

SageMaker Debugger Profiling Report

SageMaker Debugger auto generated this report. You can generate similar reports on all supported training jobs. The report provides summary of training job, system resource usage statistics, framework metrics, rules summary, and detailed analysis from each rule. The graphs and tables are interactive.

Legal disclaimer: This report and any recommendations are provided for informational purposes only and are not definitive. You are responsible for making your own independent assessment of the information.

```
In [4]: # Parameters
processing_job_arn = "arn:aws:sagemaker:us-east-1:791618627463:processing-job/
sagemaker-xgboost-2021-12--profilerreport-1638611047-be46ffa2"
```

Training job summary

System usage statistics

Framework metrics summary

Rules summary

The following table shows a profiling summary of the Debugger built-in rules. The table is sorted by the rules that triggered the most frequently. During your training job, the BatchSize rule was the most frequently triggered. It processed 124 datapoints and was triggered 0 times.

	Description	Recommendation	Number of times rule triggered	Number of datapoints	Rule parameters
BatchSize	Checks if GPUs are underutilized because the batch size is too small. To detect this problem, the rule analyzes the average GPU memory footprint, the CPU and the GPU utilization.	The batch size is too small, and GPUs are underutilized. Consider running on a smaller instance type or increasing the batch size.	0	124	cpu_threshold, gpu_threshold, gpu_memory_threshold, patience
GPUMemoryIncrease	Measures the average GPU memory footprint and triggers if there is a large increase.	Choose a larger instance type with more memory if footprint is close to maximum available memory.	0	0	patience
CPUBottleneck	Checks if the CPU utilization is high and the GPU utilization is low. It might indicate CPU bottlenecks, where the GPUs are waiting for data to arrive from the CPUs. The rule evaluates the CPU and GPU utilization rates, and triggers the issue if the time spent on the CPU bottlenecks exceeds a threshold percent of the total training time. The default threshold is 50 percent.	Consider increasing the number of data loaders or applying data pre-fetching.	0	128	threshold, cpu_threshold, gpu_threshold, patience

	Description	Recommendation	Number of times rule triggered	Number of datapoints	Rule p
MaxInitializationTime	Checks if the time spent on initialization exceeds a threshold percent of the total training time. The rule waits until the first step of training loop starts. The initialization can take longer if downloading the entire dataset from Amazon S3 in File mode. The default threshold is 20 minutes.	Initialization takes too long. If using File mode, consider switching to Pipe mode in case you are using TensorFlow framework.	0	0	tt
Dataloader	Checks how many data loaders are running in parallel and whether the total number is equal the number of available CPU cores. The rule triggers if number is much smaller or larger than the number of available cores. If too small, it might lead to low GPU utilization. If too large, it might impact other compute intensive operations on CPU.	Change the number of data loader processes.	0	0	min_th max_thr
StepOutlier	Detects outliers in step duration. The step duration for forward and backward pass should be roughly the same throughout the training. If there are significant outliers, it may indicate a system stall or bottleneck issues.	Check if there are any bottlenecks (CPU, I/O) correlated to the step outliers.	0	0	t n n_

	Description	Recommendation	Number of times rule triggered	Number of datapoints	Rule p
LoadBalancing	Detects workload balancing issues across GPUs. Workload imbalance can occur in training jobs with data parallelism. The gradients are accumulated on a primary GPU, and this GPU might be overused with regard to other GPUs, resulting in reducing the efficiency of data parallelization.	Choose a different distributed training strategy or a different distributed training framework.	0	0	thr pal
LowGPUUtilization	Checks if the GPU utilization is low or fluctuating. This can happen due to bottlenecks, blocking calls for synchronizations, or a small batch size.	Check if there are bottlenecks, minimize blocking calls, change distributed training strategy, or increase the batch size.	0	0	thresh thres w pal
IOBottleneck	Checks if the data I/O wait time is high and the GPU utilization is low. It might indicate IO bottlenecks where GPU is waiting for data to arrive from storage. The rule evaluates the I/O and GPU utilization rates and triggers the issue if the time spent on the IO bottlenecks exceeds a threshold percent of the total training time. The default threshold is 50 percent.	Pre-fetch data or choose different file formats, such as binary formats that improve I/O performance.	0	128	th io_th gpu_th pal

Analyzing the training loop

Step duration analysis

GPU utilization analysis

Usage per GPU

Workload balancing

Dataloading analysis

Batch size

CPU bottlenecks

The CPUBottleneck rule checked when the CPU utilization was above `cpu_threshold` of 90% and GPU utilization is likely to be zero, so the rule skipped the first 1000 datapoints. With this configuration the rule triggered 0 times. This is below the threshold of 50%. The rule analysed 128 data points and triggered 0 times.

I/O bottlenecks

The IOBottleneck rule checked when I/O wait time was above `io_threshold` of 50% and GPU utilization was likely to be zero, so the rule skipped the first 1000 datapoints. With this configuration the rule triggered 0 times. This is below the threshold of 50%. The rule analysed 128 datapoints and triggered 0 times.

GPU memory

The GPUMemoryIncrease rule helps to detect large increase in memory usage on GPUs. The rule checks for a more than 5.0% increase. So if the moving average increased for instance from 10% to 16.0%, the rule would have triggered. The rule skipped the first 1000 datapoints. The moving average was computed on a window size of 10 datapoints where the moving average between previous and current time window increased by more than 5.0%.

