CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

S0418

Project Title

When Learners Surpass Their Models: Mathematical Modeling of Learning from an Inconsistent Source

Abstract

Objectives/Goals

This project is a second-year study, in which I worked on developing and studying an algorithm to model successful learning from an inconsistent source. It has been reported in the literature that both adults and children can, to a different degree, modify and regularize the often inconsistent linguistic input they receive. Their regularization has been attributed to an innate sense of grammar, also known as universal grammar (UG). We aim to demonstrate that the observed regularization does not require such innate abilities. We present an algorithm to model and investigate the learning process of a learner mastering a set of (grammatical or syntactic) forms from an inconsistent source without possessing any innate biases about the language.

Methods/Materials

I conducted a thourough analytical study of the algorithm using the apparatus of Markov Chains and also a numerical study by writing several computer codes in Fortran. The results from my study were then compared to the data collected by E. Newport and J. Singleton.

Results

We show, both rigorously by proving two theorems about the algorithm, and numerically, that the algorithm possesses a frequency-boosting property, whereby the frequency of the most common form of the source is increased by the learner. Furthermore, I found several paterns showing the relationship of speed and quality of learning with various parameters

Conclusions/Discussion

We show that the algorithm possesses a frequency-boosting property, whereby the frequency of the most common form of the source is increased by the learner. We also explain several key findings of the Newport-Singleton experimental study. Ultimately, we show that it is possible for a learner to achieve results similar to those in the observational/experimental data without the learner having any innate biases or constraints about the patterns that exist in the language.

Summary Statement

I developed and analyzed a mathematical model which shows that a learner can successfully learn from and surpass its inconsistent sources without any innate sense of grammar.

Help Received