PREFACE

Proceedings of ACML 2021

Foreword

Welcome to the thirteenth edition of the Proceedings of Machine Learning Research (PMLR) for the Asian Conference on Machine Learning (ACML).

This volume contains 115 papers accepted to the thirteenth Asian Conference on Machine Learning (ACML 2021) held virtually from 17th to 19th November 2021. The papers comprise a wide variety of contemporary state-of-the-art topics including trustworthy machine learning, computer vision, natural language processing, optimization, reinforcement learning, deep learning theory, Bayesian models, online and bandit learning, learning from limited or noisy data, as well as applications to real-world problems. ACML aims at providing a leading international forum for researchers in machine learning and related fields to share their original research findings, new ideas and achievements. Continuing with ACML conference trends in recent years, highlighting its worldwide reach, ACML 2021 received submissions from authors in 30+ countries from the Asia-Pacific as well as different parts of the world including Algeria, Australia, Bangladesh, Belgium, Canada, China, Czech Republic, Denmark, Ecuador, Finland, France, Germany, Greece, Hungary, India, Iran, Israel, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Russia, Saudi Arabia, Singapore, South Africa, South Korea, Sri Lanka, Sweden, Turkey, United Kingdom, and the United States.

ACML 2021 occupies a special place in the history of the conference (along with the 2020 edition), due to the COVID-19 pandemic that rampaged around the world. We take a moment to express our deepest sympathies to all affected around the world by the pandemic. Despite the significant impact the pandemic had on many members of our research community, the ACML 2021 conference received 378 submissions, a record-high in the history of the conference. A strict double-blind reviewing process was followed, and each paper was assigned to one meta-reviewer, and at least 3 reviewers. The Program Committee (PC) had 292 PC members (reviewers) and 41 Senior PC members (meta-reviewers). Papers were allocated based on paper bidding, similarity of subject areas, and the Toronto Paper Machine System (TPMS) scores. The Program Committee contributed their valuable time to provide expert reviews, ensuring the high standard of papers selected for the conference. Our sincere gratitude to each of our reviewers and meta-reviewers without whom the conference would not have been possible. 115 of the submissions were accepted into the main program, with an acceptance rate of 30.4%. Of the papers accepted to the conference track, 48 were selected to be Long Orals at the conference (an acceptance rate of 12.7%) with the remaining 67 presented as Short Orals.

The journal track of ACML 2021 was overseen by the Journal Track Co-Chairs Yu-Feng Li and Mehmet Gonen. This track received 63 submissions and 15 papers were accepted for publication in the Springer Machine Learning Journal. The same program committee reviewed both the conference and journal tracks of ACML. For only the second time, ACML 2021 consisted of parallel sessions. All accepted papers from the two tracks were presented as either a Long Oral (20-minute presentations) or Short Oral (10-minute presentations). In addition, all papers also had a poster presentation.

This year's program featured four invited talks from leading experts from different parts of the world: Johan Suykens (KU Leuven and Leuven.AI Institute), Sarit Kraus (Bar-Ilan University), Balaraman Ravindran (Indian Institute of Technology Madras), and Tong Zhang (Hong Kong University of Science and Technology), who presented thought-provoking perspectives to the audience. In addition to the main program, we also had a full day of tutorials and workshops prior to the main conference organized by Tutorial Co-Chairs Vivian Chen and Dani Yogatama, and

Workshop Co-Chairs Hiromi Arai and Emtiyaz Khan. Five tutorials were delivered on contemporary topics: Battle of Bandits: Online learning from Preference Feedback, Optimal Transport, Automated Learning from Graph-Structured Data, Learning under Noisy Supervision, and Differential Geometry for Generative Modeling. In parallel to the tutorials, we had three workshops: Weakly Supervised Learning Workshop, Workshop on Machine Learning for Mobile Robot Vision and Control (MRVC), and Power-efficient Deep Learning.

For the first time in the history of the conference, ACML 2021 also hosted the first Online Asian Machine Learning School (OAMLS) to help prepare the next generation of machine learning researchers and practitioners, from the Asia-Pacific region. OAMLS was held online between November 8 - 19, 2021, and received a large number of applications from budding researchers. The online school featured lectures from 13 speakers on topics including Bayesian machine learning, optimal transport, causality, deep learning theory, meta-learning, reinforcement learning, computer vision, natural language processing, graph representation learning, and computational biology.

We take the opportunity to thank all speakers and organizers for putting together a strong engaging program for the conference. ACML Steering Committee Chair, Masashi Sugiyama, together with the Steering Committee, provided invaluable advice for the organization of the conference. The General Co-Chairs, Wee Sun Lee and Kee-Eung Kim, provided oversight over the entire conference, and worked tirelessly to put together the different pieces of the conference, especially considering the online mode of the conference. The Web Chair Muhammad Rizki Aulia Rahman Maulana played an important part in this online conference version by ensuring the website represented the latest information. The Publication Chair Mohammed Haroon Dupty handled the preparation and publication of the proceedings. The Workflow Chairs, Jinliang Deng and Tong Wei, played an important role in maintaining the workflows of the conference, especially the CMT site used for submission, review and decision-making of papers. Considering the virtual nature of the conference, the Online Co-Chairs, Titipat Achakulvisut and Wittawat Jitkrittum, coordinated the virtual portal for the conference including the online poster sessions. This was particularly a significant component of the virtual ACML 2021 conference. Without the help of all the people involved in organizing the conference, the event would not have been possible.

We are also grateful to the generous sponsorship of our industry sponsors: DeepMind, Google and Sea (platinum sponsors); and Appier and CSIRO (gold sponsors), for their support to the conference and the machine learning school. We once again thank each speaker, author, organizer, sponsor, volunteer and attendee for the success of ACML 2021!

November 2021

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Invited Talks

Title: Understanding Overparameterized Machine Learning Models: Optimization, Sampling, Generalization, and Privacy

Presenter: Tong Zhang (Hong Kong University of Science and Technology)

Abstract:

Overparametrized models are widely used in modern machine learning applications. However, they exist behaviors that are not explained by the traditional statistical analysis. In this talk, I will discuss some interesting questions and new theoretical analysis to understand these overparameterized models.

Bio:

Tong Zhang is a professor of Computer Science and Mathematics at The Hong Kong University of Science and Technology. Previously, he was a professor at Rutgers university, and worked at IBM, Yahoo, Baidu, and Tencent. Tong Zhang's research interests include machine learning algorithms and theory, statistical methods for big data and their applications. He is a fellow of ASA, IEEE, and IMS, and he has been in the editorial boards of leading machine learning journals and program committees of top machine learning conferences.

Tong Zhang received a B.A. in mathematics and computer science from Cornell University and a Ph.D. in Computer Science from Stanford University.

TITLE: Deep Kernel Machines

PRESENTER: Johan Suykens (KU Leuven, ESAT-Stadius and Leuven.AI Institute)

ABSTRACT:

With neural networks and deep learning flexible and powerful architectures have been proposed, while with support vector machines and kernel machines solid foundations in learning theory and optimization have been achieved. In recent work on restricted kernel machines (RKM), new connections have been established between restricted Boltzmann machines (RBM), kernel principal component analysis (KPCA) and least squares support vector machines (LS-SVM). An important role for revealing the unexpected connections is played by duality principles. It enables to conceive Deep Kernel Machines for supervised and unsupervised learning, such as deep forms of KPCA and Deep RKMs. Within the framework one can either work with explicit (e.g. multi-layered, convolutional) feature maps or implicit feature maps in connection to kernel functions. New developments will be shown for generative kernel machines, multi-view and tensor based models, latent space exploration, robustness and explainability. Future perspectives and challenges will be outlined.

BIO:

Johan A.K. Suykens was born in Willebroek Belgium, May 18 1966. He received the master degree in Electro-Mechanical Engineering and the PhD degree in Applied Sciences from the Katholieke Universiteit Leuven, in 1989 and 1995, respectively. In 1996 he has been a Visiting Postdoctoral Researcher at the University of California, Berkeley. He has been a Postdoctoral Researcher with the Fund for Scientific Research FWO Flanders and is currently a full Professor with KU Leuven. He is author of the books "Artificial Neural Networks for Modelling and Control of Non-linear Systems" (Kluwer Academic Publishers) and "Least Squares Support Vector Machines" (World Scientific), co-author of the book "Cellular Neural Networks, Multi-Scroll Chaos and Synchronization" (World Scientific) and editor of the books "Nonlinear Modeling: Advanced Black-Box Techniques" (Kluwer Academic Publishers), "Advances in Learning Theory: Methods, Models and Applications" (IOS Press) and "Regularization, Optimization, Kernels, and Support Vector Machines" (Chapman & HallCRC). In 1998 he organized an International Workshop on Nonlinear Modelling with Time-series Prediction Competition. He has served as associate editor for the IEEE Transactions on Circuits and Systems (1997-1999 and 2004-2007), the IEEE Transactions on Neural Networks (1998-2009), the IEEE Transactions on Neural Networks and Learning Systems (from 2017) and the IEEE Transactions on Artificial Intelligence (from April 2020). He received an IEEE Signal Processing Society 1999 Best Paper Award, a 2019 Entropy Best Paper Award and several Best Paper Awards at International Conferences. He is a recipient of the International Neural Networks Society INNS 2000 Young Investigator Award for significant contributions in the field of neural networks. He has served as a Director and Organizer of the NATO Advanced Study Institute on Learning Theory and Practice (Leuven 2002), as a program co-chair for the International Joint Conference on Neural Networks 2004 and the International Symposium on Nonlinear Theory and its Applications 2005, as an organizer of the International Symposium on Synchronization in Complex Networks 2007, a co-organizer of the NIPS 2010 workshop on Tensors, Kernels and Machine Learning, and chair of ROKS 2013. He has been awarded an ERC Advanced Grant 2011 and 2017, has been elevated IEEE Fellow 2015 for developing least squares support vector machines, and is ELLIS Fellow. He is currently serving as program director of Master AI at KU Leuven.

Title: Reinforcement Learning with Structured Actions and Policies

Presenter: Balaraman Ravindran (Indian Institute of Technology Madras)

Abstract:

Deep Reinforcement Learning has been very successful in solving a variety of hard problems. But many RL architectures treat the action as coming from an unordered set or from a bounded interval. It is often the case that the actions and policies have a non-trivial structure that can be exploited for more efficient learning. This ranges from game playing settings where the same action is repeated multiple times, to supply-chain problems where the action space has a combinatorial structure, to problems that require a hierarchical decomposition to solve effectively. In this talk, I will present several scenarios in which taking advantage of the structure leads to more efficient learning. In particular, our talk about some of our recent work on action repetition, actions that are related via a graph structure, ensemble policies, and policies learnt through a combination of hierarchical planning and learning.

Bio:

Professor B. Ravindran heads the Robert Bosch Centre for Data Science & Artificial Intelligence (RBCDSAI) at IIT Madras, one of the leading interdisciplinary AI research centre in India. He is the Mindtree Faculty Fellow and Professor in the Department of Computer Science and Engineering at IIT Madras. He has held visiting positions at the Indian Institute of Science, Bangalore, India, University of Technology, Sydney, Australia and Google Research. Currently, his research interests are centred on learning from and through interactions and span the areas of geometric deep learning and reinforcement learning. He is one of the founding executive committee members of the India chapter of ACM SIGKDD. He is currently serving on the editorial boards of Machine Learning Journal (MLJ), Journal of AI Research (JAIR), ACM Transactions on Intelligent Systems and Technology (ACM TIST), PLOS One, and Frontiers in Big Data and AI. He has published nearly 100 papers in premier journals and conferences. His work with students have won multiple best paper awards, the most recent being the best application paper at PAKDD 2021. He received his PhD from the University of Massachusetts, Amherst and his Master's degree from the Indian Institute of Science, Bangalore. He is a senior member of the Association for Advancement of AI (AAAI).

TITLE: Agent-Human collaboration for increasing users satisfaction

PRESENTER: Sarit Kraus (Bar-Ilan University)

ABSTRACT:

We consider environments where a set of human workers needs to handle a large set of tasks while interacting with human users. The arriving tasks vary: they may differ in their urgency, their difficulty and the required knowledge and time duration in which to perform them. Our goal is to decrease the number of workers, which we refer to as operators that are handling the tasks while increasing the users' satisfaction. We present automated intelligent agents that will work together with the human operators in order to improve the overall performance of such systems and increase both operators' and users' satisfaction. Examples include: home hospitalization environments where remote specialists will instruct and supervise treatments that are carried out at the patients' homes; operators that tele-operate autonomous vehicles when human intervention is needed and bankers that provide online service to customers. The automated agents could support the operators: the machine learning-based agent follows the operator's work and makes recommendations, helping him interact proficiently with the users. The agents can also learn from the operators and eventually replace the operators in many of their tasks.

BIO:

Sarit Kraus (Ph.D. Computer Science, Hebrew University, 1989) is a Professor of Computer Science at Bar-Ilan University. Her research is focused on intelligent agents and multi-agent systems integrating machine-learning techniques with optimization and game theory methods. In particular, she studies the development of intelligent agents that can interact proficiently with people and with robots. She has also contributed to the research on machine learning, agent optimization, autonomous vehicles, homeland security, adversarial patrolling, social networks and nonmonotonic reasoning. For her work she received many prestigious awards. She was awarded the IJCAI Computers and Thought Award, the ACM SIGART Agents Research award, the ACM Athena Lecturer, the EMET prize and was twice the winner of the IFAAMAS influential paper award. She is an ACM, AAAI and EurAI fellow and a recipient of the advanced ERC grant. She also received a special commendation from the city of Los Angeles, together with Prof. Tambe, Prof. Ordonez and their USC students, for the creation of the ARMOR security scheduling system. She has published over 400 papers in leading journals and major conferences and co-authored five books. She is a member of the board of directors of the International Foundation for Multi-agent Systems (IFAAMAS) and was IJCAI 2019 program chair. She is an elected member of the Israel Academy of Sciences and Humanities.

Tutorials

Title: Battle of Bandits: Online learning from Preference Feedback

Presenter: Aadirupa Saha (Microsoft Research New York City)

Abstract:

This tutorial would cover the development and recent progress on Preference based Bandits where the goal is to sequentially learn the best-action of a decision set from preference feedback over an actively chosen subset of items. We initially start with a brief overview of the motivation and problem formulation, and then understand the breakthrough results for the simplest pairwise preference setting (where the subsets are of size 2), famously studied as the 'Dueling Bandit' problem in the literature. Will then generalize it to the 'Battling Bandits' framework for subsets of any arbitrary size and understand the tradeoff between learning rates-vs-increasing subset sizes.

Title: Optimal Transport

Presenter: Viet Huynh (Monash University), He Zhao (Monash University), Nhat Ho (University of Texas at Austin), Dinh Phung (Monash University)

Abstract:

Optimal transport has a long history in mathematics which was proposed by Gaspard Monge in the eighteenth century [Old/New book]. The theory was later investigated by Nobelists (for a joint prize in economic sciences) Koopmans and Kantorovich as well as Fields medalists Villani (2010) and Figalli (2018). Recently, advances in optimal transport theory have paved the way for its use in the ML/AI community, particularly for formulating models and learning with high-dimensional data. This tutorial aims to introduce pivotal computational, practical aspects of OT as well as applica- tions of OT for unsupervised learning problems. The topics of this tutorial consist of three main parts. In the first part, we will present the theoretical and computational background of optimal transport theory. In the second part, we will summarize the application of OT estimating of deep generative models. The clustering and topic modelling methods with OT will be summarized in the last part of the tutorial. Implementation of algorithms and illustrative examples will also be presented.

TITLE: Automated Learning form Graph-Structured Data

PRESENTER: Quanming Yao (Tsinghua University), Huan Zhao (4Paradigm Inc., China), Yongqi Zhang (4Paradigm Inc., China)

ABSTRACT:

Graph-structured data (GSD) is ubiquitous in real-life applications, which appears in many learning applications such as property prediction for molecular graphs, product recommendations from heterogeneous information networks, and logical queries from knowledge graphs. Recently, learning from graph-structured data has also become a research focus in the machine learning community. However, again due to such diversities in GSD, there are no universal learning models that can perform well and consistently across different learning applications based on graphs. In sharp contrast to this, convolutional neural networks work well on natural images, and transformers are good choices for text data. In this tutorial, we will talk about using automated machine learning (AutoML) as a tool to design learning models for GSD. Specifically, we will elaborate on what is AutoML, what kind of prior information from graphs can be explored by AutoML, and how can insights be generated from the searched models.

TITLE: Learning under Noisy Supervision

PRESENTER: Masashi Sugiyama (RIKEN Center for Advanced Intelligence Project), Tongliang Liu (University of Sydney), Bo Han (Hong Kong Baptist University), Quanming Yao (Tsinghua University), Gang Niu (RIKEN Center for Advanced Intelligence Project)

ABSTRACT:

Noisy data is ubiquitous and harms the performance of most learning algorithms, and sometimes makes existing algorithms break down. This tutorial summarizes the most recent noisy-supervision-tolerant techniques, from the viewpoint of statistical learning, deep learning and their applications in industry. More information here: https://wsl-workshop.github.io/acml21-tutorial.

TITLE: Differential geometry for generative modeling

PRESENTER: Søren Hauberg (Technical University of Denmark)

ABSTRACT:

Differential geometry is playing an increasing role in manifold learning, and generative modeling in particular. Geometry provides us with well-defined and well-behaved tools for interpolation and statistical analysis on the learned manifolds, and provides a principled solution to the identifiability problem that plagues many generative models. While the geometric approach is elegant it comes with a steep learning curve as the literature is developed from a mathematical rather than applied perspective. In this tutorial we first develop the classic differential geometry needed to understand deterministic manifolds, and then show how this applies to the stochastic setting. We show how to turn the mathematical concepts into simple algorithms that allow for principled data analysis over learned manifolds. Importantly, we require little more mathematical background from the audience than knowledge of Taylor expansions.

Workshops

ACML 2021 Workshop on Weakly Supervised Learning

Organisers: Alex Ratner (University of Washington), Sharon Li (University of Wisconsin-Madison), Paroma Varma (Snorkel AI), Yang Liu (University of California Santa Cruz), Chang Xu (University of Sydney), Yu-Feng Li (Nanjing University), Chunyuan Li (Microsoft Research, Redmond)

Machine learning should not be accessible only to those who can pay. Specifically, modern machine learning is migrating to the era of complex models (e.g., deep neural networks), which emphasizes the data representation highly. This learning paradigm is known as representation learning. Specifically, via deep neural networks, learned representations often result in much better performance than can be obtained with hand-designed representations. It is noted that representation learning normally requires a plethora of well-annotated data. Giant companies have enough money to collect well-annotated data. Nonetheless, for startups or non-profit organizations, such data is barely acquirable due to the cost of labeling data or the intrinsic scarcity in the given domain. These practical issues motivate us to research and pay attention to weakly supervised representation learning (WSRL), since WSRL does not require such a huge amount of annotated data. We define WSRL as the collection of representation learning problem settings and algorithms that share the same goals as supervised representation learning but can only access to less supervised information than supervised representation learning. In this workshop, we discuss both theoretical and applied aspects of WSRL. Meanwhile, we will invite qualified submissions to Machine Learning Journal Special Issue on Weakly Supervised Representation Learning. Topics of Interest include:

- Algorithms and theories of incomplete supervision, e.g., semi-supervised representation learning, active representation learning and positive-unlabeled representation learning;
- Algorithms and theories of inexact supervision, e.g., multi-instance representation learning and complementary representation learning;
- Algorithms and theories of inaccurate supervision, e.g., crowdsourced representation learning and label-noise representation learning;
- Algorithms and theories of cross-domain supervision, e.g., zero-/one-/few-shot representation learning, transferable representation learning and multi-task representation leaning;
- Algorithms and theories of imperfect demonstration, e.g., inverse reinforcement representation learning and imitation representation learning with non-expert demonstrations;
- Broad applications of weakly-supervised representation learning, such as weakly supervised object detection, weakly supervised sequence modeling, weakly supervised cross-media retrieval, and weakly supervised medical image segmentation.

ACML 2021 Workshop on Machine Learning for Mobile Robot Vision and Control (MRVC)

Organisers: Chun-Yi Lee (National Tsing Hua University, Taiwan), Ryo Yonetani (OMRON SINIC X Keio University, Japan), Asako Kanezaki (Tokyo Institute of Technology, Japan), Mohammadamin Barekatain (DeepMind, UK), Simon See (NVIDIA AI Technology Center, Singapore), Shang-Hong Lai (Microsoft AI R&D Center, Taiwan)

In recent years, the advances in machine learning for vision and control applications support the increasing demands for mobile robots. Such demands surge especially in the past several months, arguably due to the spread of COVID-19. While mobile robots are typically expected to work in controlled environments (e.g., supply chain automation at factories), more challenging unconstrained situations (e.g., cleaning, sanitizing, etc.) have also begun attracting attention, which in turn causes automation and safety of mobile robots to become a serious concern.
To enable mobile robots to meet such demands, equipping them with satisfactory vision and control capabilities is necessary and has become the key focus of relevant robotic research endeavors. Many sophisticated computer vision / machine learning / robotics approaches have been developed to meet this aim, including but not limited to semantic segmentation, optical flow estimation, depth estimation, object detection and tracking, domain adaptation, sim-to-real transfer, reinforcement learning and imitation learning for robot navigation. However, these advances have not yet been properly translated to significant progress in practical mobile robot applications due to the insufficiency of effective data samples from the real world, leading to unsatisfactory performance and safety concerns of mobile robots during deployment.
Moreover, effectively collecting data and efficiently utilizing them for training vision and control models, especially in unconstrained outdoor environments, have further raised a number of fundamental challenges for mobile robot applications. These challenges include several open but crucial issues, such as multimodal sensing, privacy issues, human activity recognition and prediction, as well as the constraints on batteries, computing capabilities, and limited field of view.
To better understand the aforementioned issues and improve the current solutions, this MRVC workshop presents a timely opportunity to bring together researchers in computer vision, machine learning, and robotics communities together to discuss the unique challenges and opportunities for mobile robots.
Topics of interest include:

- Machine learning for mobile robot control
- Machine learning for unconstrained and real environments
- Computer vision for mobile robots
- Other applications of learning in robot manipulation, navigation, driving, flight, and other areas of robotics

ACML 2021 WORKSHOP: Power efficient deep learning

Organisers: Sébastien Loustau (UPPA), Johannes Lederer (Ruhr-University Bochum), Guillaume Bellec (EPFL), Paul Gay (UPPA), Anne-Cécile Orgerie (IRISA laboratory in Rennes)

Neural networks (NN) have become the most used family of machine learning algorithms. Among the universality of architectures emerging now, NNs are still prohibitive regarding environmental impact due to electric consumption.
In this workshop, we expect to address these issues, based on both a theoretical and practical deep learning analysis of standard pipeline and new paradigms. The main theoretical discussions lie on how mathematical statistics or recent mathematical models can be applied to learn lighter architectures in order to reduce training and inference. We also propose to use recent softwares like RAPL and nvidia-smi in a dedicated tutorial and competition where the energy consumed by deep learning algorithms will be measured and reduced.

Conference Organisation

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