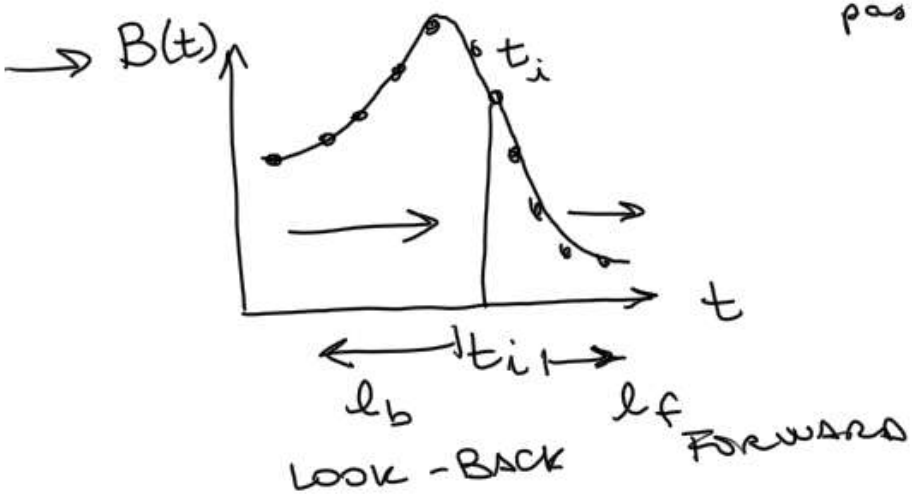
SEQUENTIAL DATA

$X_1 \dots X_n$

$\hookrightarrow 2$

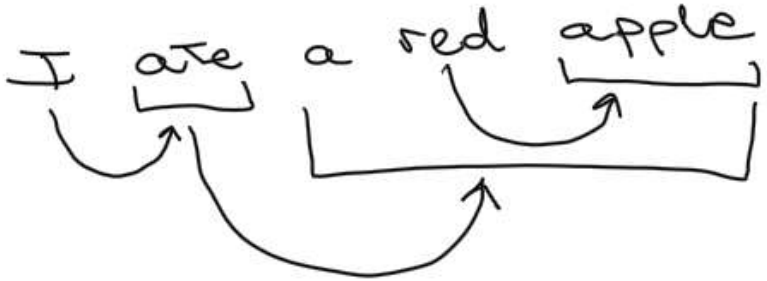
① time series $X(t) \rightarrow X(t_1) \dots X(t_n)$

past → future



② NLP

text prediction



Techniques

Recurrent NNs RNN

GRU

LSTM

Attention

Transformers Embeddings

Apply them to

- Space weather } LSTMs
- Traffic of Valencia
- Competition COMPETION

Competition M6 2023-24 Shares

- TWITTER ↔ TESLA
- POLITICAL DISCOURSE → PARTIES

RNNs

Seq.

(X, y)

① recording sound → text

$x_r(t)$

A (x_1) bunch (x_2) of (x_3) sentence (x_4)

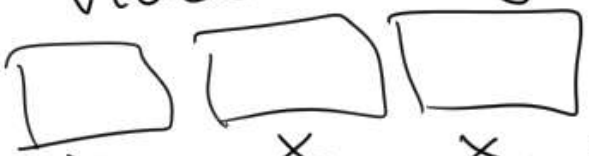
Seq 2 Seq

② prompt (0,1) → music

Bach

Seq

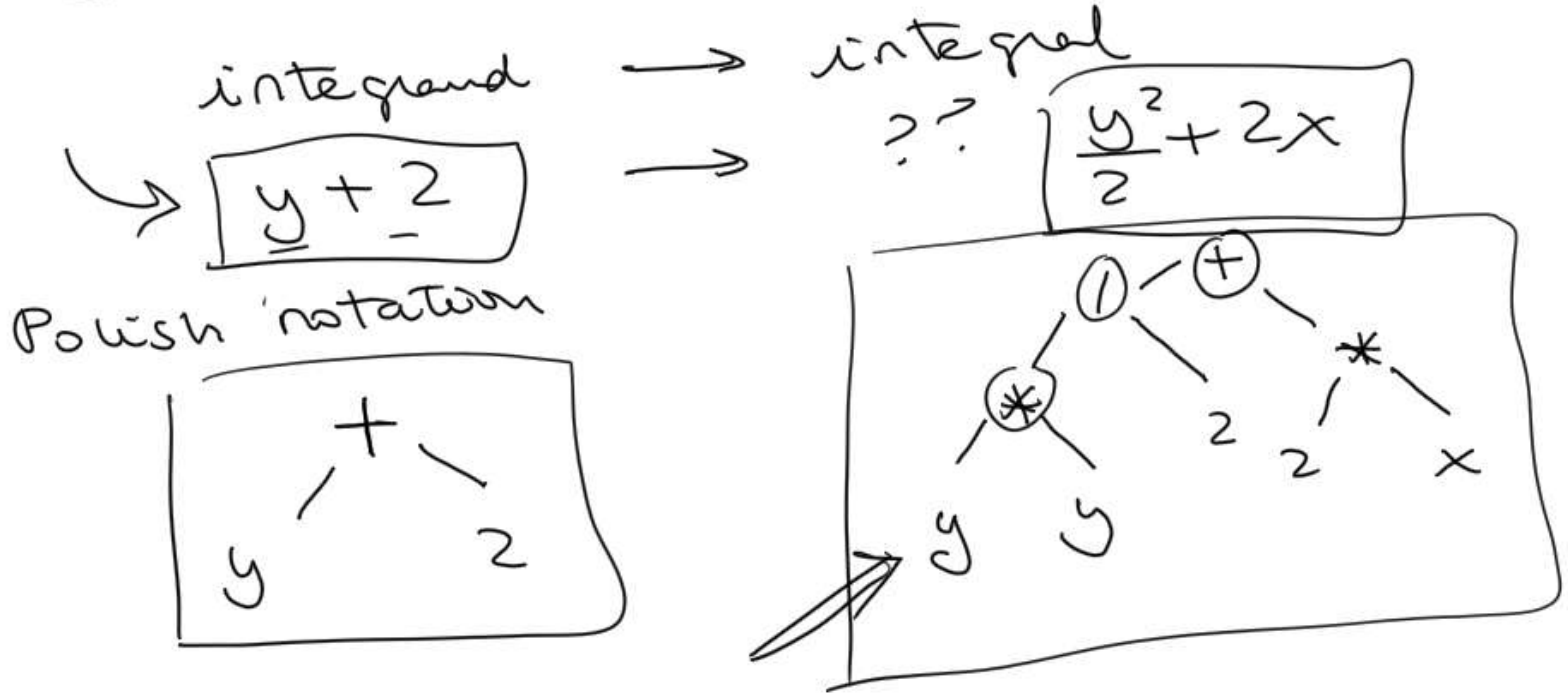
③ video recording → violence



x_1 x_2 x_3 ...

Seq → class.

④ Symb. mathematical regression



Seq 2 Seq $(\underline{X}, \underline{y})$

$x_1 \text{ ---- } x_n \quad T_x = n$

$\downarrow$

$y_1 \text{ --- } y_m \quad T_y = m$

$\Big\} \; (\vec{X}, \vec{y}, T_x, T_y)$

$x \rightarrow \underline{x(t)\ \text{past}} \quad l_b$

$y \rightarrow \underline{x(t)\ \text{future}} \quad l_f$

NLP

I like potatoes

I hate sausages

define | dictionary

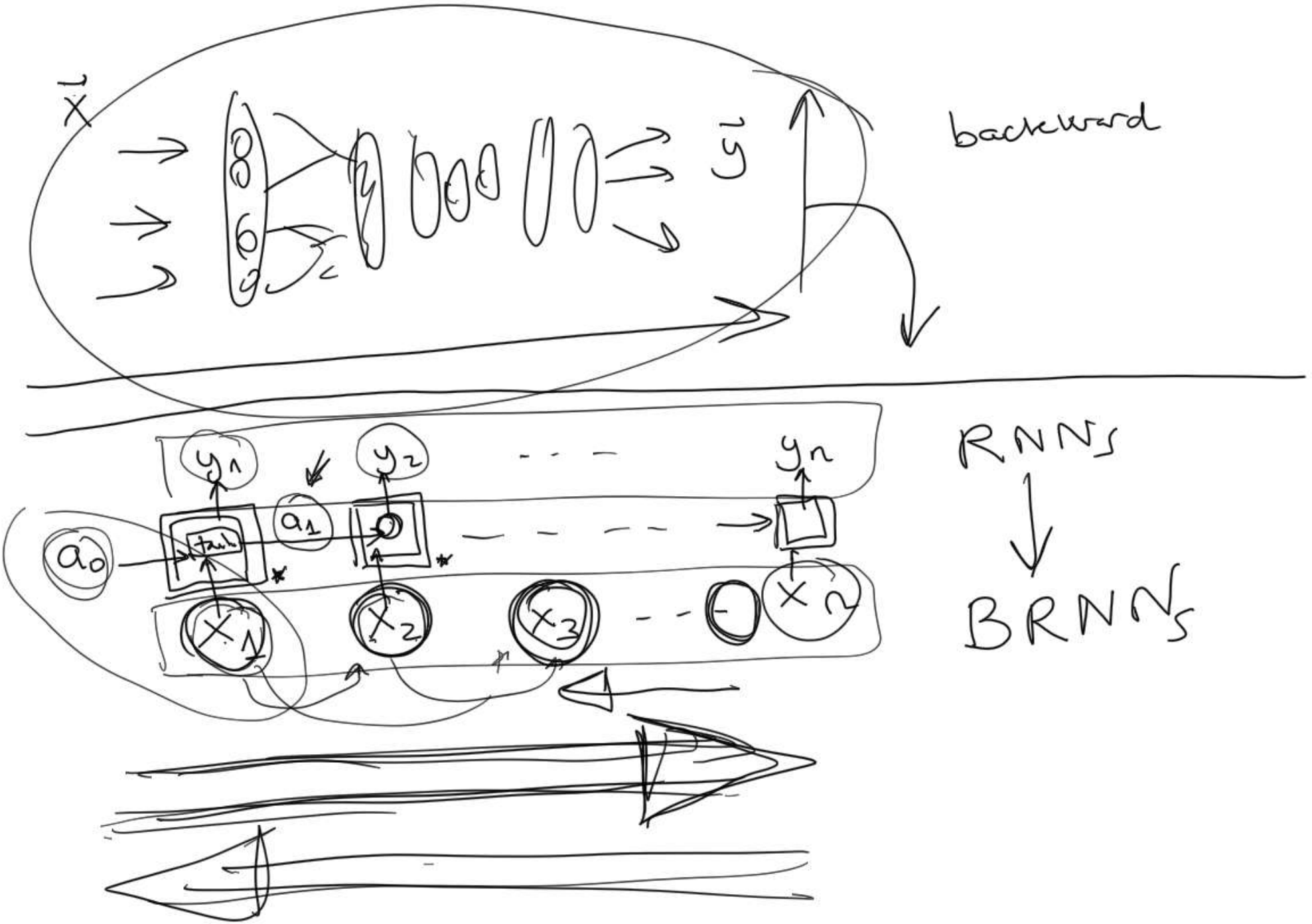
I	like	potatoes	...
1	2	3	

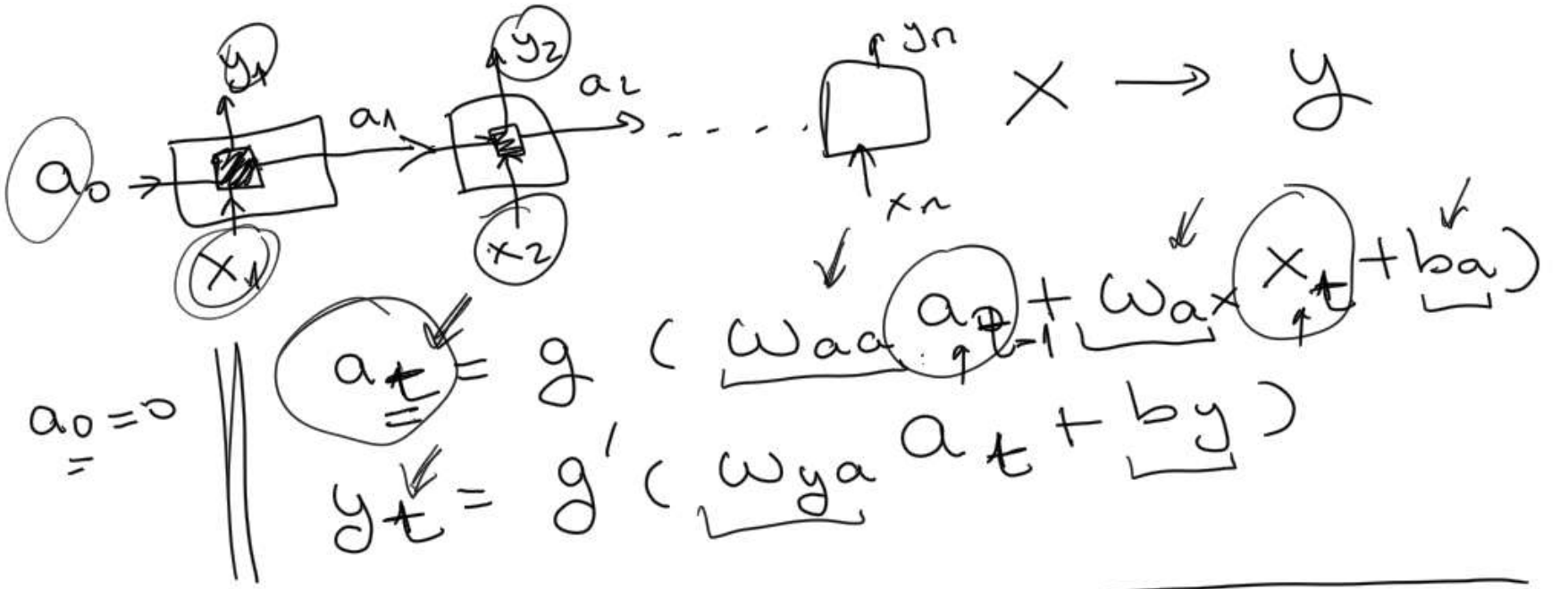
potato → (0, 0, 1 ..... 0)

vector

one-hot

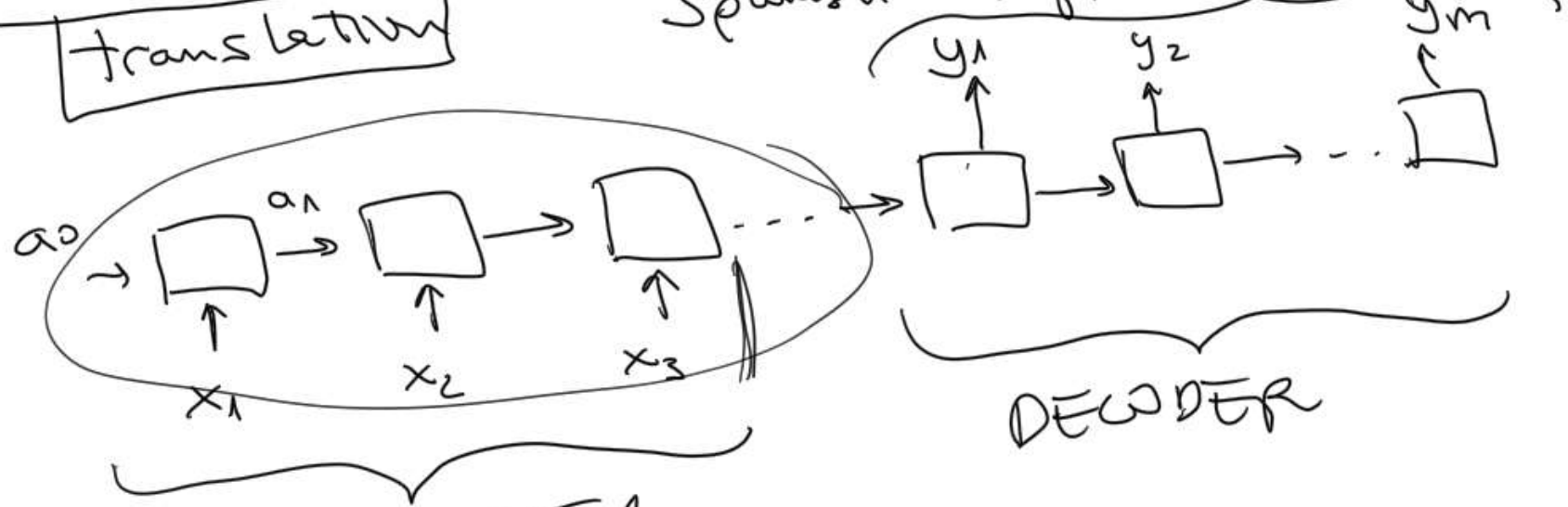
$x_1 = (1\ 1\ 1\ 0 \ldots 0)$

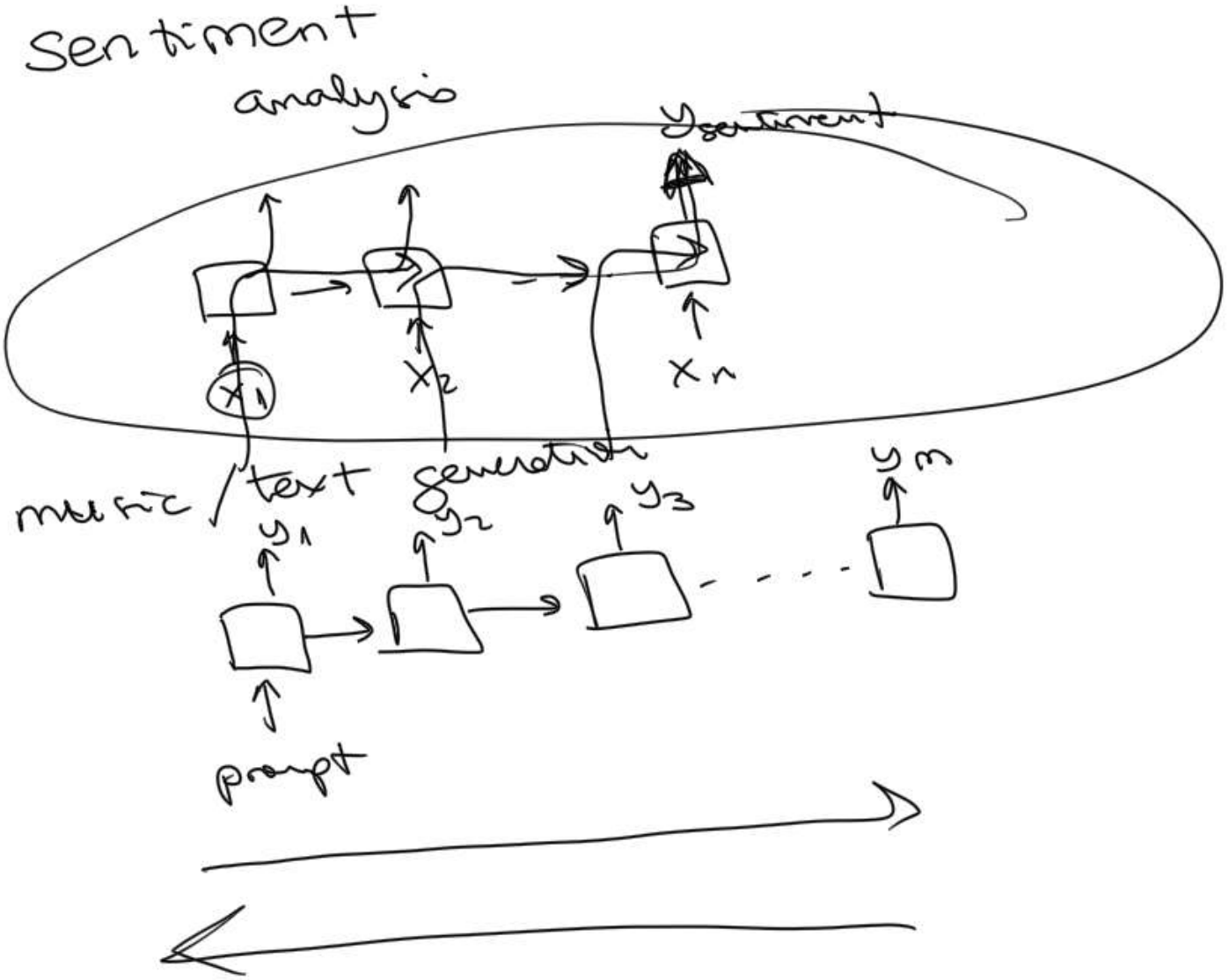

backward
RNNs
BRNNs
tanh



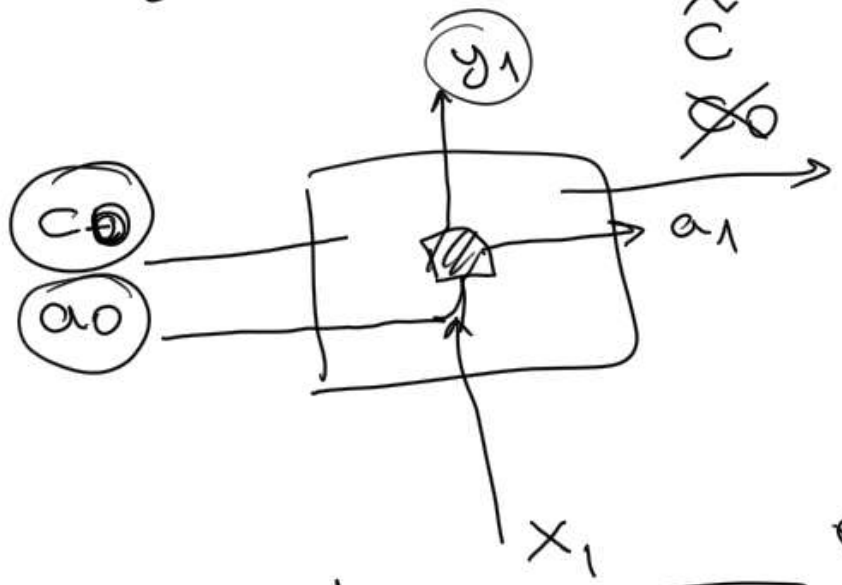
translation

Spanish → french




Sentiment
analysis
y sentiment
x1
x2
xn
text
generation
y1
y2
y3
ym
prompt

RNN basic unit



GRU

gated new element memory cell

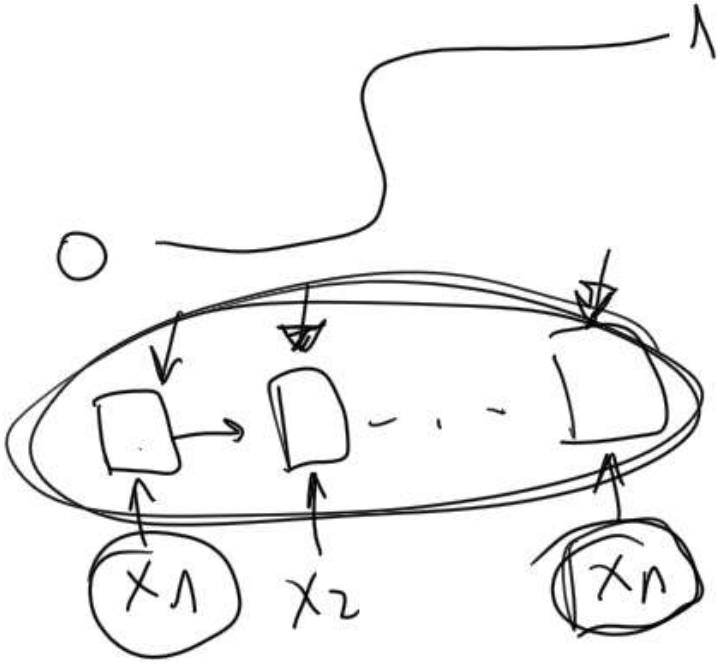
$C = a$

evaluate $\tilde{C}_t = g(W_c(c_{t-1}, x_t) + b_c)$

replacement

Gate $\Gamma_u = sig(W_u[c] + b_u)$

$$c_t = \Gamma_u \tilde{c}_t + (1 - \Gamma_u) c_{t-1}$$



LSTM more general

$a_t \neq c_t$

$\tilde{c}_t = g(w[a_{t-1}, x_t] + b)$

c_{t-1}

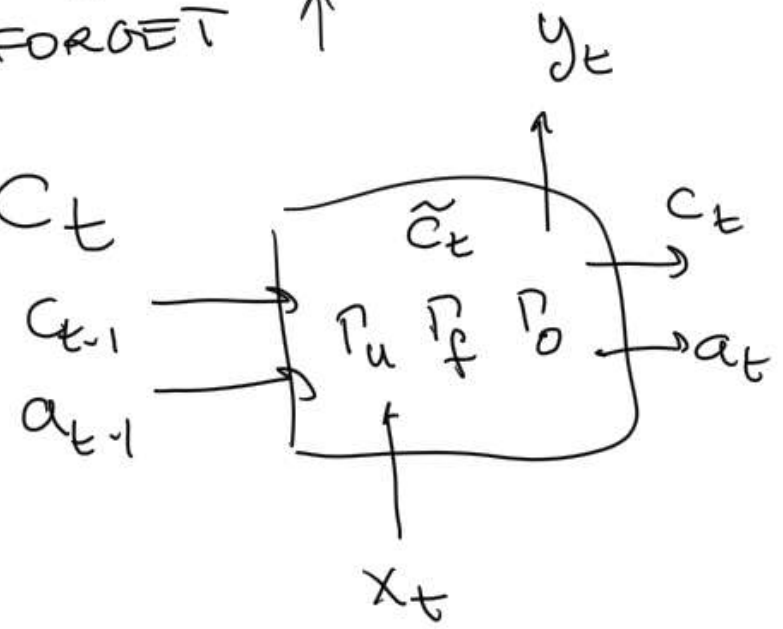
$c_t = \Gamma_u \tilde{c}_t + (1 - \Gamma_f) c_{t-1}$

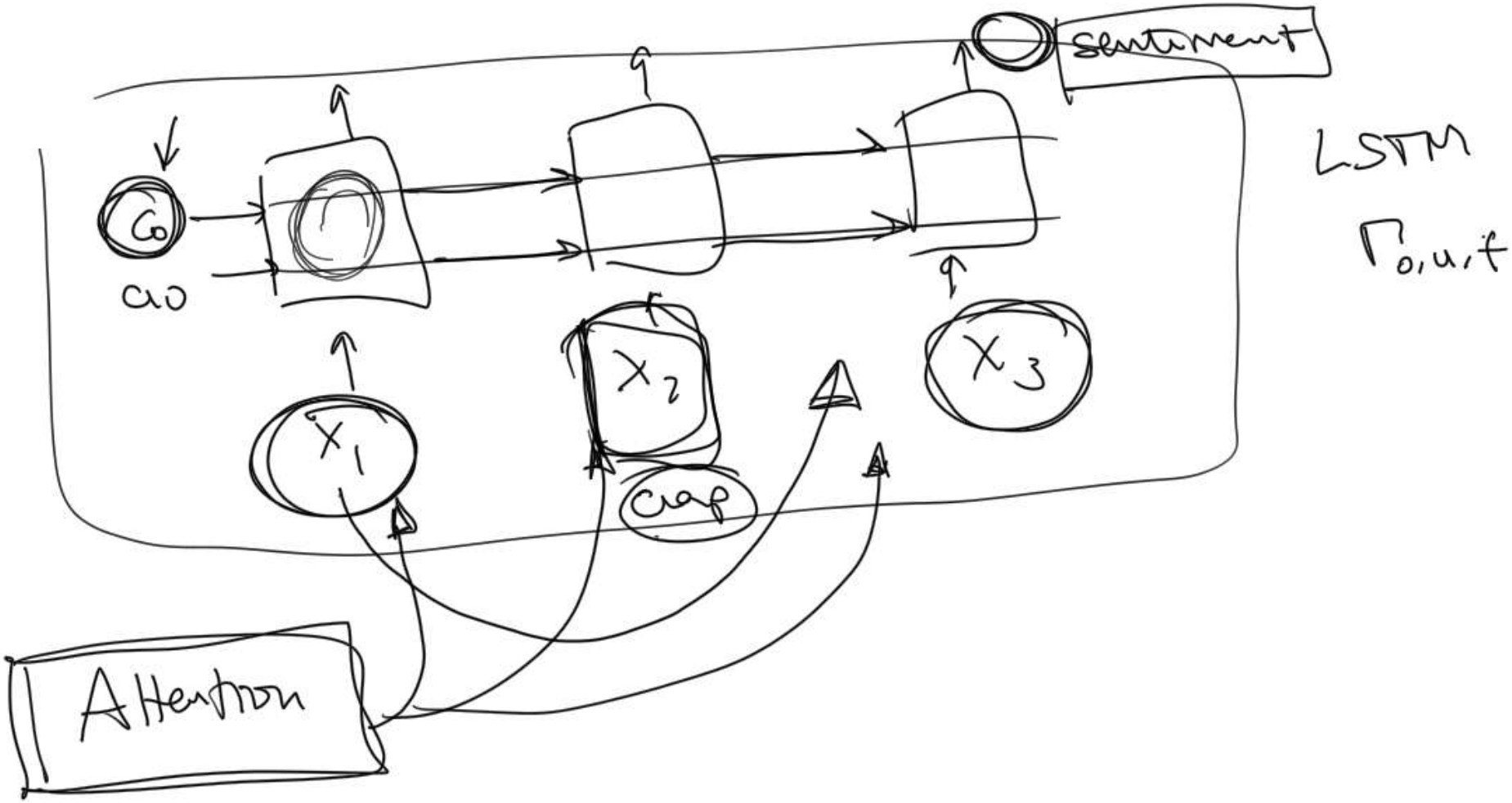
Γ_u UPDATE

Γ_f FORGET

$a_t = \Gamma_o \tanh c_t$

Γ_o OUTPUT




Sentiment
LSTM
$\Gamma_{o,u,f}$
c_0
x_1
x_2
x_3
Attention