

Virginia Vassilevska Williams

Curriculum Vitae

Steven and Renee Finn Career Development Associate Professor
Massachusetts Institute of Technology
Computer Science and Artificial Intelligence Lab
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Maiden Name: Virginia Panayotova Vassilevska

Education

B.S. California Institute of Technology, 2003,
double major in mathematics and engineering and applied science (CS), with Honor

M.S. Carnegie Mellon University, 2007, computer science

Ph.D. Carnegie Mellon University, 2008, computer science,
advisor: Guy Blelloch,
thesis title: *Efficient Algorithms for Path Problems in Weighted Graphs*

Awards and Honors

- Invited lecture at ICM 2018;
- Alfred P. Sloan Research Fellowship;
- NSF Career Award;
- Steven and Renee Finn Career Development Chair;
- Hoover Fellow, Stanford School of Engineering;
- Invited plenary lectures: COCOON 2017, WADS 2017, CSR 2016, Highlights in Algorithms (HALG'16), MFCS 2016, STACS 2016, ALGO/IPEC 2015, China Theory Week 2015, China Theory week 2014 (declined);
- US Junior Oberwolfach Fellow, 2012;
- Paper on matrix multiplication one of 3 highlighted papers at STOC 2012;
- Computing Innovation Fellow 2009–2011;
- Special issue papers for SODA 2008, FOCS 2015, STOC 2015, SODA 2016 and FOCS 2016;

- Paper selected as one of the top 33 exceptional papers at AAAI 2010;
- Carnegie Mellon School of Computer Science Anonymous Graduate Fellowship, 2005–2008;
- Invited to participate in China Theory Week 2008;
- Student Travel Awards (sponsored by IBM for SODA 2008 and by SIAM for the Workshop on Combinatorial Scientific Computing, 2004)
- NSF Graduate Research Fellowship Honorable Mention;
- Herbert Ryser Award in Mathematics – Caltech, May 2002;
- Upper Class Merit Award (Carnation Merit Award) – 2001–2002, 2002–2003;
- Named Arthur R. Adams Summer Undergraduate Research Fellow – Summer 2002, and Marcella Bonsall Summer Undergraduate Research Fellow – Summer 2001;
- Member of the Tau Beta Pi Honor society – 2002–present.

Grants

- NSF Career Award (starting 2017)
- AFOSR MURI (until Sept. 2016)
- BSF Grant # 2016365 (2018-2022)
- NSF Small Grant CCF-1528078 (2015-2018)
- NSF Medium Grant CCF-1514339 (2015-2019)
- NSF Travel Grant CCF-1417238 (2013-2017)
- BSF Grant # 2012338 (2013-2017)

Work Experience

- Associate professor, MIT, Jan. 2017 – present
- Assistant professor, Stanford University, Sept. 2013 – Dec. 2016
- Research associate at Stanford University, Sept. 2011–Sept. 2013
- Assistant research engineer at UC Berkeley, Sept. 2011–Sept. 2013
- Postdoctoral Scholar at UC Berkeley, Sept. 2009–Sept. 2011
- Postdoctoral Scholar – member at the Institute for Advanced Study, Sept. 2008–Sept. 2009
- Summer Internship at TTI–Chicago (2006)
- Summer Internship at LBNL (2003)
- Laboratory assistant in biochemistry lab (2000, 2001)
- Summer Research Fellowships at Caltech: in biochemistry (2000), in mathematics (2001, 2002)

Teaching

- 6.S078, MIT, Spring 2018: Fine-Grained Complexity and Algorithms
- 6.046, MIT, Fall 2017: Introduction to Algorithms
- 6.890, MIT, Spring 2017: Algorithms for Graphs and Matrices
- CS 161, Stanford, Spring 2015, Spring 2016: Introduction to Algorithms
- CS 367, Stanford, Spring 2014, Fall 2015: Algebraic Graph Algorithms
- CS 267, Stanford, Winter 2014, Winter 2015, Winter 2016, Fall 2016: Graph Algorithms
- CS 266, Stanford, Spring 2013: Parameterized Algorithms
- (*Wonderful and Crazy Ideas in Theoretical Computer Science and Math*), Summer 2009 - co-taught a course on theoretical computer science for high school students for the Governor's school of New Jersey.

Peer-Refereed Conference Publications

- *Towards Tight Approximation Bounds for Graph Diameter and Eccentricities*, Arturs Backurs, Liam Roditty, G. Segal, V. Vassilevska Williams, Nicole Wein, STOC 2018.
- *Fine-grained I/O Complexity via Reductions: New lower bounds, faster algorithms, and a time hierarchy*, Erik Demaine, Andrea Lincoln, Quanquan Liu, Jason Lynch and V. Vassilevska Williams, ITCS 2018.
- *Further limitations of the known approaches for matrix multiplication*, Josh Alman and V. Vassilevska Williams, ITCS 2018.
- *Optimal Vertex Fault Tolerant Spanners (for fixed stretch)*, Greg Bodwin, Michael Dinitz, Merav Parter and V. Vassilevska Williams, SODA 2018.
- *Approximating Cycles in Directed Graphs*, Jakub Pachocki, Liam Roditty, Aaron Sidford, Roei Tov and V. Vassilevska Williams, SODA 2018.
- *Tight Hardness for Shortest Cycles and Paths in Sparse Graphs*, Andrea Lincoln, V. Vassilevska Williams and Ryan Williams, SODA 2018.
- *Preserving Distances in Very Faulty Graphs*, Greg Bodwin, Fabrizio Grandoni, Merav Parter, Virginia Vassilevska Williams, ICALP 2017.
- *Dynamic Parameterized Problems and Algorithms*, Josh Alman, Matthias Mnich, Virginia Vassilevska Williams, ICALP 2017.
- *Parameterized Complexity of Group Activity Selection*, Haden Lee and V. Vassilevska Williams, AAMAS 2017.
- *Complexity of the Stable Invitations Problem*, Haden Lee and V. Vassilevska Williams, AAAI 2017.
- *Conditional hardness for sensitivity problems*, Monika Henzinger, Andrea Lincoln, Stefan Neumann and V. Vassilevska Williams, ITCS 2017.
- *Metatheorems for dynamic weighted matching*, Daniel Stubbs and V. Vassilevska Williams, ITCS 2017.
- *Truly Sub-cubic Algorithms for Language Edit Distance and RNA Folding via Fast Bounded-Difference Min-Plus Product*, Karl Bringmann, Fabrizio Grandoni, Barna Saha and V. Vassilevska Williams, FOCS 2016, **invited to special issue**.

- *Deterministic Time-Space Tradeoffs for k -SUM*, Andrea Lincoln, V. Vassilevska Williams, Josh R. Wang, Ryan Williams, ICALP 2016.
- *Simulating Branching Programs with Edit Distance and Friends or: A Polylog Shaved is a Lower Bound Made*, Amir Abboud, Thomas D. Hansen, V. Vassilevska Williams and Ryan Williams, STOC 2016.
- *Who Can Win a Single-Elimination Tournament?*, Michael P. Kim, Warut Suksompong, V. Vassilevska Williams, AAI 2016 (also at COMSOC 2016).
- *Subtree Isomorphism Revisited*, Amir Abboud, Arturs Backurs, Thomas Dueholm Hansen, V. Vassilevska Williams, Or Zamir, SODA 2016, **invited to special issue**.
- *Better Distance Preservers and Additive Spanners*, Greg Bodwin and V. Vassilevska Williams, SODA 2016.
- *Approximation and Fixed Parameter Subquadratic Algorithms for Radius and Diameter in Sparse Graphs*, Amir Abboud, Josh Wang, V. Vassilevska Williams, SODA 2016.
- *If the Current Clique Algorithms are Optimal, so is Valiant's Parser*, Amir Abboud, Arturs Backurs and V. Vassilevska Williams, FOCS 2015, **invited to special issue**.
- *Tight Hardness Results for LCS and other Sequence Similarity Measures*, Amir Abboud, Arturs Backurs and V. Vassilevska Williams, FOCS 2015.
- *Fixing tournaments for kings, chokers and more*, Michael P. Kim and V. Vassilevska Williams, IJCAI 2015.
- *Matching triangles and basing hardness on an extremely popular conjecture*, Amir Abboud, V. Vassilevska Williams and Huacheng Yu, STOC 2015, **invited to special issue**.
- *Quantum algorithms for shortest paths problems*, Aran Nayebi and V. Vassilevska Williams, SQUINT 2015.
- *Better sparse spanners and emulators*, Greg Bodwin and V. Vassilevska Williams, ITCS 2015.
- *Subcubic Equivalences Between Graph Centrality Problems, APSP and Diameter*, Amir Abboud, Fabrizio Grandoni and V. Vassilevska Williams, SODA 2015.
- *Finding Four-Node Subgraphs in Triangle Time*, V. Vassilevska Williams, Josh Wang, Ryan Williams and Huacheng Yu, SODA 2015.
- *Popular conjectures imply strong lower bounds for dynamic problems*, Amir Abboud and V. Vassilevska Williams, FOCS 2014.
- *Listing triangles*, Andreas Bjorklund, Rasmus Pagh, V. Vassilevska Williams and Uri Zwick, ICALP 2014.
- *Consequences of faster sequence alignment*, Amir Abboud, V. Vassilevska Williams and Oren Weimann, ICALP 2014.
- *Better Approximation Algorithms for the Graph Diameter*, Shiri Chechik, Daniel Larkin, Liam Roditty, Grant Schoenebeck, Bob Tarjan and V. Vassilevska Williams, SODA 2014.
- *Fast approximation algorithms for the diameter and radius of sparse graphs*, Liam Roditty and V. Vassilevska Williams, STOC 2013.
- *Improved Distance Sensitivity Oracles via Fast Single-Source Replacement Paths*, Fabrizio Grandoni and V. Vassilevska Williams, FOCS 2012.
- *Multiplying Matrices Faster than Coppersmith-Winograd*, V. Vassilevska Williams, STOC 2012.
- *Subquadratic Approximation Algorithms for the Girth*, Liam Roditty and V. Vassilevska Williams, SODA 2012.

- *Manipulating Stochastically Generated Single-Elimination Tournaments for Nearly All Players*, Isabelle Stanton and V. Vassilevska Williams, WINE 2011.
- *Minimum Weight Cycles and Triangles: Equivalences and Algorithms*, Liam Roditty and V. Vassilevska Williams, FOCS 2011.
- *Manipulating Single-Elimination Tournaments in the Braverman-Mossel Model*, Isabelle Stanton and V. Vassilevska Williams, WSCAI at IJCAI 2011.
- *Rigging Tournament Brackets for Weaker Players*, Isabelle Stanton and V. Vassilevska Williams, IJCAI 2011.
- *Faster Replacement Paths*, V. Vassilevska Williams, SODA 2011.
- *Rigging a Single-Elimination Tournament for Weaker Players*, Isabelle Stanton and V. Vassilevska Williams, workshop on “Computational Social Science and the Wisdom of Crowds” (NIPS 2010).
- *Subcubic Equivalences between Path, Matrix and Triangle problems*, V. Vassilevska Williams and Ryan Williams, FOCS 2010.
- *Fixing a Tournament*, V. Vassilevska Williams, AAAI 2010 (both poster and presentation).
- *Finding, Minimizing and Counting Weighted Subgraphs*, V. Vassilevska and Ryan Williams, STOC 2009.
- *A New Combinatorial Approach to Sparse Graph Problems*, Guy Blelloch, V. Vassilevska, Ryan Williams, ICALP 2008.
- *Uniquely Represented Data Structures for Computational Geometry*, Guy Blelloch, Daniel Golovin, V. Vassilevska, SWAT 2008.
- *Nondecreasing Paths in a Weighted Graph or: How to Optimally Read a Train Schedule*, V. Vassilevska, SODA 2008, **invited to special issue**.
- *All Pairs Bottleneck Paths in General Graphs in Truly Subcubic Time*, V. Vassilevska, Ryan Williams, Raphael Yuster, STOC 2007.
- *Finding the Smallest H -Subgraph in Real Weighted Graphs and Related Problems*, V. Vassilevska, Ryan Williams, Raphael Yuster, ICALP 2006.
- *Finding a Maximum Weight Triangle in Sub-Cubic Time, With Applications*, V. Vassilevska and Ryan Williams, STOC 2006.
- *Confronting Hardness Using A Hybrid Approach*, V. Vassilevska, Ryan Williams and Shan Leung Maverick Woo, SODA 2006.
- *Explicit Inapproximability Bounds for the Shortest Superstring Problem*, V. Vassilevska, MFCS 2005.

Peer-Refereed Journal Publications

- *Who Can Win a Single-Elimination Tournament?*, Michael P. Kim, Warut Suksompong, and Virginia Vassilevska Williams, SIAM J. Discrete Math., 31(3), 17511764.
- *Truly Sub-cubic Algorithms for Language Edit Distance and RNA Folding via Fast Bounded-Difference Min-Plus Product*, Karl Bringmann, Fabrizio Grandoni, Barna Saha and V. Vassilevska Williams, SIAM Journal on Computing, 2016, Special Issue for FOCS’16, accepted.
- *Matching triangles and basing hardness on an extremely popular conjecture*, Amir Abboud, V. Vassilevska Williams and Huacheng Yu, SIAM Journal on Computing, 2016, Special Issue for STOC’16, accepted.

- *Subcubic Equivalences Between Path, Matrix, and Triangle Problems*, V. Vassilevska Williams and Ryan Williams, Journal of the ACM, accepted.
- *The Structure and Efficacy of Double-Elimination Tournaments*, Isabelle Stanton and V. Vassilevska Williams, Journal of Quantitative Analysis of Sports, 2013.
- *Finding, Minimizing, and Counting Weighted Subgraphs*, V. Vassilevska Williams, Ryan Williams, SIAM Journal on Computing, 42(3), 83185,2013.
- *Nondecreasing Paths in a Weighted Graph or: How to Optimally Read a Train Schedule*, V. Vassilevska, Transactions on Algorithms (TALG), 6(4) (2010), 1–24, special issue dedicated to the best papers of SODA 2008.
- *Finding Heaviest H-Subgraphs in Real Weighted Graphs, with Applications*, V. Vassilevska, Ryan Williams, Raphael Yuster, Transactions on Algorithms (TALG) 6(3) (2010), 1–23.
- *All Pairs Bottleneck Paths and Max-Min Matrix Products in Truly Subcubic Time*, V. Vassilevska, Ryan Williams, Raphael Yuster, Theory of Computing 5 (2009) 173–189.
- *Efficient Algorithms for Clique Problems*, V. Vassilevska, Information Processing Letters, 109(4) (2009), 254–257.
- *Finding Nonoverlapping Dense Blocks of a Sparse Matrix*, Ali Pinar, V. Vassilevska, the special issue of ETNA on Combinatorial Scientific Computing, 2005.

Unpublished Manuscripts and Technical Reports

- *Uniquely Represented Data Structures for Computational Geometry*, Guy Blelloch, Daniel Golovin, V. Vassilevska, CMU Technical Report CMU-CS-08-115, 2008.
- *Ordered Subsets with Applications*, Guy Blelloch, V. Vassilevska, 2007.
- *A Two Player Game to Combat WebSpam*, Michelle Goodstein, V. Vassilevska, CMU Technical Report CMU-CS-07-134, 2007.
- *Traceable Data Structures*, Umut Acar, Guy Blelloch, Srinath Sridhar, V. Vassilevska, 2006.
- *A New Dynamic Algorithm for Planar Point Location*, Guy Blelloch, Srinath Sridhar, V. Vassilevska, 2005.
- *Confronting Hardness Using A Hybrid Approach*, V. Vassilevska, Ryan Williams and Shan Leung Maverick Woo, CMU Technical Report CMU-CS-05-125, 2005.

Surveys and Book Chapters

- *On some fine-grained questions in algorithms and complexity*. V. Vassilevska Williams, In the Proceedings of the International Congress of Mathematicians, 2018.
- *An overview of the recent progress on matrix multiplication*. V. Vassilevska Williams, SIGACT News 43, 4 (December 2012), 57–69.
- *Knockout Tournaments*, V. Vassilevska Williams, in Handbook of Computational Social Choice, to appear.

Press Coverage

Key mathematical tool sees first advance in 24 years, *New Scientist*, J. Aron, Dec. 9, 2011, <http://www.newscientist.com/article/dn21255-key-mathematical-tool-sees-first-advance-in-24-years.html>.

UMass Amherst Computer Scientist and International Team Offer Theoretical Solution to 36-Year-Old Computation Problem, *UMass Amherst News*, Janet Lanthrop, Nov. 28, 2017, <https://www.umass.edu/newsoffice/article/umass-amherst-computer-scientist-and>.

Invited Talks

- *A Matrix Product Approach to Weighted Graph Problems*, California Institute of Technology, Computer Science Seminar, Pasadena, CA, 2007.
- *Algorithms for Path Problems*, University of Rochester, Rochester, NY, 2008.
- *Nondecreasing Paths in Weighted Graphs; Or: How to Optimally Read a Flight Schedule*, Rochester Institute of Technology, Rochester, NY, 2008.
- *Nondecreasing Paths in Weighted Graphs; Or: How to Optimally Read a Flight Schedule*, Tsinghua University, China Theory Week, Beijing, China, 2008.
- *Matrix Products and All Pairs Path Problems*, Princeton University, Intractability Center Meeting, Princeton, NJ, 2008.
- *Detecting, Finding and Minimizing Weighted Triangles*, Rutgers University, DIMACS Seminar, New Brunswick, NJ, 2009.
- *Detecting, Finding and Minimizing Weighted Triangles*, University of Toronto, Toronto, Ontario, Canada, 2009.
- *Detecting, Finding and Minimizing Weighted Triangles*, University of Pennsylvania, Philadelphia, PA, 2009.
- *Finding Patterns in Graphs*, Lawrence Livermore National Laboratory, Livermore, CA, 2009.
- *Finding Patterns in Graphs*, Sandia National Laboratory, Livermore, CA, 2009.
- *Matrix Products and Subgraph Problems*, Institute for Advanced Study, Princeton, NJ, 2009.
- *Weighted Triangles, 3SUM and Shortest Paths*, UC Berkeley, Berkeley, CA, 2009.
- *All Pairs Path Problems, Matrix Products and Triangles*, UC Davis, Davis, CA, 2009.
- *Weighted Triangles, 3SUM and Shortest Paths*, Microsoft Research, Silicon Valley, 2009.
- *Triangle Detection vs Matrix Multiplication*, Stanford University, 2010.
- *Fixing a Tournament*, IBM Almaden Research Center, 2010.
- *Subcubic equivalences between path, matrix and triangle problems*, Carnegie Mellon University, 2010.
- *Subcubic equivalences between path, matrix and triangle problems*, UC San Diego, 2010.
- *Faster replacement paths*, UC Berkeley, 2010.
- *Faster replacement paths*, MIT, 2010.
- *Faster replacement paths*, Google Research NY, 2010.

- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, University of Michigan, 2011.
- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, University of Southern California, 2011.
- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, UC San Diego, 2011.
- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, UC Berkeley, 2011.
- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, Harvard, 2011.
- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, MIT, 2011.
- *Path, matrix and triangle problems – subcubic algorithms and equivalences*, Google Research, Mountain View, 2011.
- *Breaking the Coppersmith-Winograd Barrier*, UC Berkeley, 2011.
- *Multiplying matrices faster than Coppersmith-Winograd*, California Institute of Technology, 2012.
- *Multiplying matrices faster than Coppersmith-Winograd*, Stanford University, 2012.
- *Multiplying matrices faster than Coppersmith-Winograd*, Microsoft Research, Silicon Valley, 2012.
- *Multiplying matrices faster than Coppersmith-Winograd*, Georgia Institute of Technology, 2012.
- *Multiplying matrices faster than Coppersmith-Winograd*, Massachusetts Institute of Technology, 2012.
- *On the recent progress on matrix multiplication*, plenary talk at Oberwolfach, 2012.
- *Multiplying matrices faster than Coppersmith-Winograd*, UC San Diego, 2013.
- *Path problems, matrix products, algorithms, and equivalences*, Microsoft Research, Silicon Valley, 2013.
- *Path problems, matrix products, algorithms, and equivalences*, UT Austin, 2013.
- *Path problems, matrix products, algorithms, and equivalences*, Stanford University, 2013.
- *A tutorial on matrix multiplication*, Simons Institute, UC Berkeley, 2014.
- *Consequences of the strong exponential time hypothesis for problems in polynomial time*, Dagstuhl, 2014.
- *Subcubic Equivalences Between Graph Centrality Problems, APSP and Diameter*, FND'14, Lugano, 2014.
- *Invited tutorial on Hardness in P*, Tutorial at STOC'15, Portland, 2015.
- *Hardness for easy problems*, China Theory Week (keynote), Shanghai, 2015.
- *Hardness for easy problems: Implications of the Strong Exponential Time Hypothesis*, IPEC/ALGO (keynote), Patras, Greece, 2016.
- *A Fine-Grained Approach to Algorithms and Complexity*, MIT, 2016.
- *A Fine-Grained Approach to Algorithms and Complexity*, STACS (keynote), 2016.
- *A Fine-Grained Approach to Algorithms and Complexity*, ARC Theory Day, Georgia Tech, 2016.
- *RNA-Folding: from Hardness to Algorithms*, MFCS 2016 (keynote), Krakow, Poland.
- *Fine-Grained Algorithms and Complexity*, WADS (keynote), 2017.
- *Fine-Grained Algorithms and Complexity*, COCOON (keynote), 2017.

- *Fine-Grained Algorithms and Complexity*, Santa Fe Institute Workshop in Thermodynamics in Computation, 2017.
- *Fine-Grained Algorithms and Complexity*, New York Area Theory Day, 2017.
- *Fine-Grained Algorithms and Complexity*, SODA (keynote), 2018.
- *Fine-Grained Algorithms and Complexity*, ICDT (keynote), 2018.

Professional Service

- Co-organizer of the Rising Stars workshop at MIT, 2018.
- Co-organizer of a workshop at STOC 2016 on “Spanners”, June 2016.
- Co-organizer of a Dagstuhl workshop on “Hardness and Structure in P”, November 2016.
- Co-organizer of the semester-long program on “Fine-grained complexity and algorithm design” at the Simons Institute of Theoretical Computer Science, Fall 2015.
- Co-organizer of a tutorial/workshop at STOC 2015 on “Hardness for easy problems”, June 2015.
- Doctoral thesis defense committees: [At Stanford]: Amir Abboud (2017, chair), Andy Nguyen (2015), Hart Montgomery (2014), Mark Zhandry (2015), Eric Huang (2016), Kevin Lewi (2016), Rishi Gupta (2016), Yang Li (2016), Joe Zimmerman (2016), Stephen Reid (2016), Haden Lee (2016, chair).
- Qualification exam committees: Andrea Lincoln (2016), Josh Alman (2016), Nicole Wein (2016), Dylan McKay (2016), Greg Bodwin (2015), Huacheng Yu (2015), Okke Schrijvers (2015), Eric Huang (2015), Haden Lee (2015), Valeria Nikolaenko (2014), Rishi Gupta (2014).
- University chair for thesis defense oral exam of John Brunhaver (Stanford EE department), 2014.
- Associate editor of ACM Transactions on Algorithms (TALG).
- Associate editor for TALG for special issue of SODA’17.
- Associate editor for SICOMP for special issue of FOCS’13.
- Program committees: COMSOC 2012, AAMAS 2012, SWAT 2012, AAI 2012, SODA 2013, ICALP 2013, STOC 2013, IJCAI 2013, FOCS 2013, COMSOC 2014, ESA 2015, FUN 2016, IJCAI 2016, SODA 2017, ITCS 2017, WADS 2017, AAMAS 2017, IPEC 2017, STACS 2018, ICALP 2018, SOSA 2018.
- Co-organized and co-taught a course on theoretical computer science for high school students for the Governor’s school of New Jersey (*Wonderful and Crazy Ideas in Theoretical Computer Science and Math*)
- External reviewer for AAI, FOCS, SODA, ICALP, TALG, IJCAI, SICOMP, IPL, SIDMA, STOC, APPROX, IPEC, CCC, ITCS and many more.

References

Available upon request.