A Scalable Framework for Synonymy Prediction: Inserting New Biomedical Terms into the UMLS

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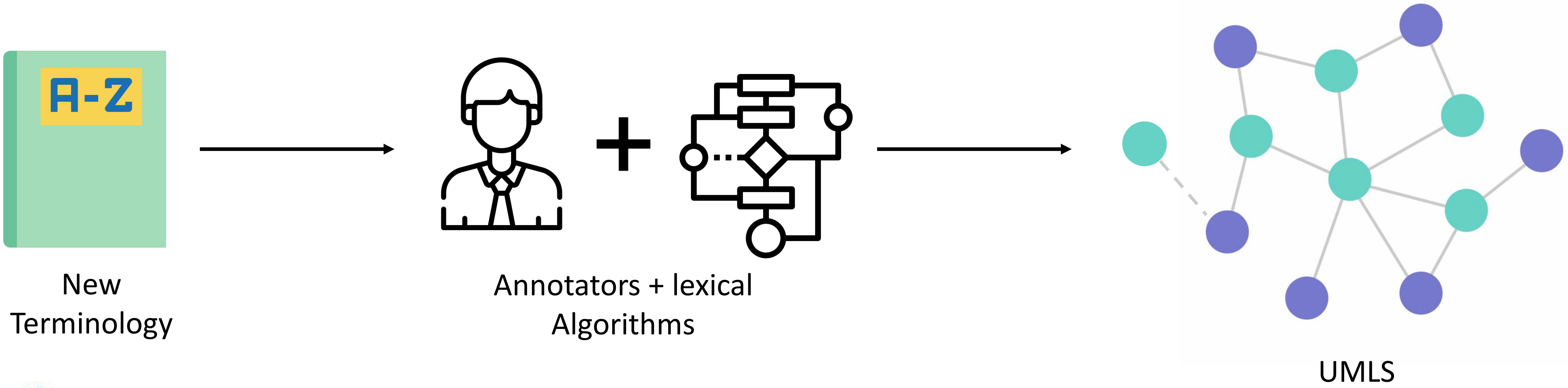
Motivation

- UMLS is a biomedical terminology integration system that integrates over 200 biomedical vocabularies
- Construction Process through human annotators and lexical algorithms
  - **Problem:** Time-consuming and Error Prone
  - **Challenge:** Reduce running time and errors



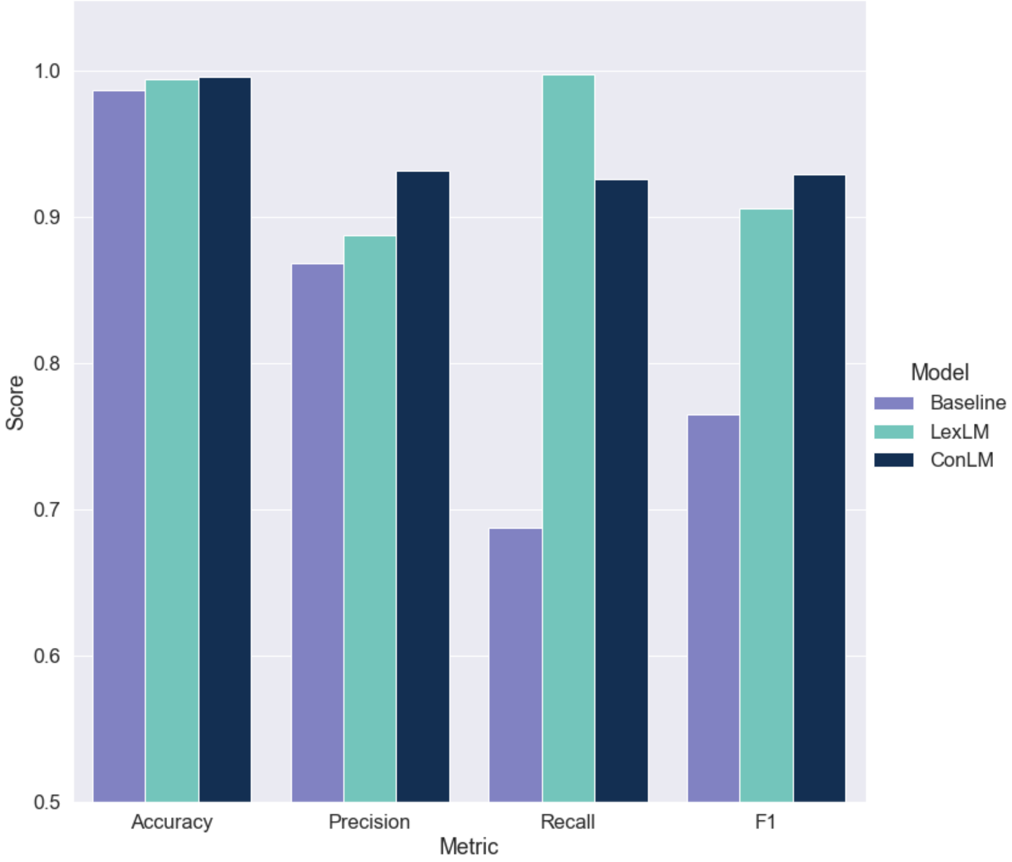
New Terminology

Annotators + lexical Algorithms

UMLS

Prior Work

- Dataset
  - UMLS Version 2020AA
  - 1.73×10^8 pairs
  - Negative pairs had varying degrees of lexical similarity
  - Maximized coverage of AUIs in training + test dataset
- Limitations:
  - Models have not been applied to real use case



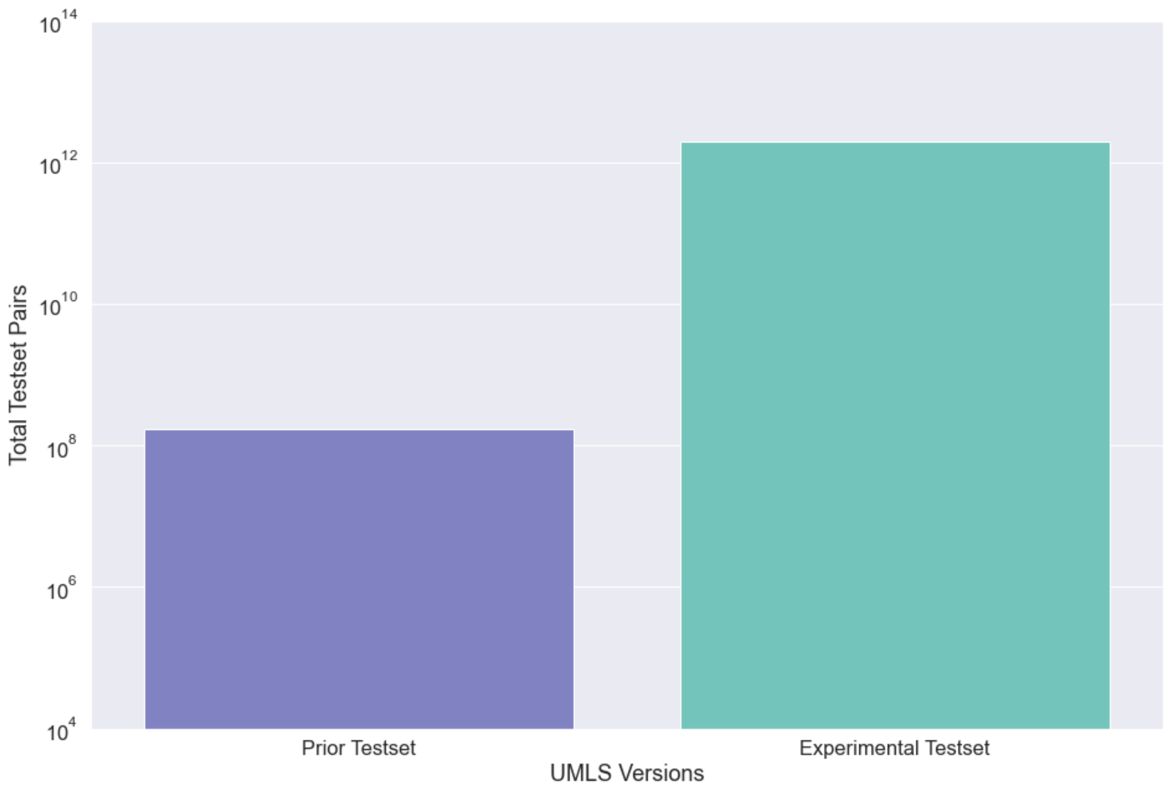
Model metrics across baseline, LexLM (model trained using lexical information), and ConLM (model trained with lexical and contextual information)

Goals

- Create a framework to apply prior models on a real use case: inserting new biomedical terms into an existing version of the UMLS Metathesaurus.
- Minimize running time when **predicting synonymy** to improve feasibility of model adoption into the UMLS construction process
    - Months and years → days and weeks

Challenges and Contribution

- Challenge:
  - Scalability
    - Experiment size: 2×10^{12}
    - Prior Dataset size: 1.73×10^{8}
- Contribution:
  - Approach to minimize running time required for synonym prediction



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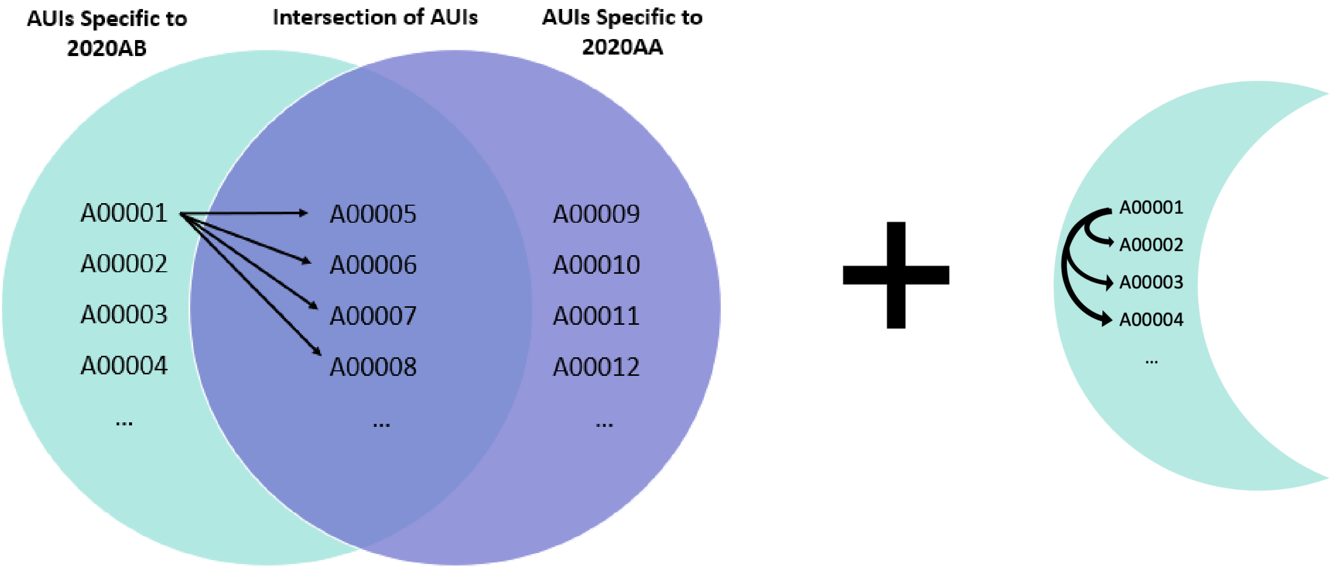
Dataset

Purpose: Insert new AUIs (2020AB) into prior version of unsuppressed AUIs (Intersection of AUIs)

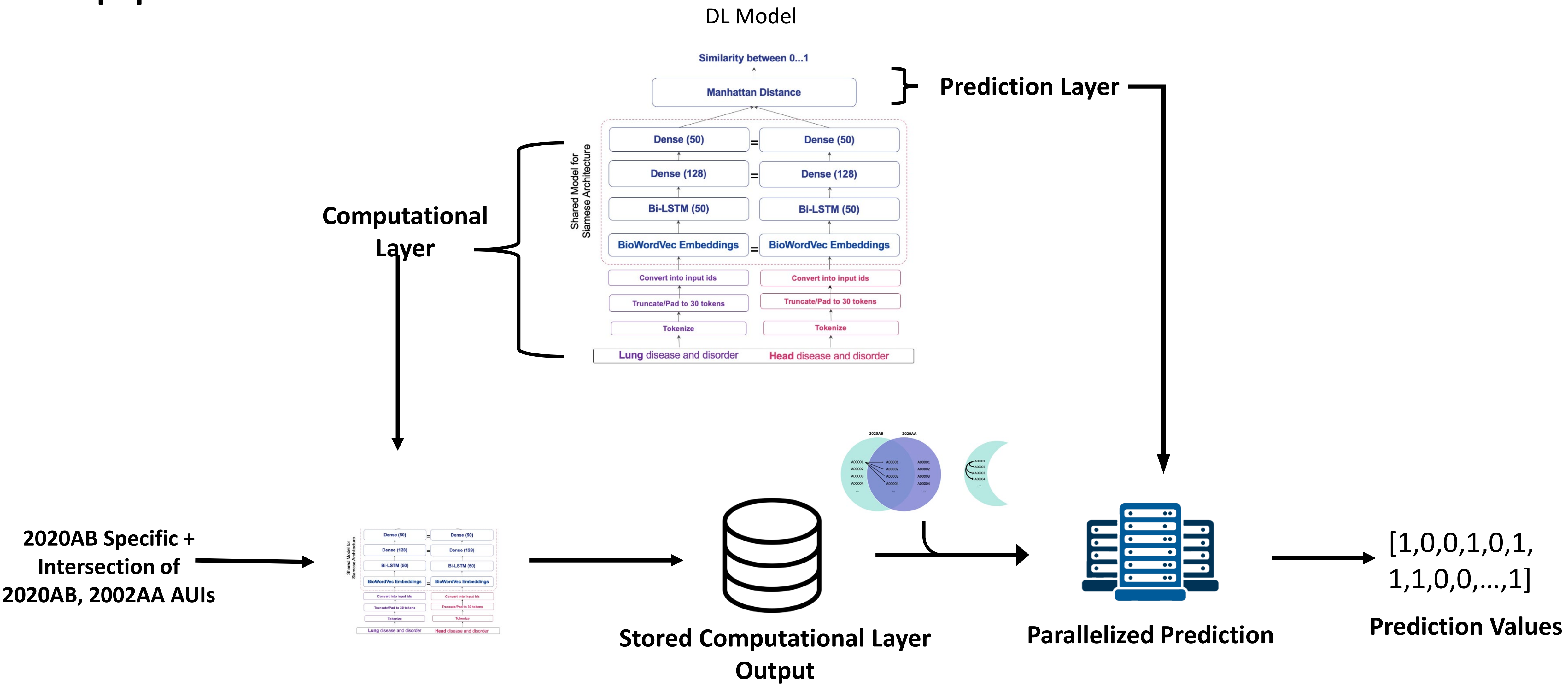
Strategy: Cross product of AUIs specific to 2020AB and Intersection of AUIs + All pairs within AUIs specific to 2020AB

Result: 2×10^{12} pairs



Dataset pairing method using AUIS specific to 2020AB and AUIs present in both 2020AB and 2020AA

Approach



DL Model

Prediction Layer

Computational Layer

2020AB Specific + Intersection of 2020AB, 2002AA AUIs

Stored Computational Layer Output

Parallelized Prediction

[1,0,0,1,0,1,
1,1,0,0,...,1]

Prediction Values

Project Progress

- Completed
  - Testset Generation
  - Precomputing AUIs using computational layer
- In Progress
  - Parallelized Predictions
- To Do:
  - Error Analysis

Conclusion

- Motivation
  - Address the laborious and error-prone UMLS construction process
- Prior Work
  - Used deep learning for synonymy prediction of AUIs
  - Greatly exceeded baseline
- Goals
  - Create framework to apply models to real use case
  - Minimize running time of synonymy prediction
- Challenge and Contribution
  - Scalability
  - Approach to minimize running time on dataset
- Approach
  - Model splitting and precomputing computational layer prior to parallelizing predictions

Acknowledgements

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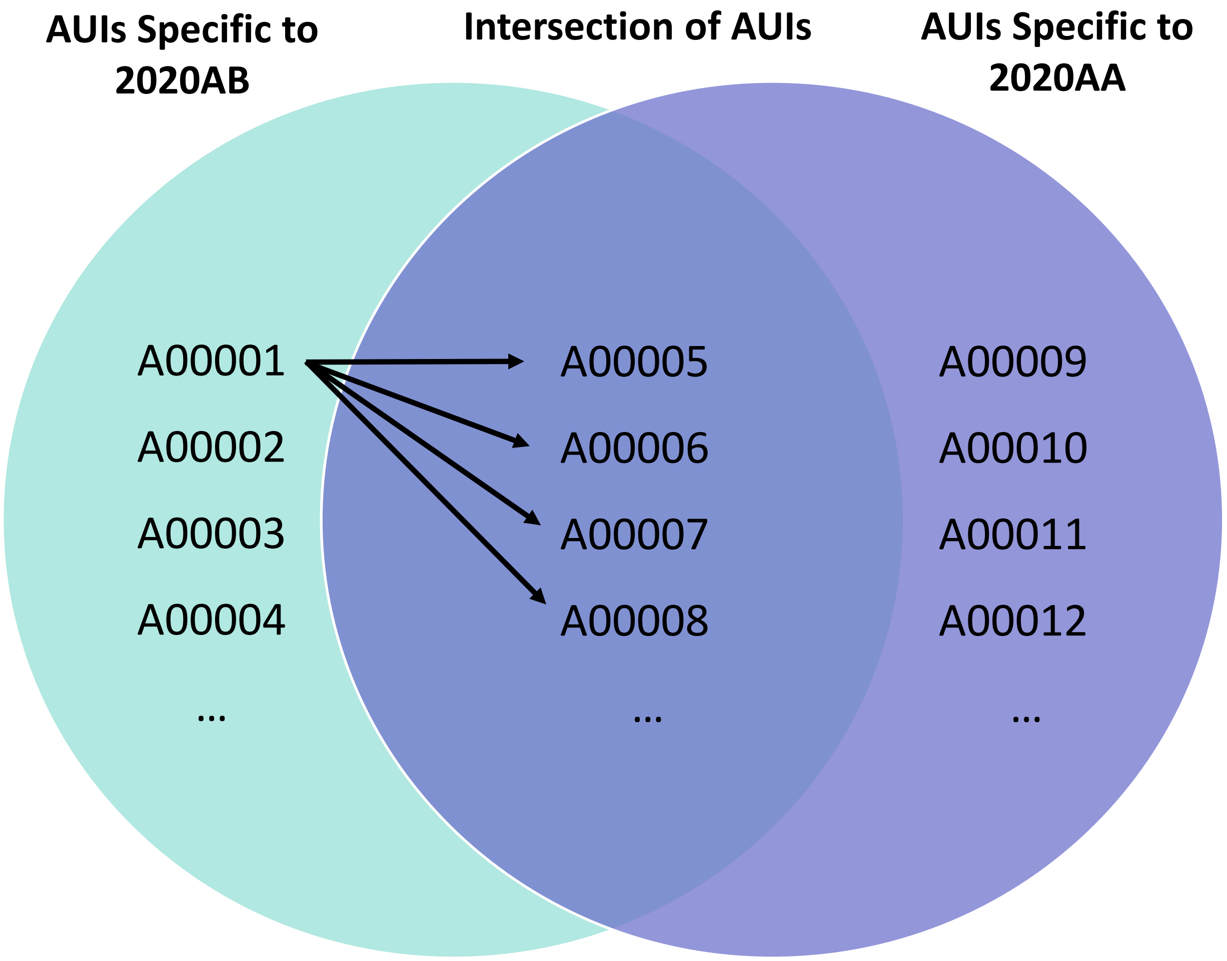
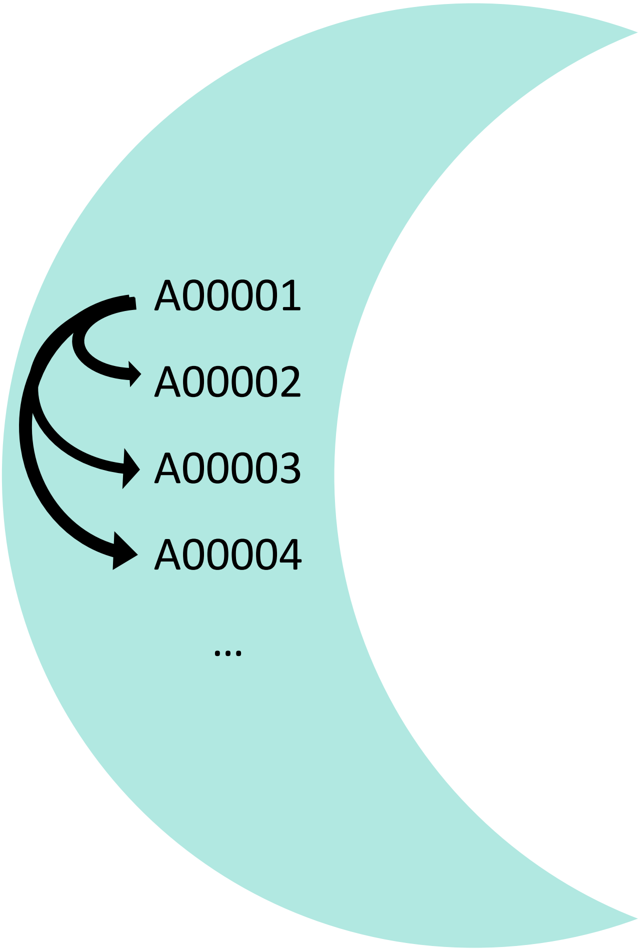
Thank you


AUIs Specific to 2020AB
Intersection of AUIs
AUIs Specific to 2020AA
A00001
A00002
A00003
A00004
…
A00005
A00006
A00007
A00008
…
A00009
A00010
A00011
A00012
…


A00001
A00002
A00003
A00004
…

Poster Layout

- Introduction
  - What is the UMLS
  - What is the problem
  - Our solution using DL
  - Our prior experiments leveraged deep learning models to predict pairs of terms as synonymous using lexical and contextual information (eg. semantic group, source synonymy).
  - While these experiments suggest a significant improvement, this new approach remains to be tested on a real use case, e.g., inserting new biomedical terms into an existing version of the UMLS Metathesaurus.
- Goals
  - we evaluate the performance of these deep learning models in predicting the synonymy between terms present in UMLS version 2020AA and 2020AB
  - improve feasibility of model adoption into the UMLS construction process,
- Challenge
  - Scalability is the primary challenge in these experiments as it would take approximately 5 months to evaluate our new testset and 17 years to predict every pair in the UMLS given a single GPU.
  - Parallelizing ith additional GPUS canl linearly reduce running time, but it remains unacceptable for our use case
- Hypothesis

- Methods
  - Dataset
  - Scalability

- Results
  - TBD
- Conclusion
  - TBD
- Future Works
- Acknowledgements