UK Workshop on Computational Intelligence

UKCI 2015
University of Exeter
7th – 9th September 2015
Organising Committee

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University of Exeter

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Shengxiang Yang, De Montfort University
Xiao-Jun Zeng, University of Manchester
Jie Zhang, Newcastle University
Shang-Ming Zhou, Swansea University
Welcome

On behalf of the UKCI 2015 organising committee, I would like to extend to you a very warm welcome to the UKCI 2015 workshop at the University of Exeter. Exeter has a long history of involvement with computational intelligence teaching and research, and so it is a privilege to welcome researchers from such a wide variety of fields.

The three days promise to be a stimulating combination of paper presentations and keynote talks from speakers across the spectrum of computational intelligence. The talks are intended to foster dialogue and debate - we hope you’ll find the topics thought provoking.

I would like to thank the organising committee for their efforts, as well as those of the programme committee who have reviewed the submitted papers and the organisers of our special sessions, all of whom have worked extremely hard to make this event a great success.

This programme contains a variety of information, including maps and timetables, as well as a complete listing of the papers that will be presented during the workshop. If you have any questions, please don’t hesitate to ask one of the local organising staff.

Professor Richard Everson
UKCI 2015 Conference Chair

Conference Timetable at a Glance

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Keynote Talks

Alberto Arribas  
Met Office  
The Met Office Informatics Lab

The Met Office Informatics Lab is a new division created in 2015 at the United Kingdoms National Weather Service. The Lab combines software engineers, scientists and designers with the mission of making environmental science and data useful. We achieve this through innovation, new technologies and experimentation so we can rapidly move from concepts to working prototypes.

In this talk members of the Lab will present our approach and latest prototypes, including interactive applications to facilitate manipulation of and immersion in big data... we are never short of data: the Met Office owns one of the biggest supercomputers in the world and we generate more than 30TB of data from operational forecasts every day.

Magnus Rattray  
University of Manchester

Modelling gene expression with Gaussian processes

We are developing probabilistic methods for studying gene expression and its regulation. Gene expression is the process whereby genes are transcribed from DNA into messenger RNA and subsequently into proteins through a series of highly regulated cellular processes. We are building models of the kinetic processes regulating the production of mRNA using time course data from high-throughput genomic technologies. We use non-parametric models called Gaussian processes to represent time-varying concentrations or activities and we integrate these non-parametric models with simple mechanistic difference or differential equation models. Parameter estimation and model-based prediction is carried out using Bayesian inference techniques. We use these models to help understand the rate-limiting steps in gene expression and how they are regulated.

Emma Hart  
Edinburgh Napier University

Lifelong Learning for Optimisation

The previous two decades have seen significant advances in meta-heuristic and hyper-heuristic optimisation techniques that are able to quickly find optimal or near-optimal solutions to problem instances in many combinatorial optimisation domains. Despite many successful applications of both these approaches, some common weaknesses exist in that if the nature of the problems to be solved changes over time, then algorithms needs to be periodically re-tuned. Furthermore, many approaches are likely to be inefficient, starting from a clean slate every time a problem is solved, therefore failing to exploit previously learned knowledge.

In contrast, in the field of machine-learning, a number of recent proposals suggest that learning algorithms should exhibit life-long learning, retaining knowledge and using it to improve learning in the future. Looking to nature, we observe that the natural immune system exhibits many properties of a life-long learning system that could be computationally exploited. I will give a brief overview of the immune system, focusing on highlighting its relevant computational properties and then show how it can be used to construct a lifelong learning optimisation system. The system is shown to adapt to new problems, exhibit memory, and produce efficient and effective solutions when tested in both the bin-packing and scheduling domains.
Monday 7th September 2015

Session 1 - Special Session, “Data Science and Heuristic Optimisation”

09:30-10:30, Chair: Ed Keedwell. Organiser: Shahriar Asta & Ender Özcan.

Improving Performance of a Hyper-heuristic Using a Multilayer Perceptron for Vehicle Routing

Raras Tyasnurita, Ender Özcan, Shahriar Asta and Robert John

A hyper-heuristic is a heuristic optimisation method which generates or selects heuristics (move operators) based on a set of components while solving a computationally difficult problem. Apprenticeship learning arises while observing the behaviour of an expert in action. In this study, we use a multilayer perceptron (MLP) as an apprenticeship learning algorithm to improve upon the performance of a state-of-the-art selection hyper-heuristic used as an expert, which was the winner of a cross-domain heuristic search challenge (CHeSC 2011). We collect data based on the relevant actions of the expert while solving selected vehicle routing problem instances from CHeSC 2011. Then an MLP is trained using this data to build a selection hyper-heuristic consisting of a number classifiers for heuristic selection, parameter control and move acceptance. The generated selection hyper-heuristic is tested on the unseen vehicle routing problem instances. The empirical results indicate the success of MLP-based hyper-heuristic achieving a better performance than the expert and some previously proposed algorithms.

Local Optima Suppression Search in Mixed Order Hyper Networks

Kevin Swingler

High order Hopfield networks, known as Mixed Order Hyper Networks (MOHNs) may be trained to represent any fitness function so that the attractor states of the network are local optima in the fitness function. These attractors are equivalent to the stored memories of a content addressable memory and their recall represents possible solutions to the constraint satisfaction task encoded by the fitness function. Finding the global optimum in such a network can be difficult if there are many local optima, particularly if the basins of attraction around those local optima are large. This paper proposes Local Optima Suppression Search (LOSS) as a method for removing local optima from a Hopfield network or MOHN as a way of allowing a random restart hill climbing algorithm to avoid any local optima it has visited before. Experimental results show that LOSS is capable of finding the global optimum in test fitness functions significantly faster than other well known methods.

Machine Learning and Statistical Approaches to Classification - A Case Study

Imo Eyoh and Robert John

The advent of information technology has led to the proliferation of data in disparate databases. Organisations have become data rich but knowledge poor. Users need efficient analysis tools to help them understand their data, predict future trends and relationships and generalise to new situations in order to make proactive knowledge-driven decisions in a competitive business world. Thus, there is an urgent need for techniques and tools that intelligently and automatically transform these data into useful information and knowledge for effective decision making. Data mining is considered to be the most appropriate technology for addressing this need. Datamining is the process of extracting or “mining” knowledge from large amounts of data. Regression analysis and classification are two datamining tasks used to predict future trends. In this study, we investigate the behaviour of a statistical model and three machine learning models (artificial neural network, decision tree and support vector machine) on a large electricity dataset. We evaluate their predictive abilities based on this dataset. Results show that machine learning models, for this real world dataset, outperform statistical regression while artificial neural network outperforms support vector machine and decision tree in the classification task. In terms of comprehensibility, decision tree is the best choice. Although not definitive this research indicates that certainly these machine learning methods are an alternative to regression with certain datasets.
Session 2 - Multi-objective Optimisation

11:00-12:20, Chair: Jonathan Fieldsend.

Approximating Multiobjective Optimization Problems with Complex Pareto Fronts  
*Shouyong Jiang and Shengxiang Yang*

The main goal of multiobjective optimization is to achieve a set of well-converged and evenly-distributed Pareto optimal points. While evolutionary algorithms have been reported to converge well, their distribution performance might not be as uniform as we expected, especially when the problems to be optimized involve complex Pareto fronts. In this paper, with the aid of a set of uniformly-distributed reference points, multiobjective optimization problems (MOPs) can be handled by minimizing least reference distances (LRD), which measure the proximity of solutions to their nearest reference points. This way, the uniformity of approximated solutions is implicitly controlled by the reference point set, and convergence is in the charge of LRD. The proposed LRD algorithm (LRDA) is tested and compared with several popular algorithms on a number of old and newly-developed MOPs that have complex Pareto fronts, showing that this method is very promising to obtain evenly-distributed Pareto optimal points for the problems considered in this paper.

A Fast Strength Pareto Evolutionary Algorithm Incorporating Predefined Preference Information  
*Shouyong Jiang and Shengxiang Yang*

Strength Pareto Evolutionary Algorithm 2 (SPEA2) has achieved great success for handling multiobjective optimization problems. However, it has been widely reported that SPEA2 gets subjected to a huge amount of computational effort while pursuing a good distribution of approximated solutions. This paper explores a new way to keep the good properties of SPEA2 and reduce its high computational burden simultaneously, with the aid of predefined preference information. By incorporating preference information, the proposed fast SPEA (FSPEA) can efficiently perform individuals’ density estimation and environmental selection, thus speeding up the whole running time of the evolution process. Empirical studies show that the proposed FSPEA algorithm can obtain very competitive performance on a number of multiobjective test problems considered in this paper.

Surrogate-Based Multiobjective Optimization: ParEGO Update and Test  
*Cristina Cristescu and Joshua Knowles*

We consider ParEGO, a well-known algorithm in the Evolutionary Multiobjective Optimization (EMO) community, and make improvements to the implementation itself and to some of the underlying algorithm components. ParEGO is a surrogate-based multiobjective optimization algorithm based on the Kriging/DACE model, designed specifically for problems with expensive evaluation functions. First described in 2006, it has been successful in empirical comparison studies and real-world applications (e.g., in water network design and iterative experimentation) since its release, but its code relies on now outdated matrix routines, which we here replace by more modern libraries. The code is also ported to GPU for further acceleration. We also add options to the ParEGO algorithm itself. Originally limited to runs of up to about 250 function evaluations (due to the heavy computational cost of some matrix operations on the full search trace), we now include methods for discarding (or ‘forgetting’) selected previous search points. We find that the pure implementation updates reproduce the performance of the original ParEGO release across a suite of benchmark problems; further, the algorithmic changes enable scaling up of ParEGO runs (i.e., no. generations) without significant loss of accuracy of the model in tests of up to 500 evaluations. The project’s code is now available for use by the EMO community and its uptake in applications with expensive functions is encouraged.

Multi-objective Differential Evolution with Helper Functions for Constrained Optimization  
*Tao Xu and Jun He*

Solving constrained optimization problems by multiobjective evolutionary algorithms has scored tremendous achievements in the last decade. Standard multi-objective schemes usually aim at minimizing the objective function and also the degree of constraint violation simultaneously. This paper proposes a new multi-objective method for solving constrained optimization problems. The new method keeps two standard objectives: the original objective function and the sum of degrees of constraint violation. But besides them, four more objectives are added. One is based on the feasible rule. The other three come from the penalty functions. This paper conducts an initial experimental study on thirteen benchmark functions. A simplified version of CMODE is applied to solving multi-objective optimization problems. Our initial experimental results confirm our expectation that adding more helper functions could be useful. The performance of SMODE with more helper functions (four or six) is better than that with only two helper functions.
Session 3 - Image Analysis

14:30-15:30, Chair: Jacqueline Christmas.

Use of Possibility-Probability Distribution for Computational Evaluation of Chinese Calligraphy
Jiamin Ge, Fei Chao, and Changle Zhou

Recently, robotic calligraphy becomes a popular research topic. Therefore, a computational calligraphy evaluation system is required to access the quality of robotic writings. This paper applies three types of feature rules, derived from Chinese calligraphy theories, to extract features of Chinese characters from Chinese Calligraphy textbooks. Then, the Possibility-Probability Distribution method deals with these extracted features, so as to obtain the feature distribution of quality handwriting characters. The Possibility-Probability Distribution method uses the extracted features to automatically build an interior-outer-set computational model based on information diffusion theory. When the computational model is established, each Chinese character, written by a robot, is also extracted to three features; then, the computational model estimates each character’s evaluation value. The experimental results demonstrate that the proposed method successfully produces an interior-outer set computational model for Chinese calligraphy. In particular, the model is able to generate an evaluation result for each character written by a robot system. To check the validation of the computational model, these characters are also evaluated by human experts. The comparison shows that the evaluation results of human experts are very similar to that of the computational model.

Detecting, Tracking and Identifying Small Animals in Video Sequences
Atchara Namburi, Richard Everson and Jacqueline Christmas

In this paper we propose a method for locating, tracking and identifying small animals in colour video sequences. We combine a Support Vector Machine (SVM) with the Visual Background Extractor (ViBe) method to classify parts of individual frames as foreground or background. This combination benefits from the accuracy provided by the SVM and the speed of ViBe, and results in a foreground probability map for each frame. We use sequential Bayesian estimation to track regions of high probability which we assume to be the animal. Finally, we identify the tracked animal by using SURF to match the animal’s tag to a set of reference images. We demonstrate good results on a number of videos, comparing the tracks and identification produced by this method with the manually extracted truth.

Facial Recognition in an Unconstrained Environment for Attendance Monitoring
Justin N. Worsey and Richard M. Everson

Traditional paper based attendance monitoring systems are time consuming and susceptible to both error and data loss. Where technical advances have attempted to solve the problem they tend to improve only small portions i.e. confidence that data has been collected satisfactory can be very high but technology can also be difficult to use, time consuming and impossible especially if the overall system is down. Facial recognition has the potential to resolve most monitoring problems. It is passive, easy and inexpensive to utilise; and if supported by a human safeguard, it can be very reliable. We propose and evaluate a strategy to monitor lecture attendance using images captured by cheap web cams in an unconstrained environment. We use a traditional pipeline in which faces are automatically detected and aligned to a standard coordinate system before extracting Scale Invariant Feature Transform (SIFT) and Local Binary Pattern (LBP) features for classification. A greedy algorithm is used to match captured faces to reference images and we show how the reference set may be augmented over time. Performance is evaluated on images captured from a small lecture series over 10 weeks. It is evident that performance improves during the series as new reference material is included within the training data. This correlation demonstrates that the success of the system is determined not only by the on-going capturing process but also the quality and variability of the initial training data. Whilst the system is capable of reasonable success, our experiment shows that it also yields an unacceptably high false positive rate and cannot be used in isolation. This is because it attempts to map other attendee’s lecture data to those it was unable to capture creating the mistaken belief that non-attendees attended as the system is unable to distinguish this.

Session 4 - Artificial Neural Networks

16:00-17:20, Chair: Richard Everson.

Adapting Resilient Propagation for Deep Learning
Alan Mosca and George D. Magoulas

The Resilient Propagation (Rprop) algorithm has been very popular for backpropagation training of multilayer feed-forward neural networks in various applications. The standard Rprop however encounters difficulties in the context of deep neural networks as typically happens with gradient-based learning algorithms. In this paper, we propose...
a modification of the Rprop that combines standard Rprop steps with a special drop out technique. We apply the method for training Deep Neural Networks as standalone components and in ensemble formulations. Results on the MNIST dataset show that the proposed modification alleviates standard Rprop’s problems demonstrating improved learning speed and accuracy.

Comprehending the Pilot Environmental Performance Index 2006
Tatiana Tambouratzis, Angeliki Mathioudaki and Kyriaki Bardi

First put forward in 2006 as the successor of the Environmental Sustainability Index (ESI), and with a revised version coming out every other year to this day, the Environmental Performance Index (EPI) constitutes the prevailing indicator of sustainable development currently in use. It is, thus, of great importance to comprehend the methodology used for creating the EPI values so as to be able (a) to reproduce the EPI values of the participating countries, and consequently (b) to accurately predict the EPI values of other (non-participating) countries of interest for which compatible data exist. The dataset used for the 133 countries that participated in the original (Pilot) EPI of 2006 is employed to this end. Complementing the initial - and only partly successful - attempt to derive the 133 Pilot EPI values of the participating countries (i) by duplicating the four-step hierarchy reported in the relevant literature, and (ii) directly from the Raw Data, the remaining scenarios (comprising elementary as well as compound steps of the EPI hierarchy) are exhaustively investigated. The EPI values derived from the application of the most accurate approximation method - selected among polynomials of various degrees and artificial neural networks of the general regression neural network (GRNN) architecture - for each step (in turn) of every scenario are compared with the reported EPI values; additionally, 10-fold cross-validation is used for determining the generalisation capability of the various scenarios. In all cases, the Pilot EPI methodology is found only partly reproducible, with sometimes significant deviations observed between the reported and the reproduced Pilot EPI values - and, consequently, ranks - of the participating countries. As a result, the potential of fully comprehending the means of deriving the Pilot EPI values is put into question.

Hidden Potential Learning to Improve Generalization Performance in Information-Theoretic Neural Networks
Ryotaro Kamimura

The present paper aims to estimate the potentiality of hidden neurons to be used for improving generalization performance. The information-theoretic methods have been so far applied extensively to neural networks. However, the computational complexity and excessive acquisition of information content have made it difficult to improve generalization performance and to be applied to large-scaled data sets. Thus, it is urgently needed to develop a method to reduce the excessive information and to simplify the computational procedures as much as possible. In this context, a new measure of information is proposed with the simplified computational procedures, focusing not on storing information but on the potentiality of the information for many different situations. The potentiality means hidden neurons’ ability to respond appropriately to as many situations as possible, which can be approximated by the variance of hidden neurons. The potentiality method was applied to two data sets, namely, the artificial and symmetric data and the spam data sets. In the symmetric data set, the potential method extracted the symmetric property of the data set only with one hidden neuron. In the spam data set, only one hidden neuron showed the higher potentiality with better generalization performance.

Tuesday 8th September

Session 5 - Fuzzy Logic
09:30-10:30, Chair: Antony Galton.

Intelligent Home Heating Controller Using Fuzzy Rule Interpolation
Jie Li, Longzhi Yang, Hubert P. H. Shum, Graham Sexton and Yao Tan

The reduction of domestic energy waste helps in achieving the legal binding target in the UK that CO2 emissions needs to be reduced by at least 34% below base year (1990) levels by 2020. Space heating consumes about 60% of the household energy consumption, and it has been reported by the Household Electricity Survey from GOV.UK, that 23% of residents leave the heating on while going out. To minimise the waste of heating unoccupied homes, a number of sensor-based and programmable controllers for central heating system have been developed, which can successfully switch off the home heating systems when a property is unoccupied. However, these systems cannot successfully efficiently preheat the homes before occupants return without manual inputs or leaving the heating on unnecessarily longer than needed, which has limited the wide application of such devices. In order to address this limitation, this paper proposes a smart home heating controller, which enables a home heating system to efficiently preheat the home by successfully predicting the users’ home time. In particular, residents’ home time is calculated by employing fuzzy rule interpolation, supported by users’ historic and current location data from
portable devices (commonly smart mobile phones). The proposed system has been applied to a real-world case and promising result has been generated.

**Representation of Fuzzy Concept Lattices**
*Trevor Martin*

Fuzzy formal concept analysis is a useful aid for formalising communication between machines and human experts, but can suffer from computational overheads. We present two related ways in which a fuzzy formal context can be converted to a crisp table. This enables existing software and tools to be adapted for fuzzy use without any change in the underlying code.

**Fuzzy Expert System on Android Platform for Course Registration Decision Recommendation**
*Walid Mohamed Aly and Amir Serry Selim*

In every semester, college students face issues in deciding whether or not to register an optional course. Aiming to help students to find a correct decision in short time and effort, this research designs and implements an expert fuzzy recommendation system. The proposed system operates as an Android mobile application. The proposed system suggests a model that uses six variables as inputs; these inputs are fuzzified and entered to a fuzzy inference system. Result of the inference system will be defuzzified to a crisp number representing a percentile recommendation for registering the course. The proposed system was built and tested for validation with real input from real students. The experimental results showed that a system have an average root mean square error of 6.64% and thus can be used successfully to identify the possibility that registering for the course is a correct decision.

**Session 6 - NCAF**
11:00-12:20, Chair: Ian Nabney. Organiser: Ian Nabney.

**Session 7 - Special Session, “From Genetic Programming to Genetic Improvement Programming: Standing on the Shoulders of Giants”**
14:30-16:00, Chair: John Woodward. Organiser: John Woodward.

**Solving Even Parity Problems Using Carbon Nanotubes**
*Maktuba Mohid and Julian F. Miller*

Natural evolution has been exploiting the properties of materials ever since life first appeared. Evolution-in-materio (EIM) is a technique that is inspired by this. In EIM, computer-controlled evolution is used to directly manipulate or tune the properties of physical materials so that computational problems can be solved. The thinking behind this is that materials have many internal physical interactions that could be exploited by computer-controlled evolution to solve a computational problem. We show that using a purpose-built hardware platform called Mecobo, it is possible to evolve voltages and signals applied to a mixture of carbon nanotubes and a polymer to build Boolean even-parity functions. We also investigate the merits of different ways of mapping the problem inputs to physical variables that can be applied to the material and different ways of mapping sampled physical outputs from the material to computational outputs. This is the first time that even-parity problems have been solved with evolution-in-materio. We compare the results with a well-known and highly effective form of genetic programming, called Cartesian Genetic Programming, with encouraging results.

**Transfer Learning Approach for Financial Applications**
*Cosmin Stamate, George D. Magoulas and Michael S.C. Thomas*

Artificial neural networks learn how to solve new problems through a computationally intense and time consuming process. One way to reduce the amount of time required is to inject preexisting knowledge into the network. To make use of past knowledge, we can take advantage of techniques that transfer the knowledge learned from one task, and reuse it on another (sometimes unrelated) task. In this paper we propose a novel selective breeding technique that extends the transfer learning with behavioural genetics approach proposed by Kohli, Magoulas and Thomas (2013), and evaluate its performance on financial data. Numerical evidence demonstrates the credibility of the new approach. We provide insights on the operation of transfer learning and highlight the benefits of using behavioural principles and selective breeding when tackling a set of diverse financial applications problems.

**A Model for Foraging Ants, Controlled by Spiking Neural Networks and Double Pheromones**
*Cristian Jimenez-Romero, David Sousa-Rodrigues, Vitorino Ramos and Jeff Johnson*

A model of an Ant System where ants are controlled by a spiking neural circuit and a second order pheromone
A neural circuit is trained for individual ants and subsequently the ants are exposed to a virtual environment where a swarm of ants perform a resource foraging task. The model comprises an associative and unsupervised learning strategy for the neural circuit of the ant. The neural circuit adapts to the environment by means of classical conditioning. The initially unknown environment includes different types of stimuli representing food (rewarding) and obstacles (harmful) which, when they come in direct contact with the ant, elicit a reflex response in the motor neural system of the ant: moving towards or away from the source of the stimulus. The spiking neural circuit of the ant is trained to identify food and obstacles and move towards the former and avoid the latter. The ants are released on a landscape with multiple food sources where one ant alone would have difficulty harvesting the landscape to maximum efficiency. In this case the introduction of a double pheromone mechanism (positive and negative reinforcement feedback) yields better results than traditional ant colony optimization strategies. Traditional ant systems include mainly a positive reinforcement pheromone. This approach uses a second pheromone that acts as a marker for forbidden paths (negative feedback). This blockade is not permanent and is controlled by the evaporation rate of the pheromones. The combined action of both pheromones acts as a collective stigmergic memory of the swarm, which reduces the search space of the problem. This paper explores how the adaptation and learning abilities observed in biologically inspired cognitive architectures is synergistically enhanced by swarm optimization strategies. The model portrays two forms of artificial intelligent behaviour: at the individual level the spiking neural network is the main controller and at the collective level the pheromone distribution is a map of the solution which emerges from the colony. The presented model is an important pedagogical tool as it is also an easy to use library that allows access to the spiking neural network paradigm from inside Netlogo - a language used mostly in agent based modelling and experimentation with complex systems.

Markov Chain Selection Hyper-heuristic for the Optimisation of Constrained Magic Squares

Ahmed Kheiri and Ed Keedwell

A square matrix of size $n \times n$, containing each of the numbers $(1, \ldots, n^2)$ in which every row, column and both diagonals has the same total is referred to as a magic square. The problem can be formulated as an optimisation problem where the task is to minimise the deviation from the magic square constraints and is tackled here by using hyper-heuristics. Hyper-heuristics have recently attracted the attention of the artificial intelligence, operations research, engineering and computer science communities where the aim is to design and develop high-level strategies as general solvers which are applicable to a range of different problem domains. There are two main types of hyper-heuristics in the literature: methodologies to select and to generate heuristics and both types of approaches search the space of heuristics rather than solutions. In this study, we describe a Markov chain selection hyper-heuristic as an effective solution methodology for optimising constrained magic squares. The empirical results show that the proposed hyper-heuristic is able to outperform the current state-of-the-art method.

Wednesday 9th September

Session 8 - Evolutionary Computation & Recommender Systems

09:30-10:30, Chair: David Walker.

Derivative-Free Design Optimization of Chemical Processes by a Memetic Algorithm

Maren Urselmann, Christophe Foussette, Tim Janus, Stephen Tlatlik, Axel Gottschalk, Michael Emmerich, Thomas Bäck and Sebastian Engell

In this contribution a derivative-free memetic algorithm (MA) for the design optimization of chemical processes is introduced. The MA is a combination of an evolution strategy (ES) for the global optimization of the design decisions and a derivative-free optimization (DFO) method for the local optimization of the continuous design variables with fixed discrete decisions. The MA is coupled to the commercially available process simulation software Aspen Plus which does not provide derivatives. The focus of this contribution lies on a procedure for the definition of termination criteria for the DFO method to get a well-balanced MA in terms of the interplay between the global and the local search. The proposed procedure is applied to an industrially relevant case study. Results of the MA which is successfully applied to the case study with the new termination criteria are presented.

A Smart Calendar System Using Multiple Search Techniques

Jake Cowton and Longzhi Yang

Calendars are essential for professionals working in industry, government, education and many other fields, which play a key role in the planning and scheduling of people’s day-to-day events. The majority of existing calendars only provide insight and reminders into what is happening during a certain period of time, but do not offer any actual scheduling functionality that can assist users in creating events to be optimal to their preferences. The
burden is on the users to work out when their events should happen, and thus it would be very beneficial to develop a tool to organise personal time to be most efficient based on given tasks, preferences, and constraints, particularly for those people who have generally very busy calendars. This paper proposes a smart calendar system capable of optimising the timing of events to address the limitations of the existing calendar systems. It operates in a tiered format using three search algorithms, namely branch and bound, Hungarian and genetic algorithms, to solve different sized problems with different complexity and features, in an effort to generate a balanced solution between time consumption and optimisation satisfaction. Promising results have shown in the experimentation in personal event planning and scheduling.

Semantics based Approach for Efficient Web Page Recommendations
Saloni Aggarwal and Veenu Mangat

Large amounts of data accumulate every second on web because of rapid increase in the usage of web. The research industry is focusing on exploiting the benefits of the usage data by obtaining knowledge from the web logs. The information present in the logs includes the links clicked by the user, the order of visiting the web pages and the time that each web page was stayed on, etc. Web logs are mined in almost every field today to obtain benefits like increasing sales and revenue for online businesses, studying the browsing behavior of website, improvising the layout of website, offering personalized recommendations to users and much more. Almost every website employs a recommender system in order to offer product/service recommendations according to user interest. This eventually increases the probability of the user buying the service/product. This paper provides a comprehensive study on how semantic knowledge of website can be used along with web usage in order to design an efficient recommender system. This paper employs a novel technique based on hidden markov chain for the conceptual prediction and achieves substantial performance of recommender system in terms of precision and satisfaction parameters.

Session 9 - Applied Computational Intelligence
11:00-12:20, Chair: Zena Wood.

Intelligent Prediction of Student Examination Scores
Zhenpeng Li, Changjing Shang and Qiang Shen

The prediction of students academic performance is important to both educational institutions and students themselves for a variety of reasons. Many approaches have been developed to predict students exam scores as an indicator of their future academic performance. However, the overuse of different types of indicative attribute has led to the creation of complicated score predicting methods which may be difficult to implement and whose results may be difficult to interpret. This paper proposes a novel approach to predicting students exam scores using only common and limited attributes, such as assignment marks and class test marks, which are readily obtainable and easily interpretable. The proposed method works by employing simple clustering, classification and regression mechanisms within an integrated framework, which is convenient to implement. Comparative experimental investigations are carried out, demonstrating the potential of the proposed work in producing more intuitive and interpretable results.

Hendrix: A Conversational Intelligent Tutoring System for Java Programming
Mike Holmes, Annabel Latham, Keeley Crockett, Cathy Lewin and James O’Shea

This paper proposes a novel generic architecture for a conversational intelligent tutoring system named Hendrix. Hendrix mimics a human tutor by guiding a learner through a given knowledge domain using natural language. Hendrix converses with a learner to identify gaps in knowledge through questioning, expanding the curriculum when gaps in knowledge are identified. Hendrix supports learners by detecting questions and providing definitions and examples. Hendrix novel architecture uses a graph of concepts to dynamically generate tutorials. Hendrix uses both syntactic and semantic language analysis to extract and match information from learner utterances. Hendrix’ two loop algorithm is dependent on identifying the short term goal a learner in each conversational turn. In a pilot study, Hendrix correctly classified the utterance type of 91% of input sentences, marked 94.5% of question answers correctly, and was rated 3.93 out of 5 for user satisfaction.

Computational Intelligence Techniques for Biometrics and Forensics: A Survey
Azliza Mohd Ali and Plamen P. Angelov

In this paper, biometric and forensic techniques are reviewed from the point of view of the application of computational intelligence to them. Forensics is a branch of science that is used to solve questions related to crimes. Biometrics is an emerging technology that provides the identification and verification of people. Computational intelligence can be applied to biometrics and forensics to reduce the process of investigation and analysis of the crime cases. In this paper, we critically review the computational intelligence techniques applied to biometrics.
and forensics. We propose the integration of heterogeneous data using different computational intelligence techniques such as combining autonomous learning systems with anomaly detection, fuzzy and neuro-fuzzy systems, clustering and classification to assist the forensic investigator in solving the cases. We also discuss a case study of a virtual forensic application based on the VAST2014 challenge. In our future research, we will develop more specialized techniques that can be applied to biometrics and forensics.

Implication of Non-stationarity in Single-trial Detection Performance of Event-related Potentials
Hubert Cecotti and Anthony Ries

The electroencephalographic (EEG) signal is known to fluctuate over time due to ongoing brain activity related to various tasks that a subject can do or think of. For this reason, it is typically expected in Brain-Computer Interface (BCI) that the extracted brain responses will be non-stationary. The non-stationarity of the EEG signal can have an impact on the performance of the system during long sessions. In addition, BCI systems should aim at reducing the calibration procedure or include the calibration stage during the test phase in an invisible manner. In this paper, we propose to evaluate through different cross-validation approaches to what extent the non-stationarity of the EEG signal has an impact on single-trial detection, and if this effect can be taken into consideration for optimizing the design of BCI based on event-related potentials detection with applications for the triage of images during rapid serial visual presentation (RSVPs) tasks. We use the data obtained from sixteen healthy subjects performing an RSVP task where participants had to count a particular class of images to evaluate single-trial detection performance. The results support the conclusion that the crossvalidation technique, i.e. the order of the examples in the training database, has an impact on the performance, and that existing labeled trials that are set regularly during the test phase can provide a novel way to avoid a calibration procedure in particular BCI settings.

Session 10 - Machine Learning
14:30-15:30, Chair: Richard Everson.

Identifying Candidate Drugs for Repositioning by Graph based Modeling Techniques based on Drug Side-effects
Ken McGarry, Nicole Slater and Angela Amanning

Drug development is a lengthy and highly costly endeavor, often with limited success and high risk. The objective of drug repositioning is to apply existing drugs to different diseases or medical conditions than the original target, and thus alleviate to a certain extent the time and cost expended. The area of drug repositioning is a suitable application area for computational intelligence because numerous online databases containing technical information on drug targets, protein interactions, sideeffects and biological knowledge are freely available. Thus in silico analysis can be used as a useful first stage to screen potential candidate drugs for possible redeployment. This paper takes the position that drugs with side-effects are potential candidates for use elsewhere, it is a case of identifying potential diseases that may benefit from this re-deployment. The system uses graph based computational techniques to analyze drugs with known sideeffects and compares the proteins involved in these side-effects with proteins known to be identified with other diseases. Our intention is to find potential candidates for treating Alzheimer’s disease.

Temporal Feature Selection for Optimizing Spatial Filters in a P300 Brain-Computer Interface
Hubert Cecotti and Bertrand Rivet

For the creation of efficient and robust Brain-Computer Interfaces (BCIs) based on the detection of eventrelated potentials (ERPs) in the electroencephalogram (EEG), spatial filtering has been shown as being an important step for feature extraction and reduction. Current spatial filtering methods for ERP enhancement typically consider a global approach by enhancing the signal on a predefined time-segment that contains all the different ERP components, which can have different spatial distributions. Because several ERP components occur, it is likely that they have different neural sources, and require specific signal processing methods. We propose to use a spatial filtering method based on the maximization of the signal-to-signal plus noise ratio, and compare different approaches to determine the best time segment for optimizing the choice of the spatial filters. The evaluation was carried out on data recorded of ten healthy subjects during a P300 speller experiment. The results support the conclusion that spatial filters based on the global approach provide the best solution and outperform local and hybrid approaches.
Campus Facilities

The workshop will take place at the Innovation Centre, located on the University of Exeter’s Streatham Campus, a short walk from the city of Exeter.

Getting Here

- Exeter is well served by the M5 motorway, Exeter St. David’s mainline railway station and Exeter International Airport. Within the City there are frequent bus services and 6 further train stations. The University is a 15 minute (somewhat uphill) walk from St David’s station; alternatively taxis are available from the station. Visitors car parking is also available on campus if required.

Shops

- Market Place (Forum) open 08:00 – 18:00
- Student ship (Devonshire House) open 08:30 – 18:00

Banks

- Natwest (Forum) open 09:00 (09:30 Weds) – 16:30, includes free cashpoints
- Santander (Devonshire House) open 10:00 – 18:00 (17:00 Weds)

Cafes

- Costa Coffee (Forum) open 07:00 – 21:30
- La Touche (Building:One) open 08:00 – 17:00
- Innovation Centre Café open 08:00 – 15:00

Campus Security: 01392 723999

Exeter city centre is a 20 minute walk from campus