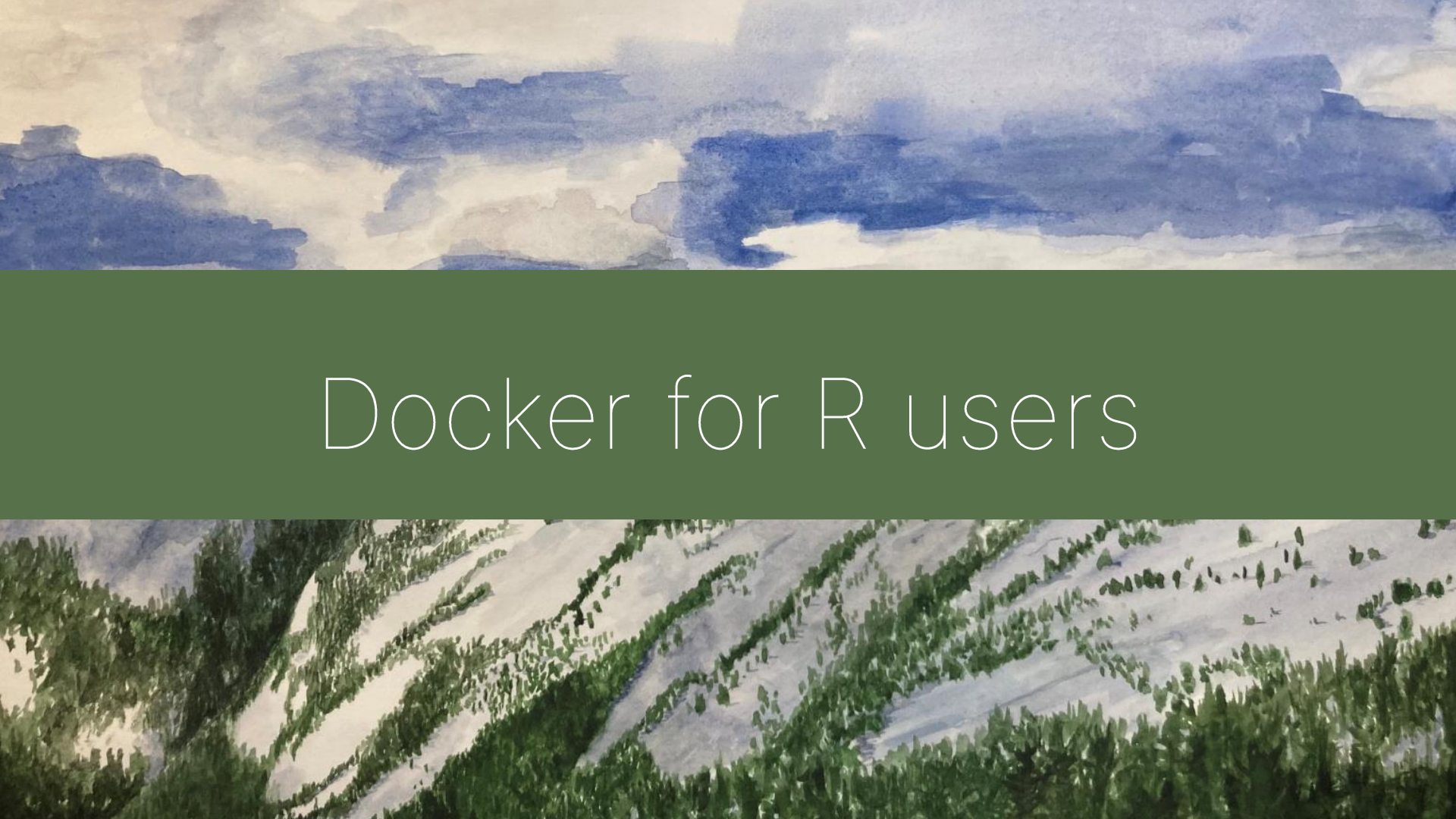


Docker for R users

My dream as a young data scientist:

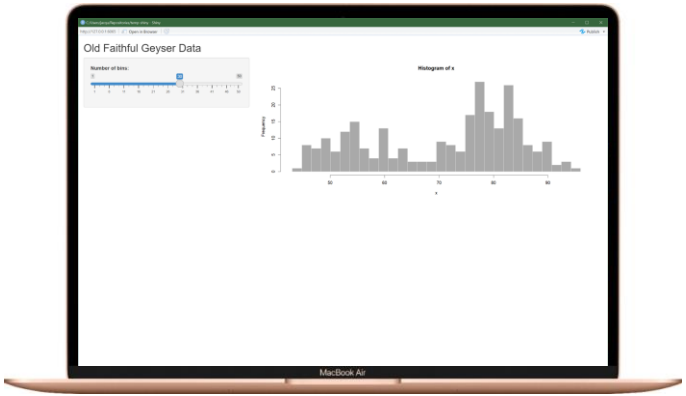
That I could write code and deploy it for other people to use

THIS HAS BEEN HARDER THAN I WOULD HAVE EXPECTED

(Spoiler: Docker makes this easier)

Maybe you want to host:

- **A Shiny dashboard** other people can see in their browser without installing R
- **An Plumber API** the engineers can pass data to without editing the code themselves
- **An arbitrary script** that runs on a fixed schedule



Could be publicly for everyone, internally within your company, as part of your companies product, or somewhere else

(Different from “I want coworkers to run my R scripts”)

Making your code run somewhere else

Option 0: Use a managed service

Pay for a product like **Posit Connect** (or Azure ML!) that can host these things for you

Pros:

- Easy UI for the developer and the end user!
- Manages permissions and other complexities

Cons:

- $$$
- May have # of user limitations
- May have concurrent user issues
- Requires engineers to set up and maintain
- Cannot give access to public

Option 1: Run it on a computer you own

This is still a server! Your R code can run here!

You can host a shiny/plumber app on it by opening port 80 on your firewall and setting up port forwarding on your router! 😱

```
shiny::runApp('app.R’, port=80L, host='0.0.0.0')
```

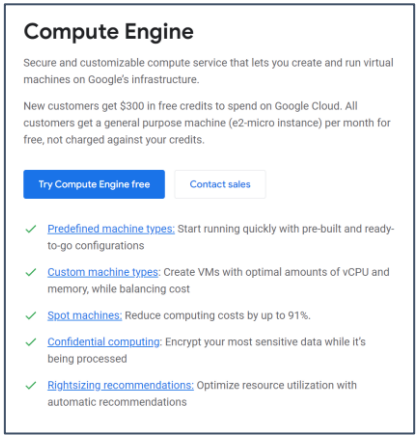
TECHNICALLY A SERVER

Pros:
- Feels like regular coding
- It’s like, right there

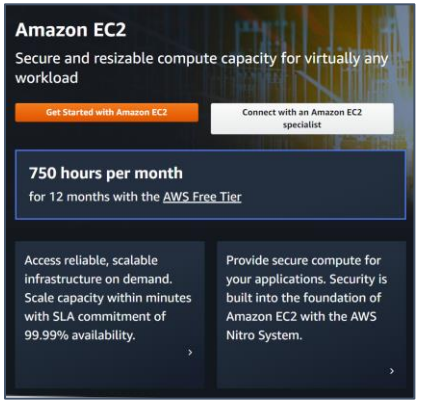
Cons:
- Power outages
- Your IT department HATES this

Option 2: Rent a computer from a cloud provider

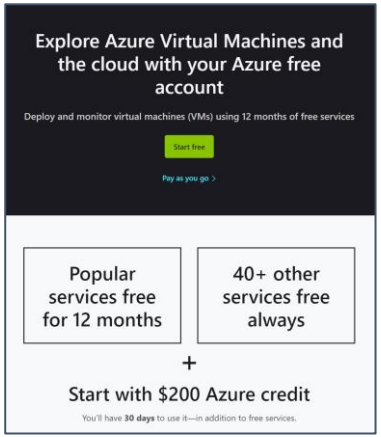
GOOGLE CLOUD PLATFORM VMs



AMAZON WEB SERVICES EC2



AZURE VMs



All cloud providers let you rent a virtual machine by the hour!

Pros:

- Still works like a regular computer
- Always on

Cons:

- Expensive to run all the time
- Install libraries, packages, and keep track of every machine

Option 3?

What if we had a way to:

- Keep track of each step used to set up a server
- Take a snapshot after each step to neatly keep track
- Run any of these snapshots very efficiency
- In a way that any engineering team could understand

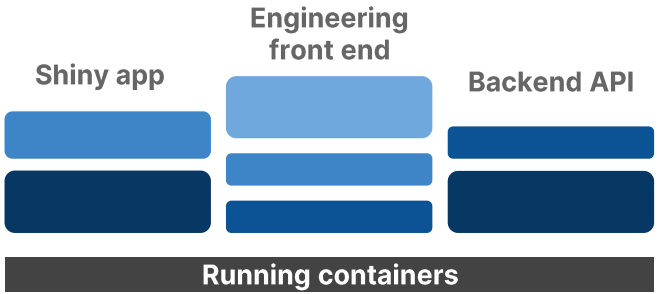
Option 3: Containers.

Containers: basic idea

- A Docker image is a snapshot of a computer that you can run
  - Images are built on top of other images
- A Dockerfile specifies how to build the image
  - Start with a base image
  - Specify other libraries and packages to install
  - State the command that should run at start
- A container is a running image
  - You can have many containers at once

(These days people say “containers” instead of “Docker”)

Build a new image on top of other ones



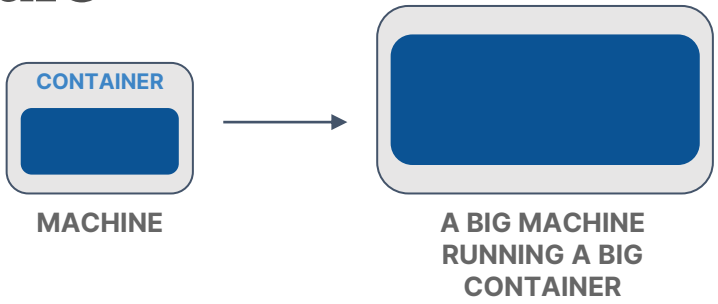
A lot of different containers can be running at once

Pros:
- A universal language for engineers
- Can be saved forever and will still run
- Don’t have to worry about what’s on the computer running them

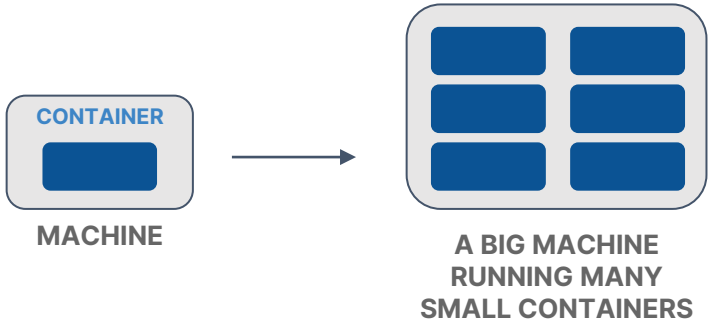
Cons:
- You have to get used to them
- Ephemeral –when they turn off you lose saved info

Containers can easily scale

- Need more CPU/RAM? Run a container on a larger machine.



- Need to handle lots of requests or parallelize your code? Run many of the same containers at once.



Example: make a container run a Shiny app

Three files

```
app.R (shiny app)
main.R (has the runApp command)
setup.R (install.packages)
```

Example Dockerfile

This is an example of a Dockerfile. Each Docker command adds new layer, meaning it will create a new image on top of the previous one.
You can build the image (let's call it shiny-docker) from the Dockerfile using `docker build -t shiny-docker .`

```
FROM rocker/tidyverse:4.4.1

COPY /src /

RUN Rscript setup.R

ENTRYPOINT ["Rscript","main.R"]
```

FROM indicates what the starting image is. All images start on top of another image. Here we are using a container with Tidyverse already installed You can use other people's images as your starting point!

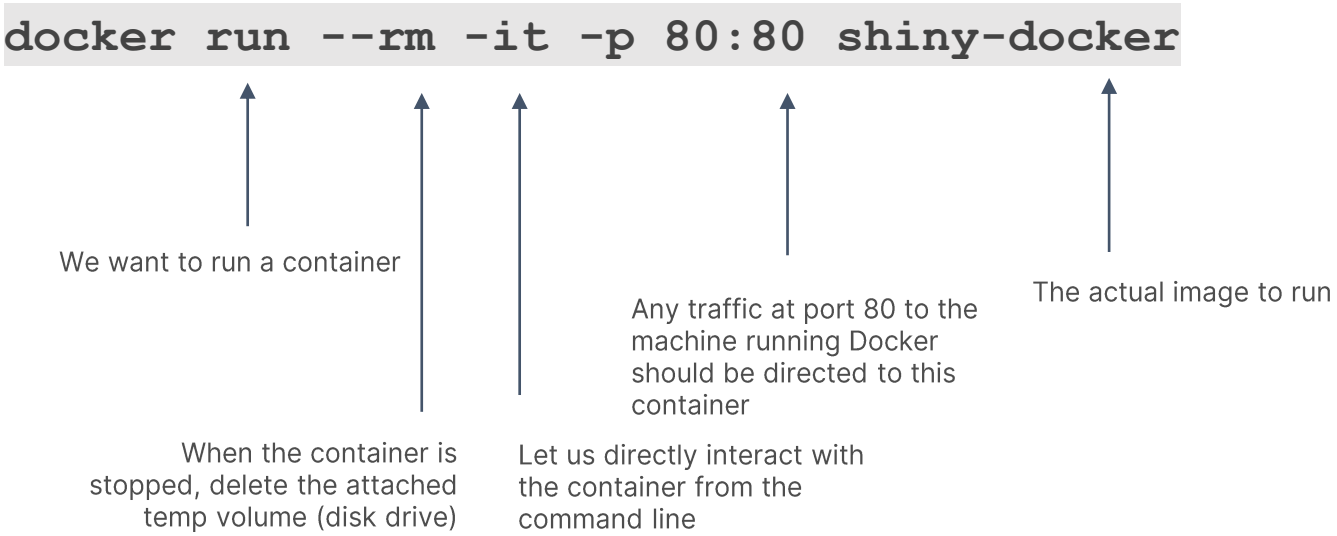
COPY will copy a file or folder from the location of the Dockerfile into the Docker image.

RUN indicates a Linux command to run. Here we are saying to run the setup R script which installs packages

ENTRYPOINT specifies the program that should run when the container starts.

Running a container

Once you have built an image, you can run it with a command like



Then go to 127.0.0.1 in your browser to see the app

Live demo!

You just ran Shiny on your laptop.
Why should I care?

R isn’t installed on my computer

Everything the Shiny app needs is in the image

The Shiny app not even running on Windows

`It's running in LINUX`

How can that possibly be?

- The container is totally isolated from the system running it
- It doesn't even have to be the same OS
- The image will stay the same forever

Let's take this baby to the cloud

- If we can isolate a container on our laptop why not run that same container somewhere else
- **Google Cloud Run** is a great place to easily run containers
- Will turn off containers when not needed (spend pennies a month!)
- Will instantly spin up more containers if a lot of people are using it

Containers on Google Cloud Run

- Upload an image to Google Artifact Registry via `docker push`
- Create a Google Cloud Run service that deploys the container
  - Choose the image to run
  - Select the max number concurrent containers, memory
  - Set up a schedule to start it on
- You can now have lots of concurrent containers running in the cloud

Live demo!

Try and break me
(with every device you own at once)

http://bit.ly/rdockerdemo

Is there anything a container can't do?

It will not: Be an object you can hold persistent data in

(local data gets deleted when containers stopped)

It will not: Let you (reasonably) interact with the R code

Very difficult to edit R code within a running container

It will not: let you easily pass code between humans

Hassle to install Docker, files aren't small, can't easily see/edit the code

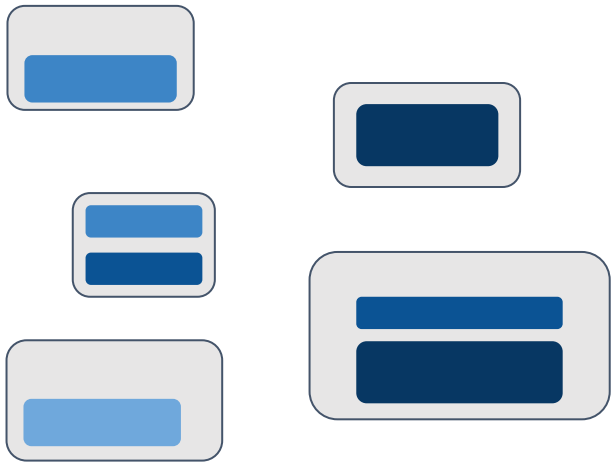
It will not: be a useful tool for running reproducible analyses

This is a hill I will die on

Epilogue What the heck is Kubernetes?

- What if instead of Google Cloud Run we had a department of our company to handle this
- That team is DevOps and they use Kubernetes as a platform
- I don’t think data scientists should have to deal with this

kubernetes



MANY MACHINES RUNNING MANY CONTAINERS

Thank you!

Code available at: https://github.com/jnolis/shiny-docker