Multi-Task Learning in Click-Through-Probability (Multi-CTP) Prediction for Real-World Digital Content Recommendation

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Objectives

We develop a predictive deep learning model structure (Multi-CTP) to handle extremely sparse data, for the start stage of content recommendation in healthcare digital marketing and education. The multi-task learning approach alleviates the learning pressure and improves the performance of the recommendation system, by using existing data to build auxiliary tasks and models to provide better feature representations of the main task.

Methods

The multi-task learning scheme involves

1) Constructing two models based on the same dataset through different task scenarios, i.e., click-or-not and viewing time, to maximize the use of variables
2) Providing enhanced embedding layer for multi-CTP by parameter sharing, to further resolve the model learning difficulty due to data sparsity and reduce the risk of overfitting given the commonly imbalanced sample.

The input data is the digital marketing data provided by one pharmaceutical manufacturer, including historical article readership behaviors of each physician, and the main topics of the articles. Factorization machine transfers the physician's behavioral data such as viewing time, and key characteristics of the articles, into an embedding layer. Combined with this embedding layer, the neural network model is developed to generate the click-through probability for each article and physician, and further filter the high-ranked articles as the recommendations.

Model Structure

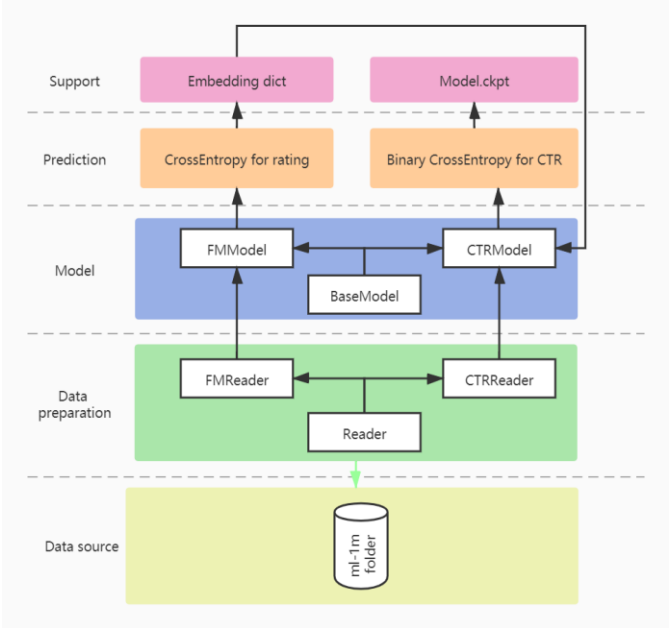

Fig1. Model structure of Multi-CTP

Conclusion

- By applying the Multi-CTP approach, we can employ customized content recommendations even when the input is too sparse to perform well with a popular content-based recommendation system.
- We envision that this algorithm can accomplish a number of goals, including commercial targeting and educational purposes.

Experiments & Results

For comparison, we used three different system for experiments, which are the baseline hired agents to manually sending message, rule-based recommendation and content-based recommendation.

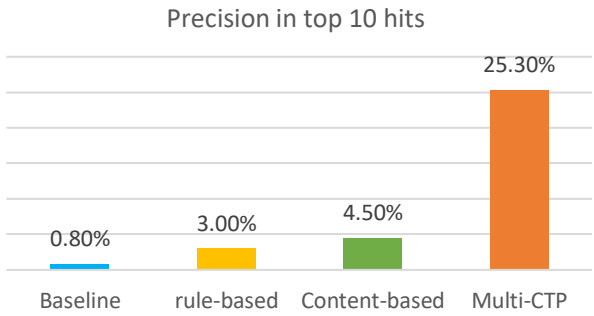

Fig2. Experiments and results

Our model generates a 25.3% precision score on the number of hits in the top 10 digital domain articles, based on the real-world of physician's click-and-view content data. Compared with the other models, Multi-CTP provides a better performance.

References

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