Permutation Probability

In the case of permutation probability, all permutations of documents (a total of n! cases) are generated, and for each case, the CE Loss between the model's predicted relevance score and the gold label is calculated and averaged

how this 'Permutation Probability' idea can be utilized in actual ranking models. It can primarily be used in two ways:

    1   As a **Loss Function during Model Training**: It's used to train the model so that its predicted ranking closely resembles the Gold Label ranking.

    2   As an **Evaluation Metric for Models**: It's used to measure how well a trained model performs."

example scenario: developing a ranking model for a search engine.

Data Preparation: You create the "ideal ranking of document Y for query X" (Gold Label) using user click logs or manual evaluations by experts.

Model Design: design a deep learning model (e.g., Transformer-based) that takes query and document features as input and outputs a relevance score for each document.

Training:

    •   **Using Listwise Loss**: For each query where multiple documents are returned, the model is trained to maximize the probability of the Gold Label ranking appearing, based on the model's predicted scores and applying a Plackett-Luce model. That is, the negative log-probability of the Gold Label ranking is used as the loss function.

    •   **Using Pairwise Loss:** If, in the Gold Label, document A ranks higher than document B, the model is trained using a Pairwise Loss (like RankNet) to assign a higher score to A than to B.

Evaluation: Once the model is trained, when it ranks documents for a new query, its performance is measured by comparing this ranking with the actual Gold Label ranking and calculating metrics such as NDCG@10 (NDCG for the top 10 results).

Definition

Permutation   The number of ways of arranging n objects into ordered groups of r objects, summarized by this formula.

$$P(n,r) = {}_nP_r = \frac{n!}{(n-r)!}$$

the likelihood of a specific ordered arrangement occurring, calculated by dividing the number of favorable ordered outcomes by the total number of possible ordered outcomes, which is found using the permutation formula P(n, r) = n! / (n - r)!.