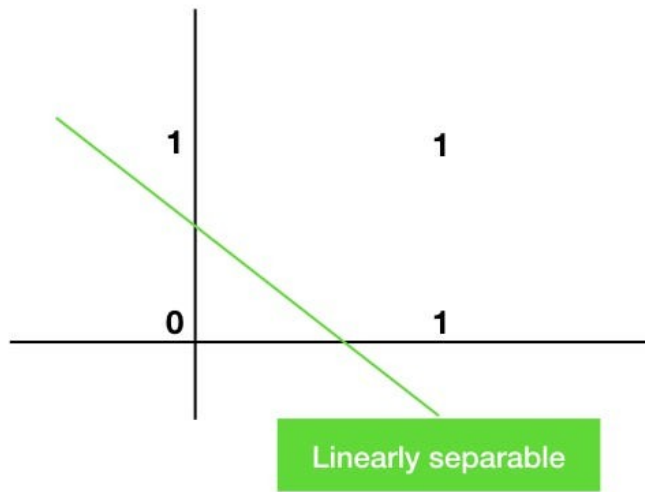# Overview of AI

2

Brief history

- 1943: W. Pitts, W. McCulloch
- 1954: Bar Hillel
- 1969: Minsky/Papert, XOR
- 1986: Rumelhart/Hinton, Backpropagation
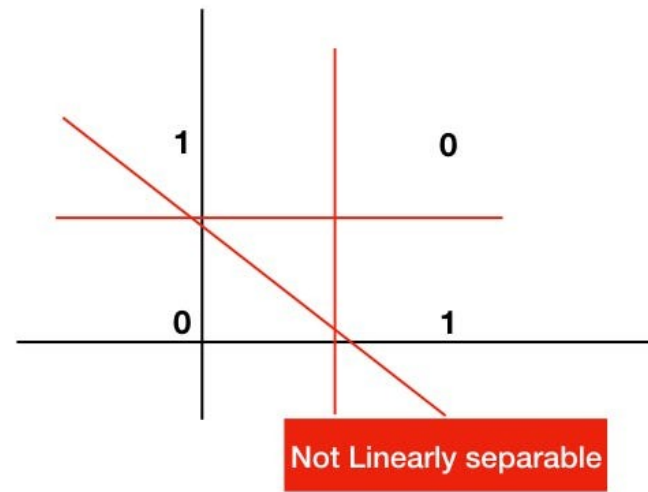- 1997: LeCun, CNN, Schmidhuber, RNN

1969

1986

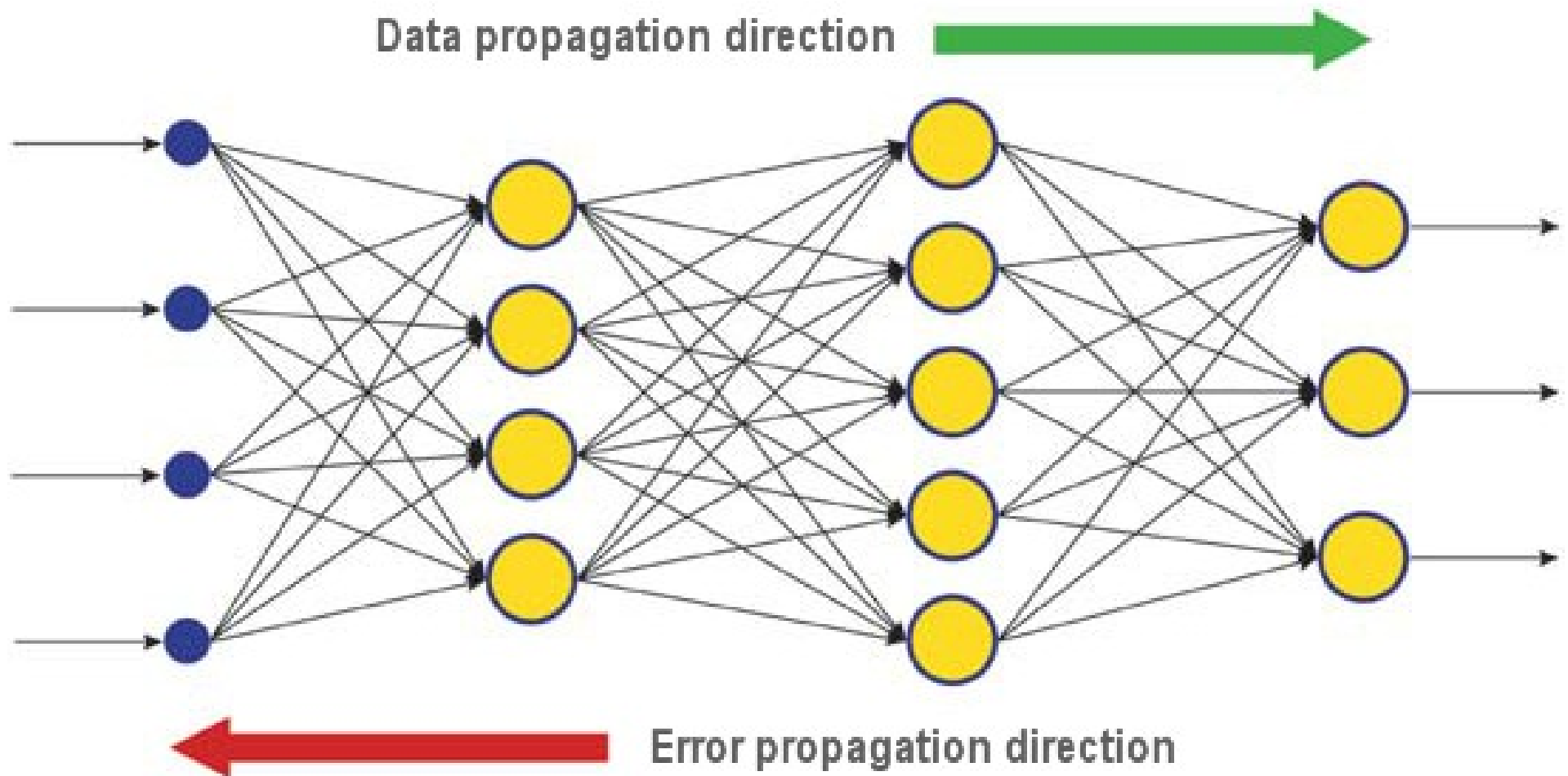# 1997 CNN

Source pixel

$(-1 \times 3) + (0 \times 0) + (1 \times 1) +$
$(-2 \times 2) + (0 \times 6) + (2 \times 2) +$
$(-1 \times 2) + (0 \times 4) + (1 \times 1) = -3$

Convolution filter

Destination pixel

1997 RNN

(a)

W_x

W_o

I

H

O

(b)

W_h

W_x

W_o

I

O

$H_1, H_2, H_3, H_4, H_5, H_6, \ldots =: H_n$

(c)

W_h

I $\quad W_x \quad$ H_n $\quad W_o \quad$ O

(a)

I H_n O

(b)

H_1 H_2 H_3 H_4

I H_1 H_2 H_3 H_4 O

(c)

$y(1)$ $y(2)$ $y(3)$ $y(4)$

W_h W_o W_h W_o W_h W_o W_h W_o W_h

$h(0)$ → ... → $h(4)$

W_x W_x W_x W_x

$x(1)$ $x(2)$ $x(3)$ $x(4)$

(a)

y(t-1) = h(t-1)

y(t) = h(t)

h(t-2)

SRN Unit 5

h(t-1)

h(t)

TANH

x(t-1)

x(t)

h(t-3)

SRN Unit 4

SRN Unit 5

SRN Unit 6

h(t)

(b)

y(t) = h(t)

LSTM Unit 5

C(t-1)

h(t-1)

C(t)

TANH

SIGM SIGM TANH

h(t)

x(t)

SIGM

C(t-3)

LSTM Unit 4

LSTM Unit 5

LSTM Unit 6

C(t)

h(t-3)

h(t)
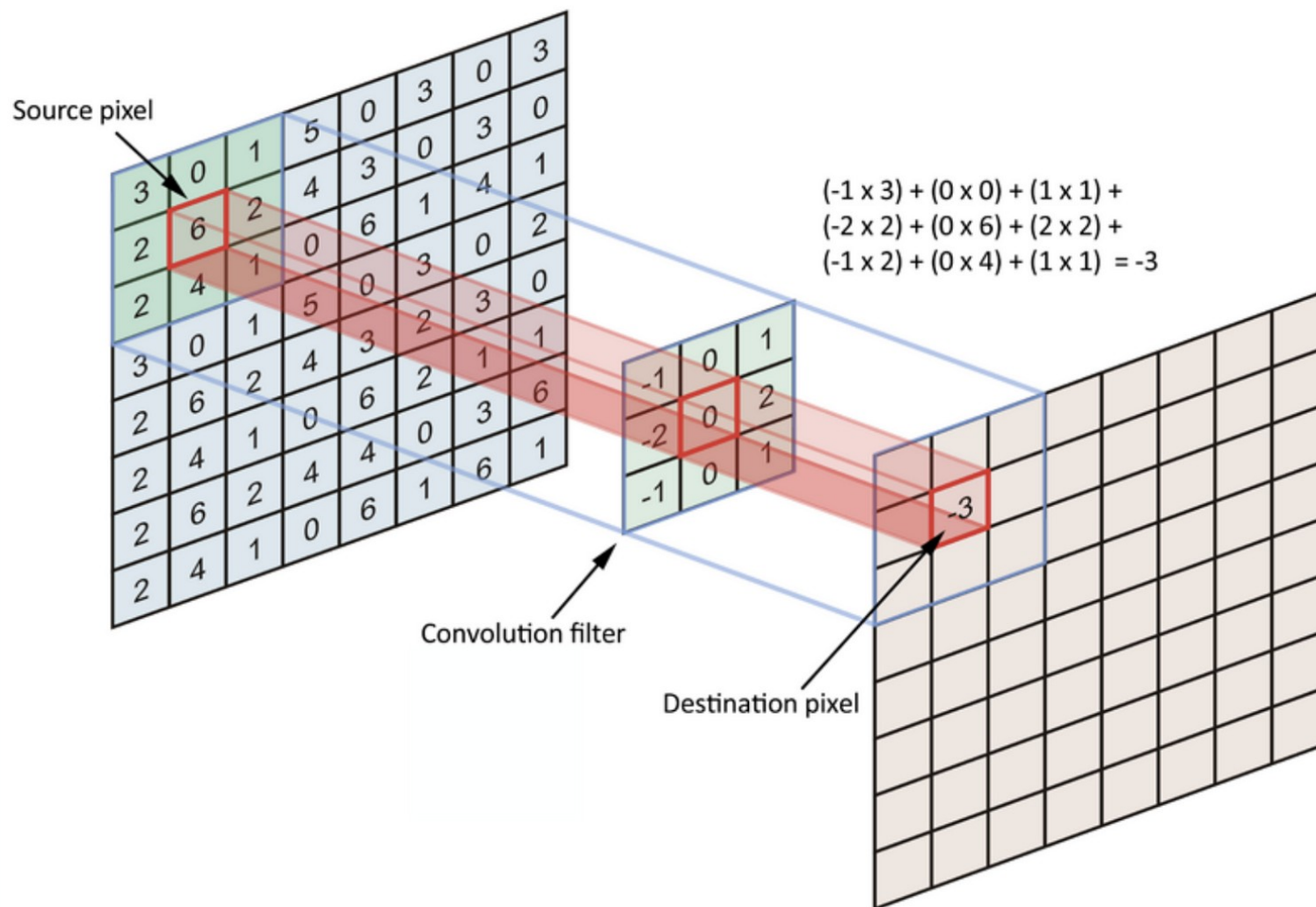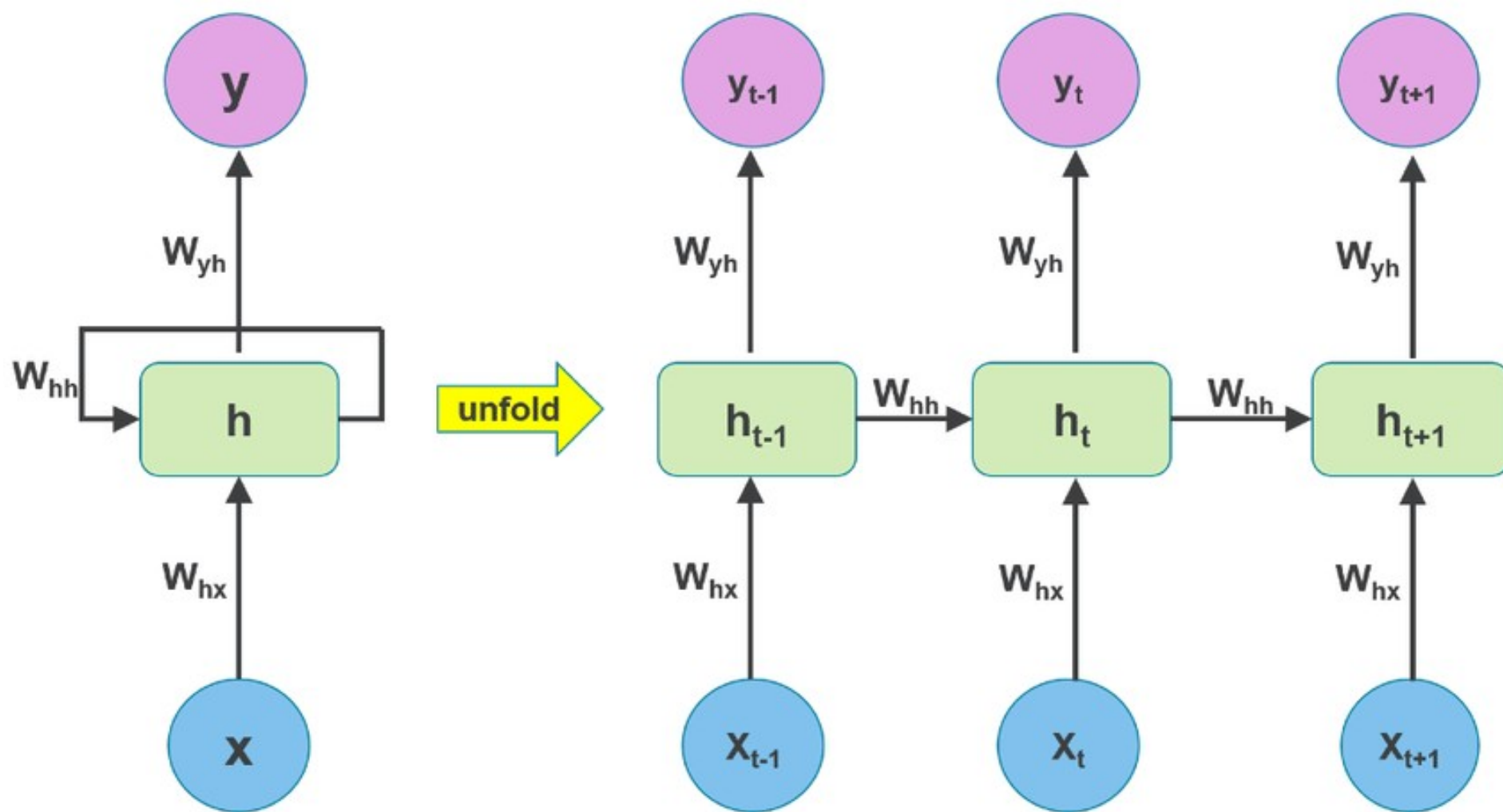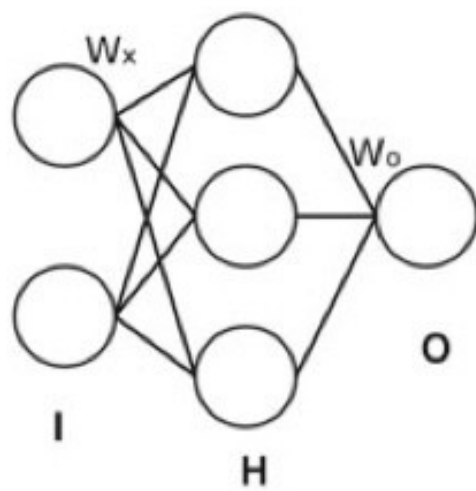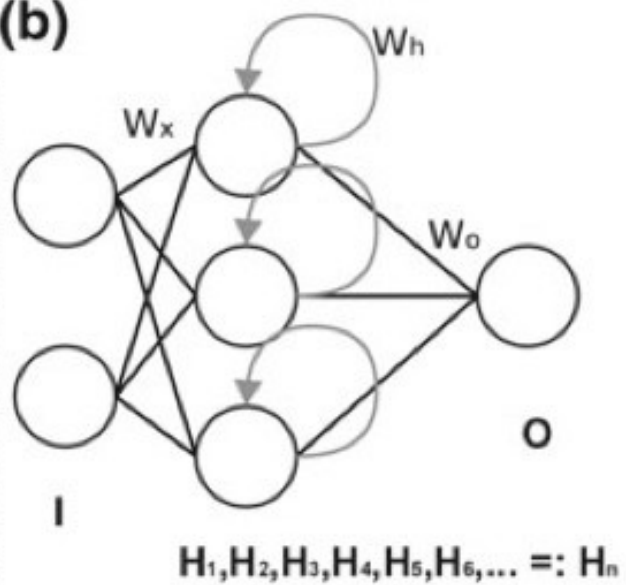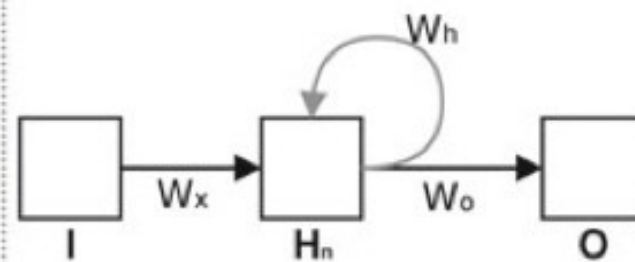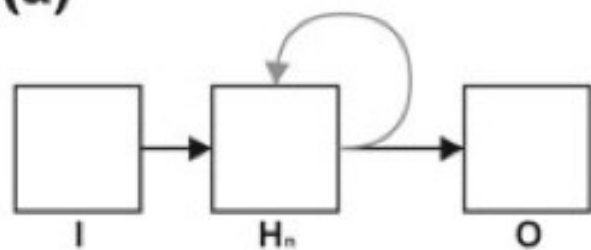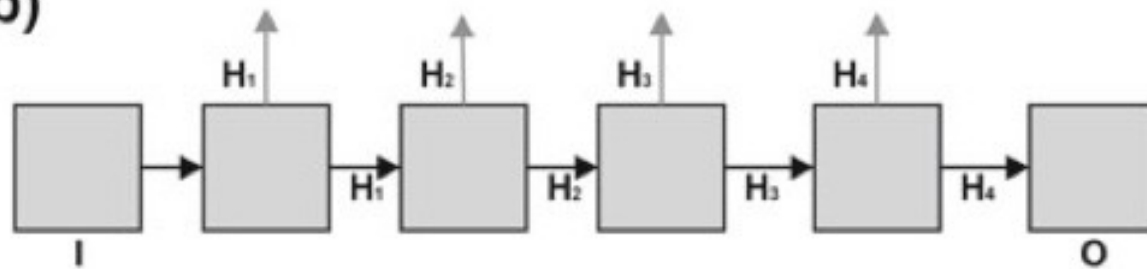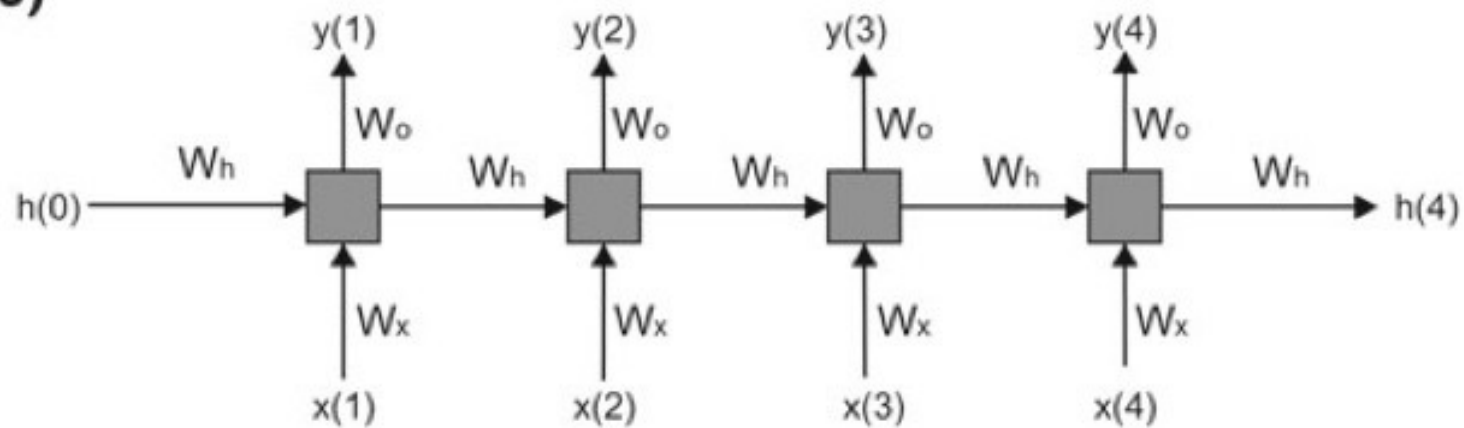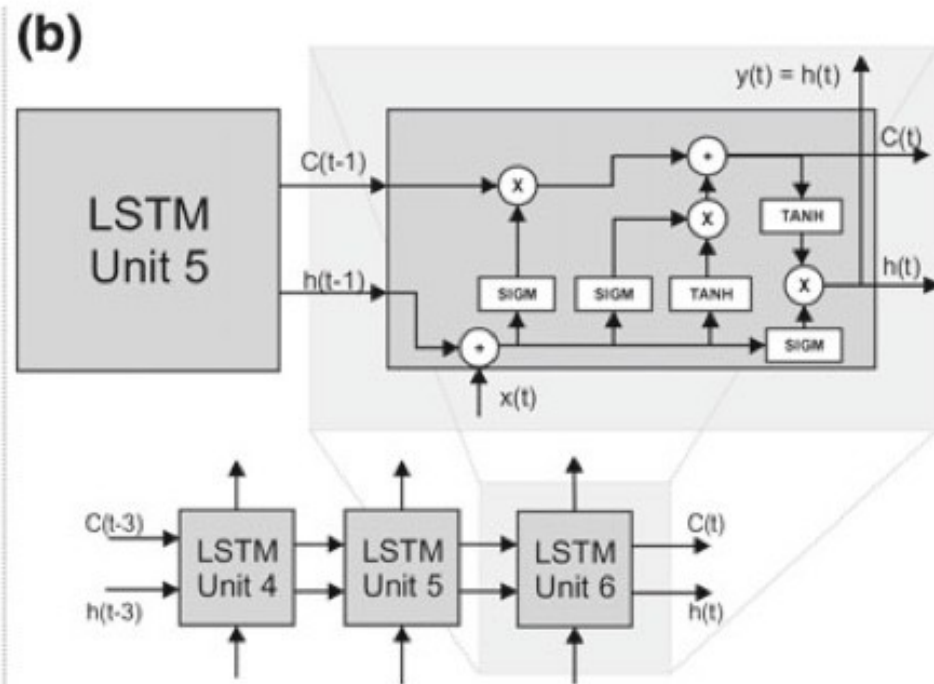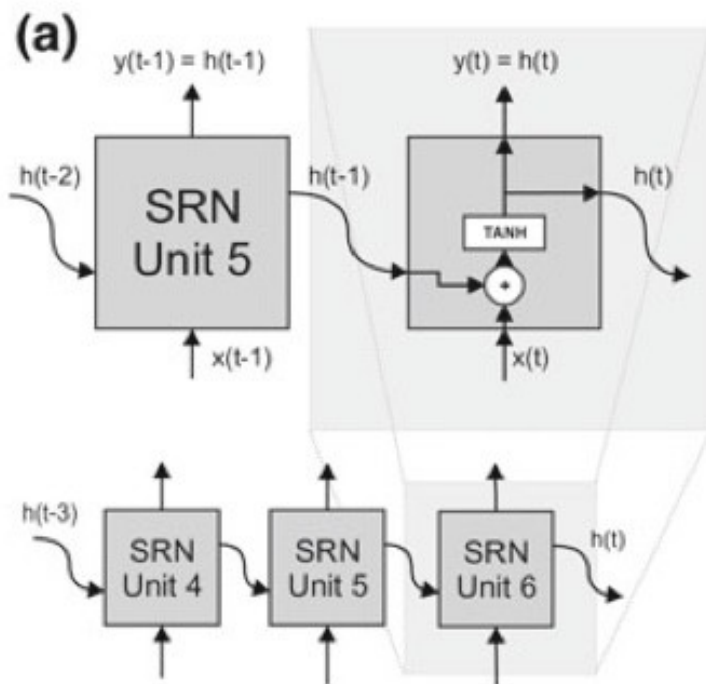
LEGEND:

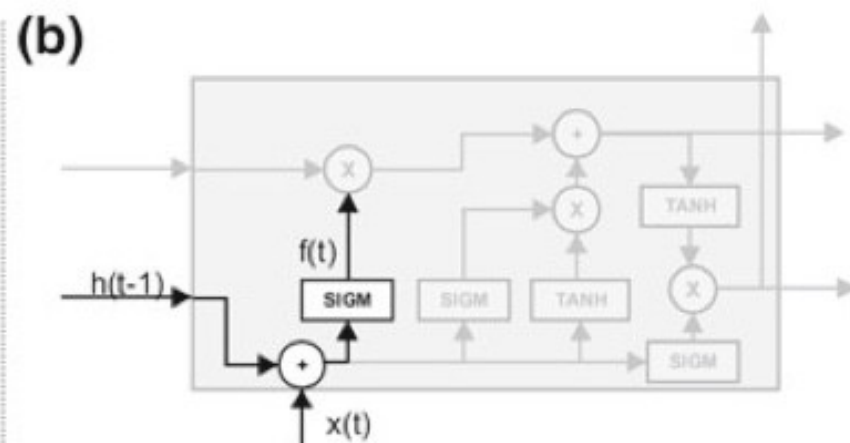Function (Sigmoid or TANH)   SIGM   TANH

Pointwise/artihmetical operator   +   x

Ordinary data flow

Data forking/data copying

(a)

C(t-1)

C(t)

f(t)

i(t)

SIGM   SIGM   TANH   TANH

SIGM

(b)

h(t-1)

f(t)

SIGM   SIGM   TANH   TANH

SIGM

x(t)

(c)

i(t)

h(t-1)

ff(t)

C*(t)

SIGM   SIGM   TANH   TANH

SIGM

x(t)

(d)

y(t)

C(t)

h(t-1)

TANH

h(t)

fff(t)

SIGM   SIGM   TANH

SIGM

x(t)
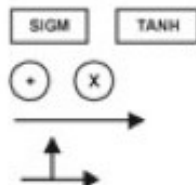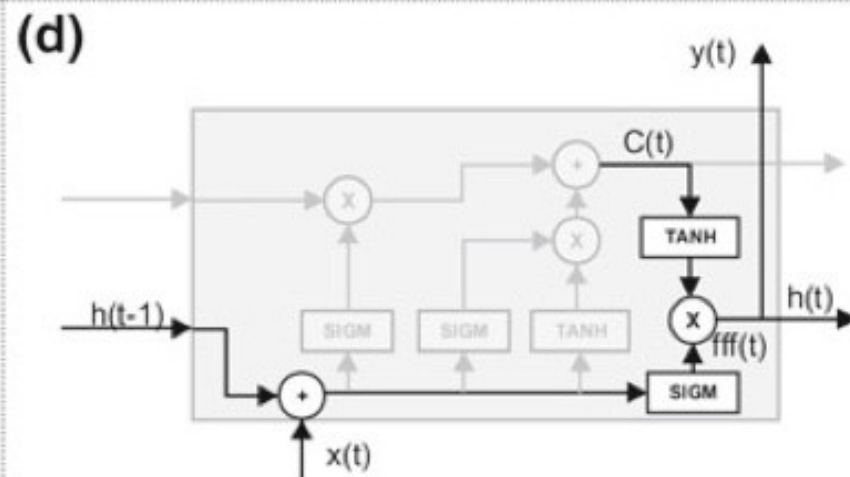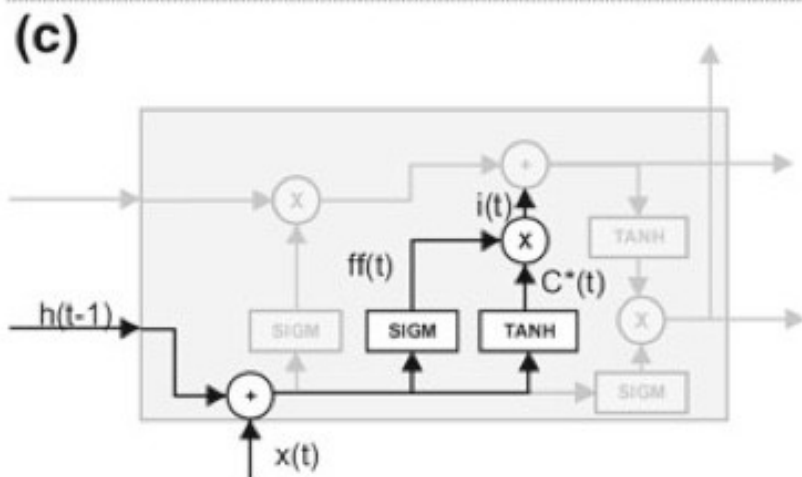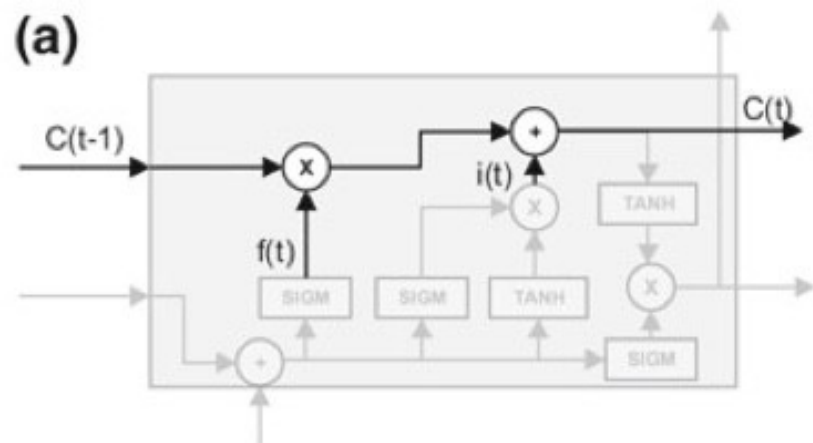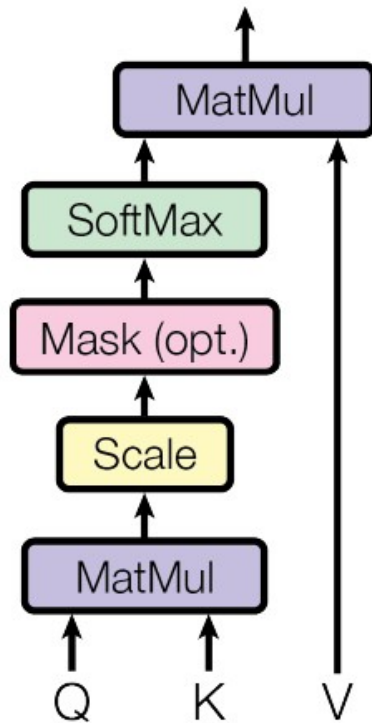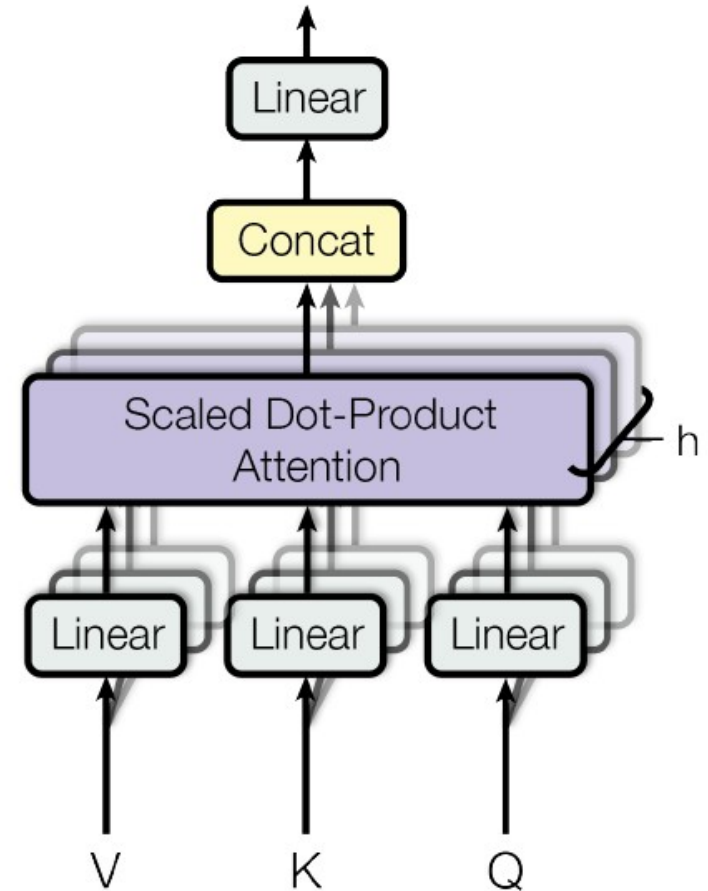
Transformers (GPT, GPT-2, GPT-3, GPT-4, BERT, DistillBERT)

Scaled Dot-Product Attention
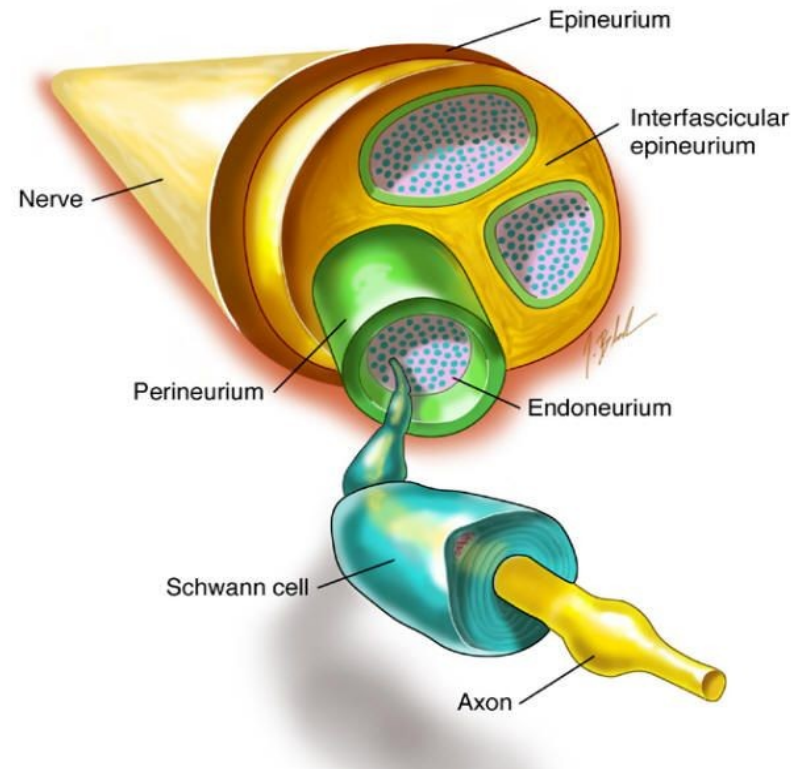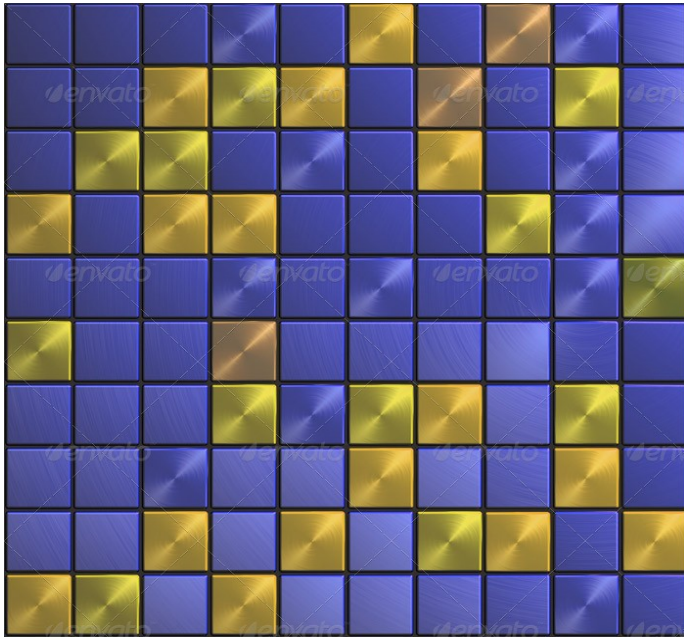
Multi-Head Attention

What they can do?

- Chatbot
- Sentiment
- NER/POS
- Article Spinning
- QnA
- Machine translation

- **Neuronsko-neuralni interface:**
  Može li se attention korisiti za routing neuralnih impulsa u slučaju prerezanih živčanih vlakana?

Prevođenje na "jezik" proteina

- Text2SQL

- Text2proteinFold (does not exist yes):

  - Aminoacids = letters

  - Proteins = words

  - Folding = sentences

    - Problem: folding is nonmonotone (in the logical sense)

      - New words „invalidate" old ones