OOKAMI PROJECT APPLICATION

Date: 06/2023

Project Title: Modeling Internal Combustion Engine Performance with Deep Learning
Usage:

☒ Testbed

☐ Production

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Usage Description:
The purpose of this project is to aid in the development of deep learning models that can predict performance and emissions characteristics of internal combustion engines. The hyperparameter optimization task in deep learning models relies on training a large number of models in a grid-search-like process to find the optimal values of hyperparameters that minimize the loss function. Model sizes currently tested for this application range from 300 thousand to 50 million parameters. The data set to be used was developed in-house and is composed of over 200 million sets of input features. The goal is to explore how different deep learning techniques such as Multilayer Perceptron (MLP), Gated Recurrent Units (GRU), Long Short Term Memory (LSTM), and 1-Dimensional Convolutional Neural Networks (CNN) can perform in this application.
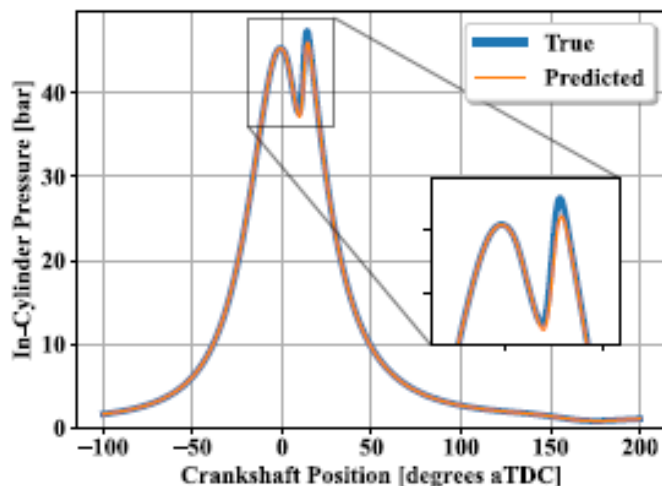
Figure 1: Sample output of model prediction

Computational Resources:

- Total node hours per year: minimally 500-2,500 with an expected maximum of 5,000 as complexity of hyperparameter optimization increases.

- Size (nodes) and duration (hours) for a typical batch job: Jobs are currently locally running on 12 CPU cores and 8 CPU cores in a python script. Estimated wall time is 1 hour per search, with 2000-3000 searches required per hyperparameter optimization process. We would be seeking to speed-up each hyperparameter optimization process and significantly increase the number of serach for each process. Accessible RAM needs ranges from 12-18 Gb on CPU or GPU.

- Disk space (home, project, scratch): Training data set is 130MB x 5 = 500 MB. 500 MB - 5GB when post-processed in python.

Personnel Resources (assistance in porting/tuning, or training for your users**):**
None

Required software:
Python 3.8 and the following libraries:
• PyTorch, NumPy, SciPy, TorchMetrics

If your research is supported by US federal agencies:

Agency: DOE & DOD

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