MLCommons Earthquake Benchmark

Gregor von Laszewski, Jacques Fleischer, Geoffrey C. Fox

Contents

MLCommons Earthquake Benchmark

Gregor von Laszewski, Jacques Fleischer, Geoffrey C. Fox

December 19, 2022

Abstract

We report here the results of the MLCommons Science Working group benchmark of the Earthquake code.

done: Describe in detail how to create the report from an existing cloudmesh sbatch run.

Make sure that the README is sufficient for running this example, and that it is properly referred to in this report.

Programming bug is in cloudmesh sbatch. Figure out how to run the dummy and document how to run the dummy sbatch.

1 Setup

Identify, for each experiment, if the YAML file is written into the experiment directory. If this is not the case, we need to fix this. We need to have an output directory for each experiment. Must have the ipynb, the output files, and the YAML file that creates the sbatch submission, and the individual SBATCH run file for that particular experiment. The YAML file takes the original in.yaml file and replaces, in that, all the variables that are being defined by the experiment, and then writes a YAML file. That is the yaml file that we need in that directory.

The code is relatively easy to set up for use on various computers using NVIDIA Cards. The code has been run on A100, V100, K100, P100, and RTX3090. Other cards may be also supported, but the code requires a fair amount of memory. Therefore, it may not be able to be run on NVIDIA Cards with less than 24GB of memory.

The documentation on how to set up the code is available as part of a README.md file under the System Setup section [1]. Instructions to run the code on the University of Virginia's Rivanna Supercomputer can be found on GitHub [2].

1.1 Rivanna

Running the earthquake code on Rivanna can be done on different filesystems available on the HPC center. This includes localscratch, a local filesystem. The localscratch configuration is best as it uses local memory, leading to faster runtimes, and it does not require special permissions like access to the /project network file system.

After running the code on Rivanna using the localscratch configuration, the output files can be found under the mlcommons dir in the home directory:

```
cd ~/mlcommons/benchmarks/
   ↪ earthquake/latest/
   ↪ experiments/rivanna/
   ↪ localscratch
ls
```

2 Cloudmesh

The code has been enhanced with benchmark functions from Cloudmesh [3]. It also uses a convenient extension to batch scripts called cloudmesh-sbatch allowing more easily to place additional templated parameters into the

SBATCH or LSF shell script parameters when submitting to batch systems. In addition, we have developed a cloudmesh compute cluster workflow management tool that allows us to submit the codes in parallel to multiple supercomputers as well as parallel batch jobs [4, 5].

2 Week Intervals is the wrong label, label must be unique

3 Report Generation

To create the report figures, we assume you have fully run the Earthquake code on Rivanna. Execute the following commands:

```
mkdir ~/cm
cd ~/cm
git clone https://github.com/
    ↪ laszewsk/mlcommons.git
cd mlcommons/benchmarks/
    ↪ earthquake/latest/report

# make fetch only works on linux,
# so run in WSL on windows
make fetch

make images
make
```

4 Benchmark Terminology

Table 1: Terminology of benchmark labels

Label	Definition
Year Back	Analysis of the previous year
6 Months Back	Analysis of previous 6 months
3 Months Back	Analysis of the previous 3 months
2 weeks Now	Analysis of 2 weeks
2wk+7AVG	The average of 7 two-week intervals
2wk+13AVG	The average of 13 two-week intervals
2wk+26AVG	The average of 26 two-week intervals

5 Results from Rivanna V100

Rivanna is a supercomputer located at the University of Virginia. It has a variety of CUDA cards, including an A100, V100, K80. In this benchmark we use its V100.

5.1 Best Accuracy

Just one entry for best accuracy.

5.2 Accuracy Comparison

We compare accuracy.

5.3 Time Comparison

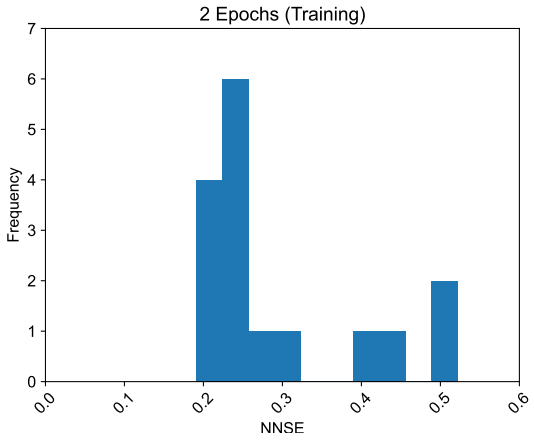
We compare time.

5.4 Power Consumption

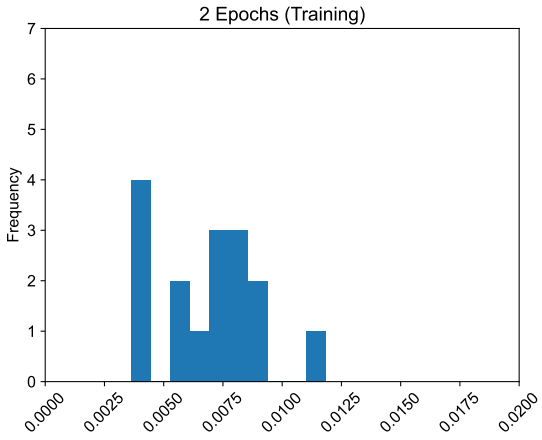
We compare power.

Table 2: To be determined

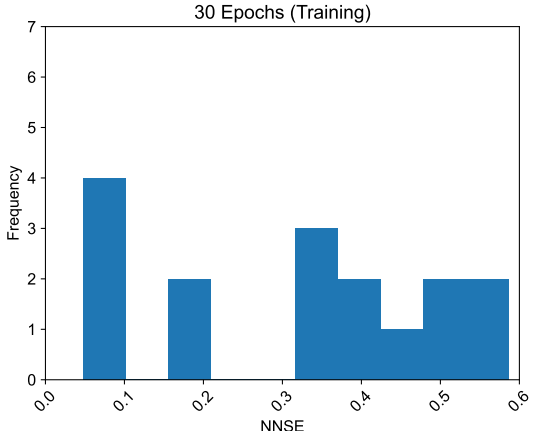
NNSE	Name
0.191300	Year Back
0.192700	6M 2wk+7AVG
0.197000	6M 2wk+13AVG
0.201600	6 Months Back
0.232600	1Y 2wk+13AVG
0.233000	3 Months Back
0.235800	1Y 2wk+7AVG
0.243000	3M 2wk+7AVG
0.251600	1Y 2wk+26AVG
0.251700	6M 2wk+26AVG
0.278800	3M 2wk+13AVG
0.302500	3M 2wk+26AVG
0.405600	Now 2wk+7AVG
0.429900	Now 2wk+13AVG
0.506800	2 weeks Now
0.521800	Now 2wk+26AVG



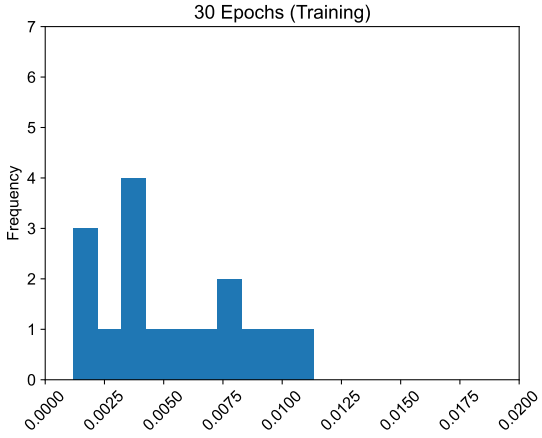
(a) NNSE - 2 epochs



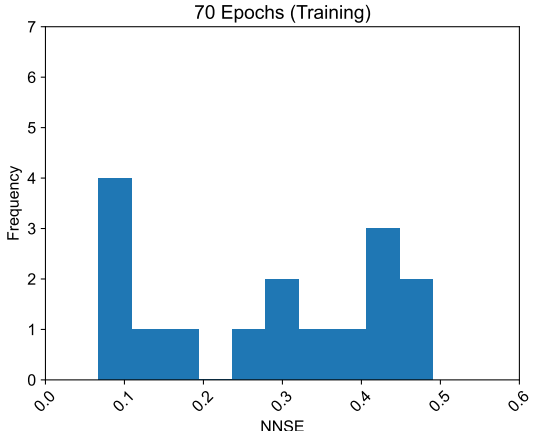
(b) MSE - 2 epochs



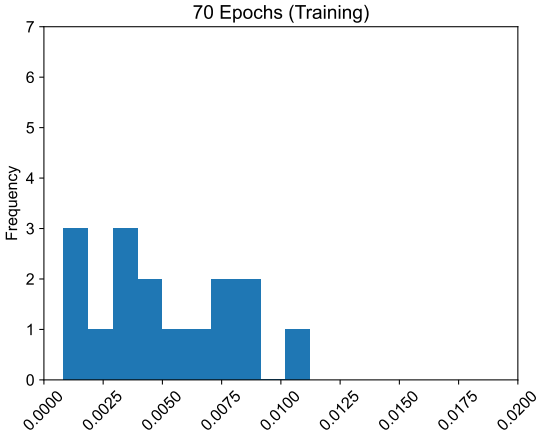
(c) NNSE - 30 epochs



(d) MSE - 30 epochs

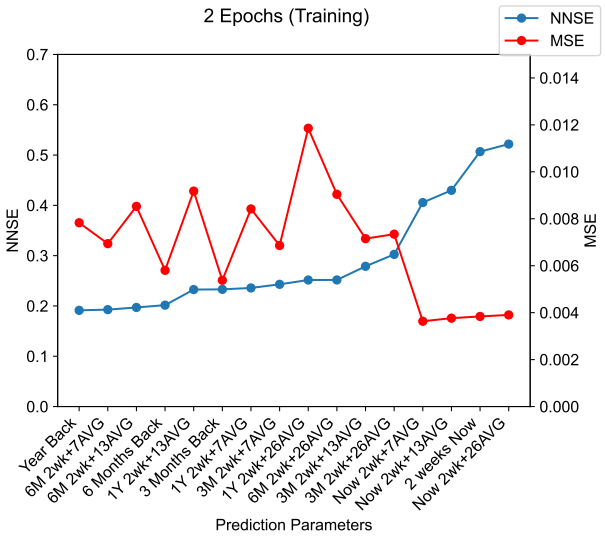


(e) NNSE - 70 epochs

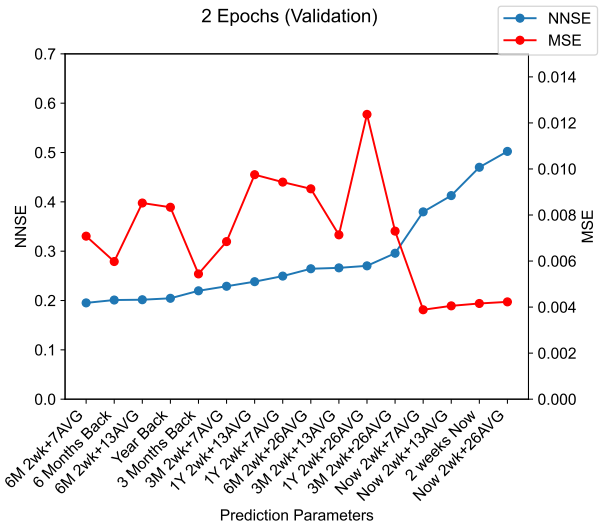


(f) MSE - 70 epochs

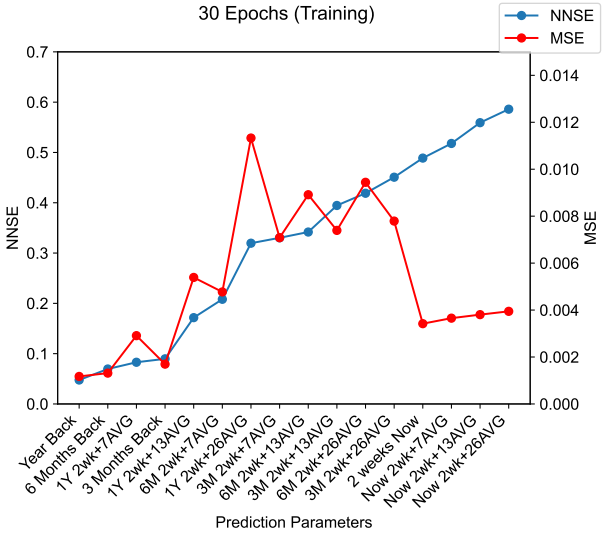
Figure 1: NNSE and MSE values for epochs 2, 30, 70 (training).



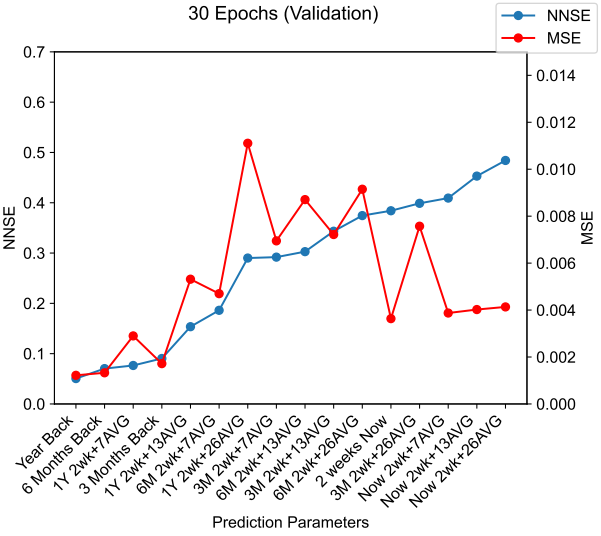
(a) MSE and NNSE - 2 epochs training



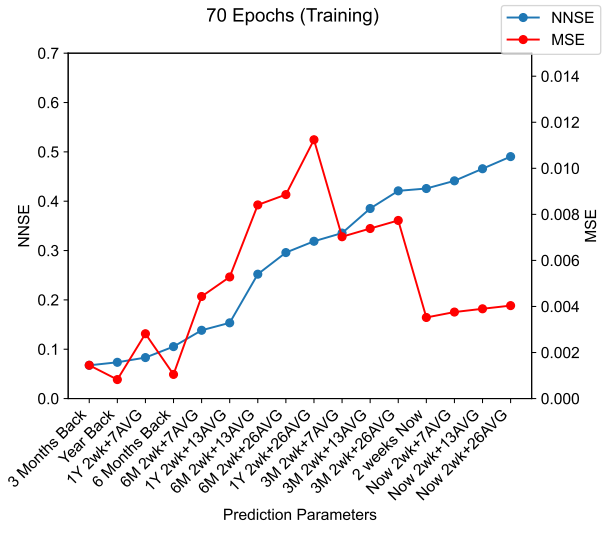
(b) MSE and NNSE - 2 epochs validation



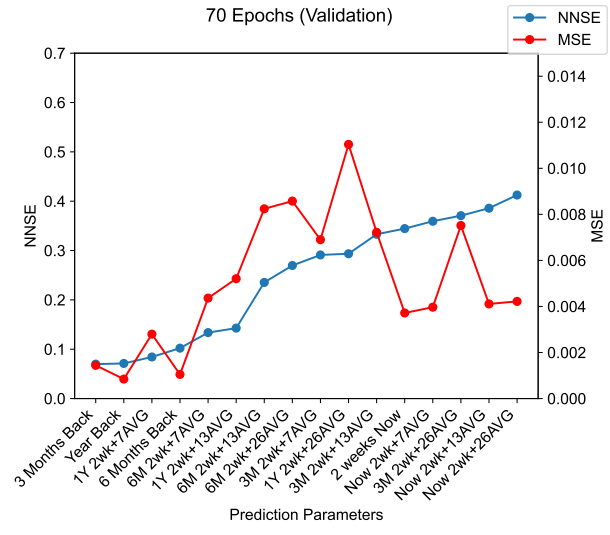
(c) MSE and NNSE - 30 epochs training



(d) MSE and NNSE - 30 epochs validation



(e) MSE and NNSE - 70 epochs training



(f) MSE and NNSE - 70 epochs validation

Figure 2: NNSE and MSE values for epochs 2, 30, 70 (training and validation).

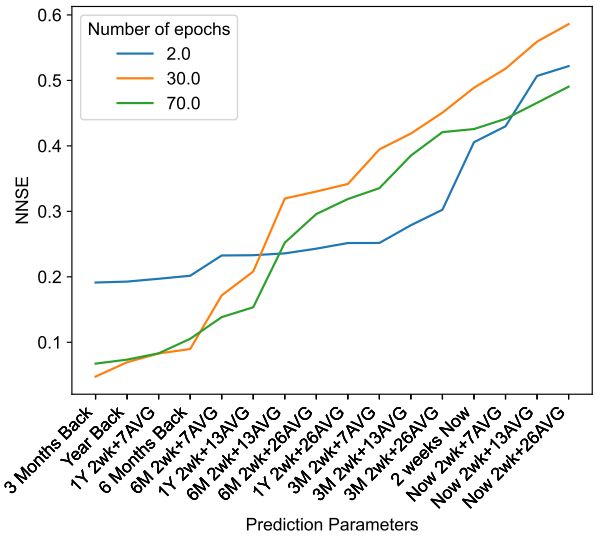


Figure 3: 2, 30, and 70 epochs and their corresponding NNSE values.

Acknowledgements

Continued work was in part funded by the NSF CyberTrain- ing: CIC: CyberTraining for Students and Technologies from Generation Z with the award numbers 1829704 and 2200409 and NIST 60NANB21D151T.

Table 3: To be determined

NNSE	Name
0.195200	6M 2wk+7AVG
0.201000	6 Months Back
0.201600	6M 2wk+13AVG
0.204500	Year Back
0.219700	3 Months Back
0.228900	3M 2wk+7AVG
0.238200	1Y 2wk+13AVG
0.249500	1Y 2wk+7AVG
0.264400	6M 2wk+26AVG
0.266200	3M 2wk+13AVG
0.270300	1Y 2wk+26AVG
0.295800	3M 2wk+26AVG
0.379700	Now 2wk+7AVG
0.412700	Now 2wk+13AVG
0.470100	2 weeks Now
0.502300	Now 2wk+26AVG

References

[1] G. C. Fox, G. v. Laszewski, R. Knuuti, T. Butler, and J. Kolessar, "Mlcommons science earthquake benchmark," GitHub, 2022. [Online]. Available: https://github.com/laszewsk/mlcommons/tree/main/benchmarks/earthquake#readme

[2] G. v. Laszewski, R. Knuuti, and J. Fleischer, "Running on rivanna using the simple configuration," GitHub, 2022. [Online]. Available: https://github.com/laszewsk/mlcommons/tree/main/benchmarks/earthquake/latest/experiments/rivanna#running-on-rivanna-using-the-simple-configuration

[3] G. v. Laszewski, "Cloudmesh repositories," GitHub, 2022. [Online]. Available: https://github.com/cloudmesh

[4] G. von Laszewski, J. P. Fleischer, and G. C. Fox, "Hybrid reusable computational analytics workflow management with cloudmesh," 2022. [Online]. Available: https://arxiv.org/abs/2210.16941

[5] G. von Laszewski, A. Orlowski, R. H. Otten, R. Markowitz, S. Gandh, A. Chai, G. C. Fox, and W. L. Chang, "Using gas for speedy generation of hybridmulti-cloud auto generated ai services," in *IEEE COMPSAC 2021: Intelligent and Resilient Computing for a Collaborative World45th Anniversary Conference*. All Virtual: IEEE, Jul. 2021. [Online]. Available: https://ieeecompsac.computer.org/2021/