OPERATE FIRST

Distributed Training Across GPU Nodes

Demo for Operate First Data Science Meet-up

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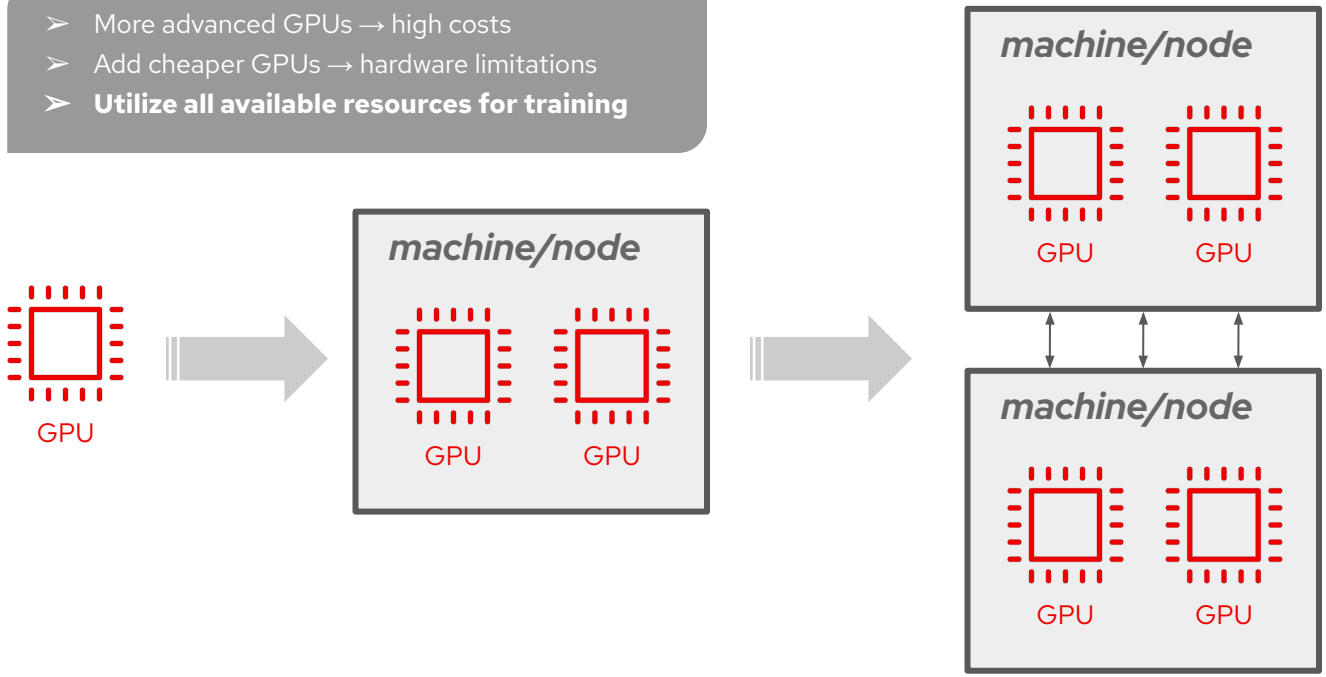
Presenter:
Selbi Nuryyeva
Software Engineer
AI Services, Red Hat

Increasing Demand for Even More Computing Power

As the datasets and models get bigger, the need for more powerful and efficient GPUs is rapidly increasing. Multi-node GPU architecture is a plausible solution.

- More advanced GPUs → high costs
- Add cheaper GPUs → hardware limitations
- **Utilize all available resources for training**



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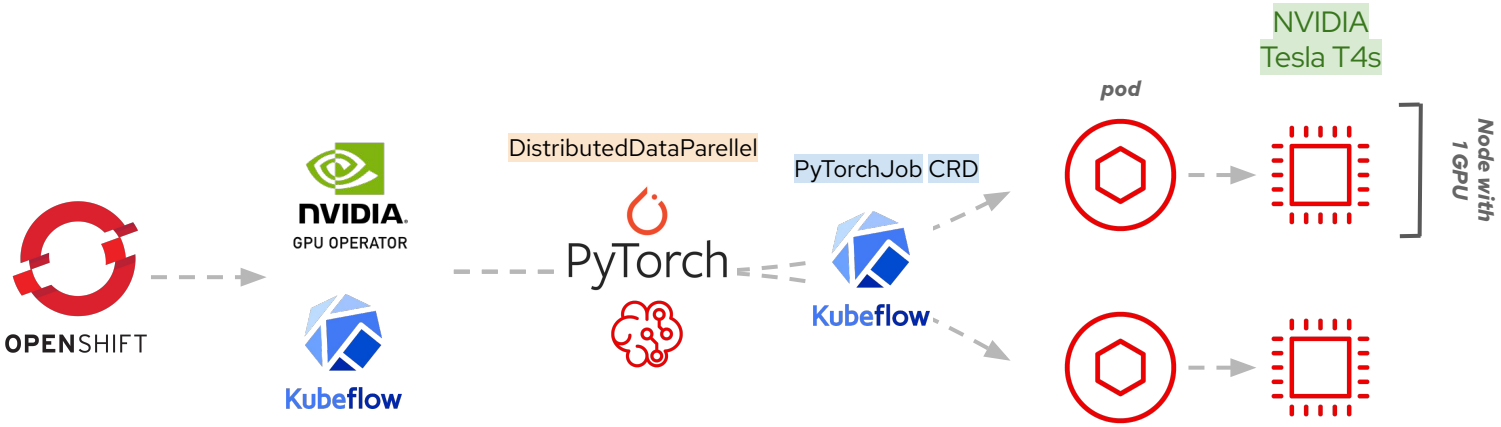
MULTI-NODE DISTRIBUTION OF ML WORKFLOW

Distribution of machine learning workflows across multiple GPU nodes with PyTorch



Install via OperatorHub

Deploy containerized ML in PyTorch via PyTorchJob of Kubeflow

PyTorchJob creates a master and a worker pod
Data is evenly distributed and model is replicated on each GPU across nodes
Gradients are averaged from each GPU during backward pass

Source: https://github.com/heyselbi/multi-node-pytorch/

Add'l Resources

Installation of

ODH:
https://opendatahub.io/docs/getting-started/quick-installation.html

Kubeflow:
https://developers.redhat.com/articles/2021/05/28/how-install-kubeflow-12-red-hat-openshift#installing_the_open_data_hub_operator

NVIDIA Operator:
https://docs.nvidia.com/datacenter/kubernetes/openshift-on-gpu-install-guide/index.html

References

PyTotchJob of Kubeflow:
https://www.kubeflow.org/docs/components/training/pytorch/

DistributedDataParallel of PyTorch:
https://pytorch.org/tutorials/intermediate/ddp_tutorial.html

Acknowledgements

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Thank you

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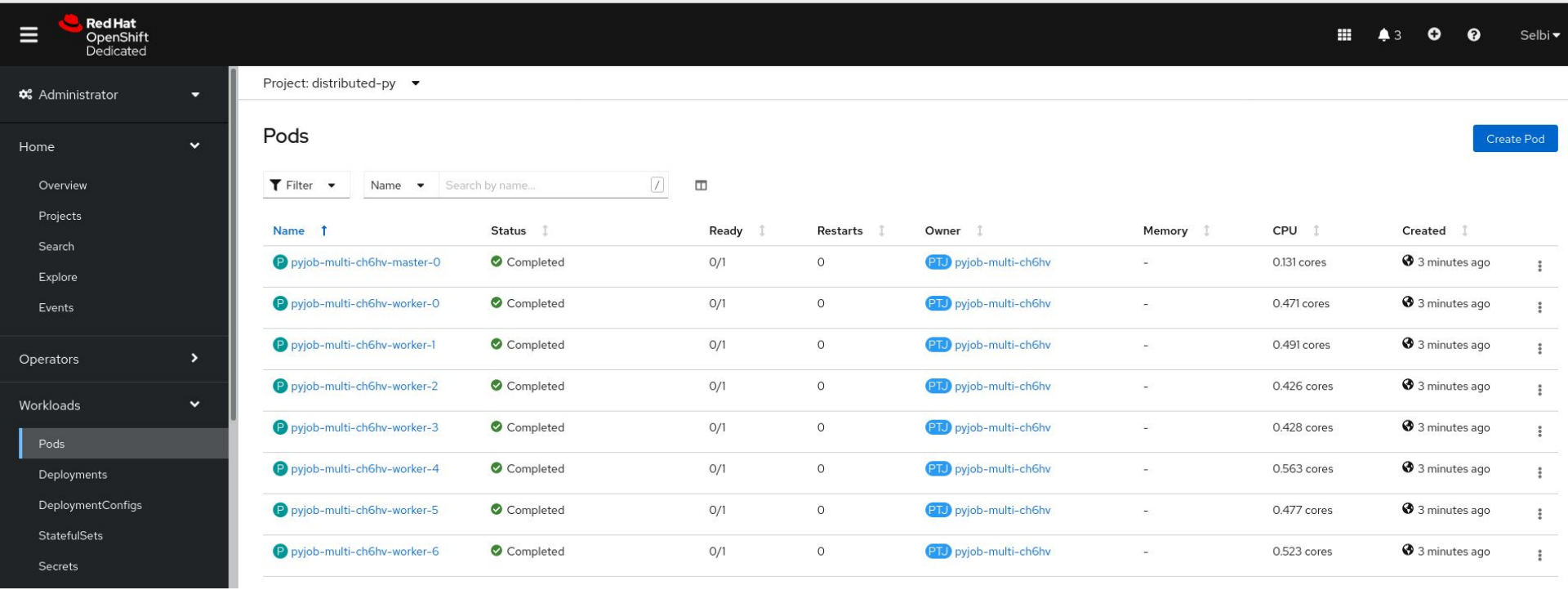
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Project: distributed-py
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Name
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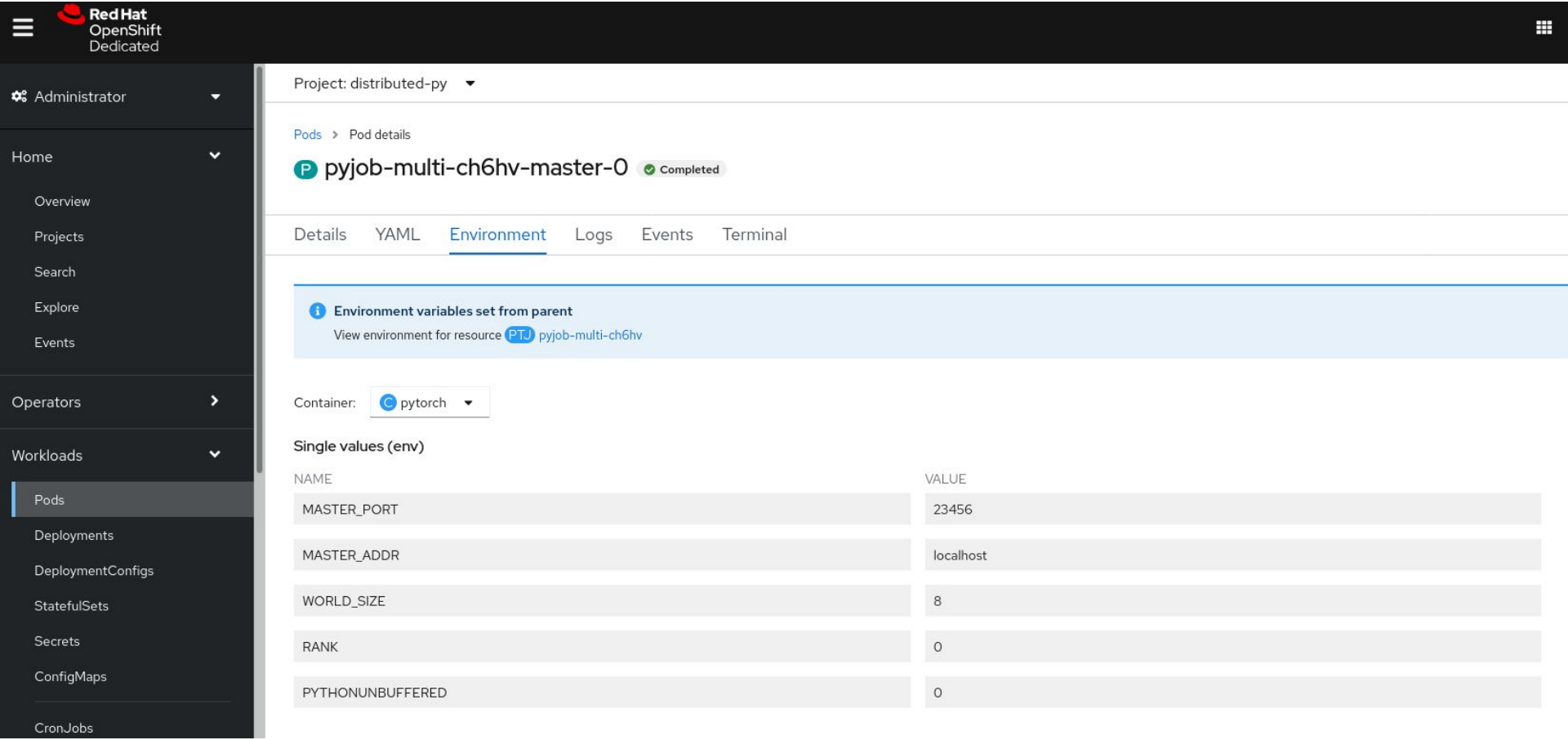
Restarts
Owner
Memory
CPU
Created
pyjob-multi-ch6hv-master-0 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.131 cores 3 minutes ago
pyjob-multi-ch6hv-worker-0 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.471 cores 3 minutes ago
pyjob-multi-ch6hv-worker-1 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.491 cores 3 minutes ago
pyjob-multi-ch6hv-worker-2 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.426 cores 3 minutes ago
pyjob-multi-ch6hv-worker-3 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.428 cores 3 minutes ago
pyjob-multi-ch6hv-worker-4 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.563 cores 3 minutes ago
pyjob-multi-ch6hv-worker-5 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.477 cores 3 minutes ago
pyjob-multi-ch6hv-worker-6 Completed 0/1 0 PTJ pyjob-multi-ch6hv - 0.523 cores 3 minutes ago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pyjob-multi-ch6hv-master-0
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View environment for resource PTJ pyjob-multi-ch6hv
Container: pytorch
Single values (env)
NAME
VALUE
MASTER_PORT
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MASTER_ADDR
localhost
WORLD_SIZE
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RANK
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PYTHONUNBUFFERED
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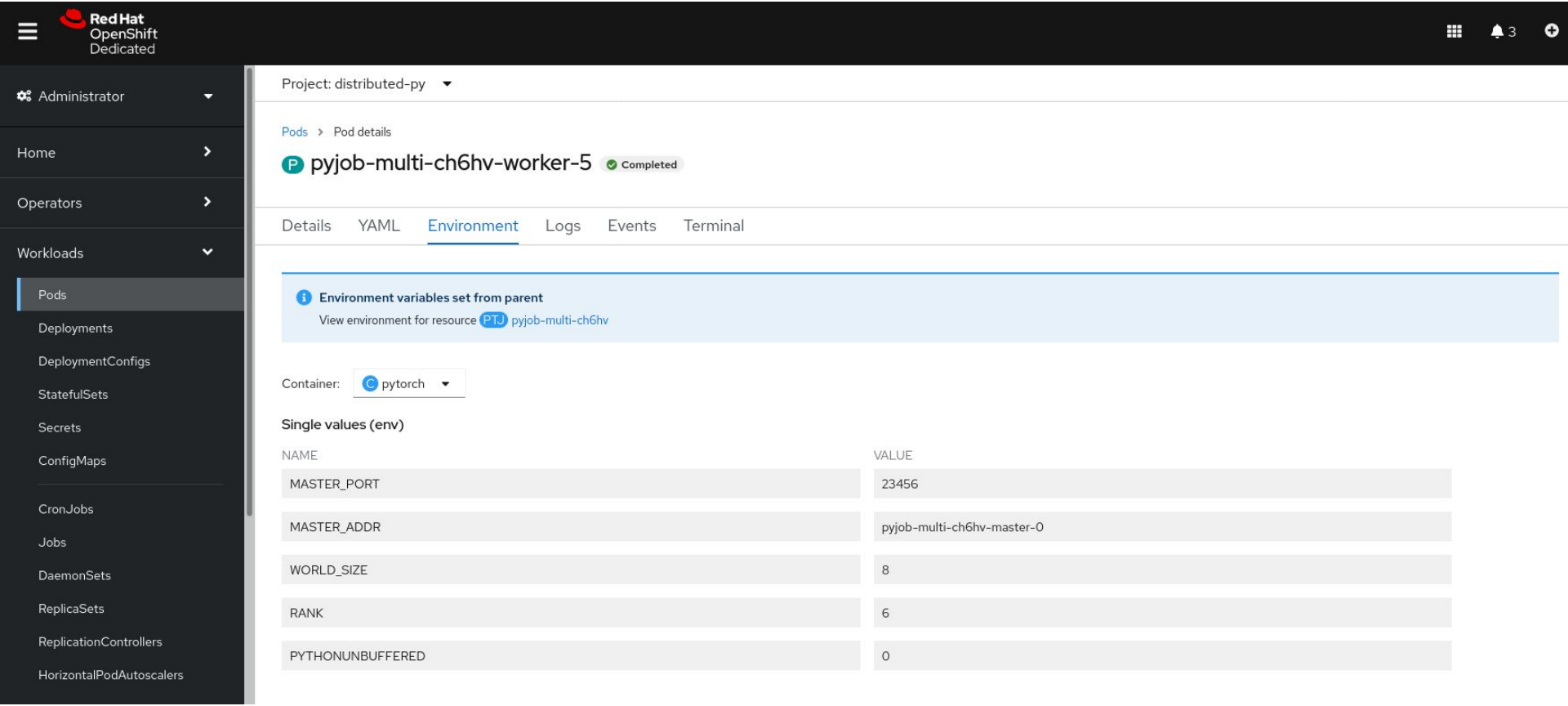
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Project: distributed-py
Pods > Pod details
pyjob-multi-ch6hv-worker-5
Completed
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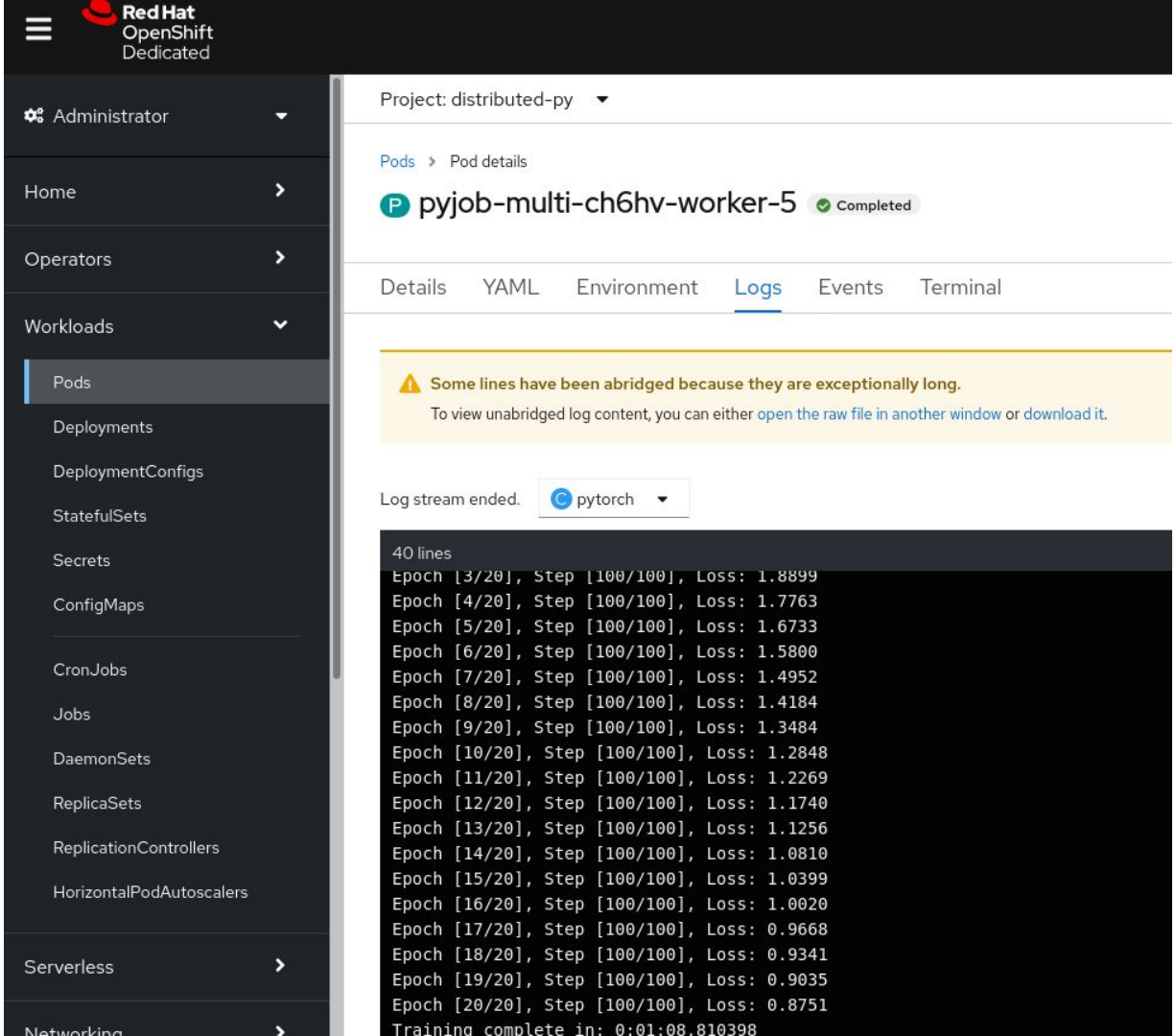
Environment variables set from parent
View environment for resource PTJ pyjob-multi-ch6hv
Container: pytorch
Single values (env)
NAME
VALUE
MASTER_PORT
23456
MASTER_ADDR
pyjob-multi-ch6hv-master-0
WORLD_SIZE
8
RANK
6
PYTHONUNBUFFERED
0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Project: distributed-py
Pods > Pod details
pyjob-multi-ch6hv-worker-5
Completed
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Some lines have been abridged because they are exceptionally long.
To view unabridged log content, you can either open the raw file in another window or download it.
Log stream ended.
pytorch
40 lines
Epoch [3/20], Step [100/100], Loss: 1.8899
Epoch [4/20], Step [100/100], Loss: 1.7763
Epoch [5/20], Step [100/100], Loss: 1.6733
Epoch [6/20], Step [100/100], Loss: 1.5800
Epoch [7/20], Step [100/100], Loss: 1.4952
Epoch [8/20], Step [100/100], Loss: 1.4184
Epoch [9/20], Step [100/100], Loss: 1.3484
Epoch [10/20], Step [100/100], Loss: 1.2848
Epoch [11/20], Step [100/100], Loss: 1.2269
Epoch [12/20], Step [100/100], Loss: 1.1740
Epoch [13/20], Step [100/100], Loss: 1.1256
Epoch [14/20], Step [100/100], Loss: 1.0810
Epoch [15/20], Step [100/100], Loss: 1.0399
Epoch [16/20], Step [100/100], Loss: 1.0020
Epoch [17/20], Step [100/100], Loss: 0.9668
Epoch [18/20], Step [100/100], Loss: 0.9341
Epoch [19/20], Step [100/100], Loss: 0.9035
Epoch [20/20], Step [100/100], Loss: 0.8751
Training complete in: 0:01:08.810398