08181 Abstracts Collection
The Evolution of Conceptual Modeling
— Dagstuhl Seminar —

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Abstract. From 24.04. to 30.04.2008, the Dagstuhl Seminar 08181 "The Evolution of Conceptual Modeling" was held in the International Conference and Research Center (IBFI), Schloss Dagstuhl. During the seminar, several participants presented their current research, and ongoing work and open problems were discussed. Abstracts of the presentations given during the seminar as well as abstracts of seminar results and ideas are put together in this paper. The first section describes the seminar topics and goals in general. Links to extended abstracts or full papers are provided, if available.

Keywords. Matrix analytic methods, markov processes, queuing theory, numerical methods, structured matrices, telecommunication modeling, performance evaluation

08181 Report – The Evolution of Conceptual Modeling

The seminar took place at Dagstuhl from 27 - 30 April 2008. It was organized by Roland Kaschek, Lois Delcambre and Heinrich C. Mayr. The seminarŠs purpose was looking into conceptual modeling from different perspectives, and along different dimensions: we wanted to achieve a better understanding of conceptual modeling issues in various domains of discourse, from a historical perspective and from a view beyond individual (modeling) projects. Consequently we did not focus on a particular application area or development project.

Keywords: Matrix analytic methods, markov processes, queuing theory, numerical methods, structured matrices, telecommunication modeling, performance evaluation

Joint work of: Delcambre, Lois ; Kaschek, Roland H. ; Mayr, Heinrich C.

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2008/1598

The Evolution of Data Warehouse Conceptual Modeling

Karen Davis (University of Cincinnati, US)

The primary focus of this paper is conceptual modeling for data warehouses. Our working definition for a data warehouse is "a repository of data extracted, cleansed, and integrated from multiple sources and intended to support analytical investigation usually involving historical, summarized data". We review the history of data warehouse modeling over several phases and refine the definition to arrive at common usage in the data warehouse research community. The phases overlap and coexist; we outline them as follows:

1. industry practitioner emphasis,
2. conceptual modeling research,
3. extended semantics, and
4. impact/application of conceptual modeling.

The historical development of data warehouse conceptual models is reviewed in this paper, culminating with recent research on advanced conceptual modeling topics and future directions.

Keywords: Data warehouse conceptual modeling

Modeling a Semantic Overlay across P2P Collaborative Systems

Valeria De Antonellis (University of Brescia, IT)

Recent distributed systems, in a P2P scenario, are characterized by a set of independent peers that dynamically need to cooperate by sharing data and services. For effective collaboration, under highly dynamic conditions and in absence of a global view of the resources shared across the information systems, semantic modeling tools need be defined. In particular, the emergence of semantics is a key issue to enforce timely discovery and integration of distributed data and services.

In the paper we discuss, in particular, the construction of a semantic overlay for service sharing and discovery in service-oriented applications in a P2P scenario. The semantic overlay is built over the P2P network: each peer has ontology-based service descriptions; semantic links between similar service descriptions belonging to different peers are established and maintained according to the network evolution; the result is P2P-integrated knowledge space (here considered for services but extendible to data). The semantic overlay can be seen as a continuously evolving conceptual map across collaborative peers that provide similar services and constitute synergic service centres in a given domain. The semantic links enable effective similarity-based service search and optimization strategies are defined for request propagation over the P2P network.

From the conceptual modeling perspective, the semantic overlay can be considered as an evolved conceptual representation where specific modeling requirements due to new technologies, service-oriented technology and P2P technology, are considered.

Keywords: Conceptual modeling, emergent semantics, semantic service discovery, P2P systems

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2008/1595

Using (fine-grained) information in multiple information sources

Lois Delcambre (Portland State University, US)

One of the primary goals of traditional conceptual modeling is to provide a single, unified view of the information of interest in an application. In contrast, we are intrigued by the explicit representation and modeling of scenarios where information from other, distinct information systems - often with distinct data models and schemas - are visible to the end-user. We have defined a mark as an encapsulated address to a potentially fine-grained information element (in another information source). Marks can be created automatically or manually - where a user selects the information to be marked, e.g., with a mouse. Marks, once created, can be placed in new information sources. This paper briefly reviews our work to date and considers other mechanisms in a number of fields used to reference small-grained information. The paper concludes with a list of open research questions regarding explicit modeling of information use across multiple information systems.

Keywords: Superimposed information, annotation, hypertext

Joint work of: Delcambre, Lois M. L.; Archer, D.; Price, S. L.; Terwilliger, J. T.

Ontology-Driven Conceptual Modeling: the First Fifteen Years

Nicola Guarino (Institute for Cognitive Sciences & Technologies, IT)

Almost 15 years ago, in March 1993, I organized in Padua the first workshop on Formal Ontology in Conceptual Analysis and Knowledge Representation. A proposal for a new kind of representation/modeling formalisms explicitly based on ontological primitives was made in 1994 (The Ontological Level), but the conceptual modeling and knowledge representation formalisms used nowadays are still (by and large) ontologically neutral, so that the task of properly modeling

a certain domain and making the related ontological choices explicit is left to the user.

In this paper I will re-visit the evolution of knowledge representation languages from the old "What's in a link" paper by Bill Woods to the current description logics, pointing out to various problems whose solution has been abandoned in exchange of achieving some manageable computational complexity.

I will also discuss the main results of applied ontology in these years, and I will conclude presenting my dream for an ontology-driven conceptual modeling system conceived as an extension of current tools such as Rational Rose, extended with ontological and linguistic competence, being able to reason and criticize the designer's choice, with reusability and understandability in mind.

Keywords: Ontology, conceptual modeling, foundations of knowledge representation, ontological analysis

Some quality issues for conceptual models

Brian Henderson-Sellers (Univ. of Technology - Sydney, AU)

With the growth of interest in conceptual modelling as a vital tool in the software developer's toolbox, it is of critical importance and urgency that the quality of both metamodels and models are ensured. Here, I outline some of the areas of concern together with some brief indication of appropriate measures of quality.

Keywords: Metamodelling modelling quality

From Conceptual Models to Ontologies

Wolfgang Hesse (Universität Marburg, DE)

Conceptual Modelling (CM) has attracted the Database and Software Engineering (SE) communities for now more than 30 years. It has laid the ground for fundamental paradigms and tools in both scientific branches as e.g. the three-level database schema architecture, the Unified Modelling Language (UML) or, more recently, for the Model- driven Architecture/Development (MDA/MDD) approach.

Ontologies are a rather new subject of research and development in many fields of Computer Science including Artificial Intelligence (AI), Web technologies and Information systems [Gua 98]. In the SE field, they are gaining attention only recently and seem to compete with conceptual models in various respects [Hes 05]. Some critics argue that ontology is just a new buzzword for conceptual model and could simply be dropped. However, there are significant differences - mainly in their scope and level of binding. On the other side, philosophers claim the philosophical origin of the ontology concept and pose the legitimate question

whether and where ontologies are really needed and what they might contribute to human cognition and science [Jan 01].

These are sufficient reasons for a closer analysis of conceptual models, ontologies and their relation to each other. ....

Keywords: Conceptual Models, Ontologies, Ontology-Based Software Development, FRISCO, semiotics, glossaries, KCPM, Model-Driven Development

On the evolution of conceptual modeling

Roland H. Kaschek (Massey University, NZ)

Since the 1980s the need increased for overcoming idiosyncrasies of approaches to modeling in the various sub-disciplines of computing. The theoretical model of evolution is used in this paper for analyzing how computing and conceptual modeling have changed. It is concluded that computing has changed into a social phenomenon with a technical core and that therefore relying on (formal) model semantics as the sole tool for the discussion of conceptual modeling is no more adequate. A number of language games of computing is identified and the task set to describe these language games to the extent necessary for deciding whether or not they can serve as the foundation of computing.

Keywords: Conceptual modelin, evolution, material languages, interactive computation, software development

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2008/1597

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2008/1597

Conceptual Foundations of Patterns in Game Playing Experience

Gunther Kreuzberger (TU Ilmenau, DE)

Research in the field of digital games is highly interdisciplinary but still lacks a common language of discourse. The difficulty lies in the heterogeneity of knowledge sources, research methodologies, and practices of discourse relevant to understanding, analysing, and possibly designing digital games. The present paper aims to fill the gap between social, pedagogic or design approaches and more formal IT based approaches in the discourse on digital games.

Particularly, the paper addresses conceptualisations that are required to describe and understand game playing experience in order to derive patterns of experience (rather than design patterns). This includes conceptualisations of digital games as entertaining media, IT application systems and interactive media respectively. For this purpose theoretical approaches in the fields of entertainment research and interactivity research are applied and combined with more formal concepts drawn from theoretical computer science studies.

Thus, the paper will contribute to a trans-disciplinary language of digital games research.

Keywords: Digital Games, Entertainment, Interactivity, Experience Pattern, Layered Language

Model-Driven Development in Practice: From Genome Models to Human Beings

Oscar Pastor Lopez (Univ. Politèc. de Valencia (UVP), ES)

Looking backwards, it makes sense to argue on the value that Conceptual Modeling has provided to the Information Systems Design and Development area. Thinking about the present, the most advanced Software Engineering approaches oriented to produce quality software use extensively model-driven approaches under different acronyms such as Model Driven Development (MDD), Model-Based Code Generation (MBCD), Model-Driven Architectures (MDA), etc. In this context, advanced approaches propose that MDD in practice means to fix how to obtain the target software products that correctly represent their source Conceptual Schema.

In any case, we can agree that Conceptual Modeling is widely used in the Information Systems domain. Nevertheless, in terms of Conceptual Model Evolution, we should wonder which new application domains will become more challenging for Conceptual Modeling in the very next future. Trying to answer that question, one path to follow is associated to the the Bioinformatics domain and concretely, to face the problem of understanding of the Human Genome. The problems around have become first-order issues in which curiously the role of Conceptual Modeling has not been fully exploited yet.

Human genome understanding is an extremely attractive topic for future research taking into account the continuous and increasing interest that is generating. It is worth to analyze how Conceptual Modeling principles, methods and techniques could help to face the problem and how Conceptual Modeling could aid to provide more efficient solutions. The basic goal of this talk will be the introduction and the discussion of these ideas. If we look at the Human Genome as the representation of some Conceptual Model -not known yet-, interesting analogies with the Model-Driven Software Development principles appear. As a precise interpretation of the Human Genome would be much easier if the underlying model is known, Conceptual Modeling can provide new ways of facing that problem to obtain new and better strategies and solutions.

Current and future scenarios based on these ideas will be presented. If Conceptual Modeling has been an effective approach to understand where programs Ű seen as a representation of a Conceptual Model- come from, why not Conceptual Modeling could be equally effective to understand the Human Genome by means of using adequately Conceptual Models? Instead of talking about going from conceptual schemas to programs, we would taking in that case about going

from Genome Models to Human Beings, where a particular Human Being would be seen as an instantiation of a source Genome Model. Since the interpretation of the Human Genome is a promising challenge for the scientific community, the use of Conceptual Modeling-based notions and methods will open exciting scenarios to undertake this problem. The final goal is to discover how to face that problem using conceptual-modeling based strategies, and how it can help to achieve an efficient set of original solutions, tools and subsequent practical applications.

Keywords: Conceptual Modeling, Human Genome, Model-Driven Development

Composing Personalised Services on top of Abstract State Services

Klaus-Dieter Schewe (Information Science Research Centre - New Zealand, NZ)

We introduce Abstract State Services (ASSs) as an abstraction of data-intensive services that can be made available for use by other systems, e.g. via the web. An ASS combines a hidden database layer with an operation-equipped view layer, and can be anything from a simple function to a full-fledged Web Information System or a Data Warehouse. We adopt the fundamental approach of Abstract State Machines to model ASSs. Then we show how tailored services can be extracted from available ASSs, integrated with other ASSs and personalised to user preferences.

Keywords: Abstract State Machines, services, integration, composition

Joint work of: Ma, Hui; Schewe, Klaus-Dieter; Thalheim, Bernhard; Wang, Qing

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2008/1597

Comparison Criteria for Ontological Multi-Level Modeling

Michael Schrefl (University of Linz, AT)

Ontological multi-level modeling refers to describing domain objects at multiple levels of abstraction. Using traditional semantic data modeling, multi-level modeling can be achieved by representing objects in different abstraction hierarchies, classification, aggregation and generalization. Multiple representation, however, leads to accidental complexity, complicating modeling and extension. Several modeling techniques, like power types, deep instantiation, materialization and m-objects may be employed to reduce unnecessary complexity in modeling objects at multiple levels.

This papers compares the use of power types, deep instantiation, materialization and m-objects for multi-level modeling using four comparison criteria: (1)

compactness (avoiding accidental complexity), (2) extensibility (ease of introducing new abstraction levels), (3) query flexibility (number and kind of pre-defined entry points for querying), and (4) multiple relationship-abstraction (such as between relationship type and relationship occurrence).

Joint work of: Neumayr, Bernd; Schrefl, Michael

On Conceptualization of Quality

Volodymyr Shekhovtsov (Kharkov Polytechnical Institute, UA)

We investigate the notion of software product quality from the point of view of its integration into conceptual modeling activities (we call this integrated notion a conceptual view of quality). We pay special attention to evolution of the treatment of this view over the history of conceptual modeling. After reviewing the body of available papers, we state that the abundance of similarly applicable techniques implementing this view (quality models, ontologies, UML profiles, and metamodels) can be confusing, especially as many of them lack clear rationale and justification of applicability. We show some ways to resolve this confusion via explicitly separating the original of quality (conceptualization source) and its conceptual view, and generalizing quality representation approaches as conceptualization rules.

Keywords: Software product quality, conceptual modeling, conceptualization

Scientific Model Management System (Working Draft)

Stefano Spaccapietra (EPFL - Lausanne, CH)

Computational models of biological systems aim at accurately simulate in vivo phenomena. In areas, such as neuroscience, some scientists believe that computational models may in a near future mimic functions of the brain. As the complexity of the target modeled system increases so does the corresponding computational model, including: scientific programs, various types and formats of data, provenance information and descriptive data, ontologies, to name a few. Managing this complex computational environment is a difficult task that currently is supported by a myriad of different tools. This work contributes to this problem by offering scientists a scientific model management system built around a data-oriented view of scientific models. The system manages scientific models and corresponding computational implementations, as well as data produced by their evaluation. A high-level declarative language with ontological support allows the specification of scientific and computational models and the automatic generation and evaluation of efficient simulations. Data therein produced are persisted and later retrieved according to model input parameters. Composite models reuse and integrate scientific models fostering collaboration between research groups.

Keywords: Scientific modeling

Dynamic MDA-based Composition of Web Service Processes

Markus Stumptner (Univ. of South Australia, AU)

We present a semantic service process composition approach that is based on the use of extended UML activity diagrams as an abstract specification, using a consistency-based matchmaking scheme to realize desired semantic candidate selection within the composition process. The extension with semantic candidate selection offers, in addition to the flexibility of the design process, the expressive power to perform candidate selection based on the web service capabilities rather than just input and output relationships. Also, we consider herein the more challenging problem of composing service processes, each consisting of a set of web services organized into a business process.

Joint work of: Stumptner, Markus; Schrefl, Michael

Introducing Memetic Evolution to Web Resources

Yuzuru Tanaka (Hokkaido University, JP)

With the growing need for interdisciplinary and international availability, distribution and exchange of intellectual resources including information, knowledge, ideas, pieces of work, and tools in reeditable and redistributable organic forms, we need new media technologies that externalize scientific, technological, and/or cultural knowledge fragments in an organic way, and promote their advanced use, international distribution, reuse, and reediting. Although WWW and browsers enabled us to publish and to browse knowledge resources, they do not enable people to reedit and redistribute knowledge resources. We need new media technologies that externalize scientific, technological, and/or cultural knowledge fragments as knowledge resources in an organic way, and promote their advanced use, international distribution, reuse, and reediting. These media can carry a variety of knowledge resources. A media object denotes such a medium with a content knowledge resource. Such media objects can replicate themselves, recombine themselves, and be naturally selected by people reusing them. We call such media 'meme media' since they carry what Richard Dawkins called 'memes'. Their environment here means the society of their producers and consumers, namely, authors and users. Strictly speaking, meme media objects do not replicate nor recombine themselves. Their users replicate them and recombine them through direct manipulation. The accumulation of meme media objects in a society will form a meme pool, which will work as a gene pool to bring a rapid evolution of knowledge resources shared by this society. This will cause an explosive increase of knowledge resources similar to the flood of consumer products in our present consumer societies. This paper points out the importance of introducing memetic evolution to knowledge resources accumulated over the Web, and shows how the application of meme media technologies to the Web will achieve this goal.

Keywords: Knowledge resource evolution, memetic evolution, meme media, meme pool, Web applications, Web services

A Historical View of Conceptual Modeling: From ER to UML to OWL and Beyond

Susan Urban (Texas Tech University - Lubbock, US)

Conceptual modeling is an important aspect of application development, providing an implementation independent platform for information systems design. For data modeling, the Entity-Relationship (ER) Model has been the most well known modeling tool, developed as a result of several pioneering conceptual modeling efforts of the early 1970's. Since that time, many ER modeling concepts and semantic data modeling concepts have been incorporated into the Unified Modeling Language (UML) class diagrams, with UML providing an integrated framework for the design of structure and behavior. With the advent of the Internet and the Semantic Web, the realm of conceptual modeling has been expanded to include 1) ontology development using languages such as the Web Ontology Language (OWL), and 2) the integration of languages such as UML and OWL in the specification of applications that involve the use of Web Services, Grid Services, and numerous other heterogeneous data sources. This paper provides a historical perspective of the evolution of conceptual modeling, with a comparison of modeling concepts from the ER model, UML class diagrams, and OWL, together with a discussion of research directions for the integration of semantic and conceptual modeling techniques for web application development.

Keywords: Conceptual modeling, ER, UML, OWL

Conceptual Modeling in Web 2.0 Times

Gottfried Vossen (Universität Münster, DE)

Recent years have seen the confluence of a number of Web developments that have commonly and collectively become known as "Web 2.0." This term characterizes the transition from a Web where people were primarily reading information to a Web where users are contributing and socializing content on a large scale, enabled by a number of software tools such as Ajax or Ruby; the term also subsumes a variety of recent developments such as the possibilities to create mash-ups as well as rich Internet applications, and to offer software no longer as a package, but as a service. We consider two modeling tasks in this Web 2.0 context: program development and architecture design. The former refers to the development of application programs, for which an increasing number of "frameworks" is currently being proposed. The latter primarily refers to service-oriented architectures which are in the process of increasingly taking Web 2.0 features into account, but no strategy is in sight for an appropriate adaption of

the respective design procedures. We briefly outline what can be done in either direction.

Keywords: Web 2.0, application development, SOA 2.0, conceptual modeling

Joint work of: Vossen, Gottfried; Thies, Gunnar

Conceptual modelin in physical and social contexts

Roel Wieringa (University of Twente, NL)

The history of the computing sciences shows a shift in attention from the syntactic properties of computation to the semantics of computing in the real world. A large part of this shift has been brought about by the introduction of conceptual modeling languages. In this paper I review this history from the early 1970s and identify the elements of real-world semantics that these notations have been used for. In the physical domains typical of control systems, conceptual modeling is always combined with causal modeling in order to register and control behavior in the domain. Because causal relationships are domain-specific, conceptual modeling languages in physical domains can be expected to evolve into domain-specific languages used by engineers. By contrast, in social domains causal modeling plays a minor role. In social domains conceptual models are shared by the people in the domain, and therefore constitute the domain. This creates a different mechanism for registration and control, in which events can be made to occur by means of social convention. Because conceptual models constitute the social world, we can expect conceptual modeling languages to evolve into domain specific languages here too, but in contrast to conceptual modeling languages in physical domains, they will be used as means of communication between engineers and members of the social domain.

This paper ends with a plea for more specialization and less standardization in conceptual modeling.