

EHReader: A Medical Healthcare Question Answering System

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Introduction & Background

- Question answering (QA)
 - Given question and context, extract answer
 - Answerability
- Applications in healthcare
 - Electronic health records (EHR)
 - Retrieve answers from clinical notes
- Main objective
 - Retrospective Reader
 - Apply RR-inspired model to medical data

Our Approach: *Datasets*

- EmrQA
 - Context-question-answer samples from clinical notes
 - Medical relations: 255,908 question-answer pairs
 - Medications: 141,243 question-answer pairs
- Creating negative samples
 - Unanswerable samples

Record Date: 08/09/98

08/31/96 ascending aortic root replacement with homograft with omentopexy. The patient continued to be hemodynamically stable making good progress. Physical examination: BMI: 33.4 Obese, high risk. Pulse: 60. resp. rate: 18

Question: Has the patient ever had an abnormal BMI?

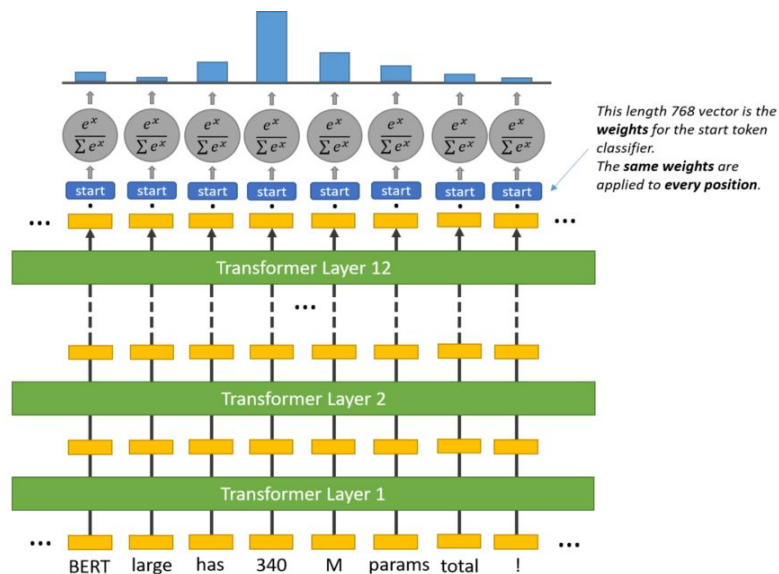
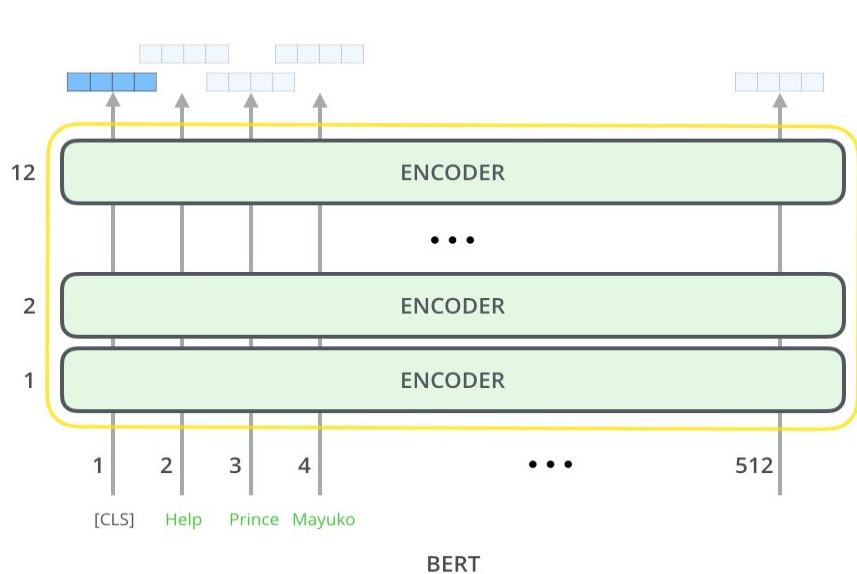
Answer: BMI: 33.4 Obese, high risk

Question: When did the patient last receive a homograft replacement ?

Answer: 08/31/96 ascending aortic root replacement with homograft with omentopexy.

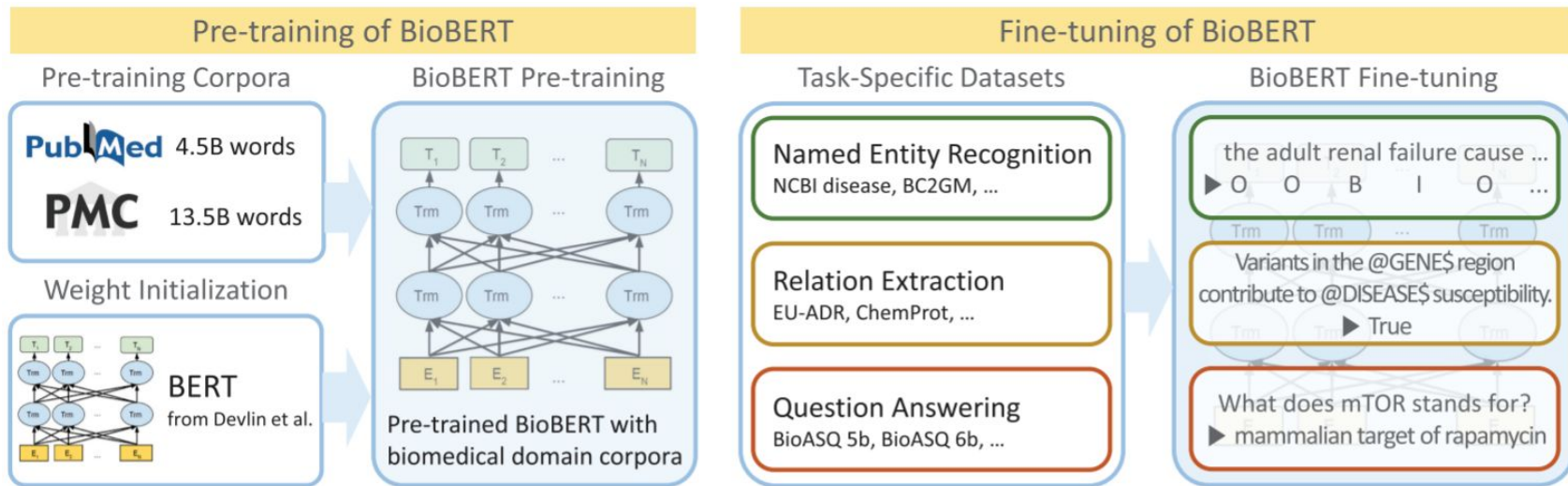
Our Approach: *distilBERT*, *bioBERT*

- Multi-layer bidirectional Transformer encoder
 - Fine-tuned for QA via start and end vectors

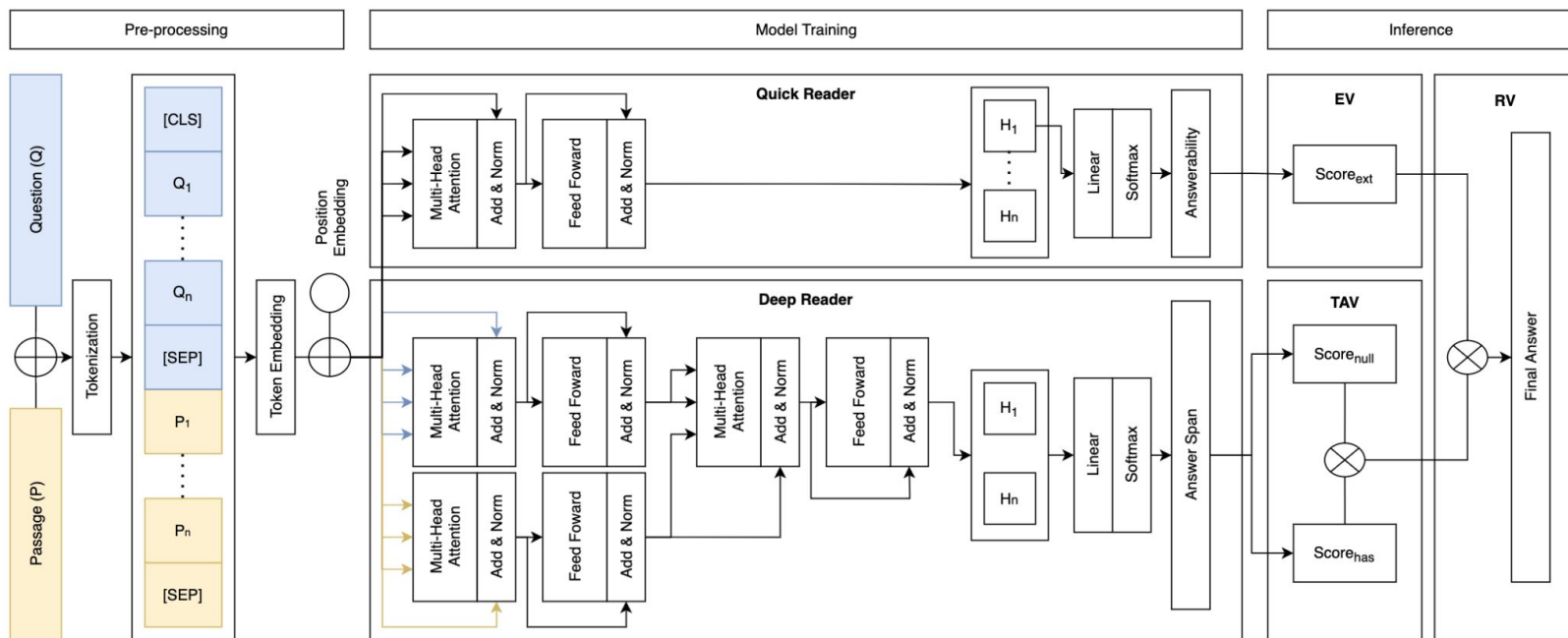


Our Approach: *distilBERT*, *bioBERT*

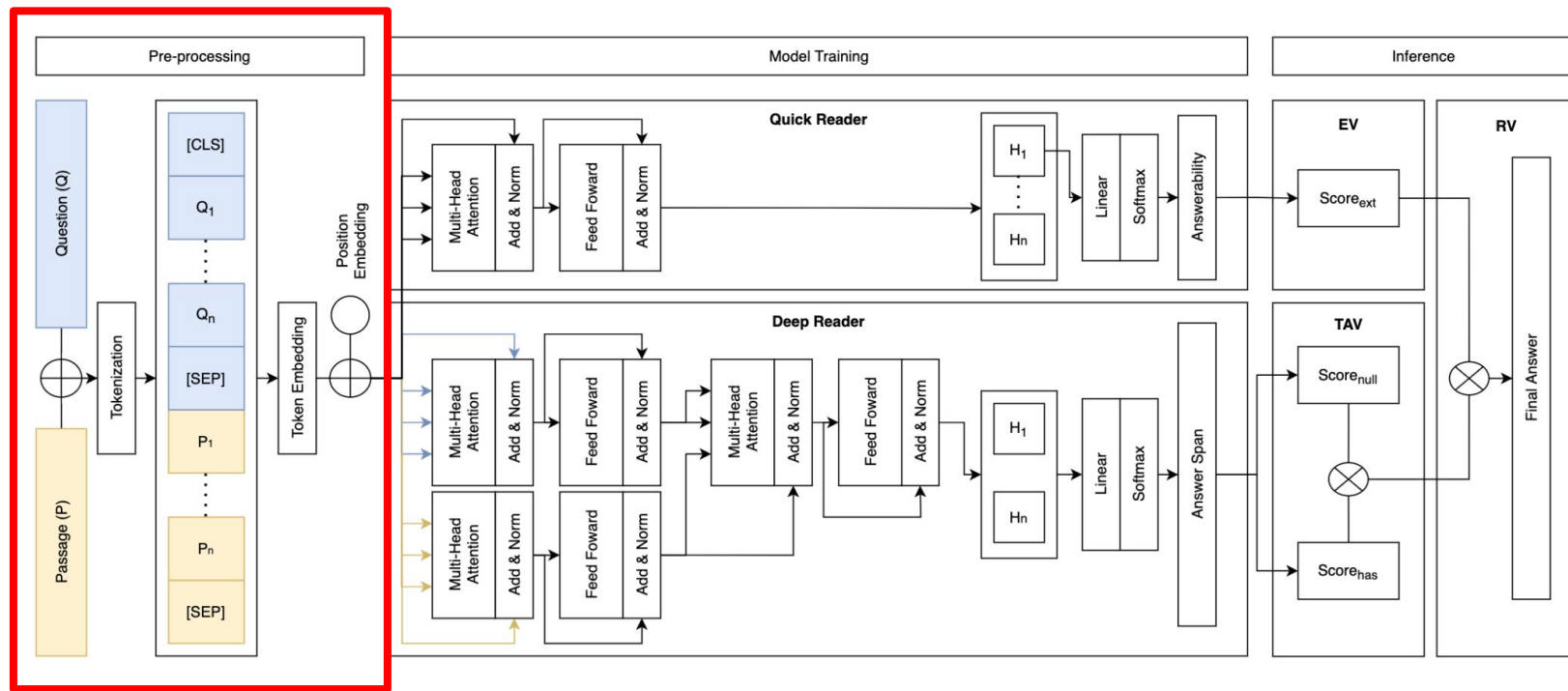
- BERT trained on medical corpora
 - Better recognition of medical terms



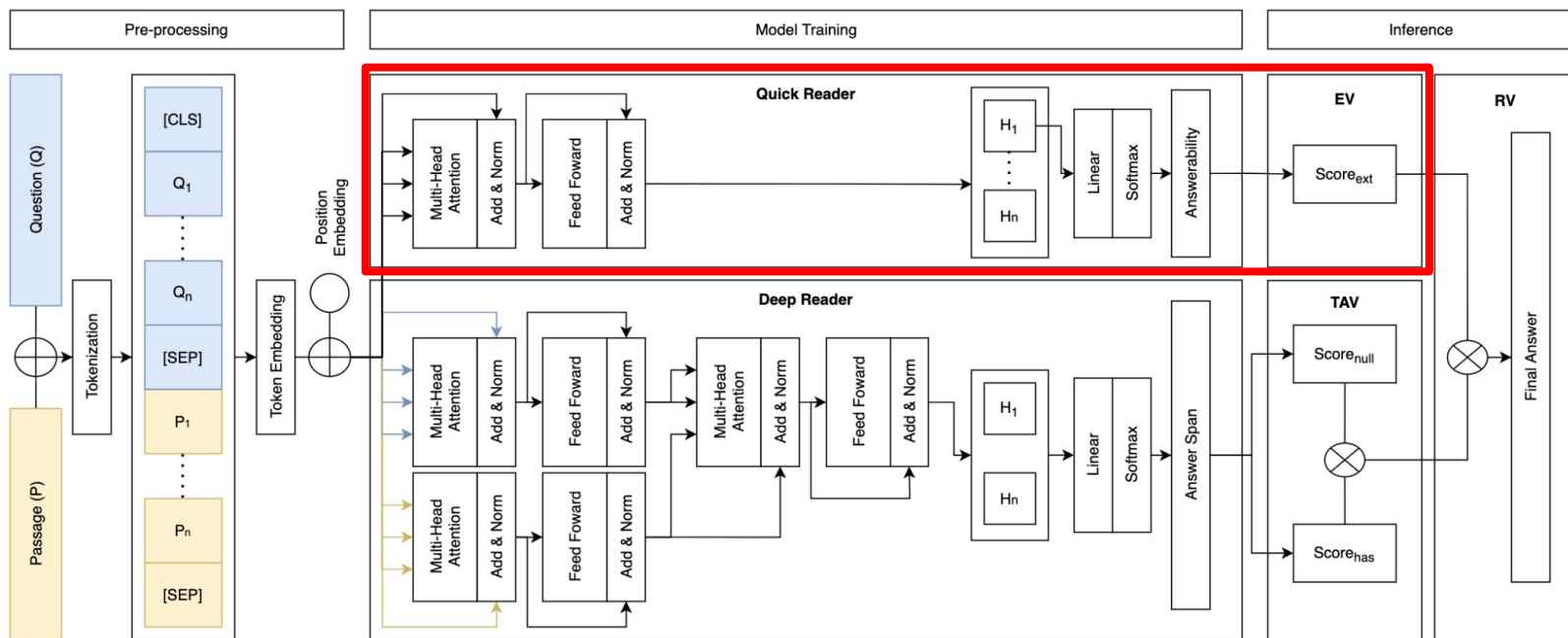
Our Approach: *EHReader*



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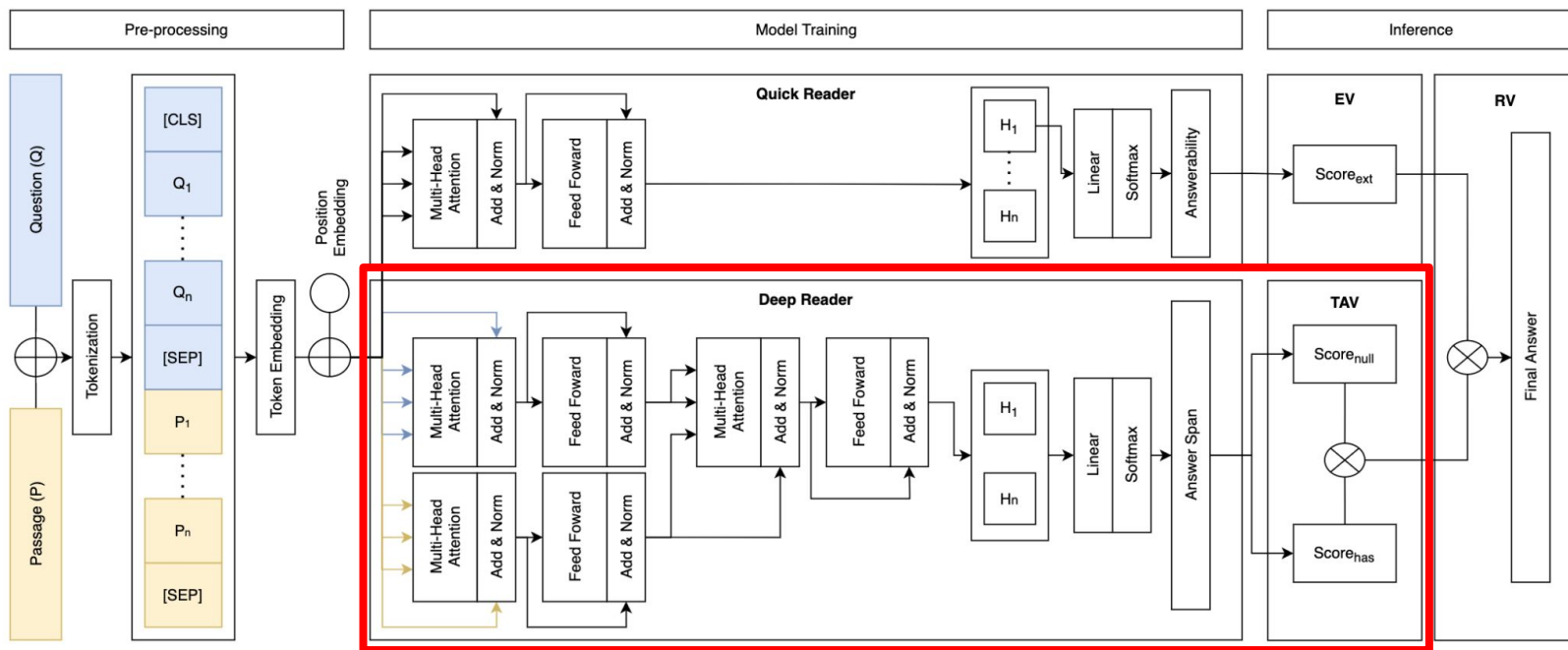
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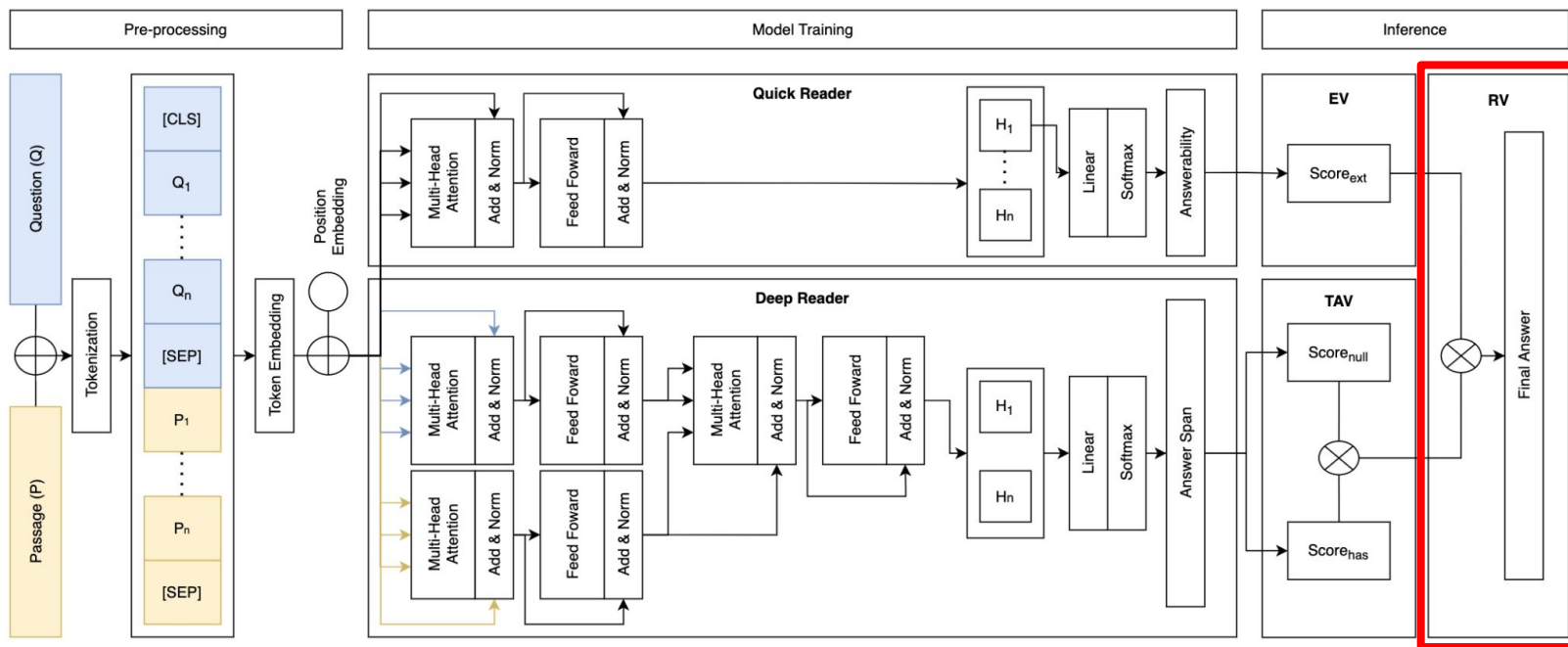
$$score_{has} = \max(s_k + e_l), \quad 1 < k \leq l \leq n$$

$$score_{null} = s_1 + e_1$$



Our Approach: *EHReader*

$$v = \beta_1 score_{ext} + \beta_2 score_{deep}$$



Results & Analysis

Model	Medication				Relations			
	Dev		Test		Dev		Test	
	EM	F1	EM	F1	EM	F1	EM	F1
<i>Our Implementation inspired by Retro-Reader (Zhang et al., 2020b)</i>								
EHReader-distilBERT(+RV)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
QuickReader-distilBERT(+RV)	94.3	95.8	86.5	89.6	97.1	97.4	94.6	95.2
<i>distilBERT (Sanh et al., 2020)</i>								
distilBERT (Frozen)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
distilBERT	93.5	95.0	85.2	88.1	96.7	97.0	94.0	94.6
distilBERT(+TAV)	94.3	95.7	86.4	89.3	97.1	97.4	94.4	95.0
<i>bioBERT (Lee et al., 2019)</i>								
bioBERT	63.2	64.5	59.3	60.8	48.1	50.9	46.4	49.2
bioBERT(+TAV)	65.8	67.5	60.9	63.0	59.6	60.0	51.2	53.1

Table 1: The results for emrQA medication and medical relations datasets (All numbers are percentages).

Demo!



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