

BIOGRAPHICAL SKETCH

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NAME: Poggio, Tomaso

eRA COMMONS USER NAME (credential, e.g., agency login): tpoggio

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
Instituto Arecco, Genoa, Genoa	BOTH	07/1965	N/A
University of Genoa, Genoa	PHD	1970	Theoretical Physics
CNR Laboratory for Biophysics, Camogli	Other training	present	Holographic Models of Memory

A. Personal Statement

Learning and vision research have been the main constant feature of my scientific life, starting with the collaboration with Werner Reichardt at the Max-Planck-Institute in Tübingen in the '70s, continuing with the collaboration with David Marr's and now focusing on the role of learning in object recognition. I was recently awarded the 2009 Okawa prize "for outstanding contributions to the establishment of computational neuroscience, and pioneering research ranging from the biophysical and behavioral studies of the visual system to the computational analysis of vision and learning in humans and machines." I was also named American Association for the Advancement of Science (AAAS) Fellow (2009) for "distinguished contributions to computational neuroscience, in particular, computational vision, learning and regularization theory, biophysics of computation and models of recognition in the visual cortex" and I received the 2014 Swartz Prize for Theoretical and Computational Neuroscience. In the last decade, I worked on a hierarchical extension of learning developing a feedforward quantitative model of visual recognition in the visual cortex which has been a useful tool to drive and interpret several physiological experiments, is consistent with human performance in rapid categorization, and suggests novel architectures to the field of computer vision. I believe that we are beginning to understand some of the computational strategies used by our brain in visual recognition and that the computational work is rapidly becoming more central to the science of vision, including computer vision. I also worked on the theoretical foundations of deep learning and on some of its puzzles such as the ability to generalize despite overparametrization. Throughout my career I have supervised about 46 graduate students and 34 post-doctoral fellows.

1. Xu M, Rangamani A, Liao Q, Galanti T, Poggio T. Dynamics in Deep Classifiers Trained with the Square Loss: Normalization, Low Rank, Neural Collapse, and Generalization Bounds. Research (Wash D C). 2023;6:0024. PubMed Central PMCID: PMC10202460.
2. Poggio T, Fraser M. Compositional Sparsity of Learnable Functions. Bulletin (New Series) of the American Mathematical Society. ; 00.
3. Poggio T, Galanti T, Xu M, Galanti L. Norm-based Generalization Bounds for Sparse Neural Networks. 37th Conference on Neural Information Processing Systems (NeurIPS 2023). .

4. Poggio T, Han Y, Cheung B. System Identification of Neural Systems: If We Got It Right, Would We Know?. Proceedings of the 40th International Conference on Machine Learning, PMLR. ; 202:12430-12444.

B. Positions, Scientific Appointments and Honors

Positions and Scientific Appointments

- | | |
|-------------|--|
| 2013 - | Director, Center for Brains, Minds and Machines (CBMM),
Massachusetts Institute of Technology (MIT), Cambridge, MA |
| 2002 - | Senior Investigator, McGovern Institute for Brain Research at MIT,
Massachusetts Institute of Technology (MIT), Cambridge, MA |
| 2002 - | Eugene McDermott Chair , McGovern Institute for Brain Research at
MIT, Massachusetts Institute of Technology (MIT), Cambridge, MA |
| 1992 - 2013 | Director, Center for Biological & Computational Learning, MIT,
Massachusetts Institute of Technology (MIT), Cambridge, MA |
| 1984 - | Professor, Massachusetts Institute of Technology (MIT), Dept. of Brain
& Cognitive Sciences and Computer Science & Artificial Intelligence
Laboratory (CSAIL), Cambridge, MA |
| 1984 - 2002 | Uncas and Helen Whitaker Chair, Massachusetts Institute of
Technology (MIT), Dept. of Brain & Cognitive Sciences, Cambridge,
MA |
| 1981 - 1984 | Associate Professor, Massachusetts Institute of Technology (MIT),
Dept. of Psychology and Artificial Intelligence Laboratory, Cambridge,
MA |
| 1971 - 1981 | Wissenschaftlicher Assistant, Max Planck Institut für Biologische
Kybernetik, Tübingen |

Honors

1995 - 1999	Member, Kuratorium of the Max Planck Society (for MPIfK, Tübingen)
1994 - 1997	Member, Biomedical Engineering Advisory Council, Johns Hopkins University
2025	2025 IJCNN Honorary Chair, International Neural Network Society
2024	Premio Lericipea Liguri nel Mondo, Associazione Premio Lerici Pea
2022	Kampé de Fériet Award, IPMU Conference
2014	Swartz prize for Computational Neuroscience , The Society for Neuroscience (SfN)
2009	Fellow, American Association for the Advancement of Science (AAAS)
2009	Okawa Prize, Okawa Foundation for Information and Telecommunications
2003	Gabor Award, International Neural Network Society
2002	Member, Visiting Committee of the Computer Science Department, Columbia University
2002	Member, Center for Neuromorphic System Eng. Advisory Board, California Technical Institute
2002	Chairman, Scientific Adv. Board, IRST (Istituto per la Ricerca Scientifica e Tecnologica, Italy)
2000	Laurea Honoris Causa in Ingegneria Informatica, Bicentenario dell'Invenzione della Pila, Cerimonia di Chiusura dell'Anno Voltiano, Pavia, Italia
1999	Member of an International Review Committee, Riken Institute
1998	Honorable Mention, Pattern Recognition Society Award
1998	Foreign Member, Italian Academy of Sciences
1997	Fellow, American Academy of Arts and Sciences,
1997	MIT 50K Entrepreneurship Competition Award, Imagen (advisor)
1992	Max Planck Research Award (with M. Fahle), Alexander von Humboldt Foundation, Bonn
1990	Founding Fellow, American Association of Artificial Intelligence
1988	Board of Trustees, The Neurosciences Institute, Neurosciences Research Foundation
1979	Otto-Hahn-Medaille Award (for outstanding young scientists) , Max-Planck-Society

C. Contribution to Science

- a. Xu M, Rangamani A, Liao Q, Galanti T, Poggio T. Dynamics in Deep Classifiers Trained with the Square Loss: Normalization, Low Rank, Neural Collapse, and Generalization Bounds. *Research (Wash D C)*. 2023;6:0024. PubMed Central PMCID: PMC10202460.
 - b. Poggio T, Fraser M. Compositional Sparsity of Learnable Functions. *Bulletin (New Series) of the American Mathematical Society*. ; 00.
 - c. Poggio T, Galanti T, Xu M, Galanti L. Norm-based Generalization Bounds for Sparse Neural Networks. *37th Conference on Neural Information Processing Systems (NeurIPS 2023)*. .
 - d. Poggio T, Han Y, Cheung B. System Identification of Neural Systems: If We Got It Right, Would We Know?. *Proceedings of the 40th International Conference on Machine Learning, PMLR*. ; 202:12430-12444.
2. With W. Reichardt, Poggio characterized quantitatively the visuo-motor control system in the fly, deriving equations that could predict the fly's tracking and fixation behavior. He also modeled the fly's neural circuitry underlying the detection of motion boundaries, connecting it to behavior and physiology, pioneering normalization circuits, later used for visual cortex.
 - a. Poggio TA, Reichardt W, Hausen K. A neuronal circuitry for relative movement discrimination by the visual system of the fly. *Naturwissenschaften*. 1981; 68(9):443-466. Available from: <https://link.springer.com/article/10.1007%2FBF01047513> DOI: 10.1007/BF01047513
 - b. Reichardt W, Poggio T. Visual control of orientation behaviour in the fly. Part I. A quantitative analysis. *Q Rev Biophys*. 1976 Aug;9(3):311-75, 428-38. PubMed PMID: 790441.
 - c. Wehrhahn C, Poggio T. Real-time delayed tracking in flies. *Nature*. 1976 May 6;261(5555):43-4. PubMed PMID: 1272370.
 - d. Geiger G, Poggio T. The Müller-Lyer figure and the fly. *Science*. 1975 Oct 31;190(4213):479-80. PubMed PMID: 1166319.
 3. With D. Marr, Poggio characterized necessary levels of analysis in computational neuroscience and developed stereo algorithms which served as the primary model of stereopsis and as exemplar for other vision algorithms; at the biophysical level, he introduced (with V. Torre and C. Koch) models suggesting that dendritic trees and synapses have a key computational role – a view now receiving experimental confirmation.
 - a. Torre V, Poggio T. A Synaptic Mechanism Possibly Underlying Directional Selectivity Motion. *Proceedings of the Royal Society London B*. 1978; 202(1148):409-416. Available from: <https://www.jstor.org/stable/77328>
 - b. Marr D, Poggio TA. From Understanding Computation to Understanding Neural Circuitry. *Neurosciences Res. Prog. Bull*. 1977; 15:470-488.
 - c. Marr D, Poggio T. Cooperative computation of stereo disparity. *Science*. 1976 Oct 15;194(4262):283-7. PubMed PMID: 968482.
 4. Poggio developed a theory of the ventral stream, capable of explaining and predicting at several different levels, based on the hypothesis that the main computational goal is the computation of invariant representations of images. The citation for the recent 2009 Okawa prize mentions his "...outstanding contributions to the establishment of computational neuroscience, and pioneering research ranging from the biophysical and behavioral studies of the visual system to the computational analysis of vision and learning in humans and machines."
 - a. Serre T, Oliva A, Poggio T. A feedforward architecture accounts for rapid categorization. *Proc Natl Acad Sci U S A*. 2007 Apr 10;104(15):6424-9. PubMed Central PMCID: PMC1847457.
 - b. Bülthoff H, Little J, Poggio T. A parallel algorithm for real-time computation of optical flow. *Nature*. 1989 Feb 9;337(6207):549-55. PubMed PMID: 2915704.
 5. On the theoretical level, Poggio introduced regularization theory as a general framework to solve the ill-posed problems of vision. During the last 5 years, he worked extensively on the theory of learning.
 - a. Poggio T, Banburski A, Liao Q. Theoretical issues in deep networks. *Proc Natl Acad Sci U S A*. 2020 Dec 1;117(48):30039-30045. PubMed Central PMCID: PMC7720221.

- b. Poggio T, Rifkin R, Mukherjee S, Niyogi P. General conditions for predictivity in learning theory. *Nature*. 2004 Mar 25;428(6981):419-22. PubMed PMID: 15042089.
- c. Poggio TA, Smale S. The Mathematics of Learning: Dealing with Data. *Notices of the American Mathematical Society (AMS)*. 2003; 50(5):537-544. Available from: <https://www.ams.org/journals/notices/200305/fea-smale.pdf>
- d. Poggio T, Girosi F. Networks for Approximation and Learning. *Proceedings of the IEEE (special issue: Neural Networks I: Theory and Modeling)*. 1990; 78(9):1481-1497. Available from: https://ieeexplore.ieee.org/abstract/document/58326?casa_token=rCA6lxdxteEAAAAA:x61RY-WqBzgUcj6gFLHoCCfpCOKzq7WN7RWBroX5TvPBnHfJfwm-8v3_dg9lkhKTnWLrIYP5 DOI: 10.1109/5.58326