# Learning How to Ask: Querying LMs with Mixture of Soft Prompts

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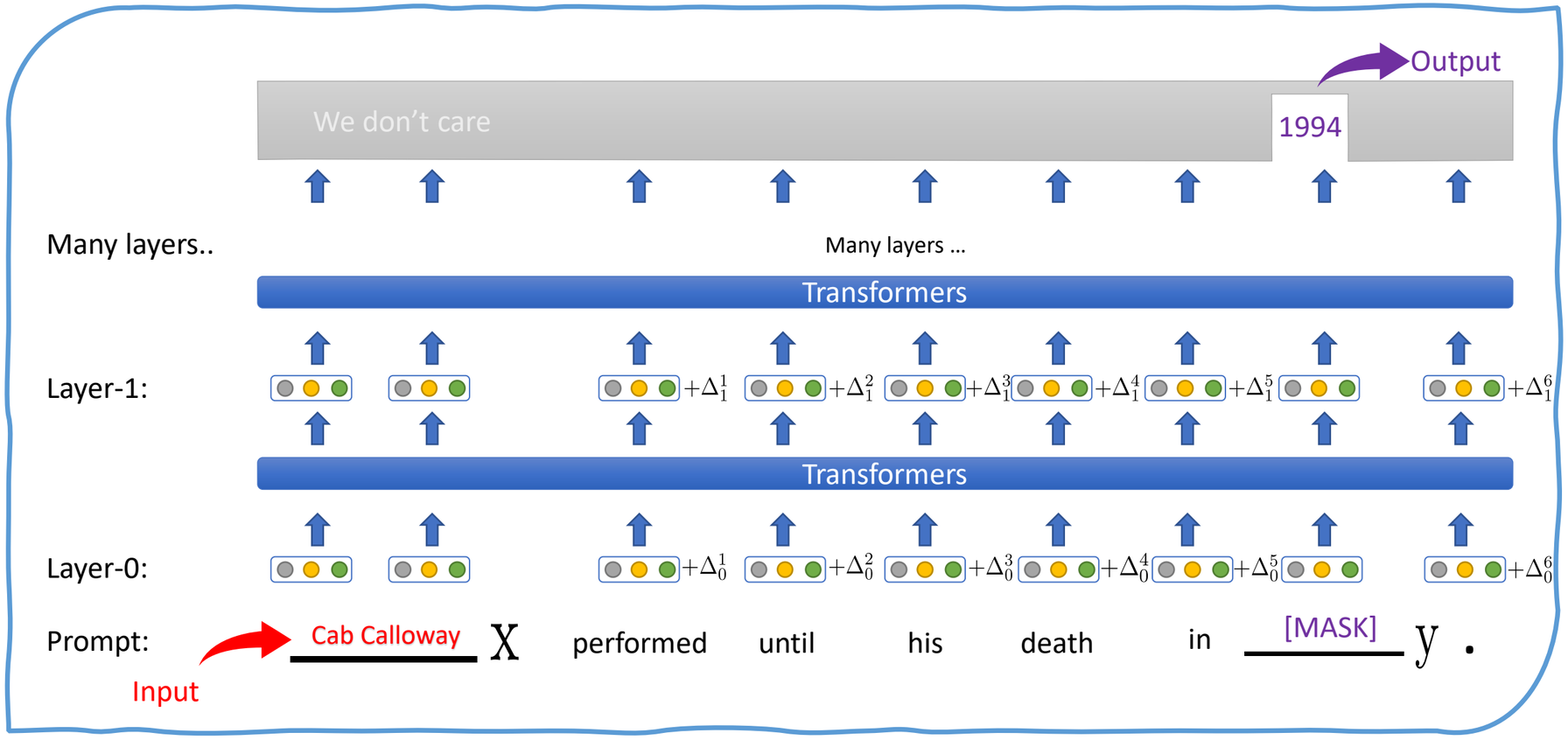
## Abstract

**Task**: Extract factual knowledge from cloze language models.
**Basic method**: Run cloze LM on prompts (sentence with blanks)
**This work**: Replace prompts with vectors that can be optimized with back-propagation in a continuous space.




## Soft Prompts

Words in prompts are discrete, but transformers are concerned with *vectors*. Instead of feeding LMs with words, we can feed *vectors* (layer-0 in diagram) that can be optimized with back-propagation.

## Why Soft?

**Easy to optimize**: Back-propagation.
**Larger space of prompts**: Vectors can be more expressive. = { performed, played, painted} can be profession-neutral; = {his, her, their} can be gender-neutral.
**Focusness**: Certain keywords can be emphasized by adjusting vector length.

## Deep Perturbation

Transformers encode the prompts with *many* layers of sequences of vectors. Extending the idea of soft prompts to all the layers, we add "perturbation biases" to each layer of transformers.

## Ensembling

We exploit a mixture of prompts, whose weights can be trained with EM algorithm.

## Experiments

Experiments conducted on T-Rex datasets show:

1. Performance improved by 12.2% if trained from other people's prompts.
2. Training from *random initialization* is almost as good as from other prompts.

**Others**: Extensive experiments on many datasets with many language models all show the effectiveness of soft prompts & deep perturbation. Please look at our paper for more details.