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Compiled by Susanne M. Humphrey and Bob Krovetz, National Library of Medicine, Bethesda, MD 20209

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Semantic Interpretation Against Ambiguity

Graeme John Hirst

Brown University, Ph.D., 1984, 331 pp.

Computer Science

ADG84-22435 Available

We describe a new approach to semantic interpretation in natural language understanding, and mechanisms for both lexical and structural disambiguation that work in concert with the semantic interpreter.

Traditionally, translation from the parse tree of a sentence to a semantic representation (such as frames or procedural semantics) has always been the most ad hoc part of natural language understanding systems. However, recent advances in linguistics, most notably the system of formal semantics known as Montague semantics, suggest ways of putting semantic interpretation onto a cleaner and firmer foundation.

Absity, the system we describe, is a Montague-inspired semantic interpreter. Like Montague formalisms, our semantics is compositional by design and is strongly typed, with semantic rules in one-to-one correspondence with the meaning-affecting rules of a Marcus parser. We have replaced the Montague semantic objects – functors and truth conditions – with elements of the frame language Frail. Absity's partial results are always well-formed Frail objects.

A semantic interpreter must be able to provide feedback to the parser to help it handle structural ambiguities. In Absity, this is done by the "Semantic Enquiry Desk", a process that answers the parser's questions on semantic preferences. Disambiguation of word senses and of case slots is done by a set of procedures, one per word or slot, each of which determines its correct sense in cooperation with the others. A partially disambiguated procedure's remaining possibilities are well-formed Frail objects that can be seen and used by other processes, including the Semantic Enquiry Desk, just as a person can see many of the details of a partly developed "instant" photograph.

It is from the fact that partial results are always well-formed semantic objects that the system gains much of its power. This, in turn, comes from the strict correspondence between syntax and semantics in Absity. The result is a foundation for semantic interpretation that we believe to be superior to previous approaches.

A Linguistic Approach to Temporal Information Analysis
Richard Li-Cheng Sheng
University of California, Berkeley, Ph.D., 1984, 159 pp.
Computer Science
ADG84-27100 Available

This dissertation presents a linguistic approach, based on test-score semantics and fuzzy logic, to the problem of fuzzy temporal inference in question answering systems.

While several models have been proposed for the analysis of historical information, little research has been done satisfactorily on the manipulation of fuzzy temporal quantifiers such as "a few days ago," which refers to absolute count, and "often", which refers to relative count. In In this dissertation, the theory of possibility is taken as an appropriate framework for dealing with such a problem.

The first step of the approach, for statements with absolute-count temporal quantifiers only, is to translate these statements into their corresponding possibility assignment equations using test-score semantics. Time information among events can then be inferred from these equations by deriving its possibility distribution. The compositional rule of inference plays the central role in solving the equations. The algorithm for computing the compositional rule can be transformed into one similar to Gaussian elimination for the solution of linear equations. This method is straightforward but inefficient. An improved technique is proposed which represents all quantifiers by fuzzy numbers and replaces the rule of composition with fuzzy addition. With this technique the desired possibility distribution can be obtained by applying a generalized Warshall's algorithm on the Time-Relation-Matrix, which is a representation for given information.

As for quantifiers which refer to relative count, such as "often," fuzzy multiplication will play the primary role. Finally, all mechanisms amount to a fuzzy temporal logic, which serves as an inference tool for temporal information analysis.

This computational approach to fuzzy temporal quantifiers has the following advantages. (1) It subsumes those approaches based on two valued logic as limiting cases. (2) It deals uniformly with the relative and absolute time relations. (3) It is easy to implement. (4) It can ge generalized to apply to other quantifiers used in different concepts such as temperature and distance.

An Analysis of the Process of Ambiguity Resolution (Disambiguation) in Sentence Processing
William Robert Loeffler
The University of Michigan, Ph.D., 1984, 167 pp.
Education, Psychology
ADG84-22279 Available

Several models have been advanced in the literature pertaining to the process of ambiguity resolution known as disambiguation. The key models include: (1) The MacKay Model; (2) The Schvaneveldt Model; (3) The Single Meaning/Multiple Meaning Hypothesis; (4) The Selective Access Hypothesis; and (5) The Prior Context Hypothesis.

This dissertation, through means of a literature search and a field experiment, attempts to sort the usefulness of these models according to their validity with respect to a large ambiguity edifice, in this case a paragraph from the U.S. Bankruptcy Code. A test instrument was developed which elicited responses through a progressively more complex and structured set of questions about the ambiguity in the sentences. These data were analyzed according to dominant response characteristics and by means of Pearson r correlations for relationships between linguistic level, order of processing, and subjects' decision-making.

Test data were consistent with evidence for the above-mentioned models, but restricted their use to particular steps within a general process of disambiguation. The data showed surface structure to be a less important factor in disambiguation than lexical and underlying/symbolic

structures for the tasks performed. Data also show context influences in the decision-making process of ambiguity resolution. The literature review and test data are incorporated into a proposed general paradigm of the disambiguation process which interfaces knowledge-based mental activities with structure-based mental activities.

The general paradigm of the disambiguation process follows order-of-processing steps in the following manner: (1) Associate memory retrieval based on prior context or previous knowledge-base; (2) Scanning of the three fundamental linguistic levels for the purpose of locating the "field" in which the ambiguity resolution is to occur; (3) Problem-solving within the selected linguistic level; (4) Tentative ambiguity resolution (disambiguation) based on a meshing of the lexical and underlying correlations; (5) Evaluative feedback of the resolution based on tentative utilization; and (6) More permanent integration of the resolution into the total language context or "field at a given time.".

Case Grammar and Functional Relations in Aboutness Recognition and Relevance Decision-Making in the Bibliographic Retrieval Environment
Dee Ann Emmel Lewis
The University of Western Ontario (Canada), Ph.D., 1984
Information Science
ADG05-55225 Unavailable

One of the most perplexing problems in Information Science has been definition of central concepts such as "relevance" and "information" at a theoretical level which incorporates and accounts for all known attributes of the concepts and the principles which underlie their particular application in this field. The objective of this thesis was to determine whether one definition of relevance, "aboutness", can be based, at least in part, on textual characteristics of queries and abstracts. To this end, this study was conducted to determine to what extent a set of functional relations based on Fillmore's case grammar theory could be used to explain the correspondence between patterns of language behavior in aboutness recognition and language patterns in the texts of queries and abstracts. The test environment was a real-life bibliographic retrieval system. Thirty subject specialists (advanced graduate students and university faculty from the Sciences, Social Sciences and Humanities) submitted queries and performed relevance assessments using "aboutness" as the operational definition for their judgements. An analysis of functional relations between the keyterms in the queries and abstracts was compared to the subject specialists' decisions. The result was that the agreement between the subject specialists' decisions and the decisions based on a match in functional relations between the queries and abstracts was 97%. The conclusion reached on the basis of this finding is that abstracts judged to be about the topic named in a query did contain the desired keyterms in functional relations which matched the functional relations between those keyterms in the query; and abstracts judged to be not about the topic named in the query did contain the same or equivalent keyterms, but not in functional relations which matched the functional relations in the query. The high level of agreement between the aboutness decisions based on functional relations and the subject specialists' decisions demonstrates clearly the consistency of language behavior in relevance assessments where the definition on which the decisions are made is aboutness or match in topic. These conclusions have implications for indexing systems, query negotiation, search strategy formation, retrieval system research and the development of interface mechanisms for on-line retrieval systems.

The Logical Organization of Written Expository Discourse in English: a Comparative Study of Japanese, Arabic, and Native Speaker Strategies
Michele J. Burtoff
Georgetown University, Ph.D., 1983, 211 pp.

This study was designed to examine the validity of Kaplan's (1966) notion of Contrastive Rhetoric: that culture groups organize their thoughts in writing in culture-specific ways. The study focused on identifying and describing culture-specific strategies beyond the scope of explicitly-taught rhetorical conventions, while also examining the effect(s) of discourse topic on those organizational strategies. This led to a twofold hypothesis. (1) When writing about a "culturally-loaded" topic, subjects

Language, Linguistics
ADG84-28443 Available

are more likely to exhibit culture-specific strategies. (2) When writing about a "universal" (and emotionally neutral) topic, subjects are more likely to exhibit collective (i.e., similar) strategies. Data consisted of essays in English on two topics written by Japanese, Arabic, and native English speakers as part of a classroom assignment. All subjects, fifteen in each group, were students in high-intermediate to advanced &esl. class- es or in university freshman composition classes; all subjects reported little or no formal writing instruction. The essay topics were: (1) What is (or should be) the role of old people in society? (2) What is a bicycle and how does it work?

The text analysis used a system of eleven logical relations adapted from categories proposed by Meyer (1975), Milic (1969), Halliday and Hasan (1976), and Jacobs (1982). The data were analyzed for similarities and differences across topics and subject groups in three areas: (1) type and use of interpropositional logical relations; (2) structure of the texts; and (3) use of subordinate arguments (or information).

Results lend support to Kaplan's notion of Contrastive Rhetoric, but with modification. All groups used the same logical relations and strategies of organization; i.e., none was group-specific. However, the frequency with which these strategies were used differed among the three groups. Therefore, we can speak only of culturally "preferred," not culture-specific, strategies of organization. Further, in support of our hypothesis, the topic of discourse appeared to influence how groups organized the text; both culturally preferred and collective strategies differed across topics. Pedagogical implications and directions for future research are discussed.

Discourse Structure and Anaphora in Written and Conversational English
Barbara A. Fox
University of California, Los Angeles, Ph.D., 1984, 311 pp.
Language, Linguistics
ADG84-28514 Available

The problem of what motivates speakers and writers choose a given linguistic forms to refer to an item at a given point in a text has been of interest recently to researchers in linguistics, cognitive pyschology, and artificial intelligence. While this research has provided many valuable insights into particular aspects of the problem, no work to date has tried to provide a view of anaphora that is at once comprehensive – encompassing a wide range of test-types and anaphoric environments – and sufficiently detailed to allow for specific predictions. The present study attempts to fill this gap by examining at a fine level of detail the patterning of anaphora in English in a variety of text-types.

The fundamental assertion of this thesis is that discourse anaphora cannot be understood unless we examine the hierarchical organization of the texts which are the sources of the anaphors. In this study I have therefore adopted three hierarchical models of discourse – one of each text-type explored – so that a hierarchical structure of each individual text can be correlated with the patterns of anaphora it displays. The models used are: rhetorical structure analysis (expository texts), story structure analysis (narrative texts), and conversational analysis (non-story conversational texts). These models are used as analytic tools for understanding the structure of the texts involved.

In addition, it is claimed here that structural factors are not the only principles that guide referential choice in discourse; other non-structural principles (such as disagreement and classification) also play a role in influencing anaphoric selection.

Finally, it is claimed here that anaphoric patterning varies quite widely across text-types, so that a statement of distribution that is based on one text-type cannot be accurate for the language as a whole, or for any other given text-type. This finding raises difficult issues concerning the nature of linguistic descriptions; in particular it calls into question the common aim in linguistics of describing how a particular linguistic item is used in the language, as opposed to in a particular text-type. It is suggested that such

general claims about the uses of linguistic items may not be appropriate in the context of a multi-genre society.

Conversation and the Speech Situation: a Tagmemic Analysis
David Benjamin Frank
The University of Texas at Arlington, Ph.D., 1983, 343 pp.
Language, Linguistics
ADG84-26830 Available

Until recently, conversation, considered even now by some to be outside the scope of linguistics, has been neglected in linguistic research. Chapter One of this dissertation argues that the popular distinction between 'theories of language structure' and 'theories of language use' might be abandoned in order to allow a more integrated study of language and a clearer understanding of the nature of language in the context of human life.

To forward such an integrated study, a theoretical model on which to base the analysis of both conversation structure and other linguistic structures must be developed. The tagmemic model, developed by Kenneth Pike, Robert Longacre, and others, allows the same set of procedures to be used to analyze paragraphs, texts, and conversations as is used in analyzing words, phrases, and clauses. Chapter Two presents this model.

Consideration of the context of conversation is necessary for the adequate analysis of the conversation itself. Chapter Three illustrates the description of a speech situation using a revision of Pike's (1967) tagmemic methodology developed for the analysis of 'behavioremes'. The proposed revisions give attention to the three hierarchically structured main components of the speech situation: the physical world; the events; and, the cultural matrix. One particular behavioreme (speech situation) analyzed in Chapter Three is a wedding ceremony.

Chapter Four focuses on conversation as a particular complex of events in the behavioreme. Conversational exchanges such as question-answer and proposal-compliance are analyzed in terms of the tagmemic slot-filler and form-function distinctions. Several conversations are analyzed in this fashion. Although the focus in Chapter Four is on the exchange level, the relations among conversational exchanges and other levels of structure are pointed to.

Chapter Five summarizes the conclusions of the study. Appendices One and Two present much of the data analyzed in Chapters Three and Four respectively.

Two main goals of this dissertation have been (1) to demonstrate some of the structural patterns in conversation and the speech situation, and (2) to develop a model that facilitates an integrated analysis of conversation and other levels of linguistic and nonlinguistic structure.

The Validity of Definitions
Renison Joseph Gonsalves
City University of New York, Ph.D., 1984, 167 pp.
Language, Linguistics
ADG84-23062 Available

In this dissertation I argue for the validity of definitions for semantic representation from the point of view of Jerrold J. Katz's semantic theory. I argue that definitions are valid regardless of whether one looks at language as a psychological object or an abstract object, or if one is interested in a psycholinguistic theory of language performance. I examine a number of recent criticisms of a definitional account of meaning and present various replies to them. I develop a semantic marker account of causative verbs in order to illustrate the explanatory adequacy of a definitional theory.

Some Dimensions of Japanese Verb Semantics in Relation to Translation from English
Kimie Miyazaki
University of Hawaii, Ph.D., 1984, 133 pp.
Language, Linguistics
ADG84-29314 Available

This study explores some aspects of translation from English to Japanese in terms of a relatively small set of semantic notions, while focusing on certain dimensions of verb semantics. These dimensions include (1) the ways in which the notion of &ong., typically expressed in English by the progressive form, is realized for verbs of motion and verbs of change of state in Japanese, (2) the properties of certain Japanese double-verb constructions which correspond to verb plus preposition expressions in English, and (3) the properties of a class of transitive verbs

in Japanese which resists passivization, unlike their English counterparts. It will be seen that certain crucial semantic properties are involved, properties which can be represented as: +/-PERFECTIVE, MANNER, EXTENT OF SPACE, POINT OF SPACE, (END POINT particular) and others.

Chapter 1 explains the nature and purpose of this study, reviews the general literature, and surveys the content of the following four chapters. Chapter 2 discusses the interaction of semantic notions such as -PERFECTIVE and -MANNER for verbs of motion like *aruku* 'walk,' and +PERFECTIVE and POINT OF SPACE for verbs of motion like *iku* 'go,' when the notion of &ong. is communicated from English to Japanese. Chapter 3 discusses the interaction of very much the same set of semantic notions embodied in the translation of verb plus preposition expression in English into double-verb constructions in Japanese. In Chapter 4, we characterize a class of transitive verbs in Japanese which resists passivization. These involve the notion EXTENT OF SPACE, which may be associated with the notion END POINT or RESULT. These transitive verbs frequently have intransitive counterparts which focus only on the resulting state, corresponding to the END POINT for motion verbs. This semantic correspondence between transitive and intransitive pairs of verbs affects the acceptability of inanimate theme (or patient) passives in Japanese. Chapter 5 discusses the conclusions of this study and considers several other areas of verb semantics for which some or all of the features we have examined may be relevant.

Systemic Cohesion in Published General Academic English: Analysis and Register Description

Gail Price Rottweiler
Rutgers University, the State U. of New Jersey (New Brunswick), Ed.D., 1984, 313 pp.
Language, Linguistics
ADG84-24066 Available

The investigator uses Halliday and Hasan's (1976) paradigm of cohesion devices as the basis for synthesizing a paradigm which she applies to a sample of published general academic written texts as a beginning description of the systemic cohesion devices associated with that register. She also incorporates Gray's (1977) concept of the core assertion into the study in order to examine the extent to systematic cohesion devices in the surface sentence interface with one interpretation of the basic meaning units of the sentence.

Twelve sample texts, all approximately 400 words in length, were excerpted from the American Scholar and Daedalus in beginning, middle and end sections. They were analyzed for the following: (1) type-token frequency counts of the systemic devices included in the paradigm; (2) measures of textual distance between cohesion device and referent for those cohesion devices identified in the sample corpus; (3) linear sequencing of cohesion devices within the 12 texts; and (4) the co-occurrences of systemic cohesion devices and core assertional elements in the sentences of the text blocks. The analysis relies heavily upon visual representation of the structure of cohesion in the sample texts.

The major findings were as follows: (1) systemic cohesion devices were found to connect almost all sentences in the sample text blocks; (2) lexical cohesion devices were found to occur with greater frequency in the sample texts than either grammatical cohesion devices or conjunctive cohesion devices; (3) textual distance between cohesion device and referent were found to vary significantly among the three major types of cohesion devices: grammatical, lexical, and conjunctive; (4) systemic cohesion devices and core assertions were found to vary systematically; and (5) certain differences were found to exist among the beginning, middle, and end sections of the texts both with respect to the patterning of cohesion devices and the patterning of assertions.

The system of systemic cohesion in these published academic texts is seen as a multi-faceted reticulated network, co-occurring with other hierarchical systems in a way that is analogous to Hofstadter's concept of

Strange Loops. The implications of the study for text-linguistics and expository writing pedagogy are explored. Relevance to reading is suggested.

On Boundedness in Government-Binding Theory
John David Truscott
University of California, Irvine, Ph.D., 1984, 306 pp.
Language, Linguistics
ADG84-27821 Available

This dissertation proposes some changes in the Government-Binding Theory presented in Noam Chomsky's Lectures on Government and Binding. The changes are primarily related to the means by which the boundedness of syntactic movement is derived in the theory. It is argued, first, that the principle of subjacency, referred to by Chomsky as "the theory of bounding," should be replaced by extensions of existing government and binding principles. A detailed proposal for such a replacement is then presented. It is then shown that this proposal can be used to explain a number of other phenomena, not directly related to boundedness.

Chapter 1 serves as a general introduction. It summarizes the dissertation and offers some additional introductory comments. Chapters 2 and 3 motivate the replacement of subjacency. The former is concerned with learnability, arguing that the parameter which is associated with subjacency is not learnable. This argument is extended to include other parameters of GB Theory, as well. Chapter 3 offers extensive arguments against the use of subjacency in GB Theory. Arguments are presented from both a linguistic perspective and a learnability perspective.

Chapters 4 and 5 are the heart of the dissertation. The former offers a theory of binding, differing greatly from standard theories. The central idea is that an anaphor must be bound from the closest position from which it could be bound. This requirement applies to lexical anaphors, PRO, and traces (including trace of wh-movement). In Chapter 5 it is argued that this binding theory, in conjunction with Chomsky's Empty Category Principle, makes subjacency unnecessary. Exceptional Government (EG) is also introduced in this chapter as a means of deriving the cases in which movement is relatively unbounded, i.e., cases in which extraction is possible. In Chapter 6 EG is used to explain several additional phenomena. These include the distribution of null complementizers in tensed complement clauses, the distribution of infinitives, and raising and Exceptional Case Marking. The fact that these phenomena can be explained by the same principle used in Chapter 5 to explain extraction is taken as further evidence favoring that theory of extraction.

Children's Mastery of Co-reference Restrictions on Pronominal and Null Anaphora
Amy Alexandra Strage
University of California, Berkeley, Ph.D., 1984, 113 pp.
Psychology, Developmental
ADG84-27110 Available

Forty subjects (ages 3,4 to Adult) acted out a series of 2-sentence stories containing two types of anaphors: full pronouns or missing-objects. Test items varied as a function of: (1) Presence or absence of a syntactic constraint on grammatically acceptable resolutions of the anaphor (the missing-subject constraint, specifying the selection of the main clause subject as antecedent applied to all missing-subject items; the c-command constraint blocked forward and backward anaphora for some pronominal items); (2) Direction of anaphora; (3) Semantic bias; (4) Topic bias; and (5) Grammatical role of the anaphor.

The youngest children (ages 3-4) treated pronouns as deictic markers of references if there was no antecedent already available in the linguistic context. They selected sentence-external referents for pronouns in sentence-initial main clauses, whether or not anaphora was blocked, and sentence-internal referents for all other items. They tended to choose the subject (NP1) or object (NP2) of the clause not containing the anaphor as antecendent for both pronominal and missing-subject items (except in cases where semantic biases made one interpretation more likely than another). This suggests that these children had not adduced syntactic restrictions on the resolution of anaphora.

The middle group (ages 7-8) treated pronouns and missing-subjects as markers of the "thematic subject". They selected NP1 (or the nominated topic, if different) as antecedent for both pronominal and missing-subject anaphors, irrespective of syntactic properties of the sentences in which they occurred. Thus, for this group, hypotheses of an anaphoric function of pronouns and missing-subjects superseded syntactic hypotheses.

Adults manifested a strong bias in favor of sentence-internal interpretations of the anaphors, which competed with structure-dependent rules constraining anaphora. They offered exophoric interpretations only part of the time when c-command blocked sentence-internal interpretations, and they rarely offered sentence-external readings of the pronouns where such interpretations were viable options. Adults evidenced a constraint on missing-subject interpretation, consistently selecting NP1 as antecedent for the null anaphors, even when NP2 was nominated as topic.

The results suggest that, at all ages, subjects' interpretations are determined by a combination of structural and functional hypotheses which evolve in tandem throughout childhood.

The Mapping of Semantic and Syntactic Processing Cues by First and Second Language Learners of English, Dutch, and German

Janet L. McDonald

Carnegie-Mellon University, Ph.D., 1984, 141 pp.

Psychology, Experimental

ADG84-25823 Available

This dissertation proposes and tests a model of how the cues of word order, noun animacy, and case inflection are used to determine the roles of actor and recipient in a sentence. This mapping of cues to roles is investigated in both first and second language learners of the English, the English, Dutch and German languages.

The model proposes that the order in which mappings are acquired is determined by how informative, or valid a particular cue is over all sentences in a language. The model also proposes that the strength of the mappings is determined by exposure to sentences that contain conflicting cues, and eventually asymptotes to the relative cue validities given by these conflict sentences. The model accounts for both first and second language learners' performance by having first language learners start acquisition with initial mapping strengths of zero, while second language learners start with initial strengths corresponding to those of their first language.

Quantitative predictions about both the order of cue mapping and final strengths are made on the basis of estimates of overall and conflict sentence cue validity.

Two experiments then test these predictions in NVN sentences, relative clauses and dative constructions. In the first experiment, monolingual speakers of English and Dutch ranging from kindergarteners to college students interpret sentences containing different combinations of conflicting and non-conflicting cues to role assignment. Qualitative and quantitative predictions about the order and final strength of the mappings are confirmed.

Using the same paradigm, the second experiment investigates cue mapping in adult bilingual speakers of English, Dutch and German. Results show that second language learners gradually shift their cue-mapping strengths from those appropriate to their first language to those appropriate to the second using the same process as first language learners.

The proposed model fits the data better than several alternative models.

Selected Dissertation Abstracts Related to Knowledge Representation

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Expert Systems for Design Problem-Solving Using Design Refinement with Plan Selection and Redesign
David Christopher Brown
The Ohio State University, Ph.D., 1984, 252 pp.
Computer Science
University Microfilms Order Number ADG84-26358. 8502.

This dissertation addresses the design of mechanical components, and views design as a problem-solving activity. A previously presented theory is adopted, modified, extended and tested. The extended theory explains explains the activity of a human designer when solving a design problem. The AIR-CYL expert system embodies the extended theory. The system designs a type of Air-cylinder to user given requirements. The behavior of the system closely follows the human designer's.

This research applies to a class of design which requires that at every stage of the design the designer knows both what sequencesof design steps are appropriate and also what knowledge is required. The theory used hypothesizes that such activity is organized around a hierarchy of active concepts which may be considered to be specialists about some portion of the design. The hierarchy reflects the way that the designer thinks of the object, and shapes the design process.

Each Specialist has its own set of Plans from which to select. The plans request designs from other specialists lower in the hierarchy, and use Tasks to make small additions to the design. Tasks use Steps to decide the values of attributes. Constraints test the validity of the design. The Design Data-base contains the current state of the design and a record of its progress, plus the collected requirements from the user. Design proceeds by obtaining and checking requirements, and by doing rough-design to establish whether full design is worth pursuing. If the rough-design succeeds, then the full design is attempted. Communication between design agents is done by passing messages that give instructions and report on success or failure.

On design failure, suggestions lead to a redesign phase, where every implicated agent attempts to alter the design in order to recover from the failure. This results in dependency-based backup within chronological backup.

Design knowledge expressed in a design language and some implementation details are presented. Other design related research is examined. Some theory and implementation strengths and weaknesses conclude the dissertation.

On the Use and Internal Structure of Logic-Based Decision Support Systems
Michael Chien-Kuo Chen
Northwestern University, Ph.D., 1984,

A general decision support system based on first-order logic with desirable characteristics (like being semistructured, supporting, descriptive, effective, and evolutionary) will be presented. The proposed system improves the existing frameworks of Sprague and Bonczek, Holsapple,

143 pp.
Computer Science
University Microfilms Order Number ADG84-23215. 8501. ADG05-55097. 8503.

and Whinston in terms of flexibility and efficiency. A tool called the connection graph is used as a basis for pre-compiling queries for efficient response as well as for modifying pre-compiled queries in response to assumption analysis (such as handling "what-if" type of questions). Techniques for modifying the existing programs derived from the connection graph are described. The notion of determined variables is extended to include the case of process literals. The class of allowable formulas is extended to include constraint formulas, which may include existential quantifiers.

An Object-Oriented Office Data Model
Simon John D. Gibbs
University of Toronto (Canada), Ph.D., 1984
Computer Science
This item is not available from University Microfilms International.
ADG05-55105. 8503.

Office activities involve the sharing of a large quantity and variety of stored information. Consequently computer-based systems for managing office information (referred to as office information systems) demand a specification of the structure and organization of information present within the system. Current database management systems and their underlying data models lack the flexibility required by office information systems.

In this thesis a data model for the specification of data structures, operations, and constraints relevant to office information systems is presented. The model relies on techniques from conceptual data modelling to specify the structure and semantics of common office objects. The unusual features of the model include a constraint mechanism based on triggers, templates for presenting objects in different media, and unformatted data types such as text and audio. The representation of the office environment is described. An example is given of a high-level interface for which user commands can be translated to model operations.

Requirements Modeling: a Knowledge Representation Approach to Software Requirements Definition
Sol Jaffe Greenspan
University of Tornoto (Canada), Ph.D., 1984
Computer Science
This item is not available from University Microfilms International.

Software Engineering can be viewed as the production of a series of models beginning with a completely world-oriented (application-oriented) model and progressing toward models that are more and more machine-oriented. In this view, the first model in the series, referred to in the thesis as a requirements model, captures and formalizes information that is usually left informal in current approaches. A language for require modeling (RML) has been designed. It is based on knowledge representation ideas from Artificial Intelligence (AI): a model in RML is considered as a knowledge base about some slice of reality. RML was designed as part of the Taxis Project at the University of Toronto and is based on the same framework as the Taxis language for information system design. It offers three kinds of objects (entity, activity, and assertion) for representing concepts and three abstraction principles (aggregation, classification, and generalization) for organizing objects. RML is formally defined by giving a translation of each of its features into a First-Order Logic with time. The notion of consistency of a requirements model is thus linked to consistency of the corresponding set of FOL axioms. Among other examples of RML usage, the language is used to describe the organizing of an IFIP working conference. A connection between informal "box-and-arrow" descriptive techniques and a formal semantic model is drawn by linking RML to a well-known requirements aid, SADT.

Learning to Solve Problems by Searching for Macro-operators
Richard Earl Korf
Carnegie-Mellon University, Ph.D., 1983, 152 pp.
Computer Science
University Microfilms Order Number ADG84-25820. 8502.

This thesis explores the idea of learning efficient strategies for solving problems by searching for macro-operators. A macro-operator, or macro for short, is simply a sequence of operators chosen from the primitive operators provided by a problem. The technique is particularly useful for problems with non-serializable subgoals, such as Rubik's Cube, for which other weak methods fail. Both a problem solving program and a learning program are described in detail. The performance of these programs is analyzed in terms of the number of macros required to solve all problem

instances, the length of the resulting solutions expressed as the number of primitive moves, and the amount of time necessary to learn the macros. In addition, a theory of why the method works, and a characterization of the range of problems for which it is useful are presented. The theory introduces a new type of problem structure called operator decomposability. Finally, it is concluded that the macro technique is a valuable addition to the class of weak methods, that macro-operators constitute an interesting and important type of knowledge, and that searching for macros may be a useful general learning paradigm.

Learning Problem Solving
Bruce Walter Porter
University of California, Irvine, Ph.D., 1984, 177 pp.
Computer Science
University Microfilms Order Number ADG84-27819. 8503.

Learning to problem solve requires acquiring multiple forms of knowledge. Problem solving is viewed as a search of a state-space formulation of a problem. With this formalism, operators are applied to states to transit from the initial state to the goal state. The learning task to acquire knowledge of the state-space to guide search. In particular, three forms of knowledge are required: why each operator is useful, when to apply each operator, and what each operator does. A PROLOG implementation, named PET, demonstrates the learning approach in the domains of simultaneous linear equations and symbolic integration.

Episodic learning is a technique for learning why individual operators are useful in a solution path. Episodic learning acquires generalized operator sequences which achieve the goal state. This is done by backing-up state evaluation and learning sub-goals in the state-space.

Perturbation is a technique for learning when individual operators are useful. Perturbation guides the generalization process to discover minimally-constrained preconditions for useful operator applications. This done by experimentation, thereby reducing the teacher's role in the learning process.

Learning relational models is a technique for discovering what individual operators do. Relational models are an explicit representation of the transformation performed by operators. This representation enables the learning element to reason with operator semantics to guide further learning.

Episodic learning, perturbation and relational models form an integrated approach for learning problem solving. The approach demonstrates self-teaching by reasoned experimentation.

A Neural Model of a Semantic Network
Howard Andrew Winston
Brown University, Ph.D., 1984, 383 pp.
Computer Science
University Microfilms Order Number ADG84-22500. 8501.

A system (PSNET) is described that implements a semantic network in simulated neurally plausible hardware. It is shown how knowledge representation constructs can be reduced to aspects of a parallel associative memory model.

The PSNET system is used to demonstrate how information can be quickly accessed in very large knowledge-bases. PSNET is also used as a tool to study how the internal structure of a concept can affect its associative interactions with other concepts.

PSNET is composed of a number of subsystems that exist at different descriptive levels. Each subsystem is described along with its relations to those at adjacent levels. The top-level subsystem is a structured inheritance hierarchy that provides a formalism for the representation of real-world knowledge. A logical level network is used to represent the propositional content of the top-level semantic network links. Logical level links and nodes are in turn represented by associative matrix terms and state vectors at the associative memory level. Finally, associative memory data structures are interpreted as describing the state of a system of model neurons at the neural network level.

At the neural network level, PSNET concepts are implemented as distributed patterns of neural activity, which are represented by state

vectors. The use of a particular state vector representation of concepts (i.e., the overlapping state vector representation) for automating property inheritance and inductive generalization in semantic networks is discussed.

Three computer simulations that illustrate how low-level state vector codings of semantic network nodes can influence the results of memory retrieval processes are described. The first simulation shows how the overlapping state vector representation generalizes properties explicitly predicated of a category's exemplars to apply to the category itself. Simulation 2 shows that the structure acquired by a category, due to the overlapping representation, is prototypical in nature. That is, a category's description reflects the frequencies with which properties appear among its exemplars. The third simulation shows how a category's description can also be acquired by inductive generalization from the properties of its siblings in an inheritance hierarchy.

PSNET's parallel processing mechanisms are explored in detail. It is shown how (a) multiple access, (b) divergence, and (c) chain parallel processing occur in PSNET. A new synaptic modification rule is proposed that causes PSNET to exhibit divergent fan-effects similar to those found human subjects.

Individual Differences in Rule Discovery: an Exploratory Study of the Inductive Reasoning Game Eleusis
Diane Jane Briars
Northwestern University, Ph.D., 1984, 173 pp.
Education, Mathematics
University Microfilms Order Number ADG84-23207. 8501.

This study explored inductive discovery of condition-action rules. It's goals were: to identify behaviors associated with skilled rule discovery, to examine the relations between rule discovery and academic achievement and other reasoning abilities, and to determine the affect of selected task variables (rule presentation order and rule type) on rule discovery.

The rule discovery task was a variant of the card game Eleusis. Subjects were to discover the rule that created a card pattern (e.g., If the last card legally played was a face card, play a card of a different color. If the last card legally played was not a face card, play a card of the same color). Fifty high school seniors attempted to discover three Eleusis rules; rule presentation order was counterbalanced across subjects.

Analyses of subjects' verbal protocols indicated that Eleusis rule discovery is a generate and test process that is modified by task-specific heuristics. The most skilled subjects used very effective data-dependent heuristics based on specific knowledge relating card patterns (data) and rules. Less skilled subjects also attempted to use card pattern data to guide their rule generation; they were relatively unsuccessful in this, though, because they did not associate specific pieces of data with rule characteristics. A follow-up study supported this analysis of skilled performance. Less skilled subjects instructed in components of skilled rule discovery were significantly more successful is discovering a subsequent rule than less skilled subjects who were not so instructed.

The relation between Eleusis rule discovery and other cognitive skills and aptitudes, including academic achievement, inductive reasoning, and cognitive restructuring, were also assessed. The most striking result was that the most skilled subjects had significantly higher mathematics achievement than all other subjects. A discriminant analysis indicated that academic achievement variables were the best predictors of general rule discovery skill, and that mathematics and science achievement in particular distinguished the most skilled subjects from the successful but less skilled ones. Academic achievement is not a sufficient predictor, however; factors such as inductive reasoning ability and attitudes toward logic puzzles also appear to be involved.

Family Resemblances and the Problem of the Under-Determination of Extension

This dissertation presents an objection to Wittgenstein's concept of family resemblances, three possible solutions to the objection, evaluations of the solutions, and a sketch of Wittgenstein's approach to the objection.

James Edward Bellaimey
The University of Wisconsin (Madison), Ph.D., 1984, 105 pp.
Philosophy
University Microfilms Order Number ADG84-15545. 8503.

My thesis is that none of the three proposed solutions is satisfactory, but that Wittgenstein can deal with the objection.

Chapter I presents the Problem of the Under-Determination of Extension, the claim that family resemblances are not enough to explain the extension of a concept, since resemblances may be postulated between cases falling under different concepts.

Chapters II and III discuss three solutions proposed by commentators on family resemblances. The Basic Predicates Solution claims that points of family resemblance are sufficient conditions, and is incorrect since Wittgenstein denies that one can infer the applicability of a concept based on the presence of a resemblance to an instance of the concept. The Simple Properties Solution claims that only some concepts are family resemblance concepts, and depend upon concepts which are not family resemblance concepts, and is incorrect, since Wittgenstein does not require that family resemblance concepts be reducible to non-family resemblance concepts. The Bi-Directional Determination of Concepts Solution is the claim that a concept is determined by an interaction between facts about cases subsumed under it, and needs and purposes of language-users. This solution is non-Wittgensteinian by ignoring the ramifications of his concepts of grammar and language-games.

Chapter IV argues that Wittgenstein deals with the original objection by developing new models for understanding language, involving the concepts of grammar and language-games.

Reasoning and Change in a Language Game for Imperative and Permission Sentences
Marvin Belzer
Duke University, Ph.D., 1984, 275 pp.
Philosophy
University Microfilms Order Number ADG84-23931. 8502.

The most important problem is philosophical deontic logic is to determine the logical form of expressions of conditional obligation. The dissertation shows first that this problem is closely related to David Lewis's well-known "problem about permission" – a problem concerning the characterization of changes in normative systems. The dissertation contains a solution to the problem about permission, as well as an argument that expressions of conditional obligation cannot be represented satisfactorily by means of some combination of monadic deontic operators and a counterfactual conditional (which suggests that dyadic deontic operators cannot be decomposed).

Lewis formulates the problem about permission in terms of a language game for imperative and permission sentences. In order to solve the problem it is necessary first to point out the shortcoming in Lewis's game that it cannot be used satisfactorily to provide semantics for "contrary to duty" imperatives. Having revised the game it is possible to define the concept of relative defeasibility between imperatives. It is in terms of this concept that a solution to the problem about permission is formulated.

The "revised game" is used as well to discuss problems concerning reasoning from sets of rules, principles, and facts to "all things considered" conclusions. It is argued that two distinct senses or uses of 'ought' must be distinguished in order to represent such reasoning satisfactorily. The role of the notion ceteris paribus is discussed. The notion is given a precise definition in terms of the possible worlds semantics of the "revised game" and it is argued that the notion is not as significant in normative reasoning as commonly is supposed. An alternative notion is defined and defended.

Mereology and Identity
Robert Earl Frederick
Brown University, Ph.D., 1984, 195 pp.
Philosophy
University Microfilms Order Number ADG84-22425. 8501.

The dissertation is a study of the relations between individual things, parts of individual things, and boundaries. In first chapter I present an expanded system of axioms and definitions for the primitive mereological relation "x is a part of y". I discuss alternatives to some of the axioms, particularly the axiom of mereological essentialism, i.e. the view that things have their parts essentially. I also give axioms and definitions that

characterize the relations between three dimensional objects and their boundaries. I argue that boundaries are ontologically dependent particulars in that they cannot exist apart from or independently of three dimensional objects.

In the second chapter I discuss conjunctivism, i.e. the thesis that for any two discrete objects there is something made up of those two objects. I develop several different forms of conjunctivism, including what I describe as the conjunctivism of heaps. I consider several arguments for and against conjunctivism and conclude that none of them offer convincing grounds for either accepting or rejecting it.

In the third chapter I suggest that one way to decide between different mereological principles is via an examination of the problem of identity through time. I argue that a widely held theory of identity, the sortal theory, multiplies entities beyond what is needed to give an adequate account of identity. I then propose a strictly mereological view of identity. This view has the consequence that all individuals, other than boundaries and monads, are mereological sums, and that the only non-universal properties individuals have necessarily are those implied by mereological principles.

Children's Knowledge Structures and their Impact on the Ability to Derive Inferences from Prose Passages
Mark Thomas Smircina
Miami University, Ph.D., 1984, 219 pp.
Psychology, Developmental
University Microfilms Order Number ADG84-25420. 8502.

One aspect of school success is children's ability to make inferences from reading material. Most research has focused on making inferences from small sets of sentences or from fictional prose (e.g., Paris & Lindauer, 1976; Thorndyke, 1976). However, only one study (Pearson, Hansen, & Gordon, 1977) has utilized nonfictional prose to assess how subjects' prior knowledge of material affected their ability to make inferences from it. This study extended Pearson et al. by comparing subjects at different grades with different types of nonfictional content.

Twenty-four females from each of three grades (third, sixth, and eighth) were evenly divided among three content areas (procedural, science, and social science). Each subject read two 400-word articles on topics related to her content area. One article was on a topic the subject knew well (as evidenced by a multiple-choice pretest), while the other was on a topic not known well. After reading each article, the subjects were orally presented with six questions assessing material explicitly presented in the article and six questions requiring subjects to make an inference to answer. The information required to answer each explicit question was also necessary to answer one of the inference questions. Both passage order and question order were controlled by counterbalancing.

Analyses of variance were conducted on two dependent variables: (a) the percentage of correct responses to the explicit and inference questions, and (b) the logarithms of the response times (RTs) to the questions. As expected, the percent correct increased with age. In addition, the procedural articles were easier than the science articles, which were easier than the social science. While high knowledge articles were easier than low knowledge in both the science and social science conditions, no such difference was found for the procedural articles. In general, the greater the percent correct, the faster the response times to the questions. Contrary to prediction, there was no difference in percent correct between the explicit and inference questions; however, the latter had significantly longer RTs than the former questions.

These results support various schema theories of knowledge (e.g., Rumelhart & Ortony, 1977). In general, questions on topics for which subjects had a schema (high knowledge) were answered more quickly and accurately. Some schemas (e.g., the procedural-cooking) seemed general enough for subjects to use for answering questions about both familiar and unfamiliar topics. In addition, the longer RTs to inference questions indi-

cate that such inferences require more processing. The educational implications of these data were also discussed.

The Behavioral Consequences of Schema Activation
Geoffrey Teh-Chih Fong
The University of Michigan, Ph.D., 1984, 126 pp.
Psychology, Social
University Microfilms Order Number ADG84-22225. 8501.

Cognitive approaches to experimental and social psychology hold that people come to understand the world through cognitive structures, or schemas. Although much research has been conducted on how these schemas influence information processing, much less has been conducted on two equally important problems: (1) What are the factors that determine whether any given schema will be activated or primed?, and (2) How do schemas influence meaningful social behavior? The two experiments reported here addressed these problems.

to prime conceptions of helping. Some of these articles were designed to prime the schema for helping people. Other articles were designed to prime the schema for helping science. Next, subjects were given an opportunity to either help a person (assist a person walking up the stairs on crutches) or help science (volunteers for additional psychology experiments). Subjects were not aware that the helping task had anything to do with the experiment. Even so, the priming articles had a significant and specific effect on behavior. For example, an article that was designed to prime the science helping schema served to enhance volunteering, but did not influence helping the person. Moreover, it was found that priming the schema through a persona was particularly effective in enhancing schema-relevant behavior. In addition to enhancing behavior, the priming articles also enhanced the correlation between attitudes and behavior. These findings have implications for research that attempts to determine the nature and content of schemas, and suggests that future approaches to cognitive social psychology should explore the relationship between schemas and social behavior.