

The Pisa approach to Logic Programming

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Logic and Energy: a visionary Inspirator
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Why a success story?

A retrospect

- Giorgio's charisma and leadership
- The background of the IEI group
- A theoretical approach always motivated by complex applications needs
- A vision of what CS would or could be

How?: An annotated bibliography

From image processing and pattern recognition to AI

- Ceccarelli M., Giorgi P., Grasselli, A., Levi G., Paci A., Sirovich F., **1969**, An Approach to quantitative analysis of dermatoglyphics by digital computer, PANMINERVA MEDICA, pp.386- 389, Vol.11, 7-8,
- Levi, G., and Montanari, U., A Grey-weighted Skeleton, Information and Control, Vol. 17, N. 1, pp. 62-91, **1970**
- G. Levi, F. Sirovich, 1972, Structural Description of Fingerprint **Images**, INFORMATION SCIENCES, pp.327- 355, Vol.4
- G. Levi, Franco Sirovich, 1973. Generalized AND/OR graphs and their relation to formal grammars
- G. Levi, Franco Sirovich, 1973. Pattern Matching and **Goal Directed Computation**
- Giorgio Levi, Fabrizio Luccio: A technique for graph embedding with **constraints** on node and arc correspondences. Inf. Sci. 5: 1-24 (1973)



AI: languages, semantics, theorem proving and problem solving

- **G. Levi, A Martelli, U. Montanari, C. Montanero, G. Pacini, G. Prini, F. Sirovich, F. Turini**, 1973. Progettazione ed implementazione del linguaggio **LISPP** per intelligenza artificiale, UMI, Siena,
- G. Levi, F. Sirovich, 1974. **Valutazione Simbolica e Unificazione**, Editrice tecnico scientifica, Pisa
- Giorgio Levi, Franco Sirovich: A Problem Reduction Model for Non-Independent Subproblems. **IJCAI 1975**: 340-344



The role of new PL's with clear semantics to prove properties

- Giorgio Levi, Franco Sirovich: **Proving Program Properties**, Symbolic Evaluation and **Logical Procedural Semantics**. MFCS 1975: 294-301
- G. Levi, Franco Sirovich, 1977. **TEL (Term Equation Language)**: A Proof-Theoretic Language for Efficient Symbolic Expression Manipulation
- G. Levi, Franco Sirovich, 1977. Procedural Axiomatization in **Program Verification**
- Marco Bellia, Giorgio Levi: Distributed Control, Modularity and Data Types in a Simple **Parallel Language**. International Computing Symposium 1977: 441-450



Putting semantics at work

- Patrizia Asirelli, Pierpaolo Degano, Giorgio Levi, Alberto Martelli, Ugo Montanari, Giuliano Pacini, Franco Sirovich, Franco Turini: **A Flexible Environment for Program Development** Based on a Symbolic Interpreter. ICSE **1979**: 251-264

1979-1986 CNET:

- Communication networks
- System language
- Semantic models
- Integrated environment for sw development
- Office automation



The beginning of LP in Pisa: Logic + Functional and Concurrency

- Bellia, M., P. Degano, and G. Levi, "**A Functional plus Predicate Logic Programming Language**," in Workshop on Logic Programming, Debrecen, Hungary (July **1980**).
- Bellia, M., P. Degano, G. Levi, E. Dameri, and M. Martelli, "From Term Rewriting Systems to **Distributed Program Specifications**," Technical Report, IEI-B80-34, Italy (**1980**) => **Applicative communicating processes** in first order logic. Symposium on Programming 1982: 1-14

“The distributed systems we want to model can be viewed as dynamically evolving **Systems of Computing Agents (SCA)**” [set of agents interconnected through channels]

Consolidating the group

- Roberto Barbuti, Pierpaolo Degano, Giorgio Levi: Toward an Inductionless Technique for **Proving Properties of Logic Programs**. ICLP 1982: 175-181
- M. Bellia, G. Levi, M. Martelli. “On **compiling PROLOG programs** on a demand driven architecture”. *Proc. 2nd Logic Programming Workshop*, Albufeira, 1983
- C. Palamidessi, G. Levi. On the **fixed point semantics** of Horn clauses with infinite terms. Informal Proc. of the *Workshop on Logic Programming*, pages 474-484, Albufeira, Portugal, 1983
- R. Barbuti, M. Bellia, G. Levi, M. Martelli. “On the **integration of Logic Programming and Functional Programming**”. *Proc. of the Int. Symp. on Logic Programming*, Atlantic City, IEEE, pp. 160-166, 1984
- M. Falaschi, G. Levi, C. Palamidessi. **A synchronization logic**: Axiomatics and formal semantics of generalized Horn clauses. *Information and Control*, 60(1-3):36-69 1984

Concurrency, L+F, The S- semantics

- Giorgio Levi : Logic Programming: The Foundations, the Approach and the Role of **Concurrency**, 1986
- Roberto Barbuti, Marco Bellia, Giorgio Levi, Maurizio Martelli: **LEAF**: A Language which Integrates Logic, Equations and Functions. Logic Programming: Functions, Relations, and Equations 1986: 201-238
- Giorgio Levi, Catuscia Palamidessi : An Approach to the Declarative Semantics of **Synchronization** in Logic Languages, ICLP(JICSLP), 1987
- Moreno Falaschi, Giorgio Levi : Finite Failures and Partial Computations in **Concurrent Logic Languages**, FGCS, 1988
- Moreno Falaschi, Giorgio Levi, Maurizio Martelli, Catuscia Palamidessi: **A New Declarative Semantics** for Logic Languages. ICLP/SLP 1988: 993-1005

Main directions

- S-semantics: more informative to capture all the different computational aspects (negation, infinite comp.,...)
- Language integration (functional, constraints, objects, higher order,...)
- Semantics at work: abstract interpretation, metaprograms,...
- Concurrency

Conclusion

- For being part of a extraordinary group of people
- For being taught how to do research
- For being a friend
- For being the Best Man at my wedding



Thank you
Giorgio