Transfer learning with Transformer networks

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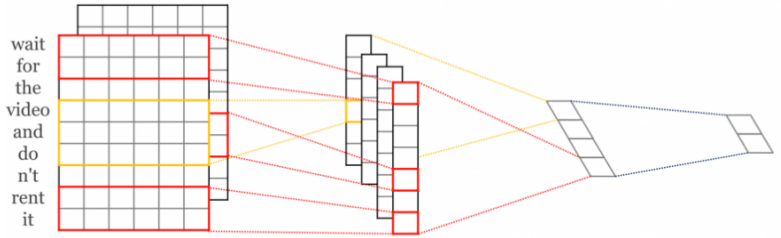
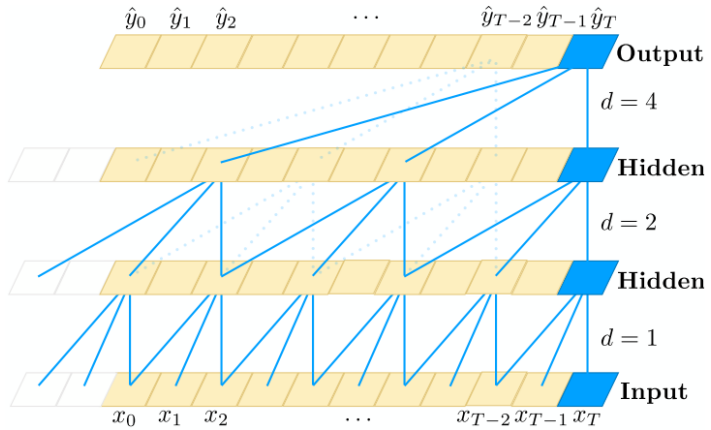
Traditional architectures for NLP

CNN



Dilated CNN



RNN

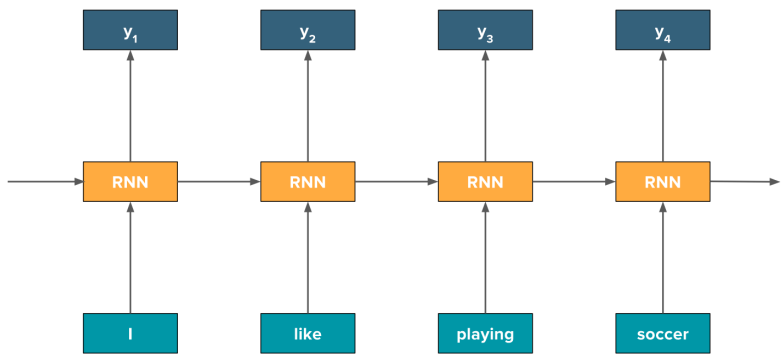
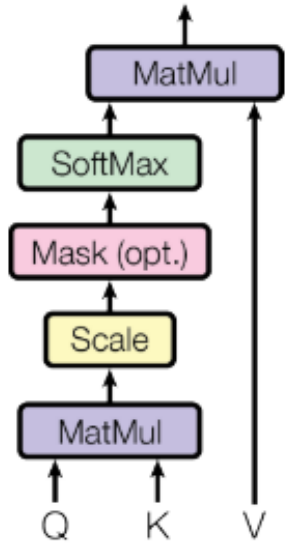


Image from https://techblog.gumgum.com/articles/deep-learning-for-natural-language-processing-part-2-rnns and

http://www.wildml.com/2015/11/understanding-convolutional-neural-networks-for-nlp/

Attention mechanisms

Scaled Dot-Product Attention

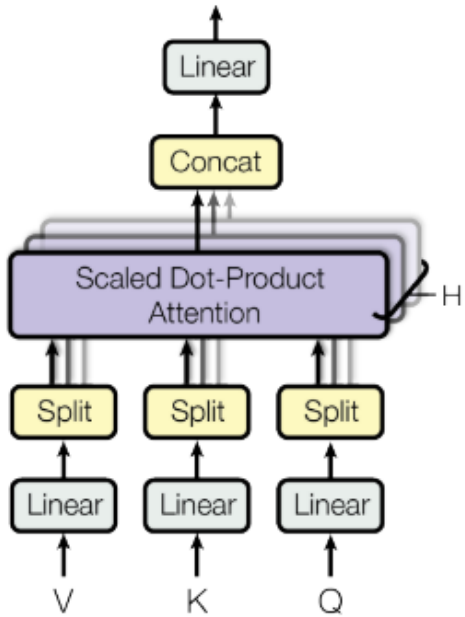


Q is the query vector, K is the key vector and V value vector.

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

Attention mechanisms

Multi-Head Attention

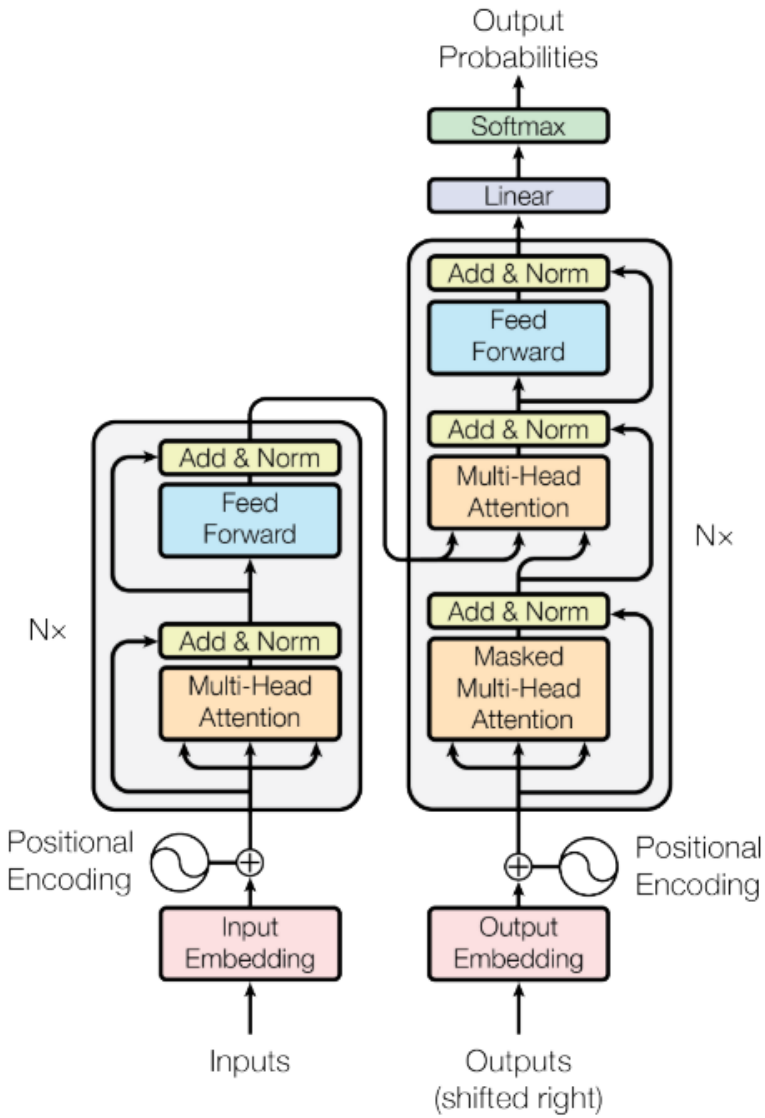


$$\text{MultiHead}(Q, K, V) = \text{Concat}(\text{head}_1, \ldots, \text{head}_h)$$
$$\text{where} \quad \text{head}_i = \text{Attention}(QW_i^Q, KW_i^K, VW_i^V)$$

where the projections W_i^Q, W_i^K and W_i^V are parameter matrices.

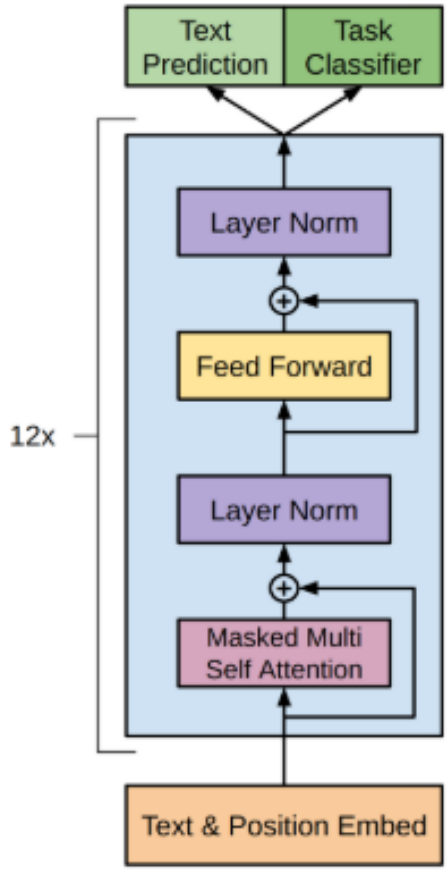
Transformer network

Original transformer



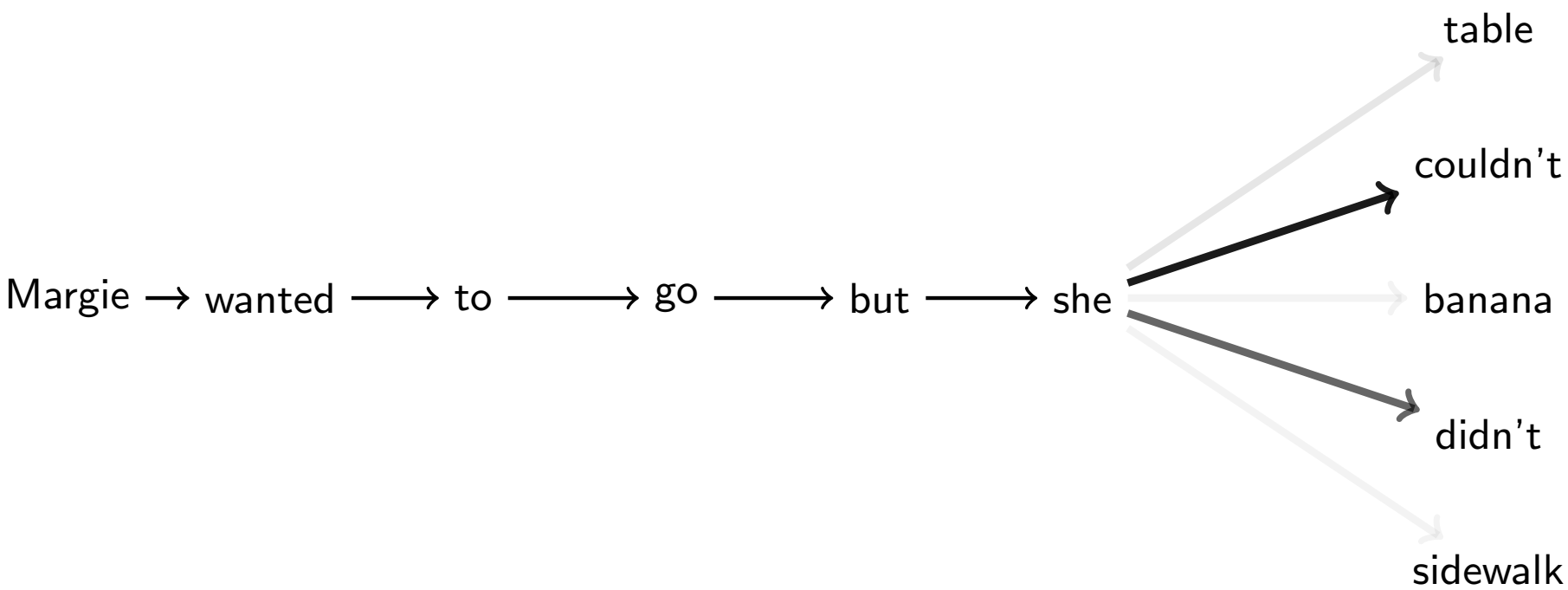
Transformer network

OpenAI multi-layer decoder



Pre-training task

Language modeling



Results on standard datasets

New state of the art on the following tasks:

- Textual Entailment
  - SNLI 89.3 → 89.9
  - MNLI Matched 80.6 → 82.1
  - MNLI Mismatched 80.1 → 81.4
  - SciTail 83.3 → 88.3
  - QNLI 82.3 → 88.1
- Semantic Similarity
  - STS-B 81.0 → 82.0
  - QQP 66.1 → 70.3
- Reading Comprehension
  - RACE 53.3 → 59.0
- Commonsense Reasoning
  - ROCStories 77.6 → 86.5
  - COPA 71.2 → 78.6
- Linguistic Acceptability
  - CoLA 35.0 → 45.4
- Multi-Task Benchmark
  - GLUE 68.9 → 72.8

References

- Vaswani, Ashish, et al. "Attention is all you need." Advances in Neural Information Processing Systems. 2017.
- Radford, Alec, et al. "Improving language understanding by generative pre-training." URL Article pdf link Blog post (2018).
- Devlin, Jacob, et al. "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding." arXiv preprint arXiv:1810.04805 (2018).