Assignment3

12110208宋子烨

Statement

Since the model I wrote by myself got a quite bad accuracy, I referred a github open source code and made some necessory modifications to generate the results image. both codes that I wrote and I referred are available in my pull request. the link of the github open source code I referred is [yihong-chen/neural-collaborative-filtering: pytorch version of neural collaborative filtering (github.com)]

Compare the three methods:

1. **Training Loss**:
    - NeuMF's training loss remains relatively stable throughout the training process with minor fluctuations.
    - GMF exhibits larger fluctuations in training loss, with occasional spikes at certain iterations.
    - MLP shows noticeable fluctuations in training loss, particularly in the middle stages, but the overall trend is decreasing.
2. **HR@10 (Hit Ratio @ 10)**:
    - NeuMF achieves the highest HR@10 throughout the training process, showing significant improvement from initial to final iterations, reaching approximately 0.65.
    - GMF and MLP have comparable HR@10 values, with GMF slightly outperforming MLP, reaching around 0.58 and 0.57, respectively, at the final iteration.
3. **NDCG@10 (Normalized Discounted Cumulative Gain @ 10)**:
    - NeuMF also outperforms in NDCG@10 throughout the training process, reaching approximately 0.4 at the final iteration.
    - GMF and MLP exhibit similar trends in NDCG@10, with GMF slightly higher than MLP, reaching approximately 0.36 and 0.35, respectively, at the final iteration.

Ablation Study Analysis:

The impact of different layer configurations on HR@10 and NDCG@10 for MLP models from the ablation study table is as follows:

1. **Layer Configuration: [16, 64, 32, 16, 8]**:
    - HR: 0.6396
    - NDCG: 0.3705
    - This configuration performs the best among all, with more layers and complex parameters, leading to superior model performance.
2. **Layer Configuration: [16, 32, 16, 8]**:
    - HR: 0.6257
    - NDCG: 0.3607

- With one fewer layer compared to the previous configuration, there's a slight performance drop, although still relatively high.

3. **Layer Configuration: [16, 16, 8]**:
   - HR: 0.6076
   - NDCG: 0.3474
   - Further reduction in the number of layers results in continued performance decline.
4. **Layer Configuration: [16, 8]**:
   - HR: 0.5803
   - NDCG: 0.3245
   - With the minimum number of layers, performance is the lowest but still noticeable.

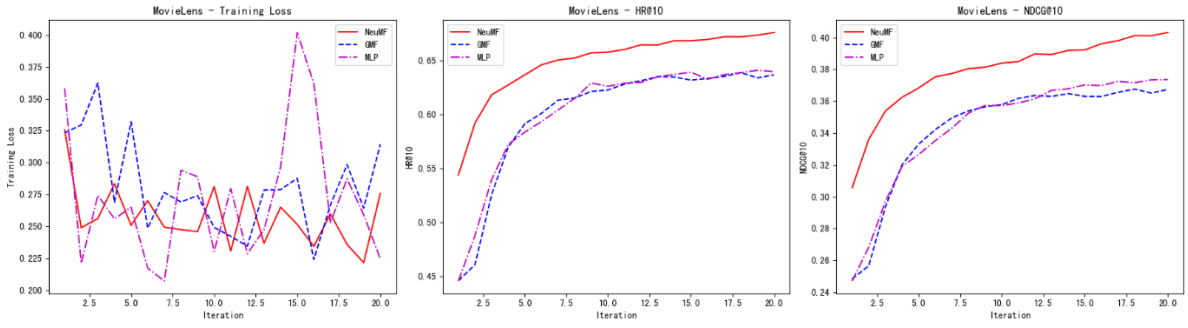
Number of Negatives

Regarding the number of negatives, I have written code to generate this part of the model results chart. However, due to GPU and time constraints, I am unable to complete the model training and provide the data to generate these line charts. You can find the code for this part at the end of my code.

Conclusion:

1. **Method Comparison**:
   - Overall, NeuMF outperforms GMF and MLP in both HR@10 and NDCG@10 metrics.
   - GMF slightly outperforms MLP, but their performance is relatively close.
2. **Ablation Study**:
   - Increasing the number of layers improves MLP's performance, indicating that more layers lead to a more complex model and better performance.
   - However, increasing layers also increases computational complexity and training time, necessitating a trade-off between performance and resources.

The output screenshots are illustrated below:

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轮数 19: HR = 0.5802980132450332, NDCG = 0.32449722176454476
层配置: [16, 64, 32, 16, 8], HR: 0.6396, NDCG: 0.3705
层配置: [16, 32, 16, 8], HR: 0.6257, NDCG: 0.3607
层配置: [16, 16, 8], HR: 0.6076, NDCG: 0.3474
层配置: [16, 8], HR: 0.5803, NDCG: 0.3245
```