E9 205 Machine Learning for Signal Processing

Recurrent Networks

05-11-2018

Established 1911

INDIAN INSTITUTE OF SCIENCE
भारतीय विज्ञान संस्थान

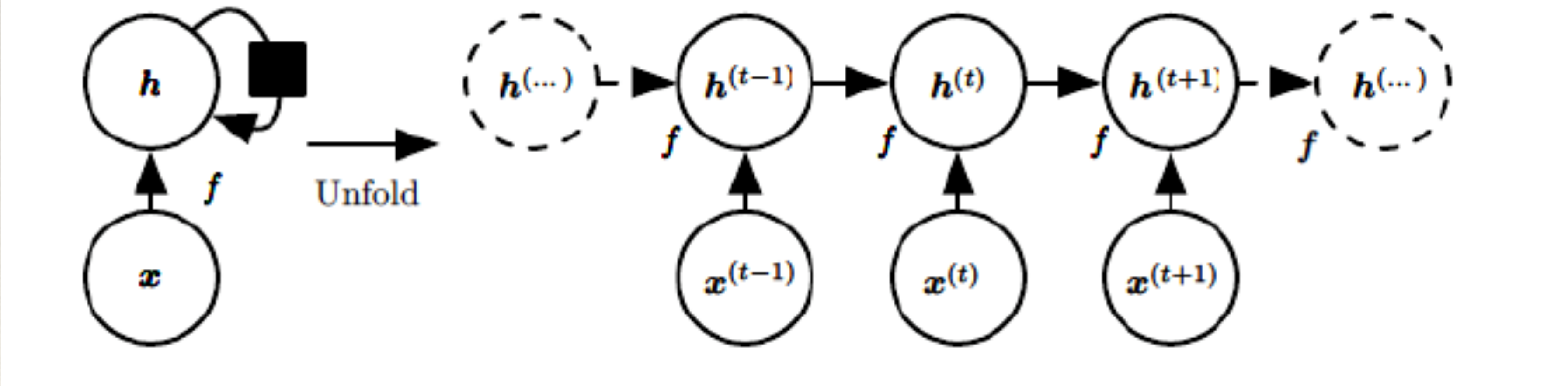
Recurrent Networks

$$s^{(t)} = f(s^{(t-1)}; \theta),$$

$$\begin{aligned} s^{(3)} &= f(s^{(2)}; \theta) \\ &= f(f(s^{(1)}; \theta); \theta) \end{aligned}$$

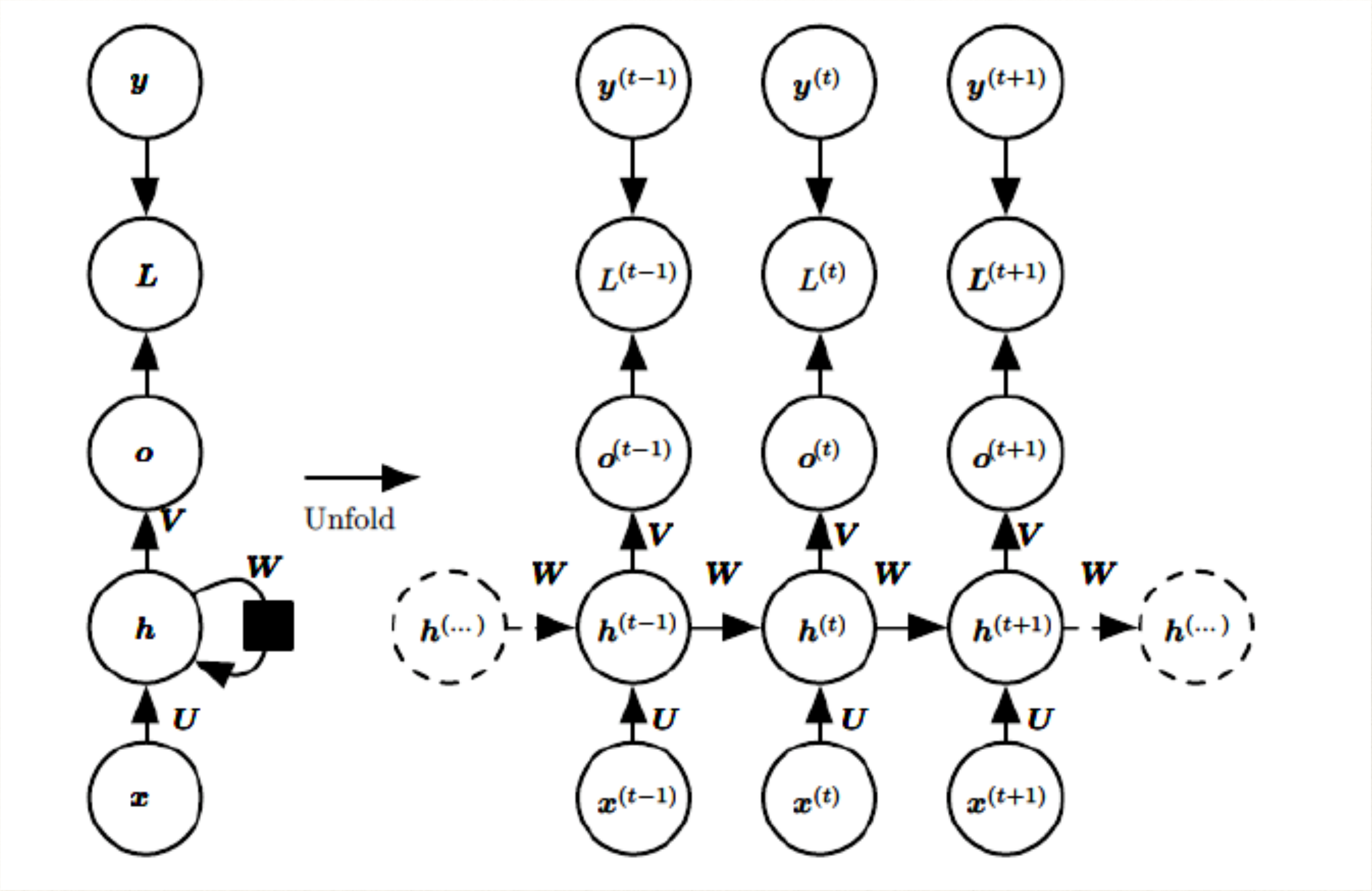
$$s^{(t)} = f(s^{(t-1)}, x^{(t)}; \theta),$$

$$h^{(t)} = f(h^{(t-1)}, x^{(t)}; \theta),$$



“Deep Learning”, Ian Goodfellow, Yoshua Bengio, Aaron Courville

Recurrent Networks



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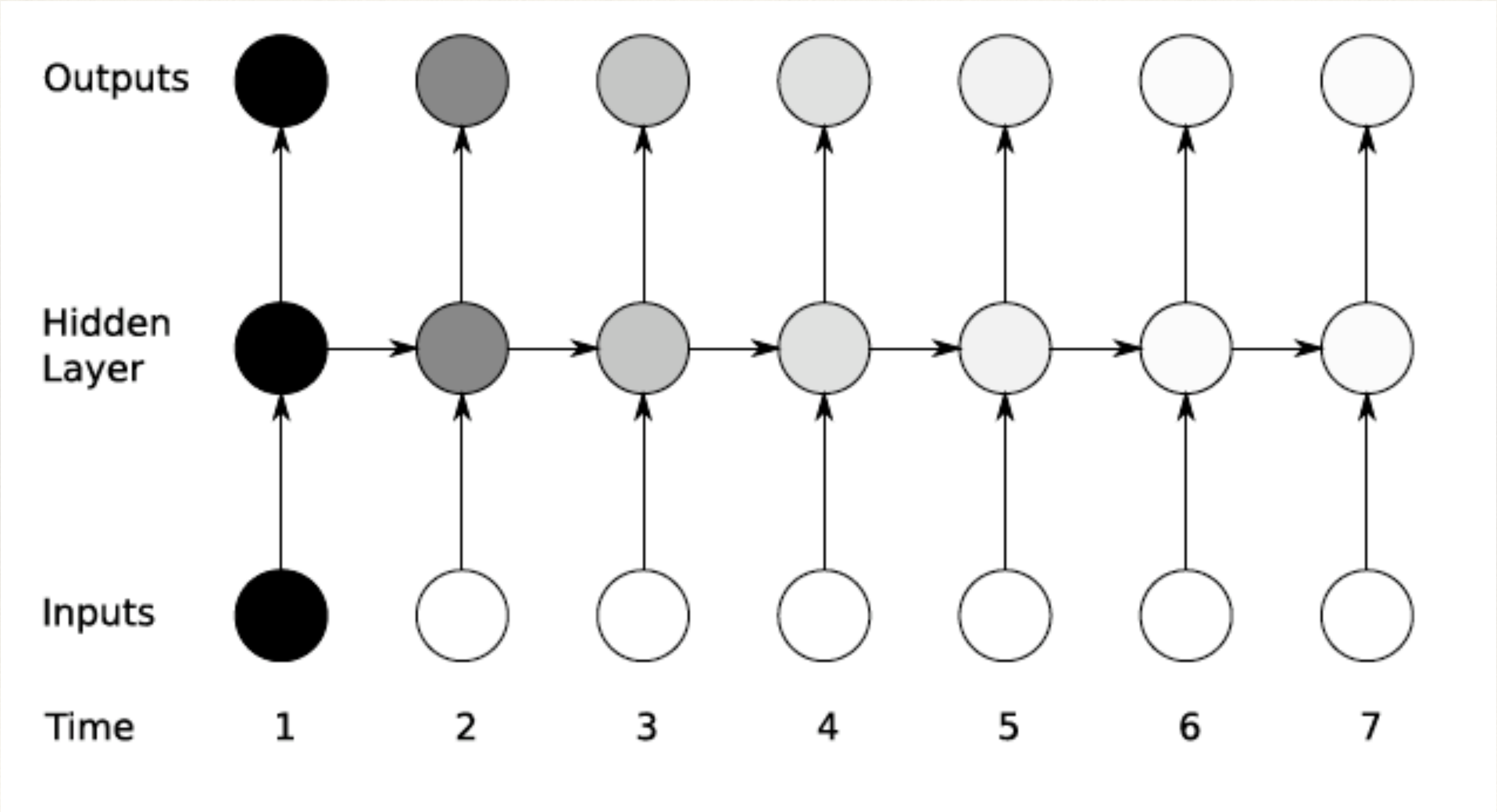
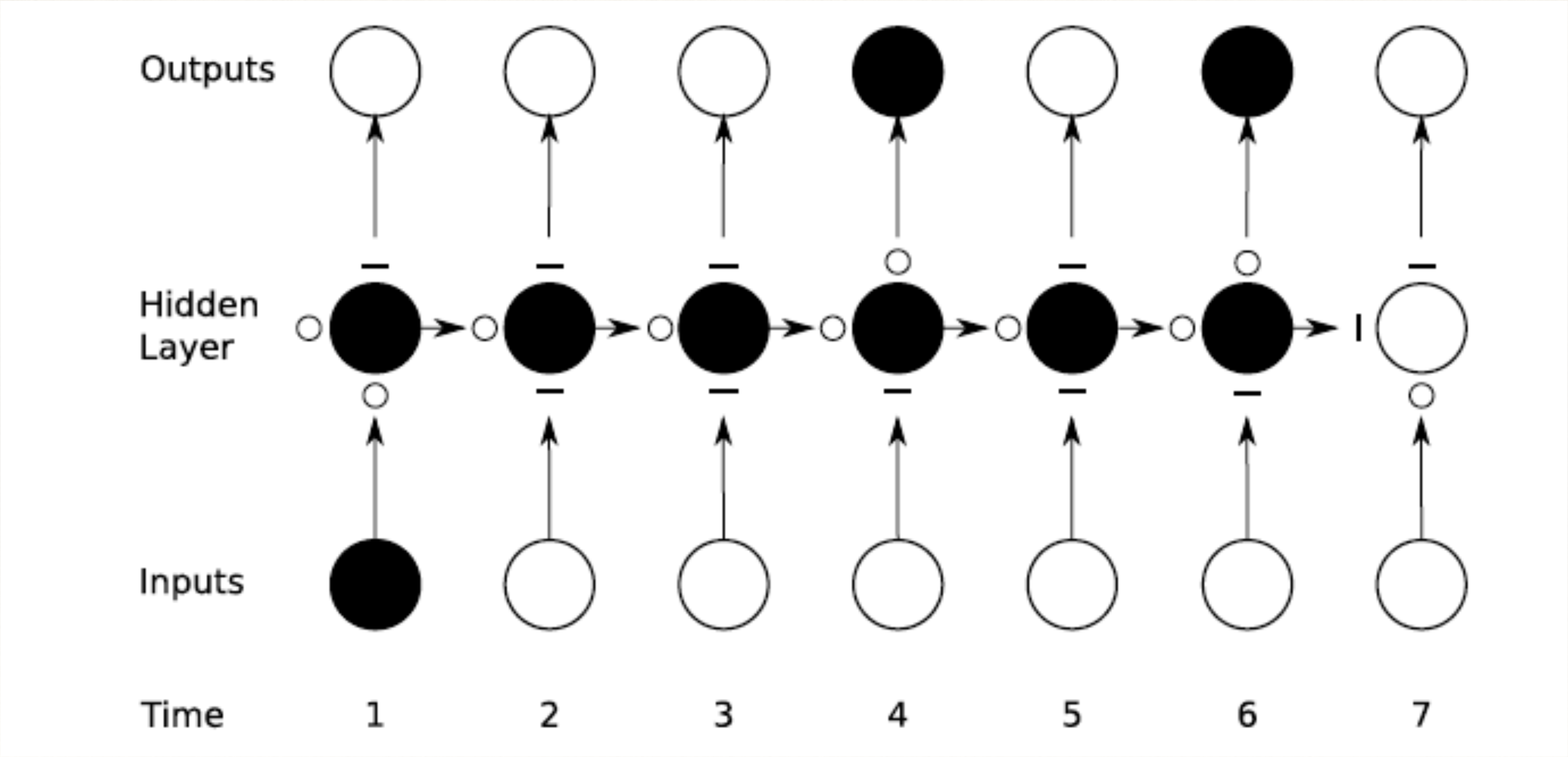
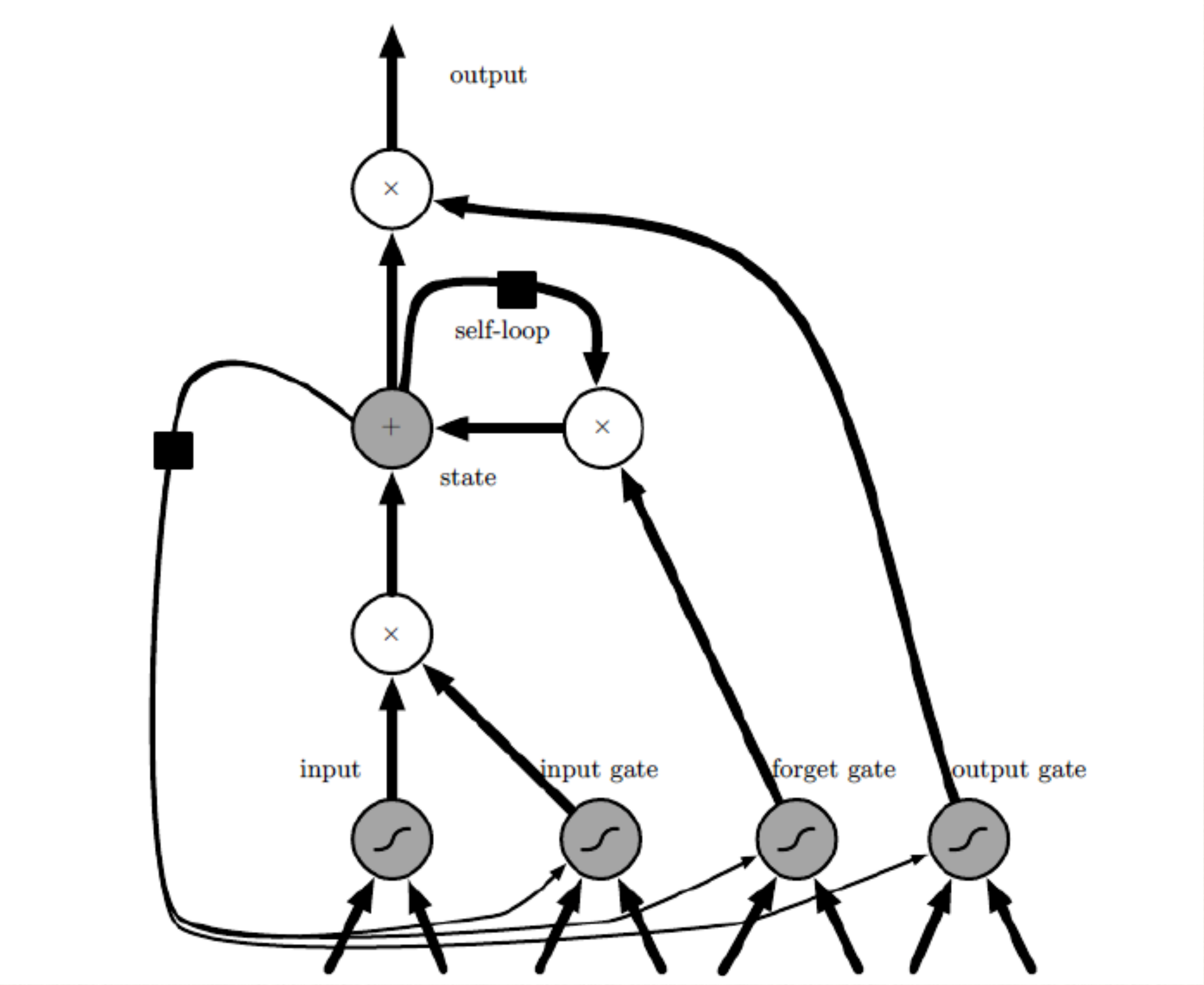
Long-term Dependency Issues



Long-Short Term Memory



Long Short Term Memory Networks



Long Short Term Memory Networks

$$f_i^{(t)} = \sigma\left(b_i^f + \sum_j U_{i,j}^f x_j^{(t)} + \sum_j W_{i,j}^f h_j^{(t-1)}\right)$$

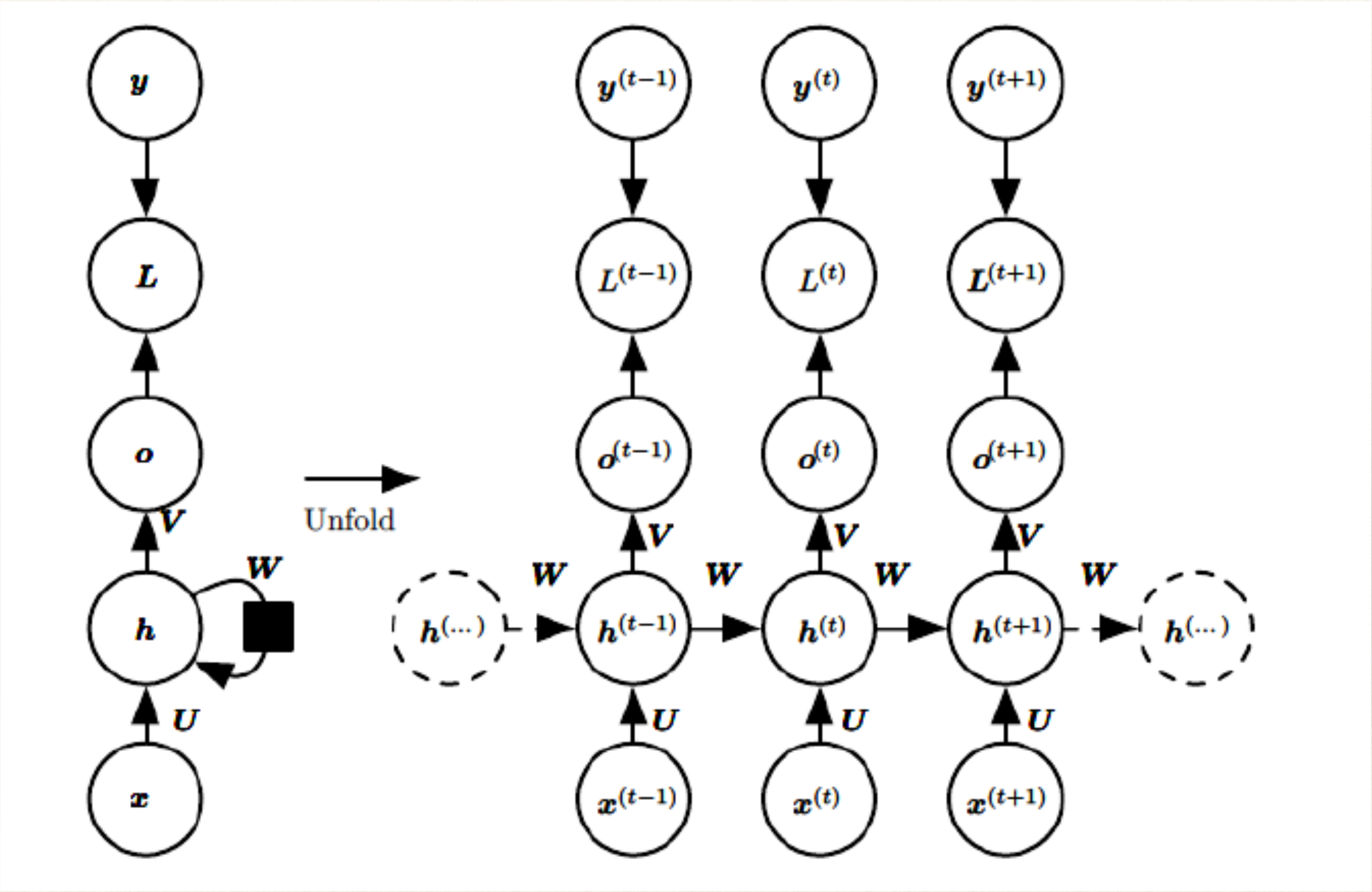
$$s_i^{(t)} = f_i^{(t)} s_i^{(t-1)} + g_i^{(t)} \sigma\left(b_i + \sum_j U_{i,j} x_j^{(t)} + \sum_j W_{i,j} h_j^{(t-1)}\right)$$

$$g_i^{(t)} = \sigma\left(b_i^g + \sum_j U_{i,j}^g x_j^{(t)} + \sum_j W_{i,j}^g h_j^{(t-1)}\right)$$

$$h_i^{(t)} = \tanh\left(s_i^{(t)}\right) q_i^{(t)}$$

$$q_i^{(t)} = \sigma\left(b_i^o + \sum_j U_{i,j}^o x_j^{(t)} + \sum_j W_{i,j}^o h_j^{(t-1)}\right)$$

Standard Recurrent Networks



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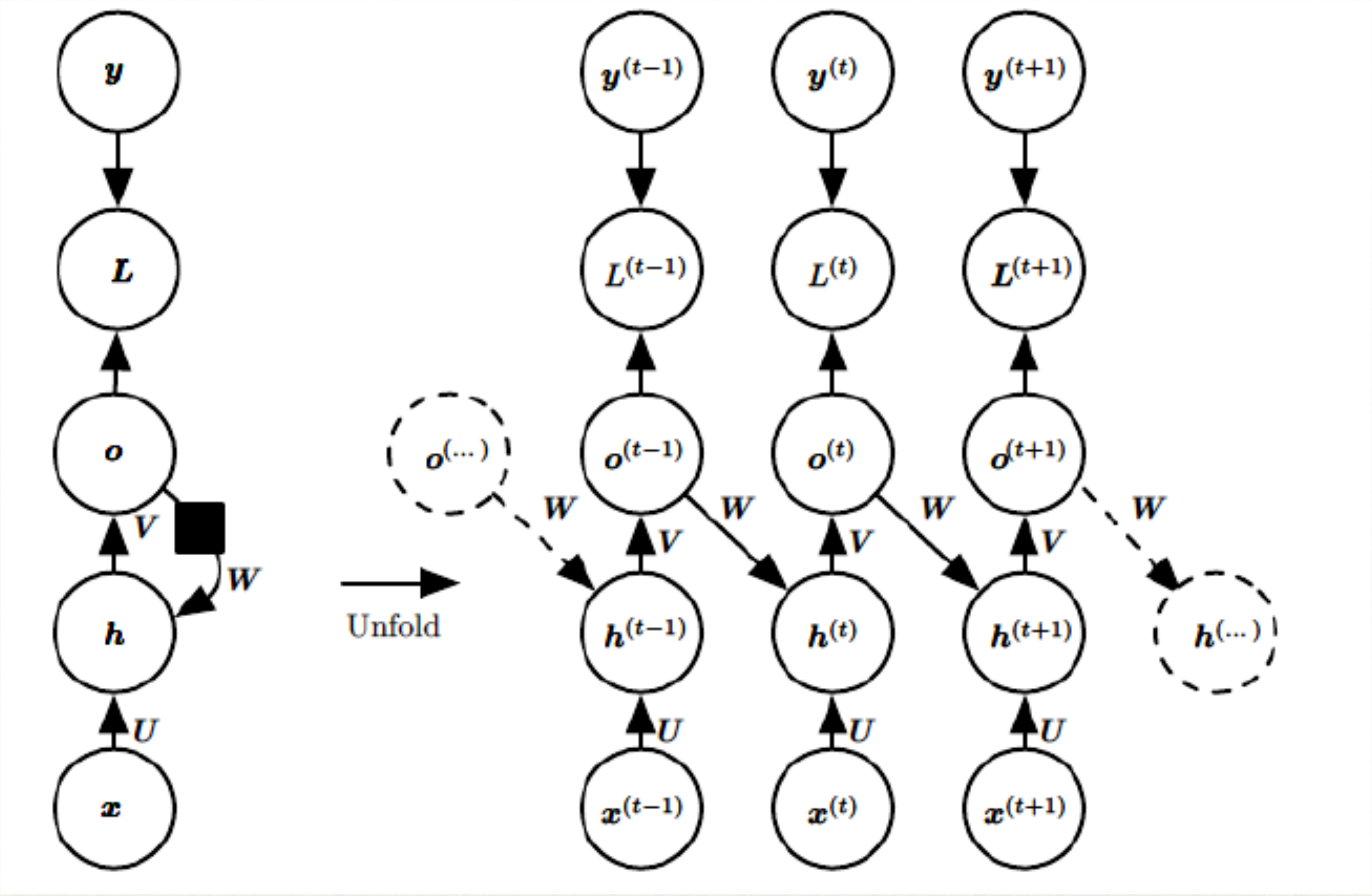
Other Recurrent Networks



Teacher Forcing Networks

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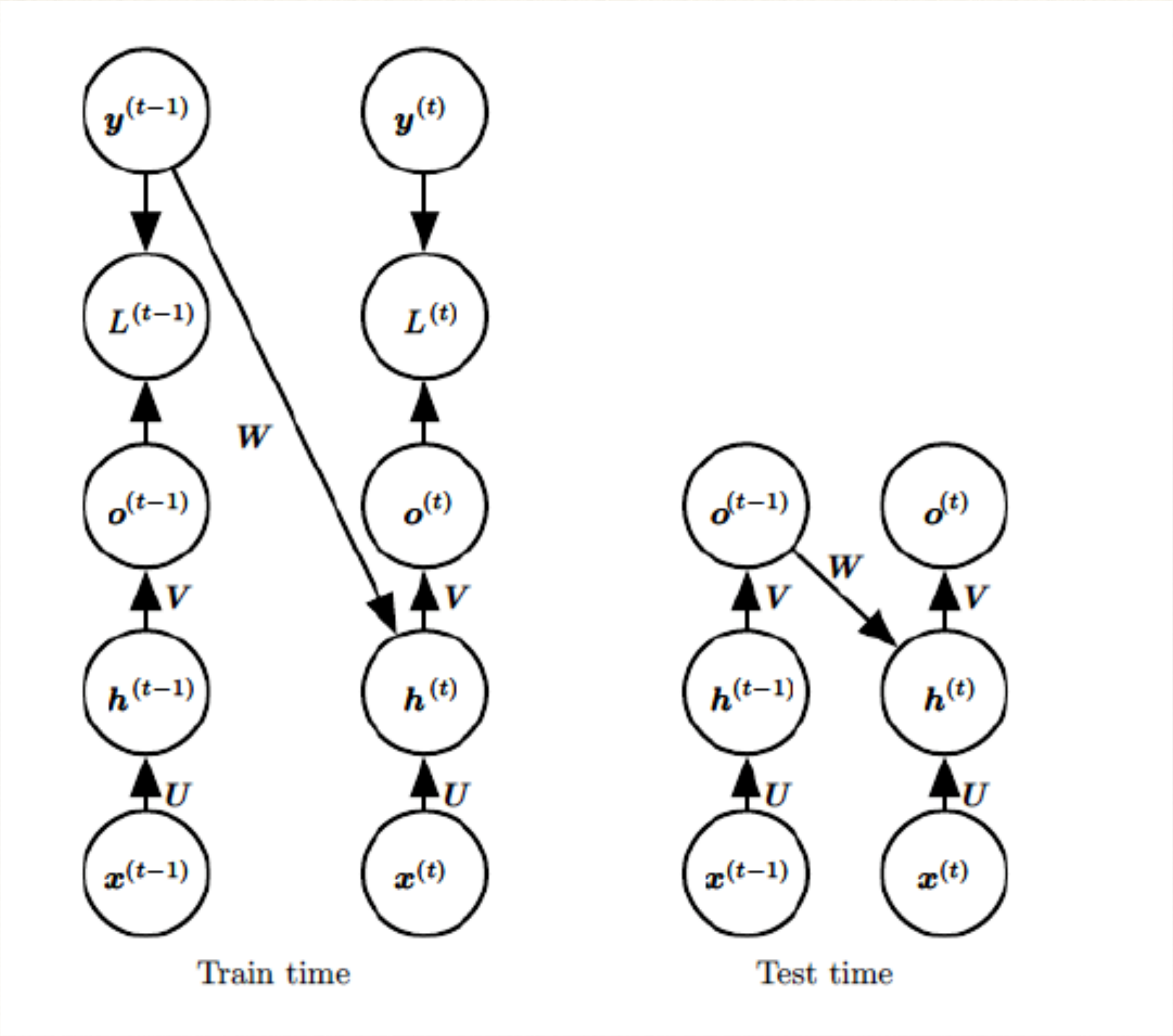
Recurrent Networks



Teacher Forcing Networks

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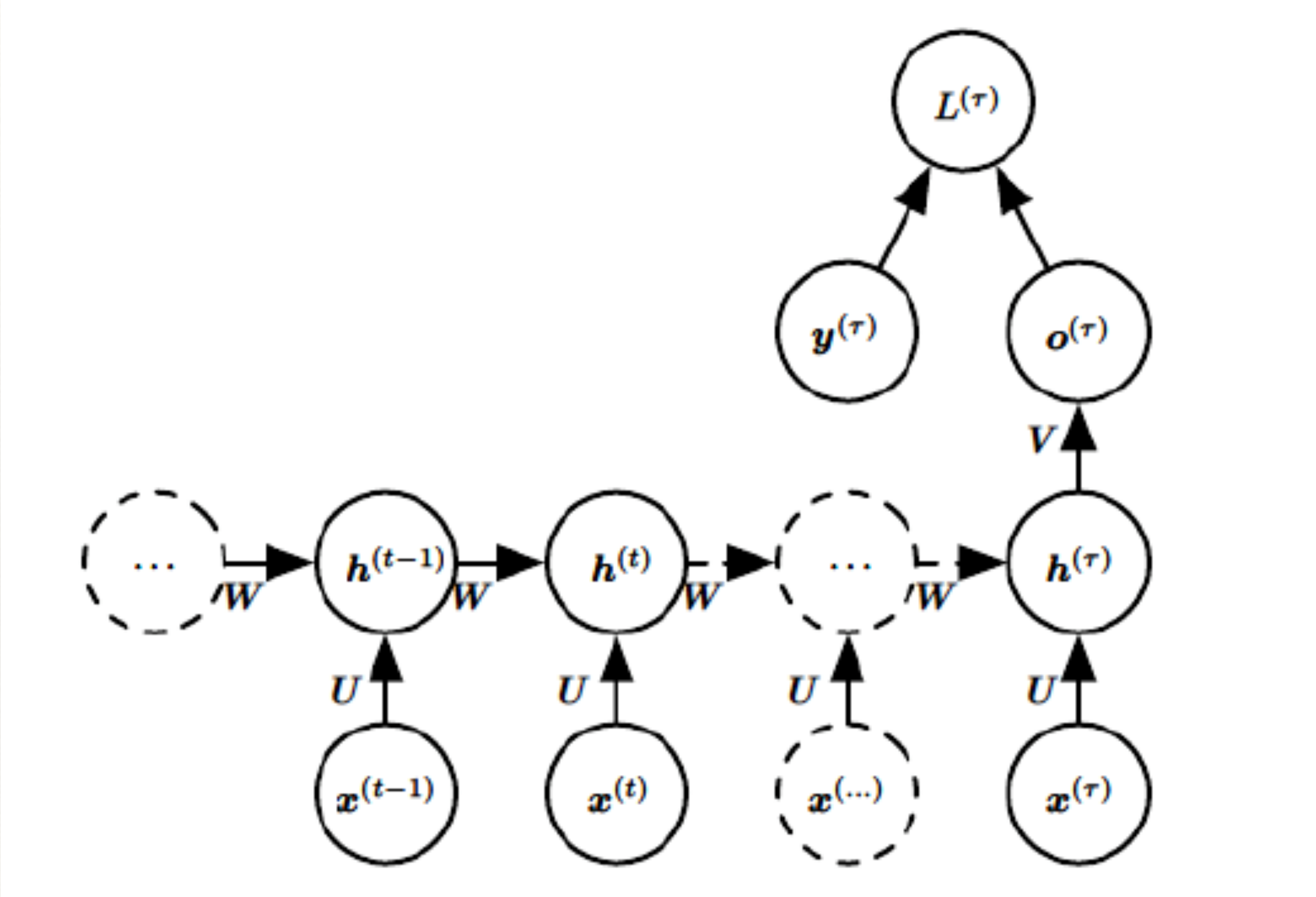
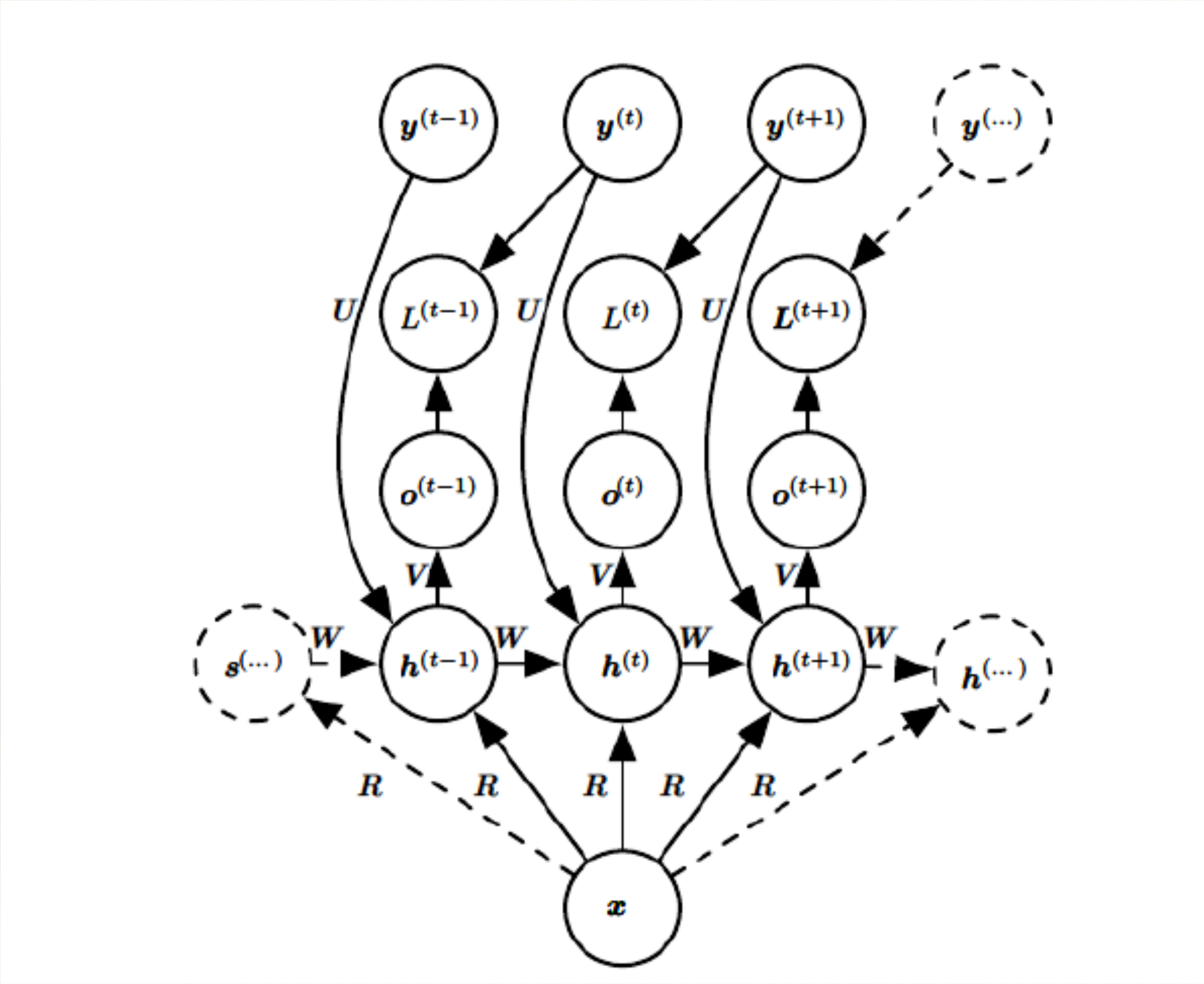
Recurrent Networks



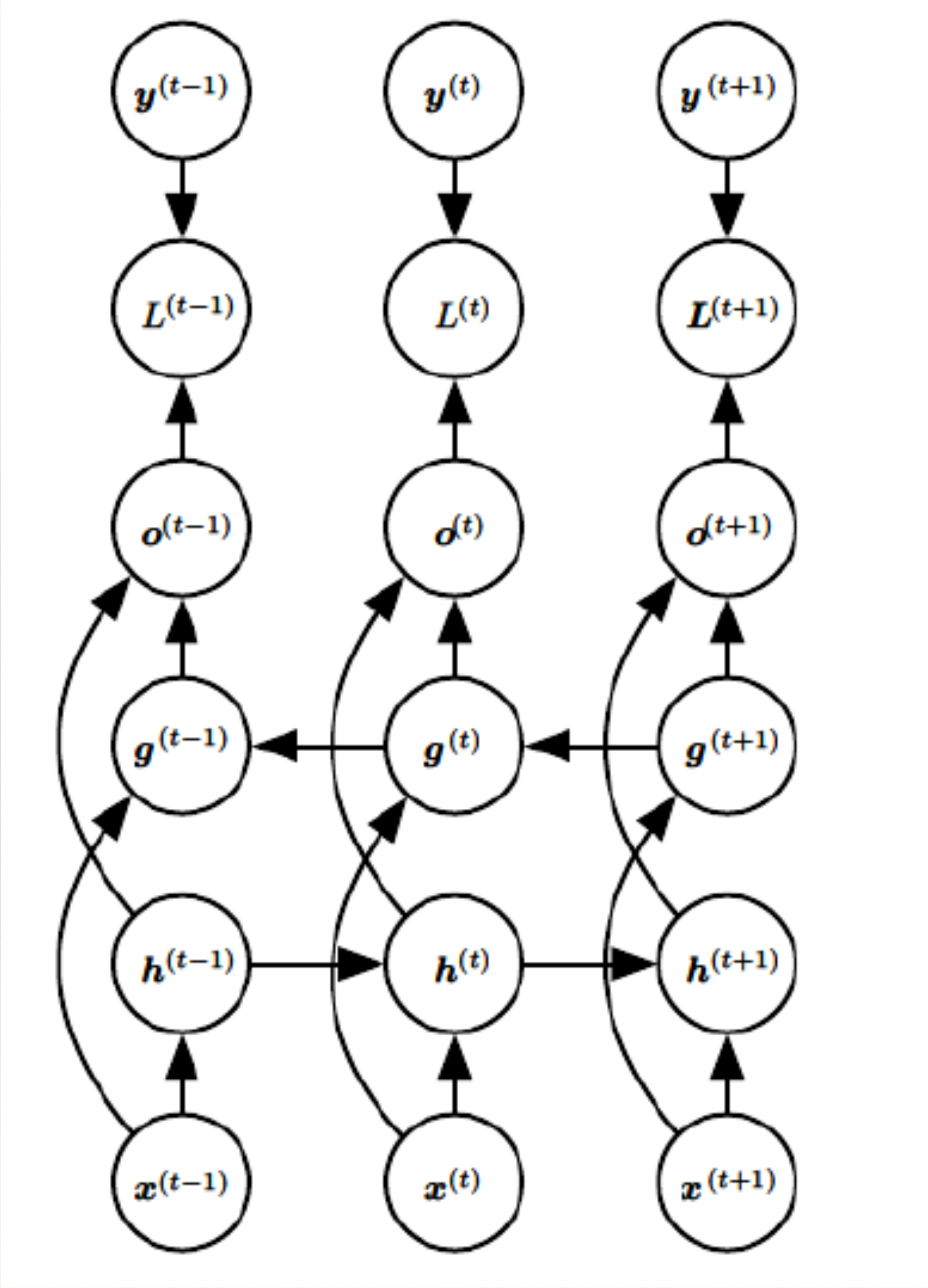
Multiple Input Single Output

Recurrent Networks



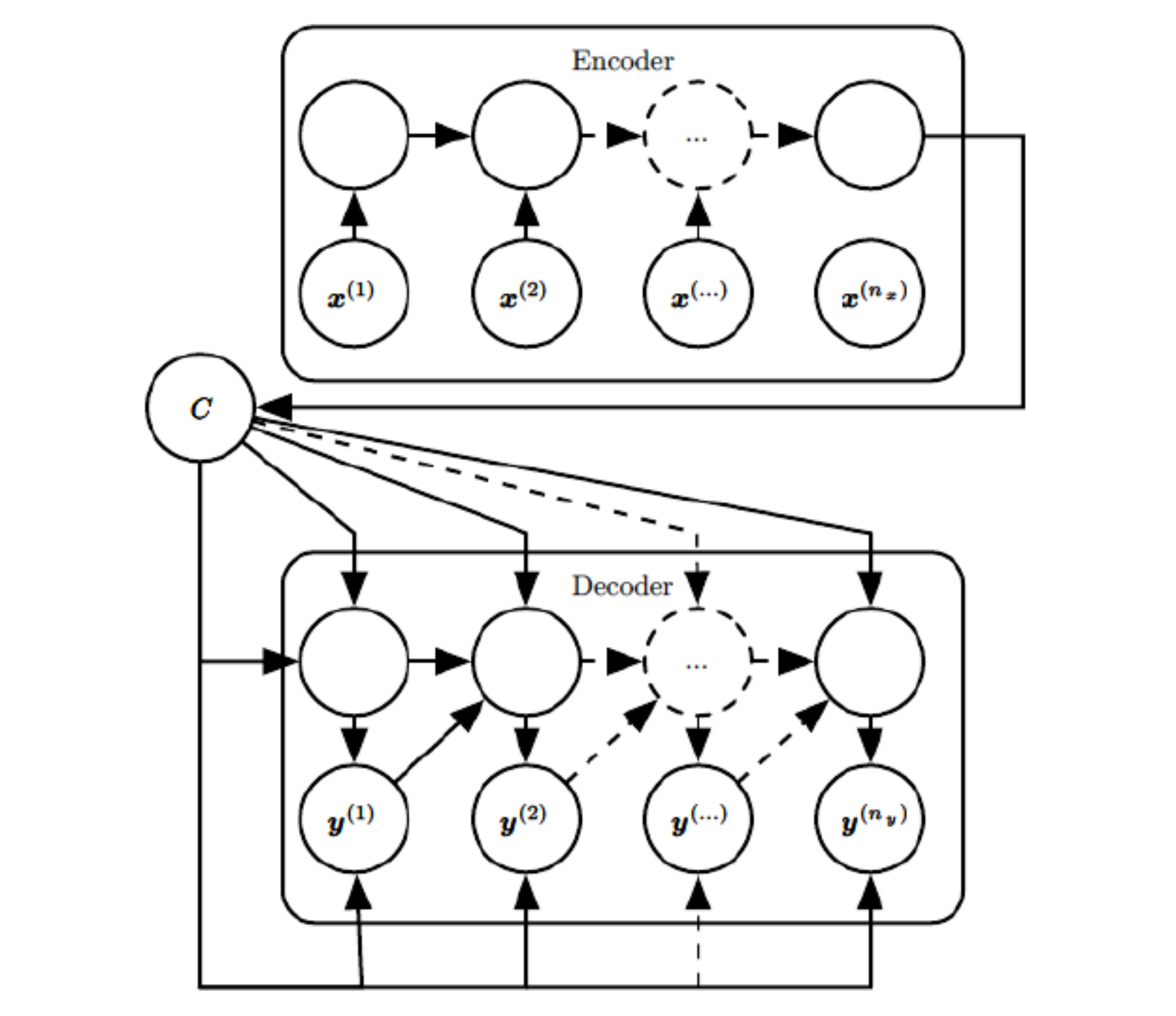
Single Input
Multiple Output

Recurrent Networks



Bi-directional Networks

Recurrent Networks



Sequence to Sequence Mapping Networks