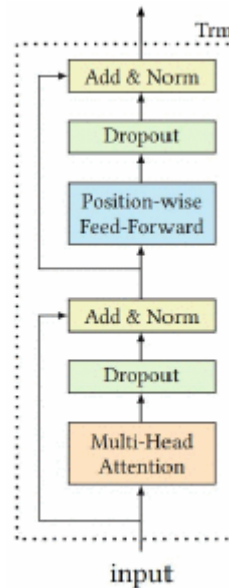


Transformer -- BERT4Rec:

- The BERT4Rec is a bidirectional model based on transformer, which allows the training of the recommendation system to be efficient.
- The model is consisted of 3 layers, the embedding layer, which process the data into information that is later used in the transformer layer, the transformer layer will process the data and forward it to the output layer, where the results would be received by the user.



- Song, K. (2023). Efficient recommendation systems for movies based on BERT4Rec. *2023 3rd International Signal Processing, Communications and Engineering Management Conference (ISPCEM)*, 789–793.

- BERT4Rec has the multi-head self-attention - The multi-head self-attention mechanism is able to fulfill different tasks. It allows the model to capture the dependencies of different data no matter how apart the data pairs are located.

To evaluate the performance of the BERT4Rec model on the Netflix Prize dataset, firstly, the reproducibility study of BERT4Rec implementation on ML-1M dataset was performed, to compare the results of the chosen implementation to the other, most significant, mentioned in [\[20\]](#).

All of the results vary by not more than 10%. One notable fact is that, the reported levels of the original implementation were achieved by training the model 30 times longer, as per [\[20\]](#). When taken into consideration, this leads to the conclusion that the replication was successful. It is also worth noticing, that slight modification in the BERT4Rec-VAE-Pytorch model architecture, presented in Table [1](#), result in insignificant changes in reported metrics, which shows, that it is both reliable and robust.

A systematic review and replicability study of bert4rec for sequential recommendation. In: 16th ACM Conference on Recommender System (2022)

- Gałka, A., Grubba, J., & Walentukiewicz, K. (2023). Performance and Reproducibility of BERT4Rec. In *New Trends in Database and Information Systems* (pp. 620–628). Springer Nature Switzerland.

Strength and Weakness

- BERT4Rec leverages the BERT language model to achieve state-of-the-art results on various recommendation tasks. The model employs a Cloze objective [19] to train on masked items and uses bidirectional self-attention to capture the contextual information of words in a sequence. This enables BERT4Rec to model the sequential patterns in user behavior, which are essential for recommendation tasks where the user's preferences may evolve over time. The model has demonstrated superior performance over previous transformer-based and traditional recommendation models on several benchmark datasets.
- BERT4Rec still only relies on item identifiers to model the user preference, ignoring other sources of information.
- Fischer, E., Zoller, D., Dallmann, A., & Hotho, A. (2020). Integrating keywords into BERT4Rec for sequential recommendation. In *Lecture Notes in Computer Science* (pp. 275–282). Springer International Publishing.

P2P --SOPRS:

- This paper presents a self-organized personalized recommendation system based on P2P, called SOPRS, which applies recommendation threshold instead of Top-N that used by the other systems in hybrid filtering and uses the authority measurement to self-organize users' nearest neighbors easily.

$$reco(au, doc) = \alpha \times (1 + sim_doc(pf, doc) / 2) \times \bar{R} + \beta \times reco_rate(au, doc)$$

- Recommendation system based on content-based information filtering could effectively recommend information to users by users' interest that already knew. While recommendation system based on collaborative filtering could learn users' new interest by users' similar action

- Compared with other systems, this system combines two methods: content-based filtering and collaborative filtering. Content-based filtering can recommend relevant documents based on users' known interests, while collaborative filtering learns new interests by analyzing similar behaviors between users. This combination allows the system to adjust recommendations as the user's interests change.
- In a recommendation system, precision is far more important than recall, because users will think poorly of a system when it recommends a wrong document. In the SOPRS, we take the precision as the most valued regulation, when it is lower than expectation the system will increase the threshold (TH) by regulative parameter α .

- **Strength:** The SOPRS is a pure P2P system; peers in the system connect and communicate each other directly. By this mean, the system is robust and easy to expand, but it's difficult to keep order of group and quality of documents without a central control server.
- Peers connect and communicate with each other directly without through servers, so the system's performance doesn't decline with the increase of user scale, on the contrary, it improves. Pure P2P structure avoids bottle-neck in the central control systems
- **Weakness:** The cold start problem exists
- **Scenarios:** Recommended for document file sharing
- Feng, G. (2007). A self-organized personalized recommendation system based on peer-to-peer networks. *Mind and Computation*.
<https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=e358f8a5284180d3a44823d406ef74f50b729108>