Dagstuhl-Seminar No. 00291

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Logics for Emerging Applications of Databases

16 – 21 July, 2000,

organized by

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Contents

1 Preface

The designers and users of present-day information systems deal with more and more complex applications that have to meet stringent quality requirements. Logic, in the form of many different logical formalisms, is a suitable tool to address some of the emerging problems, particularly those that benefit from a declarative formulation. The advantages of logic include formal, well-understood syntax and semantics, and thoroughly studied computational properties.

Emerging applications requiring database management have motivated new developments in logical frameworks for their support. Examples of these new developments are:

- logical frameworks for various aspects of electronic commerce, e.g. negotiation and communication, EDI, electronic contracts
- logics for security, for example in distributed data stores
- workflow logics as descriptive frameworks for specifying, querying, animating and modifying workflows
- logical frameworks for handling data of varying quality in data warehouses ("soft" integrity constraints, ..)
- logics for information integration, database interoperation, and virtual enterprises
- logical frameworks for the specification of multimedia applications
- logics for temporal, spatial, and spatio-temporal database applications
- logical frameworks in scientific data handling
- logical specification of agents and policies
- logical aspects of knowledge discovery in databases and OLAP.

In addition to addressing the above new developments, the seminar will focus on the critical evaluation of existing logical frameworks for databases and information systems in the light of past experience and future potential. In particular, the following are candidates for such a review: nonmonotonic logics, logics of time and action, deontic logic, deductive and constraint databases. Leading researchers from emerging database applications areas are also being invited to comment on the role of logic in their areas, hopefully generating lively discussions.

In 1995, the seminar 9529 about "The role of logics in information systems" took place in Dagstuhl. The seminar was successful in bringing together researchers from different areas connecting formal logic with database problems. The seminar discussions lead to the book "Logics in databases and information systems" published by Kluwer in 1998. Five years after this workshop, new application areas will have emerged leading to new challenges for combining logical frameworks with database technology. The Dagstuhl seminar 00291 is dedicated to logics for emerging applications of databases, continuing the interdisciplinary work started at the first seminar.

2 Final Program

Program Monday

Morning Sessions

9:00 - 9:10 Introduction to Seminar

9:10 - 9:50 Victor W. Marek, University of Kentucky:
Revision Programming

9:50 - 10:30 Leo Bertossi, Universidad Catolica de Chile:
Consistent Query Answering in Inconsistent Databases

10:30 - 11:00 *Coffee Break*

11:00 - 11:30 Alexander Celle, Universidad Catolica de Chile:
An Algorithm for Retrieving Consistent Information

11:30 - 12:00 Marcelo Arenas, Universidad Catolica de Chile:
Applications of Annotated Predicate Calculus to Querying Inconsistent Databases

Afternoon Sessions

14:00 - 14:30 Michael Kifer, SUNY at Stony Brook:
Logic-based Modelling and Analysis of Workflow

14:30 - 15:00 James Bailey, University of London:
Logic and Active Database Rules

15:00 - 15:30 Hans-Dieter Ehrich, TU Braunschweig:
Distributed Checking via Communicating Observers

15:30 - 16:00 *Coffee & Cake*

16:00 - 16:30 Torsten Schaub, Universität Potsdam:
Compiling Logic Programs with Preferences

16:30 - 17:00 Bernhard Thalheim, BTU Cottbus:
Logical Fundamentals for Internet Information Services

17:00 - 17:30 Srinath Srinivasa, TU Cottbus:
Logics for Interaction Schema Design - Category vs Deontic

Program Tuesday

Morning Sessions

9:00 - 9:30 Jack Minker, University of Maryland:
A Logic-Based Approach to Data Integration

9:30 - 10:00 Claudio Bettini, Universita di Milano:
Semantic Data Compression for Temporal Data

10:00 - 10:30 David Toman, University of Waterloo:
Expiration in Historical Data Warehouses

10:30 - 10:50 *Coffee Break*

10:50 - 11:35 Diego Calvanese, Universitá di Roma "La Sapienza":
Description Logics for Data Warehousing

11:35 - 12:10 Enrico Franconi, Manchester University:
Logics for Temporal Conceptual Modelling

Afternoon Sessions

14:00 - 14:45 Jef Wijsen, Universite de Mons:
A Query Language for Data Mining

14:45 - 15:30 Toon Calders, University of Antwerpen:
Axiomatization of Frequent Sets for Data Mining
(together with J. Paredaens)

15:30 - 16:00 *Coffee & Cake*

16:00 - 16:30 Hans-Dieter Ehrich, TU Braunschweig:
Distributed Checking via Communicating Observers

16:30 - 17:00 Dietmar Seipel, Universität Würzburg:
Program Transformation in Disjunctive Deductive Databases

17:00 - 17:30 David N. Jansen, University of Twente:
Model Checking in Twente

Program Wednesday

Morning Sessions

9:00 - 9:30 Georg Lausen, Universität Freiburg:
Mapping XML to a Simple Semistructured Datamodel

9:30 - 10:00 Anthony Hunter, University College London:
Logical Analysis and Merging of Inconsistent Structured News Reports

10:00 - 10:30 Thomas Schwentick, Universität Mainz:
Logically Defined Queries for Tree-Structured Data

10:30 - 11:00 *Coffee Break*

11:00 - 11:30 Michael Maher, Griffith University - Nathan:
Defining Constraints

11:30 - 12:10 Can Türker, ETH Zürich:
Transaction Closure Logic - A Framework for Reasoning about
Transaction Dependencies

Afternoon Excursion

Program Thursday

Morning Sessions

9:00 - 10:00 V.S. Subrahmanian, University of Maryland:
IMPACT: Interactive Maryland Platform for Agents Collaborating together

10:00 - 10:30 Thomas Eiter, TU Wien:
Impact System

10:30 - 11:00 *Coffee Break*

11:00 - 11:30 John-Jules Meyer, Utrecht University:
On Programming KARO Agents

11:30 - 12:00 Gerd Wagner, TU of Eindhoven:
Stable Generated Models Revisited

Afternoon Sessions

14:00 - 14:45 Ron van der Meyden, Univ. of New South Wales:
A Logic for SDSI's Linked Local Name Spaces

14:45 - 15:15 Jorge Lobo, Bell Labs - Murray Hill:
PDL: The Policy Description Language Project at Bell Labs

15:15 - 15:45 Jan Chomicki, Monmouth Univ. - West Long Branch:
Conflict Resolution in Policy Management

15:45 - 16:15 *Coffee & Cake*

16:15 - 17:45 Panel Discussion "XML / E-Commmerce and Logics"

19:30 - ... Working Groups (in parallel)

Program Friday (preliminary)

Morning Sessions

9:00 - 10:30 Working Groups (continued)

10:30 - 11:00 *Coffee Break*

11:00 - 12:00 Report on Working Group Results; Seminar closing session

3 Abstracts of Presentations

The following abstracts of presentations appear in alphabetical order of the speakers.

Applications of Annotated Predicate Calculus to Querying Inconsistent Databases

Marcelo Arenas Saavedra (Pontificia Universidad Catolica de Chile, Santiago)
joint work with Leopoldo Bertossi (Pontificia Universidad Catolica de Chile, Santiago)
and Michael Kifer (SUNY, Stony Brook)

Abstract

In this talk we consider the problem of specifying and computing consistent answers to queries against databases that do not satisfy given integrity constraints. This is done by simultaneously embedding the database and the integrity constraints, which are mutually inconsistent in classical logic, into a theory in annotated predicate calculus, a logic that allows non trivial reasoning in the presence of inconsistency. In this way, several goals are achieved: (a) A logical specification of the class of all minimal "repairs" of the original database, and the ability to reason about them; (b) The ability to distinguish between consistent and inconsistent information in the database; and (c) The development of computational mechanisms for retrieving consistent query answers, that is, answers that are not affected by the violation of the integrity constraints.

Logic and Active Database Rules

James Bailey (Birkbeck College, University of London)

Abstract

Active database systems enhance the functionality of traditional databases through the use of active rules or 'triggers'. When a system contains many rules, however, overall behaviour may be obscure and reasoning about rule dynamics may become very complicated. In this talk, we present several active rule languages for which analysis is decidable and then show how minimal extensions then lead to undecidability.

Consistent Queries in Inconsistent Databases

Leopoldo Bertossi (Pontificia Universidad Catolica de Chile,Santiago)

Abstract

A database may be inconsistent in the sense that it does not satisfy given integrity constraints (or some form of semantic constraints, user constraints, etc.). In spite of this, the available data is still useful and part of it is still "consistent". In this talk we present different results obtained on this issue with Marcelo Arenas, Alexander Celle, Jan Chomicki and Michael Kifer. More specifically,

(a) A model theoretic definition of consistent answer to a query posed to an inconsistent database. This notion is based on the minimal repairs of the inconsistent database.

(b) Computational mechanisms for retrieving consistent answers based on query rewriting.

(c) Implementation of such mechanisms.

(d) A specification in annotated predicate calculus of the database repairs and derivation of answering mechanisms from the specification.

(e) A specification of the database repairs based on disjunctive logic programs with exceptions for answering general queries.

(f) An analysis of consistent answers to aggregate queries in databases that violate given functional dependencies. In this framework we extend the definition of consistent answer, we present a complete complexity analysis, some algorithms for the feasible cases are given, and certain assumptions are identified that allow reduce the complexity of consistent query answering.

Data Compression for Temporal Data

Claudio Bettini (Data Compression for Temporal Data)

Abstract

When data is associated with time in a temporal database, its semantics is usually specified in terms of the data being valid at the given time (called "valid time"), or as being added to (or deleted from) the DB at the given time (called "transaction time"). However, a richer semantics is usually intended by the DB designer regarding how the values of certain attributes evolve over time and how these values change when considered in terms of different time granularities.

In previous joint work with S. Jajodia and X.S. Wang, we provided a formalism to express this richer semantics. A technique was introduced to automatically reformulate user queries based on the semantics obtaining answers in terms of instants and granularities for which no explicit data exists in the DB. In this talk I illustrated how the richer semantics can be exploited to compress the original DB into a "minimal representation". Queries can be evaluated directly against the compressed DB. An interesting issue briefly discussed in the talk is the maintanance of the compressed DB against update operations. The compression is not an alternative to standard data compression techniques, but can lead to a significant additional compression of the DB. Future work includes the extension of the same techniques to spatial data.

Axiomatization of Frequent Sets

Toon Calders (Universiteit Antwerpen, Wilrijk)
joint work with Jan Paredaens (Universiteit Antwerpen, Wilrijk)

Abstract

In data mining association rules are very popular. Most of the algorithms in the literature for finding association rules start by searching for frequent itemsets. In this work we consider frequent set expressions. A frequent set expression is a pair containing an itemset and a frequency indicating that the frequency of that itemset is greater than or equal to the given frequency. A system of frequent sets is a collection of such expressions. We give and prove an axiomatization for these systems. This axiomatization characterizes complete systems. A system is complete when it explicitly contains all information that it logically implies. Every system of frequent sets has a unique completion. We show that this completion is computable. We proof that deciding completeness is in coNP.

A Description Logics Based Approach to Data Integration

Diego Calvanese (Universit "La Sapienza", Roma)
joint work with G. De Giacomo, M. Lenzerini, D. Nardi, R. Rosati (all from Universit "La Sapienza", Roma)

Abstract

Data integration is one of the most important aspects of a Data Warehouse. When data passes from the sources of the application-oriented operational environment to the Data Warehouse, possible inconsistencies and redundancies should be resolved, so that the warehouse is able to provide an integrated and reconciled view of data of the organization. We present a novel approach to data integration in Data Warehousing, which is based on a conceptual representation of the Data Warehouse application domain in terms of an expressive Description Logic subsuming traditional conceptual and object-oriented data models. The approach we present follows the so-called local-as-view paradigm: both source and Data Warehouse relations are defined as views over the conceptual model. We introduce a technique for declaratively specifying suitable reconciliation correspondences to be used in order to solve conflicts among data in different sources. The main goal of the method is to support the design of mediators that materialize the data in the Data Warehouse relations. Starting from the specification of one such relation as a query over the conceptual model, a rewriting algorithm reformulates the query in terms of both the source relations and the reconciliation correspondences, thus obtaining a correct specification of how to load the data in the materialized view.

An Algorithm for Retrieving Consistent Information

Alexander Celle (Pontificia Universidad Catolica de Chile, Santiago)
joint work with Leopoldo Bertossi (Pontificia Universidad Catolica de Chile, Santiago)

Abstract

Querying an inconsistent database is a dangerous situation, specially if we consider that from a logical point of view, we can conclude anything from an inconsistent set of formulas. Thus, when facing an inconsistent database the usual approach is to repair it, i.e. take it back to a consistent state. This, however, has one serious drawback: it generally involves discarding inconsistent data, hence losing potentially useful information.

In this talk, algorithm QUECA was presented. This algorithm, given a first order query Q, generates a new query QUECA(Q) such that, when posed to a database, its answers correspond to the consistent answers of Q. The algorithm has been proven to be sound, terminating and complete for a class of integrity constraints that includes most of the constraints found in traditional relational database systems. Complexity issues are also addressed.

Finally, the implementation of the algorithm in XSB is described; showing, by means of some sample executions on a demo, how the system couples to a relational database system, allowing the user to interact with the database in a simple way.

Conflict Resolution in Policy Management

Jan Chomicki (SUNY Buffalo, West Long Branch)
joint work with Jorge Lobo (Lucent Bell Labs) and Shamim Naqvi (Convexant)

Abstract

The simple event-condition-action (ECA) rule paradigm of active databases has proved very useful in many database applications. However, its applicability goes beyond data management. ECA rules can be used in network management and monitoring, electronic commerce, security and access management, and other application areas, to express policies – collections of general principles specifying the desired behavior of a system. Usually, policies are coded in an imperative programming language like Java. This makes for implementation ease and efficiency but limits what can be done with policies. For instance, it is difficult to maintain, verify, or analyze such policies.

In my talk I used a declarative policy definition language PDL, in which policies are formulated as sets of ECA rules. In contrast to standard database trigger languages, PDL has a rich event sublanguage but allows only uninterpreted actions. In addition to rules, one can specify in PDL constraints on concurrent or sequential execution of actions. I addressed the issue of defining policy monitors that guarantee that constraint violations (action conflicts) are fully resolved at run-time. The monitors resolve conflicts through action cancellation or delay. The monitors may also differ with respect to a novel property called "unobtrusiveness" which requires that conflict resolution produce a result corresponding to some conflict-free execution of the policy. I showed how to specify the monitors declaratively using (a variant of) Datalog. I also presented algorithms for the evaluation of monitors and studied their computational properties. Finally, I described how conflict resolution can be added to a PDL-based policy server being used to provide centralized administration of a soft switch in a communication network.

Distributed Checking via Communicating Observers

Hans-Dieter Ehrich (Technical University of Braunschweig)

Abstract

When checking or verifying a concurrent system, the global condition is usually checked against a sequential state-transition model of the system representing concurrency by interleaving. In a sense, it represents the viewpoint of a single sequential observer outside the system. We show that it may be useful to employ several communicating observers where the observers may be situated outside or inside the system. Since each observer can be checked separately, state-space explosion can be considerably reduced. Communication among observers, however, may become complex and is not included in the checking. On the other hand, this separation of concerns opens the possibility to check communication infrastructure (like middleware) separately without checking it over and over again with the object systems built on it. We describe a multi-observer extension of CTL where each system condition is given from the viewpoint of one of the observers, using a local version of CTL enlarged by assertions about other observers. Then we describe how to distribute these "global" assertions over the observers involved, introducing communication by a basic RPC-like mechanism; here we capitalize on results on translating distributed logics (Ehrich-Caleiro, Acta Informatica 2000).

Regular Agent Programs

Thomas Eiter (TU Wien, Austria)

Abstract

The IMPACT system is a platform for building and deploying agents on top of arbitrary data structures, which allows to "agentize" new/legacy software code. In previous work, we have provided a series of successively more sophisticated declarative semantics for agent programs, and we showed that as they become epistemically more desirable, their computational complexity increases dramatically. In this talk we present a class of so called weak regular agent programs. Such programs are definable via three parameters—checking for a property called "safety", checking for a property called "conflict freedom" and checking for a "deontic stratifiability" property. A regular agent program is one that satisfies an additional "boundedness" property. We address how such programs can be built within the IMPACT Agent Development Environment.

Description Logics for Temporal Conceptual Modelling

Enrico Franconi (The University of Manchester, Manchester)

Abstract

Description Logics for Temporal Conceptual Modelling

The contribution of this paper is twofold. On the one hand, it introduces $\mathcal{TDLR}$, a novel temporal logic for temporal conceptual modelling, motivated as the obvious generalisation of the successful $\mathcal{DLR}$ Description Logic. Tight decidability and complexity results are proved for $\mathcal{TDLR}$ and the monodic fragment of it ($\mathcal{TDLR}^-$). Moreover, the decidability of conjunctive query containment under $\mathcal{TDLR}^-$ constraints is proved. On the other hand, the paper provides a formal semantic characterisation of all the important temporal conceptual modelling constructs (for valid time representation) as found in the literature. To the best of our knowledge, this is the first systematic formalisation of the constructs present in most temporal conceptual modelling systems. This systematic characterisation as $\mathcal{TDLR}$ theories is an evidence of the adequacy of the $\mathcal{TDLR}$ temporal Description Logic for temporal conceptual modelling.

A Logic-Based Approach to Data Integration

John Grant (Towson University, Maryland)
Jack Minker (University of Maryland at College Park, Maryland)

Abstract

An important aspect of data integration involves answering queries using various resources rather than by accessing database relations. The process of transforming a query from the database relations to the resources is often referred to as query folding or answering queries using views, where the views are the resources. We present a uniform approach that includes as special cases much of the previous work on this subject. Our approach is logic-based using resolution. We deal with integrity constraints, negation, and recursion also within this framework.

Logical Analysis and Merging of Inconsistent Structured News Reports

Anthony Hunter (University College London, London)

Abstract

Structured text is an idea implicit in a number of approaches to handling information such as news reports. An item of structured text is a set of semantic labels together with a word, phrase, sentence, null value, or a nested item of structured text, associated with each semantic label. As a simple example, a report on a corporate acquisition could use semantic labels such as "buyer", "seller", "acquisition", "value", and "date". Some news agencies store news reports as structured text. In addition, new technologies, such as information extraction and XML, will massively increase the amount of structured text available. The advent of structured text raises the need for tools for structured text analysis. This talk focuses on analysis for identifying and acting on incompleteness and inconsistency in news reports, including addressing the problem of merging news reports from multiple sources. The research involves integrating established theories for logic-based approaches to inconsistency and incompleteness. A logic-based approach is required for the sophisticated domain knowledge for managing the uncertainty arising in the information in items of structured text. In particular, default reasoning is required since the meaning of the elements in an item of structured text depends on the context. In addition there is a need for paraconsistent reasoning and argumentation with the potential conflicts that can arise between news reports and the domain knowledge.

Logic Based Modeling and Analysis of Workflows

Michael Kifer (SUNY at Stony Brook, Stony Brook)
joint work with Hasan Davulcu, C.R. Ramakrishnan, I.V. Ramakrishnan (all from SUNY at Stony Brook, Stony Brook)

Abstract

A workflow is a collection of cooperating, coordinated activities designed to carry out a well-defined complex process, such as trip planning, graduate student registration procedure, or a business process in a large enterprise. An activity in a workflow might be performed by a human, a device, or a program. Workflow management systems provide a framework for capturing the interaction among the activities in a workflow and are recognized as a new paradigm for integrating disparate systems, including legacy systems. Ideally, they should also help the user in analysis and reasoning about complex business processes.

In this paper, we develop a novel framework for specifying, analyzing and executing workflows based on Transaction Logic.

Mapping XML to a Simple Semistructured Datamodel

Georg Lausen (University Freiburg, Freiburg)
Pedro José Marrón (University Freiburg, Freiburg)

Abstract

XML is the proposed internet standard for data exchange. Processing of XML documents currently is discussed mostly without taking the internet explicitly into account; it is either document or database oriented with an additional link- (URI-) facility. We propose to emulate XML processing by current standard internet technology and exemplify this with the LDAP directory access protocol. We first introduce a simple semistructured datamodel and show how XML documents can be mapped onto it. We then argue that this datamodel directly corresponds to the LDAP information model. To map XML queries the basic LDAP query facilities have to be extended. As a first step into this direction we extend LDAP to be able to emulate full XPAth.

The Policy Description Language Project at Bell Labs

Jorge Lobo (Bell Labs, Murray Hill)

Abstract

The simple event-condition-action (ECA) rule paradigm of active databases has proved very useful in many database applications. However, its applicability goes beyond data management. ECA rules can be used in network management and monitoring, electronic commerce, security and access management, and other application areas, to express policies – collections of general principles specifying the desired behavior of a system. Usually, policies are coded in an imperative programming language like Java. This makes for implementation ease and efficiency but limits what can be done with policies. For instance, it is difficult to maintain, verify, or analyze such policies.

In this talk I will describe PDL, a declarative policy definition language in which policies are formulated as sets of ECA rules. In contrast with standard database trigger languages, PDL has a rich event sublanguage but allows only uninterpreted actions. I will review results on the complexity of evaluating policies, tracing and debugging policies, resolving intra and inter policy conflicts and doing hypothetical reasoning abut policies. I will also describe the architecture of a policy server developed at Bell Labs that is been used to provide centralized administration of a soft switch in a communication network.

Assessing Reactive Constraints

Michael Maher (Griffith University, Nathan)

Abstract

We address an issue in the definition and use of reactive constraints in constraint database systems. Reactive constraints are somewhat ad hoc relations added to a constraint programming system - by system developers or system users - to address a perceived lack of expressiveness of the underlying constraint solver. Their implementation is often incomplete in comparison with the underlying constraint solver and there has been no principled way in which different implementations might be compared. We address this problem by formulating a parameterized notion of completeness based on timely propagation of constraints. This issue is of particular significance for constraint databases, since query optimization must depend on understanding of constraint propagation.

Revision Programming

Victor W. Marek (University of Kentucky, Lexington)

Abstract

We present both fundamentals and recent developments of a formalism called "Revision Programming", a declarative tool for enforcing updates in databases, as well as conducting some classes of repairs.

We focus on the reduction of revision programming to logic programming with stable semantics, so the computing environments such as deres, smodels and dlv can be employed.

A logic for SDSI's Linked Local Name Spaces

Ron van der Meyden (The University of New South Wales, Sydney)
joint work with Joe Halpern (Cornell University, Ithaca)

Abstract

SDSI is the Simple Distributed Security Infrastructure proposed by Rivest and Lampson. This talk presented LLNC, the Logic of Local Name Containment, which provides a logical treatment of local names in SDSI. The logic improves upon a prior proposal by Abadi, which has a somewhat unintuitive semantics and which draws conclusions about local names that do not follow from SDSI's name resolution algorithm. LLNC has a clear semantics and provides a tight characterization of SDSI name resolution. The semantics is closely related to that of logic programs, leading to an approach to the efficient implementation of queries concerning local names. A complete axiomatization of the logic was also discussed. The talk concluded with a general discussion of logical treatments of trust management in distributed systems.

Compiling Logic Programs with Preferences

Torsten Schaub (University of Potsdam, Potsdam)

Abstract

We describe an approach for compiling dynamic preferences into logic programs under the answer set semantics. An *ordered* logic program is an extended logic program in which rules are named by unique terms, and in which preferences among rules are given by a set of atoms of the form $s \prec t$ where s and t are names. An ordered logic program is transformed into a second, regular, extended logic program wherein the preferences are respected, in that the answer sets obtained in the transformed theory correspond with the preferred answer sets of the original theory. Our approach allows the specification of *static* orderings (in which preferences are external to a logic program), as well as *dynamic* orderings (in which preferences can appear within a program), and orderings on *sets* of rules. In large part then, we are interested in describing a general *methodology* for uniformly incorporating preference information in a logic program. Since the result of our translation is an extended logic program, we can make use of existing implementations, such as `dlv` and `smodels`. To this end, we have developed a compiler, available on the web, as a front-end for these programming systems.

Logic-based query languages for tree-structured data

Thomas Schwentick (Johannes Gutenberg-University, Mainz)

Abstract

It would be desirable to have a query language for tree-structured data that is (1) as easily usable as SQL, (2) based on a nice, expressive logic (like MSO), and (3) efficiently evaluable. The talk develops some ideas in this direction. It considers logics that are as expressive as FO-logic, FO-logic + regular expressions and MSO-logic, respectively, but which have comparably low combined complexity. Their definition uses guarded quantification. They can be seen as intermediate steps between logics and corresponding automata.

Logics for Emerging Applications of Databases

Dietmar Seipel (Universität Würzburg, Würzburg)

Abstract

Practical applications of knowledge bases can benefit from advanced features for representing and reasoning about *incomplete or uncertain knowledge*, e.g. diagnostic reasoning, planning under constraints, reasoning in spatial databases, reasoning about actions or specifications. We show how *program transformations* can be used for defining and evaluating semantics of disjunctive deductive databases, where incomplete knowledge is represented in the form of disjunctions.

There are many cases where a semantics SEM^* can be characterized based on a (simpler) semantics SEM by saying $SEM^*(\mathcal{D}) = SEM(\mathcal{D}^\tau)^\otimes$, which means that SEM is applied to the transformed database $\mathcal{D}^\tau$ and a suitable mapping $\otimes$ interprets the result $SEM(\mathcal{D}^\tau)$ as the semantics of $\mathcal{D}$. For example, if SEM is stable model semantics, then it can be generalized using the TU–transformation to obtain partial stable models. The CD–transformation translates a disjunctive logic program into a normal logic program, such that the stable models remain unchanged. Based on a variant of the CD–transformation a new semantics of so–called *stable states* can be defined, which form a superset of the set of stable models.

Other program transformations mentioned in the talk are the magic sets transformation, partial evaluation, program simplification, the evidential transformation, and program completion.

Logics for Interaction Schema: Category vs Deontic

Srinath Srinivasa (Brandenburg University of Technology at Cottbus, Cottbus)

Abstract

Information systems model open systems whose dynamics are interactive in nature. Modeling interactive processes is much more difficult than modeling algorithmic processes.

In order to better address the dynamics of open systems, we propose a paradigm where we divide an information system into two abstract "spaces" – the object space representing the static structure and the interaction space representing the dynamic behavior. The IS model consists of an object schema and an interaction schema.

We explore two logics for representing interaction schemata. Category logic can be used to express sequential interactive processes as a category, and an interaction schema as a coproduct of categories. It is useful to characterize overall system dynamics in a straightforward fashion.

Deontic logic can be used to express dependencies between interactive processes in a natural fashion. Furthermore, they can be easily translated into actor deontics, making them suitable for an actor centric compilation of the system model.

Logical Fundamentals for Internet Information Services

Bernhard Thalheim (Brandenburg University of Technology at Cottbus, Cottbus)

Abstract

Internet services can be grouped into eCommerce services, community services, private sites, education/edutainment sites, and information sites. The foundation for site technology is still under development for some of the groups mentioned above or even completely missing. The CottbusNet has developed internet presentations for 18 towns and 5 regions in Germany. The overall size is currently estimated by 35.000 pages. These sites are information sites or services since they are used to provide public information. The interaction of users with the system is rather restricted. Such sites provide mainly information and are backed by several database engines. In the talk we give a survey on the algebraic and logical fundamentals of internet information services. These services are based on a number of approaches which have been developed by the CottbusNet and RADD teams: extended ER models which allow the specification of structures and processes; the codesign modeling methodology which enables in specification of structures, functions and interaction in a consistent and well-integrated form; the media object framework which is based on generalized views and the container paradigm. The logics behind these approaches are: an ER-based hierarchical predicate logic which enables in expressing integrity constraints; intentional epistemic logic which allows to specify the intentions of the user; theory extensions and theory transformations; pragmatics.

Expiration in Historical Data Warehouses

David Toman (University of Waterloo, Waterloo)

Abstract

We present a technique for automatic expiration of values in a historical data warehouse with respect to a known and fixed set of first-order queries. In particular we show that for queries with outputs bounded by the size of the data domain (set of values that have ever appeared in the warehouse), the part of the history of the data warehouse needed to answer the queries is also bounded by a function of the active data domain and does not depend on the age of the warehouse (the length of the history).

Transaction Closure Logic - A Framework for Reasoning about Transaction Dependencies

Can Türker (ETH Zürich, Zürich)

Abstract

Modern information systems require advanced transaction models providing means to describe complex activities such as transactional workflows. Complex activities consist of sets of transactions which are interrelated, i.e., there are dependencies among several transactions.

This talk sketches the notion of a transaction closure which allows to reason about different types of transaction dependencies in a common framework. A transaction closure is an acyclic transaction structure that captures different dimensions of dependencies, such as termination, execution, and object visibility dependencies. These dependencies are used to specify relationships between transactions of a transaction closure.

We first discuss reasonable types of transaction dependencies and then present criteria and checking algorithms to reason about the consistency of the transaction closure specification. These issues are fundamental to better design reliable (and efficient) complex database applications consisting of many interrelated transactions.

Intended Models Need Not Be Minimal

Gerd Wagner (Eindhoven University of Technology, NL)

Abstract

Both in the semantics of logic programs and in the semantics of nonmonotonic reasoning formalisms, one needs a suitable definition of what is a preferred or intended model. Most proposals have adopted the principle of minimality for motivating their definition of an intended model. However, this principle conflicts with the standard meaning of disjunction, according to which it should be possible to express both inclusive and exclusive disjunctions. In this paper, we revise our original definition of stable generated models for generalized logic programs in [Herre & Wagner, 1997], such that it accommodates both inclusive and exclusive disjunctions. The revision needed to achieve this is surprisingly simple: it only requires to replace the word 'minimal' by 'supported'.

Towards a Query Language for Data Mining

Jef Wijsen (Universit de Mons-Hainaut, Mons)
joint work with Toon Calders (Universiteit Antwerpen, Wilrijk)

Abstract

The relational tuple calculus is extended with variables that range over attributes and sets of attributes. This allows expressing significant data mining tasks, like finding frequent sets, finding functional dependencies, and finding inclusion dependencies. We characterize, both semantically and syntactically, a class of queries that can be solved using a common data mining technique called levelwise search.

4 List of Participants

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