

Shai Ben-David

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○ Education

Ph.D. in Mathematics, Hebrew University, Jerusalem, Israel, *Supervisor*: Prof. S. Shelah (1987).

B.Sc. and M.Sc. studies in Psychology, Hebrew University, Jerusalem, Israel.

M.Sc. in Mathematics (with distinction), Hebrew University, Israel. *Supervisor*: Prof. S. Shelah.

B.Sc. in Mathematics and Physics (with distinction), Hebrew University, Jerusalem, Israel.

○ Academic Appointments

2002- Visiting Professor, School of ECE, Cornell University.

2001-02 Visiting Professor, Computer Science Dept., Cornell University.

1997-1998 Visiting Fellow, Dept. of Systems Engineering, RSISE, Institute of Advanced Studies, Australian National University, Canberra, Australia.

1987- Dept. of Computer Science, Technion, Haifa, Israel.

1985-87 Postdoctoral Fellow, Dept. of Mathematics and Dept. of Computer Science, University of Toronto, Canada.

○ Professional Activities

My main research activity is in the area of Computational Learning Theory. There are three major international conferences in this area, COLT, EuroCOLT and ALT. I have been the steering committee chair of EuroCOLT and on the steering committee of COLT. I have also been the program chairman of all of these conferences (EuroCOLT'97, COLT'99 and ALT'04) and a frequent member of their program committees.

International Committees

- Member of the joint **COLT/EuroCOLT** steering committee, 2000-2002.
- Chair of the steering committee of **EuroCOLT**, 1997-1999.
- Member of the steering committee of **COLT**, 1996- 1999.
- Member of the *International Federation for information Processing (IFIP)* Working Group 1.4 on Computational Learning.

Journal Editorial Functions

- Action Editor of **Machine Learning Journal**.
- Member of the Editorial Board of **Neurocomputing**
- Guest editor of a special issue of **Neurocomputing** on "Theoretical analysis of real valued function classes".

Program Committees:

Chairing program committees:

- **ALT' 04** - 15th International Conference on Algorithmic Learning Theory, (Co-Chair with John Case)
- **ICML'03** - 20th International Conference on Machine Learning, (Area Chair).
- **COLT'99** 12th Annual Workshop on Computational Learning Theory, (Co-Chair with Phil Long)
- **EuroCOLT'97**, *Third European Conference on Computational Learning Theory*, (Chair).

Membership in program committees :

- COLT' 2004, 17th Annual Conference on Learning Theory.
- KDD'2004, 10th ACM SIGKDD International Conference on Knowledge Discovery and Data mining.
- *ALT'2003*, 14th annual international conference on Algorithmic Learning Theory, Japan, 2003.
- *COLT'02* 15th Annual workshop on Computational Learning Theory, Sydney, Australia, July 2002.
- *ICML'2002* 19th International Conference on Machine Learning, Sydney, Australia, July 2002.
- *ICML'2001* 18th International Conference on Machine Learning, Massachusetts, 2001.
- *ICANN'2001* the annual conference of the European Neural Networks Society, Vienna, Austria, 2001.
- *ALT'2000*, 11th annual international conference on Algorithmic Learning Theory, Sydney, Australia, 2000.
- *ALT'98*, Algorithmic Learning Theory, 9th International Workshop, Germany, 1998.
- Neural Computation, Vienna, Austria, 1998.
- *ALT'96*, Algorithmic Learning Theory, 7th International Workshop, Sydney, Australia, 1996.
- *COCOON'95*, First Annual International Computing and Combinatorics Conference, Xian, China, 1995.
- *COLT'92*, Fifth Workshop on Computational Learning Theory, Santa-Cruz, California, 1992.
- *COLT'90*, Third Workshop on Computational Learning Theory, Rochester, NY, 1990.

Organization of Conferences and Workshops

- Co-organizer (jointly with Prof Cesa-Bianchi from Milan) of the *Alpine workshop on Computational Complexity Aspects of Learning*, Italy, March 2001.
- Local arrangements for *EuroCOLT'97*, Third European Conference on Computational Learning Theory, Jerusalem, Israel, 1997.

○ **University service**

National Level

Head of an Israel council for Higher Education committee for the evaluation of the Cholon Academic Institute request for granting academic status to its Computer Science Department (1999-2001).

University Level

Chairman of the Technion Students-Faculty Committee, 1999-2000.

Faculty Level

- Chairman of the CS Faculty Curriculum Committee, 1992-1995, 1998-2000.
- Member of the CS/EE committee for the joint Computer Engineering Track, 1993-1995, 1998-2000.
- Member of the CS/IE committee for the joint Information Systems Engineering Track, 1992-1995.
- Supervisor of the CS department teaching assistants,, 1991-1994.
- Member of the CS faculty committee for graduate studies, 1989-1992.

○ **Teaching Awards**

- Excellence in Teaching award, the Hebrew University, 1996.
- Best Lecturer of the Computer Science Faculty (*every single year, 1988-1996*).

- Muriel and David Jacknow Award for Excellence in Teaching, 1994 (\$3000).
- Technion Excellent Lecturer Award, 1990
- **Recent Research Grants**
 - Site Manager for the Technion in the Neural and Computational Learning project NeuroCOLT 2. ESPRIT funded working group (No. 27150), 360,000 ECU, 1999-2002.
 - *The German-Israeli Foundation for Research and Development (GIF)*,
 - "Self Organization and Learning from Examples via Statistical-Computational processes."
 - Joint project with Prof. Buhmann (Bonn University), Prof. Simon (Dortmund University),
 - Prof Shamir and Prof. Tishby (Hebrew University). 560,000 DM, 1997-2000.
 - Head of the Technion team in the Neural and Computational Learning project, (NeuroCOLT 8559), *ESPRIT Project*, 260,000 ECU, 1998-1999.

Invited Talks at international meetings and conferences

- *Mathematical Foundations of Learning Theory*, Barcelona, June 2004.
- *Machine Learning Reductions Workshop*, TTI Chicago, September, 2003.
- *Workshop on Asymptotic Geometric Analysis and Machine Learning*, Paris, March 2003
- **Invited tutorial**: "Computational Complexity Bounds on Learning" *Alpine Workshop on Computational Complexity Aspects of Learning*, Italy, 2001.
- "A Priori Generalization Bounds for kernel Based Learning" *NIPS2001 Workshop on Kernel Based Methods*.
- "Computational Complexity vs. Statistical Generalization in Learning" *Workshop in honor of Alan Borodin's 60th birthday*, Fields Institute, Toronto, 2001.
- "The Computational Complexity of Learning with Neural Networks" *Workshop on Computational Learning and Bioinformatics*, Bonn, 2000.
- "Efficient Agnostic Learning of Linear Perceptrons", *New Perspectives in the Theory of Neural Networks*, Graz, Austria, 2000.
- "The Computational Complexity of Searching for a Predictive Hypothesis" *Foundations of Statistical Inference* - a multinational conference, Shoham, Israel, 2000.
- **Invited special tutorial** "The Computational Complexity of Learning with Neural Networks" *13th Annual Conference on the Computational Learning Theory*, Stanford, California, 2000.
- **Keynote talk**: "Computational Efficiency of Linear Perceptrons" *Second Bar-Ilan workshop on Knowledge Discovery and Learning*, Israel, 2000.
- "On the Existence of Optimal Proof Systems" *Workshop on Complexity Lower Bounds*, the Fields Institute, Toronto, Canada, 1998.
- "Models of Online Learning" *ACNN'98 - The Ninth Australian Conference on Neural Networks*, Brisbane, Australia, 1998.
- **Keynote talk**: "VC-dimension, Sample Compression Schemes and Learning." *ICMS Workshop on the Vapnik-Chervonenkis Dimension*, Edinburgh, 1996.
- **Keynote talk**: "On Computational Learning Theory." *12th Israeli Symposium on Artificial Intelligence, Computer Vision and Neural Networks*, Tel-Aviv, 1996.
- **Keynote talk**: "Learning Changing Concepts by Exploiting the Structure of Change." *NEUROCOLT - Second Annual Meeting*, France, 1996.
- "On pairwise-independent sets with applications to VC-dimension theory." *2nd Weizmann workshop on randomness and computation*, Rehovot, 1995.
- **Invited Tutorial**: "The Theory of PAC Learning." *Dagstuhl Seminar on Theory and Praxis of Machine Learning*, Dagstuhl, Germany, June 1994.
- "Combinatorial characterizations of learnability." *Israel Mathematical Union Annual Meeting*, Jerusalem, May 1992.
- "Applications of Banach-Spaces-Theory to Computational Learnability" *Eighth International Conference on Probability in Banach Spaces*, Brunswick, Main, July 1991.

- "Theories of Average-Case-Complexity" *The Israeli Theoretical Computer Science Seminar*, Tel-Aviv, March 1988.
- "Reflecting all Possible Stationary Sets" *77th Ontario Mathematical Conference*, Peterborough, Canada, October 1986.
- "A Laver-Type Indestructibility for Accessible Cardinals" *Logic Colloquium '86*, Hull, UK, July 1986.
- "A Hierarchy of Principles for Successors of Singular Cardinals" *Mid-Atlantic Mathematical Logic Seminar*, Princeton University, Princeton, NJ, USA, December 1985.
- "Relative Consistency Strength of L-like Properties" *Oberwolfach Set-Theory Seminar*, Oberwolfach, Germany, January 1985.
- "The Resurrection of Super-Compactness Technique." *New England Set Theory Seminar*, Amherst, NH, USA, November 1985.
- "Souslin Trees Above Super Compact Cardinals." *7th International Congress on Logic, Methodology and Philosophy of Science*, Salzburg, Austria, July 1983.
- **Keynote talk:** "Metrizability of Moore Spaces in Constructible Universe." *Oklahoma Topology Conference*, Oklahoma City, Oklahoma, USA, March 1978.

○ Professional Publications

Thesis

"Combinatorial Properties of Successors of Singular Cardinals."

Advisor: Saharon Shelah. Department of Mathematics, Hebrew University, Jerusalem, 1987.

Papers

- Ben-David, S., and Schuller, R., "Exploiting Task Relatedness for Multiple Task Learning." Proceedings of COLT'03.
- Ben-David, S., Gehrke, J., and Schuller, R., "A Theoretical Framework for Learning from a Pool of Disparate Data Sources." Proceedings of KDD'02.
- Ben-David, S., Eiron, N., and Simon, U., H., "Limitations of Learning via Embeddings in Euclidean Half-Spaces." *Journal of Machine Learning Research*, special issue, in press. (A preliminary version appeared in Proceedings of COLT 2001).
- Ben-David, S., Eiron, N., and Long, P., "On the Difficulty of Approximating Maximum Agreement." *Journal of Computer and System Sciences*, in press. (A preliminary version appeared in Proceedings of COLT 2000).
- Ben-David, S., Eiron, N., and Simon, H., "The Complexity of Densest Region Detection." *Journal of Computer and System Sciences* 64 (1)(special issue), 22-47, 2002. (A preliminary version appeared in Proceedings of COLT 2000).
- Bartlett, P., and Ben-David, S., "Hardness Results for Neural Networks Approximation Problems." *Theoretical Computer Science* 284(1)(special issue), 53-66 (2002). (A preliminary version appeared in Proceedings of Neuro-COLT 1999).
- Ben-David, S., "A Priori Generalization Bounds for Kernel Based Learning", NIPS 2001 workshop on Kernel Based Learning.
- Ben-David, S., Long, P., and Mansour, M., "Agnostic Boosting." Proceedings of the 14th Annual Conference on Computational Learning Theory, (COLT'01).
- Meir, R., Ben-David, S., and el-Yaniv, R., "Localized Boosting." Proceedings of the 13th Annual Conference on Computational Learning Theory (COLT 2000).
- Ben-David, S., and Simon, H., "Efficient Learning of Linear Perceptrons," Proceedings of the 14th Annual Conference on Neural Information Processing Systems (NIPS 2000).
- Ben-David, S. and Gurvits, L., "A note on VC-Dimension and Measure of Sets of Reals." *Combinatorics Probability and Computing*, Vol. 9, 2000, 391-405 (preliminary version appeared in Proceedings of COLT 1995).

- Ben-David, S., and Ben-Eliyahu, R., "A Modal Logic for Subjective Default Reasoning." *Artificial Intelligence Journal*, Volume 116, pp 217-236, 2000 (preliminary version appeared in Proceedings of LICS 1994).
- Ben-David, S., Meer, K., and Michaux, C., "A Note on Non-complete Problems in NP_R ." *Journal of Complexity*, 16, 324-332, (2000).
- Bartlett, P., Ben-David, S., and Kulkarni, S., "Learning Changing Concepts by Exploiting the Structure of Change." *Machine Learning*, 41, 153-174, 2000.
(A preliminary version appeared in Proceedings of COLT 1996).
- Lindenbaum, M., and Ben David, S., "VC-dimension Analysis of Object Recognition Tasks." *Journal of Mathematical Imaging and Vision*, 10 (1):27-49, 1999.
(A preliminary version appeared in Proceedings of the 3rd European Conference on Computer Vision 1994).
- Ben-David, S., and Eiron N. " Self Directed Learning and its Relation to VC-Dimension and to Teacher-Directed Learning." *Machine Learning*, 33 (1998), pp 87-104.
- Ben-David, S., and Lindenbaum, M., "Localization versus Identification of Semi-Algebraic Sets." *Machine Learning*, Volume 32, 3, (1998), pp 207-224.
(A preliminary version appeared in Proceedings of COLT 1993).
- Ben-David, S., and Litman, A., "Combinatorial Variability of Vapnik-Chervonenkis Classes." *Discrete Applied Mathematics*, Volume 86, 1, (1998), pp 3-25.
- Ben-David, S., "Can Finite Samples Detect Singularities of Real-Valued Functions?" *Algorithmica*, Volume 22 (1998), pp 3-17. (A preliminary version appeared in Proceedings of STOC 1992).
- Ben-David, S., and Dichterman, E., "Learning with Restricted Focus of Attention." *Journal of Computer and Systems Sciences*, Volume 56, 3, 277-298, 1998.
(A preliminary version appeared in Proceedings of COLT 1993).
- Ben-David, S., Bshouty, N., and Kushilevitz, E., "A Composition Theorem for Learning Algorithms with Application to Geometric Concept Classes." *Proceedings of 29th Symposium on Theory of Computing*, (STOC 97), ACM Press, 1997, pp 324-333.
- Ben-David, S., Kushilevitz, E., and Mansour, Y., "Online Learning Versus Offline Learning." *Machine Learning*, Volume 29, 1, (1997), pp 45-63.
(A preliminary version appeared in Proceedings of Euro-COLT 1995).
- N., Alon, S., Ben-David, N., Cesa-Bianchi, and D., Haussler. "Scale-sensitive Dimensions, Uniform Convergence, and Learnability." *Journal of the ACM*, volume 44, number 4, 1997, 615-631.
(A preliminary version appeared in Proceedings of FOCS 1993).
- Ben-David, S., and Lindenbaum, M., "Learning Distributions by their Density Levels - A paradigm for Learning Without a Teacher." *Journal of Computer and Systems Sciences*, (1997), Volume 55, No. 1, 171-182. (A preliminary version appeared in Proceedings of Euro-COLT 1995).
- Ben-David, S., Shelah, S., "The Two-Cardinals Transfer Property and Resurrection of Super-compactness." *Proceedings of the American Mathematical Society*, Volume 124, No. 9, 1996, 2827-2837.
- Ben-David, S., Benedek, G., and Mansour, Y., "A Parameterization Scheme for Classifying Models of Learnability." *Information and Computation*, Volume 120, No. 1, 1995, 11-21.
(A preliminary version appeared in Proceedings of COLT 1989).
- Ben-David, S., Itai, A., and Kushilevitz, E., "Learning by Distances." *Information and Computation*, Vol. 117, No. 2, 1995, 240-250. (A preliminary version appeared in Proceedings of COLT 1990).
- Ben-David, S., Cesa-Bianchi, N., Haussler, D. and Long, P. M., "Characterizations of Learnability for Classes of $0, \dots, n$ -valued Functions." *Journal of Computer and Systems Sciences*, 1995, Vol. 50, No. 1, 74-86. (A preliminary version appeared in Proceedings of COLT 1992).
- Ben-David, S., Eiron N. and Kushilevitz E., "On Self-directed Learning." *Proceedings of the 8th Annual Workshop on Computational Learning Theory*, (COLT'95), pp 136-143, ACM press, 1995.
- Ben-David, S., and Borodin, A., "A new measure for the Study of Online Algorithms." *Algorithmica*, Vol 11, No. 1, 1994, 73-91.

- Ben-David, S., Borodin, A., Karp, R., Tardos, G., and Wigderson, A., "On the Power of Randomization in Online Algorithms." *Algorithmica*, Vol 11, No. 1, 1994, 2-14 (preliminary version appeared in Proceedings of STOC 1990).
- Ben-David, S., Brezner, O., and Frances, N., "An Expectation Modal Logic." Technion, 1994.
- Ben-David, S., and Dichterman, E., "Learnability with Restricted Focus of Attention Guarantees Noise Tolerance." Proceedings of the *4th International Workshop on Algorithmic Learning Theory*, pp 248-259, LNAI 872, Germany, Springer-Verlag, 1994.
- Ben-David, S., Karchmer, M., and Kushilevitz, E., "On Ultra-Filters and NP." Proceedings of *9th Annual conference on Structure in Complexity Theory*, (STRUCTURES'94), pp 97-105, IEEE press, 1994.
- M. Lindenbaum and S. Ben-David, "Applying VC-dimension Analysis to Object Recognition," Proceedings of the *3rd European Conference on Computer Vision*, pp. 239-240, 1994.
- Ben-David, S., and Jacovi, M., "Learning in the Limit and Non-Uniform (ϵ, δ) -Learnability." *Proceedings of the 6th Annual Workshop on Computational Learning Theory*, (COLT'93), pp 209-217, ACM press, 1993.
- Ben-David, S., Chor, B., Goldreich, O., and Luby, M., "On the Theory of Average Case Complexity." *Journal of Computer and System Sciences*, Vol 44, No. 2, 1992, 193-219 (preliminary version appeared in Proceedings of STOC 1989).
- Ben-David, S., and Halevi, S., "On the Independence of P versus NP", Technion, TR 714, 1992.
- Ben-David, S., and Freiman, R., "Algorithms for Learning by Distances", Technion, TR 750, 1992.
- Ben-David, S., and Dvir, M., "Non-Standard Models for Independence of Arithmetical Statements." Technion, 1991.
- Ben-David, S., and Dichterman, E., "Derandomization of Online Algorithms." Technion, TR 691, 1991.
- Dichterman E., and Ben-David, S., "Randomized Online Algorithms Relative to the MAX/MAX Ration." Technion, 1991.
- Abraham, U., Ben-David, S., and Moran, S., "On the Limitation of the Global Time Assumption in Distributed Systems." *Distributed Algorithms*, S. Tueg, P.G. Spirakis, L. Kirousis (Eds.) Lecture Notes in Computer Science 579, Springer-Verlag 1992, pp 1-8. (Proceedings of the *5th International Workshop on Distributed Algorithms*, (WDAG-5), October 7-9, 1991, Delphi, Greece).
- Abraham, U., Ben-David, S., and Magidor, M., "On Global Time and Inter-Process Communication." *Semantics for Concurrency*, M.Z. Kwiatkowska, M.W. Shield, and R.M. Thomas (Eds.), Springer-Verlag, 311-323, July 1990.
- Ben-David, S., and Gafni, Y., "All We Believe Fails in Impossible Worlds (A possible-world semantics for a "Knowing at most" operator)." Technion, TR 593, 1989.
- Ben-David, S., "A Laver-Type Indestructibility for Accessible Cardinals." *Studies in Logic*, Vol. 124, *Special Issue of selected papers from Logic Colloquium '86*, (edited by F.R. Drake and J.K. Truss), 1988, 9-20.
- Ben-David, S., "The Global Time Assumption and Semantics for Concurrent Systems." *Proceedings of the 7th Annual ACM Symposium on Principles of Distributed Computing* (PODC 1988), pp 223-231, ACM press, 1988.
- Ben-David, S., and Magidor, M., "The \ast_{λ} is Really Weaker than the Full λ " *Journal of Symbolic Logic*, Vol. 51, No. 4, 1986, 1029-1033.
- Ben-David, S., and Shelah, S., "Souslin Trees and Successors of Singular Cardinals." *Annals of Pure and Applied Logic*, 30, 1986, 207-217.
- Ben-David, S., and Shelah, S., "Non-Special Aronszajn Trees on $\beta_{\omega+1}$ " *Israel Journal of Mathematics*, 53, 1986, 93-96.
- Ben-David, S., "On Shelah Compactness of Cardinals." *Israel Journal of Mathematics*, 31, 1978, 34-56.

Books

Ben-David, S., and Long, P., (editors) "Proceedings of the 12th annual conference on Computational Learning Theory." ACM Press, 1999.

Ben-David, S., (editor) "Computational Learning Theory." Collected papers, Springer-Verlag LNAI series, 1208, 1997.

Ben-David, S., "Introduction to Logic." Undergraduate textbook in Hebrew, Hebrew University 1985.

○ Teaching Experience

Courses I developed (and were taught by me, and later by others):

- *"Statistical Learning Theory"*, Cornell University, fall 2003.
- *"Large Scale Complex Adaptive Networks"*. Cornell University, spring 2003.
- *"Complexity of Proofs and Computations"*. Hebrew University, fall 1996, Technion, spring 1996.
- *"Computational Learning Theory"*. Developed at Technion in 1992 by Eyal Kushilevitz and myself and has been taught regularly since then.
- *"Foundations of Mathematical Analysis for Computer Science"*. Introduction to general topology and measure theory with applications to theoretical CS; was developed at Technion in 1989 and has been taught regularly ever since.

- *"Logic for Computer Science 1"*. A compulsory course in the Technion CS program.
- Since 1989 the course is based on my version.
- *"Logic for CS 2"*. An elective course, taught in the Technion CS department every other year.
- *"Applications of Logic in Computer Science"*. University of Toronto, 1986.

On top of these, I have also taught many regular courses, in both the graduate and undergraduate levels, on a variety of topics in mathematics and theoretical computer science. A sample of these courses includes:

- "Automata and Formal Languages" (Technion, about 100 students per class).
- "Computational Complexity" (Technion, about 30 students).
- "Introduction to Theory of Computing" (Cornell University, CS381, about 180 students).