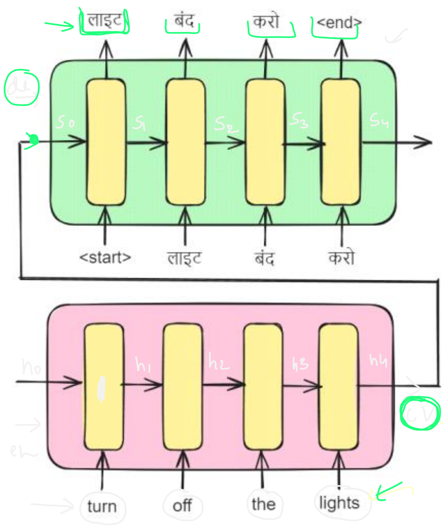
Recap

16 January 2024 16:10



turn off the lights → लाइट बंद करो

[NMT]

encoder-decoder

LSTM

stacked LSTM

set of numbers

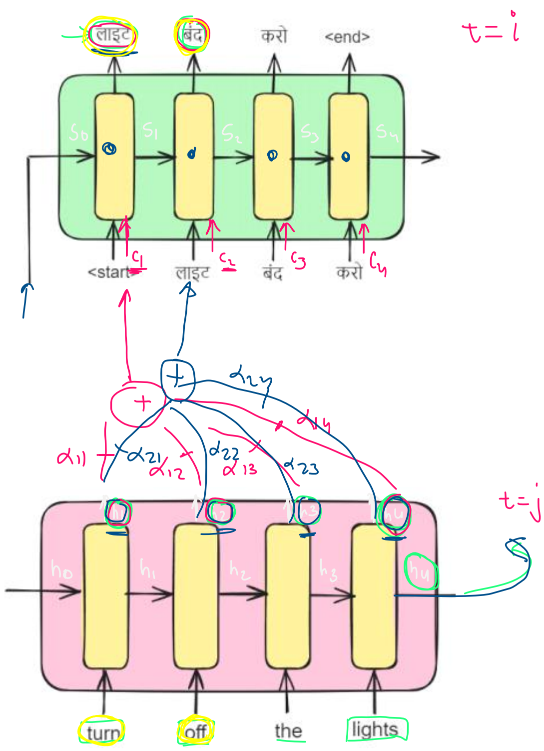
sentence >30 words

paragraph

document

translation

bottleneck → Attention mechanism



t=i

$c_1 \; c_2 \; c_3 \; c_4$

weighted sum

$$\boxed{c_i = \sum_{j=1}^{4} \alpha_{ij} h_j}$$

$\alpha \rightarrow$ alignment score

$4 \times 4 = 16$

$$c_1 = \alpha_{11} h_1 + \alpha_{12} h_2 + \alpha_{13} h_3 + \alpha_{14} h_4$$

$$c_2 = \alpha_{21} h_1 + \alpha_{22} h_2 + \alpha_{23} h_3 + \alpha_{24} h_4$$

$\alpha \rightarrow$ find out

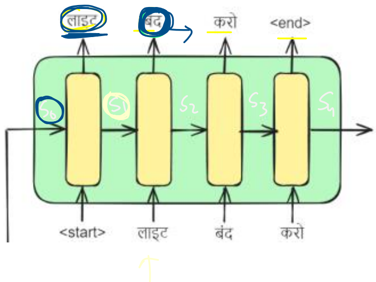
Bahdanau attention

Luong attention

Bahdanau Attention

16 January 2024 16:11

t=1



alignment score

$c_i = \sum \alpha_{ij} h_j$

given

decoder → prev hidden state

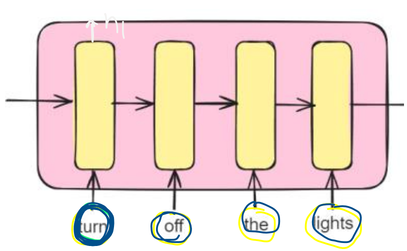
α

alignment

$\alpha_{11} \rightarrow$ लाइट → turn

$\alpha_{12} \rightarrow$ बंद → off

$\alpha_{11} = f(h_1, s_0)$ $\alpha_{21} = f(h_1, s_1)$



t=j

→ $\alpha_{ij} = f(h_j, s_{i-1})$ math func → the encode hidden | decod prev hidden state

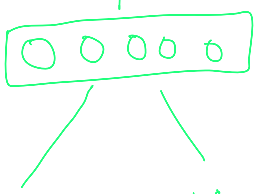
approximate

FFN → ANN → UFA

α_{ij}

softmax

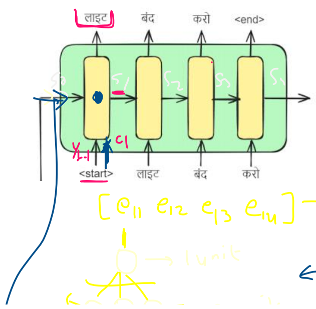
e_{ij}



s_{i-1} h_j

s_{i-1}, h_j → FFN → e_{ij} → softmax → α_{ij} → c_i → y_t

$s_0 \; y_{t-1} \; c_1 \rightarrow$ lstm → y_t (लाइट) $\boxed{s_1}$



i=1 $\boxed{t=2}$

encoder sentence

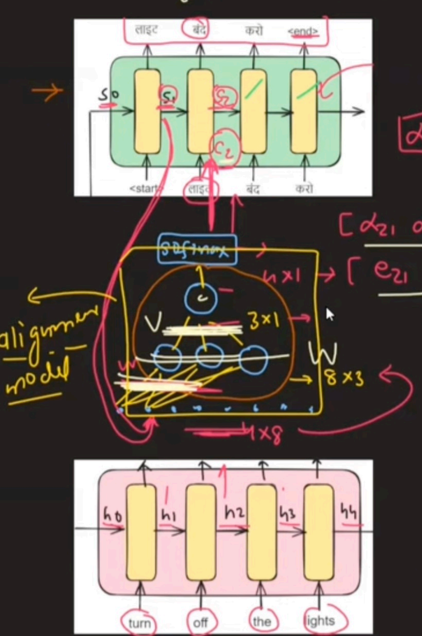
↳ $h_1 \; h_2 \; h_3 \; h_4$

s_{i-1} h_j

$c_1 = \sum \alpha_{ij} h_j$

$[e_{11} \; e_{12} \; e_{13} \; e_{14}] \rightarrow$ softmax $\rightarrow [\alpha_{11} \; \alpha_{12} \; \alpha_{13} \; \alpha_{14}]$

3×1 ← $c_1 = \alpha_{11} h_1 + \alpha_{12} h_2 + \alpha_{13} h_3 + \alpha_{14} h_4$



$c_2 = \alpha_{21} h_1 + \alpha_{22} h_2 + \alpha_{23} h_3 + \alpha_{24} h_4$

$$\begin{bmatrix} s_{11} & s_{12} & s_{13} & s_{14} & h_{11} & h_{12} & h_{13} & h_{14} \\ s_{11} & s_{12} & s_{13} & s_{14} & h_{21} & h_{22} & h_{23} & h_{24} \\ s_{11} & s_{12} & s_{13} & s_{14} & h_{31} & h_{32} & h_{33} & h_{34} \\ s_{11} & s_{12} & s_{13} & s_{14} & h_{41} & h_{42} & h_{43} & h_{44} \end{bmatrix}$$

4×8

time distributed FNN

$[\alpha_{21}\ \alpha_{22}\ \alpha_{23}\ \alpha_{24}]$

4×1 $[e_{21}\ e_{22}\ e_{23}\ e_{24}]$

4×3

$c_{ij} = \sum \alpha_{ij} h_j$

$\alpha_{ij} = \dfrac{\exp(e_{ij})}{\sum_{k=1}^{n} \exp(e_{ik})}$

$e_{ij} = V[\tanh(W[s_{i-1} : h_j] + b)]$

additive attention

3×1

8×3

batch operation 4×8 $8\times 3 \rightarrow \boxed{4\times 3}$

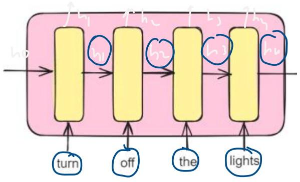
$\tan(4\times 3)$

$C_1 = \alpha_{11}h_1 + \alpha_{12}h_2 + \alpha_{13}h_3 + \alpha_{14}h_4$

$\alpha($ $s_0 = [e\ f\ g\ h]$

$[s_{i-1} : h_j]$

h_1 h_2 h_3 h_4



vector 4dim

$h_0 = [a\ b\ c\ d]$

$(4\times 3)(3\times 1)$

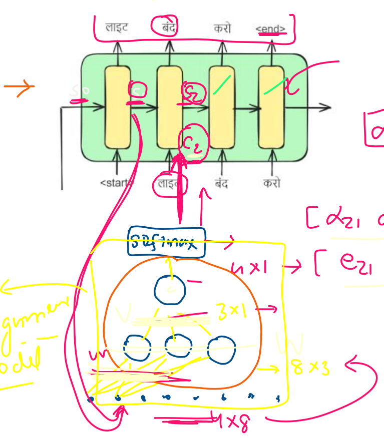
$\left[\dfrac{e^{e_{11}}}{e^{e_{11}} + e^{e_{12}} + e^{e_{13}} + e^{e_{14}}} \right.$ $(4\times 1) \rightarrow$ 4 numbers

4 rows / 8 cols 8cols

α 4 rows

s_{01}	s_{02}	s_{03}	s_{04}	h_{11}	h_{12}	h_{13}	h_{14}
s_{01}	s_{02}	s_{03}	s_{04}	h_{21}	h_{22}	h_{23}	h_{24}
s_{01}	s_{02}	s_{03}	s_{04}	h_{31}	h_{32}	h_{33}	h_{34}
s_{01}	s_{02}	s_{03}	s_{04}	h_{41}	h_{42}	h_{43}	h_{44}

true label



$C_2 = \alpha_{21}h_1 + \alpha_{22}h_2 + \alpha_{23}h_3 + \alpha_{24}h_4$

$\boxed{\alpha}$

$[\alpha_{21}\ \alpha_{22}\ \alpha_{23}\ \alpha_{24}]$

$4\times 1 \rightarrow [e_{21}\ e_{22}\ e_{23}\ e_{24}]$

4×3

s_{11}	s_{12}	s_{13}	s_{14}	h_{11}	h_{12}	h_{13}	h_{14}
s_{11}	s_{12}	s_{13}	s_{14}	h_{21}	h_{22}	h_{23}	h_{24}
s_{11}	s_{12}	s_{13}	s_{14}	h_{31}	h_{32}	h_{33}	h_{34}
s_{11}	s_{12}	s_{13}	s_{14}	h_{41}	h_{42}	h_{43}	h_{44}

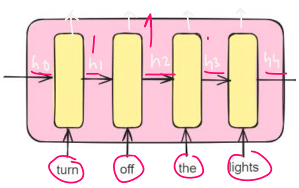
4×8

time distributed FNN

$$c_i = \sum \alpha_{ij} h_j$$

$$\alpha_{ij} = \frac{\exp(e_{ij})}{\sum_{k=1} \exp(e_{ik})}$$

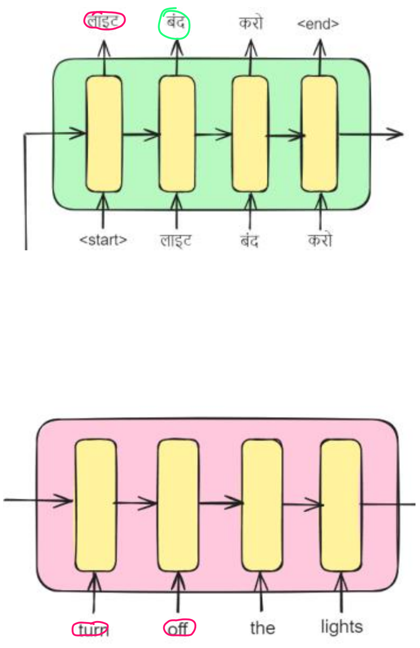
$$e_{ij} = V[\tanh(W[s_{i-1}; h_j] + b)]$$



additive attention

Luong Attention

17 January 2024 00:09



parameters → slow

$c_i = \sum \alpha_{ij} h_j$ → FFN $\{[V \tanh(W[s_{i-1} : h_j] + b)]\}$

$\alpha_{ij} = f(s_{i-1}, h_j)$ ×

$\alpha_{ij} = f(s_i, h_j)$ → $[s_i^T \cdot h_j]$ → dot product

fast

current

① diff

updated info

dynam

adjust

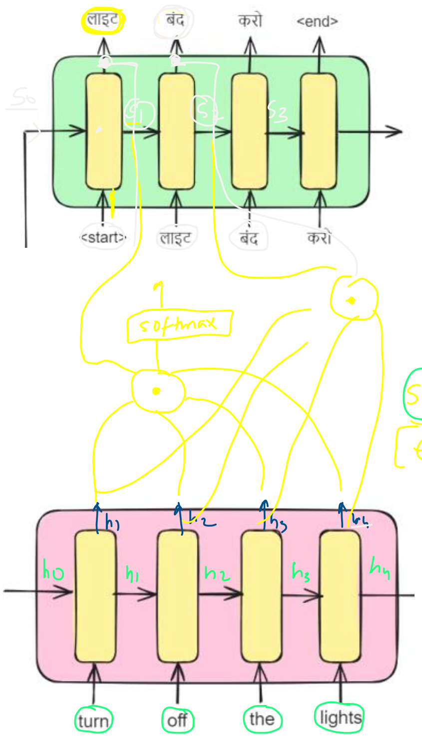
$s_i = [a\ b\ c\ d]$

$h_j = [e\ f\ g\ h]$

$\begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} [e\ f\ g\ h]$

$[ae + bf + cg + dh]$ → scalar → attention

α_{ij} ← softmax ← $\boxed{e_{ij}}$



output

multiplicative atten

$[e_{21}\ e_{22}\ e_{23}\ e_{24}]$ softm → $\alpha_{21}\ \alpha_{22}\ \alpha_{23}\ \alpha_{24}$ → c_2

$s_1 h_1$ $s_1 h_2$ $s_1 h_3$ $s_1 h_4$

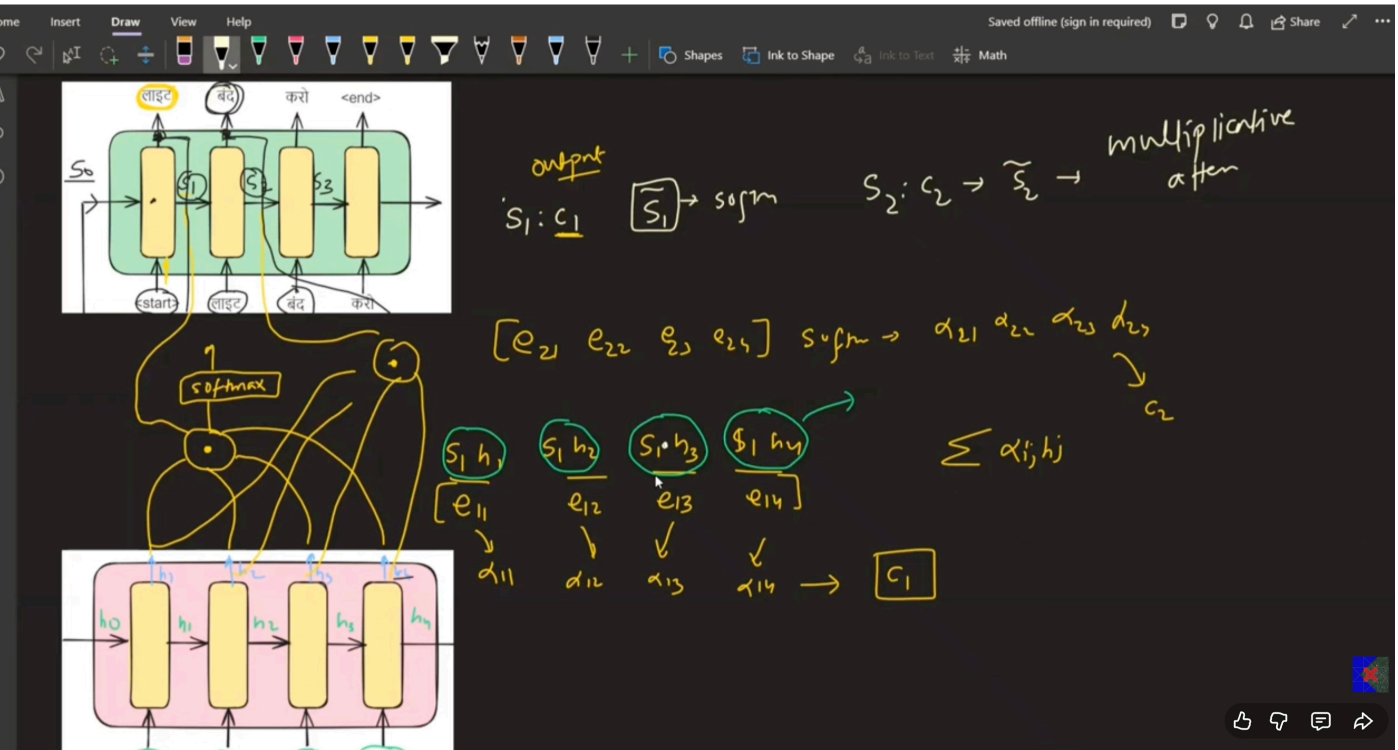
$[e_{11}\ e_{12}\ e_{13}\ e_{14}]$

$\alpha_{11}\ \alpha_{12}\ \alpha_{13}\ \alpha_{14}$ → $\boxed{c_1}$

$\sum \alpha_{ij} h_j$

Here in Luong , we made two changes , instead of providing context vector in input we are providing it in output , also it changes how alignment score is calculated now instead of neural network we are using dot product , also we are using current decoder hidden state and input to calculate (which is more dynamic)

Due to dot product involvement it is also called multiplicative attention.



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Shapes
Ink to Shape
Ink to Text
Math
Saved offline (sign in required)
Share
लाइट
बंद
करो
<end>
<start>
softmax
output
s1 : c1
s1 → softm
s2 : c2 → s2 →
multiplicative atten
[e21 e22 e23 e24] softm → α21 α22 α23 α24
c2
s1 h1
s1 h2
s1·h3
s1 h4
Σ αij hj
[e11 e12 e13 e14]
α11 α12 α13 α14 → c1