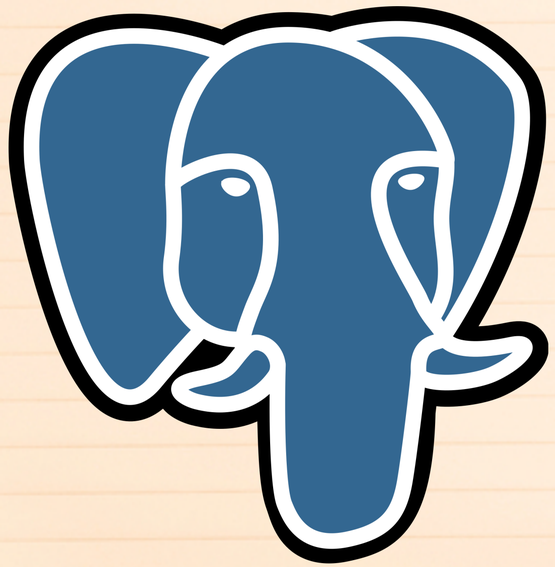
Do



Don't

https://www.marketingdonut.co.uk/pr-and-promotion/exhibitions/dos-and-don-ts-when-exhibiting

PostgreSQL Kubernetes

simplyblock

Chris Engelbert

Devrel @ simplyblock

Previous fun companies:

- Ubisoft / Blue Byte
- Hazelcast
- Instana
- clevabit
- Timescale

Interests:

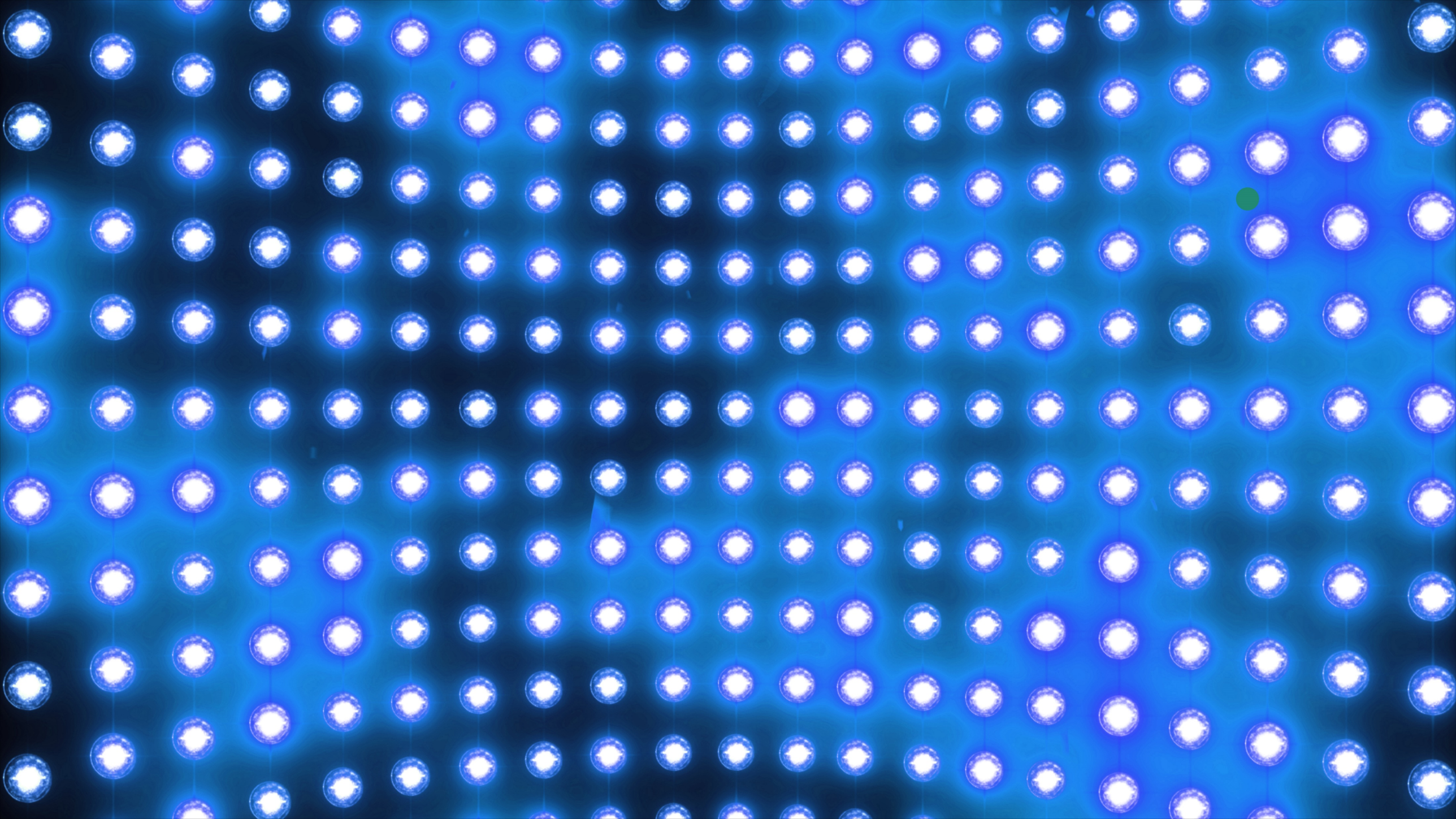
- Developer Relations
- Anything Performance Engineering
- Backend Technologies
- Fairy Tales (AMD, Intel, Nvidia)

@noctarius2k

@noctarius2k@mastodon.online

@noctarius.com

FAMILY
FEUD



Question 01

FAMILY FEUD

Question 01

Why you shouldn't run a database in Kubernetes?

Why not to run a database in Kubernetes?

Christoph Engelbert / Noctarius ツ / エンゲルベルト クリス
@noctarius2k

Why you ***SHOULD NOT*** run a database in Kubernetes?
What do you think? Please help me, I need you! 🙏💙

PS: Asking for a friend! 😅

via: #postgresql #mysql #mariadb #kafka #kubernetes

Why not to run a database in Kubernetes?

simplyblock

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

Persistent Data will kill you! Too slow!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

Persistent Data will kill you! Too slow!

Nobody understands Kubernetes!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

Persistent Data will kill you! Too slow!

Nobody understands Kubernetes!

What’s the benefit; databases don’t need autoscaling!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

Persistent Data will kill you! Too slow!

Nobody understands Kubernetes!

What’s the benefit; databases don’t need autoscaling!

Databases and applications should be separated!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

Persistent Data will kill you! Too slow!

Nobody understands Kubernetes!

What’s the benefit; databases don’t need autoscaling!

Databases and applications should be separated!

Not another layer of indirection / abstraction!

Why not to run a database in Kubernetes?

K8s is not designed with Databases in mind!

Never run Stateful Workloads in k8s!

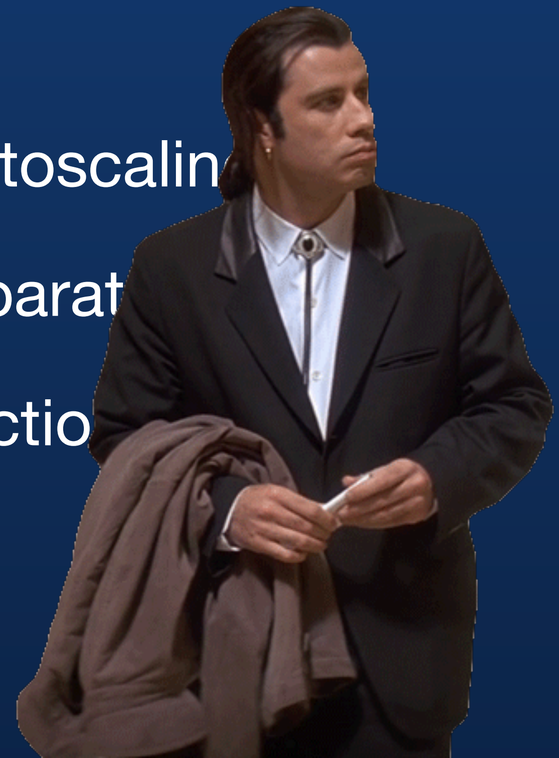
Persistent Data will kill you! Too slow!

Nobody understands Kubernetes!

What’s the benefit; databases don’t need autoscalin

Databases and applications should be separat

Not another layer of indirectio / abstractio

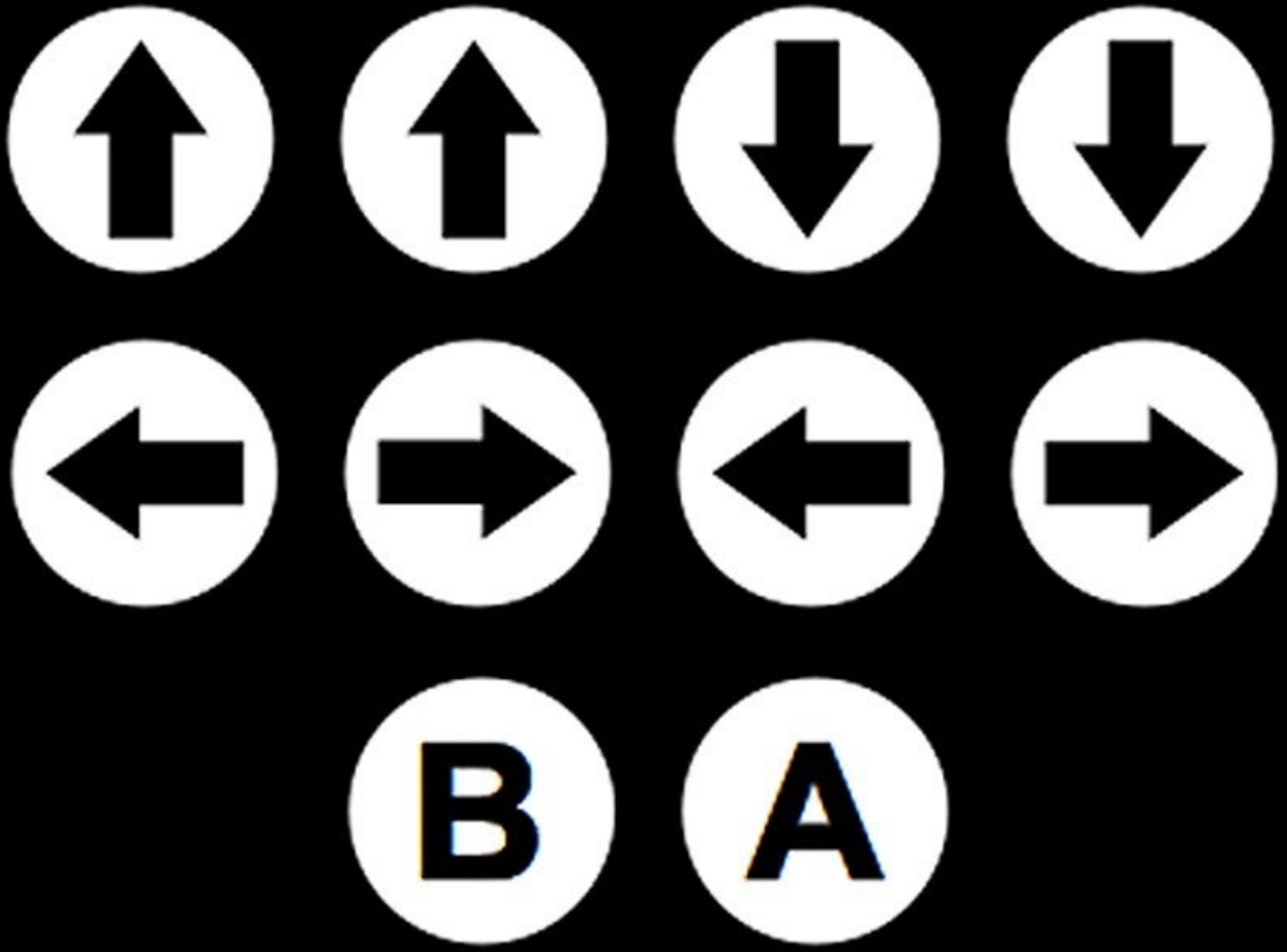


simplyblock

BURN IN HELL!
joyreactor.com

The Happy Place

So we need to cheat!?


B
A

Why?

simplyblock

Why?

No Cloud-Vendor Lock-In

simplyblock

Why?

No Cloud-Vendor Lock-In

Faster Time To Market

simplyblock

Why?

No Cloud-Vendor Lock-In

Faster Time To Market

Decreasing cost

simplyblock

Why?

No Cloud-Vendor Lock-In

Faster Time To Market

Decreasing cost

Automation

simplyblock

Why?

No Cloud-Vendor Lock-In

Faster Time To Market

Decreasing cost

Automation

Unified deployment architecture

simplyblock

Why?

No Cloud-Vendor Lock-In

Faster Time To Market

Decreasing cost

Automation

Unified deployment architecture

Need read-only replicas

simplyblock

Let’s get something
out of the way first!

Call the Police!

simplyblock

Call the Police!

Enable TLS

simplyblock

Call the Police!

Enable TLS

Use Kubernetes Secrets

simplyblock

Call the Police!

Enable TLS

Use Kubernetes Secrets

Use Cert-Manager

simplyblock

Call the Police!

Enable TLS

Use Kubernetes Secrets

Use Cert-Manager

Encrypt Data-At-Rest

simplyblock

Call the Police!

Enable TLS

Use Kubernetes Secrets

Use Cert-Manager

Encrypt Data-At-Rest

simplyblock

Backup and Recovery

simplyblock

https://www.ovhcloud.com/de/bare-metal/backup-storage/

Backup and Recovery

You want Continuous Backup and PITR

simplyblock

https://www.ovhcloud.com/de/bare-metal/backup-storage/

Backup and Recovery

You want Continuous Backup and PITR

Roll your own pg_basebackup or pg_dump (don’t!)

simplyblock

https://www.ovhcloud.com/de/bare-metal/backup-storage/

Backup and Recovery

You want Continuous Backup and PITR

Roll your own pg_basebackup or pg_dump (don’t!)

Use tools like pgbackrest, barman, PGHoard, …

simplyblock

https://www.ovhcloud.com/de/bare-metal/backup-storage/

Backup and Recovery

You want Continuous Backup and PITR

Roll your own pg_basebackup or pg_dump (don’t!)

Use tools like pgbackrest, barman, PGHoard, …

Upload backups to S3? Cost!

simplyblock

https://www.ovhcloud.com/de/bare-metal/backup-storage/

Backup and Recovery

You want Continuous Backup and PITR

Roll your own pg_basebackup or pg_dump (don’t!)

Use tools like pgbackrest, barman, PGHoard, …

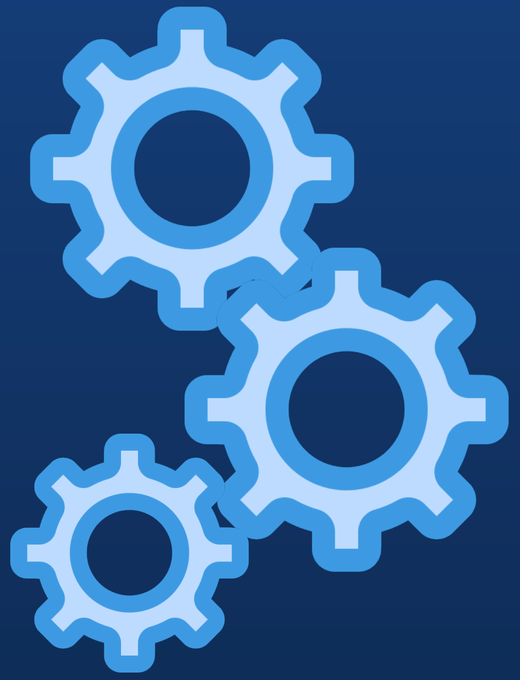
Upload backups to S3? Cost!

😅 Test Your Backups 😅

simplyblock

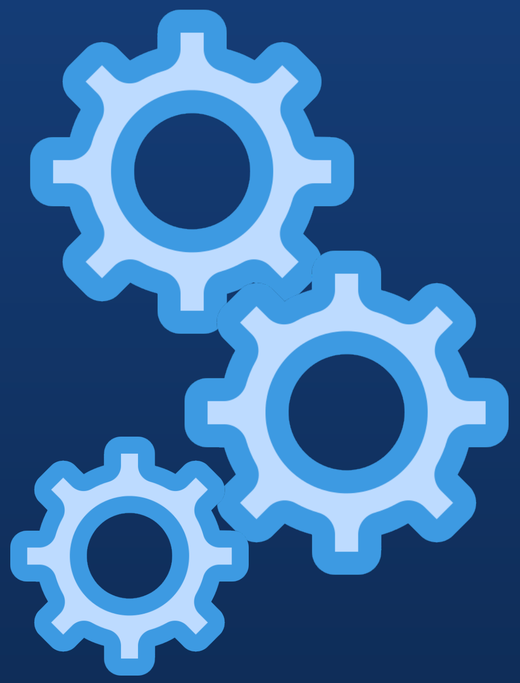
https://www.ovhcloud.com/de/bare-metal/backup-storage/

PostgreSQL Configuration



simplyblock

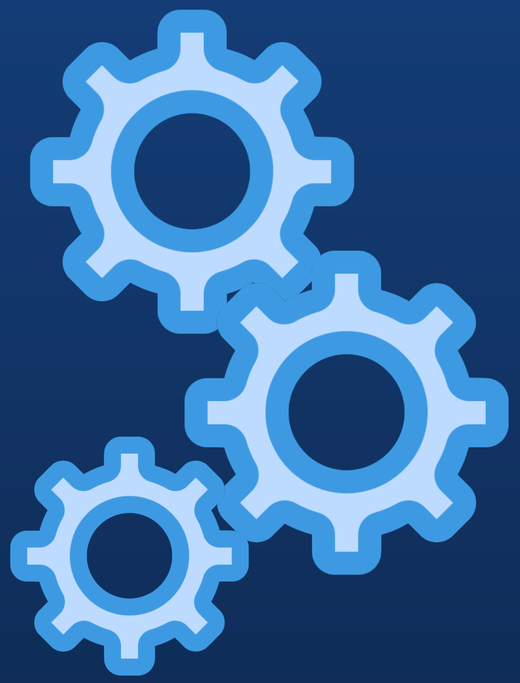
PostgreSQL Configuration



The PostgreSQL Configuration isn’t too much influenced

simplyblock

PostgreSQL Configuration



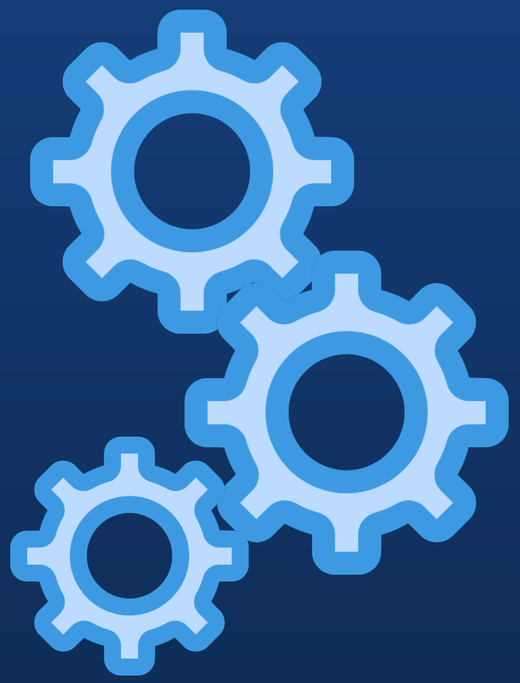
The PostgreSQL Configuration isn’t too much influenced

shared_buffers

(maintenance_)work_mem

effective_cache_size

PostgreSQL Configuration



The PostgreSQL Configuration isn’t too much influenced

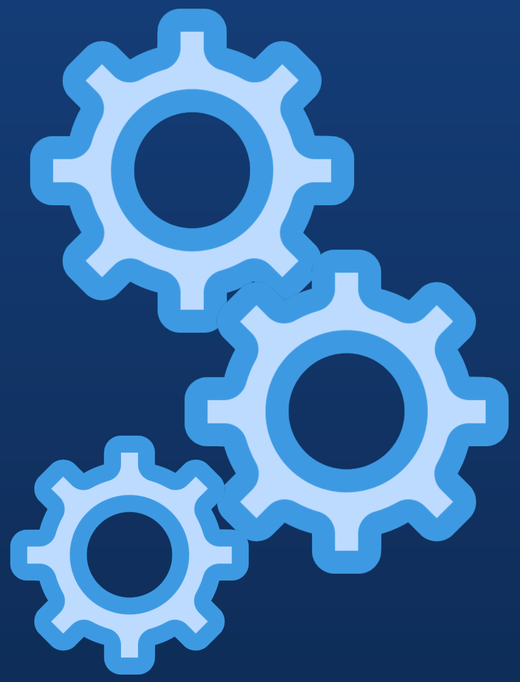
shared_buffers

(maintenance_)work_mem

effective_cache_size

Use Huge Pages!

PostgreSQL Configuration



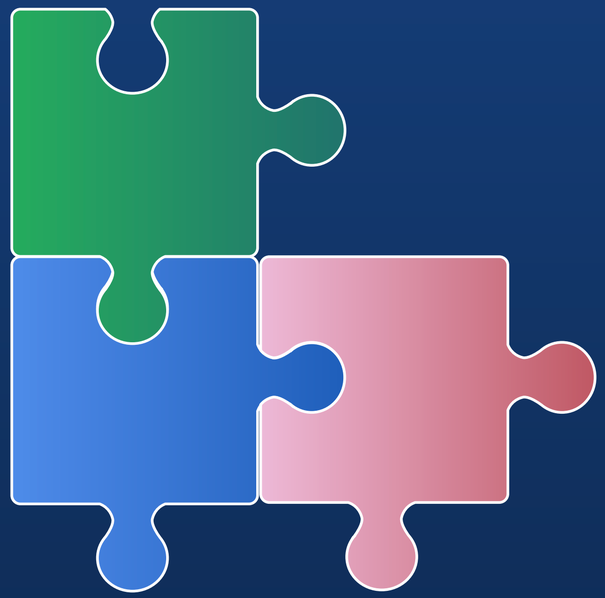
https://www.youtube.com/watch?v=S0LEDGbAnn8

https://www.crunchydata.com/blog/optimize-postgresql-server-performance

https://www.percona.com/blog/using-huge-pages-with-postgresql-running-inside-kubernetes/

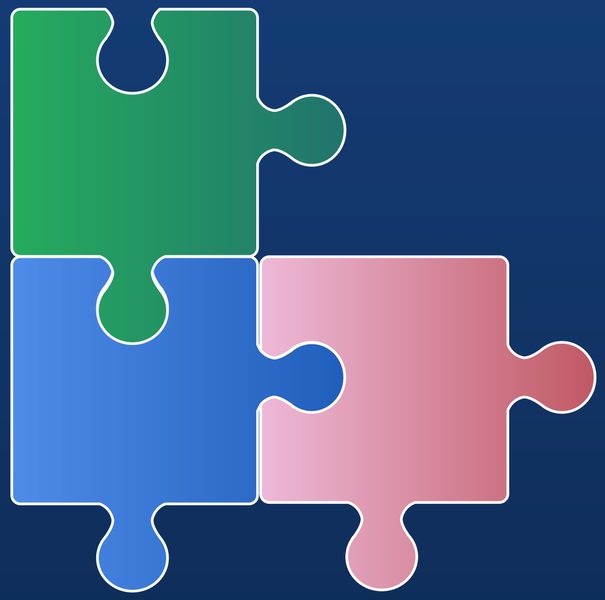
simplyblock

Do you need more? Extensions!



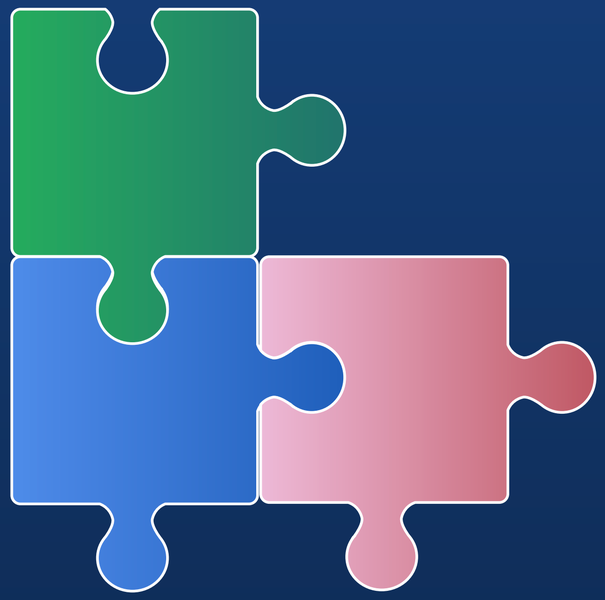
simplyblock

Do you need more? Extensions!



Do you need PG Extensions?

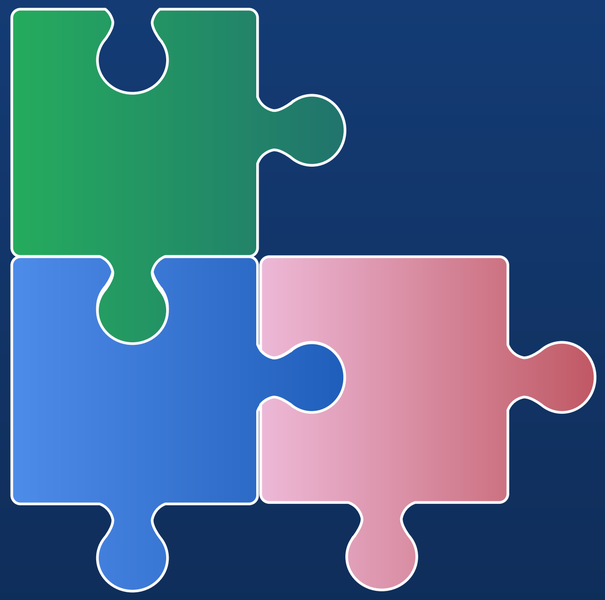
Do you need more? Extensions!



Do you need PG Extensions?

Is the extension part of the container image?

Do you need more? Extensions!



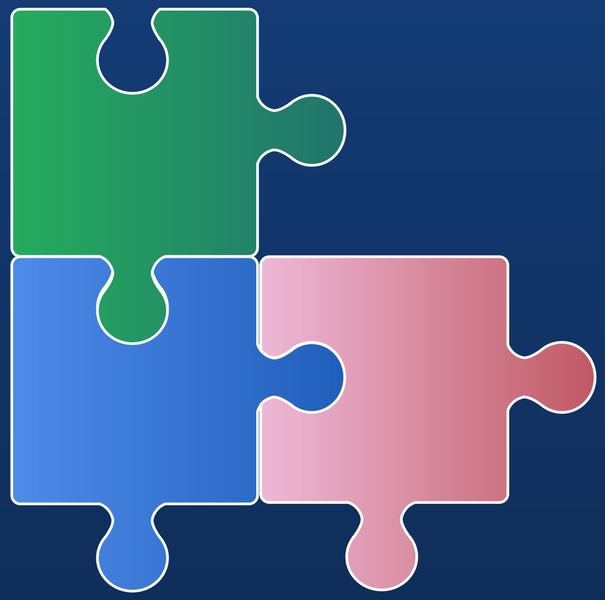
Do you need PG Extensions?

Is the extension part of the container image?

If not, you need to build your own layer…

simplyblock

Do you need more? Extensions!



Do you need PG Extensions?

Is the extension part of the container image?

If not, you need to build your own layer…

or use some magic (more on this later).

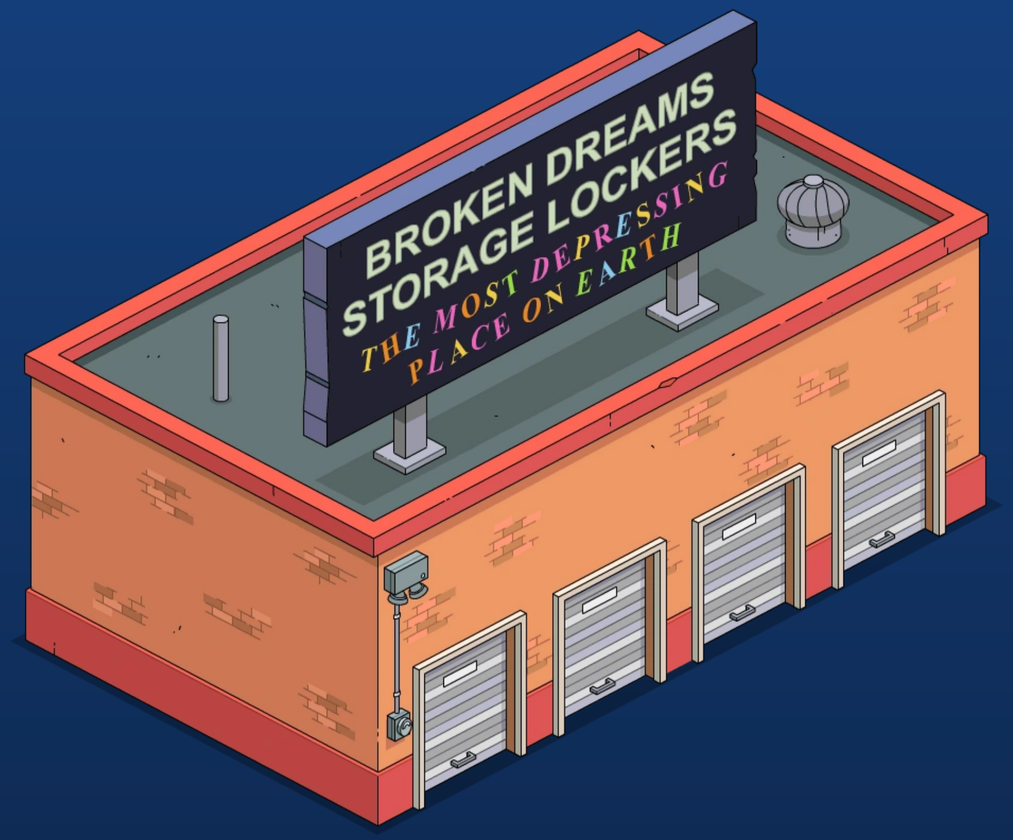
Keep an Eye on PG and Kubernetes Versions

So *What* is important or different?

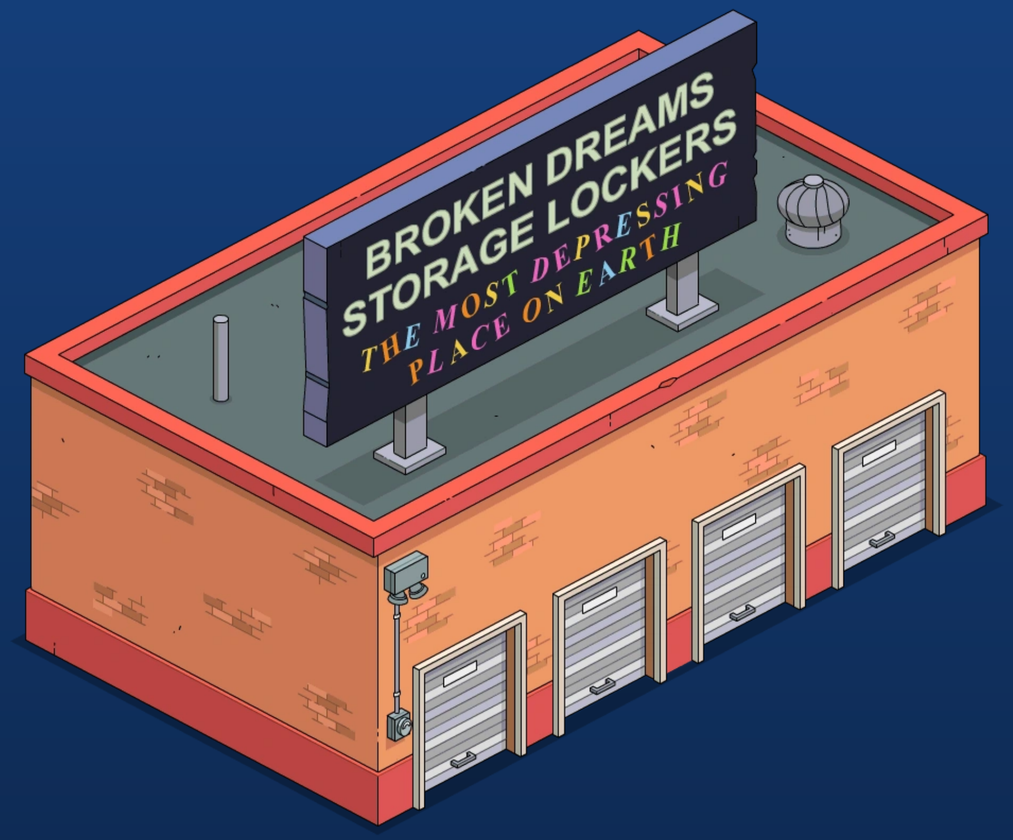
Storage

simplyblock

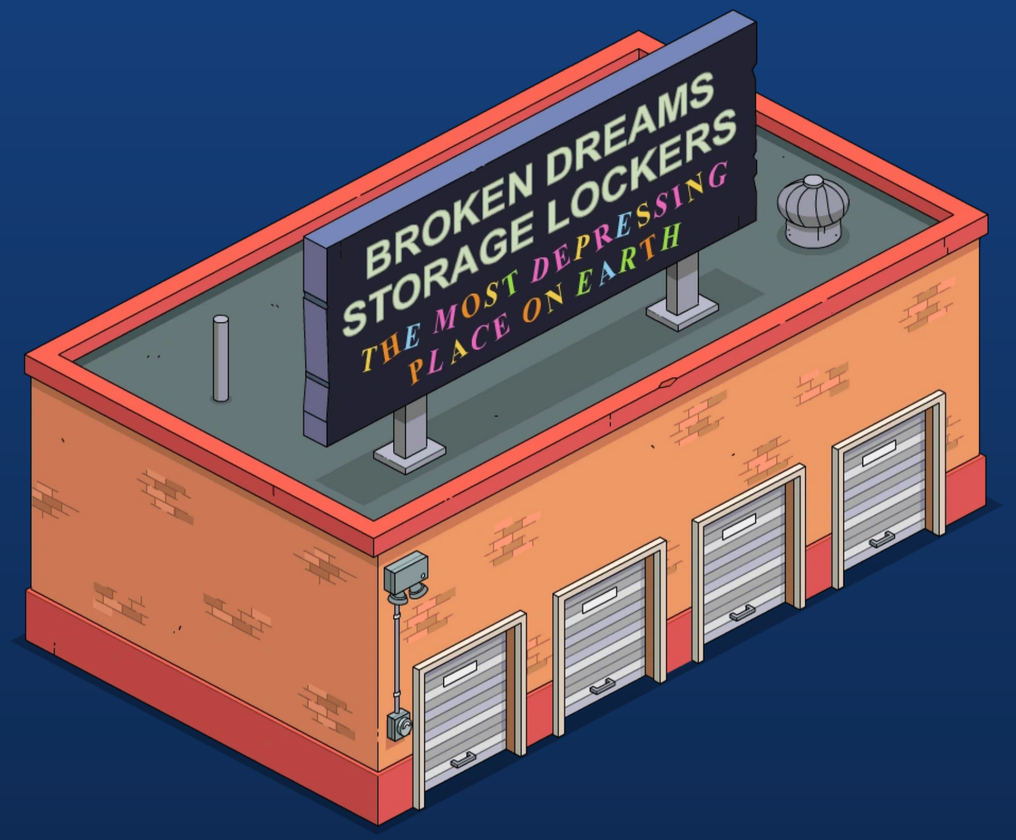
Storage



simplyblock

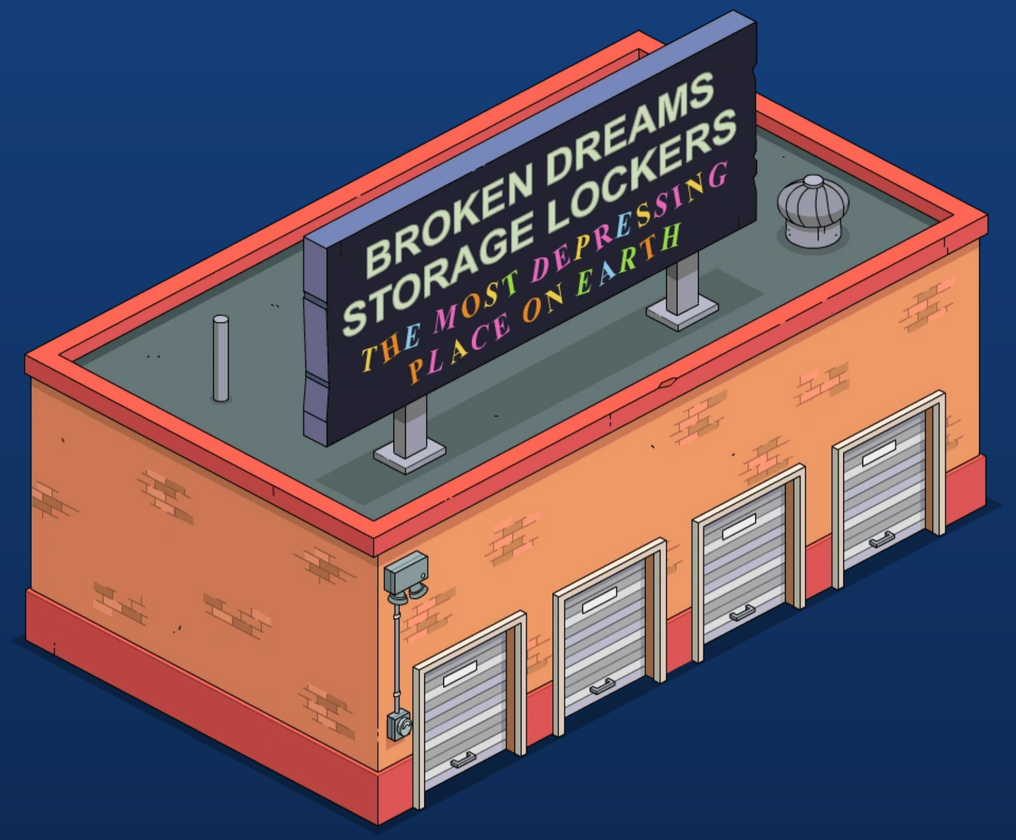


Use Persistent Volumes



Use Persistent Volumes

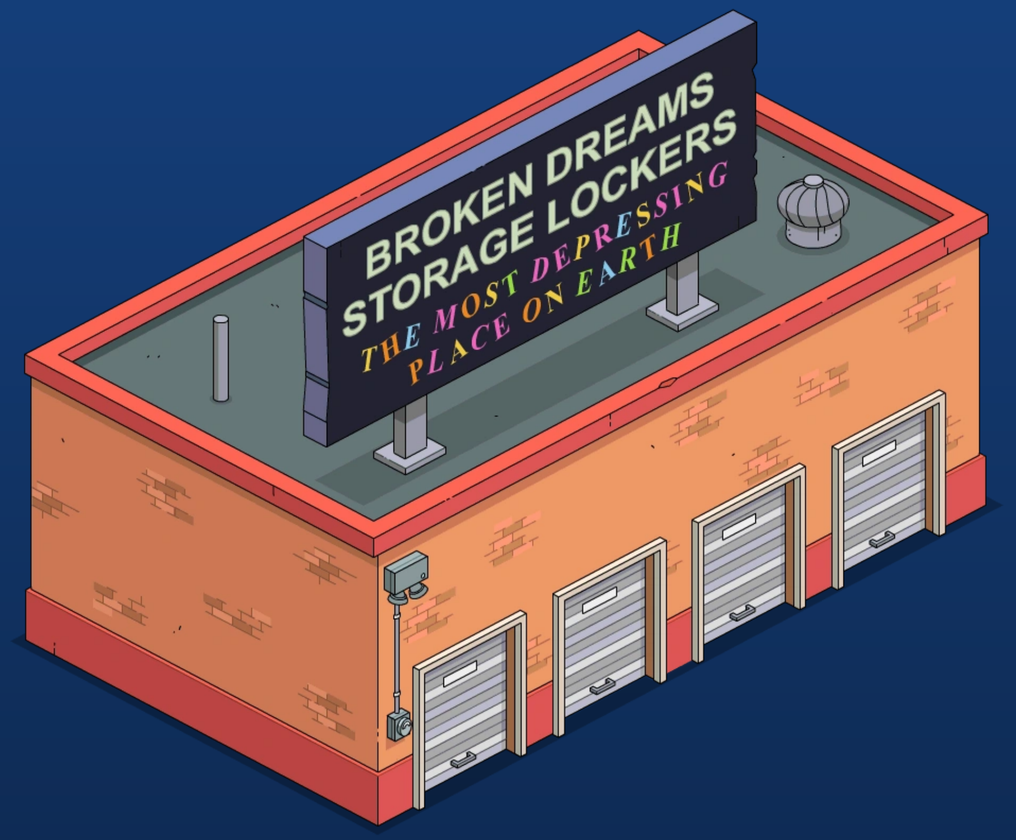
(local volumes are a bad idea)



Use Persistent Volumes

(local volumes are a bad idea)

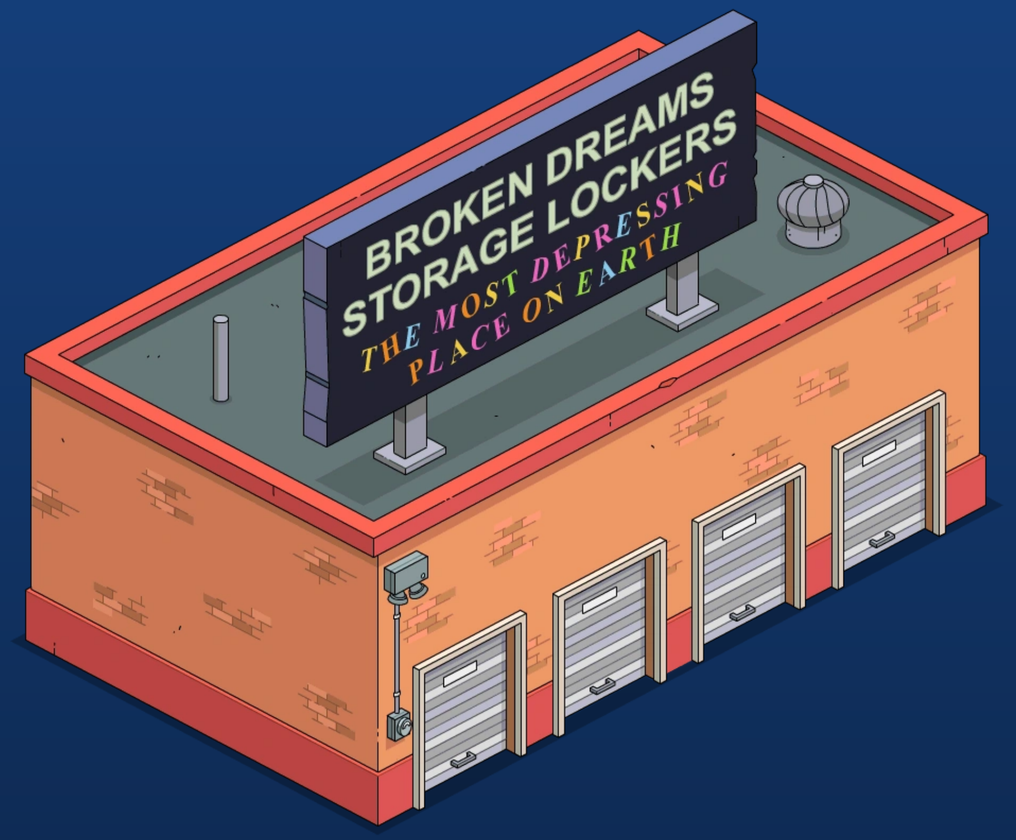
Should be dynamically provisioned



Use Persistent Volumes
(local volumes are a bad idea)

Should be dynamically provisioned

CSI provider enables encryption at rest

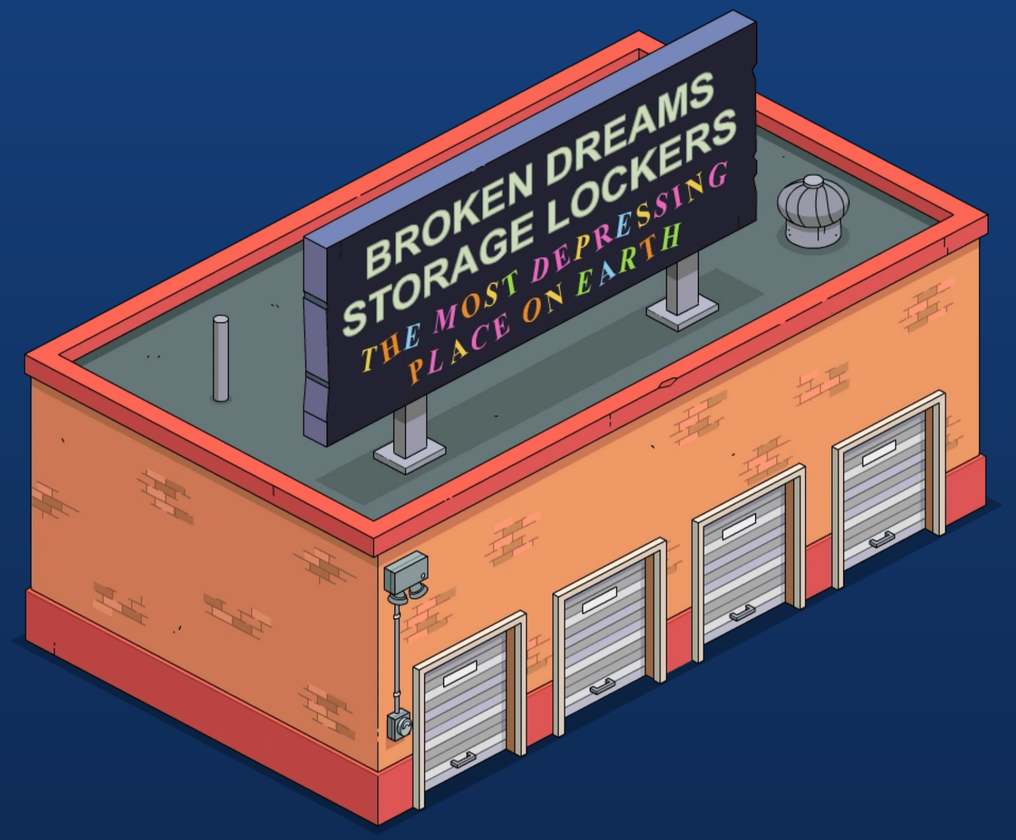


Use Persistent Volumes
(local volumes are a bad idea)

Should be dynamically provisioned

CSI provider enables encryption at rest

High IOPS (SSD or NVMe)



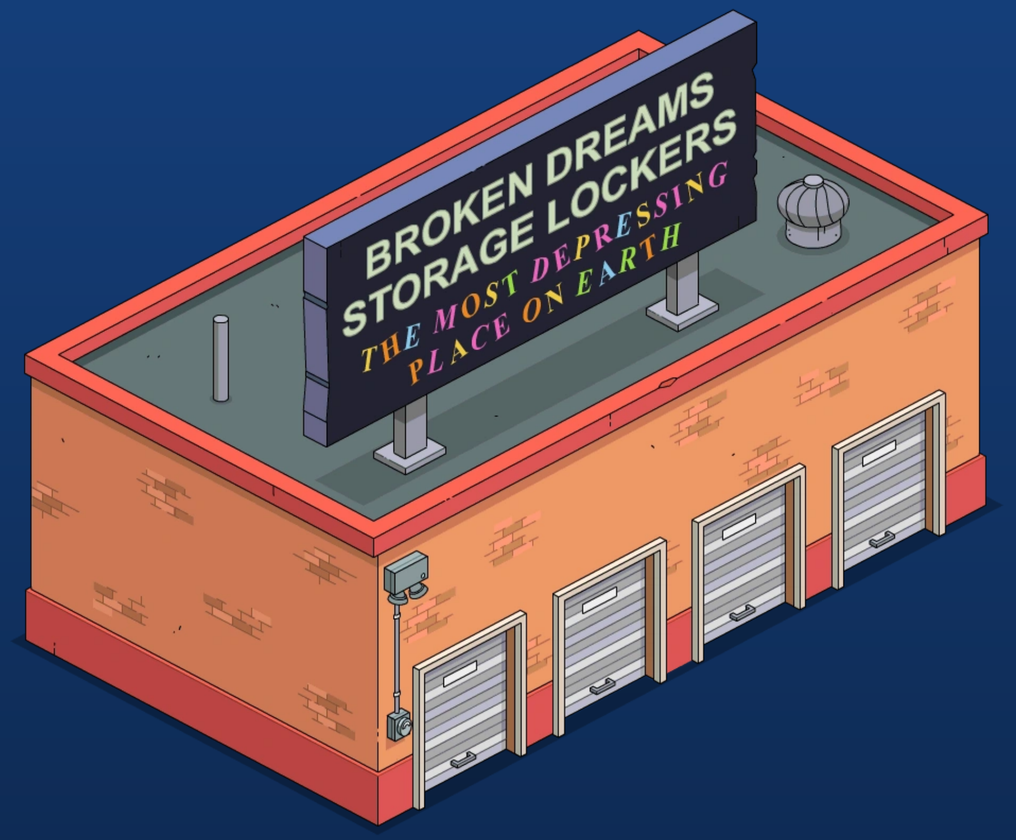
Use Persistent Volumes
(local volumes are a bad idea)

Should be dynamically provisioned

CSI provider enables encryption at rest

High IOPS (SSD or NVMe)

Low Latency



Use Persistent Volumes
(local volumes are a bad idea)

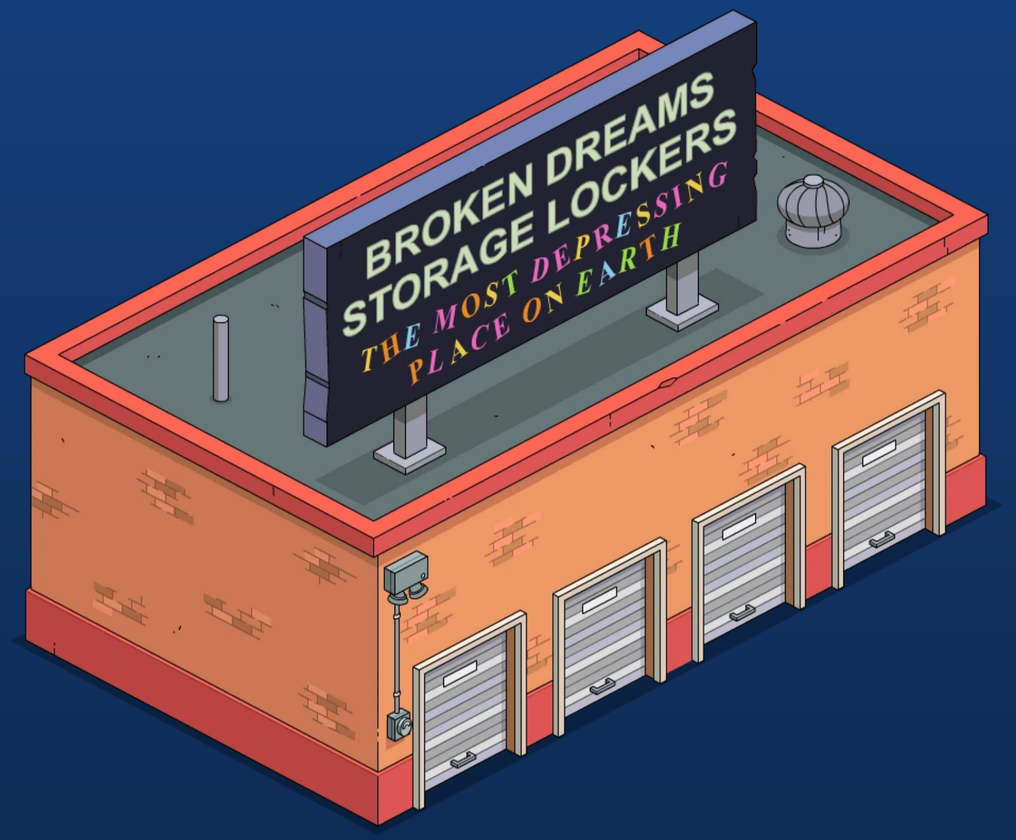
Should be dynamically provisioned

CSI provider enables encryption at rest

High IOPS (SSD or NVMe)

Low Latency

Database performance is as fast as your storage



Use Persistent Volumes
(local volumes are a bad idea)

Should be dynamically provisioned

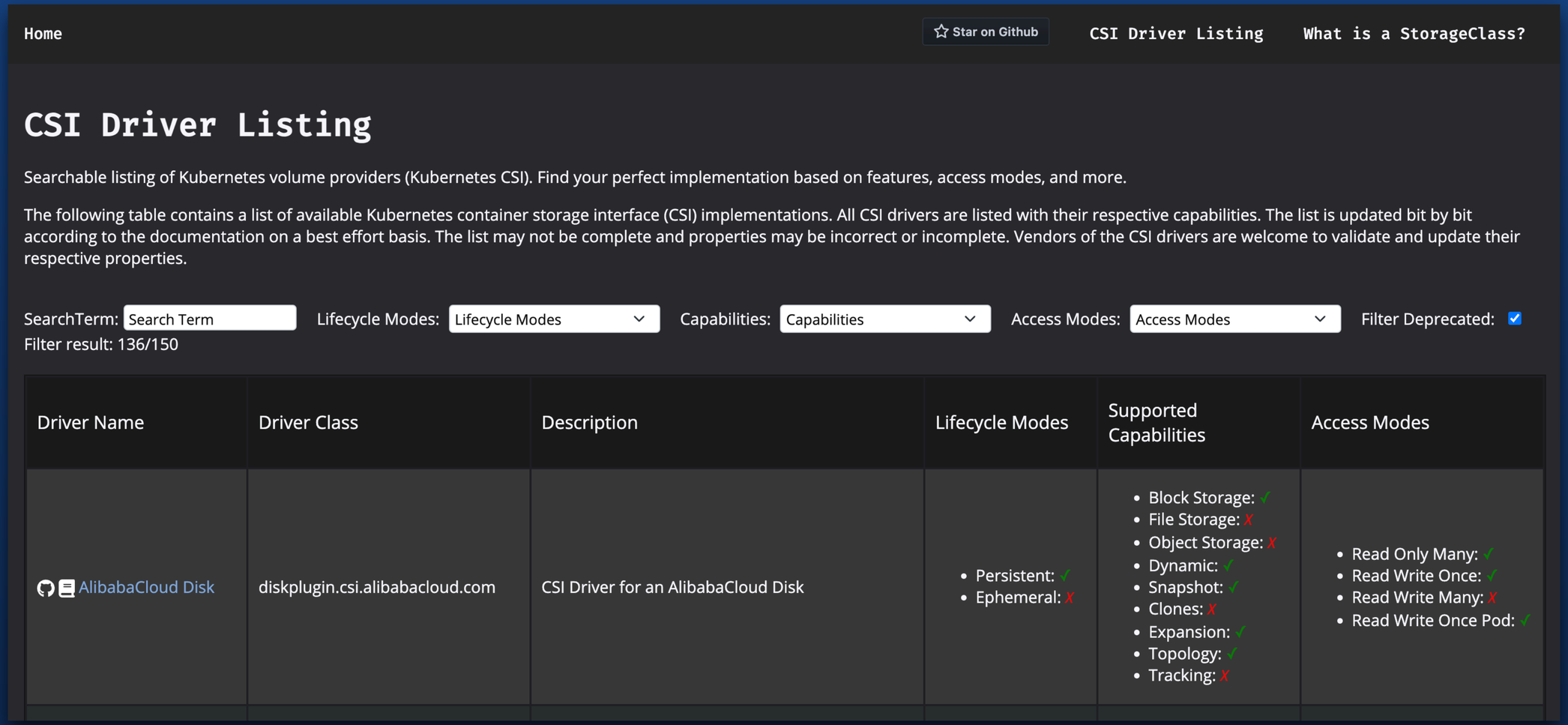
CSI provider enables encryption at rest

High IOPS (SSD or NVMe)

Low Latency

Database performance is as fast as your storage

I’d recommend a disaggregated storage!



Home ☆ Star on Github CSI Driver Listing What is a StorageClass?

CSI Driver Listing

Searchable listing of Kubernetes volume providers (Kubernetes CSI). Find your perfect implementation based on features, access modes, and more.

The following table contains a list of available Kubernetes container storage interface (CSI) implementations. All CSI drivers are listed with their respective capabilities. The list is updated bit by bit according to the documentation on a best effort basis. The list may not be complete and properties may be incorrect or incomplete. Vendors of the CSI drivers are welcome to validate and update their respective properties.

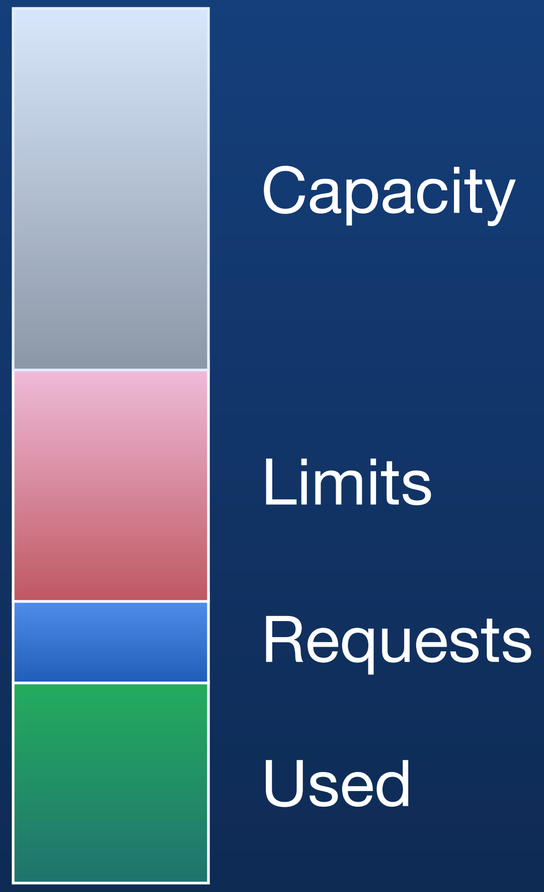
SearchTerm: Search Term Lifecycle Modes: Lifecycle Modes Capabilities: Capabilities Access Modes: Access Modes Filter Deprecated:

Filter result: 136/150

Driver Name	Driver Class	Description	Lifecycle Modes	Supported Capabilities	Access Modes
AlibabaCloud Disk	diskplugin.csi.alibabacloud.com	CSI Driver for an AlibabaCloud Disk	• Persistent: ✓ • Ephemeral: ✗	• Block Storage: ✓ • File Storage: ✗ • Object Storage: ✗ • Dynamic: ✓ • Snapshot: ✓ • Clones: ✗ • Expansion: ✓ • Topology: ✓ • Tracking: ✗	• Read Only Many: ✓ • Read Write Once: ✓ • Read Write Many: ✗ • Read Write Once Pod: ✓

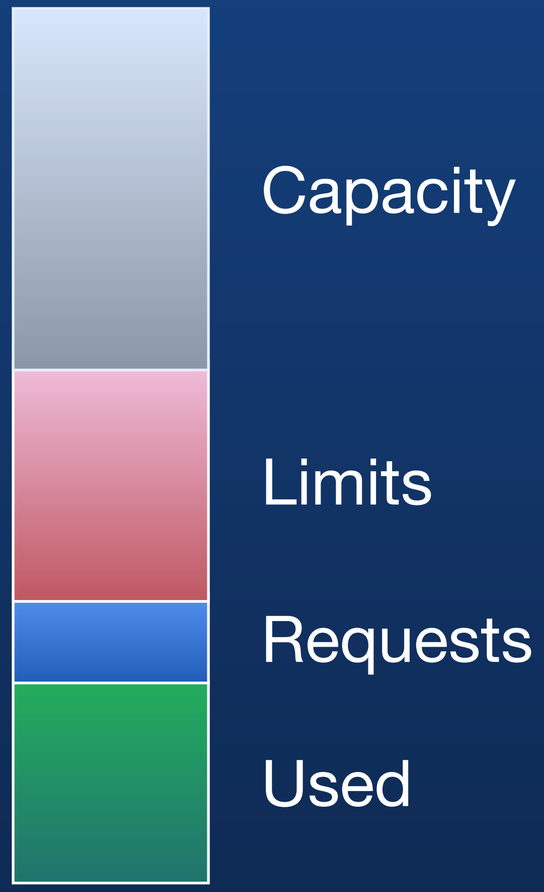
www.storageclass.info/csidrivers

Requests, Limits, and Quotas



simplyblock

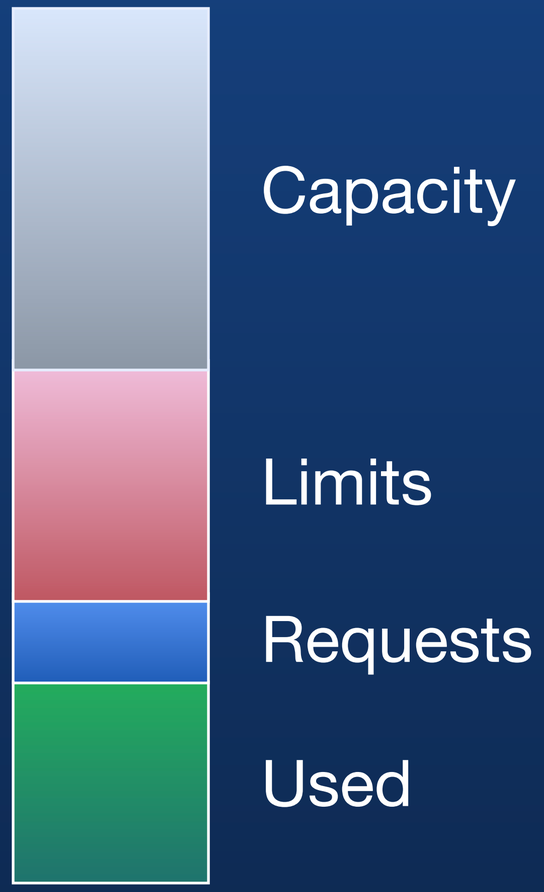
Requests, Limits, and Quotas



Use Resource Requests, Limits, Quotas

simplyblock

Requests, Limits, and Quotas

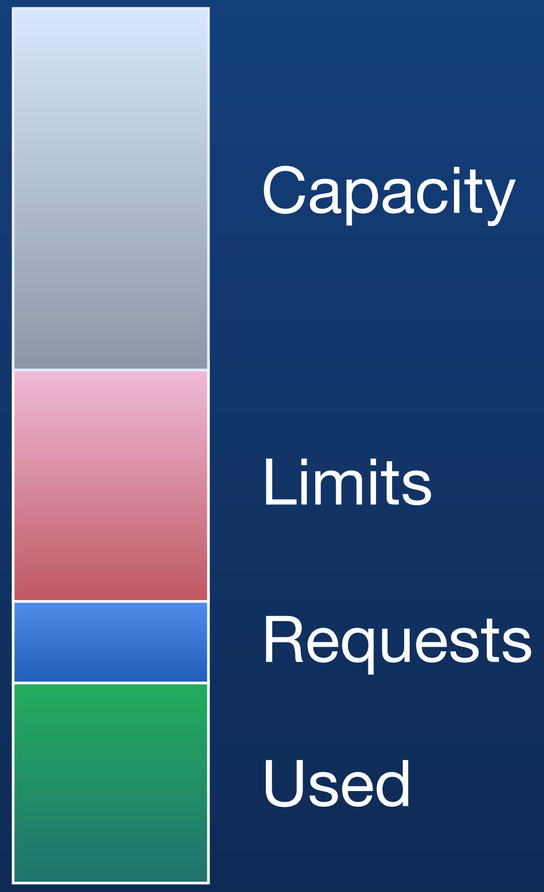


Use Resource Requests, Limits, Quotas

CPU and memory requests need to be accurate
to prevent contention and ensure predictable performance

simplyblock

Requests, Limits, and Quotas



Use Resource Requests, Limits, Quotas

CPU and memory requests need to be accurate
to prevent contention and ensure predictable performance

https://codimite.ai/blog/kubernetes-resources-and-scaling-a-beginners-guide/

simplyblock

Enable Huge Pages!

Make it big!

Enable Huge Pages!

In your OS and the Resource Descriptor.

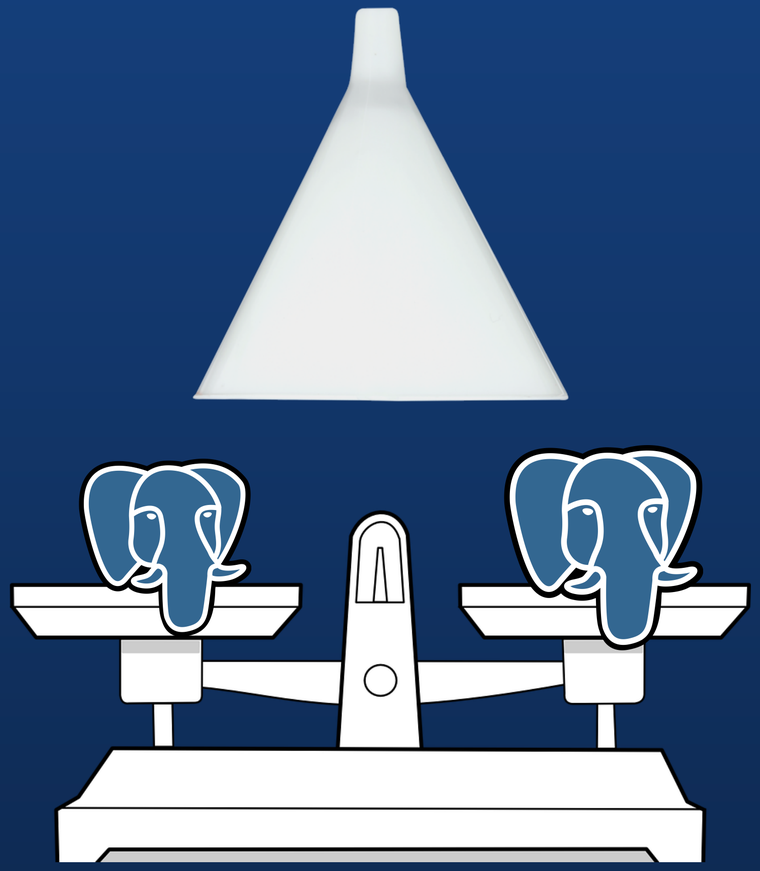
simplyblock

Enable Huge Pages!

In your OS and the Resource Descriptor.

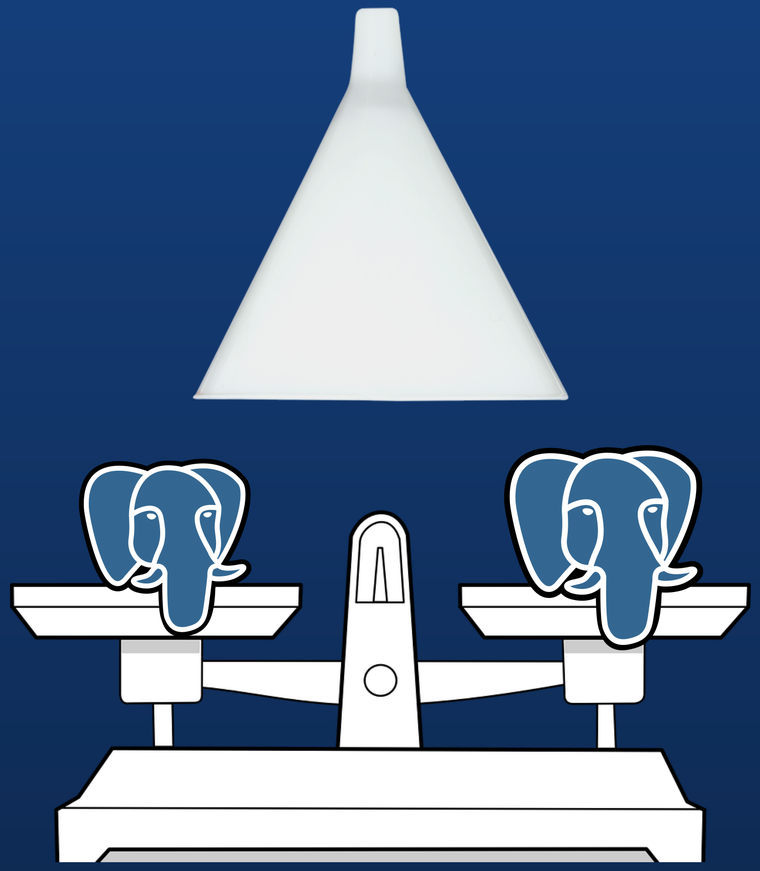
https://www.percona.com/blog/using-huge-pages-with-postgresql-running-inside-kubernetes/

Resiliency and Overhead



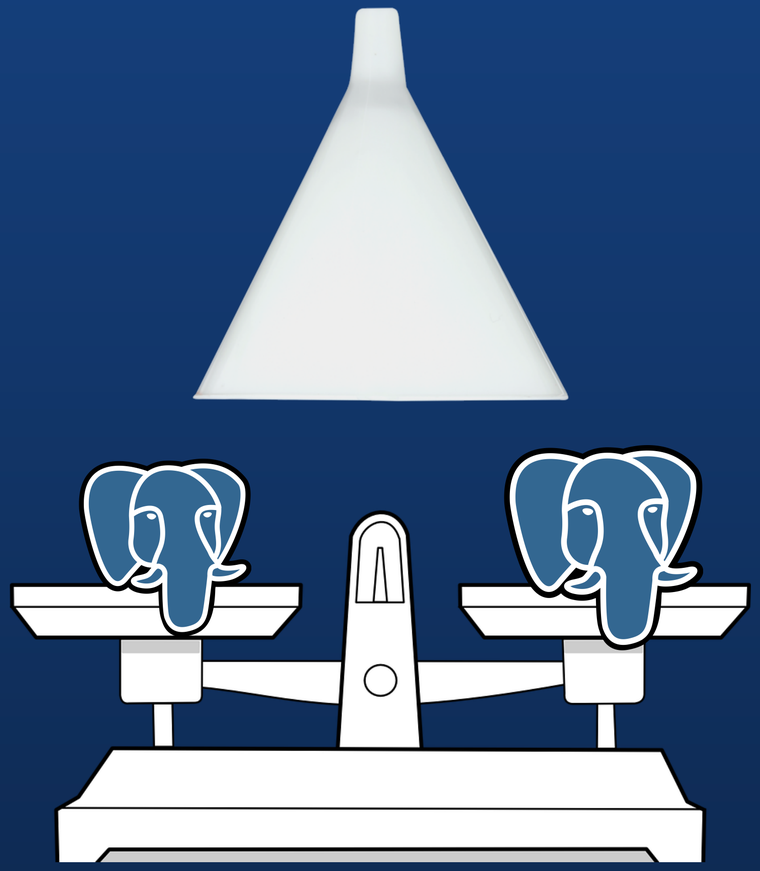
simplyblock

Resiliency and Overhead



High Availability

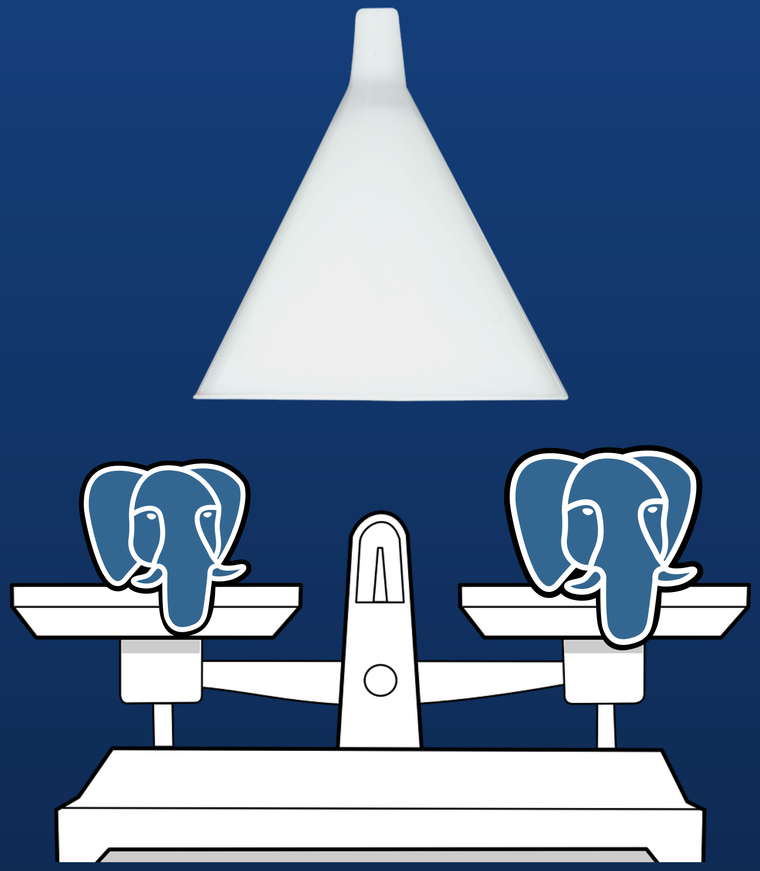
Resiliency and Overhead



High Availability

Patroni, repmgr, pg_auto_failover, …

Resiliency and Overhead

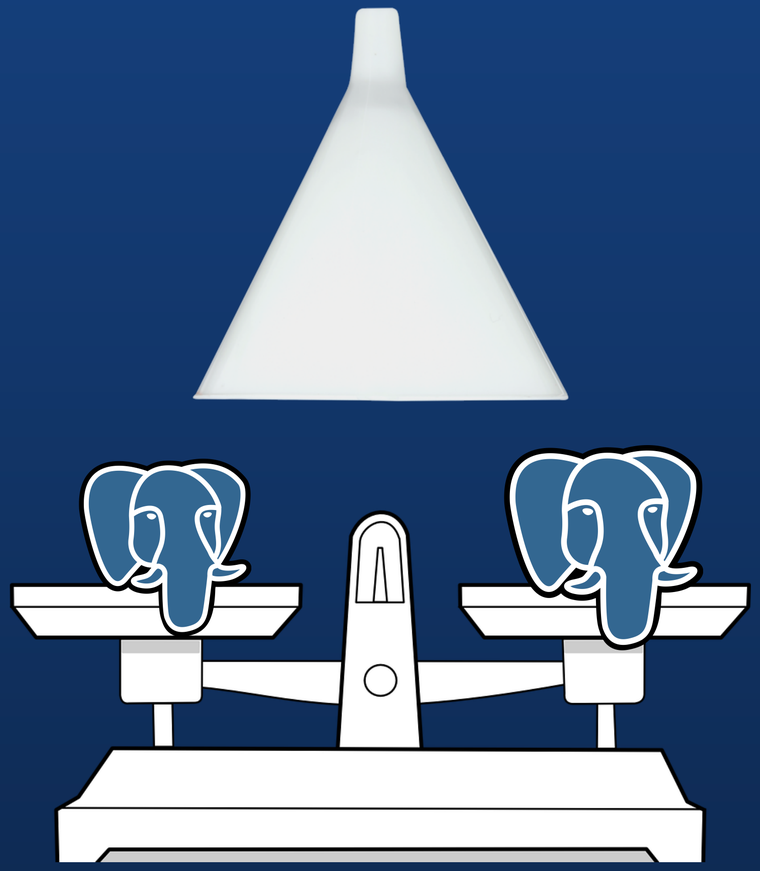


High Availability

Patroni, repmgr, pg_auto_failover, …

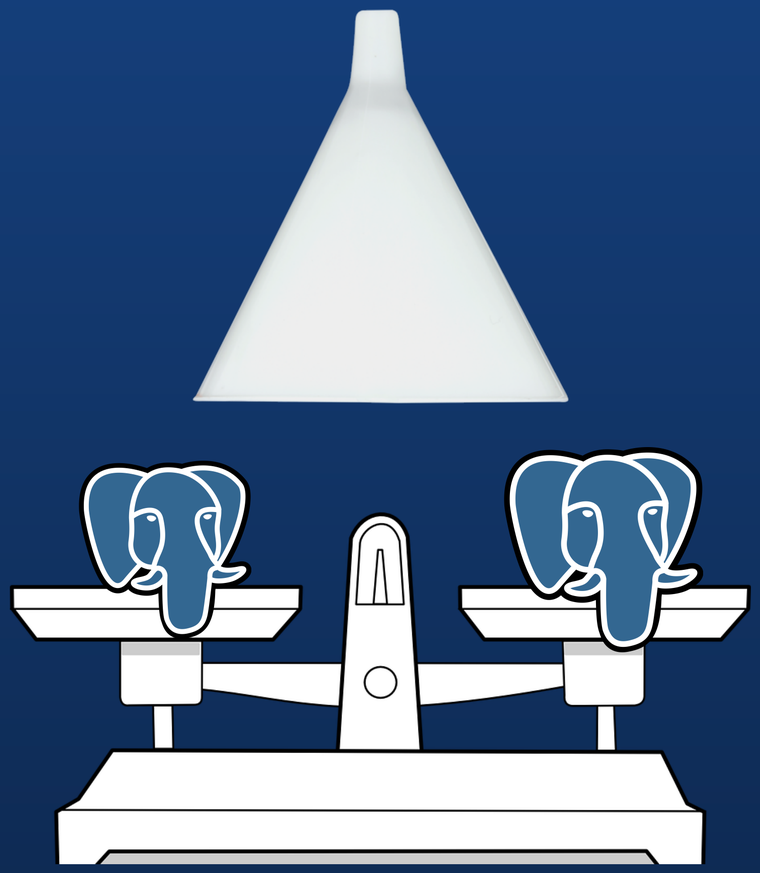
https://medium.com/@kristi.anderson/whats-the-best-postgresql-high-availability-framework...

Resiliency and Overhead

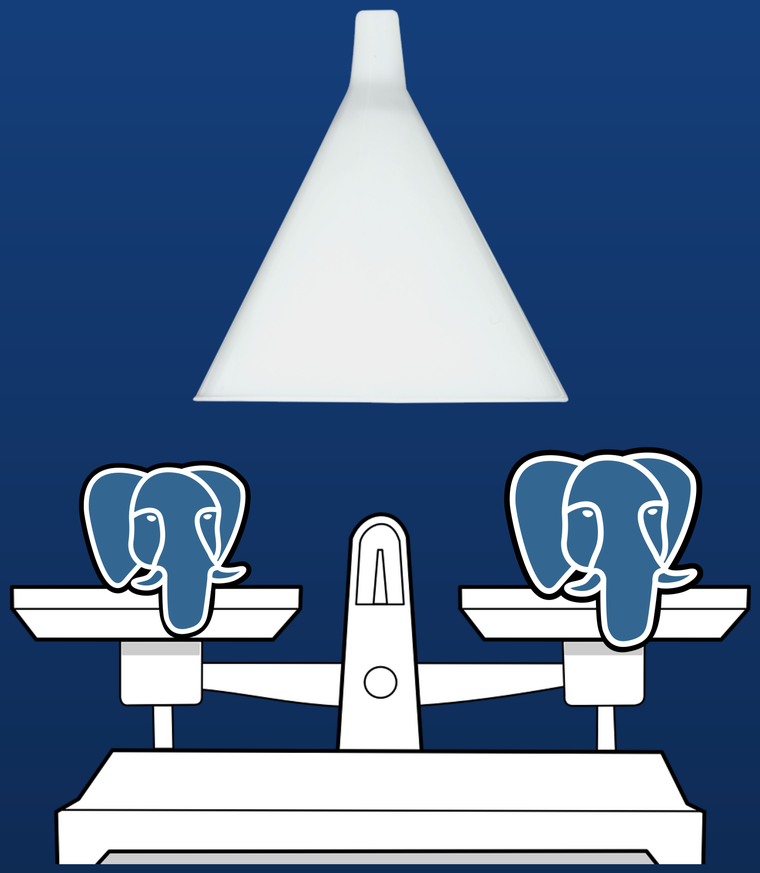


simplyblock

Resiliency and Overhead

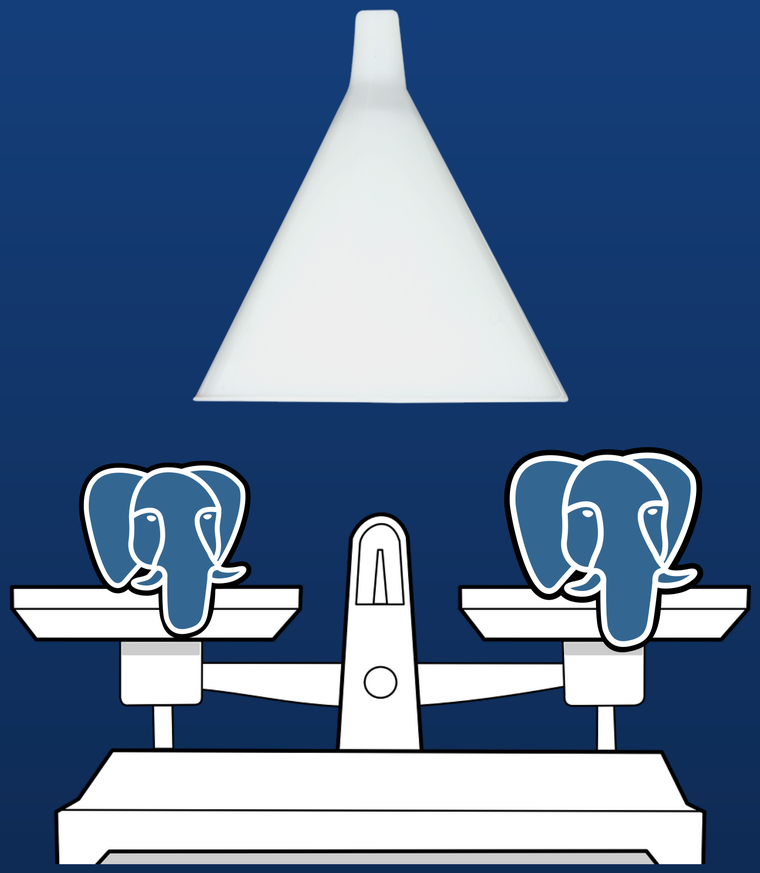


Connection Pooling



Connection Pooling

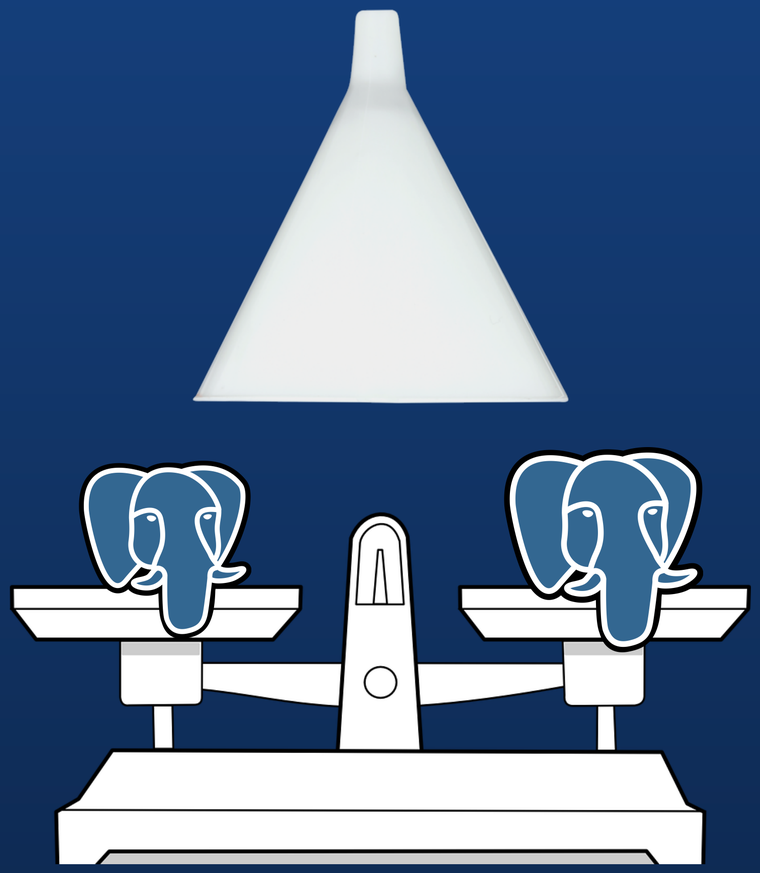
Never use PostgreSQL without Connection Pooling!



Connection Pooling

Never use PostgreSQL without Connection Pooling!

Optimizes Overhead and Resource Utilization

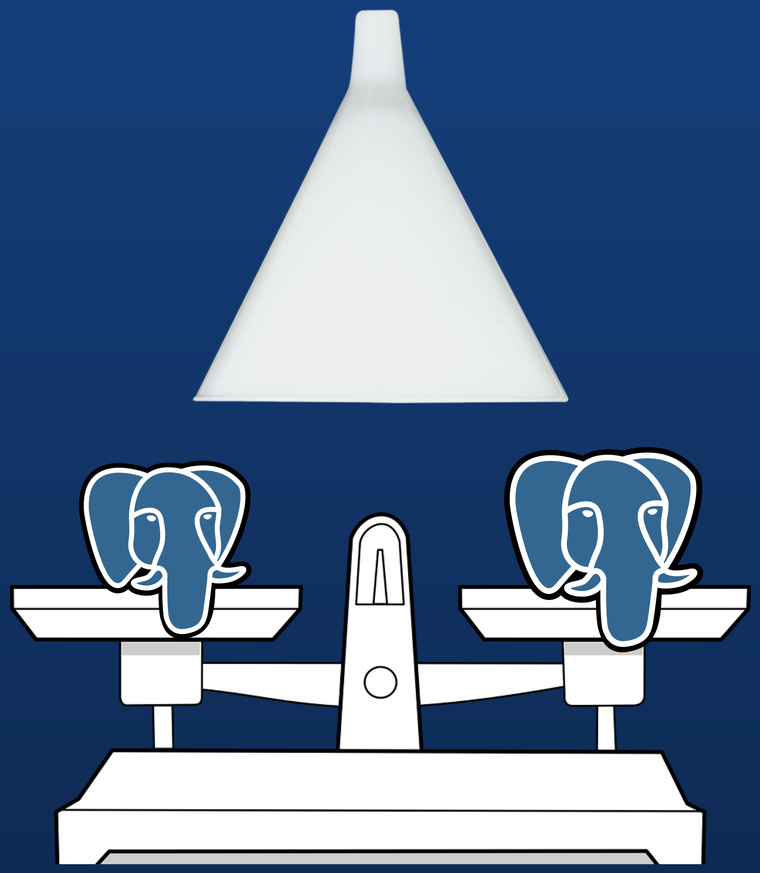


Connection Pooling

Never use PostgreSQL without Connection Pooling!

Optimizes Overhead and Resource Utilization

Handles failovers, central switching of Primary



Connection Pooling

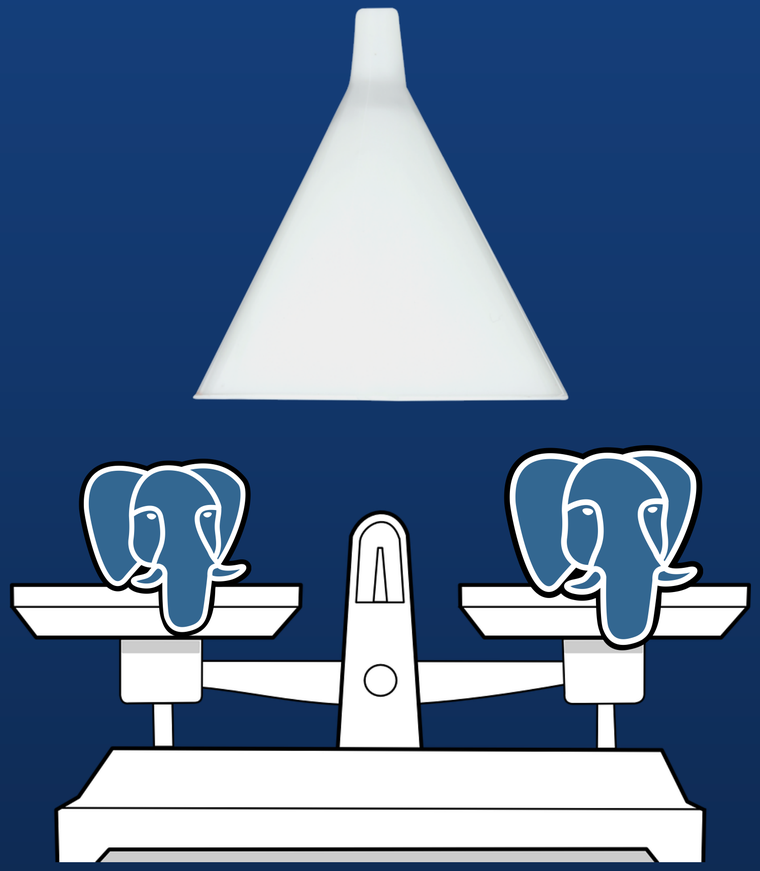
Never use PostgreSQL without Connection Pooling!

Optimizes Overhead and Resource Utilization

Handles failovers, central switching of Primary

Enables easy use of Read-Replicas

Resiliency and Overhead



Connection Pooling

Never use PostgreSQL without Connection Pooling!

Optimizes Overhead and Resource Utilization

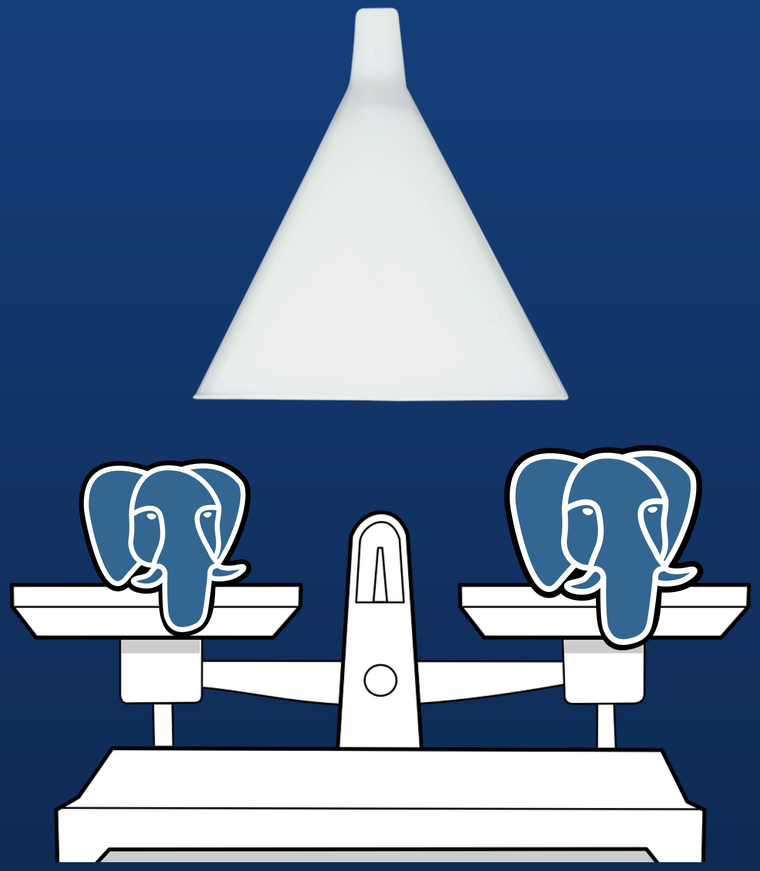
Handles failovers, central switching of Primary

Enables easy use of Read-Replicas

PgBouncer, PgPool-II, pgagroal, PgCat, Odyssey, …

simplyblock

Resiliency and Overhead



Connection Pooling

Never use PostgreSQL without Connection Pooling!

Optimizes Overhead and Resource Utilization

Handles failovers, central switching of Primary

Enables easy use of Read-Replicas

PgBouncer, PgPool-II, pgagroal, PgCat, Odyssey, …

https://tembo.io/blog/postgres-connection-poolers

Where’s my Replicant?

simplyblock

Where’s my Replicant?

Use available Kubernetes features

simplyblock

Where’s my Replicant?

Use available Kubernetes features

StatefulSet

simplyblock

Where’s my Replicant?

Use available Kubernetes features

StatefulSet

simplyblock

Networking and Access Control

simplyblock

https://timeclock365.com/tc22-door-access-controller/

Networking and Access Control

Use Network Policies

simplyblock

https://timeclock365.com/tc22-door-access-controller/

Networking and Access Control

Use Network Policies

Enable TLS (you remember?!)

simplyblock

https://timeclock365.com/tc22-door-access-controller/

Networking and Access Control

Use Network Policies

Enable TLS (you remember?!)

Setup Security Policies

simplyblock

https://timeclock365.com/tc22-door-access-controller/

Networking and Access Control

Use Network Policies

Enable TLS (you remember?!)

Setup Security Policies

Configure RBAC (Role-Based Access Control)

simplyblock

https://timeclock365.com/tc22-door-access-controller/

Networking and Access Control

Use Network Policies

Enable TLS (you remember?!)

Setup Security Policies

Configure RBAC (Role-Based Access Control)

Think about a policy manager such as OPA or kyverno

simplyblock

https://timeclock365.com/tc22-door-access-controller/

Observability and Alerting

simplyblock

Observability and Alerting

Like anything cloud, make sure you have monitoring (meaning observability) and alerting!

Observability and Alerting

Like anything cloud, make sure you have

monitoring (meaning observability) and alerting!

Prometheus Exporter, Log Collector, Aggregation, Analysis, Traceability, …

simplyblock

Observability and Alerting

Like anything cloud, make sure you have

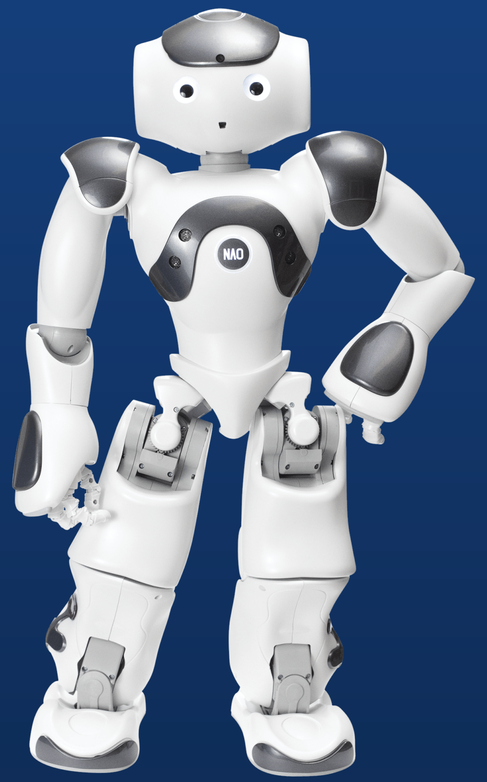
monitoring (meaning observability) and alerting!

Prometheus Exporter, Log Collector, Aggregation, Analysis, Traceability, …

Datadog, Instana, DynaTrace, Grafana, …

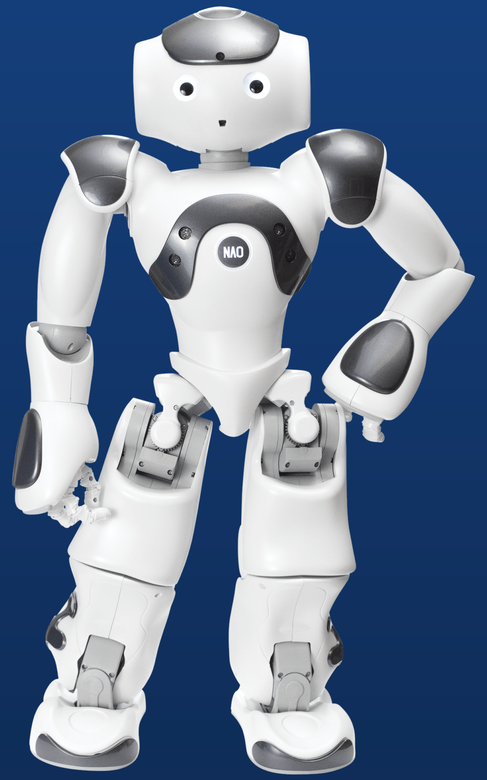
simplyblock

Operator



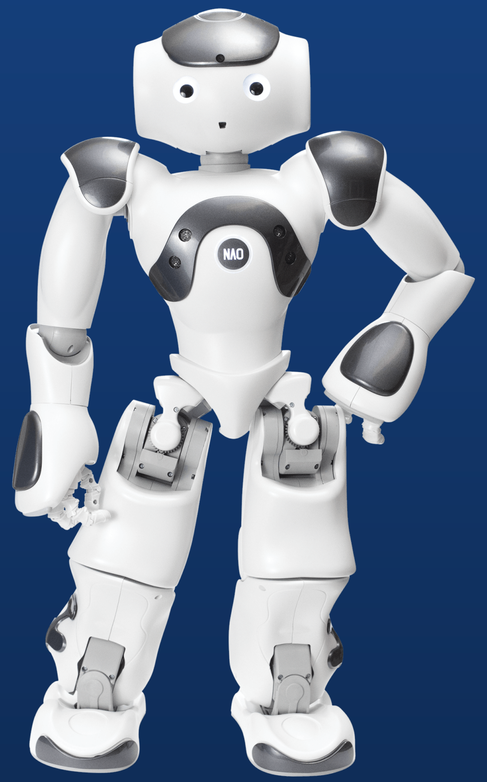
simplyblock

Operator



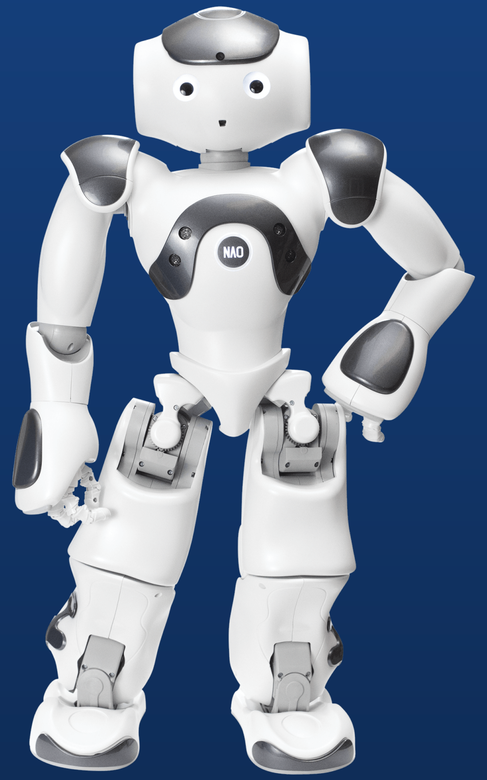
Use a Postgres Kubernetes Operator

simplyblock



Use a Postgres Kubernetes Operator

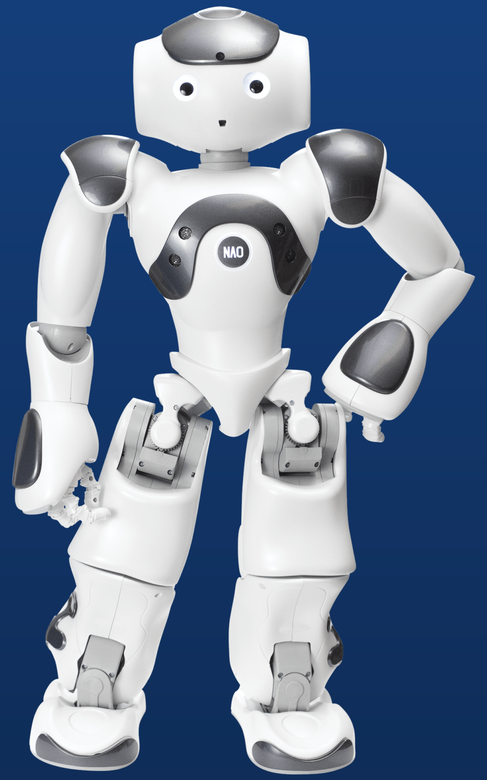
Handles or configures many of the typical tasks (HA, backup, …)



Use a Postgres Kubernetes Operator

Handles or configures many of the typical tasks (HA, backup, …)

Brings cloud-nativeness to PG



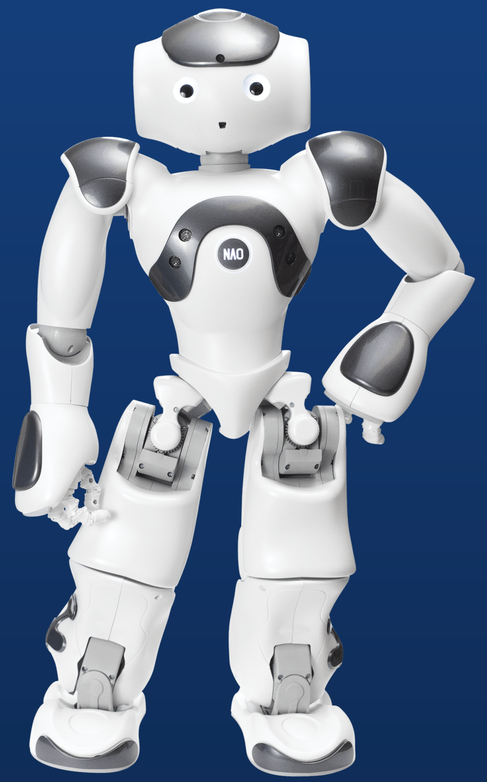
Use a Postgres Kubernetes Operator

Handles or configures many of the typical tasks (HA, backup, …)

Brings cloud-nativeness to PG

Integrates PG into k8s

Operator



Use a Postgres Kubernetes Operator

Handles or configures many of the typical tasks (HA, backup, …)

Brings cloud-nativeness to PG

Integrates PG into k8s

If not, use Helm Charts

simplyblock

Operator

	CloudNativePG	Crunchy Postgres for Kubernetes	OnGres StackGres	KubeDB	Zalando Postgres Operator
Supported versions	12, 13, 14, 15, 16	11, 12, 13, 14, 15, 16	12, 13, 14, 15, 16	9.6, 10, 11, 12, 13, 14	11, 12, 13, 14, 15, 16
Postgres Clusters	✔	✔	✔	✔	✔
Streaming replication	✔	✔	✔	✔	✔
Supports Extensions	✔	✔	✔	✔	✔

Operator

	CloudNativePG	Crunchy Postgres for Kubernetes	OnGres StackGres	KubeDB	Zalando Postgres Operator
Hot Standby	✔	✔	✔	✔	✔
Warm Standby	✔	✔	✔	✔	✔
Automatic Failover	✔	✔	✔	✔	✔
Continuous Archiving	✔	✔	✔	✔	✔
Restore from WAL archive	✔	✔	✔	✔	✔
Supports PITR	✔	✔	✔	✔	✔
Manual backups	✔	✔	✔	✔	✔
Scheduled backups	✔	✔	✔	✔	✔

Operator

	CloudNativePG	Crunchy Postgres for Kubernetes	OnGres StackGres	KubeDB	Zalando Postgres Operator
Backups via Kubernetes	✔	✘	✔	✔	✘
Custom resources	✔	✔	✔	✔	✔
Uses default PG images	✘	✔	✔	✘	✘
CLI access	✔	✔	✔	✔	✘
WebUI	✘	✘	✔	✔	✘
Tolerations	✔	✔	✔	✔	✔
Node affinity	✔	✔	✔	✔	✔

Operator

https://www.simplyblock.io/post/choosing-a-postgres-kubernetes-operator

https://operatorhub.io/?keyword=postgres

simplyblock

Pinning and Tainting

simplyblock

Pinning and Tainting

Always use specific, dedicated machines for your database.

simplyblock

Pinning and Tainting

Always use specific, dedicated machines for your database.

(except you’re running super small databases)

Pinning and Tainting

Always use specific, dedicated machines for your database.

(except you’re running super small databases)

Pin your database containers to those hosts.

simplyblock

Pinning and Tainting

Always use specific, dedicated machines for your database.

(except you’re running super small databases)

Pin your database containers to those hosts.

Taint the hosts to prevent anything else from running on it.

Pinning and Tainting

Always use specific, dedicated machines for your database.

(except you’re running super small databases)

Pin your database containers to those hosts.

Taint the hosts to prevent anything else from running on it.

(except the minimum necessary Kubernetes services, like KubeProxy)

Trust me, I'm Kelsey!

Kelsey Hightower ✓
@kelseyhightower

> **Soham Dasgupta** @thesobercoder · Feb 10, 2023
> @kelseyhightower Bust a myth for us please - running any sort of database on a Kubernetes instance is bad idea. I've heard this enough times to actually start believing it. #kubernetes #mythbuster

5:21 PM · Feb 10, 2023 · **326.7K** Views

43 149 839 224

https://x.com/kelseyhightower/status/1624081136073994240

simplyblock

Trust me, I'm Kelsey!

Kelsey Hightower ✓
@kelseyhightower

You can run databases on Kubernetes because it's fundamentally the same as running a database on a VM. The biggest challenge is understanding that rubbing Kubernetes on Postgres won't turn it into Cloud SQL. 🧵

> **Soham Dasgupta** 🇮🇳 @thesobercoder · Feb 10, 2023
> @kelseyhightower Bust a myth for us please - running any sort of database on a Kubernetes instance is bad idea. I've heard this enough times to actually start believing it. #kubernetes #mythbuster

5:21 PM · Feb 10, 2023 · **326.7K** Views

43 149 839 224

https://x.com/kelseyhightower/status/1624081136073994240

simplyblock

More Resources

Data on Kubernetes Community: https://dok.community

Data on Kubernetes Whitepaper

simplyblock

@noctarius2k
@noctarius2k@mastodon.online
@noctarius.com

Thank you very much!
Questions?

simplyblock