

Deep Learning: Theory and Practice

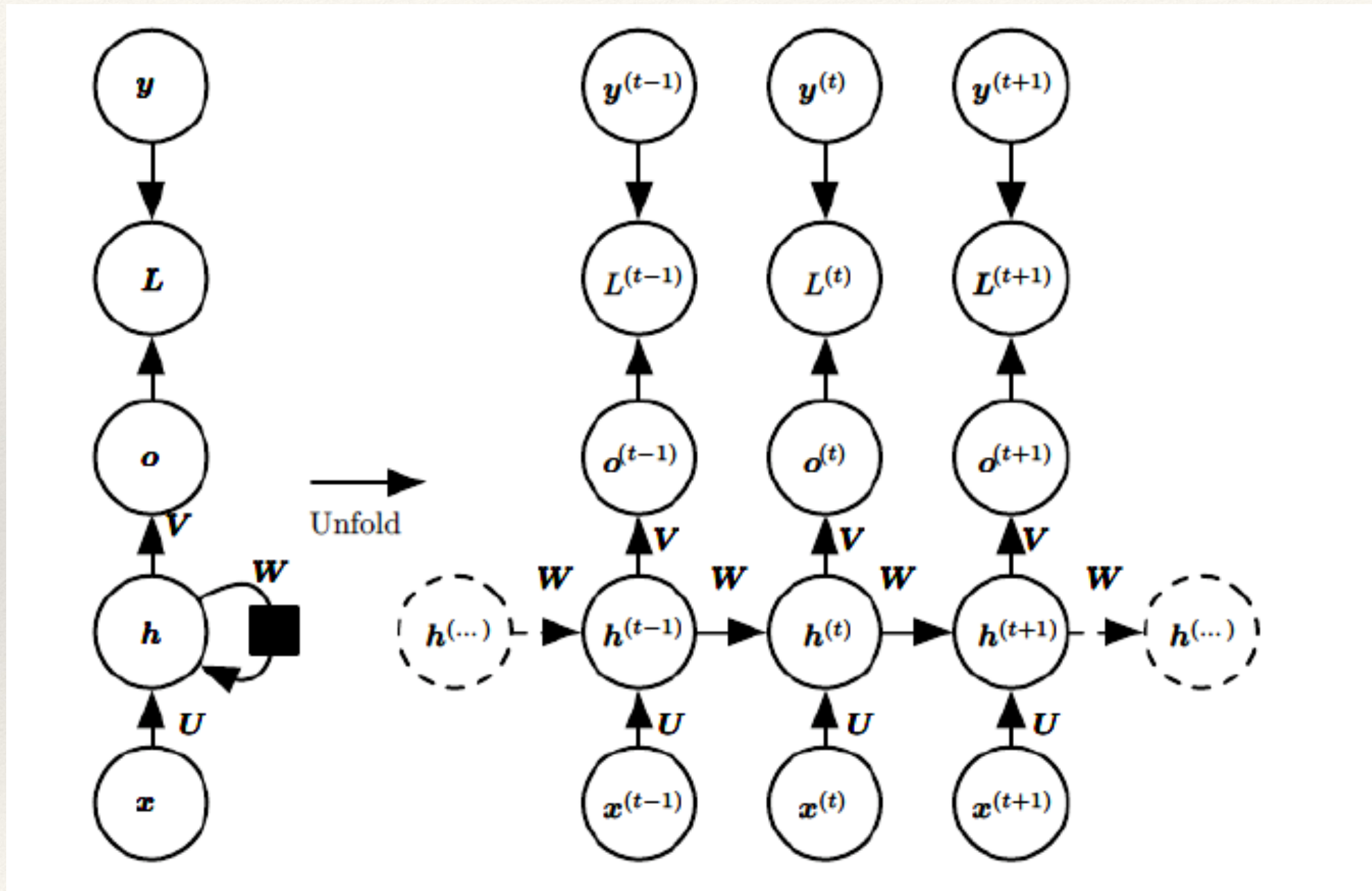
LSTMs and Unsupervised Learning

12-04-2018

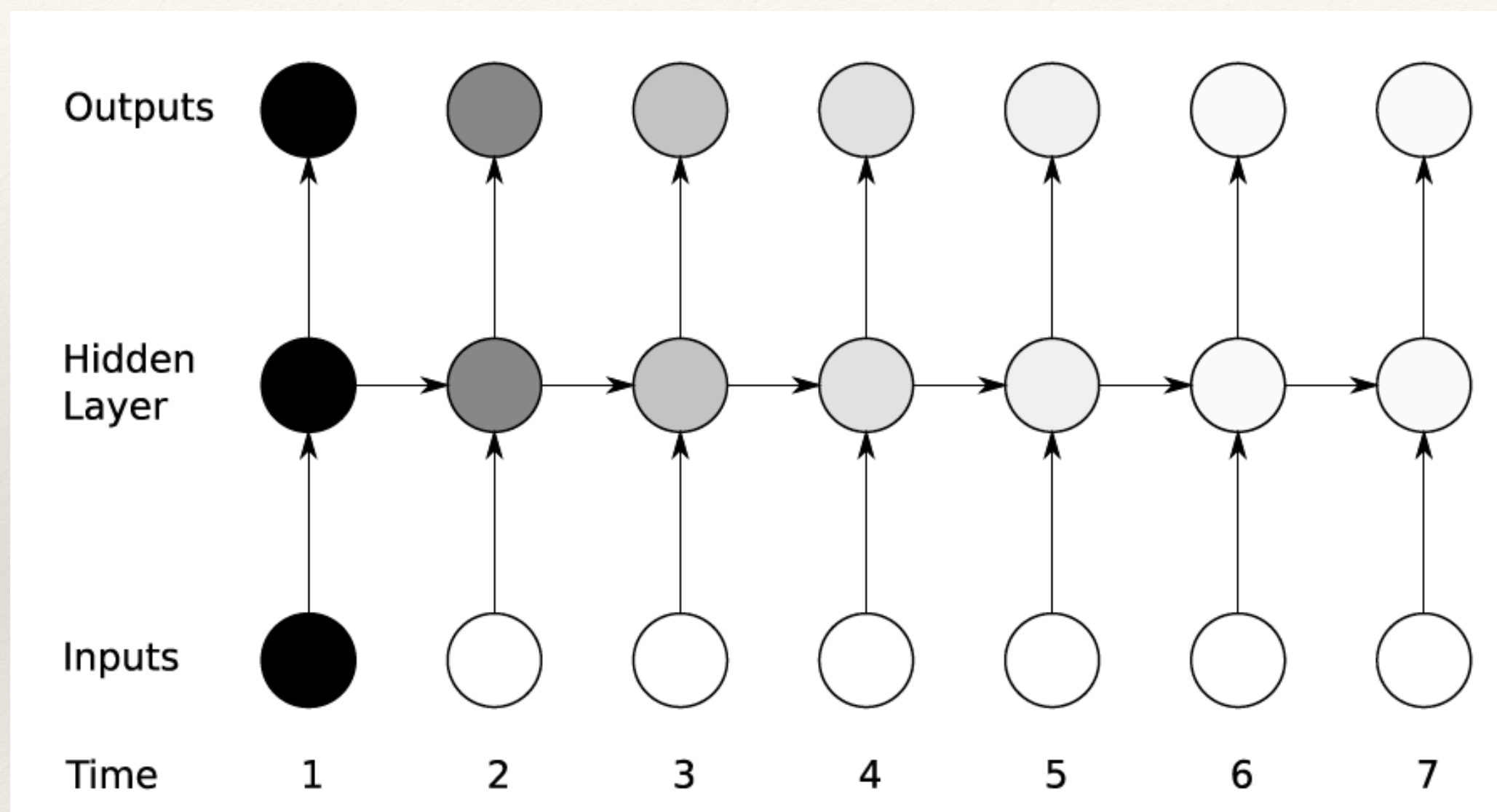
deeplearning.cce2018@gmail.com



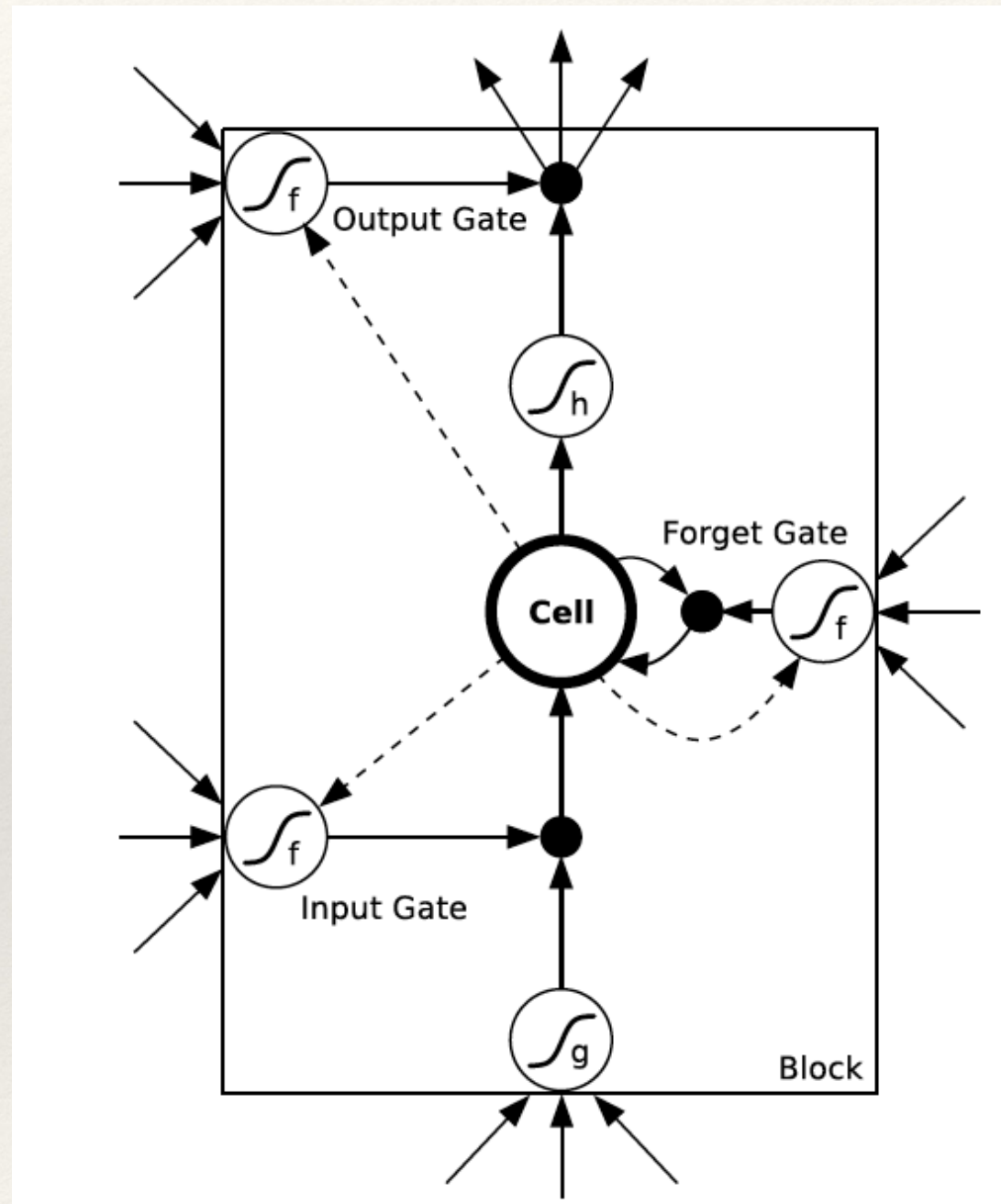
Recurrent Networks



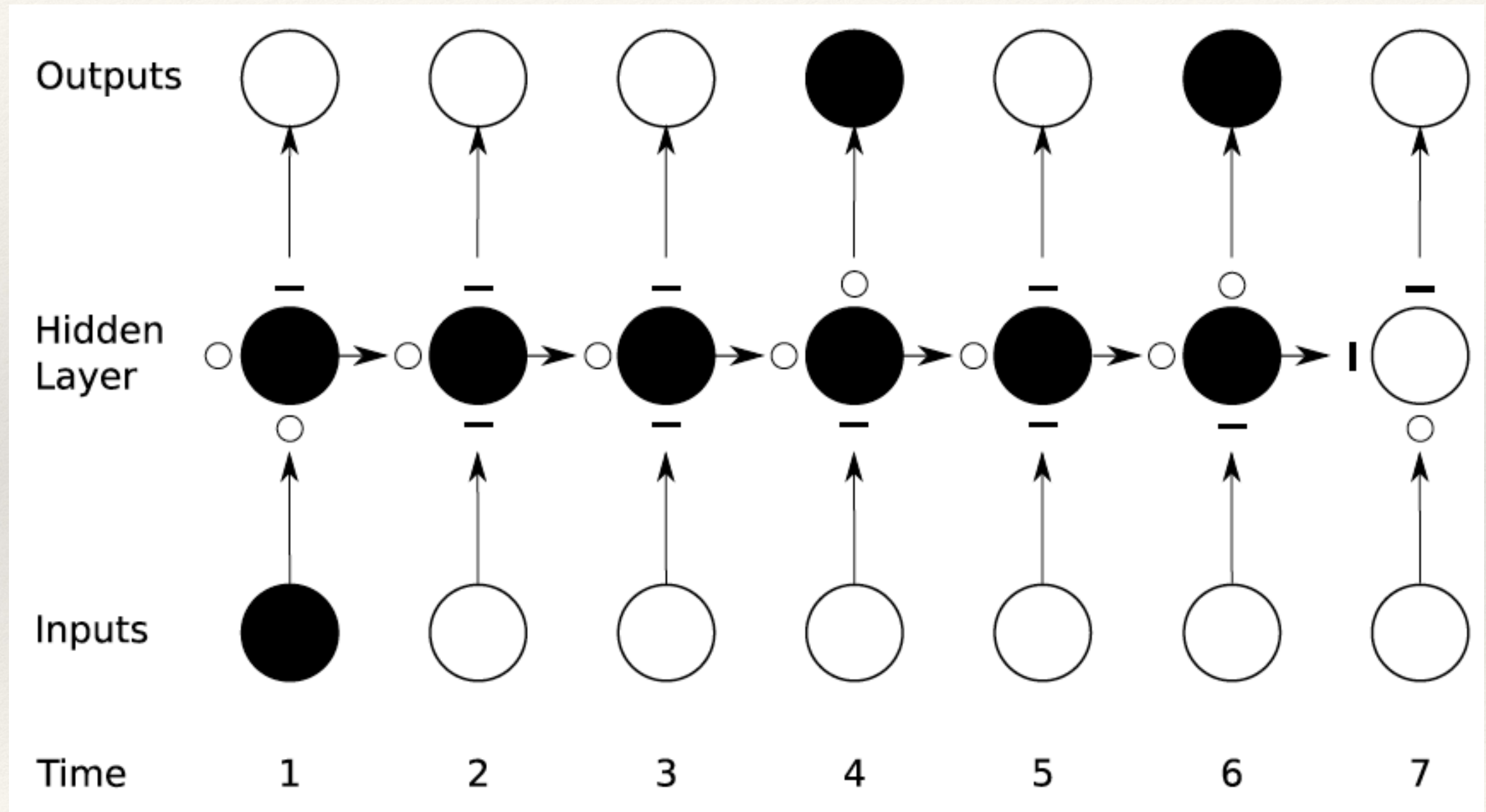
Problem of Long-term Dependencies



A Way to Solve this - LSTM



A Way to Solve this - LSTM



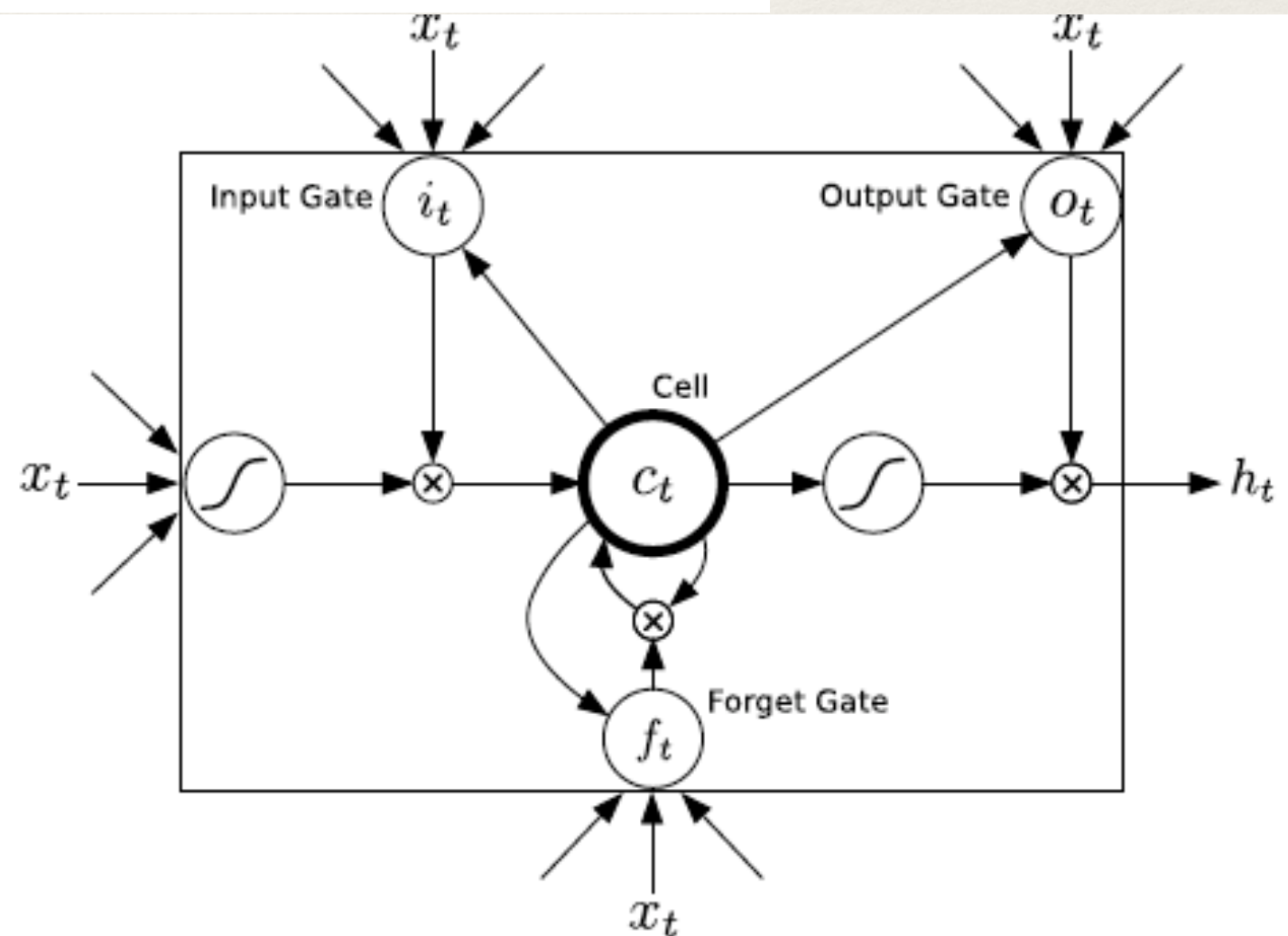
$$i_t = \sigma(W_{xi}x_t + W_{hi}h_{t-1} + W_{ci}c_{t-1} + b_i)$$

$$f_t = \sigma(W_{xf}x_t + W_{hf}h_{t-1} + W_{cf}c_{t-1} + b_f)$$

$$c_t = f_t c_{t-1} + i_t \tanh(W_{xc}x_t + W_{hc}h_{t-1} + b_c)$$

$$o_t = \sigma(W_{xo}x_t + W_{ho}h_{t-1} + W_{co}c_t + b_o)$$

$$h_t = o_t \tanh(c_t)$$



LSTM

$$i_t = \sigma (W_{xi}x_t + W_{hi}h_{t-1} + W_{ci}c_{t-1} + b_i)$$

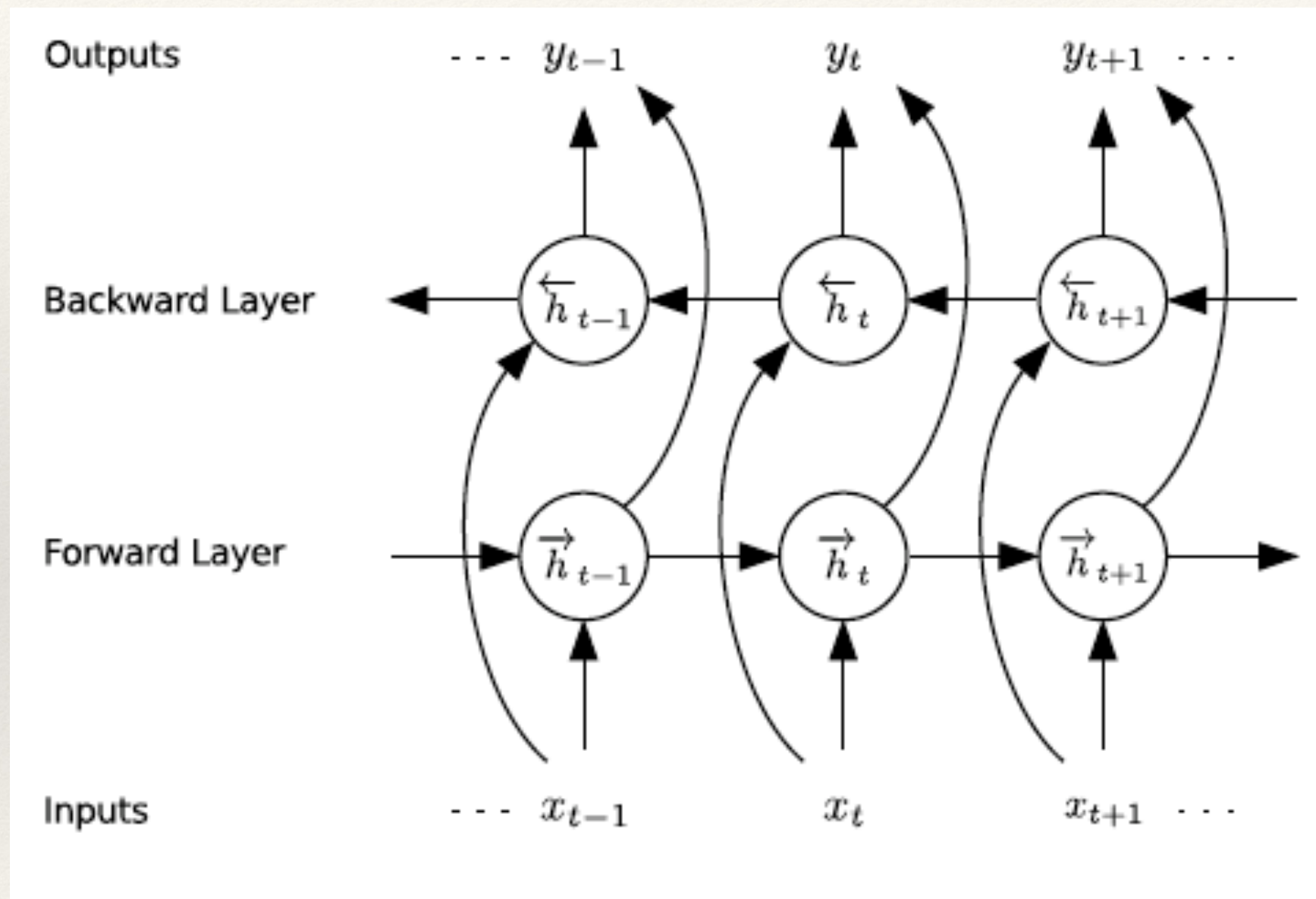
$$f_t = \sigma (W_{xf}x_t + W_{hf}h_{t-1} + W_{cf}c_{t-1} + b_f)$$

$$c_t = f_t c_{t-1} + i_t \tanh (W_{xc}x_t + W_{hc}h_{t-1} + b_c)$$

$$o_t = \sigma (W_{xo}x_t + W_{ho}h_{t-1} + W_{co}c_t + b_o)$$

$$h_t = o_t \tanh(c_t)$$

Bidirectional LSTMs



Deep Unsupervised Learning

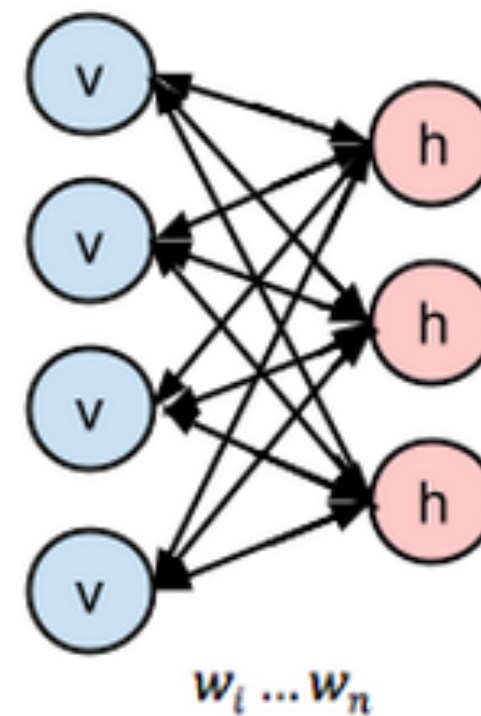
RBM's

$$P(\mathbf{v} = \mathbf{v}, \mathbf{h} = \mathbf{h}) = \frac{1}{Z} \exp(-E(\mathbf{v}, \mathbf{h}))$$

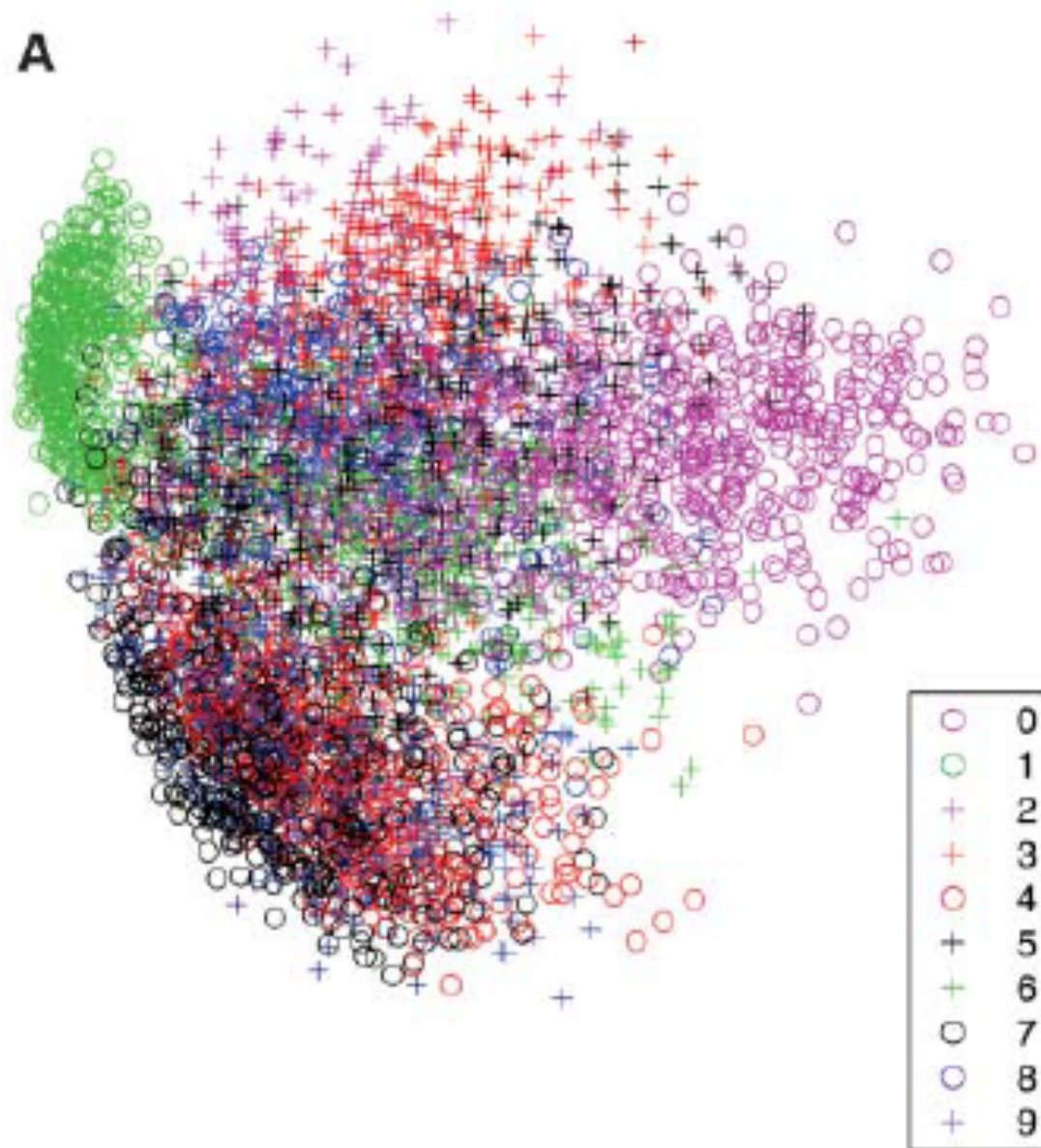
$$E(\mathbf{v}, \mathbf{h}) = -\mathbf{b}^\top \mathbf{v} - \mathbf{c}^\top \mathbf{h} - \mathbf{v}^\top \mathbf{W} \mathbf{h}$$

$$Z = \sum_{\mathbf{v}} \sum_{\mathbf{h}} \exp\{-E(\mathbf{v}, \mathbf{h})\}$$

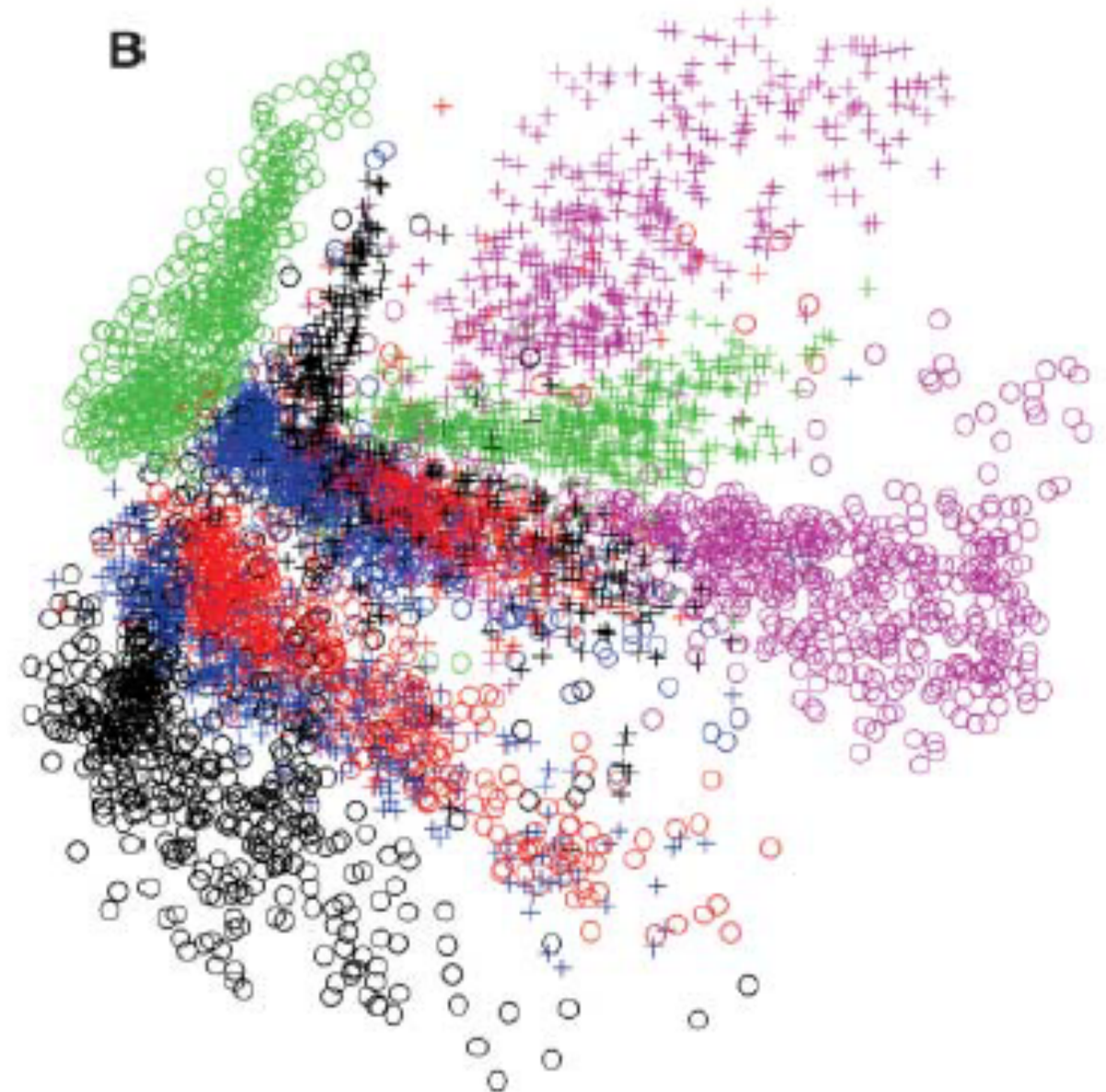
A Symmetrical, Bipartite, Bidirectional Graph with Shared Weights



Restricted Boltzmann Machine

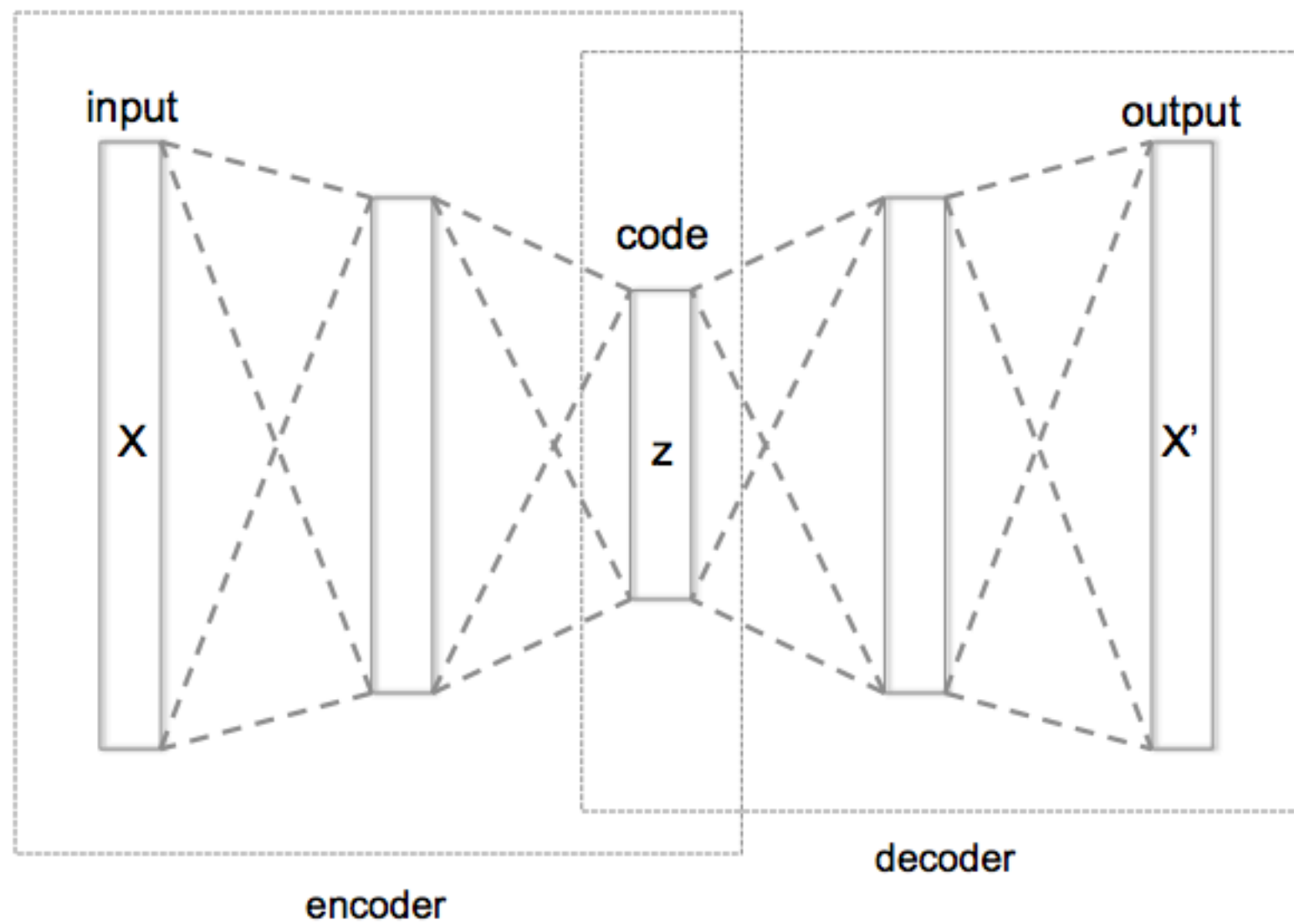


PCA

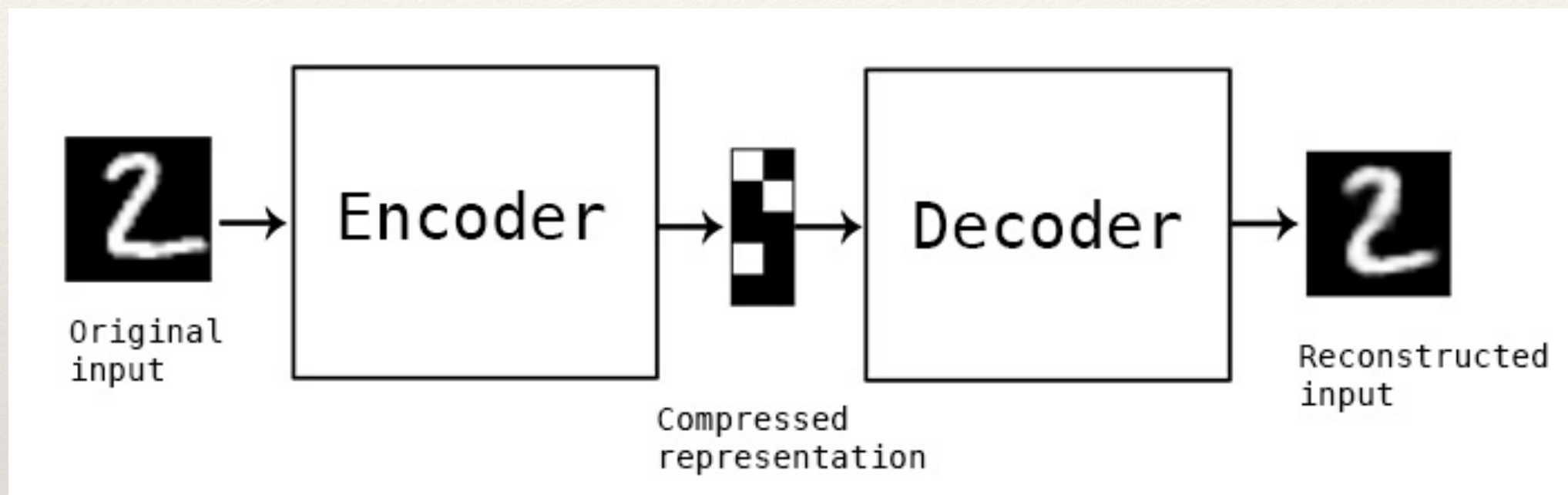


RBM

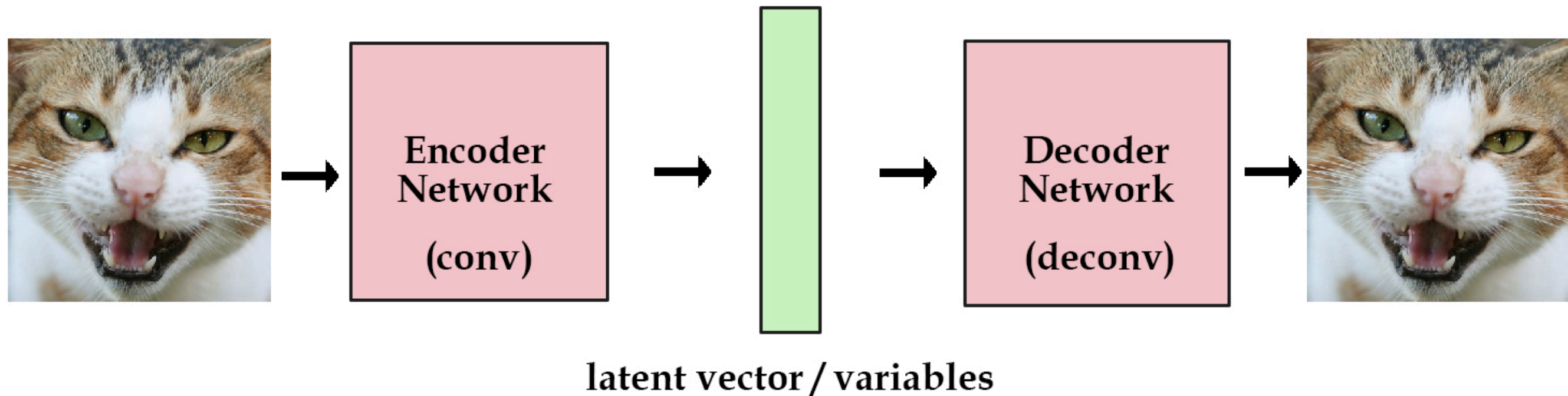
Autoencoders



Autoencoders

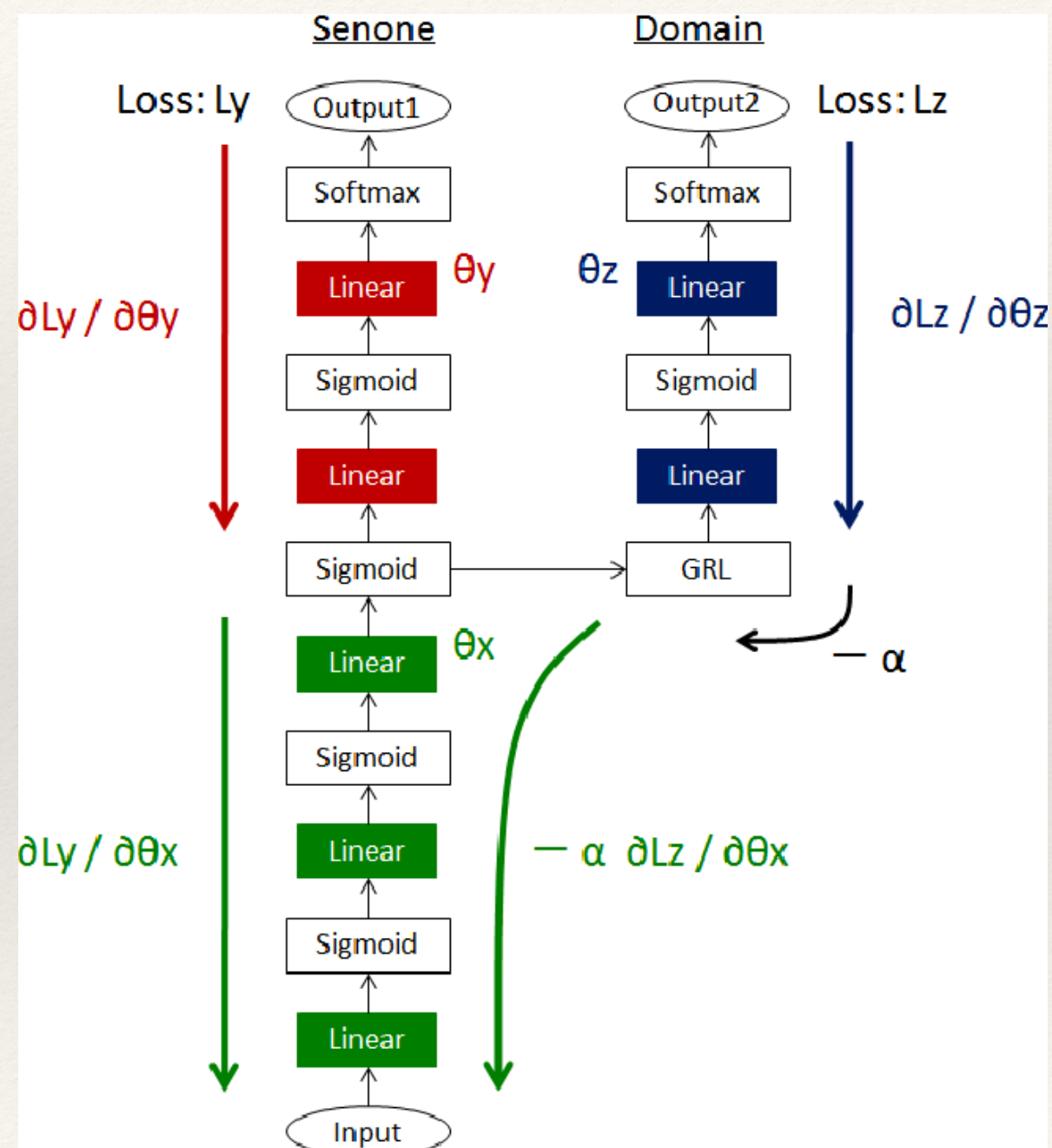


Convolutional Autoencoders



Adversarial Learning

- The target can be learned
 - using original gradient.
 - domain adversarial gradient.
- Model will learn to be domain invariant



[Shinohara et al. 2017]

Applications of Deep Learning

Deep Learning: Applications

DEEP LEARNING EVERYWHERE



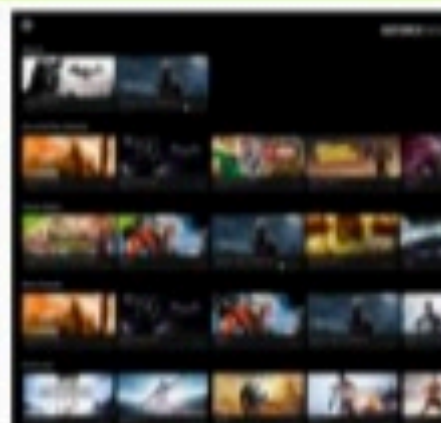
INTERNET & CLOUD

Image Classification
Speech Recognition
Language Translation
Language Processing
Sentiment Analysis
Recommendation



MEDICINE & BIOLOGY

Cancer Cell Detection
Diabetic Grading
Drug Discovery



MEDIA & ENTERTAINMENT

Video Captioning
Video Search
Real Time Translation



SECURITY & DEFENSE

Face Detection
Video Surveillance
Satellite Imagery



AUTONOMOUS MACHINES

Pedestrian Detection
Lane Tracking
Recognize Traffic Sign