

Ernest Davis

Contact: Courant Institute of Mathematical Sciences
251 Mercer St.
New York, NY 10012
Phone: (212) 998-3123
Fax: (212) 995-4121
DAVISE@CS.NYU.EDU
<http://cs.nyu.edu/faculty/davise/index.html>

Education: Yale University Ph.D. (Computer Science) 1984
MIT B.Sc. (Mathematics) 1977

Employment: Computer Science Dept., New York University
Professor 2008–
Associate Professor 1989–2008
Assistant Professor 1983–1989

Computer Science Dept., Yale University
Research Assistant 1980–83
Teaching Assistant 1980–82

Computer Graphics Dept., CE Lummus Inc., Bloomfield, NJ
Program Analyst 1977–79

Math Dept. M.I.T.
Calculus Tutor 1975–77.

Honors: Keynote Speaker, COSIT-11 2011
Outstanding Program Committee Member, AAAI-06 2006
Knowledge Representation and Reasoning Distinguished Lecturer, 1996
Universities of York and Leeds.
IBM Graduate Fellowship 1982–83
NSF Graduate Fellowship 1979–82
Phi Beta Kappa 1977
Sigma Xi 1977
Putnam Fellow, Putnam Mathematical Test 1976

Professional Activities

Reviewer: AI Journal, JACM, NSF, International Journal of Approximate Reasoning, IEEE Transactions on Software Engineering, Cognitive Science, IEEE Transactions on Knowledge and Data Engineering, Annals of Mathematics and Artificial Intelligence, IEEE Transactions on Pattern Analysis and Machine Intelligence, Journal of Logic and Computation, ACM Computing Surveys, Computational Intelligence, Fundamenta Informaticae, Mathematical Reviews, Spatial Cognition and Computation.

Senior Program Committee: AAAI-10, and committee on NECTAR papers at AAAI-10. IJCAI-11.

Program Committee: IJCAI-87, Second Symposium on Logical Formalizations of Commonsense Reasoning 1992, KR-94, Math and AI 1996, KR-96, AAI-97, KR-98, AAI-98, Commonsense 98, Formal Ontologies for Intelligent Systems 1998, IJCAI-99, AAI-99, BISFAI-99, AAI-00, FOIS-01, IJCAI-01, KR-02, Commonsense-03, KR-04, FOIS-04, Commonsense-05, AAI-06, FOIS-06, KR-06, Commonsense-07, AAI-07, KR-08, AAI-08, Commonsense-09, FOIS-10, KR-10, KR-12.

Referee: IJCAI-85, IJCAI-89, IJCAI-91, IJCAI-93, IJCAI-95, IJCAI-05, Cognitive Science '05, IJCAI-07. STeDy 2010 (International Workshop on Spatio-Temporal Dynamics).

Chair, Panel on Temporal Reasoning, First International Conference on Principles of Knowledge Representation, May, 1989.

Co-chair and organizer (with L. Morgenstern and K. Sanders), Workshop on Knowledge, Perception, and Planning, IJCAI-89.

Invited participant, Workshop on Mental Models, M.I.T., March 12-13, 1990.

Epistemic Logic and Its Applications (with L. Morgenstern), Tutorial, IJCAI-93.

Book reviews editor, *IEEE Expert*, 1994-1998.

Co-chair (with L. Morgenstern, J. McCarthy, and R. Reiter) of the Fifth Symposium on Logical Formalizations of Commonsense Reasoning, May 2001, New York City.

Guest Editor (with L. Morgenstern), *Artificial Intelligence* vol. 153, nos. 1-2, special issue on Logical Formalizations of Commonsense Reasoning, March 2004.

Area editor, *ACM Transactions on Computational Logic*.

Second reader for chapter 1 "First Order Logic" and chapter 9 "Qualitative Reasoning" in *The Handbook of Knowledge Representation*, Frank van Harmelen, Vladimir Lifschitz, and Bruce Porter (eds.), Elsevier, Oxford, 2008.

Panelist, NSF IRIS review panel, 2009.

Co-chair (with P. Doherty and E. Erdem) of the Tenth Symposium on Logical Formalizations of Commonsense Reasoning, March 2011, Stanford University.

Associate editor, ACM Computer Classification System, 2010-2011.

Co-chair (with Mehul Bhatt and Hans Guesgen) STeDy 2012 (International Workshop on Spatio-Temporal Dynamics).

Membership: AAI (American Association of Artificial Intelligence).

Ph.D. Students:

Leora Morgenstern, "Foundations of a Logic of Knowledge, Action, and Communication," September, 1988.

Leo Joskowicz, "Reasoning about Shape and Kinematic Function in Mechanical Devices," September, 1988.

Pasquale Caianiello, "Learning as the Evolution of Representation," November, 1989.

Alexander Botta, "A Theory of Natural Learning," May, 1991.

Jen-Lung Chiu, "Planning in an Imperfect World Using Previous Experiences," January 1995.

Tamir Klinger, "Adversarial Reasoning: A Logical Approach for Computer GO." January 2001.

Gedaminas Adomavicius, “Expert-Driven Validation of Set-Based Data Mining Results” (nominal co-advisor with Alex Tuzhilin.) July 2002.

Ji-Ae Shin, “TM-LPSAT: Encoding Temporal Metric Planning in Continuous Time,” May 2004.

Tatiana Kichkaylo, “Construction of Component-Based Applications by Planning,” (co-advisor with Vijay Karamcheti), December 2004

Ziyang Wang, “Incremental Web Search: Tracking Changes in the Web.” May 2006.

MS theses supervised:

Yanai Lehavi, “Charlie: A Treaty Reinsurance Underwriter”.

Kumar Shashi Prabh, “Performance of BLACKBOX Planning System on a Hard Problem of Satisfiability”, May 2001.

Paul Bethe, “DTAC: A method for planning to claim in Bridge.” May 2010.

Azam Asl, “A Qualitative Calculus for Three-Dimensional Rotations.” (NYU Poly Computer Engineering Dept.) December 2011.

Grants:

Reasoning about Shape and Function, NSF DCR-8402309, \$50,000, 12/15/84 - 5/31/86.

Physical and Spatial Reasoning with Solid Objects, NSF DCR-8603758, \$82,600, 7/1/86 - 12/31/88.

Perception and Planning, (with L. Morgenstern), NSF IRI-8801529, \$115,000, 7/1/88 - 12/31/90.

Perception and Planning, (renewed, with no co-PI), NSF IRI-9001447, \$148,937, 8/1/90 - 7/31/93.

Knowledge Representation for Physical Reasoning, NSF IRI-9300446, \$180,000, 8/93-8/96.

Physical and Spatial Reasoning across Multiple Scales, NSF IRI-9625859, \$236,000, 8/96-8/99.

Commonsense Reasoning about Loosely Constrained Systems of Rigid Solid Objects, NSF IIS-0097537, \$289,000, 6/01-5/04.

Automating Commonsense Reasoning for Elementary Physical Science, NSF IIS-0534809, \$328,877, 2/06-8/10.

Invited Talks and Panel Participation:

“Geographic Reasoning,” Workshop on Naive Physics, University of Rochester, Spring 1982

“Planning and Execution in Navigation,” DARPA Workshop on Planning and Robot Problem Solving, Washington D.C., May 15, 1986.

“A Logical Framework for Solid Object Physics,” Workshop on Space Telerobotics, Jet Propulsion Labs, January 20-22, 1987; Workshop on Qualitative Physics, University of Illinois at Urbana, May 27-29, 1987; CIAR Graduate Student Workshop on Knowledge Representation, Edmonton, Alberta, June 6-8, 1988.

“Inferring Ignorance from the Locality of Visual Perception,” IBM Watson Labs, July 1988.

“Error Correction in Cognitive Maps,” SPIE Workshop on Sensor Fusion: Spatial Reasoning and Scene Interpretation, Boston, Nov. 19, 1988.

“Reasoning about Perception and Knowledge,” University of Toronto, Jan. 19, 1989.

“Lucid Representations,” *Bar Ilan Symposium on the Foundations of Artificial Intelligence*, Bar Ilan University, June 18, 1991 (Invited hour address); U. Connecticut at Storrs, November, 1991.

“QR work on Spatial Reasoning,” IFIP Workshop on Knowledge Representation and Qualitative Reasoning, Islamorada, Fla, Feb. 1992.

Panel on “Hard Problems in Physical Reasoning,” IFIP Workshop on Knowledge Representation and Qualitative Reasoning, Islamorada, Fla, Feb. 1992.

“Knowledge Preconditions for Plans,” Bell Labs, April 22, 1993. IBM Watson Labs, June 1, 1993.

“Approximation and Abstraction in Solid Object Kinematics.” Yale University, Dec. 1994. Rutgers University, Oct. 1995.

“The Automation of Commonsense Physical Reasoning” and “Qualitative Kinematics”, Knowledge Representation and Reasoning Distinguished Lecturer, Universities of York and Leeds, May 1996.

“Formal Theories of Spatial Reasoning,” NSF Workshop on Visual Cognition and Spatial Reasoning, Ellicott City, MD, May 15-17, 1997.

“Methodological Difficulties in Automating Commonsense Reasoning” Symposium on Architectures for Commonsense Reasoning, IBM Watson Labs, March 13-14, 2002.

“A First-Order Theory of Communication and Multi-Agent Plans,” Computer Science Department Colloquium, City University of New York, November 11, 2004.

“Why Computers are So Stupid and What Can Be Done About It: Artificial Intelligence and Commonsense Knowledge,” Palladium Lecture, Palladium Residence House, New York University, February 27, 2006.

“Commonsense Physical Reasoning: Boxes and Pitchers,” IBM Watson Labs, June 6, 2007.

“Some metalogical properties of first-order languages that quantify over spatial regions.” Seminar in Logic and Games, CUNY Graduate Center, October 8, 2010.

“Commonsense Reasoning about Chemistry Experiments: Ontologies and Representations”, Commonsense-2009, Toronto, June 2, 2009; and University of Illinois at Chicago, April 12, 2011.

“Qualitative Spatial Reasoning in Interpreting Text and Narrative.” Conference on Spatial Information Theory (Keynote address). September 13, 2011.

“Why Computers Are So Stupid and What Can Be Done About It,” *Science on Saturdays*, Princeton Plasma Physics Lab, March 3, 2012.

Publications

Where not otherwise indicated, Ernest Davis is the sole author.

Books

- B.1 *Representing and Acquiring Geographic Knowledge*
Pitman Press, London, 1986

- B.2 *Representations of Commonsense Knowledge*
Morgan Kaufmann, San Mateo, CA, 1990.
- B.3 *Linear Algebra and Probability for Computer Science Applications*.
CRC Press, A.K. Peters. 2012, in press.
- B.4 *The Logic of Iron, Fire, Water, and Steam, Hand, Eye, and Mind: Representing the Interface between Common Sense and Science*. In preparation.

Journal Articles

- J.1 Algorithms for Scheduling Tasks on Unrelated Processors.
By E. Davis and J. Jaffe. *JACM*, Vol. 28 No. 4, October 1981, pp. 721-736
- J.2 What's the Point?
By R. Schank, G. Collins, E. Davis, P. Johnson, S. Lytinen, and B. Reiser. *Cognitive Science*, Vol. 6, No. 3, 1982
- J.3 Planning and Executing Routes through Uncertain Territory.
By D. McDermott and E. Davis. *Artificial Intelligence*, vol. 22, pp. 107-156, 1984
- J.4 Constraint Propagation with Interval Labels.
Artificial Intelligence, vol. 32, 1987, pp. 281-331.
- J.5 A Logical Framework for Commonsense Predictions of Solid Object Behavior.
AI in Engineering, vol. 3 no. 3, 1988, pp. 125-140.
- J.6 The Kinematics of Cutting Solid Objects.
Annals of Mathematics and Artificial Intelligence, vol. 9, no. 3,4, 1993, pp. 253-305.
- J.7 Knowledge Preconditions for Plans.
Journal of Logic and Computation, vol. 4, no. 5, Oct. 1994, pp. 721-766
- J.8 Order of Magnitude Comparisons of Distance
Journal of AI Research, vol. 10, 1999, pp. 1-38.
- J.9 Constraint Networks of Topological Relations and Convexity.
By E. Davis, N.M. Gotts and A.G. Cohn. *CONSTRAINTS*, Vol. 4 No. 3, 1999, pp. 241-280.
- J.10 Continuous Shape Transformations and Metrics on Regions,
Fundamenta Informaticae, Vol. 46, Nos. 1-2, 2001, pp. 31-54.
- J.11 A First-Order Theory of Communication and Multi-Agent Plans.
By E. Davis and L. Morgenstern. *Journal of Logic and Computation*, Vol. 15, No. 5, 2005, pp. 701-749. This paper has two online appendices, 7 and 16 pages long respectively, at <http://cs.nyu.edu/faculty/davise/commplan/commplan-appa.pdf> and [commplan-appb.pdf](http://cs.nyu.edu/faculty/davise/commplan/commplan-appb.pdf).
- J.12 Knowledge and Communication: A First-Order Theory.
Artificial Intelligence, vol. 166 nos. 1-2, 2005, pp. 81-140.
- J.13 Processes and Continuous Change in a SAT-Based Planner.
By J. Shin and E. Davis. *Artificial Intelligence*, vol. 166 nos. 1-2, 2005, pp. 194-253.
- J.14 The Expressivity of Quantifying over Regions.
Journal of Logic and Computation, vol. 16, 2006, pp. 891-916.
- J.15 Pouring Liquids: A Study in Commonsense Physical Reasoning.
Artificial Intelligence, vol. 172, 2008, pp. 1540-1578. This paper has a 18 page online appendix at <http://cs.nyu.edu/faculty/davise/papers/liqAppa.pdf>.

- J.16 How Does a Box Work? A Study in the Qualitative Dynamics of Solid Objects.
Artificial Intelligence, **175**, 2011, pp. 299-345. This paper has a 20 page online appendix at <http://cs.nyu.edu/faculty/davise/box-proof.pdf>.
- J.17 Preserving Geometric Properties in Reconstructing Regions from Internal and Nearby Points.
Computational Geometry: Theory and Applications, 45:5-6, 2012, 234-253.
- J.18 Elementary Equivalent Domains for Topological Languages over Regions in Euclidean Space.
Submitted to *Journal of Computational Logic*.
- J.19 Qualitative Spatial Reasoning in Interpreting Text and Narrative. *Spatial Cognition and Computation*, to appear.
- J.20 A Qualitative Calculus for Three-Dimensional Rotations.
By A. Asl and E. Davis. In preparation.

Conference Proceedings

- P.1 The MERCATOR Representation of Spatial Knowledge.
Proceedings of the 8th IJCAI, 1983
- P.2 A Representation for Complex Physical Domains.
By S. Addanki and E. Davis. *Proceedings of the 9th IJCAI*, pp. 443-446, 1985
- P.3 Inferring Ignorance from the Locality of Visual Perception.
Proc. AAAI-88, pp. 786-790
- P.4 Error Correction in Cognitive Maps.
Proc. Workshop on Sensor Fusion: Spatial Reasoning and Scene Interpretation, SPIE, 1988.
- P.5 Solutions to a Paradox of Perception with Limited Acuity.
First International Conference on Knowledge Representation and Reasoning, 1989.
- P.6 The Semantics of Tasks that can be Interrupted or Abandoned.
First International Conference on AI Planning Systems, 1992, pp. 37-44.
- P.7 Axiomatizing Qualitative Process Theory.
Third International Conference on Knowledge Representation and Reasoning, 1992, pp. 177-188.
- P.8 Infinite Loops in Finite Time: Some Observations.
Third International Conference on Knowledge Representation and Reasoning, 1992, pp. 47-58.
- P.9 Branching Continuous Time and the Semantics of Continuous Action.
Second International Conference on AI Planning Systems, 1994, pp. 231-236.
- P.10 A First-Order Theory of Communicating First-Order Formulas.
Ninth International Conference on Knowledge Representation and Reasoning, 2004. pp. 235-245. [Conference-length version of J.12]
- P.11 Continuous Time in a SAT-Based Planner.
By J. Shin and E. Davis. *Proc AAAI-2004*. pp. 531-536. [Conference-length version of J.13]
- P.12 Ontologies and Representations of Matter.
AAAI-10.
- P.13 The Winograd Schema Challenge.
By H. Levesque, E. Davis, and L. Morgenstern. *KR-2012*, to appear.

Chapters in Books

- C.1 Limits and Inadequacies in Artificial Intelligence.
In *No Way: On the Nature of the Impossible*, Philip Davis and David Park, (eds.), W.H. Freeman, 1987, pp. 90-110
- C.2 Commonsense Reasoning.
In *The Encyclopedia of Artificial Intelligence*, Stuart Shapiro, (ed.), John Wiley and Sons, 1987, pp. 833-840.
Revised for second edition, 1990.
- C.3 A Framework for Qualitative Reasoning about Solid Objects.
In J. de Kleer and D. Weld (eds.), *Readings in Qualitative Physical Reasoning*, Morgan Kaufmann, 1989, pp. 603-609.
(Modified version of [J.5])
- C.4 Order of Magnitude Reasoning in Qualitative Differential Equations.
In J. de Kleer and D. Weld (eds.), *Readings in Qualitative Physical Reasoning*, Morgan Kaufmann, 1989, pp. 422-434.
- C.5 Knowledge Representation.
The International Encyclopedia of the Social and Behavioral Sciences, Neil J. Smelser and Paul B. Baltes (eds), Elsevier Science Pubs, Oxford, 2001, pp. 8132-8139.
Revised for 2nd edition. To appear.
- C.6 Physical Reasoning.
The Handbook of Knowledge Representation, F. van Harmelen, V. Lifschitz, and B. Porter (eds.), Elsevier, Oxford, 2008, chap. 14, pp. 597-620.
- C.7 Qualitative Reasoning and Spatio-Temporal Continuity.
Qualitative Spatio-Temporal Representation and Reasoning: Trends and Future Directions, S. Hazarika (ed.), IGI Global, to appear.

Other contributions to books

- D.1 47 original exercises with solutions in S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach* 3rd edn. and accompanying instructor's manual, Prentice Hall, 2009.

Unrefereed magazine articles

- M.1 The Naive Physics Perplex.
AI Magazine, Winter 1998, Vol. 19. No. 4. pp. 51-79.

Reviews and Commentary

- R.1 Response to "Prolegomena to any future Qualitative Physics," by Elisha Sacks and Jon Doyle.
Computational Intelligence, vol. 8, no. 2, 1991, pp. 316-318.
- R.2 Review of *Mirror Worlds*, by David Gelernter, Oxford U. Press, 1991. *SIAM News*, vol. 25, no. 3, 1992, p. 6.
- R.3 Response to reviews of *Representations of Commonsense Knowledge*. *Artificial Intelligence*, vol. 61, 1993, pp. 175-179 .

- R.4 Review of *Qualitative Reasoning*, by Benjamin Kuipers, MIT Press. *IEEE Expert*, vol. 9, no. 6, 1994, pp. 70-71.
- R.5 Review of *The Uncertain Reasoner's Companion: A Mathematical Perspective*, by J.B. Paris, Cambridge University Press. *IEEE Expert*, vol. 10, no. 5, 1995, pp. 78-79.
- R.6 *Gödel, Escher, Bach* redux. *IEEE Expert*, vol. 11, no. 3, 1996, pp. 7, 9.
- R.7 Two Machine Learning Textbooks: An Instructor's Perspective (Reviews of *Machine Learning* by Tom Mitchell and of *Data Mining* by Ian H. Witten and Eibe Frank). *Artificial Intelligence*, vol. 131, Sept. 2001, pp. 191-198.
- R.8 Mathematics as Metaphor: Review of *Where Mathematics Comes From*, by George Lakoff and Raphael Nuñez. *Journal of Experimental and Theoretical Artificial Intelligence*, vol. 17, no. 3, 2005, pp. 305-315.
- R.9 Review of *In the Land of Invented Languages*, by Arika Okrent, *SIAM News*, June, 2010, pp. 4,6.
- R.10 Review of *Donald Michie on Machine Intelligence, Biology, and More*, ed. Ashwin Srinivasan, *Times Literary Supplement*, July 16, 2010, p. 27.
- R.11 Review of *The Invisible Gorilla: And Other Ways our Intuitions Deceive Us*, by Christopher Chabris and Daniel Simons, *American Scientist*, Sept-Oct. 2010, **98**:5, p. 428-430.
- R.12 Review of *Roads to Infinity: The Mathematics of Truth and Proof* by John Stillwell. *SIAM News*, Vol. 43, No. 8, October 2010, pp. 6,7.
- R.13 Review of *Galileo*, by J.L. Heilbron, *SIAM News*, 44:4, May 2011.
- R.14 Review of *The Information: A history, a theory, a flood*, by James Gleick, *Times Literary Supplement*, August 17, 2011, #5655-6, p. 10.
- R.15 Review of *Geometry Revealed: A Jacob's Ladder to Modern Higher Geometry* by Marcel Berger, *SIAM News*, 44:7, September 2011.
- R.16 Review of *Metareasoning: Thinking about Thinking* ed. Michael Cox and Anita Raja, *Computing Reviews*, August 12, 2011, Review #139347.
- R.17 Review of "A note on a generalization of the muddy children problem" by N. Gierasimczuk and J. Szymanik, *TARK 13*, 2011. Review #139441 in *Computing Reviews*, Sept. 9, 2011.
- R.18 Review of *Language technology for cultural heritage : selected papers from the LaTeCH Workshop Series* ed. C. Sporleder, Antal van den Bosch and K. Zervanou. *Computing Reviews*, Nov. 2, 2011, Review #139550.
- R.19 Review of *Nine Algorithms that Changed the Future: The Ingenious Ideas that Drive Today's Computers*, by John MacCormick, *SIAM News*, March, 2012.
- R.20 Review of "Robust grasping under object pose uncertainty," by Kaijen Hsaio, Leslie Pack Kaelbling, and Tomas Lozano-Pérez, *Autonomous Robots*, 2011, **31**:253-268. Review #CR140061 in *Computing Reviews*, April 2012.

Commentary

- C.1 AI Research in Progress at the Courant Institute, New York University.
 Edited by E. Davis and R. Grishman. *AI Magazine*, Winter, 1986, Vol. 7, No. 5, pp. 82-86

- C.2 Qualitative simulation and prediction.
IEEE Expert, vol. 12, no. 3, 1997, p. 103.
- C.3 Guide to Axiomatizing Domains in First Order Logic
E. Sandewall (ed.) *Electronic Newsletter on Reasoning about Actions and Change*, Issue 99002, March 8, 1999.
- C.4 Progress in Formal Commonsense Reasoning.
By E. Davis and L. Morgenstern. *Artificial Intelligence*, vol. 153, March 2004, nos. 1-2, pp. 1-12.
- C.5 Reports of the AAAI 2011 Spring Symposia.
M. Buller et al. (19 authors, including E. Davis). *AI Magazine*, Fall 2011, Vol. 32, No. 3, 119-127.

Technical Reports and Unpublished Workshop Notes, not otherwise listed

- T.1 Organizing Spatial Knowledge
Tech. Report #193, Yale Computer Science Dept., January 1981
- T.2 An Ontology of Physical Action
Tech. Rep. 123, NYU Comp. Sci. Dept., June 1984
- T.3 Shape and Function of Solid Objects: Some Examples
Tech. Rep 137, NYU Comp. Sci. Dept., October 1984
- T.4 A High Level Real-Time Programming Language
Tech. Rep. 145, NYU Comp. Sci. Dept., October 1984
- T.5 Reasoning about Hand-Eye Coordination.
IJCAI-89 Workshop on Knowledge, Perception, and Planning
- T.6 Physical Idealization as Plausible Inference.
Tech. Rep. 534, NYU Comp. Sci. Dept., December, 1990.
Logical Formalisms of Commonsense Reasoning, Stanford Spring Symposium, 1991.
- T.7 Lucid Representations.
Tech. Rep. 565, NYU Comp. Sci. Dept., June 1991.
- T.8 Epistemic Logic and Its Applications (with L. Morgenstern).
Epistemic Logic: Annotated Bibliography.
Tutorial Notes, IJCAI-93.
- T.9 Approximations of Shape and Configuration Space.
NYU Computer Science Tech. Report #703, September 1995. Extensively revised under the title “Kinematic Tolerance and the Topology of Configuration Space,” at <http://www.cs.nyu.edu/faculty/davise/papers/path.pdf>, 2007.
- T.9 Approximation and Abstraction in Solid Object Kinematics.
NYU Computer Science Tech. Report #706, September 1995.
- T.10 A Highly Expressive Language of Spatial Constraints.
NYU Computer Science Tech. Report #714, December 1995.
- T.11 Describing spatial transitions using mereotopological relations over histories.
NYU Computer Science Tech. Report #2000-809, October 2000.
- T.12 Collection of Winograd Schemas. At <http://www.cs.nyu.edu/faculty/davise/papers/WS.html>. Created September 2011 and updated since.