# Attention is All You Need

overview of the transformer architecture, applications and established improvements

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March 30, 2023

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Compression

Transformer

Compression

**Transformer**

# Transformer

**Output**

Dimensions

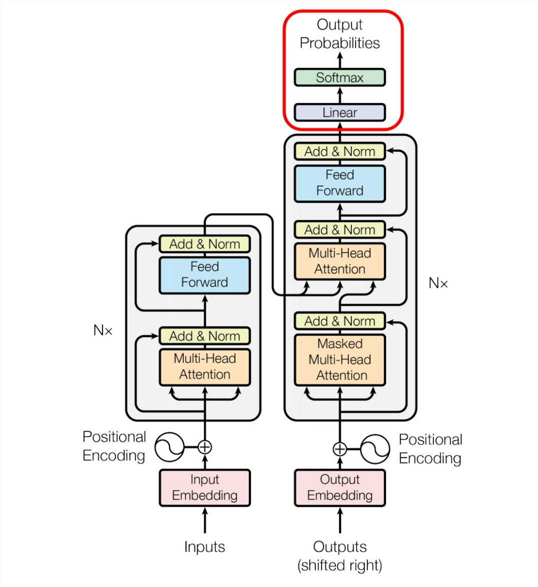
Putting it all Together

Interpretation

Sparse Transformer

Linear Time Transformers

# Output



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)

# Transformer

Output

**Dimensions**

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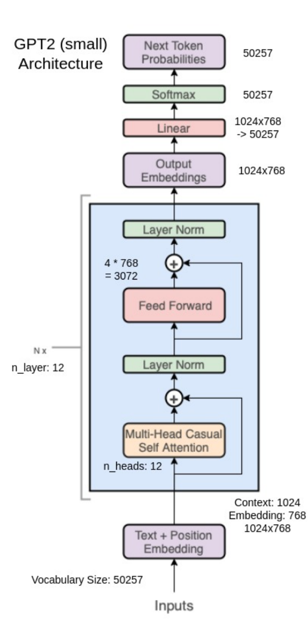
# Dimensions


GPT2 (small)
Architecture
Next Token Probabilities
50257
Softmax
50257
Linear
1024x768
-> 50257
Output Embeddings
1024x768
Layer Norm
4 * 768
= 3072
Feed Forward
N x
n_layer: 12
Layer Norm
Multi-Head Casual Self Attention
n_heads: 12
Context: 1024
Embedding: 768
1024x768
Text + Position Embedding
Vocabulary Size: 50257
Inputs

# Dimensions II

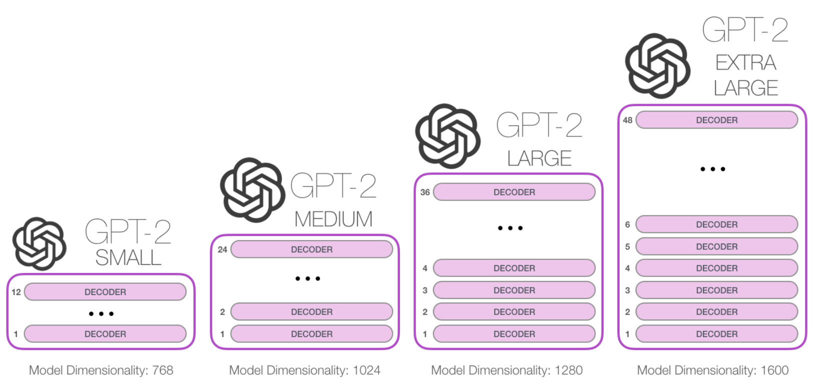


Image Source: [1]

# Transformer

- Output
- Dimensions
- **Putting it all Together**
- Interpretation
- Sparse Transformer
- Linear Time Transformers

# Full Architecture Overview

# Transformer

Output

Dimensions

Putting it all Together

**Interpretation**

Sparse Transformer

Linear Time Transformers

# Solving PDE [2]

# Transformer

Output

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**Sparse Transformer**

Linear Time Transformers

Even the original GPT didn't use 'full' transformers, but Sparse Transformer [3]

# Transformer

Output

Dimensions

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Interpretation

Sparse Transformer

**Linear Time Transformers**

FastFormer [4]
Transformer Quality in Linear Time [5]
FlashAttention [6]

Transformer

# Compression

# Compression

Quantization

Distillation

Rank Reduction

GPTQ [7] (spun up for LlaMa just two weeks after 'release')

# Compression

Quantization

Distillation

Rank Reduction

Training a smaller model on outputting similar outputs distributions for given inputs [8] [9]

# Compression

Quantization

Distillation

Rank Reduction

LoRA [10] (spun up for LlaMa just a month after 'release')

# Sources i

[1] J. Alammar, “The Illustrated GPT-2 (Visualizing Transformer Language Models),” Aug. 2019.

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# Sources ii

[4] C. Wu, F. Wu, T. Qi, Y. Huang, and X. Xie, "Fastformer: Additive Attention Can Be All You Need," *arXiv:arXiv:2108.09084*, Sept. 2021.

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# Sources iii

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[9] A. Polino, R. Pascanu, and D. Alistarh, "Model compression via distillation and quantization," *arXiv:arXiv:1802.05668*, Feb. 2018.

# Sources iv

[10] E. J. Hu, Y. Shen, P. Wallis, Z. Allen-Zhu, Y. Li, S. Wang, L. Wang, and W. Chen, “LoRA: Low-Rank Adaptation of Large Language Models,” *arXiv:arXiv:2106.09685*, Oct. 2021.