Software Architecture Morning, 04.08.2022

Kubernetes Developer Survival Kit

Sandra Parsick
@SandraParsick
mail@sandra-parsick.de

Wer bin ich?

- Sandra Parsick
- Freiberuflicher Softwareentwickler und Consultant im Java-Umfeld
- Schwerpunkte:
  - Java Enterprise Anwendungen
  - Agile Methoden
  - Software Craftmanship
  - Automatisierung von Entwicklungsprozessen
- Trainings
- Workshops

mail@sandra-parsick.de

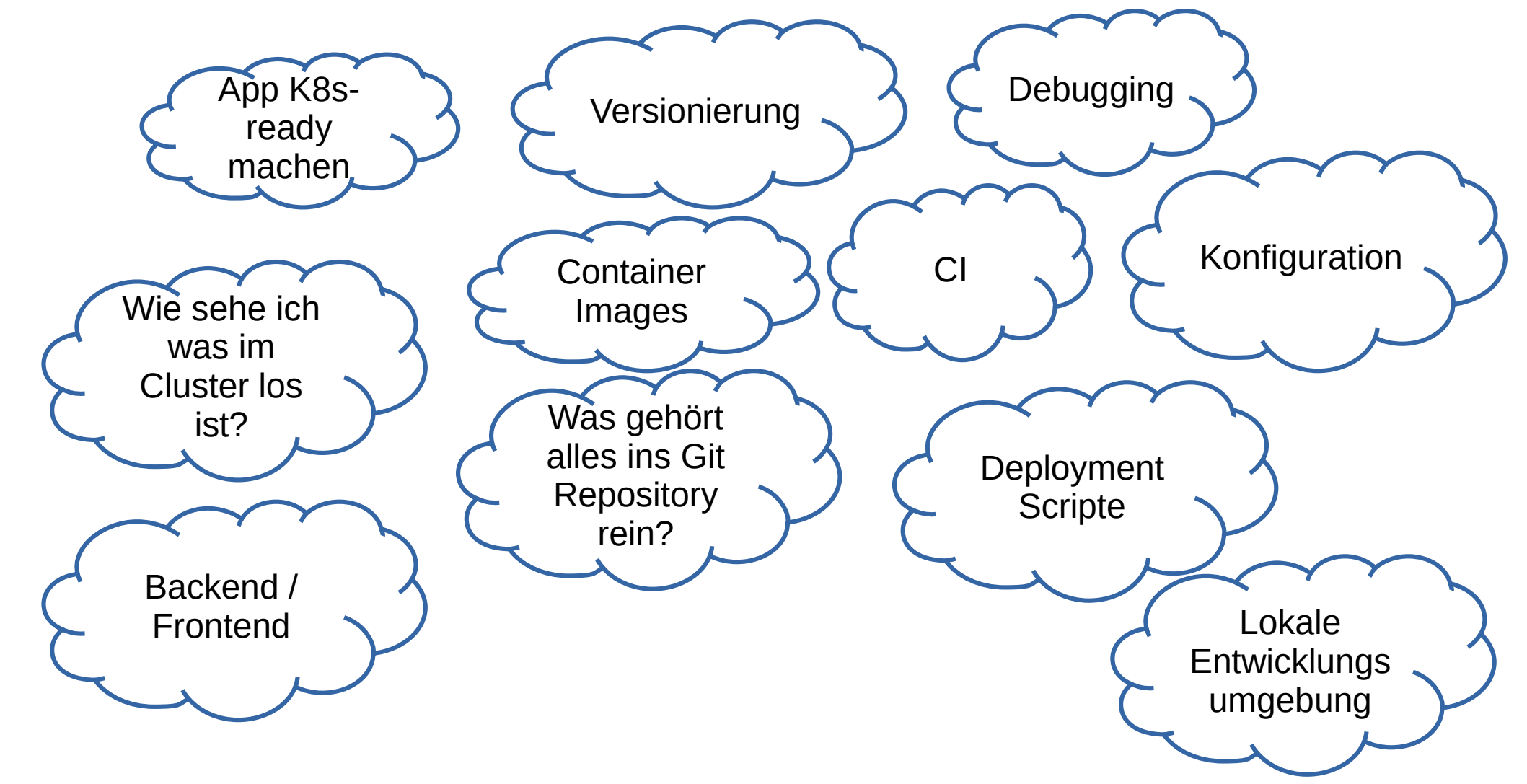
@SandraParsick

xing.to/sparsick

https://www.sandra-parsick.de

https://ready-for-review.dev


SSA TERMINALS
SSATerminals
NORTHERN JUSTICE
MADEIRA


App K8s-ready machen
Versionierung
Debugging
Container Images
CI
Konfiguration
Wie sehe ich was im Cluster los ist?
Was gehört alles ins Git Repository rein?
Deployment Scripte
Backend / Frontend
Lokale Entwicklungs umgebung

Friendly Reminder: 12 Factor App

I. Codebase
One codebase tracked in revision control, many deploys

II. Dependencies
Explicitly declare and isolate dependencies

III. Config
Store config in the environment

IV. Backing services
Treat backing services as attached resources

V. Build, release, run
Strictly separate build and run stages

VI. Processes
Execute the app as one or more stateless processes

Friendly Reminder: 12 Factor App

VII. Port binding
Export services via port binding

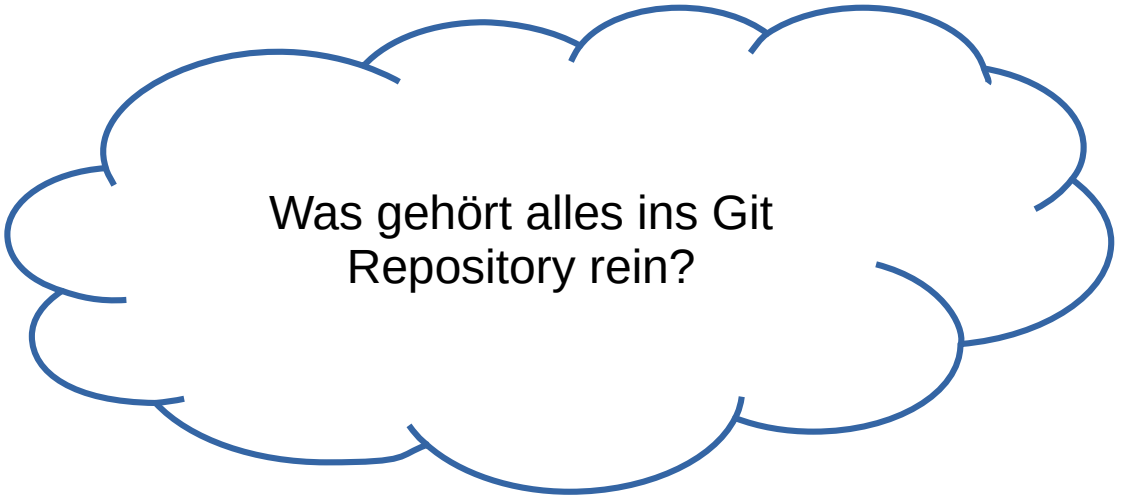
VIII. Concurrency
Scale out via the process model

IX. Disposability
Maximize robustness with fast startup and graceful shutdown

X. Dev/prod parity
Keep development, staging, and production as similar as possible

XI. Logs
Treat logs as event streams

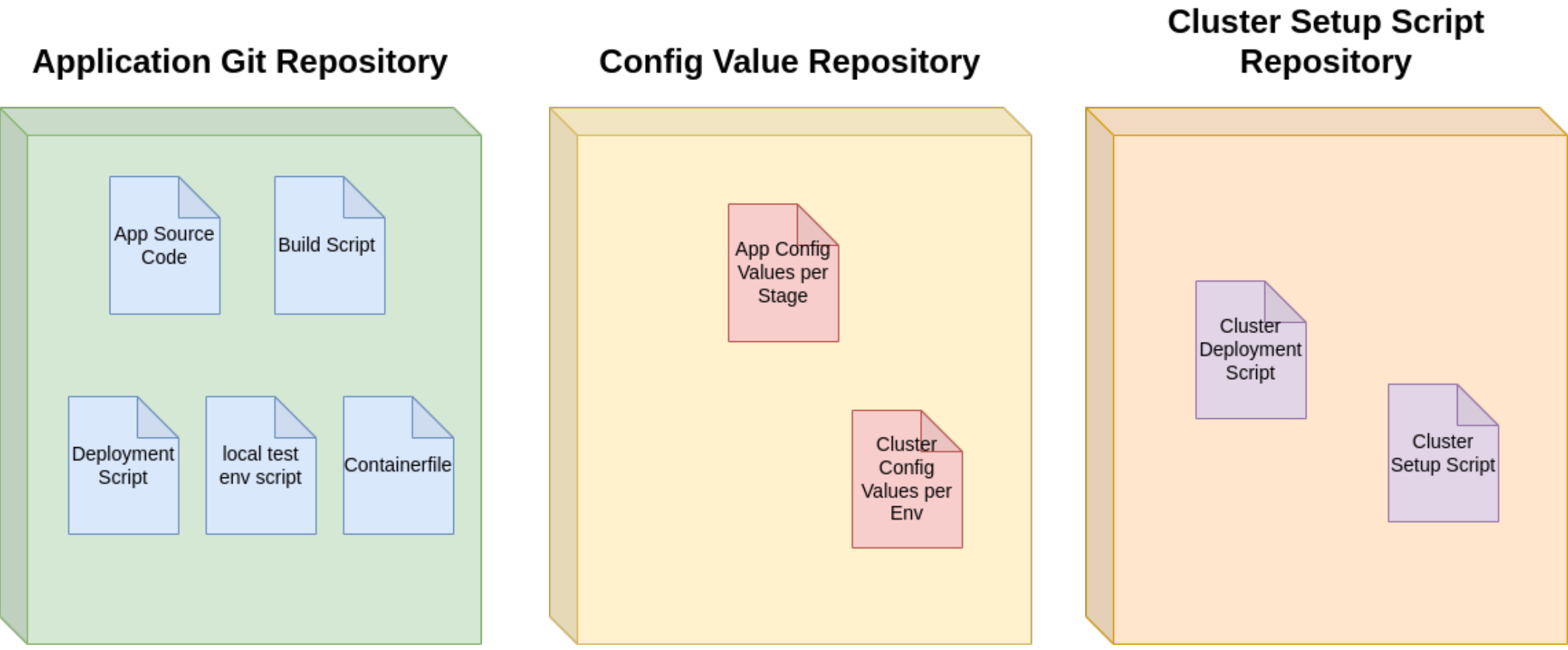
XII. Admin processes
Run admin/management tasks as one-off processes


Was gehört alles ins Git
Repository rein?

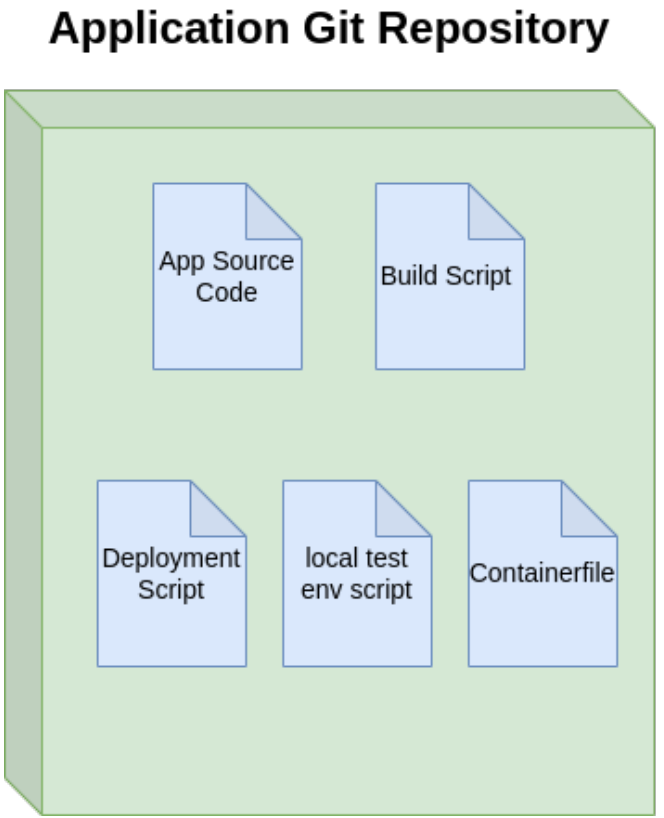
Kurzform: ALLES

Eigentliche Fragestellung:
Wieviele Repositories?

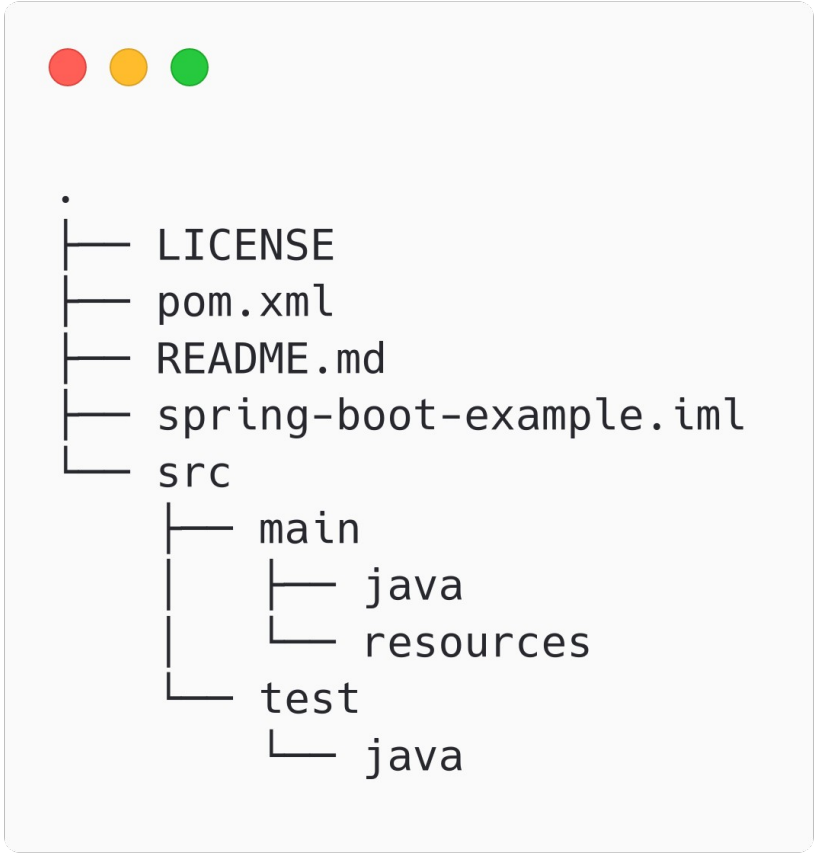
Beispiel für eine Aufteilung



Für Devs am wichtigsten

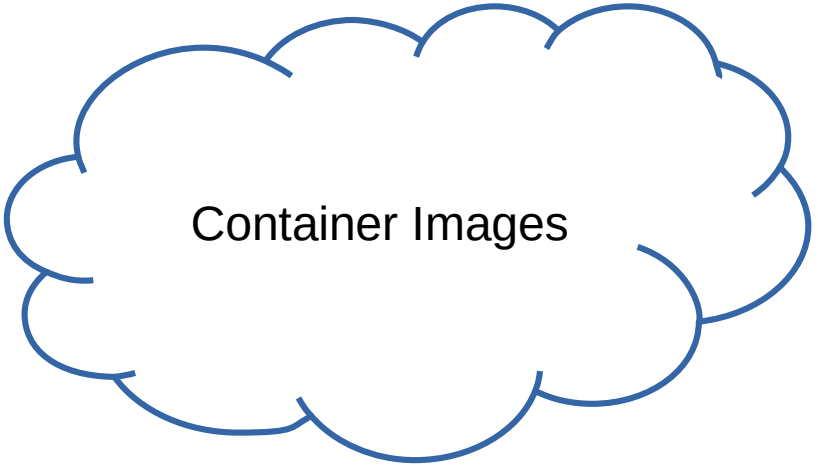


Ausgangspunkt eine Java App

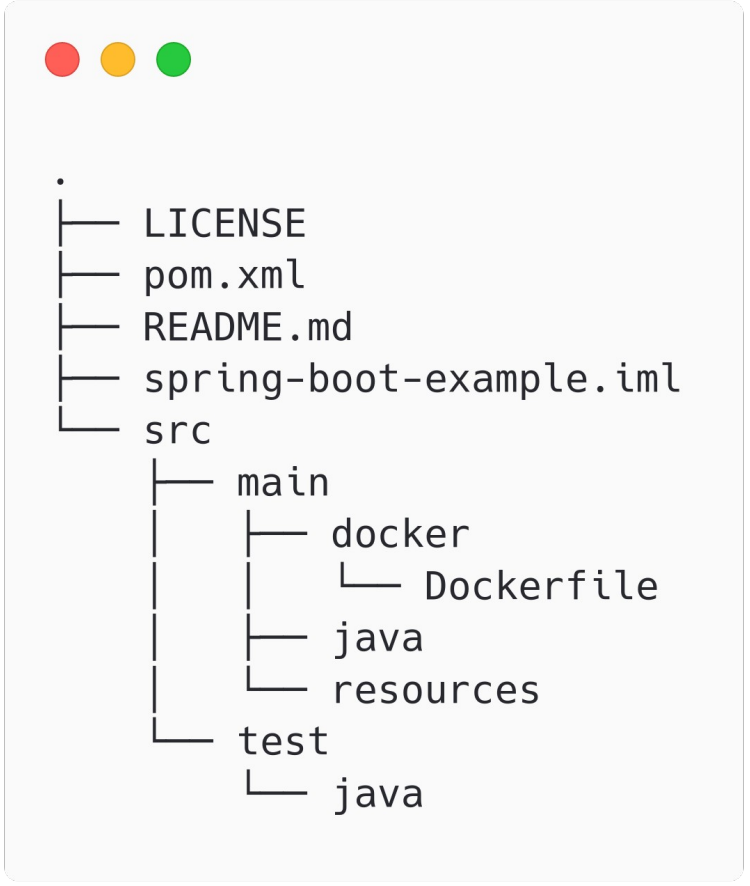


Technologiestack:

- Java 17
- Spring Boot 2.7.x
- Thymeleaf
- Apache Maven


Container Images

Basis: Container



Basis: Container

```
FROM docker.io/eclipse-temurin:17.0.1_12-jre as builder
WORKDIR /application
COPY maven/*.jar application.jar
RUN java -Djarmode=layertools -jar application.jar extract

FROM gcr.io/distroless/java17-debian11
WORKDIR /application
EXPOSE 8080
COPY --from=builder /application/dependencies/ ./
COPY --from=builder /application/spring-boot-loader/ ./
COPY --from=builder /application/snapshot-dependencies/ ./
COPY --from=builder /application/application/ ./
ENTRYPOINT ["java", "org.springframework.boot.loader.JarLauncher"]
```

```
<plugin>
    <groupId>io.fabric8</groupId>
    <artifactId>docker-maven-plugin</artifactId>
    <version>0.40.0</version>
    <executions>
        <execution>
            <id>docker-build</id>
            <goals>
                <goal>build</goal>
                <goal>push</goal>
            </goals>
        </execution>
    </executions>
    <configuration>
        <images>
            <image>
                <name>spring-boot-demo:latest</name>
                <build>
                    <dockerFile>Dockerfile</dockerFile>
                    <assembly>
                        <descriptorRef>artifact</descriptorRef>
                    </assembly>
                </build>
            </image>
        </images>
        <pushRegistry>localhost:6000</pushRegistry>
  </configuration>
</plugin>
```

Alternativen

- Buildpacks (spring-boot-maven-plugin)
- JIB (jib-maven-plugin)
- Buildah
- Podman
- Weitere Infos im Artikel „Container-Images Deep Dive“ auf Informatik Aktuell
-

Container-Image-Bau ist Teil des Buildprozess und lokal ausführbar

Good Practises Container Image Build

- unnötige Tools aus dem Image entfernen
- nur eine Services pro Image verpacken
- kleine Image bauen
- Build-Cache optimieren

- Eigene Container Registry benutzen
- Tags beim Releasen nur einmal verwenden

- Vulnerability-Scans der Container Images

Optimierter Container Image

```
FROM docker.io/eclipse-temurin:17.0.1_12-jre as builder
WORKDIR /application
COPY maven/*.jar application.jar
RUN java -Djarmode=layertools -jar application.jar extract

FROM gcr.io/distroless/java17-debian11
WORKDIR /application
EXPOSE 8080
COPY --from=builder /application/dependencies/ ./
COPY --from=builder /application/spring-boot-loader/ ./
COPY --from=builder /application/snapshot-dependencies/ ./
COPY --from=builder /application/application/ ./
ENTRYPOINT ["java", "org.springframework.boot.loader.JarLauncher"]
```

Container Registry

- Cloud Provider:
  - Azure Container Registry
  - AWS Elastic Container Registry
  - Google Container Registry
- On Premise:
  - JFrog Container Registry
  - Red Hat Quay
  - Harbor
  - Artifactory
  - Sonatype Nexus

Vulnerability-Scans (Bsp.: Trivy)

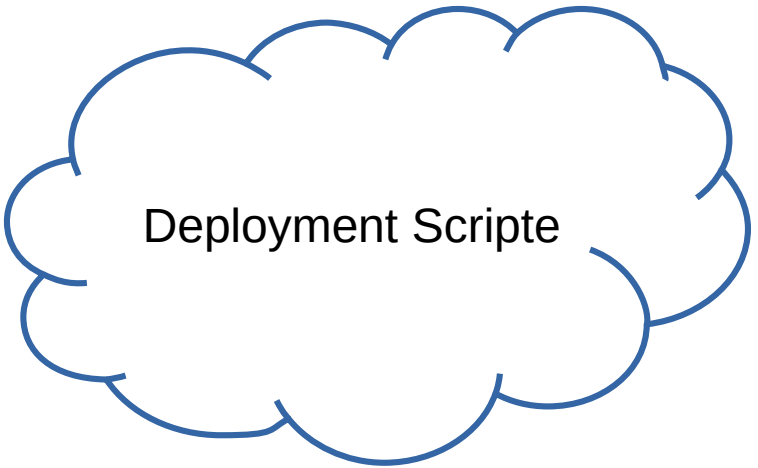
```
→ trivy i --ignore-unfixed -o result  spring-boot-demo:latest
2022-06-23T09:55:56.244+0200    INFO    Vulnerability scanning is enabled
2022-06-23T09:55:56.245+0200    INFO    Secret scanning is enabled
2022-06-23T09:55:56.245+0200    INFO    If your scanning is slow, please try '--security-checks vuln'
to disable secret scanning
2022-06-23T09:55:56.245+0200    INFO    Please see also https://aquasecurity.github.io/trivy/v0.29.2
/docs/secret/scanning/#recommendation for faster secret detection
2022-06-23T09:55:56.254+0200    INFO    Detected OS: debian
2022-06-23T09:55:56.255+0200    INFO    Detecting Debian vulnerabilities...
2022-06-23T09:55:56.265+0200    INFO    Number of language-specific files: 1
2022-06-23T09:55:56.265+0200    INFO    Detecting jar vulnerabilities...

spring-boot-demo:latest (debian 11.2)
=====================================
Total: 23 (UNKNOWN: 1, LOW: 2, MEDIUM: 6, HIGH: 6, CRITICAL: 8)


Java (jar)
==========
Total: 0 (UNKNOWN: 0, LOW: 0, MEDIUM: 0, HIGH: 0, CRITICAL: 0)
```

Vulnerability-Scans (Bsp.: Trivy)

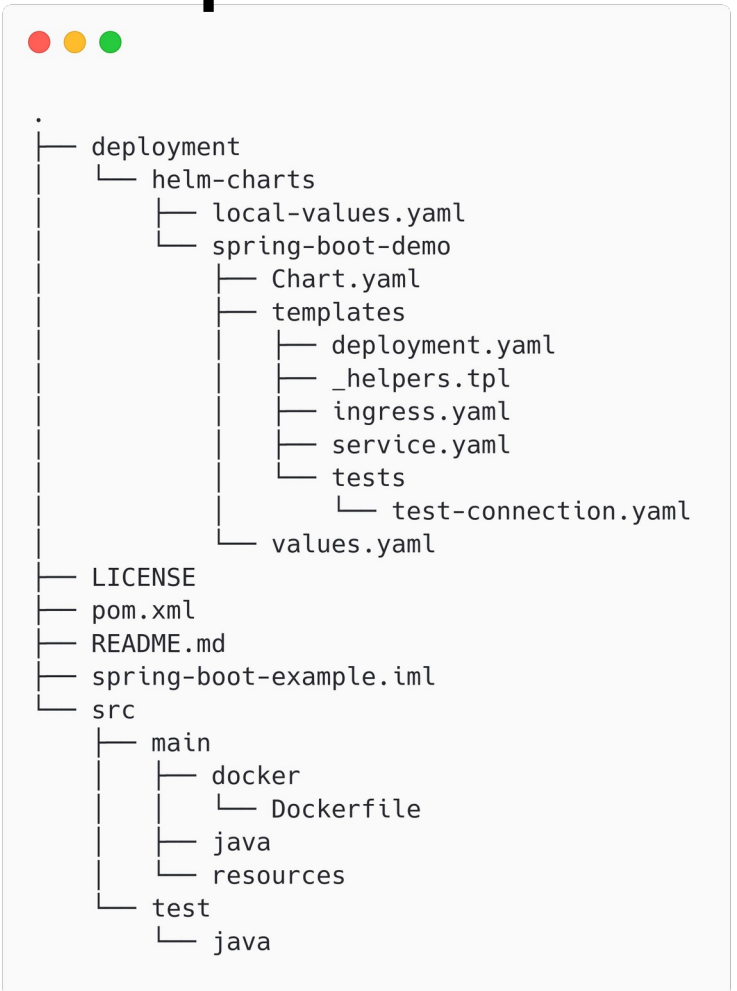
Library	Vulnerability	Severity	Installed Version	Fixed Version	Title
libc6	CVE-2021-33574	CRITICAL	2.31-13+deb11u2	2.31-13+deb11u3	glibc: mq_notify does not handle separately allocated thread attributes https://avd.aquasec.com/nvd/cve-2021-33574
	CVE-2022-23218				glibc: Stack-based buffer overflow in svcunix_create via long pathnames https://avd.aquasec.com/nvd/cve-2022-23218
	CVE-2022-23219				glibc: Stack-based buffer overflow in sunrpc clnt_create via a long pathname https://avd.aquasec.com/nvd/cve-2022-23219
	CVE-2021-43396	LOW			glibc: conversion from ISO-2022-JP-3 with iconv may emit spurious NUL character on... https://avd.aquasec.com/nvd/cve-2021-43396

Vulnerability-Scans Weitergedacht

- Was ist mit
  - Container in der Registry
  - Container, die schon im Cluster laufen


Deployment Scripte

Next Step: Helm Charts



Auszug: Service Definition

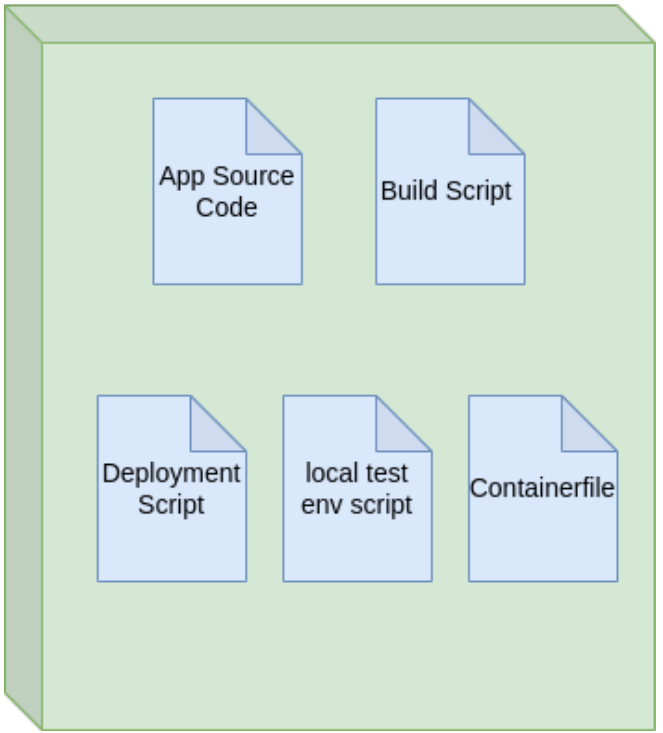
```yaml
apiVersion: v1
kind: Service
metadata:
  name: {{ include "spring-boot-demo.fullname" . }}
  namespace: {{ include "spring-boot-demo.namespaceName" . }}
  labels:
    {{- include "spring-boot-demo.labels" . | nindent 4 }}
spec:
  type: {{ .Values.service.type }}
  ports:
    - port: {{ .Values.service.port }}
      targetPort: 8080
      protocol: TCP
      name: http
  selector:
    {{- include "spring-boot-demo.selectorLabels" . | nindent 4 }}
```

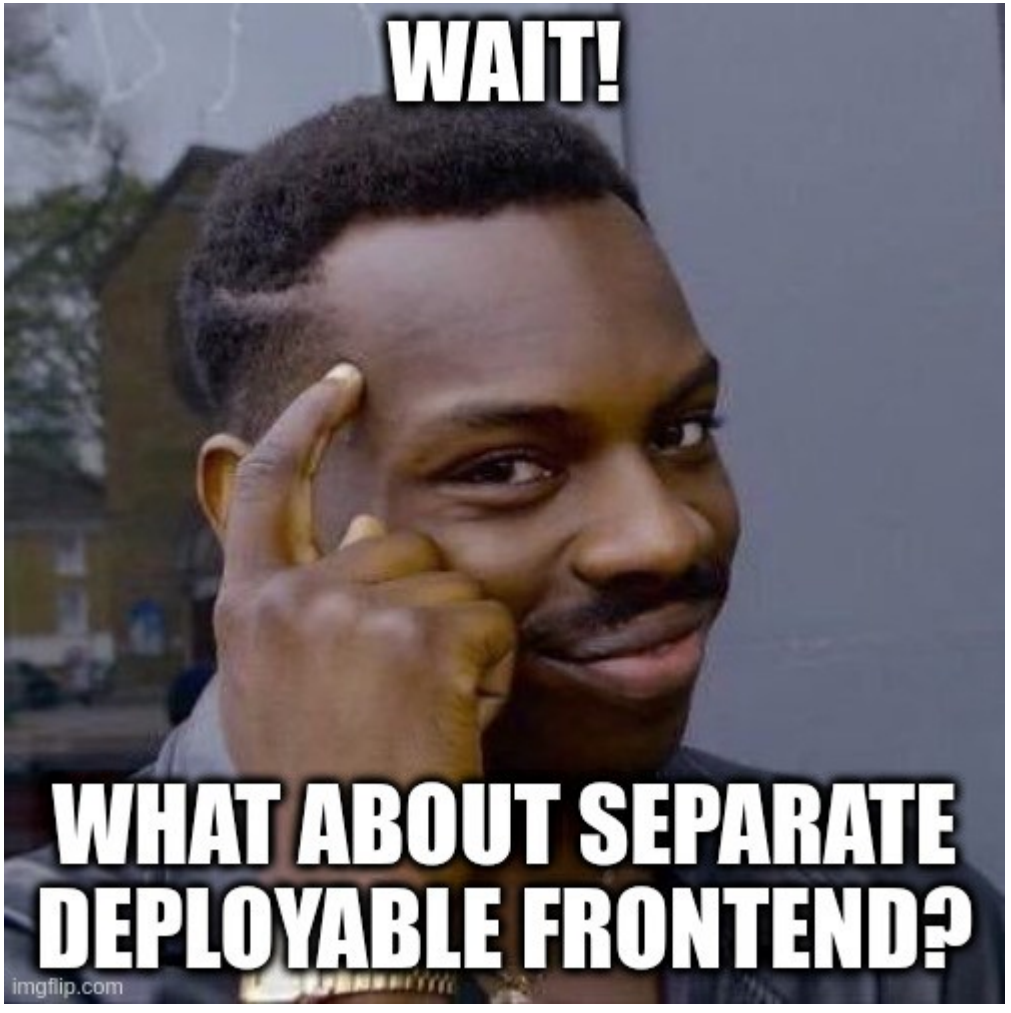
```xml
<plugin>
    <groupId>io.kokuwa.maven</groupId>
    <artifactId>helm-maven-plugin</artifactId>
    <version>6.3.0</version>
    <configuration>
        <chartDirectory>${project.basedir}/deployment/helm-charts</chartDirectory>
        <chartVersion>${project.version}</chartVersion>
        <helmVersion>3.8.1</helmVersion>
    </configuration>
    <executions>
        <execution>
            <id>build-chart</id>
            <phase>package</phase>
            <goals>
                <goal>package</goal>
            </goals>
        </execution>
        <execution>
            <id>upload-chart</id>
            <phase>deploy</phase>
            <goals>
                <goal>upload</goal>
            </goals>
      </execution>
    </executions>
</plugin>
```

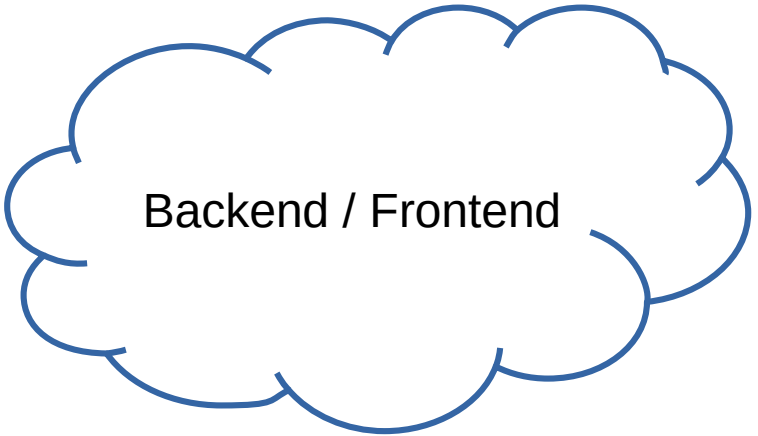
Helm Charts Paketierung Teil des Build Prozesses

Helm Chart Repository

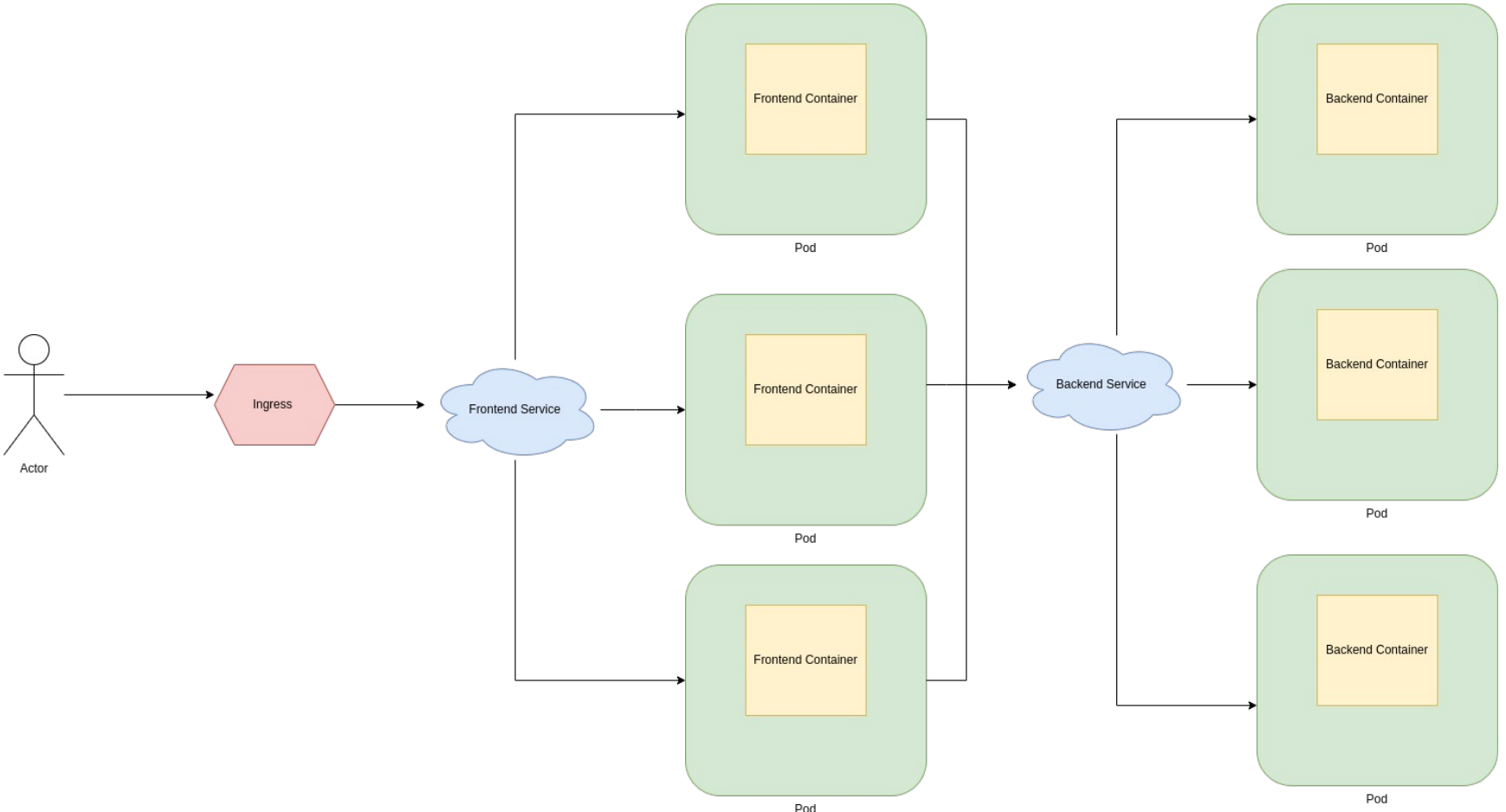
- Allgemein:
  - Jede Container Registry kann dafür genutzt werden
- Darauf spezialisiert:
  - Chartmuseum
  - JFrog Container Registry
  - Artifactory
  - Sonatype Nexus


Application Git Repository
App Source Code
Build Script
Deployment Script
local test env script
Containerfile

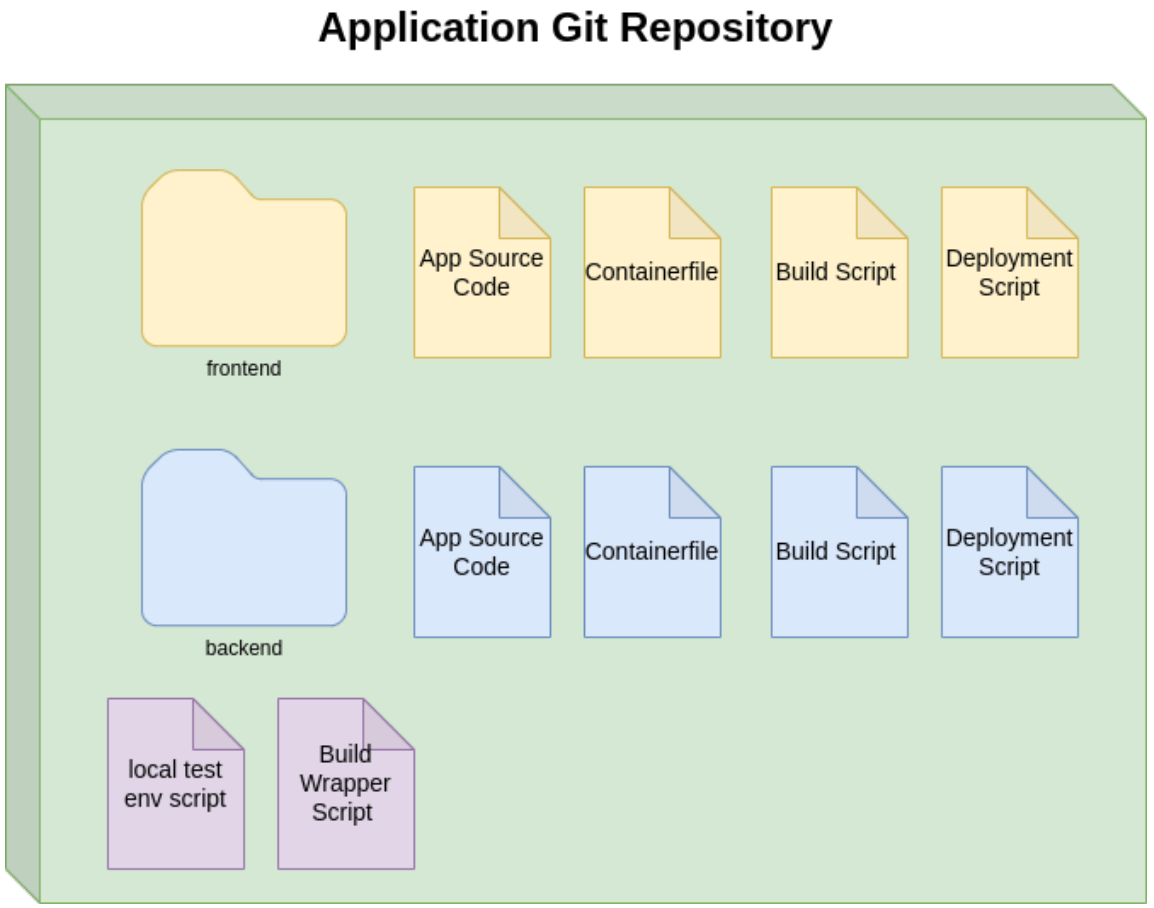

WAIT!
WHAT ABOUT SEPARATE DEPLOYABLE FRONTEND?
imgflip.com


Backend / Frontend

Frontend und Backend in K8s



Git Repository Struktur



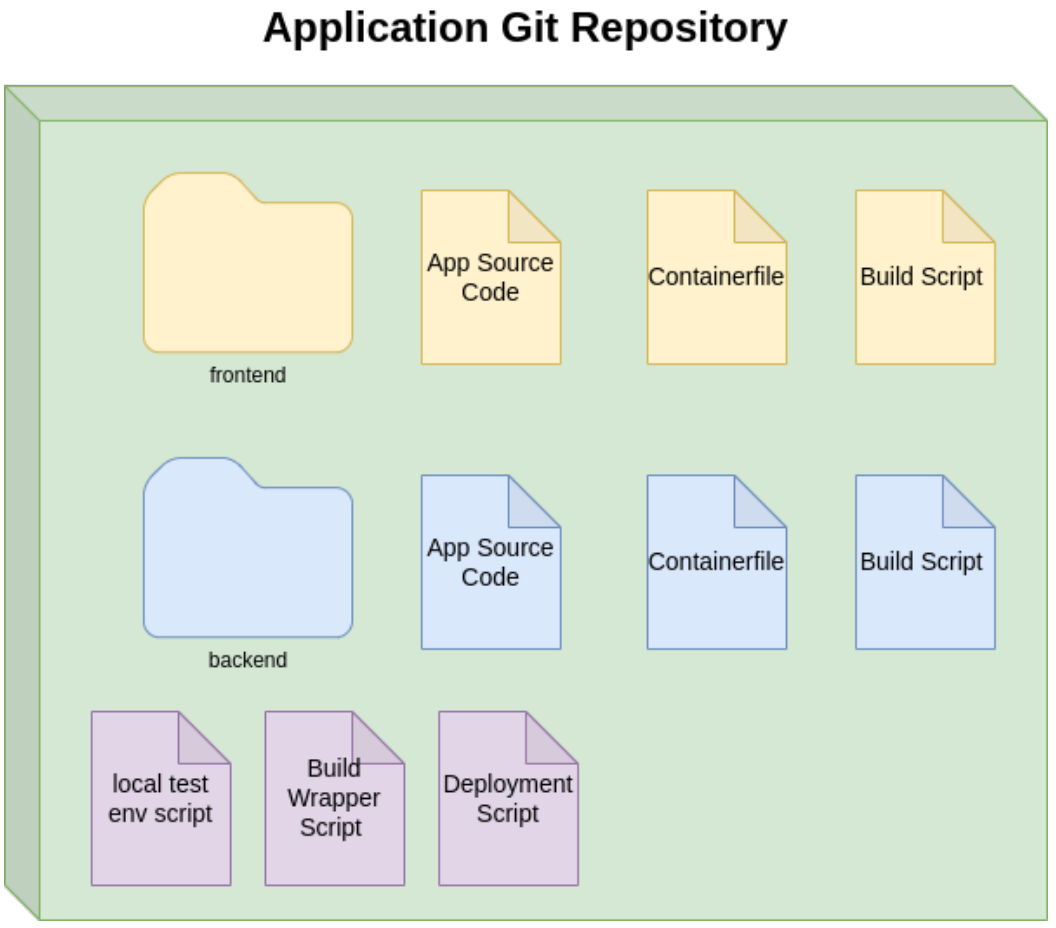
Deployment Script

- Ingress
- Frontend Service
- Frontend Deployment

Deployment Script

- Backend Service
- Backend Deployment

Git Repository Struktur

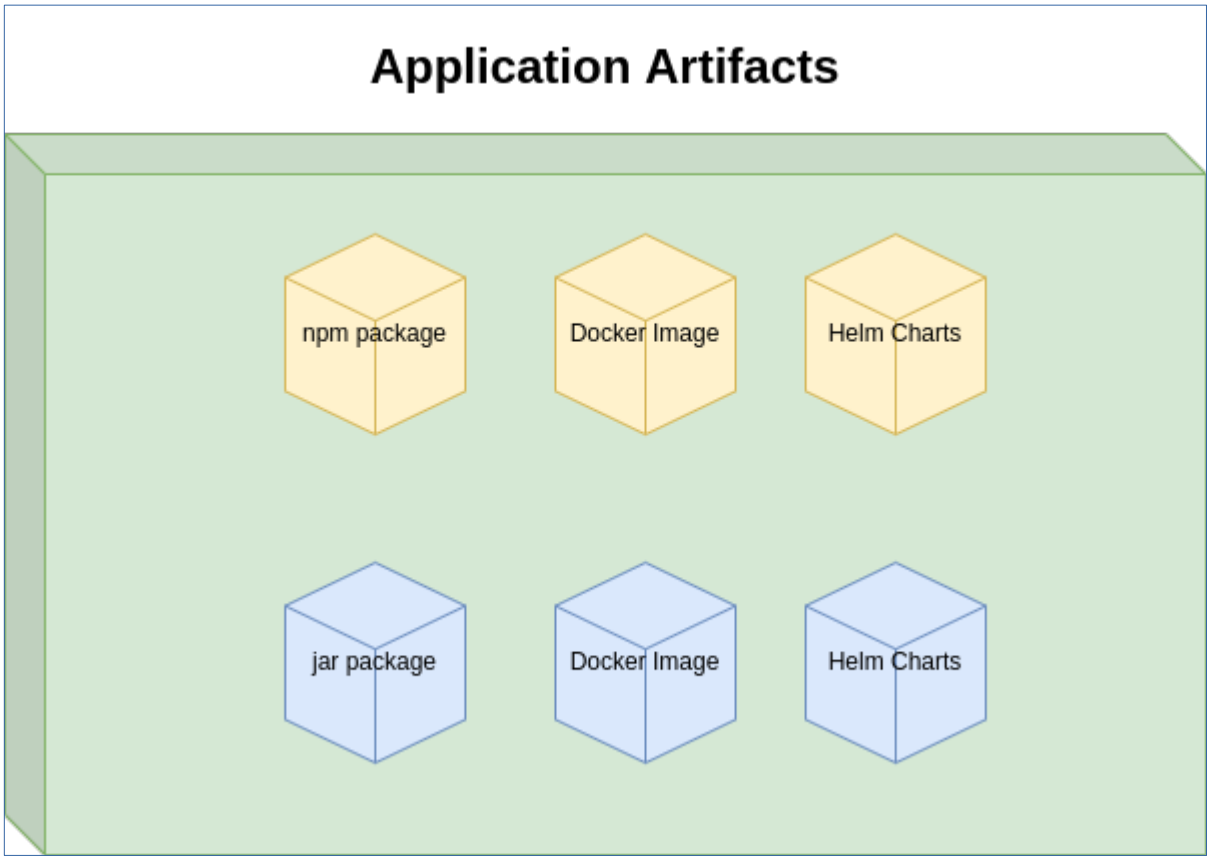


Deployment Script

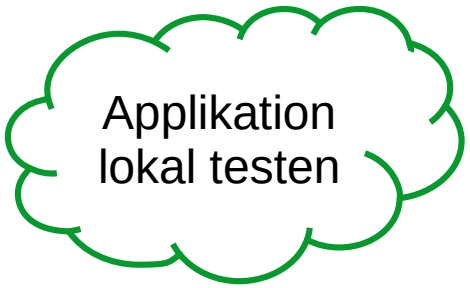
- Ingress
- Frontend Service
- Frontend Deployment
- Backend Service
- Backend Deployment


Versionierung

Fängt einfach an:
Eine Versionsnummer über alle Artifakte

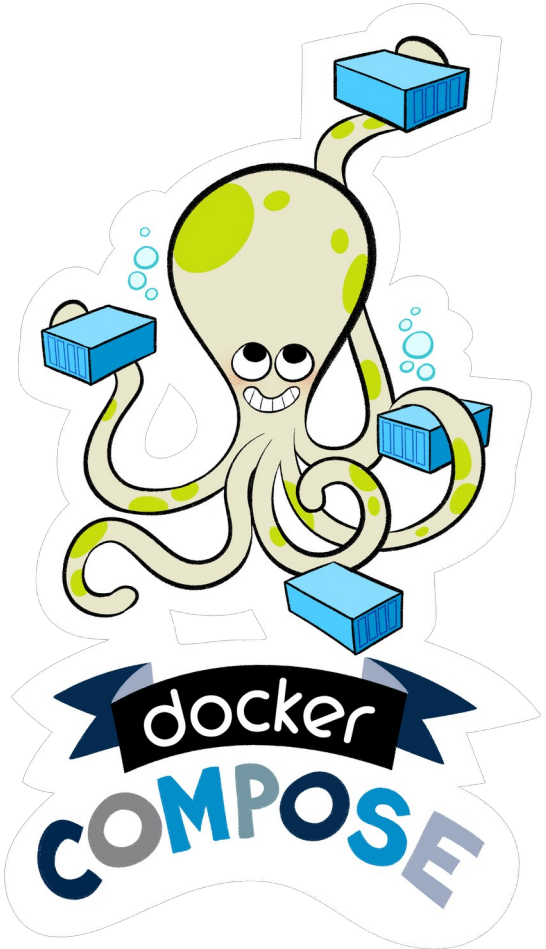

Application Artifacts
npm package
Docker Image
Helm Charts
jar package
Docker Image
Helm Charts


Lokale
Entwicklungsumgebung


Applikation
lokal testen


Deployment
Skripte lokal
entwicken

Applikation lokal testen



spring

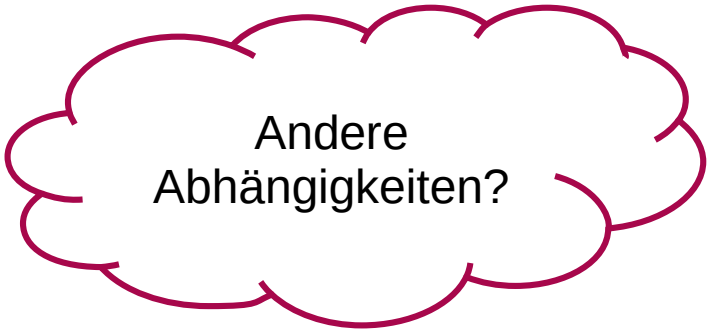
Spring Boot Maven Plugin

Applikation lokal testen

```yaml
version: "3.9"
services:
  database:
    image: mongo:4.2.21
    restart: always
    ports:
      - 27017:27017
    environment:
      MONGO_INITDB_ROOT_USERNAME: root
      MONGO_INITDB_ROOT_PASSWORD: root123
    volumes:
      - ./local-env/:/dockerentrypoint-initdb.d/
```

```xml
        <plugin>
               <groupId>org.springframework.boot</groupId>
               <artifactId>spring-boot-maven-plugin</artifactId>
               <configuration>
                   <layers>
                       <enabled>true</enabled>
                   </layers>
                   <environmentVariables>
                       <MONGODB_ENABLED>true</MONGODB_ENABLED>
                       <MONGODB_URI>mongodb://test:test123@localhost/test</MONGODB_URI>
                   </environmentVariables>
               </configuration>
        </plugin>
```

```yaml
version: "3.9"
services:
  demo-app:
    image: spring-boot-demo:latest
    restart: always
    ports:
      - 80:8080
    environment:
      MONGODB_ENABLED: "true"
      MONGODB_URI: mongodb://test:test123@database:27017/test
    depends_on:
      - database

  database:
    image: mongo:4.2.21
    restart: always
    ports:
      - 27017:27017
    environment:
      MONGO_INITDB_ROOT_USERNAME: root
      MONGO_INITDB_ROOT_PASSWORD: root123
    volumes:
      - ./local-env/:/docker-entrypoint-initdb.d/
```


Andere
Abhängigkeiten?

Mocking

- https://www.mock-server.com
- https://github.com/navikt/mock-oauth2-server

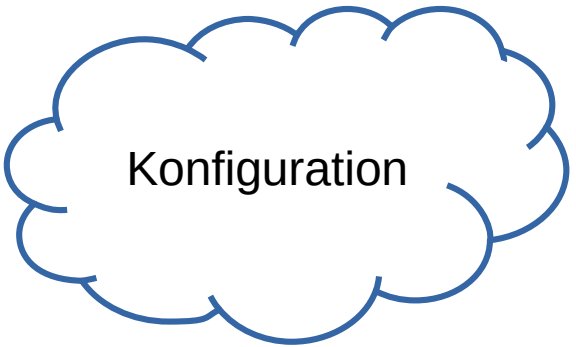
```yaml
version: "3.9"
services:
  mockserver:
    image: mockserver/mockserver:latest
    restart: always
    ports:
      - 1080:1080
    environment:
      MOCKSERVER_INITIALIZATION_JSON_PATH: /config/expectation.json
    volumes:
      - ./local-env/mockserver:/config
```

```
[
  {
    "httpRequest": {
      "path": "/success"
    },
    "httpResponse": {
      "body": "Successful!"
    }
  },
  {
    "httpRequest": {
      "path": "/fail"
    },
    "httpResponse": {
      "statusCode": 400
    }
  }
]
```

Deployment Skripte lokal entwicken

Alternativen zu Minikube

- k3s
- k3d
- kind
- microk8s
- k0s


Konfiguration

12 Factor App:
Die Konfiguration in Umgebungsvariablen ablegen

Applikation vorbereiten


```
# snippet application.properties

spring.data.mongodb.uri=${MONGODB_URI:mongodb://localhost/test}

mongodb.enabled=${MONGODB_ENABLED:false}
```

Helm Charts anpassen

```yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: {{ include "spring-boot-demo.fullname" . }}-config
  namespace: {{ include "spring-boot-demo.namespaceName" . }}
  labels:
  {{- include "spring-boot-demo.labels" . | nindent 4 }}
data:
  MONGODB_URI: "{{ .Values.mongodb.uri }}"
  MONGODB_ENABLED:  "{{ .Values.mongodb.enabled }}"
```

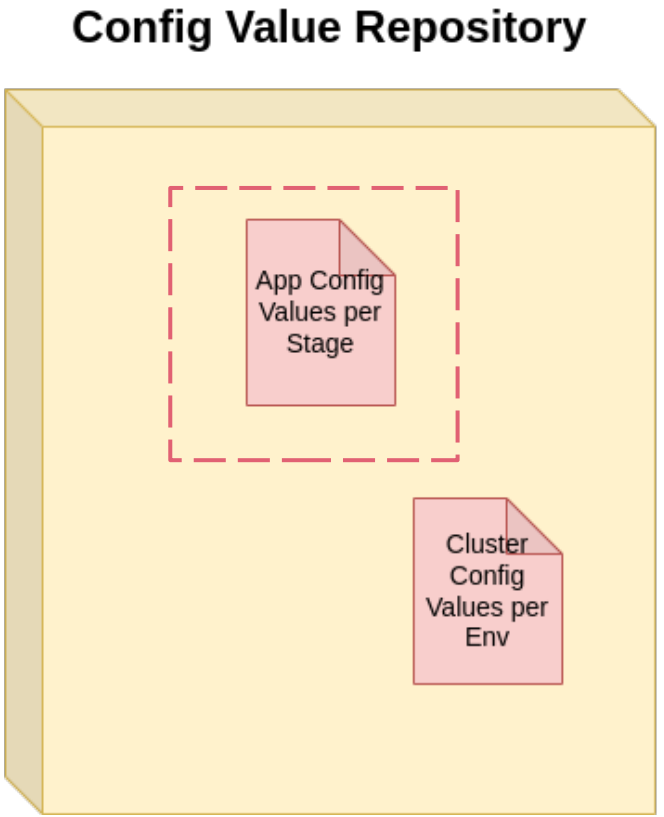
Helm Charts anpassen

```yaml
# code snippet with the important part
apiVersion: apps/v1
kind: Deployment
# ...
spec:
  template:
    metadata:
      annotations:
        checksum/config: {{ include (print $.Template.BasePath "/config.yaml") . | sha256sum }}
    spec:
      containers:
      - name: {{ .Chart.Name }}
        image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
        args: [{{ .Values.spring_boot_demo_chart.container_args }}]
        imagePullPolicy: {{ .Values.image.pullPolicy }}
        envFrom:
          - configMapRef:
              name: {{ include "spring-boot-demo.fullname" . }}-config
```

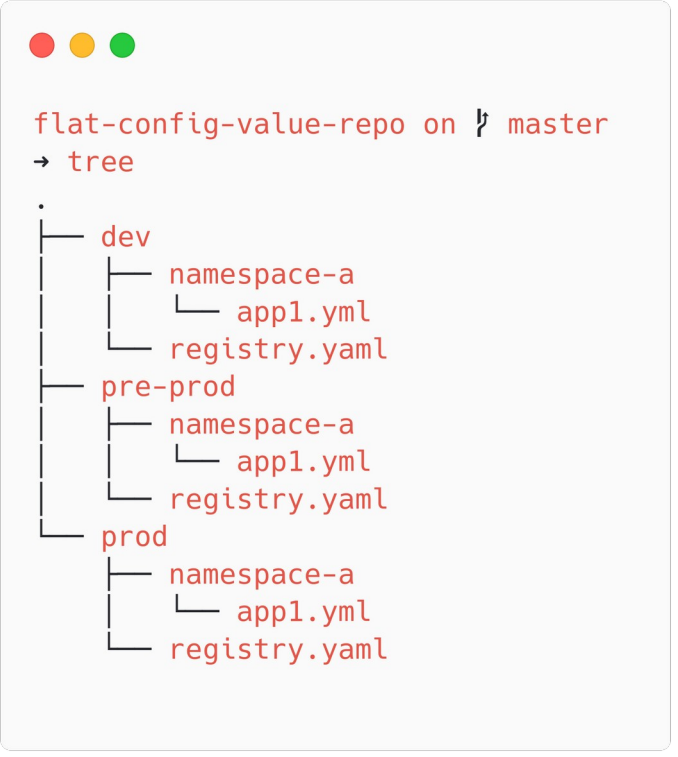
Helm Charts anpassen

```yaml
# code snippet with the important part from value.yaml
mongodb:
  enabled: false
  uri: mongodb://test:test@localhost/test
```

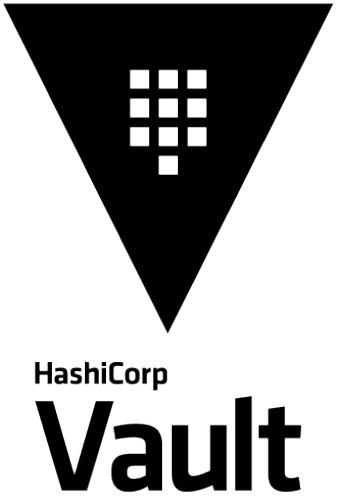
Konfiguration verwalten



Konfiguration verwalten



Secrets



Cloud Lösungen (Bsp):

- Google Secret Manager
- AWS Secrets & Configuration Provider
- Azure Key Vault Provider

Helm Secret Plugin

```
→ helm plugin install https://github.com/jkroepke/helm-secrets --version v3.12.0
→ helm secrets help

Secrets encryption in Helm Charts

This plugin provides ability to encrypt/decrypt secrets files
to store in less secure places, before they are installed using
Helm.

For more information, see the README at github.com/jkroepke/helm-secrets

To decrypt/encrypt/edit you need to initialize/first encrypt secrets with
sops - https://github.com/mozilla/sops
```

Helm Secret Plugin

```
// sops must be configured
➜ helm secrets enc examples/sops/secrets.yaml
Encrypting examples/sops/secrets.yaml
Encrypted examples/sops/secrets.yaml
➜ helm upgrade name . -f secrets://examples/sops/secrets.yaml value.yaml
```


App K8s-ready
machen

Good Practices für Anwendungen in Container

- Nur ein Anwendungsprozess pro Container
- Ausführung als root vermeiden
- Privilegierte Container vermeiden
- Zustandslose Anwendungen bevorzugen
- Log-Nachrichten auf stdout
- Anwendungsüberwachung bedenken
- Robust hoch- und runterfahren können

Log-Nachrichten auf stdout

Tipp: Nutzt Spring Default Logging Settings

Anwendungsüberwachung


```xml
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
<dependency>
    <groupId>io.micrometer</groupId>
    <artifactId>micrometer-registry-prometheus</artifactId>
</dependency>
```

```
management.metrics.export.prometheus.enabled=true
management.metrics.web.server.request.autotime.enabled=true
management.endpoints.web.exposure.include=prometheus
```

Robust hoch- und runterfahren


```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```

```
management.endpoints.web.exposure.include=info,health
```

Robust hoch- und runterfahren

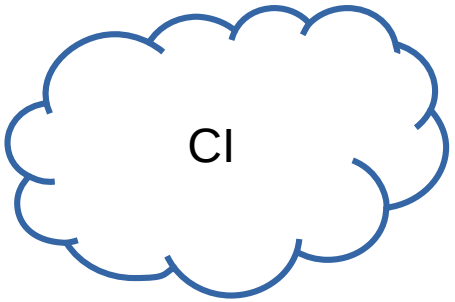
```yaml
# code snippet with the important part
apiVersion: apps/v1
kind: Deployment
spec:
  template:
    spec:
      containers:
      - name: {{ .Chart.Name }}
        image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
        ports:
        - name: container-http
          containerPort: 8080
          protocol: TCP
        livenessProbe:
          httpGet:
            path: /actuator/health/liveness
            port: container-http
          initialDelaySeconds: {{ .Values.livenessProbe.initialDelaySeconds }}
          periodSeconds: {{ .Values.livenessProbe.periodSeconds }}
          timeoutSeconds: {{ .Values.livenessProbe.timeoutSeconds }}
        readinessProbe:
          httpGet:
            path: /actuator/health/readiness
            port: container-http
          initialDelaySeconds: {{ .Values.readinessProbe.initialDelaySeconds }}
          periodSeconds: {{ .Values.readinessProbe.periodSeconds }}
          timeoutSeconds: {{ .Values.readinessProbe.timeoutSeconds }}
```

Robust hoch- und runterfahren

Wichtig:
Sichert diese Endpunkte nach außen ab!

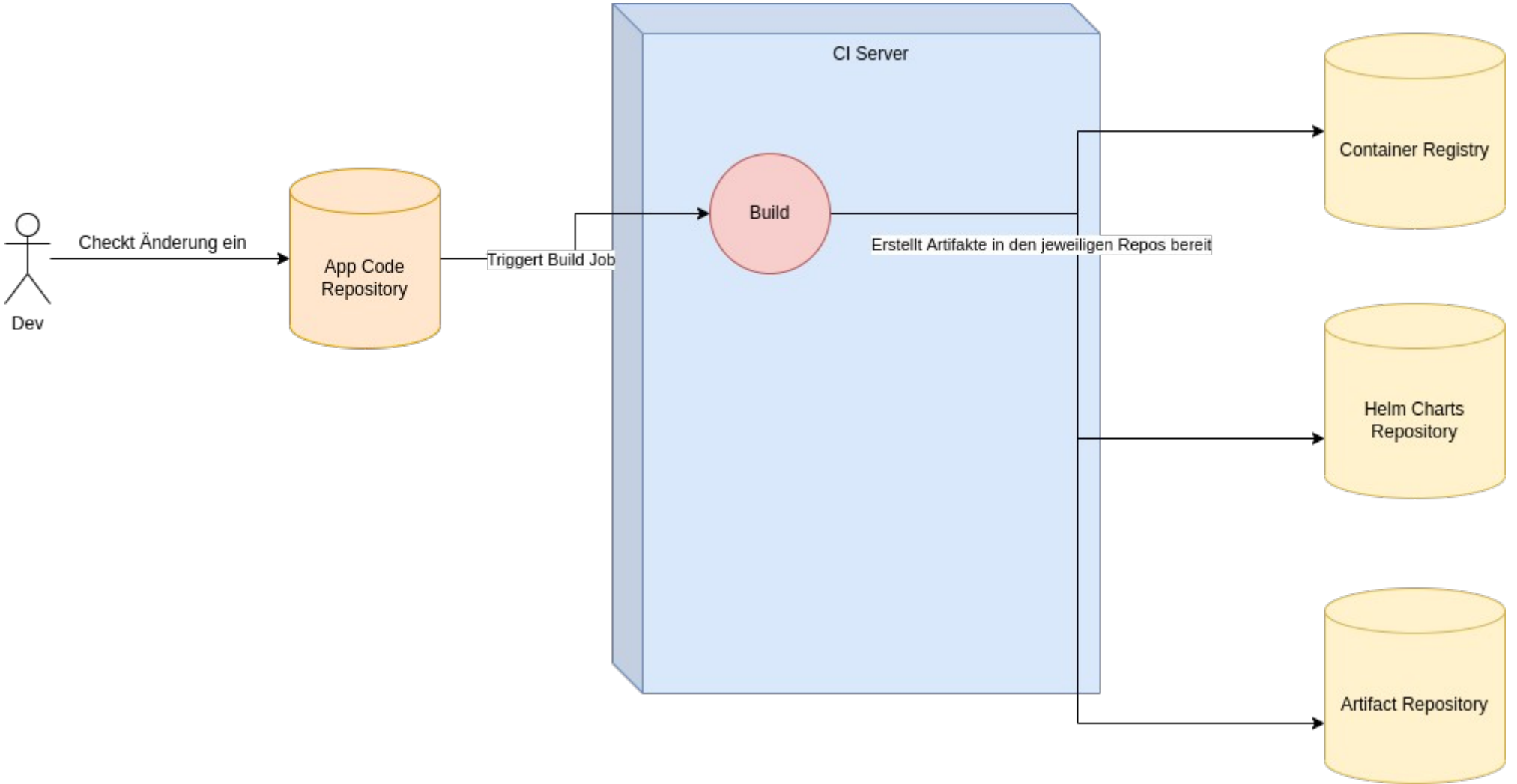
Robust hoch- und runterfahren

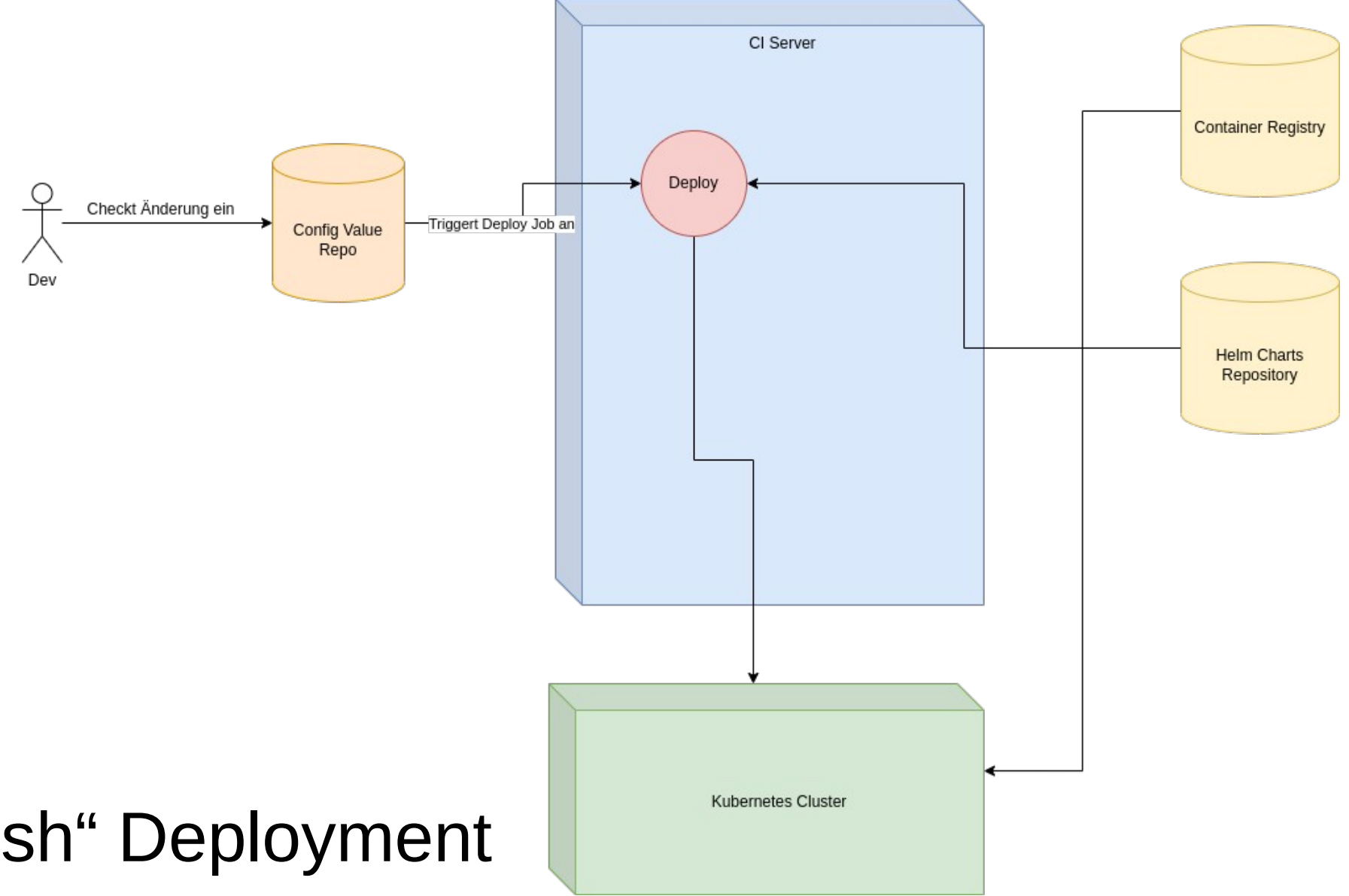
```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: {{ include "spring-boot-demo.fullname" . }}
  namespace: {{ include "spring-boot-demo.namespaceName" . }}
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /$1
    nginx.ingress.kubernetes.io/x-forwarded-prefix: "/"
    nginx.ingress.kubernetes.io/server-snippet: |
      location ~* "^/actuator/" {
          deny all;
          return 403;
        }
spec:
  rules:
    - host: {{ .Values.ingress.host }}
      http:
        paths:
          - path: /(.*)
            pathType: Prefix
            backend:
              service:
                name: {{ include "spring-boot-demo.fullname" . }}
                port:
                  number: 8080
```


Cl

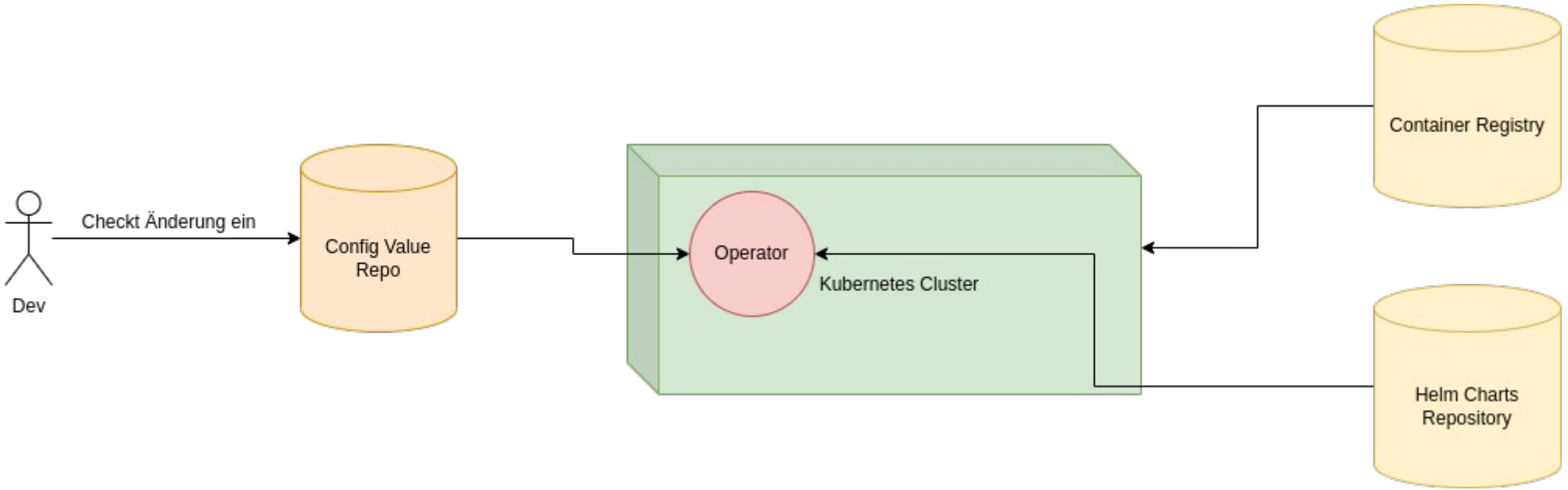
12 Factor App:
Build- und Run-Phase strikt trennen

Build


CI Server
Container Registry
Build
Checkt Änderung ein
App Code Repository
Triggert Build Job
Erstellt Artifakte in den jeweiligen Repos bereit
Dev
Helm Charts Repository
Artifact Repository



„Push“ Deployment



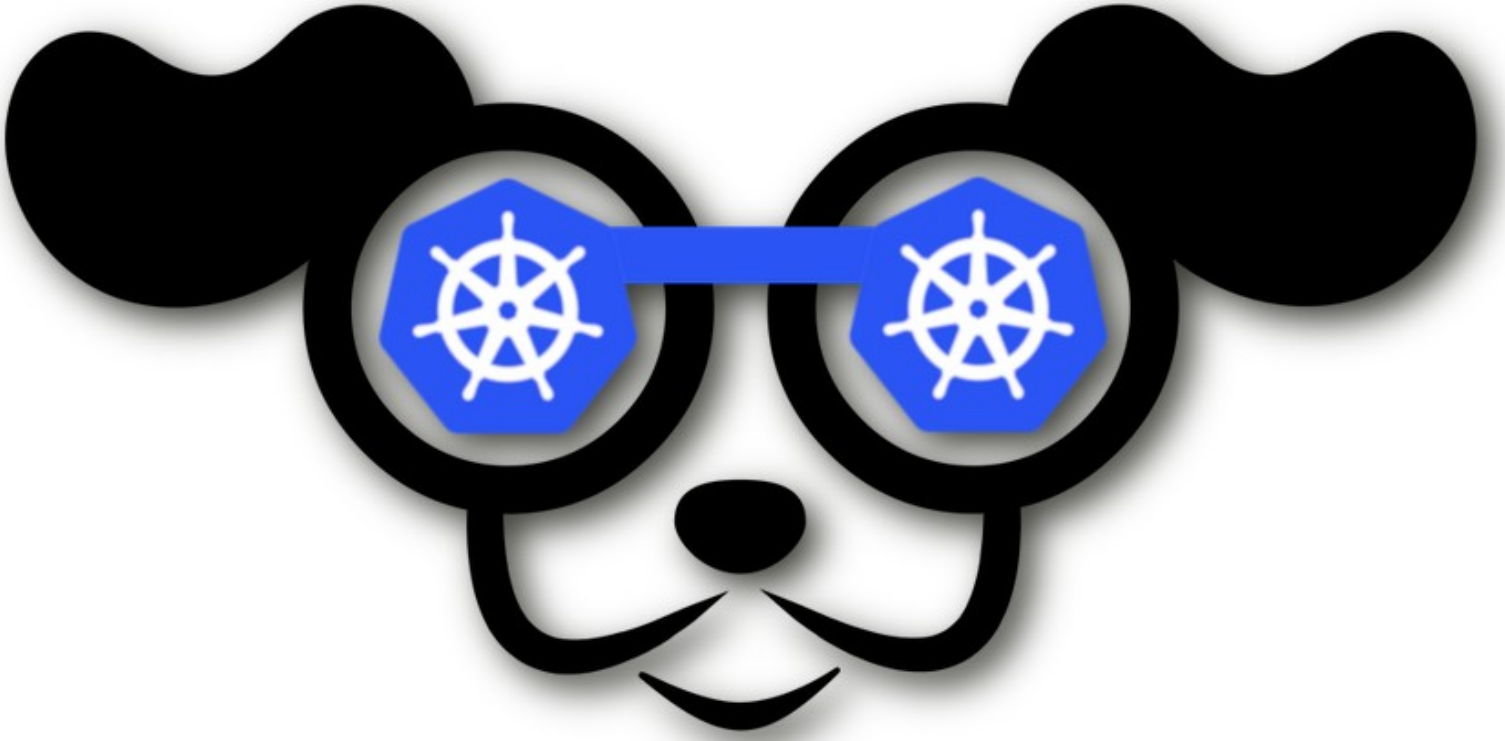
„Pull“ Deployment


Wie sehe ich
was im
Cluster los
ist?

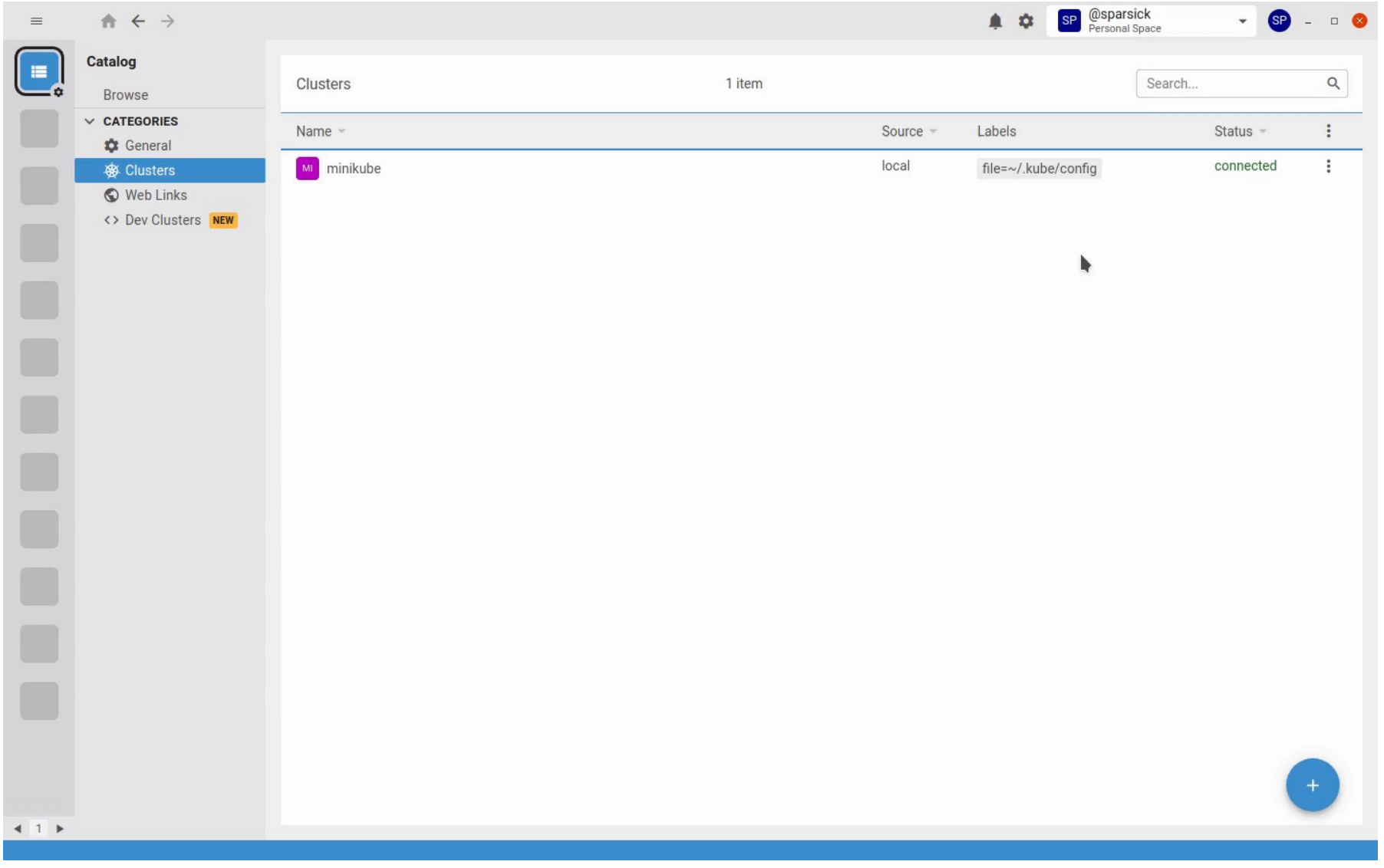
kubectl

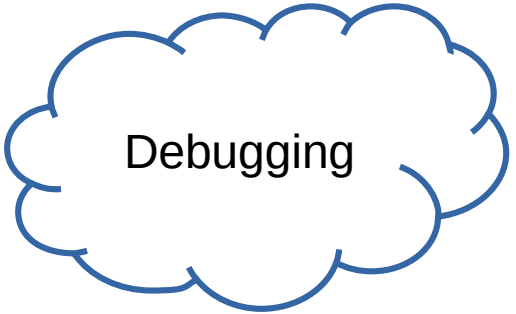
k9s

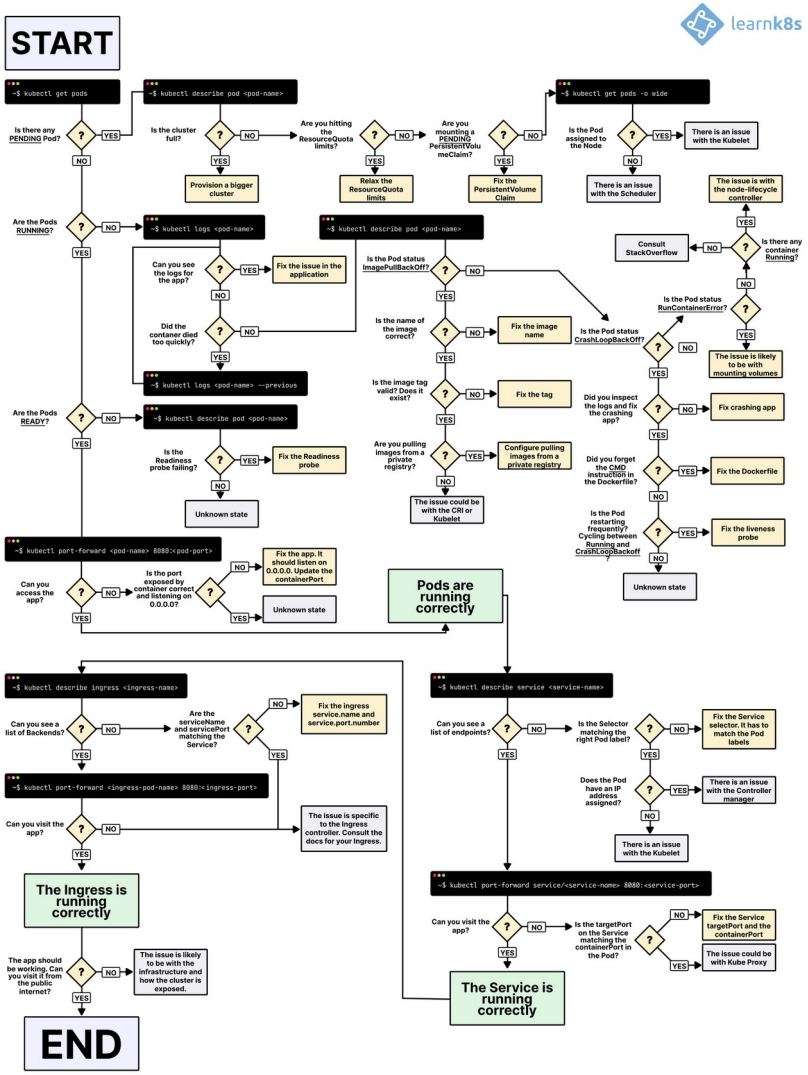
Kubernetes CLI To Manage Your Clusters In Style!



K8s Lens


@sparsick
Personal Space
Catalog
Browse
CATEGORIES
General
Clusters
Web Links
Dev Clusters
NEW
Clusters
1 item
Search...
Name
Source
Labels
Status
MI
minikube
local
file=~/.kube/config
connected
1


Debugging



Troubleshooting flowchart https://learnk8s.io/troubleshooting-deployments learnk8s

https://learnk8s.io/troubleshooting-deployments

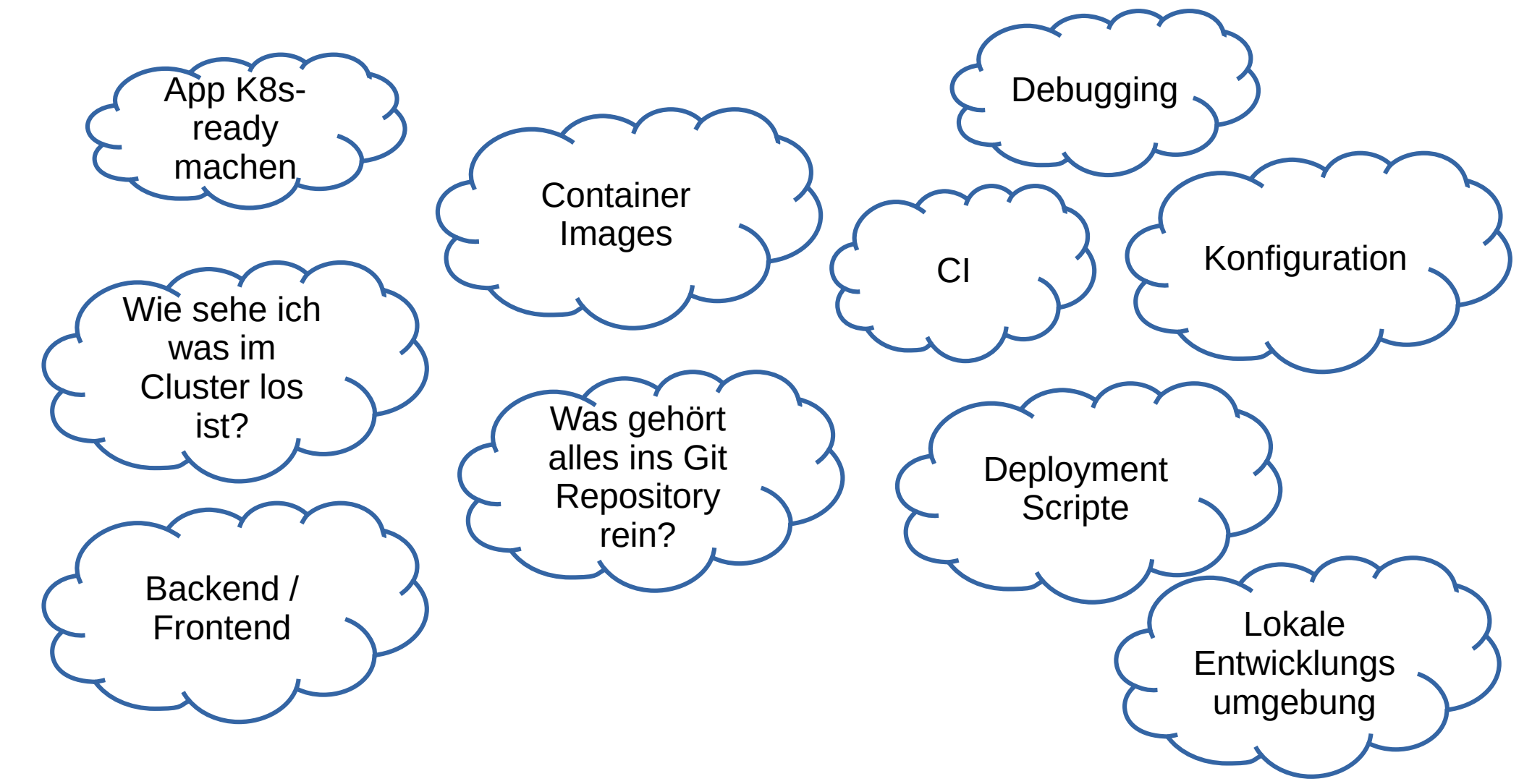
Troubleshooting Applications

This doc contains a set of resources for fixing issues with containerized applications. It covers things like common issues with Kubernetes resources (like Pods, Services, or StatefulSets), advice on making sense of container termination messages, and ways to debug running containers.

https://kubernetes.io/docs/tasks/debug/debug-application/

debug container (K8s v1.23)

```
$ kubectl run ephemeral-demo --image=k8s.gcr.io/pause:3.1 --restart=Never

$ kubectl exec -it ephemeral-demo -- sh
OCI runtime exec failed: exec failed: container_linux.go:346: starting container process caused "exec:
\"sh\": executable file not found in $PATH": unknown

$ kubectl debug -it ephemeral-demo --image=busybox:1.28 --target=ephemeral-demo
Defaulting debug container name to debugger-8xzrl.
If you don't see a command prompt, try pressing enter.
/ #
```


App K8s-ready machen
Container Images
Debugging
CI
Konfiguration
Wie sehe ich was im Cluster los ist?
Was gehört alles ins Git Repository rein?
Deployment Scripte
Backend / Frontend
Lokale Entwicklungs umgebung

Fragen?

mail@sandra-parsick.de
@SandraParsick

https://github.com/sparsick/k8s-dev-survival-kit-talk

Weitere gute Vorträge zum Thema

- Vortrag „Wenn ich das nur vorher gewusst hätte: Kubernetes für Entwickler“ von Stefan Schlott
- Vortrag „Kubernetes-Lektionen aus der Wolke“ von Jochen Mader
- Vortrag „What's going on in my cluster?“ von Matthias Häussler

Weitere Informationen

- https://www.informatik-aktuell.de/entwicklung/methoden/container-images-deep-dive-101-wege-zum-bauen-und-bereitstellen.html
- „Kubernetes in Action“ von Marko Lukša
- „Docker in Action“ von Jeff Nickoloff, Stephen Kuenzli

Bildnachweise

- https://unsplash.com/photos/RfwGg5ZZh4Q?utm_source=unsplash&utm_medium=referral&utm_content=creditShareLink
- https://unsplash.com/photos/CpsTAUPoScw?utm_source=unsplash&utm_medium=referral&utm_content=creditShareLink