Situations and Dispositions.
Some Formal and Empirical Tools for Semantic Analysis.*

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Revising some fundamental assumptions in model theory, Barwise/Perry [1] have arrived at a new approach to formal semantics, based on the concept of *situation.* Within their relational model of semantics, meaning appears to be the derivative of information processing which (natural/artificial) systems — due to their own structuredness — perform by recognizing similarities or invariants between situations that structure their surrounding realities (or fragments thereof). By mapping these invariants as *uniformities* across situations, cognitive systems attuned to them constitute what appears to be their view of reality: a flow of situations related by uniformities like individuals, properties, relations, locations, etc. which constrain "a world teaming with meaning". Complementory to this *sign-system-view* of the external world, the *symbol-system-view* of natural languages makes *words* (as types) appear to be such uniformities whose employment (as tokens) in texts exhibits a special form of *structurally conditioned* constraints. Not only allows their use speakers/hearers to convey/understand meanings differently in different discourse situations (*efficiency*), but at the same time the discourses' total vocabulary and word usages also provide an empirically accessible basis for the analysis of structural (as opposed to referential) aspects of *event-types* and how these are related by virtue of word-uniformities across phrases, sentences, and texts uttered. Thus, as a means for the intensional (as opposed to the extensional) description of (abstract, real, and actual) situations, the regularities of word-usages may serve as a representational format to specify those constraints dynamically which underlie and condition any word's *linguistic meaning,* the *interpretations* it allows within possible contexts of use, and the *information* its actual employment on a particular occasion may convey. Under the notion of *semantic dispositions* [2] a textlinguistic access has been found which may prove to become an empirical tool to the analysis and dynamic representation of *structural constraints* underlying linguistic meanings. Based upon the empirical analysis of discourse that real speakers/writers produce in actual situations of performed or intended communication (1), the present approach (2) makes essential use of algorithmic means to map fuzzy word meanings and their connotative interrelations in a format of *stereotypes.* Their dependencies (3) are generated procedurally selecting only those relations which can be — under differing aspects differently — considered relevant. Such dynamic dispositional dependencies would seem to be an operational prerequisite to and a promising candidate for any em-

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pirical component to Situation-Semantics which is to cope with and at the same time to exploit the *perspectival relativity* of language from its contextual milieu of communicative discourse situations.

1. Based upon statistical means for the empirical analysis and the formal representation of vague word meanings in natural language texts, procedures have been devised which allow for the systematic modelling of a fragment of the lexical structure as constituted by the vocabulary employed in the texts and the concomitantly conveyed components of linguistic meaning concerned [3]. The coefficients applied will map lexical items onto fuzzy subsets of the vocabulary according to the numerically specified regularities these items have been used with in the discourse analysed. The resulting system of sets of fuzzy subsets [4] is a datastructure which may be interpreted topologically as a hyperspace with a natural metric. Its elements are abstract objects representing meaning points, and the distances between them represent their mutual meaning differences. They form discernable clouds and clusters whose meanings are measured and mapped as a composite function of any one lexical item's collection of differences of usage regularities calculated against those of all other items occurring in the texts analysed [5]. Thus, the analysing algorithm takes natural language discourse from any specified subject domain as input and produces as output a distance-like datastructure (semantic space) of linguistically labeled elements (meaning points) whose topologies (position, adjacency, environment, etc.) reveal associative properties of the conceptual prototypes according to which lexical items have been employed in the texts to form stereotypical linguistic meanings.

2. In order to cope with phenomena of semantic *efficiency* like usage similarities of different and/or contextual variations of identical items, the present model separates the format of a basic (stereotype) meaning representation system from its latent (dependency) relational organization by means of variable conditional constraints to be modeled. Whereas the former is a rather static, topologically structured (associative) memory representing the data that text analysing algorithms provide, the latter can be characterized as a collection of dynamic processes to re-organize these data under various principles. Other than *inefficient* meanings allowing *declarative knowledge* to be characterized by *unconditional constraints* and represented in pre-defined structures like semantic networks, *efficient* meanings of contextual knowledge are heavily dependent on the communicative situations and vary according to the *conditional constraints* concerned. One of these can be formulated as and modelled by a generative algorithm that induces a relation of lexical relevance which — under any item's perspective — will produce varying dependencies called *semantic dispositions* whenever and only executed on changing data [6].

3. This is achieved by a recursively defined procedure which operates on the semantic space structure. Given one meaning point's position as a start, the algorithm will work its way through all labeled points in the semantic space — unless stopped under conditions of a given target node, number of nodes to be processed, or threshold of maximal distance — transforming prevailing similarities of meanings as represented by adjacency of points to induce a binary, non-symmetric, and transitive relation between them. This relation allows for the hierarchical reorganization of meaning points as nodes under a primed head in an n-ary tree or *dispositional dependency structure* (DDS). Weighted numerically as a function of a node's distance values and its level and position in the tree,
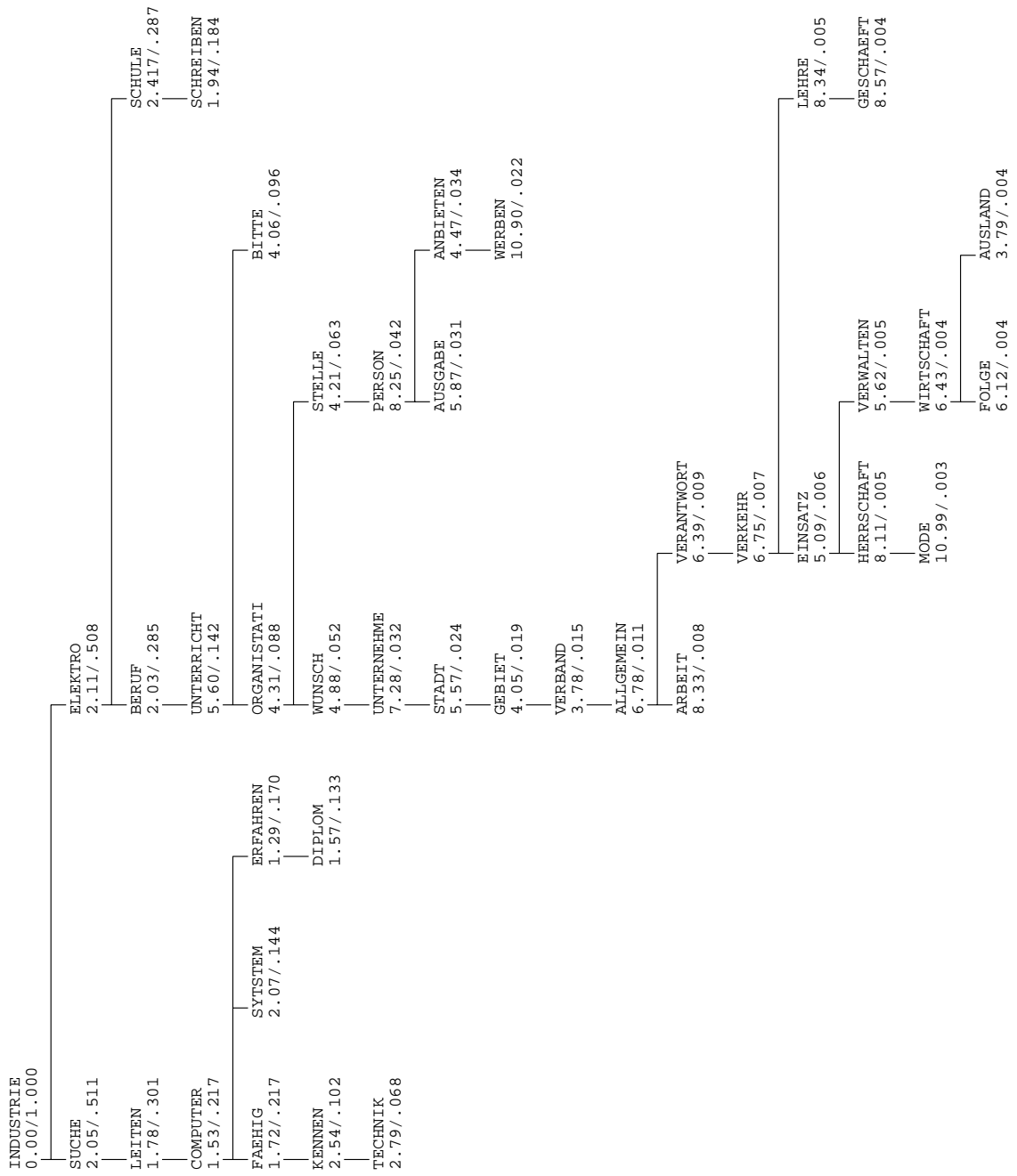
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INDUSTRIE
0.00/1.000

SUCHE
2.05/.511

ELEKTRO
2.11/.508

SCHULE
2.417/.287

SCHREIBEN
1.94/.184

LEITEN
1.78/.301

BERUF
2.03/.285

UNTERRICHT
5.60/.142

ORGANISTATI
4.31/.088

BITTE
4.06/.096

STELLE
4.21/.063

WUNSCH
4.88/.052

PERSON
8.25/.042

ANBIETEN
4.47/.034

COMPUTER
1.53/.217

UNTERNEHME
7.28/.032

AUSGABE
5.87/.031

WERBEN
10.90/.022

FAEHIG
1.72/.217

SYTSTEM
2.07/.144

ERFAHREN
1.29/.170

STADT
5.57/.024

GEBIET
4.05/.019

DIPLOM
1.57/.133

KENNEN
2.54/.102

VERBAND
3.78/.015

ALLGEMEIN
6.78/.011

VERANTWORT
6.39/.009

LEHRE
8.34/.005

TECHNIK
2.79/.068

ARBEIT
8.33/.008

VERKEHR
6.75/.007

EINSATZ
5.09/.006

VERWALTEN
5.62/.005

GESCHAEFT
8.57/.004

HERRSCHAFT
8.11/.005

WIRTSCHAFT
6.43/.004

MODE
10.99/.003

FOLGE
6.12/.004

AUSLAND
3.79/.004

Fig. 1

this relation either expresses the head-node's *meaning-dependencies* on the daughter-nodes or inversely their *meaning-criterialities* under the specific aspect determined by that head [7]. To illustrate the feasibility of the generative procedure operating on the semantic space structure to yield DDS-trees, Fig. 1 shows the *linguistic meaning* of the lexical item INDUSTRIE in the format of its *semantic dispositions.* These are constrained by those other meanings/items that proved to be relevant (first value: distance/second value: criteriality) according to their usages in a corpus of German newspaper texts ("Die Welt", 1964).

References

[1] Barwise, J./Perry, J.: Situations and Attitudes. Cambridge, MA (MIT) 1983.

[2] Rieger, B.: Semantische Dispositionen. Prozedurale Wissensstrukturen mit stereotypisch repräsentierten Wortbedeutungen. In: Rieger, B. (Ed.): Dynamik in der Bedeutungskonstitution, Hamburg (Buske) 1985, 163–228.

[3] Rieger, B.: Feasible Fuzzy Semantics. Eikmeyer/Rieser (Eds.): Words, Worlds, and Contexts. New Approaches to Word Semantics, Berlin/New York (de Gruyter) 1981, 193–209.

[4] Zadeh, L. A.: Quantitative fuzzy semantics. Information Science 3 (1971), 159–176.

[5] Rieger, B.: Clusters in Semantic Space. In: Delatte (Ed.): Actes du Congrés international Informatique et Sciences Humaines, Université de Lièges (LASLA), 1983, 805–814.

[6] Rieger, B.: Semantic Relevance and Aspect Dependency in a given Subject Domain. Context-driven algorithmic processing of fuzzy word-meanings. In: Walker, D. E. (Ed): COLING 84 Proceedings, Stanford (ACL) 1984, 298–301.

[7] Rieger, B.: Lexical Relevance and Semantic Disposition. In: Hoppenbrouwers/ Seuren/Weijters (Eds.): Meaning and the Lexicon. Dordrecht (Foris Publications) 1985, 387–400.