

Curriculum Vitae

Personal data

Name: Paolo Frasconi

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Born: Montevarchi (Italy). April 9, 1963.

Citizenship: Italian.

Languages: Italian (native), English (professional).

Education

- Ph.D. in Computer Engineering, 1994, Università degli Studi di Firenze. Thesis: Recurrent neural networks and adaptive processing of sequences.
- Laurea degree, Electronics Engineering, 1990 Università degli Studi di Firenze, Cum Laude.

Academic Positions

- **Full Professor.** Dec 2010 – present. Università degli Studi di Firenze.
- **Visiting Professor.** Feb. 2010 – Sept. 2010. K.U. Leuven (Computer Science).
- **Associate Professor.** Nov. 1999 – 2010. Università degli Studi di Firenze.
- **Associate Professor.** Nov. 1998 – Ott. 1999. Università degli Studi di Cagliari
- **Lecturer.** Jun 1998–Oct. 1998. School of Information Technology and Computer Science, University of Wollongong (Australia).
- **Assistant Professor.** Jul. 1995 – Oct. 1998. Università degli Studi di Firenze (Ingegneria).
- **Contract Professor.** 1993. Università degli Studi di Siena.
- **Visiting Scholar** 1992. Dept. of Brain and Cognitive Sciences, M.I.T.

Grants

- Main funded research projects:
 - “Strumenti di Supporto all’Agenzia per la Mobilità Metropolitana” (tools in supports of the metropolitan mobility agency); (2008-2009) founded by the Florence Foundation for Research and Innovation.
 - BIOPTRAIN, Bioinformatics Optimization Training, Marie Curie EST, 2005–2009; funded by the European Commission.

- APRIL II, Applications of Inductive Logic Programming, FET, 2003–2007; funded by the European Commission.
- BIOPATTERN, Network of Excellence, 2003–2008; funded by the European Commission.
- Machine learning tools for text analysis and retrieval, (2003-2004); funded by Italian Ministry of University and Research.
- Machine learning tools for structural and functional genomics, as National Coordinator, (2002-2003); funded by Italian Ministry of University and Research.
- Machine learning techniques for quantitative analysis of chemical compounds, (2001-2002); funded by Italian Ministry of University and Research.

Professional activities

- Journal Special Issues: Journal of Machine Learning Research (2008) [122] (with K. Kersting, H. Toivonen, K. Tsuda), ACM Transactions on Internet Technology (2004) [124, 123] (with M. Maggini, C.L. Giles, G. Flakes), Cognitive Systems Research (2002) [125] (with M. Gori, A. Sperduti), IEEE Transactions on Knowledge and Data Engineering (2001) [126] (with M. Gori, A. Sperduti), AIAA Magazine [127].
- Editorial Boards:
 - Associate Editor, *Artificial Intelligence Journal*, since 2009.
 - Action Editor, *Machine Learning Journal*, since 2010.
 - Editorial board member, *Machine Learning Journal*, 2009.
 - Editorial board member *Source Code for Biology and Medicine*, 2008–present.
 - Associate Editor, *IEEE Transactions on Knowledge and Data Engineering* 2000–2005.
 - Associate Editor, *IEEE Transactions on Neural Networks* 2000–2004.
 - Associate Editor, *ACM Transactions on Internet Technology* 2003–2004.
- Conference Program Committee/Referee: several, including AAAI (2008, and Co-Chair for the Special Track on AI and Bioinformatics, 2010), Conference on Neural Information Processing Systems (as Area Chair, 2008 and 2009; as referee 1996-2001,2004), Int. Joint Conference on Artificial Intelligence (as senior PC member, 2009, 2011), International Conference on Data Mining (as Vice-Chair, 2003), International Conference on Machine Learning (2004-2006, 2008), IEEE Int. Conference on Intelligent Systems in Molecular Biology (2003), European Conference on Machine Learning (2006-2008), IEEE Computer Society Conference on Bioinformatics (2003), European Conference on Evolutionary Computation Machine Learning and Data Mining in Bioinformatics (2008).
- Organization of scientific events:
 - Program Co-Chair, 20th International Conference on Inductive Logic Programming 2010.
 - 5th International Workshop on “Mining and Learning with Graphs”, Università degli Studi di Firenze, August 1-3, 2007 (Program Co-Chair, with K. Kersting, K. Tsuda) [3].
 - Special Session “Machine Learning in Bioinformatics”, 6th Int. Conf. on Knowledge-Based Intelligent Information Engineering Systems & Allied Technologies (September 2002).
 - Co-director, NATO Advanced Studies Institute “Artificial Intelligence and Heuristic Methods for Bioinformatics”, San Miniato, 1–11 Ottobre 2001 (A. Apostolico, P. Baldi, S. Brunak, R. Casadio, A. Covacci, D. Geiger, D. Haussler, N. Kolchanov, S. Muggleton, B. Rost, R. Serra, R. Shamir) [4].
 - Workshop “Foundations of connectionist-symbolic integration: representation, paradigms, and algorithms”, European Conference on Artificial Intelligence (ECAI), 2000.

- Workshop “Learning dynamical data structures: From sequences to graphs”, at Neural Information Processing Systems, Denver (CO), December 1997
- Scientific Publications: over 100.
- Invited book chapters: over 10.
- Authored books: 1 [1]. Edited books: 2 [2, 4].
- Invited talks and keynote speaker. Several, including the Workshop on Random Growing, and Infinite Networks (Blaubeuren, Jan 2008), 17th Annual International Conference on Inductive Logic Programming (ILP’07), Freiburg, Leuven & Friends, Workshop on Advances in Machine Learning (Montreal), 2003, Imperial College London, University of California, Irvine, University of Ulm, University College London, University College Dublin.
- Reviewer for about 25 journals, including *Machine Learning*, *Journal of Machine Learning Research*, *Bioinformatics*, *BMC Bioinformatics*, *Journal of Biological Inorganic Chemistry*, *Molecular Biology and Evolution*, *Journal of Human Evolution*.
- Reviewer for several scientific funding bodies including European Commission (STREP evaluator), European Science Foundation, European Research Council, Australian Research Council, Austrian Science Fund, Research Foundation - Flanders (Belgium), Science Foundation Ireland, Research Grants Council Hong Kong, Italian Government’s Department of Research and Education (MIUR).
- Teachers in tutorials and summer schools: several, including School of Mathematics “G. Stampacchia”, European Science Foundation Workshops, SOCRATES Intensive Programmes, NATO ASI, International Joint Conference on Artificial Intelligence (IJCAI), International School on Neural Networks.
- Present Ph.D. Students: Matteo Bertini
- Past Ph.D. Students: Alessio Ceroni (Research Assistant, Imperial College London), Fabrizio Costa (Research assistant, K.U. Leuven), Marco Lippi (Research Assistant, University of Florence) Sauro Menchetti, Andrea Passerini (Assistant Professor, University of Trento), Marc Vincent, Alessandro Vullo (Scientist, European Bioinformatics Institute).
- Awarded “E. Caianiello prize” (1996, for the Ph.D. Thesis)

Main results

Paolo Frasconi is active since 1990 in the areas of machine learning (in particular, neural networks, Markov models, kernel machines, and logic-based approaches for relational learning) and bioinformatics (in particular, protein structure and function, small molecules). Besides bioinformatics, he has contributed applications to natural language processing, text, and pattern recognition. He has published more than 100 refereed papers in the areas of machine learning and bioinformatics, collecting about 3500 citations and an h-number of 29 (Google Scholar, 2009). He is ranked 4607 in the “Citeseer Top 10,000 authors list in Computer Science”, out of a total of 790329 authors (August 2006). Main results are as follows:

- Prediction of protein structural and functional properties: cysteine bonding state and disulfide connectivity [66, 24, 21, 14, 10], discrimination between disulfide bonded and cysteines involved in prosthetic groups and metal ions [20]; subcellular localization [57, 110]; prediction of zincoproteins [56, 12] and transition metal binding sites [13, 9]; metal bonding geometry [52].
- Prediction of biological properties of small molecules [11, 57, 55, 15].
- Prediction of protein structure: secondary structure [31, 17], beta partners [7], coarse contact maps [67, 23, 65, 16];

- Neural networks and graphical models for learning structured data [89, 86, 33, 87, 83]. Algorithms for learning structured outputs [52, 8, 21]. Applications to RNA structure [8] pattern recognition problems [49, 77, 26] and fingerprint classification [74, 27].
- Structured output learning with kernel methods [52] and Markov logic networks [7].
- Kernels for data structures [57] and logical representations [58, 133, 48, 15, 55, 2]. Applications to protein fold classification [15, 2].
- Multiclass classification using support vector machines [22].
- Algorithms and models for the World Wide Web [78, 61] including a book [1] and two special issues of *ACM Trans. on Internet Technology* [124, 123].
- Natural language processing. Disambiguation in incremental parsing [81, 76, 28, 25, 19, 18]. Text categorization [29, 73]. Information extraction [48, 132]
- Sequence learning. The problem of long-term dependencies [96, 43, 92, 39]. Input-Output Hidden Markov Models (IOHMM) [94, 147, 50, 35]. Grammatical inference [93, 37, 36]. Local feedback recurrent neural networks [45] and their applications to speech recognition [100, 106].
- Integration of symbolic and subsymbolic knowledge [103, 105, 99, 42, 38].
- Optimal learning in feedforward networks [97, 40] and RBF networks [41, 34, 30].

Teaching Experience

- *Machine Learning*, 2003-Present. Graduate and PhD programs in Computer Engineering and Automation Engineering, University of Florence.
- *Artificial Intelligence*. 2004. Degree in Computer Engineering, University of Florence.
- *Algorithms and Data Structures - C++ Programming*. 2002-present. Undergraduate program in Computer Engineering, University of Florence.
- *Information Technology*. 2000-2002. Degree in Civil Engineering, University of Florence.
- *Algorithms and C programming*. Degree in Telecommunications Engineering. 2000-2002. University of Florence.
- *Fundamentals of Computer Science*. Degree in Computer Engineering. 1999. University of Cagliari.
- *Artificial Intelligence*. Degree in Computer Engineering. 1999. University of Cagliari.
- *Artificial Intelligence*, Fall 1998, School of Information Technology and Computer Science, Univ. Wollongong, (Australia)

Industrial Experience

- Consultant. 1999: Talent s.r.l, Florence (Italy); neural networks for data mining. 1995: Panerai SpA, Florence (Italy); neural networks for pattern recognition. 1993: OTE SpA Florence (Italy), speech recognition for mobile phones. 1990: IRST Trento (Italy), speech Recognition.
- Scientific Advisor. 1998: NetID Inc., Los Angeles, CA; hidden Markov models.
- Visiting researcher. 1994: Centro Studi e Laboratori Telecomunicazioni (CSELT), Turin (Italy); neural networks and IOHMMs for speech recognition.

Firenze, January 4, 2011

Paolo Frasconi

List of Publications

Books

- [1] P. Baldi, P. Frasconi, and P. Smyth. *Modeling the Internet and the Web: Probabilistic Methods and Algorithms*. John Wiley & Sons, 2003. ISBN 978-0-470-84906-4.

Edited Books/Proceedings

- [2] L. De Raedt, P. Frasconi, K. Kersting, and S. Muggleton, editors. *Probabilistic Inductive Logic Programming — Theory and Applications*. LNAI 4911. Springer, 2008. ISBN 978-3-540-78651-1.
- [3] P. Frasconi, K. Kersting, and K. Tsuda, editors. *Proceedings of the 5th Int. Workshop on Mining and Learning with Graphs (MLG'07)*. 2007.
- [4] P. Frasconi and R. Shamir, editors. *Artificial Intelligence and Heuristic Methods for Bioinformatics*. NATO Science Series (Computer and Systems Sciences). IOS Press, Amsterdam, 2003. ISBN 978-1-58603-294-4.

Refereed Journal Papers

- [5] Marco Lippi, Manfred Jaeger, Paolo Frasconi, and Andrea Passerini. Relational information gain. *Machine Learning*, pages 1–21, 2010. 10.1007/s10994-010-5194-7.
- [6] Niels Landwehr, Andrea Passerini, Luc De Raedt, and Paolo Frasconi. *Machine Learning*, 78(3):305–342.
- [7] Marco Lippi and Paolo Frasconi. Prediction of protein beta-residue contacts by markov logic networks with grounding specific weights. *Bioinformatics*, 2009.
- [8] Fabrizio Costa, Andrea Passerini, Marco Lippi, and Paolo Frasconi. A semiparametric generative model for efficient structured-output supervised learning. *Annals of Mathematics and Artificial Intelligence*, 54(1-3):207–222, 2008. Special issue on Probabilistic Relational Learning.
- [9] Marco Lippi, Andrea Passerini, Marco Punta, Burkhard Rost, and Paolo Frasconi. Metaldetector: a web server for predicting metal binding sites and disulfide bridges in proteins from sequence. *Bioinformatics*, 24(18):2094–2095, 2008.
- [10] M. Vincent, A. Passerini, M. Labbè, and P. Frasconi. A simplified approach to disulfide connectivity prediction from protein sequences. *BMC Bioinformatics*, 9(20), 2008.
- [11] A. Ceroni, F. Costa, and P. Frasconi. Classification of small molecules by two-and three-dimensional decomposition kernels. *Bioinformatics*, 23(16):2038–2045, 2007.
- [12] A. Passerini, C. Andreini, S. Menchetti, A. Rosato, and P. Frasconi. Predicting zinc binding at the proteome level. *BMC Bioinformatics*, 8(39), February 2007.
- [13] A. Passerini, M. Punta, A. Ceroni, B. Rost, and P. Frasconi. Identifying cysteines and histidines in transition-metal-binding sites using support vector machines and neural networks. *Proteins: Structure, Function, and Bioinformatics*, (65):305–316, 2006.
- [14] A. Ceroni, A. Passerini, A. Vullo, and P. Frasconi. DISULFIND: a disulfide bonding state and cysteine connectivity prediction server. *Nucleic Acids Research*, 34:W177–W181, 2006. Web Server Issue.
- [15] A. Passerini, P. Frasconi, and L. De Raedt. Kernels on prolog proof trees: Statistical learning in the ILP setting. *Journal of Machine Learning Research*, 7:307–342, 2006.
- [16] G. Pollastri, A. Vullo, P. Frasconi, and P. Baldi. Modular DAG-RNN Architectures for Assembling Coarse Protein Structures. *Journal of Computational Biology*, 13(3):631–650, 2006.
- [17] A. Ceroni, P. Frasconi, and G. Pollastri. Learning protein secondary structure from sequential and relational data. *Neural Networks*, 18(8):1029–39, 2005.
- [18] S. Menchetti, F. Costa, P. Frasconi, and M. Pontil. Wide coverage natural language processing using kernel methods and neural networks for structured data. *Pattern Recognition Letters*, 26:1896–1906, 2005.
- [19] F. Costa, P. Frasconi, V. Lombardo, P. Sturt, and G. Soda. Ambiguity resolution in incremental parsing of natural language. *IEEE Transactions on Neural Networks*, 16(4):959–71, 2005.

- [20] A. Passerini and P. Frasconi. Learning to discriminate between ligand bound and disulfide bound cysteines. *Protein Engineering Design and Selection*, 7(4):367–73, 2004.
- [21] A. Vullo and P. Frasconi. Disulfide connectivity prediction using recursive neural networks and multiple alignments. *Bioinformatics*, 20(5):653–9, 2004.
- [22] A. Passerini, M. Pontil, and P. Frasconi. New results on error correcting output codes of kernel machines. *IEEE Transactions on Neural Networks*, 15(1):45–54, 2004.
- [23] A. Vullo and P. Frasconi. Prediction of protein coarse contact maps. *Journal of Bioinformatics and Computational Biology*, 1(2):411–431, 2003.
- [24] A. Ceroni, P. Frasconi, A. Passerini, and A. Vullo. Predicting the disulfide bonding state of cysteines with combinations of kernel machines. *Journal of VLSI Signal Processing*, 35(3):287–295, 2003.
- [25] P. Sturt, F. Costa, V. Lombardo, and P. Frasconi. Learning first-pass attachment preferences with dynamic grammars and recursive neural networks. *Cognition*, 88(2):133–169, 2003.
- [26] M. Diligenti, P. Frasconi, and M. Gori. Hidden tree Markov models for image document classification. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 25(4):519–523, 2003.
- [27] Y. Yao, G.L. Marcialis, M. Pontil, P. Frasconi, and F. Roli. Combining flat and structured representations for fingerprint classification with recursive neural networks and support vector machines. *Pattern Recognition*, 36(2):397–406, 2003.
- [28] F. Costa, P. Frasconi, V. Lombardo, and G. Soda. Towards incremental parsing of natural language using recursive neural networks. *Applied Intelligence*, 19(1/2):9–25, 2003.
- [29] P. Frasconi, G. Soda, and A. Vullo. Hidden Markov models for text categorization in multi-page documents. *Journal of Intelligent Information Systems*, 18(2/3):195–217, 2002. Special Issue on Automated Text Categorization.
- [30] P. Cosi, P. Frasconi, M. Gori, L. Lastrucci, and G. Soda. Competitive radial basis functions training for phone classification. *Neurocomputing*, 34(1-4):117–129, 2000.
- [31] P. Baldi, S. Brunak, P. Frasconi, G. Soda, and G. Pollastri. Exploiting the past and the future in protein secondary structure prediction. *Bioinformatics*, 15(11):937–946, 1999.
- [32] P. Frasconi, M. Gori, and G. Soda. Data categorization using decision trellises. *IEEE Transactions on Knowledge and Data Engineering*, 11(5):697–712, 1999.
- [33] P. Frasconi, M. Gori, and A. Sperduti. A general framework for adaptive processing of data structures. *IEEE Transactions on Neural Networks*, 9(5):768–786, 1998.
- [34] P. Frasconi, M. Gori, and G. Soda. Links between LVQ and backpropagation. *Pattern Recognition Letters*, 18(4):303–310, 1997.
- [35] Y. Bengio and P. Frasconi. Input-output HMM’s for sequence processing. *IEEE Transactions on Neural Networks*, 7(5):1231–1249, 1996.
- [36] P. Frasconi and M. Gori. Computational capabilities of local-feedback recurrent networks acting as finite-state machines. *IEEE Transactions on Neural Networks*, 7(6):1521–1525, 1996.
- [37] P. Frasconi, M. Gori, M. Maggini, and G. Soda. Representation of finite state automata in recurrent radial basis function networks. *Machine Learning*, 23(1):5–32, 1996.
- [38] P. Frasconi, M. Gori, and G. Soda. Recurrent neural networks and prior knowledge for sequence processing: A constrained nondeterministic approach. *Knowledge Based Systems*, 8(6):313–332, 1995.
- [39] Y. Bengio and P. Frasconi. Diffusion of context and credit information in Markovian models. *J. Artif. Intell. Res. (JAIR)*, 3:249–270, 1995.
- [40] M. Bianchini, P. Frasconi, and M. Gori. Learning in multilayered networks used as autoassociators. *IEEE Transactions on Neural Networks*, 6(2):512–515, March 1995.
- [41] Monica Bianchini, Paolo Frasconi, and Marco Gori. Learning without local minima in radial basis function networks. *IEEE Transactions on Neural Networks*, 6(3):749–756, May 1995.
- [42] P. Frasconi, M. Gori, M. Maggini, and G. Soda. Unified integration of explicit knowledge and learning by example in recurrent networks. *IEEE Transactions on Knowledge and Data Engineering*, 7(2):340–346, 1995.
- [43] Y. Bengio, P. Simard, and P. Frasconi. Learning long-term dependencies with gradient descent is difficult. *IEEE Transactions on Neural Networks*, 5(2):157–166, March 1994.
- [44] P. Frasconi, M. Gori, and G. Soda. Daphne: Data parallelism neural network simulator. *International Journal of Modern Physics C*, 4(1):17–28, 1993. Special Issue: Science on the Connection Machine.
- [45] P. Frasconi, M. Gori, and G. Soda. Local feedback multi-layered networks. *Neural Computation*, 4(1):120–130, 1992.

Refereed International Conference Papers

- [46] Marco Lippi, Matteo Bertini, and Paolo Frasconi. Collective traffic forecasting. In Jos   Balc  zar, Francesco Bonchi, Aristides Gionis, and Mich  le Sebag, editors, *Machine Learning and Knowledge Discovery in Databases*, volume 6322 of *Lecture Notes in Computer Science*, pages 259–273. Springer Berlin / Heidelberg, 2010. 10.1007/978-3-642-15883-4_17.
- [47] Paolo Frasconi, Manfred Jaeger, and Andrea Passerini. Feature discovery with type extension trees. In Filip Zelezny and Nada Lavrac, editors, *18th International Conference on Inductive Logic Programming (ILP'08)*, volume LNCS 5194, pages 122–139. Springer, 2008.
- [48] P. Frasconi, A. Passerini, S. Muggleton, and H. Lodhi. Declarative kernels. In S. Kramer and B. Pfahringer, editors, *Inductive Logic Programming, 15th International Conference, ILP 2005, Late-Breaking Papers*, pages 17–19, 2005.
- [49] E. Francesconi, P. Frasconi, M. Gori, S. Marinai, J. Sheng, G. Soda, and A. Sperduti. Logo recognition by recursive neural networks. In K. Tombe and A. K. Chhabra, editors, *Graphics Recognition, Algorithms and Systems, Second Int. Workshop*, volume 1389 of *Lecture Notes in Computer Science*, pages 104–117. Springer, 1997.
- [50] Y. Bengio and P. Frasconi. An input output HMM architecture. In G. Tesauro, D. S. Touretzky, and T. K. Leen, editors, *Advances in Neural Information Processing Systems 7 (NIPS'94)*, pages 427–434, 1995.
- [51] Marco Lippi, Manfred Jaeger, Paolo Frasconi, and Andrea Passerini. Relational information gain (ilp). In Luc De Raedt, editor, *19th International Conference on Inductive Logic Programming (ILP'09)*, 2009.
- [52] Paolo Frasconi and Andrea Passerini. Predicting the geometry of metal binding sites from protein sequence. In Daphne Koller, Dale Schuurmans, Yoshua Bengio, and L  on Bottou, editors, *Proceedings of the Twenty-Second Annual Conference on Neural Information Processing Systems (NIPS'08)*, pages 465–472. MIT Press, 2009.
- [53] P. Frasconi. Learning with kernels and logical representations (extended abstract). In H. Blockeel, J. Ramon, J. Shavlik, and P. Tadepalli, editors, *Proc. 17th International Conference on Inductive Logic Programming*, LNAI 4893, pages 1–3. Springer, 2007. Extended abstract, invited keynote talk.
- [54] A. Vullo, A. Passerini, P. Frasconi, F. Costa, and G. Pollastri. On the convergence of protein structure and dynamics. statistical learning studies of pseudo folding pathways. In E. Marchiori and J.H. Moore, editors, *Proc. 6th European Conf. on Evolutionary Computation, Machine Learning and Data Mining in Bioinformatics (EVO-BIO'08)*, number 4973 in LNCS, pages 200–211. Springer, 2008.
- [55] N. Landwehr, A. Passerini, L. De Raedt, and P. Frasconi. kFOIL: Learning simple relational kernels. In Y. Gil and R. Mooney, editors, *Proc. Twenty-First National Conference on Artificial Intelligence (AAAI-06)*, 2006.
- [56] S. Menchetti, A. Passerini, P. Frasconi, C. Andreini, and A. Rosato. Improving prediction of zinc binding sites by modeling the linkage between residues close in sequence. In Alberto Apostolico, Concettina Guerra, Sorin Istrail, Pavel A. Pevzner, and Michael S. Waterman, editors, *Proc. Tenth Annual International Conference on Research in Computational Molecular Biology (RECOMB'06)*, volume 3909 of LNCS, pages 309–320. Springer, 2006.
- [57] S. Menchetti, F. Costa, and P. Frasconi. Weighted decomposition kernels. In *Proc. Int. Conf. on Machine Learning (ICML'05)*, 2005.
- [58] A. Passerini and P. Frasconi. Kernels on prolog ground terms. In *Int. Joint Conf. on Artificial Intelligence (IJ-CAI'05)*, Edinburgh, 2005.
- [59] A. Ceroni and P. Frasconi. On the role of long-range dependencies in learning protein secondary structure. In *Proc. IEEE Int. Joint Conf. on Neural Networks (IJCNN'04)*, volume 3, pages 1899–1904, 2004.
- [60] A. Ceroni and P. Frasconi. Protein structure assembly from knowledge of beta-sheet motifs and secondary structure. In *Int. meeting on Computational Intelligence Methods for Bioinformatics and Biostatistics*, 2004.
- [61] F. Costa and P. Frasconi. Distributed community crawling. In *Proc. 13th Int. Conf. on World Wide Web (WWW'04)- Alternate Track Papers & Posters*, page 362, New York, 2004.
- [62] S. Menchetti, F. Costa, P. Frasconi, and M. Pontil. Convolution kernels and recursive neural networks for learning preferences on structured data. In *IAPR-TC3 Int. Workshop on Artificial Neural Networks in Pattern Recognition*, 2003.
- [63] A. Vullo and P. Frasconi. A recursive connectionist approach for predicting disulfide connectivity in proteins. In *Eighteenth Annual ACM Symposium on Applied Computing (SAC '03)*, pages 67–71, 2003. Special Track on Bioinformatics.

- [64] A. Ceroni, P. Frasconi, A. Passerini, and A. Vullo. A combination of support vector machines and bidirectional recurrent neural networks for protein secondary structure prediction. In A. Cappelli and F. Turini, editors, *AI*IA 2003: Advances in Artificial Intelligence*, volume 2829 of *Lecture Notes in Computer Science*, pages 142–153. Springer-Verlag, 2003.
- [65] G. Pollastri, P. Baldi, A. Vullo, and P. Frasconi. Prediction of protein topologies using generalized IOHMMs and RNNs. In S. Becker, S. Thrun, and K. Obermayer, editors, *Neural Information Processing Systems (NIPS'02)*, pages 1449–1456. MIT Press, 2002.
- [66] P. Frasconi, A. Passerini, and A. Vullo. A two-stage SVM architecture for predicting the disulfide bonding state of cysteines. In *IEEE Neural Networks for Signal Processing*, pages 25–34, 2002.
- [67] A. Vullo and P. Frasconi. A bi-recursive neural network architecture for the prediction of protein coarse contact maps. In *1st IEEE Computer Society Bioinformatics Conference (CSB'02)*, pages 187–196, Stanford, CA, 2002.
- [68] P. Frasconi and A. Vullo. Prediction of protein coarse contact maps using recursive neural networks. In *Proc. IEEE-EMBS Conference on Molecular, Cellular, and Tissue Engineering*, 2002.
- [69] A. Passerini, M. Pontil, and P. Frasconi. From margins to probabilities in multiclass learning problems. In Frank van Harmelen, editor, *15th European Conf. on Artificial Intelligence*, pages 400–404, Lyon, 2002.
- [70] F. Costa, P. Frasconi, V. Lombardo, P. Sturt, and G. Soda. Enhancing first-pass attachment prediction. In Frank van Harmelen, editor, *15th European Conf. on Artificial Intelligence*, pages 508–512, Lyon, 2002.
- [71] F. Costa, P. Frasconi, P. Sturt, and V. Lombardo. Exploring the effect of experience on a recursive neural network mode of structural preferences. In *15th Annual CUNY Conference on Human Sentence Processing*, New York, 2002.
- [72] F. Costa, P. Sturt, V. Lombardo, and P. Frasconi. The effect of experience on a hybrid model of human first-pass attachment preferences. In *Int. Conf. Architectures and Mechanisms of Language Processing (AMLaP'01)*, Saarbruecken, 2001.
- [73] P. Frasconi, G. Soda, and A. Vullo. Text categorization for multi-page documents: A hybrid naive bayes HMM approach. In *ACM-IEEE Joint Conference on Digital Libraries (JCDL'01)*, pages 11–20, Roanoke, VA, 2001.
- [74] G. L. Marcialis, F. Roli, and P. Frasconi. Fingerprint classification by combination of flat and structural approaches. In *3rd Int. Conf. on Audio- and Video-Based Biometric Person Authentication*, volume 2091 of *Lecture Notes in Computer Science*, pages 241–246. Springer, 2001.
- [75] Y. Yao, P. Frasconi, and M. Pontil. Fingerprint classification with combinations of support vector machines. In *3rd Int. Conf. on Audio- and Video-Based Biometric Person Authentication*, volume 2091 of *Lecture Notes in Computer Science*, pages 253–258. Springer, 2001.
- [76] P. Sturt, V. Lombardo, F. Costa, and P. Frasconi. A wide-coverage model of first-pass structural preferences in human parsing. In *14th Annual CUNY Conference on Human Sentence Processing*, New York, 2001.
- [77] M. Diligenti, P. Frasconi, and M. Gori. Image document categorization using hidden tree-markov models and structured representations. In *Second International Conference on Advances in Pattern Recognition*, volume 2013 of *Lecture Notes in Computer Science*, pages 147–156. Springer, 2001.
- [78] A. Passerini, P. Frasconi, and G. Soda. Evaluation methods for focused crawling. In F. Esposito, editor, *AI*IA 2001: Advances in Artificial Intelligence, 7th Congress of the Italian Association for Artificial Intelligence*, volume 2175 of *Lecture Notes in Computer Science*, pages 33–39. Springer, 2001.
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