Curriculum Vitae of László Babai

Personal. Born in 1950, Budapest, Hungary.
Citizenship: U. S.

Current position

George and Elizabeth Yovovich professor
Department of Computer Science,
Department of Mathematics,
and the Physical Sciences Collegiate Division,
University of Chicago
E-mail: laci@cs.uchicago.edu

Education, degrees.

D.Sc. in the Mathematical Sciences, 1984, Hungarian Academy of Sciences.
Ph.D. in the Mathematical Sciences, 1975, Hungarian Academy of Sciences.
Diploma in Mathematics, 1973, Eötvös University, Budapest.
Studied mathematics at Eötvös University, Budapest, 1968-73.
One semester at Leningrad State University, U.S.S.R. (1971).

Positions held

University of Chicago, Department of Computer Science: professor since 1987
(visiting professor: 1984-86); joint appointment with the Department of Mathematics since 1995; George and Elizabeth Yovovich professor since July 1, 2010
Eötvös University, Budapest, Department of Algebra: professor, 1987-1994 (teaching positions held at same place from 1971)

Short-term visits at a number of universities and research institutes in the Soviet Union, Canada, the U.S., Germany, the Netherlands, Australia, France, Italy, Switzerland.

Publications

Published more than 180 research papers in combinatorics, algebra, and theoretical computer science; many of them with coauthors. The venues include the Annals of Mathematics, Inventiones Math., J. Amer. Math. Soc., J. Algebra, and conference volumes selected by program committees (including 30 papers in STOC and FOCS). Miscellaneous publications include popular articles on the theory of computing and obituaries, memorial articles, and biographies, including extensive studies of the life and work of Paul Erdős.

Research areas. Major areas: complexity theory, algorithms, combinatorics, asymptotic group theory, and the many interactions among these fields, including problems of "pure mathematics" motivated by questions in the theory of computing.

Specific subareas include:

- Complexity theory:
  - Unconditional lower bounds
    * communication complexity theory (2-party and multi-party)
    * other models of computation: Turing machines, branching programs, circuit complexity, span programs, decision trees, locally testable codes, property testing
  - Randomization in complexity theory
    * random self-reducibility
    * interactive proofs (2-party and multi-party),
    * holographic proofs, Probabilistically Checkable Proofs, hardness of approximation

- Algorithms:
  - the Graph Isomorphism problem, group isomorphism
  - algorithmic group theory (permutation groups, matrix groups, black-box groups)
  - randomization, random walks, derandomization, expansion
  - the nearest vector problem, diophantine approximation
  - image processing
  - diameter of finite groups, random walks on finite groups, finite Markov chains
  - parallel algorithms
  - approximate counting, random generation

- Asymptotic group theory, combinatorial problems in finite groups

- Polynomials, extremal combinatorics, Ramsey theory, spectral graph theory
  - linear algebra methods and probabilistic methods in the study of combinatorial and geometric objects and of models of computation

- Symmetry and regularity
  - Vertex-transitive graphs, pointwise limits of graphs
  - Highly regular structures: strongly regular graphs, coherent configurations, block designs

- topological graph theory

- The Abelian Sandpile model

- miscellaneous work in general topology and transfinite combinatorics

Congress Lectures

Plenary lecture at the *International Congress of Mathematicians*, Zürich, 1994
Plenary lecture at the *First European Congress of Mathematics*, Paris, 1992.
Invited section speaker at the *International Congress of Mathematicians*, Kyoto, 1990.

Named lectureships

Carl J. Rees Distinguished Lecturer, May 2008, U. Delaware

John M. Chemerda Lecturer in Science, Penn State, 1997

Pólya Lecturer, M.A.A. 1996-98

André-Aisenstadt Chair[1], CRM, Université de Montréal, Fall 1996 (two two-week series of lectures)

Other honors and awards.

George and Elizabeth Yovovich professorship, University of Chicago, July 1, 2010

International Conference on Combinatorics, Groups, Algorithms, and Complexity, in honor of my 60th birthday, Ohio State University, March 2010

The Llewellyn John and Harriet Manchester Quantrell Award for Excellence in Undergraduate Teaching, University of Chicago, 2005

Honorary doctorate, Technical University, Budapest, 1999

Gödel Prize, EATCS/ACM SIGACT 1993

T. Szele Prize, J. Bolyai Mathematical Society, 1993 (for mentoring and advising young researchers in mathematical sciences)

Full member of the Hungarian Academy of Sciences (elected 1994; corresponding member: 1990)

Hungarian State Prize, 1988

Mathematical Prize ("Erdős Prize"), Hungarian Academy of Sciences, 1983 (an annual prize founded by Paul Erdős in honor of his parents)

G. Grünwald Prize, J. Bolyai Mathematical Society, 1972 (a prize for work by mathematicians under 30)

K. Rényi Prize, J. Bolyai Mathematical Society 1971 (a prize for research papers by undergraduates)

Other lecture series given include:

Vertex-transitive graphs, diameter of groups, and computation, Centre Bernoulli, Lausanne, Switzerland, May 2007

The Abelian Sandpile Model, Centre Bernoulli, Lausanne, Switzerland, May 2007

Polynomial-time algorithms for black-box groups, "Groups and Geometries" conference, Milan, Italy, May 2000

Combinatorial Models and Algebraic Questions in the Theory of Computing, "Current Developments in Mathematics" conference, Harvard, November 1999

Statistical Methods in Group Algorithms, Workshop on Groups and Probability, Hebrew University, Jerusalem, March 1998

Statistical methods in group algorithms, Groups - St. Andrews 1997 at Bath, Bath, U.K., July 1997

Communication Complexity, Dipartimento di Scienze dell'Informazione, Universitá di Roma "La Sapienza," Rome, July 1996

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[1]The holders of the André Aisenstadt Chair include 7 out of the 13 Fields medalists since 1994.

Transparent proofs and inapproximability, École Normale Supérieure, Paris, March-April 1994.

Complexity of computation in finite groups, Workshop on Group Actions, Australian National University, Canberra, June-July 1993

Other recent invited lectures at conferences, workshops, thematic semesters include:

Algebra, Combinatorics, and More, in celebration of Peter Cameron, London (opening lecture), July 7-10, 2013

Erdős Centennial Conference, Budapest, June 30-July 5, 2013

Extremal Combinatorics, UIUC, March 16-18, 2013

Computational Group Theory, Oberwolfach, July 31 - Aug 6, 2011

6th International Computer Science Symposium in Russia, Saint Petersburg, June 16, 2011

4th Israel Theory Day, Ra'anana, March 24, 2011

Algebraic Graph Theory Conference, Dubrovnik, June 5, 2009

Special Session on "Extremal and Probabilistic Combinatorics," AMS Regional Meeting, UIUC, March 28, 2009

Midwest Graph Theory Day (MIGHTY), IIT (Chicago), November 8, 2008

Visualization Day, NYU and CCNY, April 30, 2008

Groups and Computation workshop, Ohio State U., March 18, 2008

Special Session on Expanders, AMS Joint Meetings, San Diego, Jan 8, 2008

Arithmetic Combinatorics special program, Institute for Advanced Study, Princeton, Nov 13, 2007

Lie Groups, Representations, and Discrete Mathematics workshop, Institute for Advanced Study, Princeton, Feb 5-10, 2006

New England Discrete Mathematics Day, Worchester Polytechnic Institute, May 3, 2003 (1-hour invited address)

Plenary lecture at the *AMS Regional Meeting*, University of Michigan, Ann Arbor, March 1-3, 2002

Recent colloquium and seminar lectures include:

Hebrew University, Jerusalem, March 27, 2011

Distinguished Lecture, Ben Gurion University, Israel, March 25, 2011

CS Theory Colloquium, MIT, October 6, 2009

Dartmouth College, Dept. Math. Colloquium, April 10, 2008

Univ. Illinois at Urbana-Champaign, Dept. Math. Colloq. Oct 11, 2007

Université Paris-Sud (Orsay), Lab. Rech. Informatique Colloq., March 2007

University of Illinois at Chicago, Dept. Math. Colloq., Dec 2006

Emory University, Dept Math and CS, "Distinguished Lecture" May 2006

Penn State, Dept. Computer Science Colloquium, 2004

Award Committee, Program Committee, and NSF Panel membership (past decade)

NSF Math/CS Panel, April 2009
Gödel Prize award committee chair (ACM SIGACT - EATCS), 2005
Pólya Lectureship award committee chair (MAA), 2005
Program Committee Chair, ACM STOC (Symp. on Theory of Computing), 2004.
Gödel Prize award committee member (ACM SIGACT - EATCS), 2003, 2004
Pólya Lectureship award committee member (MAA), 2002–2004

Grants

Principal Investigator, National Science Foundation Grant CCF-1017781 (Univ. of Chicago, 9/1/2010-8/31/2013, extended through 8/31/2014) **(current)**

Principal Investigator, National Science Foundation Grant CCF-0830370 (Univ. of Chicago, 8/1/2008-7/31/2010, extended through 7/31/2011)

Principal Investigator, National Science Foundation Grant CCR-9732205 (Univ. of Chicago, 8/98-7/01, extended through 7/02)

Principal Investigator, National Security Agency Grant MDA904-1-0033 (Univ. of Chicago, 1/97–1/99)

European Science Foundation Conference Grant: "Group Theory: Finite to Infinite" conference, July 1996, Castelvecchio Pascoli, Italy (European Science Foundation, European Mathematical Society)

Principal Investigator, National Science Foundation Grant CCR-9014562 (Univ. of Chicago, 1991-1994).

Principal Investigator, together with Janos Simon, National Science Foundation Grant CCR-8710078 (Univ. of Chicago, 1987-90).

Professional experience

Lead organizer of the University of Chicago/TTIC alliance's bid to host the Simons Institute for the Theory of Computing ($6m/year) (2010-12); designated first director of the institute if Chicago wins the contest. In October 2011, Chicago became one of the three finalists, along with Berkeley and an MIT/Harvard consortium. In April 2012, the Institute was awarded to Berkeley.

Director of the Chicago Center for the Theory of Computing and Allied Areas (currently under development)

Teaching, research, advising and mentoring graduate students in computer science and in mathematics as well as undergraduates at the University of Chicago, since 1984.

Chair of the Computer Science Department Graduate Committee, 1996–2005.

Teaching, research, advising and mentoring undergraduate and graduate students at Eötvös University, Budapest, Department of Algebra, 1973–1994.

Part-time teaching and curriculum development for Informatics (Computer Science) majors at the School of Electrical Engineering, Technical University, Budapest (1987–89).

Part-time consulting at the Institute of Computers and Automation of the Hungarian Academy of Sciences, 1980-83.

Extensive experience in **creating new institutions** and building volunteer networks, including the Budapest Semesters in Mathematics program; see details under the header "Journals and programs founded" below.

Mentoring on all levels, from high school to postodctoral

Mentored a number of high school students and a large number of college students, a large number of PhD students whom I did not formally advise, and several colleagues at a postdoctoral stage of their careers. The list below does not include my Ph.D. students except those whom I also mentored either before or after their graduate studies. The list is highly incomplete; those included have achieved exceptional success by some clear measure. Among the nine former mentees listed, five were invited speakers at the International Congress of Mathematicians (ICM), one of the most coveted honor for mathematicians; and one became a twofold recipient of the Gödel Prize. All of them are professors at major universities.

- High-school mentees include

  - **Marianna Csörnyei** (professor, University of Chicago, Dept Math. **ICM–2010 speaker** in the Analysis section) (Marianna was the star problem solver in the high school math club I conducted in Budapest in 1991-1993; she credits one of the exercises I assigned there for a central idea in one of her major papers in geometric measure theory)
  - **György Turán** (professor, University of Illinois at Chicago, Dept. Math.) (3 joint papers),

- Undergraduate mentees include

  - **Éva Tardos** (professor, Cornell, Dept. CS, member of the National Academy of Science, **ICM–1990 speaker** in the Combinatorics section) (Éva's breakthrough 1987 paper in complexity theory – exponential separation between monotone and non-monotone Boolean circuits – has its roots in her undergraduate work in my seminar)
  - **János Kollár** (professor, Princeton Dept. Math., **ICM–1990 speaker** in the Algebraic Geometry section) (2 joint papers, one while János was an undergaduate; two more papers written by János while he was an undergraduate freshman were inspired by the area to which I had introduced him),
  - **Péter P. Pálfy** (4 joint papers) and **Lajos Rónyai** (4 joint papers) (after having mentored them as undergraduates, both of them became my PhD students; now both of them are members of the Hungarian Academy of Science).

- Doctoral mentees include

  - **Anna Gál** (3 joint papers) (professor, U. Texas at Austin, Dept. CS)

- Postdoctoral mentees include

  - **Ákos Seress** (1958-2013), professor, Ohio State University, Dept. Math., **ICM–2006 speaker** in the Algebra section, in the area, computational group theory, to which I had introduced him after his PhD. Ákos became my #1 collaborator (15

joint papers over a period of 25 years). A year before his untimely death he made a major breakthrough with Harald Helfgott on the diameter of permutation groups, heavily building on our decades of joint work on this subject and in algorithmic group theory as well as on my work in asymptotic group theory (appearing in the *Annals of Math.*)

– **Mario Szegedy** (professor, Rutgers University, Dept. CS. Prior to being my postdoctoral mentee, Mario was also my PhD student (jointly advised with Janos Simon). Subsequently he became a two-times winner of the Gödel Prize in theoretical computer science; the first of these for work in a subject, holographic proofs, to which I had introduced him during his postdoctoral period) (4 joint papers).

Research Experience for Undergraduates

Each summer since 2002, taught extensively in the summer REU program of the Department of Mathematics, University of Chicago. These included in most of those years, 2 blocks of 4 weeks each under the general title "Discrete Mathematics" (each block on a different subject, and with a new curriculum every year); and additionally, a 4-week (in recent years, 5-week) "apprentice program" for the rising sophomores each year since 2004. In addition to teaching, individually supervised several undergraduates' research. All course material posted on my website.

Ph. D. dissertations supervised

Currently advising 6 PhD students and mentoring several more.

Completed Ph. D. dissertations supervised:

Ozgur Sumer: "Adaptive Methods for Exact and Approximate Inference," 2012 (coadvised with Umut A. Acar and Ramgopal R. Mettu)

Paolo Codenotti: "Testing Isomorphism of Combinatorial and Algebraic Structures," 2011

Sourav Chakraborty: "Models of Query Complexity for Boolean Functions," 2008

Murali K. Ganapathy: "Robust Mixing," 2006

Aytek Erdil: "Two-sided matching with ties," 2006 (coadvised with Roger Myerson)

Daniel Štefankovič: "Algorithms for Simple Curves on Surfaces, String Graphs and Crossing Numbers," 2005

Evelin Toumpakari: "On the Abelian Sandpile Model," 2005 (coadvised with Steven Lalley)

Thomas Hayes: "Rapidly mixing Markov chains," 2003 (coadvised with Eric Vigoda)

Samuel Kutin: "Algorithmic stability and ensemble-based learning," 2002 (coadvised with Partha Niyogi)

Peter Kimmel: "Communication Complexity Theory," 1997

Barry Guiduli: "Spectral Extrema For Graphs," 1996

Satya V. Lokam: "Algebraic and Combinatorial Methods in Computational Complexity Theory," 1996

Katalin Friedl: "Decomposition of Matrix Groups and Algebras," 1994

Robert M. Beals: "Algorithms for Finite Groups," 1993

José Augusto Ramos Soares: "Graph Spanners," 1992

Albert J. Goodman: "Automorphism Groups of Graphs: Asymptotic Problems," 1992

Carsten Lund: "The Power of Interaction," 1991 (coadvised with Lance Fortnow)

Mario Szegedy: "Algebraic Methods in Lower Bounds for Computational Models with Limited Communication," 1989 (coadvised with Janos Simon)

Péter Hajnal: "Complexity of Graph Problems," 1988 (coadvised with Janos Simon)

Gábor Tardos: "Constructions in Universal Algebra," 1988

Lajos Rónyai: "Algebraic Algorithms," 1987

Tamás Lengyel: "Some Combinatorial and Probability Theoretical Problems of Cluster Analysis," 1986

Péter P. Pálfy: "Group Theory Methods in Combinatorics and Universal Algebra," 1983 (coadvised with Ervin Fried)

Doctoral mentees who recently completed their PhD:

Eric Purdy (2013, Chicago, advisor: Pedro Felzenszwalb) – advised him through his Masters thesis and continued to act as a mentor afterwards

Joshua Grochow (2012, Chicago, advisors: Lance Fortnow and Ketan Mulmuley) – advised him for much of his graduate study. We have a joint paper that motivated part of his dissertation)

Youming Qiao (2012, Tsinghua University, advisor: Andrew C-C. Yao) – our 3 joint papers with Youming constituted the bulk of his dissertation

Raghav Kulkarni (2010, Chicago, advisor: Janos Simon) – mentored him throughout his graduate studies, we have a joint paper

Journals and programs founded

Founder and Editor-in-Chief of the open access online journal **Theory of Computing** (http://theoryofcomputing.org) since 2004. The journal is entirely free (no author fees) and is operated by a group of volunteers.

Co-founder and member of the Board of **Budapest Semesters in Mathematics**, a highly acclaimed study-abroad program for North American undergraduates (since 1984). I originally designed the program (1983-84) and introduced it to the US and Canadian college scene (1984-86), with zero funding, primarily through a volunteer network. The program started in 1985. To-date, more than 1400 US/Canadian students have attended the program. For students from liberal arts colleges, Budapest is now cosidered a critical stop on the way to a math Ph. D. BSM alumni include three tenured members of the Cornell mathematics faculty.

Co-founder and one of the Editors-in-Chief of the journal **Combinatorica** (since 1980; publisher: Bolyai Society and Springer).

Initiated and organized the **CECE journal donation program** to 49 mathematics and computer science libraries across 15 countries of Eastern and Central Europe (1991-1998) in response to the economic shock that swept the region in the wake of the collapse of Communism. The program ran under the

aegis of the **ACM Committee on Central and Eastern Europe (CECE)** which I organized and chaired. Through the generosity of ACM and SIAM and multiplying the effects of a seed grant of \$16,000 by the Soros Foundation, over a period of seven years the CECE program delivered \$665,000 worth of journals on list price value. All donated journals were targeted to specific local need through a volunteer network that represented the constituencies of each affected library.

Co-founder and Series editor (1996-2000) of the "Bolyai Society Mathematical Studies" (1996-present; distributed by the A.M.S. and subsequently by Springer)

Additional editorial service

Member of the Editorial Board of "Journal of Combinatorics" (International Press) (since inception; journal started in 2010)

Member of the Editorial Board of "The Electronic Journal of Combinatorics" (since inception; journal started in 1994)

Member of the Editorial Board of the electronic journal "Chicago Journal of Thoretical Computer Science" (since inception; journal started in 1995)

Member of the Editorial Board of the journal "Combinatorics, Probability and Computing" (from inception to 2010; journal started in 1992, Cambridge University Press).

Member of the Editorial Board of the "Journal of Algebraic Combinatorics" (from inception to 2009; journal started in 1992; publisher: Kluwer)

Member of the Editorial Board of the "Journal of Combinatorial Theory, Ser. A" (since 1991, Academic Press/Elsevier)

Member of the Editorial Board of "Acta Mathematica Hungarica" (Budapest, since 1990)

STOC 2004 Special issue editor for the SIAM Journal of Computing

Member of the Publication Board of J. Bolyai Mathematical Society, Hungary, since 1996

Member of the Editorial Board of the journal "Information and Computation" (1987–1995).

Member of the Editorial Board of the "International Journal of Foundations of Computer Science" (1989-1995)

Member of the Editorial Board of the journal "Computational Complexity" (from inception to 2003; journal started in 1991; publisher: Springer/Birkhäuser)

Member of the Editorial Board of "SIAM Journal on Computing" (1992-94)

Language skills.
Native tongue: Hungarian. Fluent in English. Conversant in German and Russian.

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