

Deep Neural Networks for Parameter Estimation with Inverse Maps and for Subgrid-Scale Models on the Cerebras CS-2 AI-Cluster

LDRD
Advanced
Computing
Expedition

Scientific Achievement

- Train large-scale neural networks on the Cerebras CS-2 AI accelerator to learn **inverse maps** that estimate parameters in physical and statistical models
- Design new convolutional neural networks enabling super-resolution for **subgrid-scale variability** of wind speeds in Earth's atmosphere

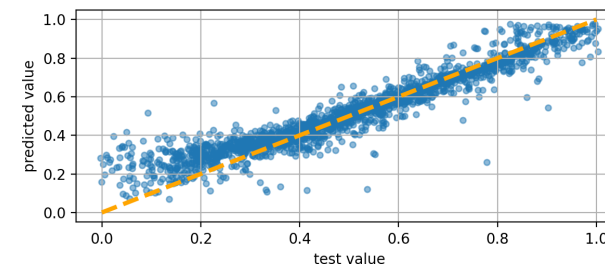
Significance and Impact

Leverage new AI hardware to quickly train large-scale neural network models with tens of millions of trainable parameters. Training time on Cerebras CS-2 increases only mildly while the number of trainable parameters grows exponentially.

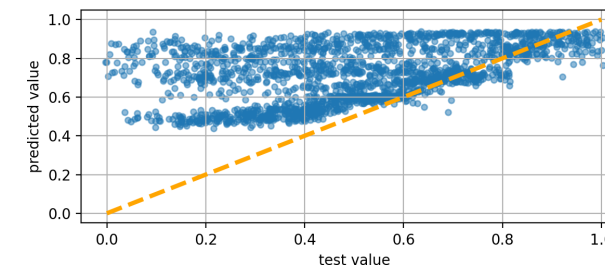
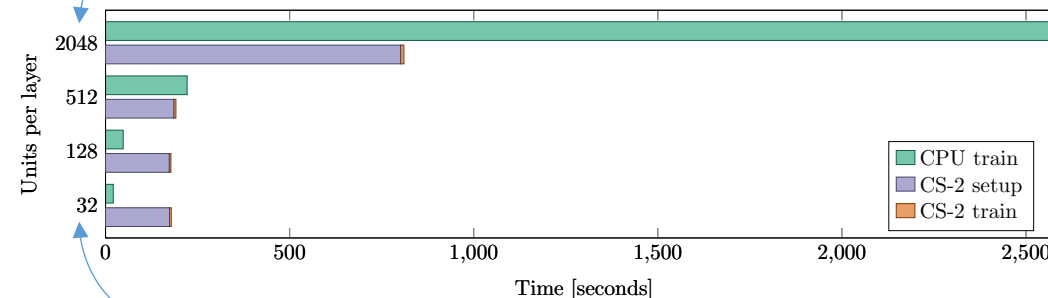
Research Details

- Performance evaluation of training on Cerebras CS-2 compared to a 4-core CPU system shows that large-scale models with tens of millions of parameters are trained extremely efficiently on the CS-2 platform
- Long setup phase of CS-2 is amortized by fast execution of training algo's
- In order to transition to CS-2 system, operations in neural network models must be supported by the Cerebras framework

Inverse Maps for Parameter Estimation



High accuracy with neural network model with **31M** trainable parameters



Low accuracy with neural network model with **39K** trainable parameters

Super-Resolution for Subgrid-Scale Variability

