BOOK OF ABSTRACTS

The 8th International Conference on the Dynamics of Information Systems (DIS 2025)

June 1–5, 2025

Middlesex University

Foreword

It is with great pleasure that we welcome you to the 8th International Conference on Dynamics of Information Systems (DIS 2025), taking place at Middlesex University London, UK from 1–5 June 2025. Following the tradition of previous successful editions in both the United States and Europe, DIS 2025 continues to provide an interdisciplinary platform for researchers and practitioners to explore the complex dynamics of information systems. The conference brings together experts from information science, optimisation, operations research, machine learning, artificial intelligence, economics and electrical engineering to discuss pressing challenges and emerging opportunities in the field.

This year's program reflects our commitment to bridging theoretical advances and real world applications. Contributions span a wide range of topics, including optimization and information theories, value and geometry of information, uncertainty modelling, quantum information, data science, optimisation with information constraints and applications in diverse domains such as robotics, energy and environmental sciences. In addition to the main conference track, DIS 2025 features keynote presentations from thought leaders, invited sessions and opportunities for networking and interdisciplinary dialogue.

We would like to express our sincere gratitude to all who made DIS 2025 possible: our authors for sharing their work, our reviewers for their thoughtful evaluations, our keynote speakers for their insights, and the organising and technical teams for their dedication. We are also grateful for the ongoing support of the DIS community in continuing to build a space for cutting edge research and collaboration.

We hope you find the conference intellectually stimulating and professionally rewarding and that your time in London inspires new ideas, collaborations and friendships.

London,
June 2025

The DIS 2025
Organising Committee

Conference Organization

General Chairs:

- Roman Belavkin, Middlesex University, UK
- Hossein Moosaei, Jan Evangelista Purkyně University, Czech Republic
- Panos M. Pardalos, University of Florida, USA

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- Dandan Han, Middlesex University, UK
- Silviu Marc, Middlesex University, UK
- Xiaohong Gao, Middlesex University, UK
- David Windridge, Middlesex University, UK

Contents

I
Invited Speakers

Panos M. Pardalos, University of Florida, USA

Dynamics of Information Systems (DIS)

In the first part of the lecture we will discuss the history and initial ideas used to establish the series of conferences on DIS. In the second part of the lecture we will address diffusive processes in networks in the context of complexity. Networks possess a diffusive potential that depends on their topological configuration, but diffusion also relies on the process and initial conditions. The lecture introduces the concept of Diffusion Capacity, a measure of a node's potential to diffuse information that incorporates a distance distribution considering both geodesic and weighted shortest paths and the dynamic features of the diffusion process. This concept provides a comprehensive depiction of individual nodes' roles during the diffusion process and can identify structural modifications that may improve diffusion mechanisms. The lecture also defines Diffusion Capacity for interconnected networks and introduces Relative Gain, a tool that compares a node's performance in a single structure versus an interconnected one. To demonstrate the concept's utility, we apply the methodology to a global climate network formed from surface air temperature data, revealing a significant shift in diffusion capacity around the year 2000. This suggests a decline in the planet's diffusion capacity, which may contribute to the emergence of more frequent climatic events. Our goal is to gain a deeper understanding of the complexities of diffusive processes in networks and the potential applications of the Diffusion Capacity concept.

Panos M. Pardalos is a world-leading expert in global and combinatorial optimization. His recent research interests include network design problems, optimization in telecommunications, e-commerce, data mining, biomedical applications, and massive computing. He serves as Professor Emeritus of Industrial and Systems Engineering at the University of Florida. Additionally, he is the Paul and Heidi Brown Preeminent Professor of industrial and systems engineering. He is also an affiliated faculty member of the Computer and information science Department, the Hellenic Studies Center, and the Biomedical Engineering program. He is also the director of the Center for Applied Optimization.

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Schieber, T., Carpi, L., Díaz-Guilera, A. et al. Quantification of network structural dissimilarities. *Nat Commun* 8, 13928 (2017).https://doi.org/10.1038/ncomms13928

Ruslan L. Stratonovich. Theory of Information and Its Value. Roman V. Belavkin, Panos M. Pardalos, José C. Principe (Editors), Springer (2020)

José C. Principe, Ph.D., University of Florida, USA

Self-Organization with Information Dynamics

Information theory is crucial in the optimal design of communication systems, but it can also play fundamental roles in learning theory and information dynamics. This talk will briefly review estimators of information theoretic descriptors and their application for machine learning. We will focus on the less known Principle of Entropy Minimization to improve the mean square error loss that can be applied to estimate parameters under noisy conditions. It leads to the unexpected result of achieving noise free estimation, under quite mild conditions. Furthermore, the talk will also present the Principle of Relevant Information, a cost function for self-organized dynamics, where a fixed-point iteration constrained by a cost using entropy and mutual information will discover statistical structure in a single data source.

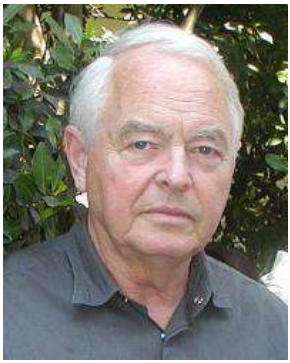
José C. Principe (M'83-SM'90-F'00) is a Distinguished Professor of Electrical and Computer Engineering and Biomedical Engineering at the University of Florida where he teaches statistical signal processing, machine learning and brain computer interfaces modeling. He is Eckis Endowed Professor and the Founder and Director of the University of Florida Computational NeuroEngineering Laboratory (CNEL) www.cnel.ufl.edu. His primary area of interest is time series analysis in functional spaces, information theoretic learning and AI cognitive architectures. Dr. Principe is an IEEE, AAAS, IABME, AIMBE and NDA Fellow. He was awarded the IEEE Neural Network Pioneer Award from the Computational intelligence Society, the IEEE Shannon-Nyquist Technical Achievement Award from the Signal Processing Society, the EMBS Career Achievement Award, and the Teacher Scholar of the Year from the U. of Florida. He was the past Chair of the Technical Committee on Neural Networks of the IEEE Signal Processing Society, Past-President of the International Neural Network Society, and Past-Editor in Chief of the IEEE Transactions on Biomedical Engineering. Dr. Principe has more than 800 publications and an H index of 102 (Google Scholar). He directed 108 Ph.D. dissertations and 65 Master theses. He wrote in 2000 an interactive electronic book entitled "Neural and Adaptive Systems" published by John Wiley and Sons and more recently co-authored several books on "Brain Machine Interface Engineering" Morgan and Claypool, "Information Theoretic Learning", Springer, and "Kernel Adaptive Filtering", Wiley.

R. Tyrrell Rockafellar, University of Washington, USA

Adapting Information to Different Quantifactions of Risk

Information and entropy, going back in concept to Shannon in appraising how much can be learned from one probability distribution relative to another, is fundamental in Bayesian statistics and the classics of means and variances. But in application to a random loss, the distribution of which might be influenced by decision variables in a problem of optimization, the expectation is just risk-neutral. It's best when circumstances where the loss is greater than expected will be balanced in the long run by instances where it is less. Many situations in finance and engineering, however, don't include a long run, and the focus must then be on risk-averse appraisals. It has been found dangerous, for instance, to view the value of a stock just through historical mean and variance; properties of the tail distribution associated with losses, especially high losses, are more important than parts associated with gains.

A broad theory has, for this reason, been developed about alternative quantifications of risk. A quantification that is averse and deemed coherent fits into a scheme which identifies a corresponding alternative for standard deviation and is able to trigger a tailored approach to regression beyond least-squares. Such quantifications have been shown moreover to be closedly tied to stochastic divergences beyond Kullbach-Leibler. This suggest perhaps defining information and entropy differently for each of them and exploring the many consequences.



Ralph Tyrrell Rockafellar is an American mathematician and one of the leading scholars in optimization theory and related fields of analysis and combinatorics. He is the author of four major books including the landmark text *Convex Analysis* (1970), which has been cited more than 34,000 times according to Google Scholar and remains the standard reference on the subject, and *Variational Analysis* (1998, with Roger J-B Wets) for which the authors received the Frederick W. Lanchester Prize from the Institute for Operations Research and the Management Sciences (INFORMS).

Xin-She Yang, Middlesex University, UK

Insights and Open Problems in Nature-Inspired Computing

Nature-inspired computing techniques such as genetic algorithms, particle swarm optimization and firefly algorithm have been widely used to solve problems in optimization, data mining and computational intelligence. The number of nature-inspired algorithms has increased significantly in recent years. However, it lacks some in-depth mathematical analysis of these algorithms. This talk highlights some of the challenges and open problems in nature-inspired computing.

Xin-She Yang is Reader in Simulation & Modelling at Middlesex University. His research activites span nature-inspired computing, mathematical modelling, engineering simulation, artificial intelligence, algorithms and optimization in engineering applications. IEEE CIS Task Force Chair of BIKM (2015-2020), also part of the Technical Committee of Computational Finance and Economics of IEEE Computational Intelligence Society. Book Series Editor for Springer Tracts on Nature-Inspired Computing. Advisor for International Journal of Bio-Inspired Computation (IJBIC, Web of Science). Editorial Board Member of Engineering Applications of Artificial Intelligence (Web of Science). Editorial Board Member of Elsevier's Journal of Computational Science (Web of Science). Editorial Board Member of International Journal of Computer Mathematics (Web of Science). Editorial Board Member of International Journal of Parallel, Emergent and Distributed Systems (Web of Science). Editor-in-Chief of Int. J. Mathematical Modelling and Numerical Optimisation (Scopus) [2009-2022]

Roman V. Belavkin, Middlesex University

Information dynamics and dynamical value of information

The value of information (VoI) quantifies the best possible improvement in the performance of an information system due to receiving a given amount of extra information. This theory, inspired by the work of Shannon and developed in the 1960s by Ruslan Stratonovich, has been developed for many examples of various kinds of information in the context of Bayesian decision-making. Here we extend this idea to sequential optimization problems with dynamic information constraints. This leads us to generalizations and 'soft-max' versions of the Bellman and the Hamilton–Jacobi–Bellman equations from the optimal control theory.

Roman Belavkin obtained MSc in Physics from the Moscow State University and PhD in Computer Science from the University of Nottingham. His research interests span several areas including geometric analysis of optimal and learning systems, dynamics of information, value of information, quantum information, topology of information, geometry and combinatorics of mutation and recombination of sequences, optimal control of evolutionary algorithms, cognitive modelling. Roman joined Middlesex University in 2002, where he participated in several research projects and organized research seminars of the Artificial Intelligence group. From 2009 Roman has been the Principle Investigator of the EPSRC project 'SANDPIT: Evolution as an Information Dynamic System', which was led by Middlesex University in collaboration with Universities of Manchester, Keele and Warwick. In this project, Roman developed a theory of optimal control of mutation rate in evolutionary systems, and the team discovered plastic mutation rates in microbes (`https://doi.org/skb`, `https://doi.org/cb9s`). Roman's current work is on geometric and dynamic value of information theory, which has applications in parameter control and optimization of learning, adaptive and evolving systems. He has been an associate member of the '*Centre of Applied Optimization*' in the University of Florida, USA; his collaboration with Tokyo University of Science was recognized in 2014 by the award from the university's president Professor Akira Fujishima. He serves on the editorial board of the '*Optimization Letters*' and '*SN Operations Research Forum*' journals.

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Ruslan L. Stratonovich. Theory of Information and its Value. Roman V. Belavkin, Panos M. Pardalos, José C. Principe (Editors). Springer (2020)

II
Regular Papers

Session 1
Network and Portfolio Optimization

Alexander Semenov, Alexander Veremyev, Donald McMann, Eduardo L. Pasiliao, and Vladimir Boginski (University of Central Florida)*

Sparsification of Fully Connected Neural Networks Inspired by Optimal Strongly Attack Tolerant Network Configurations

Artificial neural network (ANN) architectures typically involve several successive layers of neurons, where the patterns of connections between pairs of successive layers are often represented by complete (fully connected) bipartite graphs. Although fully connected neural network architectures may provide certain benefits, they also have potential drawbacks in terms of being computationally expensive and prone to overfitting. In this work, we explore a structural sparsification (pruning) technique for fully connected neural networks, which is inspired by graph-theoretic concepts of cliques and clique relaxations. Cliques in real-world graphs or networks (e.g., social, communication, and other types of networks) represent fully connected groups of nodes with all possible links, whereas clique relaxations are increasingly popular graph-theoretic concepts that "relax" certain characteristics of cliques by removing links, while still maintaining a certain level of structural connectivity and cohesion. Specifically, we propose using optimal R-robust 2-club network configurations, which has shown in our previous work to possess the so-called "strong attack tolerance" property: after the removal of any R-1 nodes and/or links, these structures are guaranteed to maintain not only the overall connectivity but also short (two-hop) distances between any pair of nodes, while requiring the minimum possible number of links for the respective network design. We adapt the concept of optimal R-robust 2-club network configurations to a time-expanded setting in order to develop structurally sparsified ANN architectures, where the levels of sparseness of the resulting ANN architectures are explicitly controlled by the parameter R. We conduct computational experiments using the well-known FashionMNIST dataset, training a multi-layer perceptron with varying sparsification levels over 20 epochs. The performance is evaluated based on test accuracy, revealing the trade-offs between connectivity and computational efficiency. Preliminary results demonstrate that the proposed sparsified neural network architectures maintain high classification accuracy, while significantly reducing the network complexity.

Dávid Kubek (Charles University, Prague, Czech Republic); David Hartman (The Institute of Computer Science of the Czech Academy of Sciences, Prague)*; Jaroslav Hlinka (The Institute of Computer Science of the Czech Academy of Sciences, Prague); Ctirad Matonoha (The Institute of Computer Science of the Czech Academy of Sciences, Prague); Anna Pidnebesna (The Institute of Computer Science of the Czech Academy of Sciences, Prague); František Szczepanik (The Institute of Computer Science of the Czech Academy of Sciences, Prague); Petra Vidnerová (The Institute of Computer Science of the Czech Academy of Sciences, Prague)

Improving the efficiency of methods evaluating approximate symmetry

Graph-theoretical analysis is a key tool for studying complex networks. Recently, network symmetry has gained attention. This approach uses automorphism group characteristics to evaluate the symmetry of the corresponding systems. However, real-world networks often involve uncertainty, requiring approximate symmetry evaluation. A method based on minimizing the distance to a permuted adjacency matrix was recently introduced using simulated annealing for numerical solution. A consequent study shows that simulated annealing can be improved and the problem can be solved by relaxing it to the Quadratic Assignment Problem recalling thus Graph Matching Problem approaches. Despite improvements, effectiveness varied across different scenarios. This work extends the abovementioned results in two ways. First, for local methods like simulated annealing, we introduce a heuristic approach based on graph centralities. We also propose to use genetic algorithms as an alternative to simulated annealing. Both approaches provide improvements to previous numerical solutions. Second, we refine the relaxed problem formulation by enhancing constraints and employing a trust-region-based numerical algorithm, leading to improved efficiency and further potential advancements.

Imma Lory Aprea (University of Naples Parthenope)*; Gabriele Sbaiz (University of Trieste)

Optimizing sustainable portfolio allocation with neural networks and particle swarm algorithm

This study proposes a hybrid approach that combines neural networks and the particle swarm optimizer to solve sustainable portfolio optimization problems. The objective function to be minimized is represented by the Delta Conditional Value-at-Risk, a tail-dependence risk measure quantifying the potential portfolio losses arising from the tail risk associated with an individual asset or a group of assets. In the portfolio construction process, we incorporate real-world trading constraints, including stock market restrictions, buy-in thresholds, and budget limits. We further impose a minimum expected return and, in order to limit transaction costs, we set a turnover threshold restricting the number of trades in rebalancing phases. Additionally, to address the increasing demand for sustainable investments, we introduce a green threshold as part of the portfolio design. To solve these asset allocation problems, we employ a hybrid constraint-handling procedure, integrated within an enhanced Particle Swarm Optimization (PSO) algorithm. The key parameters of the PSO technique are dynamically adjusted through a feed-forward neural network, which significantly improves the optimizer's performance. On the other hand, the Delta Conditional Value-at-Risk of each asset is estimated using a quantile Long-Short Term Memory (LSTM) network. We perform empirical tests using American datasets to evaluate how investment performance evolves with different sustainable preferences.

Gabriele Sbaiz*, Luca Manzoni, Gloria Pietropolli, Teresa Tonelli (University of Trieste)

Genetic Programming for the Reconstruction of Delay Differential Equations in Economics

In this talk we explore the reconstruction of a delay differential equation (DDE) model from economics, the Kalecki's business cycle model, with a variant of genetic programming (GP) encoding the structure of DDEs. The results of this preliminary work show that GP can correctly reconstruct the model starting only from approximated data, showing that the investigation of GP for interpretable reconstruction of DDEs can be a worthwile research direction. This is a joint work with Luca Manzoni, Gloria Pietropolli and Teresa Tonelli.

Michael Hirsch (ISEA TEK and TOXEUS Systems)*; Alexander Semenov (University of Florida); William Trevena (TOXEUS Systems); Panos Pardalos (University of Florida and TOXEUS Systems)

Social Network Influence Propagation, Stability, and Systems of Nonlinear Equations

How information spreads throughout a complex network can be modeled through influence propagation, Stability analysis, done through simulation of the influence propagation on the network over time, allows one to realize the final effects of the influence on all nodes of the network. In this research, we investigate various influence propagation models and the stability of the underlying complex network through the solving of systems of nonlinear equations, and compare computational results when using simulation.

Eva K Lee (Whitaker-NSF Center for Operations Research in Medicine and Homeland Security)

RealOpt-Contingency — A Computational PlaAorm for All Hazard and Disaster Response

Catastrophic calamities such as an earthquake, nuclear or pandemic disasters, or deliberate terrorist aJacks could cause tens or hundreds of thousands of casualties, destroy the physical and social livelihoods of the displaced, paralyze the economy, and trigger cascading effects across critical infrastructures and national security. In response, rapid decisive actions and mobilization of limited resources must be carried out for mass casualty mitigation and population protection. This work aims to advance applied scientific knowledge, and in-service training in national and public health emergency response and logistic operations by developing a computational plaOorm, RealOpt-Contingency, that enables logistics analysis, inventory management, and computational modeling technologies to support all hazard and disaster response during a contingency. RealOpt-Contingency enables users to (1) establish camps and medical facilities for the affected population; (2) design facility layout for optimal usage and safety; (3) optimize distribution of relief supplies; (4) determine rations, water, fuel, and other supplies required per camp and medical facilities; (5) calculate transportation labor and resource requirements, and determine/optimize routes; (6) develop distribution plans from the incident LSA to LSA hubs and to camps and medical facilities; (7) design decontamination and dispensing sites; (8) perform epidemiological disease/contamination plume modeling; and (9) track movement of displaced personnel for rapid on-the-ground reconfiguration. The front-end graphical interface allows users to outline the affected region, design layout of facilities, input inventory level, demand requests, estimated population size, etc. The backend translates this information automatically into appropriate mathematical formulations and simulation parameters. RealOpt-Contingency includes powerful computational-optimization engines including multiple resource allocation, transportation and routing algorithms, simulation and ODE disease spread modeling, facility layout design heuristics, inventory control stochastic processes, and machine learning and prediction of influence networks. The modular design allows continued technological advances and adaptation using on-the-ground knowledge. RealOpt-Contingency facilitates experimentation, operations analysis, and decision support for preparedness, planning, and response, enabling decision/policy makers to understand tradeoffs, competing goals, and interdependencies during disaster emergency response. We will discuss actual usage of RealOpt-Contingency for (a) COVID-19 mass diagnostic tests, mass vaccination, and clinical redesign; (b) radiological emergency response for sheltering, resupply, decontamination, and population health registry; and (c) earthquake emergency response, rescue and treatment. This work was carried out in collaboration with the National Guard Bureau and was partially supported by the Centers for Disease Control and Prevention, and the Department of Homeland Security.

Session 2
Optimization Theory

Jean-Jacques Godeme (Inria Sophia & LJAD)*

Differentiation of inertial methods for optimizing smooth parametric function

In this paper, we consider the minimization of a C^2-smooth and strongly convex objective depending on a given parameter, which is usually found in many practical applications. We suppose that we desire to solve the problem with some inertial methods which cover a broader existing well-known inertial methods. Our main goal is to analyze the derivative of this algorithm as an infinite iterative process in the sense of "automatic" differentiation. This procedure is very common and has recently gained more attention. From a pure optimization perspective and under some mild premises, we show that any sequence generated by these inertial methods converge to the unique minimizer of the problem, which depends on the parameter. Moreover, we show a local linear convergence rate of the generated sequence. Concerning the differentiation of the scheme, we prove that the derivative of the sequence with respect to the parameter converges to the derivative of the limit of the sequence showing that it is $\ll$derivative stable$\gg$. Finally, we investigate the rate at which the convergence occurs. We show that, it is locally linear with an error term tending to zero.

Jean-Jacques Godeme (Inria Sophia & LJAD)*

Quadratic optimization from a control theory perspective

In this short notes, we introduce and study the controllability of the trajectories of a linear dynamical system which is usually used to solve the minimization of a quadratic function in finite dimension. We coin this dynamical system the *controlled gradient flow*. Finally, we introduce what we call the *controlled gradient descent* and the *controlled proximity operator* which are respectively the Euler explicit and implicit discretization of the controlled gradient flow.

Ghurumuruhan Ganesan (University of Bristol); Thomas Parr (University of Bristol); Aasna Choudhary (University of Bristol)

Extracting High Quality Data Subsets using Monte-Carlo Search

Often, big or imbalanced datasets are subject to undersampling in order to improve the overall accuracy of the underlying predictive model. In this paper, we study undersampling from the perspective of information content and propose and analyze a Monte-Carlo search methodology to obtain high quality, low redundancy data subsets from large datasets. Our strategy is to transform the data redundancy structure into a graph theoretic format and assign importance to each data point in terms of vertex degrees. We then extract low redundancy data points via iteration, allowing for random exploration in the intermediate steps. Our simulation results indicate that if the redundancy graph is sufficiently sparse, then there is a non-trivial exploration probability that maximizes the quality of the final dataset. We illustrate our methodologies using the zoo animal dataset available in Kaggle and also discuss theoretical questions for potential future research, regarding the properties of the optimal exploration probability.

Panos Parpas (Imperial College London)*

Using Witten Laplacians to locate index-1 saddle points

We introduce a new stochastic algorithm to locate the index-1 saddle points of a function $V : \mathbb{R}^d \to \mathbb{R}$, with d possibly large. This algorithm can be seen as an equivalent of the stochastic gradient descent which is a natural stochastic process to locate local minima. It relies on two ingredients: (i) the concentration properties on index-1 saddle points of the first eigenmodes of the Witten Laplacian (associated with V) on 1-forms and (ii) a probabilistic representation of a partial differential equation involving this differential operator. Numerical examples on simple molecular systems illustrate the efficacy of the proposed approach.

Session 3
Operations Research

Adam Górski (Jagiellonian University)

Optimization of a car production process specified by an extended task graph

The genetic algorithm for a car production process is proposed in this paper. Unlike others algorithms the approach presented in this paper investigate the situation when some of the tasks can be executed by more than one resource at the same time. The algorithm also consider some of local constrains. Therefore presented algorithm is more universal than others and can be used in more situations. Proposed algorithm starts from a randomly generated population and creates new individuals using standard genetic operators: selection, crossover, mutation and cloning.

Salma Ahmed (Wilfrid Laurier University); Dariush Ebrahimi (Wilfrid Laurier University)*

Dynamic Priority-Based Management to Optimize Emergency Department Flow

The emergency department (ED) is a critical facility for unplanned care, handling patients without prior appointments. As patient volume increases, managing timely treatment becomes increasingly difficult, especially when prioritizing high-risk patients. This often leads to significant delays for those with less urgent conditions. In this paper, we propose a dynamic patient management approach aimed at minimizing wait times while ensuring timely care for both critical and non-critical cases. Our algorithm effectively reduces wait times for patients across all acuity levels and improves overall patient flow, while maintaining priority for those in the most urgent need of care. The results highlight the effectiveness of the proposed method in enhancing the efficiency and fairness of ED operations, demonstrating considerable improvements over traditional patient management algorithms.

Dariush Ebrahimi (Wilfrid Laurier University)*; Het Thumar (Wilfrid Laurier University); Dhrumil Makwana (Wilfrid Laurier University); Madhav Savani (Wilfrid Laurier University); Nishita Patel (Wilfrid Laurier University); Fadi Alzhouri (GUST University)

Dynamic Resource Allocation in Cloud Computing: A Real-Time Adaptive Task Scheduling Approach

Cloud computing has become a cornerstone of modern IT infrastructure, offering scalable and on-demand resources for diverse applications. However, efficient resource management remains a critical challenge due to dynamic workloads, varying task demands, and energy consumption concerns. This paper proposes a Real-Time Adaptive Task Scheduling Algorithm (RTATS) designed for cloud environments, tackling these challenges through a dynamic, cost-based task allocation strategy. RTATS optimizes scheduling by balancing execution time and energy consumption, leveraging advanced techniques such as Dynamic Voltage and Frequency Scaling (DVFS), dynamic virtual machine activation and deactivation, and real-time load monitoring. It also incorporates a task reallocation mechanism to ensure load balancing and fairness. Extensive simulations demonstrate that RTATS significantly reduces makespan, enhances load balancing, and minimizes energy consumption compared to traditional approaches such as EMA and TRETA. These results validate RTATS as a robust, scalable, and energy-efficient solution for modern cloud environments, with practical applications in enterprise clouds, IoT, and edge computing.

Karima Rihane (University of Sciences and Technology Houari Boumediene)*; Adel Dabah (Forschungszentrum Jülich); Abdelhakim Ait Zai (University of Sciences and Technology Houari Boumediene)

Learning-Based Approaches for Job Shop Scheduling Problems: A Review

One of the most studied combinatorial optimization problems is Job Shop Scheduling (JSS). The Job Shop Scheduling Problem (JSSP) involves scheduling a set of jobs with predefined processing constraints on a set of machines to achieve a desired objective, such as minimizing makespan, tardiness, or flowtime. As JSSP has become an attractive research area, many approaches have been widely and successfully used to address this problem, including exact methods, heuristics, meta-heuristics, and artificial intelligence tools. Furthermore, various learning-based approaches have been proposed to solve the JSSP. However, these approaches are still limited when compared to the more established methods. This paper summarizes and evaluates the most important works in the literature on machine learning approaches for the JSSP. We present models, analyze their benefits and limitations, and propose future research directions.

Ifeyinwa Okonkwo (Nnamdi Azikiwe University)*

Enhancing Librarian Competence: Exploring the Relationship between Professional Development and Electronic Resource Management Skills in Nigerian Libraries.

The innovative transformation of integrating electronic resource management (ERM) in library operations has enable librarians to acquire specialized skills in effective management of these resources. This study investigates the relationship between professional development and electronic resource management (ERM) competence among librarians in South Eastern libraries of Anambra State, Nigeria. The purpose of the study sought to find out the relationship between professional development opportunities and enhancement of ERM skills. Four research questions guided the study. The population of the study comprised of 134 librarians' at the end the data collection period, a total of 119 valid responses were retrieved and analyzed using inferential statistics, with the help of Statistical packages for Social Science (SPSS). A mixed-methods approach was employed, combing a structured questionnaire and cognitive test in collecting data from 134 librarians across 5 Federal universities in South-East Nigeria. The results revealed a significant correlation between professional development and ERM competence, with librarians who participated in training programmes demonstrating higher competence in ERM. However, challenges from the study includes inadequate funding, limited access to training opportunities and lack of institutional support. The implication from the findings indicates that there is need for effective professional development programmes to enhance librarians ERM competence. The study recommends that, library administrators, policymakers, professional organizations should support librarians' professional development and provide adequate resources to ensure effective ERM in Nigerian libraries. Keywords: Professional development, electronic resources management (ERM), librarian skill, Nigerian libraries.

Session 4
Geometry and Value of Information

Valérie Girardin (Université de Caen Normandie)*

Minimum of Divergences with Relaxation: a Hilbertian Alternative Approach to Duality

Generalized moment problems –called feature moments in the area of machine learning– are here considered with and without relaxation. The solution is the minimum of φ-divergences, according to an extended Maximum Entropy Principle. Inference from sample data constraints leads to balance the divergence by a relaxation term. In the literature, the form of the minimizing solution is obtained by resorting to Fenshel's duality theorem ou the method of Lagrange multipliers. An alternative method, resorting to Hilbert spaces, presented here, yields a necessary and sufficient condition under some second order assumptions. It is based on a decomposition via a nested procedure of the relaxed problem into two successive problems, one of which without relaxation.

Kaori Yamaguchi (Ritsumeikan University)*

On statistics which are almost sufficient from the viewpoint of the Fisher metrics

Given a statistical model, a statistic on the model is sufficient if the Fisher metric of the induced model coincides with the original Fisher metric, according to the definition by Ay-Jost-Lê-Schwachhöfer. We introduce and study its quantitative version: for $0 < \delta \leq 1$, we call a statistic δ-almost sufficient if $\delta^2 \mathfrak{g}(v,v) \leq \mathfrak{g}'(v,v)$ for every tangent vector v of the parameter space, where $\mathfrak{g}$ and $\mathfrak{g}'$ are the Fisher metric of the original and the induced model, respectively. By the monotonicity theorem due to Amari-Nagaoka and Ay-Jost-Lê-Schwachhöfer, the Fisher metric $\mathfrak{g}'$ of the induced model for such a statistic is bi-Lipschitz equivalent to the original one $\mathfrak{g}$, which means that the information loss of the statistic is uniformly bounded. We characterize such statistics in terms of the conditional probability or by the existence of a certain decomposition of the density function in a way similar to the characterizations of sufficient statistics due to Ay-Jost-Lê-Schwachhöfer and Fisher-Neyman.

Stephan Weis (Czech Technical University in Prague)*

Continuity of the maximum entropy inference

The maximum entropy inference method for quantum states is a universal method that updates a prior density matrix to a posterior density matrix if new information becomes available in the form of constraints that specify a set of possible posteriors. Differing from the domain of probability distributions, the maximum entropy inference map in the quantum domain can have discontinuities, which have an interpretation as phase transitions. This talk presents novel progress in the analysis of such discontinuities. The main theoretical result is that the orthogonal projection of density matrices onto a $*$-subalgebra is an open map. It is shown in examples how this can help simplify continuity problems of the maximum entropy inference. Time permitting, the talk also addresses measures of many-body correlations.

Stefan Behringer (U Bielefeld)*; Roman V. Belavkin (Middlesex University)

Value of Information in Bayesian Environments

This paper revisits the concept of the Value of Information (VoI) based on the work of Ruslan Stratonovich and Claude Shannon in Boolean environments such as hypothesis testing. It explores the mathematical foundations of VoI, its relation to Full Baysian Significance Testing (FBST) and the Bernstein-van Mises Theorem and gives some examples and results that investigate Bayesian environments beyond the Boolean case.

Session 5
Uncertainty Modelling

Théo Grente (Groupe de Recherche en Informatique, Image, et Instrumentation de Caen)*

Deterministic Optimization Versus Markov Chain Monte Carlo for Studying the Impact of Degradation in Linear Inverse Modeling for Trophic Systems

Linear Inverse Modeling includes a class of methods used in ecology for modeling trophic networks and estimating unknown flows therein. This estimation is constrained by both structural and empirical linear equations. The empirical ones come with uncertainties, mainly due to the lack of precision of measures. In this paper, we introduce a degradation methodology whose goal is to study the impact of uncertainty on Ecological Network Analysis (ENA) indices. Two approaches are compared: one is deterministic and the other is stochastic. The deterministic approach employs Sequential Quadratic Programming to find the optimum solution of a given goal function. The stochastic approach uses Markov Chain Monte Carlo sampling based on a reflective version of Hit-and-Run. The results of these two approaches are compared for three ENA: Quadratic Energy, McArthur Index and Overhead. The comparison is illustrated by one hundred and twenty-eight degradation scenarios of an aggregated model of the Sylt-Rømø Bight ecosystem.

Senthilkumar Somasundaram*; Vivek Rajani Bathija (St. George's University)

House price forecast using Artificial Neural Networks

The house price market is a crucial aspect of a country's economy. The market has experienced periods of rapid growth and peaks but has also shown significant declines. Several researchers have done significant research to predict the house prices using various methods. An Artificial Neural Network (ANN), a computational system and linear regression model were also used to forecast the house prices in the real estate industry. The Multilayered Feed Forward Neural Network is used in this work. Activation functions play a crucial role in ANN and TanH, ReLU, ELU, and Swish functions are experimented with and as-sessed. Mean Absolute Percentage Error (MAPE) and Mean Squared Error (MSE) are applied to measure the model performance. The linear regression model is used for comparison, estimation, and benchmarking. MAPE and MSE are applied to measure the model performance. To optimize the ANN model experiment, we use Adam, RMSProp and Stochastic Gradient descent (SGD). This paper recommends the most effective model for predicting the house prices. The performance of both models will be evaluated by analyzing statistical results, pre-diction accuracy, loss, and effectiveness.

Maryam Badrizadeh (State University of New York at Farmingdale)*

Evaluating Pension Fund Performance with AI-integrated DEA

This research advances the application of Data Envelopment Analysis (DEA) to evaluate private pension fund performance, addressing unique complexities such as regulatory constraints, uncontrollable variables, and varying funding statuses (fully funded and underfunded pension plans). The author previously studied and developed an optimization framework using DEA to assess pension funds and bridge the gap between pension funds and mutual funds. Now the aim of this research is to extend this work by integrating artificial intelligence (AI) into financial optimization, exploring how AI can optimize financial vehicles more efficiently. Traditional DEA models, while effective, may not fully capture the non-linear and complicated dynamics within pension fund management. To enhance DEA's capabilities, this study will explore the integration of AI to improve variable selection, capture non-linear patterns, and differentiate controllable from uncontrollable factors. AI-driven simulations will also enable scenario analysis, providing insights into pension fund efficiency under various conditions. However, consideration should be given to valid concerns about AI reliability in financial contexts. This approach will aim to merge DEA's rigor with AI's predictive power, creating a cautious yet insightful framework for optimizing financial decision-making in complex environments. It will be expected that integrating AI with DEA enhance both the predictive power and adaptability of DEA models in assessing pension fund performance.

Pedram Farghadani Chaharsooghi (Concordia University); Hossein Hashemi Doulabi (Concordia University)*; Walter Rei (UQAM); Michel Gendreau (Polytechnique Montreal)

Stochastic Casualty Response Planning with Operational Details

In this study, we propose a two-stage stochastic programming model to consider patients with multiple injuries in casualty response planning problems with uncertain demands and hospital bed capacity. We concentrate on locating Alternative Care Facilities (ACFs) and aim to assign different types of resources in the first stage. Then, in the second stage, we allocate patients with multiple injuries to either ACFs or hospitals based on the availability of resources. We apply the L-shaped algorithm and its branch-and-cut (B&C) implementation to solve large-sized problems. To further enhance the efficiency of these algorithms, we incorporate several accelerator techniques, including Benders dual decomposition and lower bounding functional. Extensive computational results show that these features have led to a dramatic improvement in the B&C algorithm performance.

Mohammad Ali Nematollahi (Fasa University)*

ICU Outcomes Prediction Using Optimized Extra Trees Classifier and Lasso-Based Feature Selection

Accurately predicting outcomes among ICU patients is essential for enhancing clinical decision-making and optimizing healthcare resource management. This study leverages machine learning techniques to improve prediction accuracy in this critical domain. Comprehensive data preprocessing steps were undertaken, including handling missing values, normalizing data, and addressing class imbalances. Using the Least Absolute Shrinkage and Selection Operator (LASSO), 12 key predictive features were identified. Eleven machine learning models, including traditional methods such as Gaussian Naïve Bayes, Logistic Regression, and Support Vector Machines, as well as four advanced deep learning architectures like CNN-BiLSTM and hybrid models, were evaluated. Hyperparameters were optimized using Bayesian optimization to achieve peak model performance. Among these, the Extra Trees classifier outperformed others, achieving an AUC of 96.61%, accuracy of 91.80%, sensitivity of 92.81%, specificity of 91.03%, precision of 90.79%, and an $F1$ score of 83.61%. Cohen's Kappa and the Matthews Correlation Coefficient (MCC) both reached 83.62%. The findings highlight the potential of advanced machine learning models to significantly enhance outcome prediction, thereby supporting better clinical decision-making and improving patient outcomes. This work underscores the transformative role of machine learning in addressing complex challenges within critical care environments.

Session 6
Machine Learning and AI Applications I

Abdul-Rahman Mawlood-Yunis (Wilfrid Laurier University)*

Enhancing Academic Assistance with Retrieval-Augmented Generation (RAG): A Knowledge-Base Driven Approach

Academic advising plays a crucial role in student success, addressing both general program inquiries and personalized concerns. To streamline this process and reduce human intervention, we introduce an AI-driven chatbot powered by LLaMA and Retrieval-Augmented Generation (RAG). Unlike traditional intent-based chatbots, our system dynamically retrieves and synthesizes information from continuously updated knowledge bases, ensuring accurate, context-aware, and reliable responses. Compared to existing systems, our approach mitigates common issues like hallucinations and outdated information, offering factually grounded and scalable performance. This paper outlines the development lifecycle, covering dataset creation, system architecture, and experimental validation. Our results demonstrate that RAG enhances accuracy, scalability, and relevance, making it a highly effective solution for academic advising. By automating routine queries, the chatbot reduces advisor workload, allowing them to focus on complex cases while maintaining a balance between efficiency and personalized student support.

Omid Zare (University of Verona)*; Pietro Sala (University of Verona); Daniel Amadori (University of Verona); Emanuele Chini (University of Verona); Javad Hassannataj Joloudari (Islamic Azad University)

Time Series Step Tree: A Novel Interpretable Method for Prompt Classification of Time Series

The growing volume of time series (TS) data across diverse fields presents both opportunities and challenges for efficient and practical classification that can give us interpretable and in-time insight into the data. This paper introduces Time Series Step Tree (TSST), a novel and inherently interpretable method for prompt TS classification. Addressing the growing need for both timeliness and transparency in time-sensitive applications, TSST employs a progressive, step-wise evaluation of TS data with dynamically adjusted observation windows. At the core of TSST is a decision tree constructed using a novel "witness time series" (WITESS-TS) selection process at each node to maximize information gain, ensuring both classification efficacy and interpretability. Experimental results on univariate TS datasets demonstrate TSST's ability to achieve high accuracy while enabling prompt classification decisions. The inherent interpretability of the method is further highlighted through decision tree visualization and analysis. Future work will focus on extending TSST to multivariate TS and further empirical validation across diverse datasets.

Mohammad Davtalab (Islamic Azad University); Hanieh Khosravi (Islamic Azad University); Ehsanullah Zia (University of Birjand); Mohammad Maftoun (Islamic Azad University); Amirshahab Shahabi (Islamic Azad University); Maryam Khademi (Islamic Azad University); Alireza Atashi (Islamic Azad University); Omid Zare (University of Verona)*; Javad Hassannataj Joloudari (Islamic Azad University)

XRS: An Efficient Hybrid Model for Breast Cancer Recurrence Prediction

Breast cancer recurrence prediction continues to pose a sig- nificant challenge in oncology, as it has a direct effect on treatment approaches and patient outcomes. Conventional predictive techniques frequently struggle to manage the complexities of high-dimensional, imbalanced cancer datasets, hindering their efficacy. This study investigates the use of hybrid machine learning models to address these challenges and enhance predictive precision. The study utilizes an innovative hybrid stacking model (XRS), which combines Random Forest and XGBoost as foundationallearnerswithSupportVectorMachine(SVM)servingasthe meta-learner, fine-tuned through Bayesian optimization. This systematic methodology adheres to industry-standard processes for data mining, ensuring thorough data comprehension, preprocessing, and model assessment. Experimental findings illustrate the efficacy of the proposed XRS model, achieving impressive performance metrics: accuracy (91%), precision (92%), recall (88%), $F1$ score (91%), and AUC (96%). These results underscore the potential of hybrid models to deliver more precise, robust, and generalizable predictions, tackling essential challenges in cancer data analysis. By empowering healthcare providers to evaluate recurrence risks with enhanced reliability, this study plays a role in promoting personalized and effective cancer treatment. The encouraging results imply that hybrid models such as XRS could be adopted in real-world medical environments, paving the way for improved clinical decision-making in oncology.

Ivan Gruber, Zbyněk Zajíc, Miroslav Hlaváč, Petr Neduchal, Marek Hrúz, Müller Luděk (University of West Bohemia)

Automated Processing of Historical Documents Using Named Entity Recognition and Face Extraction

This paper presents advancements in an automated document digitization pipeline, particularly tailored for historical archives from the Czech Institute for Study of Totalitarian Regimes. Key contributions include the enhancement of Named Entity Recognition (NER) and the introduction of a Face Extraction block. By leveraging modern large language models (LLMs), such as GPT-4o and its fine-tuned variants, the improved NER achieves promising accuracy in identifying entities such as persons, locations, and organizations. The Face Extraction block based on two state-of-the-art models, RetinaFace for detection and ArcFace for recognition, enables the clustering and retrieval of documents featuring the same individuals. These innovations significantly streamline historians' work by improving searchability and document organization. Experimental evaluations using the challenging NKVD dataset demonstrate the efficacy of the proposed pipeline.

Pankaj Verma (NIT-Kurukshetra)*

American Sign Language Interpretation with Convolution Neural Network Models

American Sign Language (ASL) is a critical means of communication for the deaf and hard-of-hearing communities, enabling effective interaction in a predominant-ly auditory world. Automated ASL interpretation can significantly bridge the communication gap, facilitating accessibility and inclusivity. However, due to the limited number of people who understand sign language and the scarcity of inter-preters, there is a need for accessible solutions. This study explores the applica-tion of Convolutional Neural Network (CNN) models for the recognition and in-terpretation of ASL gestures. CNNs, renowned for their exceptional performance in image recognition tasks, are employed to classify static hand signs and dynam-ic gestures. In this work, we present a real-time method for fingerspelling recog-nition in American Sign Language (ASL) using neural networks. Our approach first applies a filter to the hand signs, which are then passed through a classifier to predict the corresponding gesture. We utilize two variants of Convolutional Neural Networks (CNNs) for image classification. Our proposed model achieves an accuracy of 95.8% using the first layer of our algorithm, and this accuracy in-creases to 98.0% when combining the first and second layers. Additionally, we have created our own ASL dataset for testing the proposed model performance.

Session 7
Network and Data Security

Duc-Thuan Nguyen, Jong-Myon Kim (University of Ulsan)

Leveraging Prior Knowledge for Cross-Condition Pipeline Leak Size Prediction Using Subdomain Adaptation

Pipeline leak detection and size prediction are essential for ensuring pipeline safety and operational integrity. However, domain shifts, such as variations in operating pressure, present significant challenges for models trained on one condition and applied to another. In this study, we propose a novel do-main adaptation framework for pipeline leak size prediction that leverages prior knowledge of the relationship between the b-value, derived from acoustic emission signals, and leak size. This prior knowledge is used to gen-erate pseudo-labels for target domain data, which enhance the adaptation process by enabling effective alignment of class-conditional distributions via localized maximum mean discrepancy (LMMD). Unlike conventional do-main adaptation methods, which rely solely on model-predicted labels for LMMD and struggle with large domain shifts, our approach ensures more re-liable pseudo-labels through the integration of b-value information. Experi-mental results on a steel pipeline dataset demonstrate that the proposed method significantly improves leak size prediction accuracy in target do-mains, outperforming traditional techniques. The method's ability to adapt without labeled target domain data makes it highly practical for real-world pipeline monitoring systems.

Ankit Jain (National Institute of Technology Kurukshetra)*

Detection and Mitigation of DDoS Attacks on SDN Controller in IoT Network using Gini Impurity

Nowadays, Distributed denial-of-service (DDoS) attacks are a serious threat to businesses and individuals, and it is getting more prevalent. Moreover, the expo-nential growth of IoT devices and their interdependency makes the technology more vulnerable to DDoS attacks. Therefore, this paper presents an efficient Gini-Impurity based method for detection and mitigation of DDoS attacks. The proposed approach uses the Gini impurity technique as a metric on the Software Defined Network (SDN) controller in IoT network to measure the homogeneity of the network traffic. Gini impurity-based method is efficient, fast, and requires less computing power. The approach also uses a classifier to filter the network traffic. We evaluated the effectiveness of the proposed approach using real-world network traffic datasets. The detection rate of the proposed approach varies be-tween 98% and 100%. We compared the proposed approach with existing methods, and it detects DDoS attacks early with high accuracy and a low false-positive rate.

Mohit Dua (NIT KKR)*; Nidhi Chakravarty (Thapar Institute of Engineering and Technology)

Replay Attack Detection: A Group Delay Cepstral Perspective

Voice-controlled devices (VCDs), like Amazon Alexa and Google Home, have ushered in an era of smart devices, automated home appliances, and state-of-the-art cars. However, there are issues with this technological ad-vancement, especially in relation to voice-activated services like chatbots and attacks on VCDs using audio replay. Our thorough analysis of VCD vul-nerabilities revealed that these replays might be altered under challenging cir-cumstances to get unauthorised access to Internet of Things (IoT) devices and nodes. To tackle this urgent issue, dependable, computationally efficient techniques for detecting and preventing replay attacks on VCDs and other voice-activated devices must be developed. In our work, we have developed two group delay function-based features that are Group Delay-Mel Frequency Cepstral Coefficients (GD-MFCC) and Group Delay-Linear Frequency Cepstral Coefficients (GD-LFCC) for feature extraction. Using the Keras framework, pre-trained deep learning models like Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) are used for the backend implementation. Extensive testing is carried out on Voice Spoofing Detection Corpus (VSDC) in order to verify the efficacy of the suggested approach

Pankaj Verma (NIT-Kurukshetra)*

Spectrum Sensing in Cognitive Radio using Transformer based Deep Learning Architecture

Spectrum sensing is a pivotal function in cognitive radio systems, enabling dy-namic spectrum access by identifying underutilized frequency bands. Traditional spectrum sens-ing methodologies, such as energy detection and matched filtering, often struggle with low sig-nal-to-noise ratio (SNR) conditions and require prior knowledge of the primary user signals. Re-cent advances in deep learning have shown promise in addressing these limitations by learning complex patterns from data without requiring explicit signal models. In this article, we propose a novel spectrum sensing methodology based on Transformer architecture, a deep learning model renowned for its ability to capture long-range dependencies and process sequential data effi-ciently. The proposed approach leverages the self-attention mechanism of Transformers to en-hance detection accuracy and robustness under varying channel conditions. Experimental results demonstrate that the Transformer-based model outperforms traditional and existing deep learning methods, particularly in challenging and realistic environments such as Rayleigh channel. This study highlights the potential of Transformers for sensing the spectrum efficiently in cognitive radio networks, paving the way for more intelligent and adaptive wireless communication systems.

Trailokya Sasamal (NIT Kurukshetra)*

An optimal QCA-based Demultiplexer Structure Towards Scalable Design

Quantum-Dot Cellular Automata (QCA) represents a groundbreaking nano-technology at the nanoscale with the potential to replace complementary metal oxide semiconductor (CMOS) technology. A demultiplexer (DeMUX) is a crucial combinational circuit commonly used on the receiver side of com-munication systems. It converts serial input data into parallel outputs, dis-tributing it across multiple channels. This paper presents a low-complexity, coplanar 1:2 DeMUX circuit designed with 24 QCA cells. The design efficiently manages all inputs and outputs, allowing straightforward interfacing and modular design without requiring additional crossover or QCA cells, un-like many existing designs. The proposed 1:2 DeMUX also supports the creation of higher-order DeMUX configurations, such as the 1:4 DeMUX. Performance evaluations of the proposed DeMUX circuits, conducted using QCADesigner, show notable improvements over existing designs in terms of occupied area, latency and cell count.

Session 8
Machine Learning and AI Applications II

Badis Djamaa*, Said Yacine Boulahia, Ismail benbelgacem (EMP)

Distributed Approaches for Hyperparameter Optimization of a Deep Learning Model

Deep Neural Networks (DNNs) have revolutionized numerous aspects of daily life, yet their design and training processes remain inherently complex and often unpredictable. To address these challenges and provide systematic guidance for the development of DNNs, hyperparameter optimization (HPO) has emerged as a critical research focus. This paper investigates prominent methodologies for hyperparameter optimization, beginning with an analysis of essential hyperparameters and their pivotal influence on neural network performance. We then evaluate state-of-the-art hyperparameter optimization algorithms, assessing their computational efficiency, and highlighting their scalability issues. To overcome these issues, we discuss and study key distributed HPO strategies using the Ray framework. Through extensive experimentation, we rigorously evaluate these algorithms across a spectrum of hyperparameter configurations, demonstrating their scalability and effectiveness in optimizing model performance.

Badis Djamaa*, Ali Yachir, Ayoub Behloul (EMP)

Harnessing the Power of Generative Adversarial Networks for Enhancing Android Security

The widespread adoption of the Android operating system makes its security critically important. While malware detection systems employ advanced techniques like static and dynamic code analysis along with antivirus software, they struggle against evolving obfuscation methods used by malicious developers. This work studies existing obfuscation techniques and proposes AndroGAN, a novel obfuscation as a security-through-obscurity approach using Generative Adversarial Networks (GANs). AndroGAN incorporates unique attributes including permissions, services, receivers, system calls, and sensitive tasks to enhance obfuscation. By training malware detectors and GAN-based generators, AndroGAN simulates advanced evasion tactics, aiming to improve the robustness of detection systems. Obtained results demonstrate the abilities of AndroGAN in bypassing existing detectors, which contributes to strengthening Android security by addressing current limitations and advancing resilient malware detection methods. To promote transparency, collaboration, and further research, we have made both the curated dataset and the source code of AndroGAN freely available.

Sajid Ahmed*; Yoshiura Noriaki (Saitama University, Japan)

A review on Responsible Surveillance: Bridging Technological Advancements with Ethical and Privacy Concerns

The rapid development of public surveillance technologies has transformed urban management, public safety, and environmental monitoring. Modern surveillance systems offer high capability for real-time analysis and predictive monitoring powered by artificial intelligence, facial recognition, and IoT integrations. However, this development increases the bar regarding data security, privacy concerns, and ethical implications. This paper presents a holistic review of the current paradigm of public surveillance, discussing major technologies, global regulatory frameworks, and privacy-enhancing techniques addressing these concerns. We present a comparative study of various global case studies to highlight the diverse applications of surveil-lance systems and the associated ethical, legal, and privacy challenges. We also discuss current research directions on adversarial resilience, multimodal surveil-lance, and privacy-preserving frameworks. In the light of these, the paper identifies future directions: strong security, ethics in AI, and regulatory alignment to make sure that the surveillance system is aligned with the values of society and respect individual rights. Achieving this balance between technological innovation and ethical responsibility will be of paramount importance as public surveillance continues to expand and in the process of fostering public trust and building a resilient, privacy-conscious digital future. This review contributes uniquely by integrating techno-logical advancements with ethical analyses, offering a comprehensive framework for responsible surveillance practices in the digital age.

Danial Sharifrazi (Deakin University)

Brain Ageing Prediction using Isolation Forest Technique and Residual Neural Network (ResNet)

Brain aging is a complex and dynamic process, leading to functional and structural changes in the brain. These changes could lead to the increased risk of neurodegenerative diseases and cognitive decline. Accurate brain-age estimation utilizing neuroimaging data has become necessary for detecting initial signs of neurodegeneration. Here, we propose a novel deep learning approach using the Residual Neural Network 101 Version 2 (ResNet101V2) model to predict brain age from MRI scans. To train, validate and test our proposed model, we used a large dataset of 2102 images which were selected randomly from the International Consortium for Brain Mapping (ICBM). Next, we applied data preprocessing techniques, including normalizing the images and using outlier detection via Isolation Forest method. Then, we evaluated various pre-trained approaches (namely: MobileNetV2, ResNet50V2, ResNet101V2, Xception). The results demonstrated that the ResNet101V2 model has higher performance compared with the other models, attaining MAEs of 0.9136 and 0.8242 years for before and after using Isolation Forest process. Our method achieved a high accuracy in brain age estimation in ICBM dataset and it provides a reliable brain age prediction.

Ali Kohan (Fasa University)

Enhancing Multiagent Genetic Network Programming Performance Using Search Space Reduction

Genetic Network Programming (GNP) is an evolutionary algorithm that extends Genetic Programming (GP). It is typically used in agent control problems. In contrast to GP, which employs a tree structure, GNP utilizes a directed graph structure. During the evolutionary process, the connections between nodes change to discover the optimal strategy. Due to the large number of node connections, GNP has a large search space, making it challenging to identify an appropriate graph structure. One way to reduce this search space is by utilizing simplified operators that restrict the changeable node connections to those participating in the fitness function. However, this method has not been applied to GNP structures that use separate graphs for each agent, such as situation-based GNP (SBGNP). This paper proposes a method to apply simplified operators to SBGNP. To evaluate the performance of this method, we tested it on the Tileworld benchmark, where the algorithm demonstrated improvements in average fitness.

Vashkar Ghosh (University of North Carolina, Greensboro)*

Network Structures and Audit Policies: An Operational Perspective with Security Breaches

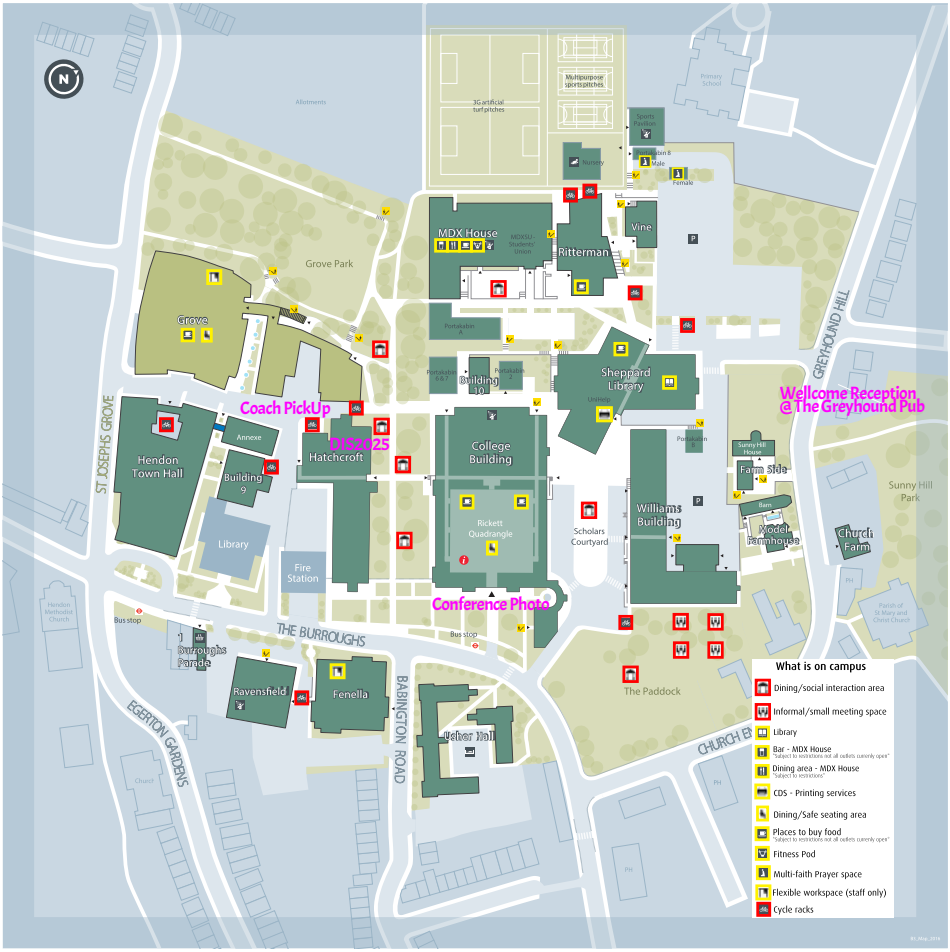
In the last decade and recently, a wide range of industries and organizations have been subject to IT-related security threats and cybersecurity breaches of varying degrees of severity at an alarming rate. A common practice adopted by organizations to ensure system and network security is to conduct regular audits and assessments. This paper takes on an organizational strategy perspective to analytically model the cost impact of random breaches in various types of networks subject to different types of audit policy. The analysis focuses on the interplay between the cost associated with a security breach on the one hand, and audit policy on the other. We develop a model for a non-stationary stochastic arrival process of security breaches and analyze the impact on mean and variance of total cost of different network configurations and audit policies. The generality of our modeling of the arrival process and the cost function permits a variety of attack and cost landscapes to be modeled and analyzed, with different breach intensities and costs (as functions of time) leading to different recommendations in terms of effective audit policy. Our analysis highlights the impact of intensity of security breach and cost of breach on the interaction between different network configurations and audit policies. One of our counter-intuitive findings is that under high security threat conditions a centralized network has a lower mean as well as a lower variance of total cost than a decentralized network, in case of cyclic and random audits; this rigorously derived proposition is an interesting instance of a dual risk-pooling effect that goes beyond conventional risk-pooling. We extend our analysis to consider an asymmetric network and correlated breaches.

Mohammad Ali Nematollahi (Fasa University)*

Malicious URL Detection Using Optimized Hist Gradient Boosting Classifier based on the Grid Search Method

Trusting the accuracy of data inputted on online platforms can be difficult due to the possibility of malicious websites gathering information for unlawful reasons. Analyzing each website individually becomes challenging with the presence of such malicious sites, making it hard to efficiently list all Uniform Resource Locators (URLs) on a blacklist. This ongoing challenge emphasizes the crucial need for strong security measures to safeguard against potential threats and unauthorized data collection. To detect the risk posed by malicious websites, it is proposed to utilize Machine Learning (ML)-based techniques. To this, we used several ML techniques such as Hist Gradient Boosting Classifier (HGBC), K-Nearest Neighbor (KNN), Logistic Regression (LR), Decision Tree (DT), Random Forest (RF), Multi-Layer Perceptron (MLP), Light Gradient Boosting Machine (LGBM), and Support Vector Machine (SVM) for detection of the benign and malicious website dataset. The dataset used contains 1781 records of malicious and benign website data with 13 features. First, we investigated missing value imputation on the dataset. Then, we normalized this data by scaling to a range of zero and one. Next, we utilized the Synthetic Minority Oversampling Technique (SMOTE) to balance the training data since the data set was unbalanced. After that, we applied ML algorithms to the balanced training set. Meanwhile, all algorithms were optimized based on grid search. Finally, the models were evaluated based on accuracy, precision, recall, $F1$ score, and the Area Under the Curve (AUC) metrics. The results demonstrated that the HGBC classifier has the best performance in terms of the mentioned metrics compared to the other classifiers.

Campus Map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Vine
Grove Park
Grove
Sheppard Library
Building 10
College Building
Rickett Quadrangle
Scholars Courtyard
Williams Building
Hendon Town Hall
Annexe
Building 9
Library
Hatchcroft
Fire Station
Coach PickUp
DISC2025
Conference Photo
Welcome Reception @ The Greyhound Pub
Farm Side
Model Farmhouse
Church Farm
Sunny Hill Park
The Paddock
Ravensfield
Fenella
Usher Hall
THE BURROUGHS
ST JOSEPHS GROVE
EGERTON GARDENS
BABINGTON ROAD
CHURCH END
GREYHOUND HILL
What is on campus
Dining/social interaction area
Informal/small meeting space
Library
Bar - MDX House
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CDS - Printing services
Dining/Safe seating area
Places to buy food
Fitness Pod
Multi-faith Prayer space
Flexible workspace (staff only)
Cycle racks

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