

Many-cloud Kubernetes

Our experiences in the
automotive sector

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Applied Intuition

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Applied Intuition's development platform
3. What we do
Lots of Kubernetes cluster across all clouds
Frequent phased deployments
4. What we learned
Infrastructure-as-code is your friend
Prod is the integration test
Containerize instead of tunneling
Mind your networking

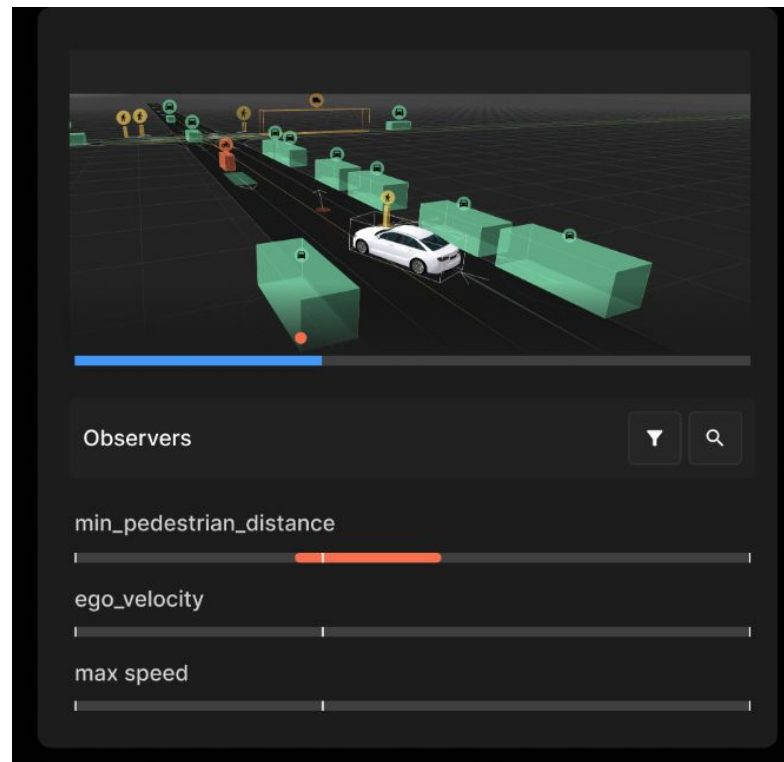
About me

- 2008-2012: PhD in super-resolution microscopy
- 2013-2018: Google CorpEng SRE
 - Migrating a traditional corp ecosystem to Kubernetes/Borg
- 2019-2024: Intrinsic (Google Cloud Robotics)
 - Distributed system: hard real-time millisecond responses with cloud-scale GPU usage
- 2024-: Applied Intuition
 - Help (almost) all the world's car OEMs to build autonomous driving at scale

Applied Intuition's Development Platform (ADP)

Applied Intuition's development platform allows engineering teams to safely develop and test ADAS and AD systems at scale. The unified toolchain spans across the entire development cycle, from simulation to data exploration and validation. It uses machine learning (ML) techniques to support increasingly realistic and complex use cases.

- ✓ Deterministic and highly scalable simulations
- ✓ Constantly evolving ML-based components
- ✓ Unified workflows for faster, safer ADAS and AD development



We run on all the clouds; Kubernetes unifies



AWS GovCloud (US)

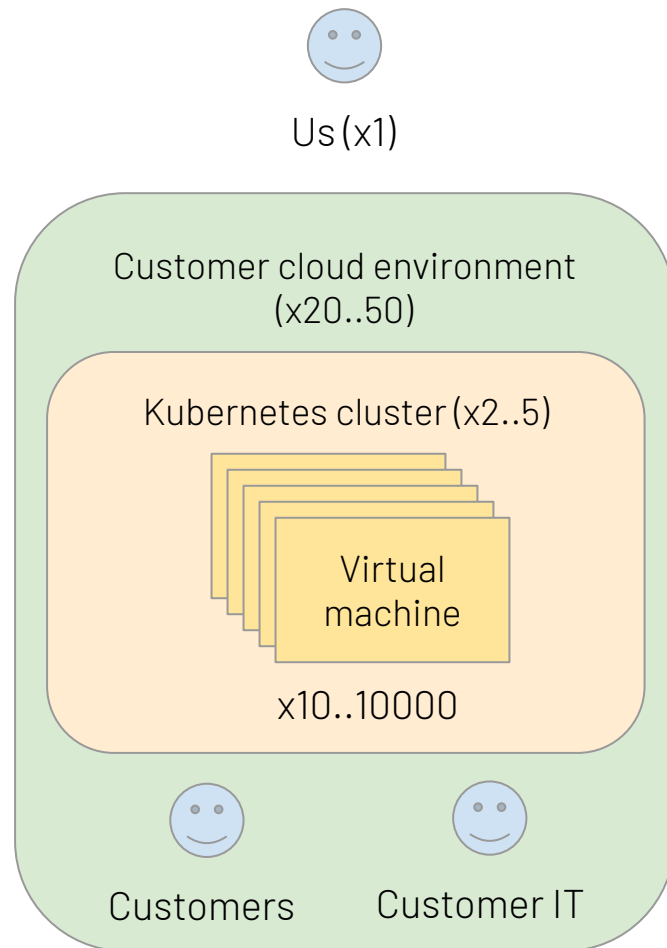
Implemented by lots of Kubernetes clusters

Background

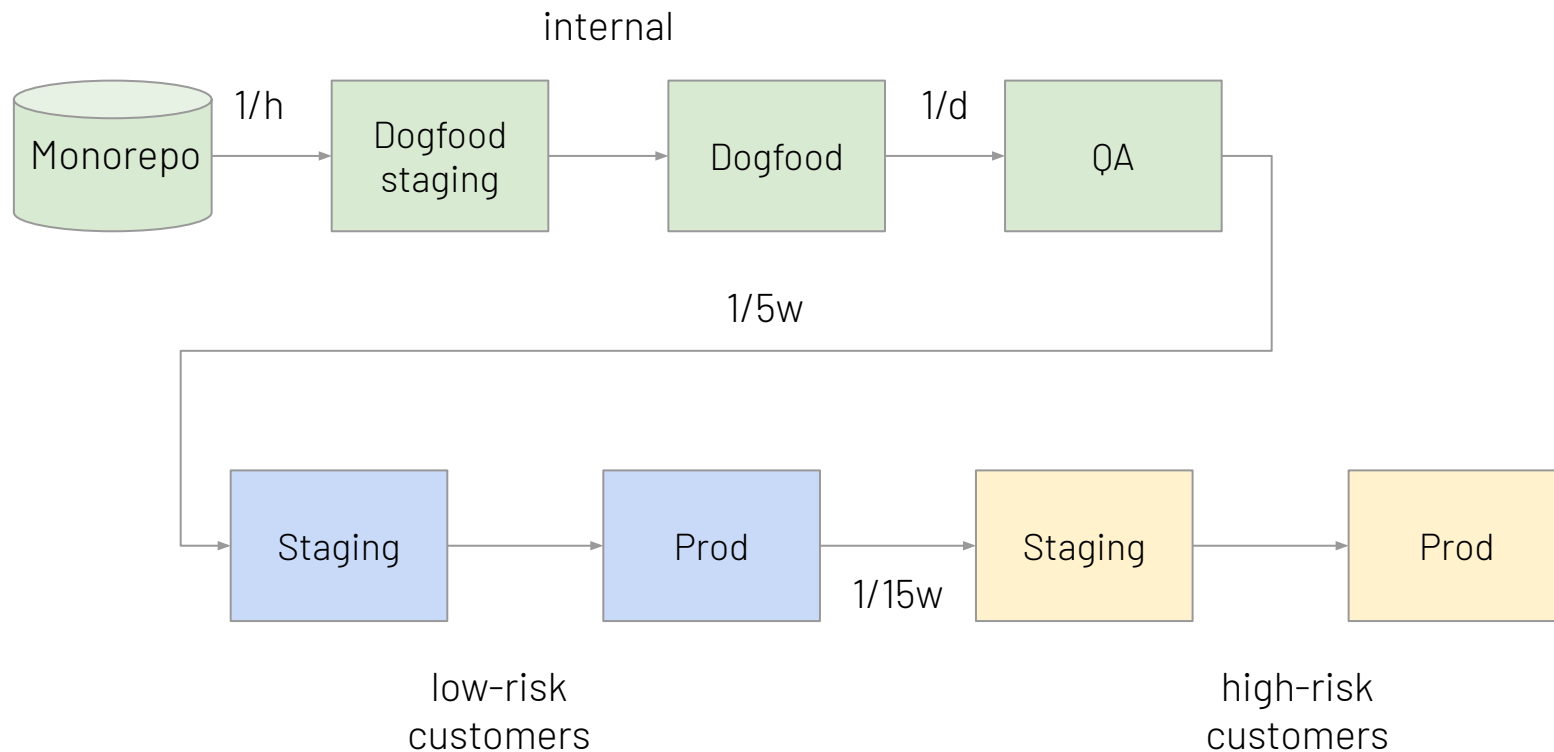
- Customers are automotive companies: OEMs and suppliers, big and small
- They upload critical business data into ADP
- IT requirements are bespoke & contradictory
- Organizational barrier between different groups at customer
- Customer IT teams generally indifferent to ADP success

Solution

- Spawn environments per customer ("single tenant")
- Replicate over dozens of customers
- Adapt to customer needs (cloud provider, security requirements, scale)



Frequent phased deployments



Lesson #1: Infrastructure-as-code is your friend

The larger you are, the more IaC you need

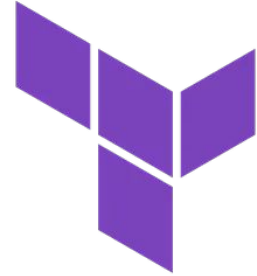
- Very effective way to collaborate
- Very effective way to transport context
- Very effective way to copy environments

Terraform everything!

- Especially if your customer IT gave it to you
- Terraform is a feedback game - apply as early as possible
- Don't couple your Terraform rollouts to the main application

Kubernetes objects use ArgoCD

- Our ArgoCD rollout is super painful and ongoing
 - Because there are scaling pitfalls in how you structure your repo & syncs
- But we still believe it's worth it



HashiCorp

Terraform



Lesson #2: Prod is the integration test

Traditional integration testing failed

- High variation between customers
- Many errors only surface at scale

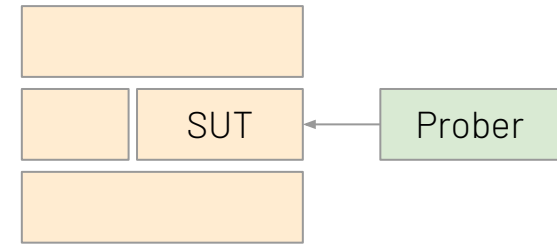
Traditional canary testing failed

- The first request already matters
- Don't have 1000s of expendable customers

Solution: Integration testing on prod

- Use synthetic traffic ("blackbox probes")
- Send it to the real production system
- Monitor results & performance
- Alert team responsible for subsystem

Production stack



Lesson #3: Containerize instead of tunneling

Used to run all tools on our workstations

- Tunneled to customer's cloud
- That worked great for small & modern companies

But: Not for large auto OEMs!

- They think in networks
- Tunnels confuse and scare them
- Required bespoke mitigations
- Complexity totally blew up

Instead, put every tool in a docker image

- Only need bespoke tooling to ship tool to customer



Only 3 of our customers are truly unhappy; all use hub-spoke IPv4 networking

- Why? Because they are all running out of IPv4 addresses
- Their cloud provider sold them into "hub and spoke" private networks
- Where everything is in a single private IPv4 (10.0.0.0/8)
- Now the cloud provider locked them in and charges 3000% markup on all network costs

This is catastrophic and only happens at scale

- These customers struggle with IP exhaustion like it's the 90s
- This will only happen at scale, when it is too late to switch
- Only one of the big three cloud providers does this

Key Takeaways

1. Infrastructure as code is your friend
2. Prod is the integration test
3. Containerize instead of tunneling
4. Mind your networking
5. Applied Intuition is hiring, come talk to me!