on subsequent runs.

Now run our project:

```
$ vagga run
```

And visit `localhost:8000`. If everything is OK, you will see Laravel default page saying “Laravel 5”.

### Setup the database

Every PHP project needs a database, and ours is not different, so let's create a container for our database:

```
containers:
# ...
mysql:
  setup:
    - !Ubuntu xenial
    - !UbuntuUniverse
    - !Sh |
      addgroup --system --gid 200 mysql
      adduser --uid 200 --system --home /data --no-create-home \
        --shell /bin/bash --group --gecos "MySQL user" \
        mysql
    - !Install
      - mysql-server-5.7
      - mysql-client-5.7
    - !Remove /var/lib/mysql
    - !EnsureDir /data
  environ: &db_config
    DB_DATABASE: vagga
    DB_USERNAME: vagga
    DB_PASSWORD: vagga
    DB_HOST: 127.0.0.1
    DB_PORT: 3307
    DB_DATA_DIR: /data
  volumes:
    /data: !Persistent
      name: mysql
      owner-uid: 200
      owner-gid: 200
      init-command: _mysql-init
    /run: !Tmpfs
      subdirs:
        mysqld: { mode: 0o777 }
```

- – Use fixed user id and group id for mysql
- – Put an anchor at the database environment so we can reference it later
- – Vagga command to initialize the volume

---

**Note:** The database will be persisted in `.vagga/.volumes/mysql`.

---

Add the command to initialize the database:

```
commands:
# ...
_mysql-init: !Command
  description: Init MySQL data volume
  container: mysql
  user-id: 200
  group-id: 200
  run: |
    set -ex
```

```

mysql -u root --initialize-insecure --datadir=$DB_DATA_DIR \
  --log-error=log

mysql -u root --datadir=$DB_DATA_DIR --skip-networking --log-error=log &

while [ ! -S /run/mysql/mysql.sock ]; do sleep 0.2; done

mysqladmin -u root create $DB_DATABASE
mysql -u root -e "CREATE USER '$DB_USERNAME'@'localhost' IDENTIFIED BY '$DB_
↪PASSWORD';"
mysql -u root -e "GRANT ALL PRIVILEGES ON $DB_DATABASE.* TO '$DB_USERNAME'@
↪'localhost';"
mysql -u root -e "FLUSH PRIVILEGES;"

mysqladmin -u root shutdown

```

Add a the php mysql module to our container:

```

containers:
  app-base:
    - !Alpine v3.5
    - !Repo community
    - !Install
    - ca-certificates
    - php7
    - # ...
    - php7-pdo_mysql # mysql module
    - # ...

```

Now change our run command to start the database alongside our project:

```

commands:
  run: !Supervise
  description: run the laravel development server
  children:
    app: !Command
    container: app
    environ: *db_config
    run: |
      php artisan cache:clear
      php artisan config:clear
      php artisan serve
    db: !Command
    container: mysql
    user-id: 200
    group-id: 200
    run: |
      exec mysql -u root --datadir=$DB_DATA_DIR \
        --bind-address=$DB_HOST --port=$DB_PORT \
        --log-error=log --gdb

```

- – Reference the database environment

And run our project:

```
$ vagga run
```

## Inspecting the database

Now that we have a working database, we can inspect it using a small php utility called `adminer`. Let's create a container for it:

```
containers:
# ...
adminer:
  setup:
  - !Alpine v3.5
  - !Repo community
  - !Install
  - php7
  - php7-pdo_mysql
  - php7-session
  - !EnsureDir /opt/adminer
  - !EnsureDir /opt/adminer/plugins
  - !Download
  url: https://www.adminer.org/static/download/4.2.5/adminer-4.2.5-mysql.php
  path: /opt/adminer/adminer.php
  - !Download
  url: https://raw.githubusercontent.com/vrana/adminer/master/designs/nette/adminer.css
  path: /opt/adminer/adminer.css
  - !Download
  url: https://raw.githubusercontent.com/vrana/adminer/master/plugins/plugin.php
  path: /opt/adminer/plugins/plugin.php
  - !Download
  url: https://raw.githubusercontent.com/vrana/adminer/master/plugins/login-servers.php
  path: /opt/adminer/plugins/login-servers.php
  - !Text
  /opt/adminer/index.php: |
    <?php
    function adminer_object() {
      include_once "./plugins/plugin.php";
      foreach (glob("plugins/*.php") as $filename) { include_once "./$filename
↵"; }

      $plugins = [new AdminerLoginServers(['127.0.0.1:3307' => 'Dev DB'])];
      return new AdminerPlugin($plugins);
    }
    include "./adminer.php";
```

- – download the adminer script.
- – use a better style (optional).
- – adminer plugin support
- – login-servers plugin to avoid typing server address and port
- – setup adminer

The container above will install PHP7 along with the mysql and session modules, then it will download adminer itself, the optional style, the plugin support and the “login-servers” plugin. This plugin will allow us to select the database we are connecting to from a list instead of filling in the host and port. The last part of the container setup configures adminer with our database.

Now change our `run` command to start the adminer container:

```
commands:
  run: !Supervise
```

```

description: run the laravel development server
children:
  app: !Command
      # ...
  db: !Command
      # ...
  adminer: !Command
      container: adminer
      run: php7 -S 127.0.0.1:8001 -t /opt/adminer

```

This command will start the php embedded server with its root pointing to the directory we setup for Adminer.

To access adminer, visit `localhost:8001` and fill the username and password fields with “vagga”.

## Adding some code

Now that we have our project working and our database is ready, let’s add some.

Let’s add a shortcut command for running artisan

```

commands:
  # ...
  artisan: !Command
      description: Shortcut for running artisan cli
      container: app
      run: [php, artisan]

```

Now, we need a layout. Fortunately, Laravel can give us one, we just have to scaffold authentication:

```
$ vagga artisan make:auth
```

This will give us a nice layout at `resources/views/layouts/app.blade.php`.

Now create a model:

```
$ vagga artisan make:model --migration Article
```

This will create a new model at `app/Article.php` and its respective migration at `database/migrations/2016_03_24_172211_create_articles_table.php` (yours will have a slightly different name).

Open the migration file and tell it to add two fields, `title` and `body`, to the database table for our Article model:

```

<?php

use Illuminate\Database\Schema\Blueprint;
use Illuminate\Database\Migrations\Migration;

class CreateArticlesTable extends Migration
{
    public function up()
    {
        Schema::create('articles', function (Blueprint $table) {
            $table->increments('id');
            $table->string('title', 100);
            $table->text('body');
            $table->timestamps();
        });
    }
}

```

```
public function down()
{
    Schema::drop('articles');
}
}
```

Open routes/web.php and setup routing:

```
<?php
Route::get('/', 'ArticleController@index');
Route::resource('/article', 'ArticleController');

Auth::routes();

Route::get('/home', 'HomeController@index');
```

Create our controller:

```
$ vagga artisan make:controller --resource ArticleController
```

This will create a controller at app/Http/Controllers/ArticleController.php populated with some CRUD method stubs.

Now change the controller to actually do something:

```
<?php

namespace App\Http\Controllers;

use Illuminate\Http\Request;

use App\Article;

class ArticleController extends Controller
{
    public function index()
    {
        $articles = Article::orderBy('created_at', 'asc')->get();
        return view('article.index', [
            'articles' => $articles
        ]);
    }

    public function create()
    {
        return view('article.create');
    }

    public function store(Request $request)
    {
        $this->validate($request, [
            'title' => 'required|max:100',
            'body' => 'required'
        ]);

        $article = new Article;
        $article->title = $request->title;
    }
}
```

```

        $article->body = $request->body;
        $article->save();

        return redirect('/');
    }

    public function show($id)
    {
        $article = Article::find($id);
        return view('article.show', [
            'article' => $article
        ]);
    }

    public function edit(Article $article)
    {
        return view('article.edit', [
            'article' => $article
        ]);
    }

    public function update(Request $request, Article $article)
    {
        $article->title = $request->title;
        $article->body = $request->body;
        $article->save();

        return redirect('/');
    }

    public function destroy(Article $article)
    {
        $article->delete();
        return redirect('/');
    }
}

```

Create the views for our controller:

```

<!-- resources/views/article/show.blade.php -->
@extends('layouts.app')

@section('content')
<div class="container">
    <div class="row">
        <div class="col-md-8 col-md-offset-2">
            <h2>{{ $article->title }}</h2>
            <p>{{ $article->body }}</p>
        </div>
    </div>
</div>
@endsection

```

```

<!-- resources/views/article/index.blade.php -->
@extends('layouts.app')

@section('content')
<div class="container">

```

```

<div class="row">
  <div class="col-md-8 col-md-offset-2">
    <h2>Article List</h2>
    <a href="{{ url('article/create') }}" class="btn">
      <i class="fa fa-btn fa-plus"></i>New Article
    </a>
    @if (count($articles) > 0)
    <table class="table table-bordered table-striped">
      <thead>
        <th>id</th>
        <th>title</a></th>
        <th>actions</th>
      </thead>
      <tbody>
        <tbody>
          @foreach($articles as $article)
            <tr>
              <td>{{ $article->id }}</td>
              <td>{{ $article->title }}</td>
              <td>
                <a href="{{ url('article/'.$article->id) }}" class="btn_
↳btn-success">
                  <i class="fa fa-btn fa-eye"></i>View
                </a>
                <a href="{{ url('article/'.$article->id.'/edit') }}"_
↳class="btn btn-primary">
                  <i class="fa fa-btn fa-pencil"></i>Edit
                </a>
                <form action="{{ url('article/'.$article->id) }}"
                  method="post" style="display: inline-block">
                  {!! csrf_field() !!}
                  {!! method_field('DELETE') !!}
                  <button type="submit" class="btn btn-danger"
                    onclick="if (!window.confirm('Are you sure?
↳')) { return false; }">
                    <i class="fa fa-btn fa-trash"></i>Delete
                  </button>
                </form>
              </td>
            </tr>
          @endforeach
        </tbody>
      </table>
    @endif
  </div>
</div>
</div>
@endsection

```

```

<!-- resources/views/article/create.blade.php -->
@extends('layouts.app')

@section('content')
<div class="container">
  <div class="row">
    <div class="col-md-8 col-md-offset-2">
      <h2>Create Article</h2>
      @include('common.errors')
      <form action="{{ url('article') }}" method="post">

```

```

        {!! csrf_field() !!}
        <div class="form-group">
            <label for="id-title">Title:</label>
            <input id="id-title" class="form-control" type="text" name="title
↪" />
        </div>
        <div class="form-group">
            <label for="id-body">Title:</label>
            <textarea id="id-body" class="form-control" name="body"></
↪textarea>
        </div>
        <button type="submit" class="btn btn-primary">Save</button>
    </form>
</div>
</div>
</div>
@endsection

```

```

<!-- resources/views/article/edit.blade.php -->
@extends('layouts.app')

@section('content')
<div class="container">
    <div class="row">
        <div class="col-md-8 col-md-offset-2">
            <h2>Edit Article</h2>
            @include('common.errors')
            <form action="{{ url('article/'.$article->id) }}" method="post">
                {!! csrf_field() !!}
                {!! method_field('PUT') !!}
                <div class="form-group">
                    <label for="id-title">Title:</label>
                    <input id="id-title" class="form-control"
                        type="text" name="title" value="{{ $article->title }}" />
                </div>
                <div class="form-group">
                    <label for="id-body">Title:</label>
                    <textarea id="id-body" class="form-control" name="body">{{
↪$article->body }}</textarea>
                </div>
                <button type="submit" class="btn btn-primary">Save</button>
            </form>
        </div>
    </div>
</div>
@endsection

```

And the view for the common errors:

```

<!-- resources/views/common/errors.blade.php -->
@if (count($errors) > 0)
<div class="alert alert-danger">
    <ul>
        @foreach ($errors->all() as $error)
            <li>{{ $error }}</li>
        @endforeach
    </ul>
</div>

```

```
@endif
```

Create a seeder to prepopulate our database:

```
$ vagga artisan make:seeder ArticleSeeder
```

This will create a seeder class at `database/seeds/ArticleSeeder.php`. Open it and change it as follows:

```
<?php
use Illuminate\Database\Seeder;

use App\Article;

class ArticleSeeder extends Seeder
{
    private $articles = [
        ['title' => 'Article 1', 'body' => 'Lorem ipsum dolor sit amet'],
        ['title' => 'Article 2', 'body' => 'Lorem ipsum dolor sit amet'],
        ['title' => 'Article 3', 'body' => 'Lorem ipsum dolor sit amet'],
        ['title' => 'Article 4', 'body' => 'Lorem ipsum dolor sit amet'],
        ['title' => 'Article 5', 'body' => 'Lorem ipsum dolor sit amet']
    ];

    public function run()
    {
        if (Article::all()->count() > 0) {
            return;
        }

        foreach ($this->articles as $article) {
            $new = new Article;
            $new->title = $article['title'];
            $new->body = $article['body'];
            $new->save();
        }
    }
}
```

Change `database/seeds/DatabaseSeeder.php` to include `ArticleSeeder`:

```
<?php
use Illuminate\Database\Seeder;

class DatabaseSeeder extends Seeder
{
    public function run()
    {
        $this->call(ArticleSeeder::class);
    }
}
```

Change the `run` command to execute the migrations and seed our database:

```
commands:
  run: !Supervise
      description: run the laravel development server
      children:
```

```

app: !Command
  container: laravel
  environ: *db_config
  run: |
    # wait for database to be ready before starting
    dsn="mysql:host=$DB_HOST;port=$DB_PORT"
    while ! php -r "new PDO('$dsn', '$DB_USERNAME', '$DB_PASSWORD');" 2> /dev/
↪null; do
      echo 'Waiting for database'
      sleep 2
    done

    php artisan cache:clear
    php artisan config:clear
    php artisan migrate
    php artisan db:seed
    php artisan serve
db: !Command
  # ...
adminer: !Command
  # ...

```

If you run our project, you will see the articles we defined in the seeder class. Try adding some articles, then access adminer at localhost:8001 to inspect the database.

## Setup Redis

Laravel can make use of [redis](#) to perform tasks like queues and events. In our project, we will use it to cache data from the database. First, let's create a command to call composer:

```

commands:
  # ...
  composer: !Command
    container: app
    description: run compose cli
    environ:
      COMPOSER_HOME: /usr/local/lib/composer
      COMPOSER_VENDOR_DIR: /usr/local/lib/composer/vendor
      COMPOSER_CACHE_DIR: /tmp
      COMPOSER_ALLOW_SUPERUSER: 1
    volumes:
      /usr/local/lib/composer/vendor: !Tmpfs
      /tmp: !CacheDir composer-cache
    run: [/usr/local/bin/composer]

```

- – setup composer home, vendor dir, cache dir and allow running as root
- – mount directory as Tmpfs to make it writeable
- – mount composer cache directory

This command setup the environment needed by composer to run properly and mount the composer cache volume to avoid downloading cached packages. The directory `/usr/local/lib/composer/vendor` needs to be writeable (composer will put packages there) so we mount it as Tmpfs.

Now let's install `redis/redis`:

```
$ vagga composer require predis/predis
```

With predis installed, we can proceed to create a container for Redis:

```
containers:
  redis:
    setup:
      - !Alpine v3.5
      - !Install [redis]
```

Add some yaml anchors on the run command so we can avoid repetition:

```
commands:
  run: !Supervise
    description: run the laravel development server
    children:
      app: !Command
        container: app
        environ: *db_config
        run: &app_cmd | #
            # ...
      db: &db_cmd !Command
        # ...
      adminer: &adminer_cmd !Command
        # ...
```

- – set an anchor at the app child command
- – set an anchor at the db child command
- – set an anchor at the adminer child command

Create the command to run with caching:

```
commands:
  # ...
  run-cached: !Supervise
    description: Start the laravel development server alongside redis
    children:
      cache: !Command
        container: redis
        run: redis-server --daemonize no --port 6380 --loglevel verbose
      app: !Command
        container: app
        environ:
          <<: *db_config
          CACHE_DRIVER: redis
          REDIS_HOST: 127.0.0.1
          REDIS_PORT: 6380
        run: *app_cmd
      db: *db_cmd
      adminer: *adminer_cmd
```

- – run redis as verbose so we see can see the cache working

Now let's change our controller to use caching:

```
<?php
```

```
namespace App\Http\Controllers;

use Illuminate\Http\Request;

use App\Article;

use Cache;

class ArticleController extends Controller
{
    public function index()
    {
        $articles = Cache::rememberForever('article:all', function() {
            return Article::orderBy('created_at', 'asc')->get();
        });
        return view('article.index', [
            'articles' => $articles
        ]);
    }

    public function create()
    {
        return view('article.create');
    }

    public function store(Request $request)
    {
        $this->validate($request, [
            'title' => 'required|max:100',
            'body' => 'required'
        ]);

        $article = new Article;
        $article->title = $request->title;
        $article->body = $request->body;
        $article->save();

        Cache::forget('article:all');

        return redirect('/');
    }

    public function show($id)
    {
        $article = Cache::rememberForever('article:'.$id, function() use ($id) {
            return Article::find($id);
        });
        return view('article.show', [
            'article' => $article
        ]);
    }

    public function edit(Article article)
    {
        return view('article.edit', [
            'article' => $article
        ]);
    }
}
```

```
public function update(Request $request, Article $article)
{
    $article->title = $request->title;
    $article->body = $request->body;
    $article->save();

    Cache::forget('article:'.$article->id);
    Cache::forget('article:all');

    return redirect('/');
}

public function destroy(Article $article)
{
    $article->delete();
    Cache::forget('article:'.$article->id);
    Cache::forget('article:all');
    return redirect('/');
}
}
```

Now run our project with caching:

```
$ vagga run-cached
```

Keep an eye on the console to see Laravel talking to redis, you will see something like:

```
3:M 15 Mar 15:20:06.418 - DB 0: 5 keys (0 volatile) in 8 slots HT.
```

## Building a Rails project

This example will show how to create a simple Rails project using vagga.

- *Creating the project structure*
- *Configuring the database from environment*
- *Adding some code*
- *Caching with memcached*
- *We should try Postgres too*

### Creating the project structure

First, let's create a directory for our new project:

```
$ mkdir -p ~/projects/vagga-rails-tutorial && cd ~/projects/vagga-rails-tutorial
```

Now we need to create our project's structure, so let's create a new container and tell it to do so.

Create the `vagga.yaml` file and add the following to it:

```
containers:
  rails:
    setup:
```

```

- !Ubuntu xenial
- !Install
  - zlib1g
- !BuildDeps
  - zlib1g-dev
- !GemInstall [rails:5.0]
environ:
  HOME: /tmp

```

- – rails depends on `nokogiri`, which depends on `zlib`.
- – tell gem to install rails.
- – The rails `new` command, which we are going to use shortly, will complain if we do not have a `$HOME`. After our project is created, we won't need it anymore.

We explicitly installed rails version 5.0. You can change to a newer version if it is available (5.1, for example) but your project may be slightly different.

And now run:

```
$ vagga _run rails rails new . --skip-bundle
```

This will create a new rails project in the current directory. The `--skip-bundle` flag tells rails `new` to not run `bundle install`, but don't worry, vagga will take care of it for us.

Now that we have our rails project, let's change our container fetch dependencies from Gemfile:

```

containers:
  base:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install
        - zlib1g
        - libsqlite3-0
        - nodejs
      - !BuildDeps
        - zlib1g-dev
        - libsqlite3-dev
      - !GemInstall
        - ffi
        - nokogiri
        - sqlite3
  rails:
    setup:
      - !Container base
      - !GemBundle

```

- – we need `sqlite` for the development database and `nodejs` for the asset pipeline (specifically, the uglifier gem).
- – install dependencies from Gemfile using `bundle install`.

We are using two containers here, `base` and `rails`, for a good reason: some gems require building modules that can take some time to compile, so building them on the `base` container will avoid having to build them every time we need to rebuild our main container.

To test if everything is Ok, let's create a command to run our project:

```
commands:
  run: !Command
      container: rails
      description: start rails development server
      run: rails server
```

Run the project:

```
$ vagga run
```

Now visit `localhost:3000` to see rails default page.

---

**Note:** You may need to remove “`tmp/pids/server.pid`” in subsequent runs, otherwise, rails will complain that the server is already running.

---

### Configuring the database from environment

By default, the rails `new` command will setup sqlite as the project database and store the configuration in `config/database.yml`. However, we will use an environment variable to tell rails where to find our database. To do so, delete the rails database file:

```
$ rm config/database.yml
```

And then set the environment variable in our `vagga.yml`:

```
containers:
  rails:
    setup:
      # ...
    environ:
      DATABASE_URL: sqlite3:db/development.sqlite3
```

This will tell rails to use the same file that was configured in `database.yml`.

Now if we run our project, everything should be the same.

### Adding some code

Before going any further, let's add some code to our project:

```
$ vagga _run rails rails g scaffold article title:string:index body:text
```

Rails scaffolding will generate everything we need, we just have to run the migrations:

```
$ vagga _run rails rake db:migrate
```

Now we need to tell rails to use our articles index page as the root of our project. Change `config/routes.rb` as follows:

```
# config/routes.rb

Rails.application.routes.draw do
  root 'articles#index'
```

```
resources :articles
# ...
end
```

Run the project now:

```
$ vagga run
```

You should see the articles list page rails generated for us.

## Caching with memcached

Many projects use `memcached` to speed up things, so let's try it out.

First, add `dalli`, a pure ruby memcached client, to our Gemfile:

```
gem 'dalli'
```

Then, open `config/environments/development.rb`, find the line that says `config.cache_store = :memory_store` and change it as follows:

```
# config/environments/production.rb
# ...
# config.cache_store = :memory_store
if ENV['MEMCACHED_URL']
  config.cache_store = :mem_cache_store, ENV['MEMCACHED_URL']
else
  config.cache_store = :memory_store
end
# ...
```

Create a container for memcached:

```
containers:
# ...
memcached:
  setup:
    - !Alpine v3.5
    - !Install [memcached]
```

Create the command to run with caching:

```
commands:
# ...
run-cached: !Supervise
  description: Start the rails development server alongside memcached
  children:
    cache: !Command
      container: memcached
      run: memcached -u memcached -vv
    app: !Command
      container: rails
      environ:
        MEMCACHED_URL: memcached://127.0.0.1:11211
      run: |
        if [ ! -f 'tmp/caching-dev.txt' ]; then
          touch tmp/caching-dev.txt
```

```
fi
rails server
```

- – run memcached as verbose so we see can see the cache working
- – set the cache url
- – creating this file will tell rails to activate cache in development

Now let's change some of our views to use caching:

```
<!-- app/views/articles/show.html.erb -->
<%# ... %>
<% cache @article do %>
  <p>
    <strong>Title:</strong>
    <%= @article.title %>
  </p>

  <p>
    <strong>Body:</strong>
    <%= @article.body %>
  </p>
<% end %>
<%# ... %>
```

```
<!-- app/views/articles/index.html.erb -->
<%# ... %>
<table>
  <%# ... %>
  <tbody>
    <% @articles.each do |article| %>
      <% cache article do %>
        <tr>
          <td><%= article.title %></td>
          <td><%= article.body %></td>
          <td><%= link_to 'Show', article %></td>
          <td><%= link_to 'Edit', edit_article_path(article) %></td>
          <td><%= link_to 'Destroy', article, method: :delete, data: { confirm: 'Are_
↪you sure?' } %></td>
        </tr>
      <% end %>
    <% end %>
  </tbody>
</table>
<%# ... %>
```

Run the project with caching:

```
$ vagga run-cached
```

Try adding some records. Keep an eye on the console to see rails talking to memcached.

### We should try Postgres too

We can test our project against a Postgres database, which is probably what we will use in production.

First, add gem pg to our Gemfile

```
gem 'pg'
```

Then add the system dependencies for gem pg

```
containers:
  base:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install
      - zlib1g
      - libsqlite3-0
      - nodejs
      - libpq5
      - !BuildDeps
      - zlib1g-dev
      - libsqlite3-dev
      - libpq-dev
      - !GemInstall
      - ffi
      - nokogiri
      - sqlite3
      - pg
  rails:
    setup:
      - !Container base
      - !GemBundle
    environ:
      DATABASE_URL: sqlite3:db/development.sqlite3
```

- – runtime dependency
- – build dependency

Create the database container

```
containers:
  # ...
  postgres:
    setup:
      - !Ubuntu xenial
      - !EnsureDir /data
      - !Sh |
          addgroup --system --gid 200 postgres
          adduser --uid 200 --system --home /data --no-create-home \
            --shell /bin/bash --group --gecos "PostgreSQL administrator" \
            postgres
      - !Install [postgresql-9.5]
    environ:
      PGDATA: /data
      PG_PORT: 5433
      PG_DB: test
      PG_USER: vagga
      PG_PASSWORD: vagga
      PG_BIN: /usr/lib/postgresql/9.5/bin
    volumes:
      /data: !Persistent
        name: postgres
        owner-uid: 200
```

```
owner-gid: 200
init-command: _pg-init
/run: !Tmpfs
subdirs:
  postgresql: { mode: 0o777 }
```

- – Use fixed user id and group id for postgres
- – Vagga command to initialize the volume

---

**Note:** The database will be persisted in `.vagga/.volumes/postgres`.

---

Now add the command to initialize the database:

```
commands:
# ...
_pg-init: !Command
  description: Init postgres database
  container: postgres
  user-id: 200
  group-id: 200
  run: |
    set -ex
    ls -la /data
    $PG_BIN/pg_ctl initdb
    $PG_BIN/pg_ctl -w -o '-F --port=$PG_PORT -k /tmp' start
    $PG_BIN/createuser -h 127.0.0.1 -p $PG_PORT $PG_USER
    $PG_BIN/createdb -h 127.0.0.1 -p $PG_PORT $PG_DB -O $PG_USER
    $PG_BIN/psql -h 127.0.0.1 -p $PG_PORT -c "ALTER ROLE $PG_USER WITH ENCRYPTED_
↪PASSWORD '$PG_PASSWORD';"
    $PG_BIN/pg_ctl stop
```

And then add the command to run with Postgres:

```
commands:
# ...
run-postgres: !Supervise
  description: Start the rails development server using Postgres database
  children:
    app: !Command
      container: rails
      environ:
        DATABASE_URL: postgresql://vagga:vagga@127.0.0.1:5433/test
      run: |
        rake db:migrate
        rails server
    db: !Command
      container: postgres
      user-id: 200
      group-id: 200
      run: exec $PG_BIN/postgres -F --port=$PG_PORT
```

Now run:

```
$ vagga run-postgres
```

We can also add some default records to the database, so we don't start with an empty database. To do so, add the following to `db/seeds.rb`:

```
# db/seeds.rb
if Article.count == 0
  Article.create([
    { title: 'Article 1', body: 'Lorem ipsum dolor sit amet' },
    { title: 'Article 2', body: 'Lorem ipsum dolor sit amet' },
    { title: 'Article 3', body: 'Lorem ipsum dolor sit amet' }
  ])
end
```

Now change the `run-postgres` command to seed the database:

```
commands:
  # ...
  run-postgres: !Supervise
    description: Start the rails development server using Postgres database
    children:
      app: !Command
        container: rails
        environ:
          DATABASE_URL: postgresql://vagga:vagga@127.0.0.1:5433/test
        run: |
          rake db:migrate
          rake db:seed
          rails server
      db: !Command
        # ...
```

- – populate the database.

Now, we run `run-postgres`, we will already have our database populated.

## Running on Alpine linux

Alpine is a distribution focused on containers, being able to produce smaller smaller images than other distributions.

To run our project on alpine, we just need two more containers:

```
containers:
  # ...
  base-alpine:
    setup:
      - !Alpine v3.5
      - !Install
        - zlib
        - sqlite-libs
        - nodejs
        - libpq
        - tzdata
        - ruby-bigdecimal
        - ruby-json
      - !BuildDeps
        - zlib-dev
        - sqlite-dev
        - postgresql-dev
        - libffi-dev
```

```
- !GemInstall
- ffi
- nokogiri
- sqlite3
- pg

rails-alpine:
  setup:
  - !Container base-alpine
  - !GemBundle
  environ:
    DATABASE_URL: sqlite3:db/development.sqlite3
```

- – Rails needs these packages to work properly on Alpine. The packages `ruby-bigdecimal` and `ruby-json` could be added in Gemfile as well.

With our containers set up, we just need a command:

```
commands:
# ...
run-alpine: !Command
  container: rails-alpine
  description: Start the rails development server on Alpine container
  run: rails server
```

The command is almost identical to the first run, with the only difference being the container used.

## 2.8.2 Examples By Category

Bellow is a list of sample configs from `vagga/examples`. To run any of them just jump to the folder and run `vagga`.

### Databases

#### PostgreSQL

Here is one example of running postgres.

```
#
# Sample Vagga configuration for running PostgreSQL server
#

containers:
  ubuntu:
    setup:
    - !Ubuntu xenial
    # Use fixed user id and group id for postgres, because in some cases
    # we may need to upgrade (rebuild) a postgres container, but keep the data
    # on a `!Persistent` volume still usable. User ids in ubuntu packages are
    # not guaranteed to be same on every installation.
    #
    # The command-lines are from the postgres-common package except
    # added --uid 200 --gid 200
    - !Sh |
      addgroup --system --gid 200 postgres
      adduser --uid 200 --system --home /data --no-create-home \
```

```

        --shell /bin/bash --group --gecos "PostgreSQL administrator" \
        postgres
- !Install [postgresql-9.5]
- !EnsureDir /data
environ:
  PG_PORT: 5433  # Port of host to use
  PG_DB: vagga
  PGDATA: /data
  PG_BIN: /usr/lib/postgresql/9.5/bin
volumes:
  /data: !Persistent
    name: postgres
    owner-uid: 200
    owner-gid: 200
    init-command: _pg-init
  /run: !Tmpfs
    subdirs:
      postgresql: { mode: 0o777 } # until we have user, group options

commands:

_pg-init: !Command
  description: Init postgres database
  container: ubuntu
  user-id: 200
  group-id: 200
  run: |
    set -ex
    ls -la /data
    $PG_BIN/pg_ctl initdb
    $PG_BIN/pg_ctl -w -o '-F --port=$PG_PORT -k /tmp' start
    $PG_BIN/createuser -h 127.0.0.1 -p $PG_PORT vagga
    $PG_BIN/createdb -h 127.0.0.1 -p $PG_PORT $PG_DB -O vagga

    # init schema usually schema shouldn't be inline here, but contained
    # in a separate file
    psql postgres://vagga:vagga@127.0.0.1:$PG_PORT/$PG_DB <<ENDSQL
    CREATE TABLE random_stuff (x TEXT);
    ENDSQL

    $PG_BIN/pg_ctl stop

postgres: &postgres !Command
  description: Run postgres database
  container: ubuntu
  user-id: 200
  group-id: 200
  run: |
    trap "$PG_BIN/pg_ctl -w stop; trap - INT; kill -INT $$" INT
    $PG_BIN/pg_ctl -w -o '-F --port=$PG_PORT -k /tmp' start
    sleep infinity

psql: &psql !Command
  description: Run postgres shell
  container: ubuntu
  run: |
    psql -U vagga postgres://$PG_USER:$PG_PASSWORD@127.0.0.1:$PG_PORT/$PG_DB

```

```
run: !Supervise
  description: Run both postgres and shell
  children:
    postgres: *postgres
    psql: *psql
```

There is a more complicated example of postgres with alembic migrations

## Redis

Simplest container with redis looks like this:

```
containers:
  redis:
    setup:
      - !Alpine v3.5
      - !Install [redis]

commands:
  server: !Command
    container: redis
    run: "redis-server --daemonize no"

  cli: !Command
    container: redis
    run: [redis-cli]
```

Here is more comprehensive example of redis installed on ubuntu and has two instances started in parallel:

```
#
# Sample Vagga config for installing and running Redis Server v3.0
# in Ubuntu xenial box.
#

containers:
  ubuntu:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Sh apt-key adv --keyserver keyserver.ubuntu.com --recv-keys C7917B12
      - !UbuntuRepo
      url: http://ppa.launchpad.net/chris-lea/redis-server/ubuntu
      suite: xenial
      components: [main]
      - !Install
      - redis-server
    environ:
      REDIS_PORT1: 6380
      REDIS_PORT2: 6381

commands:
  redis-server: !Command
    description: Run instance of Redis server
    container: ubuntu
```

```

run: |
    redis-server --daemonize no --port $REDIS_PORT1 --logfile "" --loglevel debug

cluster: !Supervise
description: Run 2 instances of redis in cluster mode and provide redis-cli
mode: stop-on-failure
kill-unresponsive-after: 1
children:
  redis1: !Command
    container: ubuntu
    run: |
      redis-server --daemonize no \
        --port $REDIS_PORT1 \
        --cluster-enabled yes \
        --cluster-config-file /tmp/cluster.conf \
        --logfile /work/redis-node-1.log \
        --dir /tmp \
        --appendonly no

  redis2: !Command
    container: ubuntu
    run: |
      redis-server --daemonize no \
        --port $REDIS_PORT2 \
        --cluster-enabled yes \
        --cluster-config-file /tmp/cluster.conf \
        --logfile /work/redis-node-2.log \
        --dir /tmp \
        --appendonly no

  meet-nodes: !Command
    container: ubuntu
    run: |
      until [ "$(redis-cli -p $REDIS_PORT1 ping 2>/dev/null)" ]; do sleep 1; done;
      until [ "$(redis-cli -p $REDIS_PORT2 ping 2>/dev/null)" ]; do sleep 1; done;
      redis-cli -p $REDIS_PORT1 CLUSTER MEET 127.0.0.1 $REDIS_PORT2;
      redis-cli -p $REDIS_PORT1;

```

## Consul

```

containers:

  ubuntu-consul:
    setup:
      - !Ubuntu xenial
      - !Install [unzip, wget, ca-certificates]
      - !Sh |
        cd /tmp
        wget https://releases.hashicorp.com/consul/0.6.4/consul_0.6.4_linux_amd64.zip
        unzip consul_0.6.4_linux_amd64.zip
        cp consul /usr/bin/consul

commands:

  consul-server: !Command
    description: Start consul in server mode

```

```
container: ubuntu-consul
run: |
    /usr/bin/consul agent -server -bootstrap-expect=1 \
        -data-dir=/tmp/consul -log-level=debug \
        -advertise=127.0.0.1
```

### Elasticsearch

The elasticsearch example uses *Persistent* volume so works only on development version of vagga:

```
containers:
  elastic:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      # elastic PGP & Repo
      - !AptTrust
        server: pgp.mit.edu
        keys: [D88E42B4]
      - !UbuntuRepo
        url: http://packages.elastic.co/elasticsearch/2.x/debian
        suite: stable
        components: [main]
      - !Install
        - ca-certificates
        - ca-certificates-java
        - openjdk-8-jre-headless
        - elasticsearch=2.3.3
      - !EnsureDir /var/elastic
    volumes:
      /var/elastic: !Persistent { name: elastic }

commands:
  elastic: !Command
    description: Run elasticsearch
    container: elastic
    user-id: 1
    external-user-id: 0
    run:
      - /usr/share/elasticsearch/bin/elasticsearch
      - -Des.path.conf=/etc/elasticsearch
      - -Des.path.logs=/tmp
      - -Des.path.work=/tmp
      - -Des.path.data=/var/elastic/data
```

### Influx DB

Influx db is described as a scalable datastore for metrics, events, and real-time analytics

[Home](#) / [Github](#)

Example config:

```
containers:
  influxdb:
```

```

setup:
- !Ubuntu xenial
- !Download
  url: https://dl.influxdata.com/influxdb/releases/influxdb_0.13.0_amd64.deb
  path: /tmp/influxdb.deb
- !Sh dpkg -i /tmp/influxdb.deb && rm /tmp/influxdb.deb
- !EnsureDir /var/lib/influxdb
volumes:
  /var/lib/influxdb: !Persistent { name: influxdb }

commands:
  influx: !Command
    description: Run influxdb
    container: influxdb
    user-id: 1
    external-user-id: 0
    run:
    - influxd

```

## RethinkDB

RethinkDB is described as:

RethinkDB is the open-source, scalable database that makes building realtime apps dramatically easier.

Because RethinkDB has an Ubuntu package, it's easy to setup:

```

containers:
  ubuntu:
    setup:
    - !Ubuntu xenial
    - !UbuntuRepo
      url: http://download.rethinkdb.com/apt
      suite: xenial
      components: [main]
    - !Download
      url: https://download.rethinkdb.com/apt/pubkey.gpg
      path: /tmp/pubkey.gpg
    - !Sh apt-key add /tmp/pubkey.gpg
    - !Install [rethinkdb]
    - !EnsureDir /data
    volumes:
      /data: !Persistent data

    - !NpmInstall [git://github.com/rethinkdb/rethinkdb-example-nodejs-chat.git]

commands:
  rethink: &rethink !Command
    description: Run rethink database

```

We also have a configured `example chat` application in the repository, that you may run with alongside with the database itself as follows:

```
vagga example-chat
```

## CockroachDB

Here is one example of running single node CockroachDB:

```
#
# Sample Vagga configuration for running CockroachDB server
#

containers:
  ubuntu:
    setup:
      - !Ubuntu xenial
      - !Tar
        url: https://binaries.cockroachdb.com/cockroach-v1.0.4.linux-amd64.tgz
        subdir: cockroach-v1.0.4.linux-amd64
        path: /usr/bin
      - !EnsureDir /data
    volumes:
      /data: !Persistent
        name: cockroach

commands:

  server: &server !Command
    description: Run cockroach database
    container: ubuntu
    run: [cockroach, start, --insecure, --store=path=/data]

  client: &client !Command
    description: Run cockroach shell
    container: ubuntu
    accepts-arguments: true
    run: |
      sleep 1
      exec cockroach sql --insecure "$@"

  run: !Supervise
    description: Run both cockroach server and shell
    children:
      server: *server
      client: *client
```

## ClickHouse

ClickHouse is an open-source column-oriented database management system (DBMS) for online analytical processing (OLAP).

[Home / Github](#)

```
containers:
  ubuntu:
    setup:
      - !Ubuntu xenial
      - !AptTrust keys: [EOC56BD4]
      - !UbuntuRepo
        url: https://repo.yandex.ru/clickhouse/xenial
```

```

suite: stable
components: [main]
- !Install [tzdata, clickhouse-server-common, clickhouse-client]
- !EnsureDir /var/lib/clickhouse
volumes:
  /var/lib/clickhouse: !Persistent
  name: clickhouse-data

commands:
server: &server !Command
  description: Run clickhouse server
  container: ubuntu
  work-dir: /etc/clickhouse-server
  run: clickhouse server

client: &client !Command
  description: Run clickhouse client
  container: ubuntu
  run: sleep 3 && clickhouse-client

run: !Supervise
  description: Run clickhouse server and client
  children:
    server: *server
    client: *client

```

## Kafka

```

containers:
  kafka:
    volumes:
      /tmp: !Tmpfs
      size: 1G
      subdirs:
        kafka-logs: {}
        zookeeper: {}
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install
        - openjdk-8-jre-headless
      - !Tar
        url: http://apache.volia.net/kafka/0.11.0.1/kafka_2.12-0.11.0.1.tgz
        sha256: c776f2dbb7f4e1af6b61e32d482b513a1788bf5f39602746b005ab92601a46f2
        path: /opt/kafka
        subdir: kafka_2.12-0.11.0.1
      - !EnsureDir /var/log/kafka
      - !EnsureDir /var/log/zookeeper

  kafka-manager:
    # First build can take a long time
    setup:
      - !Ubuntu xenial
      - !Install
        - openjdk-8-jre-headless
      - !AptTrust

```

```

keys: [2EE0EA64E40A89B84B2DF73499E82A75642AC823]
- !UbuntuRepo
url: https://dl.bintray.com/sbt/debian
suite: ""
components: [/]
- !BuildDeps
- openjdk-8-jdk
- sbt
- unzip
- !Env
VERSION: 1.3.3.14
- !Tar
url: https://github.com/yahoo/kafka-manager/archive/1.3.3.14.tar.gz
path: /tmp
- !CachedDirs
/root/.ivy2/cache: ivy2
- !Sh |
    cd /tmp/kafka-manager-`${VERSION}`
    sbt dist
    unzip /tmp/kafka-manager-`${VERSION}`/target/universal/kafka-manager-`${VERSION}`.
↪zip -d /opt
    mv /opt/kafka-manager-`${VERSION}` /opt/kafka-manager
- !Remove /root/.sbt

zk-shell:
setup:
- !Alpine v3.6
- !PipConfig {dependencies: true}
- !Py2Install [zk-shell]
environ:
HOME: /work
LANG: en_US.UTF-8
PYTHONIOENCODING: UTF-8

commands:
kafka: !Supervise
description: Run kafka with zookeeper
kill-unresponsive-after: 6
children:
zookeeper: !Command
container: kafka
volumes:
/tmp/zookeeper: !Persistent zookeeper
/var/log/zookeeper: !Tmpfs
run: |
export LOG_DIR=/var/log/zookeeper
cd /opt/kafka
bin/zookeeper-server-start.sh config/zookeeper.properties &
PID=$!
handler() {
    # give kafka some time to gracefully shutdown
    sleep 5
    kill $PID
}
trap handler INT
wait $PID
echo "Zookeeper stopped"
kafka: !Command

```

```

    container: kafka
    volumes:
      /tmp/kafka-logs: !Persistent kafka
      /var/log/kafka: !Tmpfs
    run: |
      export LOG_DIR=/var/log/kafka
      cd /opt/kafka
      bin/kafka-server-start.sh config/server.properties

kafka-topics: !Command
  description: Run kafka-topics script
  container: kafka
  run: [/opt/kafka/bin/kafka-topics.sh, --zookeeper, localhost:2181]

kafka-manager: !Command
  description: Run kafka manager tool
  container: kafka-manager
  environ:
    ZK_HOSTS: localhost:2181
  run:
    - /opt/kafka-manager/bin/kafka-manager
    - -Dpidfile.path=/var/run/kafka-manager.pid

zk-shell: !Command
  description: Run zk-shell against localhost zookeeper
  container: zk-shell
  run: [zk-shell, localhost:2181]

```

## Miscellaneous

### Travis Gem

The following snippet installs travis gem (into container). For example to provide github token to [Travis CI](#) (so that it can push to github), you can run the following:

```
$ vagga travis encrypt --repo xxx/yyy --org GH_TOKEN=zzz
```

The vagga configuration for the command:

```

containers:
  travis:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !BuildDeps [autoconf, automake, autotools-dev, autogen, libtool, libltdl-dev]
      - !GemInstall [travis]

commands:
  travis: !Command
    container: travis
    run: [travis]
    environ: { HOME: /tmp }

```

### Selenium Tests

Running selenium with vagga is as easy as anything else.

Setting up the GUI may take some effort because you need a display, but starting PhantomJS as a driver looks like the following:

```
containers:
  selenium:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [libfontconfig]
      - !Py3Install [selenium, py, pytest]
      # The phantomjs from Ubuntu repository seems to have problems with headless
      # environments, so we fetch the binary provided by the developers
      - !TarInstall
        url: https://bitbucket.org/ariya/phantomjs/downloads/phantomjs-2.1.1-linux-x86_
        ↪64.tar.bz2
        script: cp bin/phantomjs /usr/local/bin/phantomjs

commands:
  test: !Command
    description: Run selenium test
    container: selenium
    run: [py.test, test.py]
```

And the test may look like the following:

```
from selenium import webdriver
from selenium.webdriver.common.keys import Keys

def test_example():
    driver = webdriver.PhantomJS()
    driver.get("http://vagga.readthedocs.org/")
    assert "Welcome to Vagga" in driver.title
    driver.close()

if __name__ == '__main__':
    test_example()
```

To run the test just type:

```
> vagga test
```

### Firefox Browser

To run firefox or any other GUI application there are some extra steps involved to setup a display.

The `/tmp/.X11-unix/` directory should be mounted in the container. This can be accomplished by making it available to vagga under the name `X11` by writing the following lines in your [global configuration](#) `~/ .vagga.yaml`:

```
external-volumes:
  X11: /tmp/.X11-unix/
```

Next, you can use the following `vagga.yaml` file to setup the actual configuration (we redefine the variable `HOME` because firefox needs to write profile information).

```
containers:
  browser:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [firefox]
    volumes:
      /tmp: !Tmpfs
        size: 100Mi
        mode: 0o1777
        subdirs:
          .X11-unix:
      /tmp/.X11-unix: !BindRW /volumes/X11

commands:
  firefox: !Command
    container: browser
    environ: { HOME: /tmp }
    run: [firefox, --no-remote]
```

**Note:** If Firefox is already running on your host system, it will connect to it to avoid creating another instance and it will use the resources of your host system instead of the container's.

We pass `--no-remote` to tell it to create a new instance inside the container, to avoid exposing the host file system.

When calling `vagga`, remember to export the `DISPLAY` environment variable:

```
vagga -eDISPLAY firefox
```

To prevent `DBUS`-related errors also export the `DBUS_SESSION_BUS_ADDRESS` environmental variable:

```
vagga -eDISPLAY -eDBUS_SESSION_BUS_ADDRESS firefox
```

## WebGL Support

To enable WebGL support further steps are necessary to install the drivers inside the container, that depends on your video card model.

To setup the proprietary nvidia drivers, download the driver from the [NVIDIA website](#) in the your working directory and use the following `vagga.yaml`:

```
containers:
  browser:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [binutils, pkg-config, mesa-utils]
      - !Sh sh /work/NVIDIA-Linux-x86_64-331.67.run -a -N --ui=none --no-kernel-module
      - !Sh nvidia-xconfig -a --use-display-device=None --enable-all-gpus --
      ↪virtual=1280x1024
      - !Install [firefox]
    volumes:
```

```
/tmp: !Tmpfs
  size: 100Mi
  mode: 0o1777
  subdirs:
    .X11-unix:
/tmp/.X11-unix: !BindRW /volumes/X11

commands:
  firefox: !Command
  container: browser
  environ: { HOME: /tmp }
  run: [firefox, --no-remote]
```

For intel video cards use the following vagga .yaml (this includes also chromium and java plugin):

```
containers:
  browser:
    setup:
      - !Ubuntu xenial
      - !UbuntuUniverse
      - !Install [chromium-browser,
                  firefox, icedtea-plugin,
                  xserver-xorg-video-intel, mesa-utils, libgl1-mesa-dri]
    volumes:
      /tmp: !Tmpfs
        size: 100Mi
        mode: 0o1777
        subdirs:
          .X11-unix:
/tmp/.X11-unix: !BindRW /volumes/X11

commands:
  firefox: !Command
  container: browser
  environ: { HOME: /tmp }
  run: [firefox, --no-remote]
```

### Adding a Custom Certificate

This is useful if you have self-signed certificates that you use on local or staging or corporate resources.

In ubuntu it looks like this:

```
containers:
  some-container:
    setup:
      - !Ubuntu xenial
      - !Install [ca-certificates]
      - !Download
        url: http://example.com/your_company_root.crt
        path: /usr/local/share/ca-certificates/your_company_root.crt
      - !Sh update-ca-certificates
```

Important thing here is that `http://example.com/your_company_root.crt` should be either on a HTTP (not encrypted) host or have a certificate signed by a well-known authority (included in ubuntu `ca-certificates` package).

## Network Tolerance Testing (and Nginx)

Somewhat tiny example of the network tolerance testing code is contained in the following example:

```
containers:
  flask:
    setup:
      - !Ubuntu xenial
      - !PipConfig { dependencies: true }
      - !Py3Install [flask]

  nginx:
    setup:
      - !Ubuntu xenial
      - !Install [nginx]

  test:
    setup:
      - !Alpine v3.5
      - !Install [iptables]
      - !EnsureDir /vagga
    volumes:
      /vagga: !VaggaBin
    environ:
      PATH: /bin:/vagga:/sbin

  bench:
    setup:
      - !Alpine v3.5
      - !Repo edge/testing
      - !Install [wrk]

commands:
  run-normal: !Supervise
  description: Just run flask behind an nginx (http://172.23.255.2:8000)
  children:
    nginx: !Command
      container: nginx
      network:
        ip: 172.23.0.1
        ports: {8000: 8000}
      run: [nginx, -c, "/work/nginx.conf"]
    flask: !Command
      container: flask
      network:
        ip: 172.23.0.2
        ports: {5000: 5000}
      run: "python3 app.py"

  run-flaky: !Supervise
  description: |
    Just run flask behind nginx with network that doesn't work
    50% of the time (http://172.23.255.2:8000)
  children:
    nginx: !Command
      container: nginx
      network:
```

```
    ip: 172.23.0.1
    ports: {8000: 8000}
    run: [nginx, -c, "/work/nginx.conf"]
flask: !Command
    container: flask
    network:
        ip: 172.23.0.2
        ports: {5000: 5000}
        run: "python3 app.py"
interrupt: !BridgeCommand
    container: test
    run: |
        set -x
        while true; do
            vagga _network isolate flask
            sleep 1
            vagga _network fullmesh
            sleep 1
        done

wrk: !Command
    description: Run wrk (should try against running server)
    container: bench
    run: [wrk]
```

This example also includes almost a smallest possible nginx configuration:

```
daemon off;
master_process off;
worker_processes 1;
user root;

error_log stderr;
#pid /tmp/nginx.pid;

events {
    worker_connections 1024;
}

http {
    include /etc/nginx/mime.types;
    default_type application/octet-stream;
    access_log off;

    client_body_temp_path /tmp 1 2;
    proxy_temp_path /tmp 1 2;
    fastcgi_temp_path /tmp 1 2;
    uwsgi_temp_path /tmp 1 2;
    scgi_temp_path /tmp 1 2;

    sendfile on;

    keepalive_timeout 65;

    server {
        listen 8000;
        large_client_header_buffers 4 64k;
```

```

        charset utf-8;

        location / {
            proxy_pass http://172.18.0.2:5000;
        }
    }
}

```

**Note:** The nginx spits the following message just after start:

```

nginx: [alert] could not open error log file: open() "/var/log/nginx/error.log"
↪failed (30: Read-only file system)

```

It's fine, we can't change this directory as it's hardcoded into the source. While we can mount *Tmpfs* volume into `/var/log/nginx` we don't have to, as all other messages are actually logged into the `stderr` as configured. So this is just annoying and useless warning that is safe to ignore.

## Graphite

```

_defaults:
  carbon-volumes: &carbon-volumes
    /var/lib/carbon: !Persistent
      name: carbon
      init-command: _init-carbon-storage
    /var/log/carbon: !Tmpfs
      subdirs:
        webapp: {}
  grafana-volumes: &grafana-volumes
    /var/lib/grafana: !Persistent grafana

containers:
  graphite:
    environ:
      PYTHONPATH: "/opt/graphite/lib/:/opt/graphite/webapp/"
      GRAPHITE_STORAGE_DIR: /var/lib/carbon
    setup:
      - !Ubuntu xenial
      # Install carbon & graphite
      - !Install
        - libcairo2-dev
        - libffi-dev
        - libpython-dev
      - !PipConfig { dependencies: true }
      - !Py2Install
        - setuptools
      - !Env
        PIP_NO_BINARY: ":all:"
      - !Py2Install
        - carbon
        - whisper
        - graphite-web

```

```

- uwsgi
- !Sh |
  cd /opt/graphite/conf
  cp carbon.conf.example carbon.conf
  cp storage-schemas.conf.example storage-schemas.conf
  cp storage-aggregation.conf.example storage-aggregation.conf
- !Text
/opt/graphite/webapp/graphite/local_settings.py: |
  LOG_DIR = '/var/log/carbon/webapp'
- !EnsureDir /var/lib/carbon
- !EnsureDir /var/log/carbon
# Install grafana
- !AptTrust
keys: [418A7F2FB0E1E6E7EABF6FE8C2E73424D59097AB]
- !UbuntuRepo
url: https://packagecloud.io/grafana/stable/debian
suite: jessie
components: [main]
- !Install [grafana]

commands:
_init-carbon-storage: !Command
  container: graphite
  volumes: *carbon-volumes
  run: |
    django-admin.py migrate --run-syncdb --settings=graphite.settings

grafana: !Supervise
  description: Run carbon, graphite and grafana
  options: |
    Usage: vagga grafana [options] [--graphite-port=<graphite_port>] [--grafana-
    ↪port=<grafana_port>]

    Options:
      --graphite-port=<graphite_port>  Graphite port to listen on
      --grafana-port=<grafana_port>    Grafana port to listen on
  children:
  carbon: &carbon !Command
    container: graphite
    volumes: *carbon-volumes
    run: |
      /opt/graphite/bin/carbon-cache.py \
        --nodaemon \
        --logdir=/var/log/carbon \
        --pidfile=/var/run/carbon.pid \
        start
  graphite: !Command
    container: graphite
    volumes: *carbon-volumes
    run: |
      uwsgi --http localhost:${VAGGAOPT_GRAPHITE_PORT:-8080} \
        --wsgi-file /opt/graphite/webapp/graphite/wsgi.py \
        --static-map /static=/opt/graphite/webapp/content
  grafana: !Command
    container: graphite
    volumes: *grafana-volumes
    run: |
      grafana-server \

```

```

--homepath /usr/share/grafana \
--config /etc/grafana/grafana.ini \
--pidfile /var/run/grafana.pid \
cfg:default.paths.data=/var/lib/grafana \
cfg:default.paths.logs=/var/log/grafana \
cfg:default.server.http_port=${VAGGAOPT_GRAFANA_PORT:-3000}

```

## Build tools

### Gradle

```

_default:
  gradle-home: &gradle-home /work/.gradle
  cmd-opts: &cmd-opts
  container: jdk
  # Some java applications don't allow to run from root e.g. Elasticsearch.
  # Uncomment next rows to circumvent such software
  # user-id: 1
  # external-user-id: 0
  prerequisites: [_mk-gradle-cache]
  volumes:
    /work/.gradle/caches: !CacheDir gradle-cache

containers:
  jdk:
    environ:
      JAVA_HOME: /usr/lib/jvm/java-8-openjdk-amd64
      GRADLE_USER_HOME: *gradle-home
    setup:
      - !Ubuntu xenial
      - !Install
        - openjdk-8-jdk-headless
      - !EnsureDir /opt/gradle
      - !Unzip
        url: https://services.gradle.org/distributions/gradle-4.2.1-bin.zip
        subdir: gradle-4.2.1
        path: /opt/gradle
      - !Sh ln -s /opt/gradle/bin/gradle /usr/local/bin/gradle
      # Uncomment if you need kotlin compiler
      # - !EnsureDir /opt/kotlinc
      # - !Unzip
        # url: https://github.com/JetBrains/kotlin/releases/download/v1.1.51/kotlin-
        ↪ compiler-1.1.51.zip
        # subdir: kotlinc
        # path: /opt/kotlinc
      # - !Sh ln -s /opt/kotlinc/bin/kotlinc /usr/local/bin/kotlinc

commands:
  _mk-gradle-cache: !Command
  container: jdk
  run: mkdir -p $GRADLE_USER_HOME/caches

  gradle: !Command
  <<: *cmd-opts
  description: Runs arbitrary gradle task
  run: [gradle]

```

```
daemon: !Command
<<: *cmd-opts
description: Runs gradle daemon
run: |
  # --foreground option runs a daemon with incompatible jvm options
  # so another gradle process rejects to connect to the daemon
  gradle --dry-run --daemon
  GRADLE_PID=$(pidof java)
  echo "Gradle daemon successfully started [PID: $GRADLE_PID]."
  while [ -e /proc/$GRADLE_PID ]; do sleep 1; done

run: !Command
<<: *cmd-opts
description: Runs this project as a JVM application
run: [gradle, run]

assemble: !Command
<<: *cmd-opts
description: Assembles the outputs of this project
run: [gradle, assemble]

build: !Command
<<: *cmd-opts
description: Assembles and tests this project
run: [gradle, assemble]

test: !Command
<<: *cmd-opts
description: Runs the unit tests
run: [gradle, test]

check: !Command
<<: *cmd-opts
description: Runs all checks
run: [gradle, test]

compile: !Command
<<: *cmd-opts
description: Compiles all source sets
run: [gradle, classes, -x, processResources]

compile-test: !Command
<<: *cmd-opts
description: Compiles all test source sets
run: [gradle, testClasses, -x, processTestResources]

doc: !Command
<<: *cmd-opts
description: Generates Javadoc API documentation for the main source code
run: [gradle, javadoc]

clean: !Command
<<: *cmd-opts
description: Deletes the build directory
run: [gradle, clean]
```

## Documentation

### Sphinx Documentation

The simplest way to generate sphinx documentation is to use `py-sphinx` package from Alpine linux:

```
containers:

  doc:
    setup:
      - !Alpine v3.6
      - !Install [alpine-base, py-sphinx, make]
      # If you require additional packages to build docs uncomment this
      # - !Py3Requirements doc/requirements.txt

commands:

  doc: !Command
    description: Build documentation
    container: doc
    run: [make, html]
    work-dir: doc
    epilog: |
      -----
      Documentation is built under doc/_build/html/index.html
```

To start documentation from scratch (if you had no sphinx docs before), run the following once (and answer the questions):

```
vagga _run doc sphinx-quickstart ./doc
```

And add it to the git repository:

```
echo "/_build" >> doc/.gitignore
git add doc
```

## External Links

- A collection of examples from Andrea Ferretti. Includes nim, ocaml, scala and more.

### 2.8.3 Real World Examples

This section contains real-world examples of possibly complex vagga files. They are represented as external symlinks (github) with a description. Send a pull request to add your example here.

---

#### First Time User Hint

All the examples run in containers and install dependencies in `.vagga` subfolder of project dir. So all that possibly scary dependencies are installed automatically and **never touch your host system**. That makes it easy to experiment with vagga.

---

- `Vagga` itself – fairly complex config, includes:

- *Building* Rust with `musl` libc support
- Docs using `sphinx` and additional dependencies
- Running vagga in vagga for tests
- `Presentation` config for simple `impress.js` presentation generated from `restructured text` (`.rst`) files. Includes:
  - Installing `hovercraft` by Pip (Python 3), which generates the HTML files
  - The simple `serve` command to serve the presentation on HTTP
  - The `pdf` command which generates PDF files using `wkhtmltopdf` and some complex bash magic
- `xRandom` a web project described as “Site that allows you see adult movie free without advertisements”. Vagga config features:
  - Installation of `elasticsearch` (which is also an example to setup DB)
  - The full web server stack run with single command (`nginx + nodejs`)
  - The *hard way* of setting up the same thing for comparison

## CHAPTER 3

---

### Indices and tables

---

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