A brief history of deep learning

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Lecture 10

Readings: this article by Andrew Kurenkov

Based on work by K. Leyton-Brown, K. Larson, and P. van Beek

Outline

Learning Goals

By the end of the lecture, you should be able to

- Describe the causes and the resolutions of the two AI winters in the past.
- Describe the four lessons learned summarized by Geoff Hinton.

A brief history of deep learning

A brief history of deep learning based on this article by Andrew Kurenkov.

The birth of machine learning

(Frank Rosenblatt 1957)

- ▶ A perceptron can be used to represent and learn logic operators (AND, OR, and NOT).
- ▶ It was widely believed that AI is solved if computers can perform formal logical reasoning.

First AI winter

(Marvin Minsky 1969)

- ▶ A rigorous analysis of the limitations of perceptrons.
- ▶ (1) We need to use multi-layer perceptrons to represent simple non-linear functions such as XOR.
- ▶ (2) No one knows a good way to train multi-layer perceptrons.
- ▶ Led to the first AI winter from the 70s to the 80s.

The back-propagation algorithm

(Rumelhart, Hinton and Williams 1986)

- ▶ In their Nature article, they precisely and concisely explained how we can use the back-propagation algorithm to train multi-layer perceptrons.

Second AI Winter

- Multi-layer neural networks trained with back-propagation don't work well, especially compared to simpler models (e.g. support vector machines and/or random forests).
- Led to the second AI winter in the mid 90s.

The rise of deep learning

- In 2006, Hinton , Osindero and Teh showed that back-propagation works if the initial weights are chosen in a smart way.
- In 2012, Hinton entered the ImageNet competition using deep convolutional neural networks and did far better than the next closest entry (an error rate 15.3% rather than 26.2% for the second best entry).
- The deep learning tsunami continues today.

Lessons learned summarized by Geoff Hinton

- Our labeled data sets were thousands of times too small.
- Our computers were millions of times too slow.
- We initialized the weights in a stupid way.
- We used the wrong type of non-linearity.

Revisiting the Learning Goals

By the end of the lecture, you should be able to

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- ▶ Describe the four lessons learned summarized by Geoff Hinton.