Giovanni Manzini
Curriculum vitae

Giovanni Manzini
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Education and Current Position

1988 Master (Laurea) in Mathematics, University of Pisa and Scuola Normale Superiore, Pisa.

1995 PhD in Mathematics, Scuola Normale Superiore, Pisa.

1995-2000 Assistant professor of Numerical Analysis, University of Eastern Piedmont.

2000-2006 Associate professor of Computer Science, University of Eastern Piedmont.

2006- Professor of Computer Science, University of Eastern Piedmont.

Research Interests

My current research interests are algorithms and data structures for data compression and indexing, with applications to Bioinformatics and Web Information Retrieval. My main contribution to this field is the theoretical and practical development of the so-called FM-index, which was the first data structure to support efficient substring searches in a compressed, indexed text. This result has started the new field of compressed text indexing which has flourished and found many applications and whose concepts have been recently extended to other domains (e.g., representation of trees and graphs).

Invited Talks and Tutorials

2017 Plenary Speaker, 28th Annual Symposium on Combinatorial Pattern Matching.

2011 Plenary Speaker, 3rd Workshop on Compression, Text, and Algorithms.

2009 Plenary Speaker, 20th International Workshop on Combinatorial Algorithms.

2009 Plenary Speaker, National Meeting of the Scientific Computing Group of the Istituto Nazionale Alta Matematica.

2008 Invited Lecturer, 20th International School for Computer Science Researchers, Lipari.

2006 Invited Speaker, Interdisciplinary Center for Studies on Complex Systems, Pisa.

2006 Invited Speaker, Workshop on "Caos, Complessità e Informazione", Accademia delle Scienze, Bologna.

2005 Invited Speaker, 2nd Stringology Expert Workshop, Haifa, Israel.

2005 Invited Lecturer, International PhD School "Galileo Galilei", Pisa.

1999 Plenary Speaker, 24th International Symposium on Mathematical Foundations of Computer Science.

Scientific Activities

Co-chair of the program committee for the 22nd Annual Symposium on Combinatorial Pattern Matching (CPM 2011). Member of the Program Committee for the Conferences SPIRE '17, CPM '16, IWOCA '15, WABI '14, AlCoB '14, WABI '13, LATIN '12, SPIRE '10, SPIRE '08, ICTCS '07, SPIRE '07, SPIRE '06, CPM '05, and FUN '04.

Co-organizer of the DIMACS Workshop *The Burrows-Wheeler Transform: Ten Years Later* (2004), and Guest Editor of a special issue of *Theoretical Computer Science* devoted to the Burrows-Wheeler Transforms and its applications (2007). Guest Editor of a Special Issue of *Theoretical Computer Science* devoted to the best papers in the conference CPM '11.

Refereee for the journals: Journal of the ACM, SIAM Journal on Computing, Algorithmica, ACM Transactions on Information Systems, ACM Transactions on Algorithms, IEEE Transactions on Computers, IEEE Transactions on Parallel and Distributed Systems, The Computer Journal, INFORMS Journal on Computing, Artificial Intelligence, IEEE Transactions on Knowledge and Data Engineering, and others.

Research Projects

Site leader for the Italy-Israel FIRB Project *Pattern Matching and Discovery Algorithms in Discrete Structures with Applications to Bioinformatics* (2006–2009). Participant in many projects funded by MIUR and the National Research Council.

Awards and Patents

2007 US Patent 8156156 B2 "Method of structuring and compressing labeled trees of arbitrary degree and shape" (with P. Ferragina, F. Luccio; S. Muthukrishnan).

2004 The software library Deep-Shallow Suffix Sorter [15] licensed for use in the commercial package LEDA by Algorithmic Solutions GMBH.

2002 Research Capital Award from the University of Pisa.

Teaching

I am currently teaching Foundations of Programming, Mobile Programming, Concurrent Programming, and Bioinformatcs at the University of Eastern Piedmont. In the past I have taught basic and advanced courses on Algebra, Algorithms and Data Structures, Calculus, Cryptography, Discrete Mathematics, Numerical Analysis, and Object Oriented Programming. I have taught for both the Computer Science and the Mathematics curriculum at the Universities of Easter Piedmont and Pisa. I have lectured at the Lipari PhD School on *Algorithms: Science and Engineering*.

I have supervised many students in their Master Thesis, both in Mathematics and Computer Science, and I supervised Travis Gagie in his PhD Thesis on Data Compression at the University of Bielefeld.

Software Projects

Although my research interests are mainly theoretically oriented, I consider important to propose solutions which are both theoretically sound and work well in practice. For this reason, part of my work has consisted of the development of software projects in which I have implemented and engineered some of the algorithms proposed in my theoretical works. My most recent project is the bwtdisk library for the computation of the Burrows-Wheeler Transform of huge files in external memory.

A related project is a family of lightweight algorithms for the computation of the Suffix Array and the LCP Array. Although these algorithms are no longer the state-of-the-art, they were the first designed to use a small working space without sacrificing speed, an approach later followed by all the most successful suffix array construction algorithms.

The links to the home page of these and other (older) projects can be found in my personal home page: http://people.unipmn.it/manzini.

Publications

According to Google Scholar, as of January 2017 my publications got 4436 citations and my H-index is 31.

International Journals

[1] T. Gagie, G. Manzini, D. Valenzuela.
Compressed Spaced Suffix Arrays.
Mathematics in Computer Science, To appear, (2017).

[2] L. Egidi, G. Manzini
Multiple seeds sensitivity using a single seed with threshold.
J. Bioinformatics and Computational Biology, Vol. 13, (2015).

[3] L. Egidi, G. Manzini
Design and Analysis of Periodic Multiple Seeds.
Theoretical Computer Science, Vol. 522, (2014), 62-76.

[4] L. Egidi, G. Manzini
Spaced Seeds Design Using Perfect Rulers.
Fundam. Inform., Vol. 131, (2014), 187-203.

[5] L. Egidi, G. Manzini
Better Spaced Seeds using Quadratic Residues.
Journal of Computer and System Sciences, Vol. 79, (2013), 1144-1155.

[6] P. Ferragina, T. Gagie, G. Manzini
Lightweight Data Indexing and Compression in External Memory.
Algorithmica, Vol 63 (2012), 707–730.

[7] T. Gagie, G. Manzini.
Move-to-Front, Distance Coding, and Inversion Frequencies revisited.
Theoretical Computer Science, Vol. 411, (2010), 2925–2944.

[8] P. Ferragina, F. Luccio, G. Manzini, S. Muthukrishnan.
     Compressing and Indexing Labeled Trees, with Applications.
     Journal of the ACM, Vol. 57, n. 1, (2009).

[9] P. Ferragina, R. Giancarlo, G. Manzini.
     The Myriad Virtues of Wavelet Trees.
     Information and Computation, Vol. 207, (2009), 849–866.

[10] P. Ferragina, R. Giancarlo, V. Greco, G. Manzini, G. Valiente.
     *Compression-based Classification of Biological Sequences and Structures via the Universal
     Similarity Metric: Experimental Assessment.*
     BMC Bioinformatics, Vol. 8, (2007).

[11] P. Ferragina, G. Manzini, V. Mäkinen, G. Navarro.
     Compressed Representations of Sequences and Full-Text Indexes.
     ACM Transactions on Algorithms. Vol. 3, n. 2, (2007).

[12] P. Ferragina, G. Manzini.
     Indexing Compressed Text.
     Journal of the ACM, Vol. 52, (2005), 552–581.

[13] P. Ferragina, R. Giancarlo, G. Manzini, M. Sciortino.
     Boosting Textual Compression in Optimal Linear Time.
     Journal of the ACM, Vol. 52, (2005), 688–713.

[14] G. Manzini. M. Rastero
     A Simple and Fast DNA Compressor.
     Software: Practice and Experience, Vol. 34, (2004), 1397–1411.

[15] G. Manzini, P. Ferragina.
     Engineering a Lightweight Suffix Array Construction Algorithm.
     Algorithmica, Vol. 40, (2004), 33–50.

[16] M. D'amico, G. Manzini, L. Margara.
     On Computing the Entropy of Cellular Automata.
     Theoretical Computer Science, Vol 290, (2003), 1629–1646.

[17] G. Manzini.
     An Analysis of the Burrows-Wheeler Transform.
     Journal of the ACM, Vol. 48, n. 3, (2001), 407–430.

[18] P. Ferragina, G. Manzini.
     An Experimental Analysis of a Compressed Index (invited paper).
     Information Sciences, Vol. 135, (2001), 13–28.

[19] D. Bini, G. M. Del Corso, G. Manzini, L. Margara.
     Inversion of Circulant Matrices over $\mathbf{Z}_m$.
     Mathematics of Computation, Vol. 70, (2001), 1169–1182.

[20] R. Kosaraju, G. Manzini.
     Compression of Low Entropy Strings with Lempel-Ziv Algorithms.
     SIAM J. Computing, Vol. 29, n. 3, (2000), 893–911.

[21] G. Cattaneo, E. Formenti, G. Manzini, L. Margara.
Ergodicity, Transitivity, and Regularity for Linear Cellular Automata over $\mathbf{Z}_m$.
Theoretical Computer Science, Vol. 233, n. 1–2, (2000), 147–164.

[22] B. Codenotti, G. M. Del Corso, G. Manzini.
Matrix Rank and Communication Complexity.
Linear Algebra and its Applications, Vol. 304, n. 1–3, (2000), 193–200.

[23] M. Leoncini, G. Manzini, L. Margara,
Parallel Complexity of Numerically Accurate Linear System Solvers.
SIAM J. Computing, Vol. 28, n. 6, (1999), 2030–2058.

[24] G. Manzini, L. Margara.
Attractors of Linear Cellular Automata.
Journal of Computer and System Sciences, Vol. 58, n. 3, (1999), 597–610.

[25] G. Manzini, L. Margara.
A Complete and Efficiently Computable Topological Classification of D-dimensional Linear Cellular Automata over $\mathbf{Z}_m$.
Theoretical Computer Science, Vol. 221, n. 2, (1999), 157–177.

[26] G. M. Del Corso, G. Manzini.
Finding Exact Solutions to the Bandwidth Minimization Problem.
Computing, Vol. 62, n. 3, (1999), 189–203.

[27] G. Manzini, L. Margara.
Invertible Linear Cellular Automata over $\mathbf{Z}_m$*: Algorithmic and Dynamical Aspects.*
Journal of Computer and System Sciences, Vol. 56, n. 1, (1998), 60–67.

[28] M. Finelli, G. Manzini, L. Margara.
Lyapunov Exponents Vs Expansivity and Sensitivity in Cellular Automata.
Journal of Complexity, Vol. 14, n. 2, (1998), 210–233.

[29] G. Manzini.
Lower Bounds for Sparse Matrix Vector Multiplication on Hypercubic Networks.
Discrete Mathematics and Theoretical Computer Science, Vol. 2, (1998), 35–47.

[30] G. M. Del Corso, G. Manzini.
On the Randomized Error of Polynomial Methods for Eigenvector and Eigenvalue Estimate.
Journal of Complexity, Vol. 13, n. 4, (1997), 419–456.

[31] B. Codenotti, G. Manzini, L. Margara, G. Resta.
Perturbation: an Efficient Technique for the Solution of Very Large Instances of the Euclidean TSP.
INFORMS/ORSA Journal on Computing, Vol. 8 (1996), 125–133.

[32] G. Manzini.
On the Ordering of Sparse Linear Systems.
Theoretical Computer Science. Vol. 156 (1996), 301–313.

[33] G. Manzini.
Perimeter Search in Restricted Memory.
Computers and Mathematics with Applications, Vol. 32 n. 7 (1996), 37–45.

[34] G. Manzini, L. Margara.
Minimal Residual Algorithm and Matrix-Vector Information.
Computers and Mathematics with Applications, Vol. 32 n. 4 (1996), 57–63.

[35] G. Manzini.
BIDA*: an Improved Perimeter Search Algorithm.
Artificial Intelligence, Vol. 75 (1995), 347–360.

[36] B. Codenotti, G. Manzini, L. Margara.
Algebraic Techniques in Communication Complexity.
Information Processing Letters, Vol. 56 (1995), 191–195.

[37] G. Manzini.
Sparse Matrix Computations on the Hypercube and Related Networks.
Journal of Parallel and Distributed Computing, Vol. 21 (1994), 169–183.

[38] G. Manzini.
Sparse Matrix Vector Multiplication on Distributed Architectures: Lower Bounds and Average Complexity Results.
Information Processing Letters. Vol. 50 (1994), 231–238.

[39] G. Manzini.
Large Sorting and Routing Problems on the Hypercube and Related Networks.
Parallel Processing Letters, Vol. 1 (1991), 113–124.

[40] G. Manzini.
Radix Sort on the Hypercube.
Information Processing Letters, Vol. 38 (1991), 77–81.

[41] G. Manzini.
Searching Graphs Using Mixed Strategies.
Journal of Experimental and Theoretical Artificial Intelligence, Vol. 1 (1991), 311–317.

Book Chapters, Proceedings, and Special Issues

[42] P. Ferragina, S. Kurtz, S. Lonardi, G. Manzini,
Computational Biology.
Handbook of Data Structures and Applications, 2nd Ed., D. Mehta, S. Sahni (Editors), CRC Press, To appear.

[43] P. Ferragina, G. Manzini,
Boosting Textual Compression.
Encyclopedia of Algorithms, Ming-Yang Kao (Editor), Springer (2016).

[44] P. Ferragina, G. Manzini,
Burrows-Wheeler Transform
Encyclopedia of Algorithms, Ming-Yang Kao (Editor), Springer (2016).

[45] T. Gagie, G. Manzini,
Dictionary-Based Data Compression
Encyclopedia of Algorithms, Ming-Yang Kao (Editor), Springer (2016).

[46] R. Giancarlo, G. Manzini (Editors),
Special issue on Combinatorial Pattern Matching.
Theoretical Computer Science, Vol. 483 (2013).

[47] R. Giancarlo, G. Manzini (Editors),
Proc. 22nd Annual Symposium on Combinatorial Pattern Matching (CPM '11).
Springer Verlag Lecture Notes in Computer Science n. 6661. (2011).

[48] P. Ferragina, G. Manzini, S. Muthukrishnan, (Editors).
Special issue on The Burrows-Wheeler Transform and its applications.
Theoretical Computer Science, Vol. 387, n. 2, (2007).

International Conferences

[49] G. Decaroli, T. Gagie, G. Manzini,
A Compact Index for Order-Preserving Pattern Matching.
Proc. IEEE Data Compression Conference (DCC '17), Snowbird, USA, April 2017.

[50] A. Fariña, T. Gagie, G. Manzini, G. Navarro, A. Ordóñez Pereira,
Efficient and Compact Representations of Some Non-canonical Prefix-Free Codes.
Proc. 23rd Int. Symposium on String Processing and Information Retrieval (SPIRE '16), Beppu, Japan, 2016. Springer Verlag Lecture Notes in Computer Science n. 9954, Pages 50–60.

[51] G. Manzini,
XBWT Tricks.
Proc. 23rd Int. Symposium on String Processing and Information Retrieval (SPIRE '16), Beppu, Japan, 2016. Springer Verlag Lecture Notes in Computer Science n. 9954, Pages 80–92.

[52] C. Boucher, A. Bowe, T. Gagie, G. Manzini, J. Sirén,
Relative Select.
Proc. 22nd Int. Symposium on String Processing and Information Retrieval (SPIRE '15), London, UK, 2015. Springer Verlag Lecture Notes in Computer Science n. 9303, Pages 149–155.

[53] D. Belazzougui, T. Gagie, S. Gog, G. Manzini, J. Sirén,
Relative FM-Indexes.
Proc. 21st Int. Symposium on String Processing and Information Retrieval (SPIRE '14), Ouro Preto, Brazil, 2014. Springer Verlag Lecture Notes in Computer Science n. 8799, Pages 52–64.

[54] T. Gagie, G. Manzini, D. Valenzuela.
Compressed Spaced Suffix Arrays.
Proc. 2nd Int. Conference on Algorithms for Big Data, Palermo, Italy, 2014. CEUR Workshop Proceedings 1146. Pages 37–45.

[55] L. Egidi, G. Manzini,
Spaced Seeds Design Using Perfect Rulers.
Proc. 18th Int. Symposium on String Processing and Information Retrieval

(SPIRE '11), Pisa, Italy, 2011. Springer Verlag Lecture Notes in Computer Science n. 7024, Pages 32–43.

[56] P. Ferragina, T. Gagie, G. Manzini
Lightweight Data Indexing and Compression in External Memory.
Proc. 9th Latin American Theoretical Informatics Symposium (LATIN '10), Oaxaca, México, 2010. Springer Verlag Lecture Notes in Computer Science, n. 6034, Pages 698–711.

[57] P. Ferragina, G. Manzini
On Compressing the Textual Web.
Proc. 3rd ACM International Conference on Web Search and Data Mining (WSDM '10), New York City, USA, 2010. ACM Press, Pages 391–400.

[58] G. Manzini.
Succinct Representations of Trees (invited paper).
Proc. 20th International Workshop on Combinatorial Algorithms (IWOCA '09). Hradec nad Moravicí, Czech Republic, 2009. Springer Verlag Lecture Notes in Computer Science, n. 5874, Pages 11–18.

[59] J. Kärkkäinen, G. Manzini, S. Puglisi.
Permuted Longest-Common-Prefix Array Revisited.
Proc. 20th Symposium on Combinatorial Pattern Matching (CPM '09), Lille, France, 2009. Springer Verlag Lecture Notes in Computer Science, n. 5577, Pages 181–192.

[60] T. Gagie, G. Manzini.
Space-conscious compression.
Proc. 32nd Int. Symposium on Mathematical Foundations of Computer Science (MFCS '07), Cesky Krumlov, Czech Republic, 2007. Springer Verlag Lecture Notes in Computer Science, n. 4708, Pages 206–217.

[61] T. Gagie, G. Manzini.
Move-to-Front, Distance Coding, and Inversion Frequencies Revisited.
Proc. 18th Symposium on Combinatorial Pattern Matching (CPM '07), London, Ontario, Canada, 2007. Springer Verlag Lecture Notes in Computer Science, n. 4580, Pages 71–82.

[62] P. Ferragina, R. Giancarlo, G. Manzini.
The Engineering of a Compression Boosting Library: Theory vs Practice in BWT compression.
Proc. 14th European Symposium on Algorithms (ESA '06), Zürich, Switzerland, 2006. Springer Verlag Lecture Notes in Computer Science, n. 4168, Pages 756–767.

[63] P. Ferragina, R. Giancarlo, G. Manzini.
The Miryad Virtues of Wavelet Trees.
Proc. 33th Int. Colloquium on Automata, Languages, and Programming (ICALP '06), Venice, Italy, 2006. Springer Verlag Lecture Notes in Computer Science n. 4051. Pagg 561–572.

[64] P. Ferragina, F. Luccio, G. Manzini, S. Muthukrishnan.
Compressing and Searching XML Data Via Two Zips.
Proc. World Wide Web Conference 2006 (WWW '06). Edinburgh, Scotland, 2006. Pages 751–760.

[65] P. Ferragina, F. Luccio, G. Manzini, S. Muthukrishnan.
Structuring labeled trees for optimal succinctness, and beyond.
Proc. 46th IEEE Symposium on Foundations of Computer Science (FOCS '05). Pittsburgh (PA), 2005. Pages 184–193.

[66] P. Ferragina, G. Manzini, V. Mäkinen, G. Navarro.
An Alphabet-Friendly FM-index.
Proc. 11th Symposium on String Processing and Information Retrieval (SPIRE '04), Padova, Italy, 2004. Springer Verlag Lecture Notes in Computer Science n. 3246. Pages 150–160.

[67] G. Manzini.
Two space saving tricks for linear time LCP array computation.
Proc. 9th Scandinavian Workshop on Algorithm Theory (SWAT '04), Humlebæk, Denmark, 2004. Springer Verlag Lecture Notes in Computer Science n. 3111. Pages 372–383.

[68] P. Ferragina, G. Manzini.
Compression boosting in optimal linear time using the Burrows-Wheeler Transform.
Proc. 15th ACM-SIAM International Symposium on Discrete Algorithms (SODA '04). New Orleans LA, 2004. Pages 655–663.

[69] G. Manzini, P. Ferragina.
Engineering a lightweight suffix array construction algorithm.
Proc. 10th European Symposium on Algorithms (ESA '02), Rome, Italy, 2002. Springer Verlag Lecture Notes in Computer Science n. 2461. Pagg 698–710.

[70] P. Ferragina, G. Manzini.
An Experimental Analysis of an Opportunistic Index.
Proc. 12th ACM-SIAM International Symposium on Discrete Algorithms (SODA '01), Washington DC, 2001. Pages 269–278

[71] P. Ferragina, G. Manzini.
Opportunistic Data Structures with Applications.
Proc. 41st IEEE Symposium on Foundations of Computer Science (FOCS '00), Redondo Beach, CA, 2000. Pages 390–398.

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An Analysis of the Burrows-Wheeler Transform.
Proc. 10th ACM-SIAM International Symposium on Discrete Algorithms (SODA '99), Baltimore MD, 1999. Pages 669–677.

[73] G. Manzini.
The Burrows-Wheeler Transform: Theory and Practice (invited paper).
Proc. 24th International Symposium on Mathematical Foundations of Computer Science (MFCS '99), Szklarska Poreba, Poland, 1999. Springer Verlag Lecture Notes in Computer Science n. 1672. Pages 34–47.

[74] G. Manzini.
Efficient Algorithms for On-line Symbol Ranking Compression.
Proc. 7th European Symposium on Algorithms (ESA '99), Prague, Czech Republic, 1999. Springer Verlag Lecture Notes in Computer Science n. 1643.

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Characterization of Sensitive Linear Cellular Automata with Respect to the Counting Distance.
Proc. 23rd International Symposium on Mathematical Foundations of Computer Science (MFCS '98), Brno, Czech Republic, 1998. Springer Verlag Lecture Notes in Computer Science n. 1450.

[76] D. Bini, G. M. Del Corso, G. Manzini, L. Margara.
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Proc. 25th Int. Colloquium on Automata, Languages, and Programming (ICALP '98), Aalborg, Denmark, 1998. Springer Verlag Lecture Notes in Computer Science n. 1443.

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Proc. 25th Int. Colloquium on Automata, Languages, and Programming (ICALP '98), Aalborg, Denmark, 1998. Springer Verlag Lecture Notes in Computer Science n. 1443.

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Proc. 15th Int. Symp. on Theoretical Aspects of Computer Science (STACS '98), Paris, France, 1998. Springer Verlag Lecture Notes in Computer Science n. 1373.

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On the Parallel Complexity of Matrix Factorization Algorithms.
Proc. 9th ACM Symposium on Parallel Algorithms and Architectures (SPAA '97), Newport, Rhode Island, USA, 1997.

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Proc. 14th Int. Symp. on Theoretical Aspects of Computer Science (STACS '97), Luebeck, Germany, 1997. Springer Verlag Lecture Notes in Computer Science n. 1200.

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Proc. 4th European Symposium on Algorithms (ESA '96), Barcelona, Spain, 1996. Springer Verlag Lecture Notes in Computer Science n. 1136.

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Improving the Efficiency of Backtrack Search.
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