

# Alex Bäcker, M.Sc., Ph.D.

alex@caltech.edu

## PROFESSIONAL APPOINTMENTS

- Adapt Technologies, Inc.** 11/05 – 07/06
- Founder, President and Chief Technology Officer.
- Adapt Technologies, Inc.** 12/04 – 10/05
- Founder, President and Chief Executive Officer.
- Advanced Concepts Group, Sandia National Laboratories** 11/02 – 11/03
- Member, Brain Team.
- Computational Biology & Evolutionary Computing Department, Sandia National Laboratories** 6/02 – 05/05
- Independent research program in linguistics, evolution, olfaction, computation, mathematics, neuroinformatics and bioinformatics.
- Beckman Institute, Center for Neuromorphic Systems Engineering & Division of Biology, California Institute of Technology** 06/02 – 05/05
- Visiting scientist.
- Computation & Neural Systems Program, California Institute of Technology** 4/96 – 4/02
- Sloan Fellow for Theoretical Neurobiology. Thesis: Pattern recognition in the olfactory system. Priming, gain control and coding issues.
- Sensory Information Processing Laboratory, California Institute of Technology** 4/97 – 6/97
- Designed and constructed a video-based remote eye tracker. Advised NASA's Jet Propulsion Laboratory on eyetracker design.
- Christof Koch's Lab, California Institute of Technology** 1/96 – 3/96
- Worked on blindsight (behavior without perception) in normal observers.
- Immunogenetics Laboratory, Hospital of the University of Buenos Aires** 7/91 – 4/93
- Associate Technician, National Council of Scientific and Technical Research. Co-responsible for the set-up and operation of the first cell analyzer & sorter in Argentina.
- Institute of Biochemical Investigations, Fundacion Campomar, L.F. Leloir** Summers 89/90
- Apprenticeship in fungi and bacterial molecular biology and genetics. Assisted in the identification of the promoter for the CAB gene in tobacco.

## EDUCATION

- Ph.D., California Institute of Technology, Division of Biology and CNS** 6/97 – 4/02 GPA: 3.9/4.0
- Ph.D. in Biology with a Minor in Computation and Neural Systems.
- M.S., California Institute of Technology, Computation and Neural Systems** 9/95 – 6/97 GPA: 3.8/4.0
- Master of Science (M.S.) in Computation and Neural Systems.
  - GRE scores: Analytical 790/800, Quantitative 770/800, Verbal (English) 640/800.
- S.B., Massachusetts Institute of Technology** 9/93 - 6/95 GPA: 4.7/5.0

- Bachelor of Science in Biology with a Minor in Economics.
- Cross-registered at Harvard University.

**University of Buenos Aires, School of Natural and Exact Sciences**  
3/91 - 8/93

GPA: 10/10

## AWARDS

- Graduate Dean's Award for Outstanding Community Service, for "*great contributions to Graduate Life and outstanding qualities of Leadership and Responsibility*", 2002.
- ISTA award from the American Association for the Advancement of Science (AAAS), 2001.
- Award for Contribution to Biology Undergraduate Student Association, MIT, 1995.
- Member of Argentina's *National Team in International Olympiad of Informatics*, Greece, 1991.
- Second place, National Olympiad of Informatics, Argentina, 1991.
- National Champion, National Olympiad of Informatics, Argentina, 1990.
- Third Millennium Prize from the National Ministry of Health and Welfare for performance in 1990 *International Olympiad of Informatics*, USSR, 1990.
- Member of Argentina's *National Team in International Olympiad of Informatics*, USSR, 1990.
- *Dux Medallist* for best results ever in school's 150-yr. history (maximum scores in seven subjects) in Cambridge University (UK) 'O', 'S' and 'A'-level examinations, St. Andrew's Scots School, Buenos Aires, 1990.
- Graduated first in class of 120, St. Andrew's Scots School, Buenos Aires, 1990.
- *Ian Seyda Prize for Intellectual Curiosity*, St. Andrew's Scots School, Buenos Aires, 1990.
- Captain, Champion Team, ESSARP Inter-School General Knowledge Competition, Buenos Aires, 1990.
- Member of Argentina's *National Team* selected for *International Olympiad of Informatics*, Bulgaria, 1989.

## MENTORING

- Supervised technical work of 5 Ph.D.s, 3 Ph.D. students, and 22 undergraduate students.

## LEADERSHIP & PUBLIC SERVICE

- Vice-President and Director, Dove Creek Condominium, 2004-2005.
- Trustee, The Children's Center at Caltech, 2002-present.
- President of the Graduate Student Body and Chairman of the Board of Directors, Caltech Graduate Student Council, 2000-2001.
- Ideated & implemented new graduate student recruitment effort for Caltech's Biology & CNS programs.
- Director of the Graduate Student Council, California Institute of Technology, 1998-2002.
- Elected Officer of the Biology Undergraduate Student Association, MIT, 1994-95.
- Elected to the Council of the Department of Biology, School of Sciences, University of Buenos Aires, 1994.

## PATENTS

- Gonzalez, J. E. and Bäcker, A.: Queryless Search using a Computational Model of Curiosity and Learning from Text. U.S. Provisional Patent in course.
- Bäcker, A.: Query-specific Webpage Relevance Ranking. U.S. Provisional Patent in course.
- Bäcker, A.: Network-based trust evaluation. U.S. Provisional Patent in course.
- Bäcker, A.: System for Authentication of Electronic Communications. U.S. Provisional Patent in course.
- Bäcker, A.: Computational Method to Find Interactions between Genes Using Multiple Genomes. U.S. Provisional Patent.
- Bäcker, A.: Automatic Methods to find Associations between Expressions. U.S. Provisional Patent.

- Bäcker, A.: Method to Automatically Associate a Web Page or Document with an Expression And Summarize Documents. U.S. Provisional Patent.
- Bäcker, A.: Method to Direct Users to Relevant Portion of a Web Document. U.S. Provisional Patent.
- Bäcker, A.: User-Specific Adaptive Method to Sort Search Results by Relevance for the World Wide Web and Other Interconnected Data Structures. U.S. Provisional Patent.
- Bäcker, A, Peral, E. & Munich, M.: A Remote Video-Based Eye Tracker. U.S. Provisional Patent.

### SELECTED INVITED TALKS

- Bäcker, A. Bits, brains and genes. Institute for computational and mathematical engineering, Stanford University, 2005.
- Bäcker, A. The self-referential nature of knowledge. Center for Theoretical Physics, UCSD, 2005.
- Bäcker, A. Neural coding in an insect brain. Freie Universität Berlin, Germany, 2005.
- Bäcker, A. estimation of the topological dimensionality of a manifold. Center for Neuromorphic Systems Engineering Retreat, Caltech, 2004.
- Bäcker, A. Growth and Democratization of Science: Lowering Barriers to Entry. 4<sup>th</sup> International Conference on University Evaluation and Research Evaluation, China, 2004.
- Bäcker, A. The Digital Brain. Cognitive Systems: Human Cognitive Models in System Design, Santa Fe, 2004.
- Bäcker, A. The Impact of Sputnik and the Race to the Moon on Innovation. San José Tech Museum of Innovation, 2004.
- Bäcker, A. et al. Automated ontology generation. Sandia National Laboratories, 2004.
- European Symposium for Insect Taste and Olfaction, Norway, 2003.
- Lab d'Ethologie et Cognition Animale, Université Paul Sabatier-Toulouse III, France, 2003.
- Salk Institute for Biological Studies, La Jolla, CA, 2002.
- Rockefeller University, NY, NY, 2002.
- Neural Information Processing Systems (NIPS) Symposium: Information and Statistical Structure in Spike Trains: How can we calculate what we really want to know?, Whistler, BC, 2001 (unable to attend).
- Sloan Center for Theoretical Neurobiology Annual Meeting, Lake Tahoe, CA, 2001.
- Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina, 2001.
- Sandia National Laboratories, Computational Biology Group, Albuquerque, NM, 2001.
- Celera Corporation, Bioinformatics Research Group, Rockville, MD, 2001.
- Sloan Center for Theoretical Neurobiology Annual Meeting, Salk Institute, La Jolla, CA, 1999.
- Hebrew University of Jerusalem, Eilat, Israel, 1999.

### TECHNICAL PUBLICATIONS

- Brown, W.M. & Bäcker, A. Optimal Neuronal Tuning for Finite Stimulus Spaces, *Neural Computation* 18, 1511–1526, 2006.
- Martin, S. & Bäcker, A. Unsupervised estimation of the topological dimensionality of a manifold, *SAC, Special track on Artificial Intelligence*, 2005.
- Bäcker, A. A Future for Scientific Discourse, 2004, <http://alexbacker.pbwiki.com/A%20Future%20for%20Scientific%20Publishing>.
- Boyack, K. and Bäcker, A. The growth and memory of science, 2004.
- Hipp, J. and Bäcker, A. An activity-dependent model for the development and maintenance of the ORN–glomerular mapping. *Soc for Neurosci Abstr*, 2004.
- Bäcker, A.: A Roadmap for Cognition. Whitepaper restricted to internal SNL circulation, 2004.
- Boyack, K. & Bäcker, A.: The memory of science, *ISSI IX*, 2003.
- Bäcker, A: Gain control and concentration coding in early olfactory circuits. *Soc for Neurosci Abstr*, 2002.
- Bäcker, A.: Pattern recognition in the olfactory system of the locust: Priming, gain control and coding issues. Ph. D. Thesis, California Institute of Technology, 2002.
- Bäcker, A.: A novel computerized odor delivery system, 2002.
- Bäcker, A.: The olfactory system exhibits invariance to volatility, 2002.

- Bäcker, A.: The probability that a single underlying binomial distribution yield two given success proportions: An exact hypothesis test, 2002.
- Bäcker, A.: Asymmetric sliding-window cross-correlation, 2002.
- Bäcker, A., Dean, H. and Caporale, N.: Hedonic valence of odors in the locust, *Schistocerca americana*, 2002.
- Bäcker, A.: Gain control and multiplexing in early olfactory circuits, 2002.
- Bäcker, A.: Neuronal priming in early olfactory circuits, 2002.
- Bäcker, A.: A simple formula to accurately subtract positivity of cytometric negative controls, 2001.
- Bäcker, A. & Laurent, G.: Concentration priming in projection neuron responses in the locust olfactory system. *Soc for Neurosci Abstr*, 2000.
- Bäcker, A.: Inconclusiveness of evidence against memory in visual search, 1999.
- Bäcker, A. & Peral, E.: Does visual search have memory?: A mathematical framework suggests current experimental paradigm may not be conclusive. *Vision Research Conference*, 1999.
- Bäcker, A.: Mutator genes and natural selection, 1999.
- MacLeod, K., Bäcker, A. & Laurent, G.: Who reads the temporal information in synchronized spike trains? *Nature* 395, 693 - 698 (1998). *This paper has been cited by 97 publications to date.*
- Bäcker, A., MacLeod, K., Wehr, M. & Laurent, G.: Disruption of neuronal synchronization impairs reliable reconstruction of odors by beta lobe cells but not by projection neurons of the antennal lobe of the locust. *Soc for Neurosci Abstr*, 1998.
- Bäcker, A., Wehr, M. & Laurent, G.: Analysis of the variability of temporal response patterns of simultaneously-recorded projection neurons in the olfactory system of the locust. *Soc for Neurosci Abstr*, 1997.
- Bäcker, A & Peral, E.: A remote video-based eye tracker. *Caltech CNS/EE 148 Technical Report*, 1997.
- Bäcker, A.: To sleep, perchance to dream. *The Harvard Brain I*: 50-55, 1994.
- Contributor to Marcos, Y. et al. Two-locus involvement in the association of human leukocyte antigen with the extrahepatic manifestations of autoimmune chronic active hepatitis. *Hepatology* 19: 1371-1374, 1994.

E-prints available at <http://www.its.caltech.edu/~alex/pub.html>:

## FELLOWSHIPS, SCHOLARSHIPS & GRANTS

- Data Mining on Attributed Relationship Graphs. SNL LDRD. With B. Hendrickson and T. Kolda. 2004-2007.
- Building Cognition on Biology: Self-organization in the brain. SNL LDRD. P.I. 2004-2005.
- Metrics for Multidimensional Objects with Correlated Dimensions, Mathematics, Information and Computational Science, Office of Science, Department of Energy. P.I. 2003-present.
- Seismic Ear, SNL Senior Scientist LDRD grant, with K. Larson, 2003-present.
- Augmented Cognition: Next-Generation Intelligent Systems, SNL Grand Challenge grant, with J. Ganter, P. Reeves and K. Larson, 2002-present. Technical lead for Perception thrust, 2004-present.
- Firefox: A Brain Machine Interface, DARPA Brain Machine Interface Program grant, with R. Asher and R. Albanese, 2002-present.
- IBM Innovation Grant, 2000-present.
- Alfred P. Sloan Fellowship for Theoretical Neurobiology, 1995-2002.
- Grant from German-American Academic Council to lead expedition to Kenya to study locust behavior, 1998.
- Fellowship for the German and American Young Scholar's 1996/97 Institute (youngest fellow).
- L.P. Markey Fellowship (declined).
- Stanford University CAM fellowship (declined).
- Harvard University research fellowship (declined).
- Columbia University research fellowship (declined).
- Undergraduate Research Opportunities Program Scholarship, MIT, 1994-1995.

## **COMMUNICATION**

- Fluent in Spanish and English. Speak, read and write German and French.
- Editorial Director of Apeiron Magazine (1990), Co-editor of The Harvard Brain (1995), MIT Biology Undergraduate Student Association News Editor (1994-95), published articles in The Los Angeles Times & The California Tech as well as several letters in the New York Times and La Nación (leading Argentine newspaper).

## **TEACHING EXPERIENCE**

- Co-creator & Instructor, Sleep Laboratory, Grad/Undergrad course, California Institute of Technology, 1998-2000.
- Invited lecturer, Neurobiology & Neuroscience for Physicists & Engineers, Grad/Undergrad courses, CIT, 1999-2000.
- Teaching Assistant, Neurophysiology Lab, California Institute of Technology, 1998.
- Teaching Assistant, Neurobiology, California Institute of Technology, 1995-96.
- Teacher in the Center for Talented Youth Program, MIT, 1994 and Tutor in Genetics, MIT, 1994-95.

## **PROFESSIONAL MEMBERSHIPS**

- Society for Neuroscience.