AI/ML is changing orchestration:

Kubernetes + Airflow

GenAI can teach old dogs new tricks

Clayton Coleman
Distinguished Engineer @ Google

Airflow Summit
Let's flow together

September 19-21, 2023,
Toronto, Canada

Disclaimer:
Running AI,
not using it :(

“During a gold rush, sell picks and shovels.”

-Anon.

> In the style of an AI chatbot transcript, answer the following:
> Who is Clayton and why should we listen to him?

Clayton has been a key contributor to Kubernetes from its founding.

He helped develop many of the core concepts that now cause its users endless frustration.

As lead engineer of OpenShift at Red Hat he fought hard to standardize Kubernetes as the application platform of the enterprise, and recently moved to Google where he focuses on taking away the pain of running Kubernetes workloads on GKE, especially new ML workloads.

Help him make Kubernetes better or you'll regret it.

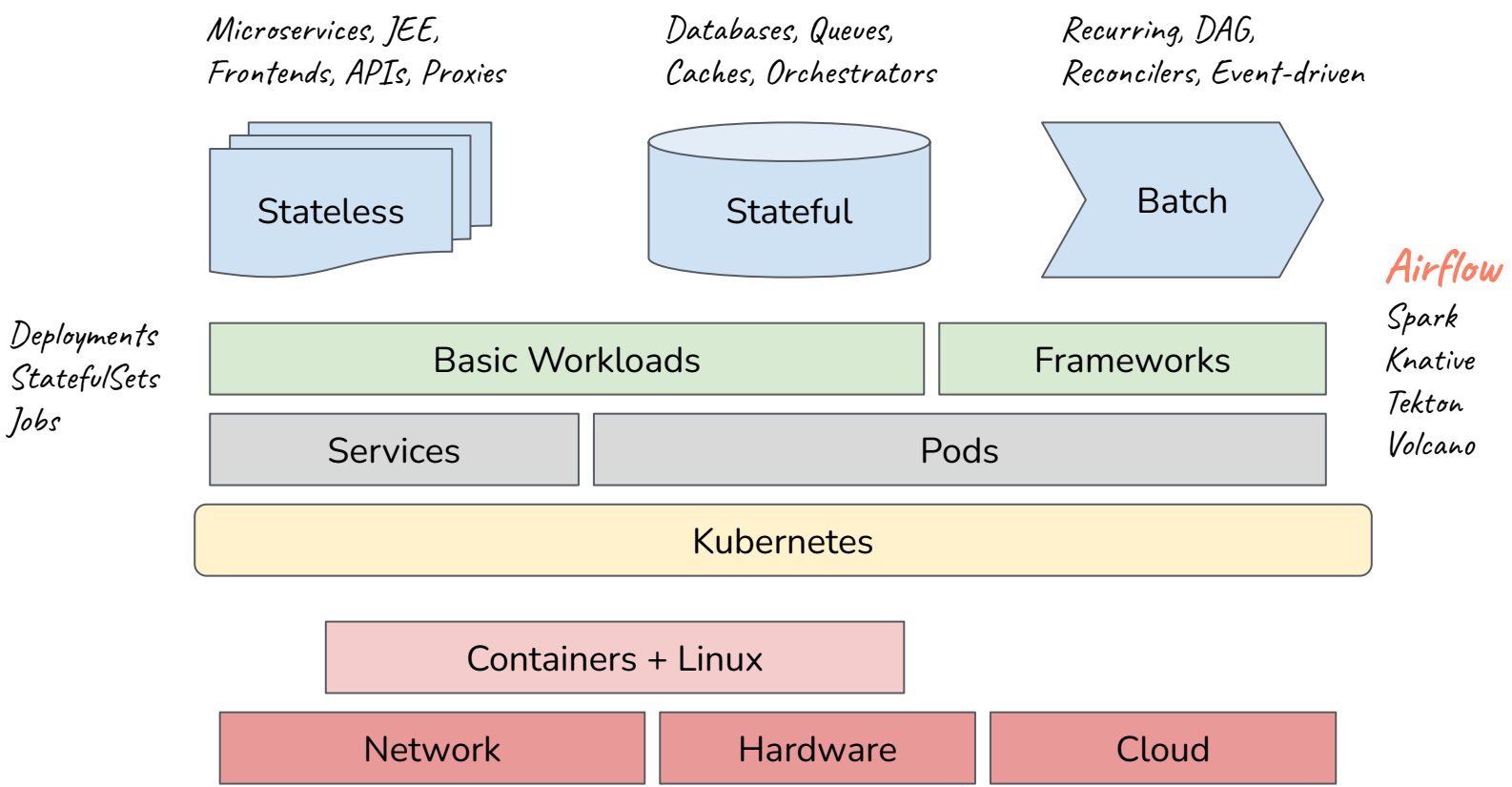
> What is the goal of Clayton's keynote?

Highlight opportunities to improve Kubernetes for Airflow users.

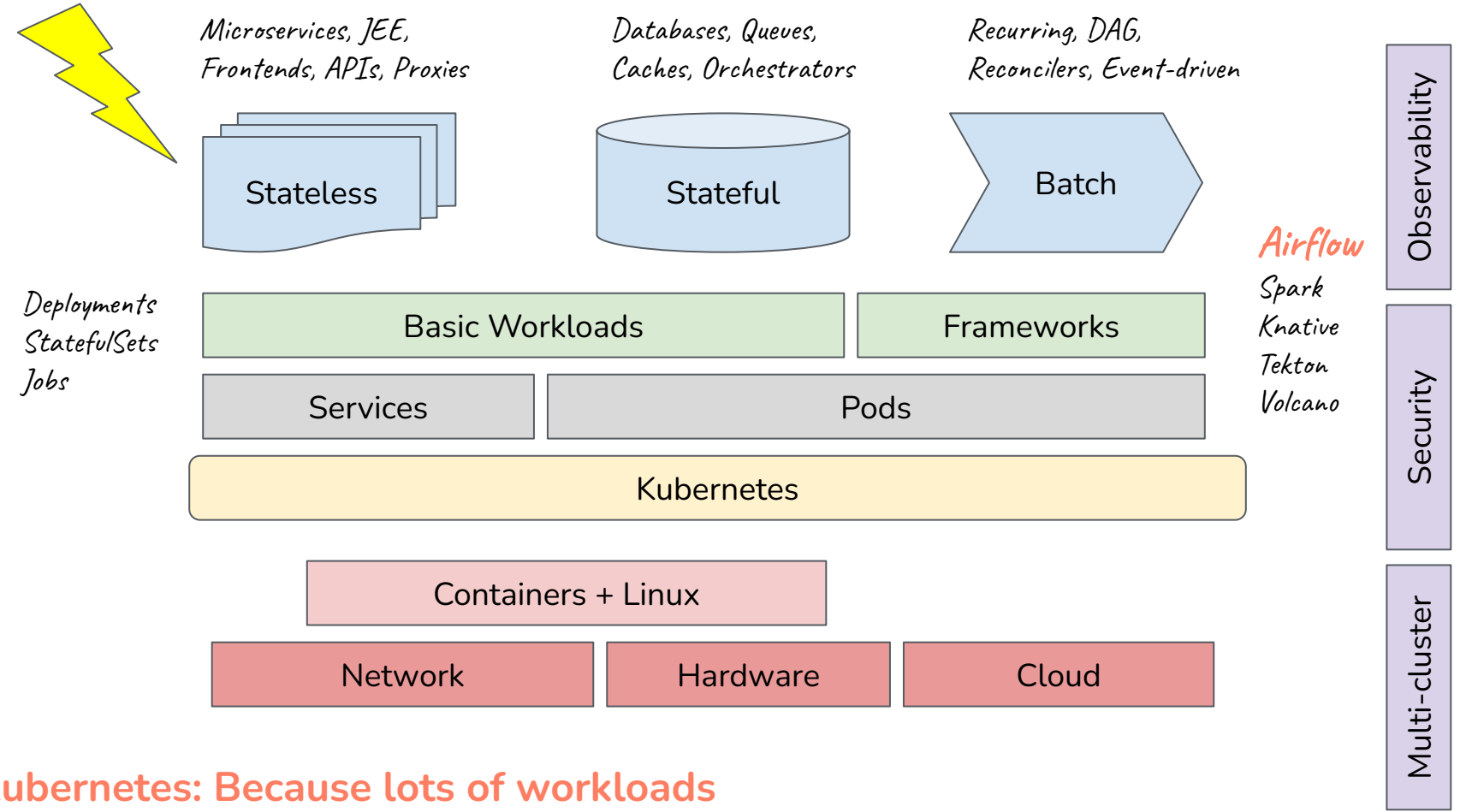
Are you using **Kubernetes AND Airflow**?

(running on top of K8S, or orchestrating workflows onto it)

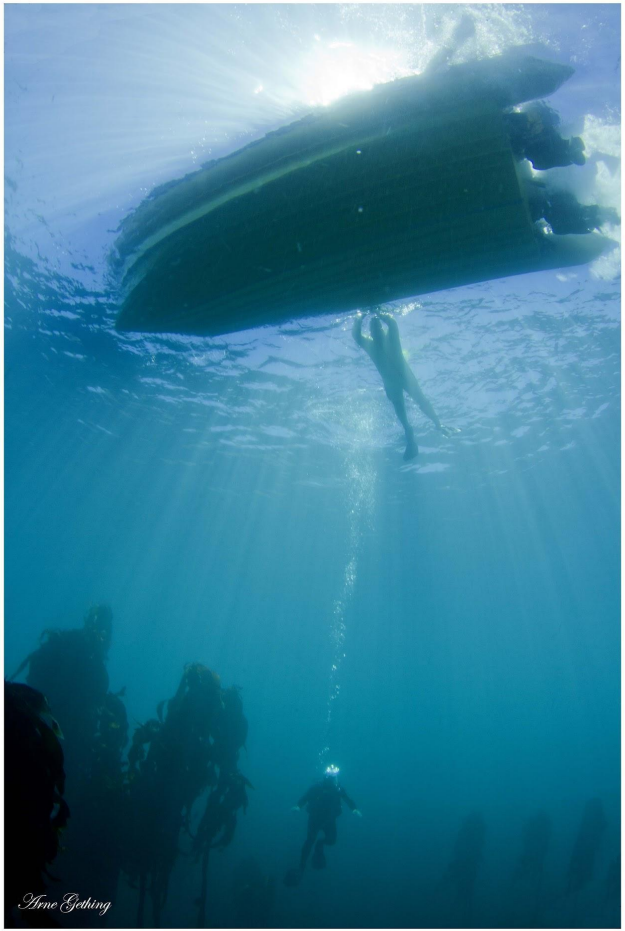
Pop Quiz



Kubernetes: But... why?



Kubernetes: Because lots of workloads

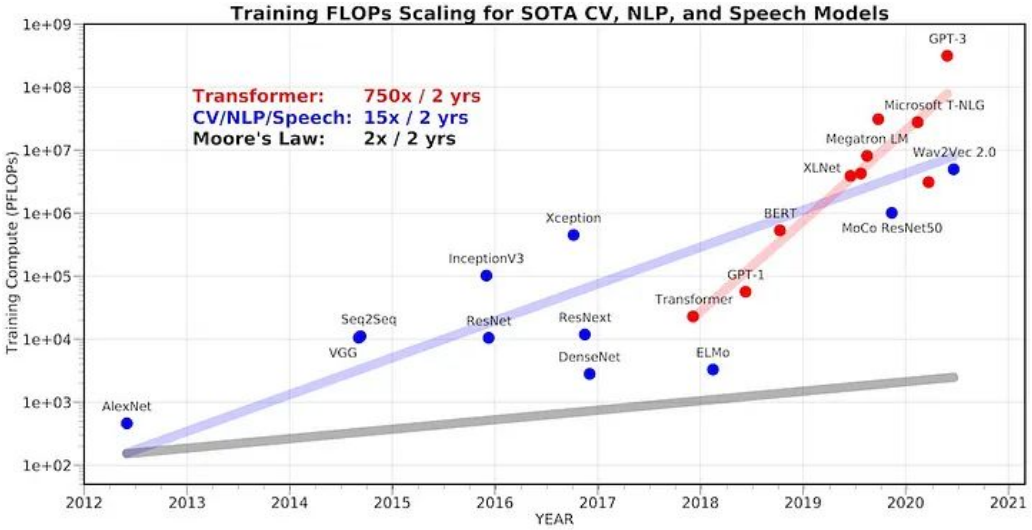


https://commons.wikimedia.org/wiki/File:Divers_under_the_boat_at_Hout_Bay_MG_4368_a.jpg

How to Improve Kubernetes

1. Do no harm
2. Solve problems for many workloads
3. Allow an escape hatch

GenerativeAI



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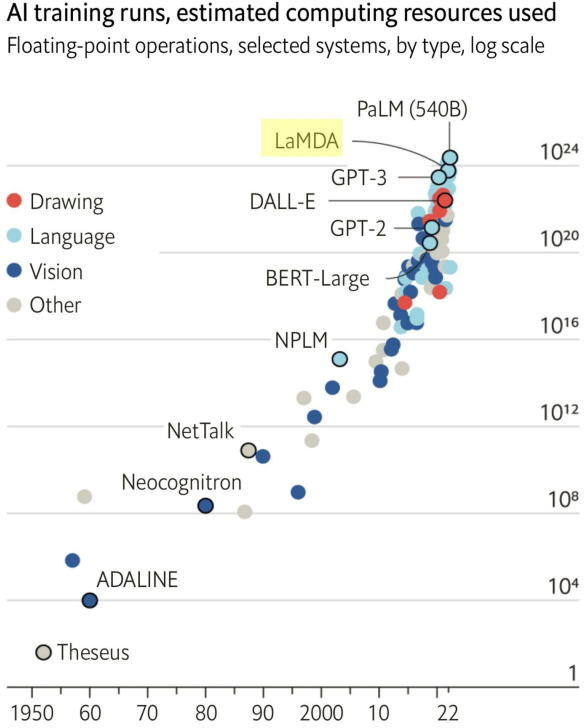
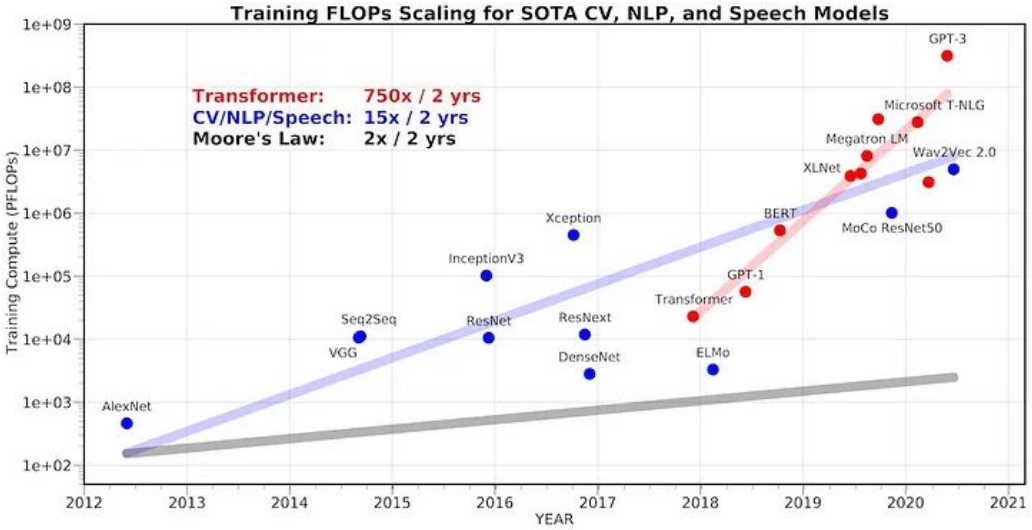


Sources: "Compute trends across three eras of machine learning", by J. Sevilla et al., arXiv, 2022; Our World in Data

"We're gonna need a bigger computer"



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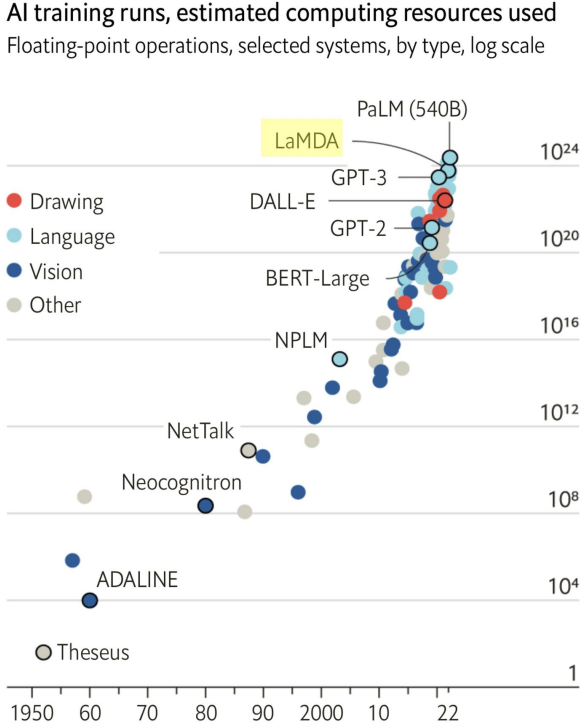

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"We're gonna need a bigger computer"

Who’s gonna orchestrate all that compute?

Growth of:

- 100x Compute
- 100x Data
- 2x Workloads
- 5x Flexibility

Constraints:

1. Ignore LLM-Prompt-as-an-App
2. Don’t make people think
3. MLOps is fragmented

Who's gonna orchestrate all that compute?

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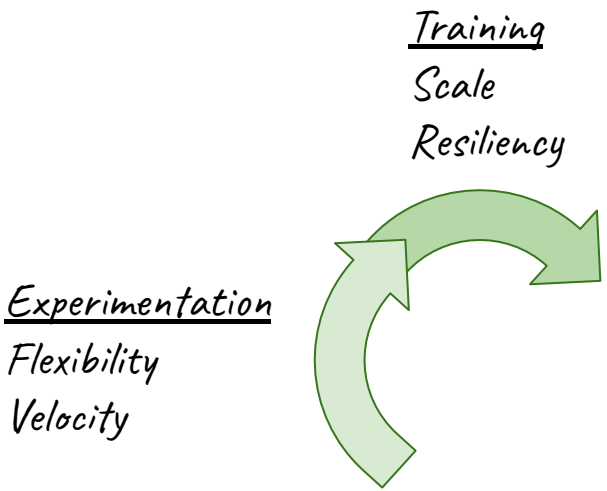
Through:

1. Orchestration
2. Scheduling
3. Fast Data



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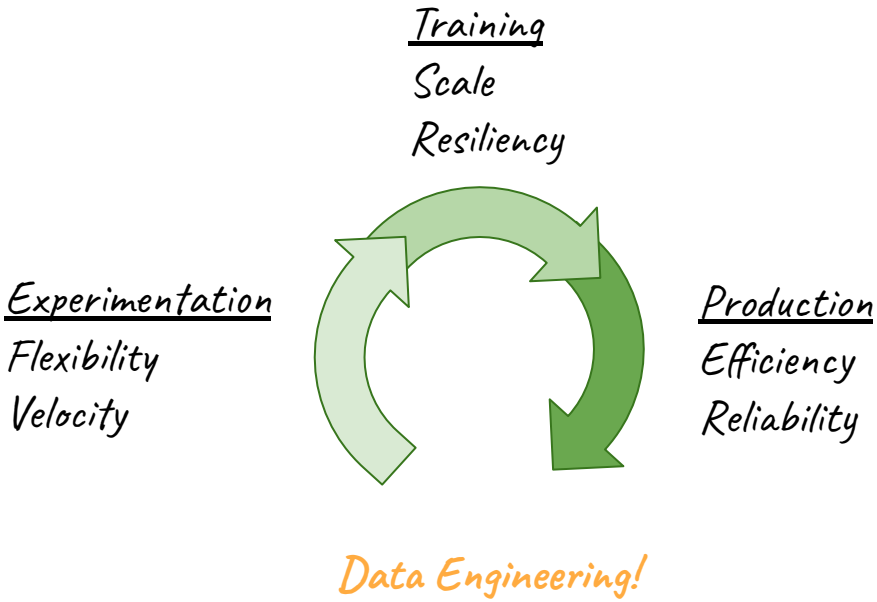

Orchestration: Container DAG

Problems:

- Compose containers
- Initialize the pod
- Isolate containers
- Parallelize more

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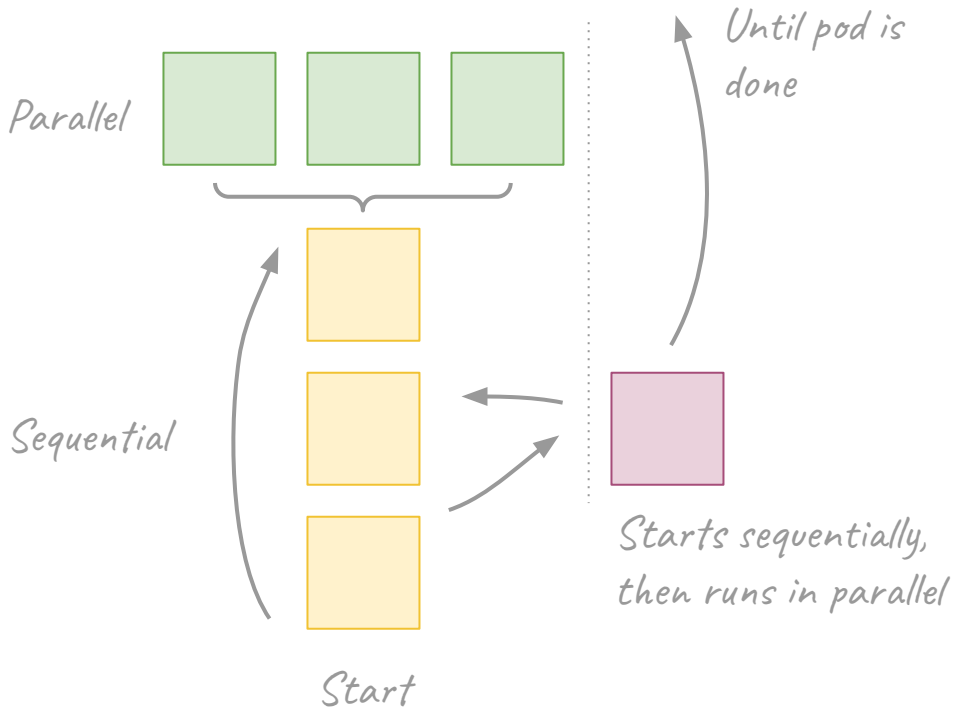
Feedback wanted:

- Sidecar (alpha in 1.27)



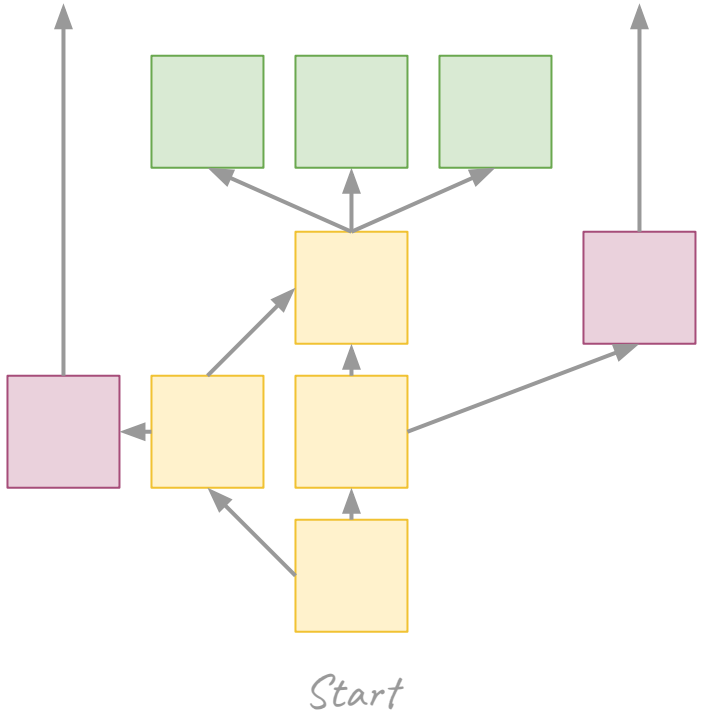
Orchestration: Container DAG

Problems:

- Compose containers
- Initialize the pod
- Isolate containers
- Parallelize more

Feedback wanted:

- Sidecar (alpha in 1.27)
- Full container DAG



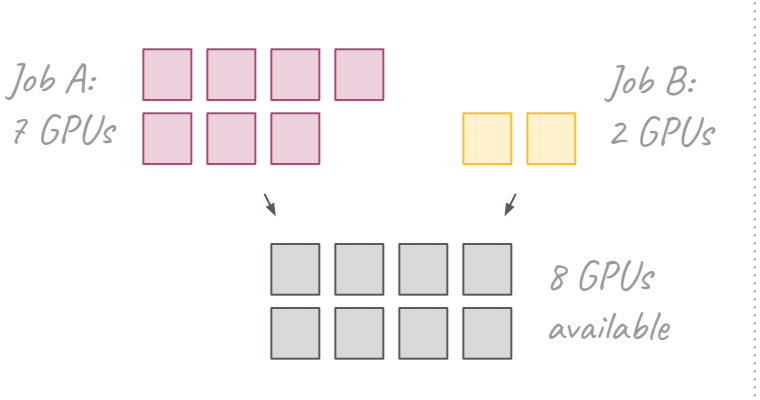
Orchestration: Batch Queueing with Kueue

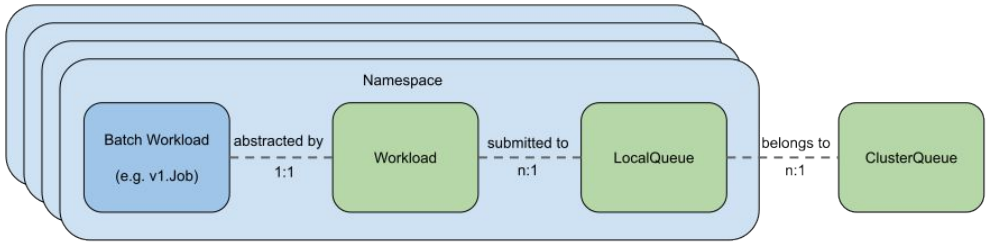
Problems:

- Jobs are too simple
- Real batch needs queues
- Scarce resources like GPU
- Competing workloads
- Standardize the ecosystem

Feedback wanted:

- Kueue the project
- Autoscaling clusters

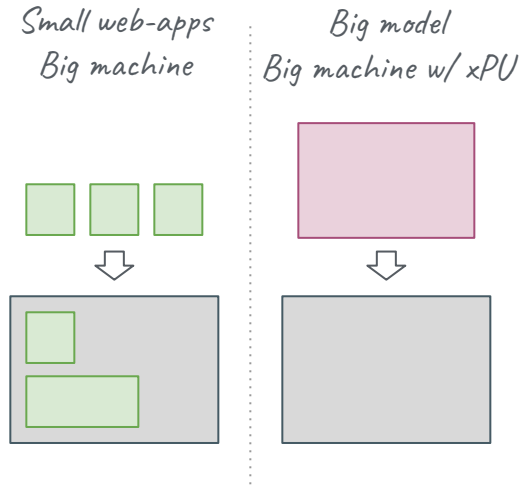




Scheduling: More Accelerators / More Problems

Problems:

- GPUs, TPUs, xPUs, oh my
- Scarce resources like GPU
- Workloads bigger than hosts
- Operational challenges
- Standardize the ecosystem



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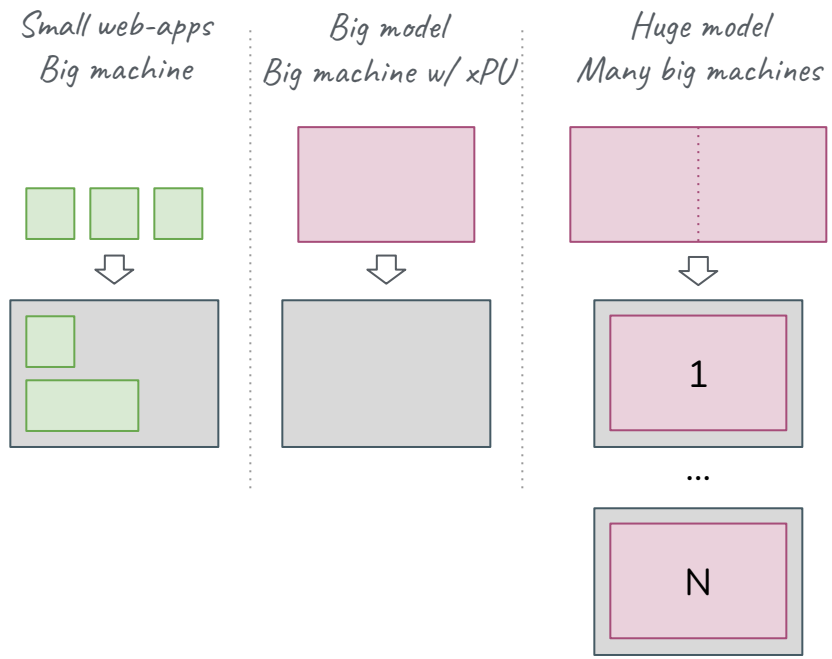
Feedback wanted:

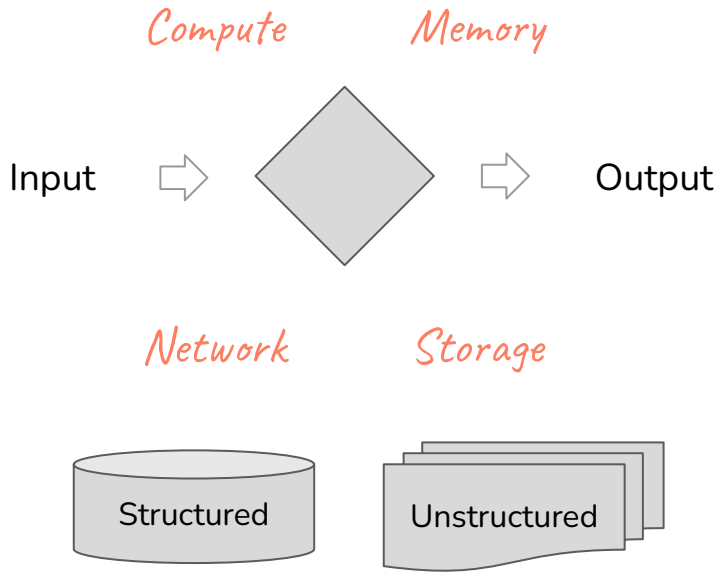
- Accelerator operational pain
- Can we flatten two-level scheduling?



Fast Data: A more unified approach

Problems:

- Moving bits around
- Mechanical sympathy
- Operational challenges
- Standardize the ecosystem



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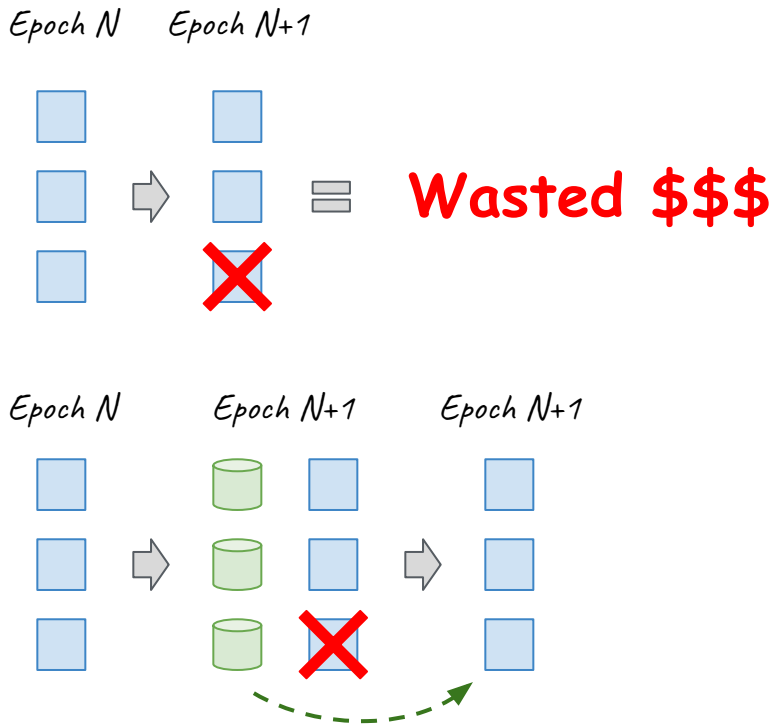
- Generalized snapshots



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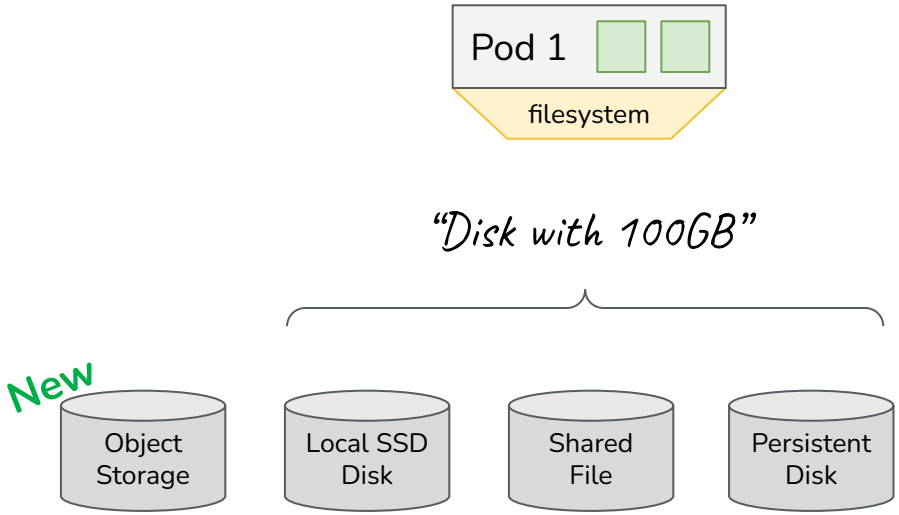

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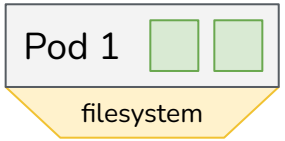
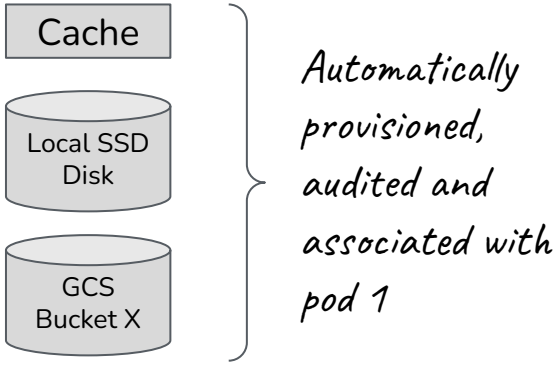
Feedback wanted:

- Generalized snapshots
- Semantic Attached Storage



"Fast cache of GCS bucket X, read only"



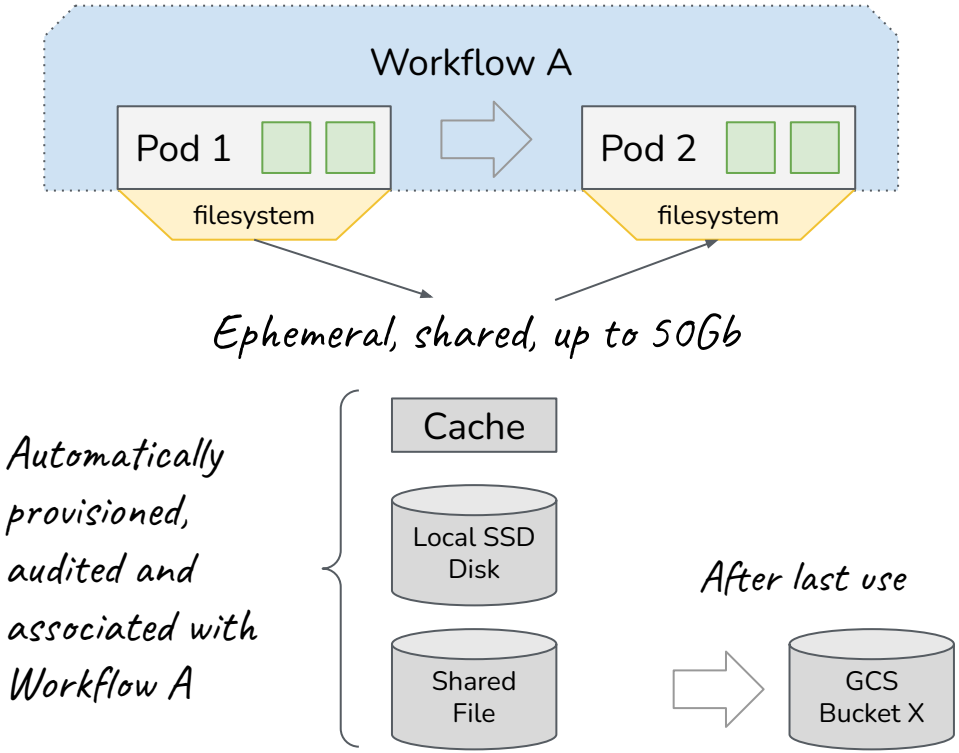
Fast Data: A more unified approach

Problems:

- Moving bits around
- Mechanical sympathy
- Operational challenges
- Standardize the ecosystem

Feedback wanted:

- Generalized snapshots
- Semantic Attached Storage
- Intra-workflow data movement



Questions?

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