KnowLab Medical Language Model

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Medical Related LLMs with LLaMA2 model as the foundation model

Asclepius 7B, 13B

- Released on 6 September
- Supervised Finetuned on 158k synthetic EHR
- They released Asclepius-R which is trained on 57k real clinical notes from the MIMIC-III dataset (available at Physionet)
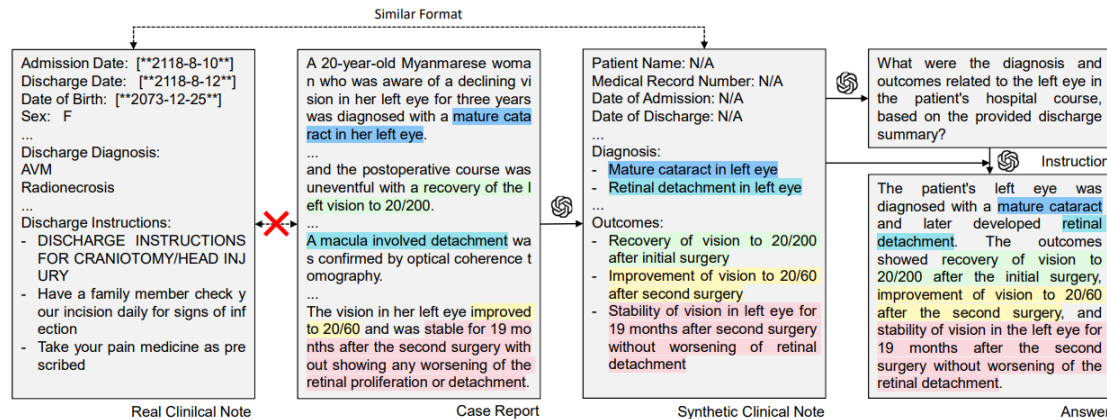

Figure 2: The first column (far left) is a part of the real discharge summary taken from MIMIC-III (Johnson et al., 2016). The second column is a case report from PMC-Patients (Zhao et al., 2023), and the third is the synthetic discharge summary created from this case report. Initially, the case report did not resemble the real clinical note in

AlpaCare 7B, 13B

- Released on 23 October
- Supervised Finetuned on Self-Instruct Generated Clinical Data
  - GPT4 to create task from clinician seed set
  - GPT3.5 to generate expected response

Figure 1: **Selected tasks from the clinician crafted seed set.** We focus on four perspectives: *topic*, *viewpoint*, *task type*, and *difficulty level*, to improve the seed set diversity. The set is further used to query GPT-4 to generate medical tasks.

```
topic: Epidemics
view: Epidemiologist
type: Text Generation
difficulty: 3

instruction: Write a brief summary about the 2009 H1N1 influenza pandemic, including
the origins, spread, and interventions.
input: <noinput>
```

```
topic: Cardiology
view: Medical Student
type: USMLE Style Q&A
difficulty: 5

instruction: Answer the following question which aims to test your knowledge about
blood flow in the heart.
input: A 50-year-old man with a history of hypertension presents to the emergency
department with complaints of chest pain radiating to his left arm, shortness of
breath, and diaphoresis. An electrocardiogram (ECG) shows ST-segment elevation in
leads II, III, and aVF. Cardiac enzymes are elevated. Which of the following changes
is most likely occurring in the coronary circulation during this acute event?
A) Vasodilation of coronary arteries;
B) Decreased oxygen extraction by the myocardium;
C) Decreased coronary blood flow;
D) Decreased coronary artery resistance;
E) Increased capillary filtration in the myocardium
```

Medical Related LLMs with LLaMA2 model as the foundation model

Clinical Camel 70B

- Released on 19 May
- Supervised Finetuned with 100k dialogues made from clinical articles
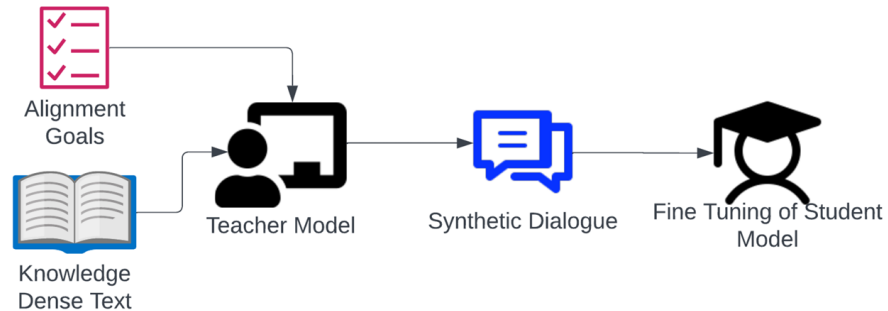- The first 70B model in medical domain.

MediTron 7B, 70B

- Released on 27 November
- Continued pretraining on PubMed papers and Medical Guidelines
- Finetuned with MedQA, MedMCQA, PubMedQA

Figure 1: Schematic representation of the Dialogue-Based Knowledge Encoding (DBKE) methodology. The process starts with a knowledge-dense input text T and a prompt P containing alignment constraints. The teacher model M_T then generates a multi-turn dialogue D, which is used to fine-tune the student model M_S. The result is a fine-tuned student model capable of improved conversational performance.
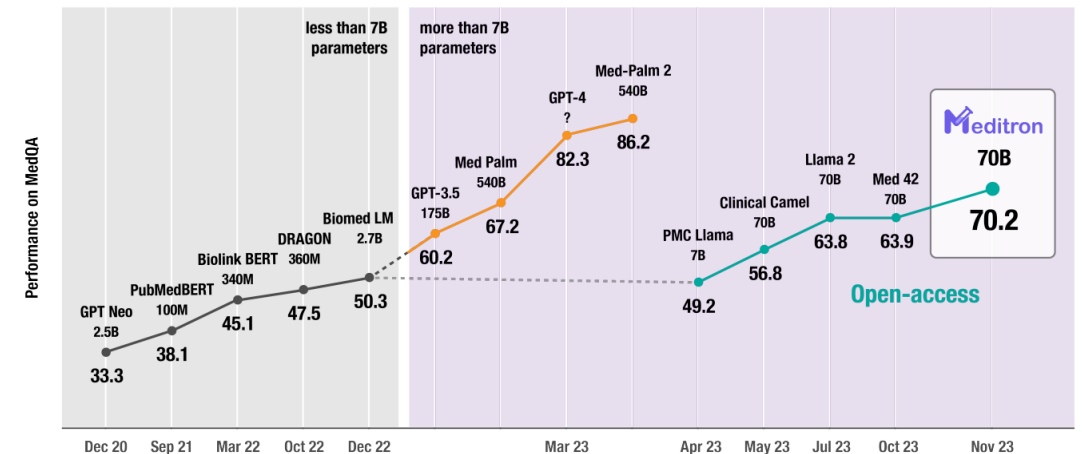
Figure 1: **MEDITRON-70B's performance on MedQA** MEDITRON-70B achieves an accuracy of 70.2 % on USMLE-style questions in the MedQA (4 options) dataset.

Toma *et al.*, 2023 [2305.12031] Clinical Camel
Chen *et al.*, 2023 [2311.16079] MEDITRON-70B

MedExQA and MedPhi-2 under review for ACL2024

Phi-2

- Released on 12 December
- 2.7B model size
- Used synthetic textbooks to train (1.4 Trillion Tokens)
- Outstanding performance considering the model size
- Claminig the era of Small Language Model (SLM).
- No paper released

MedPhi-2

- Phi-2 model was further trained using the medical datasets that are publicly available.
- Pretraining Data : 110M Tokens.
  - Includes:
    Meditron Medical Guidelines
    SNOMED CT descriptions
    Biomedical Article Abstracts
    Wikipedia Medical Terms
    PMC Patient Notes
- Finetuning Data : 239K Instructions.
  - Includes: Asclepius and AlpaCare

Our model outperforms all medical LLaMA variant models except 70B models

0-Shot Evaluation

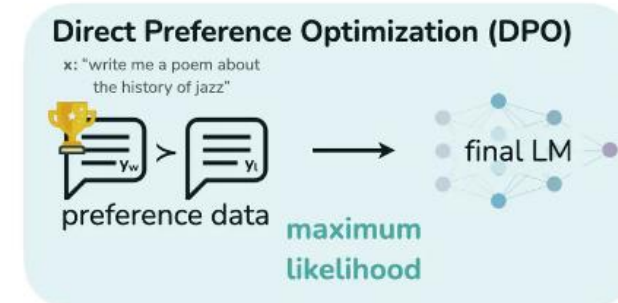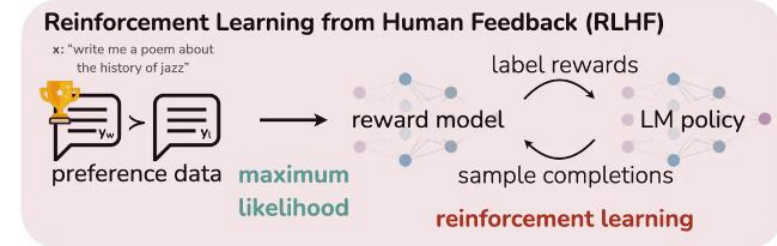| Model	Size	PubMedQA	MedQA	MedMCQA	MMLU_Med (1,871)	Avg
Meditron	7B	24.40	22.00	31.34	35.70	28.36
Gemma	2B	41.20	23.88	31.22	36.61	33.23
Asclepius-LLaMA2	7B	61.00	26.00	32.54	39.39	39.73
LLaMA2	13B	28.20	35.35	39.06	55.64	39.56
LLaMA2	7B	56.00	27.57	36.43	41.05	40.26
Asclepius-LLaMA2	13B	53.80	27.26	33.28	50.29	41.16
phi2	2.7B	42.60	30.87	36.03	55.42	41.23
AlpaCare-llama2	13B	47.60	29.93	39.28	53.18	42.50
AlpaCare-llama2	7B	68.00	25.29	36.12	44.04	43.36
MedPhi-2	2.7B	65.60	34.33	38.39	55.59	48.48
Mistral 7B	7B	59.80	45.01	49.56	66.86	55.31
Gemma	7B	73.00	43.83	46.86	66.76	57.61
LLaMA2	70B	74.60	50.98	50.82	70.02	61.61
Meditron	70B	74.40	52.79	51.30	69.11	61.90
ClinicalCamel	70B	**75.40**	52.79	52.43	71.03	62.91
Med42	70B	69.60	**60.96**	**63.02**	**75.36**	**67.23**

Further train MedPhi-2 to become more comprehensive LLM (Phi-2-KnowMed)

Training Dataset

- With datasets made from ontologies such as HPO
- More medical guidelines
- Even the life science (biomedical, pharmaceutical) domain
- List up the sources of high-quality text data
- Check the possibility of bulk download of API
  - Copyright issue should also be checked
- Download the data and transform into training dataset
  - Might involve usage of GPT-4
- **Evaluation**
  - Currently just on QA
  - Need to extend to many other tasks such as information extraction, summarisation, document classification, etc.
- **Target Journal** : NPJ Digital Medicine and JBHI(June)

Training method

- Pretraining is done very similar to BERT
- Supervised Fine-tuning is done using instruction-tuning dataset which is a dialogue
- Reinforcement Learning is done after SFT to align the format of the response to the preferred one.
  - We will use DPO instead of RLHF.

End of Presentation

Thank You!