

## TOMASO A. POGGIO

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Citizenship: U.S. + Italian

### EDUCATION

Ph.D. in Theoretical Physics, University of Genoa (1970), *Summa cum Laude*. Thesis: "On Holographic Models of Memory."

### ACADEMIC POSITIONS

Affiliated Faculty Member, Sloan Finance Group, Sloan School of Management, Massachusetts Institute of Technology, June 2014-present

Visiting Investigator, Institute for Infocomm Research, Agency for Science, Technology and Research (A\*STAR), May 2014-2018

Director, Center for Brains, Minds, and Machines (CBMM), McGovern Institute for Brain Research, Massachusetts Institute of Technology, September 2013-present.

Eugene McDermott Professor, Department of Brain & Cognitive Sciences, Computer Science & Artificial Intelligence Laboratory and McGovern Institute for Brain Research, Massachusetts Institute of Technology, 2002-present.

Associate Professor, Department of Psychology and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, 1981-1984.

Wissenschaftlicher Assistant, Max Planck Institut für Biologische Kybernetik, Tübingen, Germany, 1971-1981.

### HONORS AND SERVICE

Member of the PAMI Awards Committee, 2017-Current

Member of SfN's Swartz Prize Selection Committee, 2017-Current

Swartz Prize for Theoretical and Computational Neuroscience, Society of Neuroscience, November 2014

Honorary Chair: European Conference on Computer Vision (ECCV), Florence, Italy, October 7-13, 2012

Valedictory Talk: "The Future of the Science and Engineering of Intelligence," IEEE CIFER 2012, New York City, March 30, 2012

Honorary Chair: IEEE Computational Intelligence for Financial Engineering and Economics (CIFER) 2012, March 29-30, 2012, New York City

Member of ISICT Committee of Experts, 2010

Member of the Duke University External Review Committee (Dept. CS), 2010

General Chair, 2010 International Conference on Brain Informatics (BI 2010), August 28-30, 2010, Toronto, Canada

American Association for the Advancement of Science (AAAS) Fellow (2009)

Okawa Prize, 2009

Keynote address at V incontro annuale ISICT, Genoa, Italy, October 2009

Honorary Member of IEEE Symposium on Computational Intelligence for Financial Engineering (CIFEr 2009)

Member of the Scientific Board of ISTA Vienna, 2008 – present

Member of the Scientific Board of ISI Turin, 2006 – present

Co-organizer of Workshop on Learning Theory, FOCM '05, Santander, Spain, 2005.

Neuroscience Research Program Honorary Associate

Elected to Committee for Istituto Superiore di Studi in Tecnologie dell 'Informazione e della Comunicazione (ISICT), 2005-2006.

Gabor Award, International Neural Network Society, 2003.

Co-organizer of Workshop on Learning Theory, FOCM '02, Minneapolis, MN, 2002.

Eugene McDermott Chair, McGovern Institute for Brain Research, 2002.

Member of the Visiting Committee of the Computer Science Department, Columbia University, 2002.

Member of the Center for Neuromorphic System Engineering Advisory Board, California Technical Institute, 2002.

Chairman, Scientific Advisory Board of IRST (Istituto per la Ricerca Scientifica e Tecnologica, the main research institute in Trentino Alto Adige, Italy), June 2002.

Senior Investigator, McGovern Institute for Brain Research, 2000.

*Laurea Honoris Causa* in Ingegneria Informatica, Bicentenario dell'Invenzione della Pila Cerimonia di Chiusura dell'Anno Voltiano, Pavia, Italia, March 2000.

Member of the Riken External Review Committee (for BSI), 1999.

Member of External Advisory Committee evaluating the NEC Princeton Laboratory, 1996-1999.

Foreign Member, Istituto Lombardo dell' Accademia di Scienze e Lettere, 1998.

Foreign Member, Italian Academy of Sciences, 1998.

Honorable Mention, Pattern Recognition Society Award, October, 1998.

Honorary Chair, International ICSC/IFAC Symposium on Neural Computation/NC '98, Technical University of Vienna, September, 1998.

Fellow, American Academy of Arts and Sciences, 1997.

MIT 50K Entrepreneurship Competition Award, Imagen (advisor), 1997.

Member, Daimler-Benz Circle Member Group, 1997.

AT&T New Research Fund Award, 1996.

Member, Kuratorium of the Max Planck Society (for MPIfK, Tuebingen), 1995-1999.

Co-Chair, IEEE/IAFE "Computational Intelligence for Financial Engineering," New York, April, 1995.

Co-Chair, School of Science Committee on “The Future of Neuroscience at MIT,” 1994.

Member, Biomedical Engineering Advisory Council, Johns Hopkins University, 1994-present.

Editorial Board, “Advances in Computational Mathematics”(AiCM), May 1993 – May 1999

Co-Director, Center for Biological and Computational Learning, Department of Brain & Cognitive Sciences, Massachusetts Institute of Technology, 1992-present.

Max Planck Research Award (with M. Fahle) from the Alexander von Humboldt Foundation, Bonn, Germany, 1992.

Co-organizer (with D.A. Glaser) of the Dahlem Workshop on “Exploring Brain Functions,” Berlin, 1991.

Founding Fellow, American Association of Artificial Intelligence, 1990.

Uncas and Helen Whitaker Chair, Department of Brain & Cognitive Sciences, Massachusetts Institute of Technology, 1988-2002.

Board of Trustees, The Neurosciences Institute, Neurosciences Research Foundation, 1988.

Corporate Fellow, Thinking Machines Corporation, 1984.

Director, the Center for Biological Information Processing, Whitaker College of Health Sciences and Technology, Massachusetts Institute of Technology, 1984.

Co-Director (with P H. Winston) of the Course on Vision and Image Understanding at Ettore Majorana Center for Scientific Culture, International School of Biophysics, Erice, Italy, 1984.

“Premio Luigi Carlo Rossi” award (with V. Torre) from Elsag Elettronica, San Giorgio, Italy, 1984.

Columbus Prize of the Istituto Internazionale delle Comunicazioni Genoa, at the XXX Convegno Internazionale delle Comunicazioni, Genoa, Italy, 1982.

Member, Neurosciences Research Program, 1979.

Otto-Hahn-Medaille (for outstanding young scientists) of the Max-Planck-Society, 1979.

CNR fellowship to work on problems of Neurobiology and Computer Science at the CNR Laboratory of Biophysics and Cybernetics, Camogli, Italy, CNR, 1971.

Angelo delle Riccia Graduate Fellowship, 1969 and 1970.

Award of the Cassa di Risparmio of Genoa, 1966.

## RECENT TALKS

Invited Speaker: Stony Brook “Why Deep Learning (Sometimes) Works” December 2, 2019

Invited Speaker: Deep Math Conference, “Dynamics and Generalization in Deep Neural Networks” Oct 31 - Nov 1, 2019

Key Note Speaker: Credit Suisse 2019 Quantitative Conference, October 16, 2019

Key note speaker: Siemens Healthineers - Helmholtz Institutes AI Symposium, July 10, 2019

Invited Speaker: Malga Conference “CENTERS, SCIENTIFIC BETS, LEARNING THEORIES”

Invited Speaker: Limitations of Deep Learning Workshop in Sestri Levante, Italy, “Three Theoretical Puzzles” June 25-27, 2019

Invited Speaker: Machine Learning Prague: "Solving Three Theoretical Puzzles in Deep Networks" February 24, 2019

Norbert Wiener distinguished lecture at the Norbert Wiener Center of the University of Maryland: "Deep Networks: some theoretical puzzles" February 21, 2019

Invited Speaker: Deep Learning and the Brain: "Three puzzles in the theory of deep learning" January 20, 2019

Invited Speaker: Harvard-Geometric Analysis Approach to AI Workshop: "Three puzzles in the theory of Deep Learning" January 18, 2019

Invited Speaker: Fujitsu Laboratories Advanced Technology Symposium 2018: "The Science and the Engineering of Intelligence" October 9, 2018

Invited Speaker: Conference on International Cooperation of Science Centers, 2018: "The Science and the Engineering of Intelligence" October 19, 2018

Invited Speaker: IEEE Computer Society and GBC/ACM 2018-2019-MIT: "The Science and the Engineering of Intelligence" September 20, 2018

Brains, Minds and Machines Summer Course, at Marine Biological Laboratory "Theoretical Puzzles of Deep Nets (With Solutions)" Woods Hole, MA, August 31, 2018.

Invited Speaker: HHB "The Problem of Intelligence in Flies, Men and Machines"

Invited Speaker: University of Wisconsin-Madison Artificial Intelligence Seminar: "Learning Sparse Representations for Vision"

Invited Speaker: ICML Stockholm: "Deep Nets, the last theory puzzle: Classical Generalization bounds hold tight" July 2018

Invited Speaker: AStar- Singapore: "Hardware for Learning: The lesson from autonomous driving" June 5, 2018

Invited Speaker: DALI 2018 "Why can Deep Networks avoid the curse of Dimensionality and two other theoretical puzzles" April, 2018

Invited Speaker: Tencent AI Workshop: "From machine learning to the Science and the Engineering of Intelligence" March 2018

Invited Speaker: MIT IQ: "The Science and Engineering of Intelligence" February 2018

Invited Speaker: Seattle Allen Institute for Brain Research: "Primate Vision and Deep Learning" February 2018

Invited Speaker: Washington State MIT Washington Seminar Series: "Artificial Intelligence and Machine Learning- Why and When Can Deep Networks Avoid the Curse of Dimensionality" February 2018

Invited Speaker: EmTech Singapore: "From Machine Learning to the Neuroscience and Engineering of Intelligence" January 2018

Invited Speaker: AStar: "Science and Engineering of Intelligence" January 2018

Invited Speaker: EmTech Asia: "From Machine Learning to Engineering and Theory of Deep Learning" January 2018

Speaker: CBMM - X Summit- "Deep Networks: Three Questions" January 2018

Invited Speaker: 2016 MIT Research and Development Conference: "The Science and the Engineering of Intelligence" November 17, 2016.

Invited Speaker: Shell Advanced Analytics Summit: "Machine Learning Today" September 16, 2016.

Invited Speaker: Data Science Symposium: "The Science and the Engineering of Intelligence" Cambridge, MA, September 13, 2016.

Brains, Minds and Machines Summer Course, at Marine Biological Laboratory "Deep learning: towards a theory, AI/Language" Woods Hole, MA, August 31, 2016.

Invited Speaker: Second Chinese Congress on Artificial Intelligence: "The Science and the Engineering of Intelligence" Beijing, China, August 27, 2016.

Invited Speaker: 2016 STC Directors' Meeting: "The Science of Intelligence: a Public Effort?" August, 2016

Invited Speaker: Oberwolfach Workshop 1627b on Learning Theory and Approximation "Deep learning: a couple of theorems and a few conjectures" Oberwolfach, Germany, July 4, 2016.

Speaker and Organizer: Brains, Minds and Machines Workshop: "A theoretical framework for Deep Learning networks" Sestri Levante, Italy, June 20, 2016.

Speaker and Organizer: Workshop on Deep Learning: Theory, Algorithms and Applications: "Deep vs. Shallow: Some Theorems" MIT, Cambridge, MA, June 10, 2016.

Invited Speaker: STCs 2016: Third Annual CBMM Site Visit: "Welcome + CBMM Overview" MIT, Cambridge, MA, June 8, 2016.

Invited Speaker: Southern California Machine Learning Symposium: "Some Theorems on Hierarchical Learning Machines" UC Irvine, May 20, 2016.

Invited Speaker: Cold Spring Harbor Laboratory: "Crick's Contributions to Neuroscience" Cold Spring Harbor, NY, May 16, 2016.

Invited Speaker: 2016 Kirwan Undergraduate Lecture (KUL) "The Science and the Engineering of Intelligence" University of Maryland, April 28, 2016.

Invited Speaker: Second Annual CBMM Retreat, "State of CBMM" Cambridge, MA, April 19, 2016.

Invited Speaker: CPS Week 2016: "The problem of intelligence: Today's Science, Tomorrow's Engineering" Vienna, Austria, April 14, 2016.

Invited Speaker: The International Symposium on Artificial Intelligence: "How far Brain Science has come?" Coex, Seoul, Republic of Korea, March 16, 2016.

Invited Speaker: Visual Attention Lab Seminar at Brigham and Women's Hospital Visual Attention Lab. "Invariant representations in visual cortex" Boston, MA, January 26, 2016.

Invited Speaker: Siemens Healthcare-Diagnostic Imaging Workshop: "The Problem of Intelligence: Today's Science, Tomorrow's Engineering" Princeton, February 16, 2016.

Invited Speaker: MIT Japan Conference: "Brains, Minds and Machines: the new brain-inspired Artificial Intelligence" Tokyo, Japan, January 22, 2016.

Speaker and Organizer: MIT IAP Workshop: "The Science and Engineering of Intelligence: A bridge across Vassar Street" Cambridge, MA, January 15, 2016.

Speaker and Organizer: NIPS Symposium on Brains Minds and Machines: "The Science and the Engineering of Intelligence" Montreal, Quebec, Canada, December 2015.

Invited Speaker: Future Directions Workshop on visual common sense reasoning: "Vision of Vision" Washington DC, November 2015.

Keynote Speaker: IBM Machine Learning Day: "Deep Networks: a theory?" Haifa, Israel, November 9, 2015.

Keynote Speaker: IBM Colloquium dedicated to cognitive computing: "Vision at the Center for Brains, Minds and Machines" Haifa, Israel, November 8, 2015.

Invited Speaker: Festival della Scienza: "Artificial Intelligence Revives its Old Ambitions: Unraveling the Mystery of Intelligence" Genoa, Italy, October 2015.

Invited Speaker: The Rockefeller University: "Visual Cortex and Deep Networks" NYC, September 17, 2015.

Invited Speaker: CBMM Summer School: "Invariance, Inverse Problems" Marine Biological Laboratory Woods Hole, MA, August 13- September 2, 2015.

Invited Speaker: International Workshop on Machine Learning, Optimization & big Data- MOD: "Towards a theory of deep convolutional networks such as visual cortex" Taormina, Italy, July 21-24, 2015

Invited Speaker: Robotics: Science and Systems Conference: "Towards A Theory of the Visual Cortex and of Deep Convolutional Architectures" Rome, Italy, July 13-17, 2015.

Invited Speaker: Asia-Pacific Conference on Vision (APCV'2015): "Visual Cortex and deep convolutional architectures towards a theory" Nanyang Executive Centre, NTU, Singapore, July 10-12, 2015.

Invited Speaker: Visiting Investigatorships Symposium: "Brains, Minds and Machines" Biopolis, Singapore, June 17, 2015.

Invited Speaker: Kavli Workshop, Frontiers of Brain Science: "Unraveling the mystery of Intelligence" MIT, June 12, 2015.

Invited Speaker: CBMM Language and Vision Workshop (CVPR): "Science and Engineering of Intelligence" Boston, MA, June 11, 2015.

Invited Speaker: System Information Learning Optimization (SILO) 2015: "CBMM: An Overview" Berkeley, CA May 27-29, 2015.

Invited Speaker: Bertinoro International Center for Informatics: Deep Learning Workshop on Theory, Algorithms, and Applications: "Learning of Invariant Representations in Visual Cortex: i-theory" Bertinoro, Italy, May 24-25, 2015.

Invited Speaker: Boston University Symposium on Physics, Mathematics, and Neuroscience of Cortical function: "Invariant Representations in Visual Cortex" May 13-14, 2015.

Invited Speaker: BCS Visiting Committee Meeting: "CBMM Overview" Cambridge, MA, 2015.

Invited Speaker: SUTD Special Seminar, "Artificial Intelligence Revives Its Old Ambitions: Unraveling the Mystery of Intelligence" Singapore, April 24, 2015.

Invited Speaker: MIT Europe Conference in Vienna: "Artificial Intelligence Revives Its Old Ambitions: Unraveling the Mystery of Intelligence" Vienna, March 2015.

Invited Speaker: Computational and Neural Systems Seminar. "Learning of invariant representations in visual cortex: i-theory" Caltech, March 9, 2015.

Invited Speaker: Mobileye: "The magic of the ventral stream" Jerusalem, February 1, 2015.

Invited Speaker: Kavli Futures Symposium: "Toward a Taxonomy of Cortical Computations" NYC, January 31-February 1, 2015

Invited Speaker: "Beyond the Turing Test," 29<sup>th</sup> Annual AAAI Conference on Artificial Intelligence, Austin, Texas, January 25, 2015

Invited Speaker: Astar "The MIT Center for Brains Minds and Machines: bits and thoughts." Singapore, January 2015.

Invited Participant: The Future of AI: Opportunities and Challenges San Juan, PR, The Future of Life Institute, January 2-4, 2015

Invited Speaker: Seeing/Sounding/Sensing, The MIT CAST Symposium, September 27, 2014

Co-Director: CBMM Summer School, MBL Woods Hole, MA, May 29 - June 12, 2014

Invited Speaker: "Opening Address," REVIVE (Reverse-engineering Visual Intelligence for Cognitive Enhancement) Workshop, Fusionopolis, Singapore, May 14, 2014

Invited Speaker: "Computational approaches to mind and brain," John Hopkins, May 8, 2014

Invited Speaker: "The Computational Magic of the Ventral Stream: a Theory," Center for Theoretical Neuroscience, Columbia, April 10, 2014

Invited Speaker: "The Computational Magic of the Ventral Stream: Sketch of a theory (and why some deep architectures work)," Brown University, April 9, 2014

Invited Speaker: Siemens Distinguished Speakers Series, Siemens Corporate Research Labs, Princeton, April 2014 April 7, 2014

Invited Speaker: "A theory of Invariance," DeepMind, London, February 4, 2014

Invited Speaker: "The ventral stream: the computational level," Machine Learning from Cortical Networks (IARPA) Workshop, Washington, Feb 11, 2014

Organizer: "M-Theory," Deep Learning: Theory, Algorithms, Applications Seminar, Kanagawa, Japan, May 19-22, 2014

Invited Speaker: "Brains, minds and machines: the greatest problem in science," Rome Science Festival: Human Language and Machine Language, January 26, 2014

Invited Speaker: The Center for Brains, Minds and Machines" and "The magic theory," ASTAR visit, December 16-18, 2013

"Neural representation of action sequences: how far can a simple snippet-matching model take us," NIPS Poster, December 6, 2013

"M-theory," CBMM+IIT workshop @MIT: Learning Data Representation: Hierarchies and Invariance, November 23, 2013

Invited Speaker: MIT R&D Conference, "The Center for Brains, Minds, and Machines," Nov 13, 2013

Invited Speaker: "The Center for Brain, Minds, and Machines," ABF Workshop @MIT, November 6, 2013

"Introduction to CBMM and thrust 5 Overview," CBMM Opening Reception @MIT, October 25, 2013

Invited Speaker: "Object Recognition by Hierarchical Learning Machine," Max Planck Institute for Biological Cybernetics, Tübingen, Germany, October 13, 2013

Invited Speaker: "The computational magic of the ventral stream: sketch of a theory," UC Berkeley Math Department, August 29, 2013

Invited Speaker: "The computational magic of the ventral stream: sketch of a theory," Google, August 27, 2013

Invited Speaker: "The Center for Brains, Minds and Machines," Brains on Brains: MIT BCS, Cambridge, MA

Invited Speaker: "The computational magic of the ventral stream: sketch of a theory (and why some deep architectures work)," UC Berkeley Math Dept., August 29, 2013

Invited Speaker: "The computational magic of the ventral stream: sketch of a theory," Google, August 27, 2013

Invited Speaker: "The Center for Brains, Minds and Machines," Brains on Brains, MIT BCS Dept., Cambridge, MA

Invited Speaker: "The greatest problem in science," DARPA BASC Workshop, Washington, August 11, 2013

Invited Speaker: "The computational magic of the ventral stream: sketch of a theory (and why some deep architectures work)"Duke Workshop on Sensing and Analysis of High-Dimensional Data, July 25, 2013

Invited Speaker: "Learning representations for learning like humans do," IIT, Genoa, Italy, July 2013

Invited Speaker: "M-theory: the computational magic of visual cortex and why some deep learning architectures work," CRCNS (NSF) Workshop, Cambridge, MA, June 2013

Invited Speaker: "Object Recognition by Hierarchical Learning Machines," Max Planck Institute, Tuebingen, Germany, June 2013

Invited Speaker: A theory of the visual cortex," Innovation initiative, Cambridge, MA, May 2013

Invited Speaker: "Machine Learning and Computer Vision for Quantitative Mouse Phenotyping," Simons Workshop, MIT, Cambridge, MA, May 2013

Invited Speaker: "The MIT Center for Brains Minds and Machines: understanding objects and people by humans and machines" Workshop on Superhuman Intelligence, Seoul, South Korea, May 2013

Invited Speaker: "Artificial Intelligence," Introduction to Poggio workshop on Artificial Intelligence, MIT CSAIL, Cambridge, MA

Invited Speaker: "The computational magic of cortex: a theory," Workshop on Harmonic Analysis, Duke, Durham, NC

Invited Speaker: "The computational magic of cortex: a theory," NCSU, March 2013

Invited Speaker: "From behavior to neurons via theory," Janelia Conference: Insect Vision: Cells, Computation, and Behavior, March 4, 2013

Keynote Speaker: "The Computational Magic of Pattern Recognition in Cortex: A Theory of Selectivity and Invariance" ICPRAM 2013, Barcelona, Spain, Feb 17, 2013

Invited Speaker: "A theory of invariant recognition," Institute of Automation, Chinese Academy of Sciences, Beijing, China, November 2012

Keynote Speaker: "Invariant Recognition in Visual Cortex: a Theory" ACCV 2012, Seoul, Korea, November 7, 2012

Honorary Chair and Keynote Speaker: "The quest for a theory of Vision: from the level framework (revised) to the Invariance of the Ventral Stream", ECCV 2012, Florence, Italy, October 2012

Invited Speaker: "Computing Intelligence: Mind, Brain and Machine" Cracking the Neural Code: Third Annual Aspen Brain Forum, Aspen, CO, August 24, 2012

Invited: SciFoo, Sunnyvale, CA, August 3, 2012

Invited Speaker: EPSRC Symposium, Durham, England, July 13, 2012

Invited Speaker: "The magic of the visual cortex: Learning invariances", Dagshtul, Germany, June 24, 2012

Master Class: "Minds, Brains and Machines: Imagining the Future," The Fourth Israeli Presidential Conference: Facing Tomorrow 2012, Jerusalem, Israel, June 20, 2012

Invited Speaker: "The Computational Magic of the Ventral Stream," Computer Vision and Human Perception - Future Trends: In Honor of Prof. Shimon Ullman, The Weizmann Institute of Science, Israel, April 15, 2012

Invited Speaker: World Economic Forum Annual Meeting 2012, Davos, Switzerland, January 25-29, 2012

Organizer & Moderator: "Knowledge-Based Economies and Institutions Such As MIT," October 22, 2011, and "Science and Engineering of Intelligence," October 23, 2011, 9th Annual Festival della Scienza, Genoa, Italy

Invited Speaker: "The Computational Magic of the ventral stream: A theory", 2011 Annual Symposium: Open Questions in Neuroscience, Allen Institute for Brain Science, Seattle WA, October 4-5, 2011

Invited Speaker: World Conference on the Future of Science Mind: the essence of humanity, Venice, September 18-20, 2011

Invited Speaker: "Debate: Today the World of Tomorrow – Scientific Developments," Intelligence on the World, Europe, and Italy, Villa d'Este (on Lake Como, Italy), September 2, 2011

Invited Speaker: "From understanding vision in the fly to understanding visual cortex," ECVP 2011, Toulouse, France, August 26, 2011

Invited Speaker: "Learning Theory and Steve Smale," SmaleFest 2011, UC Berkeley, July 30-August 3, 2011

Invited Speaker: "The magic of the visual cortex," Dagstuhl Seminar: Mathematical and Computational Foundations of Learning Theory, July 17-23, 2011

Invited Speaker: "The computational magic off the ventral stream: towards a theory," IPAM, UCLA, Graduate Summer School: Probabilistic Models of Cognition, July 11, 2011

Plenary Speaker: "The Hierarchical Recognition Architecture of Visual Cortex: Learning and Discounting Transformations," The Fourth International Conference on Computational Harmonic Analysis, Hong Kong, May 23, 2011

Invited Speaker: Grand Challenges in Neural Computation II: Neuromimetic Processing and Synthetic Cognition, Los Alamos, NM, February 20-22, 2011

Invited Speaker: "Visual Recognition in the Primate Cortex," Harvard University, January 31, 2011

Invited Speaker: 'Max Birnstiel Lectures', Research Institute of Molecular Pathology (I.M.P.), Vienna, Austria, January 12, 2011

Invited Speaker: Defining Cognitive Informatics: "Learning and Intelligence in Brains and Machines," University Vienna, Austria, January 11, 2011

Invited Speaker: Jon Postel Distinguished Lecturer Series, "Intelligence in minds, brains and machines: the neuroscience perspective," UCLA, Computer Science Department, November 4, 2010

Invited Speaker: UC San Diego Neuroscience Seminar Series, "What is where: Visual Recognition and Attention in the Primate Cortex", November 2, 2010

Keynote address IEEE AIPR Conference, "Learning in Brains and Machines," Washington DC, October 13, 2010

Invited Speaker: BCE 2010, "Intelligence in Minds, Brains and Machines," Seoul, Korea, Sept 28-29, 2010.

Keynote address ECML 2010, "Hierarchical Learning Machines and Neuroscience of Visual Cortex" Barcelona, Spain, September 21, 2010

Invited Lecturer: ICVSS 2010, "Visual Recognition in Primates and Machines," Sicily, Italy, July 12, 2010

Invited Speaker: CONAS Workshop 2010, "Intelligence in minds, brains and machines," Ghent, Belgium, July 9-10, 2010

Invited Speaker: Luigi Stringa - memorial conference hosted by La Fondazione Bruno Kessler, Povo, Italy, July 5, 2010

Invited Speaker: Lagrange Prize Awarding Ceremony, Moderated conversation between James J. Collins and Tomaso Poggio, CRT Foundation, Turin, Italy July 1, 2010

Invited Speaker: SmaleFest, "What is Where: Vision and Learning", France, June 16, 2010

Invited Speaker: NSF Workshop on Shared Organizing Principles In the Computing and Biological Sciences, Arlington, VA, May 25-26, 2010

Keynote address: ATR Workshop, Memorial Symposium, "Intelligence and learning in Brains and Machines," Tokyo International Forum Hall, March 10, 2010

Invited speaker: Renaissance Technologies Colloquium, "Learning in Brains and Machines," Renaissance Corp., Stonybrook, NY, February 25, 2010

Invited speaker: New England Statistics Symposium, "Learning Theory: Kernels and Derived Kernels," Harvard University, Statistics Dept., April 17, 2010

Distinguished speaker, Heller Lecture Series in Computational Neuroscience, "Intelligence and Learning in Brains and Machines", The Hebrew University of Jerusalem, Israel, January, 2010

Invited speaker: "Learning Theory and Heierarchical Kernel Machines," INC Lecture, The Hebrew University of Jerusalem, Israel, January 7, 2010

Invited speaker: "What is where: Visual Reception I the Primate Cortex," Weizmann Institute, Jerusalem, Israel, January 6, 2010

William Benter Distinguished Lecturer, City University of Hong Kong, September 2009

Distinguished Visitor, A\*STAR program and the Biomedical Research Council, Singapore, September 2009

Keynote address at MMDS, Copenhagen "From Neuroscience to Hierarchical Learning Architectures," July 2009

Invited Speaker: Theory and Practice of Computational Learning Workshop, U. Chicago/TTI Chicago/Ohio State U., June 1-11, Chicago Illinois, 2009

Keynote address at ISMB Conference, Stockholm, "Computational Neuroscience: Models of the Visual System," July 2009

NSF Distinguished Lecture (CISE/BIO/SBE/MPS/ENG), April 24, 2009

Distinguished speaker Lincoln Lab, March 2009

Main Speaker at the Inauguration of the Werner Reichardt Center for Integrative Neuroscience, University of Tuebingen, December 8, 2008

Distinguished Speaker at NSF, Washington, August 14th, 2008

Distinguished Speaker at DARPA-IPTO, Washington, April 5<sup>th</sup>, 2008

"Models of Visual Recognition in the Ventral System" (T. Poggio) Keynote address: Cosyne 2008, Salt Lake City, Utah, February 28, 2008.

"Visual Recognition in Primates and Machines" (T. Poggio) Tutorial: Twenty-first Annual Conference Neural Information Processing Systems: NIPS Conference 2007, Vancouver, British Columbia, Canada, December 3, 2007.

## PROFESSIONAL ORGANIZATIONS

American Association for Artificial Intelligence, 1998.

American Association for the Advancement of Science, 1983.

American Mathematical Society, 1977.

I.E.E.E., 1985. Membership number: 02390904.

Institute for Scientific Interchange Foundation, 2004.  
I.U.P.A.B. Commission on Biophysics of Communication, 1982.  
Optical Society of America, 1977.  
Society for Neuroscience, 1984.

## EDITORIAL BOARDS

### Editorial Boards:

Advances in Applied Mathematics  
Advances in Computational Mathematics  
Advances in Neurocomputing  
Biological Cybernetics  
Computational Neuroscience Series of MIT Press  
Journal of Artificial Intelligence Research  
Network  
Neural Computation  
Neural Networks  
Neurocomputing  
Spatial Vision  
Synapse  
Visual Neuroscience  
PeerJ

### Associate Editor:

Journal of Computer and System Sciences, 1991.  
Systems & Control Letters, 1984.

### Advisory Boards:

National Laboratory of Pattern Recognition, 2015  
Handbook of the Senses, 2001.  
Neural Network Signal Processing Technical Committee, 1994.  
Institute of Physics Publishing, 1991.  
Annals of Mathematics and Artificial Intelligence, 1988.  
VNY Science Press, monographs in neuroinformatics and robotics, 1984.  
MIT/Bradford Press, Computational Models of Cognition and Perception, 1984.  
Lecture Notes in Biomathematics, 1979.  
Journal of Mathematical Biology, 1977.

### Review Boards:

Mathematical Reviews, 1977.

## PATENTS

### "Computer Method and Apparatus for Matching Between Line Drawings"

by Stephen E. Librande and Tomaso Poggio

M.I.T. Case No. 5831TS, United States of America Patent No. 5325475, Issued June 28, 1994

Japan Patent No. 3727061, Issued October 7, 2005

### "Computer Method and Apparatus for Video Conferencing"

"Memory-Based Method and Apparatus for Computer Graphics"

by R. Brunelli, Chiejin Cheng, Tomaso Poggio and Bin Zhang

M.I.T. Case No. 5572S, United States of America Patent No. 5416899, Issued May 16, 1995,

United States of America Patent No. 5659692, Issued August 19, 1997

European Patent Convention Patent No. 0621969, Issued July 3, 1996  
France Patent No. 0621969, Issued July 3, 1996  
Germany Patent No. 69303468.8, Issued July 3, 1996  
United Kingdom Patent No. 0621969, Issued July 3, 1996

"Object Movement Estimator Using One-Dimensional Optical Flow"  
by Nicola Ancona, John N. Harris and Tomaso Poggio  
M.I.T. Case No. 5951, United States of America Patent No. 5717792, Issued February 10, 1998

"Example-Based Image Analysis and Synthesis Using Pixelwise Correspondence"  
by David Beymer, Tomaso Poggio and Amnon Shashua  
M.I.T. Case No. 6267S, United States of America Patent No. 5745668, Issued April 28, 1998

"Image Analysis and Synthesis Networks Using Shape and Texture Information"  
by David Beymer, Michael J. Jones, Tomaso Poggio and Thomas Vetter  
M.I.T. Case No. 6779 United States of America Patent No. 5774129, Issued June 30, 1998

"Method and Apparatus for Classifying and Identifying Images"  
by W. Eric L. Grimson, Pamela Lipson, Tomaso Poggio and Pawan Sinha  
M.I.T. Case No. 7274  
United States of America Patent No. 5963670, Issued October 5, 1999  
United States of America Patent No. 6549660, Issued April 15, 2003

"Talking Facial Display Method and Apparatus"  
by Antoine F. Ezzat and Tomaso Poggio  
M.I.T. Case No. 8102, United States of America Patent No. 6250928, Issued June 26, 2001

"Trainable System to Search for Objects in Images"  
by Michael Oren, Constantine P. Papageorgiou, Tomaso Poggio and Pawan Sinha  
M.I.T. Case No. 7691, United States of America Patent No. 6421463, Issued July 16, 2002

"Correspondence between N-Dimensional Surfaces: Vector Fields That Are Defined By Surfaces and That Generate Surfaces Which Preserve Characteristics O"  
by Tomaso Poggio and Christian R. Shelton  
M.I.T. Case No. 8101, United States of America Patent No. 6525744, Issued February 25, 2003

"Trainable Videorealistic Speech Animation"  
by Antoine F. Ezzat and Tomaso Poggio  
M.I.T. Case No. 9838, United States of America Patent No. 7168953, Issued January 30, 2007

"Electronic Market-Maker"  
by Nicholas Tung. Chan, Andrew W. Lo and Tomaso Poggio  
M.I.T. Case No. 8336S, United States of America Patent No. 7,599,876, Issued October 6, 2009

"High-Performance Vision System Exploiting Key Features Of Visual Cortex"  
by Stanley M. Bileschi, Tomaso Poggio, Maximilian Riesenhuber, Thomas R. Serre and Lior Wolf  
M.I.T. Case No. 11985, United States of America Patent No. 7,606,777, Issued October 20, 2009

"Voice Morphing For Text-To-Speech"  
by Antoine F. Ezzat and Tomaso Poggio  
M.I.T. Case No. 8883

"Face Detection and Identification: The Espresso System"  
by Bernd Heisele, Purdy Ho and Tomaso Poggio  
M.I.T. Case No. 9577

"Localized Spectro-Temporal Cepstral Analysis of Speech"  
by Jacob Vincent. Bouvrie, Antoine F. Ezzat and Tomaso Poggio  
M.I.T. Case No. 12832

#### CURRENT GRADUATE STUDENTS:

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Andrzej Banburski, Ph.D

Akshay Rangamani, Ph.D

Arturo Deza, Ph.D

#### 53 FORMER GRADUATE STUDENTS, 16 OF WHICH ARE NOW FACULTY:

Owen Lewis, PhD, October 2018, Thesis Title: "Structured learning and inference with neural networks and generative models," Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Charlie Frogner, PhD, January 2018, Thesis Title: "Learning and Inference with Wasserstein Metrics" Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Andrea Tachetti, PhD, 2018 Thesis Title: "Learning Invariant Representations of Actions and Faces" Electrical Engineering & Computer Science

Chiyuan Zhang, PhD, Oct 2017, Thesis Title: "Deep Learning and Structured Data" Electrical Engineering & Computer Science

James Mutch, PhD, September 2016, Thesis Title: "Scale-invariant object categorization under eccentricity-dependent retinal resolution," Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Leyla Isik, PhD, May 2015, Thesis Title: "The dynamics of invariant object and action recognition in the human visual system," Massachusetts Institute of Technology, Computational and Systems Biology.

Youssef Mroueh, PhD, December 2014, Thesis Title: "From Bits to Information: Learning meets Compressive Sensing," Massachusetts Institute of Technology, Electrical Engineering and Computer Science.

Joel Z. Leibo, PhD, September 2013, Thesis Title: "The Invariance Hypothesis and the Ventral Stream," Massachusetts Institute of Technology, Brain and Cognitive Sciences

Cheston Tan, PhD, April 2012. Thesis Title: Towards a Unified Account of Face (and Maybe Object) Processing, Massachusetts Institute of Technology, Electrical Engineering & Computer Science

Huei-han Jhuang, PhD, June 2011. Thesis Title: Dorsal Stream: From Algorithm To Neuroscience, Massachusetts Institute of Technology, Electrical Engineering & Computer Science

Ethan Meyers, PhD, February 2011, Thesis Title: Using neural population decoding to understand high level visual processing, Massachusetts Institute of Technology, Brain and Cognitive Sciences

Ulf Knoblich, PhD, December 2010, *also with Chris Moore*, Thesis Title: Examination of the Role of Specific Interneuron Types on Temporal Properties of Neocortical Processing, Massachusetts Institute of Technology, Brain and Cognitive Sciences

Sharat Chikkerur, Ph.D., June 2010, Thesis Title: "What and Where: A Bayesian Inference Theory of Visual Attention," Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Jake Bouvrie, Ph.D., June 2009, Thesis Title: Hierarchical Learning: Theory with Applications in Speech and Vision, Massachusetts Institute of Technology, Brain & Cognitive Sciences

Giorgos Zacharia, Ph.D., February 2009. Thesis Title: Regularized Algorithms for Ranking, and Manifold, Massachusetts Institute of Technology, Electrical Engineering & Computer Science

Adlar Kim, Ph.D., May 2008, Thesis Title: An Order Flow Model and a Liquidity Measure of Financial Markets, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Minjoon Kouh, Ph.D., May 2007. Thesis Title: Toward a More Biologically Plausible Model of Object Recognition, Massachusetts Institute of Technology, Physics.

Stanley Bileschi, Ph.D., May 2006. Thesis Title: StreetScenes: Towards Scene Understanding in Still Images, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Sanmay Das, Ph.D., April 2006. Thesis Title: Dealers, Insiders and Bandits: Learning and Its Effects on Market Outcomes, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Alexander Rakhlin, Ph.D., April 2006. Thesis Title: Applications of Empirical Processes in Learning Theory: Algorithmic Stability and Generalization Bounds, Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Thomas Serre, Ph.D., March 2006. Thesis Title: Learning a Dictionary of Shape-Components in Visual Cortex: Comparison with Neurons, Humans and Machines, Massachusetts Institute of Technology, Brain & Cognitive Sciences

Gene W. Yeo, Ph.D., November 2004. Thesis title: Identification, Improved Modeling and Integration of Signals to Predict Constitutive and Alternative Splicing, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Ryan Rifkin, Ph.D., September, 2002. Thesis title: Everything Old Is New Again: A Fresh Look at Historical Approaches in Machine Learning, Massachusetts Institute of Technology, Electrical Engineering & Computer Science and Operations Research.

Martin Szummer, PH.D., September 2002. Thesis title: Learning from Partially Labeled Data, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Vinay Kumar, Ph.D., June 2002. Thesis title: Towards Trainable Man-machine Interfaces: Combining Top-down Constraints with Bottom-up Learning in Facial Analysis, Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Tony Ezzat, Ph.D., June 2002. Thesis title: Trainable Vidoerealistic Speech Animation, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Christian Shelton, Ph.D., August 2001. Thesis title: Importance Sampling for Reinforcement Learning with Multiple Objectives, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Sayan Mukherjee, Ph.D., June 2001. Thesis title: Application of Statistical Learning Theory to DNA Microarray Analysis, Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Nicholas Chan, Ph.D. February 2001. Thesis title: Artificial Markets and Intelligent Agents, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Theodoros Evgeniou, Ph.D. June 2000. Thesis title: Learning with Kernel Machine Architectures, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Maximilian Riesenhuber, Ph.D. June 2000. Thesis title: How a Part of the Brain Might or Might Not work: A New Hierarchical Model of Object Recognition, Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Constantine Papageorgiou, Ph.D., December 1999. Thesis title: A Trainable System for Object Detection in Images and Video Sequences, Massachusetts Institute of Technology, Electrical Engineering & Computer Science and Operations Research.

Edgar Osuna, Ph.D. June 1998. Thesis title: Support Vector Machines: Training and Applications, Massachusetts Institute of Technology, Electrical Engineering & Computer Science and Operations Research.

Michael Jones, Ph.D. June 1997. Thesis title: "Multidimensional Morphable Models: A Framework for Representing and Matching Object Classes," Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Robert Thau, Ph.D. June 1997. Thesis title: Reliably Mapping a Robot's Environment Using Fast Vision and Local, but not Global, Metric Data, Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Emanuela Bricolo, Ph.D., June 1996. Thesis title: On the Representation of Novel Objects: Human Psychophysics, Monkey Physiology and Computational Models, Massachusetts Institute of Technology, Brain & Cognitive Sciences.

Kah-Kay Sung (*deceased*), Ph.D., February 1996. Thesis title: Learning and Example Selection for Object and Pattern Detection, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Pawan Sinha, Ph.D., August 1995. Thesis title: Perceiving and Recognizing Three-Dimensional Forms, Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

David Beymer, Ph.D., August 1995. Thesis title: Pose-invariant Face Recognition Using Real and Virtual Views, Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Partha Niyogi, Ph.D., February 1995. Thesis title: The Informational Complexity of Learning from Examples, Massachusetts Institute of Technology, Electrical Engineering & Computer Science

James Hutchinson, Ph.D., February 1994; S.M., June 1986. Ph.D. Thesis title: A Radial Basis Function Approach to Financial Time Series Analysis, Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science. S.M. Thesis title: "Early Vision Problem Solving with Analog and Binary Resistive Networks," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Brian Subirana, Ph.D., February 1994. Thesis title: "Mid-level Vision and Recognition of Non-Rigid Objects," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Anthony Passera, Ph.D., February 1993. Thesis title: A Computational Model of Visuo-motor Development, Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences

Thomas Breuel, Ph.D., June 1992. Thesis title: Geometric Aspects of Visual Object Recognition, Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences.

Lyle Borg-Graham, Ph.D., January 1992. Thesis title: On Directional Selectivity in Vertebrate Retina: An Experimental and Computational Study, Massachusetts Institute of Technology, Harvard-MIT Division of Health Sciences and Technology.

Woodward Yang, Ph.D., September 1990. Thesis title: The Architecture and Design of CCD Processors for Computer Vision, Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Ed Gamble, Ph.D., June 1990. Thesis title: "Integration of Early Visual Cues for Recognition," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Michael Villalba, Ph.D., January 1990. Thesis title: "Fast Visual Recognition of Large Object Sets," Massachusetts Institute of Technology, Department of Aeronautics & Astronautics.

Davi Geiger, Ph.D., December 1989. Thesis title: "Visual Models with Statistical Field Theory," Massachusetts Institute of Technology, Department of Mathematics.

Anya Hurlbert, M.D./Ph.D., May 1989. Thesis title: "The Computation of Color," Harvard Medical School/Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences.

Bror Saxberg, M.D./Ph.D., May 1989; S.M., May 1985. Ph.D. Thesis title: "A Modern Differential Geometric Approach to Shape from Shading," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science. S.M. Thesis title: "Parameters of a Three-Dimensional Free Fall Trajectory from its Two-Dimensional Central Projection," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Jose Marroquin, Ph.D., September 1985. Thesis title: "Probabilistic Solution of Inverse Problems," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Christof Koch, Ph.D., October 1982. Thesis title: "Nichtlineare Informationsverarbeitung in Dendritischen Baumen Belicbiger Geometrie," University of Tübingen, Germany.

#### FORMER MASTERS STUDENTS:

Ryan Prinster, , M. Eng., May 2019, Thesis Title: "On Sample Efficiency in Artificial and Biological Agents" Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Sanjana Srivastava, M. Eng., May 2019, Thesis Title: "On foveation of deep neural networks," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Brando Miranda, M. Eng., -----, Thesis Title: ----- Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Francis Chen, M. Eng., -----, Thesis Title: ----- Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Ami Patel, M.Eng., August 2013, Thesis Title: "Effects of Neuronal Correlations on Population Decoding and Encoding Models," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Chun-Kai Wang, M.Eng., June 2013, Thesis Title: "Multiple Mice Tracking Using Microsoft Kinect," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Yuzhao (Allen) Ni, M.Eng., June 2013, Thesis Title: "Mouse Behavior Recognition with The Wisdom of Crowd", Massachusetts Institute of Technology, Computation for Design and Optimization.

Stav Braun, M.Eng, June 2012, Thesis title: "Tracking Multiple Mice," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Nicholas Edelman, M.Eng., July 2011, Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Hristo Paskov, M.Eng., July 2010, Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Andre Wibisono, M.Eng., June 2010, Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Neha Soni, S.M., EECS, MIT, February 2006. "Sequence Motifs Predictive of Tissue-specific Skipping."

James Skelley, S.M., August 2005. Thesis title: "Experiments in Expression Recognition" Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science

Charles F. Cadieu, S.M., May 2005. Thesis title: "Modeling Shape Representation in Visual Cortex Area V4," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Ian S. Martin, S.M., May 2005. Thesis title: "Robust Learning and Segmentation for Scene Understanding," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Jia (Jane) Wu, S.M., May 2005. Thesis title: "Comparing Visual Features for Morphing Based Recognition," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Jacob V. Bouvrie, S.M., June 2004. Thesis title: "Multi-Source Contingency Clustering," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Alexanderos Kyriakides, S.M., February 2004. Thesis title: "Supervised Information Retrieval for Text and Images," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Brian Leung, S.M., May 2004. Thesis title: "Component-based Car Detection in Street Scene Images," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Pascal Paysan, S.M., Computer Science, Fachhochschule Esslingen, February 2004. Thesis title: "Stereovision-based Vehicle Classification Using Support Vector Machines."

Sanmay Das, S.M., June 2003. Thesis Title: "Intelligent Market-Making in Artificial Markets," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Brian Kim, S.M., June 2003. Thesis Title: "Multi-Source Human Identification," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Jennifer Louie, S.M., May 2003. Thesis Title: "A Biological Model of Object Recognition with Feature Learning," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Ezra Rosen, S.M., May 2003. Thesis Title: "Face Representation in Cortex: Studies Using a Simple and Not So Special Model," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Stanley Bileschi, S.M., February 2003. Thesis Title: "Advances in Component Based Face Detection," Massachusetts Institute of Technology, Department of Electrical Engineering & Artificial Intelligence Laboratory.

Jennifer Huang, S.M. January 2003. Thesis title: "Component-based Face Recognition with 3D Morphable Models," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Andrew Crane, S.M. September 2002. Thesis title: "Object Recognition with Partially Labeled Examples," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Purdy Ho, S.M., May 2001. Thesis title: "Rotation Invariant Real-time Face Detection and Recognition System," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Luis Pérez-Breva, Ingeniería Superior Industrial Química, July 1999. Thesis title: "Applying Learning Techniques to Solve Engineering Problems: Preprocessing, Learning and Measuring," Universitat Ramon Llull, Barcelona, Spain. [Internship Program]

Jon Wang, S.M. May 1999. Thesis title: "Information Aggregation and Dissemination in Simulated Markets," Massachusetts Institute of Technology, Department of Computer Science.

Janet Marques, S.M., May 1999. Thesis title: "An Automatic Annotation System for Audio Data Containing Music," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Christian Shelton, S.M., May 1998. Thesis title: "Three-Dimensional Correspondence," Massachusetts Institute of Technology, Department of Electrical Engineering & Artificial Intelligence Laboratory.

Stephen Lines, S.M., June 1996. Thesis title: "The Photo-Realistic Synthesis of Novel Views from Example Images," Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Elaine Yiu, Ph.D., June 1996. Thesis title: "Image Classification Using Color Cues and Texture Orientation," Massachusetts Institute of Technology, Electrical Engineering & Computer Science.

Nicholas Chan, S.M., May 1995. Thesis title: "The Complexity and A Priori Knowledge of Learning from Examples," Massachusetts Institute of Technology, Department of Computer Science.

Anuj Mohan, S.M., June 1999. Thesis title: "Robust Object Detection in Images by Computers," Massachusetts Institute of Technology, Department of Computer Science.

James Hutchinson, S.M., June 1986; Ph.D., February 1994. S.M. Thesis title: "Early Vision Problem Solving with Analog and Binary Resistive Networks," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science. Ph.D. Thesis title: "A Radial Basis Function Approach to Financial Time Series Analysis," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Michael Jones, S.M., September 1992. Thesis title: "Using Recurrent Networks for Dimensionality Reduction," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Vijay Balasubramanian, S.M., June 1992. Thesis title: "Equivalence and Reduction of Hidden Markov Models," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Mike Drumheller, S.M., May 1989. Thesis title: "Synthesizing a Motion Detector from Examples," Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences.

Terry Sanger, S.M., June 1989. Thesis title: "Optimal Unsupervised Learning in Feedforward Neural Networks," Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences.

Walter Gillett, S.M., June 1988. Thesis title: "Issues in Parallel Stereomatching," Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences.

Harry Voorhees, S.M., June 1987. Thesis title: "Finding Texture Boundaries in Images," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Jonathan Bliss, S.M., February 1986. Thesis title: "Velocity-tuned Spatio-temporal Interpolation and Approximation in Vision," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Bror Saxberg, S.M., May 1985; M.D./PhD., May 1989. S.M. Thesis title: "Parameters of a Three-Dimensional Free Fall Trajectory from its Two-Dimensional Central Projection," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science. Ph.D. Thesis title: "A Modern Differential Geometric Approach to Shape from Shading," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Katie Cornog, S.M., February 1985. Thesis title: "Computer Controlled Eye-head Movement Coordination for a Robot: Fixation and Smooth Pursuit," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Michael Kass, S.M., June 1984. Thesis title: "Computing Stereo Correspondence," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

Eric Tiffany, S.M., June 1983. Thesis title: "Stereo Image Registration Using Monocular Image Features," Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science.

#### FORMER POSTDOCTORAL FELLOWS/ASSOCIATES:

Xavier Boix, Postdoctoral Fellow 2014-2019

Amir Adler, Postdoctoral Fellow \_\_\_\_ - 2019

Georgios Evangelopoulos, Postdoctoral Fellow (*LCSL, IIT*), 2013-2018

Gemma Roig, Postdoctoral Fellow 2014-2017

Maximilian Nickel, Postdoctoral Fellow 2013-2016

Fabio Anselmi, Postdoctoral Fellow 2011-2016

Guillermo D. Canas, Postdoctoral Fellow, 2011-2013

Jacob Bouvrie, Postdoctoral Fellow, 2012-2013

Pavan K. Mallapragada, Postdoctoral Fellow, 2010-2011

Neva Cherniavsky, Postdoctoral Fellow, 2010-2011

SangWan Lee, Postdoctoral Fellow, 2010-2011

Stan Bileschi, Postdoctoral Fellow, 2006-2009

Adlar Kim Postdoctoral Fellow, 2008-2009

Thomas Serre Postdoctoral Fellow, 2006-2009

Davide Zoccolan (*with DiCarlo*) Postdoctoral Fellow, Postdoctoral Associate, SISSA (HFSP Fellowship), 2003-2008

Stanley Bileschi, Postdoctoral Fellow, July 2006-December 2006.

Gabriel Kreiman, Postdoctoral Associate, McGovern Institute for Brain Research, 2005-2006; Postdoctoral Fellow-Whitman Fellowship, School of Science, 2002-2005.

Tony Ezzat, Postdoctoral Associate, 2002-2006.

Lior Wolf, Postdoctoral Associate, 2005-2006; Postdoctoral Fellow-Rothschild Fellowship, 2004.

Andrea Caponnetto, Postdoctoral Fellow, 2004-2006.

Sayan Mukherjee, Postdoctoral Associate, 2001-2004.

Maximilian Riesenhuber, Postdoctoral Fellow-McDonnell-Pew Fellowship, 2000-2003.

Bernd Heisele, Postdoctoral Fellow, 1999-2001.

Martin Giese, Postdoctoral Fellow, 1998-2000.

Massimiliano Pontil, Postdoctoral Fellow, 1997-2000.

Michael Oren, Postdoctoral Fellow, 1995-1997.

Pawan Sinha, Postdoctoral Fellow, 1995-1997.

Partha Niyogi, Postdoctoral Fellow, 1996-1997.

Amnon Shashua, Postdoctoral Fellow, McDonnell Pew Fellowship, 1992-1994.

Sebastian Tölz, Postdoctoral Fellow, Fellowship of the Deutsche Forschungsgemeinschaft, 1992-1993.

Lyle Borg-Graham, Postdoctoral Fellow, 1992-1993.

Thomas Vetter, Postdoctoral Fellow, 1991-1993.

Norberto Grzywacz, Postdoctoral Fellow, 1984-1988.

John G. Harris, Postdoctoral Fellow, NSF New Technologies Fellowship, 1991-1993.

Shimon Edelman, Postdoctoral Fellow-Weizmann Fellowship, 1988-1990; Postdoctoral Associate, 1990-1991.

Daphna Weinshall, Postdoctoral Fellow, 1988-1991.

Manfred Fehle, Postdoctoral Fellow, Heisenberg Award, Deutsche Forschungsgemeinschaft, 1989-1990.

James J. Little, Postdoctoral Fellow, 1985-1989.

Hanspeter Mallot, Postdoctoral Fellow, 1986-1988.

Alessandro Verri, Postdoctoral Fellow, 1986-1988.

Heinrich Buelthoff, Postdoctoral Fellow, 1985-1986.

Andrew Parker, Postdoctoral Fellow, MRC Fellowship, 1984-1985.

Christof Koch, Postdoctoral Fellow, Thyssen Foundation Fellowship, 1982-1984.

Keith Nielsen, Postdoctoral Fellow, NIH Fellowship, 1982-1984.

#### FORMER RESEARCH SCIENTISTS/RESEARCH AFFILIATES:

Carlo Ciliberto, Research Affiliate, 2014-2015

Tony Ezzat Research Scientist, 2006-2009

Federico Girosi Research Affiliate, 2000-2003.

Norberto Grzywacz Research Scientist, Center for Biological Information Processing, 1988-1993.

#### FORMER STUDENTS AND POSTDOCS (\*) NOW FACULTY

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#### PUBLICATIONS

(Statistics: h-index (from Publish or Perish) = 80 in 2008)

## BOOKS

T. Poggio and Anselmi, F., *Visual Cortex and Deep Networks: Learning Invariant Representations*. Cambridge, MA, USA: The MIT Press, 2016.

*Letters written in memory of David Marr by his friends and colleagues: Peter Rado, Tony Pay, G. S. Brindley, Benjamin Kaminer, Francis H. Crick, Whitman Richards, Tommy Poggio, Shimon Ullman, Ellen Hildreth*, MIT Press, *These letters were originally published in Lucia Vaina, Editor: From the Retina to the Neocortex: Selected Papers of David Marr (Boston: Birkhäuser, 1991) and are made available here with the kind permission of Lucia Vaina.*

*Vision: A Computational Investigation into the Human Representation and Processing of Visual Information*, D. Marr, Afterword by T. Poggio, MIT Press Cambridge, MA, 2010

*Biologically Motivated Computer Vision*, H.H. Bülthoff, S.W. Lee, T.A. Poggio, C. Wallraven (eds.), Second IEEE International Workshop, BMCV 2002, Tübingen, Germany, November 22-24, 2002. Proceedings

*Perceptual Learning*, Fahle, M. and T. Poggio (eds.), MIT Press, Cambridge, MA, 2002.

*Biologically Motivated Computer Vision*, Lee, S-W., H.H. Buelthoff and T. Poggio (eds.), First IEEE International Workshop, BMCV 2000, Seoul, Korea, May 2000.

*Early Visual Learning*, S. Nayar and T. Poggio (eds.), Oxford University Press, 1996.

*Exploring Brain Functions: Models in Neuroscience* (Proceedings of the 1992 Dahlem Conference), D.A. Glaser and T. Poggio (eds.), John Wiley & Sons, New York, NY, 1993.

*L'Occhio e il Cervello: Che cosa significa "vedere"*, T. Poggio (with M. Fontana) Edizione Theoria, Rome, Italy, 1991.

*Theoretical Approaches in Neurobiology*, W. Reichardt and T. Poggio (eds.), MIT Press, Cambridge, MA, 1980.

## JOURNAL ARTICLES

W. Xiao, Chen, H., Liao, Q., and Poggio, T., "Biologically-Plausible Learning Algorithms Can Scale to Large Datasets", in International Conference on Learning Representations, 2019.

A. Adler, Araya-Polo, M., and Poggio, T., "Deep Recurrent Architectures for Seismic Tomography", in 81st EAGE Conference and Exhibition 2019, 2019.

T. Poggio, Banburski, A., and Liao, Q., "Theoretical Issues in Deep Networks". 2019.

T. Poggio, Kur, G., and Banburski, A., "Double descent in the condition number". 2019.

L. Isik, Tacchetti, A., and Poggio, T., "A fast, invariant representation for human action in the visual system", Journal of Neurophysiology, 2018.

H. Mhaskar and Poggio, T., "An analysis of training and generalization errors in shallow and deep networks". 2018.

T. Poggio, Liao, Q., Miranda, B., Banburski, A., Boix, X., and Hidary, J., "Theory III: Dynamics and Generalization in Deep Networks". 2018.

Q. Liao, Miranda, B., Hidary, J., and Poggio, T., "Classical generalization bounds are surprisingly tight for Deep Networks". 2018.

A. Tacchetti, Isik, L., and Poggio, T., "Invariant Recognition Shapes Neural Representations of Visual Input", Annual Review of Vision Science, vol. 4, no. 1, pp. 403 - 422, 2018.

L. Arend, Han, Y., Schrimpf, M., Bashivan, P., Kar, K., Poggio, T., DiCarlo, J., and Boix, X., "Single units in a deep neural network functionally correspond with neurons in the brain: preliminary results". 2018.

- K. M. Villalobos, Dozier, J., Stih, V., Franci, A., Azevedo, F., Poggio, T., Sasaki, T., and Boix, X., "Can Deep Neural Networks Do Image Segmentation by Understanding Insideness?". 2018.
- Y. Han, Roig, G., Geiger, G., and Poggio, T., "Is the Human Visual System Invariant to Translation and Scale?", in AAAI Spring Symposium Series, Science of Intelligence, 2017.
- J. Mutch, Anselmi, F., Tacchetti, A., Rosasco, L., Leibo, J. Z., and Poggio, T., "Invariant Recognition Predicts Tuning of Neurons in Sensory Cortex", in Computational and Cognitive Neuroscience of Vision, Springer, 2017, pp. 85-104.
- A. Tacchetti, Isik, L., and Poggio, T., "Invariant recognition drives neural representations of action sequences", PLoS Comp. Bio, 2017.
- G. Roig, Chen, F., Boix, X., and Poggio, T., "Eccentricity Dependent Deep Neural Networks for Modeling Human Vision", Vision Sciences Society. 2017.
- H. Mhaskar, Liao, Q., and Poggio, T., "When and Why Are Deep Networks Better Than Shallow Ones?", AAAI-17: Thirty-First AAAI Conference on Artificial Intelligence. 2017.
- Poggio, T., H Mhaskar, L. Rosasco, B. Miranda, and Q. Liao. "Why and when can deep-but not shallow-networks avoid the curse of dimensionality: A review." *International Journal of Automation and Computing* (2017): 1-17.
- Leibo, J.Z., Q. Liao, W. Freiwald, F. Anselmi, and T. Poggio. "View-tolerant face recognition and Hebbian learning imply mirror-symmetric neural tuning to head orientation." *Current Biology* 27 (2017): 1-6.
- Chen, F., G. Roig, L. Isik, X. Boix, and T. Poggio. "Eccentricity Dependent Deep Neural Networks: Modeling Invariance in Human Vision." In AAAI Spring Symposium Series, Science of Intelligence., 2017.
- Han, Y., G. Roig, G. Geiger, and T. Poggio. "Is the Human Visual System Invariant to Translation and Scale?" In AAAI Spring Symposium Series, Science of Intelligence., 2017.
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