2021 IEEE CIS Summer School on Data-Driven Artificial/Computational Intelligence: Theory and Applications

Website

- https://sites.google.com/view/ss-ddaci/home?authuser=1

Time

- 23 - 26 August 2021, Virtual Event

Host institutions

- University of Exeter and University of Birmingham, UK

Venue

- Given the COVID-19 global pandemic, this summer school will be running in an online format. It will take place as part of the outreach activities of the Institute for Data Science and Artificial Intelligence (AI) at the University of Exeter and the Institute for Interdisciplinary Data Science and AI at the University of Birmingham. Both institutes are actively developing and fostering a culture of effective interactions for promoting data science and AI for addressing global challenges across disciplines.

General Chairs

- **Dr. Ke Li** (UKRI Future Leaders Fellow and Senior Lecturer in Computer Science, Department of Computer Science, University of Exeter, UK)
- **Dr. Leandro L. Minku** (Senior Lecturer in Computer Science, School of Computer Science, University of Birmingham, UK)

Organizing Committee Members

- **Dr. Fan Li** (PDRA, Department of Computer Science, University of Exeter, UK)
- **Dr. Jiangjiao Xu** (PDRA, Department of Computer Science, University of Exeter, UK)
- **Dr. Per Kristian Lehre** (Senior Lecturer in Computer Science, School of Computer Science, University of Birmingham, UK)
- **Dr. Rodrigo Soares** (Lecturer in Computer Science, Federal Rural University of Pernambuco, Brazil)

Attendance

- 223 registrants

Objectives

Data has been playing an ever-growing role in artificial/computational intelligence. Such role goes beyond its typical use in neural networks and learning systems, encompassing also evolutionary and other meta-heuristic optimization algorithms. The objective of this summer school is to provide a unique and vibrant platform for learning and experiencing the emerging methodologies and applications of artificial/computational intelligence highly related to data. It will offer keynotes, invited lectures, tutorials and discussion groups from high-profile UK and international experts. The summer school will target senior undergraduate, graduate students, post-doc, early career researchers and professionals from around the world who are willingly to deepen their skills in computational intelligence, in the field of artificial/computational intelligence. It will provide a unique opportunity for participants to 1)

learn about artificial/computational intelligence approaches and their applications; 2) interact with world-renowned experts in computational intelligence; and 3) communicate with experts and peers with a broad range of backgrounds to exchange ideas and form new collaborations.

Brief Profile of the Speakers

Prof. Shiping Wen

Time schedule: 9:00-10:00 BST on 23/08/2021

Title: Memristive Neuromorphic Computing: New Algorithmic Approaches to the Next Generation of AI

Abstract:
Artificial intelligence (AI) is one of the major developments of our time. The surge of deep learning over the past few years is transforming many aspects of how we do things. Yet, the algorithmic progress has brought critical challenges to today's computing architecture. Building upon transistors and CMOS technologies, the sequential processing carried out by classical computers in the context of deep learning leads to the problems of low energy efficiency.
Neuromorphic computing, which specifically mimics the human brain, provides a viable pathway to the evolution of AI. In particular, a novel nano-electronic technology, known as memristor, is considered as a key. Memristors have small size, analog storage, low power consumption and non-volatile characteristics, which are very suitable for modeling and implementing synapses. In this talk, I will explore the research and development of memristive neuromorphic computing, demonstrating how memristive neural networks can improve the performance of deep learning in a variety of settings. Furthermore, I will highlight the opportunities of developing the next generation of AI using memristive technologies.

Bio-sketch:
Prof. Shiping Wen received the M.Eng. degree in Control Science and Engineering, from School of Automation, Wuhan University of Technology, Wuhan, China, in 2010, and received the Ph.D degree in Control Science and Engineering, from School of Automation, Huazhong University of Science and Technology, Wuhan, China, in 2013. He is currently a Professor with the Australian Artificial Intelligence Institute (AAII) at University of Technology Sydney. His research interests include memristor-based neural network, deep learning, computer vision, and their applications in medical informatics et al. He was listed as a Highly Cited Researcher by Clarivate Analytics in 2018 and 2020, respectively. He received the 2017 Young Investigator Award of Asian Pacific Neural Network Association and 2015 Chinese Association of Artificial Intelligence Outstanding PhD Dissertation Award. He currently serves as Associate Editor for Knowledge-Based Systems, Neural Processing Letters, et al., and Leading Guest Editor for IEEE Transactions on Network Science and Engineering, Sustainable Cities and Society, et al.

Prof. Hao Wang

Time schedule: 10:15-10:45 BST on 23/08/2021

Title: Bayesian Optimization, Surrogate Modeling, and Their Applications to Real-World Problems

Abstract:
In this talk, I would like to walk you through a state-of-the-art paradigm of optimization algorithm - Bayesian Optimization (BO), which is extensively applied in various real-world scenarios, ranging from industrial optimization to hyperparameter tuning/automated configuration of machine learning models. Starting by recapping some basics of optimization theory, I will first introduce the basic building blocks of BO and demonstrate its working mechanism with intuitive explanations, followed by a summary of various software implementations and applications thereof. Afterward, I will address several critical aspects of BO's design - constraint handling and dealing with mixed-integer search variables, which are hugely impactful when applying BO in real-world problems. To show the theoretical work on BO, I will also cover a very basic introduction to its theoretical analysis. As BO heavily relies on a surrogate model of the real objective function to optimize, we shall discuss some common choices of surrogate models, including Gaussian Process Regression (GPR) and random forest, and how they help balance the exploration and exploitation of the search. Finally, to conclude the talk, I will point out the ongoing directions of researches on BO and suggest when/how to use it for your own problem.

Bio-sketch:
Dr. Hao Wang is employed as an assistant professor of computer science in Leiden University since September 2020. He obtained my Ph.D. (cum laude, supervisor: Prof. Thomas Bäck) at Leiden University in 2018, followed by two postdoctoral appointments: at Leiden University (2018.05 – 2019.12) and LIP6 (Laboratoire d'Informatique de Paris 6), Sorbonne University, France (2020.01 – 2020.08). He served as the proceedings chair for the PPSN 2020 conference and will be organizing the EMO (Evolutionary Multi-Objective Optimization) 2023 international conference as one of the general co-chairs. He was invited to give tutorials on benchmarking and performance analysis of stochastic optimization algorithms in training schools (2017.10, 2019.11) of COST Action CA151405 and on Bayesian optimization for the 5th International Winter School on Big Data. He received the best paper award at the PPSN (Parallel Problem Solving from Nature) 2016 conference for proposing new measures to understand the difficulties of multi-objective optimization problems.
He was also a best paper award finalist at the IEEE SMC (System, Man, and Cybernetics) 2017 conference for improving the convergence and robustness of Bayesian optimization. He designed an online self-switching optimization algorithm with my collaborators from Freiburg University and Sorbonne University, which won the NeurIPS (Neural Information Processing) 2020 competition on black-box optimization for machine learning. He led the development of a software platform: IOHprofiler for benchmarking stochastic optimizers and analyzing their performance.

Prof. Liang Feng

Time schedule: 13:00-14:00 BST on 23/08/2021

Title: Evolutionary Multi-Task Optimisation

Abstract:
Evolutionary algorithms (EAs) typically start the search from scratch by assuming no prior knowledge about the task being solved, and their capabilities usually do not improve upon past problem-solving experiences. In contrast, humans routinely make use of the knowledge learnt and accumulated from the past to facilitate dealing with a new task, which provides an effective way to solve problems in practice as real-world problems seldom exist in isolation. Similarly, practical artificial systems like optimizers will often handle a large number of

problems in their lifetime, many of which may share certain domain-specific similarities. This motivates the design of advanced optimizers which can leverage on what has been solved before to facilitate solving new tasks. In this talk, I will present recent advances in the field of evolutionary computation under the theme of evolutionary multi-task optimization via automatic knowledge transfer. Particularly, I will describe a general workflow of evolutionary multi-task optimization, which is followed by specific evolutionary multitasking algorithms for both continuous and combinatorial optimizations. Potential research directions towards advanced evolutionary multitasking design will also be covered.

Bio-sketch:
Liang Feng received the Ph.D degree from the School of Computer Engineering, Nanyang Technological University, Singapore, in 2014. He was a Postdoctoral Research Fellow at the Computational Intelligence Graduate Lab, Nanyang Technological University, Singapore. He is currently a Professor at the College of Computer Science, Chongqing University, China. His research interests include Computational and Artificial Intelligence, Memetic Computing, Big Data Optimization and Learning, as well as Transfer Learning. His research work on evolutionary multitasking won the 2019 IEEE Transactions on Evolutionary Computation Outstanding Paper Award. He is Associate Editor of the IEEE Computational Intelligence Magazine, IEEE Transactions on Emerging Topics in Computational Intelligence, Memetic Computing, and Cognitive Computation. He is also the founding Chair of the IEEE CIS Intelligent Systems Applications Technical Committee Task Force on “Transfer Learning & Transfer Optimization” and the PC member of the IEEE Task Force on “Memetic Computing”. He had co-organized and chaired the Special Session on “Memetic Computing” held at IEEE CEC’16, CEC’17, CEC’18, CEC’19, and the Special Session on "Transfer Learning in Evolutionary Computation" held at CEC’18, CEC’19, CEC’20, CEC’21.

Prof. Tim Menzies

Time schedule: 14:00-15:00 BST on 23/08/2021

Title: Software Engineering for AI (Mash Ups of Data Miners and Optimizers: A "DUO" Approach)

Abstract:
The more we use AI tools, the more we need to understand how they work, how they might fail, and how we can improve them. To that end, we propose a simple "DUO" model of data mining and optimziation: data mining chops up some space into regions and optimizers paint arrows between regions saying "please, go this way" or "danger, don't do that". In this combined approach, data mining and optimizers are two parts of a greater whole that acts like an agent leaning over the shoulder of an analyst that advises "ask this question next" or "ignore that problem, it is not relevant to your goals". Such agents can help us build "better" predictive models, where "better" can be either greater predictive accuracy or faster modeling time (which, in turn, enables the exploration of a wider range of options).
This talk presents a tutorial on this DUO approach and lists examples of DUO-in-action, from software engineering domains.

Bio-sketch:
Tim Menzies (IEEE Fellow, Ph.D., UNSW, 1995) is a full Professor in CS at North Carolina State University where he teaches software engineering, automated software engineering, and foundations of software science. He is the directory of the RAISE lab (real world AI for SE). that explores SE, data mining, AI, search-based SE, and open access science.

He is the author of over 280 referred publications and editor of three recent books summarized the state of the art in software analytics. In his career, he has been a lead researcher on projects for NSF, NIJ, DoD, NASA, USDA (funding totalling over 12 million dollars) as well as joint research work with private companies. For 2002 to 2004, he was the software engineering research chair at NASA's software Independent Verification and Validation Facility.
Prof. Menzies is the co-founder of the PROMISE conference series devoted to reproducible experiments in software engineering (http://tiny.cc/seacraft). He is an associate editor of IEEE Transactions on Software Engineering, Communications of the ACM, ACM Transactions on Software Engineering Methodologies, Empirical Software Engineering, the Automated Software Engineering Journal the Big Data Journal, Information Software Technology, IEEE Software, and the Software Quality Journal. In 2015, he served as co-chair for the ICSE'15 NIER track. He has served as co-general chair of ICSME'16 and co-PC-chair of SSBSE'17, and ASE'12. For more, see his vita (http://menzies.us/pdf/MenziesCV.pdf or his list of publications http://tiny.cc/timpubs) or his home page http://menzies.us.

Prof. Yaochu Jin

Time schedule: 9:00-10:00 BST on 24/08/2021

Title: Evolutionary Multi-objective Federated Neural Architecture Search

Abstract:
Federated learning is a powerful machine learning paradigm for privacy-preserving machine learning. In this talk, I am going to introduce a multi-objective approach to enhancing the performance of federated learning in terms of accuracy, communication efficiency and computational complexity. I'll start with a brief introduction to evolutionary multi-objective machine learning, followed by a presentation of two evolutionary multi-objective federated learning algorithms for optimizing the architecture of neural network models in federated learning, one for offline, and the other for real-time purposes. Finally, remaining research challenges will be outlined.

Bio-sketch:
Prof. Yaochu Jin received the B.Sc., M.Sc., and Ph.D. degrees from Zhejiang University, Hangzhou, China, in 1988, 1991, and 1996, respectively, and the Dr.-Ing. degree from Ruhr University Bochum, Germany, in 2001. He is currently a Distinguished Chair, Professor in Computational Intelligence, Department of Computer Science, University of Surrey, Guildford, U.K., where he heads the Nature Inspired Computing and Engineering (NICE) Group.
He was a "Finland Distinguished Professor" of University of Jyvaskyla, Finland, and "Changjiang Distinguished Visiting Professor", Northeastern University, China. In 2021, he was awarded the Alexander von Humboldt Professorship for Artificial Intelligence by the Federal Ministry of Education and Research, German. His main research interests include data-driven evolutionary optimization, evolutionary learning, trustworthy machine learning, and morphogenetic self-organizing systems.
Prof. Jin is presently the Editor-in-Chief of the IEEE TRANSACTIONS ON COGNITIVE AND DEVELOPMENTAL SYSTEMS and the Editor-in-Chief of Complex & Intelligent Systems. He is the recipient of the 2018 and 2021 IEEE Transactions on Evolutionary Computation Outstanding Paper Award, and the 2015, 2017, and 2020 IEEE Computational Intelligence Magazine Outstanding Paper Award. He was named by the Web of Science as "a

Global Highly Cited Researcher" in 2019 and 2020. He is a Member of Academia Europaea and Fellow of IEEE.

Dr. Per Kristian Lehre

Time schedule: 10:15-11:00 BST on 24/08/2021

Title: Bridging Learning and Evolution with Estimation of Distribution Algorithms

Abstract:
Estimation of Distribution Algorithms (EDAs) are a class of optimisation methods at the intersection of machine learning and evolutionary computation. They repeatedly sample search points from a probability distribution over the search space, and refine the probability distribution to increase the chance of sampling better points.
The runtime of an EDA is the number of samples required by the algorithm to discover an optimal solution. The runtime depends on
multiple factors, including its parameter settings, the class of probability distributions, and on characteristics of the optimisation problem such as the problem dimension.
This talk introduces some EDAs and techniques to estimate their runtime. Insights about the runtime of EDAs can help design more efficient EDAs for given optimisation problems.

Bio-sketch:
Dr Lehre is Senior Lecturer in the School of Computer Science at the University of Birmingham (since Jan 2017). Before joining Birmingham, he was since 2011 Assistant Professor with the University of Nottingham. He obtained MSc and PhD degrees in Computer Science from the Norwegian University of Science and Technology (NTNU) in Trondheim, He completed the PhD in 2006 under the supervision of Prof Pauline Haddow, and joined the School of Computer Science at The University of Birmingham, UK, as a Research Fellow in January 2007 with Prof Xin Yao. He was a Post Doctoral Fellow at DTU Informatics, Technical University of Denmark in Lyngby, Denmark from April 2010.
Dr Lehre's research interests are in theoretical aspects of nature-inspired search heuristics, in particular runtime analysis of population-based evolutionary algorithms. His research has won numerous best paper awards, including GECCO (2013, 2010, 2009, 2006), ICSTW (2008), and ISAAC (2014). He is vice-chair of IEEE Task Force on Theoretical Foundations of Bio-inspired Computation, and a member of the editorial board of Evolutionary Computation and associate editor of IEEE Transactions of Evolutionary Computation. He has guest-edited special issues of Theoretical Computer Science and IEEE Transaction on Evolutionary Computation on theoretical foundations of evolutionary computation. Dr Lehre has given many tutorials on evolutionary computation in summer schools and conferences.

Prof. Yanan Sun

Time schedule: 13:00-14:00 BST on 24/08/2021

Title: A Brief Review to Evolutionary Neural Architecture Algorithms

Abstract:
Deep Neural Networks (DNNs) have achieved great success in many applications. The architectures of DNNs play a crucial role in their performance, which is usually manually designed with rich expertise. However, such a design process is labour intensive because of the trial-and-error process, and also not easy to realize due to the rare expertise in practice. Neural Architecture Search (NAS) is a type of technology that can design architectures

automatically. Among different methods to realize NAS, Evolutionary Computation (EC) methods have recently gained much attention and success. We will briefly talk about the EC-based NAS algorithms over 200 papers of most recent EC-based NAS methods in light of the core components, to systematically discuss their design principles as well as justifications on the design. Furthermore, current challenges and issues are also discussed to identify future research in this emerging field.

Bio-sketch:
Yanan Sun is currently a professor at the College of Computer Science, Sichuan University, China. He received his PhD degree in computer science from Sichuan University in 2017. From June 2017 to March 2019, he was a postdoctoral fellow at Victoria University of Wellington, New Zealand. His research focuses on evolutionary computation, neural networks, and their applications in neural architecture search. In this research area, he has published 31 peer-reviewed papers including 12 first (correspondence)-authored papers in top IEEE Trans. journals. In 2016, he received the best student paper award of IEEE CIS Chengdu Chapter, National Scholarship of China, and IEEE student travel grant.
He was invited to be the organizing committee, program committee, special session chair, and tutorial chair of nine international conferences. He was the Thought Leader of Evolutionary Deep Learning from one of the six research focuses established at Victoria University of Wellington. He is the leading organizer of one workshop and two special sessions on the topic of Evolutionary Deep Learning, and the founding chair of IEEE CIS Task Force on Evolutionary Deep Learning and Applications. He is also the Guest Editor of the Special Issue on Evolutionary Computer Vision, Image Processing and Pattern Recognition in Applied Soft Computing, and the Guest Editor of the Special Issue on Evolutionary Deep Neural Architecture Design and Applications in IEEE Computational Intelligence Magazine.

Prof. Gabriela Ochoa

Time schedule: 14:00-15:00 BST on 24/08/2021

Title: Complex Networks in Search and Optimisation

Abstract:
This talk will present our recent findings and visual (static, animated, 2D and 3D) maps characterising computational search spaces. Many natural and technological systems are composed of a large number of highly interconnected units; examples are neural networks, biological systems, social interacting species, the Internet, and the World Wide Web. A key approach to capture the global properties of such systems is to model them as graphs whose nodes represent the units, and whose links stand for the interactions between them. This simple, yet powerful concept has been used to study a variety of complex systems where the goal is to analyse the pattern of connections between components in order to understand the behaviour of the system.
This talk overviews recent results on local optima networks (LONs), a network-based model of fitness landscapes where nodes are local optima and edges are possible search transitions among these optima. We will also introduce search trajectory networks (STNs) as a tool to analyse and visualise the behaviour of metaheuristics. STNs model the search trajectories of algorithms. Unlike LONs, nodes are not restricted to local optima but instead represent given states of the search process. Edges represent search progression between consecutive states. This extends the power and applicability of network-based models. Both LONs and STNs allow us to visualise realistic search spaces in ways not previously possible and bring a whole

new set of quantitative network metrics for characterising and understanding computational search.

Bio-sketch:
Gabriela Ochoa is a Professor of Computing Science at the University of Stirling in Scotland. Her research lies in the foundations and applications of evolutionary algorithms and metaheuristics, with emphasis on autonomous search, fitness landscape analysis and visualisation, combinatorial optimisation, and applications to healthcare. She holds a PhD from the University of Sussex, UK, and has held academic and research positions at the University Simon Bolivar, Venezuela, and the University of Nottingham, UK. Her recent work on network-based models of fitness landscapes has enhanced their descriptive and visualisation capabilities, producing a number of publications including 4 best-paper awards and 4 other nominations at leading venues. She collaborates cross-disciplines in the use of evolutionary algorithms in healthcare and conservation. She has been active in organisation and editorial roles within leading Evolutionary Computation venues such as the Genetic and Evolutionary Computation Conference (GECCO), Parallel Problem Solving from Nature (PPSN), the IEEE Transactions on Evolutionary Computation, the Evolutionary Computation, and recently the ACM Transactions on Evolutionary Learning and Optimisation (TELO) Journals. She was recognised in 2020 In EvoSTAR (the leading European Conference in Bio-inspired algorithms) for her outstanding contributions to the field and is a member of the ACM SIGEVO executive committee.

Prof. Xin Yao

Time schedule: 9:00-10:00 BST on 25/08/2021

Title: When Everything Else Fails, Try Co-evolution

Abstract:
Coevolution is an old but very interesting research topic in evolutionary computation. This talk presents some of the applications of coevolution in learning and optimisation. First, we look at a classical coevolutionary learning scenario when no training data are available. In fact, no teacher information is available either. Then we examine how coevolution could be used to tackle large-scale global optimisation in the black box optimisation setting. Finally, we explore how coevolution could be harnessed to design general solvers automatically for hard combinatorial optimisation problems.

Bio-sketch:
Xin Yao is a Chair Professor of Computer Science at the Southern University of Science and Technology (SUSTech), Shenzhen, China, and a part-time Professor of Computer Science at the University of Birmingham, UK. He is an IEEE Fellow and was a Distinguished Lecturer of the IEEE Computational Intelligence Society (CIS). He served as the President (2014-15) of IEEE CIS and the Editor-in-Chief (2003-08) of IEEE Transactions on Evolutionary Computation. His major research interests include evolutionary computation, ensemble learning, and their applications to software engineering. His research work won the 2001 IEEE Donald G. Fink Prize Paper Award; 2010, 2016 and 2017 IEEE Transactions on Evolutionary Computation Outstanding Paper Awards; 2011 IEEE Transactions on Neural Networks Outstanding Paper Award; and many other best paper awards at conferences. He received a Royal Society Wolfson Research Merit Award in 2012, the IEEE CIS Evolutionary Computation Pioneer Award in 2013 and the 2020 IEEE Frank Rosenblatt Award.

Dr. Yuan Yuan

Time schedule: 13:00-14:00 BST on 25/08/2021

Title: Toward Better Evolutionary Program Repair: An Integrated Approach

Abstract:
Bug repair is a major component of software maintenance, which requires a huge amount of manpower. Evolutionary computation, particularly genetic programming, is a class of promising techniques for automating this time-consuming and expensive process. Although recent research in evolutionary program repair has made significant progress, major challenges still remain. In this talk, I will first introduce the background of evolutionary program repair by focusing on a classic repair system called GenProg. Then, I will introduce our recent work ARJA, a new evolutionary repair system for Java, which aims to address challenges for the search space, search algorithm, and patch ranking in program repair. Finally, I will present the evaluation results of ARJA on 224 real-world Java bugs, in order to demonstrate its superiority over a number of advanced repair techniques.

Bio-sketch:
Dr. Yuan is currently a Postdoctoral Research Fellow with the Department of Computer Science and Engineering, Michigan State University, USA. He received the Ph.D. degree from the Department of Computer Science and Technology, Tsinghua University, Beijing, China, in 2015. From 2014 to 2015, he was a visiting Ph.D. student with the Centre of Excellence for Research in Computational Intelligence and Applications, University of Birmingham, U.K. He worked as a Research Fellow at the School of Computer Science and Engineering, Nanyang Technological University, Singapore, from 2015 to 2016. His research interests include evolutionary computation, machine learning, and search-based software engineering.

Prof. Jiayu Zhou

Time schedule: 14:30-16:00 BST on 25/08/2021

Title: Multi-Task Learning: Techniques and Applications

Abstract:
The recent decade has witnessed a surging demand in data analysis, where we built machine learning models for various data analysis tasks. The multi-task learning is a machine learning paradigm that bridges related learning tasks and transfers knowledge among the tasks. The tutorial reviews multi-task learning basics and recent advances, including distributed multi-task learning that provides efficient and privacy-preserving learning on distributed data sources; and interactive multi-task learning that solicits and integrates domain knowledge in multi-task learning, including human in the learning loop. The tutorial is concluded by a discussion of future directions of multi-task learning.

Bio-sketch:
Dr. Jiayu Zhou is currently an Associate Professor in the Department of Computer Science and Engineering at Michigan State University. He received his Ph.D. degree in computer science from Arizona State University in 2014. Dr. Zhou has a broad research interest in large-scale machine learning, data mining, and biomedical informatics, with a focus on the transfer and multi-task learning. His research has been funded by the National Science Foundation, National Institutes of Health, and Office of Naval Research, and published more than 100 peer-reviewed journal and conference papers in data mining and machine learning. Dr. Zhou is a recipient of the National Science Foundation CAREER Award (2018). His

papers received the Best Student Paper Award in 2014 IEEE International Conference on Data Mining (ICDM), the Best Student Paper Award at the 2016 International Symposium on Biomedical Imaging (ISBI), and Best Paper Award at 2016 IEEE International Conference on Big Data (BigData).

Prof. Bernhard Sendhoff

Time schedule: 9:00-10:00 BST on 26/08/2021

Title: Data-Driven AI in Engineering Design: From Tool to Partner

Abstract:
The role of data-driven AI in Engineering and particularly in Engineering Design has made significant progress in the last years. In the first part of my presentation, I will outline the CAE/AI enhanced approach to engineering design from an industrial perspective. This will include a brief description of the main components for engineering design optimization and some concrete application examples. Topology optimization including the combination of static and crash loads will be discussed as well as a brief overview of remaining challenges for CAE/AI systems in engineering design.
In the second part of my presentation, I will introduce approaches to go beyond the tool-based AI in the engineering design process chain and enable the AI methods to improve their performance over time. Experience-based Computation: learning to optimise is an EU Horizon 2020 project that addresses the issue on how optimization can be improved through learning just like the engineer becomes more and more experienced over time. I will look at one approach inspired from data mining and introduce learned representations for engineering design. Transfer learning and the advantage of multi-task optimization will be discussed.
AI as a cooperative partner in the engineering design process will be the subject of the last part of my presentation. I will briefly introduce the general concept of cooperative intelligence and then outline some of the challenges in understanding the engineer for optimal support. Many if not most engineering design decisions are made in a team, therefore, it is necessary to go beyond the cooperative interaction between the engineer and AI as a partner, but to also study the effect that an AI system can have on the decision dynamics in a team. For this I will present first results, how AI recommendations for a very simplified task can influence the human decision making process.
The presentation will conclude with a summary and some additional issues that have to be addressed to evolve AI from a tool to a partner in Engineering and in Engineering Design.

Bio-sketch:
Bernhard Sendhoff obtained a diploma in Theoretical Physics (Dipl.Phys.), in 1993, from the Ruhr-Universität Bochum, Germany, and in 1998, a PhD in Applied Physics (Artificial Intelligence). After working at Honda R&D Europe (Deutschland) GmbH, from 1999 to 2003, he has been working at the Honda Research Institute Europe GmbH from 2003 to 2011 as Chief Technology Officer and from 2011 to 2018 as the President. From 2017-2021 he was Head of Global Operations of the Honda Research Institutes and from 2019-2021 President of the Honda Research Institute Japan Co., Ltd. Japan. From 2007-2020 he was Honorary Professor of the School of Computer Science of the University of Birmingham, Great Britain. Since 2017, Bernhard Sendhoff is Operating Officer at Honda R&D Co., Ltd. Since 2021, he is Chief Executive Officer of the Global Network Honda Research Institutes and since 2008, he is Honorary Professor at the Technical University of Darmstadt, Germany. Bernhard Sendhoff is a Senior Member of the IEEE and the ACM, and a Member of the SAE. He has

authored or co-authored more than 180 peer reviewed journal and conference papers and over 40 patents.

Dr. Manuel Roveri

Time schedule: 10:15-11:00 BST on 26/08/2021

Title: TinyML: Theory and Technology

Abstract:
The "computing everywhere" paradigm (comprising Internet-of-Things and Edge Computing) will pave the way for a pervasive diffusion of Tiny Machine Learning (TinyML) in everyday life. To fully address this challenge TinyML solutions must become deeper, hence encompassing the deep-learning paradigms being the state-of-the-art in many recognition and classification applications, and wider, hence being able to operate in a collaborative and federated way within an ecosystem of heterogenous technological objects. This seminar explores the solutions and methodologies to make TinyML deeper and wider by also considering the role of an effective and efficient processing of encrypted-data through deep-learning-as-a-service in an heterogeneous-hardware ecosystem.

Bio-sketch:
Manuel Roveri received the Ph.D. degree in Computer Engineering from the Politecnico di Milano (Italy) and the MS in Computer Science from the University of Illinois at Chicago (USA). He has been Visiting Researcher at Imperial College London (UK). Currently, he is an Associate Professor at the Department of Electronics and Information of the Politecnico di Milano (Italy). Current research activity addresses Embedded and Edge AI, Learning in presence of Concept Drift and Intelligent Embedded and Cyber-physical Systems. Manuel Roveri is a Senior Member of IEEE and served as Chair and Member in several IEEE Committees. He holds 1 patent and has published about 100 papers in international journals and conference proceedings He is the recipient of the 2018 IEEE Computational Intelligence Magazine "Outstanding Paper Award" and of the 2016 IEEE Computational Intelligence Society "Outstanding Transactions on Neural Networks and Learning Systems Paper Award".

Prof. Ata Kaban

Time schedule: 13:00-14:00 BST on 26/08/2021

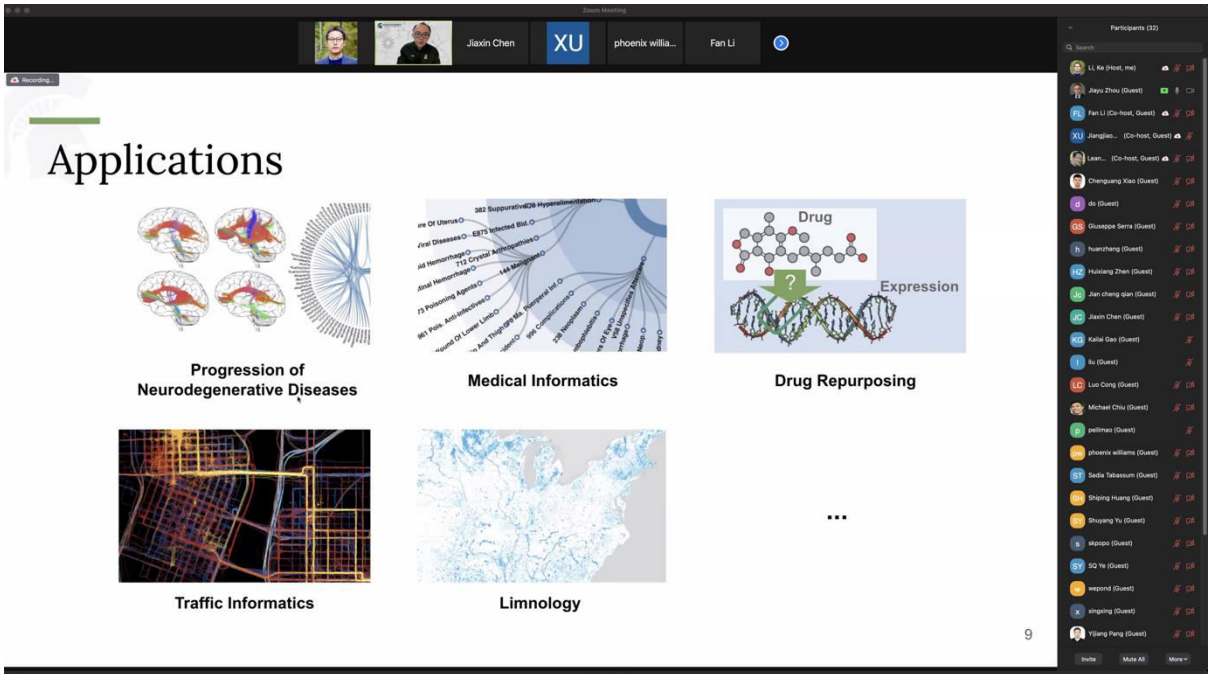
Title: Random Projection Meets Learning Theory and Beyond

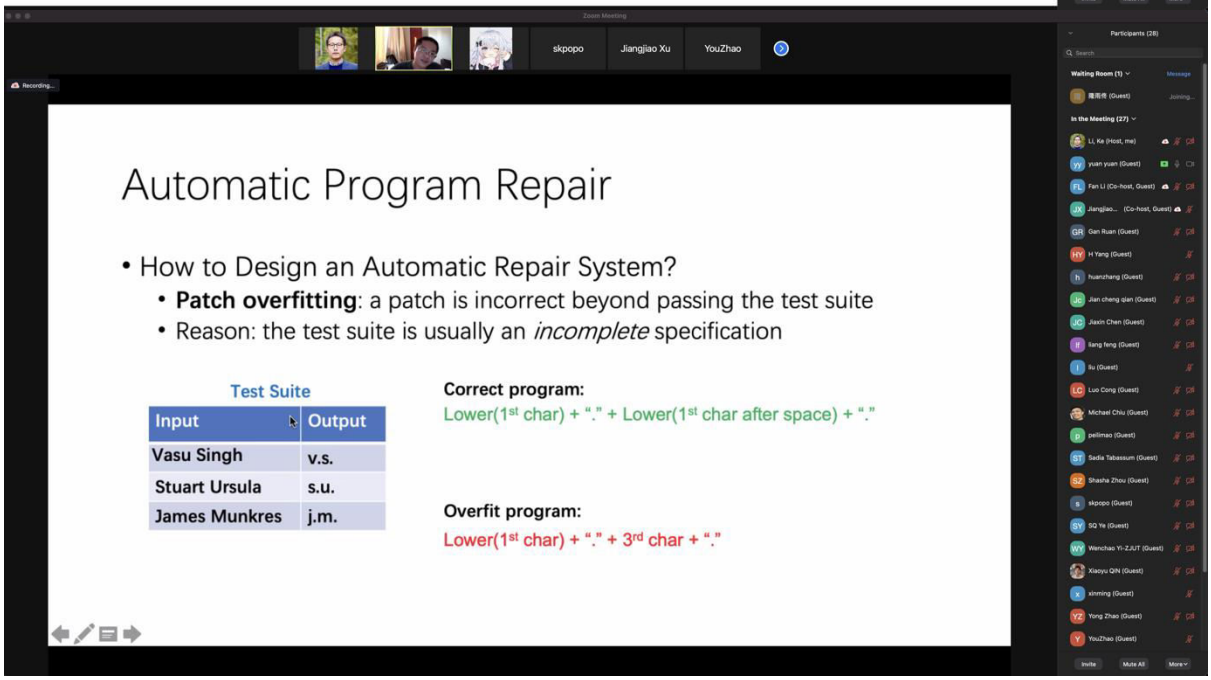
Abstract:
High dimensional problems are increasingly prevalent in machine learning, and often the space of data features or the parameter space have a dimensionality that exceeds the sample size. This tutorial will start by developing some intuition about high dimensional data spaces, and will then focus on a simple yet powerful dimensionality reduction method, Random Projection (RP) that may be used to overcome the curse of dimensionality. RP is oblivious to the data, yet it provides low distortion guarantees with high probability that depend on the underlying unknown geometric structure of the data. The tutorial will cover some underlying principles of the theory behind RP, and will delve into its effects on generalisation guarantees for subsequent learning tasks. We will also touch upon the use of RP in high dimensional search problems.

Bio-sketch:
Ata Kaban is a Professor in Computer Science and an EPSRC Fellow at the University of Birmingham UK. Her main research interests are in statistical machine learning and data

mining in high dimensional settings. She holds a PhD in Computer Science (2001) and a PhD in Musicology (1999). She is a member of the IEEE CIS Technical Committee on Data Mining and Big Data Analytics, chairs the IEEE CIS Task Force on High Dimensional Data Mining. She has been the organiser of 9 consecutive editions of the IEEE ICDM Workshop on High Dimensional Data Mining, including the upcoming HDM'21.

Selected Photos

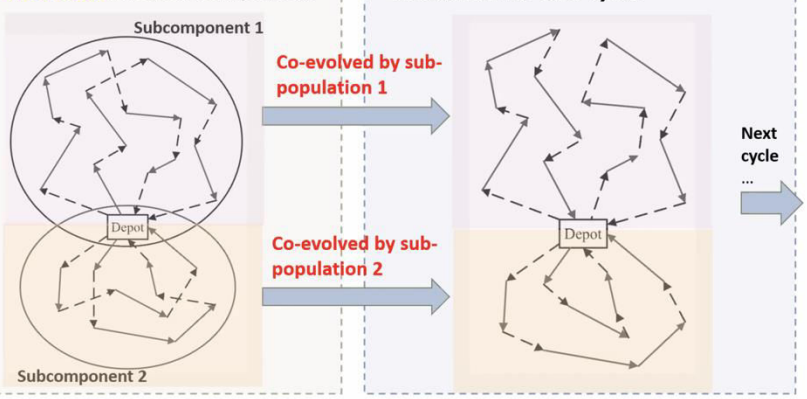




Cooperative Coevolution for CARPs

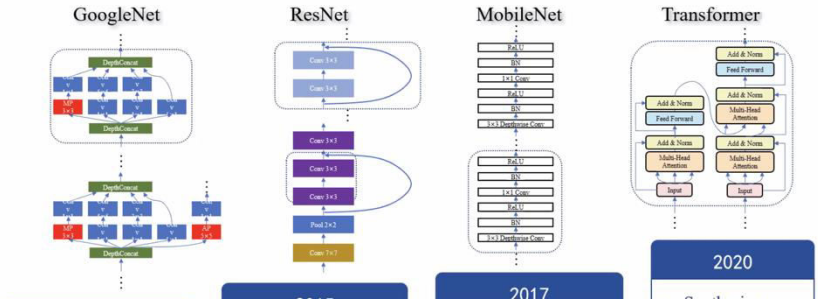
- Best-so-far solution
- Cluster the routes into 2 subcomponents

- New best solution after co-evolution for one cycle



Y .Mei, X. Li and X. Yao, "Cooperative Co-evolution with Route Distance Grouping for Large-Scale Capacitated Arc Routing Problem," *IEEE Transactions on Evolutionary Computation*, vol. 18, no. 3, pp. 435-449, 2014.

Introduction

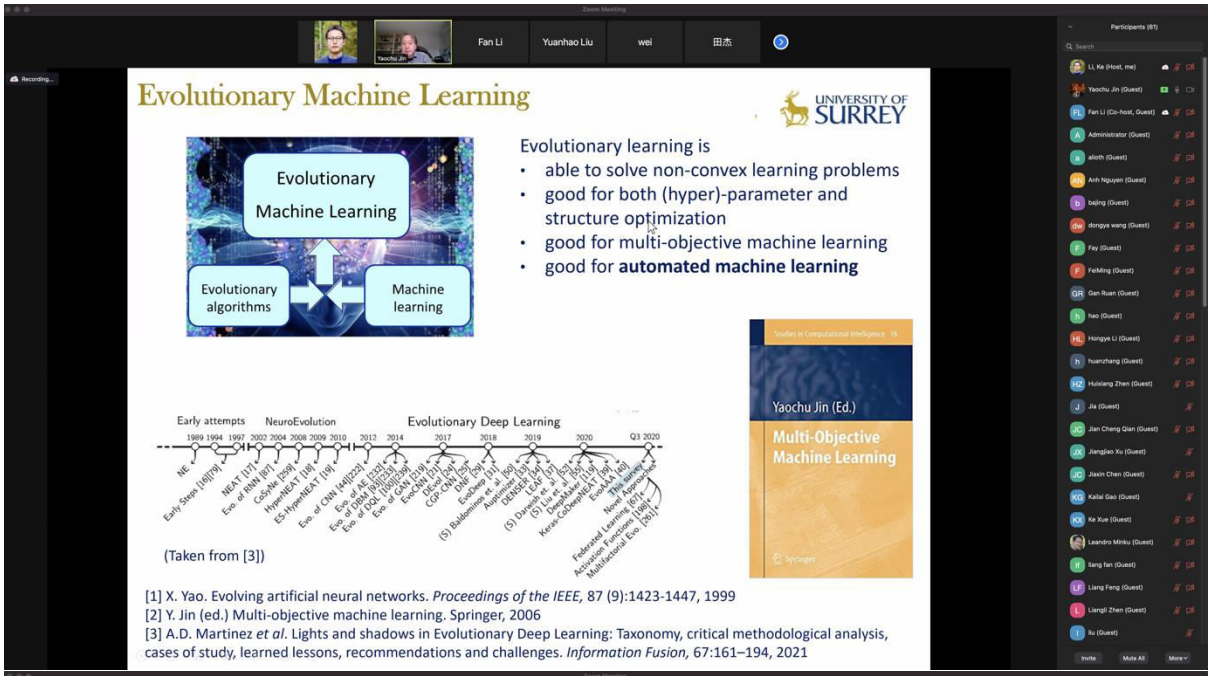


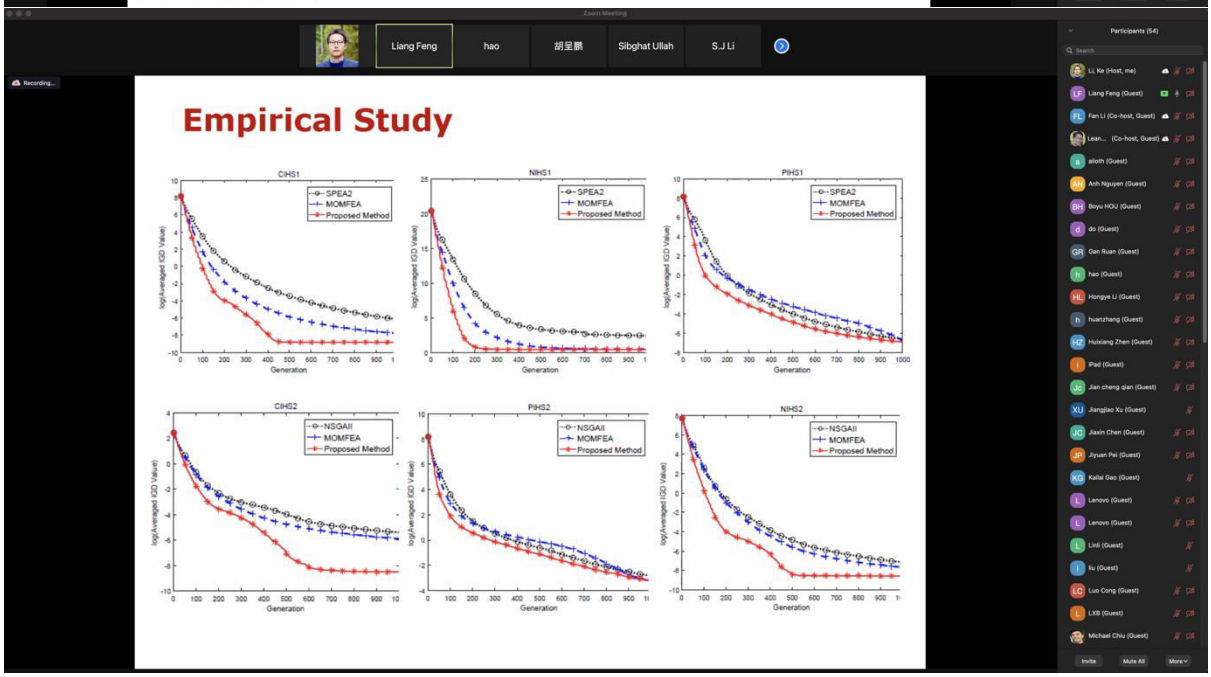
2012
- AlexNet
- NIN
- VGG
- GoogleNet
- …

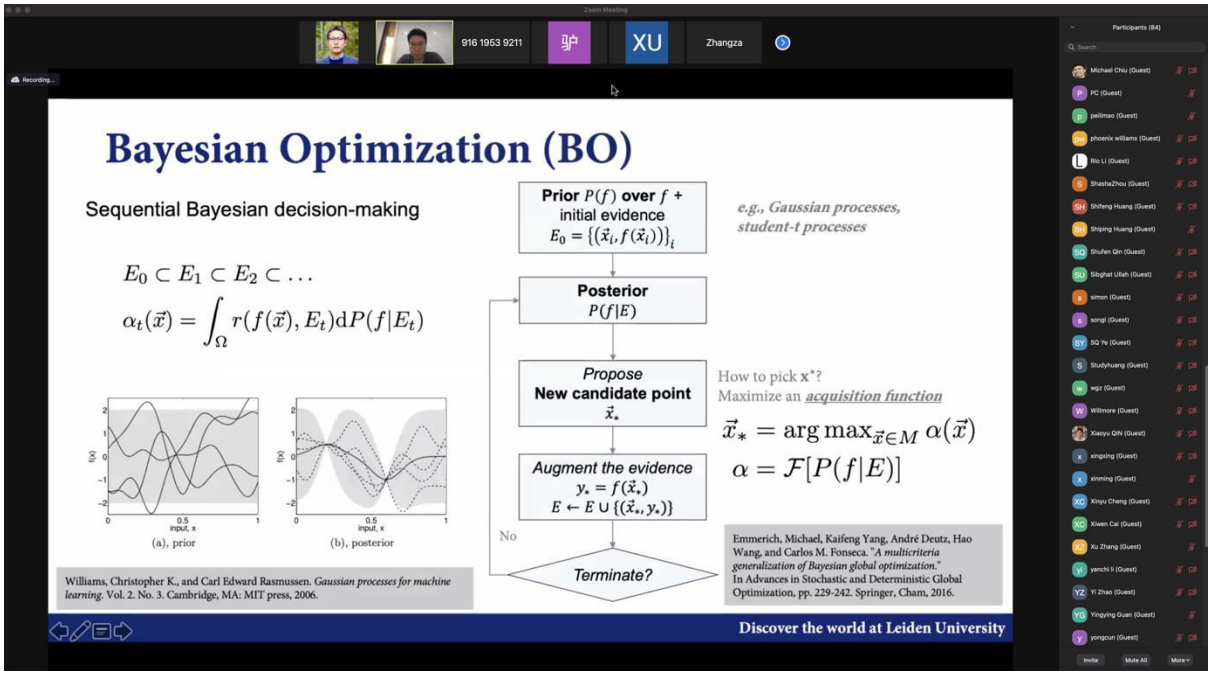
2015
- Highway Networks
- ResNet
- DenseNet
- Dual Path Network
- …

2017
- MobileNet(V1-V3)
- CondenseNet
- ShuffleNet(V1,V2)
- GhostNet
- EfficientNet
- …

2020
- Synthesizer
- Transformer-XL
- Longformer
- Reformer
- Axial Transformer
- …


Fan Li
Yuanhao Liu
wei
田杰
Evolutionary Machine Learning
UNIVERSITY OF SURREY
Evolutionary
Machine Learning
Evolutionary algorithms
Machine learning
Evolutionary learning is
able to solve non-convex learning problems
good for both (hyper)-parameter and structure optimization
good for multi-objective machine learning
good for automated machine learning
Early attempts
NeuroEvolution
Evolutionary Deep Learning
1989 1994 1997 2002 2004 2008 2009 2010 2012 2014 2017 2018 2019 2020 Q3 2020
(Taken from [3])
Studies in Computational Intelligence 16
Yaochu Jin (Ed.)
Multi-Objective Machine Learning
Springer
[1] X. Yao. Evolving artificial neural networks. Proceedings of the IEEE, 87 (9):1423-1447, 1999
[2] Y. Jin (ed.) Multi-objective machine learning. Springer, 2006
[3] A.D. Martinez et al. Lights and shadows in Evolutionary Deep Learning: Taxonomy, critical methodological analysis, cases of study, learned lessons, recommendations and challenges. Information Fusion, 67:161–194, 2021
Participants (61)


Liang Feng
hao
胡呈鹏
Sibghat Ullah
S.J Li
Empirical Study
CIHS1
NIHS1
PIHS1
CIHS2
PIHS2
NIHS2
SPEA2
NSGAII
MOMFEA
Proposed Method
log(Averaged IGD Value)
Generation
Participants (54)


Zoom Meeting
916 1953 9211
XU
Zhangza
Recording...
Bayesian Optimization (BO)
Sequential Bayesian decision-making
$E_0 \subset E_1 \subset E_2 \subset \dots$
$\alpha_t(\vec{x}) = \int_\Omega r(f(\vec{x}), E_t) \mathrm{d}P(f|E_t)$
f(x)
input, x
(a), prior
(b), posterior
Williams, Christopher K., and Carl Edward Rasmussen. Gaussian processes for machine learning. Vol. 2. No. 3. Cambridge, MA: MIT press, 2006.
Prior $P(f)$ over f + initial evidence $E_0 = \{(\vec{x}_i, f(\vec{x}_i))\}_i$
Posterior $P(f|E)$
Propose New candidate point $\vec{x}_*$
Augment the evidence $y_* = f(\vec{x}_*)$ $E \leftarrow E \cup \{(\vec{x}_*, y_*)\}$
No
Terminate?
e.g., Gaussian processes, student-t processes
How to pick x*?
Maximize an acquisition function
$\vec{x}_* = \arg\max_{\vec{x} \in M} \alpha(\vec{x})$
$\alpha = \mathcal{F}[P(f|E)]$
Emmerich, Michael, Kaifeng Yang, André Deutz, Hao Wang, and Carlos M. Fonseca. "A multicriteria generalization of Bayesian global optimization." In Advances in Stochastic and Deterministic Global Optimization, pp. 229-242. Springer, Cham, 2016.
Discover the world at Leiden University
Participants (84)
Michael Chiu (Guest)
PC (Guest)
pellimao (Guest)
phoenix williams (Guest)
Rio Li (Guest)
ShashaZhou (Guest)
Shifeng Huang (Guest)
Shiping Huang (Guest)
Shufen Qin (Guest)
Sibghat Ullah (Guest)
simon (Guest)
songl (Guest)
SQ Ye (Guest)
Studyhuang (Guest)
wgz (Guest)
Willmore (Guest)
Xiaoyu QIN (Guest)
xingxing (Guest)
xinming (Guest)
Xinyu Cheng (Guest)
Xiwen Cai (Guest)
Xu Zhang (Guest)
yanchi li (Guest)
Yi Zhao (Guest)
Yingying Guan (Guest)
yongcun (Guest)
Invite
Mute All
More

Zoom Meeting

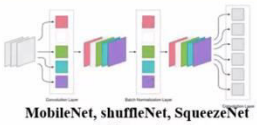

方静静 | Lei Chen | ZN

Recording...

4. Future prospects

Porting to mobile requires optimization

1. Compress the model to reduce the calculation cost and file size of the model without losing accuracy



MobileNet, shuffleNet, SqueezeNet and other networks

2. Choose the appropriate neural network framework and use the chip acceleration technology as far as possible;

Combined with memristor AI accelerator chips

Participants (83)

Search

- Li, Ke (Host, me)
- Shiping Wen (Guest)
- Fan Li (Co-host, Guest)
- 1015阮干Gan (Guest)
- alioth (Guest)
- Anh Nguyen (Guest)
- bajing (Guest)
- Chaoli Sun (Guest)
- Chenguang Xiao (Guest)
- Dana (Guest)
- dongya wang (Guest)
- Fay (Guest)
- FeiMing (Guest)
- Gaby (Guest)
- Giuseppe Serra (Guest)
- hao (Guest)
- Hongbo Cui (Guest)
- huanzhang (Guest)
- huanzhang (Guest)
- hui (Guest)
- Huixiang Zhen (Guest)
- iPad (Guest)
- Jialin Liu (Guest)
- Jian cheng qian (Guest)
- Jianzhao Wu (Guest)
- Jiaxin Chen (Guest)

Invite | Mute All | More