ecajournal.haifa.ac.il

Enumerative Combinatorics and Applications

ECA **6:4** (2026) Article #S1H1
https://doi.org/10.54550/ECA2026V6S4H1

In Memory of Professor Emanuele Munarini

Donatella Merlini

Department of Statistics, Computer Science and Applications (DiSIA),
University of Florence, Florence, Italy
Email: donatella.merlini@unifi.it

Received: July 7, 2026, **Accepted**: July 7, 2026, **Published**: July 10, 2026

Memorial

As participants in the **Ninth International Symposium on Riordan Arrays and Related Topics**, held June 3–5, 2024, at Howard University in Washington, DC, we pause to remember **Professor Emanuele Munarini**. He died suddenly and unexpectedly on October 21, 2024, only a few months after the conference. His passing is a profound loss to the combinatorics community.

Professor Munarini had been part of the Riordan-array community from its earliest international meetings. He helped organize the **first symposium**, held August 6–9, 2014, at Sungkyunkwan University in Seoul as an invited minisymposium of the Nineteenth International Linear Algebra Society Conference. He was also a member of the organizing and scientific committee for the **second meeting**, held July 14–16, 2015, at the Politecnico di Milano campus in Lecco. Over the following years, he continued to serve the symposium series, including service on the scientific committees for the third, fourth, and fifth meetings in Bloomington, Madrid, and Busan. His sustained involvement made him a familiar and cherished presence in this community.

Born and educated in Italy, Emanuele Munarini built his academic career in the Department of Mathematics at the **Politecnico di Milano**, where he served as an associate professor. He was deeply committed to both teaching and research. His lectures were appreciated for their clarity, depth, and careful organization, and he mentored students not only in technical skill but also in mathematical creativity.

His research ranged broadly across combinatorics and related algebraic methods, with particular emphasis on

- formal power series and symbolic methods;
- Riordan and Sheffer matrices, Sheffer polynomial sequences, and umbral calculus;
- enumerative and bijective combinatorics;
- combinatorial identities and special polynomial sequences;
- partially ordered sets and lattices of paths; and
- graph theory, including Fibonacci and Lucas cubes, Pell graphs, antiregular graphs, double graphs, and graph coloring.

His extensive and consistently high-quality body of work is documented in the publication list maintained on his Politecnico di Milano website. His papers built bridges among different areas of combinatorics and enriched the theory of polynomial sequences, providing new perspectives, identities, and methods.

Colleagues remember Emanuele for his kindness, gentleness, and quiet generosity. At conferences, he was never one to seek the limelight. Instead, he asked thoughtful questions, offered encouragement, and engaged with the work of others with genuine interest. He combined mathematical rigor with humility, and his warmth left a lasting impression on those who knew him.

Although he is no longer with us, his influence lives on in the theorems, identities, and frameworks he developed and in the students and collaborators he inspired. The Riordan and broader combinatorics communities will feel his absence, but his ideas and spirit endure.

We will miss his kindness and gentleness, and we will treasure the beautiful mathematics he shared with us.

Appendix: Selected Key Publications

The following non-exhaustive list highlights several of Professor Munarini's contributions. The entries are arranged chronologically and are followed by brief descriptions of their mathematical significance. A more extensive publication list appears in the bibliography below and on his Politecnico di Milano publication page*.

Year	Publication	Contribution
1998	*A combinatorial interpretation of the generalized Fibonacci numbers* [22]	Developed combinatorial models for generalized Fibonacci numbers, using ideas from partitions and combinatorial species.
2005	*A combinatorial interpretation of the connection constants for persistent sequences of polynomials*, with O. M. D'Antona [6]	Gave combinatorial interpretations for connection constants associated with persistent polynomial sequences, clarifying their structural relationship with triangular arrays.
2005	*Cayley continuants*, with D. Torri [67]	Used formal power series and umbral methods to give a direct proof of Cayley's continuant identity and to connect continuants with weighted permutations and Hankel determinants.
2006	*A combinatorial interpretation of the Chebyshev polynomials* [27]	Supplied a direct combinatorial interpretation of Chebyshev polynomials, linking classical special functions with enumerative structures.
2011	*Lattices of paths: representation theory and valuations*, with L. Ferrari [13]	Studied distributive lattices arising from Dyck, Motzkin, and Schröder paths, including their spectra, valuations, and Euler characteristics.
2011	*Riordan matrices and sums of harmonic numbers* [33]	Derived identities relating row sums of Riordan matrices to harmonic numbers and specialized them to several important combinatorial sequences.
2013	*On adjacent vertex distinguishing edge colorings of direct products of graphs*, with C. Perelli Cippo and N. Zagaglia Salvi [57]	Applied structural graph methods to distinguishing edge-colorings of direct graph products.
2014	*Enumeration of edges in some lattices of paths*, with L. Ferrari [14]	Counted edges in path lattices and linked enumerative formulas with structural properties of the underlying posets.
2015	*Enumeration of chains and saturated chains in Dyck lattices*, with L. Ferrari [15]	Developed formulas and combinatorial arguments for chains and saturated chains in Dyck-path lattices.
2018	*Combinatorial identities for Appell polynomials* [40]	Established identities for Appell polynomial sequences using umbral operators, binomial convolutions, and related symbolic techniques.
2022	*Umbral operators for Cayley and Sylvester continuants* [51]	Extended the theory of continuants by introducing umbral operators associated with the Cayley and Sylvester families and connecting them with Sheffer structures.
2023	*Two-parameter identities for q-Appell polynomials* [52]	Extended Appell and Sheffer identities to a two-parameter q-setting and connected them with q-analogues of Riordan and Sheffer methods.
2024	*Tricomi continuants* [53]	Introduced a family of continuants forming a Sheffer sequence related to Tricomi and Laguerre polynomials, together with identities and Hankel-matrix factorizations.

Selected Publications of Emanuele Munarini

[1] H. Alzer and E. Munarini, *A new class of polynomials related to the Stirling numbers and series representations for some mathematical constants*, Integers 21 (2021), Article A121.

[2] S. Capparelli, M. M. Ferrari, E. Munarini, and N. Zagaglia Salvi, *A generalization of the "Problème des rencontres"*, J. Integer Seq. 21 (2018), Article 18.2.8.

*`https://munarini.faculty.polimi.it/publications.html`.

[3] G. Castiglione, A. Frosini, E. Munarini, A. Restivo, and S. Rinaldi, *Enumeration of L-convex polyominoes. II. Bijection and area*, in Proceedings of the 17th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2005), Taormina, Italy, 2005.

[4] G. Castiglione, A. Frosini, E. Munarini, A. Restivo, and S. Rinaldi, *Combinatorial aspects of L-convex polyominoes*, European J. Combin. 28 (2007), 1724–1741.

[5] O. M. D'Antona, P. Codara, and E. Munarini, *Mathematica sa fare le somme?*, in Mathematica Italia User Group Meeting 2010: Proceedings, 2010.

[6] O. M. D'Antona and E. Munarini, *A combinatorial interpretation of the connection constants for persistent sequences of polynomials*, European J. Combin. 26 (2005), 1105–1118.

[7] O. M. D'Antona and E. Munarini, *The cycle-path indicator polynomial of a digraph*, Adv. in Appl. Math. 25 (2000), 41–56.

[8] O. M. D'Antona and E. Munarini, *A combinatorial interpretation of the punctured partitions*, J. Combin. Theory Ser. A 91 (2000), 264–282.

[9] O. M. D'Antona and E. Munarini, *Funzioni aritmetiche e serie di Dirichlet*, Boll. Docenti Mat. 55 (2007), 63–78.

[10] E. Deutsch, E. Munarini, and S. Rinaldi, *Skew Dyck paths, area, and superdiagonal bargraphs*, J. Statist. Plann. Inference 140 (2010), 1550–1562.

[11] E. Deutsch, E. Munarini, and S. Rinaldi, *Skew Dyck paths*, J. Statist. Plann. Inference 140 (2010), 2191–2203.

[12] F. Disanto and E. Munarini, *Local height in weighted Dyck models of random walks and the variability of the number of coalescent histories for caterpillar-shaped gene trees and species trees*, SN Appl. Sci. 1 (2019), Article 578.

[13] L. Ferrari and E. Munarini, *Lattices of paths: representation theory and valuations*, J. Combin. 2 (2011), 265–291.

[14] L. Ferrari and E. Munarini, *Enumeration of edges in some lattices of paths*, J. Integer Seq. 17 (2014), Article 14.1.5.

[15] L. Ferrari and E. Munarini, *Enumeration of chains and saturated chains in Dyck lattices*, Adv. in Appl. Math. 62 (2015), 118–140.

[16] M. M. Ferrari and E. Munarini, *Decomposition of some Hankel matrices generated by the generalized rencontres polynomials*, Linear Algebra Appl. 567 (2019), 180–201.

[17] S. Fontanesi, E. Munarini, and N. Zagaglia Salvi, *On the Fibonacci semilattices*, in Algebras and Combinatorics: An International Congress, ICAC '97, Springer-Verlag, Singapore, 1999, 237–245.

[18] M. M. Ferrari, E. Munarini, and N. Zagaglia Salvi, *Some combinatorial properties of the generalized derangement numbers*, Riv. Mat. Univ. Parma 11 (2020), 217–249.

[19] E. Grazzini, E. Munarini, M. Poneti, and S. Rinaldi, *m-compositions and m-partitions: exhaustive generation and Gray code*, Pure Math. Appl. **17** (2006), 111–121.

[20] R. Lucchetti, P. Radrizzani, and E. Munarini, *A new family of regular semivalues and applications*, Internat. J. Game Theory 40 (2011), 655–675.

[21] G.-C. Meloni and E. Munarini, *Purely algebraic theories of elementary operational calculus and generalized functions*, Rend. Circ. Mat. Palermo, Ser. II 64 (2000), 29–42.

[22] E. Munarini, *A combinatorial interpretation of the generalized Fibonacci numbers*, Adv. in Appl. Math. 19 (1998), 306–318.

[23] E. Munarini, *The many faces of the Fibonacci graphs*, Bull. Inst. Combin. Appl. 44 (2005), 93–98.

[24] E. Munarini, *Generalization of a binomial identity of Simons*, Integers 5 (2005), Article A15.

[25] E. Munarini, *Enumeration of order ideals of a garland*, Ars Combin. 76 (2005), 185–192.

[26] E. Munarini, *Generalized q-Fibonacci numbers*, Fibonacci Quart. 43 (2005), 234–242.

[27] E. Munarini, *A combinatorial interpretation of the Chebyshev polynomials*, SIAM J. Discrete Math. 20 (2006), 649–655.

[28] E. Munarini, *Characteristic, admittance and matching polynomials of an antiregular graph*, Appl. Anal. Discrete Math. 3 (2009), 157–176.

[29] E. Munarini, *Median double graphs*, Bull. Inst. Combin. Appl. 57 (2009), 74–78.

[30] E. Munarini, *Combinatorial properties of the antichains of a garland*, Integers 9 (2009), 353–374.

[31] E. Munarini, *On the Euler characteristic of finite distributive lattices*, in From Combinatorics to Philosophy: The Legacy of G.-C. Rota, Springer, 2009, 165–186.

[32] E. Munarini, *Formal series in Mathematica*, in Mathematica Italia User Group Meeting 2010: Proceedings, 2010.

[33] E. Munarini, *Riordan matrices and sums of harmonic numbers*, Appl. Anal. Discrete Math. 5 (2011), 176–200.
[34] E. Munarini, *Riordan matrices*, in Mathematica Italia User Group Meeting 2011: Proceedings, 2011.
[35] E. Munarini, *Reticoli di cammini*, in Mathematica Italia User Group Meeting 2015: Proceedings, 2015.
[36] E. Munarini, *Shifting property for Riordan, Sheffer and connection constants matrices*, J. Integer Seq. 20 (2017), Article 17.8.2, 31 pp.
[37] E. Munarini, *Shifting property and other binomial identities for the bivariate Fibonacci polynomials*, Bull. Inst. Combin. Appl. 82 (2018), 42–50.
[38] E. Munarini, *A generalization of André-Jeannin's symmetric identity*, Pure Math. Appl. 27 (2018), 98–118.
[39] E. Munarini, *Some q-binomial identities involving the generalized q-Fibonacci numbers*, Integers 18 (2018), Article A76.
[40] E. Munarini, *Combinatorial identities for Appell polynomials*, Appl. Anal. Discrete Math. 12 (2018), 362–388.
[41] E. Munarini, *I grafi di de Grey e le colorazioni del piano*, MaddMaths!, May 6, 2018.
[42] E. Munarini, *Pell graphs*, Discrete Math. 342 (2019), 2415–2428.
[43] E. Munarini, *Callan-like identities*, Online J. Anal. Comb. 14 (2019), Article 06.
[44] E. Munarini, *Combinatorial identities involving the central coefficients of a Sheffer matrix*, Appl. Anal. Discrete Math. 13 (2019), 495–517.
[45] E. Munarini, *q-derangement identities*, J. Integer Seq. 23 (2020), Article 20.3.8.
[46] E. Munarini, *Combinatorial identities for the Tricomi polynomials*, J. Integer Seq. 23 (2020), Article 20.9.4.
[47] E. Munarini, *Topological indices for the antiregular graphs*, Le Matematiche 76 (2021), 277–310.
[48] E. Munarini, *A combinatorial characterization of the generalized exponential and Fubini polynomials*, Online J. Anal. Comb. 16 (2021), Article 9.
[49] E. Munarini, *A note on a definite integral of combinatorial interest*, Bull. Inst. Combin. Appl. 94 (2022), 35–52.
[50] E. Munarini, *An operational approach to the generalized rencontres polynomials*, Kragujevac J. Math. 46 (2022), 461–469.
[51] E. Munarini, *Umbral operators for Cayley and Sylvester continuants*, Appl. Anal. Discrete Math. 16 (2022), 307–327.
[52] E. Munarini, *Two-parameter identities for q-Appell polynomials*, J. Integer Seq. 26 (2023), Article 23.3.1.
[53] E. Munarini, *Tricomi continuants*, Mathematics 12 (2024), Article 401.
[54] E. Munarini and C. Perelli Cippo, *On some colorings of a double graph*, Electron. Notes Discrete Math. 40 (2013), 277–281.
[55] E. Munarini, C. Perelli Cippo, and N. Zagaglia Salvi, *On the Lucas cubes*, Fibonacci Quart. 39 (2001), 12–21.
[56] E. Munarini, C. Perelli Cippo, A. Scagliola, and N. Zagaglia Salvi, *Double graphs*, Discrete Math. 308 (2008), 242–254.
[57] E. Munarini, C. Perelli Cippo, and N. Zagaglia Salvi, *On adjacent vertex distinguishing edge colorings of direct products of graphs*, in Recent Results in Designs and Graphs: A Tribute to Lucia Gionfriddo, Quaderni di Matematica 28, Aracne, Rome, 2013, 369–392.
[58] E. Munarini, M. Poneti, and S. Rinaldi, *Matrix compositions*, in Proceedings of the 18th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2006), San Diego, CA, 2006.
[59] E. Munarini, M. Poneti, and S. Rinaldi, *Matrix compositions*, J. Integer Seq. 12 (2009), Article 09.4.8.
[60] E. Munarini and N. Zagaglia Salvi, *Structural and enumerative properties of the Fibonacci cubes*, Intellectual Systems 2 (1997), 1–4. Translated into Russian.
[61] E. Munarini and N. Zagaglia Salvi, *Structural and enumerative properties of the Fibonacci cubes*, Discrete Math. 255 (2002), 317–324.
[62] E. Munarini and N. Zagaglia Salvi, *On the rank polynomial of the lattice of order ideals of fences and crowns*, Discrete Math. 259 (2002), 163–177.
[63] E. Munarini and N. Zagaglia Salvi, *Scattered subsets*, Discrete Math. 267 (2003), 213–228.
[64] E. Munarini and N. Zagaglia Salvi, *On Fibonacci-like cubes*, Rend. Sem. Mat. Messina, Ser. II 9 (2003), 185–199.
[65] E. Munarini and N. Zagaglia Salvi, *Circular binary strings without zigzags*, Integers 3 (2003), Article A19.
[66] E. Munarini and N. Zagaglia Salvi, *Binary strings without zigzags*, Sém. Lothar. Combin. 49 (2004), Article B49h.
[67] E. Munarini and D. Torri, *Cayley continuants*, Theoret. Comput. Sci. 347 (2005), 353–369.