

# COLT 2018

Conference on Learning Theory  
July 5-9 2018, Stockholm, Sweden



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We are extremely grateful to our sponsors for being so very generous in supporting COLT, critically ensuring the conference's continued success, and making attendance more affordable for students through subsidized registration fees and travel awards which were provided to more than 25 student authors. Thank you for all your support and generosity.

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# Welcome to the 31st edition of COLT, the Conference on Learning Theory

This year, we will enjoy 91 presentations, each of them lasting for 10 minutes. We thank and congratulate the different authors for their contributions. Each presenter is invited to participate in a poster session at the end of the day of their presentation. During poster sessions, participants are able to engage directly with the presenter and learn more about the content of a paper. We also thank the three keynote speakers, Stephane Mallat, Susan Murphy and Johan Håstad for their participation.

*Sebastien Bubeck and Philippe Rigollet, Program chairs of COLT18*

Welcome to Stockholm, and to KTH Royal Institute of Technology! We are glad to host the conference this year, and hope you enjoy your stay in Stockholm. The social event is scheduled Sunday, July 8, at Artipelag, an astonishing museum in the archipelago. We will go there by bus. Please be in front of the main KTH building, Lindstedsvägen 1 at 7:30PM.

*Alexandre Proutiere, Local arrangement chair of COLT18*



# General information

## The conference venue

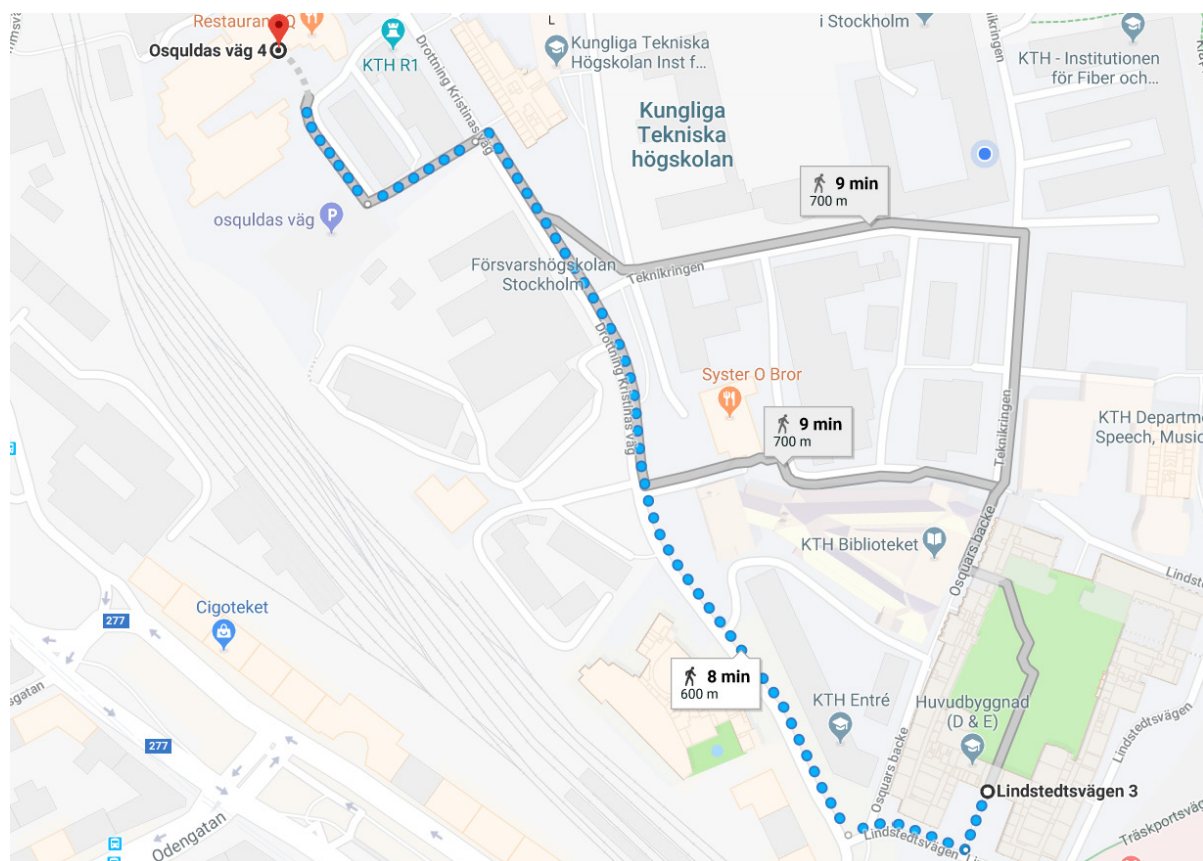
The conference venue is located in KTH main campus, room Q1, Malvinas väg 4 (previously called Osquldas väg 10), and is within walking distance from the metro (“tunnelbana”) station “Tekniska Högskolan”.

Lunches will be served in the ”Ljuskgården” at Lindstedtsvägen 3 in the E building, floor 3. See the map below showing how to walk from Q1 to Ljuskgården. Lunches on Monday will be served outside the room Q1.

## Stockholm and KTH

KTH is Sweden’s largest technical research and learning institution and home to students, researchers and faculty from around the world dedicated to advancing knowledge. KTH has over 13 000 students, about 1 800 doctoral students and 5 200 employees.

Stockholm is the beautiful capital of Sweden and the home of KTH. The city was founded in the 13th century and is situated on the east coast of Sweden, bordering the Baltic Sea. With 2.1 million inhabitants, it is the heart of Swedish trade and business life, and is known for its rich cultural history and closeness to nature.



# Practical information

## Getting around

The easiest and cheapest way to get around in Stockholm is with public transportation. The public transport system encompasses buses, tramways and metro, as well as commuter trains and some ferries.

The transport provider SL has recently changed to a completely electronic ticket system. You can not pay in cash when getting on board on a bus, tramway, metro or train. You can buy a card at the airport, any SL Center, Pressbyrån or at the manual ticket booths when entering the subway. Have the card pre-set to journeys within one zone (all of central Stockholm is the same zone).

You can also use the app “SL-Reseplanerare och biljetter” to pay for your ticket with your credit card.

If you are planning to use public transportation we encourage you to download the app “Res i Sthlm”, which will help you to plan your traveling. It can be set to English mode if desired.

## WiFi

You can use the WiFi “KTH-Conference”. The password for the first three days is xazupape, and on Monday vetyparo. Alternatively, you can use eduroam.



# Travel information

Arlanda Airport is located 40 kilometers north of Stockholm City and connected to downtown by a high-speed train and airport coach as well as public transportation alternatives.

## Airport coach

The buses from Arlanda take about 35-45 min and buses depart every 10-20 minutes from Arlanda Airport to the City Terminal (located next to Stockholm Central Station). Tickets cost 99 SEK if you buy online and 119 SEK when buying on the bus.

Website: <https://www.flygbussarna.se/en>

## The Arlanda Express train

The train from Arlanda takes about 20 min and departs every 15 minutes (most hours of the day). Ticket prices vary: 140 SEK for students, 150 SEK for youth up to 25 years and 280 SEK for adult 26 years and over. If you hold an International Student Identification Card (ISIC), ask for a student discount on the Arlanda Express train.

Website: <https://www.arlandaexpress.com/>

## Taxi

A taxi from Arlanda to the central station takes about 30 min. The prices are often fixed to any destination in Stockholm City and average at 520 SEK.

This is an affordable option if you are a group of students traveling together. We strongly recommend that you ask for the estimated price or the fixed price before you start a taxi journey. We recommend use of the major companies Taxi Stockholm and Taxi Kurir.

## Local transportation via commuter train

Local transportation takes about 38 minutes. The commuter trains depart from SkyCity located between terminal 4 and 5 regularly and the price is 151 SEK (regular SL ticket + extra airport fee).

Website: [www.sl.se/en](http://www.sl.se/en)

# Organizers

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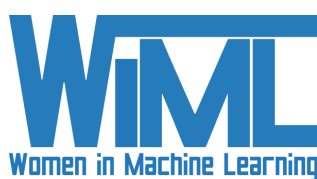
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## Host

KTH

## Local arrangements

Cecilia Lunglöf and Alexandre Proutiere

## Booklet design

Louise Gustafsson

## Program at a glance

**Thursday**  
5th of July  
Welcome reception and registration 6pm – 8pm, Ljusgården,  
E building KTH, 18:00

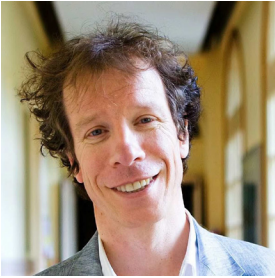
**Friday**  
6th of July  
Registration, 08:00-08:55  
Sessions in room Q1, 09:00-17:30  
Posters in rooms Q31 and Q34, 17:30-19:00

**Saturday**  
7th of July  
Sessions in room Q1, 09:00-17:00  
Posters in rooms Q31 and Q34, 18:00-20:00

**Sunday**  
8th of July  
Sessions in room Q1, 09:00-17:30  
Posters in rooms Q31 and Q34, 17:30-19:30  
Banquet at Artipelag, 19:30- 23:30,  
Bus departs at 19:30 from Lindstedsv. 1, <https://artipelag.se/>

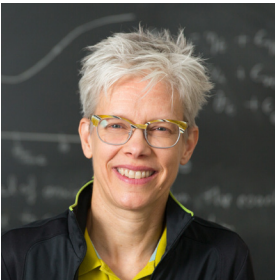
**Monday**  
9th of July  
09:00-12:00, Sessions in room Q1  
12:00-14:00, Posters in rooms Q31 and Q34

## Keynote speakers



### Stephane Mallat (Ecole Polytechnique)

Stephane Mallat's research interests include learning, signal processing, and harmonic analysis. He is a member of the French Academy of sciences, an IEEE Fellow and a EUSIPCO Fellow. In 1997, he received the Outstanding Achievement Award from the SPIE Society and was a plenary lecturer at the International Congress of Mathematicians in 1998.



### Susan Murphy (Harvard)

Susan Murphy's research focuses on improving sequential, individualized, decision making in health, in particular on clinical trial design and data analysis to inform the development of adaptive interventions (e.g. treatment policies). She is a member of the US National Academy of Sciences, a former editor of the Annals of Statistics and a 2013 MacArthur Fellow.



### Johan Håstad (KTH)

Johan Håstad is a theoretical computer scientist best known for his work on complexity theory. He has received two Gödel prizes, one in 1994 for his work on circuit lower bounds and one in 2011 for his work on hardness of approximation. He is a fellow of the American Mathematical Society and was a plenary speaker at the International Congress of Mathematicians in 1998.

## Friday, 6th of July

### Session 1: Registration (08:00-08:55)

### Session 2: Opening remarks (08:55-09:00)

Opening remarks by chairs Sebastien Bubeck and Philippe Rigollet

### Session 3 (09:00-10:00)

- 09:00 Tim Roughgarden and Joshua Wang  
An Optimal Learning Algorithm for Online Unconstrained Submodular Maximization
- 09:10 Ashok Cutkosky and Francesco Orabona  
Black-Box Reductions for Parameter-free Online Learning in Banach Spaces
- 09:20 Dirk van der Hoeven, Tim van Erven and Wojciech Kottowski  
The Many Faces of Exponential Weights in Online Learning
- 09:30 Gautam Goel, Niangjun Chen and Adam Wierman  
Smoothed Online Convex Optimization in High Dimensions via Online Balanced Descent
- 09:40 Jason Altschuler and Kunal Talwar  
Online learning over a finite action set with limited switching
- 09:50 Dylan Foster, Alexander Rakhlin and Karthik Sridharan  
Online Learning: Sufficient Statistics and the Burkholder Method

### Coffee break (10:00-10:30)

### Session 4 (10:30-12:00)

- 10:30 Rishabh Dudeja and Daniel Hsu  
Learning Single Index Models in Gaussian Space
- 10:40 David Durfee, Kevin A. Lai and Saurabh Sawlani  
L1 Regression using Lewis Weights Preconditioning and Stochastic Gradient Descent
- 10:50 Matthew Brennan, Guy Bresler and Wasim Huleihel  
Reducibility and Computational Lower Bounds for Problems with Planted Sparse Structure
- 11:00 Florent Krzakala, Lenka Zdeborova, Jean Barbier, Nicolas Macris and Leo Miolane  
Optimal Errors and Phase Transitions in High-Dimensional Generalized Linear Models
- 11:10 Guillaume Martinet and Samory Kpotufe  
Marginal Singularity, and the Benefits of Labels in Covariate-Shift
- 11:20 Yuanzhi Li and Yingyu Liang  
Learning Mixtures of Linear Regressions with Nearly Optimal Complexity
- 11:30 Adam Klivans, Pravesh K Kothari and Raghu Meka  
Efficient Algorithms for Outlier-Robust Regression
- 11:40 Dylan Foster, Satyen Kale, Haipeng Luo, Mehryar Mohri and Karthik Sridharan  
Logistic Regression: The Importance of Being Improper
- 11:50 Shiva Kasiviswanathan and Mark Rudelson  
Restricted Eigenvalue from Stable Rank with Applications to Sparse Linear Regression

**Lunch break (12:00-14:00)****Session 5: Invited talk Stephane Mallat (14:00-15:00)****Session 6 (15:20-16:20)**

- 15:20** Jonathan Weed  
An explicit analysis of the entropic penalty in linear programming
- 15:30** Naman Agarwal and Elad Hazan  
Lower Bounds for Higher-Order Convex Optimization
- 15:40** Yin Tat Lee, Aaron Sidford and Santosh Vempala  
Efficient Convex Optimization with Membership Oracles
- 15:50** Jacob Abernethy, Kevin A. Lai, Kfir Y. Levy and Jun-Kun Wang  
Faster Rates for Convex-Concave Games
- 16:00** Srinadh Bhojanapalli, Nicolas Boumal, Prateek Jain and Praneeth Netrapalli  
Smoothed Analysis for Efficient Semi-definite Programming
- 16:10** Oren Mangoubi and Nisheeth Vishnoi  
Convex Optimization with Unbounded Nonconvex Oracles Using Simulated Annealing

**Session 7 (16:30-17:30)**

CHAIR: Sacha Tsybakov

- 16:30** Yanjun Han, Jiantao Jiao and Tsachy Weissman  
Local moment matching: A unified methodology for symmetric functional estimation and distribution estimation under Wasserstein distance
- 16:40** Ilias Diakonikolas, Jerry Li and Ludwig Schmidt  
Fast and Sample Near-Optimal Algorithms for Learning Multidimensional Histograms
- 16:50** James Sharpnack  
Learning Patterns for Detection with Multiscale Scan Statistics
- 17:00** Yuval Dagan and Ohad Shamir  
Detecting Correlations with Little Memory and Communication
- 17:10** Steve Hanneke, Adam Kalai, Gautam Kamath and Christos Tzamos  
Actively Avoiding Nonsense in Generative Models
- 17:20** Timothy Carpenter, Ilias Diakonikolas, Anastasios Sidiropoulos and Alistair Stewart  
Near-Optimal Sample Complexity Bounds for Maximum Likelihood Estimation of Multivariate Log-concave Densities

**Session 8: Poster session (17:30-19:30)**

## Saturday, 7th of July

### Session 9 (09:00-10:00)

- 09:00 Manish Raghavan, Aleksandrs Slivkins, Jennifer Wortman Vaughan and Zhiwei Steven Wu  
The Externalities of Exploration and How Data Diversity Helps Exploitation
- 09:10 Max Simchowitz, Horia Mania, Stephen Tu, Michael Jordan and Benjamin Recht  
Learning Without Mixing: Towards A Sharp Analysis of Linear System Identification
- 09:20 Constantinos Daskalakis, Nishanth Dikkala and Nick Gravin  
Testing Symmetric Markov Chains From a Single Trajectory
- 09:30 Ana Busic and Sean Meyn  
Action-Constrained Markov Decision Processes With Kullback-Leibler Cost
- 09:40 Jalaj Bhandari, Daniel Russo and Raghav Singal  
A Finite Time Analysis of Temporal Difference Learning With Linear Function Approximation
- 09:50 Gal Dalal, Balazs Szorenyi, Gugan Thoppe and Shie Mannor  
Finite Sample Analysis of Two-Timescale Stochastic Approximation with Applications to Reinforcement Learning

### Coffee break (10:00-10:30)

### Session 10 (10:30-12:00)

- 10:30 Vladimir Kolmogorov  
A Faster Approximation Algorithm for the Gibbs Partition Function
- 10:40 Vishesh Jain, Frederic Koehler and Elchanan Mossel  
The Mean-Field Approximation: Information Inequalities, Algorithms, and Complexity
- 10:50 Vishesh Jain, Frederic Koehler and Elchanan Mossel  
The Vertex Sample Complexity of Free Energy is Polynomial
- 11:00 Guy Bresler and Dheeraj Nagaraj  
Optimal Single Sample Tests for Structured versus Unstructured Network Data
- 11:10 Marco Mondelli and Andrea Montanari  
Fundamental Limits of Weak Recovery with Applications to Phase Retrieval
- 11:20 Yu Cheng and Rong Ge  
Non-Convex Matrix Completion Against a Semi-Random Adversary
- 11:30 Jason Klusowski and Yihong Wu  
Counting Motifs with Graph Sampling
- 11:40 Cheng Mao, Ashwin Pananjady and Martin Wainwright  
Breaking the  $\frac{1}{\sqrt{n}}$  Barrier: Faster Rates for Permutation-based Models in Polynomial Time
- 11:50 Yanjun Han, Ayfer Ozgur and Tsachy Weissman  
Geometric Lower Bounds for Distributed Parameter Estimation under Communication Constraints

**Lunch break (12:00-13:40)****Session 11: Open Problems (13:40-14:00)****Session 12: Invited talk Susan Murphy (14:00-15:00)****Session 13 (15:20-16:50)**

- 15:20** Hongyi Zhang and Suvrit Sra  
An Estimate Sequence for Geodesically Convex Optimization
- 15:30** Nilesh Tripuraneni, Nicolas Flammarion, Francis Bach and Michael Jordan  
Averaged Stochastic Gradient Descent on Riemannian Manifolds
- 15:40** Prateek Jain, Sham Kakade, Rahul Kidambi, Praneeth Netrapalli and Aaron Sidford  
Accelerating Stochastic Gradient Descent for Least Squares Regression
- 15:50** Chi Jin, Praneeth Netrapalli and Michael Jordan  
Accelerated Gradient Descent Escapes Saddle Points Faster than Gradient Descent
- 16:00** Loucas Pillaud-Vivien, Alessandro Rudi and Francis Bach  
Exponential convergence of testing error for stochastic gradient methods
- 16:10** Oliver Hinder  
Cutting plane methods can be extended into nonconvex optimization
- 16:20** Zalán Borsos, Andreas Krause and Kfir Y. Levy  
Online Variance Reduction for Stochastic Optimization
- 16:30** John Duchi, Feng Ruan and Chulhee Yun  
Minimax Bounds on Stochastic Batched Convex Optimization
- 16:40** Gergely Neu and Lorenzo Rosasco  
Iterate averaging as regularization for stochastic gradient descent

**Session 14: Business meeting (17:00-18:00)****Session 15: Poster session (18:00-20:00)**

## Sunday, 8th of July

### Session 16 (09:00-10:00)

- 09:00 Espen Bernton  
Langevin Monte Carlo and JKO splitting
- 09:10 Raaz Dwivedi, Yuansi Chen, Martin Wainwright and Bin Yu  
Log-concave sampling: Metropolis-Hastings algorithms are fast!
- 09:20 Andre Wibisono  
Sampling as optimization in the space of measures: The Langevin dynamics as a composite optimization problem
- 09:30 Wenlong Mou, Liwei Wang, Xiyu Zhai and Kai Zheng  
Generalization Bounds of SGLD for Non-convex Learning: Two Theoretical Viewpoints
- 09:40 Belinda Tzen, Tengyuan Liang and Maxim Raginsky  
Local Optimality and Generalization Guarantees for the Langevin Algorithm via Empirical Metastability
- 09:50 Xiang Cheng, Niladri S. Chatterji, Peter Bartlett and Michael Jordan  
Underdamped Langevin MCMC: A non-asymptotic analysis

### Coffee break (10:00-10:30)

### Session 17 (10:30-12:00)

- 10:30 Bangrui Chen, Peter Frazier and David Kempe  
Incentivizing Exploration by Heterogeneous Users
- 10:40 Asaf Cassel, Assaf Zeevi and Shie Mannor  
A General Approach to Multi-Armed Bandits Under Risk Criteria
- 10:50 Nicolo' Cesa-Bianchi, Claudio Gentile and Yishay Mansour  
Nonstochastic Bandits with Composite Anonymous Feedback
- 11:00 Chen-Yu Wei and Haipeng Luo  
More Adaptive Algorithms for Adversarial Bandits
- 11:10 Yasin Abbasi-Yadkori, Peter Bartlett, Victor Gabillon, Alan Malek and Michal Valko  
Best of Both Worlds: Stochastic & Adversarial Best-Arm Identification
- 11:20 Haipeng Luo, Chen-Yu Wei, Alekh Agarwal and John Langford  
Efficient Contextual Bandits in Non-stationary Worlds
- 11:30 Andrea Locatelli and Alexandra Carpentier  
Adaptivity to Smoothness in X-armed bandits
- 11:40 Thodoris Lykouris, Karthik Sridharan and Eva Tardos  
Small-loss bounds for online learning with partial information
- 11:50 Johannes Kirschner and Andreas Krause  
Information Directed Sampling and Bandits with Heteroscedastic Noise



**Lunch break (12:00-14:00)****Session 18: Invited talk Johan Hastad (14:00-15:00)****Session 19 (15:20-16:20)**

- 15:20** Yuanzhi Li, Tengyu Ma and Hongyang Zhang  
Algorithmic Regularization in Over-parameterized Matrix Sensing and Neural Networks with Quadratic Activations
- 15:50** Paul Hand and Vladislav Voroninski  
Global Guarantees for Enforcing Deep Generative Priors by Empirical Risk
- 16:00** Noah Golowich, Alexander Rakhlin and Ohad Shamir  
Size-Independent Sample Complexity of Neural Networks
- 16:10** Dmitry Yarotsky  
Optimal approximation of continuous functions by very deep ReLU networks

**Session 20 (16:30-17:30)**

- 16:30** Nina Holden, Robin Pemantle and Yuval Peres  
Subpolynomial trace reconstruction for random strings and arbitrary deletion probability
- 16:40** Ahmed El Alaoui and Michael Jordan  
Detection limits in the high-dimensional spiked rectangular model
- 16:50** Yingjie Fei and Yudong Chen  
Hidden Integrality of SDP Relaxations for Sub-Gaussian Mixture Models
- 17:10** Sanjeev Arora, Wei Hu and Pravesh K Kothari  
An Analysis of the t-SNE Algorithm for Data Visualization
- 17:20** Charles Fefferman, Sergei Ivanov, Yaroslav Kurylev, Matti Lassas and Hariharan Narayanan  
Fitting a putative manifold to noisy data
- 17:20** Yan Shuo Tan and Roman Vershynin  
Polynomial Time and Sample Complexity for Non-Gaussian Component Analysis: Spectral Methods

**Session 21: Poster session (17:30-19:20)****Banquet at Artipelag**

**The bus departs at 19:30 from Lindstedtsvägen 1.**  
<https://artipelag.se/>

## Monday, 9th of July

### Session 22 (09:00-10:00)

- 09:00 Themis Gouleakis, Christos Tzamos and Manolis Zampetakis  
Learning from Unreliable Datasets
- 09:10 Cynthia Dwork and Vitaly Feldman  
Privacy-preserving Prediction
- 09:20 Vitaly Feldman and Thomas Steinke  
Calibrating Noise to Variance in Adaptive Data Analysis
- 09:30 Michela Meister and Gregory Valiant  
A Data Prism: Semi-verified learning in the small-alpha regime
- 09:40 Daniel Alabi, Nicole Immorlica and Adam Tauman Kalai  
Unleashing Linear Optimizers for Group-Fair Learning and Optimization
- 09:50 John Tsitsiklis, Kuang Xu and Zhi Xu  
Private Sequential Learning

### Coffee break (10:00-10:30)

### Session 23 (10:30-12:00)

- 10:30 Arnab Bhattacharyya, Suprovat Ghoshal and Rishi Saket  
Hardness of Learning Noisy Halfspaces using Polynomial Thresholds
- 10:40 Avrim Blum and Lunjia Hu  
Active Tolerant Testing
- 10:50 Paul Beame, Shayan Oveis Gharan and Xin Yang  
Time-Space Tradeoffs for Learning Finite Functions from Random Tests, with Applications to Polynomials
- 11:00 Andreas Maurer and Massimiliano Pontil  
Empirical bounds for functions with weak interactions
- 11:10 Ido Nachum, Jonathan Shafer and Amir Yehudayoff  
A Direct Sum for Information Learners
- 11:20 Victor Chernozhukov, Kaspar Wuthrich and Yinchu Zhu  
Exact and Robust Conformal Inference Methods for Predictive Machine Learning With Dependent Data
- 11:30 Mikhail Belkin  
Approximation beats concentration? An approximation view on inference with smooth radial kernels
- 11:40 Piotr Indyk and Tal Wagner  
Approximate Nearest Neighbors in Limited Space
- 11:50 Chicheng Zhang  
Efficient Active Learning of Sparse Halfspaces

Lunch break (12:00-14:00)

Session 24: Poster session (12:00-14:00)

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