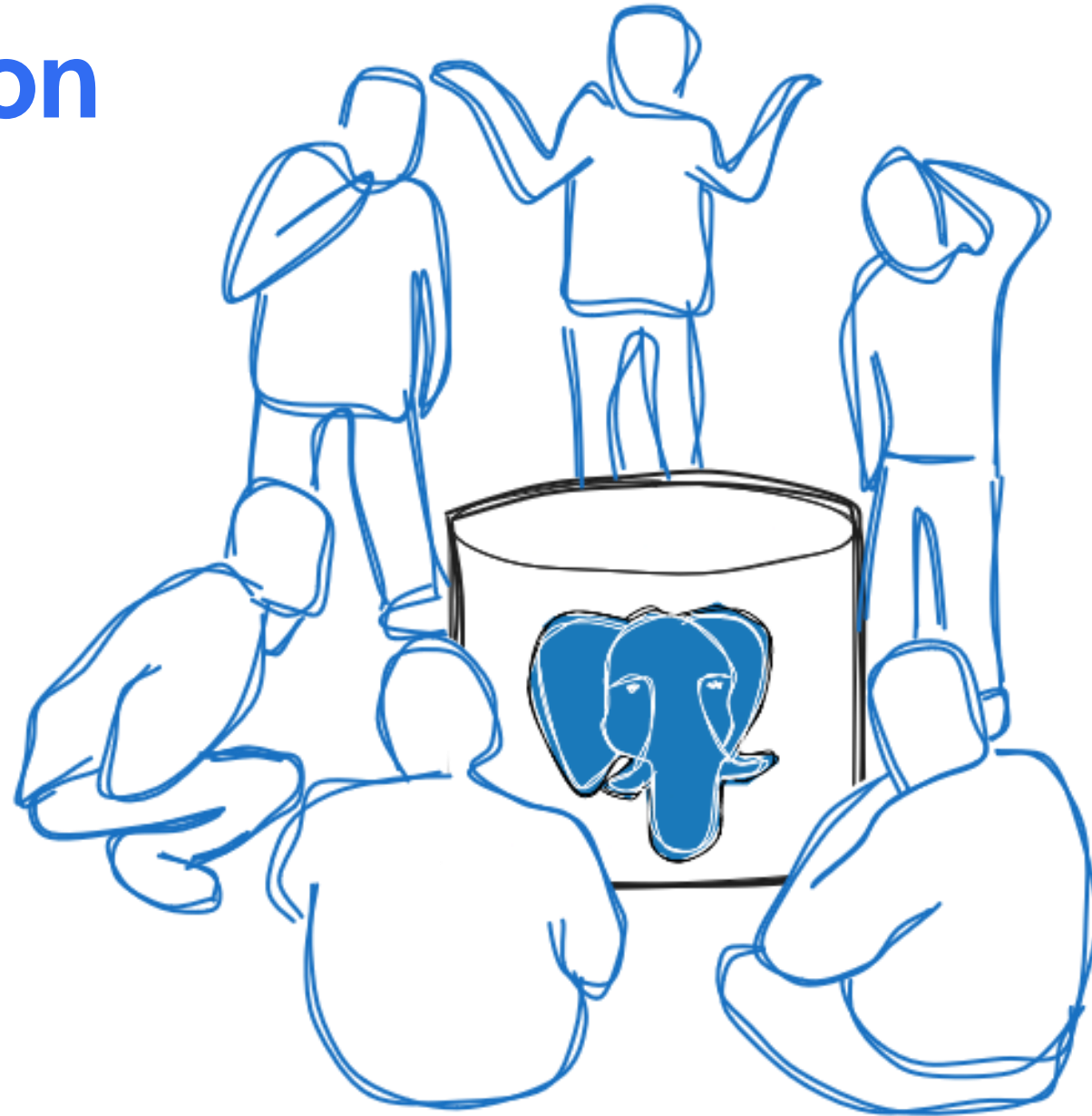


A wireframe elephant, composed of light blue lines forming a mesh, is positioned in the background on the left side of the slide. The elephant is facing right and appears to be holding a small object in its trunk. The entire scene is set against a solid blue background.

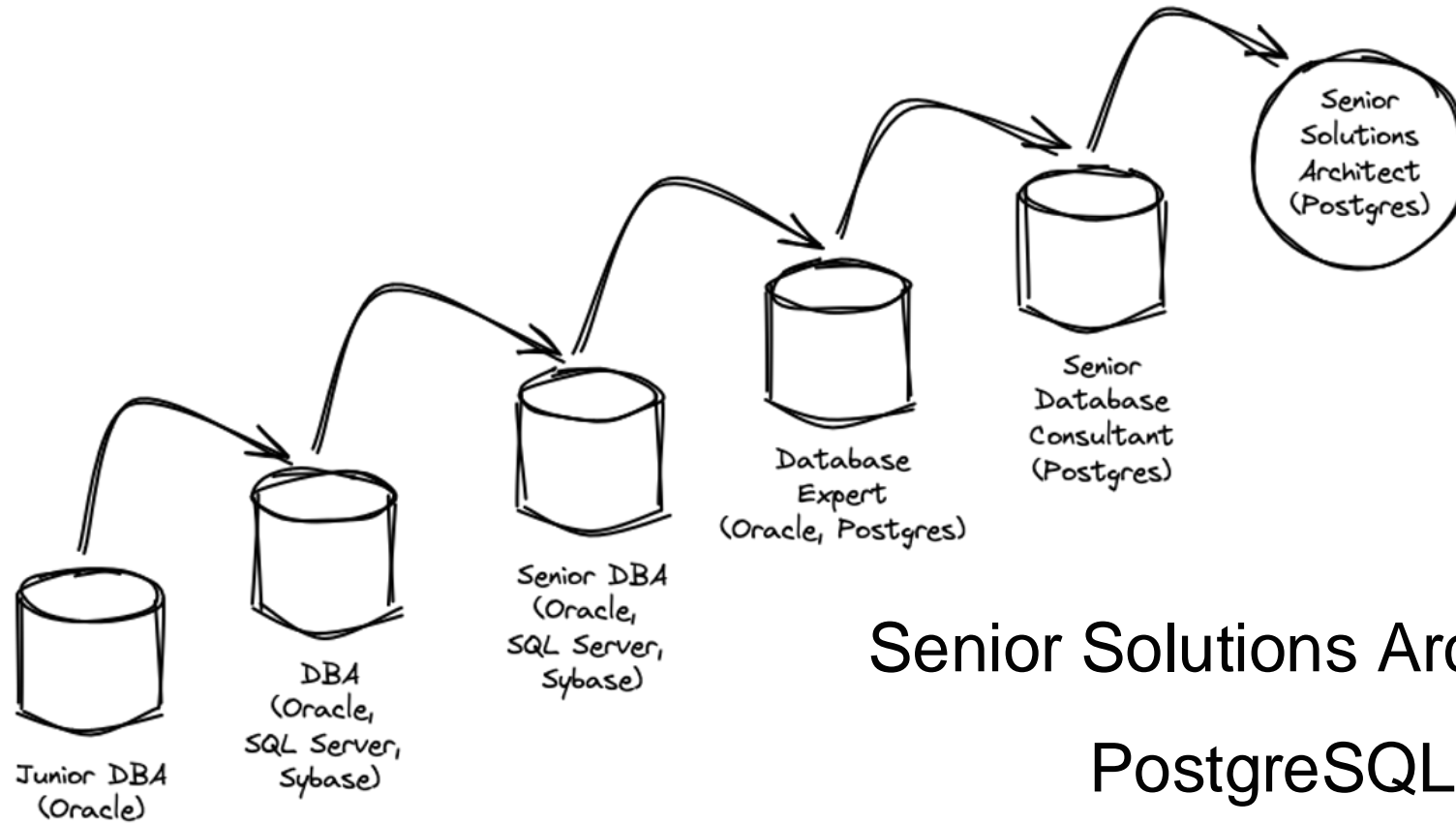
**Karen Jex | Senior solutions Architect**  
**PGConf.EU 2024 | Athens**

# **Crunchy Postgres for Kubernetes: Your Virtual DBA**

# Introduction



# whoami



Senior Solutions Architect @ Crunchy Data

PostgreSQL Europe Board Member

PostgreSQL Europe Diversity Committee Chair

# Postgres Anywhere

## BARE METAL, VMS, CLOUD

### Crunchy Postgres

Crunchy Certified PostgreSQL is production ready Postgres.

#### INCLUDES:

- ✓ Backups
- ✓ Disaster recovery
- ✓ High availability
- ✓ Monitoring
- ✓ Automation
- ✓ Self managed

## KUBERNETES

### Crunchy Postgres for Kubernetes

Cloud Native Postgres on Kubernetes powered by Crunchy Postgres Operator.

#### INCLUDES:

- ✓ Simple provisioning
- ✓ Backups and DR included
- ✓ High availability
- ✓ Seamless upgrades
- ✓ Scale from 1 to 1000s of DBs
- ✓ Self managed

## FULLY MANAGED CLOUD

### Crunchy Bridge

The fully managed Postgres option on your choice of Cloud provider.

#### INCLUDES:

- ✓ AWS, Azure or GCP
- ✓ Continuous protection
- ✓ Backups included
- ✓ Point in Time Recovery
- ✓ Pay for what you use
- ✓ The developer experience you want

# Agenda

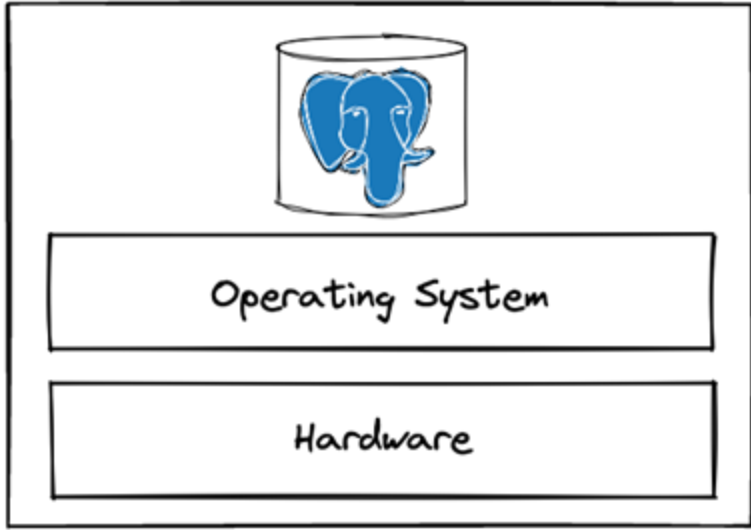


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8. Getting Started with CPK

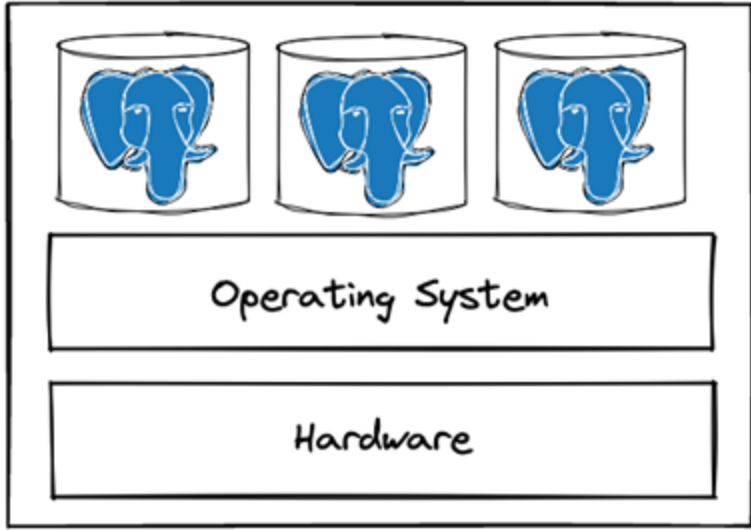
# Agenda



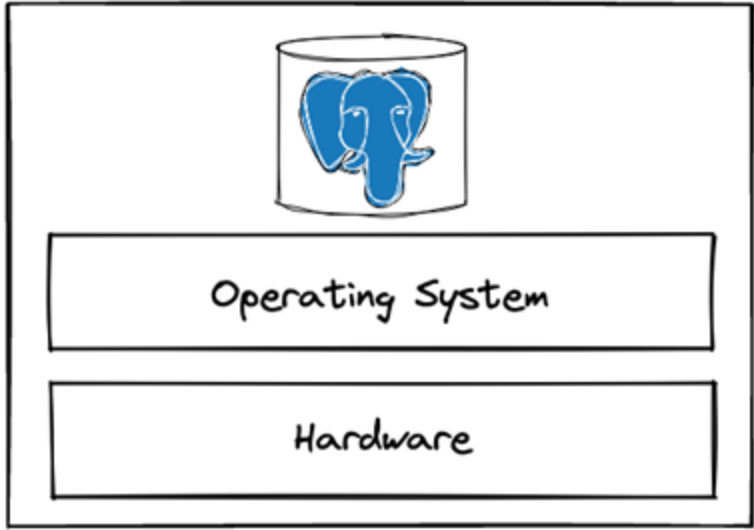
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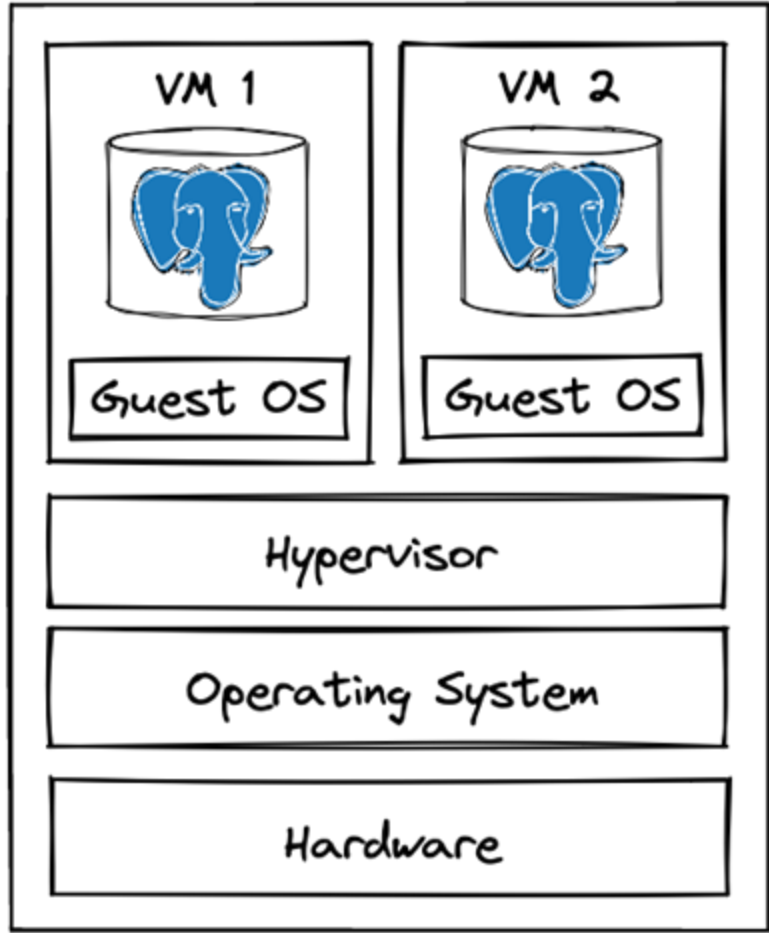
Physical Server



Physical Server

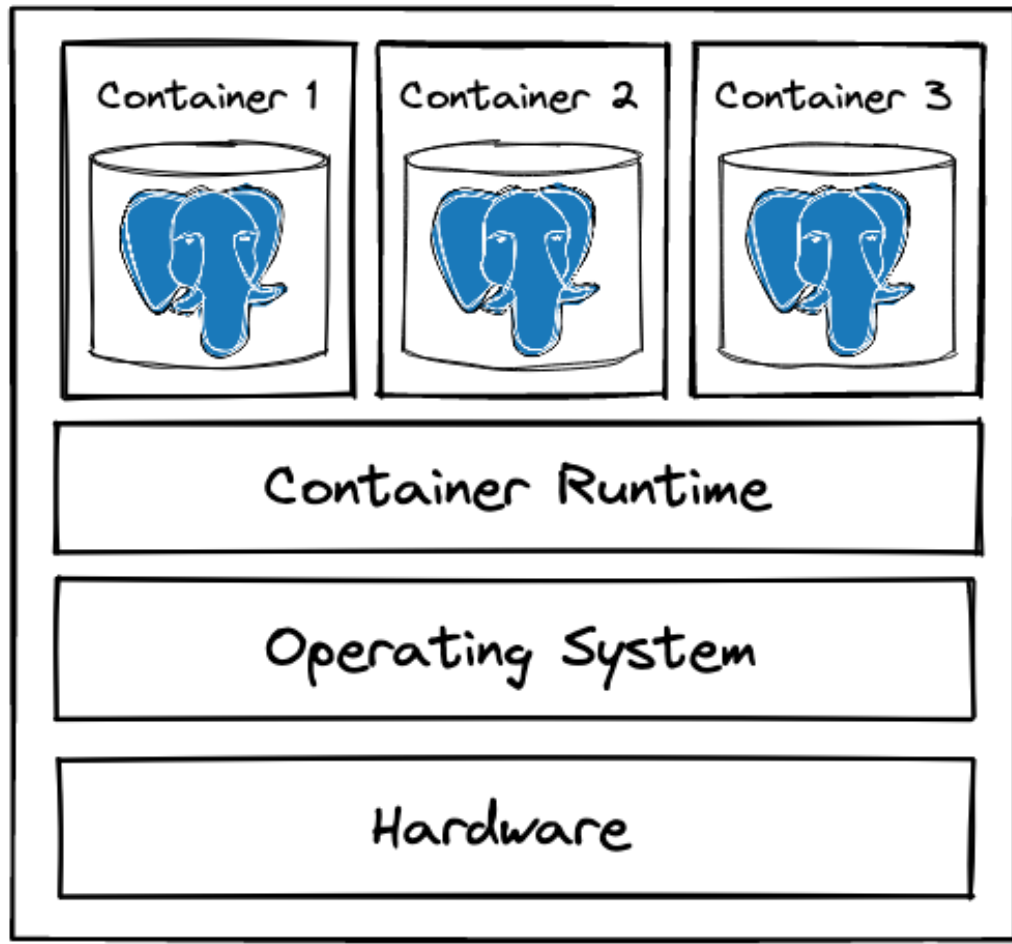


Physical Server



Virtual Machines





Containers

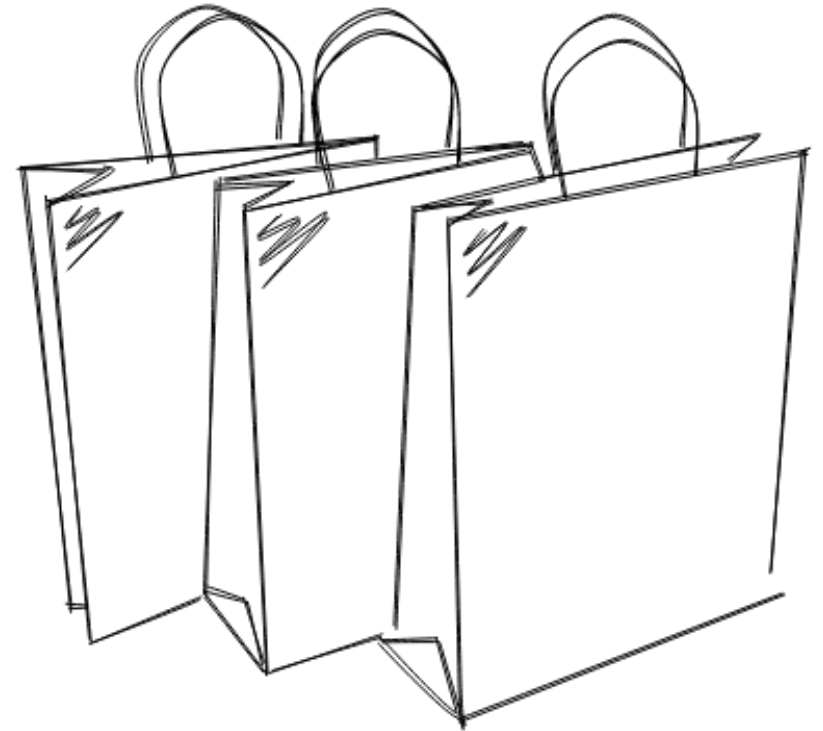
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# Features of Containers

- Lightweight
- Scalable
- Portable
- Isolated
- Stateless
- Ephemeral







**Herding Cats (Managing Containers)**



# Container Orchestration

- Tools such as Kubernetes
- Manage many containers
- Automate container lifecycle
- Integrate with DevOps tools



# Container Orchestration Tasks

- Provisioning
- Deployment
- Configuration
- Scheduling
- Scaling up and down
- Self-healing
- Services
- Storage
- Resource allocation
- Load Balancing
- Networking
- Security

# What is Kubernetes?



**Kubernetes is an open-source system for automating deployment, scaling, and management of containerized applications**

Kubernetes was accepted to CNCF on March 10, 2016 at the **Incubating** maturity level and then moved to the **Graduated** maturity level on March 6, 2018.

VISIT PROJECT WEBSITE



<https://www.cncf.io/projects/kubernetes/>

# Why Postgres on Kubernetes?

- Automation
- Deploying at Scale
- Multitenancy
- Microservices
- Kubernetes already in use
- DBaaS





# Agenda

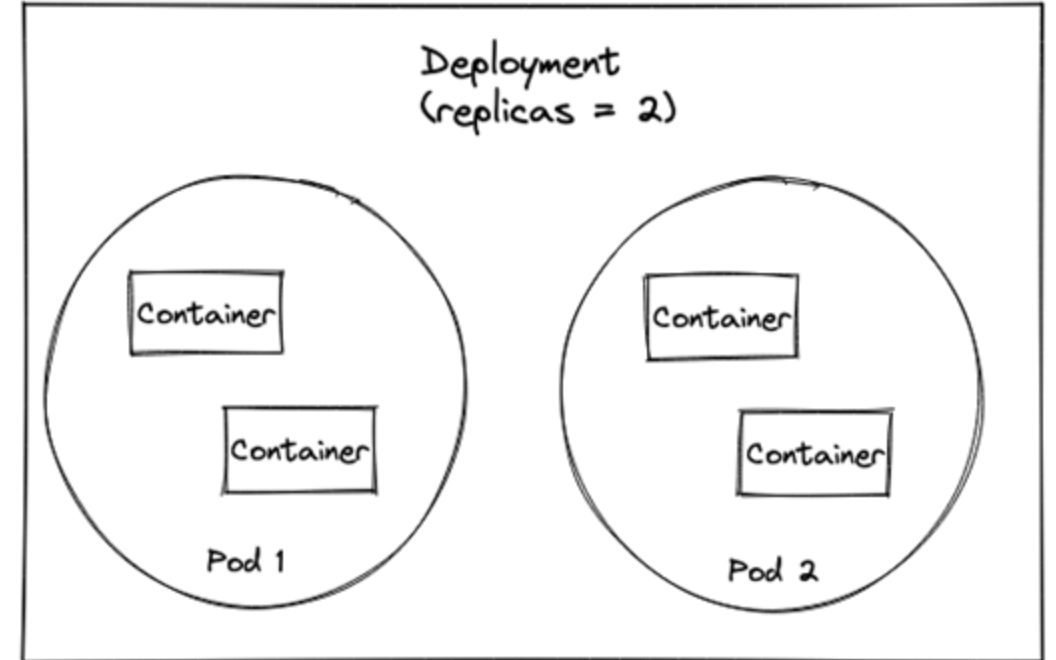


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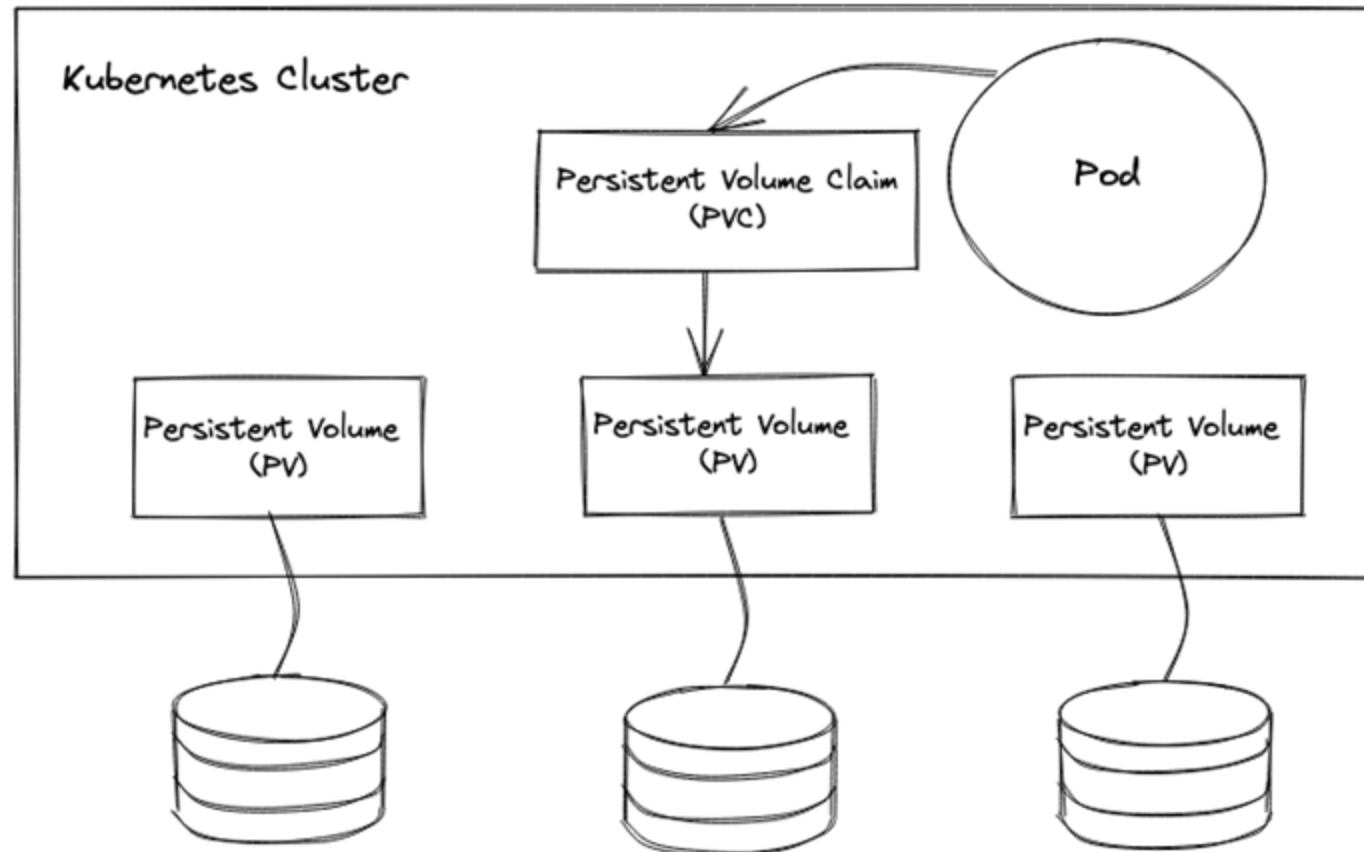
# Pods & Deployments

**Pod** contains 1 or more containers

**Deployment** consists of 1 or more replica pods



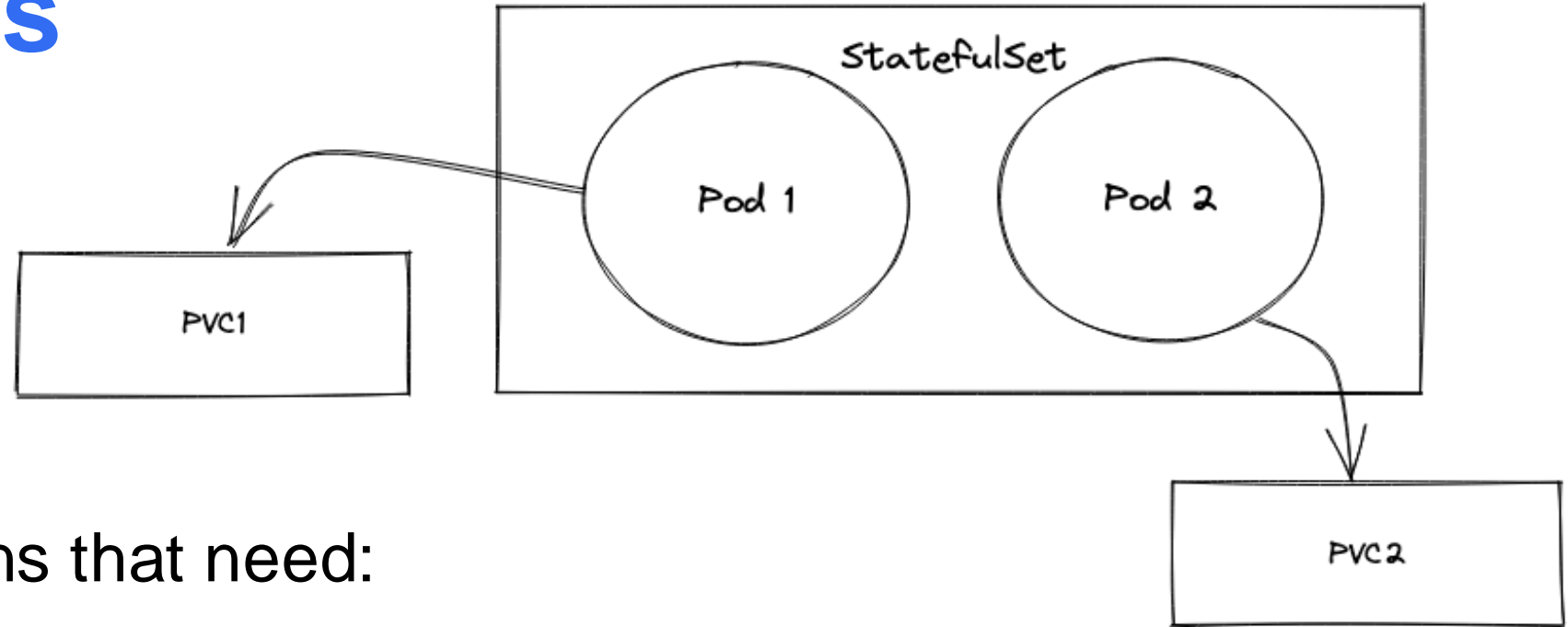
# Persistent Volumes (PVs)



# What about Standby Databases?

- Pods in a deployment are interchangeable
- What about a HA environment?
- Primary and standby databases aren't interchangeable
- Need ordered startup/shutdown

# StatefulSets



Useful for applications that need:

- Stable, persistent storage
- Ordered, graceful deployment and scaling
- Ordered, automated rolling updates

# Sidecars

- “Helper” container
- Tightly coupled with main container
- eg: metrics exporter, backup tool



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# What is a DBA?

“Database administrators **create, organise and look after computer systems that store data** for a company.” <https://nationalcareers.service.gov.uk/job-profiles/database-administrator>

“A database administrator, or DBA, is responsible for **maintaining, securing, and operating databases** and also ensures that **data is correctly stored and retrieved.**” <https://www.oracle.com/database/what-is-a-dba/>

“Database administrators **use specialist software to organise and maintain a secure database.**” <https://www.prospects.ac.uk/job-profiles/database-administrator>

“A Database Administrator, or Database Manager is responsible for **managing computer systems that store and organise data** for companies. Their duties include... **securing data** and **identifying areas for improvement with the infrastructure.**” <https://www.indeed.com/career/database-administrator>



# DBA Responsibilities

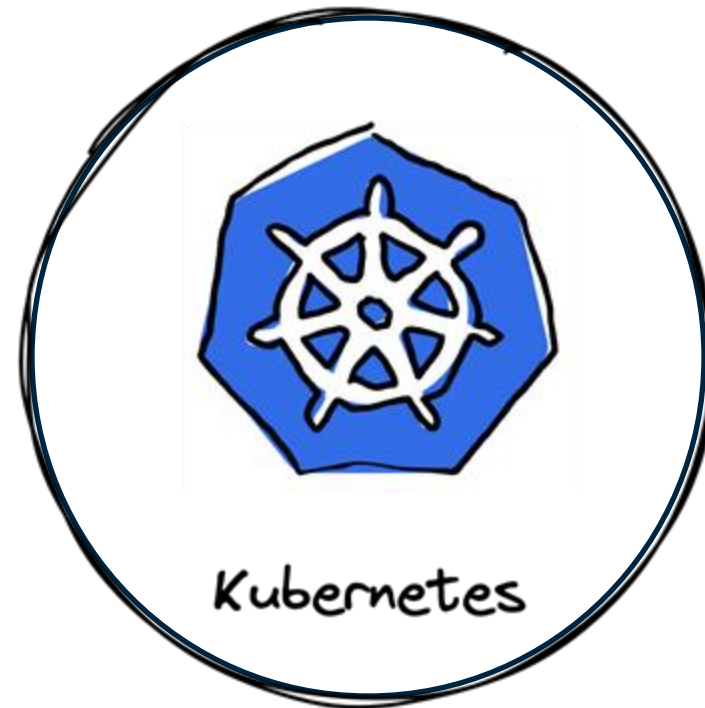
- Database (High) Availability
- Backup and Recovery
- Security & Data Protection
- Monitoring
- DB Design/Data Modelling
- Support/Troubleshooting
- DB Software install/upgrade
- Database Expertise
- Performance Tuning
- Capacity Planning
- Database Creation
- Database Maintenance

# Agenda



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# Running Postgres on Kubernetes

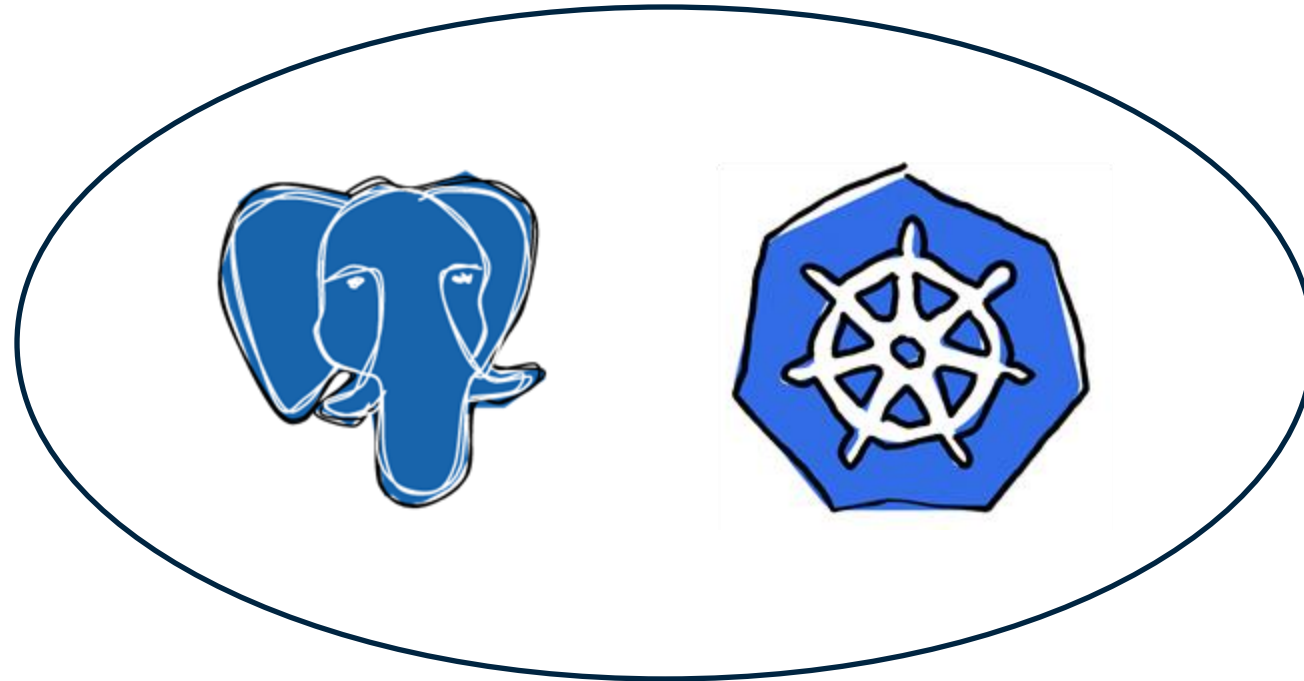


# Kubernetes Operators

“Operators are software extensions to Kubernetes that make use of **custom resources** to manage applications and their components. Operators follow Kubernetes principles, notably **the control loop**.”

<https://kubernetes.io/docs/concepts/extend-kubernetes/operator/>

# Postgres Operators for Kubernetes



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# ~~DBA~~ Operator Responsibilities

- Database (High) Availability
- Backup and Recovery
- Security & Data Protection
- Monitoring
- ~~DB Design/Data Modelling~~
- Support/Troubleshooting
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# Agenda



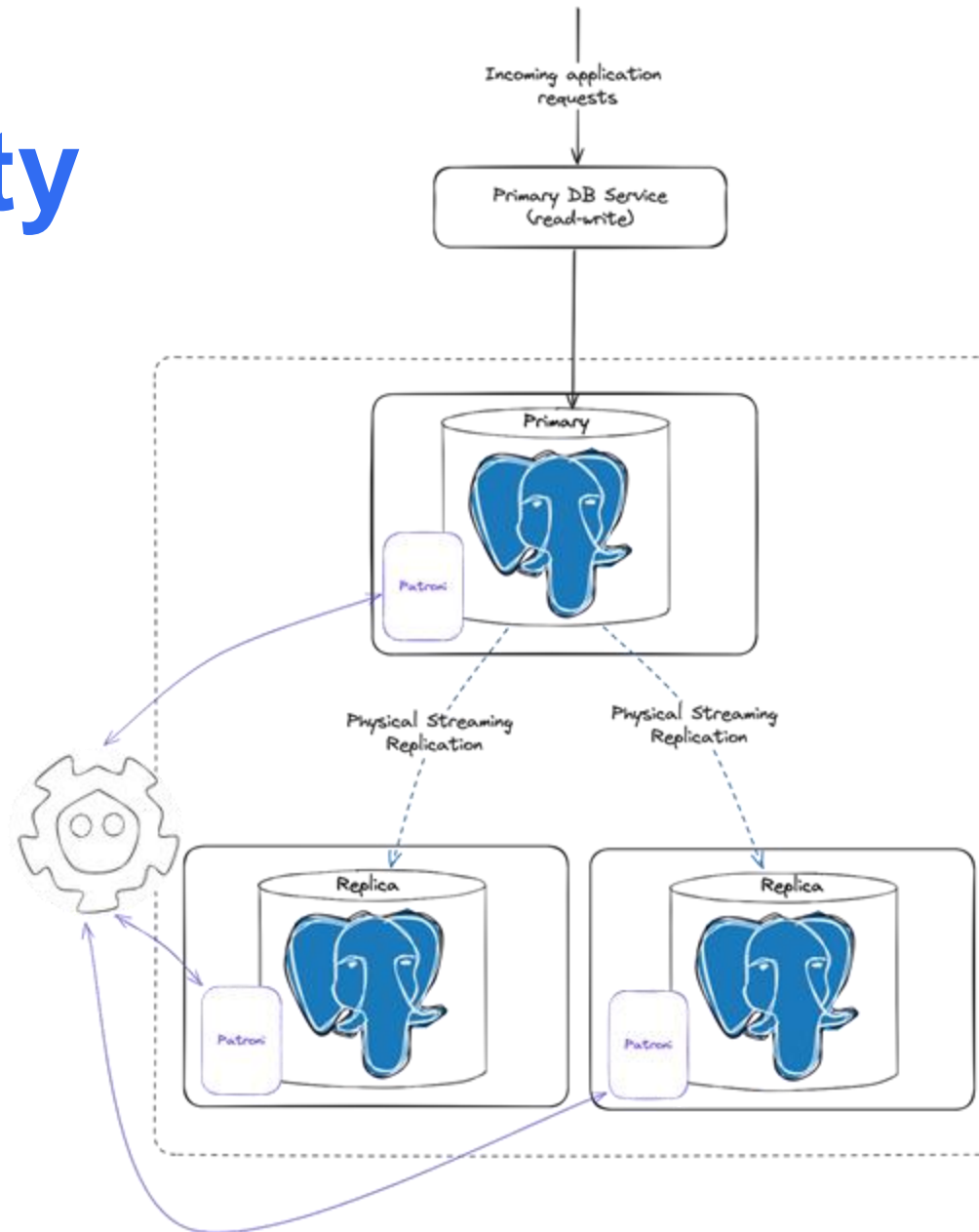
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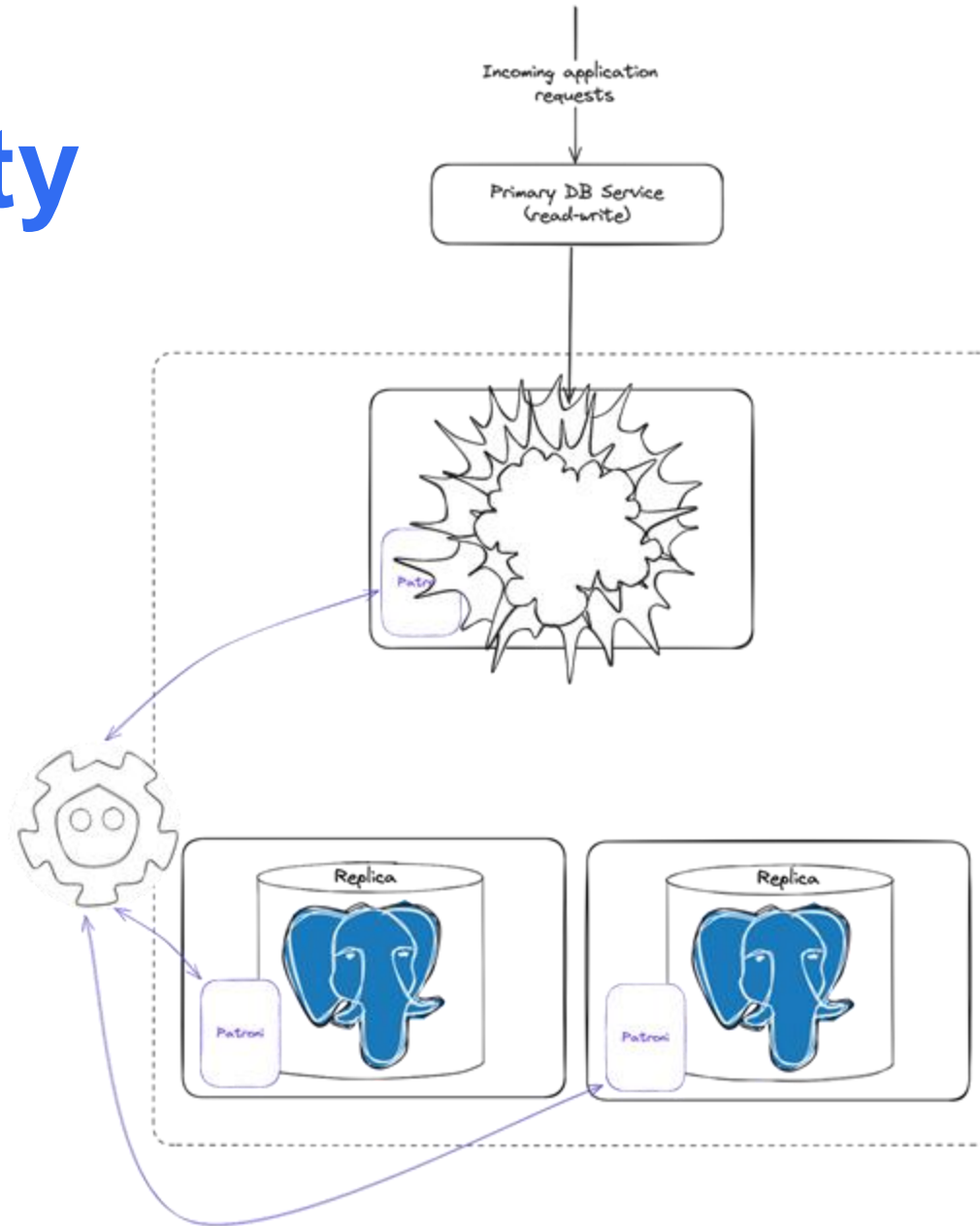
# What does CPK do for you?

- Database (High) Availability
- Backup and Recovery
- Security & Data Protection
- Monitoring
- ~~DB Design/Data Modelling~~
- Support/Troubleshooting
- DB Software install/upgrade
- Database Expertise
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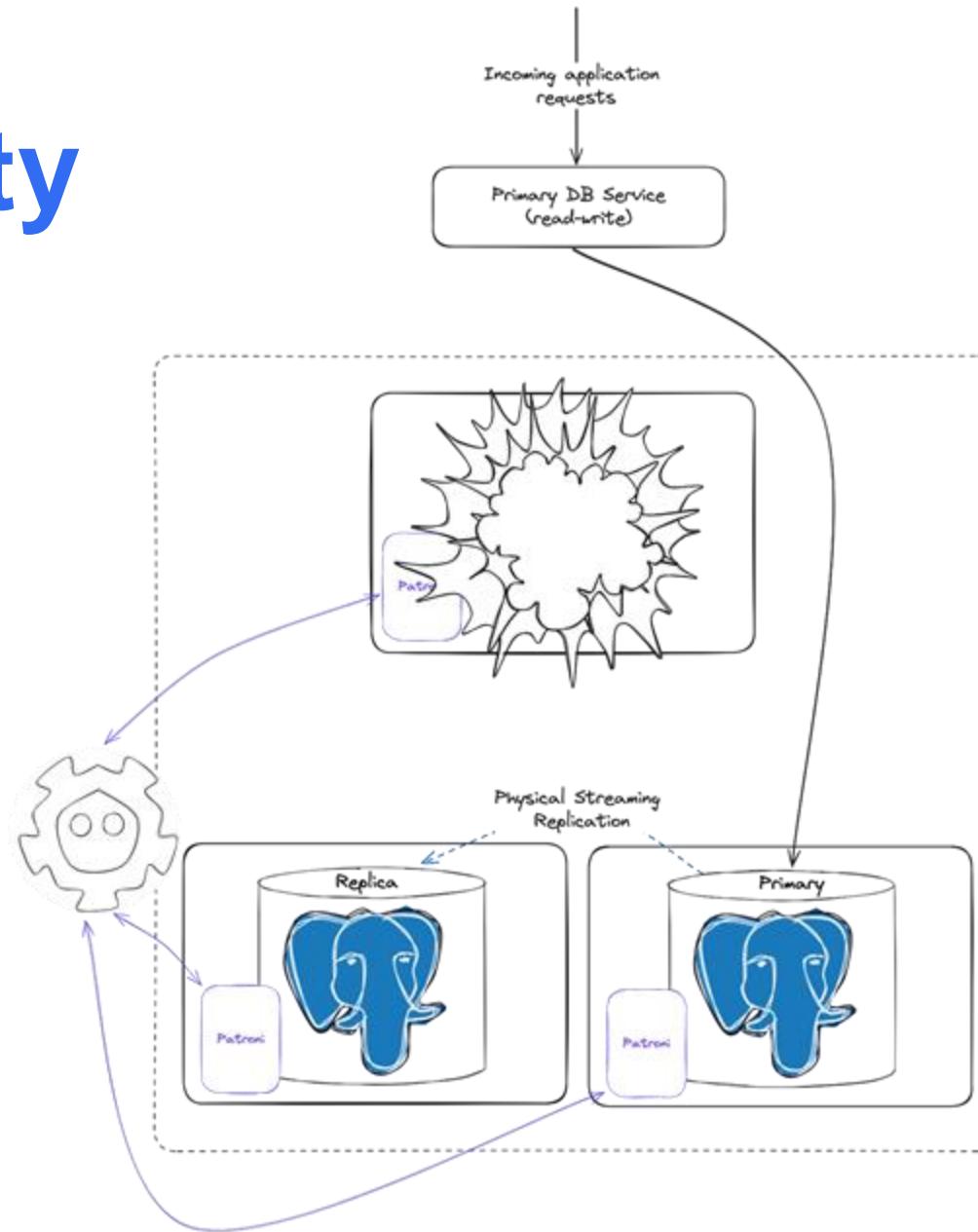
# CPK: High Availability



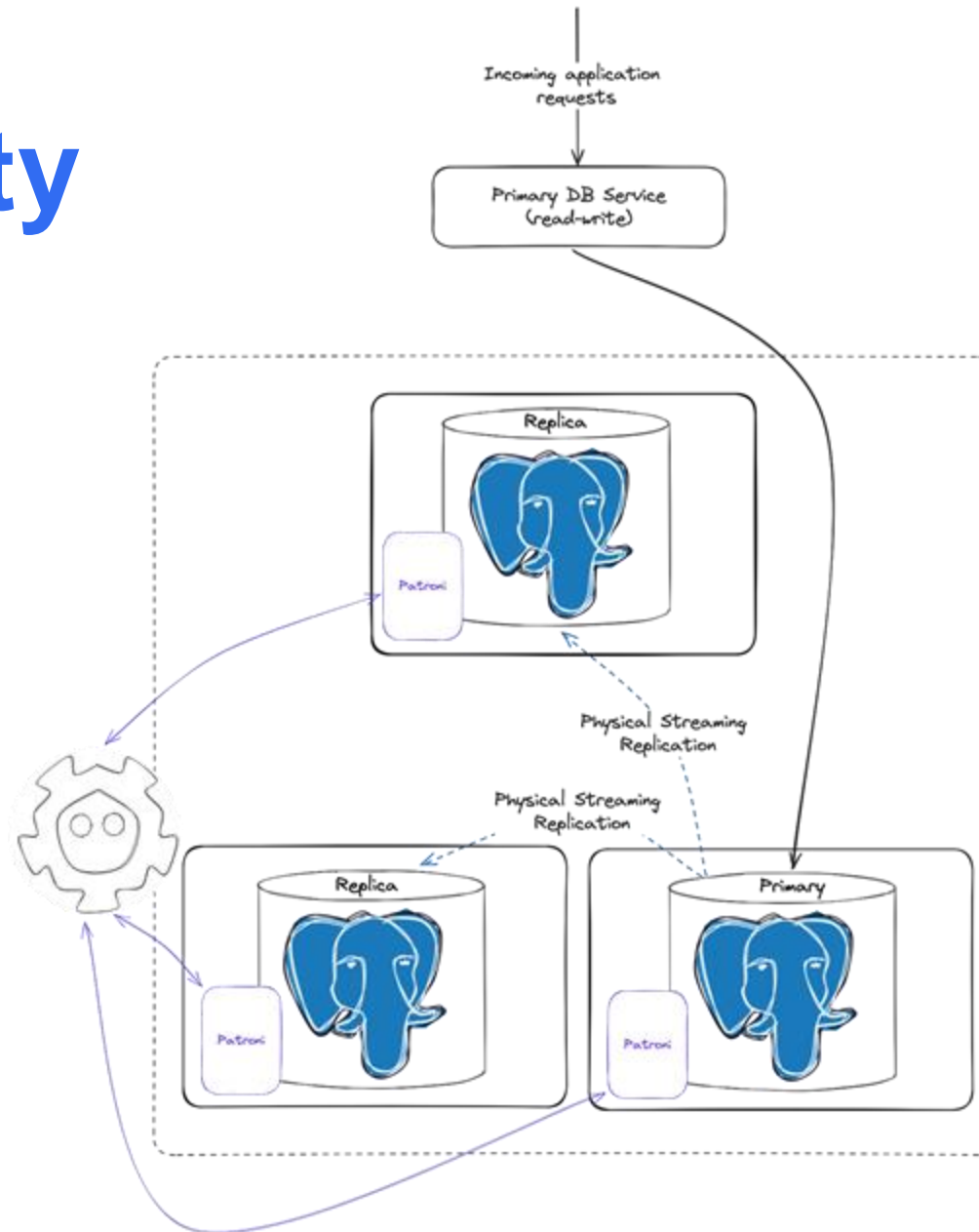
# CPK: High Availability



# CPK: High Availability



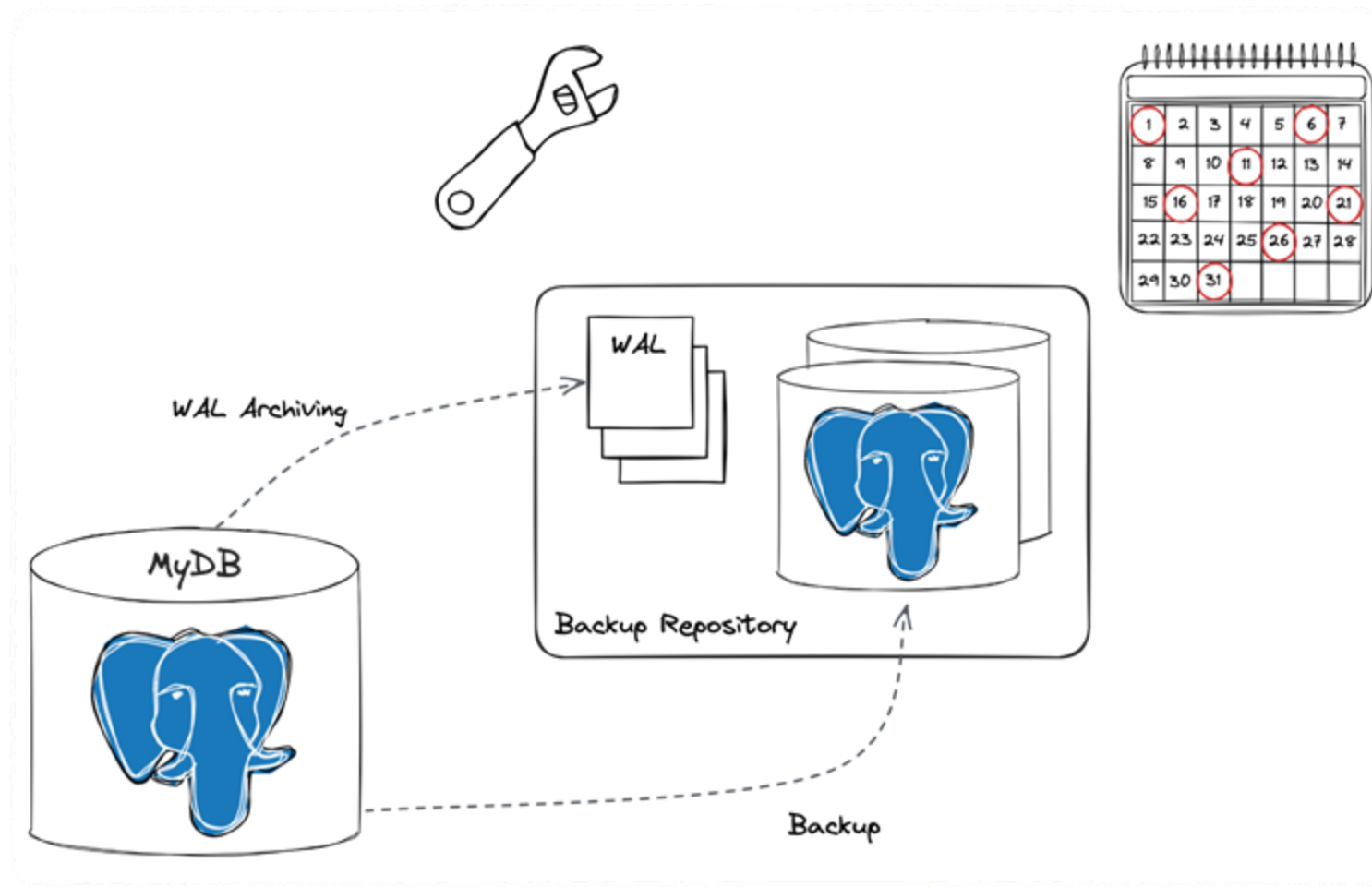
# CPK: High Availability



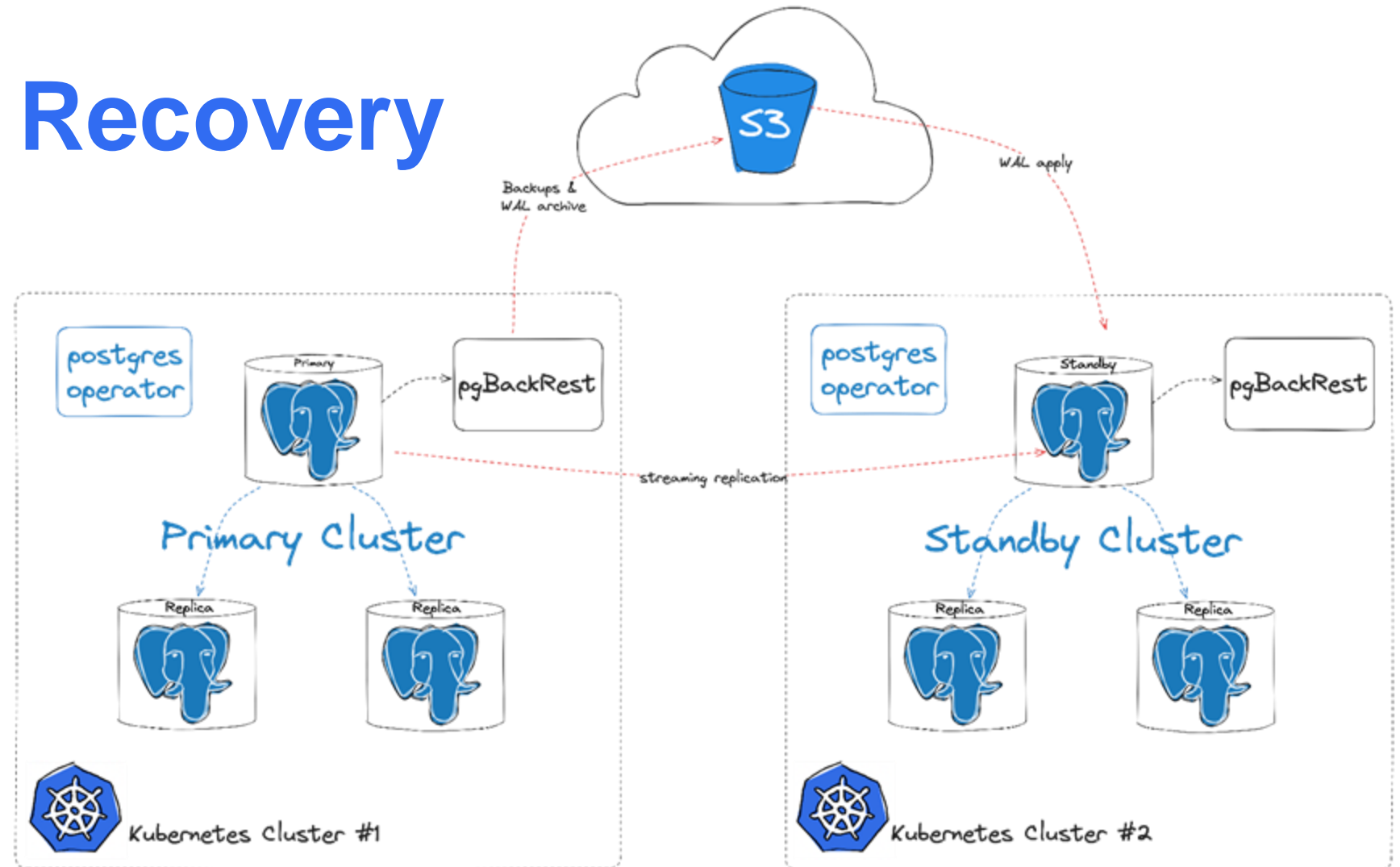
# CPK: High Availability

- Kubernetes
- Operator (PostgresCluster)
- Patroni

# CPK: Backup & Recovery



# CPK: Backup & Recovery

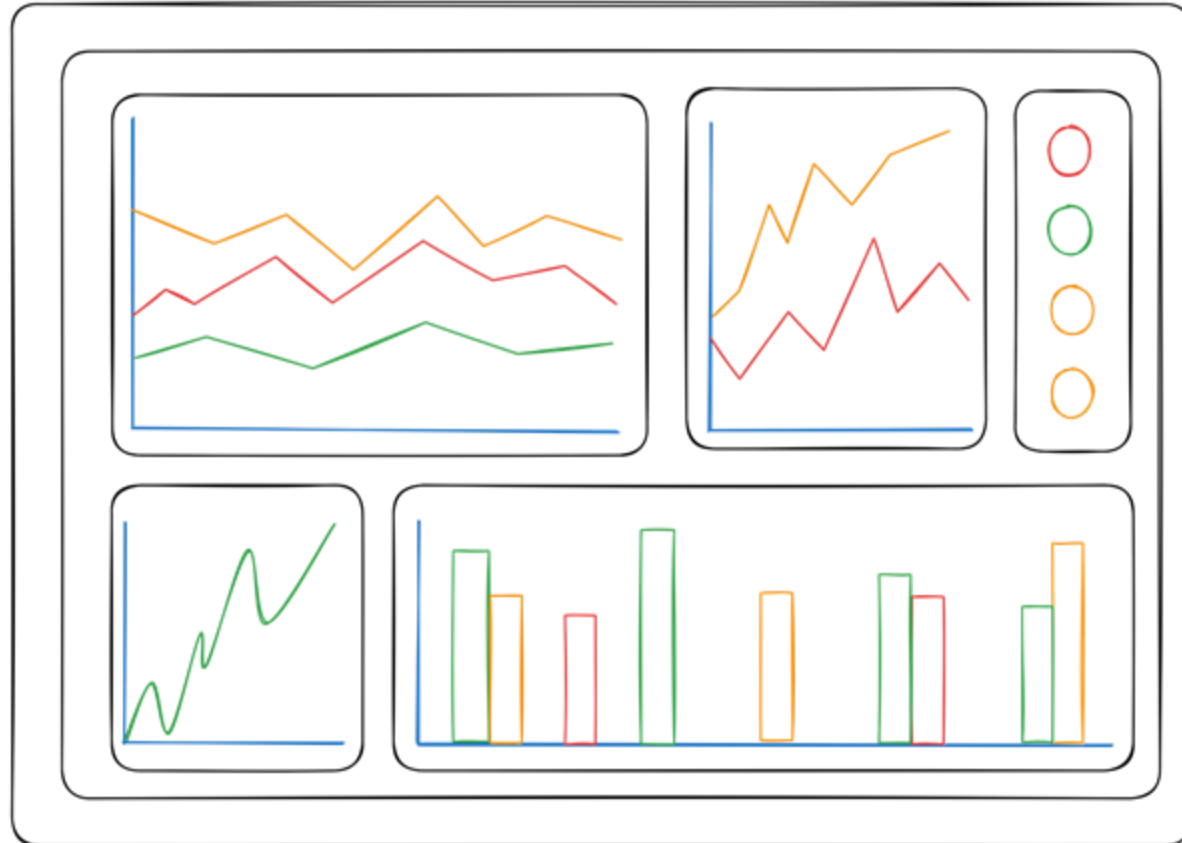




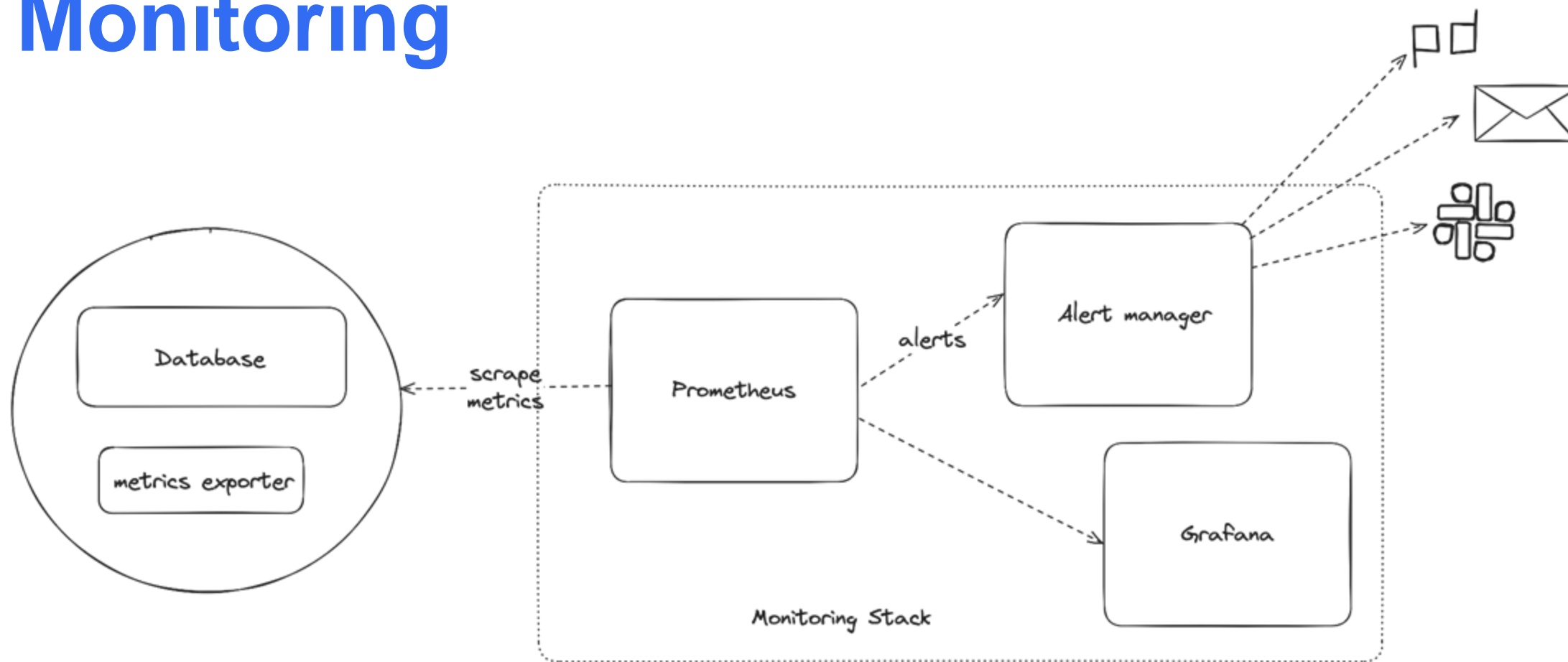
# CPK: Security

- Database Access
- Password Encryption
- Secrets
- SSL/TLS
- Certificates

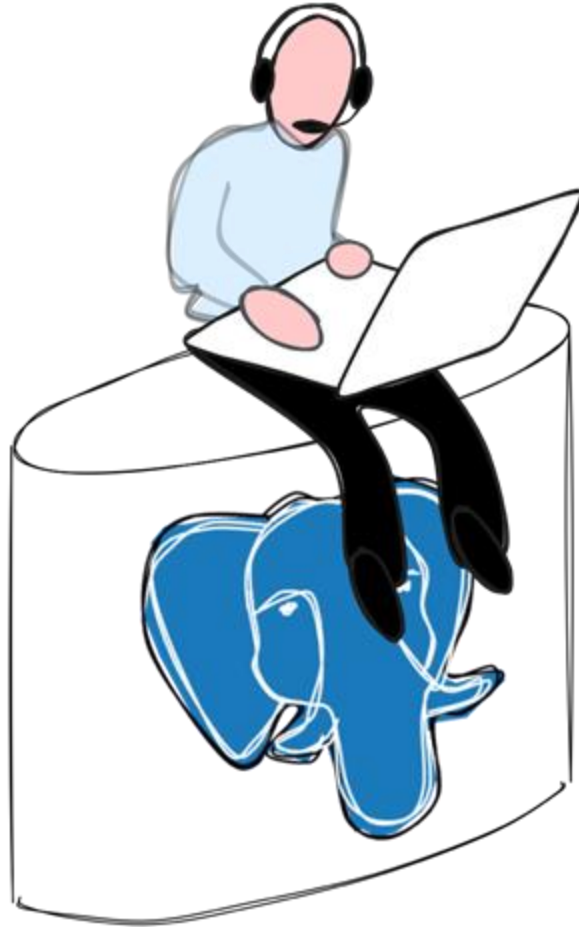
# CPK: Monitoring



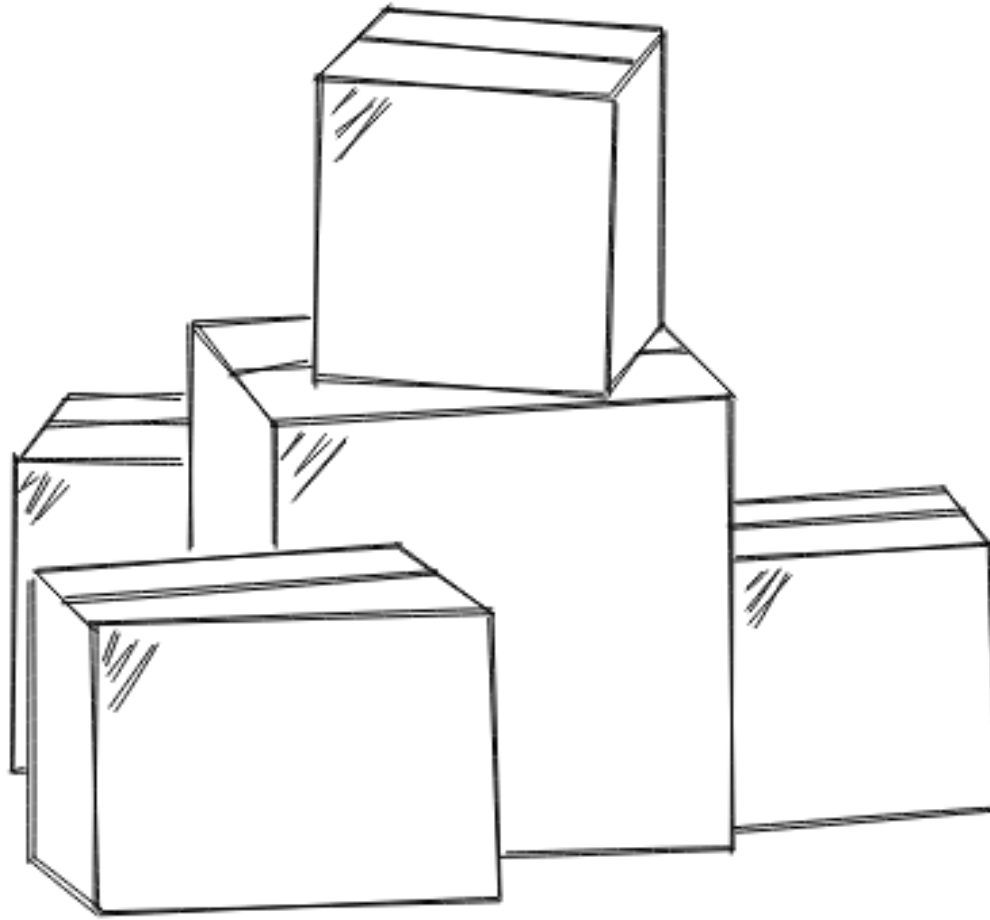
# CPK: Monitoring



# CPK: Support/Troubleshooting



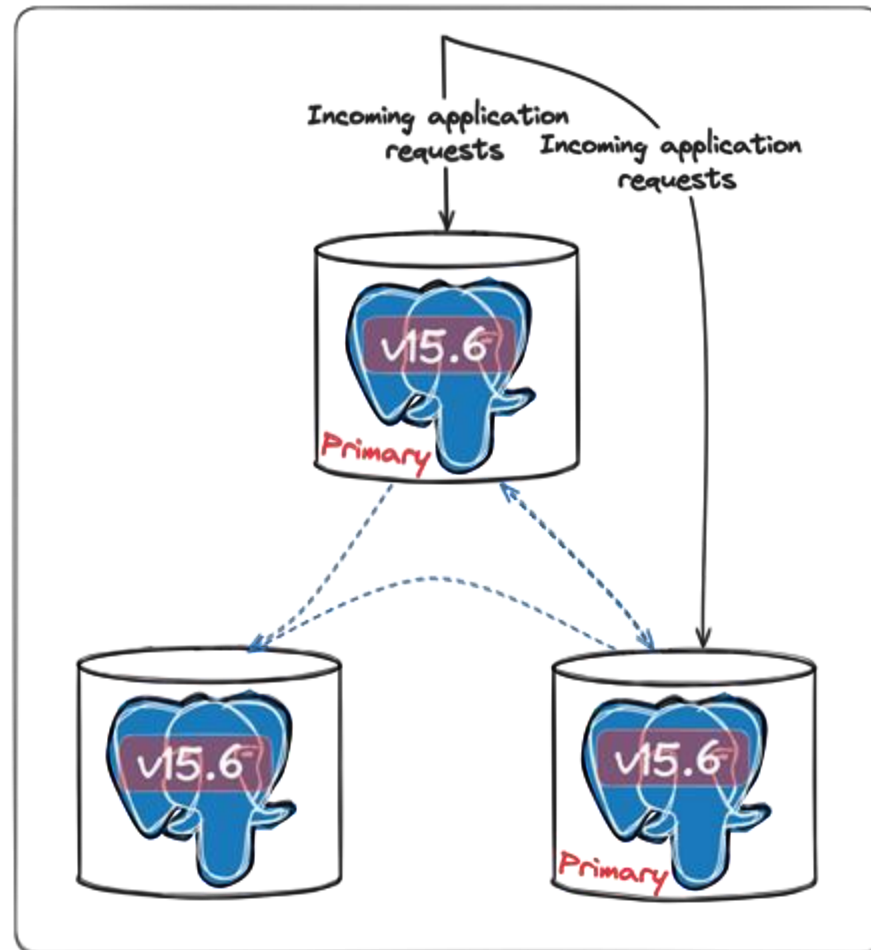
# CPK: DB Software Install/Upgrade Install





# CPK: DB Software Install/Upgrade Postgres Minor Upgrade

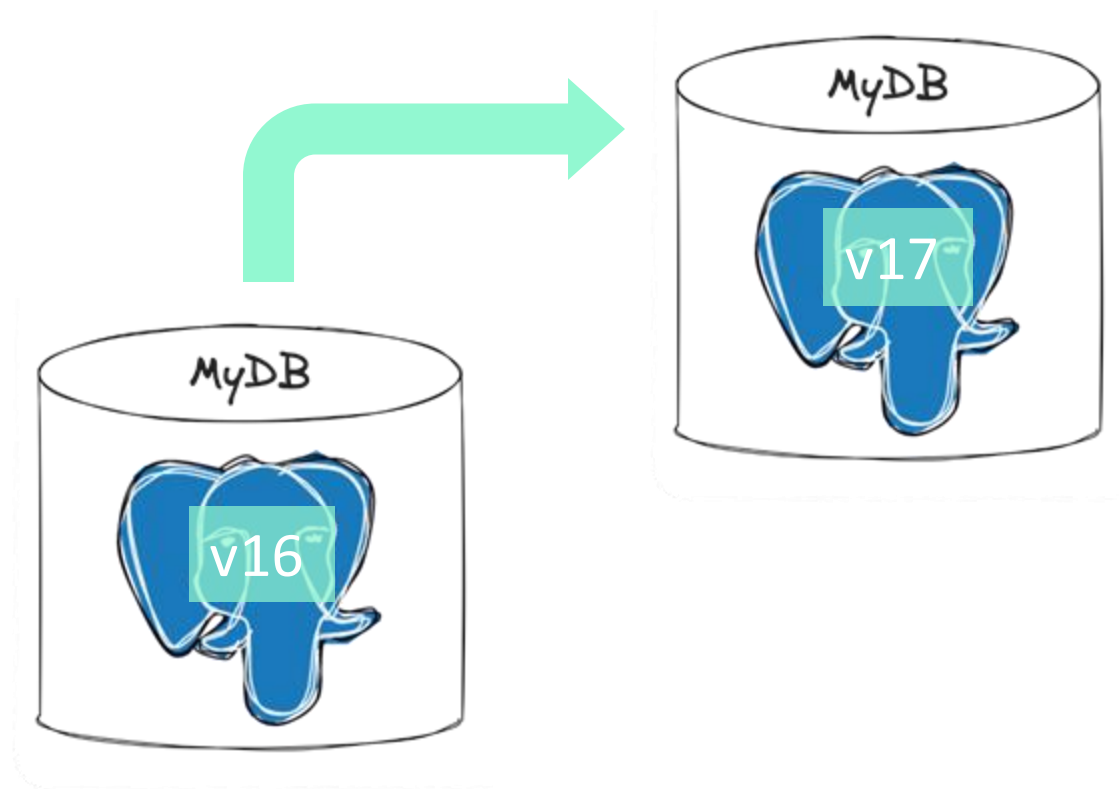
Ordered, automated rolling updates



# CPK: DB Software Install/Upgrade

## Postgres Major Upgrade

- Automated by Operator
- Human planning & testing!



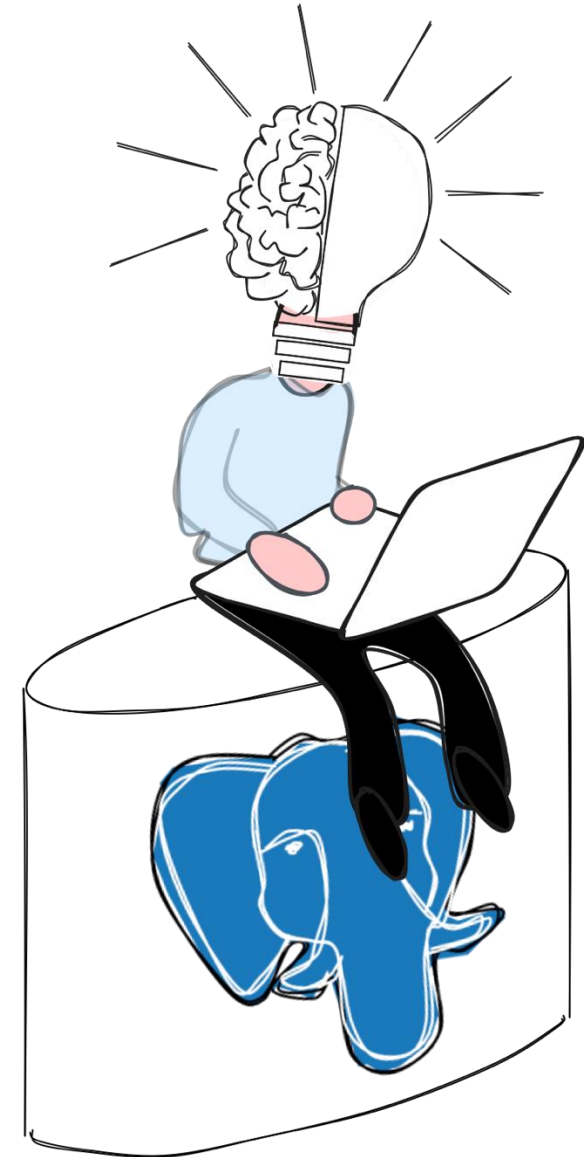
# CPK: Database Expertise

Operator:

- Built-in database expertise

Human expert:

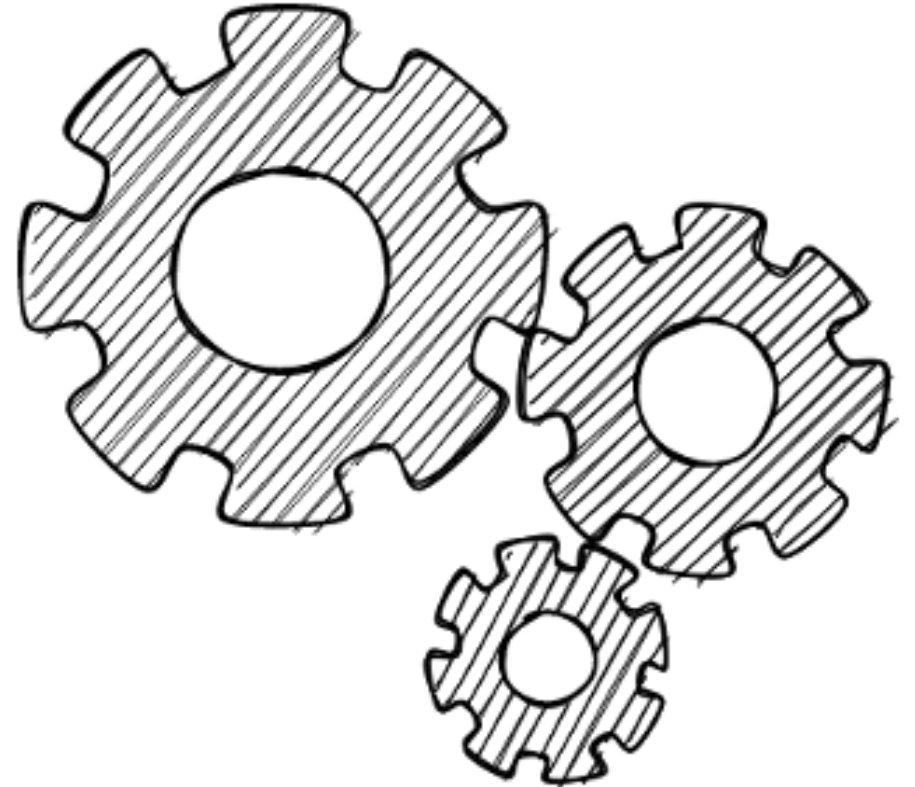
- Strategic considerations
- Application needs
- Business requirements





# CPK: Performance Tuning

- Configuration Parameters
- Connection pooling
- `pg_stat_statements`
- Logging
- Monitoring and alerting



# CPK: Capacity Planning

```
dataVolumeClaimSpec:  
  accessModes:  
  - "ReadWriteOnce"  
  resources:  
    requests:  
      storage: 1Gi  
      storage: 10Gi
```

# CPK: Database Creation

```
users:  
- name: slonik  
  databases:  
    - pgconfeu
```

# CPK: Database Maintenance

- Taking backups
- Creating users
- Rebuilding Indexes
- Gathering statistics
- Fixing errors
- Log management

*Not an exhaustive list!*

# Agenda

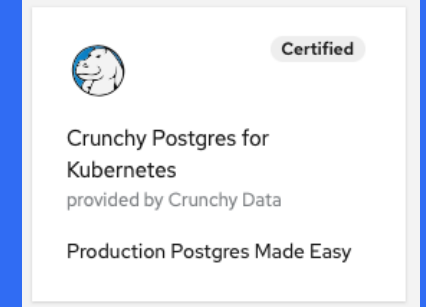


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# Getting Started with CPK

1.

**Deploy Operator from OperatorHub**



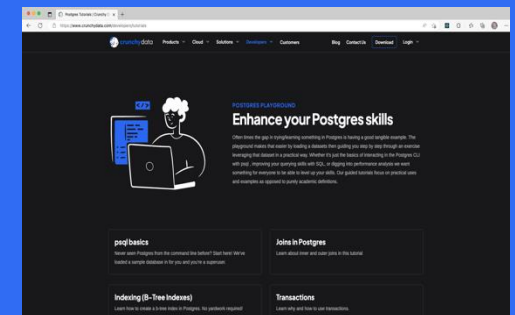
2.

**Deploy using examples repository**  
(<https://github.com/CrunchyData/postgres-operator-examples>)

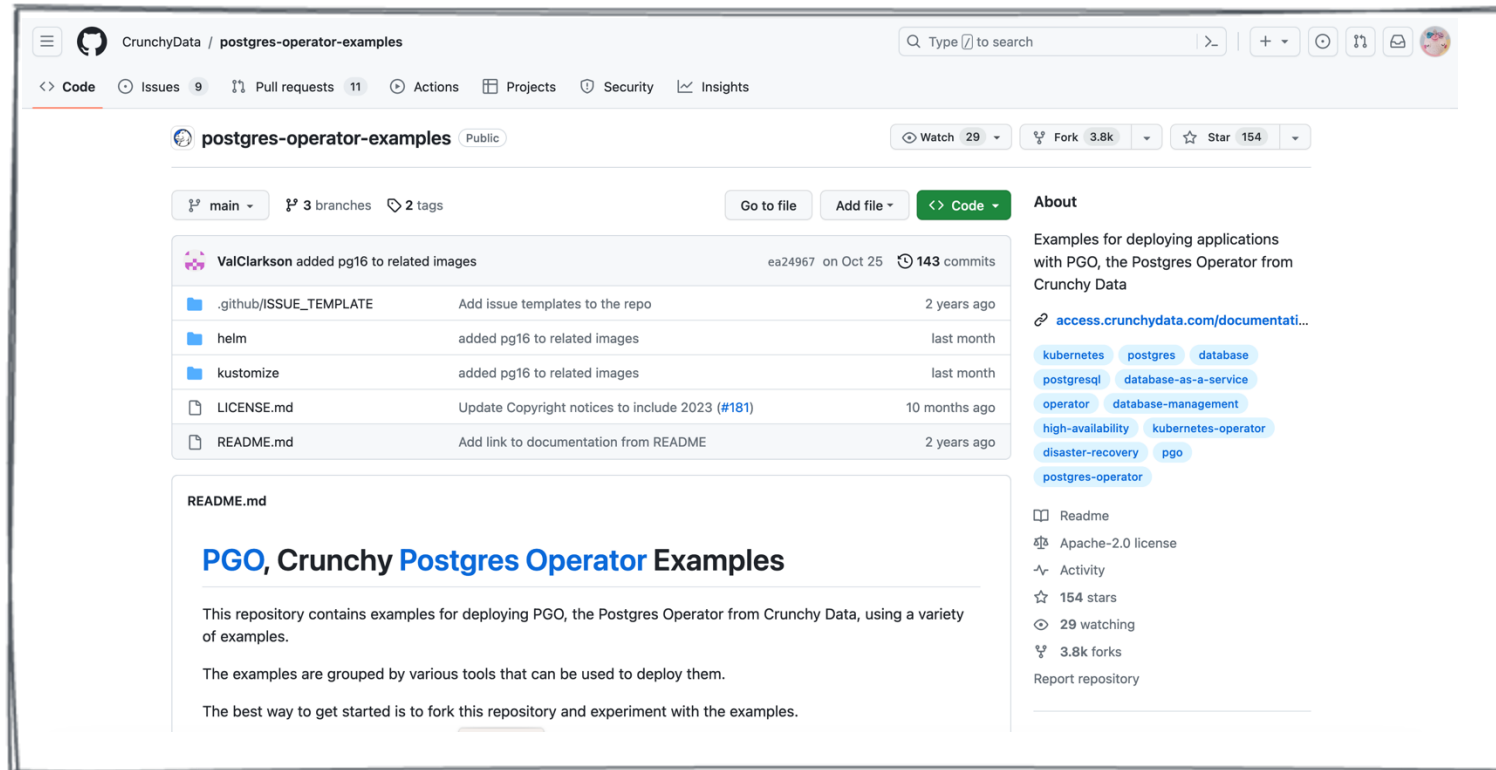


3.

**Learn PostgreSQL**  
(<https://www.crunchydata.com/developers/tutorials>)



# Getting Started with CPK



The screenshot shows the GitHub repository page for `postgres-operator-examples` by CrunchyData. The repository is public and has 29 watchers, 3.8k forks, and 154 stars. The main branch is selected, and there are 3 branches and 2 tags. The repository contains several files and folders, including `.github/ISSUE_TEMPLATE`, `helm`, `kustomize`, `LICENSE.md`, and `README.md`. The `README.md` file is highlighted, showing the title `PGO, Crunchy Postgres Operator Examples` and the following text:

This repository contains examples for deploying PGO, the Postgres Operator from Crunchy Data, using a variety of examples.

The examples are grouped by various tools that can be used to deploy them.

The best way to get started is to fork [this repository](#) and experiment with the examples.

The `About` section provides a description of the repository: "Examples for deploying applications with PGO, the Postgres Operator from Crunchy Data". It also includes a link to the documentation and a list of tags: `kubernetes`, `postgres`, `database`, `postgresql`, `database-as-a-service`, `operator`, `database-management`, `high-availability`, `kubernetes-operator`, `disaster-recovery`, `pgo`, and `postgres-operator`.

<https://github.com/CrunchyData/postgres-operator-examples>

# Getting Started with CPK

## Install the Operator

```
% git clone git@github.com:myuser/postgres-operator-examples.git
% cd postgres-operator-examples

% kubectl create namespace postgres-operator
% kubectl config set-context --current --namespace=postgres-operator

% kubectl apply --server-side -k customize/install/default
```



# Getting Started with CPK

## Install the Operator

```
customresourcedefinition.apiextensions.k8s.io/pgadmins.postgres-  
operator.crunchydata.com serverside-applied  
customresourcedefinition.apiextensions.k8s.io/pgupgrades.postgres-  
operator.crunchydata.com serverside-applied  
customresourcedefinition.apiextensions.k8s.io/postgresclusters.postgres-  
operator.crunchydata.com serverside-applied  
serviceaccount/pgo serverside-applied  
clusterrole.rbac.authorization.k8s.io/postgres-operator serverside-applied  
clusterrolebinding.rbac.authorization.k8s.io/postgres-operator serverside-  
applied  
deployment.apps/pgo serverside-applied
```

# Getting Started with CPK

## Create a PostgresCluster

```
% cp -r kustomize/postgres kustomize/pgconfeu  
% vi kustomize/pgconfeu/postgres.yaml
```

# Getting Started with CPK PostgresCluster Manifest

```
apiVersion: postgres-operator.crunchydata.com/v1beta1
kind: PostgresCluster
metadata:
  name: athens
spec:
  postgresVersion: 17
  instances:
    - name: instance1
      replicas: 3
      dataVolumeClaimSpec:
        accessModes:
          - "ReadWriteOnce"
      resources:
        requests:
          storage: 1Gi
```

# Getting Started with CPK PostgresCluster Manifest (contd.)

```
backups:  
  pgbackrest:  
    repos:  
      - name: repo1  
        volume:  
          volumeClaimSpec:  
            accessModes:  
              - "ReadWriteOnce"  
            resources:  
              requests:  
                storage: 1Gi
```

# Getting Started with CPK

## Create a PostgresCluster

```
% kubectl apply -k athens
```

```
% kubectl get pods
```

NAME	READY	STATUS	RESTARTS	AGE
athens-backup-b7v4-krfkb	0/1	Completed	0	13m
athens-instance1-b9nq-0	4/4	Running	0	13m
athens-instance1-ljg8-0	4/4	Running	0	13m
athens-instance1-m6mx-0	4/4	Running	0	13m
athens-repo-host-0	2/2	Running	0	13m
pgadmin-611942b8-585c-4dea-886a-6774a1eccd7a-0	1/1	Running	0	45m
pgo-6fdd547449-6ghr9	1/1	Running	0	46m

# Conclusions

- CPK: Your Virtual DBA
- Postgres Expertise
- Automation
- Robust, Secure, Scalable Architecture
- Combined Strength: Postgres & Kubernetes
- Leaves the Fun Stuff to You!

A wireframe elephant in light blue on a dark blue background. The elephant is positioned on the left side of the frame, facing right. The text "Thank You!" is centered in the upper half of the image.

# Thank You!

**Karen Jex | Crunchy Data | [karen.jex@crunchydata.com](mailto:karen.jex@crunchydata.com)**