Enriching Unsupervised User Embedding via Medical Concepts

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1. Unsupervised User Embedding is effective to capture patient patterns with broad real-world applications.

2. Medical concepts significantly boost patient modeling & potentially enhance interpretation.

https://github.com/xiaoleihuang/UserEmb_Explainable

User embedding models user behaviors by mapping all user info into a unified vector space.

Medical concepts: basic units for medical info, such as disease symptom and clinical drug.

Unsupervised

avoid *error-prone labels*[1]

reduce *labor*

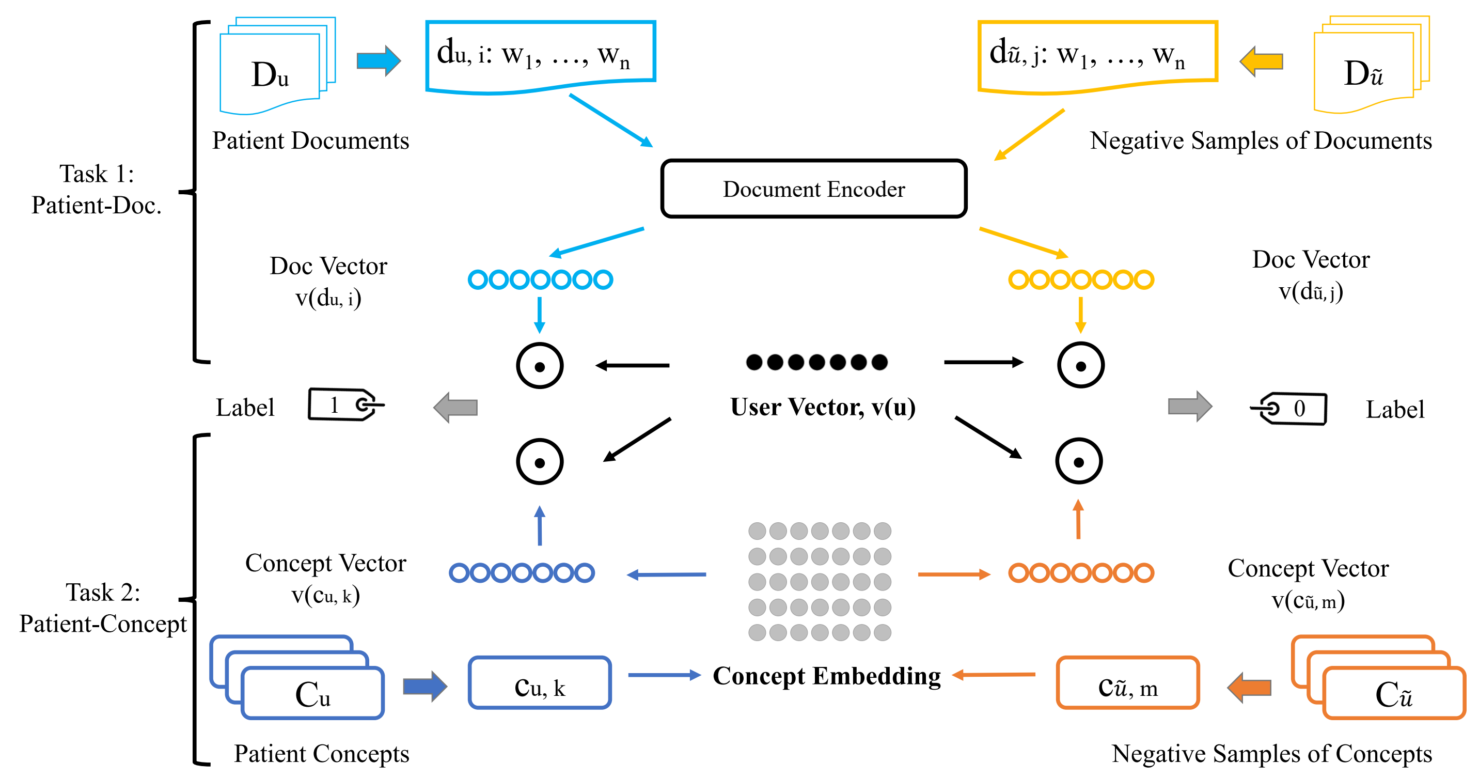
save *money*

Data	Statistics			
	Doc	User	U-label	U-Concept
Diabetes[3]	1265	288	10	89
MIMIC-III[2]	54888	48807	276	94

MetaMap[4]

Model

Concept-Aware User Embedding (*CAUE*)



Task 1: Patient-Document	Task 2: Patient-Concept
$\mathcal{L}(u,d) = -log(\sigma(v(u)\cdot v(d_u))) - log(1-\sigma(v(u)\cdot v(d_{\tilde{u}})))$	$\mathcal{L}(u,c) = -log(\sigma(v(u)\cdot v(c_u))) - log(1-\sigma(v(u)\cdot v(c_{\tilde{u}})))$

simulate diagnosis process:
enforce models to recognize patients (u) of medical notes (d) / concepts (c).

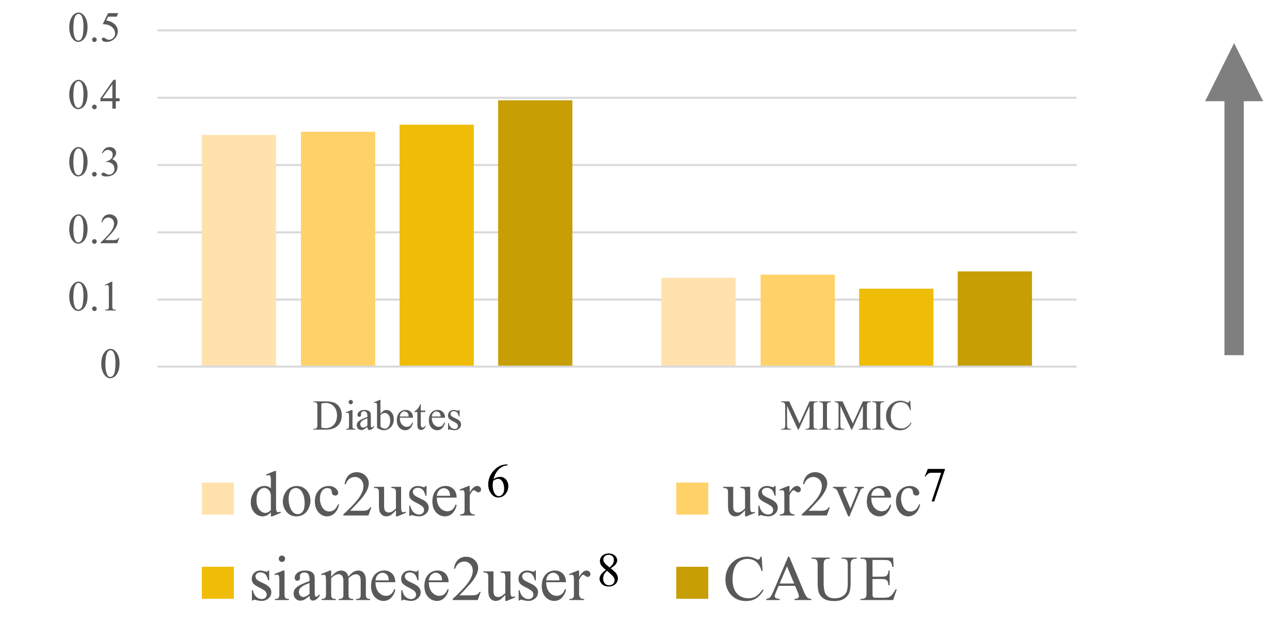
Key Methods

1. *contrastive learning*[5]: generate counterfactuals → model robustness
2. *negative sampling*: convert to binary prediction (self-supervision)

Eval & Apps

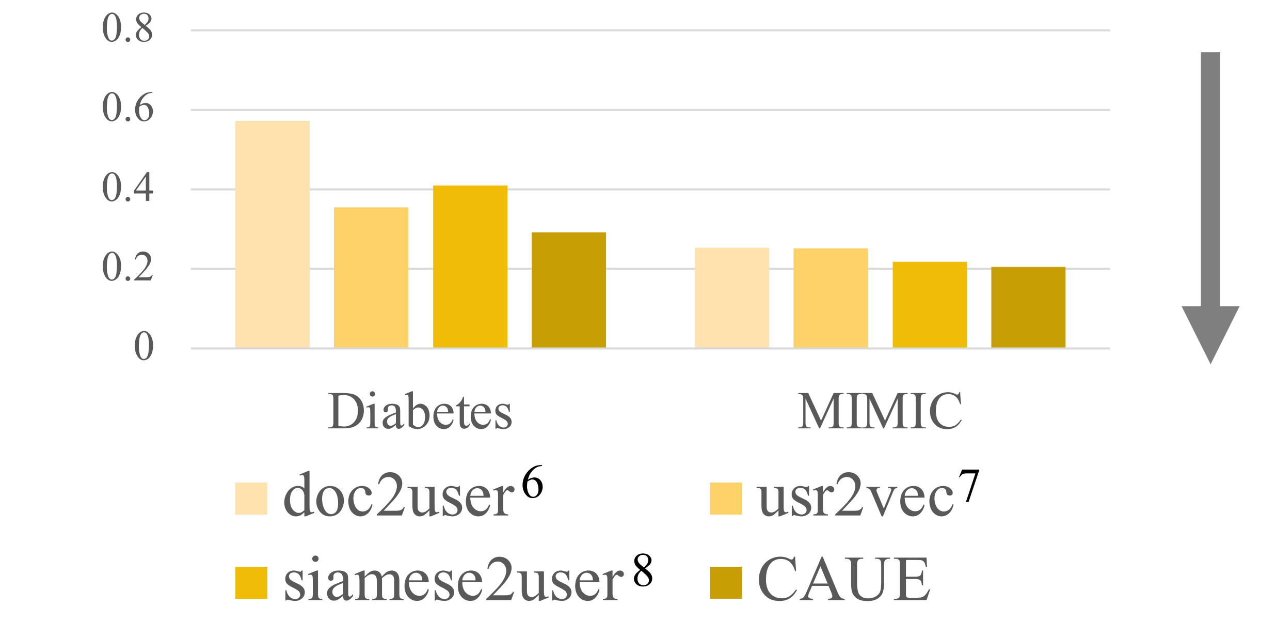
Patient Retrieval

$$Jaccard(u_1,u_2) = \frac{|l_1 \cap l_2|}{|l_1 \cup l_2|}$$



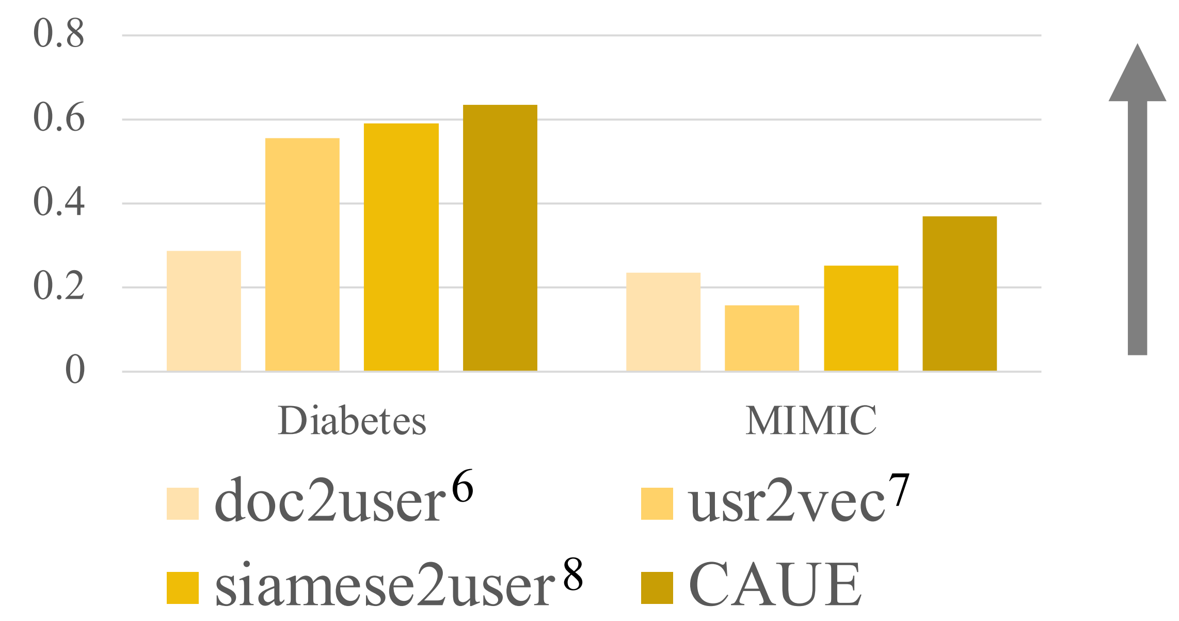
Patient Relatedness

MSE: Mean Square Error



Phenotype Inference

MAP: Mean Average Precision



Reference:

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