

Future Challenges

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Future challenges

- Integrated feed-forward and feedback
 - Deep Boltzmann machine do this, but there are issues of scalability.
- Integrating supervised and unsupervised learning in a single algorithm
Integrating deep learning and structured prediction (“reasoning”)
 - This has been around since the 1990's but needs to be revived
- Learning representations for complex reasoning
 - “recursive” networks [Pollack 90's] [Bottou 10] [Socher 11]
- Integrating Deep Learning with “memory”
 - LSTM [Hochreiter 97], MemNN [Weston 14], NTM [Graves 14]
- Representation learning in natural language processing
 - [Y. Bengio 01],[Collobert Weston 10], [Mnih Hinton 11] [Socher 12]
- Better theoretical understanding of deep learning and convolutional nets
 - e.g. Stephane Mallat's “scattering transform”, work on the sparse representations from the applied math community....

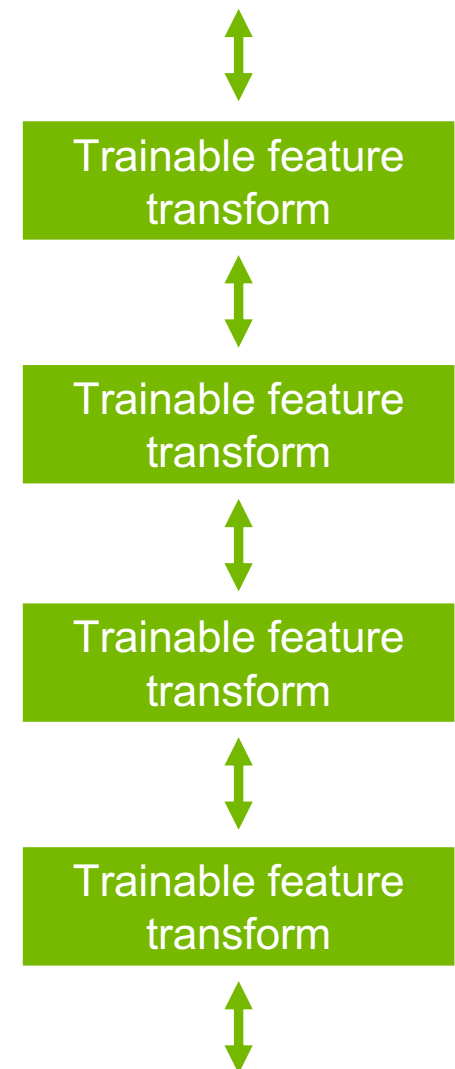
Towards practical AI: Challenges

- Applying deep learning to NLP (requires “structured prediction”)
- Video analysis/understanding (requires unsupervised learning)
- High-performance/low power embedded systems for ConvNets (FPGA/ASIC?)
- Very-large-scale deep learning (distributed optimization)
- Integrating reasoning with DL (“energy-based models”, recursive neural nets)
- Then we can have
 - Automatically-created high-performance data analytics systems
 - Vector-space embedding of everything (language, users,...)
 - Multimedia content understanding, search and indexing
 - Multilingual speech dialog systems
 - Driver-less cars
 - Autonomous maintenance robots / personal care robots

The Future: Unification

Feed-Forward & Feedback; Supervised & Unsupervised

- Marrying feed-forward convolutional nets with generative “deconvolutional nets”
 - Deconvolutional networks
 - [Zeiler-Graham-Fergus ICCV 2011]
- Feed-forward/Feedback networks allow reconstruction, multimodal prediction, restoration, etc...
 - Deep Boltzmann machines can do this, but there are scalability issues with training
- Finding a single rule for supervised and unsupervised learning
 - Deep Boltzmann machines can also do this, but there are scalability issues with training



The graph of deep learning \leftrightarrow sparse modeling \leftrightarrow neuroscience

