



NICOLÒ CESA-BIANCHI
PROFESSOR OF COMPUTER SCIENCE

Dipartimento di Informatica
Università degli Studi di Milano
via Comelico 39
20135 Milano, Italy

Phone: +39-02-503-16280 (fax: -16253)
Email: nicolo.<last-name>@unimi.it

RESEARCH

- Design and analysis of machine learning algorithms, especially in the online learning model.
- Algorithms for multiarmed bandit problems, with applications to personalized recommendations and online auctions.
- Graph analytics, with applications to social networks and bioinformatics.

Papers

Perdition, burning, and flames (a hell of a book)

I am a recipient of the 2017 **Criteo Faculty Research Award**

I am member of the **EUROPEAN NETWORK FOR GAME THEORY**

PROFESSIONAL ACTIVITIES

Associate editor: **Information and Inference**

COLT 2018 PC member

AISTATS 2018 Area chair

WWW 2018 PC member Web Search and Mining track

NIPS 2018 Co-chair

EVENTS

Workshop on Multi-Armed Bandits and Learning Algorithms. May 24-25, 2018. Rotterdam, The Netherlands

Paris Symposium on Games. June 11-15, 2018. Paris, France

The 29th International Conference on Game Theory. July 16-20, 2018. New York, USA

GAMENET Conference. September 17-21, 2018. Kraków, Poland

TEACHING

Metodi statistici per l'apprendimento
(2009- , magistrale Informatica)

Complementi di Algoritmi e Strutture Dati
(2016- , triennale Informatica)

Machine learning with experts and bandits
(2017, Dottorato in Informatica)

Teoria dell'Informazione e della Trasmissione

NICOLÒ CESA-BIANCHI - SELECTED PAPERS

"These scientific products take of course some time to fructuate." - V. Nabokov

Prediction with Expert Advice and Game-Theoretic Learning

- N. Cesa-Bianchi, O. Dekel, O. Shamir
Online learning with switching costs and other adaptive adversaries
Advances in Neural Information Processing Systems 26. Pages 1160-1168, 2013.
- E. Gofer, N. Cesa-Bianchi, C. Gentile, and Y. Mansour
Regret minimization for branching experts
Proceedings of the 26th Conference on Learning Theory. JMLR Workshop and Conference Proceedings, **30**:618-638, 2013.
- N. Cesa-Bianchi, P. Gaillard, G. Lugosi, and G. Stoltz
Mirror Descent meets Fixed Share (and feels no regret)
Advances in Neural Information Processing Systems 25. Pages 989-997, 2012.
- N. Cesa-Bianchi, Y. Mansour, and G. Stoltz
Improved second-order bounds for prediction with expert advice
Machine Learning, **66**(2/3):321-352, 2007.
- N. Cesa-Bianchi, G. Lugosi, and G. Stoltz
Regret minimization under partial monitoring
Mathematics of Operations Research, **31**(3):562-580, 2006.
Slides presented at the IEEE 2006 Information Theory Workshop.
- N. Cesa-Bianchi, G. Lugosi, and G. Stoltz
Minimizing regret with label efficient prediction
IEEE Transactions on Information Theory, **51**(6):2152-2162, 2005.
- N. Cesa-Bianchi and G. Lugosi
Potential-based algorithms in on-line prediction and game theory
Machine Learning, **51**(3):239-261, 2003.
- N. Cesa-Bianchi
Universal prediction
In: *Principles of Nonparametric Learning*
Springer (CISM courses and lectures no. 434), 2002.
- N. Cesa-Bianchi and G. Lugosi
Worst-case bounds for the logarithmic loss of predictors
Machine Learning, **43**(3):247-264, 2001.
- N. Cesa-Bianchi and G. Lugosi
On prediction of individual sequences
Annals of Statistics, **27**(6):1865-1895, 1999.
- N. Cesa-Bianchi, D.P. Helmbold, and S. Panizza
On Bayes methods for on-line boolean prediction
Algorithmica, **22**(1/2):112-137, 1998.
- N. Cesa-Bianchi, Y. Freund, D.P. Helmbold, D. Haussler, R. Schapire, and M.K. Warmuth
How to use expert advice
Journal of the ACM, **44**(3):427-485, 1997.
- N. Cesa-Bianchi, Y. Freund, D.P. Helmbold, and M.K. Warmuth
On-line prediction and conversion strategies
Machine Learning, **25**:71-110, 1996.

Bandit Problems

- N. Cesa-Bianchi, C. Gentile, and Y. Mansour
Nonstochastic bandits with composite anonymous feedback
Proceedings of the 31st Conference on Learning Theory (COLT). JMLR Workshop and Conference Proceedings, 2018. To appear.
- N. Cesa-Bianchi and O. Shamir
Bandit regret scaling with the effective loss range
Proceedings of the 29th International Conference on Algorithmic Learning Theory (ALT). PMLR **83**:128-151, 2018.
- N. Cesa-Bianchi, C. Gentile, G. Lugosi, G. Neu
Boltzmann exploration done right
Advances in Neural Information Processing Systems 31 (NIPS 2017). Pages 6284-6293, 2017.
- N. Alon, N. Cesa-Bianchi, C. Gentile, S. Mannor, Y. Mansour, and O. Shamir
Nonstochastic multi-armed bandits with graph-structured feedback
SIAM Journal on Computing. **46**(6):1785-1826, 2017.
- N. Cesa-Bianchi, P. Gaillard, C. Gentile, and S. Gerchinovitz
Algorithmic chaining and the role of partial feedback in online nonparametric learning
Proceedings of the 30th Conference on Learning Theory (COLT). PMLR **65**:465-481, 2017.
- N. Cesa-Bianchi, C. Gentile, Y. Mansour, and A. Minora
Delay and cooperation in nonstochastic bandits
Proceedings of the 29th Conference on Learning Theory (COLT). JMLR Workshop and Conference Proceedings, **49**:605-622, 2016.
Full paper. Submitted for journal publication, 2017.
- N. Cesa-Bianchi
Multi-armed bandit problem
Encyclopedia of Algorithms. Pages 1356-1359, 2016.
- N. Alon, N. Cesa-Bianchi, O. Dekel, and T. Koren
Online learning with feedback graphs: beyond bandits
Proceedings of the 28th Conference on Learning Theory (COLT). JMLR Workshop and Conference Proceedings, **40**:23-35, 2015.
- N. Cesa-Bianchi, C. Gentile, and Y. Mansour
Regret minimization for reserve prices in second-price auctions
IEEE Transactions on Information Theory, **61**(1):549-564, 2015.

- N. Cesa-Bianchi, C. Gentile, and G. Zappella
A gang of bandits
Advances in Neural Information Processing Systems 26. Pages 737-745, 2013.
- S. Bubeck, N. Cesa-Bianchi, and G. Lugosi
Bandits with heavy tail
IEEE Transactions on Information Theory, **59**(11):7711-7717, 2013.
- S. Bubeck and N. Cesa-Bianchi
Regret analysis of stochastic and nonstochastic multi-armed bandit problems
Foundations and Trends in Machine Learning, **5**(1):1-122, 2012.
- S. Bubeck, N. Cesa-Bianchi, and S. Kakade
Towards minimax policies for online linear optimization with bandit feedback
Proceedings of the 25th Annual Conference on Learning Theory (COLT). JMLR Workshop and Conference Proceedings, **23**:41.1-41.14, 2012.
- N. Cesa-Bianchi and G. Lugosi
Combinatorial bandits
Journal of Computer and Systems Sciences, **78**:1404-1422, 2012.
- P. Auer, N. Cesa-Bianchi, and P. Fischer
Finite-time analysis of the multiarmed bandit problem
Machine Learning, **47**(2/3):235-256, 2002.
- P. Auer, N. Cesa-Bianchi, Y. Freund, and R.E. Schapire
The nonstochastic multiarmed bandit problem
SIAM Journal on Computing, **32**(1):48-77, 2002.

Learning on Graphs

- G. Le Falher, N. Cesa-Bianchi, C. Gentile, F. Vitale
On the troll-trust model for edge sign prediction in social networks
Proceedings of the 20th International Conference on Artificial Intelligence and Statistics (AISTATS 2017). JMLR Workshop and Conference Proceedings, **54**:4
- N. Cesa-Bianchi, C. Gentile, F. Vitale, and G. Zappella
A linear time active learning algorithm for link classification
Advances in Neural Information Processing Systems 25 (NIPS 2012). Pages 1619-1627, 2012.
- N. Cesa-Bianchi, C. Gentile, F. Vitale, and G. Zappella
A correlation clustering approach to link classification in signed networks
Proceedings of the 25th Annual Conference on Learning Theory. JMLR Workshop and Conference Proceedings, **23**:34.1-34.20, 2012.
- F. Vitale, N. Cesa-Bianchi, C. Gentile, and G. Zappella
See the tree through the lines: the Shazoo algorithm
Advances in Neural Information Processing Systems 24 (NIPS 2011). Pages 1584-1592, 2011.
Full paper.
- N. Cesa-Bianchi, C. Gentile, F. Vitale, and G. Zappella
Active learning on trees and graphs
Proceedings of the 23rd Conference on Learning Theory. Omnipress, 2010.
- N. Cesa-Bianchi, C. Gentile, F. Vitale, and G. Zappella
Random spanning trees and the prediction of weighted graphs
Journal of Machine Learning Research, **14**:1251-1284, 2013.
- N. Cesa-Bianchi, C. Gentile, and F. Vitale
Predicting the labels of an unknown graph via adaptive exploration
Theoretical Computer Science, **412**(19):1791-1804, 2011.
- N. Cesa-Bianchi, C. Gentile, and F. Vitale
Fast and optimal prediction on a labeled tree
Proceedings of the 22nd Conference on Learning Theory. Omnipress, 2009.

Pattern Classification and Regression

- I. Kuzborskij and N. Cesa-Bianchi
Nonparametric online regression while learning the metric
Advances in Neural Information Processing Systems 31 (NIPS 2017). Pages 667-676, 2017.
- R. De Rosa and N. Cesa-Bianchi
Confidence decision trees via online and active learning for streaming data
Journal of Artificial Intelligence Research, **60**:1031-1055, 2017.
- R. De Rosa, I. Gori, F. Cuzzolin, and N. Cesa-Bianchi
Active incremental recognition of human activities in a streaming context
Pattern Recognition Letters. **99**:48-56, 2017.
- H. Luo, A. Agarwal, N. Cesa-Bianchi, and J. Langford
Efficient second order online learning by sketching
Advances in Neural Information Processing Systems 30 (NIPS 2016). Pages 902-910, 2016.
- R. De Rosa, F. Orabona, and N. Cesa-Bianchi
The ABACOC algorithm: A novel approach for nonparametric classification of data streams
Proceedings of the IEEE International Conference on Data Mining (ICDM). Pages 733-738, 2015.
Long version.
- F. Orabona, K. Crammer, and N. Cesa-Bianchi
A generalized online mirror descent with applications to classification and regression
Machine Learning, **99**(3):411-435, 2015.
- N. Cesa-Bianchi and O. Shamir
Efficient transductive online learning via randomized rounding
In: *Empirical Inference, Festschrift in Honor of Vladimir N. Vapnik*. Springer, 2013.
(A preliminary version **Efficient online learning via randomized rounding** appeared in: *Advances in Neural Information Processing Systems 24 (NIPS 2011)*). F
- F. Orabona, N. Cesa-Bianchi, and C. Gentile
Beyond logarithmic bounds in online learning
Proceedings of the 15th International Conference on Artificial Intelligence and Statistics. JMLR Workshop and Conference Proceedings, **22**:823-831, 2012.

- F. Orabona and N. Cesa-Bianchi
Better algorithms for selective sampling
Proceedings of the 28th International Conference on Machine Learning. Omnipress, 2011.
- N. Cesa-Bianchi, S. Shalev-Shwartz, and O. Shamir
Quantity makes quality: learning with partial views
Proceedings of the 25th AAAI Conference on Artificial Intelligence (Nectar Program). AAAI Press, 2011.
- N. Cesa-Bianchi, S. Shalev-Shwartz, and O. Shamir
Online learning of noisy data with kernels
IEEE Transaction on Information Theory, 57(12):7907-7931, 2011.
- L. Jie, F. Orabona, M. Fornoni, B. Caputo, and N. Cesa-Bianchi
OM-2: An online multi-class multi-kernel learning algorithm
Proceedings of the 4th IEEE Online Learning for Computer Vision Workshop. IEEE Press, 2010.
- N. Cesa-Bianchi, S. Shalev-Shwartz, and O. Shamir
Efficient learning with partially observed attributes
Journal of Machine Learning Research, 12:2857-2878, 2011.
- G. Cavallanti, N. Cesa-Bianchi, and C. Gentile
Linear algorithms for online multitask classification
Journal of Machine Learning Research, 11:2901-2934, 2010.
- N. Cesa-Bianchi, C. Gentile, and F. Orabona
Robust bounds for classification via selective sampling
Proceedings of the 26th International Conference on Machine Learning. Omnipress, 2009.
- G. Cavallanti, N. Cesa-Bianchi, and C. Gentile
Tracking the best hyperplane with a simple budget Perceptron
Machine Learning, 69(2/3):143-167. Springer, 2007.
- N. Cesa-Bianchi
Applications of regularized least squares to pattern classification
Theoretical Computer Science, 382(3):221-231. Elsevier, 2007.
- N. Cesa-Bianchi, C. Gentile, and L. Zaniboni
Worst-case analysis of selective sampling for linear classification
Journal of Machine Learning Research, 7:1205-1230, 2006.
- N. Cesa-Bianchi, C. Gentile, and L. Zaniboni
Hierarchical classification: combining Bayes with SVM
Proceedings of the 23rd International Conference on Machine Learning, 2006.
- N. Cesa-Bianchi, C. Gentile, and L. Zaniboni
Incremental algorithms for hierarchical classification
Journal of Machine Learning Research, 7:31-54, 2006.
- N. Cesa-Bianchi, A. Conconi, and C. Gentile
A second-order Perceptron algorithm
SIAM Journal on Computing, 34(3):640-668. SIAM, 2005.
- P. Auer, N. Cesa-Bianchi, and C. Gentile
Adaptive and self-confident on-line learning algorithms
Journal of Computer and System Sciences, 64(1):48-75, 2002.
- N. Cesa-Bianchi
Analysis of two gradient-based algorithms for on-line regression
Journal of Computer and System Sciences, 59(3):392-411, 1999.
- N. Cesa-Bianchi, P.M. Long, and M.K. Warmuth
Worst-case quadratic loss bounds for prediction using linear functions and gradient descent
IEEE Transactions on Neural Networks, 7(3):604-619, 1996.

Statistical Learning Theory

- N. Cesa-Bianchi, Y. Mansour, and O. Shamir
On the complexity of learning with kernels
Proceedings of the 28th Annual Conference on Learning Theory. JMLR Workshop and Conference Proceedings, 40:297-325, 2015.
- G. Cavallanti, N. Cesa-Bianchi, and C. Gentile
Learning noisy linear classifiers via adaptive and selective sampling
Machine Learning, 83:71-102, 2011.
- N. Cesa-Bianchi and C. Gentile
Improved risk tail bounds for on-line algorithms
IEEE Transactions on Information Theory, 54(1):386-390, 2008.
- N. Cesa-Bianchi, A. Conconi, and C. Gentile
On the generalization ability of on-line learning algorithms
IEEE Transactions on Information Theory, 50(9):2050-2057, 2004.
- N. Cesa-Bianchi, E. Dichterman, P. Fischer, E. Shamir, and H.U. Simon
Sample-efficient strategies for learning in the presence of noise
Journal of the ACM, 46(5):684-719, 1999.
- N. Alon, S. Ben-David, N. Cesa-Bianchi, and D. Haussler
Scale-sensitive dimensions, uniform convergence, and learnability
Journal of the ACM, 44(4):615-631, 1997.
- S. Ben-David, N. Cesa-Bianchi, D. Haussler, and P.M. Long
Characterizations of learnability for classes of $\{0, \dots, n\}$ -valued functions
Journal of Computer and System Sciences, 50(1):74-86, 1995.

Boolean Learning and Learning with Queries

- P. Auer and N. Cesa-Bianchi
On-line learning with malicious noise and the closure algorithm
Annals of AI and Mathematics, 23(1/2):83-99, 1998.

- A. Bertoni, N. Cesa-Bianchi e G. Fiorino
Efficient learning with equivalence queries of conjunctions of modulo functions
Information Processing Letters, **56**:15–17, 1995.

Bioinformatics

- M. Frasca and N. Cesa-Bianchi
Multitask protein function prediction through task dissimilarity
IEEE/ACM Transactions on Computational Biology and Bioinformatics. To appear.
An extended abstract was presented at the 15th International Workshop on Data Mining in Bioinformatics (BIOKDD'16).
- N. Cesa-Bianchi, M. Re, and G. Valentini
Synergy of multilabel hierarchical ensembles, data fusion, and cost-sensitive methods for gene functional inference
Machine Learning, **88**:209-241, 2012.
- N. Cesa-Bianchi and G. Valentini
Hierarchical cost-sensitive algorithms for genome-wide gene function prediction
Proceedings of the 3rd International Workshop on Machine Learning in Systems Biology, JMLR Workshop and Conference Proceedings, **8**:14-29, 2010.
- G. Valentini and N. Cesa-Bianchi
HCGene: a software tool to support the hierarchical classification of genes
Bioinformatics, **24**(5):729-731, 2008.

Other Areas

- Y. Seldin, F. Laviolette, N. Cesa-Bianchi, J. Shawe-Taylor, and P. Auer
PAC-Bayesian Inequalities for Martingales
IEEE Transactions on Information Theory, **58**(12):7086-7093, 2012.
- P. Auer and N. Cesa-Bianchi
A distributed voting scheme to maximize preferences
RAIRO - Theoretical Informatics and Applications, **40**:389-403, 2006.
- N. Cesa-Bianchi and G. Lugosi
Minimax values and metric entropy bounds for portfolio selection problems
Communicated at the *First World Congress of the Game Theory Society (Games 2000)*.
- N. Cesa-Bianchi and D. Haussler,
A graph-theoretic generalization of the Sauer-Shelah lemma
Discrete Applied Mathematics, **86**(1):27-35, 1998.
- N. Cesa-Bianchi, A. Krogh and M.K. Warmuth
Bounds on approximate steepest descent for likelihood maximization in exponential families
IEEE Transactions on Information Theory, **40**(4):1215-1218, 1994.
- B. Apolloni, N. Cesa-Bianchi, and D. De Falco
A numerical implementation of quantum annealing
Stochastic Processes, Physics and Geometry: Proceedings of the Ascona-Locarno Conference, pages 97-111, 1988.
- G. Cattaneo and N. Cesa-Bianchi
Microcanonical annealing on neural networks
Proceedings of the First Annual Meeting of the International Neural Network Society, page 81, 1988.