A Natural Logic for Natural-language Knowledge Bases

We describe a natural logic for computational reasoning with a regimented fragment of natural language. The natural logic comes with intuitive inference rules enabling deductions and with an internal graph representation facilitating conceptual path finding between pairs of terms as an approach to semantic querying. Our core natural logic proposal covers formal ontologies and generative extensions thereof. It further provides means of expressing general relationships between classes in an application. We discuss extensions of the core natural logic with various conservative as well as non-conservative constructs in order to approach scientific use of natural language. Finally, we outline a prototype system addressing life science for the natural logic knowledge base setup being under continuous development.

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Pathway computation in models derived from bio-science text sources
This paper outlines a system, OntoScape, serving to accomplish complex inference tasks on knowledge bases and bio-models derived from life-science text corpora. The system applies so-called natural logic, a form of logic which is readable
for humans. This logic affords ontological representations of complex terms appearing in the text sources. Along with logical propositions, the system applies a semantic graph representation facilitating calculation of bio-pathways. More generally, the system affords means of query answering appealing to general and domain specific inference rules.

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**Querying Natural Logic Knowledge Bases**

This paper describes the principles of a system applying natural logic as a knowledge base language. Natural logics are regimented fragments of natural language employing high level inference rules. We advocate the use of natural logic for knowledge bases dealing with querying of classes in ontologies and class-relationships such as are common in life-science descriptions. The paper adopts a version of natural logic with recursive restrictive clauses such as relative clauses and adnominal prepositional phrases. It includes passive as well as active voice sentences. We outline a prototype for partial translation of natural language into natural logic, featuring further querying and conceptual path finding in natural logic knowledge bases.

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On the Relationship between a Computational Natural Logic and Natural Language

This paper makes a case for adopting appropriate forms of natural logic as target language for computational reasoning with descriptive natural language. Natural logics are stylized fragments of natural language where reasoning can be conducted directly by natural reasoning rules reflecting intuitive reasoning in natural language. The approach taken in this paper is to extend natural logic stepwise with a view to covering successively larger parts of natural language. We envisage applications for computational querying and reasoning, in particular within the life-sciences.

A System for Conceptual Pathway Finding and Deductive Querying

We describe principles and design of a system for knowledge bases applying a natural logic. Natural logics are forms of logic which appear as stylized fragments of natural language sentences. Accordingly, such knowledge base sentences can be read and understood directly by a domain expert. The system applies a graph form computed from the input natural logic sentences. The graph form generalizes the usual partial-order ontological sub-class structures by accommodation of affirmative sentences comprising recursive phrase structures. In this paper we focus on the logical inference rules for extending the concept graph form enabling deductive querying as well as computation of pathways between the concepts mentioned in the sentences.
Computing Pathways in Bio-Models Derived from Bio-Science Text Sources

This paper outlines a system, OntoScape, serving to accomplish complex inference tasks on knowledge bases and bio-models derived from life-science text corpora. The system applies so-called natural logic, a form of logic which is readable for humans. This logic affords ontological representations of complex terms appearing in the text sources. Along with logical propositions, the system applies a semantic graph representation facilitating calculation of bio-pathways. More generally, the system aords means of query answering appealing to general and domain specific inference rules.

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Semantic Text Processing in Bio-Informatics, Bio-models using Natural Logic and Semantic Graphs, Pathway Computation
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In Pursuit of Natural Logics for Ontology-Structured Knowledge Bases

We argue for adopting a form of natural logic for ontology-structured knowledge bases with complex sentences. This serves to ease reading of knowledge base for domain experts and to make reasoning and querying and path-finding more comprehensible. We explain natural logic as a development from traditional logic, pointing to essential differences to description logic. We conclude with a knowledge base set-up with an embedding into clausal logic, offering also a graph view of the sentences.

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Electronic versions: cognitive_2015_3_20_40044.pdf
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A Case for Embedded Natural Logic for Ontological Knowledge Bases

We argue in favour of adopting a form of natural logic for ontology-structured knowledge bases as an alternative to description logic and rule based languages. Natural logic is a form of logic resembling natural language assertions, unlike description logic. This is essential e.g. in life sciences, where the large and evolving knowledge specifications should be directly accessible to domain experts. Moreover, natural logic comes with intuitive inference rules. The considered version of natural logic leans toward the closed world assumption (CWA) unlike the open world assumption with classical negation in description logic. We embed the natural logic in DATALOG clauses which is to take care of the computational inference in connection with querying.
A System for Computing Conceptual Pathways in Bio-medical Text Models
This paper describes the key principles in a system for querying and conceptual path finding in a logic-based knowledge base. The knowledge base is extracted from textual descriptions in bio-, pharma- and medical areas. The knowledge base applies natural logic, that is, a variable-free term-algebraic form of predicate logic. Natural logics are distinguished by coming close to natural language so that propositions are readable by domain experts. The natural logic knowledge base is accompanied by an internal graph representation, where the nodes represent simple concept terms as well as compound concepts stemming from entire phrases. Path finding between concepts is facilitated by a labelled graph form that represents the knowledge base as well as the ontological information.

IS-A diversified
We reconsider the nature and formal properties of the class inclusion relation, IS-A, from the point of view of information modeling and engineering of formal ontologies. In particular we review approaches to the elusive notion of intensionality. We then conduct an analysis adopting a metalogic setup where classes and properties are reified. This approach affords choices along the extensionality/intensionality spectrum. Our analysis concludes that the distinction between epistemic modes for distinguishing definitions, norms, hypotheses, and observational evidence is more important the extensionality/intensionality dichotomy in ontological engineering.
Regaining the Square of Opposition in Formal Ontology Development

Use of formal ontologies is becoming widespread in information systems. Forerunners of formal ontologies are scientific classification systems such as the Linnaean biological ones. Unlike biological classifications modern formal ontologies are often non-hierarchical. A formal ontology in its basic form simply specifies all direct inclusion relationships between a finite repertoire of classes. Individuals may be conceived of as singleton classes. An assertion "P sub Q" states that class P is an immediate subclass of Q. These given relationships are often rendered as directed graphs. The subclass relationship induces a partial order relation corresponding to the relationship "all P are Q" in the square of opposition. Accordingly, so far, formal ontologies provide only assertions of the form "all P are Q". However, it is our contention that the three other assertion forms in the square of opposition come about implicitly by appropriate, often tacitly assumed default conventions as to be explained. Assume existential import so that all classes are considered non-empty, implying that there is no empty null class. Defaults: 1) Overlapping (i.e. non-disjoint) classes, viz. "some P are Q", has at least one common subclass. 2) Dually, classes are disjoint ("no P is Q") if they do not have a common subclass. 3) The assertion form "some P are not Q" is -- analogously to class overlap -- achieved by requiring that there be a subclass of P which is disjoint with Q. More radically this assertion may be held simply in the case that "all P are Q" does not hold. These default rules are routinely adopted in ontology development without mentioning. Appealing to these conventions, the 4 sentence forms in the square are effectively made at disposal. We discuss a first order metalogical formalization of the 4 sentence forms with classes reified as individual constants elucidating the logical relationships between the sentence forms. Our formalization appeals to non-provability. Non-provability incurs non-monotonicity, implying that extension of an ontology with additional subclass relationships may call for 86 retraction of derived square of opposition relationships. This reflects the crucial distinction between the closed world assumption (CWA) and the open world assumption (OWA).

Conceptual Pathway Querying of Natural Logic Knowledge Bases from Text Bases

We describe a framework affording computation of conceptual pathways between a pair of terms presented as a query to a text database. In this framework, information is extracted from text sentences and becomes represented in natural logic, which is a form of logic coming much closer to natural language than predicate logic. Natural logic accommodates a variety of scientific parlance, ontologies and domain models. It also supports a semantic net or graph view of the knowledge base. This admits computation of relationships between concepts simultaneously through pathfinding in the knowledge base graph and deductive inference with the stored assertions. We envisage use of the developed pathway functionality, e.g., within bio-, pharma-, and medical sciences for calculating bio-pathways and causal chains.
Diagrammatic Reasoning with Classes and Relationships
We present and discuss a diagrammatic visualization and reasoning language coming about by augmenting Euler diagrams with higraphs. The diagrams serve (hierarchical as well as trans-hierarchical) classification and specification of various logical relationships between classes. The diagrams rely on a well-defined underlying class-relationship logic, called CRL, being a fragment of predicate logic. The inference rules at the level of diagrams take form of simple diagrammatic ipso facto rules. The diagrams are intended for computerization by offering navigation and zooming facilities as known from road maps. As such they may facilitate ontological engineering, which often involves larger amounts of data. The underlying inference process is expressible in function-free definite clauses, datalog. We also discuss the relationship to similar diagram and logic proposals.

A Semantics-Based Approach to Retrieving Biomedical Information
This paper describes an approach to representing, organising, and accessing conceptual content of biomedical texts using a formal ontology. The ontology is based on UMLS resources supplemented with domain ontologies developed in the project. The approach introduces the notion of ‘generative ontologies’, i.e., ontologies providing increasingly specialised concepts reflecting the phrase structure of natural language. Furthermore, we propose a novel so called ontological
semantics which maps noun phrases from texts and queries into nodes in the generative ontology. This enables an advanced form of data mining of texts identifying paraphrases and concept relations and measuring distances between key concepts in texts. Thus, the project is distinct in its attempt to provide a formal underpinning of conceptual similarity or relatedness of meaning.

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**Querying Class-Relationship Logic in a Metalogic Framework**
We introduce a class relationship logic for stating various forms of logical relationships between classes. This logic is intended for ontologies and knowledge bases and combinations thereof. Reasoning and querying is conducted in the Datalog logical language, which serves as an embracing decidable and tractable metalogic.

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Computing an Ontological Semantics for a Natural Language Fragment

The key objective of the research that has been carried out has been to establish theoretically sound connections between the following two areas: • Computational processing of texts in natural language by means of logical methods • Theories and methods for engineering of formal ontologies

We have tried to establish a domain independent “ontological semantics” for relevant fragments of natural language. The purpose of this research is to develop methods and systems for taking advantage of formal ontologies for the purpose of extracting the meaning contents of texts. This functionality is desirable e.g. for future content–based search systems in contrast to today’s keyword based search systems (viz., Google) which rely chiefly on recognition of stated keywords in the targeted text. Logical methods were introduced into semantic theories for natural language already during the 60’s in what is today known as Montague semantics. However, this well–established tradition addresses mainly the domain independent logical structures of language such as quantifiers/determiners by means of logic [18], such as type theory [2]. By contrast this project focuses on the domain–specific parts of language (nouns, verbs, adjectives) introducing formal so–called generative ontologies as semantic target domains for noun– and verb phrases. Such a logico–semantic theory links the meaning of a sentence phrases to nodes in the chosen ontology for the domain.

Logik, computere og kunstig intelligens

ONTOGRABBING: Extracting Information from Texts Using Generative Ontologies

We describe principles for extracting information from texts using a so–called generative ontology in combination with syntactic analysis. Generative ontologies are introduced as semantic domains for natural language phrases. Generative ontologies extend ordinary finite ontologies with rules for producing recursively shaped terms representing the ontological content (ontological semantics) of NL noun phrases and other phrases. We focus here on achieving a robust, often only
partial, ontology-driven parsing of and ascription of semantics to a sentence in the text corpus. The aim of the ontological analysis is primarily to identify paraphrases, thereby achieving a search functionality beyond mere keyword search with synsets. We further envisage use of the generative ontology as a phrase-based rather than word-based browser into text corpora.

**General information**

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**A Common Framework for Board Games and Argumentation Games**

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**A rule-sceptic characterization of acceptable legal arguments**

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Specifying Geographic Information - Ontology, Knowledge Representation, and Formal Constraints

This thesis deals with the specification of geographic information. On the basis of the role of geographic information as an infrastructure element, a method is developed for the making of specifications which are well-structured and ensure the connection between the data collections being part of a joint infrastructure. The motivation for the presented work is to meet the need for topical geographic information at any time, so that the requirements for data content and quality are fulfilled, and the information can thus form actively part of the task performance in public administration as well as in the private sector. The theoretical background is the establishment of a representational system, which ontologically comprises a representation of notions in the "real world" and notions which include the representation of these. Thus, the thesis leans towards a traditional division between modeling of domains and conceptualization of these. The thesis contributes a formalization of what is understood by domain models and conceptual models, when the focus is on geographic information. Moreover, it is shown how specifications for geographic information are related to this representational system. The starting point of the thesis is an analysis mapping the elements in a specification for geographic information. The basis of this empirical investigation is TOP10DK's data content specification, version 3.2 of the National Survey and Cadastre. The basic idea is to view a specification as a collection of requirements and rules, building on terms from the domain and concept ontologies. In combination with the theoretical basis the analysis is used for developing an underlying model of notions, which defines the individual elements in a specification and the relations between them. In the chapters of the thesis this underlying model is extended to include a number of components, which each contribute to the model being able to form the basis of a strong and productive specification tool for the making and maintenance of specifications for geographic information. These components among others include description of quality requirements and formalization of rules, so that they can be used for verification of produced information. An essential contribution is a formal specification language dedicated to the formulation of formal rules to be observed by the information. The language is based on a formal semantic model which makes translation into other languages possible. In the thesis it is shown how statements can be translated into SQL and thus form the basis of direct implementation in the production environments where the geographic information is procured. To be able to describe requirements for the quality of geographic information is an essential part of a specification. The thesis contributes a structure of quality descriptions by introducing two notions: "Acceptable Quality Levels" (AQL) and "Quality Element Requirements" (QER), which designate respectively the minimum quality requirements for information produced according to a given specification and the requirements for the quality parameters used to describe this information. The two notions are incorporated and related to the developed system of notions for specification for geographic information. It is an important part of an infrastructure for geographic information that there is a connection between the individual data collections. This thesis argues for ensuring the connection by first and foremost describing these as an integrated part of the specification work. The thesis contributes a model which describes relations and dependencies by writing specifications in the context of one or more other specifications. As an illustration of the applications of specifications written in the developed specification language, a concept is developed in the thesis to make possible a decentralized collection and distribution of information about changes to be used for updating geographic information.

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Legal rules and argumentation in a metalogic framework

Ontological Constitutions for Classes and Properties

Ontology-based Semantics for Prepositions
A metalogic formalization of legal argumentation as game trees with defeasible reasoning

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Entity-Relationship Models reconsidered as Grammars and Algebras

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Logical Theories for Agent Introspection

Artificial intelligence systems (agents) generally have models of the environments they inhabit which they use for representing facts, for reasoning about these facts and for planning actions. Much intelligent behaviour seems to involve an ability to model not only one's external environment but also oneself and one's own reasoning. We would therefore wish to be able to construct artificial intelligence systems having such abilities. We call these abilities introspective. In the
attempt to construct agents with introspective abilities, a number of theoretical problems is encountered. In particular, problems related to self-reference make it difficult to avoid the possibility of such agents performing self-contradictory reasoning. It is the aim of this thesis to demonstrate how we can construct agents with introspective abilities, while at the same time circumventing the problems imposed by self-reference. The standard approach taken in artificial intelligence, the model that an agent has of its environment is represented as a set of beliefs. These beliefs are expressed as logical formulas within a formal, logical theory. When the logical theory is expressive enough to allow introspective reasoning, the presence of self-reference causes the theory to be prone to inconsistency. The challenge therefore becomes to construct logical theories supporting introspective reasoning while at the same time ensuring that consistency is retained. In the thesis, we meet this challenge by devising several such logical theories which we prove to be consistent. These theories are all based on first-order predicate logic. To prove our consistency results, we develop a general mathematical framework, suitable for proving a large number of consistency results concerning logical theories involving various kinds of reflection. The principal idea of the framework is to relate self-reference and other problems involved in introspection to properties of certain kinds of graphs. These are graphs representing the semantical dependencies among the logical sentences. The framework is mainly inspired by developments within semantics for logic programming within computational logic and formal theories of truth within philosophical logic. The thesis provides a number of examples showing how the developed theories can be used as reasoning frameworks for agents with introspective abilities.
Synthesis of Programs in Computational Logic

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Ontology-based Semantics for Prepositions

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Are there Ontological Grammars?

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OntoQuery: Ontology-based Querying of Texts

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Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

**A Conceptual Space Logic**

Conceptual spaces have been proposed as topological or geometric means for establishing conceptual structures and models. This paper, after briefly reviewing conceptual spaces, focuses on the relationship between conceptual spaces and logical concept languages with operations for combining concepts to form concepts. Specifically is introduced an algebraic concept logic, for which conceptual spaces are installed as semantic domain as replacement for, or enrichment of, the traditional.

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Place of publication: Hachimantai, Iwate
Publisher: IOS Press
Main Research Area: Technical/natural sciences
Conference: 9th European-Japanese Conference on Information Modelling and Knowledge Bases, Hachimantai, Iwate, Japan, 01/01/1999
Source: orbit
Source-ID: 176515
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

**Conceptual Graphs as Algebras - with an Application to Analogical Reasoning**

**General information**

State: Published
Organisations: Department of Information Technology, Aalborg University
Authors: Nilsson, J. F. (Intern), Brauner, T. (Ekstern), Rasmussen, A. (Ekstern)
Pages: 456-469
Publication date: 1999

**Host publication information**

Title of host publication: Conceptual Structures: Standards and Practices, LNAI 1640
Publisher: Springer
Main Research Area: Technical/natural sciences
Conference: 7th Int. Conf. on Conceptual Structures, ICCS'99, Blacksburg, VA, USA, 01/01/1999
Source: orbit
Source-ID: 175479
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

**Inductive Logic Programming with Well-modedness Constraints**

**General information**

State: Published
Inductive Synthesis of Logic Programs by Composition of Combinatory Program Schemes

General information
State: Published
Organisations: Department of Information Technology, Uppsala University
Authors: Nilsson, J. F. (Intern), Hamfelt, A. (Ekstern)
Pages: 143-158
Publication date: 1999

Host publication information
Title of host publication: Logic-Based Program Synthesis and Transformation (Lopstr’98, selected papers), LNCS 1559
Publisher: Springer
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 175476
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

Data Logic

General information
State: Published
Organisations: Department of Information Technology
Authors: Nilsson, J. F. (Intern)
Number of pages: 186
Publication date: 1998

Publication information
Place of publication: Lyngby
Publisher: IT/DTU
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170334
Publication: Research - peer-review › Book – Annual report year: 1998

Inducing queries from examples as concept formation

General information
State: Published
Organisations: Department of Information Technology, Tallinn University of Technology
Authors: Nilsson, J. F. (Intern), Haav, H. (Ekstern)
Pages: 341-352
Publication date: 1998

Host publication information
Title of host publication: Proceedings of the 8'th European-Japanese Conference on Information Modeling and Knowledge Bases
Place of publication: Tampere
Publisher: Tampere University of Technology
Inductive Synthesis of Logic Programs by Composition of Combinatory Program Schemes

General information
State: Published
Organisations: Department of Information Technology, Uppsala University
Authors: Nilsson, J. F. (Intern), Hamfelt, A. (Ekstern)
Pages: 180-187
Publication date: 1998

Host publication information
Title of host publication: Pre-proceedings of LOPSTR'98
Place of publication: Manchester
Publisher: University of Manchester
Main Research Area: Technical/natural sciences
Conference: LOPSTR’98, Manchester, 01/01/1998
Source: orbit
Source-ID: 170343
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

Towards computing with Extensions and Intensions of Concepts

General information
State: Published
Organisations: Department of Information Technology, University of Tampere
Authors: Nilsson, J. F. (Intern), Palomaki, J. (Ekstern)
Pages: 100-114
Publication date: 1998

Host publication information
Title of host publication: Information Modelling and Knowledge Bases IX
Place of publication: Amsterdam
Publisher: IOS Press
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166910
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

Fuzzy Querying in a Concept Object Algebraic Model

General information
State: Published
Organisations: Department of Information Technology, Roskilde University
Authors: Nilsson, J. F. (Intern), Larsen, H. L. (Ekstern)
Pages: 123-140
Publication date: 1997

Host publication information
Title of host publication: Flexible Query Answering Systems
Publisher: Kluwer
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166903
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

Towards a Logic Programming Methodology based on Higher-order Predicates
Declarative logic programming with primitive recursive relations on lists

Information Modelling and Knowledge Bases VIII

Projects:

Formal Ontologies + Natural language semantics = Ontological semantics
Geodata-Infrastruktur

Department of Informatics and Mathematical Modeling
Period: 01/02/2002 → 01/08/2007
Number of participants: 8
Phd Student:
Christensen, Jesper Vinther (Intern)
Supervisor:
Bjørner, Dines (Intern)
Frederiksen, Poul (Intern)
Jacobi, Ole Illum (Intern)
Main Supervisor:
Nilsson, Jørgen Fischer (Intern)
Examiner:
Villadsen, Jørgen (Intern)
Andreasen, Troels (Ekstern)
Östman, Anders (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU, Samfinansiering
Project: PhD

Compositional logic programming
Logic programming is programming within certain fragments of logic. We advocate an operator form of logic which encourage compositional programming, and we examine theoretical and methodological aspects of the approach.

Department of Information Technology
Department of Electrical Engineering

Uppsala University
Period: 01/12/2000 → 01/01/9999
Number of participants: 2
Project participant:
Hamfelt, Andreas (Ekstern)
Project Manager, organisational:
Nilsson, Jørgen Fischer (Intern)

Sprog og logikker for ontologier

Department of Informatics and Mathematical Modeling
Period: 01/08/2000 → 16/02/2004
Number of participants: 6
Phd Student:
Oldager, Steen Nikolaj (Intern)
Supervisor:
Bruun, Hans (Intern)
Logiske teorier for datamaskinel introspektion og selv-reference med henblik på autonome agenter

Department of Informatics and Mathematical Modeling
Period: 01/09/1999 → 16/02/2004
Number of participants: 6
Phd Student:
Bolander, Thomas (Intern)
Supervisor:
Jensen, Helge Elbrønd (Intern)
Main Supervisor:
Nilsson, Jørgen Fischer (Intern)
Examiner:
Pedersen, Stig Andur (Intern)
Fitting, Melvin (Ekstern)
Gehrke, Mai (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

ONTOQUERY Ontology-based Querying
The purpose of the interdisciplinary project OntoQuery is to develop theories and methods for content-based information retrieval by devising a description language whose expressive power covers not only the purely linguistic analysis of texts, but also the description of a concept ontology and the analysis of queries. This part of the project is intended to serve as the basis of the construction of a prototype system for content-based retrieval of texts from (existing) text databases and knowledge bases. Since the query language will be Danish, the prototype system will have built-in knowledge of the morphology, grammatical functions, possible meanings, and sense relations of the relevant Danish words and phrases. This system functionality is obtained by devising an internal representation, viz. the above-mentioned ontology, which combines the descriptions of words with a coherent taxonomy of the concepts and terms of the domains selected. In this sense the system will be more intelligent and user friendly than search engines currently in use, which typically employ comparatively primitive search strategies based solely on the occurrence of string sequences, words, or combinations of words. The project is funded by the Danish Research Agency under the Information Technology Programme. See also www.ontoquery.dk

Department of Information Technology
Department of Electrical Engineering
University of Copenhagen
HHK
Roskilde University
University of Southern Denmark
Period: 01/01/1999 → 31/12/2004
Number of participants: 12
Project participant:
Bruun, Hans (Intern)
Oldager, Steen Nikolaj (Intern)
Paggio, Patrizia (Ekstern)
Pedersen, Bolette Sandford (Ekstern)
Madsen, Bodil Nistrup (Ekstern)
Thomsen, Hanne Erdmann (Ekstern)
Andreasen, Troels (Ekstern)
Christiansen, Henning (Ekstern)
Knappe, Rasmus (Ekstern)
Bulskov, Henrik (Ekstern)
Jensen, Per Anker (Ekstern)

Project Manager, organisational:
Nilsson, Jørgen Fischer (Intern)

**Domainmodellingssprog**

Department of Information Technology  
Period: 01/09/1996 → 01/08/1997  
Number of participants: 3  
Phd Student:  
Laustrup, Hans (Intern)  
Supervisor:  
Nilsson, Jørgen Fischer (Intern)  
Main Supervisor:  
Hansen, Bo Stig (Intern)

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: DTU-Su Stipendium, Eksperiment  
Project: PhD

**Knowledge Base Methodology**  
This project is concerned with theories, methods, and tools for application domain modelling and knowledge base construction. The project focusses on integration of object and logic paradigms.

Department of Information Technology  
Period: 01/02/1995 → …  
Number of participants: 2  
Project participant:  
Bruun, Hans (Intern)  
Project Manager, organisational:  
Nilsson, Jørgen Fischer (Intern)  

**Logic Programming Methodology**  
The project is concerned with development of a methodology for logic program construction based on composition of program schemes conceived as higher-order predicates.

Department of Information Technology  
Uppsala University  
Period: 01/01/1995 → …  
Number of participants: 1  
Project Manager, organisational:  
Nilsson, Jørgen Fischer (Intern)  

**Datalogisk retsvidskab. Vidensrepræsentation og inferens i forb. med menneskeskabte overenskomster og forskrifter**

Department of Informatics and Mathematical Modeling  
Period: 01/03/1990 → 15/08/1995  
Number of participants: 3  
Phd Student:
Karpf, Jørgen (Intern)  
Supervisor:  
Østerby, Tom (Intern)  
Main Supervisor:  
Nilsson, Jørgen Fischer (Intern)  

Financing sources  
Source: Internal funding (public)  
Name of research programme: Gammel ordning u/skema-SU  
Project: PhD

Meta-logiske teorier i datalogien  
Department of Informatics and Mathematical Modeling  
Period: 01/09/1989 → 06/09/1995  
Number of participants: 3  
Phd Student:  
Villadsen, Jørgen (Intern)  
Main Supervisor:  
Nilsson, Jørgen Fischer (Intern)  
Examiner:  
Jensen, Hans Siggård (Intern)  

Financing sources  
Source: Internal funding (public)  
Name of research programme: DTU-stipendium  
Project: PhD