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Green AI Architecture Experimentation

Technology Office | Lincoln Laboratory

As artificial intelligence and machine learning (AI/ML) continue to become an increasingly large percentage of compute workloads in High-Performance Computing (HPC) centers and commercial clouds, data centers are becoming an increasingly large source of carbon emissions. In particular, research, experimentation, and development of AI can be extremely energy intensive, with deep learning being particularly computationally demanding. Training these models can incur a significant carbon footprint—for example, contemporary AI models used in natural language processing can easily generate emissions comparable to the lifetime emission of multiple cars.

The GAIA-X project aims to reduce energy use in data centers through new approaches to AI training and development, hardware power modulation, and AI approaches to datacenter optimization.

To address this challenge, the Green AI Architecture Experimentation (GAIA-X) project, funded through the Climate Initiative Technical Investment Portfolio, is developing technologies to promote the concept of green computing by establishing foundational tools and proposing power-reduction strategies. This project aims to: (1) reduce energy consumption for AI training in data centers and cloud environments, (2) develop metrics and a dashboard to inform users about the environmental impact of their AI application, and (3) develop a Green AI Challenge geared towards establishing standards and increasing involvement from the AI community on new approaches to energy reduction in AI training and inference. The team behind the project anticipates that this will allow them to reduce the energy consumption of Lincoln Laboratory Supercomputing Center data centers by 20 percent. Additionally, the team is working in collaboration with Professor Charles Leiserson and Dr. Neil Thompson at MIT CSAIL to strengthen community engagement and further raise awareness on this topic. With their plans to host a Green AI Challenge, the team aims to bring both the computing and AI research communities together to crowdsource, innovate, and accelerate novel solutions to address AI's carbon footprint.

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power consumption in the data center, and demonstrating the effectiveness of various power reduction strategies on AI training and experimentation. Concurrently, they are developing novel approaches aimed at reducing the computational resources required for expensive model architecture searches and exhaustive hyperparameter optimization by explicitly accounting for the energy expenditure required for model training. The team plans to extend these approaches in order to cover additional computing platforms, developing power reduction strategies for diverse platforms while improving the adaptability, as well as applicability, of their technology.

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