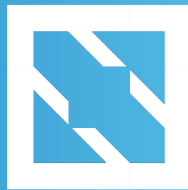




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WASM + KWOK Wizardry: Writing and Testing Scheduler Plugins at Scale

Dejan Pejčev & Jonathan Giannuzzi, G-Research



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CloudNativeCon

North America 2024



**Dejan
Pejčev**



<https://linktr.ee/wasmkwokwizards>



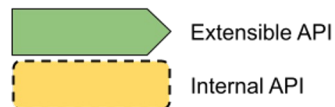
**Jonathan
Giannuzzi**



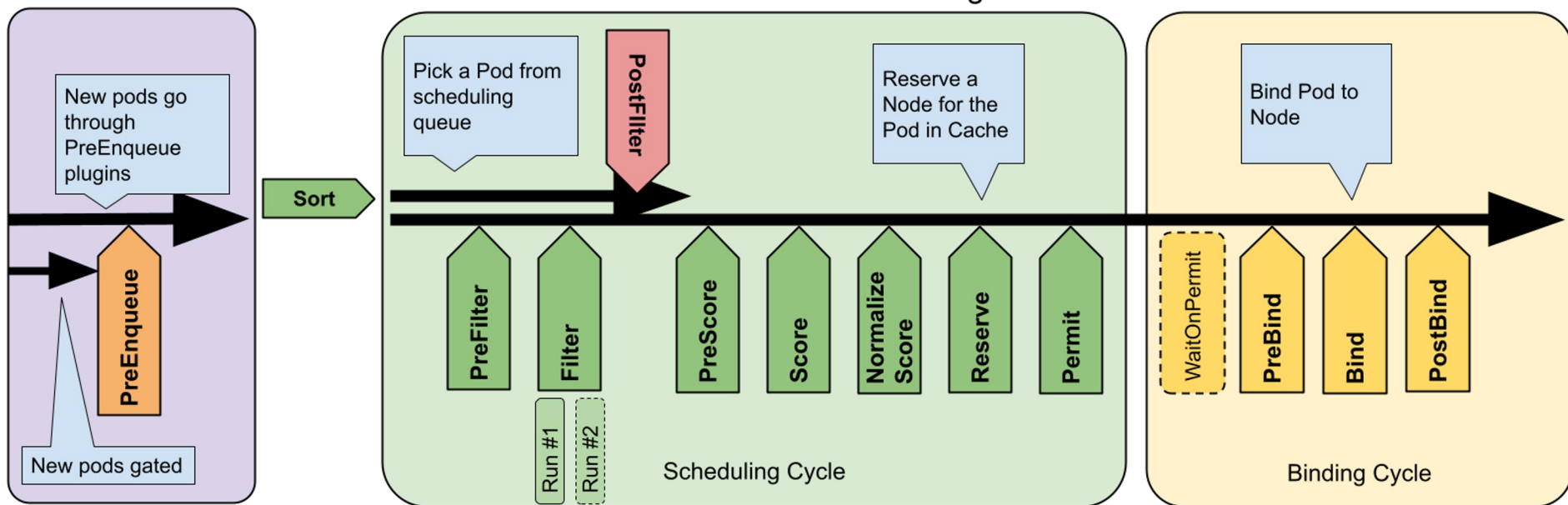
OPEN
SOURCE
SOFTWARE

- Essential control plane component
- *Assigns* **Pods** to **Nodes** based on resource availability, policies, and constraints
- *Preempts* lower-priority **Pods** when necessary

Scheduling Lifecycle



Pod Scheduling Context



- The **kubernetes-sigs/kube-scheduler-simulator** is an open-source tool designed to aid in the development and testing of custom **Kubernetes** scheduler plugins.
- For plugin developers, it is essential to validate that their custom scheduler behaves as expected and does not negatively affect cluster performance.
- The **Simulator** provides an intuitive interface and detailed metrics to help developers easily visualize and analyze scheduler behavior and performance.

Demo

- **Scheduler Extenders**
- Scheduling Framework plugins
- WASM plugins

- Original approach for **extending** the default scheduling logic
- Simple json **webhooks**
- Any programming **language** can be used
- Higher **latency**
- **No cache** consistency
- Phases: **Filter**, **Preempt**, **Prioritize** (Sort), **Bind**

Demo

Extending the scheduler

- Scheduler Extenders
- **Scheduling Framework plugins**
- WASM plugins

- The **Kubernetes Scheduling Framework** is a powerful and flexible architecture that allows developers to customize scheduling logic and extend the capabilities of the default **Kubernetes Scheduler**.
- **Scheduler** plugins implement and register various extensions points: **filter**, **score**, **sort**...
- **In-tree plugins**: Part of the **Kubernetes** codebase: `NodeName`, `ImageLocality`, `NodeResourcesFit`...
- **Out-of-tree plugins**: Part of the [kubernetes-sigs/scheduler-plugins](https://github.com/kubernetes-sigs/scheduler-plugins) and other repositories: `Capacity Scheduling`, `Coscheduling`, `Network`...

Demo

Extending the scheduler

- Scheduler Extenders
- Scheduling Framework plugins
- **WASM plugins**

WebAssembly (WASM) Overview

- New approach built on scheduling framework
- WASM modules loaded at runtime via URL
- In-process - no latency & cache issues
- WASI-compatible languages (currently only Go)

- Future: WASM component model?



Demo

- **What is KWOK?**

- A toolkit for simulating **Kubernetes** clusters with thousands of **Nodes** in seconds.
- Simulates **Node** behavior to resemble real clusters while maintaining a minimal resource footprint.

- **How can KWOK be leveraged?**

- **dejanzele/batch-simulator** can be used to test Scheduler Plugins in a batch scheduling scenario
- **Scheduler Testing:** Validate scheduler performance with large-scale Node and Pod simulations.
- **CRD Controller Testing:** Test controllers without relying on fake clients for more realistic scenarios.
- **Control Plane Performance:** Assess control plane performance at scale without significant infrastructure costs.

Kubernetes WithOut Kubelet

Kubernetes / Kube scheduler

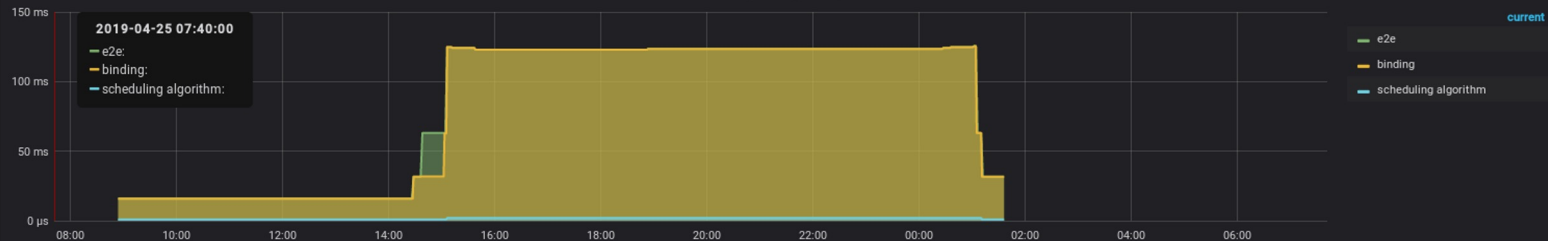
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Instance All

Up

3

Scheduling latency 99th quantile



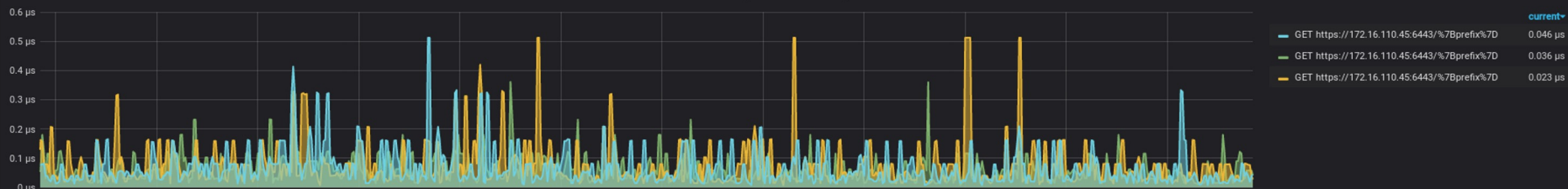
Kube API Request Rate



Post Request duration 99th quantile



GET Request duration 99th quantile



THANK YOU!

**PLEASE DON'T ASK ANY DIFFICULT
QUESTIONS**

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