

# **CiML 2018 - Machine Learning competitions "in the wild": Playing in the real world or in real time**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Isabelle Guyon · Evelyne Viegas · Sergio Escalera · Jacob D Abernethy*

Challenges in machine learning and data science are competitions running over several weeks or months to resolve problems using provided datasets or simulated environments. The playful nature of challenges naturally attracts students, making challenge a great teaching resource. For this fifth edition of the CiML workshop at NIPS we want to go beyond simple data science challenges using canned data. We will explore the possibilities offered by challenges in which code submitted by participants are evaluated "in the wild", directly interacting in real time with users or with real or simulated systems. Organizing challenges "in the wild" is not new. One of the most impactful such challenge organized relatively recently is the DARPA grant challenge 2005 on autonomous navigation, which accelerated research on autonomous vehicles, leading to self-driving cars. Other high profile challenge series with live competitions include RoboCup, which has been running from the past 22 years. Recently, the machine learning community has started being interested in such interactive challenges, with last year at NIPS the learning to run challenge, an reinforcement learning challenge in which a human avatar had to be controlled with simulated muscular contractions, and the ChatBot challenge in which humans and robots had to engage into an intelligent conversation. Applications are countless for machine learning and artificial intelligence programs to solve problems in real time in the real world, by interacting with the environment. But organizing such challenges is far from trivial. The workshop will give a large part to discussions around two principal axes: (1) Design principles and implementation issues; (2) Opportunities to organize new impactful challenges. Our objectives include bringing together potential partner to organize new such challenges and stimulating "machine learning for good", i.e. the organization of challenges for the benefit of society. CiML is a forum that brings together workshop organizers, platform providers, and participants to discuss best practices in challenge organization and new methods and application opportunities to design high impact challenges. Following the success of previous years' workshops, we propose to reconvene and discuss new opportunities for challenges "in the wild", one of the hottest topics in challenge organization. We have invited prominent speakers having experience in this domain. The audience of this workshop is targeted to workshop organizers, participants, and anyone with scientific problem involving machine learning, which may be formulated as a challenge. The emphasis of the workshop is on challenge design. Hence it complements nicely the workshop on the NIPS 2018 competition track and will help paving the way toward next year's competition program. Submit abstract (up to 2 pages) before October 10 by sending email to [nips2018@chalearn.org](mailto:nips2018@chalearn.org). See <http://ciml.chalearn.org/ciml2018#CALL>.

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## **Learning by Instruction**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Shashank Srivastava · Igor Labutov · Bishan Yang · Amos Azaria · Tom Mitchell*

Today machine learning is largely about pattern discovery and function approximation. But as computing devices that interact with us in natural language become ubiquitous (e.g., Siri, Alexa, Google Now), and as computer perceptual abilities become more accurate, they open an exciting possibility of enabling end-users to teach machines similar to the way in which humans teach one another. Natural language conversation, gesturing, demonstrating, teleoperating and other modes of communication offer a new paradigm for machine learning through instruction from humans. This builds on several existing machine learning paradigms (e.g., active learning, supervised learning, reinforcement learning), but also brings a new set of advantages and research challenges that lie at the intersection of several fields including machine learning, natural language understanding, computer perception, and HCI. The aim of this workshop is to engage researchers from these diverse fields to explore fundamental research questions in this new area, such as:

How do people interact with learning agents when teaching them new learning tasks and knowledge? What novel learning algorithms are needed to learn from grounded human interaction? What are the practical considerations towards building practical systems that can learn from instruction?

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## **NIPS 2018 Competition Track Day 2**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @**

*Ralf Herbrich · Sergio Escalera*

NIPS 2018 Competitions, day 2: Live NIPS competitions & Machine Learning Challenges "in the Wild"

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## **NIPS Workshop on Machine Learning for Intelligent Transportation Systems 2018**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Li Erran Li · Anca Dragan · Juan Carlos Niebles · Silvio Savarese*

Our transportation systems are poised for a transformation as we make progress on autonomous vehicles, vehicle-to-vehicle (V2V) and vehicle-to-everything (V2X) communication infrastructures, and smart road infrastructures (like smart traffic lights). But many challenges stand in the way of this transformation. For example, how do we make perception accurate and robust enough to accomplish safe autonomous driving? How do we generate policies that equip autonomous cars with adaptive human negotiation skills when merging, overtaking, or yielding? How do we decide when a

system is safe enough to deploy? And how do we optimize efficiency through intelligent traffic management and control of fleets? To meet these requirements in safety, efficiency, control, and capacity, the systems must be automated with intelligent decision making. Machine learning will be an essential component of that. Machine learning has made rapid progress in the self-driving domain (e.g., in real-time perception and prediction of traffic scenes); has started to be applied to ride-sharing platforms such as Uber (e.g., demand forecasting); and by crowd-sourced video scene analysis companies such as Nexar (e.g., understanding and avoiding accidents). But to address the challenges arising in our future transportation system, we need to consider the transportation systems as a whole rather than solving problems in isolation, from prediction, to behavior, to infrastructure. The goal of this workshop is to bring together researchers and practitioners from all areas of intelligent transportation systems to address core challenges with machine learning. These challenges include, but are not limited to pedestrian detection, intent recognition, and negotiation, coordination with human-driven vehicles, machine learning for object tracking, unsupervised representation learning for autonomous driving, deep reinforcement learning for learning driving policies, cross-modal and simulator to real-world transfer learning, scene classification, real-time perception and prediction of traffic scenes, uncertainty propagation in deep neural networks, efficient inference with deep neural networks, predictive modeling of risk and accidents through telematics, modeling, simulation and forecast of demand and mobility patterns in large scale urban transportation systems, machine learning approaches for control and coordination of traffic leveraging V2V and V2X infrastructures. The workshop will include invited speakers, panels, presentations of accepted papers, and posters. We invite papers in the form of short, long, and position papers to address the core challenges mentioned above. We encourage researchers and practitioners on self-driving cars, transportation systems and ride-sharing platforms to participate. Since this is a topic of broad and current interest, we expect at least 150 participants from leading university researchers, auto-companies and ride-sharing companies. This will be the 3rd NIPS workshop in this series. Previous workshops have been very successful and have attracted large numbers of participants from both academia and industry.

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## **Relational Representation Learning**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Aditya Grover · Paroma Varma · Frederic Sala · Christopher Ré · Jennifer Neville · Stefano Ermon · Steven Holtzen*

Relational reasoning, i.e., learning and inference with relational data, is key to understanding how objects interact with each other and give rise to complex phenomena in the everyday world. Well-known applications include knowledge base completion and social network analysis. Although many relational datasets are available, integrating them directly into modern machine learning algorithms and systems that rely on continuous, gradient-based optimization and make strong i.i.d. assumptions is challenging. Relational representation learning has the potential to overcome these obstacles: it enables the fusion of recent advancements like deep learning and relational reasoning to learn from

high-dimensional data. Success of such methods can facilitate novel applications of relational reasoning in areas like scene understanding, visual question-answering, reasoning over chemical and biological domains, program synthesis and analysis, and decision-making in multi-agent systems. How should we rethink classical representation learning theory for relational representations? Classical approaches based on dimensionality reduction techniques such as isoMap and spectral decompositions still serve as strong baselines and are slowly paving the way for modern methods in relational representation learning based on random walks over graphs, message-passing in neural networks, group-invariant deep architectures etc. amongst many others. How can systems be designed and potentially deployed for large scale representation learning? What are promising avenues, beyond traditional applications like knowledge base and social network analysis, that can benefit from relational representation learning? This workshop aims to bring together researchers from both academia and industry interested in addressing various aspects of representation learning for relational reasoning. Topics include, but are not limited to:

- \* Algorithmic approaches. E.g., probabilistic generative models, message-passing neural networks, embedding methods, dimensionality reduction techniques, group-invariant architectures etc. for relational data
- \* Theoretical aspects. E.g., when and why do learned representations aid relational reasoning? How does the non-i.i.d. nature of relational data conflict with our current understanding of representation learning?
- \* Optimization and scalability challenges due to the inherent discreteness and curse of dimensionality of relational datasets
- \* Evaluation of learned relational representations
- \* Security and privacy challenges
- \* Domain-specific applications
- \* Any other topic of interest

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## **Machine Learning for Systems**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Anna Goldie · Azalia Mirhoseini · Jonathan Raiman · Kevin Swersky · Milad Hashemi*

This workshop is part two of a two-part series with one day focusing on Machine Learning for Systems and the other on Systems for Machine Learning. Although the two workshops are being led by different organizers, we are coordinating our call for papers to ensure that the workshops complement each other and that submitted papers are routed to the appropriate venue. The Systems for Machine Learning workshop focuses on designing systems to enable ML, whereas we focus on developing ML to optimize systems. Both fields are mature enough to warrant a dedicated workshop. Organizers on both sides are open to merging in the future, but this year we plan to run them separately on two different days. Designing specialized hardware and systems for deep learning is a topic that has received significant research attention, both in industrial and academic settings, leading to exponential increases in compute capability in GPUs and accelerators. However, using machine learning to optimize and accelerate software and hardware systems is a lightly explored but promising field, with broad implications for computing as a whole. Very recent work has outlined a broad scope where deep learning vastly outperforms traditional heuristics, including topics such as: scheduling [1], data structure design [2], microarchitecture [3], compilers [4], and control of warehouse scale computing systems [5]. The focus of this workshop is to expand upon this recent

work and build a community focused on using machine learning in computer systems problems. We seek to improve the state of the art in the areas where learning has already proven to perform better than traditional heuristics, as well as expand to new areas throughout the system stack such as hardware/circuit design and operating/runtime systems. By forming a community of academic and industrial researchers who are excited about this area, we seek to build towards intelligent, self optimizing systems and answer questions such as: How do we generate and share high quality datasets that span the layers of the system stack? Which learned representations best represent code performance and runtime? Which simulators and simulation methodologies provide a tractable proving ground for techniques like reinforcement learning? To this end, the target audience for this workshop includes a wide variety of attendees from state-of-the-art researchers in machine learning to domain experts in computer systems design. We have invited a broad set of expert speakers to present the potential for impact of combining machine learning research with computer systems. We hope that providing a formal venue for researchers from both fields to meet and interact will push forward both fundamental research in ML as well as real-world impact to computer systems design and implementation. The workshop will host 6 speakers/panelists (all confirmed) and we will put out a call for researchers to submit relevant papers, up to 4 pages in the default NIPS style, that will undergo a peer review process. Selected works will be presented as spotlights, contributed talks and/or posters. Speakers will be invited to participate in an interactive panel discussion to conclude the workshop. The organizers of this workshop span core research in machine learning, computer systems and architecture, as well as their intersection. Jointly, they have published in top-tier systems and machine learning conferences including: NIPS, ICML, ICLR, ISCA, MICRO, DAC, and SIGMETRICS. References: [1] Device Placement Optimization with Reinforcement Learning, <https://arxiv.org/pdf/1706.04972.pdf> [2] The Case for Learned Index Structures, <https://arxiv.org/abs/1712.01208> [3] Learning Memory Access Patterns, <https://arxiv.org/pdf/1803.02329.pdf> [4] End to End Deep Learning of Optimization Heuristics: <https://ieeexplore.ieee.org/document/8091247/?reload=true> [5] <https://deepmind.com/blog/deepmind-ai-reduces-google-data-centre-cooling-bill-40/> [6] Bayesian optimization for tuning the JVM, <https://www.youtube.com/watch?v=YhNl468S8CI> [7] Safe Exploration for Identifying Linear Systems via Robust Optimization: <https://arxiv.org/abs/1711.11165>

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## **Machine Learning for the Developing World (ML4D):** **Achieving sustainable impact**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*William Herlands · Maria De-Arteaga · Amanda Coston*

Global development experts are beginning to employ ML for diverse problems such as aiding rescue workers allocate resources during natural disasters, providing intelligent educational and healthcare services in regions with few human experts, and detecting corruption in government contracts. While ML represents a tremendous hope for accelerated development and societal change, it is often difficult to ensure that machine learning projects provide their promised benefit. The challenging

reality in developing regions is that pilot projects disappear after a few years or do not have the same effect when expanded beyond the initial test site, and prototypes of novel methodologies are often never deployed. At the center of this year's program is how to achieve sustainable impact of Machine Learning for the Developing World (ML4D). This one-day workshop will bring together a diverse set of participants from across the globe to discuss major roadblocks and paths to action. Practitioners and development experts will discuss essential elements for ensuring successful deployment and maintenance of technology in developing regions. Additionally, the workshop will feature cutting edge research in areas such as transfer learning, unsupervised learning, and active learning that can help ensure long-term ML system viability. Attendees will learn about contextual components to ensure effective projects, development challenges that can benefit from machine learning solutions, and how these problems can inspire novel machine learning research. The workshop will include invited and contributed talks, a poster session of accepted papers, panel discussions, and breakout sessions tailored to the workshop theme. We welcome paper submissions focussing on core ML methodology addressing ML4D roadblocks, application papers that showcase successful examples of ML4D, and research that evaluates the societal impact of ML.

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## **Infer to Control: Probabilistic Reinforcement Learning and Structured Control**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Leslie Kaelbling · Martin Riedmiller · Marc Toussaint · Igor Mordatch · Roy Fox · Tuomas Haarnoja*

Reinforcement learning and imitation learning are effective paradigms for learning controllers of dynamical systems from experience. These fields have been empowered by recent success in deep learning of differentiable parametric models, allowing end-to-end training of highly nonlinear controllers that encompass perception, memory, prediction, and decision making. The aptitude of these models to represent latent dynamics, high-level goals, and long-term outcomes is unfortunately curbed by the poor sample complexity of many current algorithms for learning these models from experience. Probabilistic reinforcement learning and inference of control structure are emerging as promising approaches for avoiding prohibitive amounts of controller-system interactions. These methods leverage informative priors on useful behavior, as well as controller structure such as hierarchy and modularity, as useful inductive biases that reduce the effective size of policy search space and shape the optimization landscape. Intrinsic and self-supervised signals can further guide the training process of distinct internal components — such as perceptual embeddings, predictive models, exploration policies, and inter-agent communication — to break down the hard holistic problem of control into more efficiently learnable parts. Effective inference methods are crucial for probabilistic approaches to reinforcement learning and structured control. Approximate control and model-free reinforcement learning exploit latent system structure and priors on policy structure, that are not directly evident in the controller-system interactions, and must be inferred by the learning algorithm. The growing interest of the reinforcement learning and optimal control community in the application of inference methods is synchronized well with the

development by the probabilistic learning community of powerful inference techniques, such as probabilistic programming, variational inference, Gaussian processes, and nonparametric regression. This workshop is a venue for the inference and reinforcement learning communities to come together in discussing recent advances, developing insights, and future potential in inference methods and their application to probabilistic reinforcement learning and structured control. The goal of this workshop is to catalyze tighter collaboration within and between the communities, that will be leveraged in upcoming years to rise to the challenges of real-world control problems.

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## **Emergent Communication Workshop**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Jakob Foerster · Angeliki Lazaridou · Ryan Lowe · Igor Mordatch · Douwe Kiela · Kyunghyun Cho*

Workshop website

Abstract Communication is one of the most impressive human abilities. The question of how communication arises has been studied for many decades, if not centuries. However, due to computational and representational limitations, past work was restricted to low dimensional, simple observation spaces. With the rise of deep reinforcement learning methods, this question can now be studied in complex multi-agent settings, which has led to flourishing activity in the area over the last two years. In these settings agents can learn to communicate in grounded multi-modal environments and rich communication protocols emerge. Last year at NIPS 2017 we successfully organized the inaugural workshop on emergent communication (<https://sites.google.com/site/emecom2017/>). We had a number of interesting submissions looking into the question of how language can emerge using evolution (see this Nature paper that was also presented at the workshop last year, <https://www.nature.com/articles/srep34615>) and under what conditions emerged language exhibits compositional properties, while others explored specific applications of agents that can communicate (e.g., answering questions about textual inputs, a paper presented by Google that was subsequently accepted as an oral presentation at ICLR this year, etc.). While last year's workshop was a great success, there are a lot of open questions. In particular, the more challenging and realistic use cases come from situations where agents do not have fully aligned interests and goals, i.e., how can we have credible communication amongst self-interested agents where each agent maximizes its own individual rewards rather than a joint team reward? This is a new computational modeling challenge for the community and recent preliminary results (e.g. "Emergent Communication through Negotiation", Cao et al., ICLR 2018.) reinforce the fact that it is no easy feat. Since machine learning has exploded in popularity recently, there is a tendency for researchers to only engage with recent machine learning literature, therefore at best reinventing the wheel and at worst recycling the same ideas over and over, increasing the probability of being stuck in local optima. For these reasons, just like last year, we want to take an interdisciplinary approach on the topic of emergent communication, inviting researchers from different fields (machine learning, game theory, evolutionary biology, linguistics, cognitive science, and programming languages) interested in the question of communication and emergent language to exchange ideas. This is particularly

important for this year's focus, since the question of communication in general-sum settings has been an active topic of research in game theory and evolutionary biology for a number of years, while it's a nascent topic in the area of machine learning.

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## **Interpretability and Robustness in Audio, Speech, and Language**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Mirco Ravanelli · Dmitry Serdyuk · Ehsan Variani · Bhuvana Ramabhadran*

Domains of natural and spoken language processing have a rich history deeply rooted in information theory, statistics, digital signal processing and machine learning. With the rapid rise of deep learning ("deep learning revolution"), many of these systematic approaches have been replaced by variants of deep neural methods, that often achieve unprecedented performance levels in many fields. With more and more of the spoken language processing pipeline being replaced by sophisticated neural layers, feature extraction, adaptation, noise robustness are learnt inherently within the network. More recently, end-to-end frameworks that learn a mapping from speech (audio) to target labels (words, phones, graphemes, sub-word units, etc.) are becoming increasingly popular across the board in speech processing in tasks ranging from speech recognition, speaker identification, language/dialect identification, multilingual speech processing, code switching, natural language processing, speech synthesis and much much more. A key aspect behind the success of deep learning lies in the discovered low and high-level representations, that can potentially capture relevant underlying structure in the training data. In the NLP domain, for instance, researchers have mapped word and sentence embeddings to semantic and syntactic similarity and argued that the models capture latent representations of meaning. Nevertheless, some recent works on adversarial examples have shown that it is possible to easily fool a neural network (such as a speech recognizer or a speaker verification system) by just adding a small amount of specially constructed noise. Such a remarkable sensibility towards adversarial attacks highlights how superficial the discovered representations could be, rising crucial concerns on the actual robustness, security, and interpretability of modern deep neural networks. This weakness naturally leads researchers to ask very crucial questions on what these models are really learning, how we can interpret what they have learned, and how the representations provided by current neural networks can be revealed or explained in a fashion that modeling power can be enhanced further. These open questions have recently raised the interest towards interpretability of deep models, as witness by the numerous works recently published on this topic in all the major machine learning conferences. Moreover, some workshops at NIPS 2016, NIPS 2017 and Interspeech 2017 have promoted research and discussion around this important issue. With our initiative, we wish to further foster some progresses on interpretability and robustness of modern deep learning techniques, with a particular focus on audio, speech and NLP technologies. The workshop will also analyze the connection between deep learning and models developed earlier for machine learning, linguistic analysis, signal processing, and speech recognition. This way we hope to encourage a discussion



amongst experts and practitioners in these areas with the expectation of understanding these models better and allowing to build upon the existing collective expertise. The workshop will feature invited talks, panel discussions, as well as oral and poster contributed presentations. We welcome papers that specifically address one or more of the leading questions listed below:

1. Is there a theoretical/linguistic motivation/analysis that can explain how nets encapsulate the structure of the training data it learns from?
2. Does the visualization of this information (MDS, t-SNE) offer any insights to creating a better model?
3. How can we design more powerful networks with simpler architectures?
4. How can we exploit adversarial examples to improve the system robustness?
5. Do alternative methods offer any complementary modeling power to what the networks can memorize?
6. Can we explain the path of inference?
7. How do we analyze data requirements for a given model? How does multilingual data improve learning power?

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## **Machine Learning Open Source Software 2018: Sustainable communities**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Heiko Strathmann · Viktor Gal · Ryan Curtin · Antti Honkela · Sergey Lisitsyn · Cheng Soon Ong*

Machine learning open source software (MLOSS) is one of the cornerstones of open science and reproducible research. Once a niche area for ML research, MLOSS today has gathered significant momentum, fostered both by scientific community, and more recently by corporate organizations. Along with open access and open data, it enables free reuse and extension of current developments in ML. The past mloss.org workshops at NIPS06, NIPS08, ICML10, NIPS13, and ICML15 successfully brought together researchers and developers from both fields, to exchange experiences and lessons learnt, to encourage interoperability between people and projects, and to demonstrate software to users in the ML community. Continuing the tradition in 2018, we plan to have a workshop that is a mix of invited speakers, contributed talks and discussion/activity sessions. This year's headline aims to give an insight of the challenges faced by projects as they seek long-term sustainability, with a particular focus on community building and preservation, and diverse teams. In the talks, we will cover some of the latest technical innovations as done by established and new projects. The main focus, however, will be on insights on project sustainability, diversity, funding and attracting new developers, both from academia and industry. We will discuss various strategies that help promoting gender diversity in projects (e.g. implementing quotas etc.) and how to promote developer growth within a project. We aim to make this workshop as diverse as possible within the field. This includes a gender balanced speakers, focussing on programming languages from different scientific communities, and in particular most of our invited speakers represent umbrella projects with a hugely diverse set of applications and users (NumFOCUS, openML, tidyverse). With a call for participation for software project demos, we aim to provide improved outreach and visibility, especially for smaller OSS projects as typically present in academia. In addition, our workshop will serve as a gathering of OSS developers in academia, for peer to peer exchange of learnt lessons, experiences, and sustainability and diversity tactics. The workshop will

include an interactive session to produce general techniques for driving community engagement and sustainability, such as application templates (Google Summer of Code, etc), “getting started” guides for new developers, and a collection of potential funding sources. We plan to conclude the workshop with a discussion on the headline topic.

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## **Integration of Deep Learning Theories**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Richard Baraniuk · Anima Anandkumar · Stephane Mallat · Ankit Patel · nhật Hồ*

Deep learning has driven dramatic performance advances on numerous difficult machine learning tasks in a wide range of applications. Yet, its theoretical foundations remain poorly understood, with many more questions than answers. For example: What are the modeling assumptions underlying deep networks? How well can we expect deep networks to perform? When a certain network succeeds or fails, can we determine why and how? How can we adapt deep learning to new domains in a principled way? While some progress has been made recently towards a foundational understanding of deep learning, most theory work has been disjointed, and a coherent picture has yet to emerge. Indeed, the current state of deep learning theory is like the fable “The Blind Men and the Elephant”. The goal of this workshop is to provide a forum where theoretical researchers of all stripes can come together not only to share reports on their individual progress but also to find new ways to join forces towards the goal of a coherent theory of deep learning. Topics to be discussed include:- Statistical guarantees for deep learning models- Expressive power and capacity of neural networks- New probabilistic models from which various deep architectures can be derived - Optimization landscapes of deep networks- Deep representations and invariance to latent factors- Tensor analysis of deep learning- Deep learning from an approximation theory perspective- Sparse coding and deep learning- Mixture models, the EM algorithm, and deep learning. In addition to invited and contributed talks by leading researchers from diverse backgrounds, the workshop will feature an extended poster/discussion session and panel discussion on which combinations of ideas are most likely to move theory of deep learning forward and which might lead to blind alleys.

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## **Wordplay: Reinforcement and Language Learning in Text-based Games**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Adam Trischler · Angeliki Lazaridou · Yonatan Bisk · Wendy Tay · Nate Kushman · Marc-Alexandre Côté · Alessandro Sordoni · Daniel Ricks · Tom Zahavy · Hal Daumé III*

Video games, via interactive learning environments like ALE [Bellemare et al., 2013], have been fundamental to the development of reinforcement learning algorithms that work on raw video inputs

rather than featurized representations. Recent work has shown that text-based games may present a similar opportunity to develop RL algorithms for natural language inputs [Narasimhan et al., 2015, Haroush et al., 2018]. Drawing on insights from both the RL and NLP communities, this workshop will explore this opportunity, considering synergies between text-based and video games as learning environments as well as important differences and pitfalls. Video games provide infinite worlds of interaction and grounding defined by simple, physics-like dynamics. While it is difficult, if not impossible, to simulate the full and social dynamics of linguistic interaction (see, e.g., work on user simulation and dialogue [Georgila et al., 2006, El Asri et al., 2016]), text-based games nevertheless present complex, interactive simulations that ground language in world and action semantics. Games like Zork [Infocom, 1980] rose to prominence in the age before advanced computer graphics. They use simple language to describe the state of the environment and to report the effects of player actions. Players interact with the environment through text commands that respect a predefined grammar, which, though simplistic, must be discovered in each game. Through sequential decision making, language understanding, and language generation, players work toward goals that may or may not be specified explicitly, and earn rewards (points) at completion or along the way. Text-based games present a broad spectrum of challenges for learning algorithms. In addition to language understanding, successful play generally requires long-term memory and planning, exploration/experimentation, affordance extraction [Fulda et al., 2017], and common sense. Text games also highlight major open challenges for RL: the action space (text) is combinatorial and compositional, while game states are partially observable, since text is often ambiguous or underspecific. Furthermore, in text games the set of actions that affect the state is not known in advance but must be learned through experimentation, typically informed by prior world/linguistic knowledge. There has been a host of recent work towards solving text games [Narasimhan et al., 2015, Fulda et al., 2017, Kostka et al., 2017, Zhilin, et al., 2017, Haroush et al., 2018]. Nevertheless, commercial games like Zork remain beyond the capabilities of existing approaches. We argue that addressing even a subset of the aforementioned challenges would represent important progress in machine learning. Agents that solve text-based games may further learn functional properties of language; however, it is unclear what limitations the constraints and simplifications of text games (e.g., on linguistic diversity) impose on agents trained to solve them. This workshop will highlight research that investigates existing or novel RL techniques for text-based settings, what agents that solve text-based games (might) learn about language, and more generally whether text-based games provide a good testbed for research at the intersection of RL and NLP. The program will feature a collection of invited talks alongside contributed posters and spotlight talks, curated by a committee with broad coverage of the RL and NLP communities. Panel discussions will highlight perspectives of influential researchers from both fields and encourage open dialogue. We will also pose a text-based game challenge several months in advance of the workshop (a similar competition is held annually at the IEEE Conference on Computational Intelligence and Games). This optional component will enable participants to design, train, and test agents in a carefully constructed, interactive text environment. The best-performing agent(s) will be recognized and discussed at the workshop. In addition to the exchange of ideas and the initiation of collaboration, an expected outcome is that text-based games emerge more prominently as a benchmark task to bridge RL and NLP research. Relevant topics to be addressed at the workshop include (but are not limited to):- RL in compositional, combinatorial action spaces- Open RL problems that are especially pernicious in

text-based games, like (sub)goal identification and efficient experimentation- Grounded language understanding- Online language acquisition- Affordance extraction (on the fly)- Language generation and evaluation in goal-oriented settings- Automatic or crowdsourcing methods for linguistic diversity in simulations- Use of language to constrain or index RL policies [Andreas et al., 2017]

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## **Machine Learning for Molecules and Materials**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*José Miguel Hernández-Lobato · Klaus-Robert Müller · Brooks Paige · Matt Kusner · Stefan Chmiela · Kristof Schütt*

Workshop Website: <http://www.quantum-machine.org/workshops/nips2018draft/> Deadline: November 2nd, 11:59pm UTC The success of machine learning has been demonstrated time and time again in classification, generative modelling, and reinforcement learning. This revolution in machine learning has largely been in domains with at least one of two key properties: (1) the input space is continuous, and thus classifiers and generative models are able to smoothly model unseen data that is ‘similar’ to the training distribution, or (2) it is trivial to generate data, such as in controlled reinforcement learning settings such as Atari or Go games, where agents can re-play the game millions of times. Unfortunately there are many important learning problems in chemistry, physics, materials science, and biology that do not share these attractive properties, problems where the input is molecular or material data. Accurate prediction of atomistic properties is a crucial ingredient toward rational compound design in chemical and pharmaceutical industries. Many discoveries in chemistry can be guided by screening large databases of computational molecular structures and properties, but high level quantum-chemical calculations can take up to several days per molecule or material at the required accuracy, placing the ultimate achievement of in silico design out of reach for the foreseeable future. In large part the current state of the art for such problems is the expertise of individual researchers or at best highly-specific rule-based heuristic systems. Efficient methods in machine learning, applied to the prediction of atomistic properties as well as compound design and crystal structure prediction, can therefore have pivotal impact in enabling chemical discovery and foster fundamental insights. Because of this, in the past few years there has been a flurry of recent work towards designing machine learning techniques for molecule and material data [1-38]. These works have drawn inspiration from and made significant contributions to areas of machine learning as diverse as learning on graphs to models in natural language processing. Recent advances enabled the acceleration of molecular dynamics simulations, contributed to a better understanding of interactions within quantum many-body system and increased the efficiency of density based quantum mechanical modeling methods. This young field offers unique opportunities for machine learning researchers and practitioners, as it presents a wide spectrum of challenges and open questions, including but not limited to representations of physical systems, physically constrained models, manifold learning, interpretability, model bias, and causality. The goal of this workshop is to bring together researchers and industrial practitioners in the fields of computer science, chemistry, physics, materials science, and biology all working to

innovate and apply machine learning to tackle the challenges involving molecules and materials. In a highly interactive format, we will outline the current frontiers and present emerging research directions. We aim to use this workshop as an opportunity to establish a common language between all communities, to actively discuss new research problems, and also to collect datasets by which novel machine learning models can be benchmarked. The program is a collection of invited talks, alongside contributed posters. A panel discussion will provide different perspectives and experiences of influential researchers from both fields and also engage open participant conversation. An expected outcome of this workshop is the interdisciplinary exchange of ideas and initiation of collaboration.

**Call for papers:** The 1 day NIPS 2018 Workshop on Machine Learning for Molecules and Materials is calling for contributions on theoretical models, empirical studies, and applications of machine learning for molecules and materials. We also welcome challenge papers on possible applications or datasets. Topics of interest (though not exhaustive) include: chemoinformatics, applications of deep learning to predict molecular properties, drug-discovery and material design, retrosynthesis and synthetic route prediction, modeling and prediction of chemical reaction data, and the analysis of molecular dynamics simulations. We invite submissions that either address new problems and insights for chemistry and quantum physics or present progress on established problems. The workshop includes a poster session, giving the opportunity to present novel ideas and ongoing projects. Submissions should be no longer than 10 pages in any format. Please email all submissions to: [nips2018moleculesworkshop@gmail.com](mailto:nips2018moleculesworkshop@gmail.com)

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## **Medical Imaging meets NIPS**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Ender Konukoglu · Ben Glocker · Hervé Lombaert · Marleen de Bruijne*

Scope 'Medical Imaging meets NIPS' is a new satellite workshop established in 2017. The workshop aims to bring researchers together from the medical image computing and machine learning communities. The objective is to discuss the major challenges in the field and opportunities for joining forces. This year the workshop will feature an oral and poster session where accepted works are presented. In addition, there will be a series of high-profile invited speakers from industry, academia, engineering and medical sciences giving an overview of recent advances, challenges, latest technology and efforts for sharing clinical data. Motivation Medical imaging is facing a major crisis with an ever increasing complexity and volume of data and immense economic pressure. The interpretation of medical images pushes human abilities to the limit with the risk that critical patterns of disease go undetected. Machine learning has emerged as a key technology for developing novel tools in computer aided diagnosis, therapy and intervention. Still, progress is slow compared to other fields of visual recognition which is mainly due to the domain complexity and constraints in clinical applications which require most robust, accurate, and reliable solutions. Call for Abstracts We invite submissions of extended abstracts for oral and poster presentation during the workshop. Submitting an abstract is an ideal way of engaging with the workshop and to showcase research in the area of machine learning for medical imaging. Submitted work does not have to be original and can be already published elsewhere and/or can be of preliminary nature. There will be no workshop proceedings, but accepted abstracts together with author information will be made available on this website. Dates

Submissions: Monday, October 15th, 23:59 PST Notifications: Wednesday, October 31st Workshop: Saturday, December 8th

### Invited Talks

Max Welling (University of Amsterdam) Olaf Ronneberger (DeepMind Health) Tal Arbel (McGill University) Holger Roth (NVIDIA)

### Organizers

Ender Konukoglu (ETH Zurich, Switzerland) Hervé Lombaert (ETS Montreal – Inria, Canada) Ben Glocker (Imperial College London, UK) Marleen de Bruijne (Erasmus MC, Rotterdam, The Netherlands)

## **Reinforcement Learning under Partial Observability**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Joni Pajarinen · Chris Amato · Pascal Poupart · David Hsu*

Reinforcement learning (RL) has succeeded in many challenging tasks such as Atari, Go, and Chess and even in high dimensional continuous domains such as robotics. Most impressive successes are in tasks where the agent observes the task features fully. However, in real world problems, the agent usually can only rely on partial observations. In real time games the agent makes only local observations; in robotics the agent has to cope with noisy sensors, occlusions, and unknown dynamics. Even more fundamentally, any agent without a full a priori world model or without full access to the system state, has to make decisions based on partial knowledge about the environment and its dynamics. Reinforcement learning under partial observability has been tackled in the operations research, control, planning, and machine learning communities. One of the goals of the workshop is to bring researchers from different backgrounds together. Moreover, the workshop aims to highlight future applications. In addition to robotics where partial observability is a well known challenge, many diverse applications such as wireless networking, human-robot interaction and autonomous driving require taking partial observability into account. Partial observability introduces unique challenges: the agent has to remember the past but also connect the present with potential futures requiring memory, exploration, and value propagation techniques that can handle partial observability. Current model-based methods can handle discrete values and take long term information gathering into account while model-free methods can handle high-dimensional continuous problems but often assume that the state space has been created for the problem at hand such that there is sufficient information for optimal decision making or just add memory to the policy without taking partial observability explicitly into account. In this workshop, we want to go further and ask among others the following questions.\* How can we extend deep RL methods to robustly solve partially observable problems?\* Can we learn concise abstractions of history that are sufficient for high-quality decision-making?\* There have been several successes in decision making under partial observability despite the inherent challenges. Can we characterize problems where computing good policies is feasible?\* Since decision making is hard under partial observability do we want to use more complex models and solve them approximately or use (inaccurate) simple models and solve them exactly? Or not use models at all?\* How can we use control theory together with reinforcement learning to advance decision making under partial observability?\* Can we combine the strengths of model-based and model-free methods under partial observability?\* Can recent method improvements in general RL already tackle some partially observable applications which were not previously possible?\* How do we scale up reinforcement learning in multi-agent systems with partial observability?\* Do hierarchical models / temporal abstraction improve RL efficiency under partial observability?



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## **Second Workshop on Machine Learning for Creativity and Design**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Luba Elliott · Sander Dieleman · Rebecca Fiebrink · Jesse Engel · Adam Roberts · Tom White*

Over the past few years, generative machine learning and machine creativity have continued grow and attract a wider audience to machine learning. Generative models enable new types of media creation across images, music, and text - including recent advances such as sketch-rnn and the Universal Music Translation Network. This one-day workshop broadly explores issues in the applications of machine learning to creativity and design. We will look at algorithms for generation and creation of new media and new designs, engaging researchers building the next generation of generative models (GANs, RL, etc). We investigate the social and cultural impact of these new models, engaging researchers from HCI/UX communities and those using machine learning to develop new creative tools. In addition to covering the technical advances, we also address the ethical concerns ranging from the use of biased datasets to building tools for better “DeepFakes”. Finally, we’ll hear from some of the artists and musicians who are adopting machine learning including deep learning and reinforcement learning as part of their own artistic process. We aim to balance the technical issues and challenges of applying the latest generative models to creativity and design with philosophical and cultural issues that surround this area of research. BackgroundIn 2016, DeepMind’s AlphaGo made two moves against Lee Sedol that were described by the Go community as “brilliant,” “surprising,” “beautiful,” and so forth. Moreover, there was little discussion surrounding the fact that these very creative moves were actually made by a machine; it was enough that they were great examples of go playing. At the same time, the general public showed more concern for other applications of generative models. Algorithms that allow for convincing voice style transfer (Lyrebird) or puppet-like video face control (Face2Face) have raised ethical concerns that generative ML will be used to make convincing forms of fake news Balancing this, the arts and music worlds have positively embraced generative models. Starting with DeepDream and expanding with image and video generation advances (e.g. GANs) we’ve seen lots of new and interesting art and music technologies provided by the machine learning community. We’ve seen research projects like Google Brain’s Magenta, Sony CSL’s FlowMachines and IBM’s Watson undertake collaborations and attempt to build tools and ML models for use by these communities. ResearchRecent advances in generative models enable new possibilities in art and music production. Language models can be used to write science fiction film scripts (Sunspring), theatre plays (Beyond the Fence) and even replicate the style of individual authors (Deep Tingle). Generative models for image and video allow us to create visions of people, places and things that resemble the distribution of actual images (GANs etc). Sequence modelling techniques have opened up the possibility of generating realistic musical scores (MIDI generation etc) and even raw audio that resembles human speech and physical instruments (DeepMind’s WaveNet, MILA’s Char2Wav and Google’s NSynth). In addition, sequence modelling allows us to model vector images to construct stroke-based drawings of common objects according to human doodles (sketch-rnn). Lately, domain transfer techniques

(FAIR's Universal Music Translation Network) have enabled the translation of music across musical instruments, genres, and styles. In addition to field-specific research, a number of papers have come out that are directly applicable to the challenges of generation and evaluation such as learning from human preferences (Christiano et al., 2017) and CycleGAN. The application of Novelty Search (Stanley), evolutionary complexification (Stanley - CPPN, NEAT, Nguyen et al - Plug&Play GANs, Innovation Engine) and intrinsic motivation (Oudeyer et al 2007, Schmidhuber on Fun and Creativity) techniques, where objective functions are constantly evolving, is still not common practice in art and music generation using machine learning. Another focus of the workshop is how to better enable human influence over generative models. This could include learning from human preferences, exposing model parameters in ways that are understandable and relevant to users in a given application domain (e.g., similar to Morris et al. 2008), enabling users to manipulate models through changes to training data (Fiebrink et al. 2011), allowing users to dynamically mix between multiple generative models (Akten & Grierson 2016), or other techniques. Although questions of how to make learning algorithms controllable and understandable to users are relatively nascent in the modern context of deep learning and reinforcement learning, such questions have been a growing focus of work within the human-computer interaction community (e.g., examined in a CHI 2016 workshop on Human-Centred Machine Learning), and the AI Safety community (e.g. Christiano et al. 2017, using human preferences to train deep reinforcement learning systems). Such considerations also underpin the new Google "People + AI Research" (PAIR) initiative. Artists and MusiciansAll the above techniques improve our capabilities of producing text, sound and images and have helped popularise the themes of machine learning and artificial intelligence in the art world with a number of art exhibitions (ZKM's Open Codes, Frankfurter Kunstverein's I am here to learn, NRW Forum's Pendoran Vinci) and media art festivals (Impakt Festival 2018 Algorithmic Superstructures, Retune 2016) dedicated to the topic. Art and music that stands the test of time however requires more than generative capabilities. Recent research includes a focus on novelty in creative adversarial networks (Elgammal et al., 2017) and considers how generative algorithms can integrate into human creative processes, supporting exploration of new ideas as well as human influence over generated content (Akten & Grierson 2016a, 2016b). Artists including Mario Klingemann, Roman Lipski, Mike Tyka, and Memo Akten have further contributed to this space of work by creating artwork that compellingly demonstrates capabilities of generative algorithms, and by publicly reflecting on the artistic affordances of these new tools. Other artists such as Mimi Onuoha, Caroline Sinderson, and Adam Harvey have explored the ethical dimensions of machine learning technologies, reflecting on the issues of biased datasets and facial recognition. The goal of this workshop is to bring together researchers interested in advancing art and music generation to present new work, foster collaborations and build networks. In this workshop, we are particularly interested in how the following can be used in art and music generation: reinforcement learning, generative adversarial networks, novelty search and evaluation as well as learning from user preferences. We welcome submissions of short papers, demos and extended abstracts related to the above. Like last year, there will be an open call for a display of artworks incorporating machine learning techniques. The exhibited works serve as a separate and more personal forum for collecting and sharing some of the latest creative works incorporating machine learning techniques with the NIPS community.

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## **Privacy Preserving Machine Learning**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Adria Gascon · Aurélien Bellet · Niki Kilbertus · Olga Ohrimenko · Mariana Raykova · Adrian Weller*

Website Description This one day workshop focuses on privacy preserving techniques for training, inference, and disclosure in large scale data analysis, both in the distributed and centralized settings. We have observed increasing interest of the ML community in leveraging cryptographic techniques such as Multi-Party Computation (MPC) and Homomorphic Encryption (HE) for privacy preserving training and inference, as well as Differential Privacy (DP) for disclosure. Simultaneously, the systems security and cryptography community has proposed various secure frameworks for ML. We encourage both theory and application-oriented submissions exploring a range of approaches, including:

secure multi-party computation techniques for ML homomorphic encryption techniques for ML hardware-based approaches to privacy preserving ML centralized and decentralized protocols for learning on encrypted data differential privacy: theory, applications, and implementations statistical notions of privacy including relaxations of differential privacy empirical and theoretical comparisons between different notions of privacy trade-offs between privacy and utility

We think it will be very valuable to have a forum to unify different perspectives and start a discussion about the relative merits of each approach. The workshop will also serve as a venue for networking people from different communities interested in this problem, and hopefully foster fruitful long-term collaboration.

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## **AI for social good**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Margaux Luck · Tristan Sylvain · Joseph Paul Cohen · Arsene Fansi Tchango · Valentine Goddard · Aurelie Helouis · Yoshua Bengio · Samuel Greydanus · Cody Wild · Taras Kucherenko · Arya Farahi · Jonathan Penn · Sean McGregor · Mark Crowley · Abhishek Gupta · Kenny Chen · Myriam Côté*

AI for Social Good Important information Workshop website Submission website Abstract The “AI for Social Good” will focus on social problems for which artificial intelligence has the potential to offer meaningful solutions. The problems we chose to focus on are inspired by the United Nations Sustainable Development Goals (SDGs), a set of seventeen objectives that must be addressed in order to bring the world to a more equitable, prosperous, and sustainable path. In particular, we will focus on the following areas: health, education, protecting democracy, urban planning, assistive technology for people with disabilities, agriculture, environmental sustainability, economic

inequality, social welfare and justice. Each of these themes present opportunities for AI to meaningfully impact society by reducing human suffering and improving our democracies. The AI for Social Good workshop divides the in-focus problem areas into thematic blocks of talks, panels, breakout planning sessions, and posters. Particular emphasis is given to celebrating recent achievements in AI solutions, and fostering collaborations for the next generation of solutions for social good. First, the workshop will feature a series of invited talks and panels on agriculture and environmental protection, education, health and assistive technologies, urban planning and social services. Secondly, it will bring together ML researchers, leaders of social impact, people who see the needs in the field as well as philanthropists in a forum to present and discuss interesting research ideas and applications with the potential to address social issues. Indeed, the rapidly expanding field of AI has the potential to transform many aspects of our lives. However, two main problems arise when attempting to tackle social issues. There are few venues in which to share successes and failures in research at the intersection of AI and social problems, an absence this workshop is designed to address by showcasing these marginalized but impactful works of research. Also, it is difficult to find and evaluate problems to address for researchers with an interest on having a social impact. We hope this will inspire the creation of new tools by the community to tackle these important problems. Also, this workshop promotes the sharing of information about datasets and potential projects which could interest machine learning researchers who want to apply their skills for social good. The workshop also explores how artificial intelligence can be used to enrich democracy, social welfare, and justice. A focus on these topics will connect researchers to civil society organizations, NGOs, local governments, and other organizations to enable applied AI research for beneficial outcomes. Various case-studies and discussions are introduced around these themes: summary of existing AI for good projects and key issues for the future, AI's impact on economic inequality, AI approaches to social sciences, and civil society organizations. The definition of what constitutes social good being essential to this workshop, we will have panel discussions with leading social scholars to frame how contemporary AI/ML applications relate to public and philosophical notions of social good. We also aim to define new, quantifiable, and impactful research questions for the AI/ML community. Also, we would like as an outcome of this event the creation of a platform to share data, a pact with leading tech companies to support research staff sabbaticals with social progress organizations, and the connection of researchers to on-the-ground problem owners and funders for social impact. We invite contributions relating to any of the workshop themes or more broadly any of the UN SDGs. The models or approaches presented do not necessarily need to be of outstanding theoretical novelty, but should demonstrate potential for a strong social impact. We invite two types of submissions. First, we invite research work as short papers (4 page limit) for oral and/or poster presentation. Second, we invite two page abstracts presenting a specific solution that would, if accepted, be discussed during round-table events. The short papers should focus on past and current work, showcasing actual results and ideally demonstrated beneficial effect on society, whereas the two page abstracts could highlight ideas that have not yet been applied in practice. These are designed to foster sharing different points of view ranging from the scientific assessment of feasibility, to discussion of practical constraints that may be encountered when they are deployed, also attracting interest from philanthropists invited to the event. The workshop provides a platform for developing these two page abstracts into real projects with a platform to connect with stakeholders, scientists, and funders.

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## **Machine Learning for Health (ML4H): Moving beyond supervised learning in healthcare**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @ None**

*Andrew Beam · Tristan Naumann · Marzyeh Ghassemi · Matthew McDermott · Madalina Fiterau · Irene Y Chen · Brett Beaulieu-Jones · Michael Hughes · Farah Shamout · Corey Chivers · Jaz Kandola · Alexandre Yahi · Samuel G Finlayson · Bruno Jedynak · Peter Schulam · Natalia Antropova · Jason Fries · Adrian Dalca · Irene Chen*

Machine learning has had many notable successes within healthcare and medicine. However, nearly all such successes to date have been driven by supervised learning techniques. As a result, many other important areas of machine learning have been neglected and under appreciated in healthcare applications. In this workshop, we will convene a diverse set of leading researchers who are pushing beyond the boundaries of traditional supervised approaches. Attendees at the workshop will gain an appreciation for problems that are unique to healthcare and a better understanding of how machine learning techniques, including clustering, active learning, dimensionality reduction, reinforcement learning, causal inference, and others, may be leveraged to solve important clinical problems. This year's program will also include spotlight presentations and two poster sessions highlighting novel research contributions at the intersection of machine learning and healthcare. We will invite submission of two page abstracts (not including references) for poster contributions. Topics of interest include but are not limited to models for diseases and clinical data, temporal models, Markov decision processes for clinical decision support, multiscale data-integration, modeling with missing or biased data, learning with non-stationary data, uncertainty and uncertainty propagation, non i.i.d. structure in the data, critique of models, interpretable models, causality, model biases, transfer learning, and incorporation of non-clinical (e.g., socioeconomic) factors. The broader goal of the NIPS 2018 Machine Learning for Health Workshop (ML4H) is to foster collaborations that meaningfully impact medicine by bringing together clinicians, health data experts, and machine learning researchers. Attendees at this workshop can also expect to broaden their network of collaborators to include clinicians and machine learning researchers who are focused on solving some of the most important problems in medicine and healthcare.

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## **NIPS 2018 Workshop on Meta-Learning**

**Workshop | Sat Dec 8th 08:00 AM -- 06:30 PM @**

*Joaquin Vanschoren · Frank Hutter · Sachin Ravi · Jane Wang · Erin Grant*

Recent years have seen rapid progress in meta-learning methods, which learn (and optimize) the performance of learning methods based on data, generate new learning methods from scratch, or learn to transfer knowledge across tasks and domains. Meta-learning can be seen as the logical

conclusion of the arc that machine learning has undergone in the last decade, from learning classifiers, to learning representations, and finally to learning algorithms that themselves acquire representations and classifiers. The ability to improve one's own learning capabilities through experience can also be viewed as a hallmark of intelligent beings, and there are strong connections with work on human learning in neuroscience. Meta-learning methods are also of substantial practical interest, since they have, e.g., been shown to yield new state-of-the-art automated machine learning methods, novel deep learning architectures, and substantially improved one-shot learning systems. Some of the fundamental questions that this workshop aims to address are:- What are the fundamental differences in the learning "task" compared to traditional "non-meta" learners?- Is there a practical limit to the number of meta-learning layers (e.g., would a meta-meta-meta-learning algorithm be of practical use)?- How can we design more sample-efficient meta-learning methods?- How can we exploit our domain knowledge to effectively guide the meta-learning process?- What are the meta-learning processes in nature (e.g, in humans), and how can we take inspiration from them?- Which ML approaches are best suited for meta-learning, in which circumstances, and why?- What principles can we learn from meta-learning to help us design the next generation of learning systems? The goal of this workshop is to bring together researchers from all the different communities and topics that fall under the umbrella of meta-learning. We expect that the presence of these different communities will result in a fruitful exchange of ideas and stimulate an open discussion about the current challenges in meta-learning, as well as possible solutions. In terms of prospective participants, our main targets are machine learning researchers interested in the processes related to understanding and improving current meta-learning algorithms. Specific target communities within machine learning include, but are not limited to: meta-learning, AutoML, reinforcement learning, deep learning, optimization, evolutionary computation, and Bayesian optimization. Our invited speakers also include researchers who study human learning, to provide a broad perspective to the attendees.

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## **Coffee Break**

**Break | Sat Dec 8th 10:30 -- 11:00 AM @**

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## **Coffee Break**

**Break | Sat Dec 8th 03:00 -- 03:30 PM @**

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**Closing Reception**

**Break | Sat Dec 8th 06:30 -- 08:30 PM @ Rooms 220 ABC Room 210 ABCD**

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