Applications of Deep Learning in Heliophysics

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What is deep learning?

What business people think it is

What neophytes think it is

What it really is

What skeptics think it is

What the public thinks it is

A tool that helps us find new things in our data
What is deep learning?

A class of machine learning algorithms that:

• Use a cascade of multiple layers of nonlinear processing units for feature extraction and transformation.

• Learn multiple levels of representations that correspond to different levels of abstraction (i.e. the levels form a hierarchy of concepts).

* Taken from Wikipedia
What is deep learning?

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Why deep learning?

Count how many times the players wearing white pass the ball
Deep learning has important limitations too
Deep learning has important limitations too
Deep learning has Important limitations too

- Deep learning algorithms are naïve and single-minded in the way they learn.

- Training data selection is absolutely critical for their success.
Deep learning and image data

What the computer sees

- 82% cat
- 15% dog
- 2% hat
- 1% mug

image classification
Deep learning and image data
Deep learning and image data

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What the computer sees

EUV Irradiance

3.2x10^{-5} W m^{-2}
Convolutional Neural Networks

Neural networks with layers made of tunable convolution filters
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Neural networks with layers made of tunable convolution filters

Several convolutional layers allow the neural network to recognize features of increased complexity
CNNs have revolutionized the way we do image classification.
NEURAL NETWORKS ARE NOT BLACK BOXES AND CAN BE MINED FOR SCIENTIFIC INSIGHT