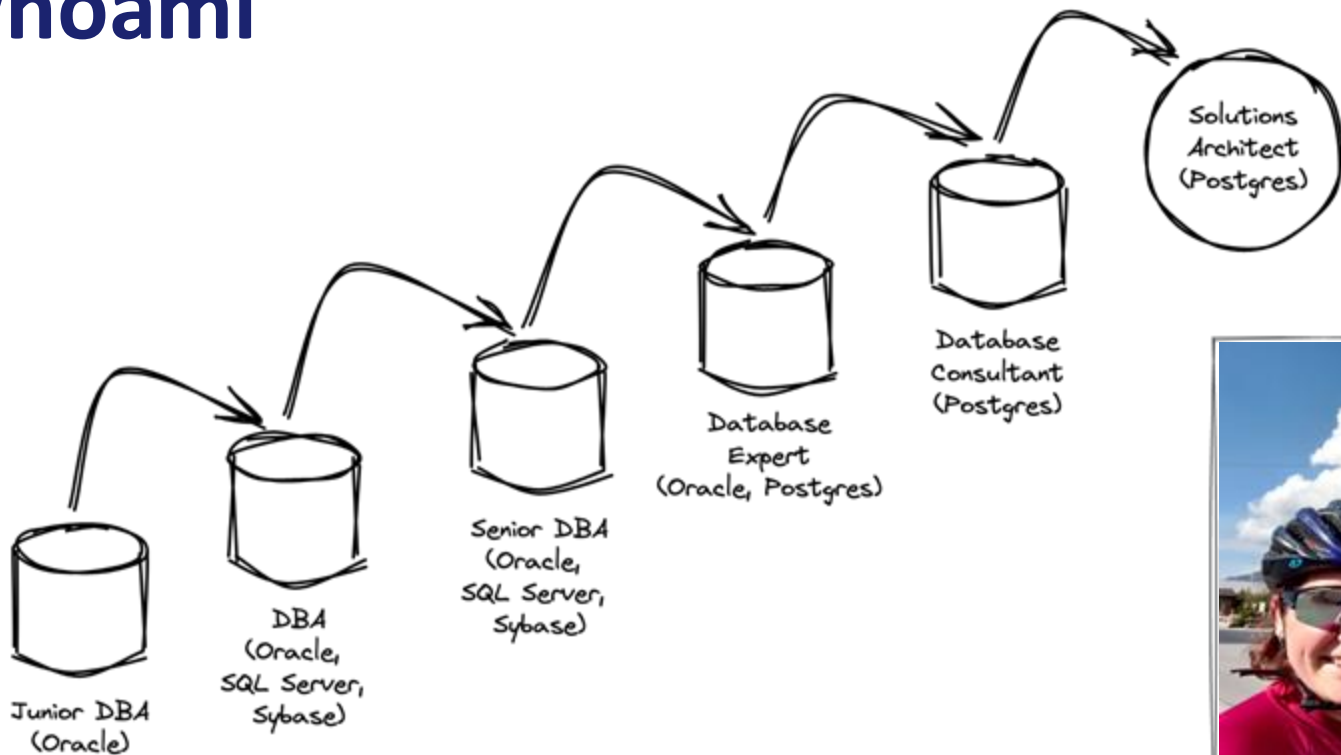# Kubernetes as Your (Virtual) DBA
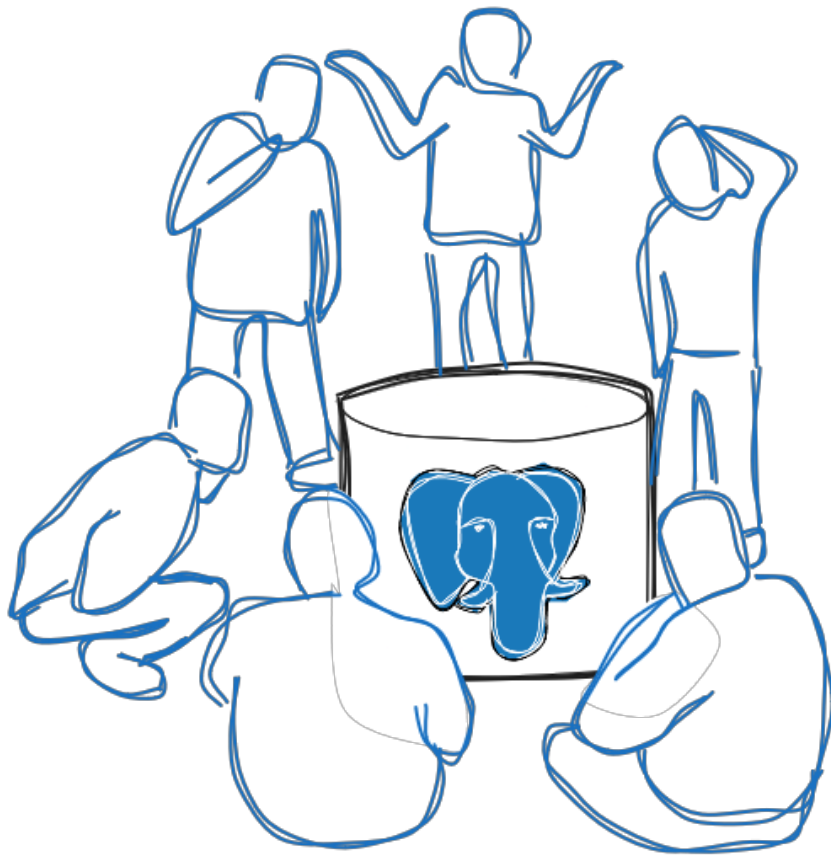
Karen Jex | Senior Solutions Architect @ Crunchy Data

Data on Kubernetes Day @ KubeCon CloudNativeCon | Salt Lake City | Nov 2024

whoami

Junior DBA
(Oracle)

DBA
(Oracle,
SQL Server,
Sybase)

Senior DBA
(Oracle,
SQL Server,
Sybase)

Database
Expert
(Oracle, Postgres)

Database
Consultant
(Postgres)

Solutions
Architect
(Postgres)

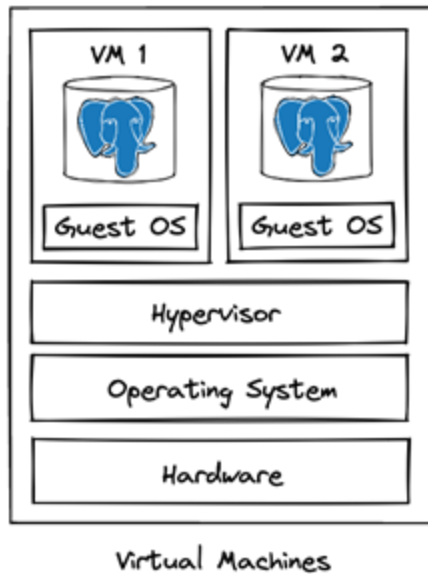crunchy data

Introduction

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Agenda

1. What Came Before?

2. What does a DBA do anyway?

3. Postgres Operators for Kubernetes

4. What do you want from an Operator?

5. How to get Started

crunchy data
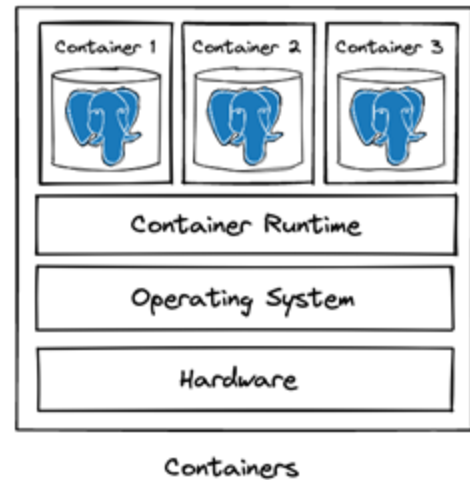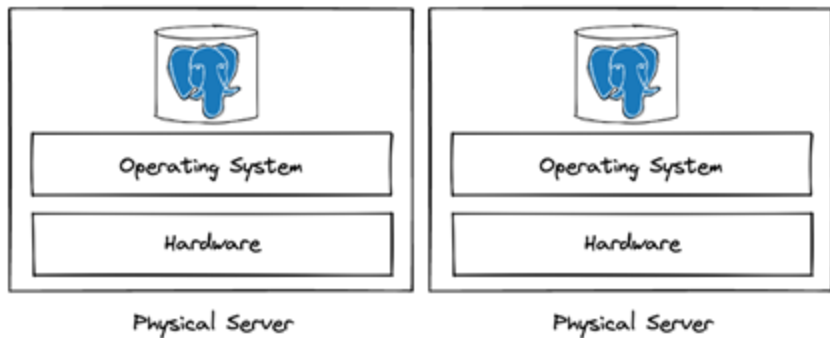
Agenda

1. **What Came Before?**

2. What does a DBA do anyway?

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Physical Server

Operating System

Hardware

Physical Server

Operating System

Hardware

Virtual Machines

VM 1 — Guest OS
VM 2 — Guest OS

Hypervisor

Operating System

Hardware

Containers

Container 1 Container 2 Container 3

Container Runtime

Operating System

Hardware

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Features of Containers

- Lightweight

- Scalable

- Portable

- Isolated

- Stateless

- Ephemeral

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Herding Cats (Managing Containers)

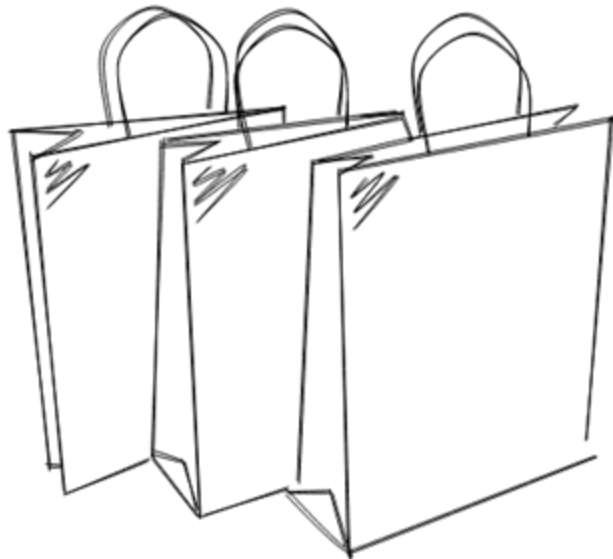Karen Jex 2024

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Agenda

1. What Came Before?

2. **What does a DBA do anyway?**

3. Postgres Operators for Kubernetes

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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

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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
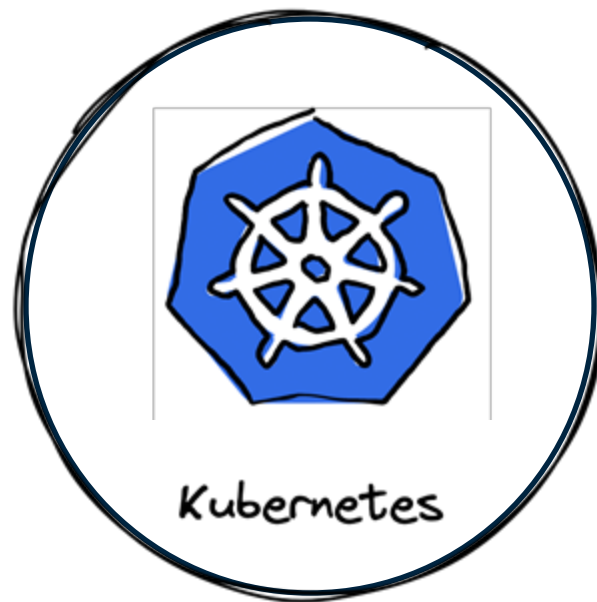
- Database Maintenance

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Agenda

1. What Came Before?

2. What does a DBA do anyway?

3. **Postgres Operators for Kubernetes**

4. What do you want from an Operator?

5. How to get Started

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Kubernetes Features

- Provisioning & Deployment

- Configuration

- Scheduling

- Scaling up & down

- Self-healing

- Services

- Storage

- Resource allocation

- Load Balancing & Networking

- Security

- Stateful Sets

- Sidecars

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Running Postgres on Kubernetes
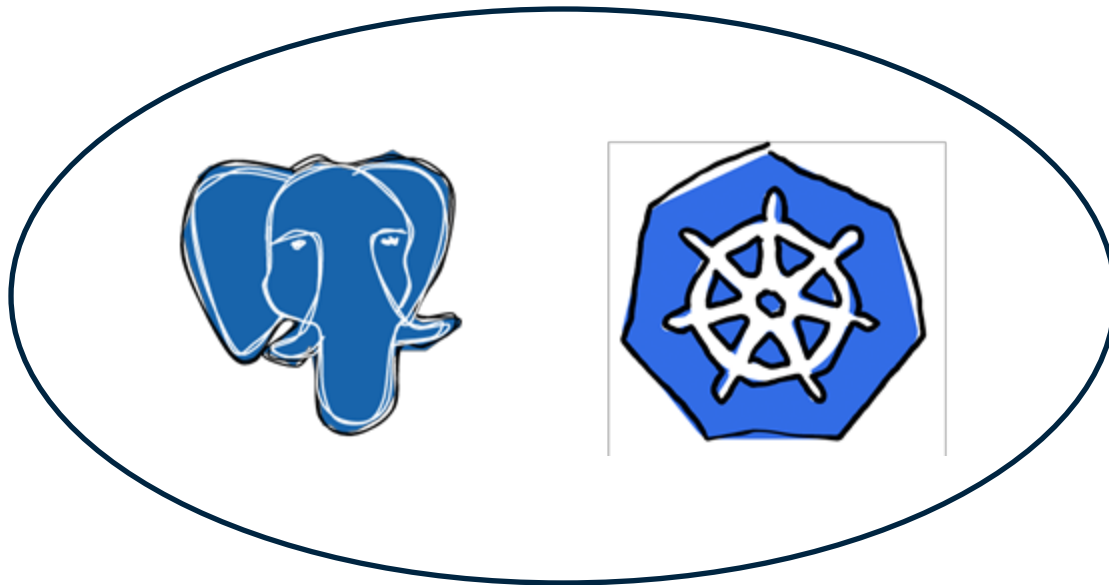

PostgreSQL

Kubernetes

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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/

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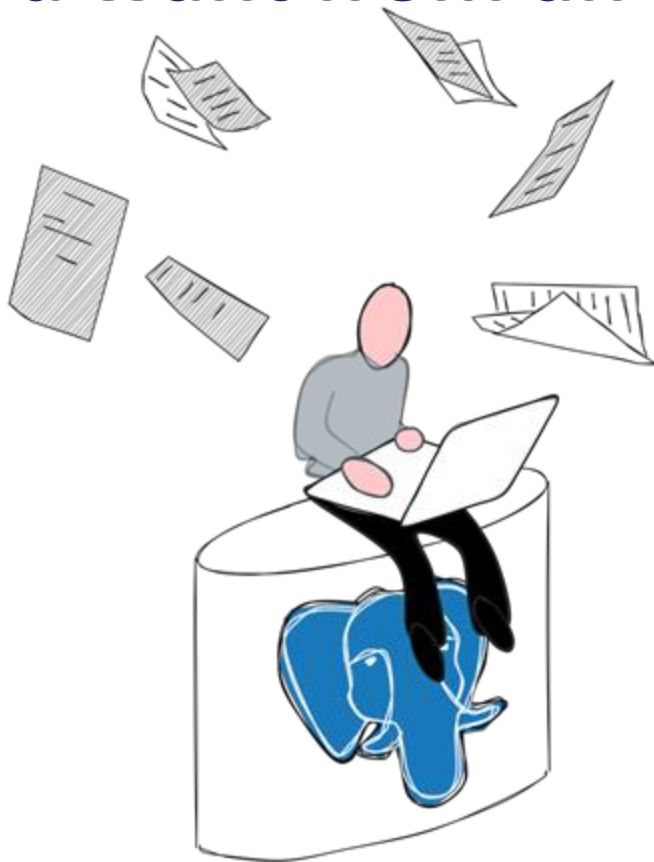# Postgres Operators for Kubernetes

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Agenda

1. What Came Before?

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3. Postgres Operators for Kubernetes

4. **What do you want from an Operator?**

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What do you want from an Operator?

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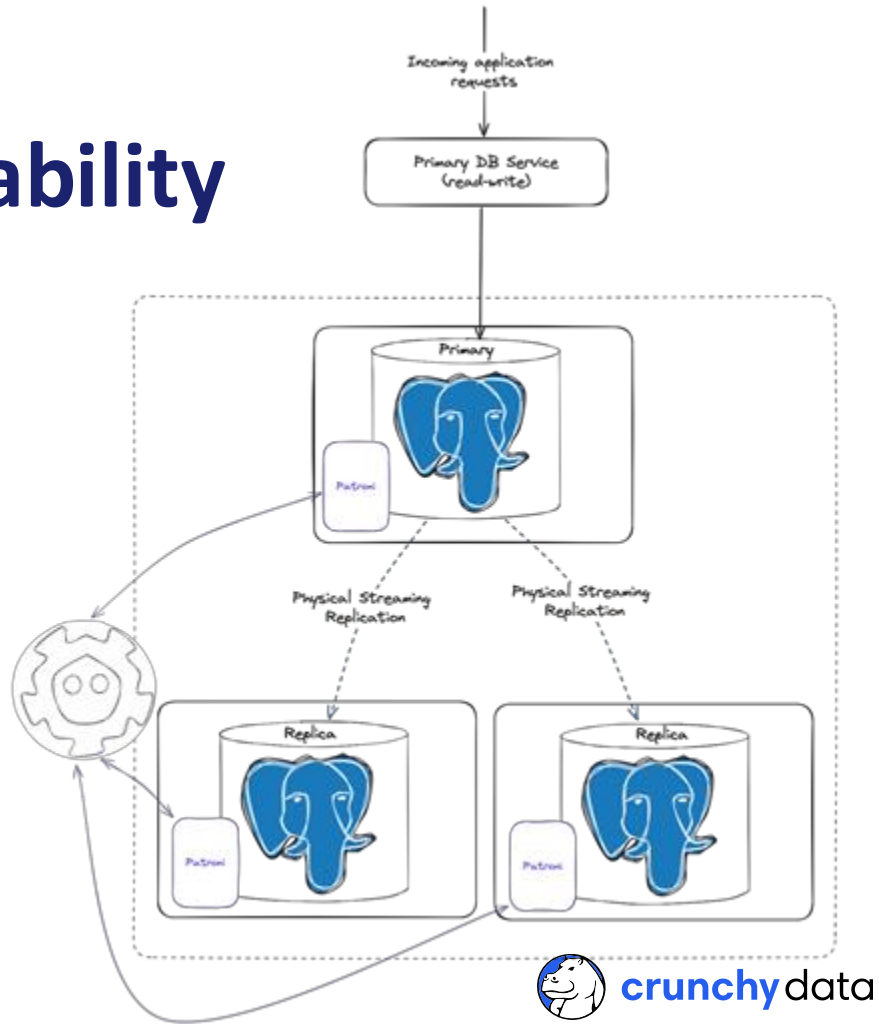- Database Creation

- Database Maintenance

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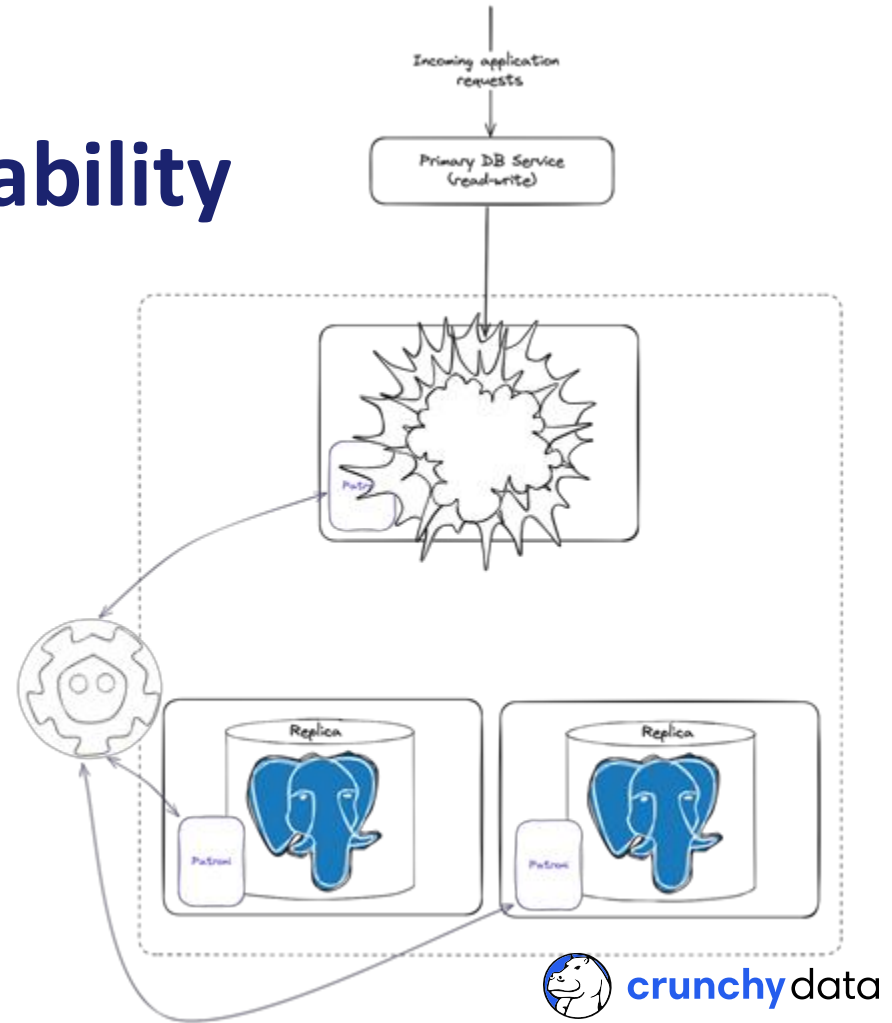
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crunchy data
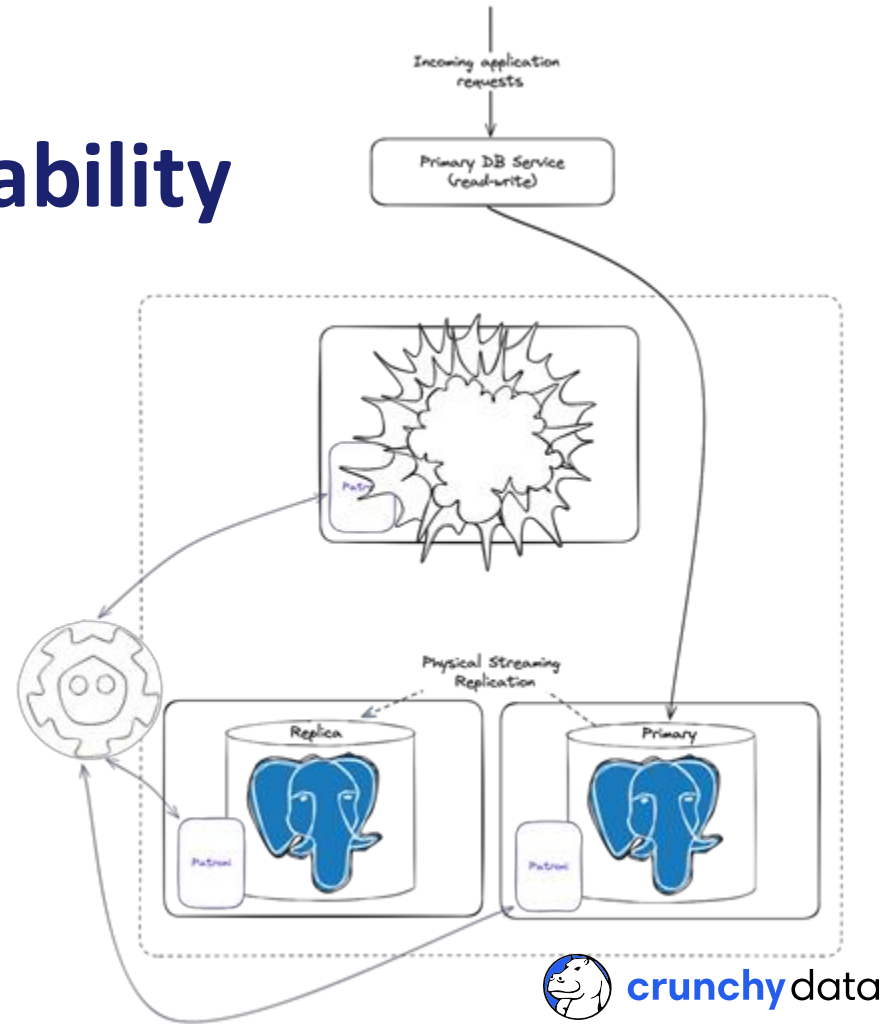
~~DBA~~ Operator Responsibilities
Database (High) Availability

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~~DBA~~ Operator Responsibilities
Database (High) Availability

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~~DBA~~ Operator Responsibilities
Database (High) Availability

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~~DBA~~ Operator Responsibilities
Database (High) Availability

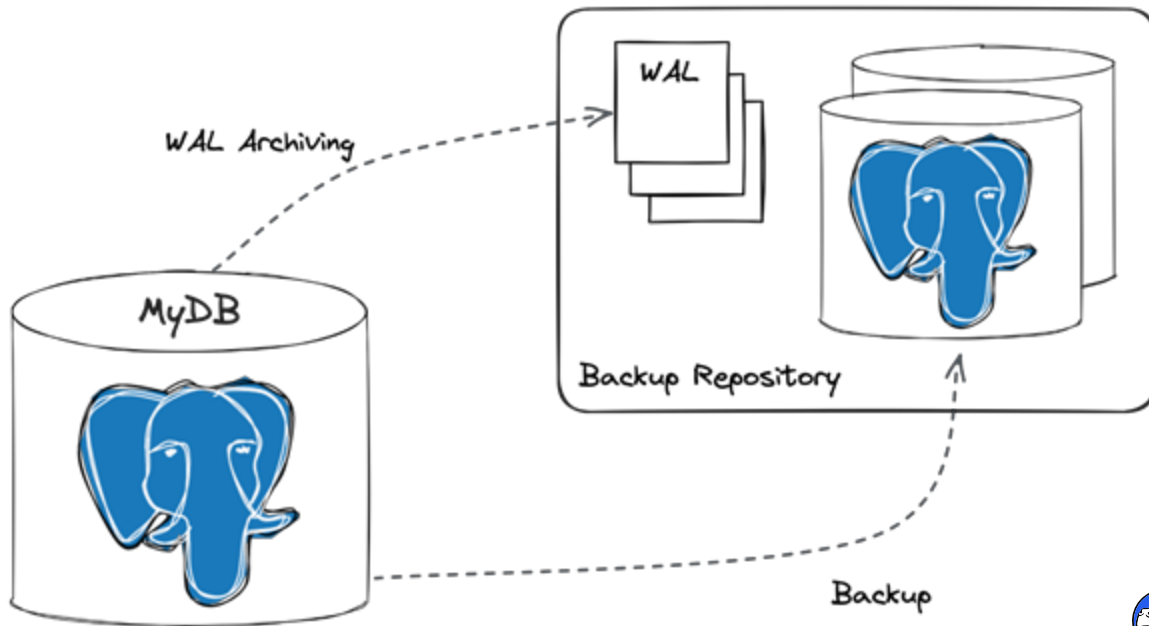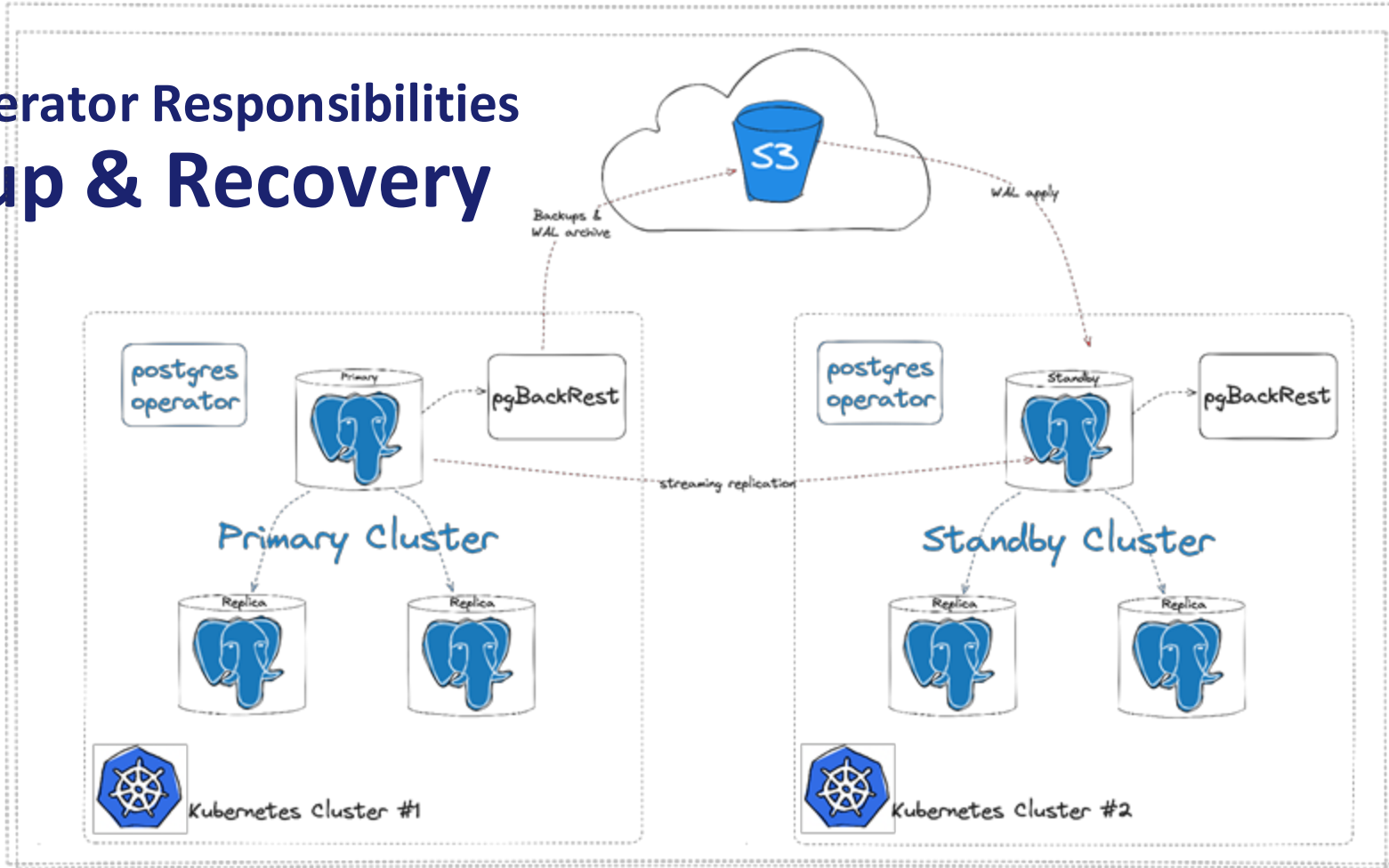# ~~DBA~~ **Operator Responsibilities**

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~~DBA~~ Operator Responsibilities
Backup & Recovery

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~~DBA~~ Operator Responsibilities
Backup & Recovery

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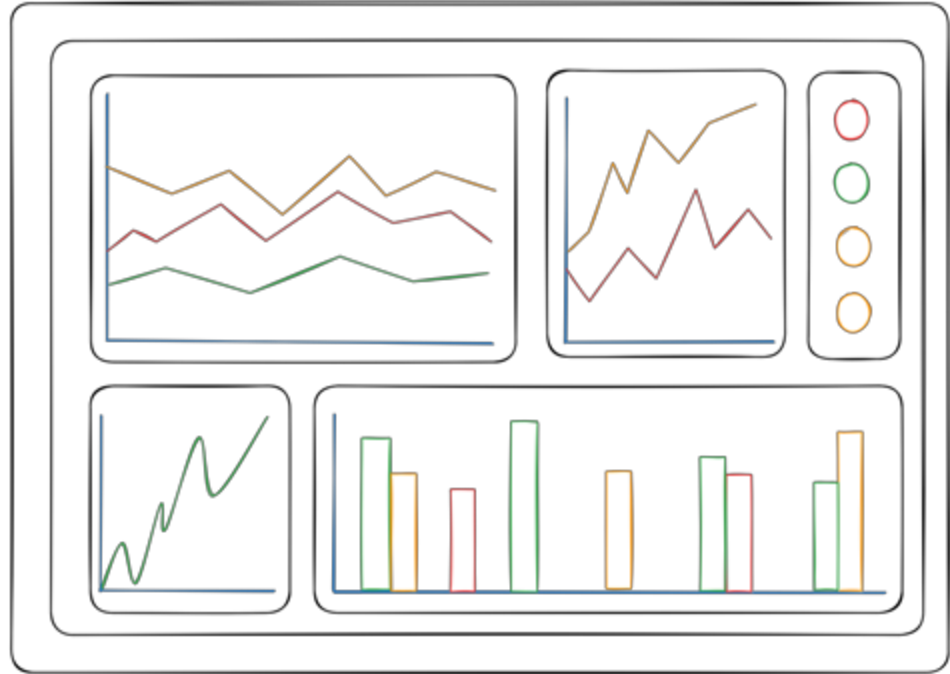crunchy data

~~DBA~~ Operator Responsibilities
Security

- Database Access

- Password Encryption

- Secrets

- SSL/TLS

- Certificates

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~~DBA~~ Operator Responsibilities

- Database (High) Availability

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- Security & Data Protection

- **Monitoring**

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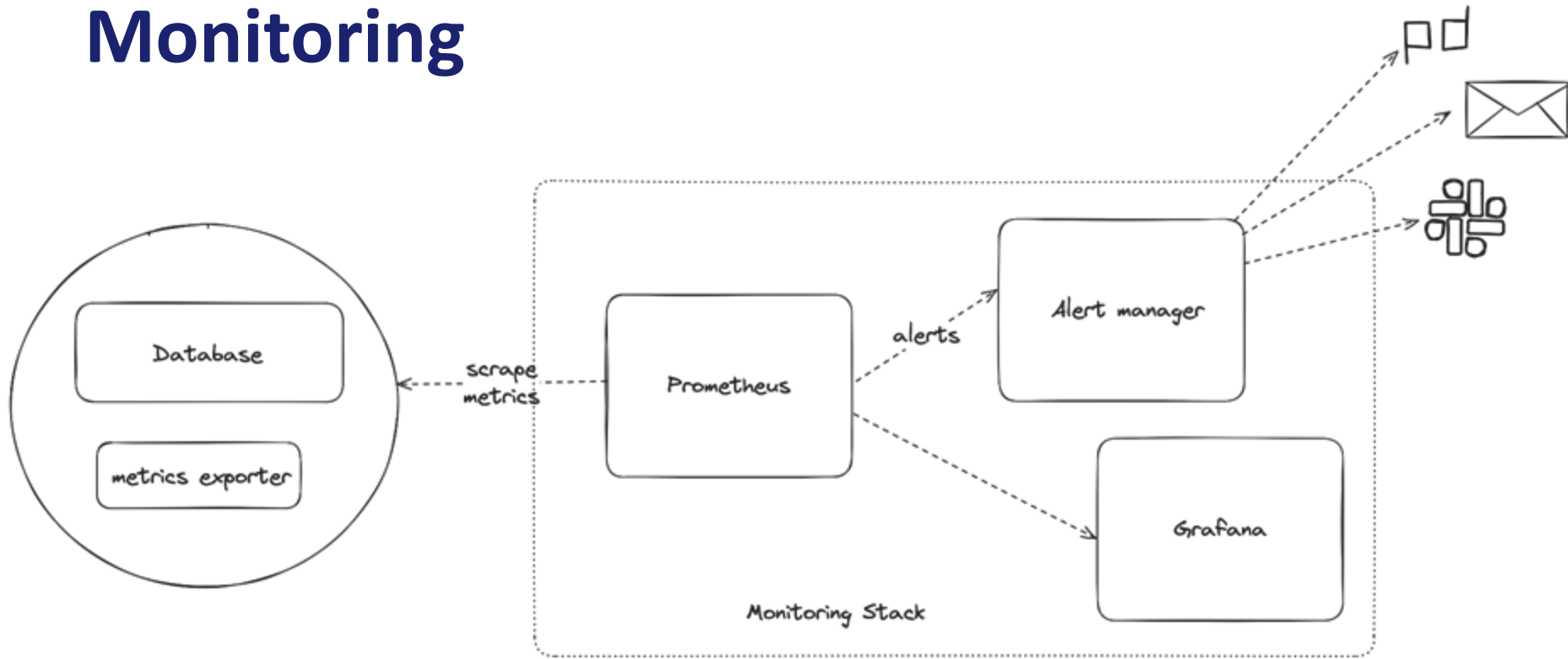
- Database Creation

- Database Maintenance

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~~DBA~~ Operator Responsibilities
Monitoring

crunchy data
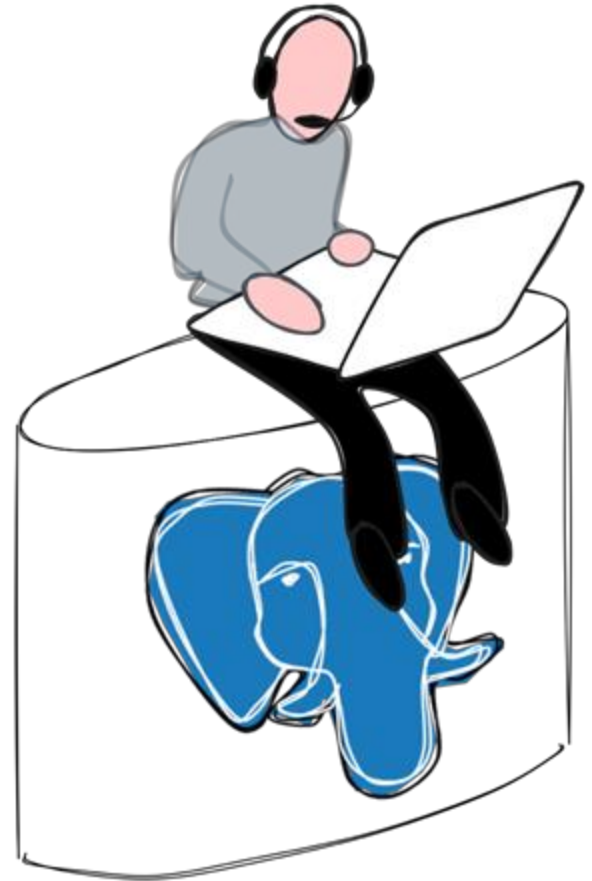
DBA Operator Responsibilities
Monitoring

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~~DBA~~ Operator Responsibilities

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- **Support/Troubleshooting**

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crunchy data

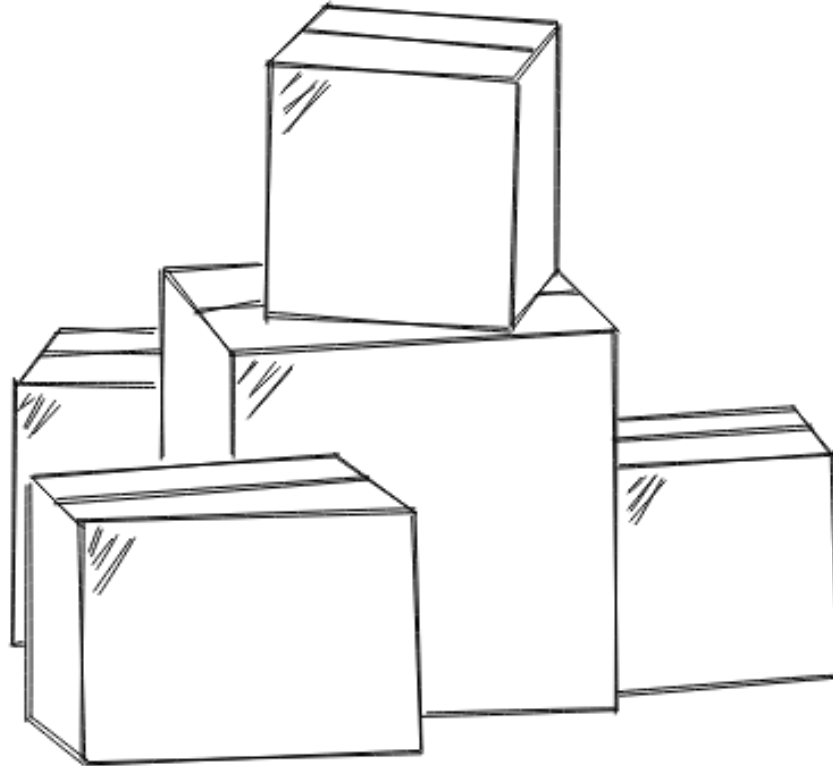# Support/Troubleshooting

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~~DBA~~ Operator Responsibilities

- Database (High) Availability

- Backup and Recovery

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- ~~DB Design/Data Modelling~~

- Support/Troubleshooting

- **DB Software install/upgrade**

- Database Expertise

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- Database Creation

- Database Maintenance

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~~DBA~~ **Operator Responsibilities**
Database Software Install

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~~DBA~~ **Operator Responsibilities**
Postgres (Minor) Upgrade

Ordered, automated rolling updates

Database Software (Major) Upgrade

- Requires planning & testing

- Automated by Operator

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~~DBA~~ **Operator 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
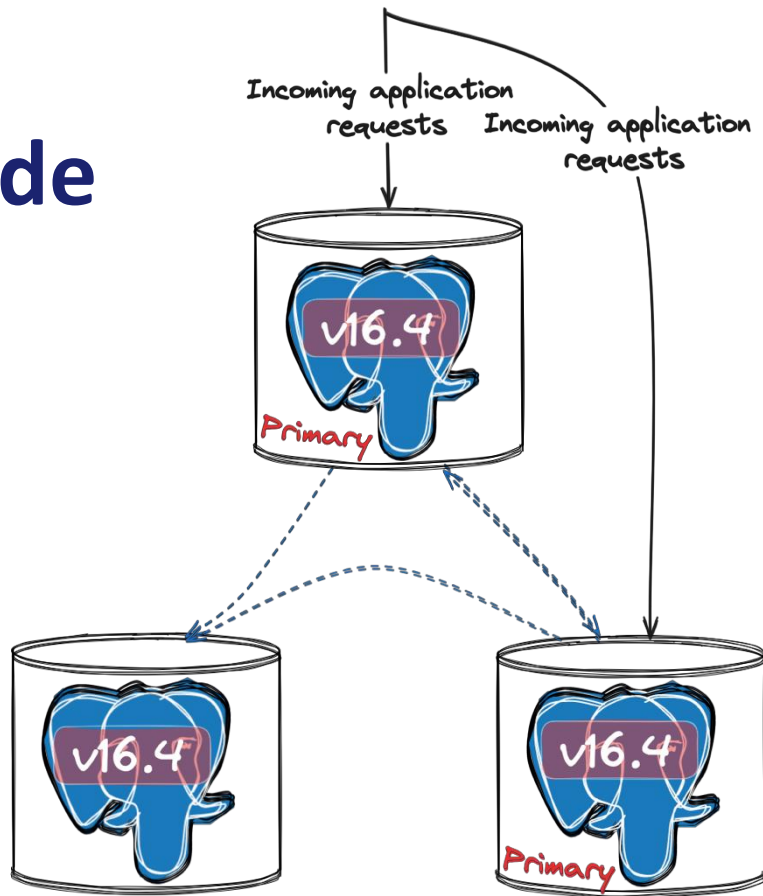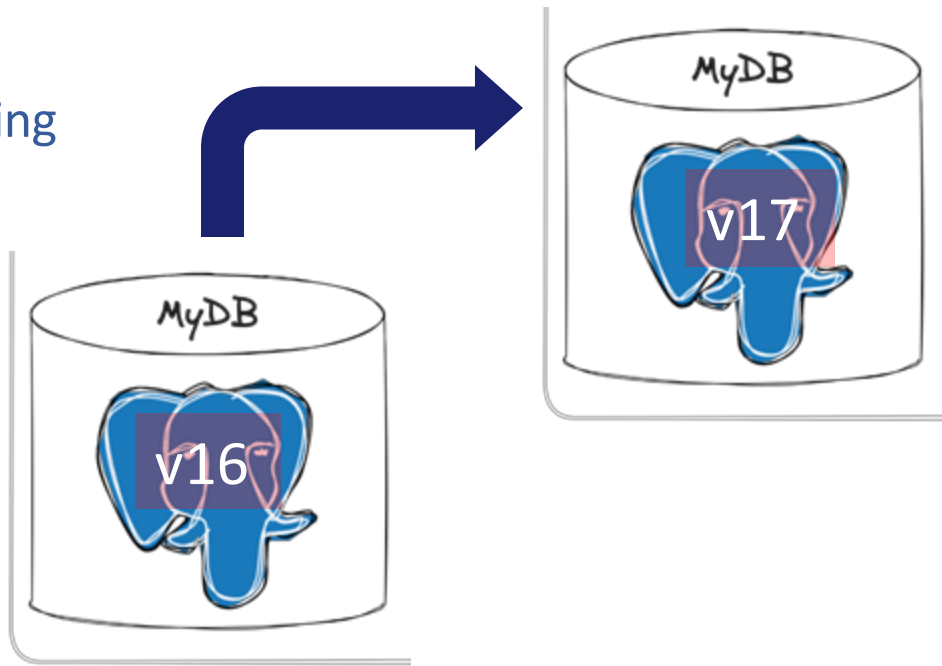
- Database Creation

- Database Maintenance

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~~DBA~~ Operator Responsibilities
Database Expertise

- Operator: Built-in database expertise

Human expert:

- Strategic considerations

- Application needs

- Business requirements

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~~DBA~~ Operator Responsibilities

- Database (High) Availability

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- Monitoring

- ~~DB Design/Data Modelling~~

- Support/Troubleshooting

- DB Software install/upgrade

- Database Expertise

- **Performance Tuning**

- Capacity Planning
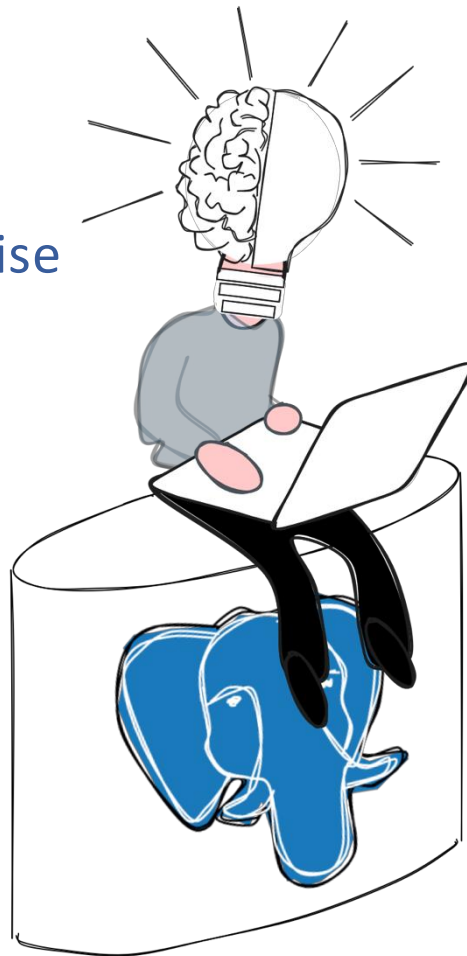
- Database Creation

- Database Maintenance

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~~DBA~~ Operator Responsibilities
Performance Tuning

- Configuration Parameters

- Connection pooling

- pg_stat_statements

- Logging

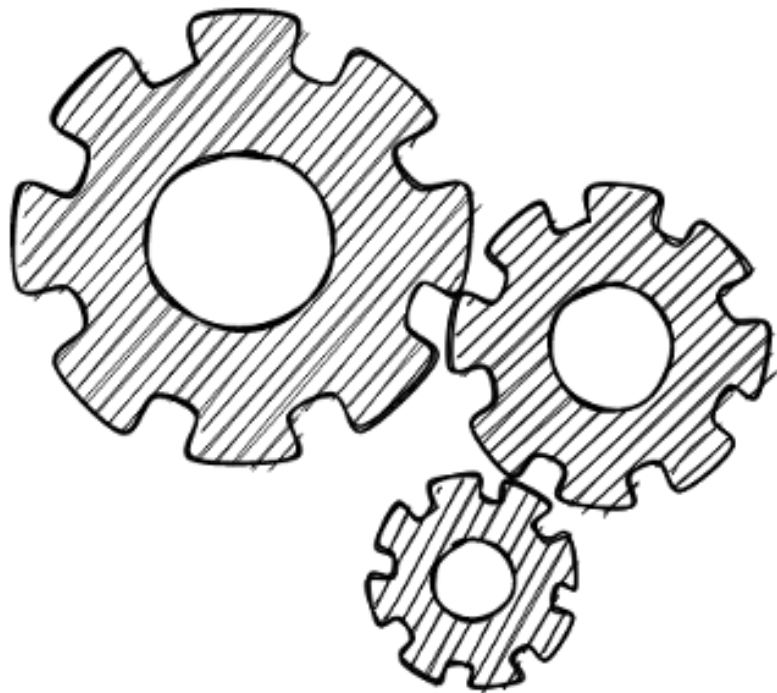- Monitoring and alerting

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~~DBA~~ Operator Responsibilities

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- ~~DB Design/Data Modelling~~

- Support/Troubleshooting

- DB Software install/upgrade

- Database Expertise

- Performance Tuning

- **Capacity Planning**

- Database Creation

- Database Maintenance

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~~DBA~~ Operator Responsibilities
Capacity Planning

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

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~~DBA~~ Operator Responsibilities

- Database (High) Availability

- Backup and Recovery

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- Monitoring

- ~~DB Design/Data Modelling~~

- Support/Troubleshooting

- DB Software install/upgrade

- Database Expertise

- Performance Tuning

- Capacity Planning

- **Database Creation**

- **Database Maintenance**

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Database Creation

```
users:
- name: hippo
  databases:
    - dokday
```

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~~DBA~~ Operator Responsibilities
Database Maintenance

- Taking backups

- Creating users

- Rebuilding Indexes

- Gathering statistics

- Log management

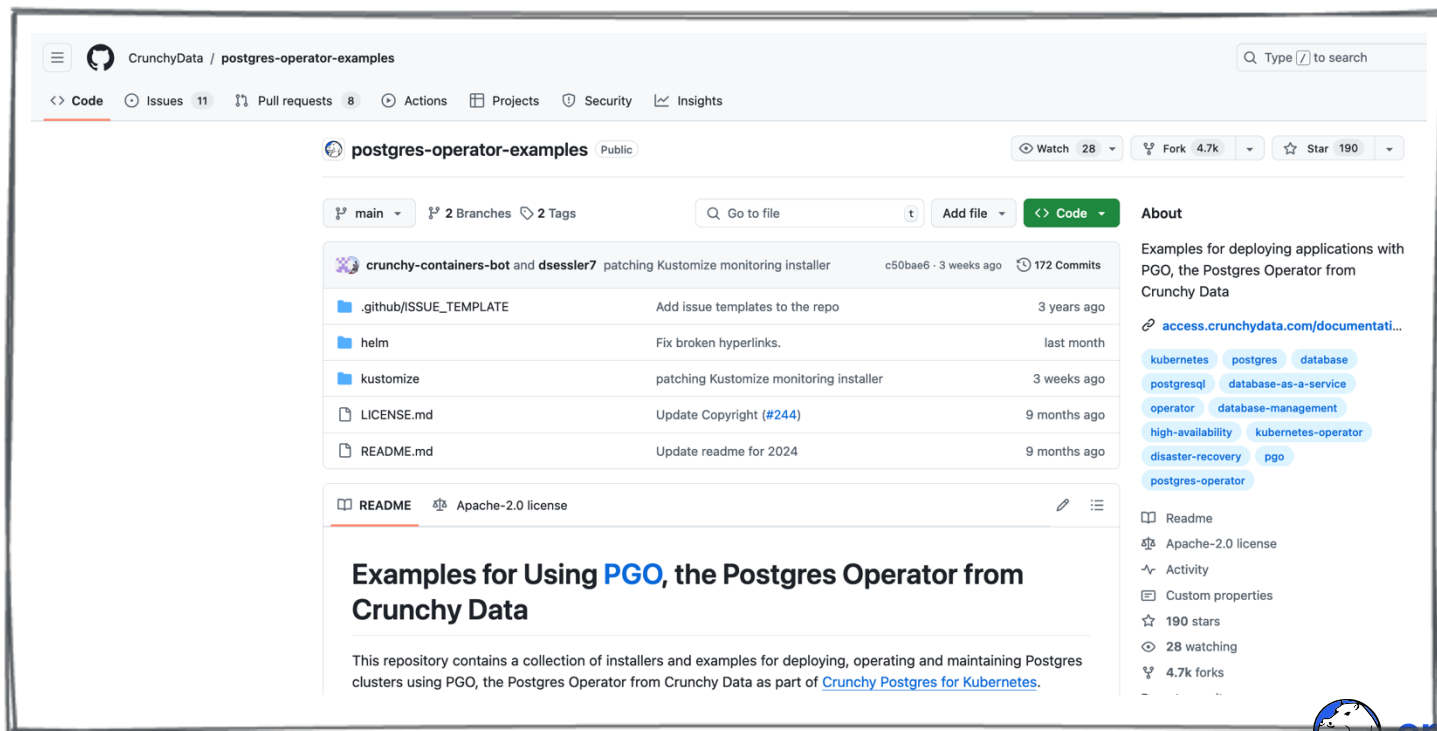Not an exhaustive list!

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Agenda

1. What Came Before?

2. What does a DBA do anyway?

3. Postgres Operators for Kubernetes

4. What do you want from an Operator?

5. **How to get Started**

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How to get Started

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

How to get Started
Install the Operator

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

```
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
```

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postgres.yaml

```yaml
apiVersion: postgres-operator.crunchydata.com/v1beta1
kind: PostgresCluster
metadata:
  name: kubecon
spec:
postgresVersion: 16
  instances:
    - name: instance1
      replicas: 3
      dataVolumeClaimSpec:
        accessModes:
        - "ReadWriteOnce"
        resources:
          requests:
            storage: 1Gi
```

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postgres.yaml (contd)

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

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How to get Started
Create a Postgres Cluster

```
% kubectl apply –k kubecon

% kubectl get pods

NAME                                              READY   STATUS      RESTARTS   AGE
kubecon-backup-b7v4-krfkb                         0/1     Completed   0          13m
kubecon-instance1-b9nq-0                          4/4     Running     0          13m
kubecon-instance1-ljg8-0                          4/4     Running     0          13m
kubecon-instance1-m6mx-0                          4/4     Running     0          13m
kubecon-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
```

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Conclusions

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Conclusions
Postgres Operator for Kubernetes

- Virtual database administrator

- PostgreSQL expertise and automation

- Robust, secure, scalable architecture

- Combined strength of PostgreSQL and Kubernetes

- Leaves you to do the Interesting Stuff!

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Thank You!

Karen Jex | @karenhjex | karen.jex@crunchydata.com