

Supercomputer and AI:

What they are and how they are used in atmospheric sciences

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The term “**supercomputer**” is commonly used to the fastest high-performance computing (HPC) systems available at any given time. Weather forecasting and climate prediction are typical applications for HPC. In atmospheric sciences, the term “**weather**” is used for short-term atmospheric conditions while the term “**climate**” is used for long-term conditions. Supercomputers are used to run Numerical Weather Prediction (NWP) models where weather data is processed by the computers. As the performance of supercomputers improves, there is progress in the accuracy of NWP [1].

In the mid-1950s, McCarthy, widely recognized as the father of “**artificial intelligence (AI)**”, coined the term AI which he would define as “the science and engineering of making intelligent machines” [2]. “**Machine learning (ML)**” is a subset of AI, which is defined as “an approach to achieve AI”. ML is intended to give computer systems the ability to learn, using the provided data and make accurate predictions. “**Deep learning (DL)**” is a subset of ML, which is defined as a technique for implementing ML [3].

Researchers in atmospheric sciences are aware of modern DL techniques and try to adopt them to solve pre-processing data, numerical weather and climate modelling and post-processing problems in their research areas. In September 2019, a workshop was held under the theme issue “Machine learning for weather and climate modelling” and the workshop articles are published by the Royal Society in 2021 [4]. Two core disagreements for adopting DL techniques in weather and climate communities are unexplainable deep neural networks and the lack of physical constraints [5].

In this talk, two questions, “What are supercomputer and AI?” and “How are supercomputer and AI currently used in atmospheric sciences?” will be introduced with focusing on DL.

[1] <https://www.weather.gov/media/ajk/brochures/NumericalWeatherPrediction.pdf>

[2] <https://www.artificial-solutions.com/blog/homage-to-john-mccarthy-the-father-of-artificial-intelligence>

[3] <https://blogs.nvidia.com/blog/2016/07/29/>

[whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/](https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/)

[4] <https://royalsocietypublishing.org/doi/10.1098/rsta.2020.0083>

[5] <https://royalsocietypublishing.org/doi/10.1098/rsta.2020.0097>