Transformer

Adaptado a series temporales

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- Aplicaciones Transformers
- RNN vs Transformers
- Arquitectura del Transformer
- Transformer para series temporales
- Nuestros resultados
- Posibles mejoras

Generating text with Transformers

Human Prompt	**In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.**
Generated Text (10 tries)	The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science. Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved. Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow. Pérez and the others then ventured further into the valley. "By the time we reached the top of one peak, the water looked blue, with some crystals on top," said Pérez. Pérez and his friends were astonished to see the unicorn herd. These creatures could be seen from the air without having to move too much to see them – they were so close they could touch their horns.

Language Models are Unsupervised Multi Task Learners, Radford et. al. (2019)

GPT-3

Describe a layout.

2 lightgrey buttons that say "Search Google" and "I'm Feeling Lucky" with padding in between them

Generate

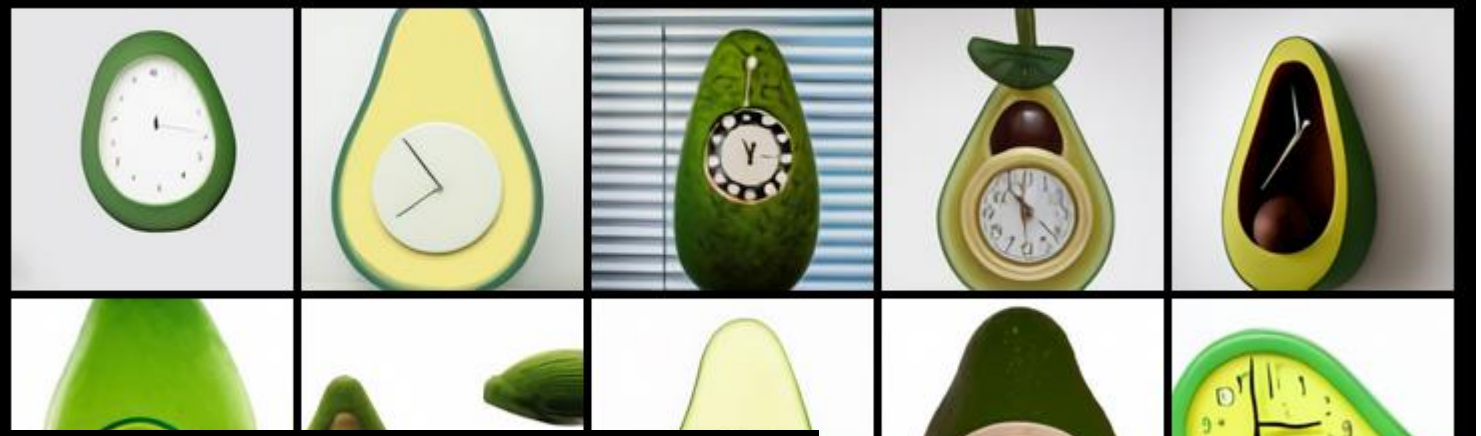
Mega-mode is on

```
// the google logo
<img
src="https://www.google.com/images/srpr/logo11

// a seach box
<input type="search"
placeholder="Search...">

// 2 lightgrey buttons that say "Search
Google" and "I'm Feeling Lucky" with padding
in between them
<div style={{padding: 10}}> <button style=
{{color: 'white', backgroundColor:
'lightgrey'}}>Search Google</button> <button
style={{color: 'white', backgroundColor:
'lightgrey'}}>I'm Feeling Lucky</button>
</div>
```

DALL - E

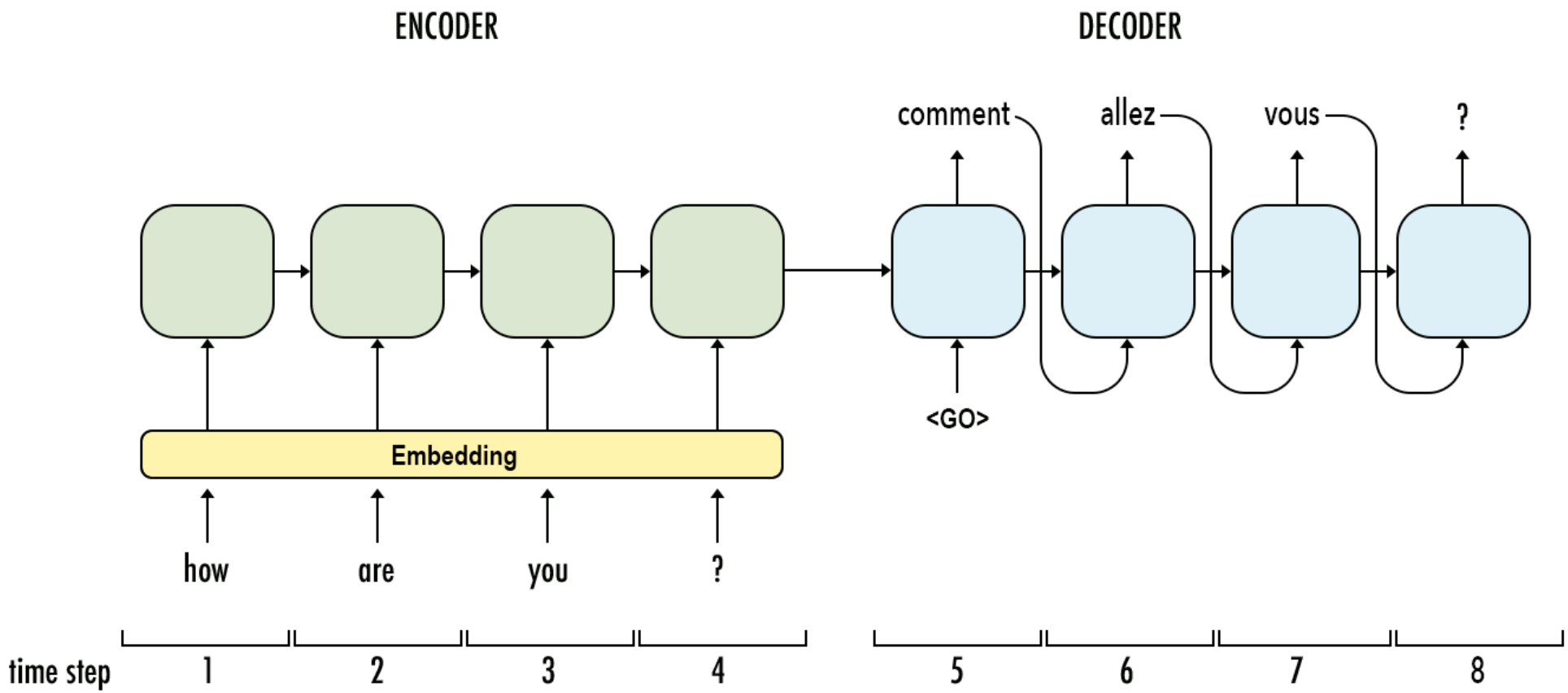
TEXT PROMPT a clock in the shape of an avocado. a clock imitating an avocado.

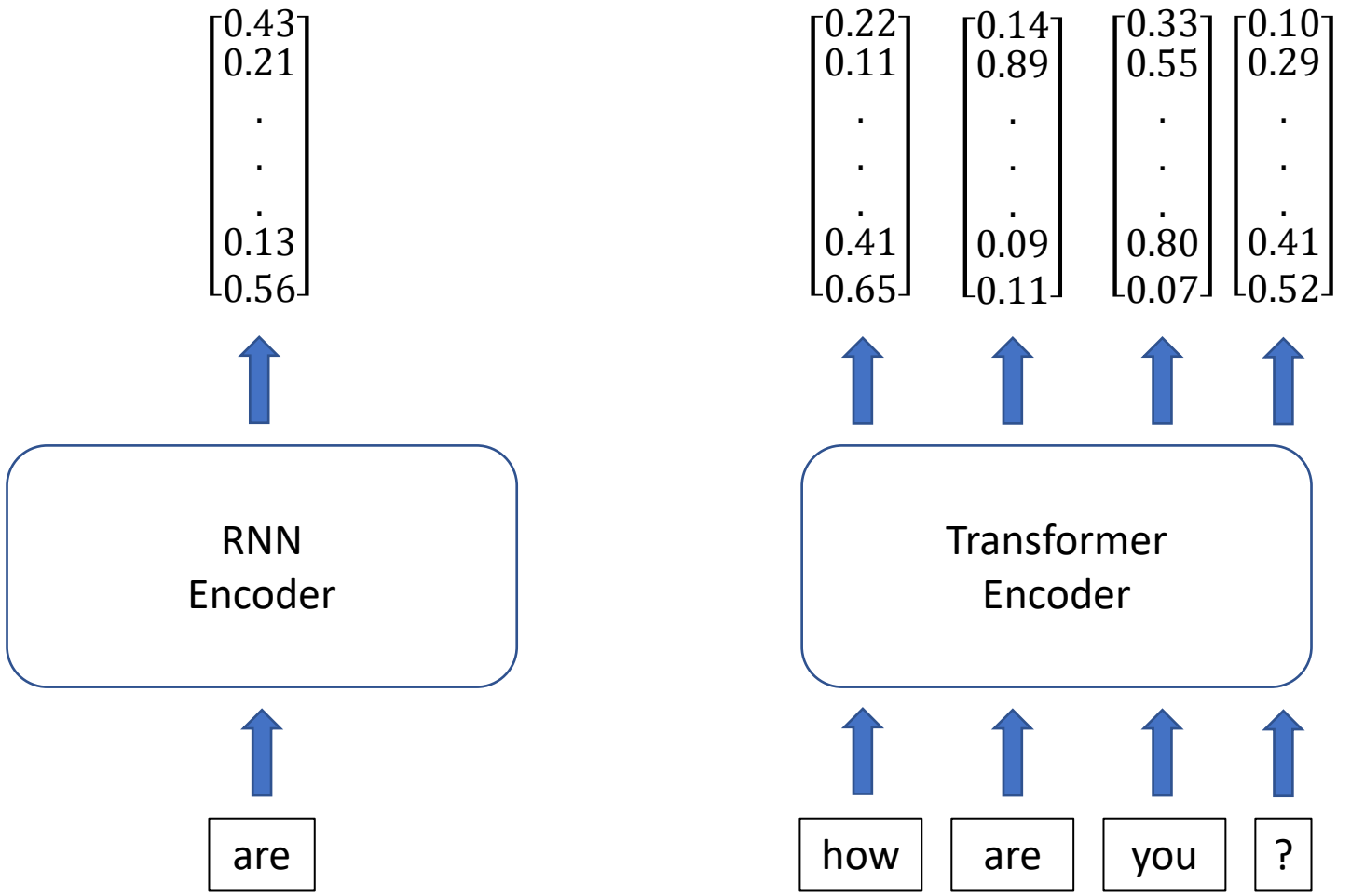
AI-GENERATED IMAGES

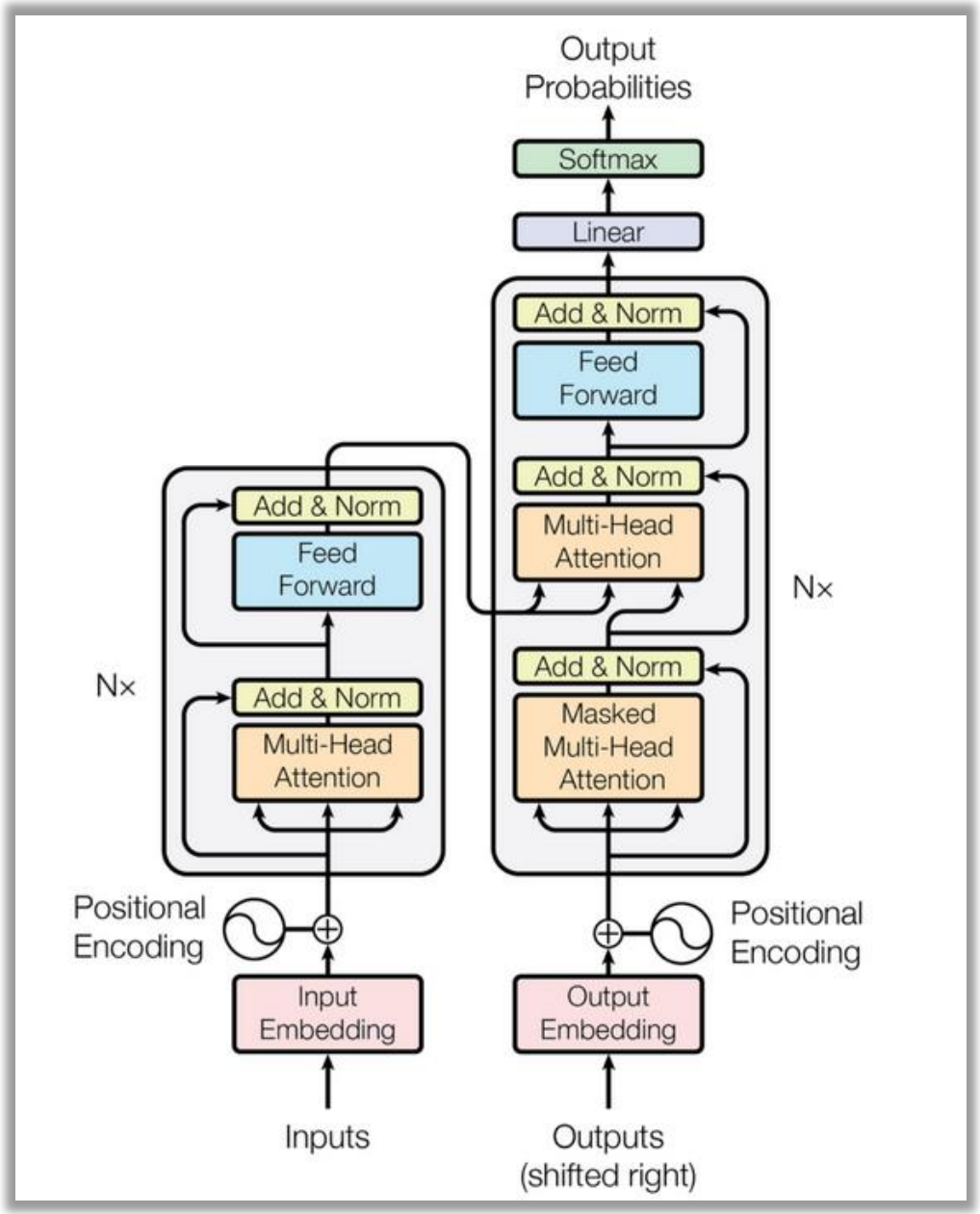


TEXT PROMPT an armchair in the shape of a strawberry. an armchair imitating a strawberry.

AI-GENERATED IMAGES


ENCODER
DECODER
comment
allez
vous
?
<GO>
Embedding
how
are
you
?
time step
1
2
3
4
5
6
7
8


0.43
0.21
0.13
0.56
RNN
Encoder
are
0.22
0.11
0.41
0.65
0.14
0.89
0.09
0.11
0.33
0.55
0.80
0.07
0.10
0.29
0.41
0.52
Transformer
Encoder
how
are
you
?


Output Probabilities
Softmax
Linear
Add & Norm
Feed Forward
Add & Norm
Multi-Head Attention
Add & Norm
Masked Multi-Head Attention
Nx
Add & Norm
Feed Forward
Add & Norm
Multi-Head Attention
Nx
Positional Encoding
Positional Encoding
Input Embedding
Output Embedding
Inputs
Outputs (shifted right)

The
Law
will
never
be
perfect
,
but
its
application
should
be
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-
this
is
what
we
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missing
,
in
my
opinion
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<EOS>
<pad>
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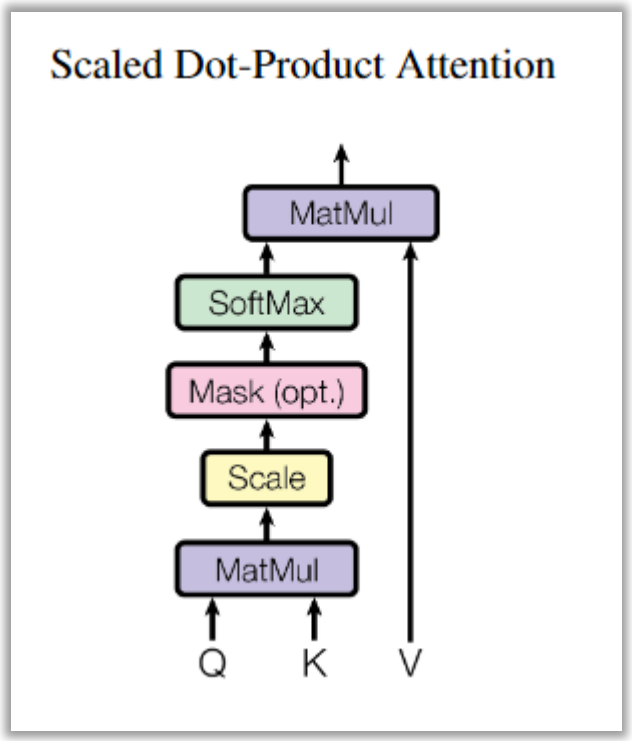
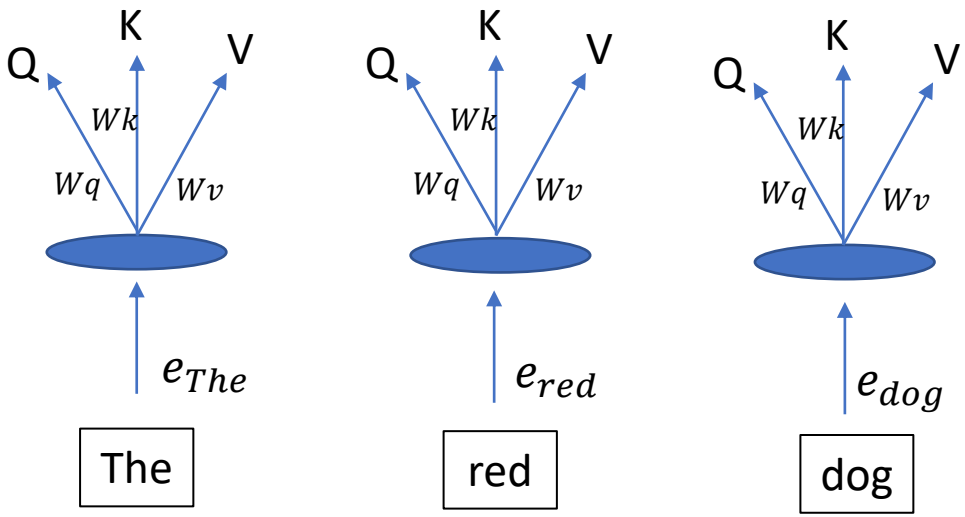
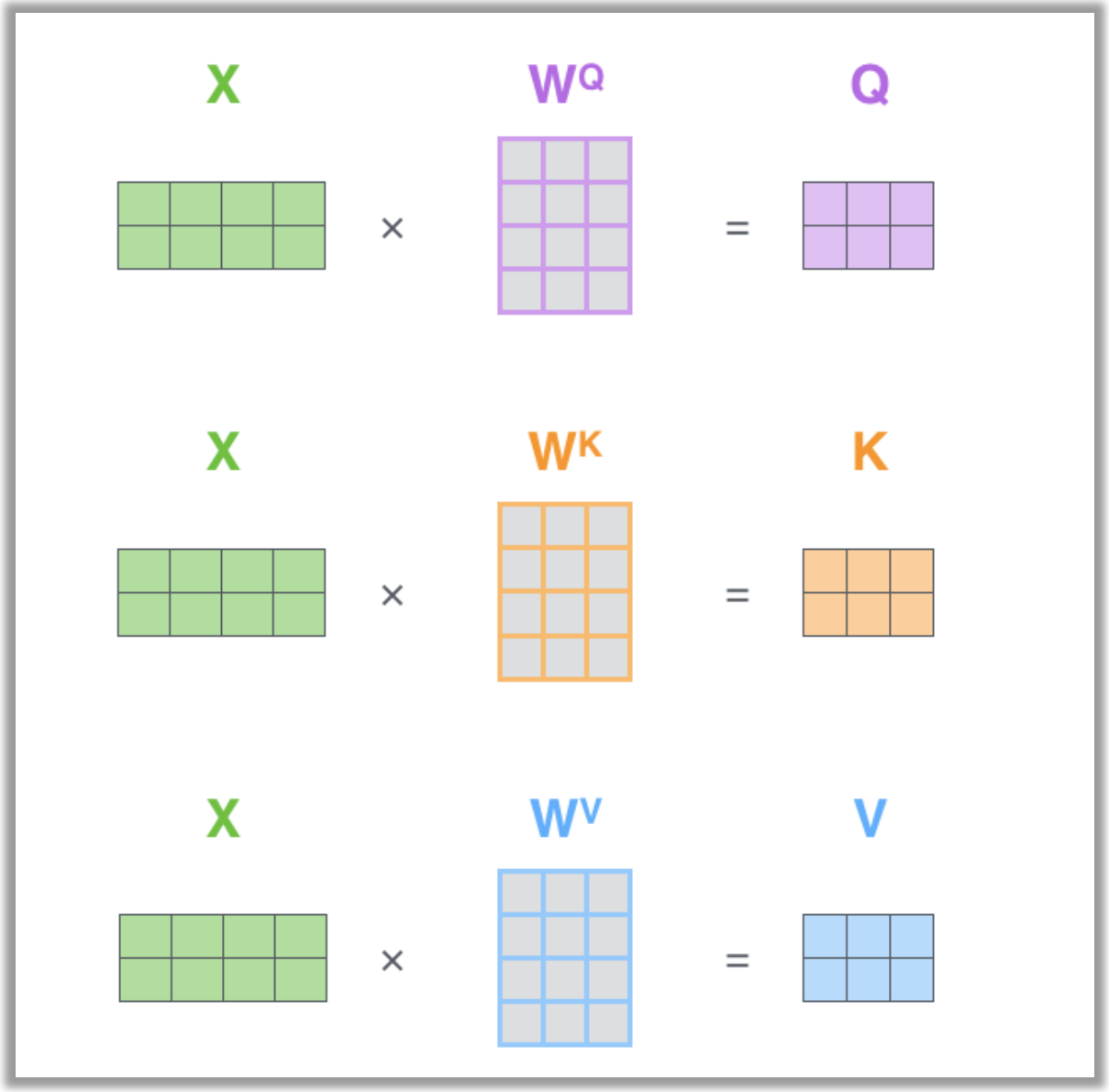
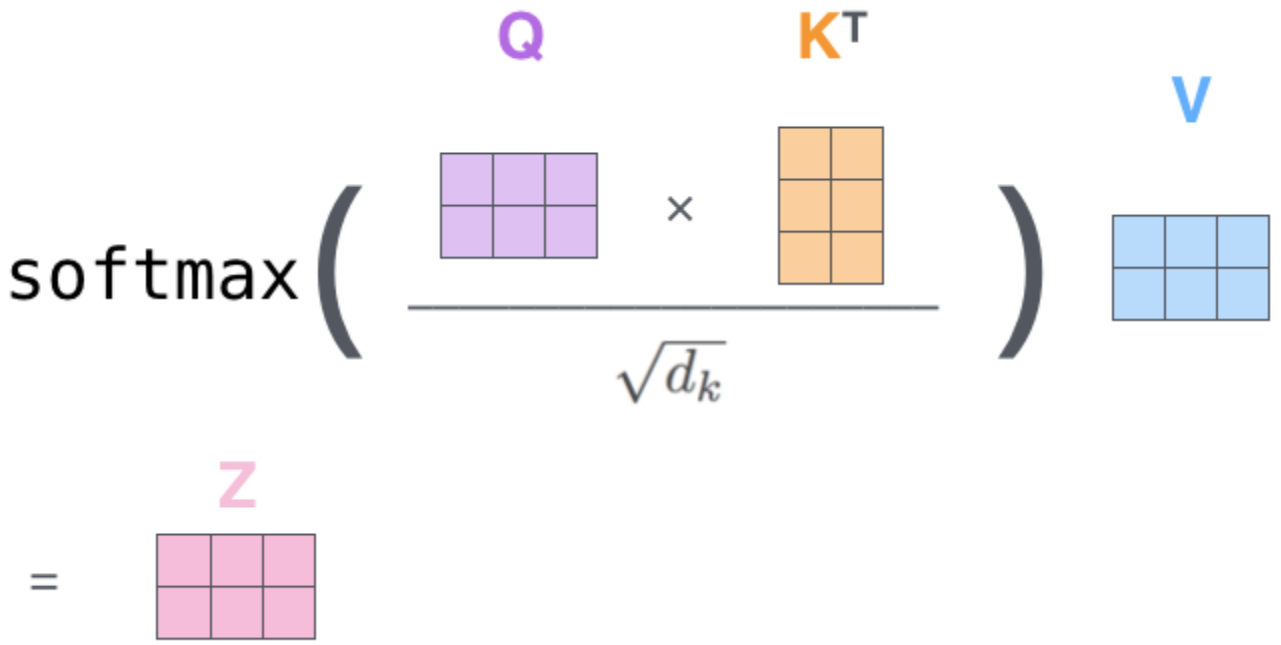


$$\text{Attention}(Q, K, V) = \text{softmax}(\frac{QK^T}{\sqrt{d_k}})V$$

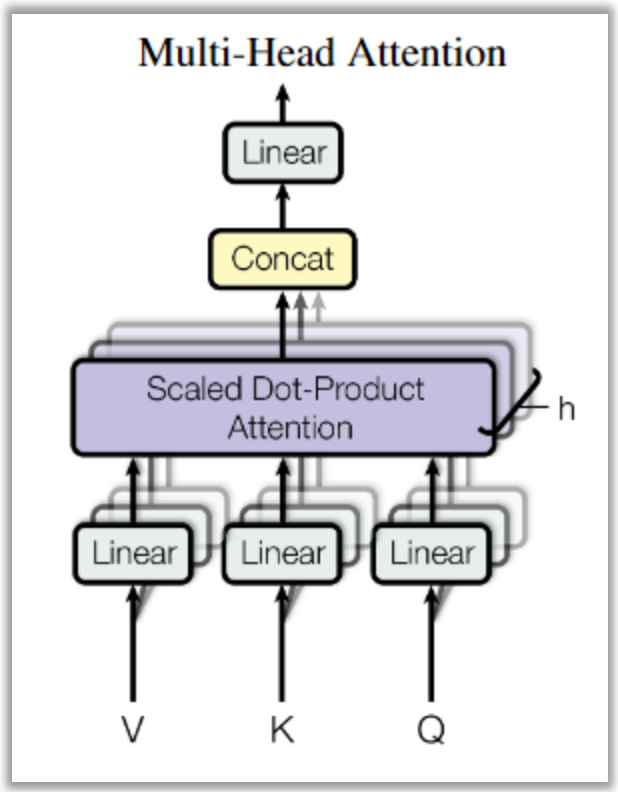


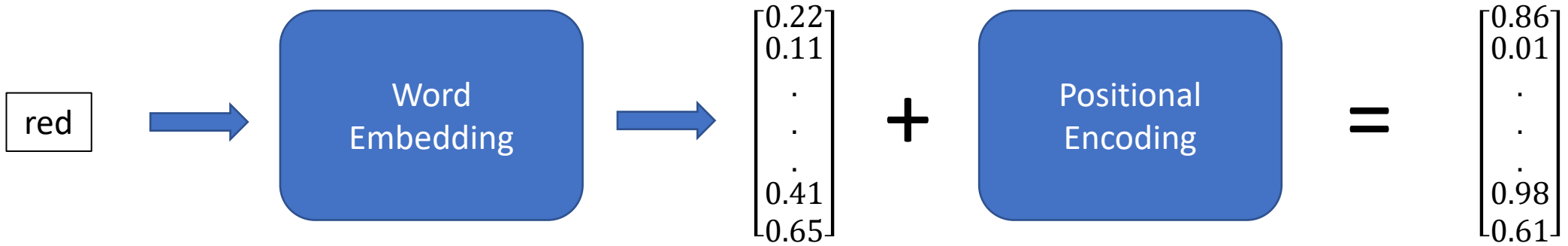


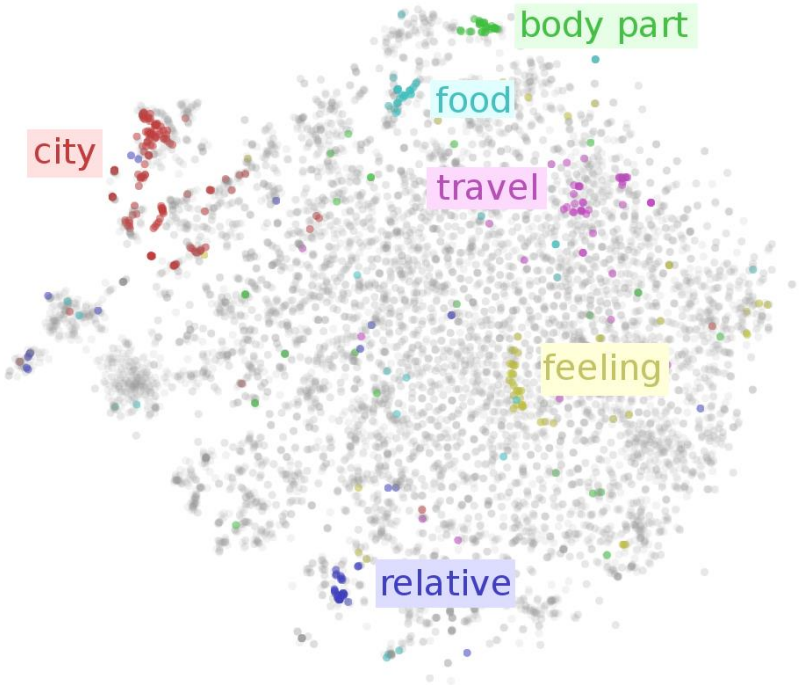
Source: The Illustrated Transformer
http://jalammar.github.io/illustrated-transformer



Source: The Illustrated Transformer
http://jalammar.github.io/illustrated-transformer


Multi-Head Attention
Linear
Concat
Scaled Dot-Product Attention
h
Linear
Linear
Linear
V
K
Q

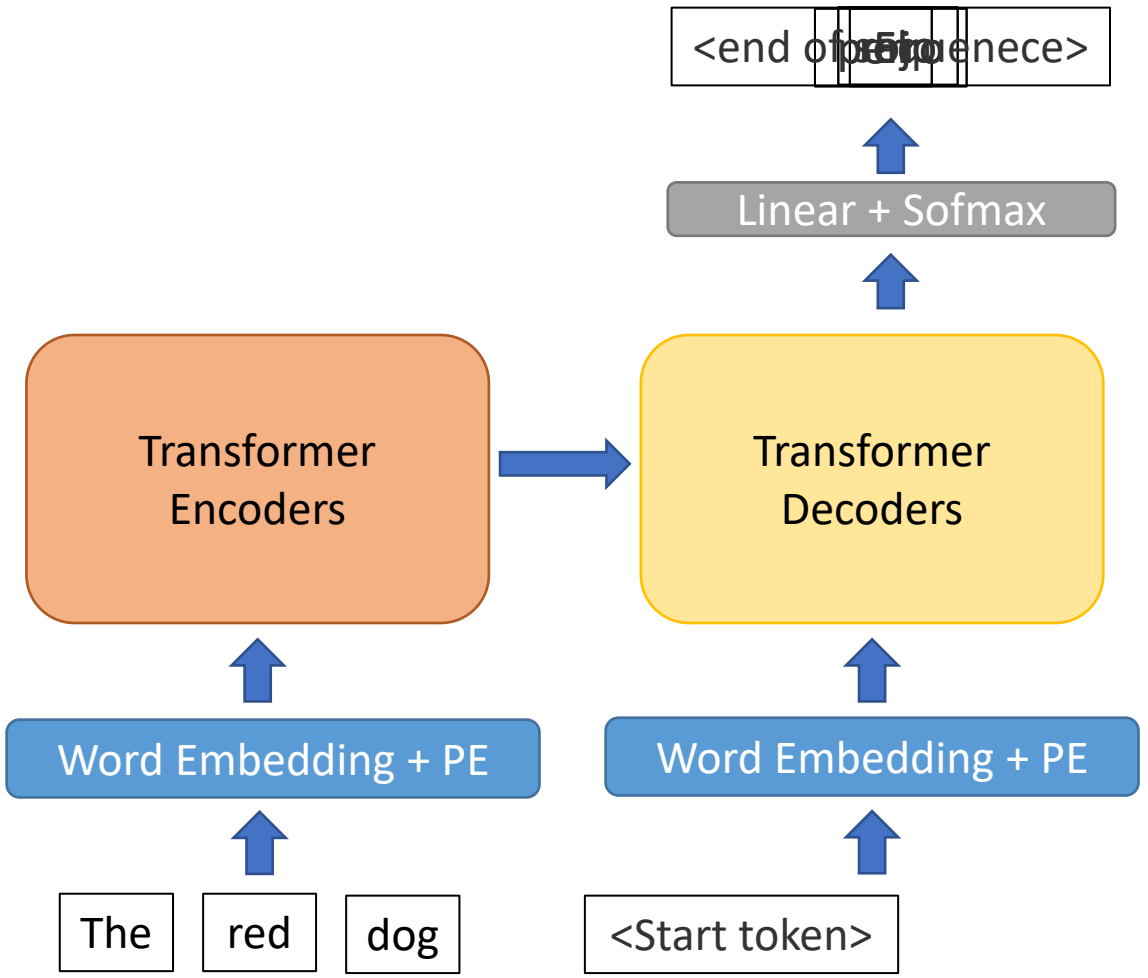




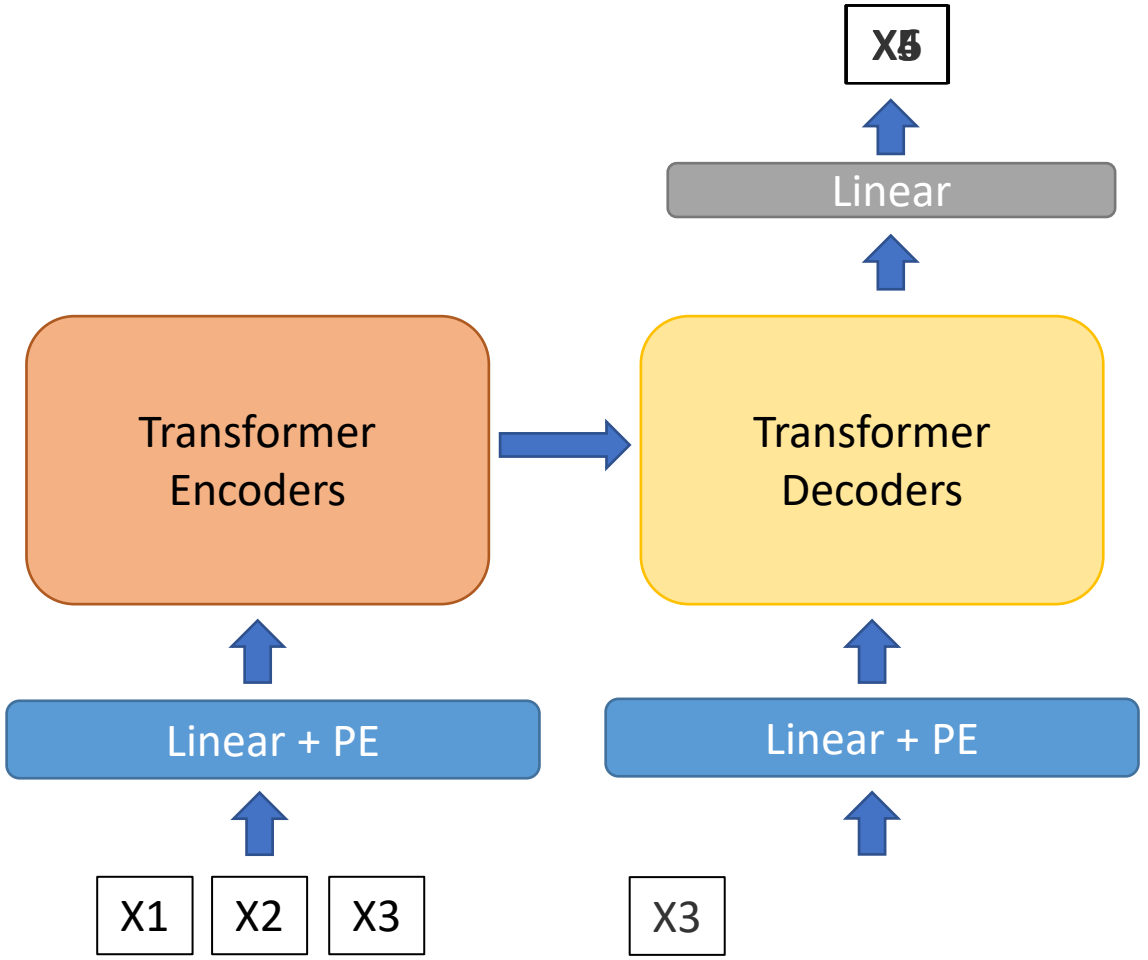
$$p_{i,2j} = \sin\left(\frac{i}{10000^{2j/d}}\right)$$

$$p_{i,2j+1} = \cos\left(\frac{i}{10000^{2j/d}}\right)$$

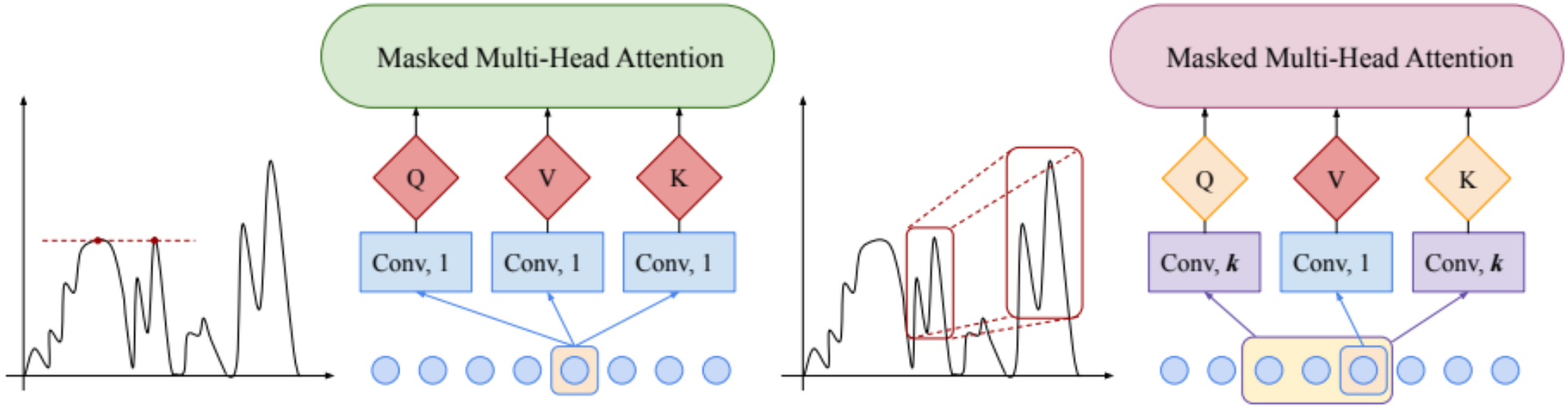
OUTPUT:


<end of sentence>
Linear + Sofmax
Transformer Encoders
Transformer Decoders
Word Embedding + PE
Word Embedding + PE
The
red
dog
<Start token>

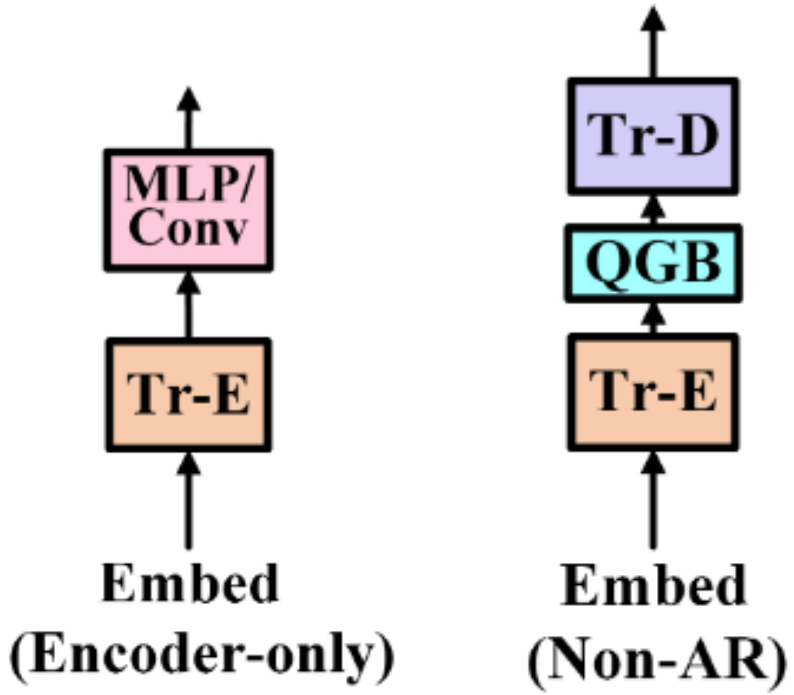
OUTPUT:


X5
Linear
Transformer Encoders
Transformer Decoders
Linear + PE
Linear + PE
X1
X2
X3
X3

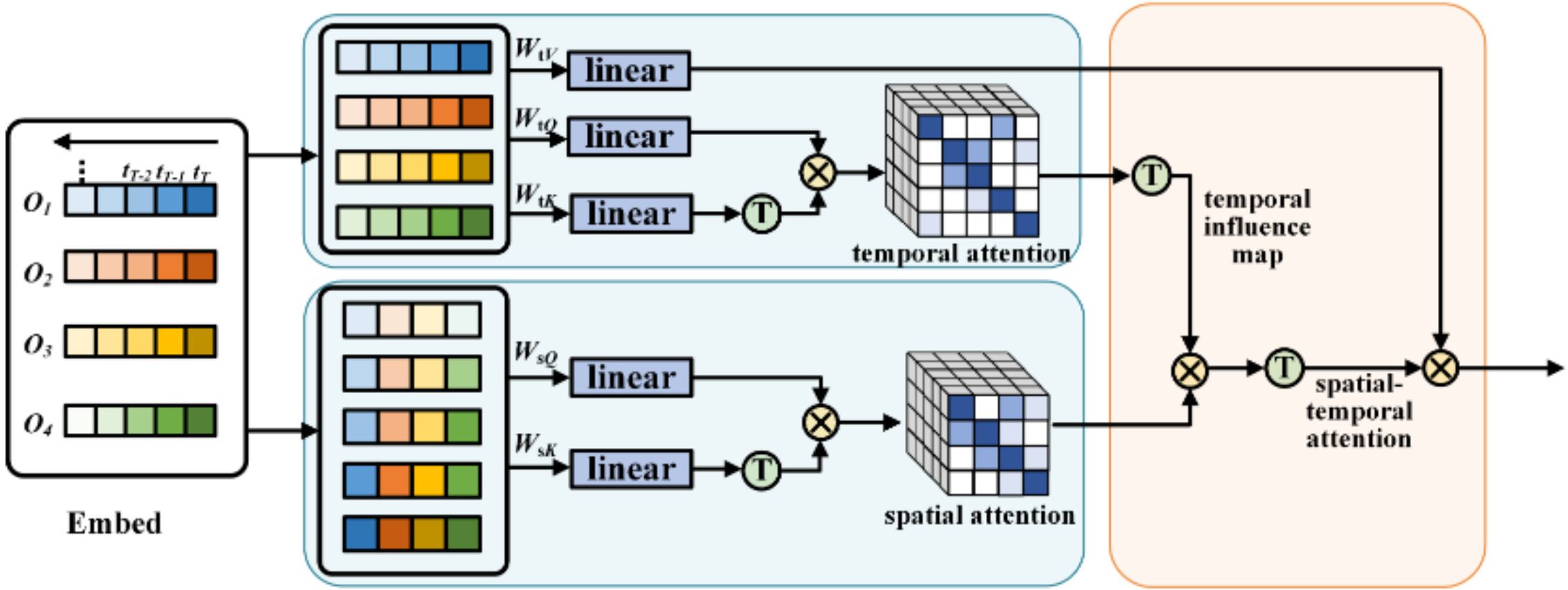
	Datasets	WAPE			MAE		
		Transformer	LSTM	CNN	**Transformer**	LSTM	CNN
1	CIF2016o12	**11.207**	12.475	12.479	12,564.18	**11,732.31**	12,762.73
2	CIF2016o6	16.157	**15.352**	17.143	**2,182,435.2**	3,636,929.7	2,833,131.5
3	ExchangeRate	0.303	**0.300**	0.335	0.0021	**0.0019**	0.0020
4	M3	**12.490**	15.282	15.612	**659.18**	700.25	709.44
5	M4	**13.587**	14.281	14.256	**588.38**	597.54	593.71
6	NN5	18.637	**18.589**	18.852	3.570	**3.538**	3.572
7	SolarEnergy	13.550	12.452	**11.717**	2.246	2.066	**1.977**
8	Tourism	18.68	19.081	**18.497**	2,202.11	2,280.09	**1,969.58**
9	Traffic	33.541	**31.960**	34.406	0.0121	**0.0114**	0.0124
10	Traffic-metr-la	3.418	3.359	**3.337**	2.029	2.009	**1.991**
11	Traffic-perms-bay	1.333	**1.314**	1.433	0.885	**0.870**	0.946
12	WikiWebTraffic	**46.110**	46.477	46.914	**11.796**	12.063	12.106
	Mean ranking	1.833	**1.750**	2.416	1.916	**1.833**	2.250



Enhancing the Locality and Breaking the Memory Bottleneck of Transformer on Time Series Forecasting, NeurIPS 2019



NAST: Non-Autoregressive Spatial-Temporal Transformerfor Time Series Forecasting



NAST: Non-Autoregressive Spatial-Temporal Transformerfor Time Series Forecasting

Referencias

- Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., ... & Polosukhin, I. (2017). Attention is all you need. In *Advances in neural information processing systems* (pp. 5998-6008)
- DeepMind's deep learning videos 2020 with UCL, Lecture: Deep Learning for Natural Language Processing, Felix Hill
- The Illustrated Transformer http://jalammar.github.io/illustrated-transformer/
- Yannic Kilcher video explaining the original paper: Attention Is All You Need
- Li, Shiyang, et al. "Enhancing the locality and breaking the memory bottleneck of transformer on time series forecasting." arXiv preprint arXiv:1907.00235 (2019).
- Chen, Kai, et al. "NAST: Non-Autoregressive Spatial-Temporal Transformer for Time Series Forecasting." arXiv preprint arXiv:2102.05624 (2021).