Chapter ML:IX (continued)

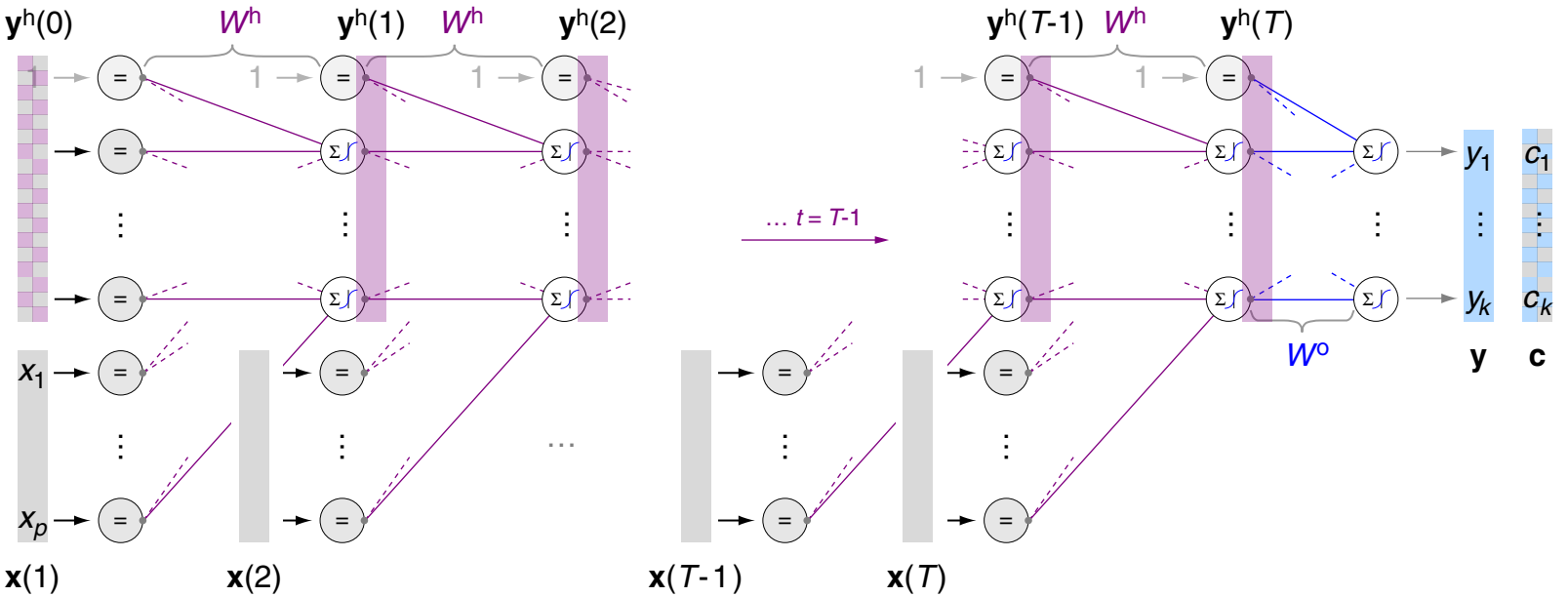
IX. Deep Learning

- Elements of Deep Learning
- Convolutional Neural Networks
- Autoencoder Networks
- Recurrent Neural Networks
- Long-Term Dependencies
- RNNs for Machine Translation
- Attention Mechanism
- Self Attention and Transformers
- Transformer Language Models
- Pretraining

Long-Term Dependencies

Notation II (computational graph)

[notation: color scheme, computational graph, language model]



$\mathbf{x}(t)$ input
in_word

$\mathbf{y}^h(t)$ hidden
$\mathbf{y}^e(t)$ hidden encoder
$\mathbf{y}^d(t)$ hidden decoder

predefined hidden

$\mathbf{y}^a(t)$ attention

$\mathbf{y}(t)$ output
out_word (test)

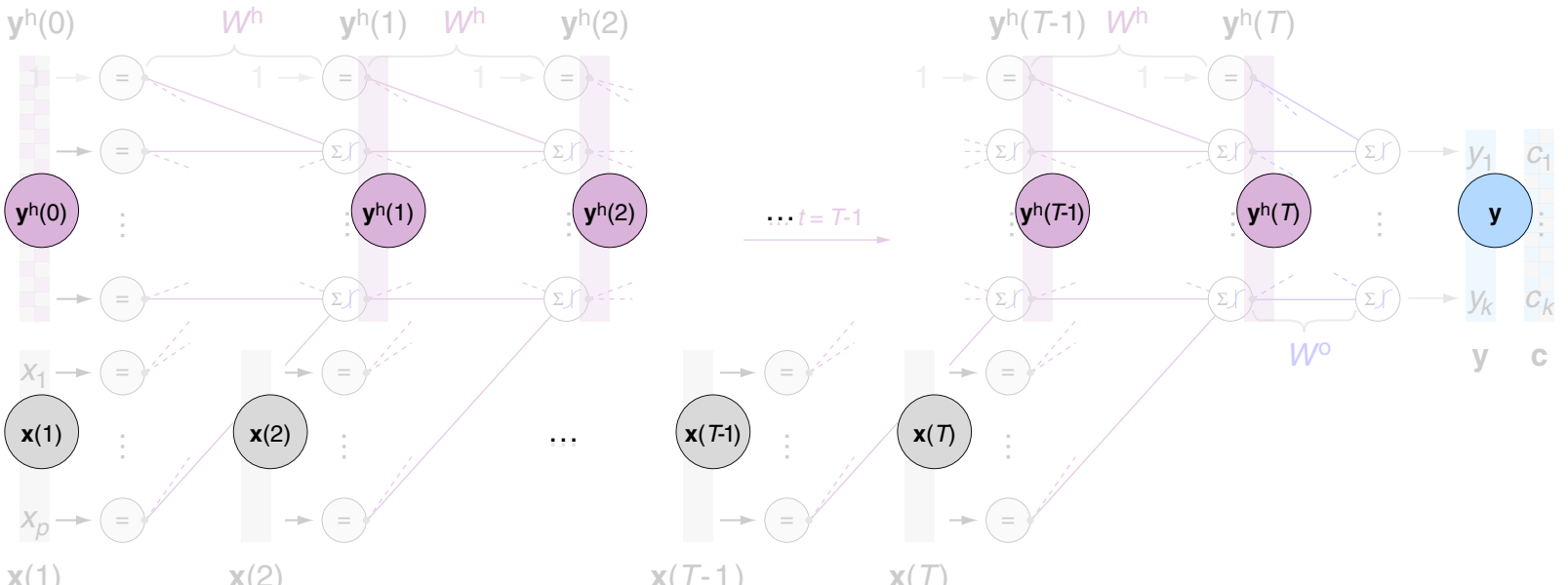
$\mathbf{c}(t)$ target
out_word (training)

$\mathbf{y}(t)$ output or $\mathbf{c}(t)$ target
(depends on training or test phase)

Long-Term Dependencies

Notation II (computational graph)

[notation: color scheme, computational graph, language model]



x(t) input
`in_word`

y^h(t) hidden
y^e(t) hidden encoder
y^d(t) hidden decoder

predefined hidden

y^a(t) attention

y(t) output
`out_word` (test)

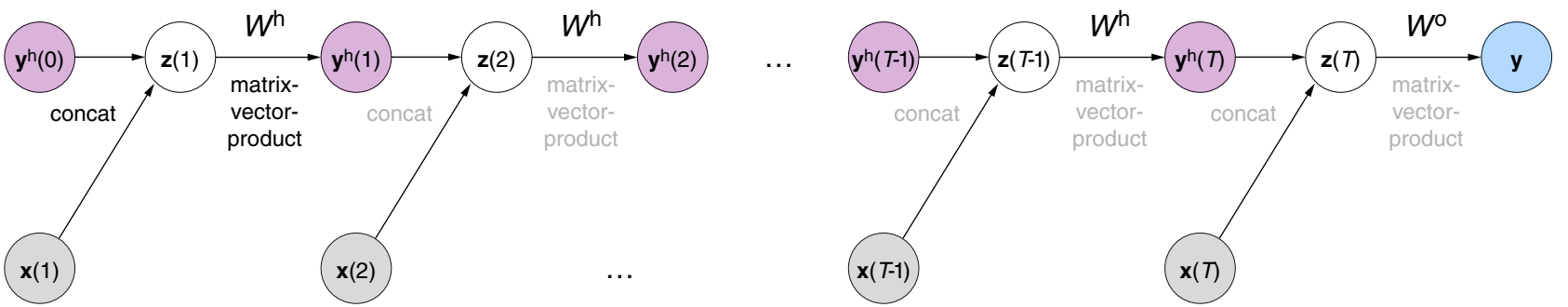
c(t) target
`out_word` (training)

y(t) output or **c**(t) target
(depends on training or test phase)

Long-Term Dependencies

Notation II (computational graph)

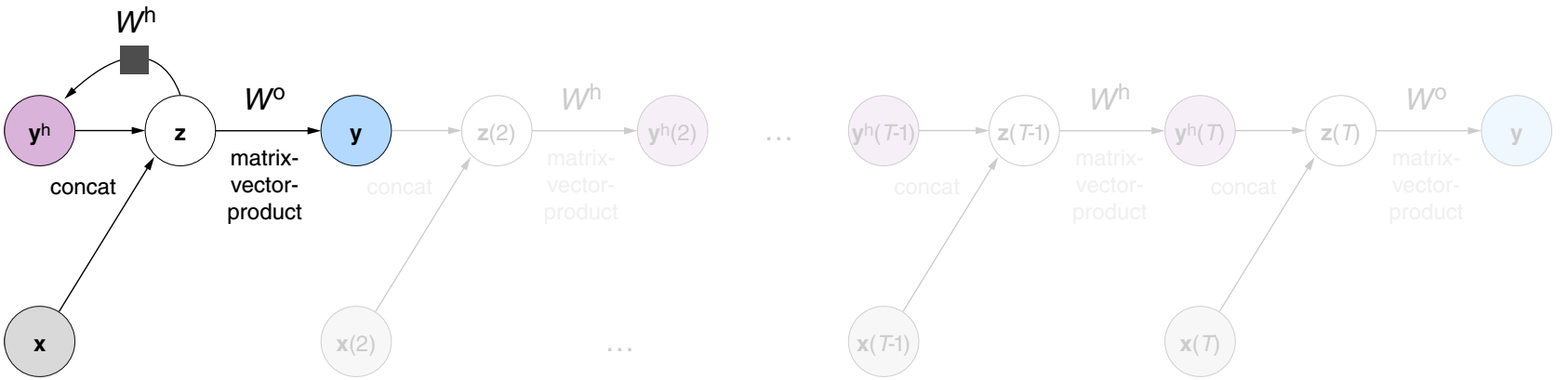
[notation: color scheme, computational graph, language model]



Long-Term Dependencies

Notation II (computational graph)

[notation: color scheme, computational graph, language model]



Remarks (computational graph) :

- The computational graph notation used here follows Goodfellow/Bengio/Courville 2016 :
  1. Each node in the graph indicates a variable. A variable may be a scalar, vector, matrix, tensor, or be of another type.
  2. An operation is a function of one or more variables. An operation returns a single output variable, which does not lose generality because the output variable can have multiple entries, such as a vector.

     If a variable b is computed by applying an operation to a variable a, a directed edge is drawn from a to b.

Long-Term Dependencies

Vanishing Gradient Problem

[*TODO*]

Long-Term Dependencies

RNN with Long Short-Term Memory (LSTM)

[*TODO*]

Remarks:

- LSTM is a recurrent neural network architecture that is very efficient at remembering long term dependencies and that is less vulnerable to the vanishing gradient problem.

Long-Term Dependencies

RNN with Gated Recurrent Units (GRU)

[*TODO*]