Contents

Contents .................................................................................. iii
Preface .................................................................................. xli
Donors .................................................................................. xlvii
NIPS foundation ................................................................. xlix
Committees ............................................................................ li
Reviewers ............................................................................... liv

Scan Order in Gibbs Sampling: Models in Which it Matters and Bounds on How Much, BRYAN HE, CHRISTOPHER SA, IOANNIS MITLIAGKAS, CHRISTOPHER RÉ, Stanford University .................. 1

Deep ADMM-Net for Compressive Sensing MRI, YAN YANG, JIAN SUN, HUIBIN LI, ZONGBEN XU, Xi’an Jiaotong University ......................... 10

A scaled Bregman theorem with applications, RICHARD NOCK, Data61 and ANU, ADITYA MENON, CHENG ONG, Data61 ......................... 19

Swapout: Learning an ensemble of deep architectures, SAURABH SINGH, DEREK HOIEM, DAVID FORSYTH, University of Illinois at Urbana-Champaign ...................................................... 28

On Regularizing Rademacher Observation Losses, RICHARD NOCK, Data61 and ANU ................................................. 37

Without-Replacement Sampling for Stochastic Gradient Methods, OHAD SHAMIR, Weizmann Institute of Science .............................. 46

Fast and Provably Good Seedings for k-Means, OLIVIER BACHEM, MARIO LUCIC, HAMED HASSANI, Eidgenössische Technische Hochschule Zürich, ANDREAS KRAUSE .................................................. 55

Unsupervised Learning for Physical Interaction through Video Prediction, CHELSEA FINN, Google Inc., IAN GOODFELLOW, SERGEY LEVINE, University of Washington ............................................ 64

High-Rank Matrix Completion and Clustering under Self-Expressive Models, EHSAN ELHAMIFAR .................................................. 73

Learning a Probabilistic Latent Space of Object Shapes via 3D Generative-Adversarial Modeling, JIAJUN WU, CHENGKAI ZHANG, TIANFAN XUE, WILLIAM FREEMAN, and JOSH TENENBAUM, Massachusetts Institute of Technology ............................. 82
Integrated perception with recurrent multi-task neural networks,
Hakan Bilen, University of Oxford, Andrea Vedaldi .......................... 235

Combining Low-Density Separators with CNNs, Yu-Xiong Wang,
Martial Hebert, Carnegie Mellon University ............................ 244

CNNpack: Packing Convolutional Neural Networks in the
Frequency Domain, Yunhe Wang, Peking University, Chang Xu, Shan
You, Dacheng Tao, and Chao Xu ........................................... 253

Cooperative Graphical Models, Josip Djolonga, Eidgenössische
Technische Hochschule Zürich, Stefanie Jegelka, Massachusetts Institute of
Technology, Sebastian Tschiatschek, Eidgenössische Technische Hochschule
Zürich, Andreas Krause ..................................................... 262

f-GAN: Training Generative Neural Samplers using Variational
Divergence Minimization, Sebastian Nowozin, Botond Cseke,
Microsoft Research, Ryota Tomioka, MSRC .......................... 271

Bayesian Optimization for Probabilistic Programs, Tom
Rainforth, Tuan Le, University of Oxford, Jan-Willem Meent,
Northeastern University, Michael Osborne, and Frank Wood ........ 280

Hierarchical Question-Image Co-Attention for Visual Question
Answering, Jiasen Lu, Jianwei Yang, Dhruv Batra, Devi Parikh,
Virginia Tech ................................................................. 289

Optimal Sparse Linear Encoders and Sparse PCA, Malik
Magdon-Ismail, Rensselaer, Christos Boutsidis ....................... 298

FPNN: Field Probing Neural Networks for 3D Data, Yangyan Li,
Soeren Pirk, Hao Su, Charles Qi, and Leonidas Guibas, Stanford
University ................................................................. 307

CRF-CNN: Modeling Structured Information in Human Pose
Estimation, Xiao Chu, Wanli Ouyang, Hongsheng Li, The Chinese
University of Hong Kong, Xiaogang Wang, Chinese University of Hong Kong 316

Fairness in Learning: Classic and Contextual Bandits, Matthew
Joseph, Michael Kearns, Jamie Morgenstern, Aaron Roth,
University of Pennsylvania ........................................... 325

Joint M-Best-Diverse Labelings as a Parametric Submodular
Minimization, Alexander Kirillov, TU Dresden, Alexander
Shekhovtsov, Carsten Rother, Bogdan Savchynskyvy ................ 334

Domain Separation Networks, Konstantinos Bousmalis, Google
Brain, George Tziggeoris, Nathan Silberman, Dilip Krishnan, and
Dumitru Erhan, Google .................................................. 343

DISCO Nets : DISsimilarity COefficients Networks, Diane
Bouchacourt, M. Kumar, University of Oxford, Sebastian Nowozin ... 352

Multimodal Residual Learning for Visual QA, Jin-Hwa Kim,
Sang-Woo Lee, Dong-Hyun Kwak, Min-Oh Heo, Seoul National
University, and Jeonghee Kim, Jung-Woo Ha, Naver Labs, Byoung-Tak
Zhang, Seoul National University ................................. 361
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA-ES with Optimal Covariance Update and Storage Complexity</td>
<td>Oswin Krause, Dídac Arbonès, University of Copenhagen</td>
<td>370</td>
</tr>
<tr>
<td>R-FCN: Object Detection via Region-based Fully Convolutional Networks</td>
<td>Jifeng Dai, Microsoft, Yi Li, Tsinghua University, Kaiming He, Jian Sun</td>
<td>379</td>
</tr>
<tr>
<td>GAP Safe Screening Rules for Sparse-Group Lasso</td>
<td>Eugene Ndiaye, Télécom ParisTech, Olivier Fercoq, Alexandre Gramfort,</td>
<td>388</td>
</tr>
<tr>
<td></td>
<td>Joseph Salmon</td>
<td></td>
</tr>
<tr>
<td>Learning and Forecasting Opinion Dynamics in Social Networks</td>
<td>Abir De, IIT Kharagpur, Isabel Valera, Niloj Ganguly, Sourangshu</td>
<td>397</td>
</tr>
<tr>
<td></td>
<td>Bhattacharya, IIT Kharagpur, and Manuel Rodriguez, MPI-SWS</td>
<td></td>
</tr>
<tr>
<td>Gradient-based Sampling: An Adaptive Importance Sampling for</td>
<td>Rong Zhu, Chinese Academy of Sciences</td>
<td>406</td>
</tr>
<tr>
<td>Least-squares</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborative Recurrent Autoencoder: Recommend while Learning to Fill</td>
<td>Hao Wang, HKUST, Xingjian Shi, Dit-Yan Yeung</td>
<td>415</td>
</tr>
<tr>
<td>the Blanks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual information for symmetric rank-one matrix estimation: A</td>
<td>Jean Barbier, Mohamad Dia, Nicolas Macris, École polytechnique</td>
<td>424</td>
</tr>
<tr>
<td>proof of the replica formula</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jean Barbier, Mohamad Dia, Nicolas Macris, École polytechnique</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Unified Approach for Learning the Parameters of Sum-Product Networks</td>
<td>Han Zhao, Carnegie Mellon University, Pascal Poupart, Geoff Gordon</td>
<td>433</td>
</tr>
<tr>
<td></td>
<td>Carnegie Mellon University</td>
<td></td>
</tr>
<tr>
<td>Training and Evaluating Multimodal Word Embeddings with Large-scale</td>
<td>Jinhua Mao, University of California Los Angeles, Jiajing Xu, Pinterest,</td>
<td>442</td>
</tr>
<tr>
<td>Web Annotated Images</td>
<td>Kevin Jing, Alan Yuille, State University of New York at Albany</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stochastic Online AUC Maximization</td>
<td>Yiming Ying, Longyin Wen, Siwei Lyu, State University of New York at</td>
<td>451</td>
</tr>
<tr>
<td></td>
<td>Albany</td>
<td></td>
</tr>
<tr>
<td>The Generalized Reparameterization Gradient</td>
<td>Francisco Ruiz, Columbia University, Michalis Titsias, David Blei,</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>Columbia University</td>
<td></td>
</tr>
<tr>
<td>Coupled Generative Adversarial Networks</td>
<td>Ming-Yu Liu, Mitsubishi Electric Research Laboratories, Oncel Tuzel,</td>
<td>469</td>
</tr>
<tr>
<td></td>
<td>Mitsubishi Electric Research Labs</td>
<td></td>
</tr>
<tr>
<td>Exponential Family Embeddings</td>
<td>Maja Rudolph, Francisco Ruiz, Columbia University, Stephen Mandt,</td>
<td>478</td>
</tr>
<tr>
<td></td>
<td>Disney Research, David Blei, Columbia University</td>
<td></td>
</tr>
<tr>
<td>Variational Information Maximization for Feature Selection</td>
<td>Shuyang Gao, University of Southern California, Greg Steeg, Aram</td>
<td>487</td>
</tr>
<tr>
<td></td>
<td>Galstyan</td>
<td></td>
</tr>
<tr>
<td>Operator Variational Inference</td>
<td>Rajesh Ranganath, Jaan Altosaar, Princeton University, Dustin Tran,</td>
<td>496</td>
</tr>
<tr>
<td></td>
<td>David Blei, Columbia University</td>
<td></td>
</tr>
<tr>
<td>Fast learning rates with heavy-tailed losses</td>
<td>Vu Dinh, Fred Hutchinson Cancer Center, Lam Ho, University of California</td>
<td>505</td>
</tr>
<tr>
<td></td>
<td>Los Angeles, Duy Nguyen, University of Wisconsin-Madison, Binh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nguyen, University of Science Vietnam</td>
<td></td>
</tr>
</tbody>
</table>
Budgeted stream-based active learning via adaptive submodular maximization, **Kaito Fujii**, **Hisashi Kashima**, Kyoto University 514

Learning feed-forward one-shot learners, **Luca Bertinetto**, **Joao Henriques**, **Jack Valmadre**, University of Oxford, **Philip Torr** and **Andrea Vedaldi** 523


Robust Spectral Detection of Global Structures in the Data by Learning a Regularization, **PAN ZHANG**, Institute of Theoretical Physics Chinese Academy of Sciences 541

Residual Networks Behave Like Ensembles of Relatively Shallow Networks, **Andreas Veit**, **Michael Wilber**, **Serge Belongie**, Cornell University 550

Adversarial Multiclass Classification: A Risk Minimization Perspective, **Rizal Fathony**, U. of Illinois at Chicago, **Anqi Liu**, **Kaiser Asif**, **Brian Ziebart**, University Of Illinois at Chicago 559

Solving Random Systems of Quadratic Equations via Truncated Generalized Gradient Flow, **Gang Wang**, **Georgios Giannakis**, University of Minnesota 568

Coin Betting and Parameter-Free Online Learning, **Francesco Orabona**, Yahoo Research, **David Pal** 577

Deep Learning without Poor Local Minima, **Kenji Kawaguchi**, Massachusetts Institute of Technology 586

Testing for Differences in Gaussian Graphical Models: Applications to Brain Connectivity, **Eugene Belilovsky**, CentraleSupelec, **Gaël Varoquaux**, **Matthew Blaschko**, KU Leuven 595

A Constant-Factor Bi-Criteria Approximation Guarantee for k-means++, **Dennis Wei**, IBM Research 604

Generating Videos with Scene Dynamics, **Carl Vondrick**, Massachusetts Institute of Technology, **Hamed Pirsiavash**, **Antonio Torralba**, Massachusetts Institute of Technology 613


A Powerful Generative Model Using Random Weights for the Deep Image Representation, **Kun He**, Huazhong University of Science and Technology, **Yan Wang**, **Huazhong University of Science and Technology**, **John Hopcroft**, Cornell University 631

Optimizing affinity-based binary hashing using auxiliary coordinates, **Ramin Raziperchikolaei**, **Miguel Carreira-Perpinan**, UC Merced 640

Double Thompson Sampling for Dueling Bandits, **Huasen Wu**, University of California at Davis, **Xin Liu**, University of California Davis 649
Generating Images with Perceptual Similarity Metrics based on Deep Networks, 
ALEXEY DOSOVITSKIY, THOMAS BROX, University of Freiburg .......................................................... 658

Dynamic Filter Networks, 
BERT BRABANDERE, XU JIA, TINNE TUYTELAAKS, KU Leuven, LUC GOOL, ETH Zürich ......................... 667

A Simple Practical Accelerated Method for Finite Sums, 
AARON DEFAZIO, Ambiata .................................................. 676

Barzilai-Borwein Step Size for Stochastic Gradient Descent, 
CONGHUI TAN, SHIQIAN MA, The Chinese University of HK, YU-HONG DAI, YUQIU QIAN, The University of Hong Kong .................. 685

On Graph Reconstruction via Empirical Risk Minimization: Fast Learning Rates and Scalability, 
GUILLAUME PAPA, Télécom ParisTech, AURÉLIEN BELLET, STEPHAN CLÉMENTON ........................................... 694

Optimal spectral transportation with application to music transcription, 
RÉMI FLAMARY, CÉDRIC FÉVOTTE, Centre national de la recherche scientifique, NICOLAS COURTY, VALENTIN EMIYA, Aix-Marseille University ................................................................. 703

Regularized Nonlinear Acceleration, 
DAMIEN SCIEUR, INRIA - ENS, ALEXANDRE D’ASPREMONT, FRANCIS BACH .......................... 712

SPALS: Fast Alternating Least Squares via Implicit Leverage Scores Sampling, 
DEHUA CHENG, Univ. of Southern California, RICHARD PENG, IOAKEIM PERROS, Georgia Institute of Technology, YAN LIU, University of Southern California ................................................. 721

Single-Image Depth Perception in the Wild, 
WEIFENG CHEN, ZHAO FU, Dawei Yang, JIA DENG, University of Michigan ..................... 730

Computational and Statistical Tradeoffs in Learning to Rank, 
ASHISH KHETAN, University of Illinois Urbana-Champaign, SEWOONG OH, University of Illinois at Urbana-Champaign .......................... 739

Online Convex Optimization with Unconstrained Domains and Losses, 
ASHOK CUTKOSKY, KWABENA BOAHEN, Stanford University ...... 748

An ensemble diversity approach to supervised binary hashing, 
MIGUEL CARREIRA-PERPINAN, RAMI RAZIPERCHIKOLAEI, UC Merced .... 757

Efficient Globally Convergent Stochastic Optimization for Canonical Correlation Analysis, 
WEIRAN WANG, TTI-Chicago, JIALEI WANG, University of Chicago, DAN GARBER, NATI SREBRO, TTI-Chicago ... 766

The Power of Adaptivity in Identifying Statistical Alternatives, 
KEVIN JAMIESON, DANIEL HAAS, BEN RECHT, UC Berkeley ........................... 775

On Explore-Then-Commit strategies, 
AURELIEN GARIVIER, TOR LATTIMORE, EMILIE KAUFMANN ........................................ 784

Sublinear Time Orthogonal Tensor Decomposition, 
ZHAO SONG, UT-Austin, DAVID WOODRUFF, HUAN ZHANG, UC-Davis ..................... 793

DECOrrelated feature space partitioning for distributed sparse regression, 
XIANGYU WANG, DAVID DUNS0N, Duke University, CHENLEI LENG, University of Warwick ................................. 802

Deep Alternative Neural Network: Exploring Contexts as Early as Possible for Action Recognition, 
JINZHUO WANG, PKU, WENMIN
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Learning for Machine Translation</td>
<td>Di He, Microsoft, Yingce Xia,USTC, Tao Qin, Microsoft, Liwei Wang, and Nenghai Yu, USTC</td>
<td>820</td>
</tr>
<tr>
<td>Dialog-based Language Learning</td>
<td>Jason Weston</td>
<td>829</td>
</tr>
<tr>
<td>Joint Line Segmentation and Transcription for End-to-End Handwritten Paragraph Recognition</td>
<td>Theodore Bluche, A2ia</td>
<td>838</td>
</tr>
<tr>
<td>Temporal Regularized Matrix Factorization for High-dimensional Time Series Prediction</td>
<td>Hsiang-Fu Yu, University of Texas at Austin, Nikhil Rao, Technicolor, Inderjit Dhillon, University of Texas at Austin</td>
<td>847</td>
</tr>
<tr>
<td>Active Nearest-Neighbor Learning in Metric Spaces</td>
<td>Aryeh Kontorovitch, Sivan Sabato, Ben-Gurion University of the Negev, Ruth Urner, MPI Tuebingen</td>
<td>856</td>
</tr>
<tr>
<td>Proximal Deep Structured Models</td>
<td>Shenlong Wang, Sanja Fidler, Raquel Urtasun, University of Toronto</td>
<td>865</td>
</tr>
<tr>
<td>Faster Projection-free Convex Optimization over the Spectrahedron</td>
<td>Dan Garber, TTI-Chicago</td>
<td>874</td>
</tr>
<tr>
<td>Bayesian Optimization with a Finite Budget: An Approximate Dynamic Programming Approach</td>
<td>Remi Lam, Karen Willcox, David Wolpert, Massachusetts Institute of Technology</td>
<td>883</td>
</tr>
<tr>
<td>SoundNet: Learning Sound Representations from Unlabeled Video</td>
<td>Yusuf Aytar, Carl Vondrick, Antonio Torralba, Massachusetts Institute of Technology</td>
<td>892</td>
</tr>
<tr>
<td>Weight Normalization: A Simple Reparameterization to Accelerate Training of Deep Neural Networks</td>
<td>Tim Salimans, Diederik Kingma</td>
<td>901</td>
</tr>
<tr>
<td>Efficient Second Order Online Learning by Sketching</td>
<td>Haipeng Luo, Princeton University, Alekh Agarwal, Microsoft, Nicolò Cesa-Bianchi, John Langford</td>
<td>910</td>
</tr>
<tr>
<td>Dynamic Mode Decomposition with Reproducing Kernels for Koopman Spectral Analysis</td>
<td>Yoshinobu Kawahara, Osaka University</td>
<td>919</td>
</tr>
<tr>
<td>Distributed Flexible Nonlinear Tensor Factorization</td>
<td>Shandian Zhe, Purdue University, Kai Zhang, NEC Labs America Princeton NJ 08540, Pengyuan Wang, Kuang-chih Lee, and Zenglin Xu, Yuan Qi, Zoubin Ghahramani</td>
<td>928</td>
</tr>
<tr>
<td>The Robustness of Estimator Composition</td>
<td>Pingfan Tang, Jeff Phillips, University of Utah</td>
<td>937</td>
</tr>
<tr>
<td>Efficient and Robust Spiking Neural Circuit for Navigation Inspired by Echolocating Bats</td>
<td>Pulkit Tandon, Yash Malviya, IIT Bombay, Bipin Rajendran, NJIT</td>
<td>946</td>
</tr>
<tr>
<td>PerforatedCNNs: Acceleration through Elimination of Redundant Convolutions</td>
<td>Michael Figurnov, Skolkovo Inst. of Sc and Tech, Aijan Ibraimova, Skolkovo Institute of Science and Technology, Dmitriy Vetrov, Pushmeet Kohli</td>
<td>955</td>
</tr>
</tbody>
</table>
What Makes Objects Similar: A Unified Multi-Metric Learning Approach, Han-Jia Ye, Nanjing University, De-Chuan Zhan, Xue-Min Si, Yuan Jiang, Nanjing University, and Zhi-Hua Zhou ........................................ 1243

Adaptive Maximization of Pointwise Submodular Functions With Budget Constraint, Nguyen Cuong, University of Cambridge, Huan Xu, National University of Singapore ................................. 1252

Dueling Bandits: Beyond Condorcet Winners to General Tournament Solutions, Siddartha Ramamohan, Indian Institute of Science, Arun Rajkumar, Shivani Agarwal, University of Pennsylvania .... 1261

Local Similarity-Aware Deep Feature Embedding, Chen Huang, Chinese University of HongKong, Chen Loy, The Chinese University of HK, Xiaoou Tang, The Chinese University of Hong Kong ......................... 1270

A Communication-Efficient Parallel Algorithm for Decision Tree, Qi Meng, Peking University, Guolin Ke, Taifeng Wang, Wei Chen, and Qiwei Ye, Microsoft Research, Zhi-Ming Ma, Academy of Mathematics and Systems Science Chinese Academy of Sciences, Tie-Yan Liu, Microsoft Research 1279

Convex Two-Layer Modeling with Latent Structure, Vignesh Ganapathiraman, University Of Illinois at Chicago, Xinhua Zhang, University of Illinois Chicago, Yaoliang Yu, Carnegie Mellon University, Junfeng Wen, University of Alberta ........................................ 1288

Sampling for Bayesian Program Learning, Kevin Ellis, Armando Solar-Lezama, Josh Tenenbaum, Massachusetts Institute of Technology 1297

Learning Kernels with Random Features, Aman Sinha, John Duchi, Stanford University ................................................................. 1306

Optimal Tagging with Markov Chain Optimization, Nir Rosenfeld, Hebrew University of Jerusalem, Amir Globerson, Tel Aviv University ............................................................. 1315

Crowdsourced Clustering: Querying Edges vs Triangles, Ramya Vinayak, Hassibi Babak, Caltech ............................................. 1324

Mixed vine copulas as joint models of spike counts and local field potentials, Arno Onken, Stefano Panzeri, IIT ........................................ 1333

Achieving the KS threshold in the general stochastic block model with linearized acyclic belief propagation, Emmanuel Abbe, Colin Sandon, Princeton University ........................................ 1342

Adaptive Concentration Inequalities for Sequential Decision Problems, Shenghia Zhao, Enze Zhou, Tsinghua University, Ashish Sabharwal, Allen Institute for AI, Stefano Ermon, Stanford University .... 1351

Nested Mini-Batch K-Means, James Newling, Françoise Fleuret, Idiap Research Institute ........................................................... 1360

Deep Learning Models of the Retinal Response to Natural Scenes, Lane McIntosh, Niru Maheswaranathan, Aran Nayebi, Surya Ganguli, and Stephen Baccus, Stanford University .................. 1369

Preference Completion from Partial Rankings, Suriya Gunasekar, UT Austin, Sanmi Koyejo, University of Illinois at Urbana-Champaign, Joydeep Ghosh, UT Austin ............................................ 1378
Dynamic Network Surgery for Efficient DNNs, Yiwen Guo, Intel Labs China, Anbang Yao, Yurong Chen 1387

Learning a Metric Embedding for Face Recognition using the Multibatch Method, Oren Tadmor, Yonatan Wexler, OrCam, Tal Rosenwein, Orcam, Shai Shalev-Shwartz, and Amnon Shashua, OrCam 1396

A Pseudo-Bayesian Algorithm for Robust PCA, Tae-Hyun Oh, KAIST, Yasuyuki Matsushita, Osaka University, In Kweon, KAIST, David Wipf 1398

End-to-End Kernel Learning with Supervised Convolutional Kernel Networks, Julien Mairal, Inria 1407

Stochastic Variance Reduction Methods for Saddle-Point Problems, P. Balamurugan, Francis Bach 1416

Flexible Models for Microclustering with Application to Entity Resolution, Giacomo Zanella, The University of Warwick, Brenda Betancourt, Duke University, Hanna Wallach, Microsoft Research, Jeffrey Miller, and Abbas Zaidi, Rebecca Steorts, Duke University 1425

Catching heuristics are optimal control policies, Boris Belousov, TU Darmstadt, Gerhard Neumann, Constantin Rothkopf, January Peters 1434

Bayesian optimization under mixed constraints with a slack-variable augmented Lagrangian, Victor Picheny, Institut National de la Recherche Agronomique, Robert Gramacy, Virginia Tech, Stefan Wild, Argonne National Lab, Sebastien Digabel, École Polytechnique de Montréal 1443

Adaptive Neural Compilation, Rudy Bunel, Oxford University, Alban Desmaison, University of Oxford, Pushmeet Kohli, Philip Torr, and M. Kumar, University of Oxford 1452

Synthesis of MCMC and Belief Propagation, Sung-Soo Ahn, KAIST, Misha Chertkov, Los Alamos National Laboratory, Jinwoo Shin, KAIST 1461

Learning Treewidth-Bounded Bayesian Networks with Thousands of Variables, Mauro Scanagatta, Giorgio Corani, Idsia, Cassio Campos, Queen’s University Belfast, Marco Zaffalon, IDSIA 1470

Unifying Count-Based Exploration and Intrinsic Motivation, Marc Bellemare, Google DeepMind, Srinivasan Srinar, Georg Ostrovski, Google DeepMind, Tom Schaul, and David Saxton, Remi Munos, Google DeepMind 1479

Large Margin Discriminant Dimensionality Reduction in Prediction Space, Mohammad Saberian, Netflix, Jose Pereira, UC San Diego, Can Xu, Google, Nuno Nvasconcelos, UC San Diego 1488

Stochastic Structured Prediction under Bandit Feedback, Artem Sokolov, Julia Kreutzer, Heidelberg University, Christopher Lo, Stefan Riezler, Heidelberg University 1497

Simple and Efficient Weighted Minwise Hashing, Anshumali Shrivastava, Rice University 1506
Truncated Variance Reduction: A Unified Approach to Bayesian Optimization and Level-Set Estimation, Ilija Bogunovic, EPFL Lausanne, Jonathan Scarlett, Andreas Krause, Volkan Cevher ... 1515

Structured Sparse Regression via Greedy Hard Thresholding, Prateek Jain, Microsoft Research, Nikhil Rao, Inderjit Dhillon, University of Texas at Austin .......................................................... 1524

Understanding Probabilistic Sparse Gaussian Process Approximations, Matthias Bauer, Mark Wilk, Carl Rasmussen, University of Cambridge .................................................... 1533

SEBOOST - Boosting Stochastic Learning Using Subspace Optimization Techniques, Elad Richardson, Technion, Rom Herskovitz, Boris Ginsburg, Michael Zibulevsky ................... 1542

Generating Long-term Trajectories Using Deep Hierarchical Networks, Stephan Zheng, Yisong Yue, Caltech, Patrick Lucey, Stats .......................................................... 1551

Learning Tree Structured Potential Games, Vikas Garg, Tommi Jaakkola, Massachusetts Institute of Technology ......................................... 1560

Observational-Interventional Priors for Dose-Response Learning, Ricardo Silva .......................................................... 1569

Learning from Rational Behavior: Predicting Solutions to Unknown Linear Programs, Shahin Jabbari, Ryan Rogers, Aaron Roth, Steven Wu, University of Pennsylvania .............................. 1578

Identification and Overidentification of Linear Structural Equation Models, Bryant Chen, University of California Los Angeles ............................ 1587

Adaptive Skills Adaptive Partitions (ASAP), Daniel Mankowitz, Technion, Timothy Mann, Google DeepMind, Shie Mannor, Technion ..... 1596

Multiple-Play Bandits in the Position-Based Model, Paul Lagrée, Université Paris Sud, Claire Vernade, Université Paris Saclay, Olivier Cappe .................................................. 1605

Optimal Black-Box Reductions Between Optimization Objectives, Zeyuan Allen-Zhu, Elad Hazan, Princeton University .............................. 1614

On Valid Optimal Assignment Kernels and Applications to Graph Classification, Nils Kröge, TU Dortmund, Pierre-Louis Giscard, Richard Wilson, University of York .............................. 1623

Robustness of classifiers: from adversarial to random noise, Alhussein Fawzi, Seyed-Mohsen Moosavi-Dezfooli, Pascal Frossard, École polytechnique fédérale de Lausanne ............................. 1632

A Non-convex One-Pass Framework for Generalized Factorization Machine and Rank-One Matrix Sensing, Ming Lin, Jieping Ye, University of Michigan ............................. 1641

Exploiting the Structure: Stochastic Gradient Methods Using Raw Clusters, Zeyuan Allen-Zhu, Princeton University, Yang Yuan, Cornell University, Karthik Sridharan, University of Pennsylvania ......... 1650

Combinatorial Multi-Armed Bandit with General Reward Functions, Wei Chen, Wei Hu, Princeton University, Fu Li, The
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boosting with Abstention</td>
<td>Corinna Cortes, Giulia DeSalvo, Mehryar Mohri</td>
<td>1659</td>
</tr>
<tr>
<td>Regret of Queueing Bandits</td>
<td>Subhashini Krishnasamy, Rajat Sen, Ramesh Johari, Sanjay Shakkottai</td>
<td>1668</td>
</tr>
<tr>
<td>Deep Learning Games</td>
<td>Dale Schuurmans, Martin Zinkevich, Google</td>
<td>1686</td>
</tr>
<tr>
<td>Globally Optimal Training of Generalized Polynomial Neural Networks</td>
<td>Antoine Gautier, Quynh Nguyen, Matthias Hein, Saarland University</td>
<td>1695</td>
</tr>
<tr>
<td>Perspective Transformer Nets: Learning Single-View 3D Object</td>
<td>Xinchen Yan, University of Michigan, Jimei Yang, Ersin Yumer, Adobe Research, Yijie Guo, and</td>
<td>1704</td>
</tr>
<tr>
<td>Reconstruction without 3D Supervision</td>
<td>Honglak Lee, University of Michigan</td>
<td></td>
</tr>
<tr>
<td>A Credit Assignment Compiler for Joint Prediction</td>
<td>Kai-Wei Chang, He He, University of Maryland, Hal III, John Langford, and Stephane Ross</td>
<td>1713</td>
</tr>
<tr>
<td>Accelerating Stochastic Composition Optimization</td>
<td>Mengdi Wang, Princeton University, Ji Liu, Ethan Fang, Pennsylvania State University</td>
<td>1722</td>
</tr>
<tr>
<td>Reward Augmented Maximum Likelihood for Neural Structured Prediction</td>
<td>Mohammad Norouzi, Samy Bengio, Zhifeng Chen, Navdeep Jaitly, Mike Schuster, Yonghui Wu, Dale</td>
<td>1731</td>
</tr>
<tr>
<td>Consistent Kernel Mean Estimation for Functions of Random Variables</td>
<td>Carl-Johann Simon-Gabriel, Adam Scibior, University of Cambridge, Ilya Tolstikhin, Bernhard</td>
<td>1740</td>
</tr>
<tr>
<td>Towards Unifying Hamiltonian Monte Carlo and Slice Sampling</td>
<td>Yizhe Zhang, Duke university, Xiangyu Wang, Duke University, Changyou Chen, Ricardo Henao,</td>
<td>1749</td>
</tr>
<tr>
<td>Scalable Adaptive Stochastic Optimization Using Random Projections</td>
<td>Gabriel Krümenacher, Eidgenössische Technische Hochschule Zürich, Brian McWilliams, Disney</td>
<td>1758</td>
</tr>
<tr>
<td>Variational Inference in Mixed Probabilistic Submodular Models</td>
<td>Josip Djolonga, Sebastian Tschatschek, Eidgenössische Technische Hochschule Zürich, Andreas</td>
<td>1767</td>
</tr>
<tr>
<td>Correlated-PCA: Principal Components’ Analysis when Data and Noise</td>
<td>Namrata Vaswani, Han Guo, Iowa State University</td>
<td>1776</td>
</tr>
<tr>
<td>The Multi-fidelity Multi-armed Bandit</td>
<td>Kirthevasan Kandasamy, Gautam Dasarath, Barnabas Poczos, Jeff Schneider, Carnegie Mellon</td>
<td>1785</td>
</tr>
</tbody>
</table>
Anchor-Free Correlated Topic Modeling: Identifiability and Algorithm, KEJUN HUANG, XIAO FU, NICHOLAS SIDIROPOULOS, University of Minnesota ..................................................... 1794

Bootstrap Model Aggregation for Distributed Statistical Learning, JUN HAN, QIANG LIU, Dartmouth College .............................. 1803

A scalable end-to-end Gaussian process adapter for irregularly sampled time series classification, STEVEN LI, BENJAMIN MARLIN, UMass Amherst ........................................ 1812

A Bandit Framework for Strategic Regression, YANG LIU, YILING CHEN, Harvard University .................................................. 1821

Architectural Complexity Measures of Recurrent Neural Networks, SAIZHEN H ZHANG, University of Montreal, YUHUAU WU, University of Toronto, TONG CHE, IHES, ZHOUHAN LIN, and ROLAND MEMISEVIC, University of Montreal, RUSLAN SALAKHUTDINOV, University of Toronto, YOSHUA BENGIO, U. Montreal .......................... 1830

Statistical Inference for Cluster Trees, JISU KIM, YEN-CHI CHEN, SIVARAMAN BALAKRISHNAN, ALESSANDRO RINALDO, and LARRY WASSERMAN, Carnegie Mellon University ............................. 1839

PAC Reinforcement Learning with Rich Observations, AKSHAY KRISHNAMURTHY, Carnegie Mellon University, ALEKH AGARWAL, Microsoft, JOHN LANGFORD ........................................... 1848

Improved Deep Metric Learning with Multi-class N-pair Loss Objective, KIHYUK SOHN ......................................................... 1857

Unsupervised Learning of Spoken Language with Visual Context, DAVID HARBATH, ANTONIO TORRALBA, JAMES GLASS, MIT CSAIL .... 1866

Low-Rank Regression with Tensor Responses, GUILLAUME RABUSSEAU, Aix-Marseille University, HACHEM KADRI ..................... 1875

PAC-Bayesian Theory Meets Bayesian Inference, PASCAL GERMAIN, FRANCIS BACH, ALEXANDRE LACOSTE, SIMON LACOSTE-JULIEN, INRIA . 1884

Data Poisoning Attacks on Factorization-Based Collaborative Filtering, BO LI, Vanderbilt University, YINING WANG, AARTI SINGH, Carnegie Mellon University, YEVGENY VOROBIEVICH, Vanderbilt University . 1893

Learned Region Sparsity and Diversity Also Predicts Visual Attention, ZIJUN WANG, Stony Brook, HOSSEIN ADELI, Stony Brook University, MINH HOAI, Stony Brook, GREGORY ZELINSKY, Stony Brook University, and DIMITRIS SAMARAS ................................. 1902

End-to-End Goal-Driven Web Navigation, RODRIGO NOGUEIRA, New York University, KYUNGHYUN CHO, University of Montreal .......................... 1911

Automated scalable segmentation of neurons from multispectral images, UYGAR SÜMBÜL, Columbia University, DOUGLAS ROOSSIEEN, University of Michigan Ann Arbor, FEI CHEN, NICHOLAS BARRY, and EDWARD BOYDEN, Massachusetts Institute of Technology, DAWEN CAI, University of Michigan Ann Arbor, JOHN CUNNINGHAM, LIAM PANINSKI, Columbia University ......................................................... 1920

Privacy Odometers and Filters: Pay-as-you-Go Composition, RYAN ROGERS, University of Pennsylvania, SALIL VATDHAN, Harvard University, AARON ROTH, University of Pennsylvania, JONATHAN ULLMAN ...... 1929
Minimax Estimation of Maximum Mean Discrepancy with Radial Kernels, Ilya Tolstikhin, Bharath Sriperumbudur, Penn State University, Bernhard Schölkopf ........................................... 1938

Adaptive optimal training of animal behavior, Ji Bak, Jung Choi, Athena Akrami, Ilana Witten, and Jonathan Pillow, Princeton University ................................................................. 1947

Hierarchical Object Representation for Open-Ended Object Learning and Recognition, Hamidreza Kasaei, IEETA University of Aveiro, Ana Tome, Luis Lopes, University of Aveiro Portugal .. 1956

Relevant sparse codes with variational information bottleneck, Matthew Chalk, IST Austria, Olivier Marre, Institut de la vision, Gasper Tkačik, Institute of Science and Technology Austria ............... 1965


Orthogonal Random Features, Felix Yu, Ananda Suresh, UC San Diego, Krzysztof Choromanski, Dan Holtmann-Rice, and Sanjiv Kumar, Google .................................................. 1983

Fast Active Set Methods for Online Spike Inference from Calcium Imaging, Johannes Friedrich, Liam Paninski, Columbia University ... 1992

Diffusion-Convolutional Neural Networks, James Atwood, Don Towsley, UMass Amherst ................................. 2001

Bayesian latent structure discovery from multi-neuron recordings, Scott Linderman, Columbia University, Ryan Adams, Harvard University, Jonathan Pillow, Princeton University ............................................... 2010

A Probabilistic Programming Approach To Probabilistic Data Analysis, Feras Saad, Vikash Mansinghka, Massachusetts Institute of Technology ......................................................... 2019

A Non-parametric Learning Method for Confidently Estimating Patient’s Clinical State and Dynamics, William Hoiles, University of California Los, Mihaela Schaar ........................................ 2028

Inference by Reparameterization in Neural Population Codes, Rajkumar Raju, Xaq Pitkow, Rice University .......................... 2037

Tensor Switching Networks, Chuan-Yung Tsai, Harvard University, Andrew Saxe, David Cox, Harvard University ............................... 2046


Coordinate-wise Power Method, Qi Lei, Kai Zhong, UT Austin, Inderjit Dhillon, University of Texas at Austin ..................... 2064

Learning Influence Functions from Incomplete Observations, Xinran He, Ke Xu, David Kempe, Yan Liu, University of Southern California ......................................................... 2073

Learning Structured Sparsity in Deep Neural Networks, Wei Wen, Chunpeng Wu, Yandan Wang, Yiran Chen, University of Pittsburgh, and Hai Li, University of Pittsburgh .......................... 2082
Sample Complexity of Automated Mechanism Design, Nina Balcan,Tuomas Sandholm, Ellen Vitercik, Carnegie Mellon University 2091

Short-Dot: Computing Large Linear Transforms Distributedly Using Coded Short Dot Products, Sanghamitra Dutta, Carnegie Mellon University, Viveck Cadambe, Pennsylvania State University, Pulkit Grover, Carnegie Mellon University 2100

Brains on Beats, Umut Guclug, Jordy Thielen, Radboud University, Michael Hanke, Otto-von-Guericke University Magdeburg, Marcel Gerven, Radboud University 2109

Learning Transferrable Representations for Unsupervised Domain Adaptation, Ozan Sener, Cornell University, Hyun Song, Google Research, Ashutosh Saxena, Brain of Things, Silvio Savarese, Stanford University 2118

Stochastic Multiple Choice Learning for Training Diverse Deep Ensembles, Stefan Lee, Indiana University, Senthil Purushwalkam, Carnegie Mellon, Michael Cogswell, Viresh Ranjan, Virginia Tech, and David Crandall, Indiana University, Dhruv Batra, Virginia Tech 2127

Active Learning from Imperfect Labelers, Songbai Yan, Kamalika Chaudhuri, Tara Javidi, University of California San Diego 2136

Learning to Communicate with Deep Multi-Agent Reinforcement Learning, Jakob Foerster, Yannis Assael, Nando Freitas, Shimon Whiteson, University of Oxford, Shimon Whiteson 2145

Value Iteration Networks, Aviv Tamar, Yi Wu, Garrett Thomas, Sergey Levine, UC Berkeley, and Pieter Abbeel, OpenAI / UC Berkeley / Gradescope 2154

Blind Regression: Nonparametric Regression for Latent Variable Models via Collaborative Filtering, Christina Lee, Yihua Li, Devavrat Shah, Dogyou Song, Massachusetts Institute of Technology 2163

On the Recursive Teaching Dimension of VC Classes, Xi Chen, Columbia University, Yu Cheng, U of Southern California, Bo Tang, University of Oxford 2172

InfoGAN: Interpretable Representation Learning by Information Maximizing Generative Adversarial Nets, Xi Chen, UC Berkeley and OpenAI, Yan Du, UC Berkeley, Rein Houthooft, Ghent University - iMinds and UC Berkeley and OpenAI, John Schulman, OpenAI, and Ilya Sutskever, Pieter Abbeel, OpenAI / UC Berkeley / Gradescope 2180

Hardness of Online Sleeping Combinatorial Optimization Problems, Satyen Kale, Chansoo Lee, University of Michigan, David Pal 2189

Mixed Linear Regression with Multiple Components, Kai Zhong, UT Austin, Prateek Jain, Microsoft Research, Inderjit Dhillon, University of Texas at Austin 2198

Sequential Neural Models with Stochastic Layers, Marco Fraccaro, DTU, Soren Sonderby, KU, Ulrich Paquet, Ole Winther, DTU 2207

Stochastic Gradient Methods for Distributionally Robust Optimization with f-divergences, Hongseok Namkoong, John Duchi, Stanford University 2216
Minimizing Quadratic Functions in Constant Time, Kohei Hayashi, AIST, Yuichi Yoshida, NII ................................. 2225

Improved Techniques for Training GANs, Tim Salimans, Ian Goodfellow, Wojciech Zaremba, Vicki Cheung, and Alec Radford, OpenAI, Xi Chen, UC Berkeley and OpenAI ................................. 2234


Learning Multiagent Communication with Backpropagation, Sainbayar Sukhbaatar, New York University, Arthur Szlam, Rob Fergus, New York University .................................................. 2252

Toward Deeper Understanding of Neural Networks: The Power of Initialization and a Dual View on Expressivity, Amit Daniely, Google Brain, Roy Frostig, Stanford University, Yoram Singer, Google ................................. 2261

Learning the Number of Neurons in Deep Networks, Jose Alvarez, NICTA, Mathieu Salzmann, Ecole polytechnique federale de Lausanne ................................................................. 2270

Finding significant combinations of features in the presence of categorical covariates, Laetitia Papaxanthos, Felipe Llinares, Dean Bodenham, Eidgenössische Technische Hochschule Zürich, Karsten Borgwardt ................................................................. 2279

Examples are not enough, learn to criticize! Criticism for Interpretability, Been Kim, Rajiv Khanna, UT Austin, Sanmi Koyejo, University of Illinois at Urbana-Champaign .................................. 2288

Optimistic Bandit Convex Optimization, Mehryar Mohri, Scott Yang, New York University ................................................................. 2297

Safe Policy Improvement by Minimizing Robust Baseline Regret, Marek Petrik, Mohammad Ghavamzadeh, Yinlam Chow, Stanford University ................................................................. 2306

Graphons, mergeons, and so on!, Justin Eldridge, Mikhail Belkin, Yusu Wang, The Ohio State University ................................................................. 2315

Hierarchical Clustering via Spreading Metrics, Aurko Roy, Georgia Tech, Sebastian Pokutta, Georgia Tech ................................................................. 2324

Learning Bayesian networks with ancestral constraints, Eunice Chen, Yuhua Shen, Arthur Choi, Adnan Darwiche, University of California Los Angeles ................................................................. 2333

Pruning Random Forests for Prediction on a Budget, Feng Nan, Joseph Wang, Venkatesh Saligrama, Boston University ................................................................. 2342

Clustering with Bregman Divergences: an Asymptotic Analysis, Chaoyue Liu, Mikhail Belkin, The Ohio State University ................................................................. 2351

Variational Autoencoder for Deep Learning of Images, Labels and Captions, Yunchen Pu, Duke University, Zhe Gan, Duke, Ricardo Henao, Duke University, Xin Yuan, Bell Labs, and Chunyuan Li, Duke, Andrew Stevens, Lawrence Carin, Duke University ................................................................. 2360
Review Networks for Caption Generation, Zhilin Yang, Ye Yuan, Yuexin Wu, Carnegie Mellon University, Ruslan Salakhutdinov, University of Toronto, and William Cohen, Carnegie Mellon University ...... 2369

Stein Variational Gradient Descent: A General Purpose Bayesian Inference Algorithm, Qiang Liu, Dilin Wang, Dartmouth College ...... 2378

A Bio-inspired Redundant Sensing Architecture, Anh Nguyen, Jian Xu, Zhi Yang, University of Minnesota ........................................ 2387

Contextual semibandits via supervised learning oracles, Akshay Krishnamurthy, Carnegie Mellon University, Alekh Agarwal, Microsoft, Miro Dudik ................................................................. 2396

Blind Attacks on Machine Learners, Alex Beatson, Zhaoran Wang, Han Liu, Princeton University ...................................... 2405

Universal Correspondence Network, Christopher Choy, JunYoung Gwak, Silvio Savarese, Stanford University, Manmohan Chandraker, NEC Labs America ................................................ 2414

Satisfying Real-world Goals with Dataset Constraints, Gabriel Goh, UC Davis, Andrew Cotter, Google, Maya Gupta, Michael Friedlander, UC Davis .......................................................... 2423

Deep Learning for Predicting Human Strategic Behavior, Jason Hartford, James Wright, University of British Columbia, Kevin Leyton-Brown ................................................................. 2432

Phased Exploration with Greedy Exploitation in Stochastic Combinatorial Partial Monitoring Games, Sougata Chaudhuri, Ambuj Tewari, University of Michigan ........................................ 2441

Eliciting Categorical Data for Optimal Aggregation, Chien-Ju Ho, Cornell University, Rafael Frongillo, Yiling Chen, Harvard University ... 2450

Measuring the reliability of MCMC inference with bidirectional Monte Carlo, Roger Grosse, Siddharth Ancha, University of Toronto, Daniel Roy ................................................................. 2459

Breaking the Bandwidth Barrier: Geometrical Adaptive Entropy Estimation, Weihao Gao, Sewoong Oh, Pramod Viswanath, University of Illinois at Urbana-Champaign 2468

Selective inference for group-sparse linear models, Fan Yang, Rina Barber, University of Chicago, Prateek Jain, Microsoft Research, John Lafferty ................................................................. 2477

Graph Clustering: Block-models and model free results, Yali Wan, Marina Meila, University of Washington ......................... 2486

Maximizing Influence in an Ising Network: A Mean-Field Optimal Solution, Christopher Lynn, Daniel Lee, University of Pennsylvania ... 2495

Hypothesis Testing in Unsupervised Domain Adaptation with Applications in Alzheimer’s Disease, Hao Zhou, Sathya Ravi, University of Wisconsin Madison, Vamsi Ithapu, Sterling Johnson, and Grace Wahba, University of Wisconsin Madison, Vikas Singh, UW Madison 2504

Geometric Dirichlet Means Algorithm for topic inference, Mikhail Yurochkin, Xuanlong Nguyen, University of Michigan ............ 2513

xx
Structured Prediction Theory Based on Factor Graph Complexity, CORINNA CORTES, VITALY KUZNETSOV, Courant Institute, MEHRYAR MOHRI, SCOTT YANG, New York University ........................................ 2522

Improved Dropout for Shallow and Deep Learning, ZHE LI, The University of Iowa, BOQING GONG, University of Central Florida, TIANBAO YANG, University of Iowa ........................................ 2531

Constraints Based Convex Belief Propagation, YANIV TENZER, The Hebrew University, ALEXANDER SCHWING, University of Toronto, KEVIN GIMPEL, TTI-Chicago, TAMIR HAZAN ........................................... 2540

Error Analysis of Generalized Nyström Kernel Regression, HONG CHEN, University of Texas, HAIFENG XIA, Huazhong Agricultural University, WEIDONG CAI, University of Sydney, HENG HUANG, University of Texas Arlington ................................................ 2549

A Probabilistic Framework for Deep Learning, ANKIT PATEL, Baylor College of Medicine and Rice University, TAN NGUYEN, RICHARD BARANIUK, Rice University .................................................. 2558

General Tensor Spectral Co-clustering for Higher-Order Data, TAO WU, Purdue University, AUSTIN BENSON, Stanford University, DAVID GLEICH, Purdue University .......................... 2567

Cyclades: Conflict-free Asynchronous Machine Learning, XINGHAO PAN, MAXIMILIAN LAM, STEPHEN TU, DIMITRIS PAPAILOPOULOS, UC Berkeley, and CE ZHANG, Stanford University, MICHAEL JORDAN, OpenAI / UC Berkeley / Gradescope, KANNAN RAMCHANDRAN, UC Berkeley, CHRISTOPHER RE, Stanford University, BEN RECHT, UC Berkeley .................. 2576

Single Pass PCA of Matrix Products, SHANSAN WU, UT Austin, SRINADH BHOMANAPALLI, TTI Chicago, SUJAY SANGHAVI, ALEXANDROS DIMAKIS, The University of Texas at Austin .................. 2585

Stochastic Variational Deep Kernel Learning, ANDREW WILSON, ZHITING HU, Carnegie Mellon University, RUSLAN SALAKHUTDINOV, University of Toronto, ERIC XING, Carnegie Mellon University .................. 2594

Interaction Screening: Efficient and Sample-Optimal Learning of Ising Models, MARC VUFFRAY, SIDHANT MISRA, ANDREY LOKHOV, MISHA CHERTKOV, Los Alamos National Laboratory .................. 2603

Long-term Causal Effects via Behavioral Game Theory, PANOS TOULIS, University of Chicago, DAVID PARKES, Harvard University .................. 2612

Measuring Neural Net Robustness with Constraints, OSBERT BASTANI, Stanford University, YANI IOANNOU, University of Cambridge, LEONIDAS LAMPROPOULOS, University of Pennsylvania, DIMITRIOS VYTINIOITIS, and ADITYA NORI, Microsoft Research, ANTONIO CRIMINISI .... 2621

Reshaped Wirtinger Flow for Solving Quadratic System of Equations, HUISHUAI ZHANG, YINGBIN LIANG, Syracuse University .... 2630

Nearly Isometric Embedding by Relaxation, JAMES MCQUEEN, MARINA MEILA, University of Washington, DOMINIQUE JONCAS, Google .... 2639

Probabilistic Inference with Generating Functions for Poisson Latent Variable Models, KEVIN WINNER, Umass CICS, DANIEL SHELDON, Umass Amherst .................. 2648
Causal meets Submodular: Subset Selection with Directed Information, Yuxun Zhou, UC Berkeley, Costas Spanos ............... 2657

Depth from a Single Image by Harmonizing Overcomplete Local Network Predictions, Ayan Chakrabarti, TTI-Chicago, Jingyu Shao, University of California Los Angeles, Greg Shakhnarovich, TTI-Chicago .... 2666

Deep Neural Networks with Inexact Matching for Person Re-identification, Arulkumar Subramaniam, Moitrey Chatterjee, Anurag Mittal, IIT Madras ....................... 2675

Global Analysis of Expectation Maximization for Mixtures of Two Gaussians, Ji Xu, Columbia University, Daniel Hsu, Arian Maleki, Columbia University ........................................ 2684

Estimating the class prior and posterior from noisy positives and unlabeled data, Shanatnu Jain, Martha White, Predrag Radivojac, Indiana University ........................................ 2693

Kronecker Determinantal Point Processes, Zelda Mariet, Suvrit Sra, Massachusetts Institute of Technology .................................. 2702

Finite Sample Prediction and Recovery Bounds for Ordinal Embedding, Lalit Jain, University of Michigan, Kevin Jamieson, UC Berkeley, Robert Nowak, University of Wisconsin Madison .................. 2711

Feature-distributed sparse regression: a screen-and-clean approach, Jiyan Yang, Stanford University, Michael Mahoney, Michael Saunders, Stanford University, Yuekai Sun, University of Michigan .......................................................... 2720

Learning Bound for Parameter Transfer Learning, Wataru Kumagai, Kanagawa University ........................................... 2729

Learning under uncertainty: a comparison between R-W and Bayesian approach, He Huang, Martin Paulus, LIBR ................. 2738

Bi-Objective Online Matching and Submodular Allocations, Hossein Esfandiari, University of Maryland, Nitish Korula, Google Research, Vahab Mirrokni, Google .......................................... 2747

Quantized Random Projections and Non-Linear Estimation of Cosine Similarity, Ping Li, Rutgers University and Amazon, Michael Mitzenmacher, Harvard University, Martin Slawski .......................... 2756

The non-convex Burer-Monteiro approach works on smooth semidefinite programs, Nicolas Boumal, Vlad Voroninski, Massachusetts Institute of Technology, Afonso Bandeira ................... 2765

Dimensionality Reduction of Massive Sparse Datasets Using Coresets, Dan Feldman, Mikhail Volkov, Daniela Rus, Massachusetts Institute of Technology ........................................ 2774

Using Social Dynamics to Make Individual Predictions: Variational Inference with a Stochastic Kinetic Model, Zhen Xu, Wen Dong, SUNY at Buffalo, Sargur Srihari ......................... 2783

On statistical learning via the lens of compression, Ofir David, Technion - Israel institute of technology, Shay Moran, Amir Yehudayoff, Technion - Israel institute of Technology ........................................ 2792

xxii
Generative Shape Models: Joint Text Recognition and Segmentation with Very Little Training Data, XINGHUA LOU, Vicarious FPC Inc, KEN KANSKY, WOLFGANG LEHRACH, Vicarious, CC LAAN, and BHASKARA MARTHI, D. PHOENIX, DILEEP GEORGE ................. 2801

Image Restoration Using Very Deep Convolutional Encoder-Decoder Networks with Symmetric Skip Connections, XIAO-JIAO MAO, Nanjing University, CHUNHUA SHEN, YU-BIN YANG ......................... 2810

Object based Scene Representations using Fisher Scores of Local Subspace Projections, MANDAR DIXIT, UC San Diego, NUNO VASCONCELOS ............................................................ 2819

Active Learning with Oracle Epiphany, TZU-KUO HUANG, Uber Advanced Technologies Center, LIHONG LI, Microsoft Research, ARA VARTANIAN, University of Wisconsin-Madison, SALEEMA AMERSHI, Microsoft, and XIAOJIN ZHU, University of Wisconsin-Madison ......................... 2828

Statistical Inference for Pairwise Graphical Models Using Score Matching, MING YU, The University of Chicago, MLADEN KOLAR, VARUN GUPTA, University of Chicago .................................................. 2837

Improved Error Bounds for Tree Representations of Metric Spaces, SAMIR CHOWDHURY, The Ohio State University, FACUNDO MEMOLI, ZANE SMITH, The Ohio State University ........................................ 2846

Can Peripheral Representations Improve Clutter Metrics on Complex Scenes?, ARTURO DEZA, MIGUEL ECKSTEIN, UCSB .............. 2855

On Multiplicative Integration with Recurrent Neural Networks, YUHUAI WU, University of Toronto, SAIZHENG ZHANG, YING ZHANG, University of Montreal, YOSHUA BENGIO, U. Montreal, and RUSLAN SALAKHUTDINOV, University of Toronto ........................................ 2864

Learning HMMs with Nonparametric Emissions via Spectral Decompositions of Continuous Matrices, KIRTHEVASAN KANDASAMY, MARIAN AL-SHEDIVAT, ERIC XING, Carnegie Mellon University .................. 2873

Regret Bounds for Non-decomposable Metrics with Missing Labels, NAGARAJAN NATARAJAN, PRATEEK JAIN, Microsoft Research ... 2882

Robust k-means: a Theoretical Revisit, ALEXANDROS GEORGOGIANNIS, TECHNICAL UNIVERSITY OF CRETE ................. 2891

Bayesian optimization for automated model selection, GUSTAVO MALKOMES, Washington University, CHARLES SCHAFF, Washington University in St. Louis, ROMAN GARNETT, Washington University ............................... 2900

A Probabilistic Model of Social Decision Making based on Reward Maximization, KOOSHA KHALVATI, University of Washington, SEONGMIN PARK, Cognitive Neuroscience Center, JEAN-CLAUDE DREHER, Centre de Neurosciences Cognitives, RAJESH RAO, University of Washington .............. 2909

Balancing Suspense and Surprise: Timely Decision Making with Endogenous Information Acquisition, AHMED ALAA, University of California Los Angeles, MIHAELA SCHAAR ........................................ 2918

Fast and Flexible Monotonic Functions with Ensembles of Lattices, KEVIN CANINI, ANDREW COFTER, Google, MAYA GUPTA, MAHDI FARD, and JAN PFEIFER, Google ........................................ 2927
Conditional Generative Moment-Matching Networks, YONG REN,
Tsinghua University, JUNE ZHU, JIALIAN LI, YUCEN LUO, Tsinghua University 2936

Stochastic Gradient MCMC with Stale Gradients, CHANGYOU
CHEN, NAN DING, Google, CHUNYUAN LI, Duke, YIZHE ZHANG, Duke
university, and LAWRENCE CARIN, Duke University 2945

Composing graphical models with neural networks for structured
representations and fast inference, MATTHEW JOHNSON, Massachusettts
Institute of Technology, DAVID DUVENAUD, Harvard University, ALEX
WILTSCHKO, Harvard University and Twitter, RYAN ADAMS, Harvard
University, and SANDEEP DATTA, Harvard Medical School 2954

Noise-Tolerant Life-Long Matrix Completion via Adaptive
Sampling, NINA BALCAN, HONGYANG ZHANG, Carnegie Mellon University 2963

Combinatorial semi-bandit with known covariance, RÉMY
DEGENNE, Université Paris Diderot, VIANNEY PERCHET, Ensae - Criteo Labs 2972

Matrix Completion has No Spurious Local Minimum, RONG GE,
JASON LEE, UC Berkeley, TENGYU MA, Princeton University 2981

The Multiscale Laplacian Graph Kernel, RISI KONDOR, HORACE
PAN, Uchicago 2990

Adaptive Averaging in Accelerated Descent Dynamics, WALID
KRICHENE, ALEXANDRE BAYEN, UC Berkeley, PETER BARTLETT, OpenAI /
UC Berkeley / Gradescope 2999

Sub-sampled Newton Methods with Non-uniform Sampling,
PENG XU, JIYAN YANG, Stanford University, FARBOD ROOSTA-KHORASANI,
University of California Berkeley, CHRISTOPHER RE, Stanford University, and
MICHAEL MAHONEY 3008

Stochastic Gradient Geodesic MCMC Methods, CHANG LIU,
Tsinghua University, JUNE ZHU, YANG SONG, Stanford University 3017

Variational Bayes on Monte Carlo Steroids, ADITYA GROVER,
STEFANO ERMON, Stanford University 3026

Showing versus doing: Teaching by demonstration, MARK HO,
Brown University, MICHAEL LITTMAN, JAMES MACGLASHAN, Brown
University, FIERY CUSHMAN, Harvard University, and JOE AUSTERWEIL,
University of Wisconsin-Madison 3035

Combining Fully Convolutional and Recurrent Neural Networks
for 3D Biomedical Image Segmentation, JIANXU CHEN, LIN YANG,
YIZHE ZHANG, MARK ALBER, and DANNY CHEN, University of Notre Dame 3044

Maximization of Approximately Submodular Functions, THIBAUT
HOREL, YARON SINGER, Harvard University 3053

A Comprehensive Linear Speedup Analysis for Asynchronous
Stochastic Parallel Optimization from Zeroth-Order to First-
Order, XIANGRU LIAN, University of Rochester, HUAN ZHANG, CHO-JUI
HSIEH, UC-Davis, YIJUN HUANG, and JI LIU 3062

Learning Infinite RBMs with Frank-Wolfe, WEI PING, UC Irvine,
QIANG LIU, Dartmouth College, ALEX IHLER 3071

Estimating the Size of a Large Network and its Communities from
a Random Sample, LIN CHEN, AMIN KARBASI, FORREST CRAWFORD,
Yale University 3080

xxiv
Learning Sensor Multiplexing Design through Back-propagation,
AYAN CHAKRABARTI, TTI-Chicago .................................................. 3089

On Robustness of Kernel Clustering,
BOWEI YAN, University of Texas at Austin, PURNAMRITA SARKAR, U.C. Berkeley .............................. 3098

High resolution neural connectivity from incomplete tracing data using nonnegative spline regression,
KAMERON HARRIS, University of Washington, STEFAN MIHALAS, Allen Institute for Brain Science, ERIC SHEA-BROWN, University of Washington ........................................... 3107

MoCap-guided Data Augmentation for 3D Pose Estimation in the Wild,
GREGORY ROGEZ, Inria, CORDELIA SCHMID .......................... 3116

New Liftable Classes for First-Order Probabilistic Inference,
SEYED KAZEMI, UBC, ANGELIKA KIMMIG, KU Leuven, GUY BROECK, University of California Los Angeles, DAVID POOLE, UBC ........................................ 3125

The Parallel Knowledge Gradient Method for Batch Bayesian Optimization,
JIAN WU, PETER FRAZIER, Cornell University .......................... 3134

Improved Regret Bounds for Oracle-Based Adversarial Contextual Bandits,
VASILIS SYRGKANIS, HAIPENG LUO, Princeton University, AKSHAY KRISHNAMURTHY, Carnegie Mellon University, ROBERT SCHAPIRE . 3143

Consistent Estimation of Functions of Data Missing Non-Monotonically and Not at Random,
ILYA SHPITSER, Johns Hopkins University ........................................ 3152

Optimistic Gittins Indices,
ELI GUTIN, Massachusetts Institute of Tec, VIVEK FARIAS, Massachusetts Institute of Technology .................... 3161

Finite-Dimensional BFRY Priors and Variational Bayesian Inference for Power Law Models,
JUHO LEE, POSTECH, LANCELOT JAMES, HKUST, SEUNGJIN CHOI, POSTECH ......................................... 3170

Launch and Iterate: Reducing Prediction Churn,
QUENTIN CORMIER, Google, MAHDI FARD, KEVIN CANINI, MAYA GUPTA ............ 3179

“Congruent” and “Opposite” Neurons: Sisters for Multisensory Integration and Segregation,
WENHAO ZHANG, Institute of Neuroscience Chinese Academy of Sciences, HE WANG, K. WONG, HKUST, SI WU ....... 3188

Learning shape correspondence with anisotropic convolutional neural networks,
DAVIDE BOSCAINI, University of Lugano, JONATHAN MASCI, EMANUELE RODOLÀ, MICHAEL BRONSTEIN, University of Lugano .. 3197

Pairwise Choice Markov Chains,
STEPHEN RAGAIN, JOHAN ÚGANDER, Stanford University ............................... 3206

NESTT: A Nonconvex Primal-Dual Splitting Method for Distributed and Stochastic Optimization,
DAVOOD HAJINEZHAD, MINGYI HONG, Iowa State University, TUO ZHAO, Johns Hopkins University, ZHAORAN WANG, Princeton University ................................................. 3215

Clustering with Same-Cluster Queries,
HASAN ASHTIANI, SHRINU KUSHAGRA, University of Waterloo, SHAI BEN-DAVID, U. Waterloo ............... 3224

Attend, Infer, Repeat: Fast Scene Understanding with Generative Models,
S. ESLAMI, Google DeepMind, NICOLAS HEESS, THEOPHANE WEBER, YUVAL TASSA, and DAVID SZEPESVARI, KORAY KAVUKCUOGLU, Google DeepMind, GEOFFREY HINTON, Google .................................... 3233

xxv
Parameter Learning for Log-supermodular Distributions, Tatiana Shpakova, Inria - ENS Paris, Francis Bach ................................. 3242

Deconvolving Feedback Loops in Recommender Systems, Ayan Sinha, Purdue, David Gleich, Karthik Ramani, Purdue University ...... 3251

Structured Matrix Recovery via the Generalized Dantzig Selector, Sheng Chen, Arindam Banerjee, University of Minnesota .................. 3260

Confusions over Time: An Interpretable Bayesian Model to Characterize Trends in Decision Making, Himabindu Lakkaraju, Jure Leskovec, Stanford University ....................................... 3269

Automatic Neuron Detection in Calcium Imaging Data Using Convolutional Networks, Noah Apthorpe, Alexander Riordan, Robert Aguilar, Jan Homann, and Yi Gu, David Tank, H. Seung, Princeton University ........................................................ 3278

Designing smoothing functions for improved worst-case competitive ratio in online optimization, Reza Eghbali, University of Washington, Maryam Fazel, University of Washington ............................. 3287

Convergence guarantees for kernel-based quadrature rules in misspecified settings, Motonobu Kanagawa, Bharath Sriperumbudur, Penn State University, Kenji Fukumizu ......................... 3296

Unsupervised Learning from Noisy Networks with Applications to Hi-C Data, Bo Wang, Junjie Zhu, Stanford University, Oana Ursu, Dept. of Genetics Stanford University, Armin Pourshafeie, Stanford University, and Serafim Batzoglou, Dept. of Computer Science Stanford University, Anshul Kundaje, Stanford University .......................... 3305

A Non-generative Framework and Convex Relaxations for Unsupervised Learning, Elad Hazan, Tengyu Ma, Princeton University .................................................. 3314

Equality of Opportunity in Supervised Learning, Moritz Hardt, Google Brain, Eric Price, University of Texas at Austin, Nati Srebro, TTI-Chicago ................................. 3323

Scaled Least Squares Estimator for GLMs in Large-Scale Problems, Murat A. Erdogdu, Mohsen Bayati, Stanford University, Lee Dicker, Rutgers University and Amazon .............................. 3332

Interpretable Nonlinear Dynamic Modeling of Neural Trajectories, Yuan Zhao, Il Park, Stony Brook University .............................. 3341

Search Improves Label for Active Learning, Alina Beygelzimer, Yahoo Inc, Daniel Hsu, Columbia University, John Langford, Chicheng Zhang, University of California San Diego ................................. 3350

Higher-Order Factorization Machines, Mathieu Blondel, Akinori Fujino, NTT, Naonori Ueda, Masakazu Ishihata, Hokkaido University . 3359

Exponential expressivity in deep neural networks through transient chaos, Ben Poole, Subhaneil Lahiri, Stanford University, Maithra Raghu, Cornell University, Jascha Sohl-Dickstein, and Surya Ganguli, Stanford University .................................................. 3368

Split LBI: An Iterative Regularization Path with Structural Sparsity, Chendi Huang, Xinwei Sun, Jiechao Xiong, Peking University, Yuan Yao ........................................... 3377
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>An equivalence between high dimensional Bayes optimal inference and M-estimation</td>
<td>Madhu Advani, Surya Ganguli, Stanford University</td>
<td>3386</td>
</tr>
<tr>
<td>Synthesizing the preferred inputs for neurons in neural networks via deep generator networks</td>
<td>Anh Nguyen, University of Wyoming, Alexey Dosovitskiy, University of Freiburg, Jason Yosinski, Cornell, Thomas Brox, University of Freiburg, and Jeff Clune</td>
<td>3395</td>
</tr>
<tr>
<td>Deep Submodular Functions: Definitions and Learning</td>
<td>Brian Dolhansky, University of Washington, Jeff Bilmes, University of Washington Seattle</td>
<td>3404</td>
</tr>
<tr>
<td>Discriminative Gaifman Models</td>
<td>Mathias Niepert</td>
<td>3413</td>
</tr>
<tr>
<td>Leveraging Sparsity for Efficient Submodular Data Summarization</td>
<td>Erik Lindgren, University of Texas at Austin, Shanshan Wu, UT Austin, Alexandros Dimakis, The University of Texas at Austin</td>
<td>3422</td>
</tr>
<tr>
<td>Local Minimax Complexity of Stochastic Convex Optimization</td>
<td>Yuancheng Zhu, Sabayasachi Chatterjee, University of Chicago, John Duchi, Stanford University, John Lafferty</td>
<td>3431</td>
</tr>
<tr>
<td>Stochastic Optimization for Large-scale Optimal Transport</td>
<td>Aude Genevay, Université Paris Dauphine, Marco Cuturi, Gabriel Peyré, Francis Bach</td>
<td>3440</td>
</tr>
<tr>
<td>On Mixtures of Markov Chains</td>
<td>Rishi Gupta, Stanford University, Ravi Kumar, Sergei Vassilvitskii, Google</td>
<td>3449</td>
</tr>
<tr>
<td>Linear Contextual Bandits with Knapsacks</td>
<td>Shipra Agrawal, Columbia University, Nikhil Devanur, Microsoft Research</td>
<td>3458</td>
</tr>
<tr>
<td>Reconstructing Parameters of Spreading Models from Partial Observations</td>
<td>Andrey Lokhov, Los Alamos National Laboratory</td>
<td>3467</td>
</tr>
<tr>
<td>Spatiotemporal Residual Networks for Video Action Recognition</td>
<td>Christoph Feichtenhofer, Axel Pinz, Graz University of Technology, Richard Wildes, York University Toronto</td>
<td>3476</td>
</tr>
<tr>
<td>Path-Normalized Optimization of Recurrent Neural Networks with ReLU Activations</td>
<td>Behnam Neyshabur, TTI-Chicago, Yuhuai Wu, Ruslan Salakhutdinov, University of Toronto, Nati Srebro, TTI-Chicago</td>
<td>3485</td>
</tr>
<tr>
<td>The Limits of Learning with Missing Data</td>
<td>Brian Bullins, Elad Hazan, Princeton University, Tomer Koren, Google Brain</td>
<td>3503</td>
</tr>
<tr>
<td>RETAIN: An Interpretable Predictive Model for Healthcare using Reverse Time Attention Mechanism</td>
<td>Edward Choi, Georgia Institute of Technology, Mohammad Bahadori, Joshua Kulas, Georgia Institute of Technology, Andy Schuetz, and Walter Stewart, Sutter Health, Jimeng Sun</td>
<td>3512</td>
</tr>
<tr>
<td>Total Variation Classes Beyond 1d: Minimax Rates, and the Limitations of Linear Smoothers</td>
<td>Veeranjaneyulu Sadhanala, Yu-Xiang Wang, Carnegie Mellon University, Ryan Tibshirani</td>
<td>3521</td>
</tr>
</tbody>
</table>
Learning Sparse Gaussian Graphical Models with Overlapping Blocks, Mohammad Hosseini, Su-In Lee, University of Washington .... 3808

Yggdrasil: An Optimized System for Training Deep Decision Trees at Scale, Firas Abuzaid, Massachusetts Institute of Technology, Joseph Bradley, Databricks, Feynman Liang, Cambridge University Engineering Department, Andrew Feng, and Lee Yang, Yahoo!, Matei Zaharia, Massachusetts Institute of Technology, Ameet Talwalkar, University of California Los Angeles ............................... 3817

Average-case hardness of RIP certification, Tengyao Wang, University of Cambridge, Quentin Berthet, Yaniv Plan, University of British Columbia ............................ 3826

A forward model at Purkinje cell synapses facilitates cerebellar anticipatory control, Ivan Herreros-Alonso, Universitat Pompeu Fabra, Xerxes Arsiwalla, Paul Verschure ................. 3835

Convolutional Neural Networks on Graphs with Fast Localized Spectral Filtering, Michaël Defferrard, École polytechnique fédérale de Lausanne, Xavier Bresson, Pierre Vandergheynst, École polytechnique fédérale de Lausanne organisations ............................. 3844

CliqueCNN: Deep Unsupervised Exemplar Learning, Miguel Bautista, Artsiom Sanakoyeu, Ekaterina Tikhoncheva, Heidelberg University, Björn Ommer ........................................ 3853

Large-Scale Price Optimization via Network Flow, Shinji Ito, NEC Coorporation, Ryohei Fujimaki ........................................ 3862

Online Pricing with Strategic and Patient Buyers, Michal Feldman, TAU, Tomer Koren, Technion—Israel Inst. of Technology, Roi Livni, Huji, Yishay Mansour, Microsoft, and Aviv Zohar, huji .................. 3871

Global Optimality of Local Search for Low Rank Matrix Recovery, Srinadh Bhojanapalli, TTI Chicago, Behnam Neyshabur, Nati Srebro, TTI-Chicago ............................................ 3880

Phased LSTM: Accelerating Recurrent Network Training for Long or Event-based Sequences, Daniel Neil, Michael Pfeiffer, Institute of Neuroinformatics, SHH-ChiI Liu ............................................. 3889

Improving PAC Exploration Using the Median Of Means, Jason Pazis, Massachusetts Institute of Technology, Ronald Parr, Jonathan How, Massachusetts Institute of Technology ......................... 3898

Infinite Hidden Semi-Markov Modulated Interaction Point Process, Matt Zhang, Nicta, Peng Lin, Ting Guo, Data61, Yang Wang, and Fang Chen, Data61 CSIRO ............................ 3907

Cooperative Inverse Reinforcement Learning, Dylan Hadfield-Menell, Stuart Russell, UC Berkeley, Pieter Abbeel, OpenAI / UC Berkeley / Gradescope, Anca Dragan, UC Berkeley ......................... 3916

Spatio-Temporal Hilbert Maps for Continuous Occupancy Representation in Dynamic Environments, Ransalu Senanayake, Lionel Ott, The University of Sydney, Simon O’Callaghan, NICTA, Fabio Ramos, The University of Sydney ........................................ 3925

Select-and-Sample for Spike-and-Slab Sparse Coding, Abdul-Saboor Sheikh, SAP Labs Berlin, Jörg Lücke .......................... 3934
Tractable Operations for Arithmetic Circuits of Probabilistic Models, Yujia Shen, Arthur Choi, Adnan Darwiche, University of California Los Angeles ...................................................... 3943

Greedy Feature Construction, Dino Oglic, University of Bonn, Thomas Gaertner, The University of Nottingham ...................... 3952

Mistake Bounds for Binary Matrix Completion, Mark Herbster, Stephen Pasteris, University College London, Massimiliano Pontil ...... 3961

Data driven estimation of Laplace-Beltrami operator, Frederic Chazal, INRIA, Ilaria Giulini, Bertrand Michel ......................... 3970

Tracking the Best Expert in Non-stationary Stochastic Environments, Chen-Yu Wei, Yi-Te Hong, Chi-Jen Lu, Academia Sinica ................................................................. 3979

Learning to learn by gradient descent by gradient descent, Marcin Andrychowicz, Google Deepmind, Misha Denil, Sergio Gomez, Matthew Hoffman, and David Pfau, Google DeepMind, Tom Schaul, Nando Freitas, Google ........................................ 3988

Kernel Observers: Systems-Theoretic Modeling and Inference of Spatiotemporally Evolving Processes, Hassan Kingravi, Pindrop Security Services, Harshal Maske, Girish Chowdhary, University of Illinois at Urbana-Champaign ................................................................. 3997

Quantum Perceptron Models, Ashish Kapoor, Nathan Wiebe, Microsoft Research, Krysta Svore .................................................. 4006

Guided Policy Search via Approximate Mirror Descent, William Montgomery, Sergey Levine, University of Washington ................... 4015

The Power of Optimization from Samples, Eric Balkanski, Harvard University, Aviad Rubinstein, UC Berkeley, Yaron Singer, Harvard University ................................................... 4024

Deep Exploration via Bootstrapped DQN, Ian Osband, Charles Blundell, DeepMind, Alexander Pritzel, Benjamin Van Roy, Stanford University ............................................................. 4033

A Multi-step Inertial Forward-Backward Splitting Method for Non-convex Optimization, Jingwei Liang, GREYC ENSICAEN, Jalal Fadili, Gabriel Peyré ................................................... 4042

Scaling Factorial Hidden Markov Models: Stochastic Variational Inference without Messages, Yin Ng, Pawel Chilinski, Ricardo Silva, University College London ............................................. 4051

Convolutional Neural Fabrics, Shreyas Saxena, INRIA, Jakob Verbeek ............................................................. 4060


A Sparse Interactive Model for Matrix Completion with Side Information, Jin Lu, Guannan Liang, Jiangwen Sun, Jinbo Bi, University of Connecticut ................................................... 4078
Coresets for Scalable Bayesian Logistic Regression, Jonathan Huggins, Trevor Campbell, Tamara Broderick, Massachusetts Institute of Technology ..................................................... 4087

Agnostic Estimation for Misspecified Phase Retrieval Models, Matey Neykov, Zhaoran Wang, Han Liu, Princeton University ............... 4096

Linear Relaxations for Finding Diverse Elements in Metric Spaces, Aditya Bhaskara, University of Utah, Mehrdad Ghadiri, Sharif University of Technology, Vahab Mirrokni, Google, Ola Svensson, École polytechnique fédérale de Lausanne .......................... 4105

Binarized Neural Networks, Itay Hubara, Technion, Matthieu Courbariaux, Université de Montréal, Daniel Soudry, Columbia University, Ran El-Yaniv, Technion, and Yoshua Bengio, Université de Montréal .... 4114

Local Maxima in the Likelihood of Gaussian Mixture Models: Structural Results and Algorithmic Consequences, Chi Jin, Yuchen Zhang, UC Berkeley, Sivaraman Balakrishnan, Carnegie Mellon University, Martin Wainwright, UC Berkeley, and Michael Jordan, OpenAI / UC Berkeley / Gradescope .......................... 4123

Memory-Efficient Backpropagation Through Time, Audrunas Gruslys, Remi Munos, Google DeepMind, Ivo Danihelka, Marc Lanctot, Google DeepMind, and Alex Graves .............................. 4132

Bayesian Optimization with Robust Bayesian Neural Networks, Jost Springenberg, Aaron Klein, Stefan Falkner, Frank Hutter, University of Freiburg ....................................................... 4141

Learnable Visual Markers, Oleg Grinchuk, Vadim Lebedev, Skolkovo Institute of Science and Technology, Victor Lempitsky .............. 4150

Fast Algorithms for Robust PCA via Gradient Descent, Xinyang Yi, UT Austin, Dohyung Park, University of Texas at Austin, Yudong Chen, Cornell University, Constantine Caramanis, UT Austin ............ 4159

One-vs-Each Approximation to Softmax for Scalable Estimation of Probabilities, Michalis Titsias ........................................ 4168

Learning Deep Embeddings with Histogram Loss, Evgeniya Ustinova, Skoltech, Victor Lempitsky ........................................ 4177

Spectral Learning of Dynamic Systems from Nonequilibrium Data, Hao Wu, Free University of Berlin, Frank Noe ......................... 4186

Fast Mixing Markov Chains for Strongly Rayleigh Measures, DPPs, and Constrained Sampling, Chengtao Li, Stefanie Jegelka, Suvrit Sra, Massachusetts Institute of Technology .......................... 4195

Mapping Estimation for Discrete Optimal Transport, Michael Perrot, University of Saint-Etienne laboratoire Hubert Curien, Nicolas Courty, Rémi Flamary, Amaury Habrard, University of Saint-Etienne Laboratoire Hubert Curien ......................................................... 4204

Batched Gaussian Process Bandit Optimization via Determinantal Point Processes, Tarun Kathuria, Microsoft Research, Amit Deshpande, Pushmeet Kohli ............................................. 4213

Protein contact prediction from amino acid co-evolution using convolutional networks for graph-valued images, Vladimir
GOLKOV, Technical University of Munich, MARCIN SKWARK, Vanderbilt University, ANTONIJ GOLKOV, University of Augsburg, ALEXEY DOSOVITSIK, and THOMAS BROX, University of Freiburg, JENS MEILER, Vanderbilt University, DANIEL CREMERS, Technical University of Munich  ...  4222

Linear Feature Encoding for Reinforcement Learning, ZHAO SONG, Duke University, RONALD PARR, XUEJUN LIAO, LAWRENCE CARIN, Duke University ............................................................ 4231

A Minimax Approach to Supervised Learning, FARZAN FARNA, DAVID TSE, Stanford University ............................................ 4240

Edge-exchangeable graphs and sparsity, DIANA CAI, University of Chicago, TREVOR CAMPBELL, TAMARA BRODERICK, Massachusetts Institute of Technology ...................................................... 4249

A Locally Adaptive Normal Distribution, GEORGIOS ARVANITIDIS, DTU, LARS HANSEN, SØREN HAUBERG .................................... 4258

Completely random measures for modelling block-structured sparse networks, TUE HERLAU, MIKKEL SCHMIDT, DTU, MORTEN MØRUP, Technical University of Denmark  ...  4267

Sparse Support Recovery with Non-smooth Loss Functions, KÉVIN DEGRAUX, Université catholique de Louvain, GABRIEL PEYRÉ, CNRS DMA École Normale Supérieure Paris France, JALAL FADILI, LAURENT JACQUES, Université catholique de Louvain  ............ 4276

Neurons Equipped with Intrinsic Plasticity Learn Stimulus Intensity Statistics, TRAVIS MONK, University of Oldenburg, CRISTINA SAVIN, IST Austria, JÖRG LÜCKE  ................................................ 4285

Learning values across many orders of magnitude, HARDO HASELT, ARTHUR GUEZ, MATTEO HESSEL, Google DeepMind, VOLODYMYR MNIH, and DAVID SILVER .................................................. 4294

Adaptive Smoothed Online Multi-Task Learning, KEERTHIAM MURUGESAN, HANXIAO LIU, JAIME CARBONELL, YIMING YANG, Carnegie Mellon University  .................................................. 4303

Safe Exploration in Finite Markov Decision Processes with Gaussian Processes, MATTEO TURCHETTA, FELIX BERKENKAMP, Eidgenössische Technische Hochschule Zürich, ANDREAS KRAUSE  ...  4312

Probabilistic Linear Multistep Methods, ONUR TEYMUR, Imperial College London, CONSTANTINOS ZYGALAKIS, University of Edinburgh, BEN CALDERHEAD .................................................. 4321

Stochastic Three-Composite Convex Minimization, ALP YURTSEVER, École polytechnique fédérale de Lausanne, BANG Vu, VOLKAN CEVHER ................................................................. 4329

Using Fast Weights to Attend to the Recent Past, JIMMY BA, University of Toronto, GEOFFREY HINTON, Google, VOLODYMYR MNIH, JOEL LEIBO, Google DeepMind, and CATALIN IONESCU, Google  ................. 4338

Maximal Sparsity with Deep Networks?, BO XIN, YIZHOU WANG, Peking University, WEN GAO, peking university, BAOYUAN WANG, Microsoft Research, and DAVID WIPF  ........................................... 4347

Man is to Computer Programmer as Woman is to Homemaker? Debiasing Word Embeddings, TOLGA BOLUKBASI, Boston
Tagger: Deep Unsupervised Perceptual Grouping, Klaus Greff, IDSIA, Antti Rasmus, Mathias Berglund, Tele Hao, The Curious AI Company, and Jürgen Schmidhuber, Harri Valpola, The Curious AI Company ................................................................. 4491

An Efficient Streaming Algorithm for the Submodular Cover Problem, Ashkan Norouzi-Fard, Abbas Bazzi, École polytechnique fédérale de Lausanne, Marwa Halabi, Ilija Bogunovic, EPFL Lausanne, and Ya-Ping Hsieh, Volkan Cevher ........................................ 4500

Interaction Networks for Learning about Objects, Relations and Physics, Peter Battaglia, Google DeepMind, Razvan Pascanu, Matthew Lai, Google DeepMind, Danilo Rezende, and Koray Kavukcuoglu, Google DeepMind ........................................ 4509

Efficient state-space modularization for planning: theory, behavioral and neural signatures, Daniel McNamie, Daniel Wolpert, Mate Lengyel, University of Cambridge .......................... 4518

Provable Efficient Online Matrix Completion via Non-convex Stochastic Gradient Descent, Chi Jin, UC Berkeley, Sham Kakade, University of Washington, Praneeth Netrapalli, Microsoft Research ....... 4527

Online Bayesian Moment Matching for Topic Modeling with Unknown Number of Topics, Wei-Shou Hsu, University of Waterloo, Pascal Poupart ......................................................... 4536

Computing and maximizing influence in linear threshold and triggering models, Justin Khim, University of Pennsylvania, Varun Jog, Po-Ling Loh, Berkeley ................................................................. 4545

Coevolutionary Latent Feature Processes for Continuous-Time User-Item Interactions, Yichen Wang, Georgia Tech, Nan Du, Georgia Institute of Technology, Rakhit Trivedi, Georgia Institute of Technology, Le Song, Georgia Institute of Technology .......................... 4554

Optimal Learning for Multi-pass Stochastic Gradient Methods, Junhong Lin, Istituto Italiano di Tecnologia, Lorenzo Rosasco, Massachusetts Institute of Technology ........................................ 4563

Generative Adversarial Imitation Learning, Jonathan Ho, Stefano Ermon, Stanford University .......................................................... 4572

Latent Attention For If-Then Program Synthesis, Xinyun Chen, Shanghai Jiaotong University, Chang Liu, University of Maryland, Richard Shin, Dawn Song, UC Berkeley, and Mingcheng Chen, University of Illinois Urbana-Champaign ........................................ 4581

Dual Space Gradient Descent for Online Learning, Trung Le, University of Pedagogy Ho Chi Minh city, Tu Nguyen, Vu Nguyen, Dinh Phung, Deakin University ....................................................... 4590

Riemannian SVRG: Fast Stochastic Optimization on Riemannian Manifolds, Hongyi Zhang, Massachusetts Institute of Technology, Sashank Reddi, Carnegie Mellon University, Suvrit Sra, Massachusetts Institute of Technology ..................................................... 4599

Professor Forcing: A New Algorithm for Training Recurrent Networks, Alex Lamb, Montreal, Anirudh Goyal, Ying Zhang, Saizheng Zhang, and Aaron Courville, University of Montreal, Yoshua Bengio, U. Montreal .................................................. 4608
Learning brain regions via large-scale online structured sparse
dictionary learning, Elvis DOHMATOB, Inria, Arthur MENSCH,
inria, Gaël VAROQUAUX, Bertrand THIRION ........................... 4617

Efficient Neural Codes under Metabolic Constraints, Zhuo WANG,
Xue-Xin WEI, Alan STOCKER, Daniel LEE, University of Pennsylvania ... 4626

Approximate maximum entropy principles via Goemans-
Williamson with applications to provable variational methods,
Andréj Risteski, Yuanzhi LI, Princeton University ...................... 4635

Efficient High-Order Interaction-Aware Feature Selection Based
on Conditional Mutual Information, Alexander SHISHKIN,
Anastasia BEZUBTSEVA, Alexey DRUTSA, Ilia SHISHKOV, and
Ekaterina GLADKIKH, Yandex, Gleb GUSEV, Yandex LLC, Pavel
SERDYUKOV, Yandex ...................................................... 4644

Bayesian Intermittent Demand Forecasting for Large Inventories,
Matthias SEEGER, David SALINAS, Valentin FLUNKERT, Amazon ...... 4653

Visual Question Answering with Question Representation Update
(QRU), Ruyu LI, Jiaya JIA, The Chinese University of Hong Kong ...... 4662

Learning Parametric Sparse Models for Image Super-Resolution,
Yongbo LI, Weisheng DONG, Xuemei XIE, Guangming SHI, Xidian
University, and Xin LI, WVU, Donglai XU, Teesside University ........... 4671

Blazing the trails before beating the path: Sample-efficient
Monte-Carlo planning, Jean-Bastien GRILL, Michal VALKO, Inria
Lille - Nord Europe, Remi MUNOS, Google DeepMind ..................... 4680

Asynchronous Parallel Greedy Coordinate Descent, Yang YOU,
UC Berkeley, Xiangru LIAN, University of Rochester, Ji LIU, Hsiang-Fu
Yu, and Inderjit DIHILLON, University of Texas at Austin, James DEMMEL,
UC Berkeley, Cho-Jui HSIEH, UC-Davis .................................... 4689

Iterative Refinement of the Approximate Posterior for Directed
Belief Networks, Rex HJELM, University of New Mexico, Ruslan
Salakhutdinov, University of Toronto, Kyunghyun Cho, University of
Montreal, Nebojsa JOJIC, Microsoft Research, and Vince CALHOUN, Mind
Research Network, Junyoung CHUNG, University of Montreal ............ 4698

Assortment Optimization Under the Mallows model, Antoine
Desir, Columbia University, Vineet GOYAL, Srikant JAGABATHULA,
Danny SEGEV ............................................................. 4707

Disease Trajectory Maps, Peter SCHULAM, Raman ARORA, Johns
Hopkins University .......................................................... 4716

Multistage Campaigning in Social Networks, Mehrdad
Farajtabar, Georgia Tech, Xiaojing YE, Georgia State University, Sahar
Harati, Emory University, Le SONG, and Hongyuan ZHA, Georgia Institute
of Technology ............................................................... 4725

Learning in Games: Robustness of Fast Convergence, Dylan
Foster, Cornell University, Zhiyuan LI, Tsinghua University, Thodoris
Lykouris, Cornell University, Karthik Sridharan, University of
Pennsylvania, and Eva TARDOS, Cornell University ........................ 4734

Improving Variational Autoencoders with Inverse Autoregressive
Flow, Diederik KINGMA, Tim SALIMANS, Rafal Jozefowicz, OpenAI,
Xi CHEN, UC Berkeley and OpenAI, and Ilya SUTSKEVER, Max WELLING . 4743
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithms and matching lower bounds for approximately-convex optimization</td>
<td>Andrej Risteski, Yuanzhi Li, Princeton University</td>
<td>4752</td>
</tr>
<tr>
<td>Unified Methods for Exploiting Piecewise Linear Structure in Convex Optimization</td>
<td>Tyler Johnson, Carlos Guestrin, University of Washington</td>
<td>4761</td>
</tr>
<tr>
<td>Kernel Bayesian Inference with Posterior Regularization</td>
<td>Yang Song, Stanford University, June Zhu, Yong Ren, Tsinghua University</td>
<td>4770</td>
</tr>
<tr>
<td>Neural Universal Discrete Denoiser</td>
<td>Taesup Moon, DGIST, Seonwoo Min, Byunghan Lee, Sungroh Yoon</td>
<td>4779</td>
</tr>
<tr>
<td>Optimal Architectures in a Solvable Model of Deep Networks</td>
<td>Jonathan Kadmon, Hebrew University, Haim Sompolinsky</td>
<td>4788</td>
</tr>
<tr>
<td>Supervised Learning with Tensor Networks</td>
<td>Edwin Stoudenmire, Univ of California Irvine, David Schwab, Northwestern University</td>
<td>4806</td>
</tr>
<tr>
<td>Multi-step learning and underlying structure in statistical models</td>
<td>Maia Fraser, University of Ottawa</td>
<td>4815</td>
</tr>
<tr>
<td>Structure-Blind Signal Recovery</td>
<td>Dmitry Ostrovsky, Univ. Grenoble Alpes, Zaid Harchaoui, NYU Courant Institute, Anatoli Juditsky, Arkadi Nemirovski, Georgia Institute of Technology</td>
<td>4824</td>
</tr>
<tr>
<td>An Architecture for Deep, Hierarchical Generative Models</td>
<td>Philip Bachman</td>
<td>4833</td>
</tr>
<tr>
<td>Feature selection in functional data classification with recursive maxima hunting</td>
<td>José Torrecilla, Universidad Autónoma de Madrid, Alberto Suarez</td>
<td>4842</td>
</tr>
<tr>
<td>Achieving budget-optimality with adaptive schemes in crowdsourcing</td>
<td>Ashish Khetan, University of Illinois Urbana-, Sewoong Oh, University of Illinois at Urbana-Champaign</td>
<td>4851</td>
</tr>
<tr>
<td>Near-Optimal Smoothing of Structured Conditional Probability Matrices</td>
<td>Moein Falahatgar, University of California San Diego, Mesrob Ohannessian, Alon Orlitsky, UC San Diego</td>
<td>4860</td>
</tr>
<tr>
<td>Supervised Word Mover’s Distance</td>
<td>Gao Huang, Chuan Guo, Matt Kusner, Yu Sun, and Kilian Weinberger, Cornell University, Fei Sha, University of Southern California</td>
<td>4869</td>
</tr>
<tr>
<td>Exploiting Tradeoffs for Exact Recovery in Heterogeneous Stochastic Block Models</td>
<td>Amin Jalali, Qiyan Han, Ioana Dumitriu, Maryam Fazel, University of Washington</td>
<td>4878</td>
</tr>
<tr>
<td>Threshold Bandits, With and Without Censored Feedback</td>
<td>Jacob Abernethy, Kareem Amin, University of Michigan, Ruihao Zhu, Massachusetts Institute of Technology</td>
<td>4896</td>
</tr>
</tbody>
</table>
Understanding the Effective Receptive Field in Deep Convolutional Neural Networks, Wenjie Luo, Yujia Li, Raquel Urtasun, Richard Zemel, University of Toronto ........................................ 4905

Learning Supervised PageRank with Gradient-Based and Gradient-Free Optimization Methods, Lev Bogolubsky, Pavel Dvurechensky, Weierstrass Institute for AppI, Alexander Gasnikov, Gleb Gusev, Yandex LLC, and Yuriy Nesterov, Andrey Raigorodskii, Aleksey Tikhonov, Maksim Zhukovskii ........................................ 4914

$k^*$-Nearest Neighbors: From Global to Local, Oren Anava, Kfir Levy, Technion ............................................................................................. 4923

Normalized Spectral Map Synchronization, Yanyao Shen, UT Austin, Qixing Huang, Toyota Technological Institute at Chicago, Nati Srebro, TTI-Chicago, Sujay Sanghavi ....................................................... 4932

Beyond Exchangeability: The Chinese Voting Process, Moontae Lee, Seok Jin, David Mimno, Cornell University ........................................ 4941

A posteriori error bounds for joint matrix decomposition problems, Nicolo Colombo, University College London, Nikos Vlassis, Adobe Research .......................................................... 4950

A Bayesian method for reducing bias in neural representational similarity analysis, Ming Cai, Princeton University, Nicolas Schuck, Princeton Neuroscience Institute Princeton University, Jonathan Pillow, Yael Niv, Princeton University ......................................................... 4958

Online ICA: Understanding Global Dynamics of Nonconvex Optimization via Diffusion Processes, Chris Li, Zhaoran Wang, Han Liu, Princeton University .................................................. 4967

Following the Leader and Fast Rates in Linear Prediction: Curved Constraint Sets and Other Regularities, Ruitong Huang, University of Alberta, Tor Lattimore, Andras Gyorgy, Csaba Szepesvari, U. Alberta .............................................................................. 4976

SDP Relaxation with Randomized Rounding for Energy Disaggregation, Kiarash Shaloudegi, Andras Gyorgy, Csaba Szepesvari, U. Alberta, Wilsun Xu, University of Alberta ........................................ 4985

Recovery Guarantee of Non-negative Matrix Factorization via Alternating Updates, Yuanzhi Li, Yingyu Liang, Andrej Risteski, Princeton University .......................................................... 4994

Unsupervised Learning of 3D Structure from Images, Danilo Rezende, S. Eslami, Shakir Mohamed, Peter Battaglia, Google DeepMind, and Max Jaderberg, Nicolas Heess ........................................ 5003

Poisson–Gamma dynamical systems, Aaron Schein, UMass Amherst, Hanna Wallach, Microsoft Research, Mingyuan Zhou ........................................ 5012

Gaussian Processes for Survival Analysis, Tamara Fernandez, University of Oxford, Nicolas Rivera, King’s College London, Yee Whye Teh .......................................................... 5021

Dual Decomposed Learning with Factorwise Oracle for Structural SVM of Large Output Domain, Ian Yen, Huang Xiangru, Kai Zhong, Zhang Ruohan, and Pradeep Ravikumar, Inderjit Dhillon, University of Texas at Austin .................................................. 5030

xxxviii
Optimal Binary Classifier Aggregation for General Losses,
AKSHAY BALSUBRAMANI, YOAV FREUND, UC San Diego ................ 5039

Disentangling factors of variation in deep representation using adversarial training, MICHAEL MATHIEU, JUNBO ZHAO, ADITYA RAMESH, PABLO SPRECHMANN, and YANN LECUN, New York University ... 5047

A primal-dual method for conic constrained distributed optimization problems, NECDET AYBAT, ERFAN HAMEDANI, Penn State University ................................................................. 5056

Fundamental Limits of Budget-Fidelity Trade-off in Label Crowdsourcing, FARSHAD, BABAK HASSIBI, Caltech ................... 5065

Learning to Poke by Poking: Experiential Learning of Intuitive Physics, PULKIT AGRAWAL, ASHVIN NAIR, UC Berkeley, PIETER ABBEEL, OpenAI / UC Berkeley / Gradescope, JITENDRA MALIK, UC Berkeley, and SERGEY LEVINE, University of Washington ................................. 5074

A Neural Transducer, NAVDEEP JAITLY, QUOC LE, ORIOL VINYALS, ILYA SUTSKEVER, and DAVID SUGILLO, Google, SAMY BENGIO ............ 5083

Learning Deep Parsimonious Representations, RENJE LIAO, UofT, ALEXANDER SCHWING, RICHARD ZEMEL, RAQUEL URTASUN, University of Toronto ................................................................. 5092

Author Index ................................................................. 5101