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Alphabetical List of Authors & Conference Abstracts

Thomas Arnold, *Little Falls, MN*

A Propensity-Selection Threshold Model

I am proposing a model for explaining measured outcomes such as crime rates, health costs, product sales, wealth distributions, and other similar measurements. My thesis is that it is advantageous to think of these rates as cumulative distributions that result from the intersection of normally distributed propensity and selection processes. Propensity and selection are constantly fluctuating due to high-dimensional chaos. As propensity and selection levels vary across the population, sometimes intersecting and sometimes not intersecting, we see a highly nonlinear distribution of outcomes where there are many zero values, which transition to a gradually increasing rate, and then transition again, culminating with small percentages of people who have extremely high rates. The explanations for these distributions have typically necessitated the use of two-part models. For example, the Zero-Inflated Power Law (Zipf-Pareto), Zero-Inflated Log-Normal Distribution, Hurdle Models, Compound Distributions (e.g., Compound Poisson-Gamma), and the Generalized Pareto Distribution (GPD) for the Tail. I will show how a propensity-selection threshold model provides a single model that explains the entire range of outcomes.

Aaron Clauset *University of Colorado, Boulder*

Nearly-Optimal Prediction of Missing Links in Networks

Networks are ubiquitous in real-world data applications, e.g., in social network analysis or biological modeling, but networks are also nearly always incompletely observed. Current algorithms for predicting missing links in the hard case of a network without node attributes exhibit wide variations in their accuracy, and we lack a general understanding of how algorithm performance depends on the input network's characteristics. In this talk, I'll describe a powerful meta-learning solution to this problem that makes nearly-optimal predictions by learning to combine or 'stack' many individual link prediction methods. Using synthetic data for which we can analytically calculate the optimal performance and a large corpus of 550 structurally diverse networks from social, biological, technological, information, economic, and transportation domains, we systematically evaluate more than 200 link prediction methods individually and in combined stacked models. Across most settings, we show that model stacking nearly always performs best and produces nearly-optimal performance on synthetic networks. Furthermore, compared to state-of-the-art graph neural network techniques, we find that model stacking is typically more computationally efficient and equally accurate on multiple measures of performance. Applied to real networks, we find that the difficulty of predicting missing links varies considerably across domains: it is easiest in social networks and hardest in economic and biological networks, but performance depends strongly on network characteristics like the degree distribution, triangle density, and degree variation. I'll close with some commentary on future work on the link prediction problem.

Stephen J. Guastello, *Marquette University*
Nicholas R. Peters, *Marquette University*
Anthony F. Peressini, *Marquette University, Milwaukee, WI*

Simultaneous Emergent Phenomena: Team Synchrony as a Control Variable in the Emergence of Team Leaders

Although emergent phenomena exhibit interesting and complex dynamics when considered individually, this presentation examines the intersection between two phenomena that could occur simultaneously in an intense group interaction: autonomic synchrony among team members and the emergence of team leaders. It was

Jake Yost, *University of Central Oklahoma, Edmund*
Mickie Vanhoy, University of Central Oklahoma, *Edmund*

Multifractal and Recurrent Features of Behavior in the Presence of Colored Background Noise

People must function in environments that contain extraneous or unwanted sounds. Noise can obscure more informative sounds (signals). Noise may influence how well people perform visual tasks, but all noise is not the same. The environment can include background sounds like music, ambient noise, or noise with specific spectral features. Results are mixed about whether background noise can enhance performance. One way to analyze the influence of noise on performance is to measure the observer's sensitivity (d') to the signal independent of their response bias (β). Those are summary statistics that can describe the observer's overall accuracy and strategy but they do not capture the rich source of information in behavioral variability over time. Multifractal Detrended Fluctuation Analysis (MFDFA) can quantify the complexity and long-range correlations in eye movement patterns to distinguish between cognitive states. Recurrence Quantification Analysis (RQA) can reveal the temporal structure in the data, tracking how often and in what way the system revisits previous states or patterns. It can capture features like stability, predictability, and the presence clustered behaviors in eye movements and response times, not directly measurable by multifractal analysis. In a quiet lab, with standard computer workstations, undergraduate participants completed randomized blocks of trials where they pressed the keyboard spacebar when they noticed a visible change in the orientation of a moving Gabor patch stimulus traveling from left to right across the display. Noise-canceling headphones simultaneously played audible background noise with specific spectral features. Each block of trials contained one type of colored noise: pink, white, gray, blue, violet, or brown. We hypothesized that pink noise, which shares structural similarities with many natural signals, could potentially enhance detection performance and promote stable, adaptive responding (seen as broader multifractal spectra and more structured recurrence). The high-frequency energy of violet noise might disrupt vigilance more severely if it disrupts rhythms critical for sustained attention. Low-frequency-dominant brown noise might destabilize performance dynamics if it overwhelms sensory processing. The results show how background noise may reshape behavior states, with implications for designing environments that support sustained visual attention.

Mikhail Zimin, *2554620 Ontario LTD.*

Processing of Vibration and Temperature Data Using Mathematical Modeling of Collective Intelligence Decision Making

Optimization of preventive maintenance is often based on information about vibration and temperature of structures. But such data may contain significant noise. Therefore, enhancement of forward-looking information in such situations presents some features of interest. Before developing any new systems, it is always useful to check if there are objects, which can be used as their prototypes. In particular, it is possible to apply knowledge about living organism transform engines of data. Whatsoever, increasing interest in artificial systems capable of high quality of operational behavior under uncertainty and indeterminism clearly demonstrates necessity of infusion of adjustment mechanism from biology for improvement of functioning of required system. Wherein, experience in developing neuro-computers shows that it is not necessary to simulate all features of a real biological object for effective operation of the electronic brain. For example, a real neuron is a lot more complicated than its model used in neurocomputing, but such approach may be very effective. In real life, decisions are often made by groups of professionals. In other words, collective intelligence decision making takes place, and simulation such process may be considered an effective approach to solve many significant challenges. Upon that, functions being used for mathematical modeling in situation of this kind should adequately cover all aspects of emulated procedure. For instance, simulator of estimation of avalanche risk described in consists of functions, each of which knowingly has semantic charge, and their combination may be considered as a theory of predicting this slope process by a group of experts. For purpose of analysis of situation with the help of temperature and vibration data, values of temperature and vibration plus their time changes are used. Each of these parameters is edited with the help of function simulating of work of a separated professional, which opinion is apprized with an element of fuzzy set related to certain decision about a problem of preventive maintenance, wherein membership degree shows level of accepting such decision. Then, taking into account cooperation of group members, levels of their consent with the decision may be changed if each of them makes allowance for opinions of other experts. At the third step, the team leader fuses of opinions of experts together and makes decision. Forms of functions being used and their parameters are selected with the help of Monte Carlo technique so as results of analysis are as near as possible to known data obtained from experience. Utilizing this approach permits to avoid both downtime because of failure of equipment and unnecessary preventive maintenance, which increase effectiveness of production. Operation of equipment with relatively high temperature

and vibrations is repeatedly observed. At the same time, dangerous combination of predictors has led to failure in many cases.