

DSAA6000E Presentation

Group3 AI-Doctor : Med-LLM

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Importance

1. Importance of Intelligent Healthcare Systems:

- The emergence of the telemedicine industry has transformed healthcare services, offering remote consultations and reducing costs.
- Intelligent medical systems have incorporated features like medical information extraction, drug recommendation, and automated diagnosis.

2. Gap in Previous Research:

- Previous studies focused on specific tasks or diseases, creating a gap between experimental advancements and practical applications.
- This study aims to address this gap by providing comprehensive solutions for a broader range of medical scenarios.

3. The advantages of using LLM for patient pre-consultation:

- Accessibility: LLM allows patients to access pre-consultation information easily and conveniently. It can be accessed anytime and anywhere, eliminating the need for physical appointments or waiting times.
- Privacy and confidentiality: LLM ensures patient privacy and confidentiality. Patients can input their information directly into the system, reducing the risk of sensitive data being shared with unauthorized individuals.

Existing Research Limitations

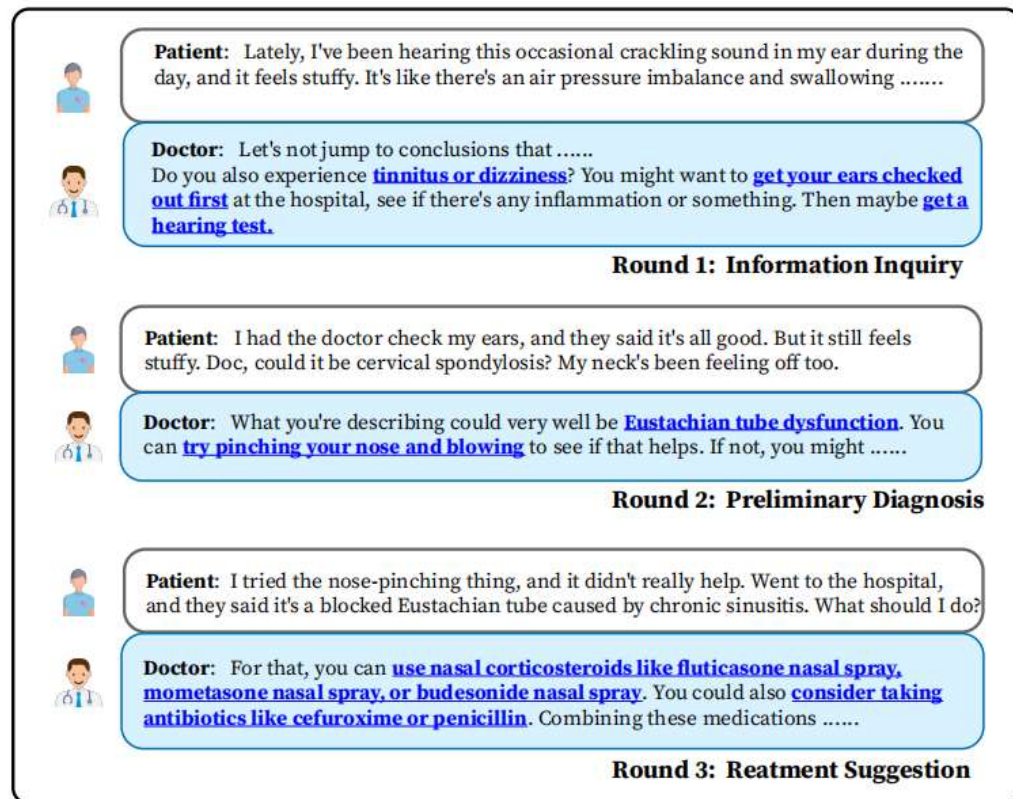


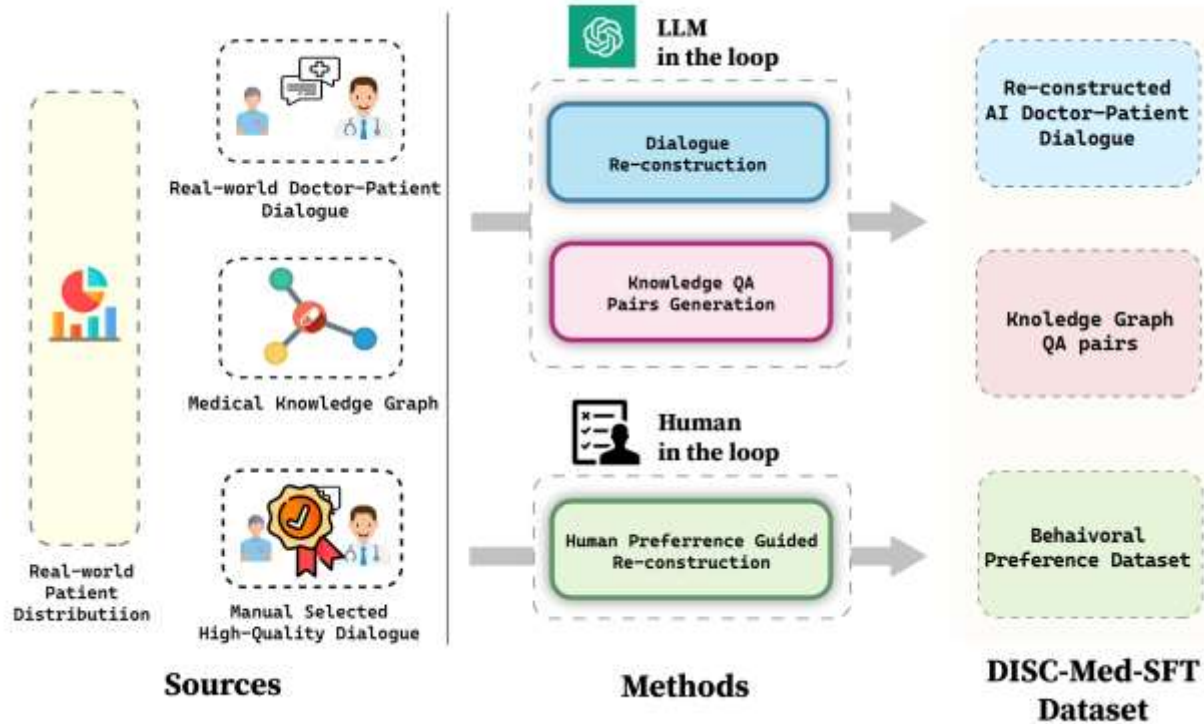
Figure 1: Dialogue Sample between a human doctor and a patient. The blue-highlighted text indicates medical entities involved in the doctor's response. Doctor's behavior reveals specific intention in each round:

- (1) In the round 1, further inquiries for information that aids in determining possible situations;
- (2) In the round 2, arrives at a preliminary diagnosis and provide valid recommendations;
- (3) In round 3, offers specific treatment options based on the medical condition.

MedLLM Model Overview:

- We developed the MedLLM model, which incorporates intensive medical knowledge and consultation behavior patterns.
- They constructed high-quality Supervised Fine Tuning (SFT) datasets using knowledge-graph-driven sample construction, real-world dialogue reconstruction, and human preference following.

Overview



The overall framework is illustrated in Figure 2. The dataset is primarily sourced from both medical knowledge graph and real-world doctor-patient consultations and the sample selection process is following a hospital department distribution extracted from real-world dataset.

- Two sample construction mechanisms are utilized, LLM in the loop plays a role in paraphrasing real-world conversations, while human in the loop ensures alignment with high-quality conversational behaviors. These efforts result in three key features of MedLLM: knowledge-intensive and reliable, ability of multi-turn inquiry, and alignment with human preferences.
- The MedLLM model, incorporating intensive medical knowledge and consultation behavior patterns, shows tremendous potential for revolutionizing medical consultations and enhancing healthcare services.

Advantages

1. Knowledge-Intensive and Reliable:

- MedLLM derives its medical knowledge from reliable sources such as medical knowledge graphs and real doctor-patient dialogues.
- By avoiding reliance solely on the model itself, MedLLM overcomes the hallucination problems often associated with LLMs.

2. Ability for Multi-Turn Inquiry:

- MedLLM leverages real-world multi-turn patient-doctor conversations, enabling it to engage in meaningful medical inquiries.
- This capability is essential for understanding comprehensive patient information and discussing symptom details.

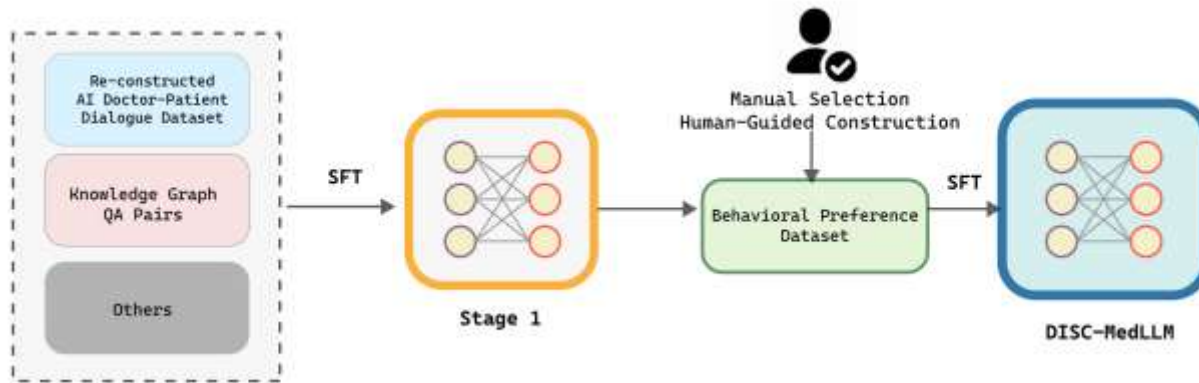
3. Alignment with Human Preference:

- MedLLM incorporates human preference-guided behavioral datasets, ensuring better alignment with desired responses and behaviors.
- By distilling the behavior patterns of ChatGPT, MedLLM provides comprehensive explanations and demonstrates a high level of empathy when interacting with patients.

4. Fusion of Medical Knowledge and Behavioral Patterns:

- MedLLM combines medical knowledge and decision-making from real doctor-patient conversations with behavioral patterns and human preferences from ChatGPT.
- This fusion allows MedLLM to align itself with observed medical consultation distributions, enhancing its effectiveness in real-world scenarios.

Methods



- Stage 1: Imbuing the model with domain knowledge and medical dialogue capabilities using large-scale samples, including a 420k adapted AI doctor-patient dialogue dataset (Fudan University's open-source dataset), 50k knowledge graph constructed QA pairs.

- Stage 2: Training the model to align with human preferences in terms of behavioral patterns and usefulness using a meticulously crafted preference-aligned behavioral preference dataset, combined with alpaca gpt4 data for training.

1. Model Development:

- The model is built on top of the Baichuan2-7B-Chat model, which uses high-quality corpus training with 2.6 trillion tokens.
- The Baichuan2 model demonstrates excellent performance in both English and Chinese languages.

2. Two-Stage Training Process:

- The training process is divided into two stages: Stage 1 and Stage 2.
- Both stages are completed using 4090GPU, ensuring efficient training.

Evaluation Setup

Evaluation Metrics for Conversation In order to perform a systematical evaluation on dialogue capability, this study propose four metrics, namely, proactivity, accuracy, helpfulness, and linguistic quality.

- . **Proactivity:** The doctor can proactively and clearly request the patient to provide more information when the information is insufficient.
- . **Accuracy:** The diagnosis or advice provided by the doctor is accurate and has no factual errors. Conclusions are not made arbitrarily.
- . **Helpfulness:** The doctor can provide the patient with clear, instructive and practical assistance, to address the patient's concerns.
- . **Linguistic Quality:** The doctor correctly understands the patient's query , and the expression of the response is smooth and natural.

GPT4-as-a-Judge Strong LLM judges like GPT-4 can match both controlled and crowdsourced human preferences well (Zheng et al. 2023).

In this evaluation, GPT-4 serves as a referee and perform evaluation in providing a rating score from 1 to 5 for each of the four criteria.

Lessons Learned

1. Work on Field Models:

- Work on field models in the medical domain focuses on continuous pretraining of generative language models and fine-tuning based on domain data instructions.
- Pretraining requires substantial data volume and computational resources, while fine-tuning involves generating domain sample data and implementing low-resource training methods.

2. Construction of Large Models in the Medical Field:

- Building private medical large models and deploying them locally has its own application scenarios due to the sensitivity of medical data and the need for local deployment.
- While the ChatGPT platform has capabilities in medical Q&A, specific medical industry requirements, such as automated processing of electronic medical records and patient diagnosis and treatment timelines, drive the development of locally deployable domain models.

3. Challenges in the Chinese Medical Field:

- Limited public data availability in the Chinese medical field poses challenges.
- Reliance on ChatGPT-generated data introduces bias and uncertainty.
- Acquiring high-quality data resources and establishing a unified evaluation method and automated evaluation tools are crucial for improving model performance and promoting standardized data quality.

Screenshots of App

AI Doctor

您好，我是MedLLM医疗助手大模型，很高兴为您服务。

我最近睡眠质量很差，有什么办法改进这种状况吗？

您可以尝试以下方法来改善睡眠质量：

1. 建立一个规律的作息时间表。每天保持固定的睡觉和起床时间有助于提高睡眠质量。
2. 在睡前避免使用电子产品。手机、电脑等会产生蓝光，这会抑制体内褪黑激素的分泌，影响睡眠质量。
3. 放松自己。可以通过冥想、深呼吸或瑜伽等方式缓解压力，促进睡眠。
4. 避免在床上做与睡眠无关的活动。例如，看电视、看书等会影响床上的舒适感。
5. 注意饮食习惯。晚上尽量少吃辛辣食物、咖啡因等刺激性食物，以免影响睡眠。

清空对话

我牙疼怎么办

很抱歉听到您的牙齿疼痛。根据您的描述的症状，可能是由于龋齿(蛀牙)、折裂牙或楔状缺损引起的牙髓感染所致。为了更准确地判断病因，我建议您尽快到医院进行检查以确诊并采取相应的治疗措施。

在等待就医的过程中，您可以尝试一些缓解牙痛的方法：用温盐水漱口来减轻炎症和杀灭口腔中的细菌；避免食用过硬或粘性食物，以免加重疼痛；保持口腔卫生，每天刷牙两次，使用软毛牙刷和温和的牙膏。

请记住，以上建议仅供参考，具体的治疗方法还需根据医生的诊断结果而定。如果您有任何其他问题或需要进一步帮助，请随时告诉我。祝您早日康复！

清空对话

AI Doctor

您好，我是MedLLM医疗助手大模型，很高兴为您服务。

My sleep quality has been very poor lately. Is there any way to improve this situation?

There are a number of things that can be done to help you get better rest and improved overall health:

1. Stick to regular sleeping times - This will train your body into getting ready for bed at the same time every night so it's easier to fall asleep faster, stay awake longer in REM (dreaming) stage which is good as far as memory retention goes; also helps with anxiety & depression 2. Create an ideal environment wherein one feels relaxed such as dimming lights or using white noise machines like those made by Pure-Sleep(R), Sleep Sheep etc because light stimulation from TV/laptop screens interfere w/melatonin secretion thus affecting deep slumber hence less dream recall during NREM phase3. Avoid caffeine intake after midday4. Exercise regularly but avoid strenuous activity close to evening5. Limit alcohol consumption6. Eat small meals throughout day rather than large ones just before going to bed7. Practice relaxation techniques8. Use herbal teas containing valerian root9. Get plenty of Vitamin D exposure via sunlight

How to treat toothache

Toothache is a common problem that can be caused by various factors such as cavities, gum disease or even an impacted wisdom tooth. Here are some tips for treating and preventing dental pain:

1. Brush your teeth regularly with fluoride-containing paste in order to remove plaque buildup which may cause decay leading to the development of painful lesions like caries (cavity) on exposed dentin surfaces; this will also help reduce inflammation associated with gingivitis/periodontal diseases causing swelling around affected areas resulting in severe discomfort during eating food items containing acidic substances eg citrus fruits etc 2. Use mouthwash after brushing since it contains antibacterial agents capable of killing bacteria responsible for infections thus reducing chances of bacterial growth within oral tissues thereby decreasing symptoms related to infection i.e fever, malaise & generalized body aches due to systemic spread from local site(s). If left untreated these conditions could lead to death so its very important not to ignore any signs suggestive of infected area until proper treatment has been given3. Avoid chewing hard foods because they tend to damage enamel surface exposing underlying pulp tissue making them susceptible to microbial invasion4. Gargle salt water when you have sores inside tongue /cheeks5. Take over the counter medications available at pharmacies but make sure consult pharmacist before using6. If possible avoid smoking cigarettes7. In case there's no relief take prescription drugs8. Seek professional advice9. Remember regular check ups every six months

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Thanks for listening

