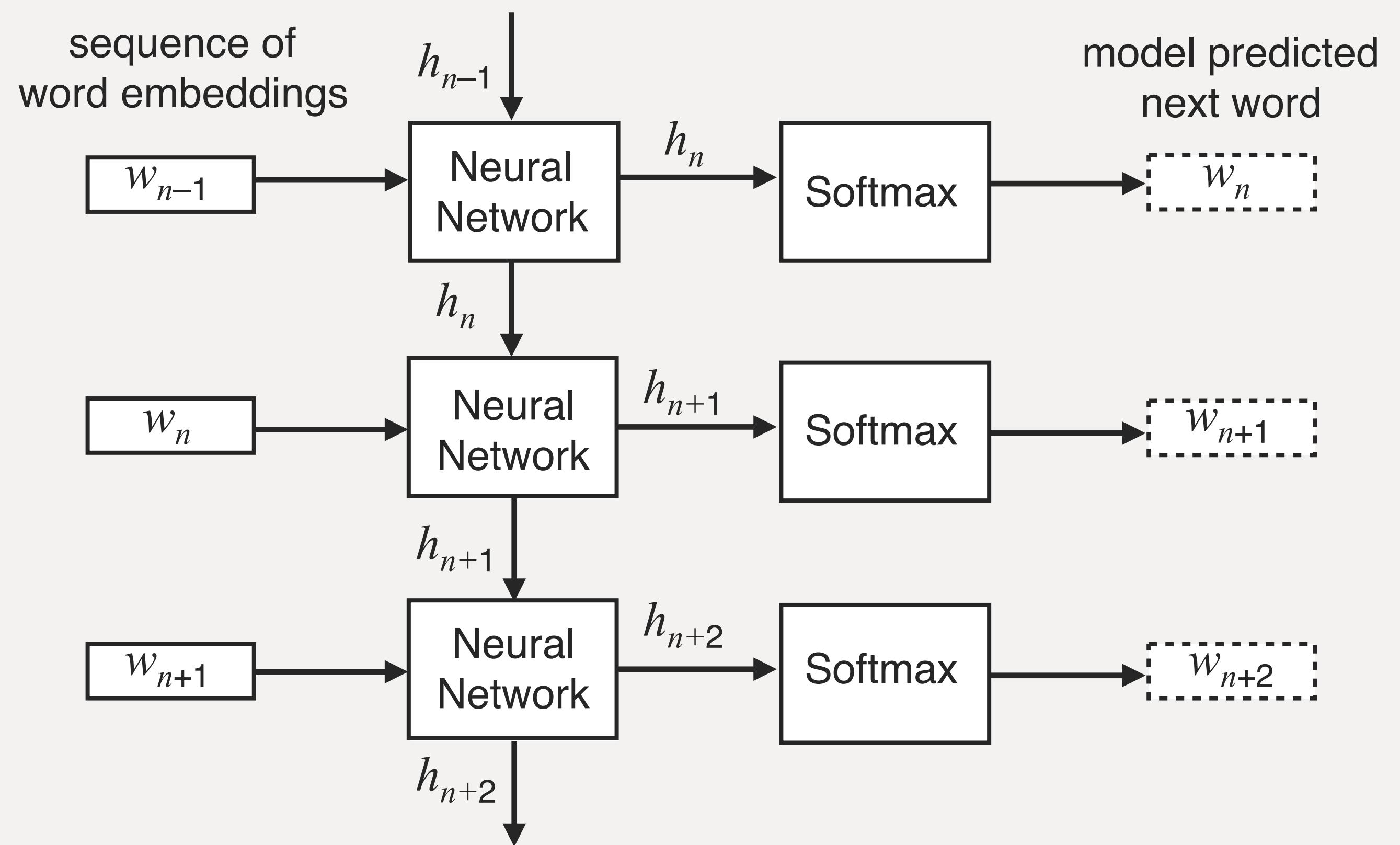
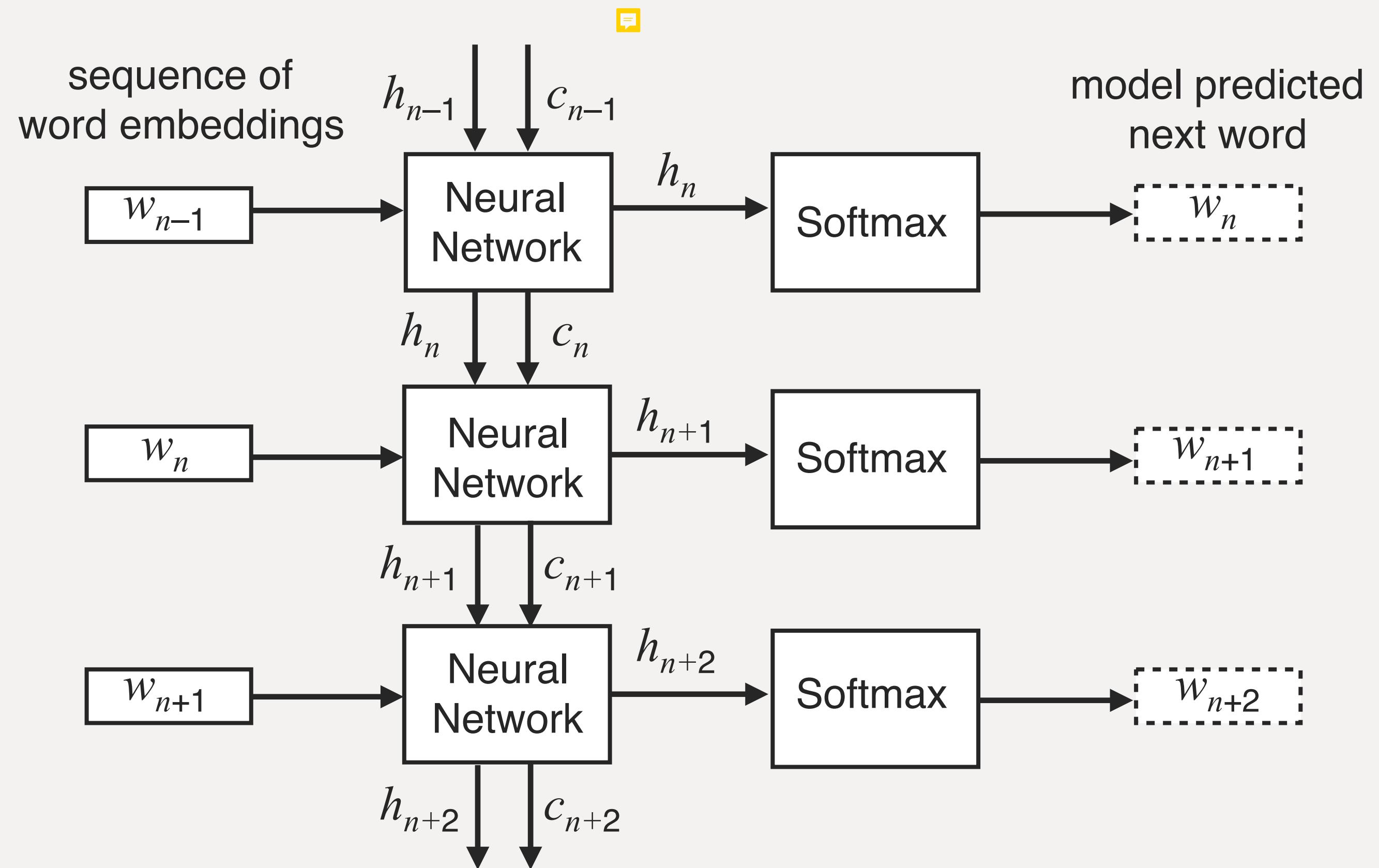
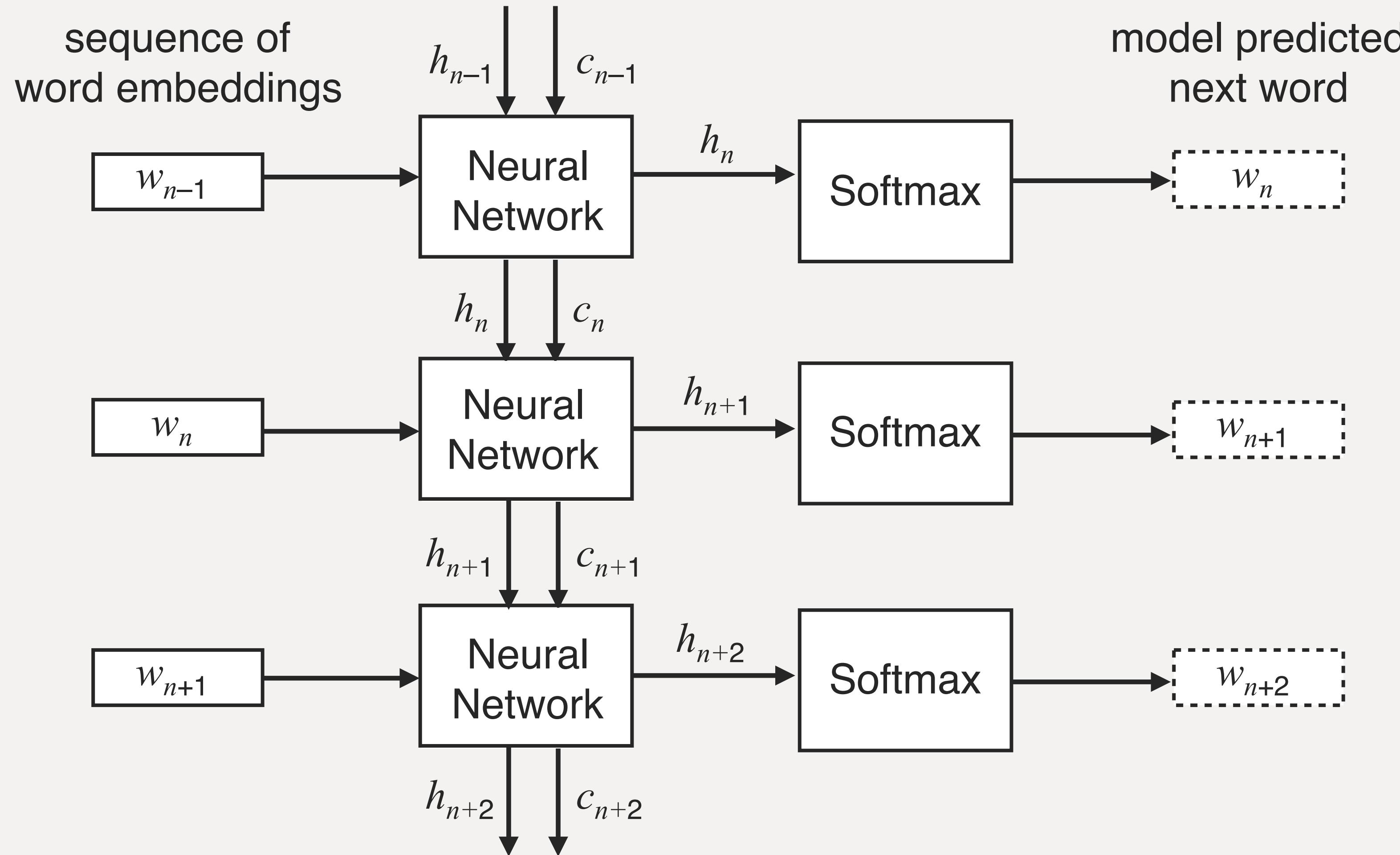


Long Short-Term Memory

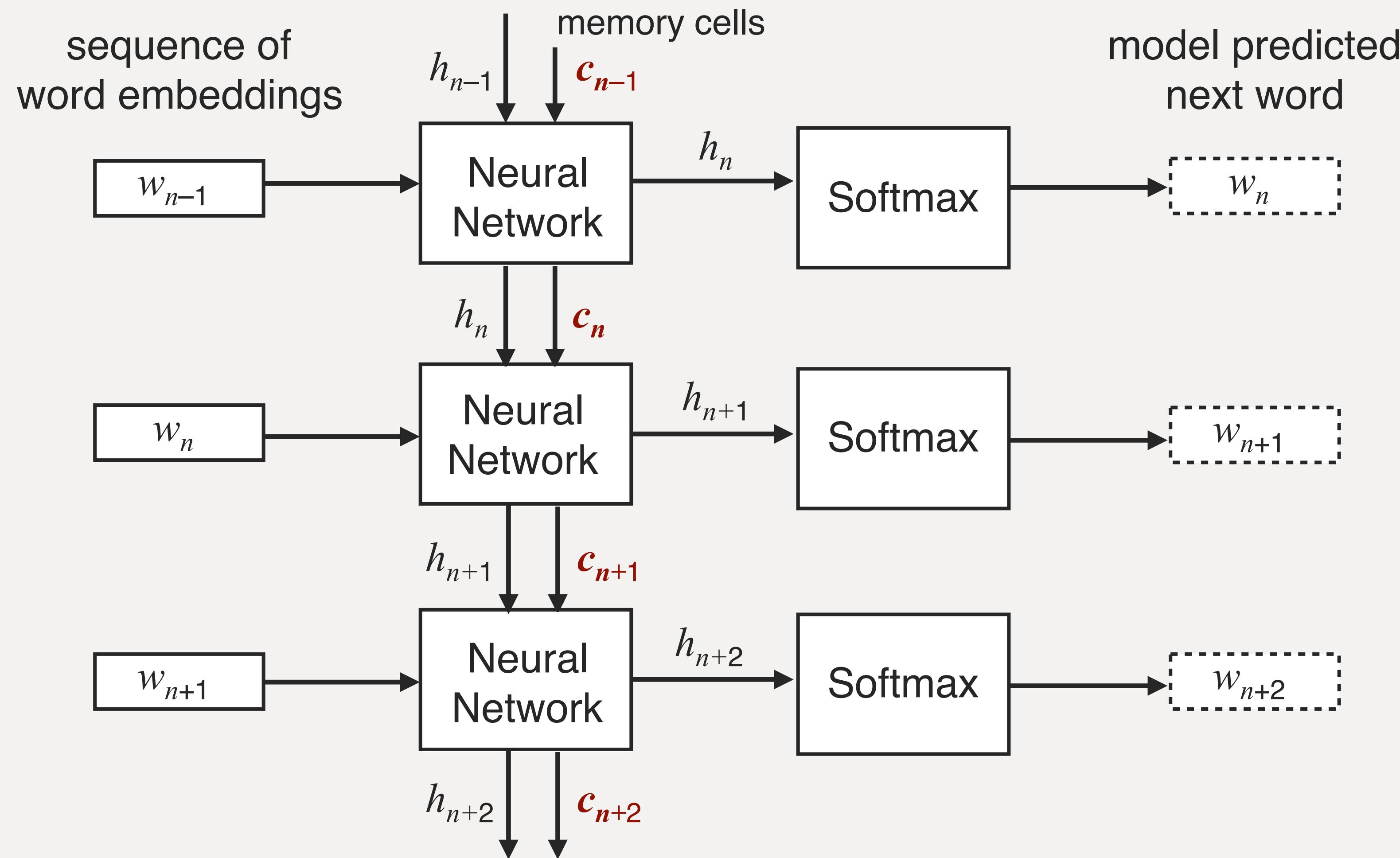




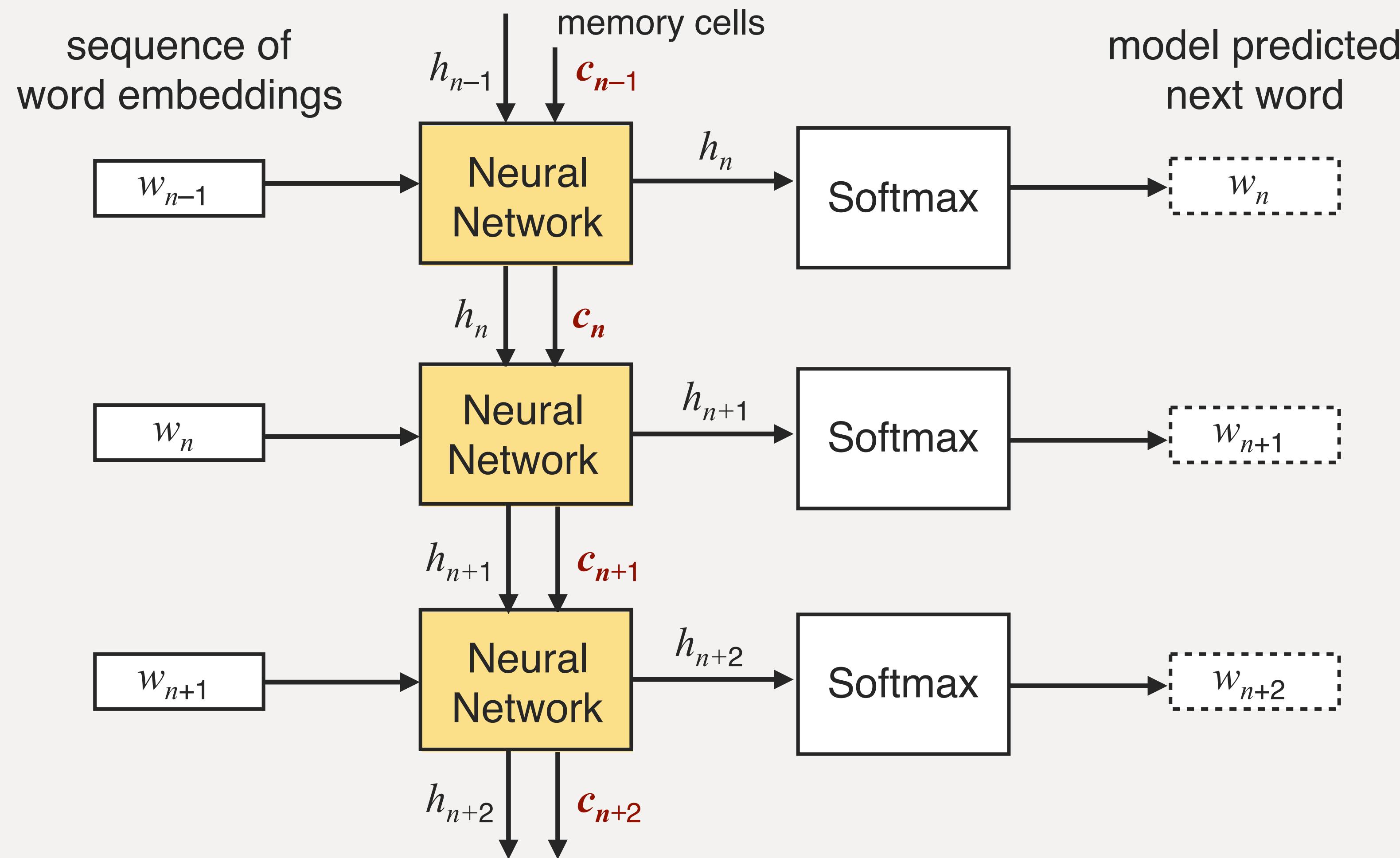
Recurrent Neural Network with Memory Cells and Output



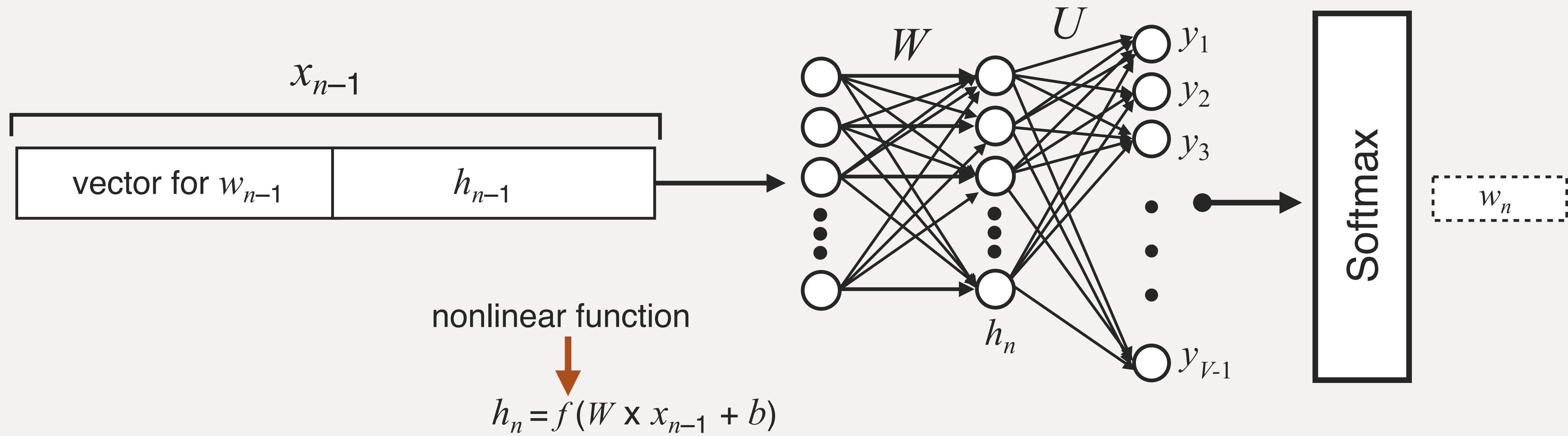
Recurrent Neural Network with Memory Cells and Output



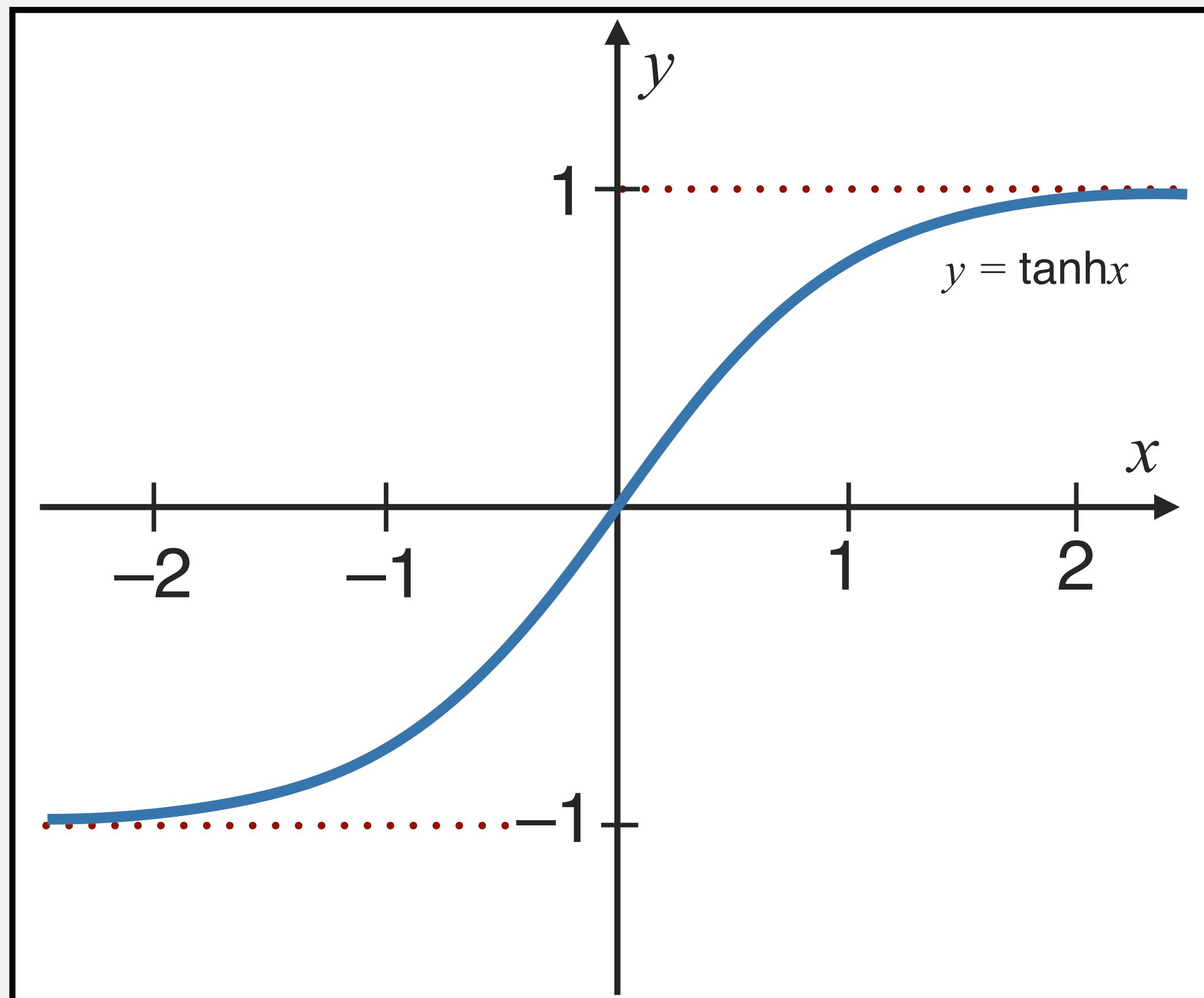
Recurrent Neural Network with Memory Cells and Output



Notation



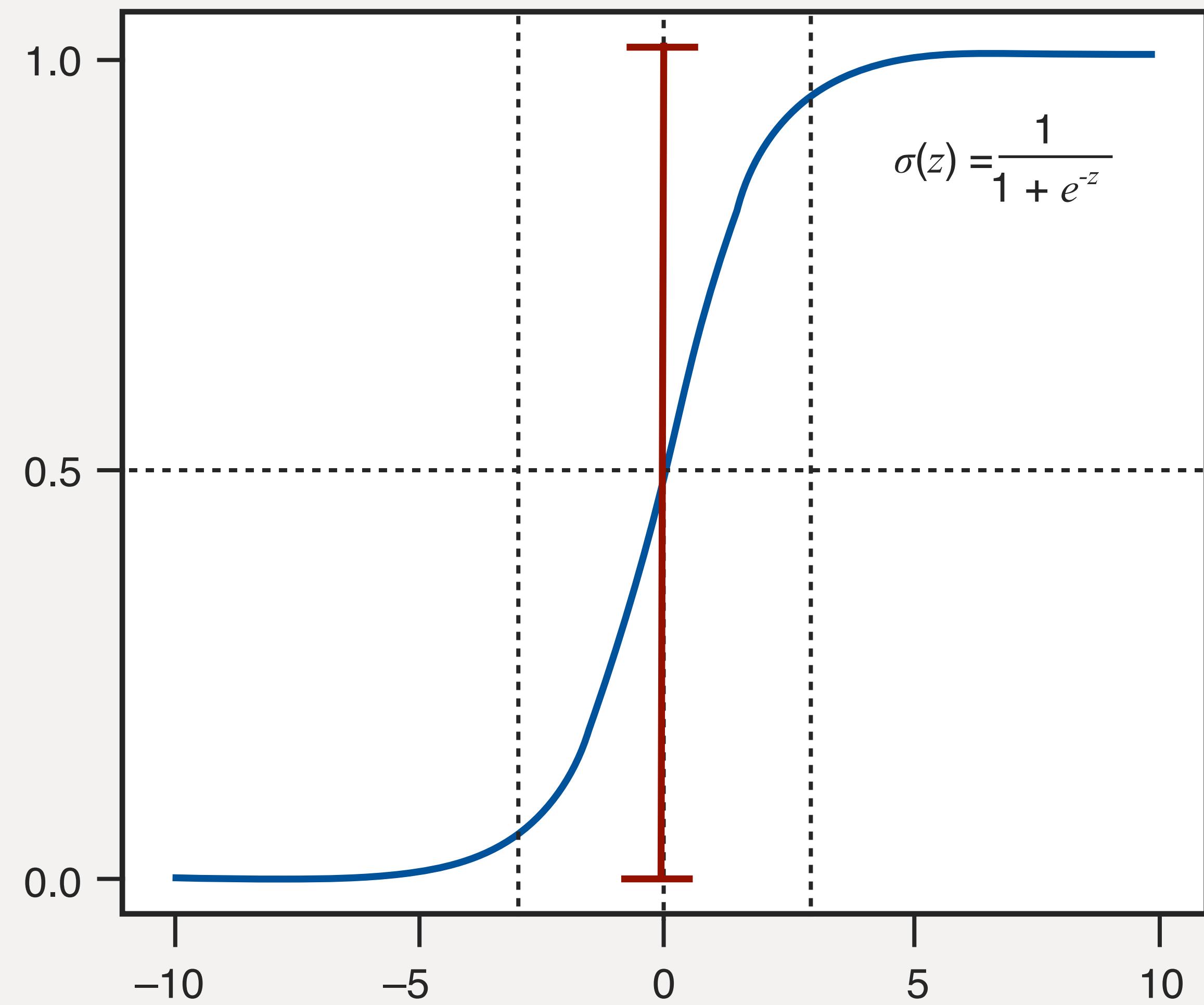
$$h_n = \tanh(W \times x_{n-1} + b)$$



Hyperbolic Tangent

- If input (x) is large and positive output (y) tends to $+1$
- If input (x) is negative and large output (y) tends to -1

$$h_n = \sigma(W \mathbf{x} x_{n-1} + b)$$

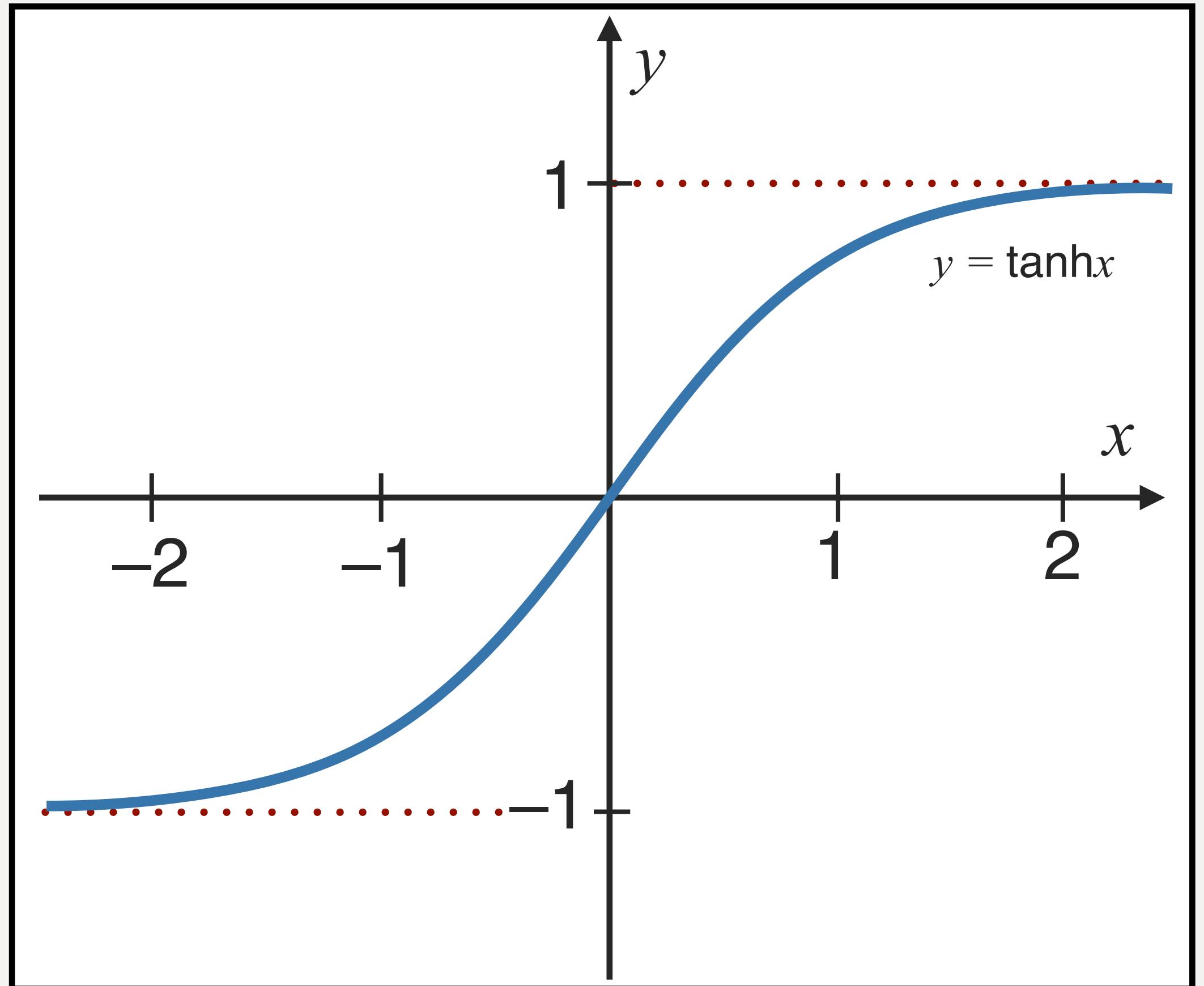


Sigmoid Function

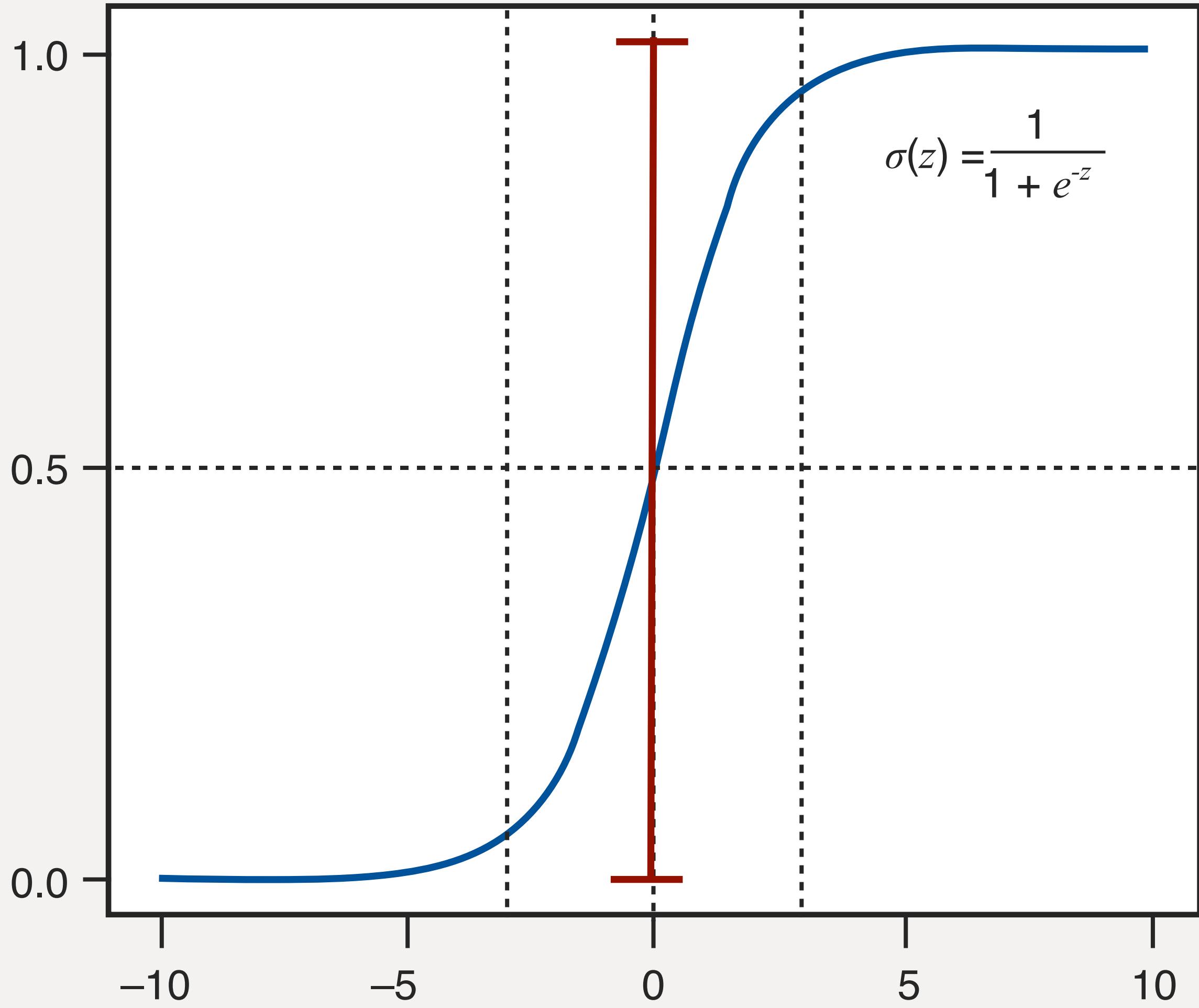
- If input is large and positive output tends towards 1
- If input is negative and large output tends towards 0



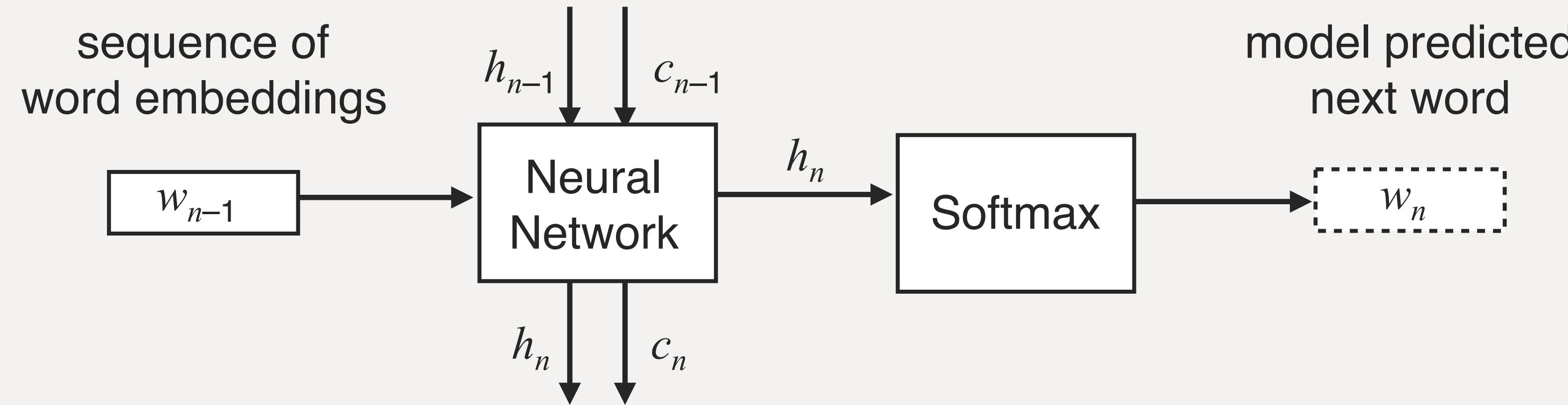
$$h_n = \tanh(W \mathbf{x} x_{n-1} + b)$$



$$h_n = \sigma(W \mathbf{x} x_{n-1} + b)$$



Recurrent Neural Network



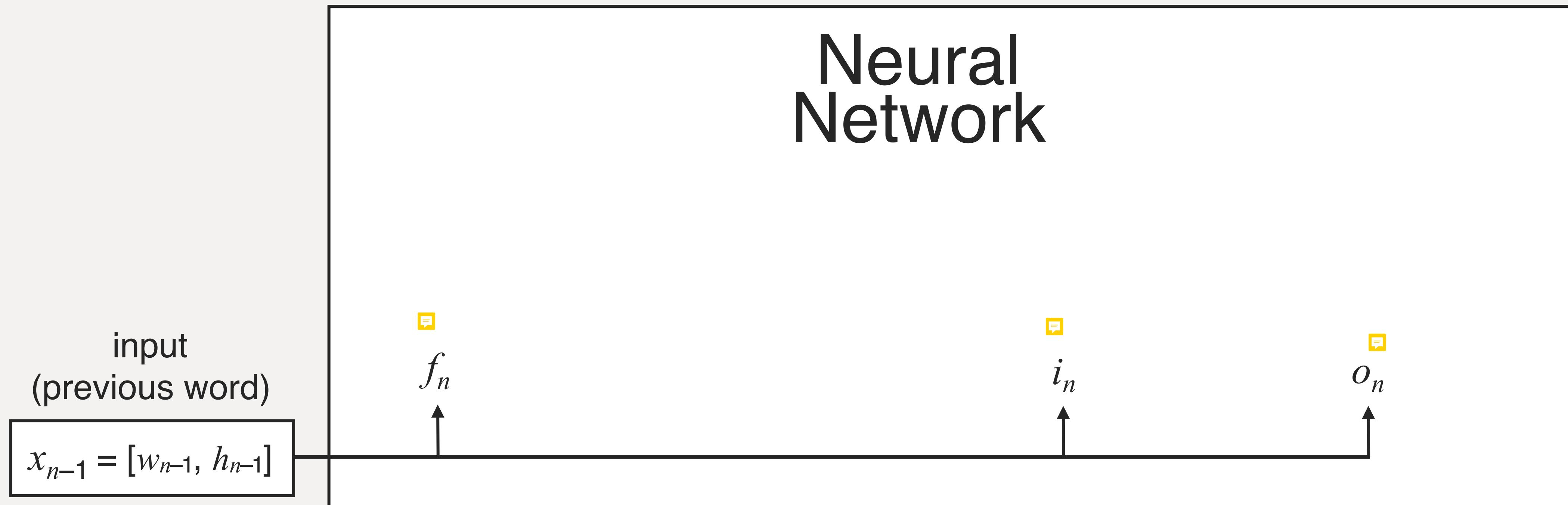
Inside the Recurrent Neural Network

Neural
Network

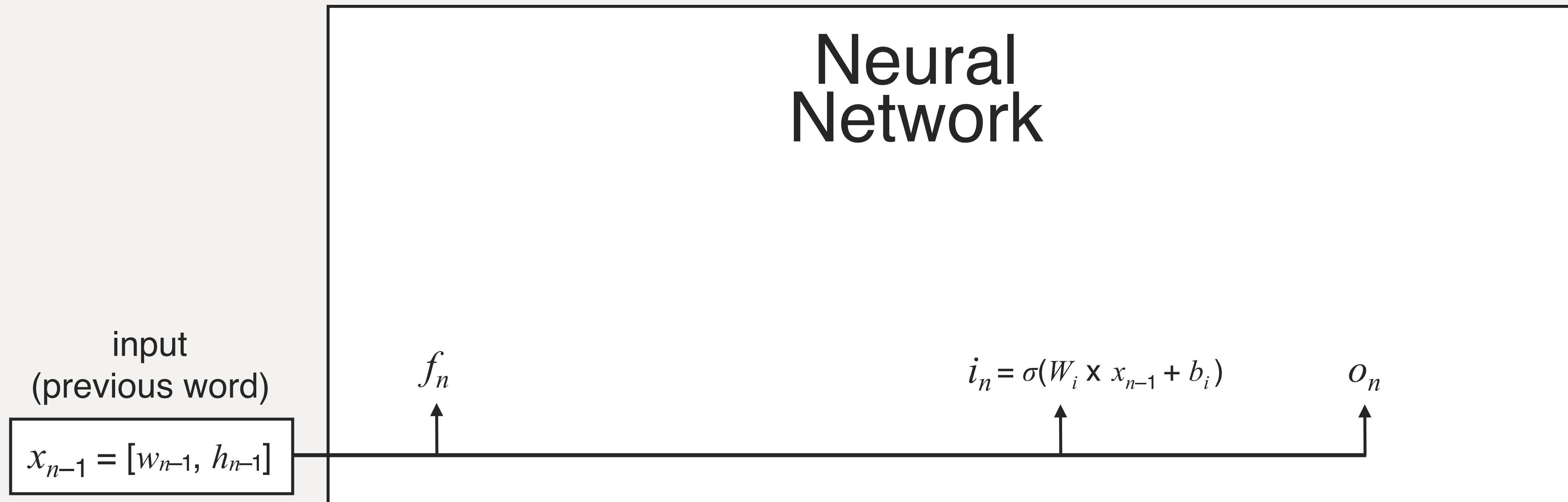
input
(previous word)

$$x_{n-1} = [w_{n-1}, h_{n-1}]$$

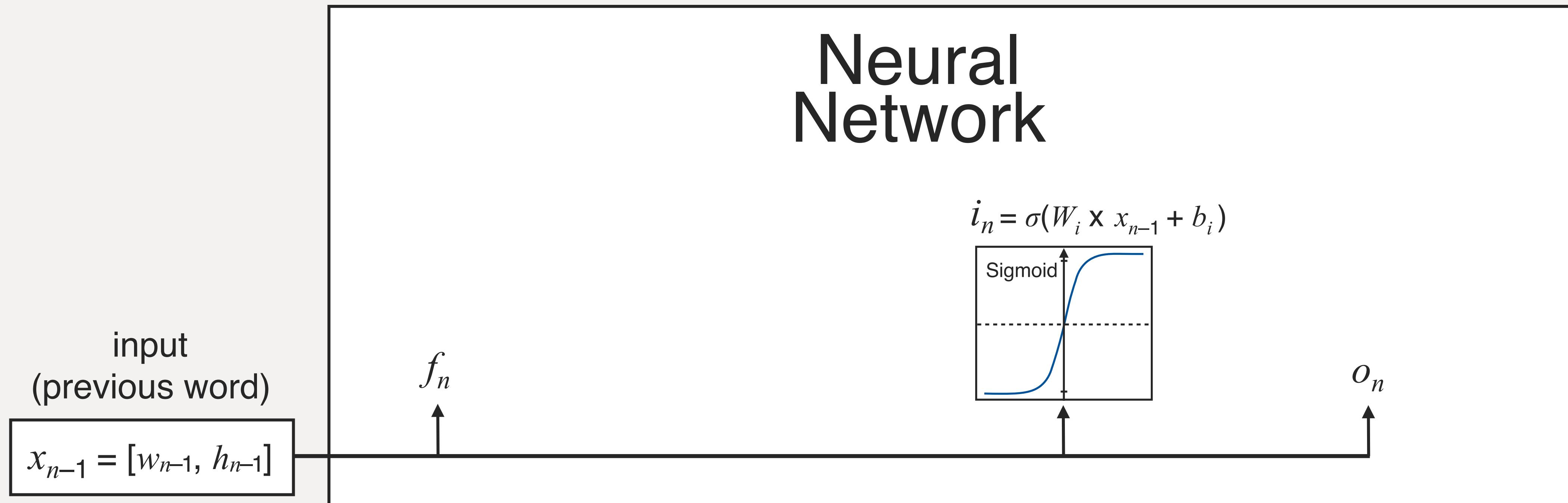
Inside the Recurrent Neural Network



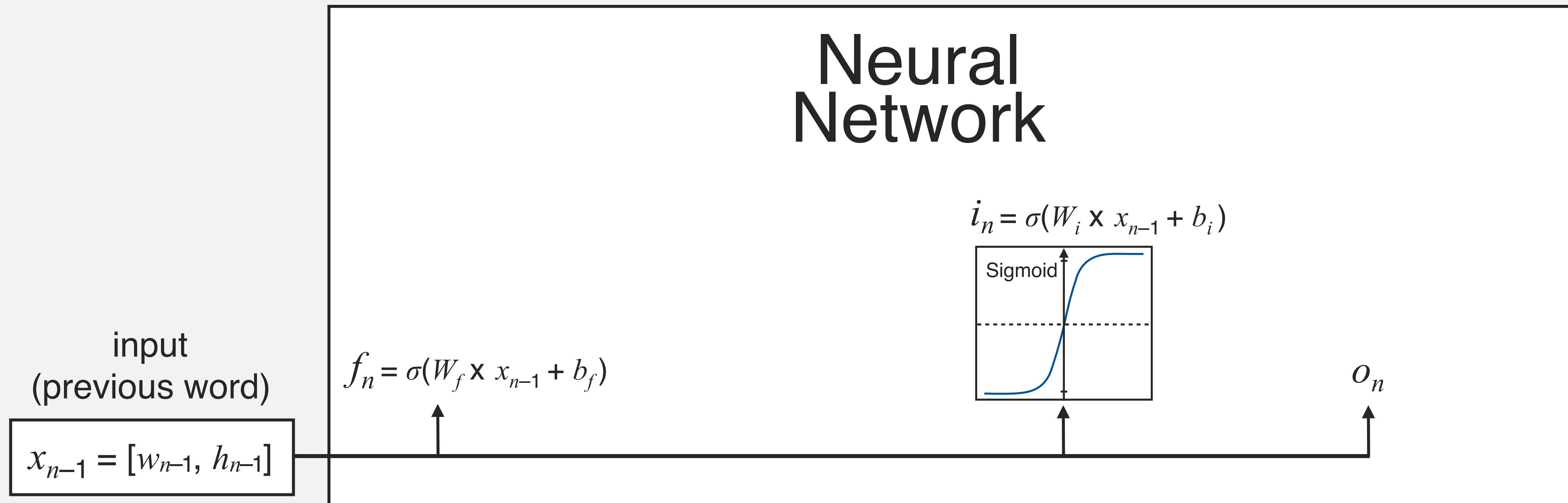
Inside the Recurrent Neural Network



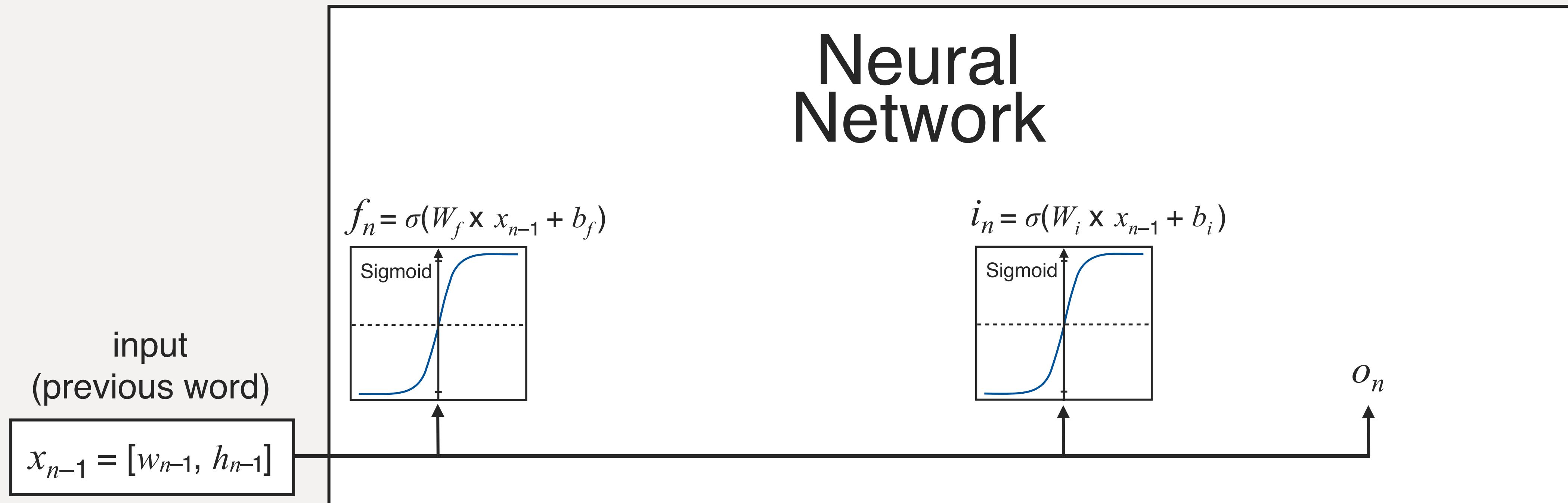
Inside the Recurrent Neural Network



Inside the Recurrent Neural Network



Inside the Recurrent Neural Network

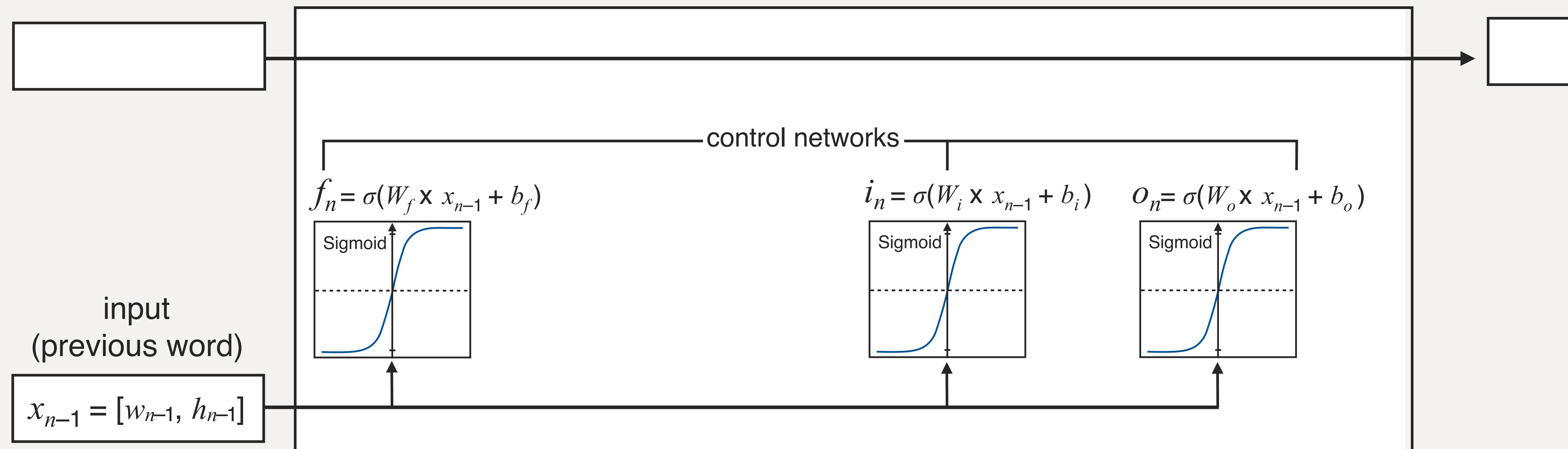


Inside the Recurrent Neural Network

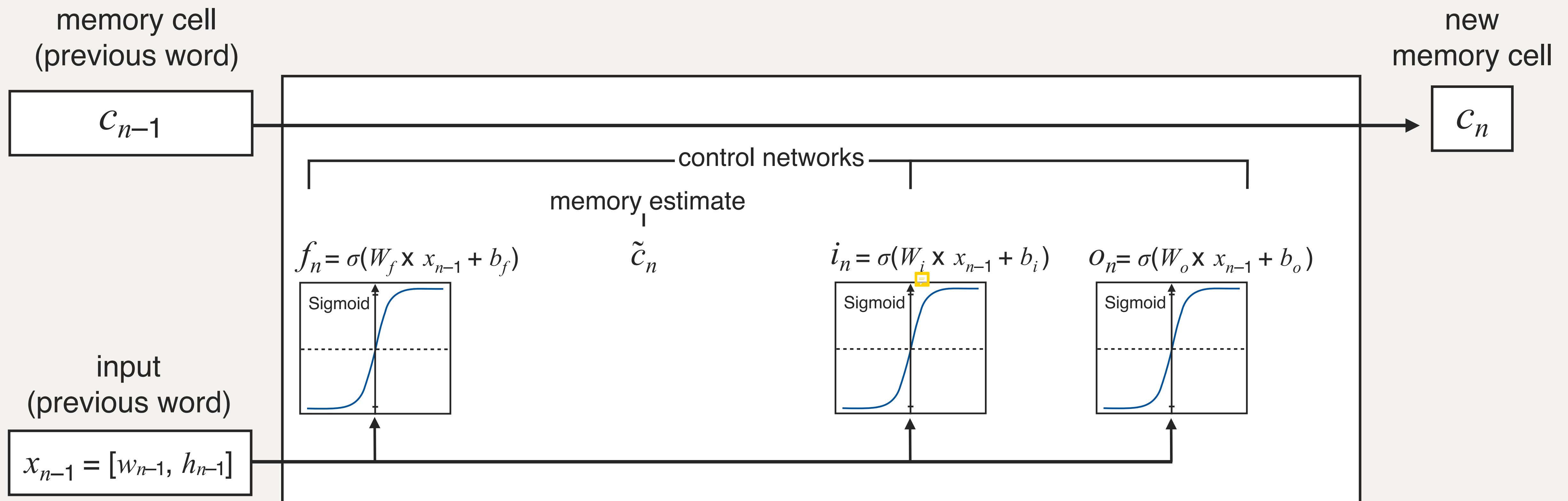
Neural Network



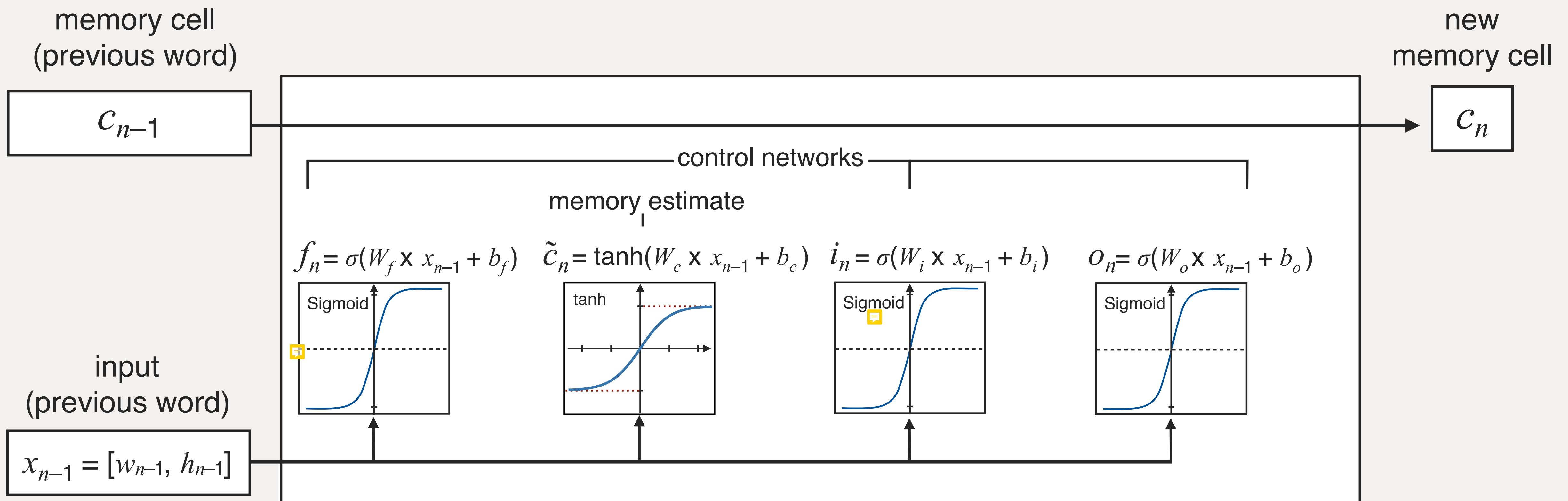
Inside the Recurrent Neural Network



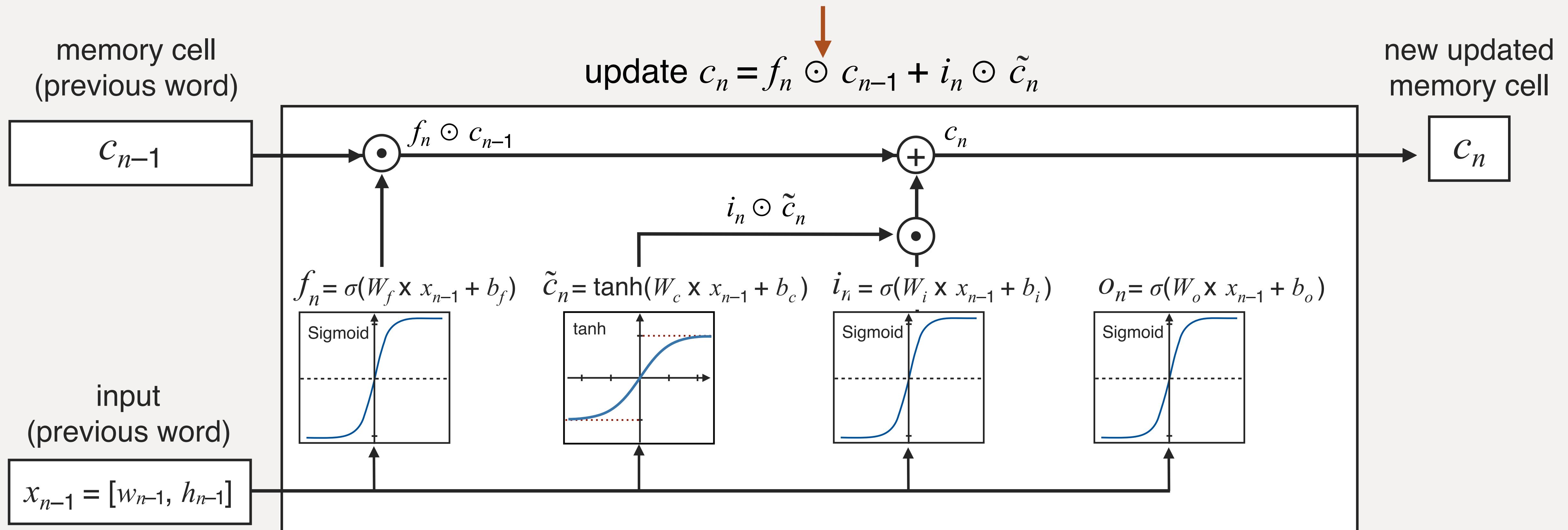
Long Short-Term Memory



Long Short-Term Memory



Long Short-Term Memory



Understanding the Update

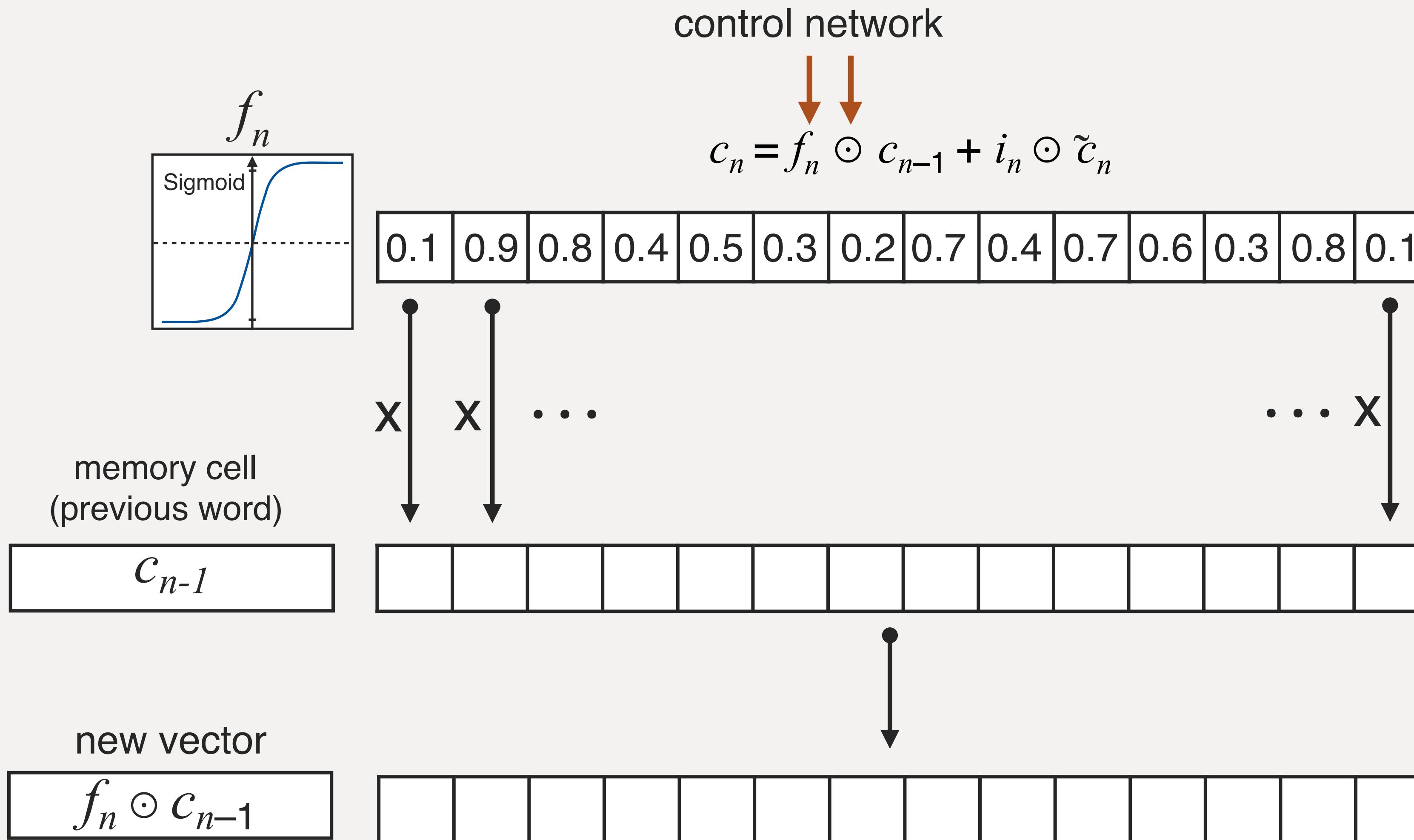
control network



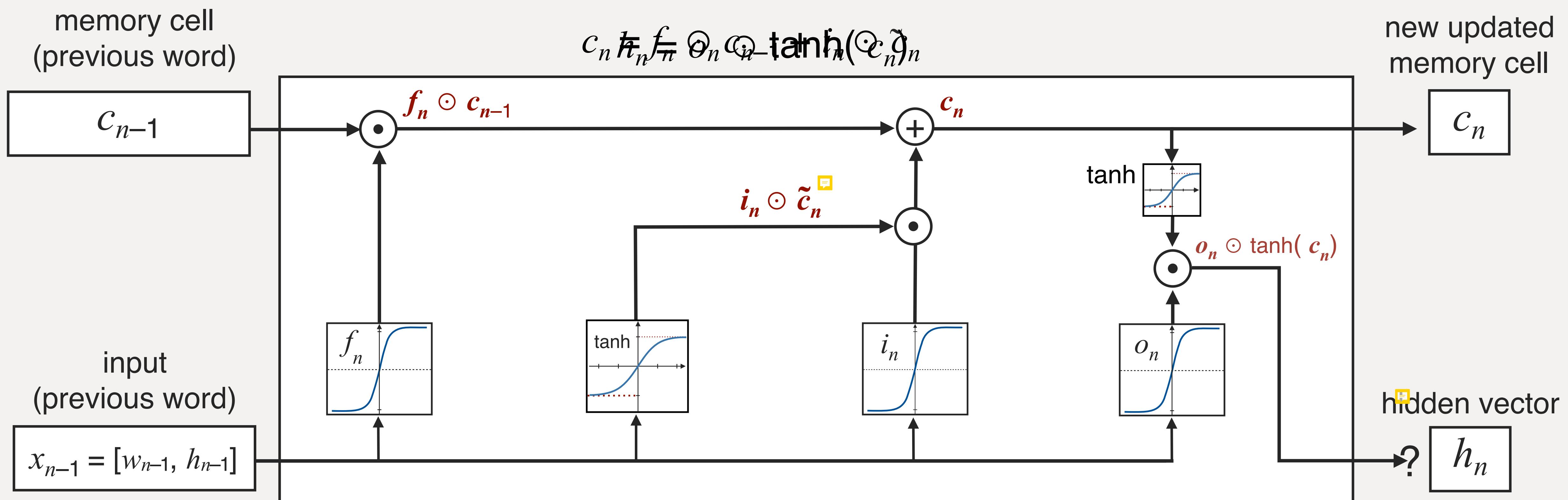
$$c_n = f_n \odot c_{n-1} + i_n \odot \tilde{c}_n$$

$$f_n \quad \boxed{0.1 \mid 0.9 \mid 0.8 \mid 0.4 \mid 0.5 \mid 0.3 \mid 0.2 \mid 0.7 \mid 0.4 \mid 0.7 \mid 0.6 \mid 0.3 \mid 0.8 \mid 0.1}$$

Understanding the Update



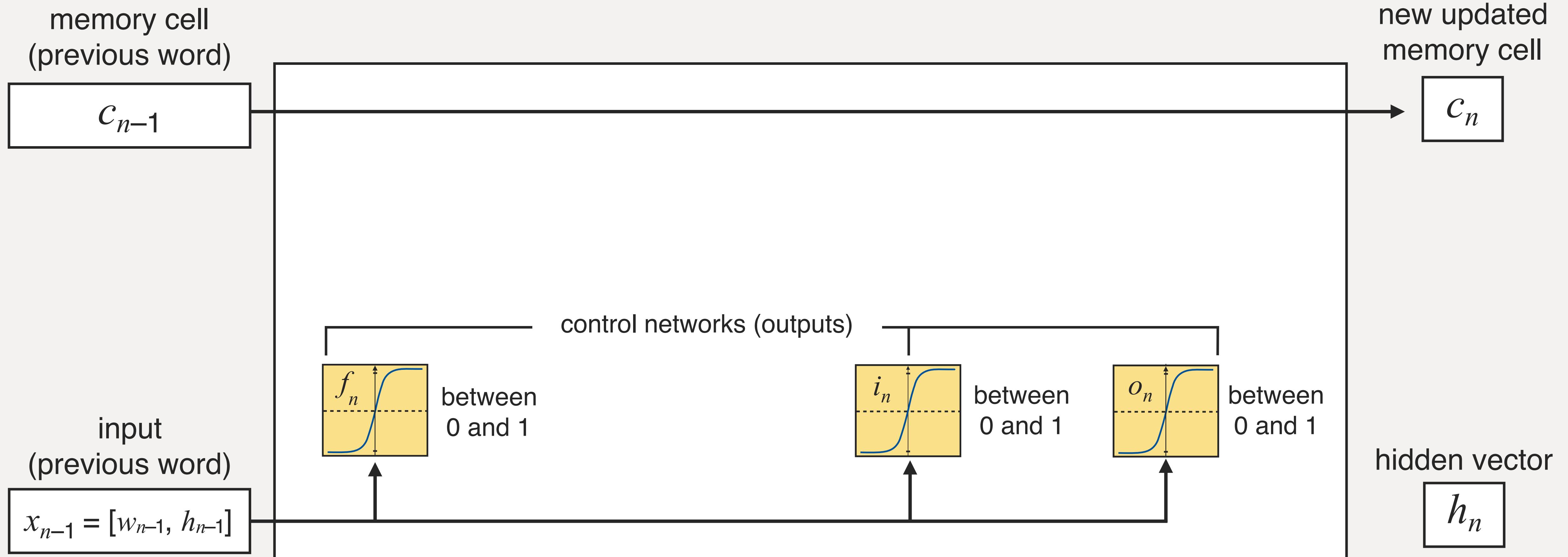
How do we get our next hidden state?



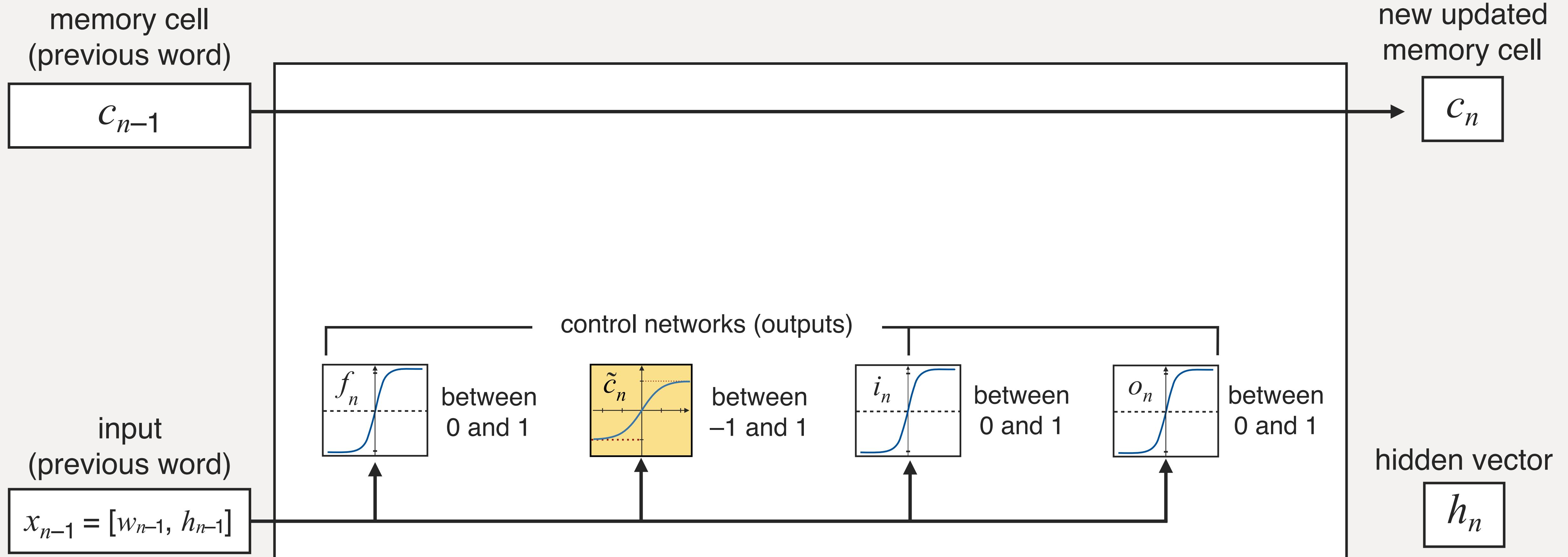


Going back through the
Long Short-Term Memory

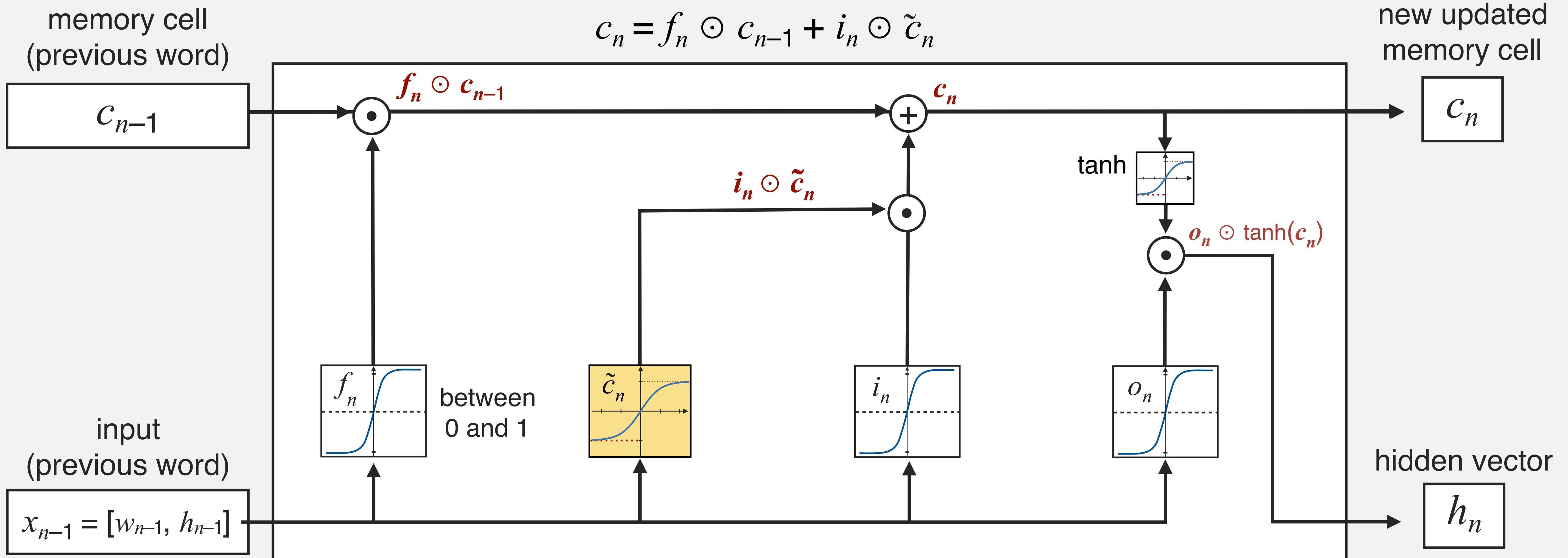
Long Short-Term Memory



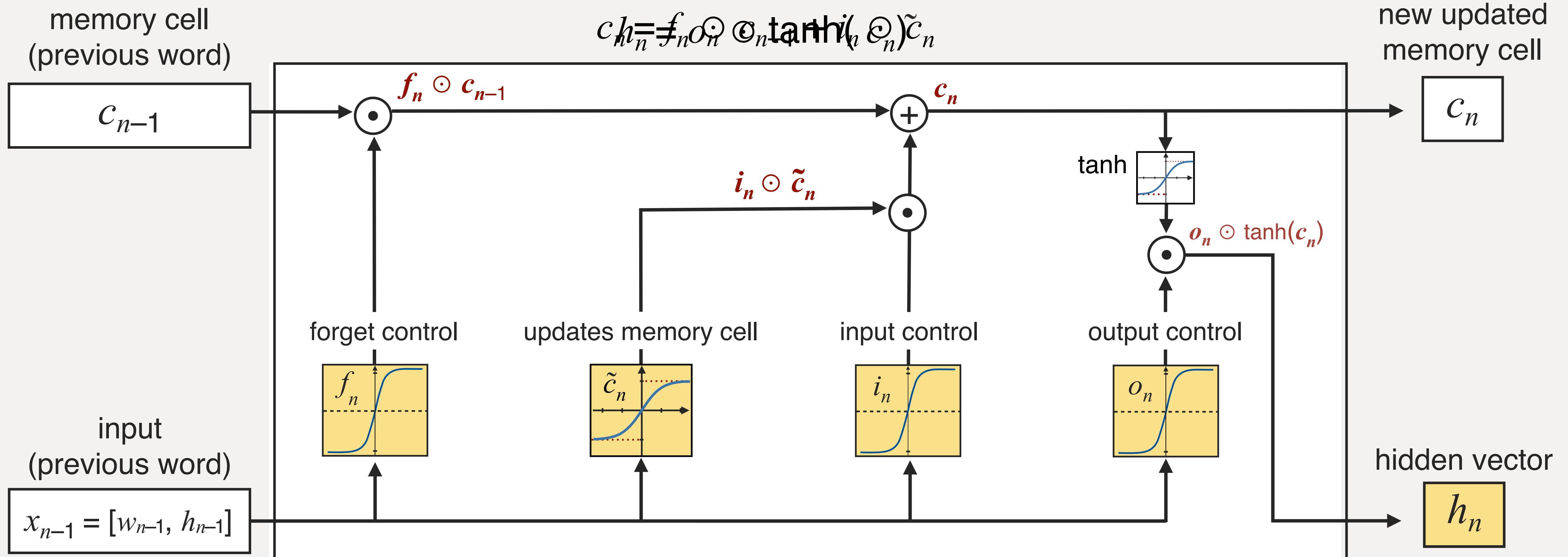
Long Short-Term Memory



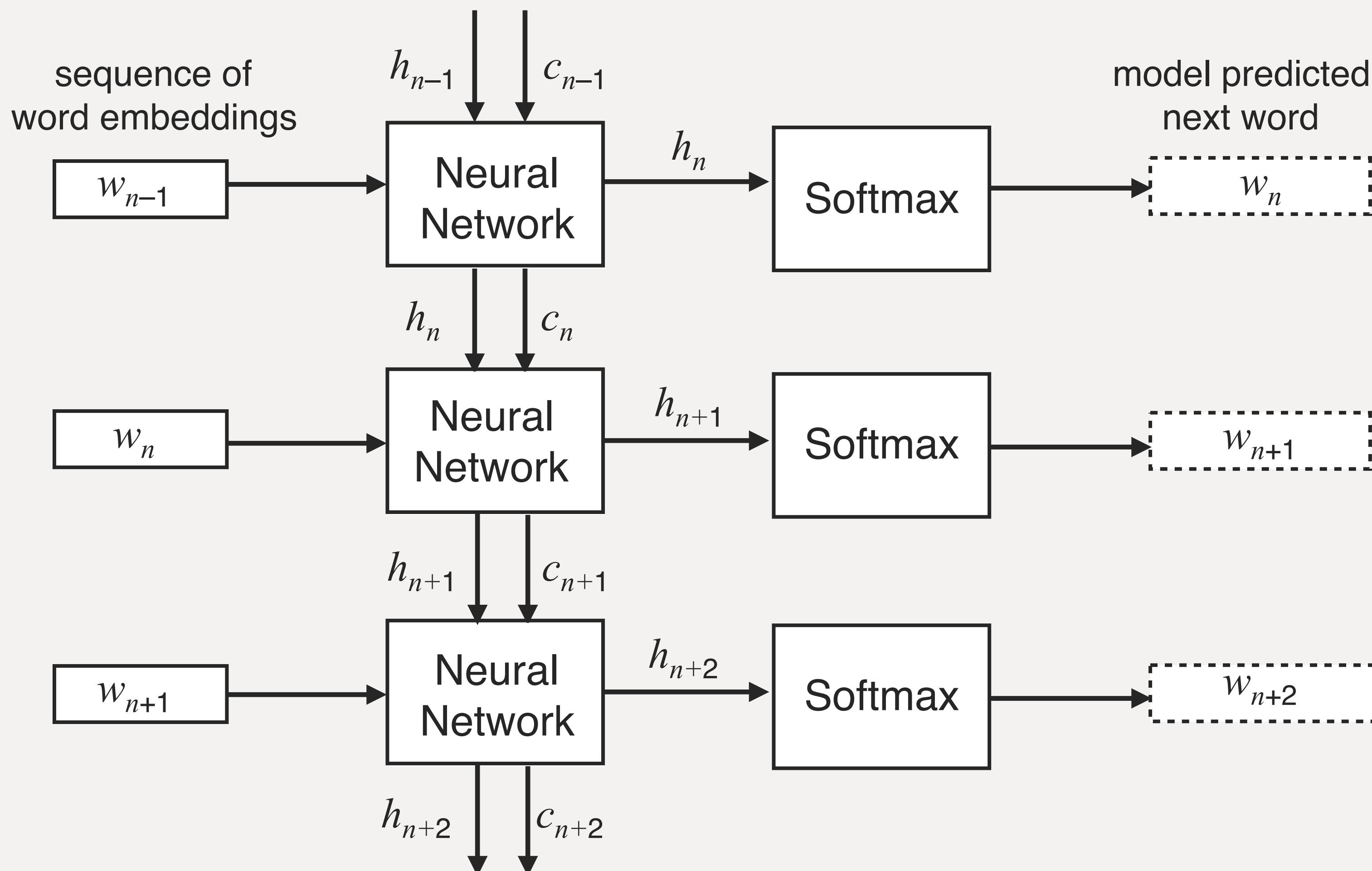
Long Short-Term Memory

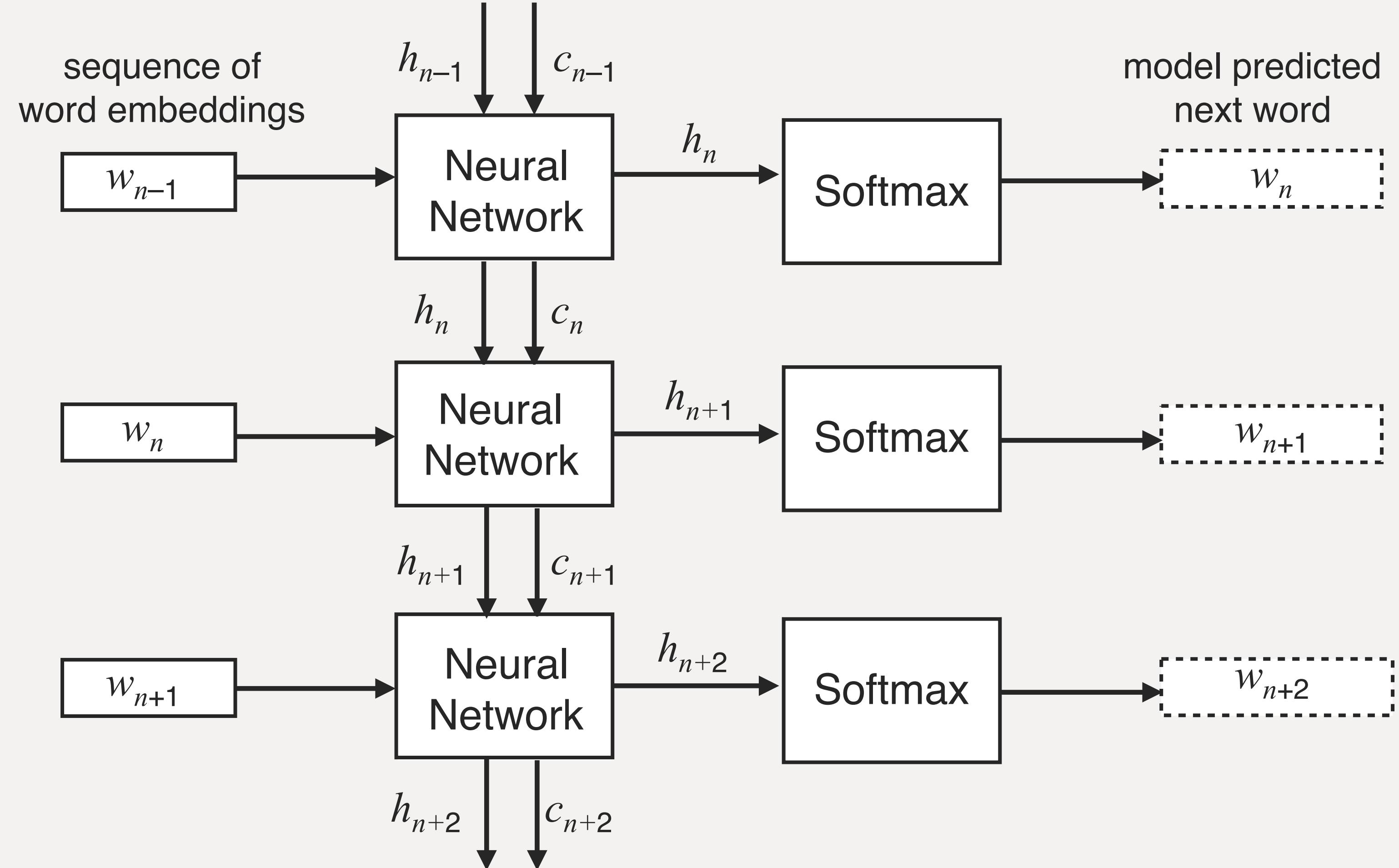


Long Short-Term Memory



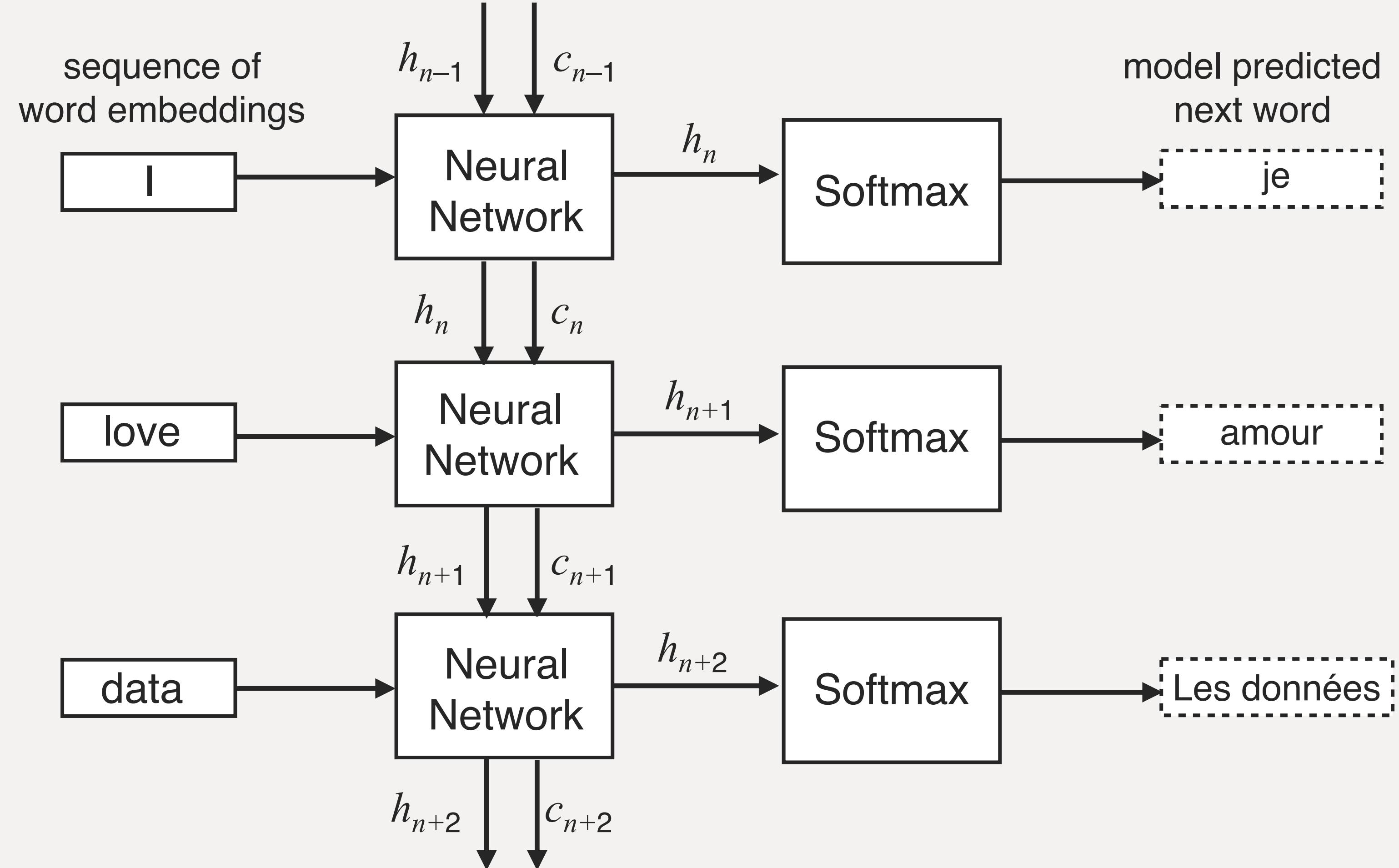
Long Short-Term Memory





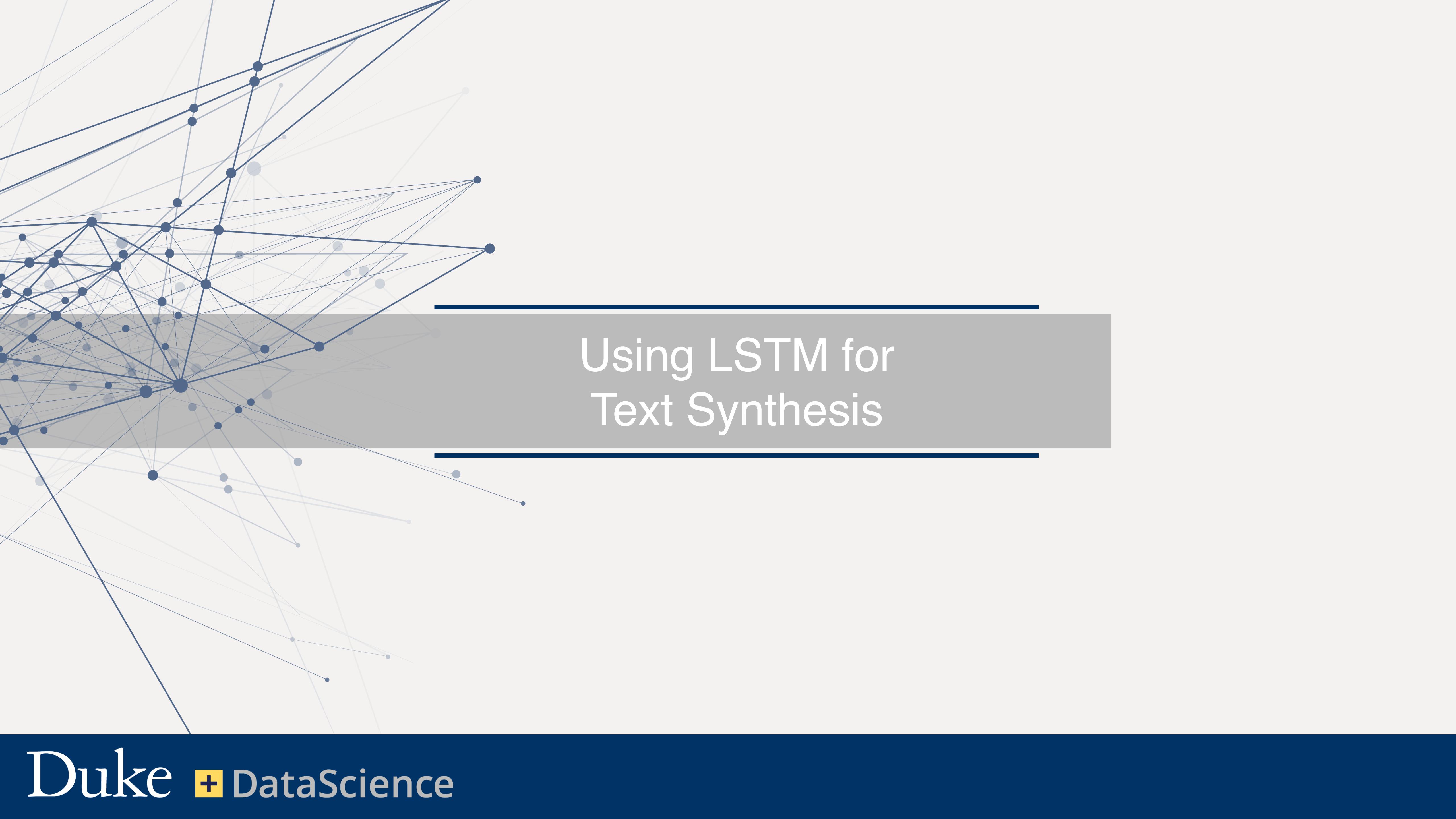
Learning LSTM Parameters

- All LSTM parameters can be learned using unlabeled data
- Word vectors may be treated as additional parameters, and learned as well
- Allows word embedding vectors and the synthesis of text



Learning LSTM Parameters

- All LSTM parameters can be learned using unlabeled data
- Word vectors may be treated as additional parameters, and learned as well
- Allows word embedding vectors and the synthesis of text



Using LSTM for Text Synthesis

Text Synthesis

English

a player holding a
hockey stick



Spanish

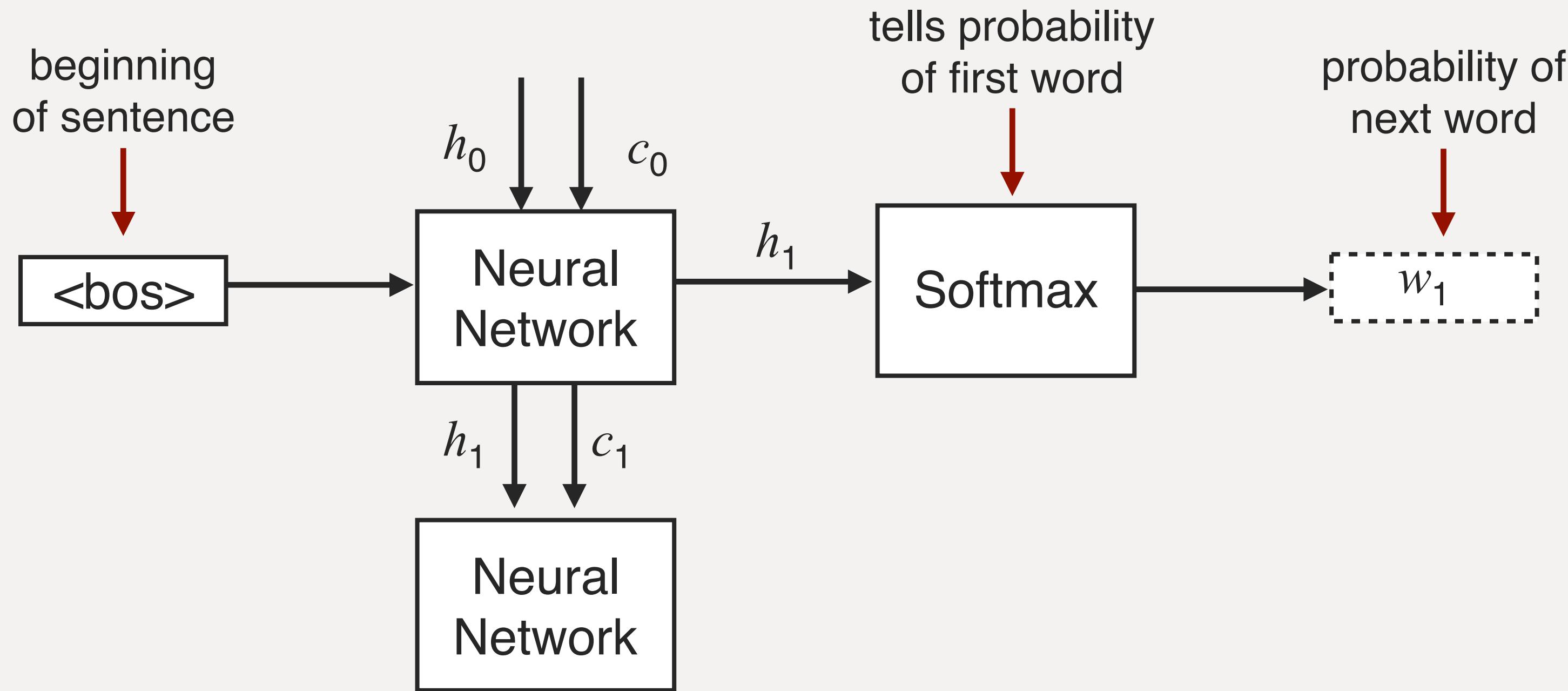
un jugador sosteniendo
un palo de hockey

synthesized text

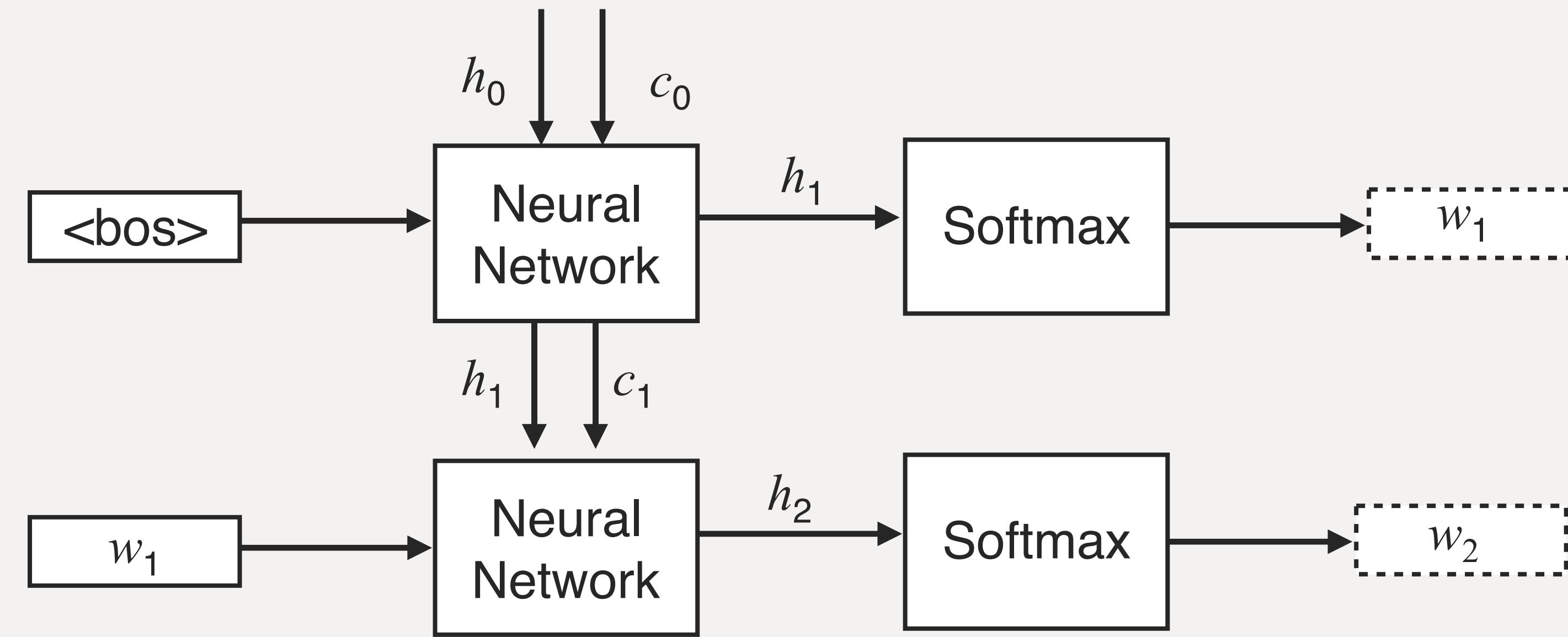
a player holding a
hockey stick

How can we use the LSTM to synthesize text?

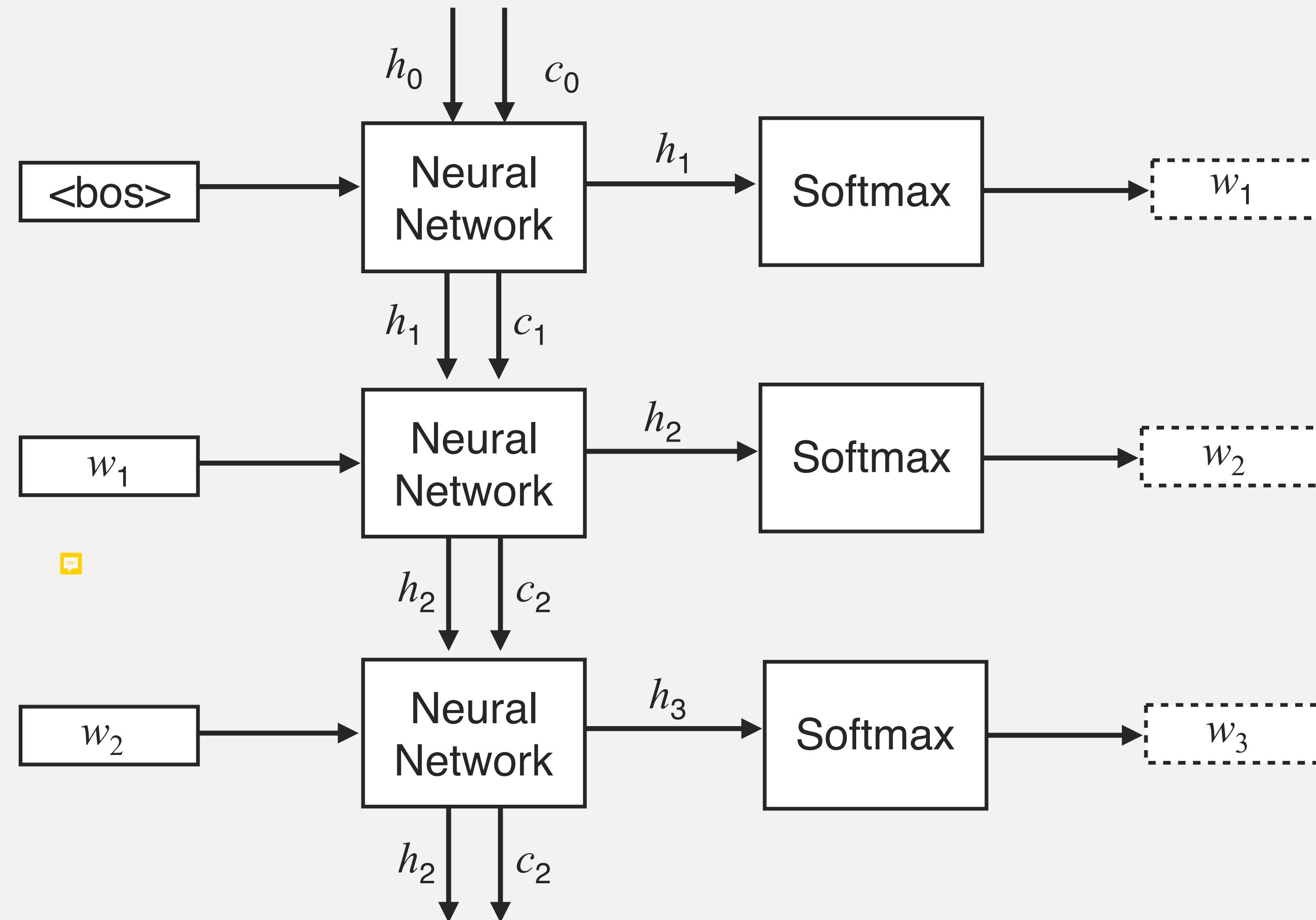
LSTM Based Text Synthesis



LSTM Based Text Synthesis



LSTM Based Text Synthesis



Initializing LSTM Memory Cell

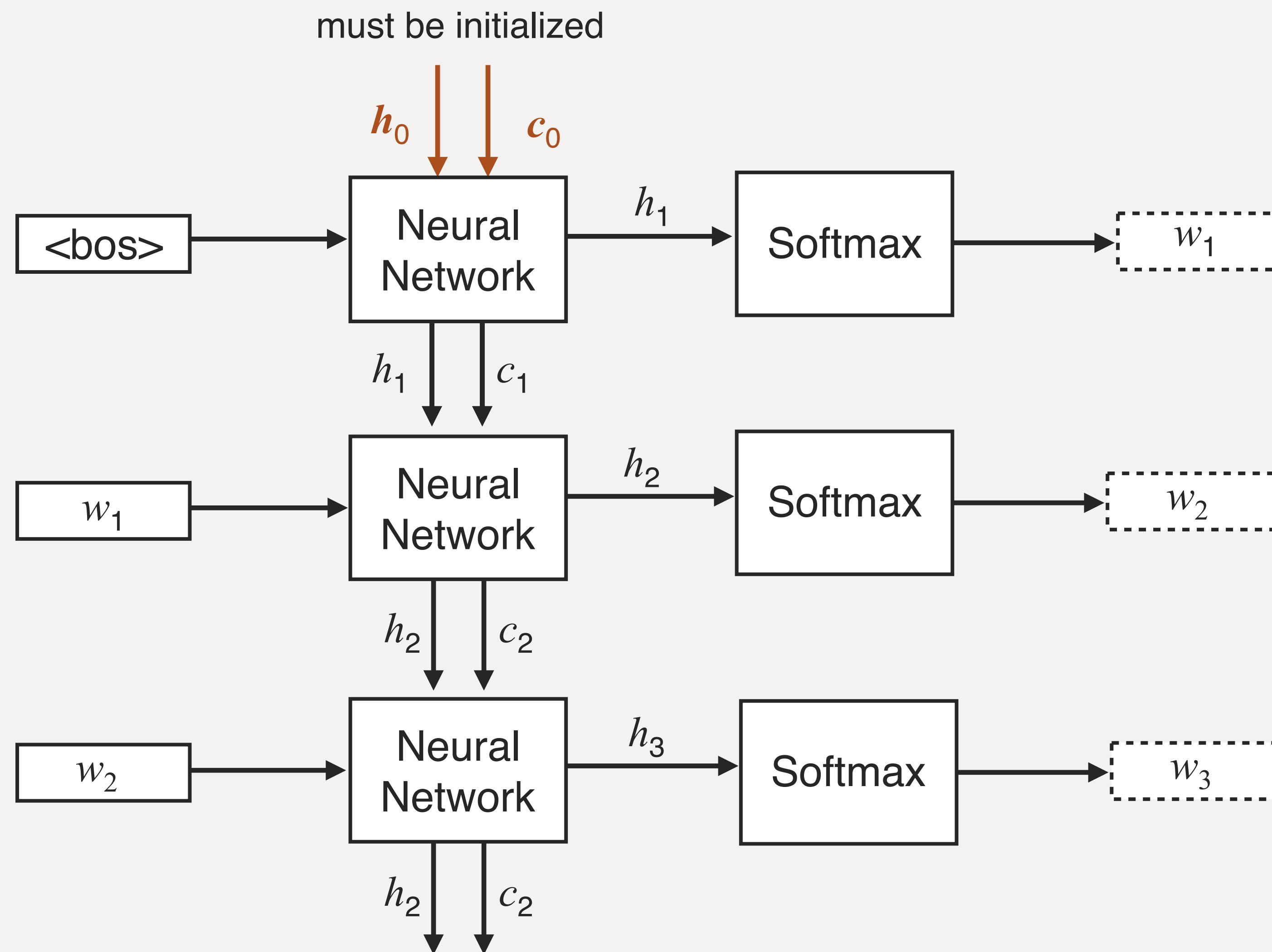
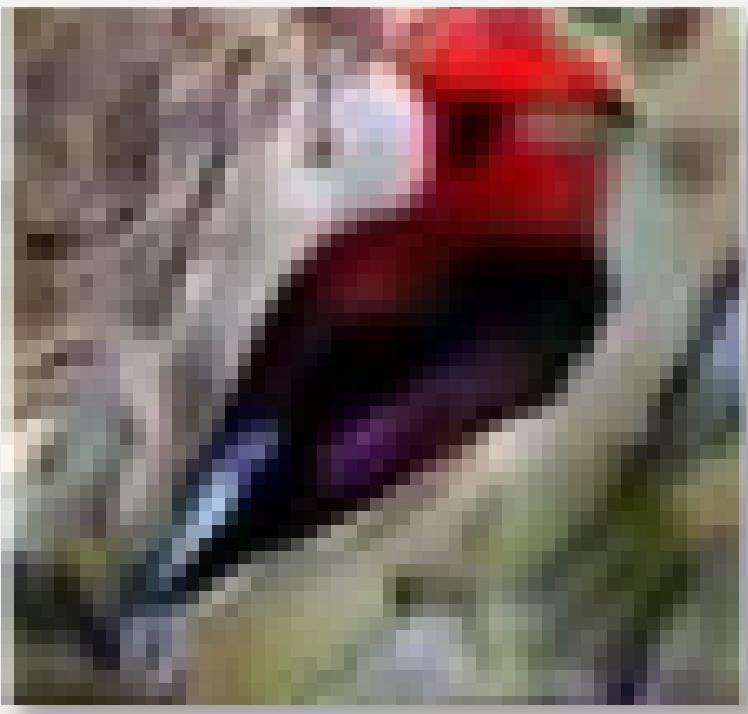
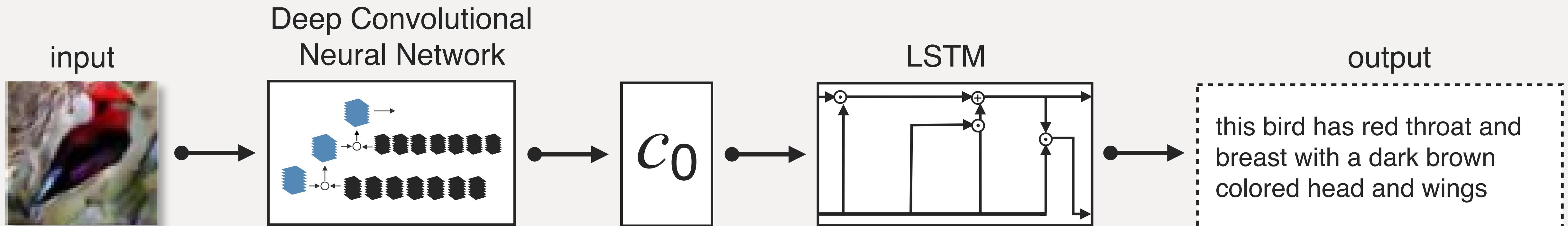


Image-to-Caption



this bird has red throat and breast with a dark brown colored head and wings





a cat is eating some kind of food



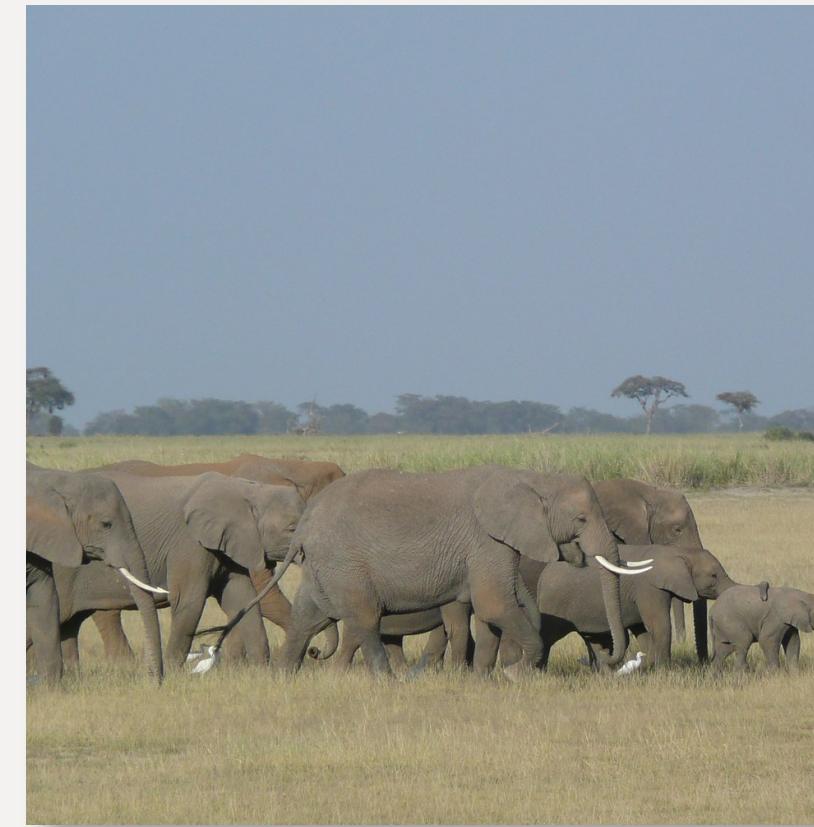
a big black dog standing on the grass



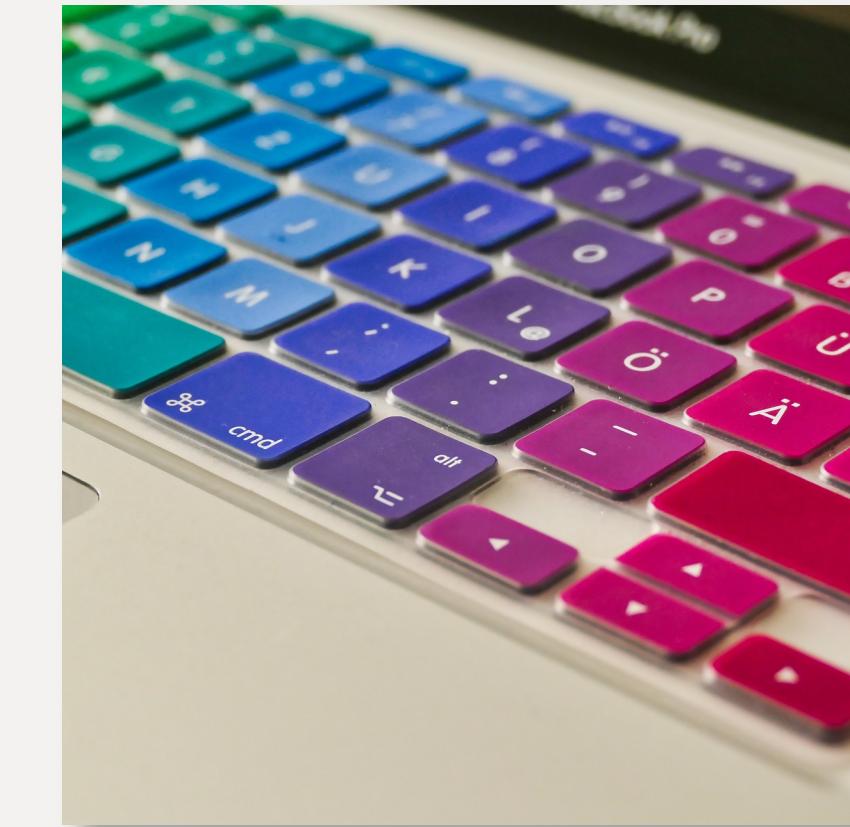
a player holding a hockey stick



a box full of apples and oranges



a group of elephants standing next to each other

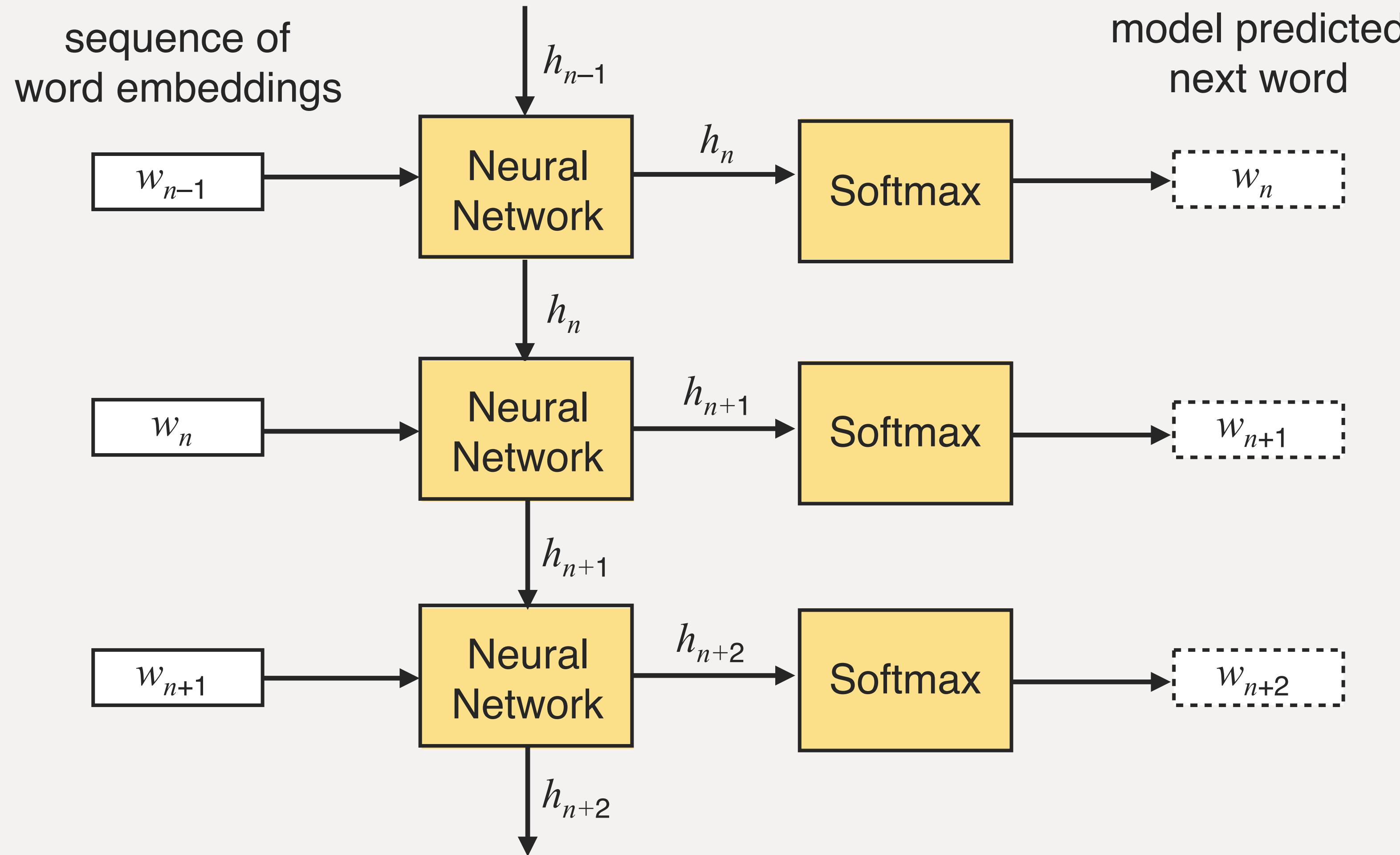


a keyboard on a desk

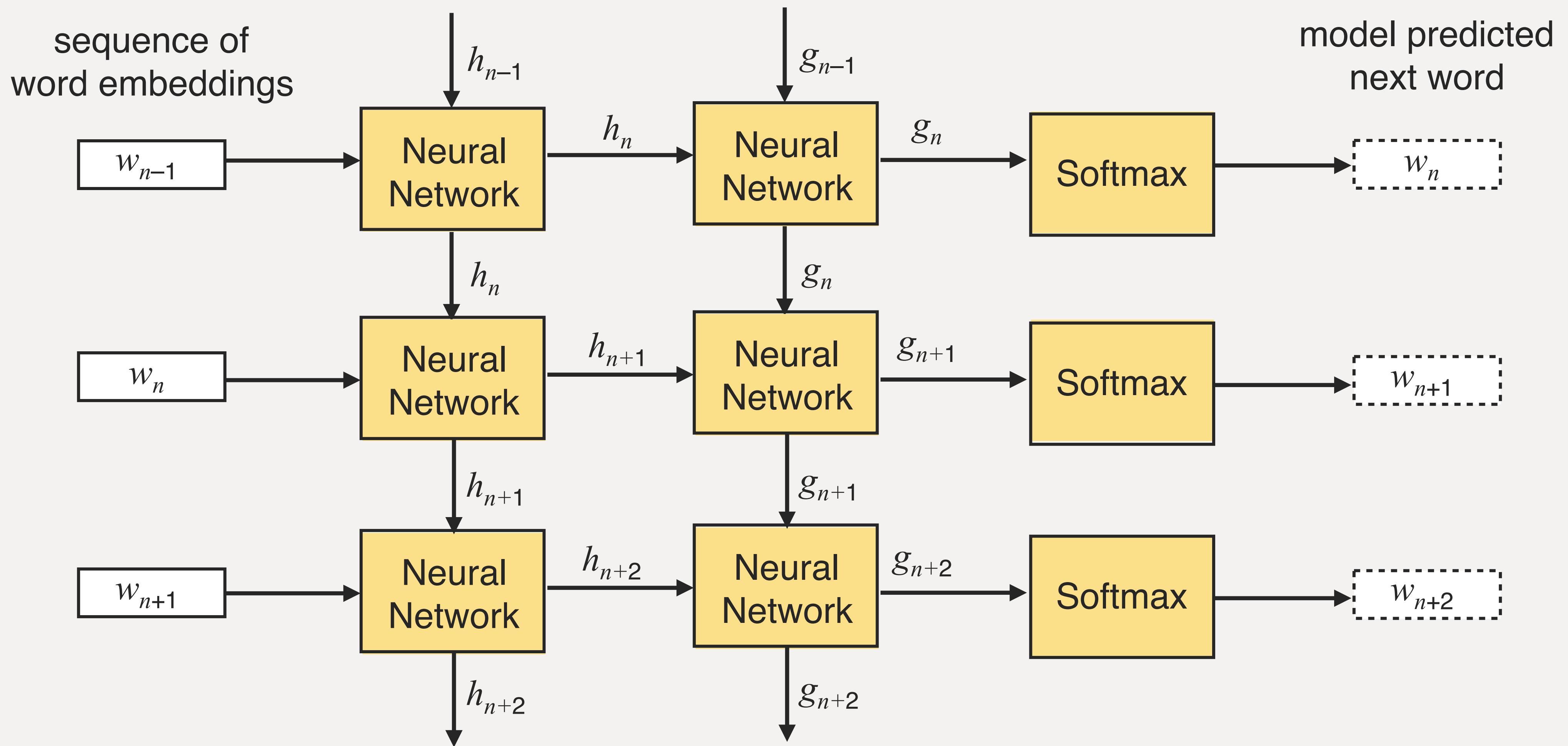


Going Deeper

Recurrent Neural Network



Stacked Recurrent Neural Network





Finishing Up

Conclusions

- Recurrent Neural Networks are commonly used in natural language processing
- Many different variants of networks (LSTMs are widely used, in addition to Gated Recurrent Units (GRUs))
- Word embeddings are critical for top performance
- Networks are still learned by stochastic gradient methods
- Fast-moving research area!
- Case studies will highlight important use cases

Text generation a few years ago

-
- A** the service was great, the receptionist was very friendly and the place was clean, we waited for a while, and then our room was ready .
-
- same with all the other reviews, this place is a good place to eat, i came here with a group of friends for a birthday dinner, we were hungry and decided to try it, we were seated promptly.
 - this place is a little bit of a drive from the strip, my husband and i were looking for a place to eat, all the food was good, the only thing i didn t like was the sweet potato fries.
 - this is not a good place to go, the guy at the front desk was rude and unprofessional, it s a very small room, and the place was not clean.
 - service was poor, the food is terrible, when i asked for a refill on my drink, no one even acknowledged me, they are so rude and unprofessional.
-
- B** how is this place still in business, the staff is rude, no one knows what they are doing, they lost my business .
-

SYSTEM PROMPT (HUMAN-WRITTEN)

A train carriage containing controlled nuclear materials was stolen in Cincinnati today. Its whereabouts are unknown.

“Better Language Models and Their Implications”

2/14/19
OPENAI

MODEL COMPLETION (MACHINE-WRITTEN, FIRST TRY)

The incident occurred on the downtown train line, which runs from Covington and Ashland stations.

In an email to Ohio news outlets, the U.S. Department of Energy said it is working with the Federal Railroad Administration to find the thief.

“The theft of this nuclear material will have significant negative consequences on public and environmental health, our workforce and the economy of our nation,” said Tom Hicks, the U.S. Energy Secretary, in a statement. “Our top priority is to secure the theft and ensure it doesn’t happen again.”

The stolen material was taken from the University of Cincinnati’s Research Triangle Park nuclear research site, according to a news release from Department officials. The Nuclear Regulatory Commission did not immediately release any information.

According to the release, the U.S. Department of Energy’s Office of Nuclear Material Safety and Security is leading that team’s investigation.

“The safety of people, the environment and the nation’s nuclear stockpile is our highest priority,” Hicks said. “We will get to the bottom of this and make no excuses.