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Erez Lieberman Aiden

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Current

Fellow, *Harvard Society of Fellows*
Visiting Faculty, *Google Inc.*
Principal Investigator, *Harvard Laboratory-at-Large*

Education

Harvard University & Massachusetts Institute of Technology 2003-2010

- PhD, Applied Math & Health Sciences and Technology
Dissertation: *Evolution and the Emergence of Structure (243 pages)*. Advisors: Eric Lander, Martin Nowak.
- MA, Applied Physics.

Yeshiva University 2002-2003

- MA, History. Dissertation:
Leone Modena, Kol Sachal, and the Covert Legacy of the Hussites. Advisor: Elisheva Carlebach.

Princeton University 1998-2002

- BA, Mathematics, *magna cum laude*
Also completed graduation requirements for Physics and Philosophy (*magna cum laude*)
Math Thesis: *Sphere Packing, Generalization Graphs, and Finite Languages (46 pages)*. Advisor: Martin Nowak.
Philosophy Thesis:
After Truth: Philosophical and Mathematical Explorations on Language, Induction, and Meaning (169 pages)
Advisors: Saul Kripke, Scott Weinstein, and Gideon Rosen.
- Minors: Applied and Computational Mathematics, Environmental Sciences.

Honors and Awards

USA Today All-USA Academic Team, 2001
USA Today All-USA Academic Team, 2002
Best Undergraduate Thesis, Applied Mathematics, Princeton University, 2002
Best Undergraduate Thesis, Philosophy, Princeton University, 2002 (awarded counterfactually)
National Defense Science and Engineering Grant (NDSEG) Graduate Fellow, 2002 (Declined)
National Defense Science and Engineering Grant (NDSEG) Graduate Fellow, 2003
National Science Foundation Graduate Fellow, 2003
Howard Hughes Medical Institute Predoctoral Fellow, 2003 (Declined)
Best New Technology, International Manufacturing Technology Show, 2006
(Trade show with 90,000 attendees, for Molecular Decomposition Process)
Best Books of 2006, PhotoEye. (The Apollo Prophecies)
Nature, Best Papers of 2007 (18 papers selected by *Nature* Editors) [Linguistics]
Grand Champion, \$50K Lunar Ventures Business Plan Competition, 2008 [iShoe]
Fannie and John Hertz Foundation Fellowship, 2008
Top Twenty "Biotech Breakthroughs that will Change Medicine", *Popular Mechanics*, 2009 [iShoe]
TR35: Top 35 Innovators under 35, *Technology Review*, 2009
Nature Methods, *Method to Watch*, 2009 [Hi-C]
Elected Junior Fellow of the Harvard Society of Fellows, 2010
\$30,000 Lemelson-MIT Student Prize, 2010 (to the best student inventor at MIT)
Harold M. Weintraub Graduate Student Prize, 2010
("to recognize outstanding achievement during graduate studies in the biological sciences", 12 worldwide)
American Physical Society, Award for Best Doctoral Thesis in Biological Physics, 2010

Hertz Foundation Dissertation Prize for Best Doctoral Dissertation, 2010
Featured on Front Page of New York Times, Boston Globe, and Wall Street Journal, 2010
Dan David Prize Scholar (Category: Past/Evolution), 2011
NIH New Innovator Award, 2011 (“to support exceptionally creative new investigators”, ~30/yr)
\$25,000 GE & Science Prize, 2011
 (“for the outstanding thesis in the general area of molecular biology as described in a 1000-word essay”)

Papers

1. Erez Lieberman Aiden. Zoom! *Science* **334** (2011).
2. Jean-Baptiste Michel*, Yuan Kui Shen, Aviva P. Aiden, Adrian Veres, Matthew K. Gray, The Google Books Team, Joseph P. Pickett, Dale Hoiberg, Dan Clancy, Peter Norvig, Jon Orwant, Steven Pinker, Martin A. Nowak, and **Erez Lieberman Aiden***. Quantitative analysis of culture using millions of digitized books. *Science* **331** (2011). **Cover Article**.
News Features: Nature, Science.
3. **Erez Lieberman-Aiden***, Nynke L. van Berkum*, et al. Comprehensive mapping of long-range interactions reveals folding principles of the human genome. *Science* 326 (2009). **Cover Article**. GScholar Citations: 313. Research Highlights: Nature, Nature Genetics, Nature Reviews Genetics, Nature Biotechnology, Nature Methods, Cell Research, EMBO Journal, Nucleus, Physics Today.
4. **Erez Lieberman***, Jean-Baptiste Michel*, Joe Jackson, Tina Tang, and Martin Nowak. Quantifying the Evolutionary Dynamics of Language. *Nature* 449 (2007). GScholar Citations: 59. **Cover Article**.
5. Tarjei S Mikkelsen, Manching Ku, David B Jaffe, Biju Issac, **Erez Lieberman**, et al. Genome-wide maps of chromatin state in pluripotent and lineage-committed cells. *Nature* 448 (2007). GScholar Citations: 1180.
6. Hisashi Ohtsuki, Christoph Hauert, **Erez Lieberman**, and Martin Nowak. A Simple Rule for the Evolution of Cooperation on Graphs and Social Networks. *Nature* 441 (2006). GScholar Citations: 475.
7. **Erez Lieberman**, Christoph Hauert, and Martin Nowak. Evolutionary Dynamics on Graphs. *Nature* 433 (2005). GScholar Citations: 325.

*Contributed Equally

Issued Patents and Patent Applications

My co-inventors include Bill Gates, Eric Lander, and Robert Langer.

1. Method of identifying interactions between genomic loci. US2009005249
2. Parallel Proximity Ligation Event Analysis. 12/407,547
3. Determining Postural Stability. 12/323,912
4. Methods and systems for sensing equilibrium. 12/236,433
5. Methods and systems for monitoring and recording carbon footprint data. 12/233,008
6. Pulmonary malarial vaccine. 11/125,010
7. Awarding privileges to a vehicle based upon one or more fuel utilization characteristics. 12/387,483
8. Awarding standings to a vehicle based upon one or more fuel utilization characteristics. 12/798,911
9. Device including altered microorganisms, and methods and systems of use. 12/802,148
10. Wearable Power Source. 12/800,250
11. Wearable Power Source Carryable by a Health Care Provider. 12/800,231
12. Wearable Wireless Power Transmitter. 12/800,243
13. Wearable Power-Output Device Operable to Deliver Wirelessly Received Power. 12/800,249
14. System Including Wearable Power Receiver and Wearable Power-Output Device. 12/800,242
15. Material, System, and Method that Provide Indication of a Breach. 12/927,972
16. Method, Device, or System Using Lung Sensor for Detecting a Physiological Condition In a Vertebrate Subject. 12/930,968
17. Identifying a Characteristic of an Individual Utilizing Facial Recognition and Providing a Display for the Individual. 12/931,157.
18. A Computer Program Product for Reporting a Result of an Evaluation of a Sample After Queueing the Result for Transmission. 13/068,291
19. A Method for Receiving Notification of a Benefit After Queueing the Result for Transmission. 13/068,295

20. A System and Device for Reporting a Result of an Evaluation of a Sample After Queuing the Result for Transmission. 13/068,296
21. A Method for Reporting a Result of an Evaluation of a Sample After Queuing the Result for Transmission. 13/068,297
22. A Computer Program Product for Receiving Notification of a Benefit After Queuing the Result for Transmission. 13/068,298
23. A System and Device for Receiving Notification of a Benefit After Queuing the Result for Transmission. 13/068,298.
24. Systems, Devices, Admixtures, and Methods Including Transponders for Indication of Food Attributes. 13/199,360.
25. Systems, Devices, Methods, and Admixtures of Transponders and Food Products for Indication of Food Attributes. 13/199,358.
26. Systems, Devices, Methods, and Admixtures Including Interrogators and Interrogation of Tags for Indication of Food Attributes. 13/199,372.
27. Registering A Region Of Interest Of A Body Part To A Landmark Subsurface Feature Of The Body Part. 13/200,114.
28. Registering Regions Of Interest Of A Body Part To A Coordinate System. 13/200,110.
29. Coregistering Images Of A Region Of Interest During Several Conditions Using A Landmark Subsurface Feature. 13/200,107.
30. Creating A Subsurface Feature Atlas Of At Least Two Subsurface Features. 13/200,108.
31. Indicating Proximity Of A Body-Insertable Device To A Destination Region Of Interest. 13/200,104.
32. Guidance Information Indicating An Operational Proximity Of A Body-Insertable Device To A Region Of Interest. 13/200,112.
33. Confirming That An Image Includes At Least A Portion Of A Target Region Of Interest. 13/200,111.
34. Listing Instances Of A Body-Insertable Device Being Proximate To Target Regions Of Interest. 13/200,103.
35. Patient Verification Based On A Landmark Subsurface Feature Of The Patient's Body Part. 13/200,105.
36. Reporting Imaged Portions Of A Patient's Body Part. 13/200,109.
37. Devices and methods for recording information on a subject's body. 13/199,038.

Funding

1. *PI*. NIH New Innovator Award. Exploring how the genome folds through proximity ligation and sequencing. (9/2011-9/2016). \$2,500,000.
2. *Co-Investigator*. Center for Cell Circuits. P50, Center for Excellence in Genome Sciences. (5/2011 – 5/2016). Will oversee development of SNAPPLE and COOLAID. *PI*: Aviv Regev. [\$10,000,000 (Direct costs); SubK: ~\$100K/yr (Direct costs)]
3. *PI*. Culturomics. Unrestricted gift from Google. \$250,000.
4. *PI*. Dirt-Power for Cell Phone Charging in Rural Africa. (5/2011 – 5/2012). Bill and Melinda Gates Foundation “Grand Challenges” Grant. \$100,000.
5. *PIs: Erez Lieberman Aiden and Edward Boyden*. Systematic Classification of Neural Cell Types via Single-Cell Transcriptomics. McGovern Institute Neurotechnology Program. (5/2011 – 5/2012). \$100,000.
6. *PI*. High-throughput Behavioral Economics in an Online Laboratory. Milton Fund. (1/2011 – 12/2011). \$40,000.
7. *Co-PI*. Cross-linked Oligo-Oligo Ligation and Interaction Detection. Broad Institute SPARC Grant, \$100,000. *PI*: Eric Lander.

Referee Activity

Applied Math: Applied Mathematical Modeling, Ars Combinatoria, Mathematical and Computer Modeling. *Biology*: Biology Letters, Genome Biology, Journal of Theoretical Biology, Nature Biotechnology, PLOS Computational Biology, Theoretical Population Biology, Trends in Genetics. *Multidisciplinary*: Journal of Historical Linguistics. *Multidisciplinary*: Nature, PLOS ONE, Proceedings of the National Academy of Sciences, Proceedings of the Royal Society A & B, Science. *Physics*: New Journal of Physics.

Other Training

Medical Clerkships: VA Hospital in West Roxbury.

Internships: Biosphere II. Princeton Plasma Physics Laboratory. Weizmann Institute. Institute for Advanced Study. NASA, Johnson Space Center.

Teaching

Lecturer: Mathematics 4999. Numbers, Games and the Infinite. Spring 2003. Yeshiva University.

Designed and taught a course from scratch on the relationships between Transfinite Arithmetic and Game Theory.

Teaching Assistantships:

Physics 1041: General Physics/Mechanics. Fall 2002. Yeshiva University.

Physics 1042: General Physics/Electromagnetism. Fall 2002. Yeshiva University.

Mathematics 243: Evolutionary Dynamics. Spring 2007, Spring 2008. Harvard University.

Computer Science 232: Computational Molecular Biology. Spring 2005. Harvard University.

Research:

ROME: Research Opportunities in Mathematical Evolution, 2004-2010. <http://www.ped.fas.harvard.edu/teaching/rome/>

Founded and directed science research internship program for undergraduates

Matched 30+ students with research advisors.

Advised numerous research projects. Taught research and presentation skills. Wrote recommendations.

Organized Annual ROME Colloquium. Many undergraduates that presented had never given a scientific talk before.

Mentoring:

House Fellow, Pforzheimer House, Harvard.

Member of Senior Common Room.

Provide academic and personal mentorship to students in the House.

Selected Talks

Named Lectures:

1. R. Kent Nagle Lecture, University of South Florida. April 2011. (Upcoming)

General Audience:

1. What we learned from 5 million books. TEDxBoston. June 2011. (/w JB Michel) [~1 million viewers online]
2. Innovation. NSF Engineering Research Centers, 25th Anniversary Meeting. Keynote Address. Bethesda, MD.
3. How to Invent. Lemelson-MIT Student Prize Ceremony, MIT. March 2010.
4. Happy Birthday Sned! An Inventive Agenda for the 21st Century. Eurekafest, MIT. June 2010.

Three Dimensional Genome Sequencing:

1. Physics of Genome Folding. American Physical Society March Meeting. March, 2012 (Upcoming).
2. Physical Analogues of Peano Curves: from genome folding to new symmetries. Mathematical Association of America/American Mathematical Society Joint Mathematics Meeting. AMS Special Session on Fractal Geometry in Pure and Applied Mathematics (in memory of Benoit Mandelbrot). January, 2012 (Upcoming).
3. How the human genome folds. McGovern Institute for Brain Research. MIT. November, 2011.
4. How the human genome folds. Frontiers in Quantitative Biology. Stanford University. November, 2011.
5. How the human genome folds. University of Chicago. November, 2011.
6. How the human genome folds. Physics Colloquium. New York University. October, 2011.
7. How the human genome folds. Physics Departmental Seminar. Case Western Reserve. September, 2011.
8. How the genome folds. American Physical Society March Meeting. March, 2011.
9. How the human genome folds. Princeton University Biophysics Seminar Series. February, 2011.
10. Mapping Genomes in 3D. FAS Center for Systems Biology Seminar. May, 2010.

11. Mapping the three dimensional architecture of genomes. Caltech. Host: David Baltimore. April 2010.
12. Physical Analogues of Spacefilling Curves: the Folding Principles of the Human Genome. Harvard Differential Geometry Seminar. Host: Shing-tung Yau. April 2010.
13. The Fractal Globule and its Physical Properties. CSHL Systems Biology. March 2010.
14. Mapping the three dimensional architecture of genomes. Broad Institute Annual Retreat. November 2009.
15. The Genome as Polymer. Harvard Squishy Physics Seminar. Cambridge, MA. July, 2009.
16. The three dimensional organization of the human genome. CSHL Biology of Genomes. May 2009.

Evolution of Language and Culture

1. The Future Is Here: Pioneers Discuss the Future of Digital Humanities. Presidential Session, American Historical Association 126th Annual Meeting. Chair: Anthony Grafton. January, 2012 (Upcoming).
2. Quantitative Analysis of Culture. Department of Psychology, Harvard University. November 2011. (w/ JB Michel)
3. Quantitative Analysis of Culture. Rational Choice Workshop. Department of Economics, University of Chicago. November 2011.
4. Culturomics. Digital Humanities 2011. Keynote Address. June 2011. (w/ JB Michel)
5. Culturomics. National Endowment for the Humanities "Digging into Data" Summit. Keynote Address. January 2011. (w/ JB Michel)
6. Culturomics. American Historical Association Annual Meeting. Special Session. January 2011. (w/ JB Michel)
7. Culturomics. Linguistic Society of America Annual Meeting. Special Session. January 2011. (w/ JB Michel)
8. Culturomics: I'm feeling lucky. Google Library Summit. Keynote Address. Googleplex. November 2010. (w/ JB Michel)
9. Google Books and the Evolution of Search. Google Library Summit. Keynote Address. Googleplex. October 2009. (w/ JB Michel)
10. The half-life of an irregular verb is the square root of its frequency. BioLinguistic Investigations. Santo Domingo. February 2007.

iShoe

1. Standing Around: Theory and Application. Or, iShoe: The Shoe with IQ. NASA Division of Neuroscience Seminar. Johnson Space Center. Houston, TX. June 2007.

Evolutionary Graph Theory

1. Evolution on Graphs. CGR Weekly Colloquium. Harvard University. May 2005.
2. Distributed Computations on Evolutionary Graphs. Biocomputation Seminar. University of Massachusetts: Amherst. May 2004.
3. Evolutionary Graph Theory. Math/Physics Joint Seminar. Brandeis University. April 2004.

Conferences Organized

1. Organizer & Chair: "Physics of Genome Folding I: Fractal Globules and Condensed Polymer States." Focus Session, American Physical Society March Meeting 2012.
2. Organizer & Chair: "Physics of Genome Folding II: Chromosomes and Nucleosomes." Focus Session, American Physical Society March Meeting 2012.

Languages

Hebrew, Hungarian, Aramaic.

Books

Kahn, Selesnick, Falkner, Lieberman. *City of Salt*. Aperture Press, 9/05.
 Kahn, Selesnick, Lieberman. *The Apollo Prophecies*. Aperture Press, 11/06.

Exhibitions (collaboration with Kahn/Selesnick)

The Apollo Prophecies.

2005: Lisa Sette Gallery; Scottsdale, AZ. Carl Hammer Gallery; Chicago, IL. Irvine Contemporary; Washington, DC.
Paul Kopeikan Gallery; Los Angeles, CA.

2004: Yancey Richardson Gallery; New York, NY. DNA Gallery; Provincetown, MA. Pepper Gallery; Boston, MA.

2002: DNA Gallery; Provincetown, MA.

City of Salt.

2003: Focus Gallery; London, UK. Yancey Richardson Gallery; New York, NY.

2002: Carl Hammer Gallery; New York, NY.