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Introduction (You can customize these blocks as you like)

In this paper, we present HuatuoGPT, a Large Language Model (LLM) for medical consultation.

The core recipe of HuatuoGPT is to leverage both *distilled data from* ***ChatGPT*** and *real-world data from* ***doctors*** in the supervised fine-tuning stage. This is not only because purely using **ChatGPT**-distilled data might cause 'model collapse', but also because real-world data from **doctors** would be complementary to **ChatGPT**-distilled data.

The responses from ChatGPT are usually detailed, well-presented, fluent, and instruction-followed, but it cannot perform like a doctor in many aspects, e.g., interactive diagnosis. Therefore, the extra doctors' data could tame a distilled language model to perform like doctors.

To synergize the strengths of both data sources, we introduce RLMF (Reinforcement Learning from Mixed Feedback) where a reward model is trained to align the language model with the merits that both sources (ChatGPT and doctors) bring.

Experimental results (in GPT-4 evaluation, human evaluation, and medical benchmark datasets) demonstrate that HuatuoGPT achieves state-of-the-art results in performing medical consultation among open-source LLMs. It is worth noting that by using additional real-world data and RLMF, the distilled language model (i.e., HuatuoGPT) outperforms its teacher model (i.e., ChatGPT) in most cases. See our demo in https://www.huatuogpt.cn .

Motivation

ChatGPT vs. Doctor

User: 我肚子痛 (*I have a stomachache.*)

ChatGPT: 我很抱歉听到你肚子痛。肚子痛可能有许多不同的原因，包括消化问题、感染、肠道问题或其他健康状况。我是一个语言模型，无法给出确切的医疗诊断，但我可以给你一些建议来缓解肚子痛的不适。(*I'm sorry to hear that you have a stomachache. Stomachaches can have various causes, including digestive issues, infections, gastrointestinal problems, or other health conditions. As a language model, I cannot provide a precise medical diagnosis, but I can give you some advice to alleviate the discomfort of a stomachache.*)
以下是一些可能有助于缓解肚子痛的常见方法 (Here are some common methods that may help alleviate a stomachache)：

- 休息 (*Rest*)：给自己一些时间休息，放松身体，避免过度活动。(*Give yourself some time to rest, relax your body, and avoid excessive physical activity.*)
- 热敷 (Warm compress)：可以尝试在肚子疼痛的区域放置热水袋或热毛巾，这有时可以缓解不适。(You can try placing a hot water bottle or warm towel on the area of the stomachache. This can sometimes help alleviate discomfort.)

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- 医疗咨询 (*Medical consultation*)：如果肚子痛持续或加重，或伴随其他严重症状（如持续呕吐、高烧、血便等），请尽快咨询医生，以获取专业的建议和治疗。(*If your stomachache persists or worsens, or if it is accompanied by other severe symptoms such as persistent vomiting, high fever, bloody stools, etc., please consult a doctor as soon as possible for professional advice and treatment.*)

记住，以上建议仅供参考，如果你的症状持续存在或加重，最好咨询医生以获取专业的诊断和治疗建议。(*Please remember that the above suggestions are for reference only. If your symptoms persist or worsen, it is best to consult a doctor for a professional diagnosis and treatment advice.*)

Doctor: 肚子哪个部位痛？是剧烈的还是轻微的？持续多久了？(*Where is your abdominal pain? Is it severe or mild? How long has it been going on?*)

User: 下腹部，有点疼，昨晚开始的，有小半天了。(*Lower abdomen, a bit painful, started last night, been about half a day.*)

Doctor: 是否伴随其他症状如恶心、呕吐或发热等？(*Are there any accompanying symptoms such as nausea, vomiting, or fever?*)

User: 有点呕吐。(*I vomited.*)

Doctor: 昨晚吃什么了？(*What did you eat last night?*)

User: 昨晚吃了点小龙虾。会不会是这个导致的？(*Eating some crayfish last night, could that be the cause?*)

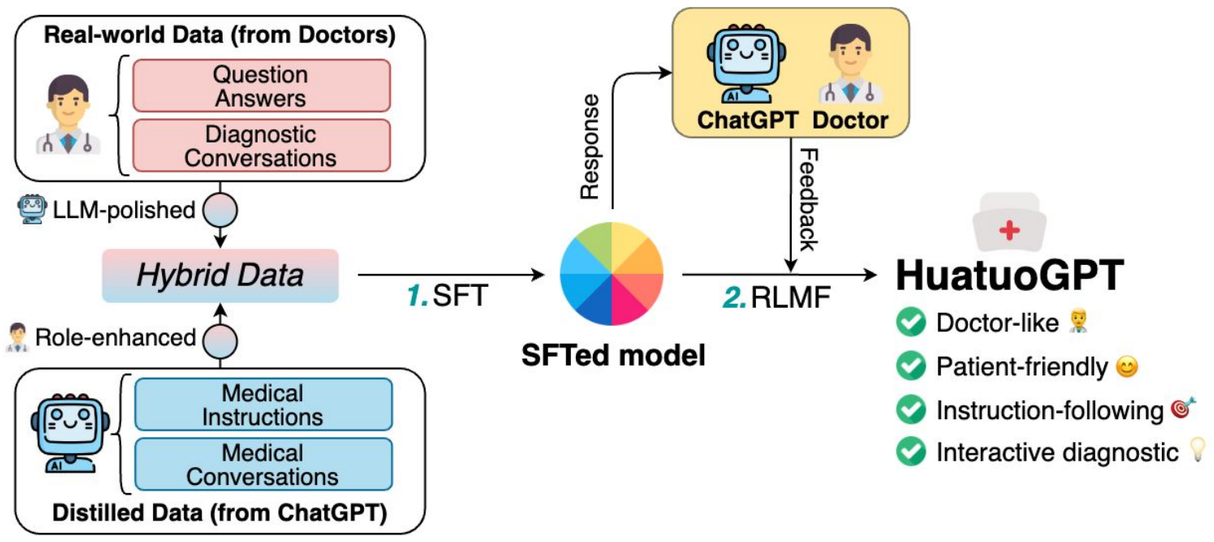
Doctor: 很可能是急性肠胃炎，通常是由于食物中毒引起的，而小龙虾中含有细菌和寄生虫，很容易引起肠胃感染。(*It's highly possible that you have acute gastroenteritis, which is often caused by food poisoning. Crayfish, in particular, can contain bacteria and parasites that easily lead to gastrointestinal infections.*)

Features	Aspects	ChatGPT	Doctor	HuatuoGPT
Doctor-like	Diagnostic ability	-	High	High
	Raising questions ability	-	High	High
	Expert-level accuracy	-	High	High
Patient-friendly	Informativeness	High	-	High
	Patience	High	-	High
	Presentation quality	High	-	High

HuatuoGPT Demo

HuatuoGPT Github

Methodology



I. SFT with Hybrid Data

- *Distilled Data from ChatGPT*

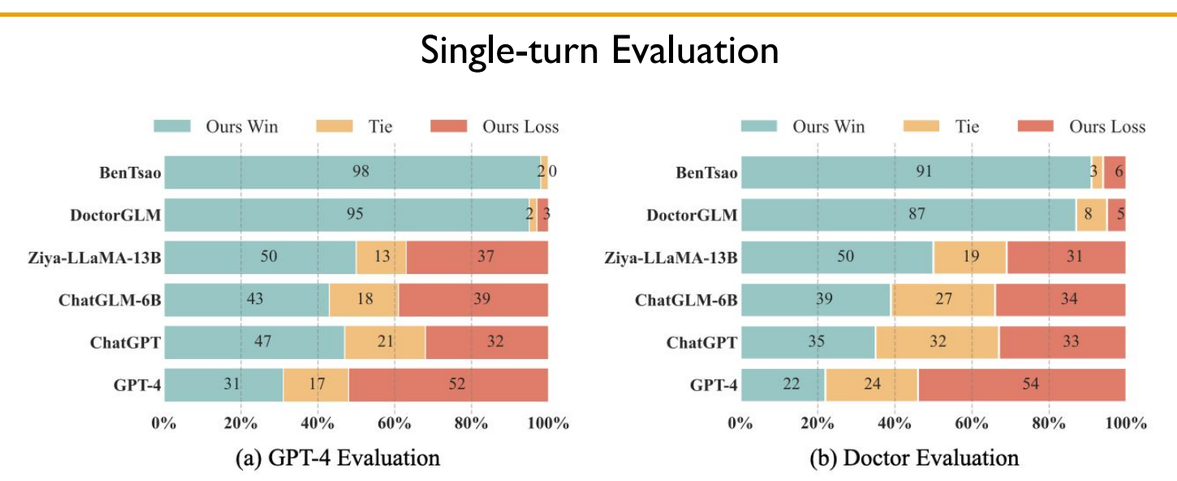
  Synthetic instructions and conversations from ChatGPT support a diverse output from the medical instruction dataset using a role-use case taxonomy. In dialogue synthesis, alternating roles between two ChatGPTs as patient and doctor pull from real-world medical data for consistent, detailed, and structured conversational output.
- *Real-world Data from Doctors*

  Drawn from authentic doctor-patient exchanges, the initial data is refined via language models to enhance clarity and patient-friendliness, overcoming issues with informal language and noise. Further details reside in the appendices.

II. RL with Mixed Feedback (RLMF)

Reinforcement learning with mixed feedback is envisioned for model realignment and response quality improvement. This progression towards alignment embraces artificial intelligence capabilities in mirroring human preferences. Drawn from such pioneering techniques, a new pipeline is designed prioritizing varied feedback sources, thereby ensuring informative, logical response generation consistent with the doctor's diagnosis.

Results



HuatuoGPT, trained on ChatGPT and real-world data, creates doctor-like, accessible responses. Its conversational ability, enhanced by reinforcement learning with mixed feedback, surpasses existing LLMs and often outperforms ChatGPT, highlighting its prominent role in future medical AI advancements.