Predicting Discharge Medication at Time of Admission with Attention Networks

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Introduction

- Medication discrepancies occurring at discharge time might cause severe harm to patients.
- Current clinical significance of medication history errors is high and varies substantially between 11% and 59%[1].
- In our paper, we explore ways to better predict discharge medications based on unstructured admission notes.
- If successful, this will result in **significant reduction in medical reconciliation costs and improvements in patient safety.**

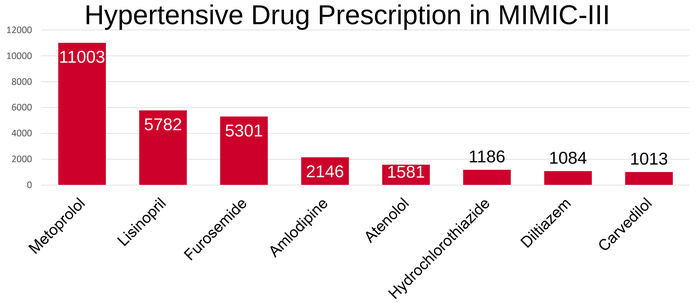
Related Work

- In Yang, et al (2017), the authors investigated how to assist physicians in predicting discharge medication.
- In Choi, et al (2017), the authors introduced an interpretable predictive model using LSTM with Reverse Time Attention Mechanism, and the predictive power remains the same with RNN, while increasing the interpretability a lot.

Dataset

- MIMIC-III dataset: a public dataset containing 52,000 patient-visits who stayed in the ICU at Beth Israel Deaconess Medical Center between 2001 and 2012.
- Multi-label classification of 8 antihypertensive medications on discharge.

Hypertensive Drug Prescription in MIMIC-III



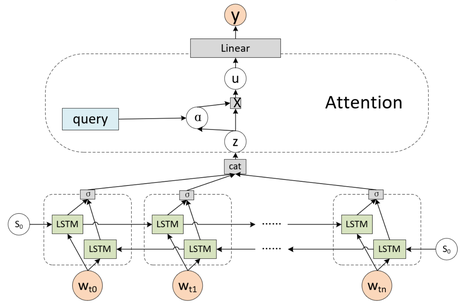
Reference

[1] Tam VC, Knowles SR, Cornish PL, Fine N, Marchesano R, Etchells EE. “Frequency, type and clinical importance of medication history errors at admission to hospital: a systematic review”, Canadian Medical Association Journal. 2005;173(5):510–515.

[2] Y. Yang, P. Xie, X. Gao, C. Cheng, C. Li, H. Zhang, E. Xing, “Predicting Discharge Medications at Admission Time Based on Deep Learning”, arXiv preprint arXiv:1711.01386

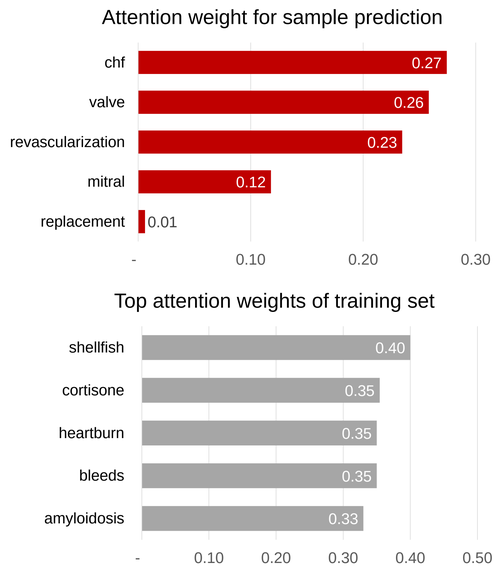
Method

- Admission notes are cleaned and tokenized to convert to word embeddings, and fed into neural networks.
- Discharge medications are extracted from discharge notes (there may be multiple medication for a patient).
- Text-CNN, LSTM, Attention-based LSTM and Hierarchical Attention LSTM are implemented to perform the multi-label classification task.
- Label smoothing and weighted loss function are implemented to solve the imbalance label problem.



Results

Attention Weight Visualization for Metoprolol

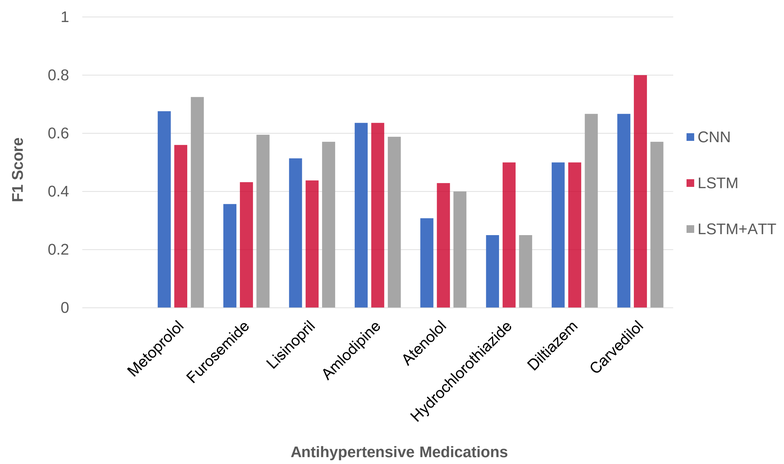


Chf: Congestive Heart Failure is a condition where the heart does not pump blood as well as it should.

Revascularization: In medical and surgical therapy, revascularization is the restoration of perfusion to a body part or organ that has suffered ischemia

Mitral: The mitral valve, also known as the bicuspid valve or left atrioventricular valve, is a valve with two flaps in the heart, that lies between the left atrium and the left ventricle.

Antihypertensive Medication Predictions with Different Models



F1 Score	CNN	LSTM	LSTM+ATT
Micro Average	0.55	0.52	0.62
Macro Average	0.49	0.54	0.55

Conclusion

- Neural networks can predict discharge medication accurately at time of admission
- Attention-Based LSTM model performs better than our base LSTM and CNN models.
- Introducing attention mechanism increases predictive power and interpretability. First, for new coming patients we can show which part of the admission notes we should pay attention to, second, the overall attention weights can provide inference for medical guidelines

Future Work

- Performances have been improved after introducing attention and label smoothing, but not to a satisfying degree, future work could be done to solve this problem.
- There are noises and varied formats in admission notes, so performance could be improved further with a more elaborate admission notes extraction processing.
- Finding suitable embeddings of the admission notes could result in improved performance of models.