Kubebench: Benchmarking ML Workloads on Kubernetes

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Why Kubebench?

• Understanding system performance is essential for moving ML from lab to production.

• Benchmarking and analyzing ML workloads on Kubernetes is not an easy job today.

• Many requirements for a good benchmark: compliance, consistency, reproducibility, …
What is Kubebench?

Kubebench is a harness for benchmarking and analyzing Machine Learning workloads on Kubernetes.
Goals of Kubebench

• Support benchmarking in various scenarios
  • Multi-cloud and various infrastructure
  • Different ML frameworks
  • Distributed workloads
  • …

• Make it easier to manage benchmarks
  • Consistent workloads
  • Reproducible results
  • Integrable with the rest of ML lifecycle
  • …
Tech Stack

**Kubebench**
Benchmark config/result management; Benchmark workflow deployment

**Kubeflow**
ML job deployment / lifecycle management

**Kubernetes**
Production grade container orchestration

**Infrastructure**
Cloud/On-premise infrastructure environment
Architecture

Workflow (Argo)

- Configurator
- Job Deployer/Manager
- Reporter

Workload

- Pre-process Job
- Main Kubeflow Job (TFJob/PyTorchJob/etc.)
- Post-process Job

Monitoring

- Metrics Visualization (Grafana)
- Monitoring Service (Prometheus)

Storage

- Configs
- Data
- Experiment Records

Dashboard

API

Interface

Manage

Deploy

Read

Read/Write

Deploy

Read/Write

Monitor

Kubebench-provided

User-defined
User’s Perspective

Job Developer

Pre-job pod ➔ Main job pods ➔ Post-job pod

Shared storage (auto mounted)

Kubebench workflow

Experiment Runner

Job template (.ksonnet)

Job params (.yaml)

Kubebench workflow ➔ Benchmark results
Where we are

Initial release (v0.3):

- Support local/distributed training workloads
- Support multiple frameworks
  - TFJob
  - PyTorchJob
  - (more planned)
- Support result aggregation for multi-experiments
  - Stored in filesystem
  - (Remote/Cloud DB planned)
- Quick starter package
  - E2E example for quick start
  - Example workloads (TF-CNN)

Upcoming and Future releases:

- UI/UX
  - Dashboard
  - Results/metrics visualizations
- API
  - Kubebench CRD
- More benchmarking scenarios
  - Serving/inference benchmarks
  - Mixed/scaled workloads
- …
Demo

Kirill Prosvirov, Andrey Velichkevich
Case Study

Ce Gao
Local Training Benchmark

TensorFlow CNN Benchmark
Dataset: imagenet (synthetic)
Mode: forward-only
SingleSess: False
Num batches: 100
Num epochs: 0.00
Data format: NCHW
Optimizer: sgd
Variables: parameter_server

Training performance among different GPU numbers, batch sizes, and platforms
Distributed Training Benchmark

TensorFlow CNN Benchmark
Dataset: imagenet (synthetic)
Mode: forward-only
SingleSess: False
Num batches: 100
Num epochs: 0.00
Data format: NCHW
Optimizer: sgd
Variables: parameter_server

1 PS
2 workers (2 GPU per worker)

Training performance between different platforms
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<tr>
<th>Dependency</th>
<th>Version</th>
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<td>Kubernetes Version</td>
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Thanks!

Contributors & Advisors
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