

Curriculum Vitae

Sebastiano Vigna

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Spoken Languages

Italian, English, French.

Education

Laurea *cum laude* in Mathematics, Università di Milano, Italy, 1991 (*Una teoria categoriale degli alberi*). Ph.D. in Computer Science, Università di Milano, Italy, 1996 (*Distributive computability*).

Present Position

Full professor, Dipartimento di Informatica, Università degli Studi di Milano, Italy.

Research Interests

Web graph crawling and analysis, web ranking, search-engine algorithms and implementation, succinct and compressed data structures, web-graph compression, pseudorandom number generators, query recommendation, distributed computation, self-stabilization, real computability, spectral graph theory.

Reviewer

Journals: ACM Transactions on the Web, Theoretical Computer Science, Networks, Distributed Computing, Science of Computer Programming, Data & Knowledge Engineering, Software: Practice & Experience, Linear Algebra and Its Applications, Journal of System Architecture, ACM Transactions on Information Systems, Information Retrieval, Journal of Computational and Applied Mathematics, Mathematics of Computation.

Conferences: PODC, DISC, WWW, FUN, SPIRE, STACS, ESA, SIROCCO, Applications and Theory of Petri Nets.

Program Committee Member: WWW, WSDM, STACS, DISC, SPIRE, SIROCCO, FUN.

Research Projects, Collaborations, Contracts

Member of European Projects NeuroColt, NeuroColt II (about real number computations, neural networks and computational learning) and DELIS (Dynamically Evolving, Large-scale Information Systems).

Consultant for Italia On Line for the construction of Arianna, the largest Italian search engine.

Consultant for Pitagora and Cerved, the largest Italian database of enterprises.

Consultant for the GATE group of Sheffield University.

Head of the LAW (Laboratory for Web Algorithms) at the Computer Science Department, Università degli Studi di Milano, Italy.

Coordinator for EU-STREP FET NADINE (“New tools and Algorithms for Directed Network Analysis”; 300 240 €);

Principal investigator for Google Focused Award “Algorithms and Mathematical Optimization” (subproject “Practical succinct data structures”; 1 000 000 USD).

Principal investigator for Google Faculty Award (“Entity disambiguation by geometric centralities”; 60 000 USD).

Principal investigator for Amazon Research Award (75 000 USD + 25 000 USD in AWS credits).

Software

fastutil a high-performance Java library for type-specific basic data structures;

MG4J a scalable Java search engine implementing several new algorithms (with Paolo Boldi);

WebGraph a framework for web-graph compression [33];

Sux4J efficient implementation of a number of succinct data structures in Java;

The DSI utilities mish-mash of utility classes for large datasets developed at the LAW (with Paolo Boldi);

ERW a framework for model-driven generation of web forms to access databases described by entity-relationship schemata;

BUBiNG a scalable, fully distributed crawler [89];

ne a simple but powerful editor for UN*X;

xorshift128+ the pseudorandom number generator currently used in the Javascript engines of all major browsers [84], and in V8 (Google’s Javascript engine), powering Node.js and similar frameworks.

List of Publications

Conference Proceedings

- [1] Paolo Boldi, Francesco Bonchi, Carlos Castillo, and Sebastiano Vigna. From “dango” to “japanese cakes”: Query reformulation models and patterns. In *Proc. of the 2009 IEEE/WIC/ACM International Conferences on Web Intelligence (WI'09)*. ACM Press, 2009. Winner of the best paper award.
- [2] Paolo Boldi, Francesco Bonchi, Carlos Castillo, Debora Donato, Aristides Giannis, and Sebastiano Vigna. The query-flow graph: model and applications. In *Proc. of ACM 17th Conference on Information and Knowledge Management (CIKM)*, pages 609–618, Napa Valley, CA, USA, 2008. ACM Press.
- [3] Paolo Boldi, Francesco Bonchi, Carlos Castillo, Debora Donato, and Sebastiano Vigna. Query suggestions using query-flow graphs. In *Proceedings of the 2009 workshop on Web Search Click Data, WSCD '09*, pages 56–63. ACM, 2009.
- [4] Paolo Boldi, Francesco Bonchi, Carlos Castillo, and Sebastiano Vigna. Voting in social networks. In *Proc. of ACM 18th Conference on Information and Knowledge Management (CIKM)*, Napa Valley, CA, USA, 2009. ACM Press.
- [5] Ilaria Bordino, Paolo Boldi, Debora Donato, Massimo Santini, and Sebastiano Vigna. Temporal evolution of the UK web. In *ICDM Workshops*, pages 909–918. IEEE Computer Society, 2008.
- [6] Djamel Belazzougui, Paolo Boldi, Giuseppe Ottaviano, Rossano Venturini, and Sebastiano Vigna. Cache-oblivious peeling of random hypergraphs. In *2014 Data Compression Conference (DCC 2014)*, pages 352–361. IEEE, 2014.
- [7] Djamel Belazzougui, Paolo Boldi, Rasmus Pagh, and Sebastiano Vigna. Fast prefix search in little space, with applications. In Mark de Berg and Ulrich Meyer, editors, *Algorithms - ESA 2010, 18th Annual European Symposium, Liverpool, UK, September 6-8, 2010. Proceedings, Part I*, volume 6346 of *Lecture Notes in Computer Science*, pages 427–438. Springer, 2010.
- [8] Djamel Belazzougui, Paolo Boldi, Rasmus Pagh, and Sebastiano Vigna. Monotone minimal perfect hashing: Searching a sorted table with $O(1)$ accesses. In *Proceedings of the 20th Annual ACM-SIAM Symposium On Discrete Mathematics (SODA)*, pages 785–794, New York, 2009. ACM Press.
- [9] Djamel Belazzougui, Paolo Boldi, Rasmus Pagh, and Sebastiano Vigna. Theory and practise of monotone minimal perfect hashing. In *Proceedings of the Tenth Workshop on Algorithm Engineering and Experiments (ALENEX)*, pages 132–144. SIAM, 2009.
- [10] Lars Backstrom, Paolo Boldi, Marco Rosa, Johan Ugander, and Sebastiano Vigna. Four degrees of separation. In *ACM Web Science 2012: Conference Proceedings*, pages 45–54. ACM Press, 2012. Best paper award.
- [11] Djamel Belazzougui, Paolo Boldi, and Sebastiano Vigna. Dynamic z-fast tries. In Edgar Chávez and Stefano Lonardi, editors, *String Processing and Information Retrieval - 17th International Symposium, SPIRE 2010, Los Cabos, Mexico*,

October 11-13, 2010. *Proceedings*, volume 6393 of *Lecture Notes in Computer Science*, pages 159–172. Springer, 2010.

- [12] Paolo Boldi, Bruno Codenotti, Peter Gemmell, Shella Shammah, Janos Simon, and Sebastiano Vigna. Symmetry breaking in anonymous networks: Characterizations. In *Proc. 4th Israeli Symposium on Theory of Computing and Systems*, pages 16–26. IEEE Press, 1996.
- [13] Luca Bernardinello, Giorgio De Michelis, Katia Petruni, and Sebastiano Vigna. On the synchronic structure of transition systems. In Jorg Desel, editor, *Structures in Concurrency Theory. Proceedings of the International Workshop on Structures in Concurrency Theory (STRICT)*, Workshops in Computing, pages 69–84, Berlin, 1995. Springer-Verlag.
- [14] Roi Blanco, Peter Mika, and Sebastiano Vigna. Effective and efficient entity search in RDF data. In Lora Aroyo, Chris Welty, Harith Alani, Jamie Taylor, Abraham Bernstein, Lalana Kagal, Natasha Noy, and Eva Blomqvist, editors, *The Semantic Web — ISWC 2011. 10th International Semantic Web Conference, Proceedings, Part I*, volume 7031 of *Lecture Notes in Computer Science*, pages 83–97. Springer, 2011.
- [15] Charles Meyssonier, Paolo Boldi, and Sebastiano Vigna. δ -approximable functions. In *Proc. CCA 2000 (Computability and Complexity in Analysis)*, number 2064 in *Lecture Notes in Computer Science*, pages 187–199, Swansea, Wales, UK, 2001. Springer-Verlag.
- [16] Paolo Boldi, Roberto Posenato, Massimo Santini, and Sebastiano Vigna. Traps and pitfalls of topic-biased PageRank. In William Aiello, Andrei Broder, Jeanette Janssen, and Evangelos Milios, editors, *WAW 2006. Fourth Workshop on Algorithms and Models for the Web-Graph*, volume 4936 of *Lecture Notes in Computer Science*, pages 107–116. Springer-Verlag, 2008.
- [17] Paolo Boldi, Marco Rosa, Massimo Santini, and Sebastiano Vigna. Layered label propagation: A multiresolution coordinate-free ordering for compressing social networks. In Sadagopan Srinivasan, Krithi Ramamritham, Arun Kumar, M. P. Ravindra, Elisa Bertino, and Ravi Kumar, editors, *Proceedings of the 20th international conference on World Wide Web*, pages 587–596. ACM, 2011.
- [18] Paolo Boldi, Marco Rosa, and Sebastiano Vigna. HyperANF: Approximating the neighbourhood function of very large graphs on a budget. In Sadagopan Srinivasan, Krithi Ramamritham, Arun Kumar, M. P. Ravindra, Elisa Bertino, and Ravi Kumar, editors, *Proceedings of the 20th international conference on World Wide Web*, pages 625–634. ACM, 2011.
- [19] Paolo Boldi, Marco Rosa, and Sebastiano Vigna. Robustness of social networks: Comparative results based on distance distributions. In *Social Informatics, Third International Conference, SocInfo 2011*, volume 6894 of *Lecture Notes in Computer Science*, pages 8–21. Springer, 2011.
- [20] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. PageRank as a function of the damping factor. In *Proc. of the Fourteenth International World Wide Web Conference (WWW 2005)*, pages 557–566, Chiba, Japan, 2005. ACM Press.

- [21] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. Permuting web graphs. In Konstantin Avrachenkov, Debora Donato, and Nelly Litvak, editors, *Algorithms and Models for the Web-Graph, 6th International Workshop, WAW 2009*, volume 5427 of *Lecture Notes in Computer Science*, pages 116–126. Springer, 2009.
- [22] Paolo Boldi and Sebastiano Vigna. Computing anonymously with arbitrary knowledge. In *Proc. 18th ACM Symposium on Principles of Distributed Computing*, pages 181–188. ACM Press, 1999.
- [23] Paolo Boldi and Sebastiano Vigna. Compressed perfect embedded skip lists for quick inverted-index lookups. In *Proc. SPIRE 2005*, volume 3772 of *Lecture Notes in Computer Science*, pages 25–28. Springer–Verlag, 2005.
- [24] Paolo Boldi and Sebastiano Vigna. Computing vector functions on anonymous networks. In Danny Krizanc and Peter Widmayer, editors, *SIROCCO '97. Proc. 4th International Colloquium on Structural Information and Communication Complexity*, volume 1 of *Proceedings in Informatics*, pages 201–214. Carleton Scientific, 1997. Un riassunto è apparso come *Brief Announcement* in *Proc. PODC '97*, ACM Press.
- [25] Paolo Boldi and Sebastiano Vigna. An effective characterization of computability in anonymous networks. In Jennifer L. Welch, editor, *Distributed Computing. 15th International Conference, DISC 2001*, number 2180 in *Lecture Notes in Computer Science*, pages 33–47. Springer–Verlag, 2001.
- [26] Paolo Boldi and Sebastiano Vigna. Efficient lazy algorithms for minimal-interval semantics. In Fabio Crestani, Paolo Ferragina, and Mark Sanderson, editors, *Proc. SPIRE 2006*, number 4209 in *Lecture Notes in Computer Science*, pages 134–149. Springer–Verlag, 2006.
- [27] Paolo Boldi and Sebastiano Vigna. Four degrees of separation, really. In *Proceedings of the 2012 International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2012)*, pages 1222–1227. IEEE Computer Society, 2012.
- [28] Paolo Boldi and Sebastiano Vigna. In-core computation of geometric centralities with HyperBall: A hundred billion nodes and beyond. In *Proc. of 2013 IEEE 13th International Conference on Data Mining Workshops (ICDMW 2013)*. IEEE, 2013.
- [29] Paolo Boldi and Sebastiano Vigna. Holographic trees. In *LATIN 2002*, number 2286 in *Lecture Notes in Computer Science*, pages 465–478, Cancún, México, 2002. Springer–Verlag.
- [30] Paolo Boldi and Sebastiano Vigna. Rethinking Java strings. In *Proc. of the 2nd International Conference on Principles and Practice of Programming in Java*, ACM International Conference Proceedings Series, pages 27–30, Kilkenny City, Ireland, 2003. Computer Science Press, Inc., New York, NY, USA.
- [31] Paolo Boldi and Sebastiano Vigna. On some constructions which preserve sense of direction. In Nicola Santoro and Paul Spirakis, editors, *Structure, Information and Communication Complexity. Proc. 3rd Colloquium SIROCCO '96*, volume 6 of *International Informatics Series*, pages 47–57. Carleton University Press, 1997.

- [32] Paolo Boldi and Sebastiano Vigna. Self-stabilizing universal algorithms. In Sukumar Ghosh and Ted Herman, editors, *Self-Stabilizing Systems (Proc. of the 3rd Workshop on Self-Stabilizing Systems, Santa Barbara, California, 1997)*, volume 7 of *International Informatics Series*, pages 141–156. Carleton University Press, 1997.
- [33] Paolo Boldi and Sebastiano Vigna. The WebGraph framework I: Compression techniques. In *Proc. of the Thirteenth International World Wide Web Conference (WWW 2004)*, pages 595–601, Manhattan, USA, 2004. ACM Press.
- [34] Paolo Boldi and Sebastiano Vigna. WebGraph: Things you thought you could not do with Java™. In *Proc. of the 3rd International Conference on Principles and Practice of Programming in Java*, ACM International Conference Proceedings Series, pages 1–8, Las Vegas, Nevada, USA, 2004. Computer Science Press, Trinity College, Dublin, Ireland.
- [35] Pierpaolo Degano, Roberto Gorrieri, and Sebastiano Vigna. On relating some models for concurrency. In *TAPSOFT '93: Theory and Practice of Software Development, 4th International Joint Conference CAAP/FASE*, number 668 in *Lecture Notes in Computer Science*, pages 15–30, Orsay, France, 1993.
- [36] Pierpaolo Degano, Stefano Kasangian, and Sebastiano Vigna. Applications of the calculus of trees to process description languages. In *Proceedings of the CTCS '91 Conference*, number 530 in *Lecture Notes in Computer Science*, pages 282–301, 1991.
- [37] Marco Genuzio, Giuseppe Ottaviano, and Sebastiano Vigna. Fast scalable construction of (minimal perfect hash) functions. In Andrew V. Goldberg and Alexander S. Kulikov, editors, *Experimental Algorithms: 15th International Symposium, SEA 2016, St. Petersburg, Russia, June 5-8, 2016, Proceedings*, number 9685 in *Lecture Notes in Computer Science*, pages 339–352. Springer, 2016.
- [38] Stefano Kasangian and Sebastiano Vigna. Introducing a calculus of trees. In *Proceedings of the International Joint Conference on Theory and Practice of Software Development (TAPSOFT/CAAP '91)*, number 493 in *Lecture Notes in Computer Science*, pages 215–240. Springer-Verlag, 1991.
- [39] Stefano Kasangian and Sebastiano Vigna. Trees in a distributive category. In *Proceedings of the Category Theory '90 Conference in Como*, number 1488 in *Lecture Notes in Mathematics*, pages 237–248. Springer-Verlag, 1991.
- [40] Jimmy Lin, Matt Crane, Andrew Trotman, Jamie Callan, Ishan Chattopadhyaya, John Foley, Grant Ingersoll, Craig Macdonald, and Sebastiano Vigna. Toward reproducible baselines: The open-source ir reproducibility challenge. In Nicola Ferro, Fabio Crestani, Marie-Francine Moens, Josiane Mothe, Fabrizio Silvestri, Maria Giorgio Di Nunzio, Claudia Hauff, and Gianmaria Silvello, editors, *Advances in Information Retrieval: 38th European Conference on IR Research, ECIR 2016, Padua, Italy, March 20-23, 2016. Proceedings*, pages 408–420. Springer International Publishing, 2016.
- [41] Robert Meusel, Sebastiano Vigna, Oliver Lehmborg, and Christian Bizer. Graph structure in the web — Revisited, or a trick of the heavy tail. In *WWW'14 Companion*, pages 427–432. International World Wide Web Conferences Steering Committee, 2014.

- [42] Nicoletta Sabadini, Sebastiano Vigna, and Robert F.C. Walters. A notion of refinement for automata. In M. Nivat, C. Rattray, T. Rus, and G. Scollo, editors, *Algebraic Methodology and Software Technology (AMAST'93), Proceedings of the Third International Conference on Algebraic Methodology and Software Technology*, Workshops in Computing, pages 327–334, University of Twente, The Netherlands, 1993. Springer–Verlag.
- [43] Sebastiano Vigna. Automatic generation of content management systems from EER-based specifications. In *18th IEEE International Conference on Automated Software Engineering*, pages 259–262, Montréal, Québec, Canada, 2003. IEEE Press. Short paper.
- [44] Sebastiano Vigna. Broadword implementation of rank/select queries. In Catherine C. McGeoch, editor, *Experimental Algorithms. 7th International Workshop, WEA 2008*, number 5038 in Lecture Notes in Computer Science, pages 154–168. Springer–Verlag, 2008.
- [45] Sebastiano Vigna. Distributed, large-scale latent semantic analysis by index interpolation. In Ronny Lempel, Raffaele Perego, and Fabrizio Silvestri, editors, *InfoScale '08: Proceedings of the 3rd international conference on Scalable information systems*, Vico Equense, Italy, 2008. ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering).
- [46] Sebastiano Vigna. Multirelational semantics for extended entity-relationship schemata with applications. In *Conceptual Modeling—ER 2002. 21st International Conference on Conceptual Modeling*, number 2503 in Lecture Notes in Computer Science, pages 35–49. Springer–Verlag, 2002.
- [47] Sebastiano Vigna. Quasi-succinct indices. In Stefano Leonardi, Alessandro Panconesi, Paolo Ferragina, and Aristides Gionis, editors, *Proceedings of the 6th ACM International Conference on Web Search and Data Mining, WSDM'13*, pages 83–92. ACM, 2013.
- [48] Sebastiano Vigna. Reachability problems in entity-relationship schema instances. In *Conceptual Modeling—ER 2004. 23rd International Conference on Conceptual Modeling*, number 3288 in Lecture Notes in Computer Science, pages 96–109. Springer–Verlag, 2004.
- [49] Sebastiano Vigna. A weighted correlation index for rankings with ties. In Sadagopan Srinivasan, Krithi Ramamritham, Arun Kumar, M. P. Ravindra, Elisa Bertino, and Ravi Kumar, editors, *Proceedings of the 24th international conference on World Wide Web*, pages 1166–1176. ACM, 2015.

Journals

- [50] Paolo Boldi, Francesco Bonchi, Carlos Castillo, and Sebastiano Vigna. Query reformulation mining: models, patterns, and applications. *Information Retrieval*, 14(3):257–289, 2011.
- [51] Paolo Boldi, Francesco Bonchi, Carlos Castillo, and Sebastiano Vigna. Viscous democracy for social networks. *Commun. ACM*, 54(6):129–137, June 2011.

- [52] Djamel Belazzougui, Paolo Boldi, Rasmus Pagh, and Sebastiano Vigna. Theory and practice of monotone minimal perfect hashing. *ACM Journal of Experimental Algorithmics*, 16(3):3.2:1–3.2:26, 2011.
- [53] Paolo Boldi, Bruno Codenotti, Massimo Santini, and Sebastiano Vigna. Ubi-Crawler: A scalable fully distributed web crawler. *Software: Practice & Experience*, 34(8):711–726, 2004.
- [54] Paolo Boldi, Flavio Chierichetti, and Sebastiano Vigna. Pictures from Mongolia. Extracting the top elements from a partially ordered set. *Theory Comput. Systems*, 44(2):269–288, 2009.
- [55] Paolo Boldi, Violetta Lonati, Massimo Santini, and Sebastiano Vigna. Graph fibrations, graph isomorphism, and PageRank. *RAIRO Inform. Théor.*, 40:227–253, 2006.
- [56] Paolo Boldi, Alessandro Luongo, and Sebastiano Vigna. Rank monotonicity in centrality measures. *Network Science*, 5(4):529–550, 2017.
- [57] Paolo Boldi, Marco Rosa, and Sebastiano Vigna. Robustness of social and web graphs to node removal. *Social Network Analysis and Mining*, 3(4):829–842, 2013.
- [58] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. Measuring with jugs. *Theoretical Computer Science*, 282(2):259–270, 2002.
- [59] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. Paradoxical effects in PageRank incremental computations. *Internet Math.*, 2(3):387–404, 2005.
- [60] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. PageRank: Functional dependencies. *ACM Trans. Inf. Sys.*, 27(4):1–23, 2009.
- [61] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. Permuting web and social graphs. *Internet Math.*, 6(3):257–283, 2010.
- [62] Paolo Boldi and Sebastiano Vigna. Axioms for centrality. *Internet Math.*, 10(3-4):222–262, 2014.
- [63] Paolo Boldi and Sebastiano Vigna. Complexity of deciding sense of direction. *SIAM J. Comput.*, 29(3):779–789, 2000.
- [64] Paolo Boldi and Sebastiano Vigna. Coverings that preserve sense of direction. *Inform. Process. Lett.*, 75:175–180, 2000.
- [65] Paolo Boldi and Sebastiano Vigna. Codes for the World–Wide Web. *Internet Math.*, 2(4):405–427, 2005.
- [66] Paolo Boldi and Sebastiano Vigna. Equality is a jump. *Theoretical Computer Science*, 219(1–2):49–64, 1999.
- [67] Paolo Boldi and Sebastiano Vigna. $E = I + T$: The internal extent formula for compacted tries. *Inform. Process. Lett.*, 111:310–313, 2011.
- [68] Paolo Boldi and Sebastiano Vigna. Efficient optimally lazy algorithms for minimal-interval semantics. *Theoretical Computer Science*, 648:8–25, 2016.

- [69] Paolo Boldi and Sebastiano Vigna. Fibrations of graphs. *Discrete Math.*, 243:21–66, 2002.
- [70] Paolo Boldi and Sebastiano Vigna. On the lattice of antichains of finite intervals. *Order*, 38(1):57–81, 2018.
- [71] Paolo Boldi and Sebastiano Vigna. Lower bounds for sense of direction in regular graphs. *Distr. Comput.*, 16(4):279–286, 2003.
- [72] Paolo Boldi and Sebastiano Vigna. Lower bounds for weak sense of direction. *J. Discrete Algorithms*, 1:119–128, 2003.
- [73] Paolo Boldi and Sebastiano Vigna. Minimal sense of direction and decision problems for Cayley graphs. *Inform. Process. Lett.*, 64(6):299–303, 1997.
- [74] Paolo Boldi and Sebastiano Vigna. Mutable strings in Java: Design, implementation and lightweight text-search algorithms. *Sci. Comput. Programming*, 54(1):3–23, 2005.
- [75] Paolo Boldi and Sebastiano Vigna. The Turing closure of an Archimedean field. *Theoretical Computer Science*, 231:143–156, 2000.
- [76] Paolo Boldi and Sebastiano Vigna. Universal dynamic synchronous self-stabilization. *Distr. Comput.*, 15(3):137–153, 2002.
- [77] Paolo Boldi and Sebastiano Vigna. δ -uniform BSS machines. *J. Complexity*, 14(2):234–256, 1998.
- [78] Bruno Codenotti, Ivan Gerace, and Sebastiano Vigna. Hardness results and spectral techniques for combinatorial problems on circulant graphs. *Linear Algebra Appl.*, 285(1–3):123–142, 1998.
- [79] Young-Ho Eom, Pablo Aragón, David Laniado, Andreas Kaltenbrunner, Sebastiano Vigna, and Dima L. Shepelyansky. Interactions of cultures and top people of Wikipedia from ranking of 24 language editions. *PLoS ONE*, 10(3), 2015.
- [80] Stefano Kasangian and Sebastiano Vigna. The topos of labelled trees: A categorical semantics for SCCS. *Fund. Inform.*, 32:27–45, 1997.
- [81] Robert Meusel, Sebastiano Vigna, Oliver Lehmborg, and Christian Bizer. The graph structure in the web—Analyzed on different aggregation levels. *The Journal of Web Science*, 1(1):33–47, 2015.
- [82] Nicoletta Sabadini, Sebastiano Vigna, and Robert F.C. Walters. A note on recursive functions. *Math. Struct. Comp. Sci.*, 6:127–139, 1996.
- [83] Sebastiano Vigna. An experimental exploration of Marsaglia’s xorshift generators, scrambled. *ACM Trans. Math. Software*, 42(4), 2016. Article No. 30.
- [84] Sebastiano Vigna. Further scramblings of Marsaglia’s xorshift generators. *Journal of Computational and Applied Mathematics*, 315:175–181, 2016.
- [85] Sebastiano Vigna. On the relations between distributive computability and the BSS model. *Theoretical Computer Science*, 162:5–21, 1996.

Posters

- [86] Paolo Boldi, Bruno Codenotti, Massimo Santini, and Sebastiano Vigna. Structural properties of the African web. In *Poster Proc. of Eleventh International World Wide Web Conference*, Honolulu, USA, 2002.
- [87] Paolo Boldi, Bruno Codenotti, Massimo Santini, and Sebastiano Vigna. Trovatore: Towards a highly scalable distributed web crawler. In *Poster Proc. of Tenth International World Wide Web Conference*, pages 140–141, Hong Kong, China, 2001. Vincitore del Best Poster Award.
- [88] Paolo Boldi, Bruno Codenotti, Massimo Santini, and Sebastiano Vigna. Ubi-Crawler: Scalability and fault-tolerance issues. In *Poster Proc. of Eleventh International World Wide Web Conference*, Honolulu, USA, 2002.
- [89] Paolo Boldi, Andrea Marino, Massimo Santini, and Sebastiano Vigna. BUbiNG: Massive crawling for the masses. In *Proceedings of the Companion Publication of the 23rd International Conference on World Wide Web, WWW Companion '14*, pages 227–228. International World Wide Web Conferences Steering Committee, 2014.
- [90] Sebastiano Vigna. ERW: Entities and relationships on the web. In *Poster Proc. of Eleventh International World Wide Web Conference*, Honolulu, USA, 2002.
- [91] Sebastiano Vigna. TruRank: Taking PageRank to the limit. In *Fourteenth International World Wide Web Conference (WWW 2005), Special Interest Tracks & Posters*, pages 976–977, Chiba, Japan, 2005. ACM Press.

Miscellaneous

- [92] Paolo Boldi, Massimo Santini, and Sebastiano Vigna. A large time-aware graph. *SIGIR Forum*, 42(2):33–38, 2008.
- [93] David Blackman and Sebastiano Vigna. Scrambled linear pseudorandom number generators, 2018.
- [94] Paolo Boldi and Sebastiano Vigna. The push algorithm for spectral ranking. *CoRR*, abs/1109.4680, 2011.
- [95] Carlos Castillo, Debora Donato, Luca Becchetti, Paolo Boldi, Stefano Leonardi, Massimo Santini, and Sebastiano Vigna. A reference collection for web spam. *SIGIR Forum*, 40(2):11–24, 2006.
- [96] Alessio Orlandi and Sebastiano Vigna. Compressed collections for simulated crawling. *SIGIR Forum*, 42(2):39–44, 2008.
- [97] Sebastiano Vigna. Fibonacci binning. *CoRR*, abs/1312.3749, 2013.
- [98] Sebastiano Vigna. Stanford matrix considered harmful. In Andreas Frommer, Michael W. Mahoney, and Daniel B. Szyld, editors, *Web Information Retrieval and Linear Algebra Algorithms*, number 07071 in Dagstuhl Seminar Proceedings, 2007. <http://arxiv.org/abs/0710.1962>.

[99] Sebastiano Vigna. Spectral ranking. *Network Science*, 4(4):433–445, 2016.

Technical reports

[100] Sebastiano Vigna. A guided tour in the topos of graphs. Technical Report 199-97, Università di Milano, Dipartimento di Scienze dell'Informazione, 1997.