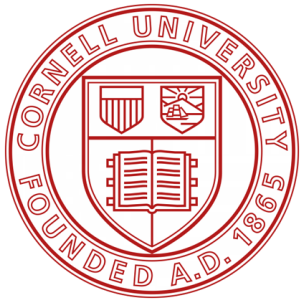
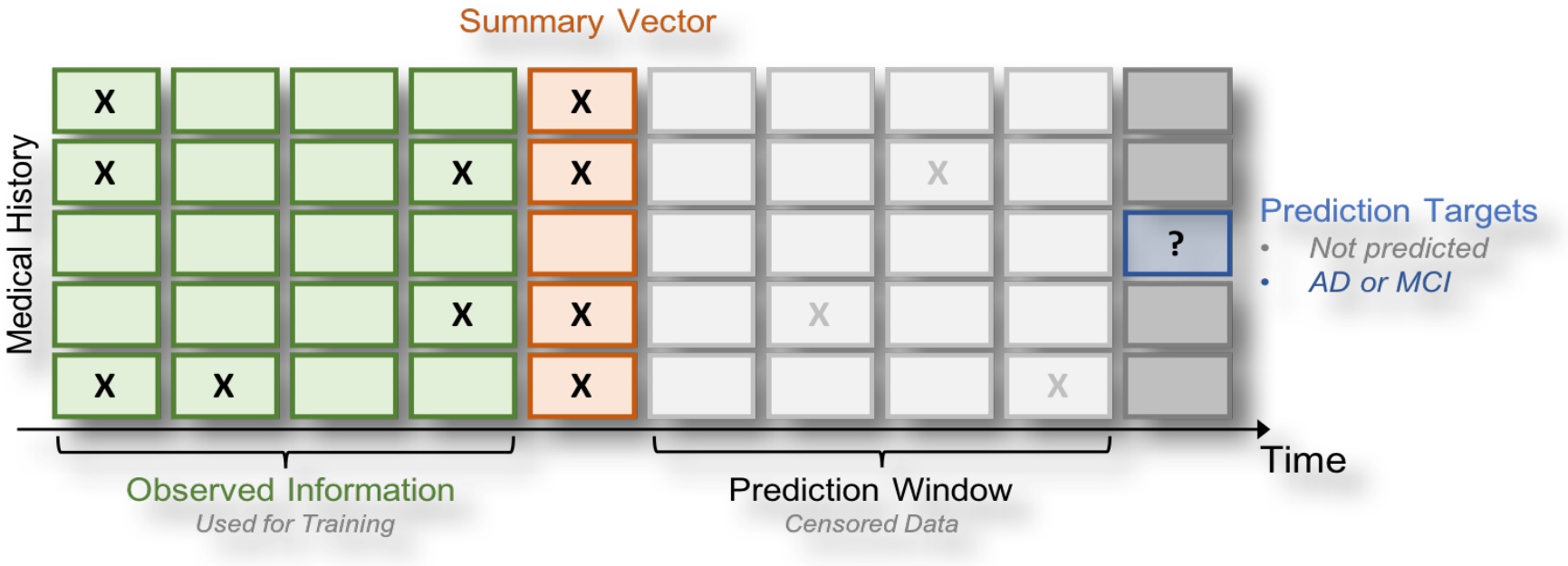


MetaPred: Meta-Learning for Clinical Risk Prediction with Limited Patient Electronic Health Records

Xi S. Zhang, Fengyi Tang, Hiroko H. Dodge,

Jiayu Zhou, Fei Wang

Clinical Risk Prediction



- Patient EHRs: each patient has a sequence of vectors;
- Predictive models: build for clinical risks, such as in-hospital mortality, hospital readmission, chronic disease onset, condition exacerbation, etc.
  - LR, SVM, k-Nearest Neighbor, Random Forest, MLP;
  - RNN, CNN.

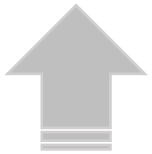
Limited Patient EHRs

How about patient samples that are insufficient?

- it is expensive and sometimes even impossible for obtaining labeled new samples
- reusing data on other domain/tasks becomes a feasible strategy

  - transfer learning

  - meta-learning (learning to transfer)

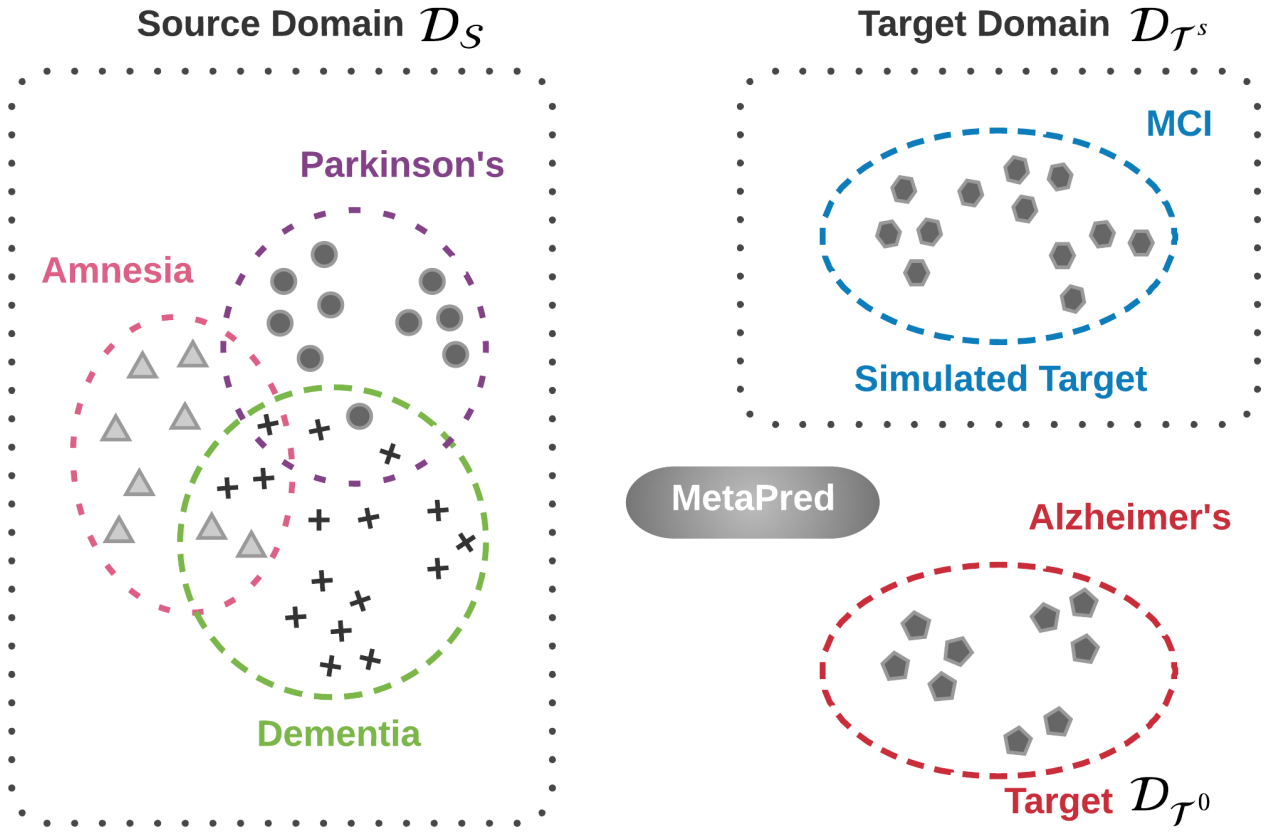


Using the learning experiences from a set of relevant tasks …

Problem Setup

Goal: is to predict the risks of target disease with few labeled patients, which give rise to a low-resource classification.

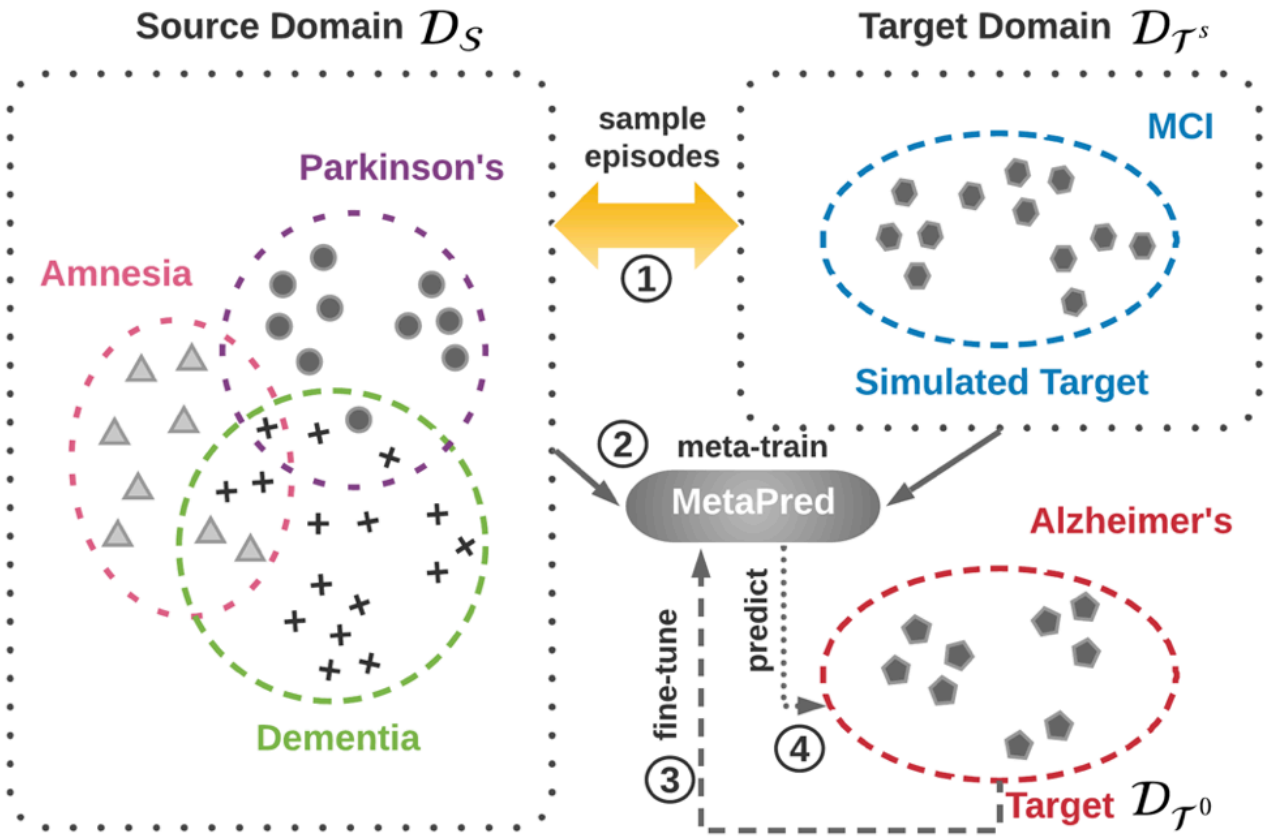
The idea: is to take advantage of labeled patients from other relevant high-resource domains and design the learning to transfer framework with sources and a simulated target.



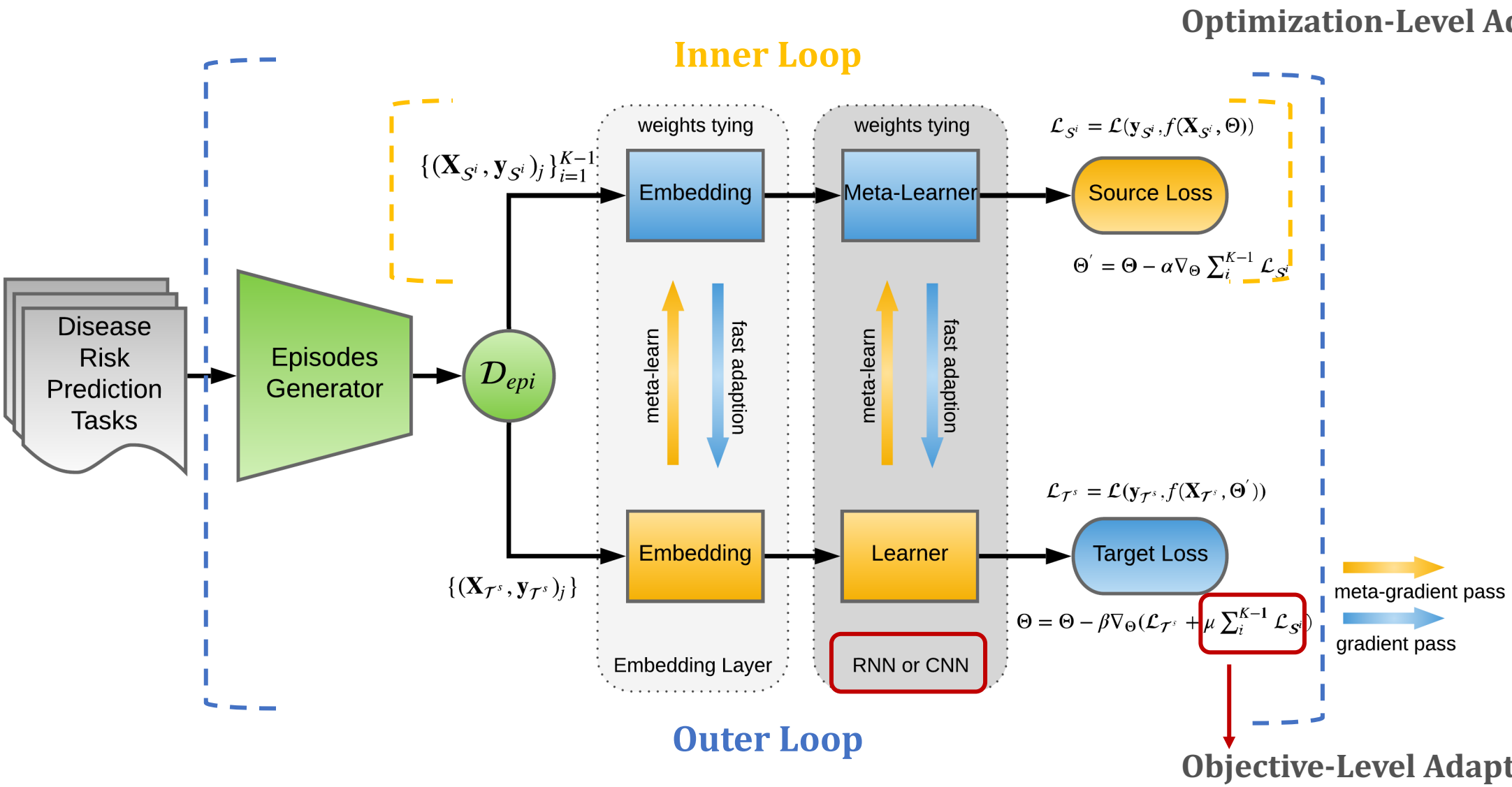
Problem Setup

4 steps:

- ✓ sample episode
- ✓ meta-train
- ✓ fine-tune
- ✓ predict



The MetaPred Framework



Dataset

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Table 1: Statistics of datasets with disease domains.

Domain	Case	Control	# of visit	Ave. # of visit
MCI	1,965	4,388	161,773	22.24
Alzheimer's	1,165	4,628	136,197	20.73
Parkinson's	1,348	3,588	105,053	20.01
Dementia	3,438	1,591	98,187	18.06
Amnesia	2,974	4,215	180,091	21.60

Targets

Results

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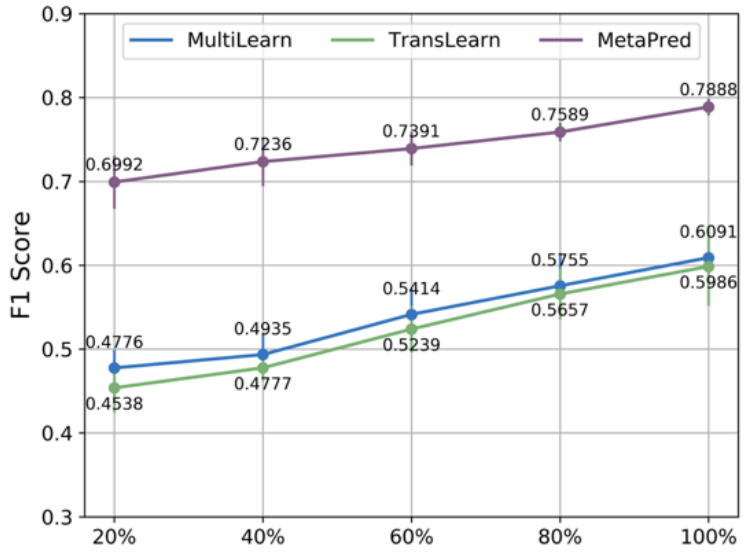
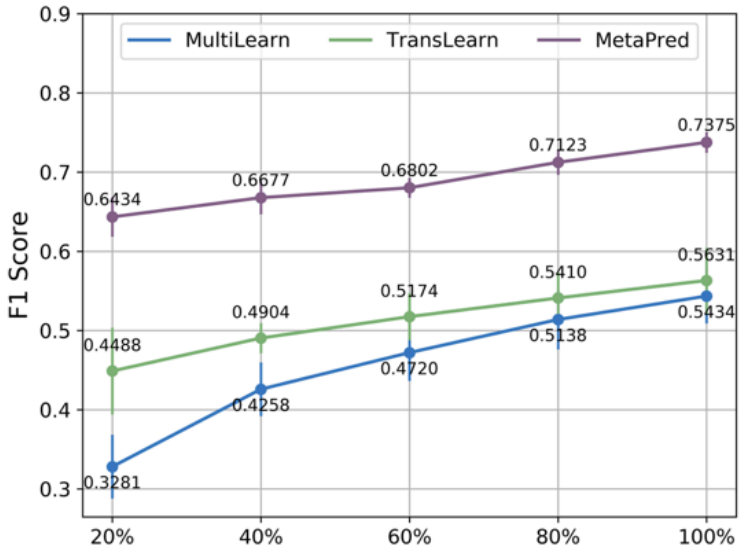
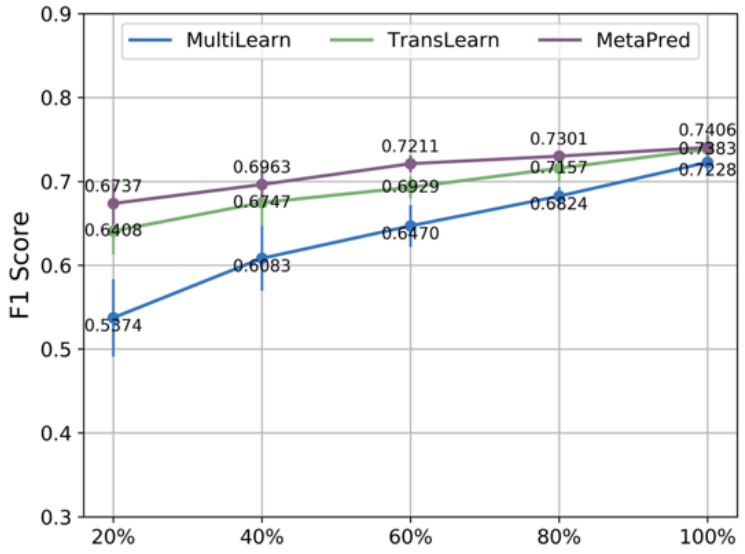
Mild Cognitive Impairment



Alzheimer's Disease



Parkinson's Disease



Compared with multi-task learning and transfer learning.

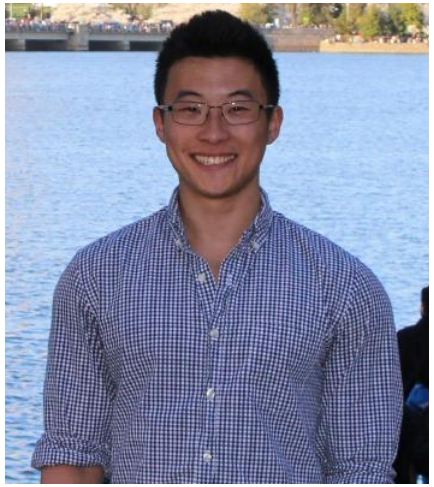
Conclusion

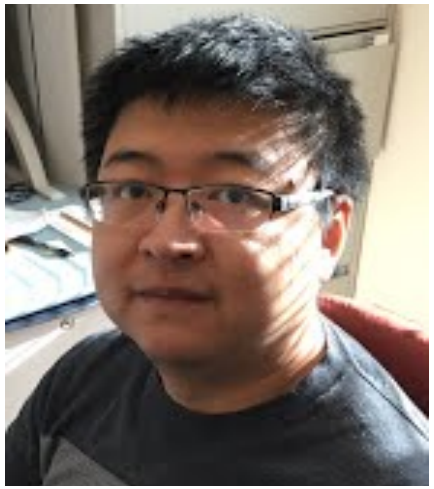
- Leverages deep predictive modeling with the model agnostic meta-learning to exploit the medical records from high-resource domain.

- Introduce an objective- level adaptation for MetaPred which not only take advantage of fast adaptation from optimization-level but also take the supervision of the high-resources domain into account.

- Extensive evaluation involving 5 cognitive diseases is conducted on real-world EHR data for risk prediction tasks under various source/target combinations.

- Open Source Code:
  `https://github.com/sheryl-ai/MetaPred`





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