21st Century Policing – Cross Cultural Competency

Lieutenant Matt Smith

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Natural Language Grammatical Inference with Recurrent Neural Networks

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Abstract—This paper examines the inductive inference of a complex grammar with neural networks—specifically, the task considered is that of training a network to classify natural language sentences as grammatical or ungrammatical, thereby exhibiting the same kind of discriminatory power provided by the Principles and Parameters linguistic framework, or Government-and-Binding theory. Neural networks are trained, without the division into learned vs. innate components assumed by Chomsky, in an attempt to produce the same judgments as native speakers on sharply grammatical/ungrammatical data. How a recurrent neural network could possess linguistic capability and the properties of various common recurrent neural network architectures are discussed. The problem exhibits training behavior which is often not present with smaller grammars and training was initially difficult. However, after implementing several techniques aimed at improving the convergence of the gradient descent backpropagation-through-time training algorithm, significant learning was possible. It was found that certain architectures are better able to learn an appropriate grammar. The operation of the networks and their training is analyzed. Finally, the extraction of rules in the form of deterministic finite state automata is investigated.

Index Terms—Recurrent neural networks, natural language processing, grammatical inference, government-and-binding theory, gradient descent, simulated annealing, principles-and-parameters framework, automata extraction.

◆

1 INTRODUCTION

THIS paper considers the task of classifying natural language sentences as grammatical or ungrammatical. We attempt to train neural networks, without the bifurcation into learned vs. innate components assumed by Chomsky, to produce the same judgments as native speakers on sharply grammatical/ungrammatical data. Only recurrent neural networks are investigated for computational reasons. Computationally, recurrent neural networks are more powerful than feedforward networks and some recurrent architectures have been shown to be at least Turing equivalent [53], [54]. We investigate the properties of various popular recurrent neural network architectures, in particular Elman, Narendra and Parthasarathy (N&P), and Williams and Zipser (W&Z) recurrent networks, and also Frasconi-Gori-Soda (FGS) locally recurrent networks. We find that both Elman and W&Z recurrent neural networks are able to learn an appropriate grammar after implementing techniques for improving the convergence of the gradient descent based backpropagation-through-time training algorithm. We analyze the operation of the networks and investigate a rule approximation of what the recurrent network has learned—specifically, the extraction of rules in the form of deterministic finite state automata.

Previous work [38] has compared neural networks with other machine learning paradigms on this problem—this work focuses on recurrent neural networks, investigates

additional networks, analyzes the operation of the networks and the training algorithm, and investigates rule extraction.

This paper is organized as follows: Section 2 provides the motivation for the task attempted. Section 3 provides a brief introduction to formal grammars and grammatical inference and describes the data. Section 4 lists the recurrent neural network models investigated and provides details of the data encoding for the networks. Section 5 presents the results of investigation into various training heuristics and investigation of training with simulated annealing. Section 6 presents the main results and simulation details and investigates the operation of the networks. The extraction of rules in the form of deterministic finite state automata is investigated in Section 7 and Section 8 presents a discussion of the results and conclusions.

2 MOTIVATION

2.1 Representational Power

Natural language has traditionally been handled using symbolic computation and recursive processes. The most successful stochastic language models have been based on finite-state descriptions such as n-grams or hidden Markov models. However, finite-state models cannot represent hierarchical structures as found in natural language[1] [48]. In the past few years, several recurrent neural network architectures have emerged which have been used for grammatical inference [9], [21], [19], [20], [68]. Recurrent neural networks have been used for several smaller natural language problems, e.g., papers using the Elman network for natural language tasks include: [1], [12], [24], [58], [59]. Neural network models have been shown to be able to

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1. The inside-outside reestimation algorithm is an extension of hidden Markov models intended to be useful for learning hierarchical systems. The algorithm is currently only practical for relatively small grammars [48].

Learning Objectives

1. Review Culture And The Role It Plays In Policing A Society.

2. Review Of The Constitution, CVPD Mission Statement And Other Articles That Create The Culture Which Governs Your Conduct Within The Community.

3. Review of How Implicit Bias Contributes to Conflict

4. Discuss Effective Methods of De-Escalating Conflict by Being Culturally Aware/Competent

2014 Obama Administration Executive Order Created A Taskforce On 21st Century Policing
Six-Pillar Task Force Recommendations

1. Build Trust And Legitimacy – Foster Trust. Don't Act As If We Occupy An Area.

2. Policy Oversight - Align Policies With Community Values –Carotid Banned-knees To Neck

3. Technology And Social Media - Embrace New Technology. Drones, Live 911, Media Platforms

4. Community Policing And Crime Reduction - Prioritize Community Engagement

5. Officer Training And Education - Invest In Training- Mental Health Crisis, Procedural Justice

6. Officer Safety/Wellness - Cultivate The Well-being Of Officers

OUR VALUES

Leadership Respect Integrity Accountability

Task Force Recommendations on Procedural Justice and Implicit Bias

1. Fair In Process (Pedestrian Enforcement Due To Fatalities)

2. Transparent In Action (BWC Release)

3. Opportunity For A Voice (Listen And Ask More Questions -They Want To Be Heard-Expect reasonable resistance)

4. Impartial In Decision Making (All People Are Treated The Same.)

5. Decrease Tension And Increase Trust (Apologize When You Get It Wrong-"Dust-off")

Why Did You Want To Be A Police Officer?

Why You Are A Police Officer-
The Social Contract Theory

- "We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. That to secure these rights, Governments are instituted among Men, deriving their just Powers from the Consent of the Governed…." – Thomas Jefferson

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★

Our most-guiding principle- The Constitution- ratified in 1789

What Are The Three Parts Of The Constitution?

1. Preamble – We The People…

2. Articles- There Are Seven Articles, Which Among Other Things, Establish Our Three Branches Of Government (Legislative, Executive, And Judicial) And Rules For How Future Amendments To The Constitution Should Be Made. Provides power to States.

3. Amendments –
    1. The First Ten Amendments Are Called The Bill Of Rights
    2. There Have Been 27 Amendments To Date

    The Constitution Establishes A Culture Of DEMOCRACY

Police Authority and Legitimacy

Oath Of Office

Mission Statement

Code Of Ethics

CITY OF CHULA VISTA

OATH OR AFFIRMATION OF ALLEGIANCE
FOR CITY OFFICIALS AND EMPLOYEES

STATE OF CALIFORNIA · CITY OF CHULA VISTA

I, _____, solemnly swear (or affirm) that I will support and defend the Constitution of the United States and the Constitution of the State of California against all enemies, foreign and domestic; that I will bear true faith and allegiance to the Constitution of the United States and the Constitution of the State of California; that I take this obligation freely, without any mental reservation or purpose of evasion; and that I will well and faithfully discharge the duties upon which I am about to enter.

SUBSCRIBED AND SWORN TO ME ON THIS DATE OF _____

_____   _____
Signature of Oath Administrator   Signature of Person Taking Oath

_____   _____
City Clerk
Title of Oath Administrator   Title of Person Taking Oath

OUR MISSION

The Chula Vista Police Department, in partnership with the Community, is dedicated to providing community policing, with the highest level of professionalism and transparency.

Chula Vista Police Department Employees will provide fair, courteous, and compassionate service to enhance the quality of life in Chula Vista.

OUR VALUES

Leadership   Respect   Integrity   Accountability

Chula Vista Police Department
Chula Vista PD Policy Manual

LAW ENFORCEMENT CODE OF ETHICS

As a law enforcement officer, my fundamental duty is to serve the community; to safeguard lives and property; to protect the innocent against deception, the weak against oppression or intimidation, and the peaceful against violence or disorder; and to respect the constitutional rights of all to liberty, equality and justice.

I will keep my private life unsullied as an example to all and will behave in a manner that does not bring discredit to me or to my agency. I will maintain courageous calm in the face of danger, scorn or ridicule; develop self-restraint; and be constantly mindful of the welfare of others. Honest in thought and deed both in my personal and official life, I will be exemplary in obeying the law and the regulations of my department. Whatever I see or hear of a confidential nature or that is confided to me in my official capacity will be kept ever secret unless revelation is necessary in the performance of my duty.

I will never act officiously or permit personal feelings, prejudices, political beliefs, aspirations, animosities or friendships to influence my decisions. With no compromise for crime and with relentless prosecution of criminals, I will enforce the law courteously and appropriately without fear or favor, malice or ill will, never employing unnecessary force or violence and never accepting gratuities.

I recognize the badge of my office as a symbol of public faith, and I accept it as a public trust to be held so long as I am true to the ethics of police service. I will never engage in acts of corruption or bribery, nor will I condone such acts by other police officers. I will cooperate with all legally authorized agencies and their representatives in the pursuit of justice.

I know that I alone am responsible for my own standard of professional performance and will take every reasonable opportunity to enhance and improve my level of knowledge and competence.

I will constantly strive to achieve these objectives and ideals, dedicating myself before God to my chosen profession . . . law enforcement.

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Law Enforcement Code of Ethics - 1

—— **OUR VALUES** ——

★ ★ ★   **Leadership Respect Integrity Accountability**   ★ ★ ★

Procedural and Restorative Justice

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★
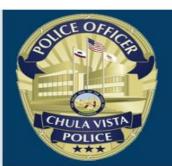
Procedural Justice Video

Procedural and Restorative Justice
"Dust Off"

- Department members should work to establish best practices to work collaboratively with the community to mitigate complaints

- Allow citizens to review CFS on MDC (absent CLETS info) and/or have dispatch air descriptions/nature of call on radio (inquiry) – so the citizen hears the CFS info

- Emphasize mission statement/values as it pertains to transparency

- Work through potential issues with citizens before leaving the scene

- Debrief incidents internally

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★

Furry Potato Arrested

NC TYRANT HUNTER

POLICE OFFICER
CHULA VISTA
POLICE

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★

CHULA VISTA
POLICE

Bias-base Policing

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★
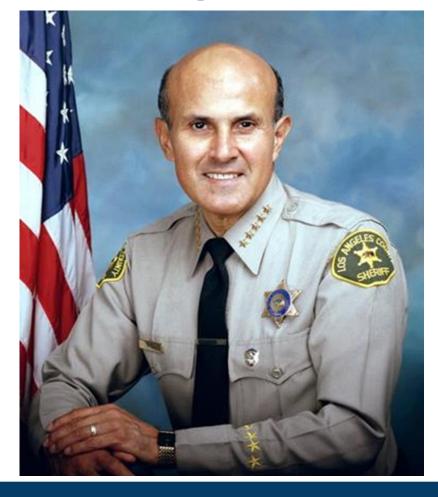
Bias-based Policing

Bias-based Policing

Use of Force on Wrong Person

Qualified Immunity

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★

Implicit Bias

OUR VALUES

★ ★ ★ Leadership Respect Integrity Accountability ★ ★ ★