More Identifiable yet Equally Performant Transformers for Text Classification

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Key Takeaways

- ⊖ Attention-based interpretations of Transformer models can be faulty.
- ⊖ Identifiability issue: Attention weights are not unique to the Transformer's attention head. They can be made more identifiable!
  - ⊕ By decreasing the size of key vector.
  - ⊕ By increasing the size of value vector followed by head addition.

Motivation

Interpretability is an important aspect when it comes to **trust** a model's prediction.

- Famous Transformer architecture-based systems are ubiquitous.
- Multi-head self-attention is its basic building block.

Introduction

Identifiability of attention weights

"Identifiable if they can be uniquely determined from the head's output"
-On identifiability in transformers [Brunner et al., 2019]

Why is it important?

Explanations based on non-unique attention weights might be misleading.

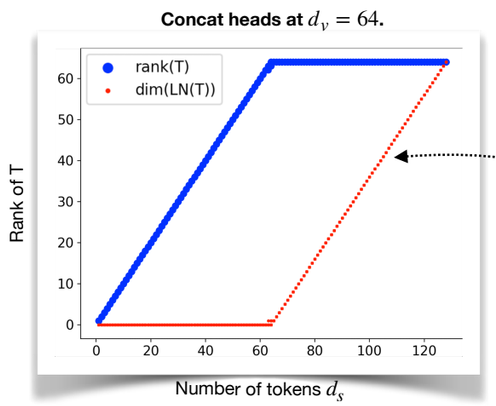
Attention Head

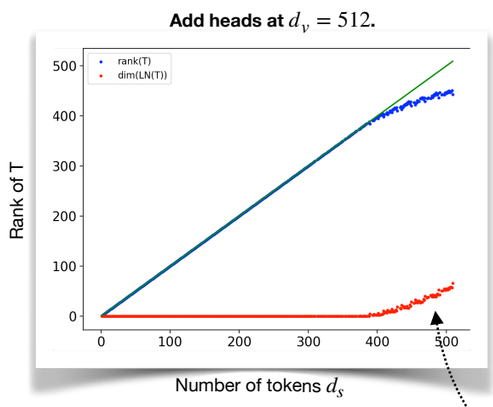
Attention: Query, Key

Phase:1 $\mathbf{A} = softmax\left(\frac{\mathbf{Q}\,\mathbf{K}^T}{\sqrt{d_q}}\right)$

Value, Weights

Phase:2 $\mathbf{H} = \mathbf{A}\,\mathbf{V}\,\mathbf{D} = \mathbf{A}\,\mathbf{T}$





Paper

Code

Uniqueness of A

Constraint-1	Constraint-2	Constraint-3
$\tilde{\mathbf{A}}\,\mathbf{T} = \mathbf{0}$	$\tilde{\mathbf{A}}\,\mathbf{1} = \mathbf{0}$	$(\mathbf{A} + \tilde{\mathbf{A}}) \geq \mathbf{0}$

Sample

LN (T)

Probability constraints

Role of key vector size

Let's say $\tilde{\mathbf{A}}$ satisfies above constraints.

$$softmax\left(\frac{\mathbf{Q}\,\mathbf{K}^T}{\sqrt{d_q}}\right) \overset{?}{\rightarrow} (\mathbf{A} + \tilde{\mathbf{A}})\,.$$ (Phase1 output)

Solutions

We propose the following solutions to identifiability.

- Decrease the size of key vector.
- Increase the size of value vector and add head outputs.

Classification performance of the model on ten text datasets does not vary significantly.

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