Remembering Allen Van Gelder

Pragmatics of SAT

August 11, 2025

Allen Van Gelder (1939-2025)

- ▶ Professor at the University of California, Santa Cruz
- ▶ Lecturer in complexity, data structure and algorithms
- ▶ Researcher in logic programming, databases, image visualization, **satisfiability testing**

Education/Positions

- ▶ BSc in Mathematics, MIT (1961)

- ▶ Systems Analyst, Project Mgr., Transamerica Information Systems Division, San Francisco (1970-1972)

- ▶ Consultant in System Development and Modeling, (self-employed), San Francisco (1972-1981)

- ▶ Graduate Student and Research Assistant, Stanford University; and Student Research Associate at SRI International, Menlo Park, CA and IBM Research Center, San Jose, CA (1981-1986) **PhD in Computer Science, Stanford University (1987)** *Logic programming for parallel implementation* advised by Jeffrey Ullman

- ▶ Computer Scientist, Quintus Computer Systems, Mountain View, CA (1987)

- ▶ University of California, Santa Cruz
    - ▶ Assistant Professor (1987-1994)
    - ▶ Associate Professor (1994-2000)
    - ▶ Professor (2000-2025)

AVG, the lecturer
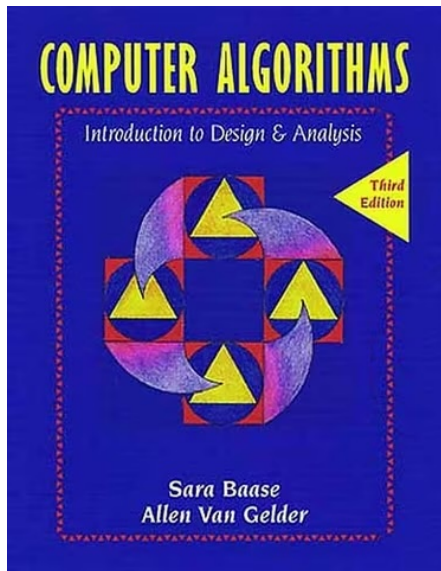
- ▶ Co-author of the third revision.
- ▶ Wrote the new chapters and improved existing ones about **data structure and algorithms**.
- ▶ Language used is Java

Research on computer visualization 1/4

- Jane Wilhelms, Allen Van Gelder: Topological considerations in isosurface generation extended abstract. VVS 1990: 79-86

- Jane Wilhelms, Allen Van Gelder: Octrees for faster isosurface generation. VVS 1990: 57-62

- Jane Wilhelms, Allen Van Gelder: A coherent projection approach for direct volume rendering. SIGGRAPH 1991: 275-284

- Allen Van Gelder, Jane Wilhelms: Interactive Visualization of Flow Fields. VVS 1992: 47-54

- Jane Wilhelms, Allen Van Gelder: Octrees for Faster Isosurface Generation. ACM Trans. Graph. 11(3): 201-227 (1992)

- Allen Van Gelder, Jane Wilhelms: Rapid Exploration of Curvilinear Grids Using Direct Volume Rendering. IEEE Visualization 1993: 70-77

- ▶ Allen Van Gelder, Jane Wilhelms: Topological considerations in isosurface generation. ACM Trans. Graph. 13(4): 337-375 (1994)

- ▶ Jane Wilhelms, Allen Van Gelder: Multi-Dimensional Trees for Controlled Volume Rendering and Compression. VVS 1995: 27-34

- ▶ Allen Van Gelder, Kwansik Kim: Direct Volume Rendering with Shading via Three-Dimensional Textures. VVS 1996: 23-30

- ▶ Jane Wilhelms, Allen Van Gelder, Paul Tarantino, Jonathan Gibbs: Hierarchical and Parallelizable Direct Volume Rendering for Irregular and Multiple Grids. IEEE Visualization 1996: 57-64

- ▶ Jane Wilhelms, Allen Van Gelder: Anatomically based modeling. SIGGRAPH 1997: 173-180

- ▶ Allen Van Gelder, Jane Wilhelms: Varying spring constants for accurate simulation of elastic materials. SIGGRAPH Visual Proceedings 1997: 153

Research on computer visualization 3/4

- ▶ Allen Van Gelder, Jane Wilhelms: An Interactive Fur Modeling Technique. Graphics Interface 1997: 181-188

- ▶ Allen Van Gelder: Approximate Simulation of Elastic Membranes by Triangulated Spring Meshes. J. Graphics, GPU, & Game Tools 3(2): 21-41 (1998)

- ▶ Allen Van Gelder, Vivek Verma, Jane Wilhelms: Volume Decimation of Irregular Tetrahedral Grids. Computer Graphics International 1999: 222-

- ▶ Jane Wilhelms, Allen Van Gelder, L. Atkinson-Derman, A. Luo: Human Motion from Active Contours. Workshop on Human Motion 2000: 155-160

- ▶ Allen Van Gelder: Stream Surface Generation for Fluid Flow Solutions on Curvilinear Grids. VisSym 2001: 95-106

- ▶ Jane Wilhelms, Allen Van Gelder: Fast and Easy Reach-Cone Joint Limits. J. Graphics, GPU, & Game Tools 6(2): 27-41 (2001)

Research on computer visualization 4/4

- **Maryann Simmons, Jane Wilhelms, Allen Van Gelder: Model-based reconstruction for creature animation. Symposium on Computer Animation 2002: 139-146**

- Jane Wilhelms, Allen Van Gelder: Combining vision and computer graphics for video motion capture. Vis. Comput. 19(6): 360-376 (2003)

- Alisa Neeman, Rebecca M. Brannon, Boris Jeremic, Allen Van Gelder, Alex Pang: Decomposition and Visualization of Fourth-Order Elastic-Plastic Tensors. VG/PBG@SIGGRAPH 2008: 121-128

- Allen Van Gelder, Alex Pang: Using PVsolve to Analyze and Locate Positions of Parallel Vectors. IEEE Trans. Vis. Comput. Graph. 15(4): 682-695 (2009)

- Tino Weinkauf, Holger Theisel, Allen Van Gelder, Alex T. Pang: Stable Feature Flow Fields. IEEE Trans. Vis. Comput. Graph. 17(6): 770-780 (2011)

- Allen Van Gelder: Vortex core detection: back to basics. Visualization and Data Analysis 2012: 829413

Research on computer visualization example

Model-based Reconstruction for Creature Animation

Maryann Simmons   Jane Wilhelms   Allen Van Gelder

University of California, Santa Cruz

Research on satisfiability: early work, 2cl SAT solver

- ▶ Allen Van Gelder: A Satisfiability Tester for Non-Clausal Propositional Calculus. CADE 1984: 101-112

- ▶ Allen Van Gelder: A Satisfiability Tester for Non-clausal Propositional Calculus. Inf. Comput. 79(1): 1-21 (1988)

- ▶ **Allen Van Gelder, Yumi K. Tsuji: Satisfiability testing with more reasoning and less guessing. Cliques, Coloring, and Satisfiability 1993: 559-586**

- ▶ Tai Joon Park, Allen Van Gelder: Partitioning Methods for Satisfiability Testing on Large Formulas. CADE 1996: 748-762

- ▶ Tai Joon Park, Allen Van Gelder: Partitioning Methods for Satisfiability Testing on Large Formulas. Inf. Comput. 162(1-2): 179-184 (2000)

Research on satisfiability: modoc SAT solver

- ▶ Allen Van Gelder: Autarky Pruning in Propositional Model Elimination Reduces Failure Redundancy. J. Autom. Reason. 23(2): 137-193 (1999)

- ▶ Allen Van Gelder: Complexity Analysis of Propositional Resolution with Autarky Pruning. Discret. Appl. Math. 96-97: 195-221 (1999)

- ▶ Allen Van Gelder, Fumiaki Okushi: Lemma and cut strategies for propositional model elimination. Ann. Math. Artif. Intell. 26(1-4): 113-132 (1999)

- ▶ Allen Van Gelder, Fumiaki Okushi: A propositional theorem prover to solve planning and other problems. Ann. Math. Artif. Intell. 26(1-4): 87-112 (1999)

- ▶ Fumiaki Okushi, Allen Van Gelder: Persistent and Quasi-Persistent Lemmas in Propositional Model Elimination. AI&M 2000

Research on satisfiability: other works

▶ Allen Van Gelder: Combining Preorder and Postorder Resolution in a Satisfiability Solver. Electron. Notes Discret. Math. 9: 115-128 (2001)

▶ John V. Franco, Allen Van Gelder: A perspective on certain polynomial-time solvable classes of satisfiability. Discret. Appl. Math. 125(2-3): 177-214 (2003)

▶ Fumiaki Okushi, Allen Van Gelder: Persistent and Quasi-Persistent Lemmas in Propositional Model Elimination. Ann. Math. Artif. Intell. 40(3-4): 373-402 (2004)

▶ Allen Van Gelder: Toward leaner binary-clause reasoning in a satisfiability solver. Ann. Math. Artif. Intell. 43(1): 239-253 (2005)

▶ Allen Van Gelder: Another look at graph coloring via propositional satisfiability. Discret. Appl. Math. 156(2): 230-243 (2008)

▶ Philipp Hertel, Fahiem Bacchus, Toniann Pitassi, Allen Van Gelder: Clause Learning Can Effectively P-Simulate General Propositional Resolution. AAAI 2008: 283-290

Research on satisfiability: work on CDCL SAT solvers

- ▶ Allen Van Gelder: Generalizations of Watched Literals for Backtracking Search. AI&M 2002

- ▶ Allen Van Gelder: Improved Conflict-Clause Minimization Leads to Improved Propositional Proof Traces. SAT 2009: 141-146

- ▶ Allen Van Gelder: Generalized Conflict-Clause Strengthening for Satisfiability Solvers. SAT 2011: 329-342

- ▶ Allen Van Gelder: Contrasat - A Contrarian SAT Solver. J. Satisf. Boolean Model. Comput. 8(3/4): 117-122 (2012)

Research on satisfiability UNSAT proofs

- ▶ Allen Van Gelder: Extracting (Easily) Checkable Proofs from a Satisfiability Solver that Employs both Preorder and Postorder Resolution. AI&M 2002

- ▶ Allen Van Gelder: Input Distance and Lower Bounds for Propositional Resolution Proof Length. SAT 2005: 282-293

- ▶ Allen Van Gelder: Pool Resolution and Its Relation to Regular Resolution and DPLL with Clause Learning. LPAR 2005: 580-594

- ▶ Allen Van Gelder: Independently Checkable Proofs from Decision Procedures: Issues and Progress. LPAR 2005: 1

- ▶ Allen Van Gelder: Preliminary Report on Input Cover Number as a Metric for Propositional Resolution Proofs. SAT 2006: 48-53

- ▶ Allen Van Gelder: Verifying Propositional Unsatisfiability: Pitfalls to Avoid. SAT 2007: 328-333

- ▶ Allen Van Gelder: Verifying RUP Proofs of Propositional Unsatisfiability. ISAIM 2008

Research on satisfiability: contributions to the SAT competition

Purse score
- ▶ Sharing the "solving difficulty" of a benchmarks among the solvers that solved it, taking into account to time to do so.
- ▶ **dependent of the participants of the competition**
- ▶ Other proposal in Allen Van Gelder: Careful Ranking of Multiple Solvers with Timeouts and Ties. SAT 2011: 317-328

https://users.soe.ucsc.edu/~avg/purse-poster.pdf
https://www.satisfiability.org/competition/2007/rules07.html

Certified UNSAT track
- ▶ Organized in 2005, 2007, 2009 and 2011 by Allen Van Gelder, which provided the input format and the checker.
- ▶ RES format for the checker
- ▶ RUP format for the solver was available since 2007 (Picosat used it)

Research on satisfiability: QBF 1/2

- Alexandra Goultiaeva, Allen Van Gelder, Fahiem Bacchus: A Uniform Approach for Generating Proofs and Strategies for Both True and False QBF Formulas. IJCAI 2011: 546-553

- Allen Van Gelder: Variable Independence and Resolution Paths for Quantified Boolean Formulas. CP 2011: 789-803

- Allen Van Gelder, Samuel B. Wood, Florian Lonsing: Extended Failed-Literal Preprocessing for Quantified Boolean Formulas. SAT 2012: 86-99

- Allen Van Gelder: Contributions to the Theory of Practical Quantified Boolean Formula Solving. CP 2012: 647-663

- Florian Lonsing, Uwe Egly, Allen Van Gelder: Efficient Clause Learning for Quantified Boolean Formulas via QBF Pseudo Unit Propagation. SAT 2013: 100-115

- Allen Van Gelder: Primal and Dual Encoding from Applications into Quantified Boolean Formulas. CP 2013: 694-707

- ▶ Mikolas Janota, Charles Jordan, Will Klieber, Florian Lonsing, Martina Seidl, Allen Van Gelder: The QBFGallery 2014: The QBF Competition at the FLoC Olympic Games. J. Satisf. Boolean Model. Comput. 9(1): 187-206 (2014)

- ▶ Florian Lonsing, Martina Seidl, Allen Van Gelder: The QBF Gallery: Behind the scenes. Artif. Intell. 237: 92-114 (2016)

- ▶ Allen Van Gelder: Subsumption-Linear Q-Resolution for QBF Theorem Proving. WoLLIC 2023: 362-376

- ▶ Allen Van Gelder: Partial Boolean Functions for QBF Semantics. ISAIM 2024: 236-253

Contributions to the community: the PC member of the SAT conference

- ▶ Very detailed reviews
- ▶ Broad scope of knowledge (from theory to practice)
- ▶ Focussed on making the papers better
- ▶ Would read submitted papers on interest, even if not assigned
- ▶ Would often jump in conversations during reviewing

Contributions to the community: Pragmatics of SAT

Aim: sharing gory details about the design of SAT solvers or SAT procedure (at large, including PB/MAXSAT/QBF/...)

- ▶ After 4 editions of *Pragmatics of Decision Procedures in Automated Reasoning*, 4th edition organized with FLoC'06
- ▶ Organized for the first time in 2010, during FLoC'10
  - ▶ Suggested by Roberto Sebastiani (co-chair of PDPAR'06)
  - ▶ Co-chairs: Daniel Le Berre and Allen Van Gelder
- ▶ **Yearly satellite event of the SAT conference since then!**
  - ▶ 2010-2016: co-chaired by Allen
  - ▶ 2018-2013: co-chaired by Matti
  - ▶ 2024-: new chairs each year

The JSAT journal is now accepting a new kind of contribution: system descriptions.

The idea of the "System Description" category is that it will be refereed papers that describe the internals of a SAT (broad sense, MAXSAT, QBF, SMT, etc. included) solver without the usual requirements for a full paper. In fact, a "System Description" is limited to four pages

A "System Description" need not have novel unpublished ideas, as is required for a regular paper. Also, the criterion of experimental evaluation is reduced, especially if the paper can mention performance in a recognized competition. Accuracy, completeness, and clarity of the description are the primary refereeing criteria.

The criterion of citing every paper written on clause learning (or whatever) is relaxed, but relevant citations predating the work are still expected. Detailed comparisons are not.

Each paper should have an "as of" date clearly stated in the abstract and the first sentence or so of the body.

The author is NOT required to address subsequent results!

MOTIVATION

System descriptions made available during competitive events cannot be considered refereed research, and it is not really appropriate to require authors to cite such casual documents (which may well be inaccurate, not having been reviewed at all).

References

https://users.soe.ucsc.edu/~avg/

https://users.soe.ucsc.edu/~avg/avg-cv-self-study.pdf

https://news.ucsc.edu/2025/05/in-memoriam-allen-van-gelder/