








# The 30th Australasian Joint Conference on Artificial Intelligence (AI'17), Melbourne, VIC, Australia

## Program Overview

Conference presentations venue: **80.11.10** (Building 80, Level 11, Room 10), Swanston Academic Building, RMIT City Campus:

<https://www.rmit.edu.au/maps/melbourne-city-campus/building-80>

 Keynote Speeches	 Machine Learning	 Optimization	 Swarm Intelligence and Evolutionary Computing	 Text Mining and Linguistic Analysis	 Other Areas in AI	 Other events
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	8:45 – 9:00	9:00 – 10:00	10:00 – 10:30	10:30 – 12:30	12:30 – 14:00	14:00 – 16:00	16:00 – 16:30	16:30 – 17:30	18:30 -20:30
<b>Day 1</b> (19 August 2017)	AI'17 opening	Keynote 1: C. Coello Coello  Chair: X. Li	Tea Break	<b>36*(Zhang)</b> 24 (McKenzie) 41 (Hardwick-Smith) 43 (Yamada) 48 (Okesanjo) 14(Shi)	Lunch Break	<b>1*(Bhattacharjee)</b> 2 (Islam) 10 (Saremi) 15 (Gao) 17 (Mougouei) 57 (Schmidt)	Tea Break	<b>22*(Zia)</b> 54(Mo) 58 (Chen)	AI'17 Conference dinner (see notes below)
<b>Day 2</b> (20 August 2017)	No Session	Keynote 2: J. Lu  Chair: A.Damminda	Tea Break	<b>4*(Bowley)</b> 35(Huo) 40(Tran) 45(Wang) 46(Haidar) 50(Schellenberg)	Lunch Break	<b>7*(Bashar)</b> 21(Pan) 25(Ofoghi) 30(Alharbi) 32(Xu) 38(Ma)	Tea Break	<b>9*(Vallati)</b> 11(Watson)	

### Notes:

- The numbers denote paper IDs and last name of the first author. Each paper is allotted 20 mins (15-17 mins presentation + 3-5 mins Q&A/ change-over).
- For the presentation sessions, the presenters of the paper marked with (\*) will chair their respective session.
- NewQuay International Buffet, 4-6 NewQuay Promenade, Docklands 3008. URL: <https://newquaybuffet.com.au/>

# AI'17 Program Schedule

## Saturday August 19

Saturday August 19 08:00 - 08:30 **Registration**

Saturday August 19 08:45 - 09:00 **Opening Remark**

Saturday August 19 09:00 - 10:00 **Keynote#1**

Title: **Recent Results and Open Problems in Evolutionary Multiobjective Optimization**

Prof. Carlos Coello Coello, Departamento de Computacion', CINVESTAV-IPN, Av. IPN No. 2508, Mexico, D.F. 07360, Mexico

Saturday August 19 10:00 - 10:30 **Tea Break**

Saturday August 19 10:30 - 12:30 **Machine Learning**

(Chair: Tiantian Zhang)

10:30 – 10:50 [Paper#36]: Tiantian Zhang and Bo Yuan.

**Density-Based Multiscale Analysis for Clustering in Strong Noise Settings**

10:50 – 11:10 [Paper#24]: Mark McKenzie, Peter Loxley, William Billingsley and Sebastien Wong.

**Competitive Reinforcement Learning in Atari Games**

11:10 – 11:30 [Paper#41]: Will Hardwick-Smith, Yiming Peng, Gang Chen, Yi Mei and Mengjie Zhang.

**Evolving Transferable Artificial Neural Networks for Gameplay Tasks via NEAT with Phased Searching**

11:30 – 11:50 [Paper#43]: Shinichi Yamada and Kouros Neshatian.

**Multiple Kernel Learning with One-level Optimization of Radius and Margin**

11:50 – 12:10 [Paper#48]: Yemi Okesanjo and Victor Kofia.

**A Deterministic Actor-Critic Approach to Stochastic Reinforcements**

12:10 – 12:30 [Paper#14]: Yilong Shi, Hong Lin and Yuqiang Li.

**Context-Aware recommender systems based on Item-grain context clustering**

Saturday August 19 12:30 - 14:00 **Lunch Break**

Saturday August 19 14:00 - 16:00 **Optimization**

(Chair: Kalyan Bhattacharjee)

14:00 – 14:20 [Paper#1]: Kalyan Bhattacharjee, Hemant Singh and Tapabrata Ray.

**Enhanced Pareto Interpolation Method to Aid Decision Making for Discontinuous Pareto Optimal Fronts**

14:20 – 14:40 [Paper#2]: Md Monjurul Islam, Hemant Singh and Tapabrata Ray.

**Use of a non-nested formulation to improve search for bilevel optimization**

14:40 – 15:00 [Paper#10]: Shahrzad Saremi, Seyedali Mirjalili, Andrew Lewis and Alan Wee-Chung Liew.

**Let's Consider Two Objectives When Estimating Hand Postures**

15:00 – 15:20 [Paper#15]: Wanru Gao, Tobias Friedrich, Timo Kötzing and Frank Neumann.

**Scaling up Local Search for Minimum Vertex Cover in Large Graphs by Parallel Kernelization**

15:20 – 15:40 [Paper#17]: Davoud Mougouei, David Powers and Asghar Moeini.

**An Integer Linear Programming Model for Binary Knapsack Problem with Dependent Item Values**

15:40 – 16:00 [Paper#57]: Daniel Schmidt and Enes Makalic.

**Robust Lasso Regression with Student- $t$  Residuals**

Saturday August 19 16:00 - 16:30 **Tea Break**

Saturday August 19 16:30 - 17:30 **Other Areas in AI**

(Chair: Razia Zia)

16:30 – 16:50 [Paper#22]: Razia Zia, Pervez Akhtar, Arshad Aziz, Maroof Ali Shah and Dur-E-Shahwar Kundi.

**Non Sub-sampled Contourlet Transform based Feature Extraction Technique for Differentiating Glioma Grades using MRI Images**

16:50 – 17:10 [Paper#54]: Jeff Mo, Eibe Frank and Varvara Vetrova.

**Large-scale automatic species identification**

17:10 – 17:30 [Paper#58]: Lingwei Chen and Yanfang Ye. SecMD:

**Make Machine Learning More Secure Against Adversarial Malware Attacks**

## Sunday August 20

Sunday August 20 09:00 - 10:00 **Keynote#2**

Title: **Fuzzy Transfer Learning for Prediction and Decision Making**

Prof. Jie Lu, Associate Dean in Research Excellence, Director of Centre for Artificial Intelligence (CAI), Faculty of Engineering and Information Technology, University of Technology Sydney (UTS), P.O. Box 123, Broadway, NSW 2007, Australia

Sunday August 20 10:00 - 10:30 **Tea Break**

Sunday August 20 10:30 - 12:30 **Swarm Intelligence and Evolutionary Computing**

(Chair: Sarah Jean Bowley)

10:30 – 10:50 [Paper#4]: Sarah Jean Bowley and Kathryn Marrick.

**A 'Breadcrumbs' Model for Controlling an Intrinsically Motivated Swarm using a Handheld Device**

10:50 – 11:10 [Paper#35]: Jiatong Huo, Bing Xue, Lin Shang and Mengjie Zhang.

**Search Based Software Testing: Evolutionary Multi-Objective Test Data Generation**

11:10 – 11:30 [Paper#40]: Binh Tran, Bing Xue and Mengjie Zhang.

**Class Dependent Multiple Feature Construction Using Genetic Programming For High-Dimensional Data**

11:30 – 11:50 [Paper#45]: Chen Wang, Hui Ma, Aaron Chen and Sven Hartmann.

**Comprehensive Quality-Aware Automated Semantic Web Service Composition**

11:50 – 12:10 [Paper#46]: Ali Haidar and Brijesh Verma.

**Monthly Rainfall Categorization based on Optimized Features and Neural Network**

12:10 – 12:30 [Paper#50]: Sven Schellenberg, Xiaodong Li and Zbigniew Michalewicz.

**Preliminary Study on Solving Coal Processing and Blending Problems Using Lexicographic Ordering**

Sunday August 20 12:30 - 14:00 **Lunch Break**

Sunday August 20 14:00 - 16:00 **Text Mining and Linguistic Analysis**

(Chair: Md Abul Bashar)

14:00 – 14:20 [Paper#7]: Md Abul Bashar and Yuefeng Li.

**Random Set to Interpret Topic Models in terms of Ontology Concepts**

14:20 – 14:40 [Paper#21]: Luoxi Pan, Iqbal Gondal and Robert Layton.

**Improving Authorship Attribution in Twitter Through Topic-based Sampling**

14:40 – 15:00 [Paper#25]: Bahadorreza Ofoghi and Karin Verspoor.

**Textual emotion classification: An interoperability study on cross-genre data sets**

15:00 – 15:20 [Paper#30]: Abdullah Alharbi, Yuefeng Li and Yue Xu.

**Integrating LDA with Clustering Technique for Relevance Feature Selection**

15:20 – 15:40 [Paper#32]: Hong Xu, T. K. Satish Kumar and Sven Koenig.

**Min-Max Message Passing and Local Consistency in Constraint Networks**

15:40 – 16:00 [Paper#38]: Zongjie Ma, Yi Fan, Kaile Su, Chengqian Li and Abdul Sattar.

**Deterministic Tournament Selection in Local Search for Maximum Edge Weight Clique on Large Sparse Graphs**

Sunday August 20 16:00 - 16:30 **Tea Break**

Sunday August 20 16:30 - 17:10 **Other Areas in AI**

(Chair: Mauro Vallati)

16:30 – 16:50 [Paper#9]: Mauro Vallati, Federico Cerutti and Massimiliano Giacomin.

**On the Combination of Argumentation Solvers into Parallel Portfolios**

16:50 – 17:10 [Paper#11]: Ian Watson.

**Exploring the use of Case-Based Reasoning to play Eurogames**

## AI'17 Accepted Papers with Abstracts

Paper#1: Kalyan Bhattacharjee, Hemant Singh and Tapabrata Ray.

### **Enhanced Pareto Interpolation Method to Aid Decision Making for Discontinuous Pareto Optimal Fronts**

**Abstract:** Multi-criteria decision making is at the heart of many domains such as engineering, finance and logistics. It aims to address the key challenges of search for optimal solutions and decision making in the presence of multiple conflicting design objectives/criteria. The decision making aspect can be particularly challenging when there are too few Pareto optimal solutions available as this severely limits the understanding of the nature of the Pareto optimal front (POF) and subsequently affects the confidence on the choice of solutions. This problem is studied herein, where a decision maker is presented with a few outcomes and the objective is to identify regions of interest for further investigation. To address the problem, the contemporary approaches attempt to generate POF approximation through linear interpolation of a given set of (a few) Pareto optimal outcomes. While the process helps in gaining an understanding of the POF, it ignores the possibility of discontinuities or voids in the POF. In this study, we investigate two measures to alleviate this difficulty. First is to make use of infeasible solutions obtained during the search, along with the Pareto outcomes while constructing the interpolations. Second is to use proximity to a set of uniform reference directions to determine potential discontinuities. Consequently, the proposed approach enables approximation of both continuous and discontinuous POF more accurately. Additionally, a set of interpolated outcomes along uniformly distributed reference directions are presented to the decision maker. The errors in the given interpolations are also estimated in order to further aid decision making by establishing confidence on predictions. We illustrate the performance of the approach using four problems, spanning different types of fronts, such as mixed (convex/concave), degenerate, and disconnected.

Paper#2: Md Monjurul Islam, Hemant Singh and Tapabrata Ray.

### **Use of a non-nested formulation to improve search for bilevel optimization**

**Abstract:** Bilevel optimization involves searching for the optimum of an upper level problem subject to optimality of a nested lower level problem. These are also referred to as the leader and follower problems, since the lower level problem is formulated based on the decision variables at the upper level. Most evolutionary algorithms designed to deal with such problems operate in a nested mode, which makes them computationally prohibitive in terms of the number of function evaluations. In the classical literature, one of the common ways of solving the problem has been to reformulate it as a single-level problem using optimality measures (such as Karush-Kuhn-Tucker conditions) for lower level problem as complementary constraint(s). However, the mathematical properties such as linearity/convexity limits their application to more complex or black-box functions. In this study, we explore a non-nested strategy in the context of evolutionary algorithm. The constraints of the upper and lower level problems are considered together at a single-level while optimizing the upper level objective function. An additional constraint is formulated based on local exploration around the lower level decision vector, which reflects an estimate of its optimality. The approach is further enhanced through the use of periodic local search and selective “re-evaluation” of promising solutions. The proposed approach is implemented in a commonly used evolutionary algorithm framework and empirical results are shown for the SMD suite of test problems. A comparison is done with other established algorithms in the field such as BLEAQ, NBLEA, and BLMA to demonstrate the potential of the proposed approach.

Paper#4: Sarah Jean Bowley and Kathryn Marrick.

#### **A 'Breadcrumbs' Model for Controlling an Intrinsically Motivated Swarm using a Handheld Device**

**Abstract:** This paper presents a model for controlling an intrinsically motivated swarm, designed for use on a handheld device. We map touch-screen gestures to a set of 'breadcrumbs' that can be placed to influence the behaviour of the swarm. We describe a prototype system implementing the breadcrumbs model. Then we evaluate the prototype by examining how members of the swarm respond to each breadcrumb. Our results characterize the behaviour of the intrinsically motivated swarm in response to each type of 'breadcrumb' and discuss the implications for swarms of different types of robots.

Paper#7: Md Abul Bashar and Yuefeng Li.

#### **Random Set to Interpret Topic Models in terms of Ontology Concepts**

**Abstract:** Topic modelling is a popular technique in text mining. However, discovered topic models are difficult to interpret due to incoherence and lack of background context. Many applications require an accurate interpretation of topic models so that both users and machines can use them effectively. Taking the advantage of random set and a domain ontology, this research can interpret the topic models. The interpretation is evaluated by comparing it with different baseline models on two standard datasets. The results show that the performance of the interpretation is significantly better than baseline models.

Paper#9: Mauro Vallati, Federico Cerutti and Massimiliano Giacomin.

#### **On the Combination of Argumentation Solvers into Parallel Portfolios**

**Abstract:** In the light of the increasing availability of multicore machines and of the intrinsic complexity of designing parallel algorithms, a natural exploitation of parallelism is to combine solvers into parallel portfolios. In this work, we introduce six methodologies for the automatic configuration of parallel portfolios of argumentation solvers for enumerating the preferred extensions of a given framework. In particular, four methodologies aim at combining solvers in static portfolios, while two methodologies are designed for the dynamic configuration of parallel portfolios. Our empirical results demonstrate that the configuration of parallel portfolios is a fruitful way for exploiting multicore machines, and that the presented approaches outperform the state of the art of parallel argumentation solvers.

Paper#10: Shahrzad Saremi, Seyedali Mirjalili, Andrew Lewis and Alan Wee-Chung Liew.

#### **Let's Consider Two Objectives When Estimating Hand Postures**

**Abstract:** Hand posture estimation is an important step in hand gesture detection. It refers to the process of modeling hand in computer to accurately represent the actual hand obtained from an acquisition device. In the literature, several objective functions (mostly based on silhouette or point cloud) have been used to formulate and solve the problem of hand posture estimation as a minimisation problem using stochastic or deterministic algorithms. The main challenge is that the objective function is computationally expensive. In the case of using point clouds, decreasing the number of

points results in a better computational cost, but it decreases the accuracy of hand posture estimation. We argue in this paper that hand posture estimation is a bi-objective problem with two conflicting objectives: minimising the error versus minimising the number of points in the point cloud. As an early effort, this paper first formulates hand posture estimation as a bi-objective optimisation problem and then approximates its true Pareto optimal front with an improved Multi-Objective Particle Swarm Optimisation (MOPSO) algorithm. The proposed algorithm is used to determine the Pareto optimal front for 16 hand postures and compared with the original MOPSO. The results proved that the objectives are in conflict and the improved MOPSO outperforms the original algorithm when solving this problem.

Paper#11: Ian Watson.

### **Exploring the use of Case-Based Reasoning to play Eurogames**

**Abstract:** Game AI is a well-established area of research. Classic strategy board games such as Chess and Go have been the subject of AI research for several decades, and more recently modern computer games have come to be seen as a valuable test-bed for AI methods and technologies. Modern board games, in particular those known as German-Style Board Games or Eurogames, are an interesting mid-point between these fields in terms of domain complexity, but AI research in this area is more sparse. This paper discusses the design, development and performance of a game-playing agent, called SCOUT that uses the Case-Based Reasoning methodology as a means to reason and make decisions about game states in the Eurogame Race for the Galaxy. The purpose of this research is to explore the possibilities and limitations of Case-Based Reasoning within the domain of Race for the Galaxy and Eurogames in general.

Paper#14: Yilong Shi, Hong Lin and Yuqiang Li.

### **Context-Aware recommender systems based on Item-grain context clustering**

**Abstract:** Context-aware recommender systems (CARS), aiming to further improve recommendation accuracy and user satisfaction by taking context information into account, has become the hottest research topic in the field of recommendation. Integrating context information into recommendation frameworks is challenging, owing to the high dimensionality of context information and the sparsity of the observations, which state-of-the-art methods do not handle well. We suggest a novel approach for context-aware recommendation based on Item-grain context clustering (named IC-CARS), which first extracts context clusters for each item based on K-means method, then incorporates context clusters into Matrix Factorization model, and thus helps to overcome the often encountered problem of data sparsity, scalability and prediction quality. Experiments on two real-world datasets and the complexity analysis show that IC-CARS is scalable and outperforms several state-of-the-art methods for recommending.

Paper#15: Wanru Gao, Tobias Friedrich, Timo Kötzing and Frank Neumann.

### **Scaling up Local Search for Minimum Vertex Cover in Large Graphs by Parallel Kernelization**

**Abstract:** We investigate how well-performing local search algorithms for small or medium size instances can be scaled up to perform well for large inputs. We introduce a parallel kernelization technique that is motivated by the assumption that graphs in medium to large scale are composed of components which are on their own easy for state-of-the-art solvers but when hidden in large graphs are hard to solve. To show the effectiveness of our kernelization technique, we consider the well-known minimum vertex cover problem and two state-of-the-art solvers called NuMVC and FastVC.



Our kernelization approach reduces an existing large problem instance significantly and produces better quality results on a wide range of benchmark instances and real world graphs.

Paper#17: Davoud Mougouei, David Powers and Asghar Moeini.

### **An Integer Linear Programming Model for Binary Knapsack Problem with Dependent Item Values**

**Abstract:** Binary Knapsack Problem (BKP) is to select a subset of items with the highest value while keeping the size within the capacity of the knapsack. This paper presents an *Integer Linear Programming* (ILP) model for a variation of BKP where the value of an item may depend on presence or absence of other items in the knapsack. Strengths of such Value-Related Dependencies are assumed to be imprecise and hard to specify. To capture this imprecision, we have proposed modeling value-related dependencies using fuzzy graphs and their algebraic structure. We have demonstrated through simulations that our proposed ILP model is scalable to large number of items.

Paper#21: Luoxi Pan, Iqbal Gondal and Robert Layton.

### **Improving Authorship Attribution in Twitter Through Topic-based Sampling**

**Abstract:** Aliases are used as a means of anonymity on the Internet in environments such as IRC (internet relay chat), forums and micro-blogging websites such as Twitter. While there are genuine reasons for the use of aliases, such as journalists operating in politically oppressive countries, they are increasingly being used by cybercriminals and extremist organizations. In recent years, we have seen increased research on authorship attribution of Twitter messages, including authorship analysis of aliases. Previous studies have shown that anti-aliasing of randomly generated sub-aliases yields high accuracies when linking the sub-aliases, but become much less accurate when topic-based sub-aliases are used. N-gram methods have previously been demonstrated to perform better than other methods in this situation. This paper investigates the effect of topic-based sampling on authorship attribution accuracy for the popular micro-blogging website Twitter. Features are extracted using character n-grams, which accurately capture differences in authorship style. These features are analyzed using support vector machines using a one-versus-all classifier. The predictive performance of the algorithm is then evaluated using two different sampling methodologies - authors that were sampled through a context-sensitive topic based search and authors that were sampled randomly. Topic based sampling of authors is found to produce more accurate author-ship predictions. This paper presents several theories as to why this might be the case.

Paper#22: Razia Zia, Pervez Akhtar, Arshad Aziz, Maroof Ali Shah and Dur-E-Shahwar Kundi.

### **Non Sub-sampled Contourlet Transform based Feature Extraction Technique for Differentiating Glioma Grades using MRI Images**

**Abstract:** More distinguishable features can greatly improve the performance of any classification system. In this study, a new feature extraction method using shift and rotation-invariant non-subsampled contourlet transform (NSCT) and isotropic gray level co-occurrence matrix (GLCM) is proposed for the classification of three glioma grades (II, III and IV). The classification is done using support vector machines (SVMs). A dataset of 93 MRI brain tumor images containing three grades of glioma are classified using 10 fold cross validation scheme. The proposed method is also compared with Discrete Wavelet Transform (DWT) approach. The highest accuracy of 83.33\% for grade III, sensitivity of 86.95\% and specificity of 92.82\% achieved in case of grade II.

Paper#24: Mark McKenzie, Peter Loxley, William Billingsley and Sebastien Wong.

### **Competitive Reinforcement Learning in Atari Games**

**Abstract:** This research describes a study into the ability of a state of the art reinforcement learning algorithm to learn to perform multiple tasks. We demonstrate that the limitation of learning to performing two tasks can be mitigated with a competitive training method. We show that this approach results in improved generalization of the system when to performing unforeseen tasks. The learning agent assessed is an altered version of the DeepMind deep Q-learner network (DQN), which has been demonstrated to outperform human players for a number of Atari 2600 games. The key findings of this paper is that there were significant degradations in performance when learning more than one game, and how this varies depends on both similarity and the comparative complexity of the two games.

Paper#25: Bahadorreza Ofoghi and Karin Verspoor.

### **Textual emotion classification: An interoperability study on cross-genre data sets**

**Abstract:** This paper describes the application and analysis of a previously developed textual emotion classification system (READ-BioMed-EC) for English on a new data set in the same language with different textual properties. The classifier makes use of a number of lexicon-based and text-based features. The data set to tune and train this classifier contained Twitter microblogs with mentions of Ebola disease that were manually labelled with one of six emotion classes, plus sarcasm, news-related, or neutral. We applied the READ-BioMed-EC emotion classifier to a completely different and previously unseen set of Web blog posts to understand how well a Twitter-trained disease-focused emotion classifier can perform on an entirely different collection of open-domain sentences. The results of our study show that direct cross-genre application of the classifier does not achieve meaningful results, when re-trained on the open-domain data set, the READ-BioMed-EC system outperforms the previously published results. The study has implications for cross-genre applicability of emotion classifiers, suggesting that emotion is expressed differently in different text types.

Paper#30: Abdullah Alharbi, Yuefeng Li and Yue Xu.

### **Integrating LDA with Clustering Technique for Relevance Feature Selection**

**Abstract:** Selecting features from documents that describe user information needs is challenging due to the nature of text, where redundancy, synonymy, polysemy, noise and high dimensionality are common problems. Clustering algorithms group documents that share a similar topic together and show better and stable performance in retrieval systems. However, the assumption that clustered documents describe only one topic can be too simple knowing that most long documents discuss multiple topics. Topic modelling techniques, such as LDA, relax the clustering assumption and have been developed on the basis that a document can exhibit multiple topics. LDA-based models show significant improvement over the cluster-based in information retrieval. However, the integration of both techniques is still limited, and their feasibility for feature selection (FS) is still unknown. In this paper, we propose an innovative and effective cluster- and LDA- based model for relevance FS. The model also integrates a new extended random set theory to generalise the LDA local weights for document terms. It can assign a more discriminative weight to the terms based on their appearance in LDA topics and the clustered documents. The experimental results, based on the RCV1 dataset and TREC topics, show that our model significantly outperforms eight state-of-the-art baseline models in five popular performance measures.

Paper#32: Hong Xu, T. K. Satish Kumar and Sven Koenig.

### **Min-Max Message Passing and Local Consistency in Constraint Networks**

**Abstract:** In this paper, we uncover some relationships between local consistency in constraint networks (CNs) and message passing akin to belief propagation (BP) in probabilistic reasoning. We develop a new message passing algorithm, called the min-max message passing (MMMP) algorithm, for unifying the different notions of local consistency in CNs. In particular, we study its connection to arc consistency (AC), generalized arc consistency (GAC), and path consistency (PC). We show that AC-3 can be expressed more intuitively from the perspective of message passing. We also show that the MMMP algorithm can be modified to enforce path consistency (PC), and more generally, K-consistency.

Paper#35: Jiatong Huo, Bing Xue, Lin Shang and Mengjie Zhang.

### **Search Based Software Testing: Evolutionary Multi-Objective Test Data Generation**

**Abstract:** Software testing is an indispensable part in software development to ensure the quality of products. Multi-objective test data generation is a sub-area of search-based software testing which focuses on reducing the oracle cost while improving the quality of test suites through generating test data automatically. Due to the limited data representation and the lack of specific multi-objective optimization methods, existing approaches have drawbacks in dealing with real-world programs. This paper presents a new approach to multi-objective test data generation problems using genetic programming (GP) while two genetic algorithm (GA) based approaches are also implemented for comparison purposes. Moreover, three multi-objective optimization frameworks are used and compared to examine the performance of GP-based methods. Experiments have been conducted on two types of test data generation problems: integer and double. Each consists of 160 benchmark programs with different degrees of nesting. The results suggest that the new GP approaches perform much better than two GA-based approaches, and a random search baseline algorithm.

Paper#36: Tiantian Zhang and Bo Yuan.

### **Density-Based Multiscale Analysis for Clustering in Strong Noise Settings**

**Abstract:** Finding clustering patterns in data is challenging when clusters can be of arbitrary shapes and the data contains high percentage (e.g., 80%) of noise. This paper presents a novel technique named density-based multiscale analysis for clustering (DBMAC) that can conduct noise-robust clustering without any strict assumption on the shapes of clusters. Firstly, DBMAC calculates the r-neighborhood statistics with different r (radius) values. Next, instead of trying to find a single optimal r value, a set of radii appropriate for separating “clustered” objects and “noisy” objects are identified, using a formal statistical method for multimodality test. Finally, the classical DBSCAN is employed to perform clustering on the subset of data with significantly less amount of noise. Experiment results confirm that DBMAC is superior to classical DBSCAN in strong noise settings and also outperforms the latest technique SkinnyDip when the data contains arbitrarily shaped clusters.

Paper#38: Zongjie Ma, Yi Fan, Kaile Su, Chengqian Li and Abdul Sattar.

### **Deterministic Tournament Selection in Local Search for Maximum Edge Weight Clique on Large Sparse Graphs**

**Abstract:** The maximum edge weight clique (MEWC) problem is important in both theories and applications. During last decades, there has been much interest in finding optimal or near-optimal solutions to this problem. Many existing heuristics focuses on academic benchmarks of relatively

small size. However, very little attention has been paid to solving the MEWC problem in large sparse graphs. In this work, we exploit the so-called deterministic tournament selection (DTS) strategy to improve the local search MEWC algorithms. Experiments conducted on a broad range of large sparse graphs show that our algorithm outperforms state-of-the-art local search algorithms in this benchmark. Moreover it finds better solutions on a list of them.

Paper#40: Binh Tran, Bing Xue and Mengjie Zhang.

### **Class Dependent Multiple Feature Construction Using Genetic Programming For High-Dimensional Data**

**Abstract:** Genetic Programming (GP) has shown promise in feature construction where high-level features are formed by combining original features using predefined functions or operators. Multiple feature construction methods have been proposed for high-dimensional data with thousands of features. Results of these methods show that several constructed features can maintain or even improve the discriminating ability of the original feature set. However, different features can have different abilities to distinguish different classes. Therefore, it may be more difficult to construct a better discriminating feature when combining features that are relevant to different classes. In this study, we propose a new GP-based feature construction method called CDFC that constructs multiple features, each of which focuses on distinguishing one class from other classes. We propose a new representation for class-dependent feature construction and a new fitness function to better evaluate the constructed feature set. Results on eight datasets with varying difficulties showed that the features constructed by CDFC can improve the discriminating ability of thousands of original features in most cases. Results also showed that CDFC is more effective and efficient than the hybrid MGPFC method which was shown to have better performance than standard GP to feature construction.

Paper#41: Will Hardwick-Smith, Yiming Peng, Gang Chen, Yi Mei and Mengjie Zhang.

### **Evolving Transferable Artificial Neural Networks for Gameplay Tasks via NEAT with Phased Searching**

**Abstract:** NeuroEvolution of Augmenting Topologies (NEAT) has been successfully applied to intelligent gameplay. To further improve its effectiveness, a key technique is to reuse the knowledge learned from source gameplay tasks to boost performance on target gameplay tasks. We consider this as a Transfer Learning (TL) problem. However, Artificial Neural Networks (ANNs) evolved by NEAT are usually unnecessarily complicated, which may affect their transferability. To address this issue, we will investigate in this paper the capability of Phased Searching (PS) methods for controlling ANNs' complexity while maintaining their effectiveness. By dosing so, we can obtain more transferable ANNs. Furthermore, we will propose a new Power-Law Ranking Probability based PS (PLPS) method to more effectively control the randomness during the simplification phase. Several recent PS methods as well as our PLPS have been evaluated on four carefully-designed TL experiments. Results show clearly that NEAT can evolve more transferable and structurally simple ANNs with the help of PS methods, in particular PLPS.

Paper#43: Shinichi Yamada and Kourosh Neshatian.

### **Multiple Kernel Learning with One-level Optimization of Radius and Margin**

**Abstract:** Generalization error rates of support vector machines are closely related to the ratio of radius of sphere which includes all data and the margin between the separating hyperplane and the data. There are already several attempts to formulate the multiple kernel learning of SVMs using the ratio rather than only the margin. Our approach is to combine the well known formulations of SVMs and SVDDs. In our model we can compute the

optimal coefficients of kernels without imposing further constraints. In other words the proposed model is a closed system and always reaches the global optimal solutions.

Paper#45: Chen Wang, Hui Ma, Aaron Chen and Sven Hartmann.

### **Comprehensive Quality-Aware Automated Semantic Web Service Composition**

**Abstract:** Web service composition has been a prevailing research direction in recent years. There are two major challenges faced by researchers, semantic matchmaking and Quality of Service (QoS) optimisation. Semantic matchmaking aims to discover interoperable web services that can interact with each other by their resources described semantically. QoS optimisation aims to optimise the non-functional requirements of service users, such as minimum cost and maximum reliability. To meet the requirements of service users, both semantic matchmaking quality and QoS should be considered simultaneously. Most existing works on web service composition, however, focus only on one of these two aspects. Therefore, we propose a comprehensive quality model that takes both semantic matchmaking quality and QoS into account with the aim of achieving a more desirable balance of both sides. Further, we develop a PSO-based service composition approach with explicit support for the proposed comprehensive quality model. We also conduct experiments to explore the effectiveness of our PSO-based approach and the desirable balance achieved by using our comprehensive quality model.

Paper#46: Ali Haidar and Brijesh Verma.

### **Monthly Rainfall Categorization based on Optimized Features and Neural Network**

**Abstract:** Rainfall is a complex process that is a result of different atmospheric interactions. Rainfall forecasting is highly effective for various industries including sugarcane industry. In this study, we propose a neural network based approach for classifying monthly rainfall. Rainfall classification is defined as determining the category of rainfall amount based on a certain threshold. Five distinct locations were selected to perform the study: Innisfail, Plane creek, Bingera, Maryborough in Queensland, Australia and Yamba in New South Wales, Australia. Multiple local and global climate indices have been linked to formation of rain. Hence, different local and global climate indices are proposed as possible predictors of rain. A Particle Swarm Optimization (PSO) algorithm was incorporated to select best features for each month in each location. An average accuracy of 87.65 % was recorded with the proposed approach over the five selected locations. The developed models were compared against other neural network models where all features were used as input features. An average difference of 28.65%, 26.67%, 32.35%, 31.67%, 25% was recorded for Innisfail, Planecreek, Bingera, Maryborough and Yamba respectively. The analysis of statistical results suggests that the artificial neural networks can be used as a promising alternative approach for rainfall categorization over multiple weather zones and over Australia. In addition, selection of input features should be carefully considered when designing rainfall forecasting models.

Paper#48: Yemi Okesanjo and Victor Kofia.

### **A Deterministic Actor-Critic Approach to Stochastic Reinforcements**

**Abstract:** Learning optimal policies under stochastic rewards presents a challenge for well-known reinforcement learning algorithms such as Q-learning. Q-learning has been shown to suffer from a positive bias that inhibits it from learning under inconsistent rewards. It is well-known that actor-critic methods do not suffer from such bias. However under rewards of high variance, actor-critic methods may also fail to acquire the optimal

policy. We propose the use of a reward shaping function in order to reduce the variance within stochastic rewards. By reformulating Q-learning as a deterministic actor-critic, we show that the use of such reward shaping functions improves the acquisition of optimal policies under stochastic reinforcements.

Paper#50: Sven Schellenberg, Xiaodong Li and Zbigniew Michalewicz.

### **Preliminary Study on Solving Coal Processing and Blending Problems Using Lexicographic Ordering**

**Abstract:** Despite its known shortcomings, penalty function approaches are among the most commonly used constraint handling methods in the field of evolutionary computation. In this paper, we argue that some of the techniques used to alleviate these shortfalls (namely scaling and normalisation) cannot avoid undesired search biases. Instead, we introduce the notion of desired search biases to effectively solve problems with a large number of competing constraints. The methods using this notion are based on dominance comparison by lexicographic ordering of objectives. For the real-world problem we use, two of the methods outperform the best performing penalty function approach by finding feasible solutions repeatedly.

Paper#54: Jeff Mo, Eibe Frank and Varvara Vetrova.

### **Large-scale automatic species identification**

**Abstract:** The crowd-sourced Naturewatch GBIF dataset is used to obtain a species classification dataset containing approximately 1.2 million photos of nearly 20 thousand different species of biological organisms observed in their natural habitat. We present a general hierarchical species identification system based on deep convolutional neural networks and trained on NatureWatch dataset. The dataset contains images taken under a wide variety of conditions and is heavily imbalanced, with most species associated with only few images. We apply multi-view classification as a way to lend more influence to high frequency details, hierarchical fine-tuning to help with class imbalance and provide regularisation, and automatic specificity control for optimising classification depth. Our system achieves 55.8% accuracy when identifying individual species and around 90% accuracy at an average taxonomy depth of 5.1—equivalent to the taxonomic rank of "family"—when applying automatic specificity control.

Paper#57: Daniel Schmidt and Enes Makalic.

### **Robust Lasso Regression with Student- $t$ Residuals**

**Abstract:** The lasso, introduced by Robert Tibshirani in 1996, has become one of the most popular techniques for estimating Gaussian linear regression models. An important reason for this popularity is that the lasso can simultaneously estimate all regression parameters as well as select important variables, yielding accurate regression models that are highly interpretable. This paper derives an efficient procedure for fitting robust linear regression models with the lasso in the case where the model residuals follow the Student- $t$  distribution. In contrast to Gaussian lasso regression, the proposed Student- $t$  lasso regression procedure can be applied to data sets which contain large outlying observations. We demonstrate the utility of our Student- $t$  lasso regression by analysing the Boston housing data set.

Paper#58: Lingwei Chen and Yanfang Ye. SecMD:

## **Make Machine Learning More Secure Against Adversarial Malware Attacks**

**Abstract:** As machine learning based systems have been successfully deployed for malware detection, the incentive for defeating them increases. In this paper, we explore the security of machine learning in malware detection on the basis of a learning-based classifier. In particular, (1) considering different capabilities of the attackers (i.e., how much knowledge they have regarding feature representation, training set, and learning algorithm), we present a set of corresponding adversarial attacks and implement a general attack model AdvAttack to thoroughly assess the adversary behaviors; (2) to effectively counter these evasion attacks, we propose a resilient yet elegant secure-learning paradigm SecMD to improve the system security against a wide class of adversarial attacks. Promising experimental results based on the real sample collections from Comodo Cloud Security Center demonstrate the effectiveness of our proposed methods.

# AI'17 Keynote Speakers

## Keynote Speaker 1

### Recent Results and Open Problems in Evolutionary Multiobjective Optimization

**Professor Carlos Coello Coello**

*CINVESTAV-IPN, Mexico*

#### Abstract

Evolutionary algorithms (as well as a number of other metaheuristics) have become a popular choice for solving problems having two or more (often conflicting) objectives (the so-called multi-objective optimization problems). This area, known as EMOO (Evolutionary Multi-Objective Optimization) has had an important growth in the last 20 years, and several people (particularly newcomers) get the impression that it is now very difficult to make contributions of sufficient value to justify, for example, a PhD thesis. However, a lot of interesting research is still under way. In this talk, we will review some of the research topics on evolutionary multi-objective optimization that are currently attracting a lot of interest (e.g., handling many objectives, hybridization, indicator-based selection, use of surrogates, etc.) and which represent good opportunities for doing research. Some of the challenges currently faced by this discipline will also be delineated.

#### Biography



Carlos Artemio Coello Coello received a PhD in Computer Science from Tulane University (in the USA) in 1996. His PhD thesis was one of the first in a field which is now called “evolutionary multiobjective optimization”. He currently has over 450 publications which report over 34,000 citations in Google Scholar (his h-index is 74).

Dr. Coello has been a Senior Research Fellow in the Plymouth Engineering Design Centre (in England) and a Visiting Professor at DePauw University (in the USA). He is currently full professor with distinction (Investigador Cinvestav 3F) at the Computer Science Department of CINVESTAV-IPN in Mexico City, Mexico.

He currently serves as associate editor of several journals, including “IEEE Transactions on Evolutionary Computation”, “Evolutionary Computation”, “Journal of Heuristics”, “Pattern Analysis and Applications”, “Applied Soft Computing” and “Computational Optimization and Applications”.

He has received several national awards, including the “National Research Award” from the Mexican Academy of Science (in 2007), the “Medal to the Scientific Merit” from Mexico City’s Congress, the “Ciudad Capital: Heberto Castillo 2011 Award” in Basic Science, the “2012 Scopus Award” (Mexico’s



edition), and the “2012 National Medal of Science in Physics, Mathematics and Natural Sciences” from Mexico’s Presidency (this is the most important award that a scientist can receive in Mexico). He has also received several international awards, including the prestigious “2013 IEEE Kiyoo Tomiyasu Award” and the “2016 Third World Academy of Sciences (TWAS) Award in Engineering Sciences”. Since January 2011, he is an IEEE Fellow for his “contributions to multi-objective optimization and constraint-handling techniques”.

## **Keynote Speaker 2**

### **Fuzzy Transfer Learning for Prediction and Decision Making**

**Professor Jie Lu**

*University of Technology Sydney*

#### **Abstract**

This presentation highlights the value of fuzzy transfer learning methods and related algorithms for handling complex prediction problems in rapidly-changing data distribution and data-shortage situations. It provides a framework for utilizing previously-acquired knowledge to predict new but similar problems quickly and effectively by using fuzzy set techniques. It systematically presents developments in fuzzy set-based transfer learning methods for prediction, including fuzzy transfer learning-based prediction framework, fuzzy domain adaptation, fuzzy cross-domain adaptation, and in particular, cross-domain adaptive fuzzy inference system, and their respective applications in prediction and decision support. This presentation demonstrates the successful use of fuzzy techniques in facilitating the incorporation of approximation and expressiveness of data uncertainties within knowledge transfer, machine learning and data-driven decision support systems.

#### **Biography**



Distinguished Professor Jie Lu is an internationally established scientist in the areas of decision support systems, fuzzy transfer learning, concept drift, recommender systems, prediction and early warning systems. She is the Associate Dean in Research Excellence in the Faculty of Engineering and Information Technology at the University of Technology Sydney. She is also the Director of the Centre for Artificial Intelligence (CAI). She has published six research books and more than 400 papers in refereed journals and conference proceedings. She has won eight Australian Research Council (ARC) discovery grants and 10 other research grants in the last 15 years. She serves as Editor-In-Chief for Knowledge-Based Systems (Elsevier) and as Editor-In-Chief for International Journal on Computational Intelligence Systems (Atlantis), has delivered 15 keynote speeches at international conferences, and has chaired 10 international conferences. She is an ARC panel member (2016-2018).