Vita, Work, and Publications of Georg Gottlob

October 2007

Contents

1 Personal Data

Name: Georg GOTTLOB

Academic Degrees:

- Diplom-Ingenieur (M.Sc., Vienna University of Technology, 1979)
- Doctor of Technical Sciences (Vienna Univ. of Technology, 1981)
- Master of Arts (MA, Oxford University, by resolution, 2006)

Current Positions: Professor of Computing Science at Oxford University, and Adjunct Professor of Computer Science at the Vienna University of Technology.

Date and place of birth: June 30th 1956, Vienna, Austria

Nationalities: Austrian and Italian

Working address at Oxford: Oxford University Computing Laboratory, Wolfson Building, Parks Road, Oxford, OX1 3QD, England. Direct phone: +44 (0)1865 283504, Department phone: +44 (0)1865 273838, fax: +44 (0)1865 273839.

Working address in Vienna: "Institut für Informationssysteme" (Institute of Information Systems), Vienna Technical University, Favoritenstraße 9-11, A-1040 Vienna, Austria. Phone: ++43-1-58801-18420, Fax: ++43-1-58801-18492.

Private address at Oxford: 15 The Villas Rutherway, Oxford OX2 6QY UK. Phone: ++44-1865-556927, mobile: ++44-7722-883832

Private address in Vienna: Pressgasse 21/6, A-1040 Vienna, Austria. Phone: ++43-1-5863444, mobile: ++43-1-650-4688562.

Private address in Italy: Vico Nereo 2, I-16167 Genova, Italy. Phone: ++39-1-321673, mobile: ++39-347-8524086.

Email: georg.gottlob@comlab.ox.ac.uk

2 Short Bio, Education & Professional Experience

- *30th June 1956* Birth in Vienna, Austria
- *1962 - 1974* "Lycée Français" school, Vienna, Austria.
- *28th June 1974* High School Diploma (Baccalauréat).
- *1974 - 1979* Mathematics and Computer Science studies at the Vienna University of Technology (TU Wien).
- *13th Dec. 1979* Diplomingenieur (M.Sc.) in Computer Science. Thesis: "Simulation of interactively guided streetcar networks".
- *May 1980 - April 1082* University Assistant at the "Institut f"ur Angewandte Informatik und Systemanalyse" (Institute of Applied Computer Science and Systems Analysis) at TU Wien.
- *June 1981* "Doktor der technischen Wissenschaften", cum laude, TU Wien, thesis: "Multivalued Logic - Structure and Application in Computer Science"
- *Sept. 1982 - Dec. 1984* Research Associate at Politecnico di Milano, Department of Electrical Engineering.
- *Jan. 1984 - Dec. 1984* Chief consultant of the industrial research project DATANET-SAD: Development and implementation of a distributed file-server for Olivetti Microcomputers, Milano (Italy), A.R.G.-S.P.A. software company.
- *Jan. 1985 - Feb. 1988* Researcher at the Institute of Applied Mathematics of C.N.R. (Italian National Research Council), Genoa, Italy.
- *Jun.-Sept.1985 and 1986* Research Scholar at Stanford University (Invited by Gio Wiederhold) and lecturer of the course "Distributed Databases" (jointly with S.Ceri)
- *June-July 1987* Research Scholar and Lecturer at Stanford University.
- *Since 1st March 1988* Professor of Computer Science at the Vienna University of Technology (TU Wien), "Institut für Informationssyteme" (Institute of Information Systems).

- *Oct. 1989 – Sept. 1996* Director of the Christian Doppler Laboratory for Expert Systems (Laboratory for basic research in the field of expert systems, located at TU Vienna but industrially funded).
- *Since 1988* Head of the Database and AI Group of the Information Systems Department of Vienna TU (currently about 20 employees).
- *1991 – 1998* and *2001-2003* Chairman of the Information Systems Department of Vienna TU.
- *Summer semester 1993* Sabbatical at the ETH Zurich, Switzerland.
- *July 1998* Recipient of the Wittgenstein Award.
- *Spring term 1999* Invited McKay Professor at the Computer Science Division, EECS Department, University of California, Berkeley.
- *May 1999* Elected Corresponding Member of the Austrian Academy of Sciences.
- *November 2001* Co-Founder of the *Lixto Software GmbH* company (www.lixto.com), a spin-off of TU Wien offering software and services for data extraction and integration. Lixto was a finalist in the 2003 World Technology Award competition.
- *February 2002* Visiting Professor, Université Paris VII, Denis Diderot.
- *May 2004* Elected Full Member of the Austrian Academy of Sciences.
- *Since 1 January 2006* Professor of Computing Science, Oxford University.
- *Since 1 January 2006* Fellow of St. Anne's College, Oxford University.
- *March 2006* Elected Member of the German Academy of Sciences Leopoldina.
- *April 2006* Royal Society Wolfson Research Merit Award.
- *April 2006* Elected Member of the *Academia Europaea*, London.
- *September 2008* Founding Member of the Oxford Man Institute of Quantitative Finance.

3 Research Interests

- Web Data Extraction, Data Integration, and Data Exchange
- Database Theory
- Algorithms for semistructured data and XML processing
- Graph or hypergraph based algorithms for problem decomposition
- Knowledge Representation and Reasoning
- Complexity in AI and Logic Programming
- Complexity Theory
- Finite Model Theory and Descriptive Complexity
- Computational Logic.

4 Short Description of Selected Scientific Results

In the following, I briefly summarize a number of scientific achievements. I will list selected results in form of short abstracts, giving priority to the more recent results. For a more complete picture, please consult the list of my publications in Section 9.

Web Data Extraction. Web data extraction consists of automatically identifying structured data on web pages and loading the data into a database or other EDP application. A comprehensive theory of Web data extraction and data extraction from semi-structured documents was developed in [8, 105]. A first basic insight was that data extraction from tree-structered documents is a task which can be essentially described by monadic logic, and that, in particular, monadic second order logic (MSO) is a well-suited formalism for describing most relevant data extraction tasks. Since MSO is not a practical language and has a high expression complexity, we looked for a simpler extraction language having the same expressive power. We identified *monadic datalog* as a good candidate and proved that, over tree structures, monadic datalog has exactly the same expressive power as MSO, but much lower complexity (size of program times size of input document). We designed and implemented the Lixto system [110, 111, 115, 96] for visual data extraction. This system allows a designer to develop a wrapper, that is, an information extraction program, by mainly visual and interactive

operations performed on a sample document. These wrappers are formulated in an extension of monadic datalog. This means that monadic datalog programs over HTML-trees, and thus MSO mappings, can be essentially defined in a visual and interactive manner. The Lixto sytem was further developed by the spin-off company *Lixto Software*, descibed in more detail in Section 8, and is now heavily used by the industry. Our theoretical results on data extraction [105] got the best paper award at ACM PODS 2002. The Lixto software was a finalist in the World Technology Award competition 2003 in San Francisco.

XPath: Algorithms and Complexity. XPath is an important query language for XML documents, allowing one to specify a set of nodes (i.e., objects) in a document. XPath is a sublanguage of the query and transformation language XSLT and has been implemented in several query processors, and in browsers such as Internet Explorer 6. While all these systems require exponential time in the worst case for answering XPath queries, we have developed a polynomial XPath evaluation algorithm in [7, 104], and thus shown that XPath is a tractable language. In [102] we have shown that relevant fragments of XPath can be evaluated with highly parallel algorithms. In [6, 103] we have made a detailed complexity analysis of XPath evaluation, clarifying the complexity for the most relevant fragments, and showing that Core XPath (the logical core fragment of XPath) is PTIME-complete, while other fragments lie in lower complexity classes. The theoretical research was complemented by an implementation and experimental evaluation of the new XPath algorithm [7]. A patent on our new XPath evaluation algorithm has been granted.

Algorithms for Data Exchange. Data Exchange is the problem of inserting data structured under a source schema into a target schema of different structure (possibly with integrity constraints), while reflecting the source data as accurately as possible. In their recent paper "Data Exchange: Getting to the Core" (ACM PODS'03), Fagin, Kolaitis, and Popa have proposed an elegant solution to the data exchange problem that is based on the notion of the core of a structure and of the core of a data exchange problem. In [94], computational issues related to this approach were studied, and new, more efficient algorithms were developed, showing that data exchange is tractable in presence of full tuple generating dependencies. This answered an open problem posed by Fagin and colleagues. Based on this work, in [86, 1] a yet more general central problem posed by Fagin et al. is solved positively. It was proved that data exchange with cores in its most general considered

version is tractable.

Hypertree Decompositions. The concepts of *tree decomposition* and *treewidth* (a cyclicity measure for graphs) introduced by the well-known graph theorists Robertson and Seymour in 1986[1] was of great profit to Computer Science. Many NP hard problems turned out to be tractable on instances whose underying graphs have bounded treewidth. However, the structure of many problems is better described by hypergraphs than by graphs. We were thus looking for suitable hypergraph decomposition methods with similar properties as treewidth, and forged the new decomposition concept of *hypertree hypertree decompositions (HD)* and the associated notion of *hypertree width (HW)* [13, 130]. This decompoition has several favorable properties: For every constant k, it can be determined in polynomial time whether a given hypergraph has HW k, and in the positive case, a HD of width k can be computed, moreover, many problems such as conjunctive query evaluation, and constraint satisfaction problems (CSPs), which are NP complete in general, can be solved in polynomial time for instances of bounded HW. Solving an open problem, we showed that for a different decomposition method proposed by Chekuri and Rajaraman[2], it is NP-hard to determine whether a hypergraph has bounded width. A natural game-theoretic characterization of hypertree-width was given in [17, 114], where it was shown that a hypergraph has HW k iff k "marshals" (each of which can control a hyperedge) can capture a robber who can move freely along connected hyperedges not occuppied by marshals. In [19, 128, 11], the concept of hypertree width is compared to various other hypergraph decomposition methods and it is shown that hypertree-width is so far the most general method. We are currently continuing our research on hypertree decompositions in various directions: Finding new and faster decomposition algorithms, generalizing the concept, extending the range of applications.

Dualization of Monotone Boolean Functions and Hypergraph Transversal Computation. In [107, 12] we studied the problem of dualizing a monotone CNF (equivalently, computing all minimal transversals of a hypergraph), whose associated decision problem is a prominent open problem in NP-completeness. We present a number of new polynomial time resp. output-polynomial time results for significant cases, which largely advance

[1] Robertson, N. and Seymour, P. D., Graph minors II. Algorithmic aspects of tree-width, J. Algorithms 7, 1986, pp.309-322.

[2] C.Chekuri and A.Rajaraman, Conjunctive Query Containment Revisited, Proc. 6th . Intl. Conf on Database Theory, Springer LNCS 1186, 1987, pp. 56-70.

the tractability frontier and improve on previous results. Furthermore, we show that duality of two monotone CNFs can be disproved with limited nondeterminism. More precisely, this is feasible in polynomial time with $O(\chi(n) \cdot \log n)$ suitably guessed bits, where $\chi(n)$ is given by $\chi(n)^{\chi(n)} = n$; note that $\chi(n) = o(\log n)$. This result sheds new light on the complexity of this important problem. Earlier results on tractable cases and various applications were dicussed in [31].

Computing Pure Nash Equilibria of Strategic Games. In [5, 101], we investigate complexity issues related to pure Nash equilibria of strategic games. We show that, even in very restrictive settings, determining whether a game has a pure Nash equilibrium is NP-hard, while deciding whether a game has a strong Nash equilibrium is Σ_2^P-complete. We then study practically relevant restrictions that lower the complexity. In particular, we are interested in quantitative and qualitative restrictions of the way each player's move depends on moves of other players. We say that a game has small neighborhood if the utility function for each player depends only on (the actions of) a logarithmically small number of other players. The dependency structure of a game $\mathcal{G}$ can be expressed by a graph $DG(G)$ or by a hypergraph $H(G)$. By relating Nash equilibrium problems to constraint satisfaction problems (CSPs), we show that if G has small neighborhood and if $H(G)$ has bounded hypertree width (or if $DG(G)$ has bounded treewidth), then finding pure Nash and Pareto equilibria is feasible in polynomial time. If the game is graphical, then these problems are LOGCFL-complete and thus in the class NC_2 of highly parallelizable problems.

Complexity of and Algorithms for Acyclic Conjunctive Queries In [15] we study the complexity of evaluating acyclic Boolean conjunctive queries in relational databases. By well-known results of Yannakakis[3], this problem is solvable in polynomial time; its precise complexity, however, was unknown. We showed that the problem of evaluating acyclic Boolean conjunctive queries is complete for LOGCFL, the class of decision problems that are logspace-reducible to a context-free language. Since LOGCFL is contained in AC_1 and in NC_2, the evaluation problem of acyclic Boolean conjunctive queries is highly parallelizable. We present a parallel database algorithm solving this problem with a logarithmic number of parallel join operations. The algorithm is generalized to computing the output of relevant classes of nonboolean queries. The LOGCFL-completeness result is extended

[3]Proc. Intl. Conf. on Very Large Data Bases, VLDB'81, Cannes, France, 1981, pp.82–94

to the class of queries of bounded treewidth, boubed hypertree width and to other relevant query classes which are more general than the acyclic queries.

Second Order Logic over Strings and Graphs. Fagin's theorem, the first important result of descriptive complexity, asserts that a property of graphs is in NP if and only if it is definable by an existential second-order formula. In [10, 117] we study the complexity of evaluating existential second-order formulas that belong to *prefix classses* of existential second-order logic, We completely characterize the computational complexity of prefix classes of existential second-order logic (ESO) in three different contexts: (1) over directed graphs, (2) over undirected graphs with self-loops and (3) over undirected graphs without self-loops. Our main result is that in each of these three contexts a *dichotomy* holds, that is to say, each prefix class of existential second-order logic either contains sentences that can express NP-complete problems, or each of its sentences expresses a polynomial-time solvable problem. Establishing this dichotomy over undirected graphs without self-loops turned out to be a technically challenging problem that requires the use of sophisticated machinery from graph theory and combinatorics, including results about graphs of bounded tree-width and Ramsey's theorem. A similar characterization of ESO prefix classes over strings (finite words) was carried out in [26, 136] and for full second order formulas in [125].

NP-Trees. In [23, 152], I consider problems and complexity classes definable by interdependent queries to an oracle in **NP**. How the queries depend on each other is specified by a directed graph G. I first study the class of problems where G is a general dag and show that this class coincides with Δ_2^P. I then consider the class where G is a tree. The main result states that this class is identical to $\mathrm{P}^{\mathrm{NP}}[O(\log n)]$, the class of problems solvable in polynomial time with a logarithmic number of queries to an oracle in NP. This result has interesting applications in the fields of modal logic and artificial intelligence. In particular, we show that the following problems are all $\mathrm{P}^{\mathrm{NP}}[O(\log n)]$-complete: validity-checking of formulas in Carnap's modal logic, checking whether a formula is almost surely valid over finite structures in modal logics **K**, **T**, and **S4** (a problem recently considered by Halpern and Kapron), and checking whether a formula belongs to the stable set of beliefs generated by a propositional theory.

Complexity of Nonmonotonic Reasoning. During the early nineties, a series of studies on the complexity and expressive power of nonmonotinic reasoning was carried out. In [37], the exact complexity of reasoning in default logic and in autoepistemic logic with Π_2^P [37]. Prior to this, the known

lower bound had been NP and co-NP, while the exact complexity had remained open. The complexity of circumscriptive reasoning cite was an open problem, too. This problem was solved in [47] by proving that the reaoning with circumscription is also complete for classes at the second level of the polynomial-time hierarchy. In [30], the complexity of abductive reasoning is explored, while [48, 44] studies computational issues of knowledge base revision. It generally emerged that all main forms of nonmonotonic reasoning are complete for appropriate classes of the second level of the polynomial hierarchy and thus presumably harder than classical reasoning, because the nonmonotonic reasoning tasks incorporate two orthogonal sources of complexity (intractability). For many of these problems, our complexity results led to the identification of relevant tractable subclasses (where bouth complexity sources are eliminated). Another open problem was concerned with the intertranslatability betweeen nonmonotonic formalisms (and thus with expressive power). In particular, it was unclear whether default logic (DL) could be translated to (embedded into) standard autoepistemic logic (AEL). This problem was solved in [24], where such a translation was constructed, but where it was also shown that there exists no modular translation from DL to AEL. I a more recent paper [20, 87] , the fixed parameter tractability of nonmonotonic reasoning and logic programming was studied and several fixed-parameter tractable settings were identifid.

First Order Logic with Henkin Quantifiers and Oracle Computations. In [40, 142], the exact expressive power of first order logic (FO) extended by Henkin quantifiers on finite models was determined. This problem was originally posed by the well known logicians Blass and Gurevich[4], in 1986 and remained unsolved until the publication of [142]. A general theory for determining the complexity of FO extended by generalized quantifiers was developed and it was shown that, for a large class of generalized quantifiers, the extension of FO by such quantifiers corresponds to the addition of an oracle to a LOGSPACE Turing machine. Further results on generalized quantifiers and oracles were obtained in [67] and in and [138], where it was shown that a hierarchy of relativized complexity classes (defined using oracles from a specific class) collapses to its first level.

Subsumption Algorithms and Redudancy Elimination from Clause sets. Clause subsumption is an important technique for eliminating redundant clauses from the search space of a theorem prover. Subsumption tests are rather expensive. In [38] we analyzed the complexity of existing meth-

[4]Annals of Pure and Applied Logic 32(1986)

ods and developed a new, much more efficient subsumption algorithm. A refinement of the new method was presented in[162]. Our subsumption algorithms have since be used in a number of theorem provers and deductive systems. A comparison between subsumption and clause implication was reported in [53]. An algorithm is given which reduces the (in the general case undecidable) implication test in many cases to a subsumption test. This result is used in the area of Inductive Logic Programming. The problem of eliminating redundency from a single clause is addressed in [49]. The complexity of the (function free) Horn clause implication problem (whether a univesally quantified function free Horn clause logically implies another one) was more recently studied in [16].

Translating SQL into Relational Algebra. In [41] a first translation of the database query language SQL into (extended) relational algebra was given. This was the first publication of a formal semantics for SQL (before this language was standardized).

Functional Dependencies: Projections and Irredundant Covers. I developed a practical algorithm for the projection of the functional dependencies of a database schema onto a subschema [147]. While the general problem is NP hard, this algorithm behaves polynomially for a large class of input instances covering an overwhealming part of realistic instances arising in the practice of database design. This algorithm has been used in several software systems for the design of databases, which have been reported in the literature, and is often referenced in textbooks. The following problem was introduced by B. Thalheim as an open problem[5]: Given a non redundant set F of functional dependencies; Such that r is the smallest number of dependencies in a superset which is equivalent to F. How much can r and $|F|$ differ? In [55] I solved this problem and showed that all non-redundant supersets differ in their cardinality by only a minimal factor. In practice this means that the so called "optimal superset" (whose computation is NP-hard) does not need to be computed because all non-redundant (polynomially computable) supersets are very close to the optimal.

[5]EATCS-Bulletin No.32, June 1987, problem 174

5 Professional Activity

- **Invited conference talks.**

  - DL2008 The 21st International Workshop on Description Logics, May 2008, Dresden, Germany

  - SIEEEM'07 Symposium of the IEEE in Monterrey, Monterrey, Mexico, November 1-3, 2007.

  - AutoMathA 2007 Automata: from Mathematics to Applications Palermo, Italy, June 18-22, 2007.

  - CILC 2007 Convegno Italiano di Logica Computazionale Italian Conference on Computational Logic, Messina, Italy, June 2007.

  - BCTCS 2007: British Colloquium for Theoretical Computer Science, Oxford, April 2007.

  - British Logic Colloquium, Oxford, September 2007.

  - ODSA 2006: Optimal Discrete Structures and Algorithms, Rostock (Germany), September 04 - 06, 2006

  - BNCOD 2006: 23rd British National Conference on Databases Queen's University Belfast, Northern Ireland, July 18– 20, 2006.

  - MathCSP 2006: International Workshop on Mathematics of Constraint Satisfaction: Algebra, Logic and Graph Theory. St. Anne's College, University of Oxford, March 20–24, 2006.

  - Information Sciences of New Era: Brain, Mind and Society, Sendai, Japan, Sept. 26-27, 2005.

  - WG 2005: 31st International Workshop on Graph-Theoretic Concepts in Computer Science, Metz, France, June 23-25, 2005.

  - BTW 2005: 12th Conference of the German Computer Science Society on Database Systems for Business, Technology, and the Web (12. GI-Fachtagung Datenbanksysteme für Business, Technologie und Web), Karlsruhe, Germany, Winter 2005.

  - IJCAR 2004: International Joint Conference on Automated Reasoning. Cork, Ireland, July 4-8, 2004.

  - 23 ACM SIGMOD-SIGACT- SIGART Symposium on Principles of Database Systems (PODS 2004) Paris, France - June 14-16, 2004

  - Third International Symposium on Foundations of Information and Knowledge Systems (FoIKS 2004), Vienna (Austria), February 17 - 20, 2004.

  - IEEE/WIC International Conferences on Web Intelligence and Intelligent Agent Technology, (WI/IAT-03), Halifax, Canada, Oct. 13-16, 2003.

  - LICS 2002, IEEE Symposium on Logic in Computer Science, Copenhagen, Denmark, July 2002.

- Logics in Artificial Intelligence JELIA'02, Calabria, Italy, September 2002.

- Ninth International Workshop on Nonmonotonic Reasoning NMR 2002, Toulouse, France, April 2002.

- Symposium on the Effectiveness of Logic in Computer Science (ELICS), Saarbruecken, Germany, March 4-6, 2002.

- Invited system demo and paper at Intern. Workshop on Logic Programming and Nonmonotonic Reasoning (LPNMR), Vienna, 2001.

- 26th International Symposium on Mathematical Foundations of Computer Science (MFCS'01), Mariánské Lázně, CFR, 2001.

- 5th International Conference on Developments in Language Theory (DLT'01), Vienna, July 16-21, 2001.

- 7th International Conference on Logic Programming and Automated Reasoning (LPAR 2000), Reunion Island, Frankreich, November 2000.

- DEXA'99 Database and Expert Systems Applications, Florence, Italy, August/September 1999

- International Symposium on Knowledge Representation and Reasoning (KR'96), Cambridge, MA, Nov. 1996.

- 11th International Logic Programming Symposium (ILPS), Ithaca, NY, 1994.

- Logics in Artificial Intelligence JELIA'94, York, UK, 1994.

- 12th International Conference on Fundamentals of Computation Theory, (FCT'97), Krakow, September 1997.

- Second Intern. Workshop on Logic Programming and Nonmonotonic Reasoning (LPNMR), Lisbon, 1993.

- International Symposium on Mathematical Foundations of Computer Science (MFCS), Prague, 1995.

- International Summer School on Logic Programming, Alghero, Italy, June 1996.

- Conference on Inductive Logic programming (ILP'97), Prague, September 1997.

- Italian Artificial Intelligence Conference 1997, Rome, Sept. 1997.

- LLC'99 Third International Symposium on Language, Logic and Computation, Batumi, Georgia, September 1999.

- Workshop on Proof Theory, Complexity and Meta-mathematics, Kurt Gödel Society, Vienna, April 1994.

- European Conference on Computer Assisted Systems Theory (EUROCAST), Innsbruck, 1995.

- First COMPULOG Net Meeting on Knowledge Bases, Munich, 1992.

- Logic Colloquium 95, Haifa, Israel, 1995. Workshop on Non-monotonic Reasoning.

- Finite Model Theory Workshop, Oberwolfach, Germany, 1998.

- Workshop on Finite Model Theory and Implicit Complexity, at FLOC'99, Trento, July 1999.

- **Other Invitations and visits.** Over 120 talks at different european and US universities or research institutions (which are not listed in detail). Research and teaching activity at a number of different universities, e.g. Stanford University (overall 9 month), UNAM Mexico (intensive course, 1 week), ETH Zürich (sabbatical), UC Berkeley (visiting professor), Paris VII (visiting professor).

- **Awards, Scholarships, and Distinctions**

  - 1979 President Schärf Award and Scholarship.
  - Italian Government Scientific Visitor Scholarship (1982).
  - Appreciation Certificate for contributing to the educational program of Stanford University, 1985.
  - Award of the Italian Society of Electrical Engineers, 1988 (with P. Paolini and R. Zicari).
  - Medal from Helsinki University for scientific achievements, 1995.
  - Senior Fellow of the Christian Doppler Society, 1996.
  - 1998 Wittgenstein Award
  - 1999 Invited McKay Professor at the Computer Science Division, EECS Department, University of California, Berkeley.
  - 1999 Elected Corresponding Member of the Austrian National Academy of Sciences.
  - 1999 Best Paper Award (with F. Scarcello and M. Sideri) at the 5th International Conference on Logic Programming and Nonmonotonic Reasoning. El Paso, Texas.
  - 2000 Honorary Scientist of the Guizhou Academy of Sciences, Guyang, Guizhou, China.
  - 2002 Best Paper Award (with Ch. Koch) at the 21st ACM SIGACT-SIGMOD-SIGART Symposium on Principles of Database Systems (PODS), Madison, Wisconsin, June 2002.
  - 2002 Visiting Professor, Université Paris VII, Denis Diderot.

- 2002 Fellow of ECCAI, the European Artificial Intelligence Society: "For Pioneering Work in the Field of Artificial Intelligence, and Outstanding Service for the European Artificial Intelligence Community".
- 2004 Elected Full Member of the Austrian National Academy of Sciences.
- 2005 ACM Recognition of Service Award (in Appreciation for Contributions to ACM - General Chair PODS 2005).
- 2006 Elected Member of the German Academy of Sciences Leopoldina.
- 2006 Royal Society Wolfson Research Merit Award.
- 2006 Elected Member of the European Academy of Sciences *Academia Europaea*.
- 2006 Selected as *Highly Cited Scientist* by the Institute of Scientific Information (ISI).
- 2007 Best Paper Award (with Z. Miklos and Th. Schwentick) at the 26st ACM SIGACT-SIGMOD-SIGART Symposium on Principles of Database Systems (PODS), June 2007, Beijing, China.

- **Chair and membership of program committees or conferences.**

  Chairs:

  - General Chair of the 24th and 25th ACM SIGMOD SIGACT SIGART Symposia on Principles of Database Systems (PODS'2005 and 2006).
  - Program Chairman of IJCAI'03, International Joint Conference on Artificial Intelligence, Acapulco, Mexico, 2003.
  - Program Chairman of the 19th ACM SIGMOD SIGACT SIGART Symposium on Principles of Database Systems (PODS'2000), Dallas, Texas.
  - Co-chairman of the program committee for the International Conference on Database Theory 1995 (together with co-chair Moshe Vardi).
  - Program co-chairman for the 1998 Computer Science Logic conference (CSL'98). Co-chair was Etienne Grandjean.

– Chairman of the program committee of the international workshop on *Expert Systems in Engineering*, 1990, (together with co-chair Prof. Wolfgang Nejdl). 50 participants

Member of approximately 75 program committees of which a brief selection is provided here:

- Intern. Joint Conference on Artificial Intelligence 2001 (IJCAI'01).
- Constraint Programming (CP'01), Cyprus, 2001.
- 16th American National Conference on Artificial Intelligence (AAAI'98), 1998.
- ACM SIGMOD Symposium on Principles of Database Systems (PODS), 1998.
- European Conference on Artificial Intelligence (ECAI), 1996.
- Intl. Symposium on Knowledge Representation and Reasoning (KR) 1994, 1998.
- Intern. Colloquium on Automata, Languages and Programming (ICALP), 1997.
- Intern. Conference on Computational Complexity , (CCC) 1997 (Former name: Structure in Complexity Theory)
- IEEE Symp. on Logic in Computer Science, (LICS) 1996.
- ACM SIGMOD Symposium on Principles of Database Systems (PODS), 1994.
- International Conference on Data Engineering, 1987, 1988, 1989, 1991.
- International Conference on Extending Database Technology (EDBT), 1988, 1992 (Org. Chairman).
- International Conference on Very Large Data Bases (VLDB) 1989, 1990, 1995.
- International Conference on Deductive and Object-Oriented Databases (DOOD91), 1991, 1994.
- Symposium on Mathematical Fundamentals of Database and Knowledge Base Systems (MFDBS), 1991.

- **Editor and Coeditor of Journals.** Until recently: Editor in Chief of *AI Communications*. Currently or previously on the editorial/advisory boards of the following scientific journals:
  – Communications of the ACM (appointed, starting 2008)
  – Journal of Computer and System Sciences (JCSS)

- Artificial Intelligence (until December 2007)
- Journal of Applied Logic
- Annals of Mathematics and Artificial Intellignce
- Web Intelligence and Agent Systems
- Journal of Discrete Algorithms
- Informatica
- Chicago Journal of Theoretical Computer Science
- IEEE Transactions on Knowledge and Data Engineering (1999-2003)
- Theory and Practice of Logic Programming (Area Editor, 2000-2003)
- Very Large Databases (VLDB Journal, 1993–1998)
- Journal of Artificial Intelligence Research (1996–98)
- Computing (1992–1996)
- Journal of Logic Programming (1997-2000)
- Journal on Information Processing and Cybernetics (1994-1996)
- Annals of the Kurt Gödel Society.

- **Membership in scientific advisory boards:** IJCAI Board of Trustee, PODS Executive Committee (currently Chairman), LPNMR Steering Committee (Chair from 1997-2001), Scientific Council of the European Association for Computer Science Logic (EACSL), of the European Association of Theoretical Computer Science (EATCS) (1994-1998), of the Kurt Gödel Society (KGS; vice president of this society from 1990–1995), of the institute of computer science of the Consiglio Nazionale delle Ricerche (CNR) in Cosenza, Italy (1996-2002), and of the SOFSEM Seminars in the Czech Republic. Member of the Senate of the Christian Doppler Society (1995-2001). Member of the Award Committee of the Austrian Computer Society.

- **Membership in EU Networks of Excellence**: *Network of Excellence* COLOGNET (Computational Logic), GAMES (Games-Theory and Logic), REWERSE Foundations of the Semantic Web).In the past: COMPULOG (Computational Logic) and IDOMENEUS (databases).

6 Teaching

6.1 Academic Teaching

Among others, the following courses were taught:

- **Theory of Data and Knowledge Bases**, graduate course, Oxford University, Hilary term 2007.
- **Complexity of Logic Programming and Knowledge Representation**, University of California at Berkeley, spring term 1999.
- **Database Systems**. This course was taught many times at TU Wien since 1988. It is an required undergraduate course of the CS curriculum at TU Wien.
- **Expert Systems**. This course was regularly taught at TU Wien between 1988 and 1993. It was a required undergraduate course of the CS curriculum at TU Wien.
- **Introduction to Artificial Intelligence**. Taught together with other faculty members every semester since 1998.
- **Special Courses for Italian Doctoral Programs**. During the last 15 years I have tought several special courses for Ph.D. programs in Italy. These courses consisted in the compact presentation of advanced material on the complexity of database query answering, logic programming and nonmonotonic reasoning. Such courses were taught in Genoa, Pisa, and recently in Cosenza.
- **Complexity Theory**, TU Wien, 1996 and 1997.
- **Introduction to Programming for Electrical Engineers**. This course was regularly taught at TU Wien between 1991 and 1994. It is a required undergraduate course of the EE curriculum at TU Wien.
- **Database Theory**, TU Wien, 1986/87. This was a special course for graduate and Ph.D. students.
- **Distributed Databases**, Stanford University, summer terms 1985, 1986, 1987. This course, co-taught with Stefano Ceri, was a facultative course at the EE and CS Depts. of Stanford University.

- Organization and supervision of more than 20 *seminars* at TU Wien. A seminar – in this context – is a semestrial monographic course where students learn to deal with scientific literature and to present scientific results.

6.2 Supervision of Master Theses and Doctoral Dissertations

Since 1988 supervision of approximately 60 master theses and 20 Ph.D. theses. The following is a selection of Ph.D. theses.

Wolfgang Nejdl: "Query Processing in a Deductive Prolog/RDBMS System", 1988. (W.Nejdl is currently Professor of Computer Science in Hannover, Germany.)

Michael Schrefl: "Object-Oriented Database Integration", 1989, co-advised with principal advisor Prof. Erich Neuhold. (M. Schrefl is currently Professor of Computer Science at the University of Southern Australia at Adelaide.)

Thomas Frühwirth: " Types in Logic Programming", March 1990. (T. Frühwirth is currently a Professor of Computer Science at the University of Ulm, Germany)

Gerhard Friedrich: "Improvements in Model-Based Diagnosis", 1990. (G. Friedrich is currently Professor of Computer Science at the University of Klagenfurt, Austria).

Marcus Stumptner: "Redundancy and Information Content of Data Relations with different Kinds of Null Values", 1990. (M. Stumptner is currently a Professor of Computer Science at the University of South Australia in Adelaide).

Thomas Eiter: "On Transversal Hypergraph Computation and Deciding Hypergraph Saturation", 1991. (Th. Eiter is currently Professor of Computer Science at TU Vienna).

Wolfgang Slany: "Fuzzy Scheduling", 1994. (W. Slany is currently a Professor of Computer Science at TU Graz.)

Franz Wotawa: "Applying Model-Based Diagnosis to Software Debugging of Concurrent and Sequential Imperative Programming Languages", 1996. (F. Wotawa is currently a Professor of Computer Sciene at TU Graz.)

Helmut Veith: "Succinct Representation and the Complexity of Logic and Database Query Languages" (H. Veith is curently a Professor of Computer Science at TU Munich, Germany)

6.3 Nonacademic Teaching

- Various courses held for the industry (Italy, Austria, and US). The topics include Software Engineering, Database Design, Knowledge Based Systems, Distributed Databases, and Database Administration. A detailed list is omitted.

- Organisation, design and effectuation of a curriculum "Database Professional" at the Institute Fernando Santi in Genoa, Italy, 1985. This EU funded course consisted of more than 500 hours of lecturing, lab, and industry stages. The students were unemployed seamen with a high-school degree. The course was very successful: 90 percent of the attendees found a job immediately after accomplishment.

7 External Funding

- **Royal Society Wolfson Research Merit Award**. This Award consists of a salary increment and allows me to invite top class researchers to Oxford.

- **EPSRC: UK Engineering and Physical Sciences Research Council. Project EP/E010865/1: Schema Mappings and Automated Services for Data Integration and Exchange.** Description: This project, which is predominantly in the area of database theory, deals with schema mappings in the context of data exchange and data integration. Data Exchange is the problem of inserting data structured under one or more source schemas into a target schema of different structure (possibly with integrity constraints) while reflecting the source data as accurate as possible. We develop new algorithms for data exchange and analyze the complexity of data exchange problems. We will also study how data exchange and integration can be best performed via Web services and we will develop a model for this. Finally, we will implement and test our new algorithms in this context. The project (whose value is GBP 489,190) will fund one postdoc and two PhD students for 3.5 years.

- **Austrian Science Fund Project FWF P17222: "Complementary Approaches to Constraint Satisfaction".** Sept. 1, 2004–Sept 1, 2006. This project deals with *hypertree decompositions*, a method of hypergraph-based problem-decomposition introduced by Gottlob, Scarcello, and Leone [13], which leads to polynomial algorithms for large subclasses of NP-hard problems such as constraint satisfaction problems or conjunctive query evaluation. This progject aims at improving hypertree decomposition algorithms, and combining the hypertree-decomposition method with other "complementary" methods of problem simplification. The project funds a post doc researcher, a Ph.D. student, and a part-time programmer for two years.

- **Austrian Science Fund Project FWF L47: "Inductive Learning for visual Data Extraction".** April. 1, 2005–April 1, 2007. In this project, a new combination of machine learning with visual data extraction will be explored. We intend to apply supervisd machine learning techniques for learning rules for the automatic extraction of hierarchical XML-objects from Web pages. The project will fund one post doc researcher and one Ph.D. student.

- **FIT-IT Project NextWrap**. Jan. 1, 2005-Dec.31, 2006. This project is partially funded by the Austrian government and partially by the *Lixto Software* company. The project aims at scientifically improving data extraction technology by (i) extending recent HTML extraction methods to other formats such as plain text or PDF, (ii) using ontologies for data extraction, (iii) enabling wrappers to automatically adapting themselves to Web pages of changing structure. The total amount received by TU Wien for this project is approximately Euro 300,000.–

- **FIT-IT Project AllRight**. Jan. 1, 2005–Dec.31, 2006. This project is partially funded by the Austrian government and partially by the Vienna based *Lixto Software* company and the Klagenfurt based *ConfigWorks* company . The project goal is to design new algorithms, mechanisms, and software prototypes for automatically discovering new products of a certain category (e.g. cellphones, cameras, flights) and product features or attributes in the Internet. The total amount granted TU Wien for this project is of approximately Euro 350,000.–

- **EU Research Training Network GAMES: Games and Automata for Synthesis and Validation**. GAMES is a Research

Training Network funded by the European Comission under the Fifth Framework Programme. The collaboration involves seven European universities and one from the US. Research Objectives: There is a growing need for formal methods that guarantee the reliability, correctness, and efficiency of computerised systems. This project adresses this challenge by developing specification and validation methodologies that are based on games and automata. Oriented at both foundational research and modern applications, this network aims to provide a novel set of techniques for the synthesis and validation of computing systems. Gottlobs research group got funding for a PH.D. student for 2 years and for a post doc researcher for one year from the GAMES Project.

- **EU Research Training Network CoLogNET on Computational Logic**. CoLogNET is the European network funded by FET, the Future and Emerging Technologies arm of the IST Programme, FET-Open scheme. The network is dedicated to establishing computational logic as an academic discipline. CoLogNET operates in an international context and promotes exchange and co-operation between the different research areas related to computational logic. It is a network of networks which covers with its member nodes the whole area of computational logic.

- **EU Research Training Network REWERSE: Reasoning on the Web with Rules and Semantics**. REWERSE is a research "Network of Excellence" (NoE) on "Reasoning on the Web" that is funded by the EU Commission and Switzerland within the "6th Framework Programme" (FP6), Information Society Technologies (IST), Priority 2 under the project reference number 506779. REWERSE addresses the IST strategic action line "Semantic-based knowledge systems".

- **Wittgenstein Award and Grant.**

  The Wittgenstein Award is the highest funded austrian award for scientific achievements. It is usually given to to one or two (but at most three) austrian researchers per year[6] The award winners are selected by a prestigious international committee[7] The award consists of 15 million Austrian Shillings (equivalent to approx. 1.2 million US$). This amount can be spent for research at the discretion of the recipient.

[6] see http://www.fwf.ac.at/Foerderung/start-en.html.
[7] see http://www.fwf.ac.at/Statistik/1998/jury-en.html.

G. Gottlob received the Wittgenstein Award in June 1998. He used the money for research on algorithms in the area of databases and AI, query decompositions, and other topics. The project finished in 2004.

- **The Christian Doppler Laboratory.**

  This laboratory for fundamental research was awarded to G. Gottlob in 1989 after a strong selection process based on international expert opinion. It was extended, on the strength of its achievements, by five years, after an initial two year phase. It ended in September 1996 and cannot be further extended since the maximum funding period for Doppler Labs of seven years was reached. The laboratory was commissioned and supported by the ÖIAG, the holding of the nationalized industries of Austria. The total amount of funding was approx. 2 million US$.

  The CD-laboratory dealt with fundamental research and knowledge transfer in the field of expert systems, in particular research concerned with expert systems for failure diagnosis on technical installations and interfaces between expert systems and databases, the fundamentals of knowledge representation, nonmonotonic reasoning, and related topics.

- **Competence Center for Electronic Commerce** This competence center, founded in October 2000, consists of a strategic consortium of four austrian university institutes and ten companies. The goal is research and knowledge transfer in the area of electronic commerce. Within this competence center, various projects with a total average of 3 full-time employees are carried out by the group of G. Gottlob.

- **CSP-Project with DaimlerChrysler AG, Berlin**. DaimlerChrysler Research Labs (Berlin, Germany) awarded an industrial research project to G. Gottlob for incorporating structural decomposition methods into their constraint solver. In particular, the method of Hypertree Decopmpositions invented by Gottlob, Leone, and Scarcello should be used in order to decompose CSP problems and recognize polynomially solvable cases. DaimlerChrysler funds one Ph.D. student and consulting.

- **VENIVA (ESPRIT Project Nr. 20638)** The project VENIVA (Venetian Virtual Archives) of the Framework Four ESPRIT programme started on Nobember 1, 1995 and had a duration of 28 months (end: February 28, 1998). The institute of informations systems was

a contractor with two scientific staff paid from the project budget.
Objective: New methods and tools for storing multimedia Documents.
The project was successfully completed.

- **SIT-MOON (ESPRIT Project Nr. 25652)** The project SIT-MOON (System of Integrated Tools for the Creation of Multimedia Contents Delivered Off-line and On-line) of the Framework Four ESPRIT programme started on September 1, 1997 and has a duration of 24 months. The institute of informations systems is a contractor with two scientific staff paid from the project budget.
  Objective: Provide the publishng industry with a modular multimedia authoring environment suited to multimedia production for on-line (small and broad band) and off-line (e.g. CD-ROM, DVD) delivery. The integration of digital media archives into the authoring environment for storage, management, and retrieval of multimedia content is a key issue in the project.

- **Project ARTEX (Automated Routing Test Expert System)** Client: SIEMENS AG Austria. Term of contact: 3 years (1990-1992) Paid posts: 1 assistant. Content of the project: Development of expert systems to support the configuration of a new digital switchboard system (DDS), the end control of a deliverable DDS and the failure diagnosis of a working DDS. Project successfully completed.

- **MOOD: Object oriented development of object oriented systems (1990-92).** Funded by: SIEMENS AG Austria. Paid posts: 1 assistant, 1 student assistant. Content of the project: development of a method for the design of object oriented systems. Project successfully completed.

- **COCOS: Configuration by Constraint Satisfaction.** October 1990– September 1993. Funded by: SIEMENS AG Austria. Paid posts: 1,5 assistants. Content of the project: development of an automatic configurator for large scale technical systems. Project successfully completed.

- **OODB-EVAL: Object Oriented Database Evaluation** 1991-93. Funded by: SIEMENS AG Austria. Paid posts: 1 assistant, Content of the project: Evaluation and Selection of object oriented database systems for the CIRCE railway station configuration support tool marketed by SIEMENS. Project successfully completed.

- **DDV (Design Diagnosis for VHDL).** January 1994 – December 1997. Funded by: SIEMENS AG Austria. Paid posts: 1 + 2/3 assistants. Content of the project: development of an intelligent debugging tool for VHDL-based hardware designs. The first phase of this project was successfully completed by December 1995. The project was then prolongued for two further years.

- **Project ARTHUR (1989).** Client: Profisoft EDV-Vertriebs GmbH. Term of contract: 1/2 year. Paid posts: 1 freelance worker. Content of the project: Scientific support for the fundamentals and methods for the development of a relational database for an integral standard software package under OS/2. Project successfully completed.

- **Austrian construction database** This FFF project with the company INFO-TECHNO in Salzburg started in May 1995. One staff member will be paid entirely. The goal of the project is to create a CD-ROM database of building material and to make it available over the Internet. A methodology for the design of interactive catalogues was be developed. The first part of the project was successfully accomplished.

- **A Query System for Disjunctive Datatbases** FWF, co-investigator (principal investigator= Prof. Nicola Leone). Two researchers funded for two years starting Nov. 1st, 1996. The project deals with computational aspects of disjunctive deductive databases and with the implementation of a system for querying such databases (the ddv system).

8 Entrepreneurial Activity

Georg Gottlob is co-Founder of Lixto Software GmbH (see www.lixto.com). The company, which was founded in late 2001 describes itself as follows.

Company Overview

Lixto Software GmbH is a privately held company located in Vienna, Austria. We are a spin-off of Vienna University of Technology and EC3 Electronic Commerce Competence Center. Lixto Software GmbH provides solutions for automatically accessing, transforming, and syndicating data from the Deep Web.

Lixto delivers extraction and transformation services to mobile and web service providers and application software providers which are significantly easier to use through visual support and significantly cheaper to operate and support through their superior design and robustness.

Lixto has been conceived to support and extend the vision of the "semantic web" as outlined by Tim Berners Lee - to make it much easier for computers and humans to access, understand, and further process web content.

Company Focus

Lixto turns classic web pages into meaningful, structured data. The processes of access, transformation and syndication is supported. There is a wide range of applications which can benefit from Lixto.

Lixto focuses on markets where the procurement of outside web intelligence in a structured form, ready for further processing is crucial to the success of a business. These markets include System Integrators, Corporate IT Managers and Web Developers, Mobile and Internet Content providers and Software manufacturers.

Company Vision

The company vision is to enable a wide range of customers to benefit from the power of extracting and processing highly individual and complex information. This can be fulfilled in a highly automated fashion from the World Wide Web in their business applications. The methods are strongly superior to highly repetitive human tasks performed today.

Great savings in cost and productivity will be achieved by having Lixto access, transform and syndicate information, which is traditionally done with human support. Lixto will enable break through ease of use and accelerate time to market for Lixto based solutions.

For several years a group of scientists from the Vienna University of Technology has been working on this vision.

Company Mission

The company mission is to build a highly profitable business and leading European marketshare with the strongest system integration and software application providers.

9 References

References will be provided on request.

10 List of Publications of Georg Gottlob

Articles in Journals and Periodicals

[1] G. Gottlob and A. Nash. Efficient Core Computation in Data Exchange. *Journal of the ACM* To apear. 2008.

[2] G. Gottlob, Ch. Koch, and Klaus Schulz. Conjunctive Queries over Trees. *23. Journal of the ACM*, 53(2), pp.238-273, 2006.

[3] Georg Gottlob, Stephanie Tien Lee. A logical Approach to Multicut Problems. *Information Processing Letters* 103(4) pp.136–141 (2007).

[4] Th. Eiter, G. Gottlob. Reasoning under Minimal Upper Bounds. *Theoretical Computer Science* 369(1-3) 2006, pp.82–115

[5] G. Gottlob, G. Greco, and F. Scarcello. Pure Nash equilibria: Hard and Easy Games. *Journal of Artificial Intelligence Research*, vpl. 24, pp. 357–406, 2005.

[6] G. Gottlob, C. Koch, R. Pichler, L. Segoufin. The Complexity of XPath Query Evaluation and XML typing. In *Journal of the ACM*, 52:2, pp. 284-335, 2005.

[7] G. Gottlob, C. Koch, R. Pichler. Efficient Algorithms for Processing XPath Queries. *ACM Transactions on Database Systems* 30:2, pp. 444-491, 2005.

[8] G. Gottlob and C. Koch. Monadic Datalog and the Expressive Power of Languages for Web Information Extraction. *Journal of the ACM*, 51:1, pp. 74-113, Jan. 2004.

[9] N.Leone, G.Pfeifer, W. Faber, Th. Eiter, G. Gottlob, S. Perri, and F. Scarcello. The DLV system for knowledge representation and reasoning. *ACM Transactions on Computational Logic*, 7:3, pp. 499-562, 2006.

[10] G. Gottlob, Ph.G. Kolaitis, Th. Schwentick Existential Second-Order Logic over Graphs: Charting the Tractability Frontier. *Journal of the ACM 51:2, pp.312-362*, March 2004.

[11] G. Gottlob, R. Pichler. Hypergraphs in Model Checking: Acyclicity in Hypertree-Width versus Clique-Width. *SIAM Journal on Computing*, 33:2, pp. 351-378, 2004.

[12] Th. Eiter, G. Gottlob, and K. Makino. New Results on Monotone Dualization and Generating Hypergraph Transversals.. *SIAM Journal on Computing* 32(2):514-537, 2003.

[13] G. Gottlob, N. Leone, and F. Scarcello. Hypertree Decompositions and Tractable queries. *Journal of Computer and System Sciences* 64(3): 579-627 (2002).

[14] G. Gottlob, E. Grädel, H. Veith Datalog Lite: A Deductive Query Language with Linear Time Model Checking. *ACM Transactions on Computational Logic* 3:1 pp.42–79, 2002.

[15] G. Gottlob, N. Leone, F. Scarcello. The Complexity of Acyclic Conjunctive Queries. *Journal of the ACM*, 48:3, pp.431–498, 2001.

[16] G. Gottlob, Ch. Papadimitriou. On the Complexity of Single-Rule Datalog Queries. *Information and Computation* 183:1, pp.104-122, 2003.

[17] G. Gottlob, N. Leone, and F. Scarcello. Robbers, Marshals, and Guards: Game Theoretic and Logical Characterizations of Hypertree Width. *Journal of Computer and System Sciences* 66(4): 775-808, 2003.

[18] M. Cadoli, Th. Eiter, and G. Gottlob. Complexity of Propositional Nested Circumscription and Nested Abnormality Theories *ACM Transactions on Computational Logic*, 6:2, pp.232–272, April 2005.

[19] G. Gottlob, N. Leone, and F. Scarcello. A Comparison of Structural CSP Decomposition Methods. *Artificial Intelligence* 124:2, pp. 243–282, 2000.

[20] G. Gottlob, F. Scarcello, M. Sideri Fixed-Parameter Complexity in AI and Nonmonotonic Reasoning. *Artificial Intelligence* 138:(1-2):55-86 2002.

[21] R. Baumgartner, G. Gottlob. Propositional Default Logics Made Easier: Computational Complexity of Model Checking. *Theoretical Computer Science* 289(1): 591-627, 2002.

[22] G. Gottlob, R. Pichler. Working with Arms: Complexity Results on Atomic Representations of Herbrand Models. *Information and Computation*, 165:2 pp. 183–207, 2001.

[23] Georg Gottlob. NP Trees and Carnap's Modal Logic. *Journal of the ACM*, 42(2):421–457, March 1995.

[24] Georg Gottlob. Translating default Logic into Standard Autoepistemic Logic. *Journal of the ACM*, 42(4):711–740, July 1995.

[25] G. Gottlob, N. Leone, and F. Scarcello. Computing LOGCFL Certificates. *Theoretical Computer Science*, 270(1-2), pp. 761-777, 2002.

[26] Th. Eiter, G. Gottlob, and Y. Gurevich. Existential Second Order Logic Over strings. *Journal of the ACM* 47:1, pp. 77-131, 2000.

[27] F. Buccafurri, Th. Eiter, G. Gottlob, and N. Leone. On ACTL Formulas Having Linear Counterexamples. *Journal of Computer and System Sciences* 62(3), pp. 463-515 2001.

[28] Thomas Eiter, Georg Gottlob, and Heikki Mannila. Disjunctive Datalog. *ACM Transactions on Database Systems*, 22(3), Sept. 1997, pp.364–418.

[29] Thomas Eiter, Georg Gottlob. Complexity Results for some Eigenvector Problems. *International Journal of Computer Mathematics*, Vol 76, pp.59–74, 2000.

[30] Thomas Eiter and Georg Gottlob. The Complexity of Logic-Based Abduction. *Journal of the ACM*, 42(1):3–42, January 1995.

[31] Thomas Eiter and Georg Gottlob. Identifying the Minimal Transversals of a Hypergraph and Related Problems. *SIAM Journal on Computing*, 24(6), Dec. 1995, pp. 1278–1304.

[32] G. Gottlob, M. Schrefl, and B. Röck. Extending Object-Oriented Systems with Roles. *ACM Transactions on Information Systems*, vol. 14, No. 3, July 1996.

[33] E. Dantsin, Th. Eiter, G. Gottlob, and A. Voronkov. Complexity and Expressive Power of Logic Programming. *ACM Computing Surveys* 33(3):374-425 (2001).

[34] G. Gottlob. The Complexity of Default Reasoning under the Stationary Fixed Point Semantics. *Information and Computation*, 121(1):81–92, August 1995.

[35] G. Gottlob, P. Paolini, and R. Zicari. Properties and update semantics of consistent views. *ACM Transactions on Database Systems*, 13(4):486–524, December 1988.

[36] G. Gottlob, Ch. Koch, and R. Pichler. XPath Processing in a Nutshell. *ACM SIGMOD Record* 33(2): pp. 87–94, 2004.

[37] G. Gottlob. Complexity results for nonmonotonic logics. *Journal of Logic and Computation*, 2(3):397–425, june 1992.

[38] G. Gottlob and A. Leitsch. On the efficiency of subsumption algorithms. *Journal of the ACM*, 32(2):280–295, April 1985.

[39] F. Buccafurri, Th. Eiter, G. Gottlob, and N. Leone, Enhancing Model Checking and Verification by AI Techniques. *Artificial Intelligence* 112(1-2), pp. 57–104, 1999.

[40] G. Gottlob. Relativized Logspace and Generalized Quantifiers over Ordered Finite Structures. *Journal of Symbolic Logic* Vol. 62:2, June 1997, pp. 545–574.

[41] S. Ceri and G. Gottlob. Translating SQL into relational algebra: Optimization,semantics and equivalence of SQL queries. *IEEE Transactions on Software Engineering*, 11(4):324–345, April 1985.

[42] S. Ceri and G. Gottlob. Normalization of relations and Prolog. *Communications of the ACM*, 29(6):524–544, June 1986.

[43] Thomas Eiter, Georg Gottlob, and Yuri Gurevich. Normal Forms for Second-Order Logic over Finite Structures, and Classification of NP Optimization Problems. *Annals of Pure and Applied Logic*, vol. 78, pp. 111–125, 1996.

[44] Thomas Eiter and Georg Gottlob. The Complexity of Nested Counterfactuals and Iterated Knowledge Base Revisions. *Journal of Computer and System Sciences,* 53:3, pp. 497–512

[45] G. Gottlob, N. Leone, and H. Veith. Succinctness as a Source of Complexity in Logical Formalisms. *Annals of Pure and Applied Logic* 97(1-3): 231-260 1999.

[46] M. Cadoli, Th. Eiter, and G. Gottlob. An efficient method for eliminating varying predicates from a circumscription. *Artificial Intelligence*, 54:397–410, 1992.

[47] Th. Eiter and G. Gottlob. Propositional circumscription and extended closed world reasoning are $\mathbf{\Pi_2^P}$-complete. *Theoretical Computer Science*, 114(2):231–245, 1993. Addendum 118:315.

[48] Th. Eiter and G. Gottlob. On the complexity of propositional knowledge base revision, updates and counterfactuals. *Artificial Intelligence*, 57:227–270, 1992. Extended version of [148].

[49] G. Gottlob and Ch. Fermueller. Removing redundancy from a clause. *Artificial Intelligence*, 61:263–289, 1993.

[50] G. Gottlob and Zhang Mingyi. Cumulative Default Logic: Finite Characterization, Algorithms, and Complexity. *Artificial Intelligence*, 69:329–345, 1994.

[51] S. Ceri, G. Gottlob, and G. Wiederhold. Efficient database access from Prolog. *IEEE Transactions on Software Engineering*, 15(2):153–164, February 1989.

[52] G. Gottlob, M. Schrefl, and M. Stumptner. On selective inheritance of attribute values in relational databases. *Discrete Applied Mathematics*, 40:187–216, 1992.

[53] G. Gottlob. Subsumption and implication. *Information Processing Letters*, 24:109–111, January 1987.

[54] M. Cadoli, Th. Eiter, and G. Gottlob. Using Default Logic as a Query Language. *IEEE Transactions on Knowledge and Data Engineering*, 9(3), pp. 448–463, 1997.

[55] G. Gottlob. On the size of nonredundant FD-covers. *Information Processing Letters*, 24:355–360, April 1987.

[56] G. Brewka and G. Gottlob. Well-Founded Semantics for Default Logic. *Fundamenta Informaticae* vol 31, nrs. 3/4, 1997, pp 221–236.

[57] Th. Eiter and G. Gottlob. On the Computational Cost of Disjunctive Logic Programming: Propositional Case. *Annals of Mathematics and Artificial Intelligence* 15:289–323, 1995.

[58] Th. Eiter and G. Gottlob. Reasoning with Parsimonious and Moderately Grounded Expansions. *Fundamenta Informaticae*, 17:31–53, 1992.

[59] G. Gottlob and M. Truszcyński. Approximating Stable Models is Hard. *Fundamenta Informaticae*. Vol. 28(1,2), 1996, pp. 123–128.

[60] G. Friedrich, G. Gottlob, and W. Nejdl. Generating efficient diagnostic procedures from model based knowledge using logic programming techniques. *Computers and Mathematics with Applications*, 20(9/10):57–72, 1990.

[61] S. Ceri, G. Gottlob, and G. Pelagatti. Taxonomy and formal properies of distributed joins. *Information Systems*, 11(1):25–40, March 1986.

[62] S. Ceri and G. Gottlob. Optimizing joins between two partitioned relations in distributed databases. *The Journal of Parallel and Distributed Computing*, 3:183–205, 1986.

[63] G. Gottlob and L.Libkin. Investigations on Armstrong relations, dependency inference, and excluded functional dependencies. *Acta Cybernetica*, 9(4):385–402, 1990.

[64] S. Ceri, G. Gottlob, and L Tanca. What you always wanted to know about datalog (and never dared to ask). *IEEE Transactions on Knowledge and Data Engineering*, 1(1), March 1989.

[65] G. Friedrich, G. Gottlob, and W. Nejdl. Formalizing the repair process – extended report. *Annals of Mathematics and Artificial Intelligence*, 11(1-4):187–201, 1994.

[66] Th. Eiter, G. Gottlob. On the Expressiveness of Frame Satisfiability and Fragments of Second Order Logic, *Journal of Symbolic Logic*, vol. 63, nr. 1, 1998, pp. 73–82.

[67] Anuj Dawar, Georg Gottlob, and Lauri Hella. Capturing Relativized Complexity Classes without Order. *Mathematical Logic Quarterly*, 44(1998), pp.109–122, 1988.

[68] Th. Eiter, G. Gottlob, and N. Leone. Abduction From Logic Programs: Semantics and Complexity. *Theoretical Computer Science* 189(1-2) December 1997, pp.129–177

[69] S. Ceri, G. Gottlob, L. Tanca, and G. Wiederhold. Magic semi-joins. *Information Processing Letters*, 33(2):97–108, 1989.

[70] E. Albino, G. Gottlob, and G. Dettori. A multiple answer Prolog system for decomposing a data base into Boyce Codd normal form. *International Journal on Policy and Information*, 12:53–74, 1988.

[71] G. Gottlob, A. Leitsch, and W. Schimanovich. Automatisches Beweisen: Methoden und Implementation. *Österreichische Zeitschrift für Statistik und Informatik*, 16:35–55, 1986.

[72] G. Gottlob, Sh. Marcus, A. Nerode, G. Salzer, and V.S. Subrahmanian. Non-Ground Realization of the Stable and Well-Founded Semantics, *Theoretical Computer Science*,vol.166 nr. 1&2, pp.221–262, 1996.

[73] S. Ceri, G. Gottlob, and L. Tanca. DATALOG: un Tutorial *Rivista di Informatica*, 21(3):215–252, 1991.

[74] Thomas Eiter, Georg Gottlob, and Nicola Leone. Semantics and Complexity for Abduction from Default Theories. *Artificial Intelligence,* Vol. 90(1-2), pp.177-222, 1997.

[75] J. Dix, G. Gottlob, and V. Marek. Reducing Disjunctive to Nondisjunctive Semantics by Shift Operations. *Fundamenta Informaticae. Vol. 28(1,2), pp.87–100, 1996*

[76] Th. Eiter, G. Gottlob. Mächtigkeit von Logikprogrammierung über Datenbanken, *Künstliche Intelligenz* 3/96, pp. 32–39.

[77] Th. Eiter, G. Gottlob. Expressiveness of Stable Model semantics for Disjunctive Logic Programs with Functions, *The Journal of Logic Programming*, 33(2), 1997, pp.167–178.

[78] Thomas Eiter, Georg Gottlob, and Nicola Leone. On the Indiscernibility of Individuals in Logic Programming. *The Journal of Logic and Computation 7:6, December 1997, pp. 805–824.*

[79] G. Gottlob, N. Leone, and F. Scarcello. On the Complexity of Some Inductive Logic Programming Problems. *New Generation Computing* Vol. 17, Nr.1, November 1998, pp.53–75.

Conference Articles and Book Chapters

[80] Georg Gottlob, Zoltan Miklos, and Thomas Schwentick. Generalized hypertree decompositions: NP-hardness and tractable variants. *26. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-07)*, June 11-13, 2007, Beijing, China, pp.13-22, 2007. Best Paper Award.

[81] Georg Gottlob, Reinhard Pichler, and Fang Wei. Monadic datalog over finite structures with bounded treewidth. *26. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-07)*, June 11-13, 2007, Beijing, China, pp.165-174, 2007.

[82] Georg Gottlob and Gianluigi Greco. On the complexity of combinatorial auctions: structured item graphs and hypertree decomposition. *Proceedings 8th ACM Conference on Electronic Commerce (EC-2007)*, San Diego, California, USA, June 11-15, 2007, pp. 152-161, 2007.

[83] Georg Gottlob, Gianluigi Greco, Toni Mancini. Complexity of Pure Equilibria in Bayesian Games. *Proc. 20th International Joint Conference on Artificial Intelligence*, Hyderabad, India, January 6-12, pp. 1294-1299, 2007.

[84] Georg Gottlob, Gianluigi Greco, and Toni Mancini. Conditional Constraint Satisfaction: Logical Foundations and Complexity. *Proc. 20th International Joint Conference on Artificial Intelligence*, Hyderabad, India, January 6-12, pp. 88-93, 2007.

[85] Georg Gottlob, Reinhard Pichler, and Fang Wei: Efficient Datalog Abduction through Bounded Treewidth. *Proceedings of the Twenty-Second AAAI Conference on Artificial Intelligence*, July 22-26, 2007, Vancouver, British Columbia, Canada, pp. 1626–1631, 2007.

[86] G. Gottlob and A. Nash. Data Exchange – Computing Cores in Polynomial Time. *25. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-06)*, June 26-28, 2006, Chicago, IL, pp. 40-49, 2006.

[87] Georg Gottlob and Reinhard Pichler and Fang Wei. Tractable Database Design through Bounded Treewidth. *25. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-06)*, June 26-28, 2006, Chicago, IL, pp. 30-48, 2006.

[88] Georg Gottlob and Reinhard Pichler and Fang Wei. Bounded Treewidth as a Key to Tractability of Knowledge Representation and Reasoning. *Twenty-First National Conference on Artificial Intelligence AAAI'06* July 16-20, 2006, Boston, Massachusetts, USA. AAAI Press 2006. To appear.

[89] Julien Carme, Michal Ceresna, Oliver Frlich, Georg Gottlob, Tamir Hassan, Marcus Herzog, Wolfgang Holzinger, Bernhard Krpl. The Lixto

Project: Exploring New Frontiers of Web Data Extraction. *Proc. 23rd British National Conference on Databases, BNCOD 23*, Belfast, Northern Ireland, UK, July 18-20, 2006, Lecture Notes in Computer Science 4042 Springer, pp.1-15, 2006.

[90] Georg Gottlob and Christoph Koch. A Formal Comparison of Visual Web Wrapper Generators. *SOFSEM 2006: Theory and Practice of Computer Science, 32nd Conference on Current Trends in Theory and Practice of Computer Science*, Mern, Czech Republic, January 21-27, pp. 30-48, 2006.

[91] Tim Furche, Benedikt Linse, Franois Bry, Dimitris Plexousakis, Georg Gottlob. RDF Querying: Language Constructs and Evaluation Methods Compared. *Reasoning Web, Second International Summer School 2006*, Lisbon, Portugal, September 4-8, 2006, Tutorial Lectures. Lecture Notes in Computer Science 4126 Springer pp. 1-52, 2006.

[92] G. Gottlob, G. Greco, and F. Scarcello. The Complexity of Quantified Constraint Satisfaction Problems under Structural Restrictions. *Nineteenth International Joint Conference on Artificial Intelligence (IJCAI'05)*, Edinburgh, Scotland, 30 July–5 August pp.150-155, 2005.

[93] R. Rosati and G. Gottlob. Asymptotic Conditional Probability in Modal Logic: A Probabilistic Reconstruction of Nonmonotonic Logic. *Nineteenth International Joint Conference on Artificial Intelligence (IJCAI'05)*, Edinburgh, Scotland, 30 July–5 August, pp.1378-1383, 2005.

[94] G. Gottlob. Computing Cores for Data Exchange – New Algorithms and Practical Solutions. *24. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-05)*, June 13-16, 2005, Baltimore, Marylandpp.148-159, 2005.

[95] G. Gottlob, Ch. Koch, and Klaus Schulz. Conjunctive Queries over Trees. *23. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-04)*, June 14-16, 2004, Paris, France, ACM Press, pp. 189-200, 2004.

[96] G. Gottlob, Ch. Koch, R. Baumgartner, M. Herzog, S. Flesca. The Lixto Data Extraction Project, Back and Forth between Theory and Practice. *23. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-04)*, June 14-16, 2004, Paris, France, ACM Press, pp. 1-12, 2004.

[97] R. Baumgartner, G. Gottlob, M. Herzog, W. Slany. Interactively Adding Web Service Interfaces to Existing Web Applications. *2004 Symposium on Applications and the Internet (SAINT'04)*, January 26-30, 2004, Tokyo, Japan, IEEE Computer Society, pp. 74-80, 2004.

[98] G. Gottlob. Hypergraph Transversals. *Third International Symposium on Foundations of Information and Knowledge Systems (FoIKS'04)*, Vienna, Austria, February 17-20, 2004, Springer LNCS 2942, pp. 1-5, 2004.

[99] G. Gottlob. Second Order Logic Over Finite Structures – Report on a Research Programme.. *Second International Joint Conference on Automated Reasoning (IJCAR'04)*, July, 4-8, 2004, Cork, Ireland, pp.229-243.

[100] G. Gottlob, Ch. Koch. XPath Query Processing. (Abstract of invited tutorial) *9th International Workshop on Database Programming Languages (DBPL'03)*, Potsdam, Germany, September 6-8, 2003, Springer LNCS 2921, p. 20, 2003.

[101] G. Gottlob, and G. Greco, and F. Scarcello. Pure Nash equilibria: Hard and Easy Games. *Proceedings of the 9th conference on Theoretical Aspects of Rationality and Knowledge, (TARK'03)*, Univerity of Indiana, Bloomington, Indiana, June 20–22 2003, pp. 215–230, 2003.

[102] G. Gottlob, C. Koch, and R. Pichler. XPath Query Evaluation: Improving Time and Space Efficiency. *Proceedings of the 19. International Conference on Data Engineering (ICDE'03)*, March 5-8, 2003, Bangalore, India, IEEE Computer Society, pp. 379-390, 2003.

[103] G. Gottlob, C. Koch, R. Pichler. The Complexity of XPath Query Evaluation. In *Proceedings of the 22. ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-03)*, June 9-12, 2003, San Diego, CA, USA, ACM Press, pp. 179-190, 2003.

[104] G. Gottlob, C. Koch, R. Pichler. Efficient Algorithms for Processing XPath Queries. In *Proceedings of the 28th International Conference on Very Large Data Bases (VLDB'02)*, Hong Kong, China, September 2002, pp95–106, 2002.

[105] G. Gottlob and C. Koch. Monadic Datalog and the Expressive Power of Languages for Web Information Extraction. In *Proceedings of the 21. ACM SIGACT SIGMOD SIGART Symposium on Principles of*

Database Systems (PODS-02), Wisconsin, MA, May-June 2002, pp. 17-28, 2002.

[106] G. Gottlob and C. Koch. Monadic Queries over Tree-Structured Data. In *Proceedings of the 17th IEEE Symposium on Logic in Computer Science (LICS 2002)*, 22-25 July 2002, Copenhagen, Denmark, IEEE Computer Society, pp. 189–202, 2002

[107] Th. Eiter, G. Gottlob, and K. Makino. New Results on Monotone Dualization and Generating Hypergraph Transversals. In Proc. of *43. ACM of Symposium on Theory of Computing, STOC 2002*, Montreal, Canada, May 2002, pp. 14-22.

[108] R. Baumgartner, M. Ceresna, G. Gottlob, M. Herzog, and V. Zigo. Web Information Acquisition with Lixto Suite. *Proceedings of the 19. International Conference on Data Engineering (ICDE'03)*, March 5-8, 2003, Bangalore, India, IEEE Computer Society, (system demo paper), pp. 747-749, 2003.

[109] R. Baumgartner, G. Gottlob, and M. Herzog. Visual Programming of Web Data Aggregation Applications. *Proceedings of the IJCAI-03 Workshop on Information Integration on the Web (IIWeb 2003)*, Acapulco, Mexico, August 9-10, 2003.

[110] R. Baumgartner, S. Flesca,G. Gottlob. Visual Web Information Extraction with Lixto. *Proceedings of the 27th International Conference on Very Large Data Bases (VLDB'01)*, Rome, September 2001, pp. 119-128, 2001.

[111] R. Baumgartner, S. Flesca, and G. Gottlob. Supervised wrapper generation with Lixto. *Proceedings of the 27th International Conference on Very Large Data Bases (VLDB'01)*, Rome, September 2001. (System Demo Description), pp.715-116, 2001.

[112] R. Baumgartner, S. Flesca,and G. Gottlob. The Lixto Wrapper Generation Tool (Extended Abstract). Proc. of *Nono Convegno Nazionale su Sistemi Evoluti per Basi di Dati (SEBD'01)*, Venice, Italy, June 27-29, pp. 147–154, 2001.

[113] G. Gottlob, R. Pichler. Hypergraphs in Model Checking: Acyclicity in Hypertree-Width versus Clique-Width. In *Proceedings of ICALP 2001, Twenty Eighth International Colloquium on Automata, Languages and Programming*, Crete, Greece, July 8-12, 2001, pp. 708–719.

[114] G. Gottlob, N. Leone, and F. Scarcello. Robbers, Marshals, and Guards: Game Theoretic and Logical Characterizations of Hypertree Width. In *Proceedings of the Twentieth ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-01)*, Santa Barbara, CA, May 2001, pp. 195–201.

[115] R. Baumgartner, S. Flesca,G. Gottlob. The Elog Web Extraction Language. In: *Logic for Programming, Artificial Intelligence, and Reasoning, 8th International Conference, LPAR 2001*, Havana, Cuba, December 3-7, Springer Lecture Notes in Computer Science 2250, pp.548-560, 2001.

[116] R. Baumgartner, S. Flesca,G. Gottlob. Declarative Information Extraction, Web Crawling, and Recursive Wrapping with Lixto In: Proc. of *Logic Programming and Nonmonotonic Reasoning, 6th International Conference, LPNMR 2001*, Vienna, Austria, September 17-19, 2001, Lecture Notes in Computer Science 2173, pp. 21-41.

[117] G. Gottlob, Ph.G. Kolaitis, Th. Schwentick Existential Second-Order Logic over Graphs: Charting the Tractability Frontier. In: *41st Annual Symposium on Foundations of Computer Science, FOCS 2000,* 12-14 November 2000, Redondo Beach, California, USA. IEEE Computer Society, pp. 664–674, 2000

[118] M. Herzog and G.Gottlob. Infopipes: A flexible Framework for M-Commerce Applications In: Proc. of *Technologies for E-Services, Second International Workshop, TES 2001*, Rome, Italy, September 14-15, 2001, Springer Lecture Notes in Computer Science 2193, pp.175–186, 2001.

[119] M. Cadoli, Th. Eiter, and G. Gottlob. Complexity of Nested Circumscription and Abnormality Theories *Seventeenth International Joint Conference on Artificial Intelligence (IJCAI-01)*, Seattle, WA, 2001, Morgan Kaufman, pp.169-174, 2001.

[120] Th. Eiter, G. Gottlob. On the Complexity of Theory Curbing. In Proc. *Logic Programming and Automated Reasoning (LPAR'00)*, Reunion Island, November 11-12 2000, Springer LNCS/AI Nr.1955, pp. 1–19.

[121] G. Gottlob, Martin Hutle, and Franz Wotawa. Combining Hypertree, Bicomp, and Hinge Decomposition. In Proc. *Proceedings of the 15th Eureopean Conference on Artificial Intelligence, ECAI'2002*, Lyon, France, July 2002. IOS Press, pp. 161–165, 2002.

[122] Th. Eiter, Georg Gottlob, Giovambattista Ianni, Giuseppe Ielpa, Christoph Koch, Simona Perri, Axel Polleres. The DVL System. In Proc. of *Logics in Artificial Intelligence, European Conference, JELIA 2002*, Cosenza, Italy, September, 23-26, Springer Lecture Notes in Computer Science 2424, pp. 537–540, 2002.

[123] Th. Eiter, Georg Gottlob. In Proc. of *Hypergraph Transversal Computation and Related Problems in Logic and AI.* In Proc. of *Logics in Artificial Intelligence, European Conference, JELIA 2002*, Cosenza, Italy, September, 23-26, Springer Lecture Notes in Computer Science 2424, pp. 549–564, 2002.

[124] G. Gottlob, F. Scarcello, M. Sideri Fixed-Parameter Complexity in AI and Nonmonotonic Reasoning. Proceedings of the 5th International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'99, El Paso, Texas) Springer LNCS 1730, pp. 1–18.

[125] Th. Eiter, Georg Gottlob, and Th. Schwentick. Second-Order Logic over Strings: Regular and Non-regular Fragments. In *Proc. Developments in Language Theory, 5th International Conference, DLT 2001, Vienna, Austria, July 16-21, 2001, Revised Papers.* Springer Lecture Notes in Computer Science 2295, pp. 37-56, 2002.

[126] F. Buccafurri and G. Gottlob. Multiagent Compromises, Joint Fixpoints and Stable Models. In Antonis C. Kakas, Fariba Sadri (Eds.): *Computational Logic: Logic Programming and Beyond, Essays in Honour of Robert A. Kowalski, Part I*, Springer Lecture Notes in Computer Science 2407, pp.561-585, 2002

[127] G. Gottlob, Ch. Papadimitriou. On the Complexity of Single-Rule Datalog Queries. In Proc. *Logic Programming and Automated Reasoning (LPAR'99)*, Tbilissi, Georgia, September 1999, Springer LNCS/AI 1705, pp. 201-222.

[128] G. Gottlob, N. Leone, and F. Scarcello. A Comparison of Structural CSP Decomposition Methods In Proc. *Sixteenth International Joint Conference on Artificial Intelligence (IJCAI-99)*, Stockholm, Sweden, July 30-August 6, 1999, Morgan Kaufman, pp. 394–399, 1999.

[129] R. Baumgartner, G. Gottlob. On the Complexity of Model Checking for Propositional Default Logics: New Results and Tractable Cases

Proc. of the *Sixteenth International Joint Conference on Artificial Intelligence (IJCAI-99)*, Stockholm, Sweden, July 30-August 6, 1999, Morgan Kaufman, pp.64–69,1999.

[130] G. Gottlob, N. Leone, and F. Scarcello. Hypertree Decompositions and Tractable queries. In *Proceedings of the Eighteenth ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS-99)*, Philadelphia, PA, May31–June 2 1999, pages 21–32.

[131] G. Gottlob, R. Pichler. Working with Arms: Complexity Results on Atomic Representations of Herbrand Models. In Proc. *13th Annual Symposium on Logic in Computer Science LICS'99*, Trento, Italy, July 2–5 1999. IEEE Computer Society Press, pp. 306–315, 1999.

[132] Th. Eiter, G. Gottlob, and H. Veith. Generalized Quantifiers in Logic Programs. In *9th European Summer School in Logic, Language, and Information, ESSLLI'97 Workshop, Aix-en-Provence, France, August 11-22, 1997, Revised Lectures*. Lecture Notes in Computer Science 1754 Springer, pp. 72-98, 2000.

[133] G. Gottlob, N. Leone, and F. Scarcello. Computing LOGCFL Certificates. Proceedings of the *26th International Colloquium on Automata, Languages and Programming (ICALP'99)*, Prague, Czech Republic, July 1999, Springer LNCS 1644, pp. 361–371.

[134] G. Gottlob, N. Leone, and F. Scarcello. On Tractable Queries and Constraints. In Proc. *Tenth International DEXA Conference on Database and Expert Systems Applications* Florence, Italy, Aug. 30-Sept.3, Springer LNCS 1677, pp. 1-15, 1999.

[135] G. Gottlob, N. Leone, F. Scarcello. The Complexity of Acyclic Conjunctive Queries. *Proceedings of the 39-th IEEE Symposium on Foundations of Computer Science (FOCS'98)*, Palo Alto, California, November 8–11, 1998, pp. 706–715.

[136] Th. Eiter, G. Gottlob, and Y. Gurevich. Existential Second Order Logic Over strings. In *Proc. 13th Annual Symposium on Logic in Computer Science LICS'98 (Indianapolis, IN, June 1998)*. IEEE Computer Society Press, 1998.

[137] G. Gottlob and M. Schrefl. The Evolving Algebra Semantics of Class and Role Hierarchies. In Libkin and Thalheim Eds.: *Semantics in*

Databases (Selected papers of a Workshop held in Rez/Prague, 1995). Springer LNCS Nr. 1358, pp. 92–113, 1998.

[138] G. Gottlob. Collapsing Oracle-Tape Hierarchies. In *Proceedings of the Eleventh IEEE Conference on Computational Complexity (CCC'96).* IEEE Computer Science Press, Philadelphia, May 24–27, 1996, pp.33–42.

[139] J. Dix, G. Gottlob, and V. Marek. Causal Models of Disjunctive Logic Programs. In *International Conference on Logic Programming ICLP'94, Santa Margherita Ligure, Italy, June 1994*, pages 290–302. MIT Press, 1994.

[140] Th. Eiter and G. Gottlob. Complexity Aspects of Various Semantics for Disjunctive Databases. In *Proceedings of the Twelth ACM SIGACT SIGMOD-SIGART Symposium on Principles of Database Systems (PODS-93)*, pages 158–167, June 1993.

[141] G. Gottlob, G. Moerkotte, and V. S. Subrahmanian. The PARK Semantics for Active Rules. In *Proc. International Conference on Extending Database Technology, EDBT'96*, Lecture Notes in Computer Science. Springer Verlag, pp. 35–55, 1996.

[142] G. Gottlob. Relativized Logspace and Generalized Quantifiers over Finite Structures In *Proc. Tenth Annual Symposium on Logic in Computer Science LICS'95 (San Diego, CA, June 1995).* IEEE Computer Society Press, 1995.

[143] M. Cadoli, Th. Eiter, and G. Gottlob. Using Default Logic as a Query Language. In *Proceedings Fourth International Conference on Principles of Knowledge Representation and Reasoning (KR-94)*, pages 99–108, 1994.

[144] S. Ceri, G. Gottlob, and L. Lavazza. Translation and optimization of logic queries: The algebraic approach. In *Proceedings of the Twelfth International Conference on Very Large Data Bases*, pages 395–402, August 1986.

[145] Georg Gottlob. Complexity and Expressive Power of Disjunctive Logic Programming. In M. Bruynooghe, editor, *Proceedings of the 11th International Logic Programming Symposium, ILPS'94, Ithaka, NY, November 94*, pages 23–42, Vancouver, 1994. MIT Press.

[146] G. Gottlob and R. Zicari. Closed world databases opened through null values. In *Proceedings of the 14th International Conference on Very Large Data Bases*, pages 395–402, August 1988.

[147] G. Gottlob. Computing covers for embedded functional dependencies. In *Proceedings of the ACM SIGACT-SIGMOD-SIGACT Symposium on Principles of Database Systems*, pages 58–69, March 1987.

[148] Th. Eiter and G. Gottlob. On the complexity of propositional knowledge base revision, updates and counterfactuals. In *Proceedings of the ACM SIGACT-SIGMOD-SIGACT Symposium on Principles of Database Systems*, pages 261–273, June 1992.

[149] Th. Eiter and G. Gottlob. The Complexity of Logic-Based Abduction. In P. Enjalbert, A. Finkel, and K.W. Wagner, editors, *Proceedings Tenth Symposium on Theoretical Aspects of Computing STACS-93*, number 665 in LNCS, pages 70–79, Würzburg, February 1993. Springer.

[150] Th. Eiter, G. Gottlob, and H. Mannila. Adding Disjunction to Datalog. In *Proceedings of the Thirteenth ACM SIGACT SIGMOD-SIGART Symposium on Principles of Database Systems (PODS-94)*, pages 267–278, May 1994.

[151] Thomas Eiter and Georg Gottlob. Complexity Results for Disjunctive Logic Programming and Application to Nonmonotonic Logics. In D. Miller, editor, *Proceedings of the Tenth International Logic Programming Symposium (ILPS-93)*, pages 266–278, Vancouver, 1993. MIT Press.

[152] Georg Gottlob. NP Trees and Carnap's Modal Logic. In *Proceedings of the 34th Annual Symposium on Foundations of Computer Science FOCS'93 (Palo Alto, California)*, pages 42–51. IEEE Computer Science Press, New York, November 1993.

[153] Thomas Eiter and Georg Gottlob. The Complexity of Nested Counterfactuals and Iterated Knowledge Base Revisions. In R. Bajcsy, editor, *Proceedings of the Thirteenth International Joint Conference on Artificial Intelligence (IJCAI-93)*, pages 526–531. Morgan Kaufman, 1993.

[154] G. Gottlob, N. Leone, and H. Veith. Second order logic and the weak exponential hierarchies. In *Proc. Intl. Symp. on Mathematical Foundations of Computer Science, MFCS'95, Prague, CR*, LNCS nr. 969, pages 66–81. Springer, August/September 1995.

[155] Thomas Eiter, Georg Gottlob, and Yuri Gurevich. Curb Your Theory! A circumscriptive approach for inclusive interpretation of disjunctive information. In R. Bajcsy, editor, *Proceedings of the Thirteenth International Joint Conference on Artificial Intelligence (IJCAI-93)*, pages 634–639. Morgan Kaufman, 1993. Also: *Second Compulog Net Meeting on Knowledge Bases (CNKBS-93)*, Athen, April 1993.

[156] G. Friedrich, G. Gottlob, and W. Nejdl. Physical negation instead of fault models. In *Proceedings of the National Conference on Artificial Intelligence (AAAI)*, pages 331–336, Boston, 1990.

[157] Thomas Eiter, Georg Gottlob, and Nicola Leone. Complexity Results for Abductive Logic Programming. In W. Marek, A. Nerode, and M. Truszczyński, editors, *Proceedings of the Third International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR-95)*, number 982 in LNCS, subseries LNAI, pages 1–14. Springer, 1995.

[158] Thomas Eiter, Georg Gottlob, and Nicola Leone. Semantics and Complexity for Abduction from Default Theories. In Ch. Mellish, editor, *Proceedings of the Fourteenth International Joint Conference on Artificial Intelligence (IJCAI-95)*, pages 870–876. AAAI Press, 1995.

[159] G. Gottlob. Semantic representation of logical operators of programming languages by means of three valued truth tables. In *Proceedings of the Twelfth International Symposium on Multiple Valued Logic*, pages 81–87. IEEE Computer Society Press, May 1982.

[160] G. Gottlob. The power of beliefs – or translating default logic into standard autoepistemic logic. In *Proceedings of the Thirteenth International Joint Conference on Artificial Intelligence (IJCAI-93)*, pages 570–575, 1992. (This paper was also presented at the Knowledge Representation Workshop at ECAI-92, Vienna, Austria, August 1992, and published in the respective Workshop Proceedings, Springer LNCS/AI no. 810).

[161] G. Friedrich, G. Gottlob, and W. Nejdl. Formalizing the repair process. In *ECAI-92, European Conference on Artificial Intelligence, Vienna*, pages 709–713, August 1992.

[162] G. Gottlob and A. Leitsch. Fast subsumption algorithms. In *Proceedings of the EUROCAL 85 Conference on Computer Algebra*, Lecture Notes in Computer Science. Springer Verlag, 1985.

[163] G. Gottlob, M. Schrefl, and M. Stumptner. On the interaction between transitive closure and functional dependencies. In *Proc. of the 2nd Intl. Conference on Mathematical Fundamentals of Database Systems*, Lecture Notes in Computer Science. Springer, June 1989.

[164] Th. Eiter, G. Gottlob, H. Veith. Modular Logic Programming and Generalized Quantifiers. In *Proceedings of the 4th International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'97)* Springer LNCS 1265, pp.290–309.

[165] Th. Eiter, G. Gottlob. The Complexity Class Θ_2^p: Recent Results and Applications in AI and Modal Logic In *Proceedings of the 11th International Symposium on Fundamentals of Computation Theory (FCT'97)* Springer LNCS Nr. 1279, 1997, pp.1–18.

[166] E. Dantsin, Th. Eiter, G. Gottlob, and A. Voronkov. Complexity and Expressive Power of Logic Programming. In *Proceedings of the Twelfth IEEE Conference on Computational Complexity (CCC'97).* IEEE Computer Science Press, pp.82–101.

[167] G. Gottlob, N. Leone, and F. Scarcello. On the Complexity of Some Inductive Logic Programming Problems. In *Proceedings of the 7th International Workshop on Inductive Logic Programming (ILP'97).* Springer LNCS/AI Nr.1297, 1997.

[168] S. Citrigno, Th. Eiter, W. Faber, G. Gottlob, G. Koch, N. Leone, Ch. Mateis, G. Pfeifer, and F. Scarcello. The dlv System : Model Generator and Advanced Frontends In *Proceedings of the 12th Workshop on Logic Programming (WLP'97, Munich, Sept. 1997).* LMU München, 1997,pp. 128–137.

[169] F. Buccafurri, Th. Eiter, G. Gottlob, and N. Leone. Combining Abductive and Model Checking Techniques for Repair of Concurrent Programs In *Proceedings of the 2nd Workshop on Trends in Theoretical Informatics (Budapest, March 1997) Periodica Polytechnica*, pp.91–101, 1997.

[170] Georg Gottlob. Recent Complexity Results in Logic Programming and Nonmonotonic Reasoning and Why they Matter (Invited Talk Abstract). In L. Pereira and A. Nerode, editors, *Proceedings of the Second International Workshop on Logic Programming and Nonmonotonic Reasoning LPNMR'93*, page 265. MIT Press, 1993.

[171] G. Gottlob. Complexity of Expressive Power of KR Formalisms (Invited Talk Abstract). In *Proceedings of the 1996 Fifth International Conference on Principles of Knowledge Representation and Reasoning – KR'96*, Cambridge, MA, Nov.5-8, 1996, pp.647–649, 1996.

[172] G. Friedrich, G. Gottlob, and W. Nejdl. Hypothesis classification, abductive diagnosis, and therapy. In *Proceedings of the 1990 International Workshop on Principles of Diagnosis, Stanford, July 1990* and *Proceedings of the International Workshop on Expert Systems in Engineering – Principles and Applications (G. Gottlob and W.Nejdl Eds.)*, Springer LNCS/AI Nr. 462, pages 70–78, Vienna, 1990.

[173] G. Friedrich, G. Gottlob, and W. Nejdl. Towards a theory of the repair process. In *EPIA-91, 5th Portuguese Conference on Artificial Intelligence, Albufeira, Portugal*, number 541 in LNCS, pages 222–236. Springer Verlag Heidelberg, October 1-3 1991.

[174] S. Ceri, S. Crespi-Reghizzi, G. Gottlob, F. Lampertini, and L. Lavazza. The ALGRES project. In *Proceedings of the International Conference on Extending Database Technology*, Lecture Notes in Computer Science 303, pages 551–555. Springer Verlag, March 1988.

[175] S. Ceri, G. Gottlob, and G. Wiederhold. Interfacing Prolog and relational databases efficiently. In *Proceedings of the First International Conference on Expert Database Systems*, April 1986.

[176] S. Copelli and G. Gottlob. Implementation of a distributed file system on a geographic network of personal computers. In *Proceedings of the 3rd International Seminar on Distributed Data Sharing Systems*, pages 203–219. Elsevier Science Publishers, 1985.

[177] Th. Eiter, G. Gottlob, and H. Mannila. Expressive Power and Complexity of Disjunctive Datalog. In H. Blair, W. Marek, A. Nerode, and J. Remmel, editors, *Informal Proceedings of the Second Workshop on Structural Complexity and Recursion-Theoretic Methods in Logic Programming*, pages 59–79, Vancouver, October 29 1993. Cornell University, Mathematical Sciences Institute.

[178] G. Gottlob. Review of a Carnapian Extension of S5. In Ewa Orlowska, editor, *Logic at Work* , (Studies in Fuzziness and Soft Computing, Vol. 24) Physica-Verlag, ISBN 3-7908-1164-5, 1999.

[179] G. Gottlob. Promise: A redundancy detector for logic programs. In *Proceedings of the International Computer Symposium 1986*, pages 537–546, December 1986.

[180] P. Colombo, S. Copelli, G. Gottlob, L. Grossi, D. Mandrioli, G. Oldano, P. Paolini, and A. Pellegrini. Design of a distributed file system for a geographic network. In *Microcomputers: Developments in Industry, Business and Education - Proceedings of the 1983 EUROMICRO Conference*. North Holland Publishing Company, 1983.

[181] G. Gottlob, G. Kappel, and M. Schrefl. Semantics of object-oriented data models - the evolving algebra approach. In *Next Generation Information Technology, Proc. First Intl. East/West Database Workshop, Kiew, Ucranine*, number 504 in LNCS, pages 144–160. Springer Verlag Heidelberg, October 1990.

[182] Th. Eiter and G. Gottlob. Complexity Results for Logic-Based Abduction. In H. Blair, W. Marek, A. Nerode, and J. Remmel, editors, *Informal Proceedings of the Workshop on Structural Complexity and Recursion-Theoretic Methods in Logic Programming*, pages 29–44, Washington DC, November 1992. Cornell University, Mathematical Sciences Institute.

[183] A. Leitsch and G. Gottlob. Deciding Horn clause implication problems by ordered semantic resolution. In Amsterdam F. Gardin Editor, North Holland, editor, *Computational Intelligence II, Proceedings of the International Symposium, Milan, Italy, 25-27 Sept. 1989*, 1989.

[184] Th. Eiter, G. Gottlob, and H. Mannila. Disjunctive Logic Programming over Finite Structures. In U. Fuhrbach, editor, *Proceedings GI Workshop on Disjunctive Logic Programming and Disjunctive Databases, 13th World Computer Congress IFIP Congress '94*, August 1994.

[185] Th. Eiter, G. Gottlob, and H. Mannila. Expressive Power and Complexity of Disjunctive Datalog under the Stable Model Semantics. In Kai van Luck and Heinz Marburger, editors, *Management and Processing of Complex Data Structures – Proceedings of the Third Workshop on Information Systems and Artificial Intelligence*, number 777 in LNCS, pages 83–103. Springer, 1994.

[186] G. Gottlob. Man machine interaction in process oriented computer simulation. In Findler Trappl and Horn, editors, *Progress in Cybernetics and System Research*, pages 589–595, 1982.

[187] P. Colombo, S. Copelli, A. Florit, G. Gottlob, L. Grossi, D. Mandrioli, G. Oldano, P. Paolini, and A. Pellegrini. SAD: Un sistema di archivi distribuiti su una rete geografica. In *Proceedings of the AICA-Conference, Naples, Italy*, 1983.

[188] G. Gottlob. On the complexity of clause condensing. In *Proceedings of the Seventh Austrian Conference on Artificial Intelligence*, Informatik Fachberichte Nr. 287, pages 16–29. Springer Verlag, 1991.

[189] G. Gottlob and L. Tanca. Il Prolog e la progettazione di basi di dati. In *Atti del Primo Convegno Nationale sulla Programmazione Logica*, pages 96–103, March 1986.

[190] G. Gottlob and L. Tanca. Prolog and database design: A Prolog tool for database scheme decomposition. In *Proceedings of the Third International Conference on System Research, Informatics and Cybernetics*, August 1986.

***

Academic writings

[191] G. Gottlob. Diplomarbeit: Simulation von Interaktiv gesteuerten Straßenbahnnetzen. Master's thesis, Universität Wien – Institut f. Statistik u. Informatik, 1979.

[192] G. Gottlob. *Dissertation: Mehrwertige Logik – Aufbau und Anwendung in der Informatik*. PhD thesis, Technische Universität Wien, 1981.

Books

[193] S. Ceri, G. Gottlob, and L. Tanca. *Logic Programming and Databases*. Surveys in Computer Science. Springer Verlag, 1990.

[194] G. Gottlob and T. Walsh (Editors). *Proceedings of the Eighteenth International Joint Conference on Artificial Intelligence (IJCAI'03)*, Acapulco, Mexico, August 9-15, 2003, Morgan Kaufman, 2003.

[195] G. Gottlob, A. Benczúr, and J. Demetrovics (Editors). *Advances in Databases and Information Systems, 8th East European Conference (ADBIS'04)*, Budapest, Hungary, September 22-25, 2004, Springer LNCS 3255, 2004.

[196] G. Gottlob and W. Nejdl (Editors). *Expert Systems in Engineering – Principles and Applications (Proceedings of an International Workshop, Vienna,September 1990).* LNCS/AI-462. Springer Verlag Heidelberg, 1990.

[197] G. Gottlob and M. Vardi (Editors). *Database Theory – ICDT'95, 5th International Conference*. Number 893 in LNCS. Springer Verlag Heidelberg, 1995.

[198] G. Gottlob and E.Grandjean, K. Seyr (Editors). *Computer Science Logic – Proceedings of the 12th International Workshop CSL'98*. Brno, Czech Republic, August 1998. Number 1584 in LNCS. Springer Verlag Heidelberg, 1998.

[199] Th. Frühwirth, G. Gottlob, and W. Horn (Editors). *Expertensysteme – Grundlagen und Methoden*. Springers Angewandte Informatik. Springer Verlag Wien–New York, 1990.

[200] A. Pirotte, C. Delobel, and G. Gottlob, (Editors). *Advances in Database Technology EDBT92*. Number 580 in LNCS. Springer Verlag Heidelberg, 1992.

[201] G. Gottlob, A. Leitsch, and D. Mundici, (Editors). *Computational Logic and Proof Theory, Proceedings of the Third Kurt Gödel Kolloquium, Brno, Czech Republic, August 1993*. Number 713 in LNCS. Springer Verlag Heidelberg, 1993.

Other writings

[202] J. Dorn and G. Gottlob Künstliche Intelligenz. In *Informatik-Handbuch*, P. Rechenberg and G. Pomberger Eds., Hanser Verlag 1997, pp.819-838.

[203] G. Gottlob and M. Stumptner. AI und Expertensysteme - Von Software Engineering zu Knowledge Engineering. In *Technik und Trends*, Schriftenreihe des Österreichischen Industriewissenschaftlichen Instituts, 1988.

[204] G. Gottlob. On the truth functional representations of some special extensions of the propositional calculus. Technical report, TU-184-2, 1983. Manuscript.

[205] G. Gottlob. Operative dreiwertige Logiken zur Charakterisierung von Entscheidungsprozessen und Auswertunsvorgängen. In *Manuscript. Talk and Abstract presented at the International Symposium on Logic and Philosophy of Science, Kirchberg, Austria*, 1981.

[206] A. Ancona, G. Gottlob, A. Clematis, L. DeFloriani, G. Dodero, and Vl Gianuzzi. Permanent data structures for Modula2. Technical Report SP2-88, TU-184-2, 1988.

[207] S. Copelli, G. Gottlob, L. Grossi, D. Mandrioli und P. Paolini, L. Suppa, and A. Repichini. *SAD: Sistema di Archivi Distribuiti.* C.N.R.-DATANET, 1985.

[208] G. Friedrich and G. Gottlob. Inferenzstrategien. In Th. Frühwirth, G. Gottlob, and W. Horn, editors, *Expertensysteme.* Springer-Verlag, 1990.

[209] G. Gottlob, M. Schrefl, and M. Stumptner. *Datenbanksysteme (Vorlesungsskriptum).* Course Lecture Notes. Technische Universität Wien, 1989.