

## CURRICULUM VITAE of Shmuel Friedland

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*Citizenship*     USA

### *Education*

B.Sc., Israel Institute of Technology, 1967  
M.Sc., Israel Institute of Technology, 1969  
D.Sc., Israel Institute of Technology, 1971

### *Employment*

1985-present	Professor	Univ. of Illinois at Chicago
1982-85	Professor	Hebrew Univ.
1978-82	Associate Professor	Hebrew Univ.
1975-78	Senior Lecturer	Hebrew Univ.
1974-75	Visiting Member	IAS - Princeton
1973-74	Vis. Assistant Professor	Stanford Univ.
1972-73	Senior Scientist	Weizmann Inst.
1971-72	Lecturer	Technion

### *Visiting Positions*

10/07-3/08	Vis. Professor	Berlin Mathematical School
9/03-6/04	Vis. Professor	IMA-Minneapolis
9/00-12/00	Vis. Professor	Technion-Israel
1/94-6/94	Vis. Professor	IHES-France
9/91-12/91	Vis. Professor	IMA-Minneapolis
9/89-3/90	Vis. Professor	Northwestern Univ.
9/83-8/85	Vis. Professor	Cornell Univ.
9/78-8/80	Vis. Professor	Univ. of Wisconsin

### *Awards*

Visiting Professor in Berlin Mathematical School (BMS),  
October 1, 2007 - March 30, 2008.  
New Directions Professor, IMA (Univ. Minnesota), AY 2003-4.  
Lady Davis Fellow, Technion, Israel, Fall 2000.  
Winner of the first H. Schneider Prize of ILAS (International Linear Algebra Society)  
jointly with M. Fiedler and I. Gohberg (1993).

*Memberships in Prize Committees:*

H. Schneider prize committee, 1995-98.  
Householder prize committee, 1984-87.

*Organizer of Meetings, Conferences and Workshops:*

Organizer of Minisymposium: Combinatorial and Computational Aspects of the Monomer-Dimer Problem, Seventh IMACS International Symposium on Iterative Methods in Scientific Computing May 5-8, 2005, The Fields Institute for Research in the Mathematical Sciences and the University of Toronto.

Organizer of two sessions on "Capacity of multi-dimensional codes", Mini-Symposium on communications, MTNS02, Notre Dame, IN, USA, August 12-16, 2002.

Special Session on Complex Dynamics, AMS Meeting 935, Chicago, Illinois, September 12-13, 1998.

H. Schneider Conference of ILAS, June 3-6, 1998, Madison, Wisconsin, USA.

IMA workshop on Combinatorial & Graph - Theoretic Problems in Linear Algebra, IMA, University of Minnesota, Minneapolis, Minnesota, November 11 - 15, 1991.

*Distinguished Long Term Visits since 1987:*

Visiting Professor in Berlin Mathematical School (BMS), October 1, 2007 - March 30, 2008.

New Directions Professor, (supported by NSF), IMA, Probability and Statistics in Complex Systems, University of Minnesota, Minneapolis, Minnesota, AY 2003-4.

Lady Davis Fellow, Technion, Haifa, Israel October-December 2000.

Algebra Center of Lisbon University, Portugal, June 1997.

SFB 343 - Bielefeld University, Germany, July - August 1994.

IAS in Technion, Israel, May 15-June 15, 1993.

Visiting Professor, (supported by NSF), IMA, Semester of Combinatorial and Applied Linear Algebra, University of Minnesota, Minneapolis, Minnesota, Fall 1991.

*Invited Visits, Conferences and Workshops since 1990:*

Workshop on "Polya-Schur-Lax problems: hyperbolicity and stability preservers", American Institute of Mathematics in Palo Alto, California, May 28-June 1, 2007.

Workshop on "Spectra of families of matrices described by graphs, digraphs, and sign patterns", American Institute of Mathematics in Palo Alto, California, October 23-27, 2006.

"Matchings and Independent Sets: Problems, Conjectures and Results", 2nd Hamilton Workshop on Nonnegative Matrices and Related Topics, Hamilton Institute, NUI, Maynooth, Ireland July 9 - 12, 2006.

"3-Tensors: ranks and approximations", Workshop on Algorithms for Modern Massive Data Sets, sponsored by Computer Forum of the Stanford Computer Science Department, NSF and Yahoo! Research. June 21-24, 2006.

"Entropy of holomorphic and rational maps", Complex Analysis & Dynamical Systems III, in honor of D. Aharonov, L. Aizenberg, S Krushkal and U. Srebro, Nahariya, Israel, January 2-6, 2006.

Seventh IMACS International Symposium on Iterative Methods in Scientific Computing May 5-8, 2005, The Fields Institute for Research in the Mathematical Sciences and the University of Toronto. Me and my Ph.D. Student Elliot Krop giving each 25 minutes presentations on "Combinatorial and Computational Aspects of the Monomer-Dimer Problem".

"Singular value decomposition: mathematical and numerical challenges", Haifa Matrix Conference, January 3 - 7, 2005, Haifa, Israel

"Convergence of products of matrices", Plenary speaker 11th Conference of the International Linear Algebra Society, 19-22 July, 2004, Coimbra, Portugal.

"Combinatorial and Computational Aspects of the Monomer-Dimer Problems", SIAM Workshop on Combinatorial Scientific Computing, San Francisco, CA, February 28, 2004.

"Applications of Geometry and Topology to Matrices", MSRI workshop, February 27, 2004.

"Computation of entropy in statistical mechanics and information theory", Maryland-Penn State Dynamics Workshop, Univ. of Maryland, College Park, March 23, 2003.

"Multi-dimesional capacity, pressure and Hausdorff dimension", 2 hours talk in MTNS02, Notre Dame, IN, USA, August 12, 2002.

Mittag-Leffler Instiitute, Stockholm, Sweden, May 15 - June 4, 2002.

"Numerical computation of entropy", Dynamics of Numerics Workshop at Fields Instiitute, August 2001, declined.

"Generalized interval exchanges and 2-3 conjecture", AMS-SMF Joint International Meeting, Lyon, France, July 17-20, 2001.

"Generalizations of the odd degree polynomial theorem and applications", 9th ILAS Conference, 25-29 June, 2001.

"Entropy, pressure and Hausdorff dimension of  $Z^d$  subshifts", 20th Annual Western States Math. Physics meeting, Caltech, Feb. 19-20, 2001.

Oberwolfach Meeting in Nonnegative matrices, November 26 - December 2, 2000, declined. IHES, Bur-sur-Ivette, France, September 1-17, 2000.

University of Bielefeld: Conference for the final year of SFB 343 and visit: June 20-July 20, 2000.

" $Z^d$ -subshifts of finite type", Newton Institute and University of Warrick joint workshop on  $Z^d$  action, Coventry, England, April 3-7, 2000.

"Computing Hausdorff dimension of subshifts using matrices", Workshop on "Diagonal matrix scaling and its generalizations and their applications in convex programming over cones", DIMACS, Rutgers University, New Jersey, August 25, 1999.

"Discrete groups of biholomorphisms of Siegel upper half plane", AMS summer school on Ergodic Theory and Dynamical Systems, July 26 - August 6, 1999.

"Finite and infinite dimensional generalizations of Klyachko's theorem", Workshop on "Geometrical and Combinatorial Methods in Hermitian Spectral Sum Problem", Coimbra, Portugal, July 15-16, 1999.

"Differential equations, monodromy and the Jacobian conjecture", Conference on Polynomial Automorphisms and Related Topics, Krakow, Poland, July 6-11, 1999.

"Computing Hausdorff dimension of subshifts using matrices", 11-th Haifa Matrix Theory Conference, Haifa, Israel, June 20-25, 1999.

"Discrete groups of Siegel upper half plane", Multidimensional Complex Analysis Workshop, Bloomington, Indiana, February 6-7, 1999.

"The limit of the spectral radius of nonnegative Toeplitz matrices", Workshop in Applied Linear Algebra in honor of L. Elsner, Bielefeld Univ., Germany, January 21-23, 1999.

"Discrete groups of Siegel upper half plane", Special Session on Complex Dynamics, AMS Meeting 935, Chicago, Ill. September 12-13, 1998.

"Subspaces of symmetric matrices containing matrices of given rank", 7th Conference of ILAS, Madison, WI, June 3-6, 1998.

"Hausdorff measure for hyperbolic Henon maps and generalizations", Laminations and Foliations in Dynamics, Geometry and Topology, SUNY at Stony Brook, May 18-24, 1998.

"Differential equations, monodromy and the Jacobian conjecture", Japan-U.S. Workshop and Conference on "Meromorphic Mappings & Intrinsic Metrics in Complex Geometry", John Hopkins Univ., March 23-29, 1998.

Technion, Haifa, Israel, December 16 - 30, 1996.

7th Penn State Workshop in Dynamics and Related Topics, Oct. 3-6, 1996.

Second Annual Midwest Conference on Complex Dynamics in Higher Dimension, Univ. of Michigan, Ann Arbor, Apr. 19-21, 1996.

University of Maryland, Symbolic Dynamics Workshop, March 28-April 2, 1996.

Bielefeld University, December 11-22, 1995.

Goettingen University, December 5-8, 1995.

5th ILAS Conference, Reception of first H. Schneider prize, Atlanta, Georgia, August 16-19, 1995.

Banach Center Symposium "Ergodic Theory and Dynamical Systems", June 26- July 1, 1995.

SFB 343- University of Bielefeld, Germany, December 12 - 23, 1994.

4th ILAS Meeting in Rotterdam, Netherlands, August 15-19, 1994.

Workshop on Complex Dynamics in Higher Dimensions, University of Goettingen, Germany, July 29-August 2, 1994.

University of Marseille, May 30-June 3, 1994.

Workshop on Ergodic Theory & Number Theory, Warwick Symposium. University of Warwick, England, April 11-15, 1994.

The Banach Center Semester "Linear Operators," A week in February 7-May 15, 1994. Declined.

Workshop on Complex Dynamics, Indiana Univ., Bloomington, November 6-7, 1993.

J.P. Kahane's conference, Orsay, France, June 28-July 3, 1993.

Plenary Speaker, 2nd ILAS meeting, Lisbon, Portugal, August 3-7, 1992.

Workshop on "Computational Linear Algebra in Algebraic and Related Problems", Essen, Germany, July 27 - August 1, 1992.

Special semester for 100 anniversary of Banach's birth, Banach International Mathematical Center, Warsaw, Poland, May 18-24, 1992.

Technion, Tel-Aviv University and Hebrew University, June 1991.

International Conference on Dynamical Systems and Related Topics, Nagoya, Japan, Sep. 3-7, 1990.

Tel-Aviv Univ., March 1990.

*Invited seminars/colloquia since 1996*

"Counting matchings in graphs, with applications to the monomer-dimer models", BMS Friday Colloquium, February 8, 2008.

<http://www.math-berlin.de/dmdocuments/BMS-Friday26.pdf>

"Pressure and phase transition in Potts models in Statistical Mechanics", Seminario di Matematica Applicata, University of Pavia, Italy, October 9, 2007.

"Entropy of holomorphic and rational maps", Seminar in Algebraic Geometry, October 4, University of Pavia, Italy, 2007.

"The Role of Singular Value Decomposition in Data Analysis", University of South Australia, August 10, 2007.

"Analysis of Big Multidimensional Data", Google Tech Talks, June 1, 2007.

<http://video.google.com/videoplay?docid=-2720202179947384722>

"Pressure and phase transition in Potts models in Statistical Mechanics", Seminar in Ergodic Theory, Hebrew University, Dec. 26, 2006.

"Matchings and Independent Sets: Problems, Conjectures and Results", Colloquium, Technion, Dec. 25, 2006.

"Matchings and positive hyperbolic polynomials", Combinatorics Seminar, Tel Aviv University, School of Mathematical Sciences, Dec. 24, 2006.

"The Role of Singular Value Decomposition in Data Analysis", The Hebrew University CS Theory Seminar, Dec. 21, 2006.

"The Role of Singular Value Decomposition in Data Analysis", Mathematical Analysis and Applications Seminar, Faculty of Mathematics and Computer Science, The Weizmann Institute of Science, Dec 19, 2006.

"The Role of Singular Value Decomposition in Data Analysis", Applied Mathematics Seminar, UIC, April 5, 2006.

"Matchings and Positive Hyperbolic Polynomials", Combinatorics Seminar, UIC, March 8 and March 15, 2006.

"The Role of Singular Value Decomposition in Data Analysis", Seminar, Toyota Technological Institute at Chicago, January 12, 2006.

"The Role of Singular Value Decomposition in Data Analysis", Seminar, Computer Science Department, Technion, Israel, January 4, 2006

"The Role of Singular Value Decomposition in Data Analysis", Seminar, Computer Science Department, Tel Aviv University, December 29, 2005.

"Matchings and Positive Hyperbolic Polynomials", Seminar, Computer Science Department, Hebrew University, Jerusalem, December 28, 2005.

"The Role of Singular Value Decomposition in Data Analysis", Seminar, Computer Science Department, University of California, Berkeley, December 15, 2005.

"The Role of Singular Value Decomposition in Data Analysis", Seminar, Computer Science Department, Stanford University, December 14, 2005.

Elliot Krop, my Ph.D. student, gives a contributed talk on our joint work in Brualdi-fest: Linear Algebra, Graph Theory & Combinatorics Conference, University of Wisconsin-Madison, April 30-May 1, 2005

My Ph.D. student Amir Niknejad gave a contributed talk in Haifa Matrix Conference, January 3 - 7, 2005, Israel on our joint paper, which was accepted to the Proceedings of this conference

"Probabilistic and Deterministic Methods to Compute the Monomer-Dimer Entropies", Probability Seminar, Berkeley Univ., February 25, 2004.

"Probabilistic and Deterministic Methods to Compute the Monomer-Dimer Entropies", Probability Seminar, Stanford Univ., February 23, 2004.

"On the monomer-dimer problem", Colloquium, Hebrew Univ., December 18, 2003.

"On the monomer-dimer problem", Colloquium, Technion, December 15, 2003.

"On the monomer-dimer problem", Colloquium, Tel Aviv Univ., December 11, 2003.

"A Simultaneous Reconstruction of Missing Data in DNA Microarrays", Approximation Seminar, Tel Aviv Univ., December 11, 2003.

"Computation of entropy in statistical mechanics and information theory", Colloquium, Wichita State Univ., Kansas, May 9, 2003.

"The entropy of the monomer-dimer systems", Probability Seminar, Univ. of Minnesota, April 4, 2003.

"Computation of entropy in statistical mechanics and information", Math. and Appl. Seminar, Univ. of Illinois at Chicago, April 2, 2003.

"Entropy of holomorphic and rational maps in several complex variables", Geometric Analysis Seminar, Purdue Univ., Indiana, Feb. 24, 2003.

"Computation of entropy in statistical mechanics and information", Colloquium, Univ. of Wisconsin, Madison, Jan. 31, 2003.

"Revisiting Siegel upper half plane", Dynamics Seminar, Hebrew Univ., June 11, 2002.

"The Golden-Thompson inequalities for compact self adjoint operators", Functional Analysis Seminar, Technion, June 13, 2002.

"Multi-dimensional entropy in statistical mechanics and information theory", Colloquium, Technion, June 10, 2002.

"Applications of algebraic geometry and topology to some problems in matrices", Geometric Analysis Seminar, Purdue Univ., March 18, 2002.

"Multi-dimensional entropy in statistical mechanics and information theory", Math. Physics Seminar, Georgia Tech., March 11, 2002.

"Revisiting the Siegel upper half plane", Function Theory Seminar, Purdue Univ., Jan. 29, 2002.

"Concentration of permanent estimators for certain large matrices", Analysis and Probability Seminar, Northwestern Univ., Nov. 19, 2001.

"On the graph isomorphism problem", Computer Science Dept. Seminar, Hebrew University, June 27, 2001.

"On the sum and product of singular values of compact operators", Analysis Seminar, UCLA, Feb. 23, 2001.

Series of lectures on "Methods of algebraic geometry in matrix theory", Technion, Israel, Fall 2000.

"Topological pressure and Hausdorff dimension for  $Z^d$  subshifts", Ergodic Theory Seminar, Hebrew University, December 5, 2000.

"Entropy of  $Z^d$  subshifts", Combinatorics Seminar in Hebrew University, December 4, 2000.

"The measure of maximal entropy and the Hausdorff measure in complex dynamics", colloquium, University of Michigan, Ann Arbor, March 9, 1999.

"Discrete groups of Siegel upper half plane", seminar, University of Chicago, March 4, 1999.

"The measure of maximal entropy and the Hausdorff measure in complex dynamics", colloquium, Stanford Univ., Jan. 14, 1999.

"The measure of maximal entropy and the Hausdorff measure in complex dynamics", special colloquium, UCLA, Jan. 11, 1999.

"Metrics on subshifts, discrete Lyapunov exponents and Hausdorff dimension", seminar, Statistics Depart., Stanford University, Jan. 4, 1999.

"Metrics on subshifts, discrete Lyapunov exponents and Hausdorff dimension", colloquium, SFB-Bielefeld University, Dec. 21, 1998 (During an invited visit.)

"Dynamics of rational and polynomial maps in  $C^k$ ", Technion, Haifa, May 11, 1998.

Technion, Haifa, "Hausdorff dimension of limit sets of free groups", Dec. 30, 1996.

Technion, Haifa, "On complex dynamics of proper polynomial maps in  $C^2$ ", Dec. 23, 1996.

Hebrew Univ., Jerusalem, "Hausdorff dimension of limit sets of free groups", Dec. 17, 1996.

Brigham Young Univ., Provo, "Limit sets of free groups, Hausdorff dimension and subshifts of finite type", Dec. 9, 1996.

Univ. of California, Berkeley, "Hausdorff dimension, strong hyperbolicity and complex dynamics", Dec. 2, 1996.

Northwestern Univ., "Trees, free groups, limit sets and subshifts of finite type", Apr. 9, 1996.

Spring topology & Southeast dynamical systems conf., Ball State Univ., Muncie, In., "Limit sets of free groups, Hausdorff dimension and subshifts of finite type", March 7, 1996.

Carnegie Mellon Univ., "On a differential equation related to jacobian conjecture", Feb. 20, 1996.

Penn State Univ., "Trees, free groups, limit sets and subshifts of finite type", Feb. 19, 1996.

Univ. of Illinois at Chicago, "Limit sets of free groups, Hausdorff dimension and subshifts of finite type", Jan. 22, 1996.

### *Teaching*

#### **Undergraduate**

Taught a variety of standard courses as: Algebra, Analysis, Calculus, Combinatorics, Complex Analysis, Computer Algorithms, Fortran Programming, Graph Theory, Linear Algebra, Numerical Analysis, ODE, Probability.

Topics course "An introduction to fractals".

#### **Graduate**

Designed and gave graduate courses on: Algorithmic Theory of Numbers, Differentiable Manifolds and Riemannian Geometry, Dynamical Systems, Ergodic Theory, Ergodic Theory on Groups, Functional Analysis, Probability on Graphs, Special Topics in Matrices, Spectral Theory of Operators.

### *Graduate Students*

The following graduate students are under my supervision:

1. Elliot Krop. Dissertation subject: "Matching problems in graphs". Estimated graduation: Fall 2006.

The following Ph.D. students finished under my supervision:

1. G. Porta, graduated summer 1999. Dissertation title: "The limit of the product of the parametrized exponential of two operators".

2. P. Freitas, graduated summer 1999. Dissertation title: "On the action of the symplectic group on the Siegel upper half plane".

3. Amir Niknejad, graduated summer 2005. Dissertation title: "Applications of singular value decompositions in DNA microarrays".

3. S. Hersonsky was under my unofficial Ph.D. supervision. We published a joint paper [97]. He completed his Ph.D. under P. Shalen in Summer 1994.

### *Editorships*

Advisory board of the Electronic Journal of Linear Algebra Society.

Associate Editor, Linear Algebra and Its Applications.  
Associate Editor, Random and Computational Dynamics, 1992-1997.  
Special Editor of the issue of Linear Alg. Appl. for 8th Haifa Matrix Conference, 1995.  
Special Editor of the issues of Linear Algebra Appl. for the C. Davis , vol 208/209, 1994.  
Editor, IMA volume "Combinatorial and graph theoretic problems in linear algebra",  
Springer-Verlag, 1993.

*Administrative and Committee Services*

I served on various committees in the Math. Depart. in UIC as: Admission Committee, Advisory Committee, Computer Science Committee, Graduate Study Committee, Promotion and Tenure Committee.

I was Colloquium Chairman in the Hebrew University and UIC (several times).