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Kubebuilder Intro & Deep Dive

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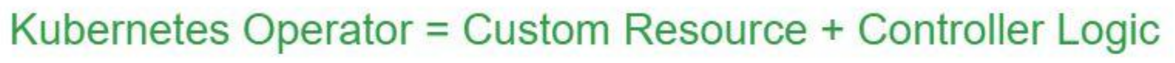
Todays's Agenda

- Prerequisites
  - Kubernetes Operator
  - Custom Resource Definitions
  - Controller and Reconciliation Loop
- Write Your Own Operators from scratch?
- What is Kubebuilder?
- How Kubebuilder Works?
- Demo with Kubebuilder and its Project Structure

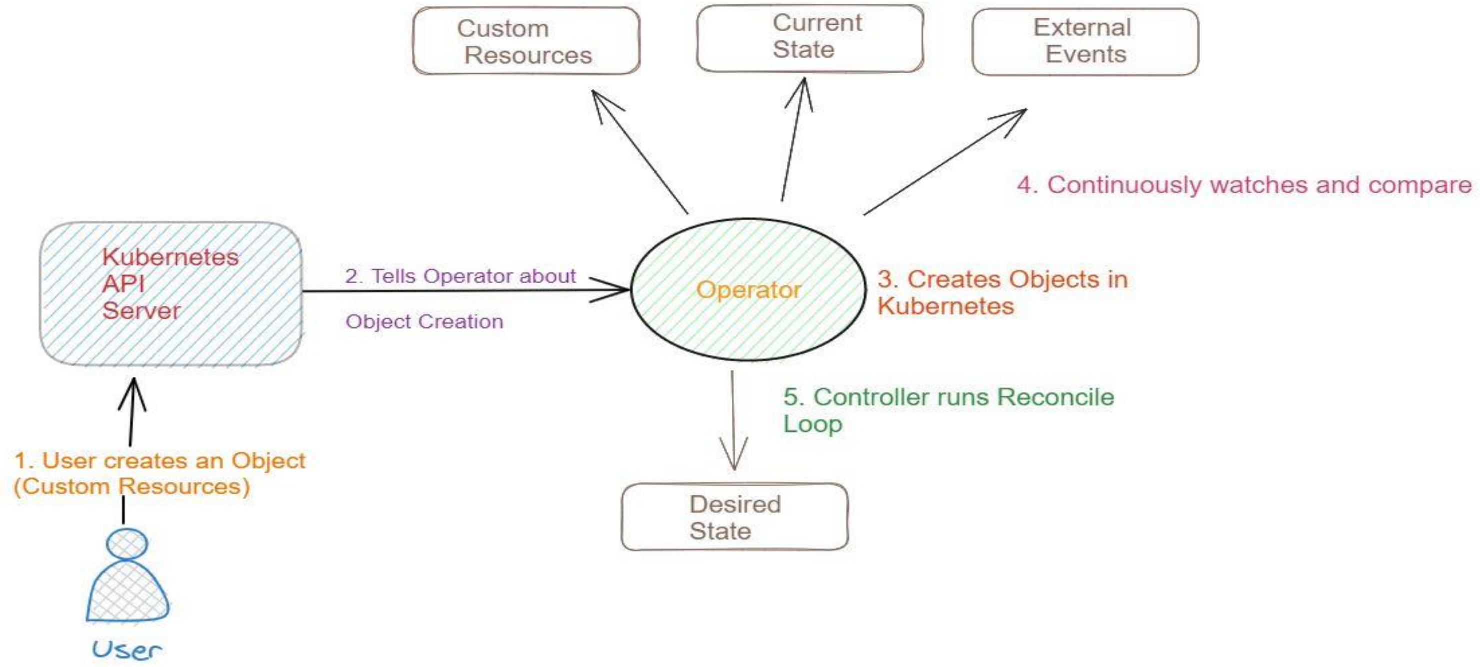
Kubernetes Operator and Custom Resources

- An application-specific controller
- A custom controller uses custom resources (CR)
- Custom resources are extension of Kubernetes API
- New objects (CR) through Custom Resource Definitions (CRDs)
- Interacts with Kubernetes API to manage Objects



Kubernetes Operator = Custom Resource + Controller Logic

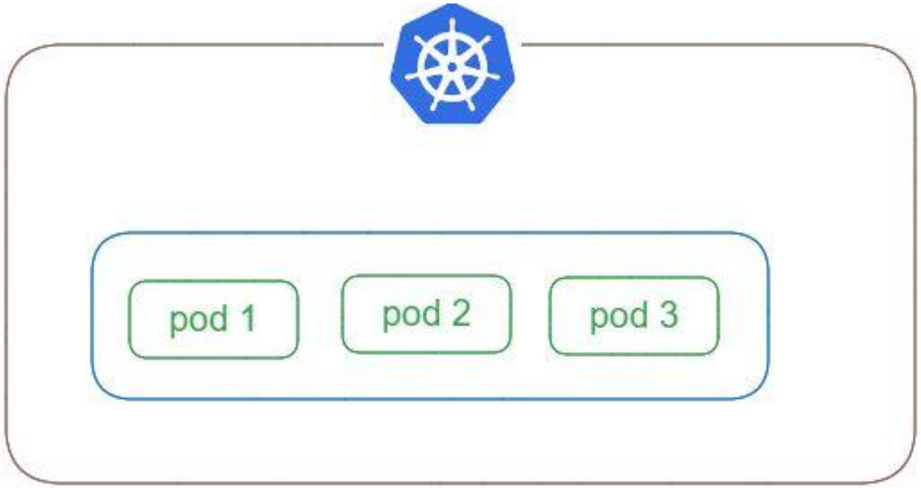
Working of Kubernetes Operator


Custom Resources
Current State
External Events
4. Continuously watches and compare
Kubernetes API Server
2. Tells Operator about
Object Creation
Operator
3. Creates Objects in Kubernetes
5. Controller runs Reconcile Loop
Desired State
1. User creates an Object (Custom Resources)
User

Why and When to Use Kubernetes Operator?

- Extends the functionality of Kubernetes API
- Automate management of complex applications
- Helps in backup,recover from failures , upgrade application automatically
- Controller watches Custom Resource and takes actions
- Desired State = Current State

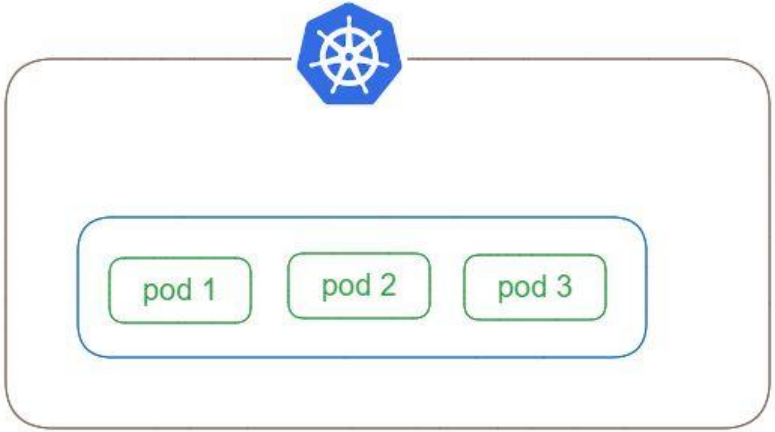
Stateless Applications

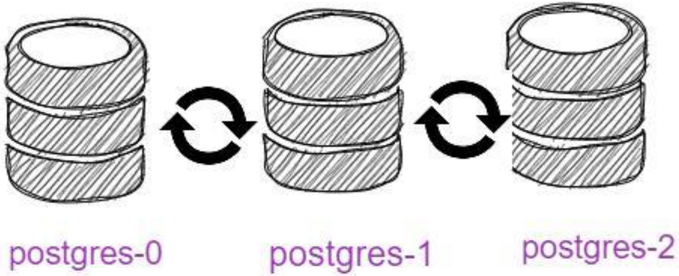


Desired = Current

updates,rollbacks,scaling

Statelful Applications





Kubernetes Objects Fields

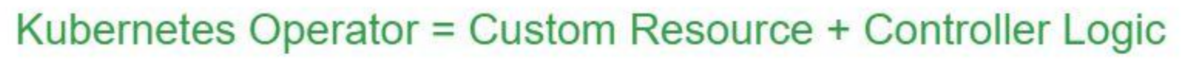
Kubernetes Objects

- TypeMeta
  - API Version
  - Kind
- ObjectMeta
  - Metadata fields
- Spec
  - Desired State
- Status
  - Current/Observed State

Kubernetes API Groups

- Core
- Named

How to Write Own Operators From Scratch?



Kubernetes Operator = Custom Resource + Controller Logic

CRDs	**Controller**	**Admission Webhook**	**Other Things**
Implement API - API Type - Scheme	Code Generation - ClientSet - Informers	Manage TLS certificates Webhook Implementation	Write Manifests Run Controller Run Webhook Build and Publish Images Deploy
	Controller Implemetation - Reconciler - Event Handler		

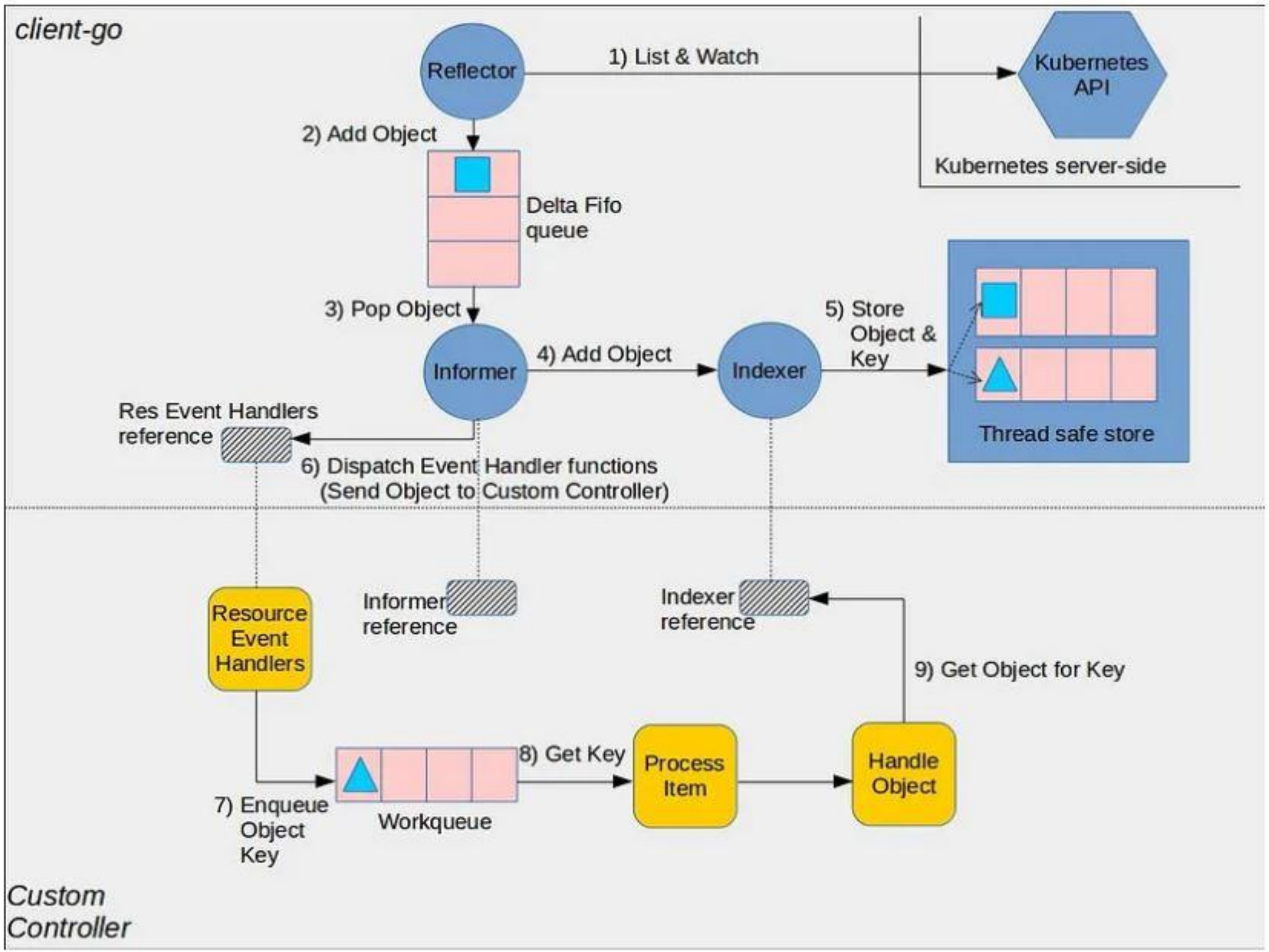


Image ref: https://bit.ly/k8s-sample-ctlr

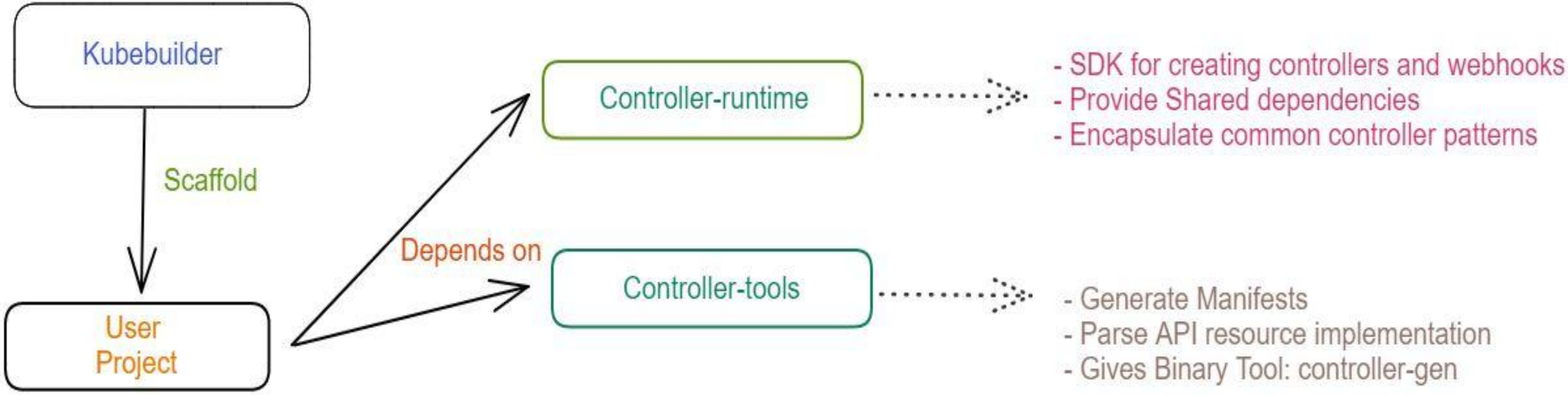
Tools to Write Operators

- Operator Framework
- **Kubebuilder**
- Metacontroller
- KubeOps , so on ...

Kubebuilder

- Kubernetes-sigs ,open-source project written in Golang
- SDK to write Operators and controllers
- Build on top of controller-runtime and controller-tools libraries
- It scaffolds the project and API definitions
- Simplify DIY ‘from scratch’ experience

Kubebuilder - Framework and SDK

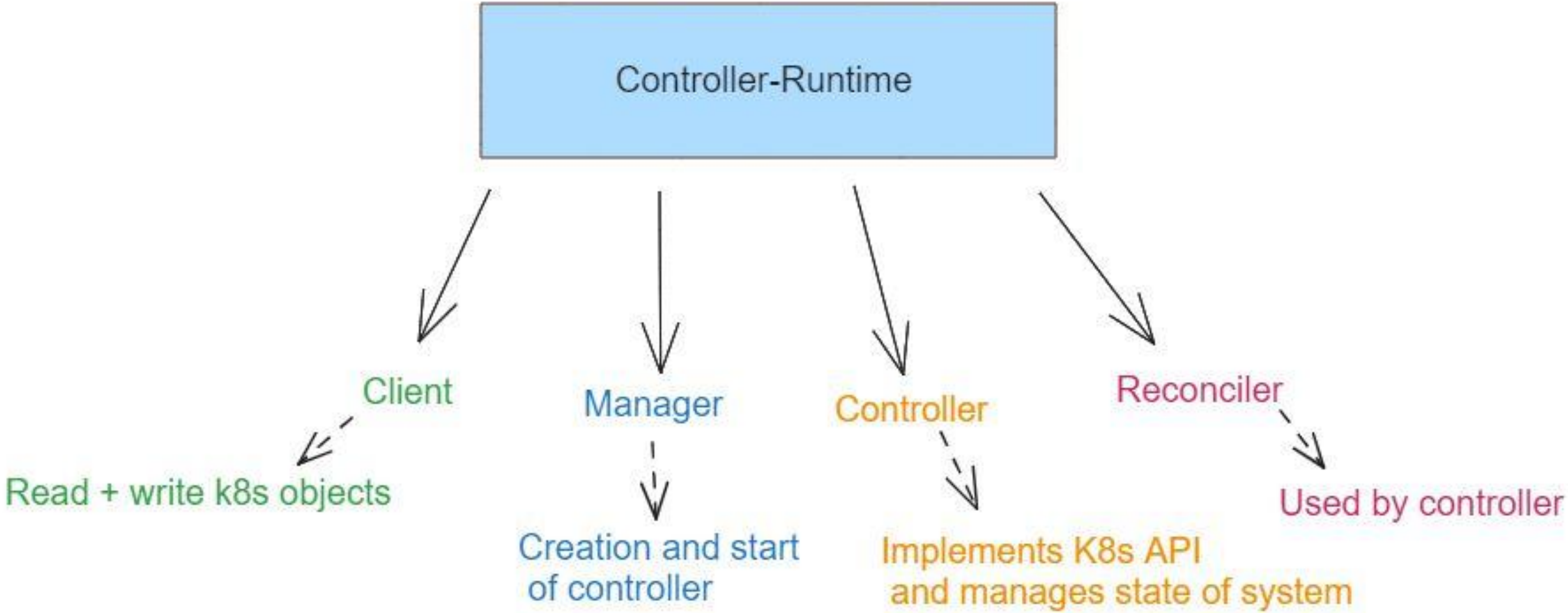


- SDK for creating controllers and webhooks
- Provide Shared dependencies
- Encapsulate common controller patterns

- Generate Manifests
- Parse API resource implementation
- Gives Binary Tool: controller-gen

Controller-Runtime

- Set of GO Libraries for building controllers
- Part of k8s-sig-api-machinery
- Used by Kubebuilder and Operator SDK
- Package pkg provides libraries for creating controllers such as:
    - Client
    - Cache
    - Manager and so on …



Controller-Runtime

Client

Read + write k8s objects

Manager

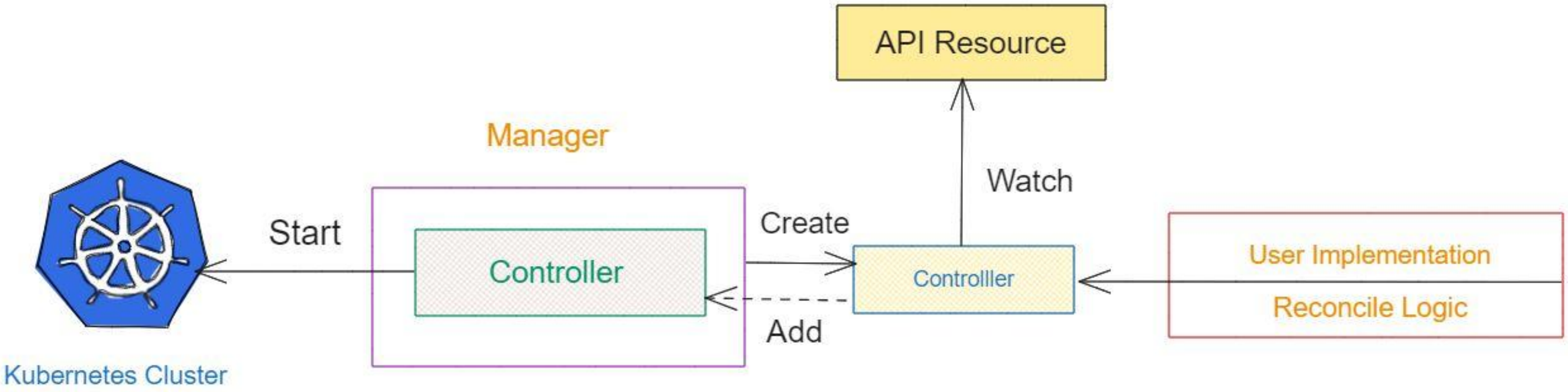
Creation and start of controller

Controller

Implements K8s API and manages state of system

Reconciler

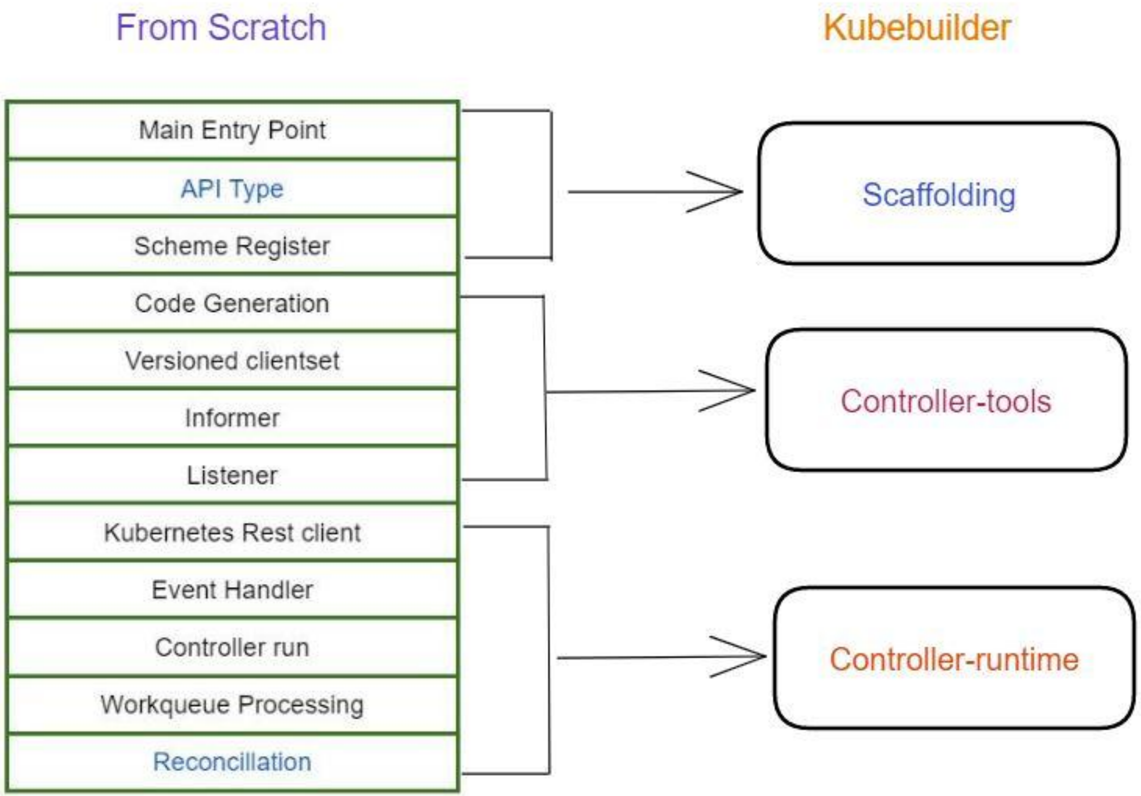
Used by controller


API Resource
Manager
Watch
Start
Create
Controller
Controlller
User Implementation
Reconcile Logic
Add
Kubernetes Cluster

Controller-Tools

- Building controllers
- Compile Go types
- Create CustomResourceDefinitons , install it in cluster
- Avoid Writing Open API Spec for CRDs

From Scratch vs Kubebuilder



Demo Agenda

- Scaffold a project with Kubebuilder
- Understand the Project Structure
- Create a Custom Resource
- Create an operator with custom controller logic
- Apply it in Kubernetes cluster
- Test the Custom Resource

Hands-on lab on Kubebuilder : https://cloudyuga.guru/hands_on_lab/kubebuilder-intro

Real Use-Cases

- Kubeflow : mpi-operator
  - Kubeflow : ML toolkit for kubernetes
  - mpi-operator : training job on single or multiple CPUs/GPUs , PR #452
- Kubevela : Application Delivery Platform , code-contribution

References

- CNCF Operator Whitepaper
- https://bit.ly/k8s-custom-ctrl
- Kubebuilder docs
- https://bit.ly/kubecon-kubebuilder
- Controller-runtime

Thank you

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