Perplexity

1 Language model

Simply put, a language model is a model used to calculate the probability of a sentence. Given a sentence

$$S = W_1, W_2, \ldots, W_k,$$

its probability can be expressed as:

$$P(S) = P(W_1, W_2, \ldots, W_k) = P(W_1)P(W_2|W_1)\ldots P(W_k|W_1, W_2, \ldots, W_{k-1}$$

That is to say, given the first k words in a sentence, we hope that the language model can predict what the $k+1$th word is, that is, give a distribution of the probability that the $k+1$th word may appear: $P(X_{k+1}|X_1, X_2, \ldots, X_k)$.

2 Definition of perplexity

In language models, perplexity is a commonly used automatic evaluation metric. It measures the predictive ability of the model on a given dataset, and the lower the perplexity, the better the model predicts.
The formula for perplexity is as follows:

$$\begin{aligned} PP(S) &= P(w_1 w_2 \ldots w_N)^{-\frac{1}{N}} \\ &= \sqrt[N]{\prod_{i=1}^{N} \frac{1}{P(w_i|w_1 w_2 \ldots w_{i-1})}} \end{aligned}$$

Among them, S represents the sentence, N is the length of the sentence, and $P(w_i)$ is the probability of the ith word. The first word

is $P(w_1|w_0)$, and w_0 is START, which means the beginning of the sentence and is a placeholder.

3 Influencing factors of Perplexity

- The larger the training dataset, the lower the Perplexity will drop
- The punctuation in the data will have a great impact on the Perplexity of the model

References

https://huggingface.co/docs/transformers/perplexity