MIT LINCOLN LABORATORY

The Bulletin

News, events, and notices transmitted weekly

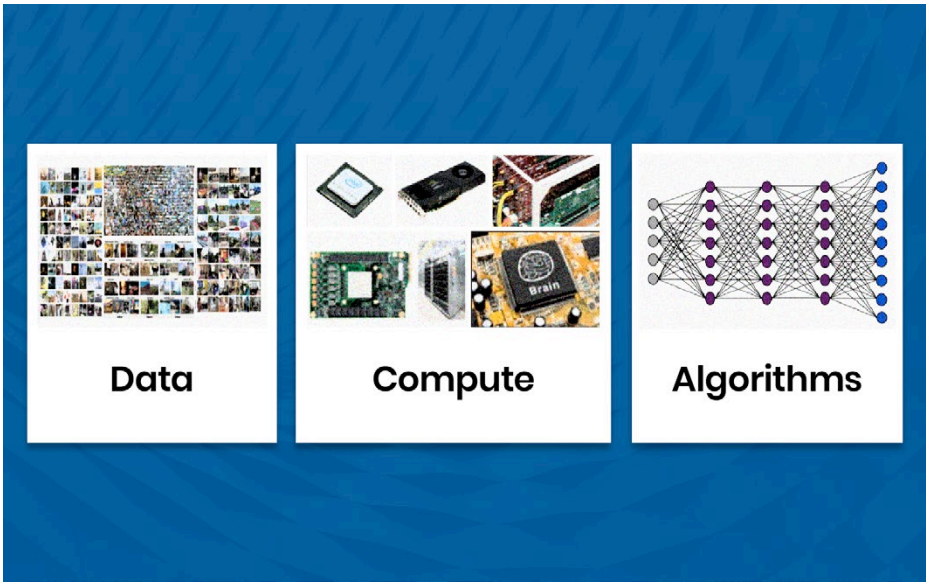
November 1, 2019

Enabling the Foundations of AI: Data, Computation, and Algorithms

Technology Office

A critical component of artificial intelligence (AI) initiatives across the government is access to computing and infrastructure that can be used by the wider national security community. While AI holds significant potential to improve Department of Defense (DoD) operations, there are a number of critical challenges that are not directly solved by commercial or academic solutions. These challenges include (1) managing DoD-specific data sets that are vast and diverse, (2) optimizing the performance of enormous inference and training calculations on heterogeneous computing hardware, and (3) developing algorithmic techniques for novel neural network architectures.

To enable AI research for a variety of Laboratory and sponsor missions, the Line-funded project Enabling the Foundations of AI is developing and operationalizing technologies within the Lincoln Laboratory Supercomputing Center (LLSC) to address these challenges. First, since data management is a critical and time-consuming part of an AI workflow, this project is focused on developing extensible data hubs that will allow collaborators to integrate federated datasets for use in AI solutions designed for DoD problems. Currently, this data hub technology is being considered for transition to the Navy. Second, training AI models on large datasets can require several days of compute time. To enable faster training and inference on new and legacy AI hardware deployed by the DoD, Laboratory staff are collaborating with Dr. Tao Schardl and Professor Charles Leiserson at MIT CSAIL to embed parallelism into compilers for AI frameworks. By optimizing low-level parallel computations, this approach has shown a speedup of 30–100 percent across different CPU architectures. Laboratory staff are also developing capabilities to enable massively parallel, distributed neural network training on LLSC's TX-GAIA cluster, which has a peak AI performance of 100 petaflops. Finally, on the algorithm front, this project is exploring the mathematical



Laboratory staff in the Lincln Laboratory Supercomputing Center are developing tools to address challenges in data management and algorithmic techniques for novel neural network architectures to enable rapid prototyping of AI.

Enabling the Foundations of AI: Data, Computation, and Algorithms (continued)

foundation of sparse AI to help make the case for using sparse processing hardware and hypersparse graphs. For demonstration purposes, this research is being applied to the example problem of detecting cyber anomalies in internet traffic.

Through developments in data management, compute optimization, and algorithms, this project has significantly impacted missions at the Laboratory and has been a critical enabler of the recently announced MIT-Air Force AI Innovation Accelerator. Any technologies developed through this program that are mature enough will be made available to all LLSC users.

For more information, contact Dr. Siddharth Samsi, LLSC, or visit the program page.

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