



Anubis, Containers, & Open Source

John Cunniff

[github/wabscale](https://github.com/wabscale)

Some slides derived from: G. Sandoval, Tanenbaum/Bo,
Jérôme Petazzoni, and Brendan Dolan-Gavitt
Thanks !!



whoami

- Graduated from NYU 2+ years ago
- Was president of the **OSIRIS Lab**
- Created & maintaining **Anubis LMS**
- **Senior Engineer & Partner**

at **Vola Dynamics**

VOLA
DYNAMICS

Intuitive. Fast. Robust.
Industry-leading options analytics.



What is Volatility Dynamics?

- “Swiss army knife” for options analytics
- 100x faster, robust & accurate option pricer & volatility fitter

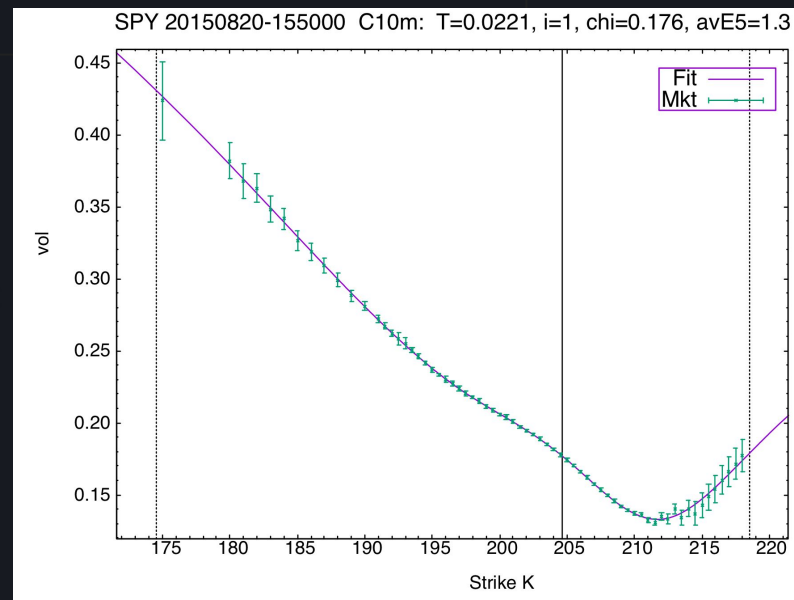
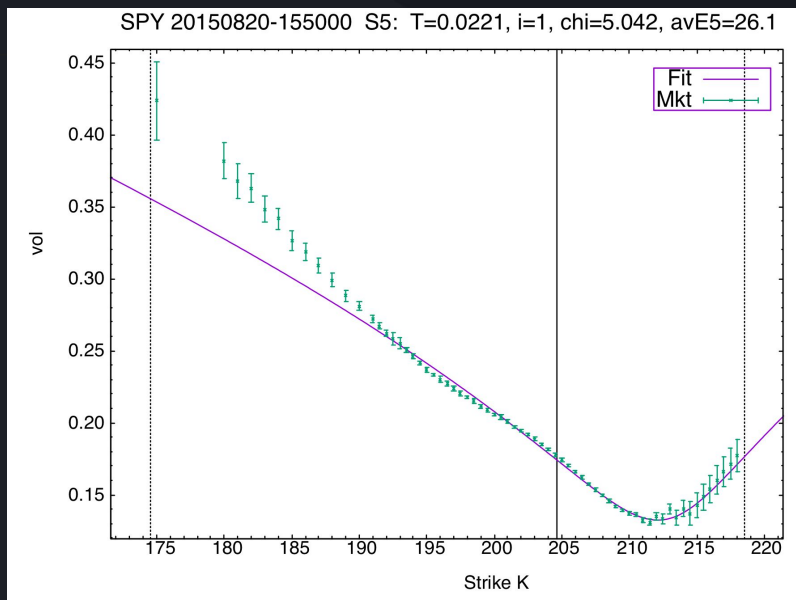
VOLA
DYNAMICS

Intuitive. Fast. Robust.
Industry-leading options analytics.



What is Volatility Dynamics?

- We do **Volatility Curve Fitting**





How Hardcore Open Source are you John?

Yes this
is a real
tattoo I
have





Questions?

[illegible]



Applied Containers & Orchestration

I may be teaching a class next semester!

Applied Containers & Orchestration

**Put in your course reviews that you want a modern
containers course!**



Anubis

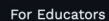
→ What is Anubis?

- What is a container?
- How does Anubis use containers?
- Future of Anubis project

Anubis



- Anubis is an open source **learning management system**
- I created Anubis when I was an undergrad sophomore
- ~2000 students from Tandon have used Anubis



For Students

Blog

Community

Completely automate your course.

Anubis is a Learning Management System that allows courses to provide consistent and customizable development environment for students. And completely automate the learning process.

Get Started

[Open Assignment](#) [View Report](#)

1 Failed
1 successful build, 1 failed test and 1 successful test

● **Build** In Progress

● Lint Succeeded

● Test 1 in Progress

● Test 2 *Failed*

Expected Output

Check Anubis out! <https://anubis-lms.io/>

Anubis Products



- **Cloud IDEs**


- Once click IDEs in the browser
- Fully configured for different classes

- **Autograding**

- CD/CI like



Anubis IDEs

 **Anubis**

LEARNING

Dashboard

Courses

Lectures

Assignments

Submissions

Repos

Profile

ADMIN

Students

Course

Forum

Lectures

Assignments

Autograde Results

Anubis Cloud IDE

Static

Reservations

jmc1283

J

Playgrounds

Your PlaygroundRunning

With Anubis Playgrounds you can run any of the IDEs we provide with one click. No course sign up necessary. Select an IDE, and a version and hit launch to start.

Don't see an IDE you need? Open an issue on our github requesting what you need, and we'll see if we can add it!

C / C++

CompArch / PL

CompArch / PL with Webtop

Devops

Golang

OSIRIS

Pincer

Proc Design

Python

Python 3 / Flask 2.0

Python 3 / MySQL

Shell Autograde

Webtop

latest

GO TO IDE

STOP SESSION

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Anubis



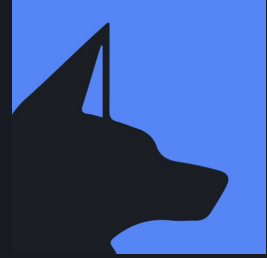
- Anubis is **open to anyone from the NYU** to use
- Sign in with NYU SSO, **one click to code**

Anubis



- Anubis can **automate** CS classes

Why does Anubis Exist?



- We **customize the platform** for the needs of the professors, students, and TAs
- We **integrate** all of our services into a **single cohesive experience** for students and admins

Why does CAS not use Anubis?



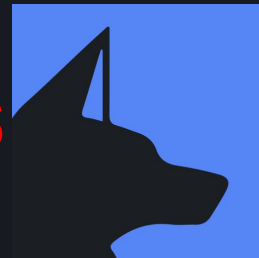
- Your administrators always think we are a startup asking for money
- We are fully funded by the CSE department of Tandon
- **Anubis will never be monetized**

Anubis Design



- Anubis is a large system split up into **microservices**
 - Example: the web static (html and js) is separate from the python api
- There can be **many containers** within those microservices

Anubis & Containers



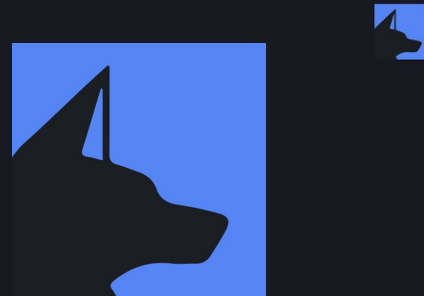
- There may be **thousands of containers running at any one time**
- 2023-02-07 there were **~366 IDEs open at once**
 - ~3000 individual containers for **JUST IDEs**

Anubis & Open Source



- Many students from Tandon have contributed in small pieces to Anubis over the years
- More often, we have **open source security audits** (generally through the OSIRIS Lab)

Anubis & Open Source

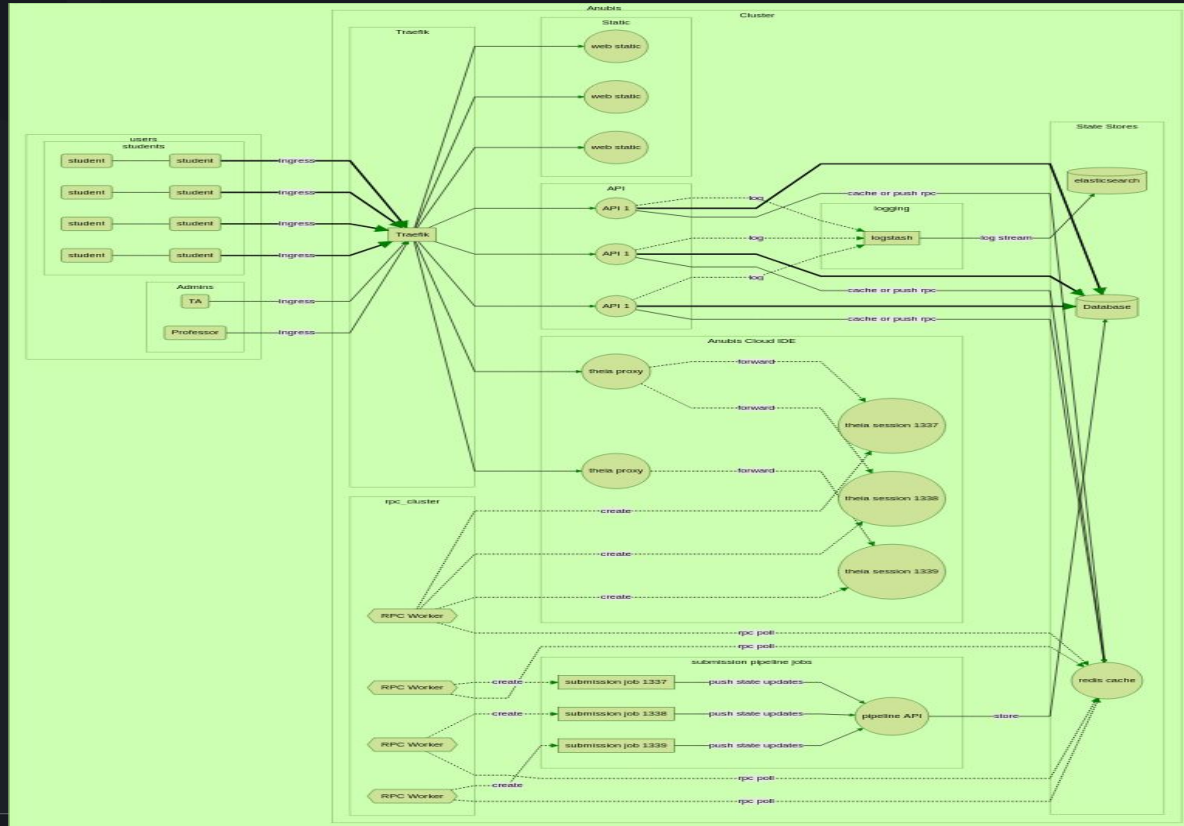


Contributors 27



+ 13 contributors

Anubis



Check Anubis out! <https://anubis-tms.io/>



Questions?





Anubis

- What is Anubis?
- **What is a container?**
- How does Anubis use containers?
- Future of Anubis project



Containers & Kubernetes

- Who has dockerized a project?
- Who has used Kubernetes?



Why are containers great for OSS?

- You can, as an open source maintainer, **package** your entire project **in a uniform way**



Why use containers?

Shares many (but not all) of the benefits of hardware virtualization with **much lower overhead**.

- Can **package** a program / service into something that will run exactly the same on most any machine.
- Can **adjust / limit** hardware container resources to system needs.
- Can **split a system** up into **microservices**, then use a CNI (container networking interface) to let them connect to each other.



Why use containers for security?

Isolation

- Container should **not leak information** inside and outside the container
- Can isolate all of the **configuration and software dependencies** a particular application needs to run



Containers

On GNU/Linux you are always in a container!

- **Linux starts in a container** with **no limits** that can see everything
- So if you think you're getting a performance benefit by not using containers you're wrong!

First Kubernetes Project





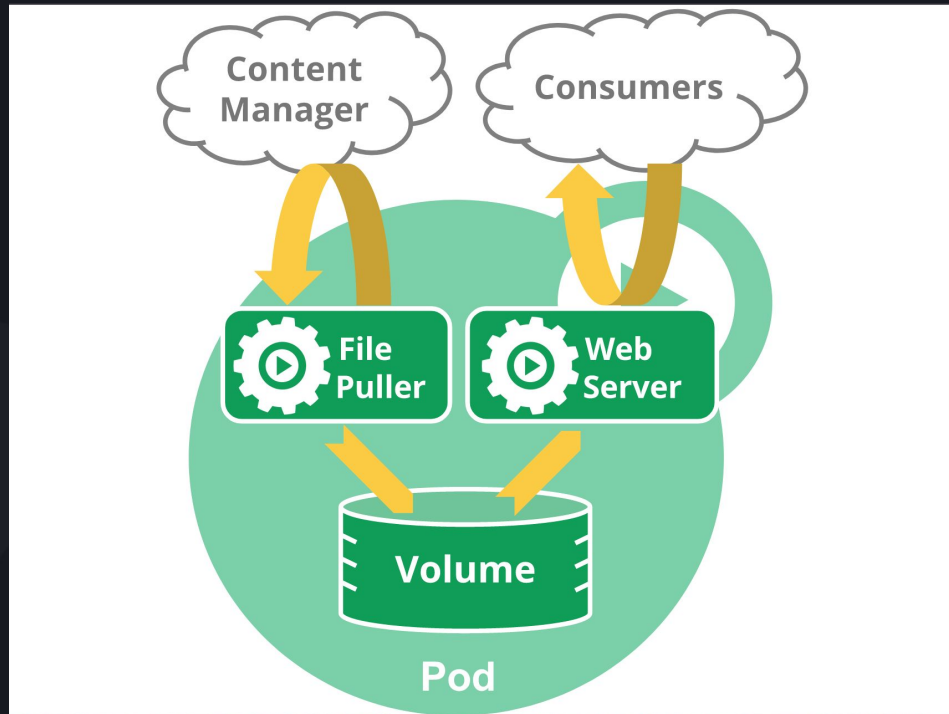
Kubernetes

- Anubis runs on a **container orchestration tool** called **Kubernetes** or k8s (the 8 is for the number of letters in between k and s)
- Kube allows for things like CNI (**container networking interfaces**) and CSI (**container storage interface**) to be extended to many, many machines connected on a network
- This lets us design and easily implement large systems that rely on **many many individual containers** communicating at once

Kubernetes Pod



- A single unit of work in kubernetes
- Pods contain **containers**, **volumes**, **config-maps**, **secrets**, ...
- Designed to be easy to **share resources** between containers in a pod



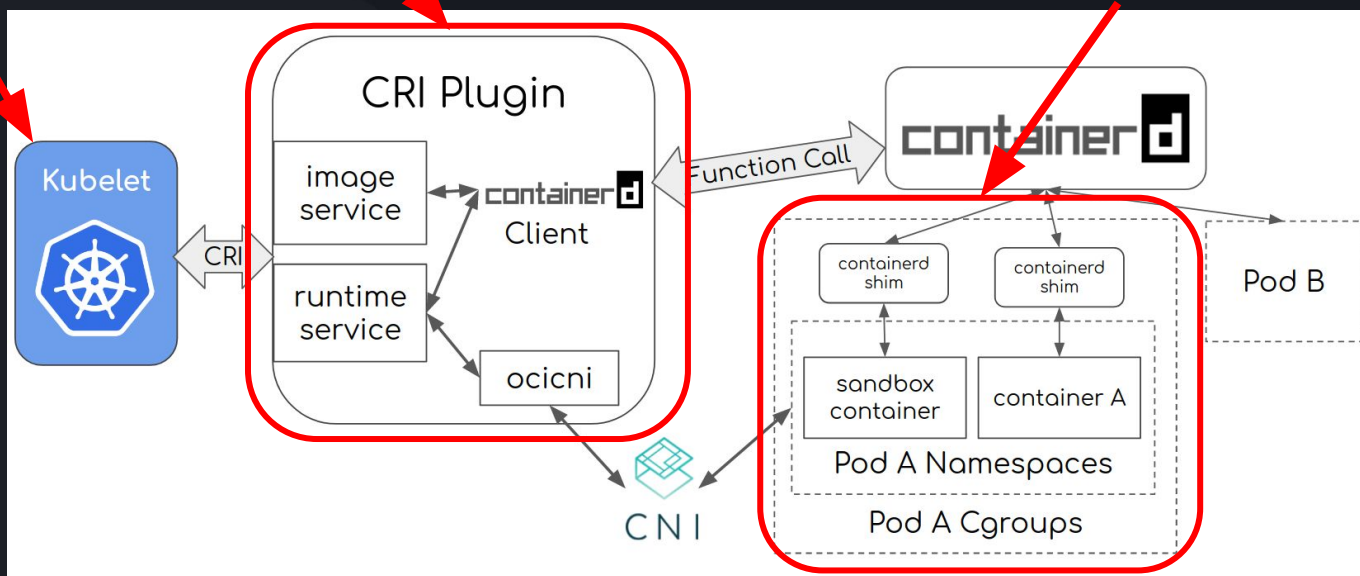
Kubernetes Pod Containerd



Primary K8S
Node Agent

Container
Resource
Interface
Plugin

Containerd
Creates Pod
Containers





Kubernetes

- Anubis uses the **Helm package manager**
- You can install Anubis on any kubernetes cluster as if you were pip installing a package

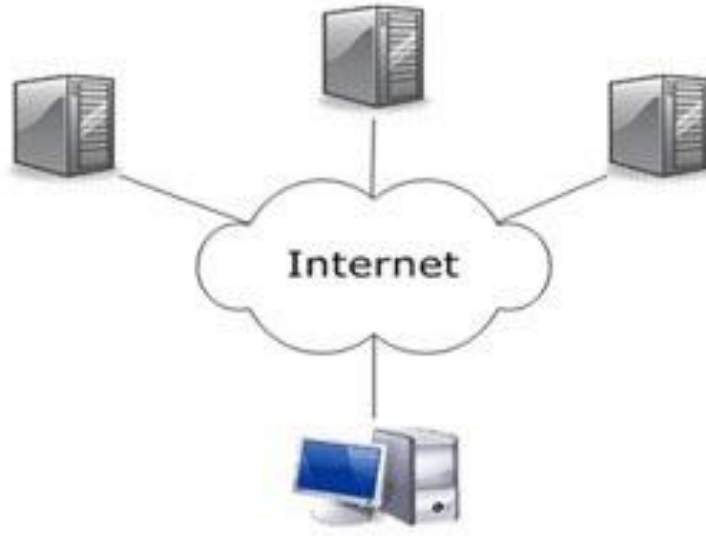


Questions?





The Cloud





The Cloud

- With the resurgence of virtualization, it has become popular to talk about the **cloud**
- This **somewhat nebulous concept** traces back to old network diagrams
- Usually used a **buzzword**



The Cloud

- In modern usage, the cloud refers to a **large number of physical servers** that rent out virtual machines for various services
- Clients get access to a **full virtual machine**
- Billing usually works according to how and what resources you use

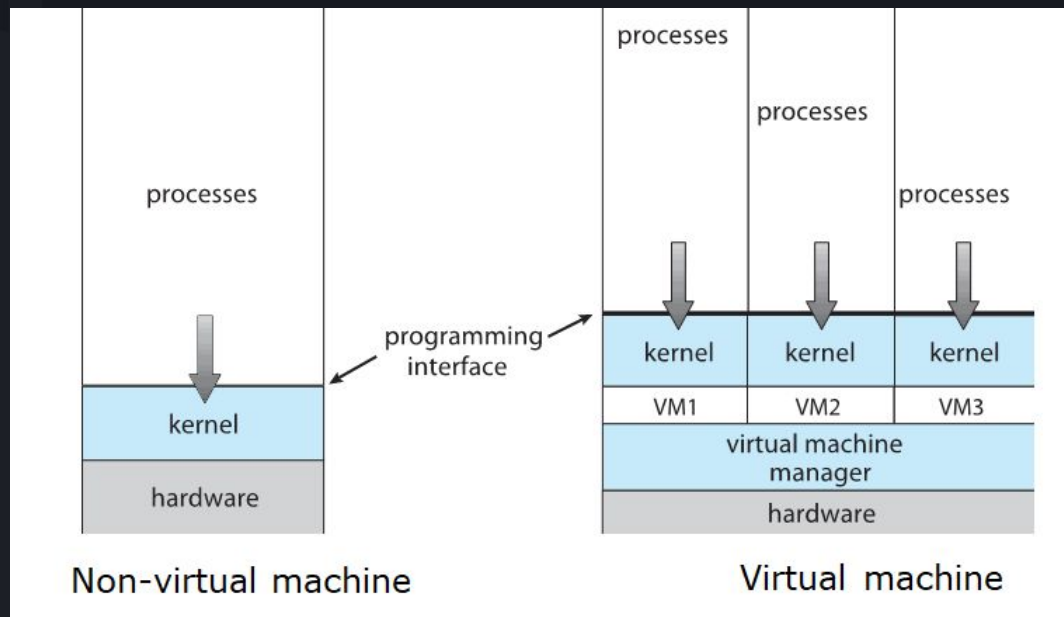


The Cloud

- Importantly, creating and destroying virtual servers can be accomplished **without human interaction**
- This ability to **flexibly acquire computing resources** can allow services to **scale** in response to changes on demand

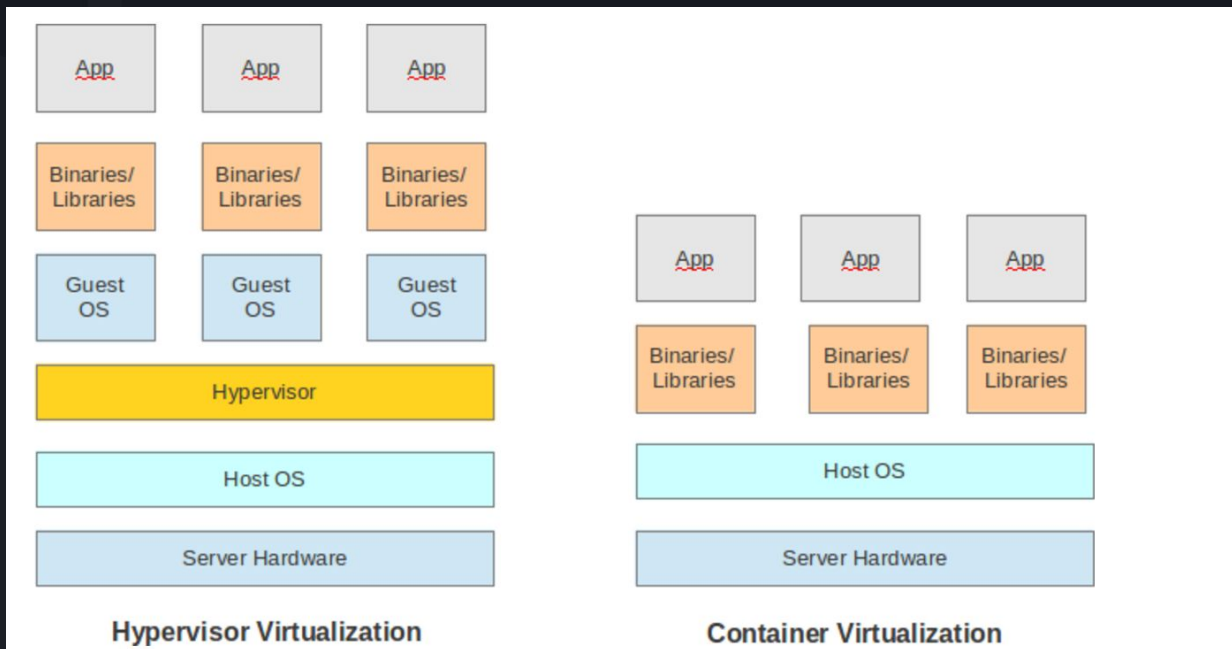


No-VM vs VM





VM vs Container





Future Readings on Containers

- Container Security by Liz Rice
 - [github/lizrice](https://github.com/lizrice)
- Basically everything by Jess Frazelle
 - [github/jessfraz](https://github.com/jessfraz)
- Presentations by Jérôme Petazzoni
 - [github/jpetazzo](https://github.com/jpetazzo)



Container Code to Read (All in Go)

- `runC` - OCI container spawning tool
 - [github/opencontainers/runc](https://github.com/opencontainers/runc)
- `containerd` - container runtime
 - [github/containerd/containerd](https://github.com/containerd/containerd)
- `kubernetes`
 - [github/kubernetes/kubernetes](https://github.com/kubernetes/kubernetes)



Questions?

My Arch install watching me read LFS





Anubis

- What is Anubis?
- What is a container?
- **How does Anubis use containers?**
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Anubis IDEs

- Anubis Cloud IDEs are made up of **individual containers**
- Each student gets their own IDE pod (and therefore **separate environment/filesystem**)
- The IDEs have **CPU and Memory limits** handled by cgroups

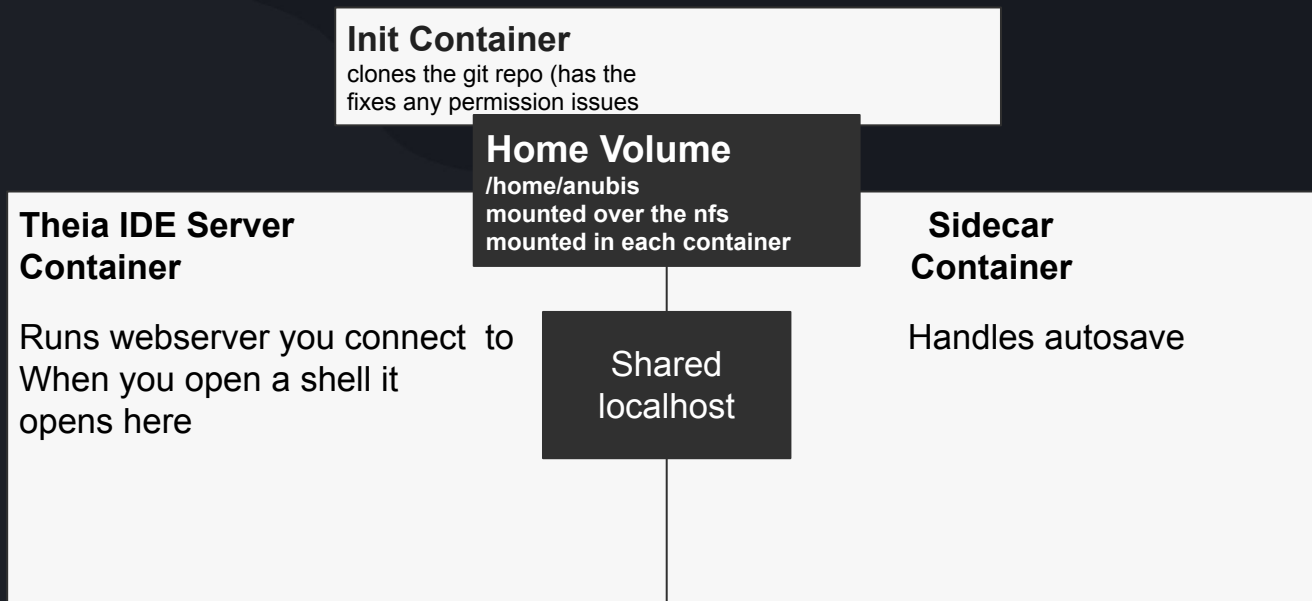


Anubis IDEs

- Each Anubis Cloud IDE is itself made up of **3+ containers**
 - An “init container”
 - IDE server
 - Autosave “sidecar”
 - Rootless Docker in Docker container



Anubis IDEs





Anubis IDEs

- The **containers work together** to make the Cloud IDEs possible
- It is all about **breaking up responsibilities**



- Recently I have added a **dockerd** sidecar container
- This means **docker in IDEs!**

```
Anubis
```

- Welcome to Anubis!
- Try using `l` instead of `ls` for prettier file listing.
- Try the autosave command to manually trigger an autosave: `% anubis autosave`

```
anubis@anubis-ide : ~  
● [0] % docker ps  
CONTAINER ID   IMAGE          COMMAND         CREATED        STATUS        PORTS          NAMES
```



Questions?

When people ask me why I
don't go outside





Docker on Linux



Docker on Mac



Docker on Windows





There's so much more!

- Some stuff we're not covering but is very cool
 - Linuxkit
 - Storage drivers
 - Overlay networks
 - Copy-on-Write!
 - Container registries
 - selinux + capabilities
 - Rootless docker
 - Build-kit
 - Breaking security



Questions?





Anubis

- What is Anubis?
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➡ **Future of Anubis project**



Making Anubis Installable Anywhere

- Many institutions have asked about running anubis on their own hardware
- I want to make Anubis something that can be **helm installed anywhere**



Making Anubis Installable Anywhere

- Hosting images
- SSO authentication
- Third party services
 - Cache
 - DB



Making Anubis Forums

- Campuswire / Piazza Clone
 - Forum questions
 - Announcements
- **Last step to making Anubis the full package for automating CS classes**



Adding Anubis Anticheat

- Mayat project from Tian Yang
[github/AlpacaMax](https://github.com/AlpacaMax)
- Ast based syntax fingerprinting ID system

