Developing a medical language model based on reasoning in Persian language

Mehrdad Ghassabi

Supervisor: Hamidreza Baradaran

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Summary

|	Gaokerena-V	Gaokerena-R
Github repository	Mehrdadghassabi/Gaokerena-V	Mehrdadghassabi/Gaokerena-R
Model repository	gaokerena/gaokerena-v1.0	gaokerena/gaokerena-r1.0
Arxiv id	2505.16000	2510.20059
Cost	$300	$70
Reasoning capability	No	Yes
Published in	ICBME2025	ICSPIS2025

Motivation

- AI and language models are transforming healthcare

- English models already provide expert-level medical Q&A

- But Persian still lacks open, reliable medical language models

- Building such models is crucial for privacy-friendly local deployment

Problem Statement

- No Open Persian medical language models existed before

- No Open Persian medical corpus, QA dataset and benchmark existed before

- Facing almost a white paper on this topic

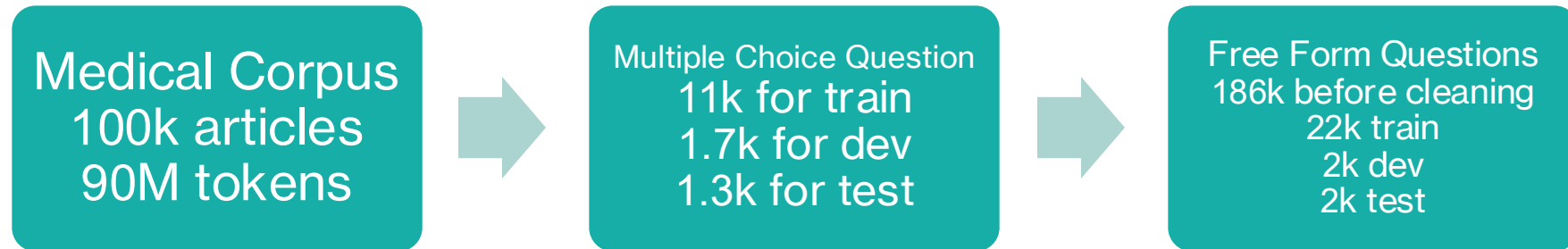# Phase 1

Baseline Model
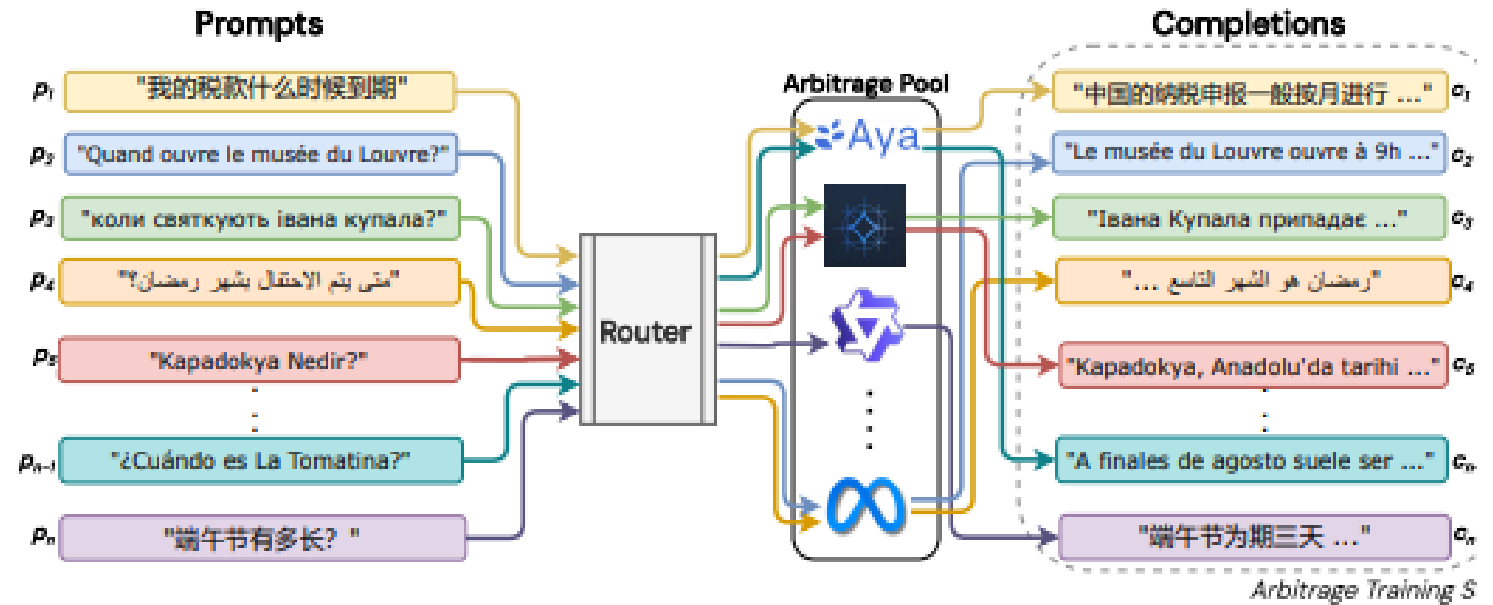
- Choosing a general purpose language model that support Persian

- Almost all baseline models had problems understanding Persian

- Aya-expanse was an exception since it had been developed to be

Collecting Data

- Crawled 100k articles from 11 medical magazines

- Crawled 186k free form QA pairs from 4 medical forums

- Crawling Codes were running about two weeks

- Cleaning Process has been done after crawling

- Created benchmark by translating from english

Collected data summary

Medical Corpus
100k articles
90M tokens

Multiple Choice Question
11k for train
1.7k for dev
1.3k for test

Free Form Questions
186k before cleaning
22k train
2k dev
2k test

Training

- Training on collected data lasted for 20 hours using a A100 GPU

- About 3300 questions should be asked for testing using a L4 gpu

- Each question answered in about 10s

- In colab plans, A100 costs about $1 per hour and L4 costs about $0.5 per hour

- Therefore Each train and test iteration costed about $25 for us

- We found the best hyperparameters in 6 iterations

hyperparameters

	Fine-tuning	Instruction-tuning
Target modules	All linear layers	All linear layers
Batch size	2	2
Gradient accumualtion	16	16
Optimizer	AdamW	AdamW
Learning rate	0.0005	0.0005
Max gradient norm	0.3	0.3
Warm up ratio	0.03	0.03
Weight decay ratio	0.1	0.5
Max Context length	1024	1024
Padding Strategy	Left side padding	Left side padding
Lora rank	8	2
Lora alpha	16	2
Drop out rate	0.05	0.4

Results

|	gaokerena-V	aya-expanse	Qwen	PersianMind
Anatomy	**48.14**	40.74	41.48	25.18
Genetics	**53.0**	49.0	52.0	34.0
College-Medicine	43.93	**44.51**	43.35	20.23
Clinical-Knowledge	**55.47**	52.07	47.92	25.28
Professional-Medicine	**47.05**	45.58	43.01	23.89
College-Biology	**47.22**	45.14	42.36	32.63
Avg	**49.31**	46.64	45.17	25.89
IBMSEE Sept 2023	**38.69**	34.52	33.33	19.64
No. parameters	8b	8b	7.6b	6.8b

Phase 2

Reasoning in language models

- In NeurIPS 2019 Bengio asserted a key deficiency in current deep learning systems, they can't reason

- That's why Sutton bitter lesson repeats

- That deficiency exists in transformers too, a new artchitecture should be developed

- But as Feb 2026 we are bounded to use transformers and try to enhace its reasoning skills

Enhacing reasoning in language models

- The zeroth approach tries to use merge connectionist AI and Symbolic AI

- The first approach which Bengio has suggested is to develop a new architecture within internal reasoning capability

- The second approach is to guide the model in the inference time using PRM,ORM

- The third approach is to train a language model using reasoning data an endeavour to mimic reasoning abilities.
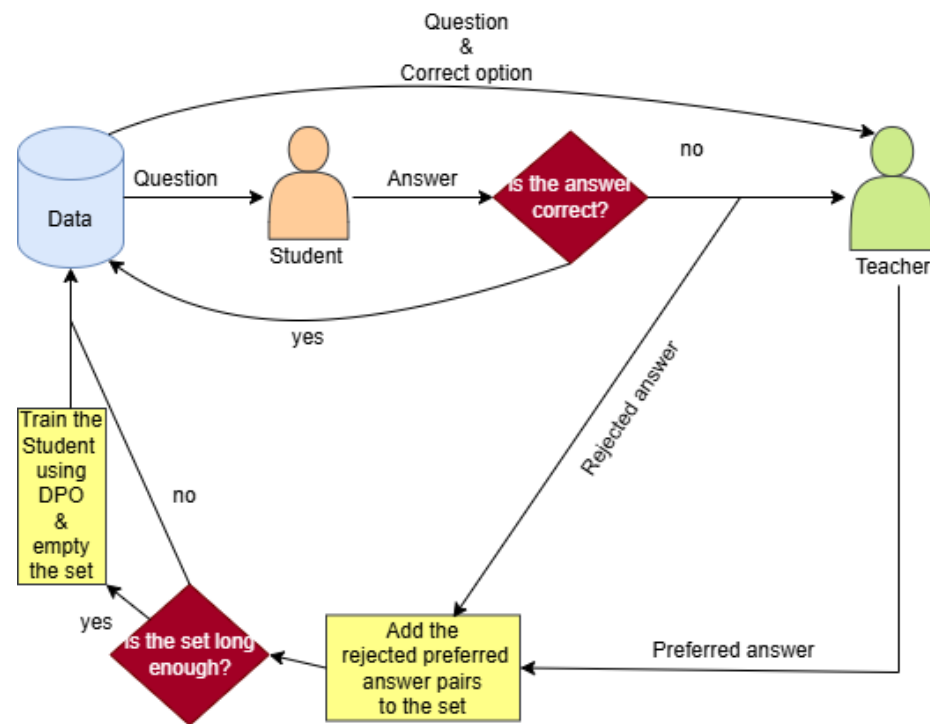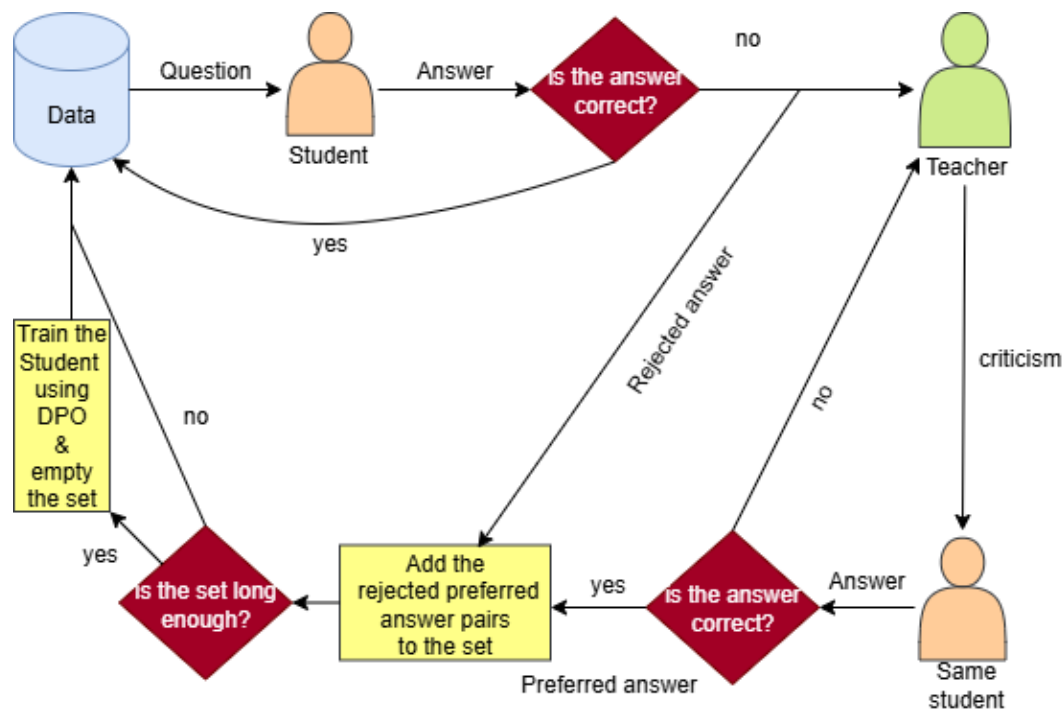
Proposed methods

Advantages

- Without collecting data and just using RLAIF we got better Result

- Only a Single hour has been used for training

- Our experiments shows the importance of reasoning in medical domain

Result

	Gaokerena-R	Gaokerena-V	aya-expanse
Anatomy	47.40	**48.14**	40.74
Genetics	**56.0**	53.0	49.0
College-medicine	**50.28**	43.93	44.51
Clinical-knowledge	**58.86**	55.47	52.07
Professional-medicine	**48.89**	47.05	45.58
College-biology	**54.86**	47.22	45.14
Avg	**52.98**	49.31	46.64
2023IBMSEE Sept	**46.42**	38.69	34.52
Prompt	Cot	Straight	Straight
No. parameters	b8	b8	b8

$$\text{pass@k} = \frac{1}{\text{\# of problems}} \sum_{i=1}^{\text{\# of problems}} \left(1 - \frac{\binom{N-C_i}{k}}{\binom{N}{k}}\right)$$

Results
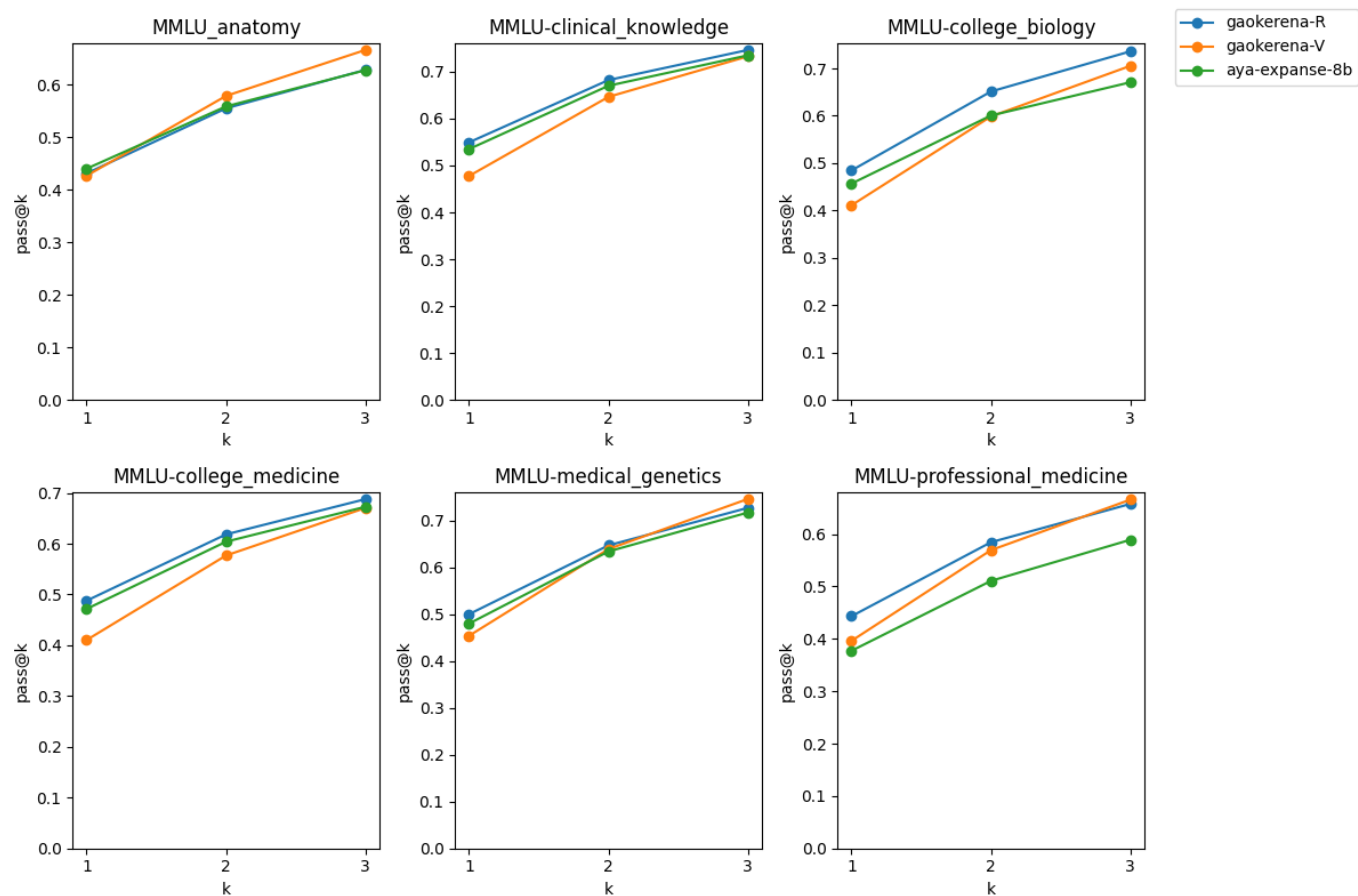
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References