A Combinatorics Approach to Pattern Recognition of Bitarray Datastreams

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Abstract

In our lives, we try to make decisions that increase the possiblity of a moral outcome. We judge others by their moral objectives and their adherance to them. Identifying, understanding, and mitigating the flaws of human thought process and decision making is essential for human progress. Despite much progress made in the field of artificial intelligence, a tool that makes better, more informed moral decisions than a human has not been developed and is the aim of this study. A novel approach that involves the field of combinatorics to bitarray datastreams with a likeness to the neuronal communication in the brain was developed to achieve these ends. The possibility of succeeding is incalcuable but increases with effort, time, and expertise. However, if good progress towards these aims are made, the consequences will pave the way for the future of a more moral society.

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Chapter 1

Introduction

1.1 Morality

Morality is commonly described as the set of principles or rules that define right and wrong actions. A moral agent is an individual that acts according to a moral system. In a moral system, an event is considered morally virtuous (good) or reprehensible (bad) if its consequences increase, or decrease the probability of a moral end respectively.

1.1.1 Moral origins

Morals can either evolve from nature or nurture. Natural morals are those that are installed without observation. Nurtural morals are those that are installed from observation. A proportion of all moral agents will act randomly Actions that are observed implies that those actions did not result in the death of the other individual. This filter ensures that random actions that result in death are not observed and are therefore not continued.

1.1.2 Moral relationships - Interaction between two moral systems

Moral ends vary between individuals. The moral ends of individuals can be only be predicted from a record of past actions. When individual moral agents interact, one of three possible interactions can be observed. Firstly, a rejection interaction manifests as an assumption that one another's actions are bad (minus - minus). Secondly, an unbalanced interaction is a consequence of the willingness of only one moral agent to encourage the others pursuit of their respective moral systemi (plus - minus). Lastly, an acceptance interaction is the understanding that the ends described by a moral system converges to the point that their continued actions weighted by their estimated probability is similar to those actions taken by the moral system of another individual (plus - plus).

1.1.3 Moral consensus - Majority moral opinion

Multimoral systems are those that involve more than two individuals As it is with the legal system, an estimation of common "good" (or a foundational moral modal) is essential for collective progress towards an average moral end. The search for this consensus is done at a personal or a collective level when we vote, tweet, poll, or protest. An estimation of common "good" is also necessary for collective arbitration of an action; a field often referred to as descriptive or comparative ethics. Once a consensus is established, the application of the golden rule, or the principle of treating others as you wish to be treated, forms the basic principles of justice and social contract. Communication of intention can often be reciprocal, that is to say one individual has and understanding of the others understanding of your understanding (and so on). An understanding of the consequences of breaking this rule encourages the enforcement of a social contract.

The lesser the amount of knowledge surrounding subject matter, the greater the room for reasonable disagreement. Factual consensus has no claim to moral authority.

1.1.4 Moral evolution - How morality changes over time

Consensus morality changes over time. Although opinions of an action can be changed by a greater understanding of probabilities of consequences that arise after the action, morals are unaffected by facts. Moral re-evaluation is also possible through the revelation of inconsistencies. The cause of this can be due to incomplete data relating to a moral question or cognitive dissonance.

1.2 The state of current majority moral opinion

Although the secularisation of western countries and adoption of enlightenment ideals is often considered a loss of moral congruency, the opposite is most likely as a consequence of interreligious moral alignment. Based on polling data, core moral principles include:

1.2.1 How is society improving?

With respect to the current moral consensus, there has been significant moral progress (Pinker, 2011).

1.2.2 How is society deteriorating?

1.3 Fallibilities and limitations of human decision making

In all humans there is a preinstalled moral operating system often referred to as natural morality. This system has evolved to promote reproduction and survival. Consensus morality today is different from natural morality In order to supress these naturalistic urges and reverse these forms of societal deterioration, it is important to look at the origins.

1.3.1 Bias and Discrimination

1.3.2 Misinformation

1.3.3 Information deficit

1.3.4 The scale of human computation

With the advancements in electronic data storage, the availability of data brings with it the potential for more accurate predictive tools than any point previously. However, the current restraints of human computational load limits the rate at which these tools can be utilised.

1.4 Alternative decision making algorithms

Computation makes decisions Currently, there has been no success in the construction of an artificial moral agent that mitigates the real issues in human moral decision making process.

1.4.1 Deep learning

1.4.2 HTM

Numenta (Numenta, n.d.), alpha go, etc

1.4.3 How to align intelligent systems with consensus moral beliefs

As with humans, if an agent has greater intelligence then there is a greater importance that the agent has a moral system that aligns with the core values that supports the current majority moral opinion. Transparency of decision making process is cruicial for the public arbitration of artificial decision making algorithms¿

1.5 AI safety and responsibility

1.5.1 The ”off button” problem

1.5.2 The paperclip problem

1.6 Project aims

Current attempts have fallen short at achieving these ends and resulted in hyperspecific reward seeking behaviour. The aim of this study is to leverage the advancements of computing to create a system that will make more moral choices than those made by a human. Separate from traditional neural network architectures, Hirachical Temporal Memory (HTM) is a technique developed by Numenta that more closely resembles the connections between axons in the brain. In this study, the guiding principles of HTM combined with a novel system for self validation will be designed to evaluate *ab initio* learning of a new machine learning model. Python will be used principally for development, testing, and validation.

Chapter 2

Datastreams

2.1 Sources of data

2.2 Binary conversion

2.3 Sparcity

2.4 Tandem data input

Chapter 3

Action

3.1 How are decisions made

Decision field theory is a method of mathematically modelling the change in utility when comparing multiple choices (Busemeyer & Diederich, 2002). Currently, machines do not act this way.

3.2 The random-pianist method

3.3 The Upgrade workflow

No delayed combinations only reinforce if you see it muliple times I = input that does not result from an action A = input that results from an action R = random input (or choice of previous set: pseudorandom) [] = combination expansion Both the action and the actions effects should be recognised by combinations

I1, R1 –¿ A1[I1, R1] I2, A1, R2 –¿ A2[I2, A1, R2] I3, A2, R3 –¿ A3[I3, A2, R3] I4, A3, R4 –¿ A4[I4, A3, R4]

Aims: 1: Learn actions from inputs 2: Decrease entropy from the UEI 3: Learn inputs from inputs

Whats being combined for each timepoint: Random doping I1, R1 I2, R2, A1[I1, R1] I3, R3, A2[I2, R2, A1[I1, R1]] ...

actions included I1, A1 I2, A1(I1) I3, A2(I2), A2(A1(I1)), A2(I2 + A1(T1))

W/O random doping I1 I2, A1[I1] I3, A2[I2, A1[I1]] ...

expanded W/O random doping I1 I2, A1(I1) I3, A2(I2), A2(A1(I1)), A2(I2 + A1(T1)) ...

translated: new input the action resulting from the second input the action resulting from the action resulting from the first input the action resulting from a combination of the second input and the action resulting from the first input

R1, I1, A1

Chapter 4

Memory

4.1 Classical combinatorics

4.2 The combination problem of scale

4.3 Slicing the combinations array

4.3.1 Combinations of combinations

4.4 Storage

4.5 Prediction

4.6 Persistance of activation

4.7 Edge contraction

4.8 Delay function

4.9 Transfer and Storage

4.10 Memory merging

Chapter 5

Runtime

5.1 Chapter introduction

Chapter 6

Testing

6.1 Chapter introduction

This chapter will focus on some of the more well known problems that face current machine learning models. As opposed to traditional testing nomenclature in software design (unit testing, integration testing), I will refer to all forms of experimentation as testing (such as Turing testing).

6.2 Test 1 - Parrot

6.3 Test 2 - Mathematics

6.3.1 True/False

6.3.2 Addition

6.3.3 Sine prediction

6.3.4 Modelling and the stock market

6.4 Test 3 - Natural language modelling

6.4.1 Text prediction

6.5 Test 4 - Sound signal processing

6.5.1 Voice recognition

6.6 Test 5 - Image classification

6.6.1 Breast cancer tissue classification

References

Busemeyer, J. R., & Diederich, A. (2002). Survey of decision field theory. *Mathematical Social Sciences*, *43*(3), 345–370.

Numenta, N. H. (n.d.). *Home page, numenta inc, 2007.*

Pinker, S. (2011). *The better angels of our nature: The decline of violence in history and its causes*. Penguin uk.

Appendix