Going Beyond the Causal Mask in Language Modeling

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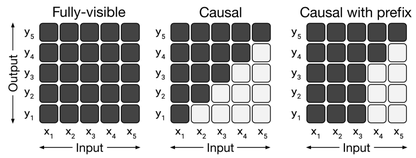
A primer on the causal mask

For causal LMs at inference time, even if n tokens have already been generated, token k with $k < n$ cannot attend to token j with $k < j < n$, even though token j is already known (Figure from Raffel, Colin et al. 2020).



- Ideally, we want to omit the mask at inference time
- Omitting the mask on a causally pre-trained LM leads to distribution shift

Addressing common misconceptions

- The causal mask is not needed to prevent information leakage from future tokens during training
- The causal mask is not needed for parallel training
- The causal mask is not needed for teacher-forcing

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Right??

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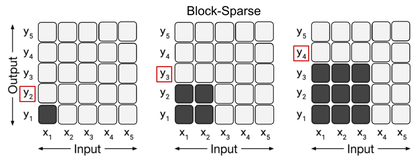
Going beyond the causal mask

- In PrefixLMs, full attention is used in the prefix, causal attention is used in the target
- Prefix language modeling leads to sparse supervision in unlabeled regime (prefix is not predicted)
- **Block-Sparse Language Modeling (BS-LM)**: Take all previous tokens as 'prefix' and each next token as sole 'target'

BS-LM simulates the mask-free inference regime.

You *do* need the causal mask for LMs

During BS-LM training, the mask depends on the position of the token to be predicted, i.e. a naïve implementation would require `seq_len` times as much memory and computation compared to causal LMs since the computational path splits token-wise after the first attention map calculation.



Moving beyond the causal mask necessitates mitigating the memory and compute overhead that comes with that.

The causal mask is a feature, not a bug.

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