CURRICULUM VITAE
Matthew Anderson

CONTACT INFO

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	Union College
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EDUCATION

University of Wisconsin-Madison

Ph.D., Computer Sciences, August 2012
- Advisor: Dieter van Melkebeek
- Minor: Mathematics

M.S., Computer Sciences, May 2009

Carnegie Mellon University

B.S., Computer Science, May 2004
B.S., Physics, May 2004

RESEARCH INTERESTS

Theory of Computing, Computational Complexity, Algebraic Complexity, Circuit Complexity, Descriptive Complexity, Derandomization, Lower Bounds, Constraint Programming, Virtual Reality

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TEACHING, RESEARCH, & ADMINISTRATIVE EXPERIENCE

Union College

Director of Undergraduate Research — Fall 2024 – Present

Responsible for administrating the College's Undergraduate Research Office and programs, including Student Research Grants, Student Conference Travel Grants, Summer Research Fellowships, and organizing Steinmetz Day, an annual celebration of student scholarship at the College.

Associate Professor — Fall 2024 – Present
Assistant Professor — Fall 2019 – Summer 2024
Visiting Assistant Professor — Fall 2014 – Summer 2019

Responsible for teaching six undergraduate courses per year, advising students, supervising senior projects, performing research, and providing service to the department and college.

COURSES
- Intro to CS: Game Development (CSC 105), F15, F17, F18, S19, S21.
- Intro to CS: Can Computers Think? (CSC 106), S16.
- Intro to CS: Scientific Computing (CSC 108), F19, S20, W21, W23, W24×2.5.
- Intro to CS for Engineers (CSC 109), F14, W15, W16, S17.
- Data Structures Lab (CSC 150L), S15, W17.
- Modeling & Simulation (CSC 235), W15.
- CS of Computer Games (CSC 245), W17.
- Algorithm Design & Analysis (CSC 250), S16, S17, S18, S19, S20, F20, S21, F22, S23, F23, S24×2.

- Operating Systems (CSC 335), S15, S18, S23.
- Theory of Computing (CSC 350), F15, F17.
- Programming Languages (CSC 370), F14, W17, F18, F23.
- Computer Graphics (CSC 385), W18, W20.
- Special Topics: Computer Security (CSC 483), W18.
- Special Topics: Quantum Computing (PHY 311 / CSC 483), W21.
- Guided Research in Computer Science: Constraint Programming (CSC 489), W23, F24.

INDEPENDENT STUDIES
- Computer Graphics, Fall 2023.
- Computational Complexity Theory (3 students), Spring 2020.
- SLAM Algorithms, Fall 2019.
- Operating Systems (3 students), Spring 2019.
- Quantum Computing, Fall 2018.
- Computational Complexity Theory Reading Group, Summer 2017.
- Programming Languages, Summer 2016.

Simons Institute for the Theory of Computing, University of California, Berkeley

Fellow   August 2016 – December 2016

Performed research in descriptive complexity in the Logical Structures in Computation program.

Technion, Israel Institute of Technology

Postdoctoral Researcher   April 2014 – August 2014

Performed postdoctoral research in circuit complexity under the supervision of Prof. Amir Shpilka.

University of Cambridge

Research Associate   July 2012 – March 2014

Performed postdoctoral research in descriptive complexity under the supervision of Prof. Anuj Dawar.

University of Wisconsin-Madison

Research Assistant   Summer 2009 – Summer 2012

Performed research pursuant to a Ph.D. under the supervision of Prof. Dieter van Melkebeek.

Instructor   Fall 2005 – Fall 2006

Taught Introduction to Computer Programming (CS 302). Responsible for lectures, grades, and office hours. Shared responsibility in developing homework assignments and exams.

Teaching Assistant   Various Semesters, 2004 – 2009

Assisted instructors with their courses by performing the following duties: leading labs, developing homework assignments, grading exams and homework, and holding office hours. Assisted in the following courses: Introduction to Computer Programming (CS 302), Introduction to Data Structures (CS 367), Introduction to Numerical Methods (CS 412), Introduction to Computer Networks (CS 640), Principles of Programming Languages (CS 704).

University of California, Los Angeles

Summer Researcher   Summer 2003

Contributed to Fortran computer simulations studying construction tolerances for the Linac Coherent Light Source being built at the SLAC National Accelerator Laboratory.

Carnegie Mellon University

Undergraduate Teaching Assistant   Fall 2001, Fall 2002 – Fall 2003

Assisted a graduate teaching assistant during discussion sections of the introductory physic course.

Shared responsibility for grading, helping students in small groups, and tutoring.

Tutor Fall 2002 – Spring 2003

Staffed physics course center that provided tutoring for all upper-level undergraduate physics courses.

PROFESSIONAL
DEVELOPMENT
- Fellow, Cultural Competence in Computing (3C) Fellows Program, Cohort 1, 2020.
- Participant, Faculty Development Institute, Union College, Summers 2017, 2020, 2024.
- Attendee, ACM SIGCSE Technical Symposium, 2019.

PUBLICATIONS (Key: "A" = Arxiv pre-print, "C" = Conference, "J" = Journal, and underlining indicates undergraduate student authors.)

[A2] M. Anderson and V. Le. *Efficiently-Verifiable Strong Uniquely Solvable Puzzles and Matrix Multiplication.* http://arxiv.org/abs/2307.06463, 21 pages, 2023.

[C7] M. Anderson and V. Le. *Efficiently-Verifiable Strong Uniquely Solvable Puzzles and Matrix Multiplication.*, 29th Annual International Computing and Combinatorics Conference (COCOON), 12 pages, 2023.

[A1] M. Anderson, Z. Ji, and A.Y. Xu. *Matrix Multiplication: Verifying Strong Uniquely Solvable Puzzles.* https://arxiv.org/abs/2301.00074, Submitted, 35 pages, 2022.

[C6] M. Anderson, Z. Ji, and A.Y. Xu. *Matrix Multiplication: Verifying Strong Uniquely Solvable Puzzles.* In: Pulina L., Seidl M. (eds) Theory and Applications of Satisfiability Testing (SAT), Lecture Notes in Computer Science, vol 12178, pages 464–480, 2020.

[J6] M. Anderson, M. A. Forbes, R. Saptharishi, A. Shpilka, and BL. Volk. *Identity Testing and Lower Bounds for Read-k Oblivious Algebraic Branching Programs.* ACM Transactions on Computation Theory (TOCT), volume 10, issue 1, pages 3:1–28, 2018.

[J5] M. Anderson and A. Dawar. *On Symmetric Circuits and Fixed-Point Logics.* Theory of Computing Systems (TOCS), volume 60, issue 3, pages 521–551, 2017.

[C5] M. Anderson, M. A. Forbes, R. Saptharishi, A. Shpilka, and BL. Volk. *Identity Testing and Lower Bounds for Read-k Oblivious Algebraic Branching Programs.* In Proceedings of the 31st Annual IEEE Conference on Computational Complexity (CCC), pages 30:1–30:25, 2016.

[J4] C. Etherington, M. Anderson, E. Bach, J. Butler, and P. Stanica. *A Parallel Approach in Computing Correlation Immunity up to Six Variables.* International Journal of Foundations of Computer Science (IJFCS), volume 27, issue 4, pages 511–528, 2016.

[J3] M. Anderson, A. Dawar, and B. Holm. *Solving Linear Programs without Breaking Abstractions.* Journal of the ACM (JACM), volume 62, issue 6, pages 48:1–48:26, 2015.

[J2] M. Anderson, D. van Melkebeek, and I. Volkovich. *Deterministic Polynomial Identity Tests for Multilinear Bounded-Read Formulae.* Computational Complexity, volume 24, issue 4, pages 695–776, 2015.

[C4] M. Anderson, and A. Dawar. *On Symmetric Circuits and Fixed-Point Logics.* In Proceedings of the 31st International Symposium on Theoretical Aspects of Computer Science (STACS), pages 41–52, 2014.

[C3] M. Anderson, A. Dawar, and B. Holm. *Maximum Matching and Linear Programming in Fixed-Point Logic with Counting.* In Proceedings of the 28th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS), pages 173–182, 2013.

[J1] M. Anderson, D. van Melkebeek, N. Schweikardt, and L. Segoufin. *Locality from Circuit Lower Bounds.* SIAM Journal on Computing (SICOMP), volume 41, issue 6, pages 1481–1523, 2012.

[C2] M. Anderson, D. van Melkebeek, and I. Volkovich. *Derandomizing Polynomial Identity Testing for Multilinear Constant-Read Formulae.* In Proceedings of the 26th Annual IEEE Conference on Computational Complexity (CCC), pages 273–282, 2011.

[C1] M. Anderson, D. van Melkebeek, N. Schweikardt, and L. Segoufin. *Locality of Queries Definable in Invariant First-Order Logic with Arbitrary Built-in Predicates.* In Proceedings of the 38th International Colloquium on Automata, Languages and Programming (ICALP), Part II, pages 368–379, 2011. Invited to the special issue for selected papers from the conference.

THESES

[T2] M. Anderson. *Advancing Algebraic and Logical Approaches to Circuit Lower Bounds.* University of Wisconsin-Madison, Ph.D. Thesis, 2012.

[T1] M. Anderson. *QCNMR: Simulation of a Nuclear Magnetic Resonance Quantum Computer.* Carnegie Mellon University, Senior Honors Thesis, 2004.

WORK IN PREPARATION & PROGRESS

[P2] M. Anderson. J. Perez, J. Subedi. *FPTAS for Ordered Slicable Treemap Layouts.* 18 pages.

[P1] K. Dong, Z. Dubinsky, M. Anderson. *Explicit Wedderburn-Artin Decomposition and Cohn-Umans Matrix Multiplication.* 17 pages.

SOFTWARE

[R1] M. Anderson, Zongliang Ji, Anthony Yang Xu, Jonathan Kimber, Akriti Dhasmana, Jingyu Yao, Kyle Doney, Jordan An, Harper Lyon, Zachary Dubinsky, Talha Mushtaq, Jing Chin, Emma Vu, Hung Duong, Vu Le, Siddhant Deka, Baibhav Barwal, Aavasna Rupakheti, Khai Dong, Jeremy Perez, Huyen Tran. *Software for Verifying and Searching for Strong Uniquely Solvable Puzzles.* `https://bitbucket.org/paraphase/matmult-v2/`. 2023.

UNPUBLISHED MANUSCRIPTS

[M5] M. Anderson. *Lower Bounds and Applications of Symmetric Circuits.* 9 pages. 2018.

[M4] M. Anderson, A. Shpilka, and BL. Volk. *Testing Read-Once Determinants.* 13 pages. 2016.

[M3] M. Anderson. *Sets that Realize Lines.* 4 pages. 2011.

[M2] M. Anderson. *Note on Compressibility and the Oracle Derandomization Hypothesis.* 3 pages. 2009.

[M1] M. Anderson. *Analysis of Nondeterministic Pass Machines.* 7 pages. 2009.

SUMMER RESEARCH FELLOWS

Supervised Union College undergraduate summer fellows working on my research:

- P. Nguyen. *Improving Simplifiable SUSP Simplify Algorithms In CUDA.* 2024.
- V. Pham. *Implementing Scalable Simplifiable SUSP Search Algorithms.* 2024.
- J. Subedi. *Algorithm for Ordered Slicable Treemap Layouts.* 2024.
- Z. AlMassri. *3D SLAM with Realtime Human-aided Correction - Back End.* 2023.
- G. Butler. *Unity Robot Control.* 2023.
- K. Dong. *Practical Implementation of Matrix Multiplication Algorithm From SUSP.* 2023.
- A. Nguyen. *Improving 3D Simultaneous Localization and Map Graphing with Interactive Graph for Map Modification.* 2023.
- J. Perez. *The Realm of Approximate Strong USPs in Matrix Multiplication .* 2023.
- J. Subedi. *3D SLAM with real-time Human-aided Correction - Front End.* 2023.
- H. Tran. *Investigating Matrix Multiplication via Approximate Strong Uniquely Solvable Puzzles.* 2023.
- Q. An. *HTCondor Scaling and Parallelization.* 2022.
- B. Barwal. *Implementing Scalable Strong Uniquely Solvable Puzzle Search Algorithms.* 2022.
- S. Deka. *Investigating Error Tolerance in the Cohn-Umans Algorithm.* 2022.
- D. Dong. *Improving 3D SLAM Reconstruction by Applying Human-Aid Suggestions.* 2022.

- V. Le. *Implementing Scalable Strong Uniquely Solvable Puzzles Search Algorithms.* 2022.
- A. Rupakheti. *Investigating Error Tolerance in the Cohn-Umans Algorithm.* 2022.
- L. Wang. *Realtime Human-Aided Correction for 3D SLAM Algorithm in Robots.* 2022.
- Q. An. *Searching for Large Puzzles to Solve Matrix Multiplication Problems using Genetic Algorithms.* 2021.
- A. Ivoko. *Control of Robots through Virtual Reality.* 2021.
- H. Lyon. *Improved Practical Implementation of Matrix Multiplication Using SUSP.* 2021.
- M.T. Mushtaq. *Using Genetic Code Algorithm to increase the efficiency of Matrix Multiplication by Researching a Large Strong Uniquely Solvable Puzzle (SUSP).* 2021.
- J. Yao. *Practical Implementation of Matrix Multiplication Algorithm From SUSP.* 2020.
- L. Zhang. *Real Time Hand Tracking Virtual Reality Interface.* 2020.
- A. Dhasmana. *Improving the Searching Technique for Uniquely Solvable Puzzles for Faster Matrix Multiplication.* 2019.
- K. Doney. *Increasing the Efficiency of Matrix Multiplication Using Machine Learning.* 2019.
- C. Munoz. *Improving Latency in Virtual Reality Interfaces used for Controlling Robots.* 2019.
- J. Ramirez. *Improving VR Control by using 3D Capturing System.* 2019.
- J. Kimber. *Searching For Large Uniquely Solvable Puzzles For Fast Matrix Multiplication.* 2018.
- I. Scilipoti. *Controlling Robots through Virtual Reality Interfaces.* 2018.
- Z. Ji. *Exploring Efficient Matrix Multipplication via Integer Programming Solvers.* 2017.
- A. Yang. *Exploring Efficient Matrix Multiplication via SAT Solvers.* 2017.
- Z. Ji. *Exploring Fast Matrix Multiplication.* 2016.

PRESENTATIONS

Efficiently-Verifiable Strong Uniquely Solvable Puzzles and Matrix Multiplication.
- 29th Annual International Computing and Combinatorics Conference (COCOON), December 2023.

Matrix Multiplication: Verifying Strong Uniquely Solvable Puzzles
- 23rd International Conference on Theory and Applications of Satisfiability Testing, July 2020.

Game Design Telephone: Hooking Students from Day One
- 8X8 Symposium, Union College, April 2019.

Computer-Aided Search for Matrix Multiplication Algorithms
- Union College, February 2019.
- Williams College, February 2019.
- Bryn Mawr College, February 2019.
- Hobart & William Smith Colleges, February 2019.
- Santa Clara University, February 2019.
- Xavier University, February 2019.
- Providence College, February 2019.
- Logical Structures in Computation Reunion Workshop, Berkeley, California, December 2017.

Privacy, Trust, and Identity
- Union College Academy for Lifelong Learning, Schenectady, New York, October 2018.

Derandomization, Lower Bounds, and Polynomial Identity Testing
- Union College, Schenectady, New York, April 2017.

Solving Linear Programs without Breaking Abstractions
- Rutgers University, New Brunswick, New Jersey, March 2017.

NP-Completeness and Gerrymandering
- Berkeley Math Circle, Berkeley, California, November 2016.

Symmetry, Logics, and Circuits

- Simons Institute, Berkeley, California, October 2016.

Maximum Matching and Linear Programming in Fixed-Point Logic with Counting
- RWTH Aachen University, Aachen, Germany, January 2014.
- Symposium on Logic in Computer Science, New Orleans, Louisiana, June 2013.

On Symmetric Circuits and Fixed-Point Logics
- Simons Institute, Berkeley, California, November 2018.
- Symposium on Theoretical Aspects of Computer Science, Lyon, France, March 2014.
- Symposium on Logic in Computer Science, New Orleans, Louisiana, June 2013.

Locality from Circuit Lower Bounds
- Midwest Theory Day, Chicago, Illinois, November 2011.
- Colloquium on Automata, Languages and Programming, Zurich, Switzerland, July 2011.

Deterministic Polynomial Identity Tests for Multilinear Bounded-Read Formulae
- Indiana State University, Terre Haute, Indiana, March 2012.
- University of Michigan, Ann Arbor, Michigan, January 2012.
- Conference on Computational Complexity, San Jose, California, June 2011.
- Dagstuhl Seminar on the Computational Complexity of Discrete Problems, Germany, March 2011.
- Midwest Theory Day, Chicago, Illinois, December 2010.

SENIOR PROJECTS   Two-term senior projects supervised at Union College (for no teaching credit):

- K. Dong. *Approaches to Lower Bounding Cohn-Umans Matrix Multiplication.* 2024.
- M. Bilakhia (with Prof. C. Gleason). *Improving the Hydra Classifier for Data Quality Monitoring at GlueX.* 2024.
- Z. Dubinsky (with Prof. J. Hatley). *Fast Matrix Multiplication and The Wedderburn-Artin Theorem.* 2023.
- F. Shyne (with Prof. TJ Schlueter). *Automatic Play-testing of Dungeons and Dragons Combat Encounters.* 2023.
- D. Tyebkhan. *Evolving Difficulty-Targeted Bouldering Routes.* 2023.
- T. Bunch. *Can Twitter Data be Used to Predict the Trading Volume and Returns of Altcoins?.* 2022.
- A. Freeman *Spatial Density in 3D Video Game Environments.* 2022.
- S.L. Ho (with Prof. D. Cheng). *Designing a Smart Contract to Deliver Cash Transfers for Venezuelan Refugees in Colombia Using Cryptocurrency.* 2022.
- J. Bergh. *Quantum Walks on Expander Graphs.* 2021.
- J. Caputo. *Effects of Bounding Tree Complexity on Immersion in a Virtual Environment.* 2021.
- T. Farina. *Creating Hybrid Images Using a Quantum Computer.* 2021.
- D. Wu. *Comparing the Performance of Volumetric Grids and Hash Tables in SLAM.* 2021.
- T. Murakami. *Approximating Subgame Perfect Equilibrium by Minimizing Counterfactual Regret.* 2020.
- B. Gokhool (with Prof. J. Wang). *Practical Efficiency of Password Authenticated Key Exchange Protocols.* 2020.
- D. Agadzhanova. *Improving Polynomial Time Approximation Algorithms for TSP.* 2019.
- N. Lockwood. *Geometry-Mapped Line Stylization.* 2019.
- R. Quiogue. *Preventing Browser Fingerprinting by Randomizing Canvas.* 2019.
- I. Scilipoti (with Prof. A. Cass). *A Virtual Reality Interface for Terrain Modeling.* 2019.
- H. Aung. *Generative Adversarial Networks for Dynamic Rendering of Terrain Textures.* 2018.
- D. Lee. *Blockchain Consensus: Secure and Fast Transactions.* 2018.
- S. Manwaring. *Combining VR and Gamification to Improve Academic Performance.* 2018.
- A. Pieper. *Heuristic Algorithms for Bike Route Generation.* 2018.
- L. Badini. *Program Satisfaction Based on the Perception of Bugs as Features.* 2017.
- J. Enquist. *The Effects of Intermittent Gaming On Word Memorization.* 2017.

- Y. Lan. *Detecting Confusion Using Eye-Tracking and Machine Learning Techniques.* 2017.
- J. Cohen. *SoundByte: An iOS Application to Enhance Music Discovery.* 2016.
- J. Curbow. *Blending Two Automatic Playlist Generation Algorithms.* 2016.
- J. Loew. *Examining the Viability of MINIX 3 as a Consumer Operating System.* 2016.
- S. DiIorio. *Optimizations for Rendering Realistic Lens Flares in Polynomial Optics.* 2015.
- A. Ivarson (with Prof. J. Spinelli). *Examining Self-Modifying Code.* 2015.
- J. Kline (with Prof. W. Zwicker). *Analysis of the PeerRank Method for Peer Grading.* 2015.

COLLEGE SERVICE | **Faculty Governance Committees**

- Division IV Representative, General Education Board, Union College, 2022 – Present.
- Center 2 Junior Representative, Faculty Review Board (FRB), Union College, 2020 – 2021.
- Division IV Representative and Faculty Co-chair, Liaison Committee on Academic Computing and Technology (LCACT), Union College, 2015 – 2021 (Co-chair, 2019 – 2021).

Other Committees

- Chair, Student Research Grant (SRG) Committee, Union College, 2024 – Present.
- Member, Student Research Grant (SRG) Committee, Union College, 2020 – 2023.
- Faculty Representative, DEI Key Priorities Initiative Committee, 2022.
- Member, Imagine Lab Advisory Group, Union College, 2020.

Miscellaneous

- Faculty Advisor, Google Student Developer Club, 2023 – Present.
- Product Owner & Developer, As part of CSC 489, lead and contributed to the creation of a software tool for the Dean of Studies to automate the assignment of incoming first-year students to advisors and courses based on students preferences, Union College, 2023.
- Panelist / Participant, Admitted Student Lunches & Other Admissions Events, Union College, various times.
- Panelist, New Faculty & Reappointment Panels, Union College, various times.
- Judge, Sigma Xi Research Award, Union College, 2019.
- Moderator, Steinmetz Day, Union College, various times.
- Participant, CPE & ME ABET Accreditation & Assessment, Union College, various times.

DEPARTMENT SERVICE | **Committee**

- Member, Visiting Assistant Professor Search Committee, Union College, 2024.
- Member, Tenure Track Assistant Professor Search Committee, Union College, 2023.
- Chair, Steinmetz Hallway Redecorating Committee, Union College, 2022 – Present.
- Member, Visiting Assistant Professor Search Committee, Union College, 2019.
- Member, System Administrator Search Committee, Union College, 2016.
- Member, Ph.D. Defense Committee, University of Wisconsin-Madison, Summer 2019.
- Member, CS Graduate Admissions, University of Wisconsin-Madison, Spring 2005.

Miscellaneous

- Maintainer, CS Video Information Kiosks, Union College, 2022 – Present.
- Organizer, CS (Winter)Fest, Union College, 2021 – Present.
- Coach, International Collegiate Programming Contest, Union College, 2014 – Present.
- Guide, CS Department Tours, Union College, various times.

- Panelist, CS Department Open Houses, Union College, various times.
- Member, Liaison to Notice-Choose-Tell, Union College, 2015.
- Coach, ACM International Collegiate Programming Contest, University of Wisconsin-Madison, 2005 – 2009.
- Organizer, Theory Student Lunch, University of Wisconsin-Madison, 2010 – 2012.

OTHER SERVICE	*Reviewer* Ongoing

Symposium on Theory of Computing (STOC), Symposium on Foundations of Computer Science (FOCS), Conference on Computational Complexity (CCC), Transactions on Computation Theory (ToCT), SIAM Journal on Computing (SICOMP), Workshop on Randomization and Computation (RANDOM), Information Processing Letters (IPL), Computability in Europe (CiE), Logical Methods in Computer Science (LMCS), Artificial Life, ACM India Doctoral Dissertation Award, ACM ICPC North American Qualifier

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PROFESSIONAL EXPERIENCE

Netrics Inc., Princeton, NJ

Software Intern <div align="right">Summer 2001, 2002</div>
Developed a software testing suite, executed performance studies and implemented optimizations for database search software running on multi-processor servers.

PROGRAMMING LANGUAGES

Python, C/C++, HTML/CSS, Java, Javascript, ML, Scheme, MATLAB, Mathematica, Fortan, QBasic, LaTeX

HONORS, AWARDS, AND GRANTS

Stillman Prize for Faculty Excellence in Teaching, Finalist – 2022, 2024

Stanley Black & Decker Research Grant – 2019

Cisco Systems Distinguished Graduate Fellowship – 2011

SIGACT STOC Student Travel Grant – 2011

Vilas Travel Grant – 2011

ACM ICPC World Finalist, Head Coach – 2009

ACM ICPC World Finalist, Assistant Coach – 2006, 2007, 2008

ACM ICPC World Finalist, Contestant – 2005

Honor Society Member: Phi Beta Kappa, Phi Kappa Phi, Lambda Sigma

National Society of Collegiate Scholars Member – 2001

AP Scholar with Distinction – 2000

ORGANIZATION MEMBERSHIP

Association for Computing Machinery, Computational Complexity Foundation