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Patrick Bowen

University: Saint Francis Xavier University
Field: Computer Science
Supervisor: Dr. Milton King

Fill in the blank stance detection with language models

Stance detection is a task in natural language processing that involves determining if a snippet of text is displaying an opinion that is in favour or against some topic. Automatically detecting the stance within text can assist organizations determine the opinions of people related to topics such as a product review or an action made by the organizations.

We approached this problem by tuning a pretrained language model (RoBERTa) on tweets that expressed their opinions on a specific topic. Language models are used to estimate the probability of a sequence of words based on the text they observe. By tuning a language model toward tweets that contain a stance, we are adjusting the probabilities of the language model to more closely represent the same stance. We then use this finetuned model to complete a blend of several "fill-in-the-blank", cloze-style sentences, which were used to assess stance present in the tweets. We evaluate our model on a subset of English tweets from the SemEval-2016 stance detection shared task.

Louis Bu

University: Dalhousie University
Field: Math & CS
Supervisor: Dr. Robert Milson
Collaborators: V. Menchions, R. Milson, D. Precioso Garcellan

Hybrid Search: Application of Zermelo's Navigation Problem

Abstract We aim to develop and test a candidate path routing algorithm for container ships on long voyages. Fuel costs compose up to 60% of the total operation costs of maritime transport, and the price of bunker fuel has doubled within the last year. A large container ship consumes around 150 metric tons of bunker fuel per day. Not only does having an efficient route helps reduce the operational costs of shipping companies, it also helps to reduce greenhouse gas emissions from container ship fleets, and improves safety and security of cargo, the cargo ships, and crews onboard.

Despite the fact that sea transport is still by far the most efficient way to move cargo, it still accounts for nearly 3% of global greenhouse gas emissions. The International Maritimes Organization is imposing strict rules to halve carbon emissions by 2050.We look for these optimal paths with 2 components. First, we combine a piece-wise locally optimal paths iteratively generated and solved by the initial value problem given by Zermelo's Navigation Problem and a simple heuristic. Next we numerically solve a boundary value problem by a parallelizable, discrete Jacobi-Newton method for path smoothing and global optimization. We implement and compute these paths by utilizing Google's Jax(for autograd, automatic obtaining the gradient of a function by differentiation), and usual scientific computing packages for Python such as Numpy, Scipy. However, we have initial success with synthetic backgrounds on a small scale, we have yet to implement ways to avoid islands, preserved ecological zones, pirate activities, and dangerous wave/wind conditions.

David Cassagrande

University: Cape Breton University
Field: Math.
Supervisor: George Chen, Cape Breton University Mathematics

Blow-up solutions of the nonlinear Schrödinger equation with moving mesh methods

We consider the initial-value problem for the radially symmetric nonlinear Schrodinger equation with cubic nonlinearity (NLS) in d = 2 and 3 space dimensions and develop a very simple moving mesh method to obtain numerical solutions with large amplitude (10^60) near the blow-up point. In our scheme, two invariances, mass and energy, are well preserved.

Peter Collier

University : Dalhousie
Field: Math, Stats or CS

Zero Forcing on subgraphs of Proper Interval Graphs

The zero forcing number is a graph parameter initially introduced by the AIM Minimum Rank – Special Graphs Work Group in 2007 as a lower bound for the minimum rank of a graph. Zero forcing is a type of graph infection process where a colour change rule is applied iteratively to a graph and an initial set of vertices, S. If S results in the entire graph becoming forced, we call this set a zero forcing set. The size of the smallest zero forcing set for a graph, G, is called the zero forcing number of G. In this talk, I will demonstrate minimal zero forcing sets for families of proper interval graphs, as well as some subgraphs of these graphs. From this, I am able to determine the expected zero forcing number of randomly generated subgraphs of these families of proper interval graphs

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Ruoyan (Christine) Fang.

University: Dalhousie University.
Field: Mathematics
Supervisor: Dr. Karl Dilcher

Stern’s Diatomic Sequence and its Analogue on Z[sqrt2]

Stern's diatomic sequence (also called the Stern sequence) was originally studied in 1858. However, there are still new findings after 2020. This talk will introduce different ways to define the Stern sequence. We described a diatomic array by the analogy of the triangular array of the Pascal triangle and find a parallel relation with the Fibonacci sequence. We will also discuss the generating function and a recurrence formula for the Stern sequence. The ratios of successive terms in the Stern sequence give all the positive rationals uniquely and also form a binary tree due to Calkin and Wilf. We are going to define a map from the rationals with denominator in the form of 2^n to all rationals, which is the inverse of Minkowski's Question Mark function. We will also discuss an analogue of the Stern sequence in Z[sqrt2], which has similar properties as the original Stern sequence.

Lauren Farrell

University: Mount Allison University
Field: Math
Supervisor: Dr. Matt Betti
Collaborator: Dr. Jane Heffernan

A Pair Formation Model with Recovery of Monkeypox

Monkeypox is a disease which spreads through close prolonged contact with an infected individual, similarly to a sexually transmitted infection. However, the recent global outbreak of monkeypox is unique because spread is mainly concentrated in men who have sex with men and infected individuals can recover with lifetime immunity. This novel situation can be modeled by combining a pair formation model, which is generally used to model STI spread, with an SIR model.

Wangwei Han

University Name: University of Prince Edward Island
Field: CS
Supervisor: Dr. Antonio Bolufe-Rohler

Machine Learning for Parameter Tuning, An Application to Differential Evolution

Metaheuristics are characterized by their ability to find sufficient solutions for very hard optimization problems. Algorithms such as Differential Evolution are currently state of the art in many fields, however, the performance of Differential Evolution is strongly influenced by the chosen values of its parameters. The most relevant parameters in Differential Evolution are the size of the population, the crossover probability and the mutation factor. In this research, we present a novel way of tuning these parameters using Machine Learning techniques. We collect data characterizing the optimization process and associate it to the result of modifying each parameter independently. We use this information to train several classification models on how to adjust each parameter. The trained models are then used to adjust the parameters after each execution of Differential Evolution. Computational results using the CEC'13 benchmark suite, show that this approach is very effective and leads to a significant improvement in performance.

Xiaoyu Jia

University: Dalhousie university
Field: Mathematics
Supervisor: Karl Dilcher

Modular Forms and Convolution Sums of the Divisor Function

In a paper published in 1916 by Ramanujan, he derived some exceptional results on certain types of functions. It is astonishing that the modular forms, whose theory was developed much later, were actually special cases of these functions. While the space of modular forms was well characterized, the space generated by some "almost-modular forms" remain mysterious. We will show some empirical results to demonstrate that these "almost-modular forms" are far from problematic and actually make the theory richer.

Matthew Kozma

University: University of Prince Edward Island
Field: CS
Supervisor: Dr. Campeanu

An Analysis and Overview of Deterministic Finite Automata with Output

The study of regular languages has been a thorough and ongoing process dating back decades, with Deterministic Finite Automata (DFAs) often being a powerful tool in the study of this class of languages. More recently there has been a growing study of a generalization of DFAs which compute values, sometimes referred to as Deterministic Finite Automata with Output (DFAOs) [1, 2, 3]. These models extend the concept of DFAs, which can viewed as computing functions of the form $f : \Sigma^* \to \{0, 1\}$, where Σ is an input alphabet that is some finite set of symbols, and 0 and 1 designate the rejection or acceptance of a word in Σ^*. DFAOs extend this by computing functions of the form $f : \Sigma^* \to [c]$, where $[c] = \{0, 1, 2, \ldots, c-1\}$. This allows DFAOs to be used for the more general purpose of modeling functions between words in an alphabet and a set of values that are not necessarily binary.

In this research we consider a model for a DFAO presented in [2] and the consequences of some of its properties on a measuring the complexity of functions using the complexity measure of automaticity [1]. We also compare two different DFAO models, one presented in [2] and one presented in [3], considering the set of functions that are computable with the two different models. Future work may focus on quantifying the difference in number of functions computable with the two different models and how the differences in the models might impact the complexity measures of different functions.

References

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[3] B. Kjos-Hanssen and L. Liu, The number of languages with maximum state complexity. In Algebra Univers. 83:33, 2022.