

Sanjoy Mahajan

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Born: 1969
Citizenship: US and UK

Positions

- 07/2011– *Olin College of Engineering* **Associate Professor of Applied Science and Engineering.**
- 09/2010–07/2011 *Olin College of Engineering* (on leave from MIT). **Visiting Associate Professor of Applied Science and Engineering.**
- 01/2007–07/2011 *Massachusetts Institute of Technology.* **Lecturer, Department of Electrical Engineering and Computer Science.** Interests: Teaching the ‘Art of Approximation’; improving the teaching of science and engineering; creating teaching materials available under free licenses.
- 07/2006–07/2011 *Massachusetts Institute of Technology.* **Associate Director for Teaching Initiatives, Teaching and Learning Laboratory.** Interests: Teaching the ‘Art of Approximation’; improving the teaching of science and engineering; creating teaching materials available under free licenses.
- 10/2002–07/2006 *University of Cambridge.* **Lecturer (US: Assistant Professor),** Department of Physics. Interests: approximation, improving physics and mathematics teaching.
- 10/2005–06/2006 *Massachusetts Institute of Technology* (on sabbatical from Cambridge). **Visiting scientist,** Cambridge–MIT Institute.
- 10/2002–09/2006 *Corpus Christi College, Cambridge.* **Research Fellow** in physics.
- 09/2003–09/2004 *African Institute for Mathematical Sciences,* Cape Town, Republic of South Africa. **Curriculum director** for this graduate institute created by Cambridge and three South African universities.
- 09/1998–09/2002 *University of Cambridge,* Department of Physics. **Postdoctoral researcher.** Researching students’ misconceptions; developing physics and mathematics teaching materials.

Education

- 09/1993–06/1998 *California Institute of Technology.* **PhD in physics.** Advisors: John Hopfield, Sterl Phinney, Carver Mead. Thesis included theoretical biophysics, probabilistic number theory, and a draft textbook on order-of-magnitude physics.
- 09/1992–05/1993 *University of Pittsburgh.* Nondegree student studying neuroscience.
- 10/1990–07/1992 *University of Oxford,* Merton College (Marshall scholar). **Honours BA in mathematics,** First Class.
- 09/1986–06/1990 *Stanford University.* **BS in physics.**

Teaching

OLIN

SCI 2099/MTH 2199. *Bayesian Inference and Reasoning* (new course, Fall 2012).

SCI 1199. *Waves and Vibrations: Physics of Music (physics foundation)* (new course, Spring 2013).

Putnam Problem Solving seminar. For the William Lowell Putnam mathematics contest (Fall 2012).

SCI 2099. *Art of Approximation in Science and Engineering* (Spring 2011 (as 19-student independent study), Spring 2012, Spring 2013).

SCI 1130. *Mechanics* (Fall 2011).

ENGR 2410. *Signals and Systems* (Spring 2011).

ENGR 2340. *Dynamics* (Fall 2010, Fall 2011).

MTH 1111. *Modeling and Simulation of the Physical World* (Fall 2010).

COLD SPRING HARBOR LABORATORY

Biology by the Numbers course for molecular-biology PhD students (March 2011, March 2013, as one of four faculty).

MIT

2.003. *Dynamics and Control I*, MIT Mechanical Engineering department (Fall 2009).

Instructor rating: 6.5/7.0. Course rating (co-taught course): 4.6/7.0.

6.055/2.038. *The Art of Approximation in Science and Engineering*, Electrical Engineering and Computer Science department (Spring 2008, Spring 2009).

Instructor rating: 6.7/7.0. Course rating: 6.3/7.0.

5.95. *Teaching College-Level Science and Engineering*, Electrical Engineering and Computer Science department (Spring 2009).

Instructor rating: 6.6/7.0. Course rating: 6.3/7.0.

18.098/6.099. *Street-Fighting Mathematics*, Mathematics department (IAP 2007, IAP 2008, IAP 2009).

Instructor rating (2007): 6.4/7.0. Course rating (2007): 6.2/7.0.

Instructor rating (2008): 6.8/7.0. Course rating (2008): 6.7/7.0.

Instructor rating (2009): 6.6/7.0. Course rating (2009): 6.4/7.0.

6.003. *Signals and Systems*, Electrical Engineering and Computer Science department (Fall 2007).

Instructor rating: 4.5/7.0. Course rating (co-taught course): 4.7/7.0.

6.084. *The Art of Approximation in Science and Engineering*, Electrical Engineering and Computer Science department (Fall 2006).

Instructor rating: 6.5/7.0. Course rating: 6.4/7.0.

6.969. *Readings in Teaching*, Electrical Engineering/Computer Science department (Fall 2006).

Instructor rating: 7.0/7.0. Course rating: 6.7/7.0.

8.298 *Lies and damn lies: The art of approximation in science*, Physics department. Independent Activities Program, sophomore/junior level (Jan–Feb 2006).
Instructor rating: 6.6/7.0. Course rating: 6.4/7.0.

UNIVERSITY OF CAMBRIDGE (PHYSICS DEPARTMENT)

Thermodynamics: sophomore lecture course, 180 students (2004).

Electronics laboratory: freshman course, 35 students (2002–2003).

Order-of-magnitude astrophysics: graduate lecture course, 5-10 students (2001–2003).

Member, working groups revising the freshman lecture and laboratory curricula: (2001).

Order-of-magnitude physics: junior/senior lecture course, 100 students (2000–2003).

Dynamics: Helped redesign sophomore lecture course to incorporate peer instruction and approximation, 180 students (1999).

CORPUS CHRISTI COLLEGE, CAMBRIDGE

Thermodynamics: tutorials for sophomore lecture course, 10 students (2004).

Intermediate dynamics: tutorials for sophomore lecture course, 10 students (2002)

Thermodynamics, kinetic theory, mechanics, special relativity: tutorials for freshman lecture courses, 20 students (1998–2003).

Director of Studies in Physics: advisor for 30 students (1999).

AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES

Introduction to GNU/Linux, HTML, and TeX: 40 students (2003–2004).

Art of Approximation in Science: 40 students (2003, 2004).

Numerical computation with Python: 40 students (2003).

Scientific writing: 40 students (2004).

OTHER

Faculty development workshop: Art of approximation in science and engineering, Olin College, 14 January 2013.

Workshop: Teaching physics for social justice, Salt Lake City, Utah. American Association of Physics Teachers summer conference (7 August 2005).

Website: Readings in internal medicine. Programmed the website that teaches evidence-based medicine to residents at Columbia's medical school (2003–2005).

Workshop: Physics misconceptions, Bletchley Park, England. In-service workshop for high-school physics teachers (6 November 2003).

Workshop: Lies, Damn Lies, and Approximations, Boise, Idaho. American Association of Physics Teachers summer conference (4 August 2002).

Habits of mind. With Eric Mazur of the Harvard physics department, designed a quantitative-reasoning course for the Harvard Core [we haven't taught it yet] (2000).

Physics approximations, Calculus. At the Mathcamp, a summer mathematics program for 100 high-school students selected from across North America (1999–2003).

Guessing and proving, Trinity College, Cambridge. Royal Institution enrichment mathematics course for high-school students (1999–2000).

Physics around you, Villiers Park, Foxton, Cambridgeshire, England. Two-week residential physics course for high-school students from across the United Kingdom (November 1998).

Physics 1a: Freshman physics, Caltech. Section leader for Caltech’s introductory physics course (1997).

Order of Magnitude Physics, Caltech. Teaching assistant for this graduate course on approximation and dimensional analysis (1995, 1997).

Keynote talks

When two equals one: The power of approximation. *Brandeis University, Quantitative Biology bootcamp* (biophysics program), 26 January 2013.

The art of approximation. *Oslo office of McKinsey, Lugano, Switzerland* (13 May 2011).

Street-fighting mathematics and science: The art of opportunistic problem solving. *Berkshire Forum, Pittsfield, Massachusetts* (15 Sep 2010).

Street-fighting higher education. *EduComm conference, Las Vegas* (7 June 2010).

Promoting thinking instead of rote learning: the Benezet experiment. *University of Chicago Splash conference* (24 Apr 2010).

Street-fighting science and engineering. *Telecosm Conference, New York* (12 Nov 2009).

Misconceptions in physics. *Gatsby Foundation Teacher Fellowships Mentoring Seminar, London* (15 Jan 2004).

Learning by rote. *Mathematics for Education and Industry conference, Nottingham, England* (5 July 2001).

Physics by rote. *Institute of Physics (UK), spring meeting, Co Cavan, Ireland* (7 April 2001).

Invited talks

Street-fighting mathematics for everyone. *Center for Curriculum Redesign, Stockholm, 22 April 2013.*

Interactive teaching. *LASPAU, Harvard* (01 November 2012).

Street-fighting mathematics and science: The art of opportunistic problem solving. *Olin Family Weekend, 27 October 2012.*

Don’t chloroform the child’s reasoning faculties: A little-known mathematics curriculum based on meaning. *National Numeracy Network annual conference, New York, 13 October 2012.*

The Olin Question. *Olin College, Commencement address, 20 May 2012.*

Street-fighting mathematics and science: Improving teaching and thinking. *Indian Institute of Technology Techkriti Festival, Kanpur, India, by videoconference* (27 January 2012).

An operator approach to discrete-time signals and systems. *NAE Frontiers of Engineering Education Conference, Irvine, CA* (13–16 November 2011).

Street-fighting mathematics and science: Improving teaching and thinking. *George Washington University, Physics Department* (15 September 2011).

From teaching to learning. *LASPAU, Harvard* (20 June 2011).

Street-fighting mathematics and science. *Big Ideas for Busy People, Cambridge Science Festival, Harvard* (29 April 2011).

Street-fighting mathematics and science: Improving teaching and thinking. *US Military Academy, West Point, New York* (19 April 2011).

Physics and war. *US Military Academy, West Point, New York* (19 April 2011).

[panel sessions:] It may be a sputnik moment, but science fairs are lagging; Labor in an era of globalization

overselling medical science; Climate strange; Transportation: Riding high speed to recovery; Public edjukashun is failing us. *Conference on World Affairs, University of Colorado, Boulder* (6–8 April 2011).

Street-fighting mathematics and science: Improving teaching and thinking. *CTY Family Academic Conference, Johns Hopkins University* (26 March 2011).

Street-fighting mathematics and science: Improving teaching and thinking. *TEDxCaltech—Feynman's Vision: The Next 50 Years, Caltech* (14 Jan 2011).

The confusions of orthodox statistics: A Bayesian answer. *American Association of Physics Teachers, Winter Meeting* (10 Jan 2011).

Two equals one: Teaching the gentle art of lying. *University of Massachusetts, Boston, Physics Department* (1 Dec 2010).

Street-fighting mathematics and science: Improving teaching and thinking. *Indiana University, Biocomplexity Institute* (12 Oct 2010).

Street-fighting mathematics (invited poster with talk). *American Association of Physics Teachers, Summer Meeting* (22 Jul 2010).

Design of the “Art of approximation” course. *Olin College of Engineering, I2E2 conference* (30 Jun 2010).

Two equals one: Teaching the gentle art of lying. *Case Western Reserve University, Physics Department* (01 Apr 2010).

The gentle art of lying: A diagnostic and remedy for rote learning. *Olin College of Engineering* (02 Mar 2010).

Two equals one: Teaching the gentle art of lying. *University of Colorado, Boulder, DBER [science faculty/postdocs working group on educational change]* (7 April 2009).

Two equals one: Teaching the gentle art of lying. *Cornell University, Department of Theoretical and Applied Mechanics* (11 March 2009).

Two equals one, or the virtues of lying and guessing. *Wellesley College, Department of Mathematics* (13 March 2007).

What kinds of teaching and learning produce world-class experts? *Massachusetts General Hospital, Palliative Care Service grand rounds* (13 December 2006).

Rote learning in physics. *Clark University, Department of Physics* (28 September 2006).

Two equals one: Teaching the gentle art of lying. *Harvard University*, Applied Mechanics seminar (20 September 2006).

History of education. *Quintessa Vineyard* (25 February 2006).

Students' misconceptions about fundamental concepts in physics. *MIT*, Department of Physics (25 January 2006).

Lies and damn lies: The art of approximation. *University of Maine, Orono*, Department of Physics (4 November 2005).

War is the health of the physics community. *University College, University of London*, Department of Science and Technology Studies (9 May 2005).

Physics Education Research: Or it's so hard to find good help these days. *American Association of Physics Teachers conference*, Winter Meeting (19 Jan 2004).

Teaching the art of lying using the history of the pendulum. *American Association of Physics Teachers*, Summer Meeting (4 August 2003)

Hassler Whitney's ideas for humanistic mathematics education. *7th International History & Philosophy of Science Teaching conference*, Winnipeg, Manitoba (1 August 2003).

Physics by rote: The way students learn physics, and how we might improve it. *Rochester Institute of Technology*, Department of Physics (27 September 2002).

Improving physics teaching. *New York University*, Department of Physics (17 Sep 2002).

The Benezet experiment in mathematics teaching. *Rutgers University*, Graduate School of Education (31 July 2001).

Pretending to be Schoenfeld. *Physics Education Research Conference*, Rochester, New York (26 July 2001).

Physics by rote. *Queen's University, Belfast*, Northern Ireland physics teachers conference (27 June 2001).

Physics teaching. *Trinity College, Dublin*, teaching day, Dublin, Ireland (15 May 2001).

The Benezet experiment and rote learning in mathematics. *University College, University of London*, Institute for Cognitive Neuroscience (31 October 2000).

How we might improve physics teaching. *University of Edinburgh*, Department of Physics (12 May 1999).

Publications

TEXTBOOKS

Sanjoy Mahajan. *Street-Fighting Mathematics: The Art of Educated Guessing and Opportunistic Problem Solving*, MIT Press (March 2010). Reviews include one by John A. Adam in the November 2010 issue of the *American Journal of Physics*, 78(11):1230–1232 (“Bottom line: This is a very creative book.”).

Sanjoy Mahajan. *Art of Approximation in Science and Engineering*. Manuscript in preparation, to be published in 2014 by MIT Press.

Sanjoy Mahajan and Dennis Freeman. *Discrete-Time Signals and Systems: The Operator Approach*. Manuscript in preparation.

OTHER BOOKS

Sanjoy Mahajan. *Numbersight: A Street-Fighting Mathematician Teaches How to Make Better Decisions*. Manuscript in preparation. (MIT Press offered a contract but I will self publish in order to keep the price low and the reach a wide audience.)

PEER-REVIEWED ARTICLES

Sacha Zyto, David Karger, Mark Ackerman, and Sanjoy Mahajan. Successful classroom deployment of a social document annotation system. *CHI '12: CHI Conference on Human Factors in Computing Systems Proceedings*. In press: accepted 18 January 2012.

Lee, K. and Mahajan, S. Development of a world-class Othello program. *Artificial Intelligence* **43**:21–36 (1990).

Lee, K. and Mahajan, S. A pattern-classification approach to evaluation-function learning. *Artificial Intelligence* **36**:1–25 (1988).

OTHER ARTICLES

Hogg, D. W. and S. Mahajan. Introductory physics: The new scholasticism.
<http://arxiv.org/abs/physics/0412107> (Dec 2004)

Mahajan, S. Physics Education Research: Or it's so hard to find good help these days.
<http://arxiv.org/abs/physics/0405006/> (May 2004)

Mahajan, S. Estimating light bending using order-of-magnitude physics.
<http://www.inference.phy.cam.ac.uk/sanjoy/teaching/approximation/> (June 2002).

Mahajan, S. and R. R. Hake. Is it finally time for a physics counterpart of the Benezet–Berman math experiment of the 1930's? (March 2002) At <http://arxiv.org/abs/physics/0512202> (Dec 2005). First presented as an invited poster at the Physics Education Research Conference (2000).

Mahajan, S. A radical experiment in mathematics teaching.
<http://www.inference.phy.cam.ac.uk/sanjoy/ihpst/> (November 2001). First presented at the 6th International History & Philosophy of Science Teaching conference, Denver, Colorado.

Mahajan, S. Learning proof and questioning lies.
<http://www.inference.phy.cam.ac.uk/sanjoy/ihpst/> (November 2001). First presented at the 6th International History & Philosophy of Science Teaching conference, Denver, Colorado.

Mahajan, S. Physics students learn nothing, so try history of science.
www.inference.phy.cam.ac.uk/sanjoy/ihpst/ (November 2001). First presented at the 6th International History & Philosophy of Science Teaching conference, Denver, Colorado.

Mahajan, S. Estimating gas mileage: An example of order-of-magnitude physics. (Aug 2001). At <http://arxiv.org/abs/physics/0512209> (Dec 2005).

Mahajan, S. and D. MacKay. Physics teaching survey.
<http://www.inference.phy.cam.ac.uk/teaching/survey/> (March 2000).

Mahajan, S. Observations on teaching first-year physics (Dec 1998). At <http://arxiv.org/abs/physics/0512001> (Dec 2005).

Lee, K. and Mahajan, S. Corrective and reinforcement learning for speaker-independent continuous speech recognition. Carnegie Mellon CS Department Technical Report CMU-CS-89-100 (1989).

Lee, K. and Mahajan, S. BILL: A table-based, knowledge-intensive Othello program. Carnegie Mellon CS Department Technical Report CMU-CS-86-141 (1986).

Grants, honors, and awards

Scientific Advisory Board, Informal Science Education Program NSF grant (PI: Eric Klopfer at MIT), 2010– (if funded).

Scientific Advisory Board, Physics Problems to Tutor Generic Expertise, NSF grant (PI: David Pritchard at MIT), 2007–.

Research Fellowship, Corpus Christi College, Cambridge (2002–2006).

Associate Editor of Science & Education, a journal devoted to the history of science and its relation to science teaching (2001–2009).

Marshall Scholarship to study mathematics at Merton College, University of Oxford (1990–92).

Caltech Distinguished Teaching Assistant award for Order of Magnitude Physics (1995).

Whitaker Foundation PhD Fellowship (1993–1994).

Hertz Foundation PhD Fellowship (1995–98).

William Lowell Putnam Mathematical Competition, 44th place nationally (1989).

Member, Stanford University's ACM Programming Contest team placing 6th in the national finals (1989).

Member of the US Physics Olympiad training team (1986).