Causality with Deep Learning

Proposal
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1 Introduction

Traditionally, to determine the causal relationship, one must perform the randomized test to determine the causality of the variables. However, alternatively, one can create a causal model to determine the causal relationship. Both of which can be exploited with deep learning. However, the hypothesis testing exploitation will be explored

1.1 Hypothesis testing exploitation

As the process of hypothesis testing involves evaluating the test statistics and using that to find the critical region under the distribution. However, that can be simplified, hopefully, into the classification problem that can be exploited with the machine learning model. The transformation of the data into its representation form, i.e., embedding might reveal the underlying causal relation. The use of a machine learning model in substitution for hypothesis testing for causal inference will be explored, along with the analysis of the power of testing using a classification model.

2 Dataset

ASSISTments dataset[1] will be explored in various aspects.

3 Proposed Method (Roughly)

3.1 Hypothesis testing exploitation

1. Explore the hypothesis testing and analyze the classification problem as the statistical test to show the feasibility of the method and analyze the tradeoff of this method.
2. Comparing the traditional method of determining the causal relationship with the deep learning model mainly aims to classify whether to reject the null hypothesis (whether A has an effect on B) or not.

4 Possible way

Let say we use a Siamese network

$$L(\mathbf{x}_1, \mathbf{x}_2, y) = \frac{1}{2}(1-y)d(\mathbf{x}_1, \mathbf{x}_2)^2 + \frac{1}{2}yd(\mathbf{x}_1, \mathbf{x}_2)^2$$

with a metric $d(\mathbf{x}_1, \mathbf{x}_2)$

References

[1] Wang, Y., Heffernan, N. T., and Heffernan, C. Towards better affect detectors: Effect of missing skills, class features and common wrong answers. In *Proceedings of the Fifth International Conference on Learning Analytics And Knowledge* (New York, NY, USA, 2015), LAK '15, Association for Computing Machinery, p. 31–35.