

Historical Trends in Deep Learning

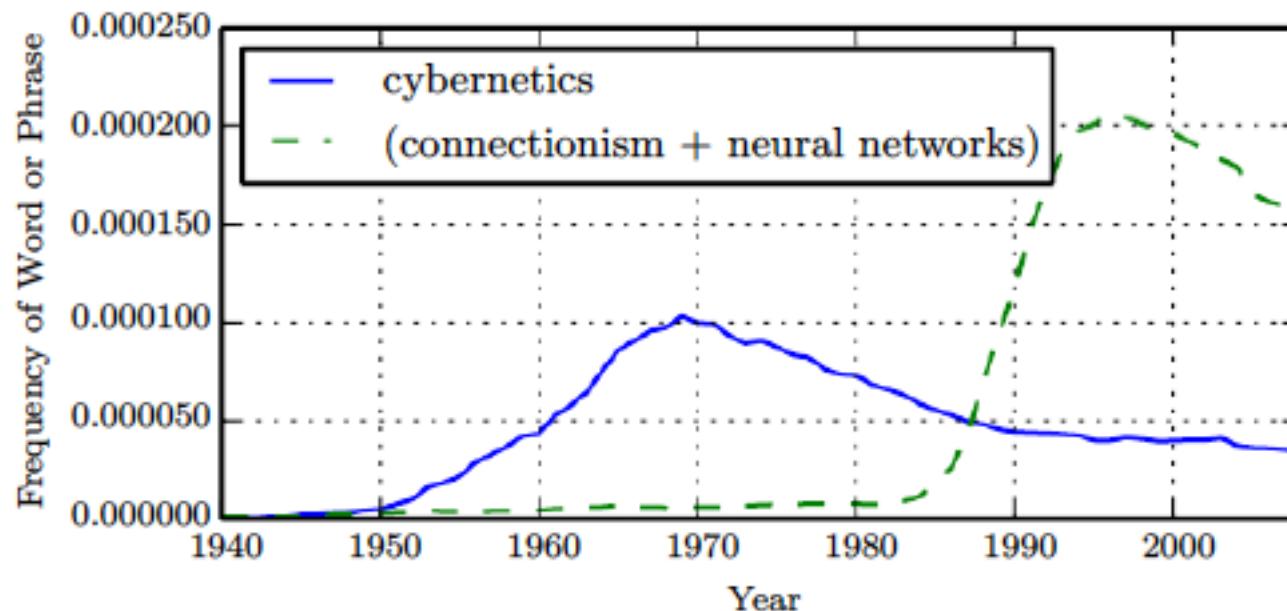
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This is part of lecture slides on [Deep Learning](#):
<http://www.cedar.buffalo.edu/~srihari/CSE676>

History of Deep Learning

- Dates back to 1940s
- Three historical waves:
 - Cybernetics, peaked in 1970
 - connectionism/neural networks, peaked in 1995
 - Deep learning, 2006+ (layerwise training, big data)

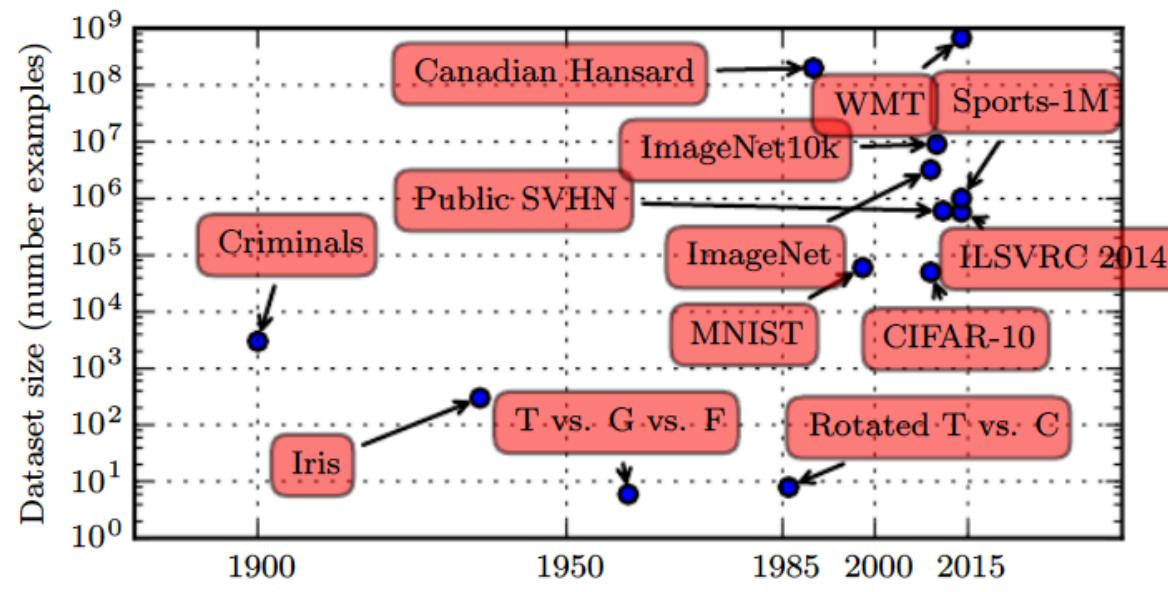


Why this resurgence?

- Data set sizes needed to succeed
- Increasing computational resources (model sizes)
 - Dense connectivity
 - Increased no. of neurons

Large Data Sets

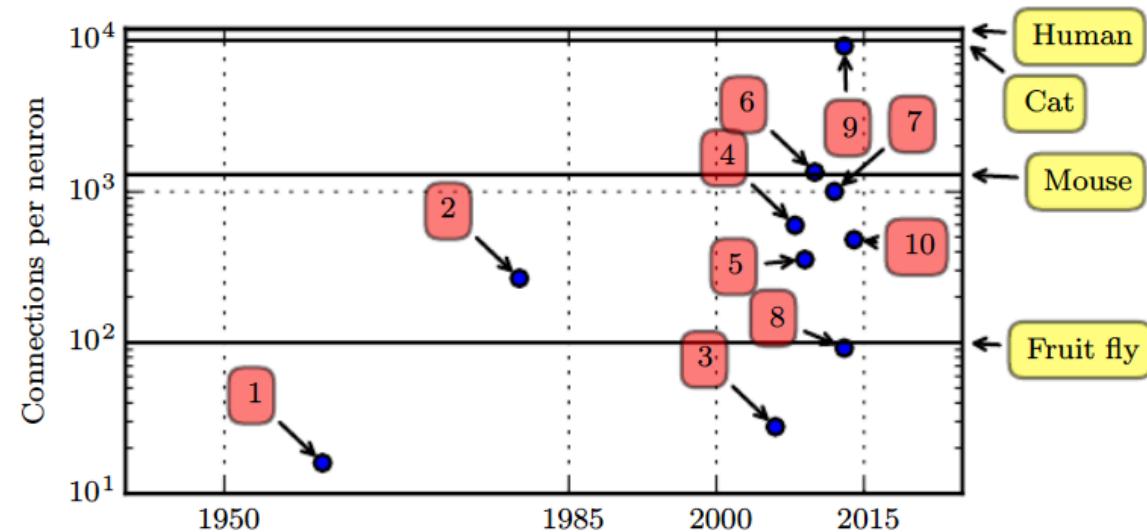
- Algorithms can be provided with data sets needed to succeed



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4	2	6	4	7	5	5	4	7	8	9	2	9	3	9	3	8	2	0	5
0	1	0	4	2	6	5	3	5	3	8	0	0	3	4	1	5	3	0	8
3	0	6	2	7	1	1	8	1	7	1	3	8	9	7	6	7	4	1	6
7	5	1	7	1	9	8	0	6	9	4	9	9	3	7	1	9	2	2	5
3	7	8	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	0
1	2	3	4	5	6	7	8	9	8	1	0	5	5	1	9	0	4	1	9
3	8	4	7	7	8	5	0	6	5	5	3	3	3	9	8	1	4	0	6
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9	9	8	5	3	7	0	7	7	5	7	9	9	4	7	0	3	4	1	4
4	7	5	8	1	4	8	4	1	8	6	4	4	6	3	5	7	2	5	9

Increased Connectivity

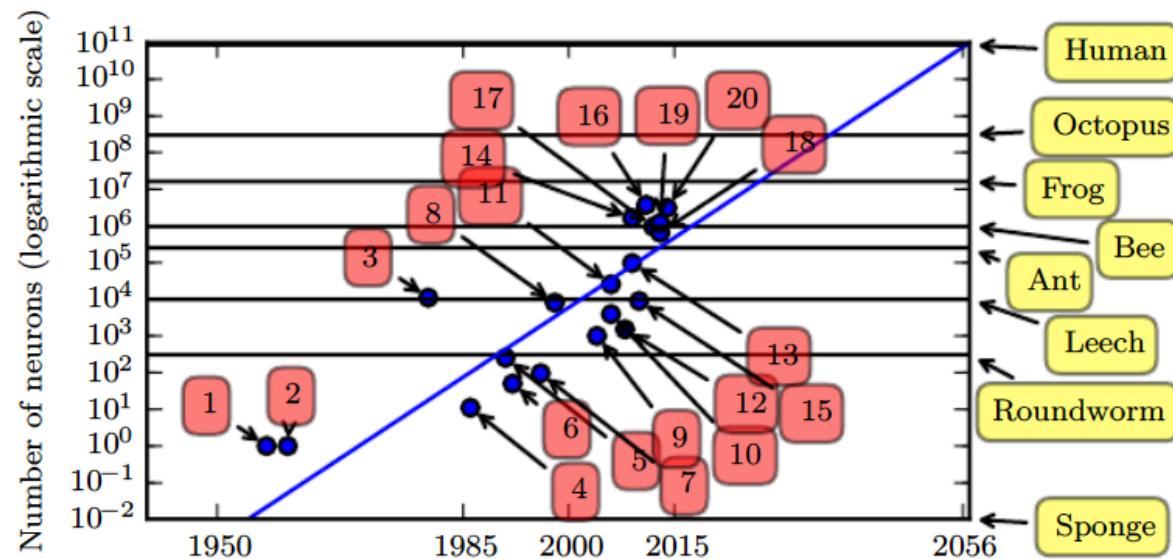
- Intelligence achieved when many neurons work together
 - 1. Adaptive Linear element (Adaline), 1960
 - 2. Neocognitron
 - 3. GPU CNN
 - 4. Deep Boltzmann
 - 5. Unsup. CNN
 - 6. GPU MLP
 - 7. Distributed Autc
 - 8. Multi-GPU CNN
 - 9. COTS Unsupervised CNN
 - 10. GoogLeNet



Increased no. of neurons

- Since introduction of hidden units, doubling of neurons every 2.4 years

1. Perceptron
2. Adaline
3. Neocognitron
4. Early backpro
5. RNN speech
6. MLP speech
7. Mean-field Belief Net
8. LeNet5
9. Echo-state network
10. Deep Belief Net
11. GPU CNN



Increasing Accuracy

- Image Net Large Scale Visual Recognition Challenge

