

FORMALIZATION OF ARGUMENTATION STRUCTURES
IN NEWSPAPER TEXTS

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The paper discusses the role of argumentation schemata and their interaction with other knowledge sources within a computer model for in-depth understanding of newspaper texts about jobmarket developments. Some of these schemata are presented; the "ALTHOUGH ..." argumentation (German: "TROTZ ...") and its formalization are discussed in detail.

1. Introduction

Reading newspapers may be seen as an "everyday cognitive task". Therefore it is not astonishing that some work in Artificial Intelligence aims at the simulation of aspects of the understanding processes of newspaper readers [Eisenstadt 1977; Rosenberg 1977]. There have even been pioneering systems: the Script Applier Mechanism [Cullingford 1978] demonstrated careful reading of "event"-oriented news stories about earthquakes, vehicle accidents, plane crashes and so on, whereas FRUMP [DeJong 1979] simulated skimming abilities using texts about the same themes.

We are working with texts about jobmarket developments taken from West German newspapers [Laubsch&Roesner 1980]. An important aspect of our texts is that they deal with argumentations about reported data and their respective changes. In this paper we describe our (not yet implemented) conceptual approach for processing such structures.

2. Understanding argumentation

In our view, argumentation schemata in general work on a kind of "theory" of the domain of discourse, i.e. on a structure that encodes knowledge about domain-specific dependencies. We use a dependency-network in order to represent the average reader's expertise and qualitative reasoning ability about the jobmarket. Our representation is influenced by ideas from [Sussmans&Steele 1980].

In some sense, one may interpret an argumentation schema as a function that takes propositions (<PROP>s) as arguments. In case of coherent or correct use, these propositions have to fulfill certain constraints that are defined with reference to the "theory" of the specific domain of discourse.

Thus, "**understanding**" argumentation in terms of these schemata can be seen as establishing the constraint relations between given propositions by an inference mechanism that operates on the dependency net of the domain. This always involves testing on discourse coherence (if it is assumed to have a correct "theory") and/or checking the "theory" (if it is assumed to have correct texts).

3. Explanation schemata

Explanation schemata deal with reasons - in our domain these are mostly reasons for the jobmarket fluctuations under discussion. Although we use German surface-oriented labels (which we transcribe into English), we are discussing all of the following examples as deep structures that may be underlying to diverse surface constructs.

"WEGEN <PROP-1> <PROP-2>": (BECAUSE-OF <PROP-1> <PROP-2>)

This is a general explanation schema. If used correctly, then <PROP-1> gives reason(s) for <PROP-2> : If <PROP-1> is a "simple" fact in our theory, then there must be an inference path in the dependency net along cause-effect links leading from <PROP-1> to <PROP-2>. If <PROP-1> is a conjunction of two (or more) "simple" facts, then inference paths starting from those points must interfere in such a way that they finally lead to <PROP-2>.

Among German surface triggers for the BECAUSE-OF-schema are: "WEGEN ...", "WELCHES ...", "DA ...", "DURCH ...", "AUFGRUND VON ...", "INFOLGE DES ...", but also more elaborate ones like "... DARAUFGURUECKFUEHREN DASS ..." or "... DAMIT BEGRUENDEN DASS ...".

"DARUEBER-HINAUS <PROP>": (MOREOVER <PROP>)

This schema may be used if we are discussing a complex situation where consequences of several factors interfere and where the already mentioned (or derived) propositions are not sufficient to explain a given result. <PROP> must satisfy the constraint that it gives additional supportive reason for an unexplained effect, i.e. <PROP> opens a new inference-path in the dependency net such that interference with previous incomplete paths is possible in a way which finally produces the explanation that is searched for.

"TROTZ <PROP-1> <PROP-2>": (ALTHOUGH <PROP-1> <PROP-2>)

This schema deals with expectations and their non-fulfillment. Other surface manifestations are constructs like "OBWOHL <PROP-1> <PROP-2>", "UNGEACHTET <PROP-1> <PROP-2>" or "ZWAR <PROP-1> DENNOCH <PROP-2>".

The relation between <PROP-1> and <PROP-2> in an ALTHOUGH-schema involves a third proposition <PROP-2'>, whose constraints are:

- a) <PROP-2'> is in a contradictive relation (e.g. negation) to <PROP-2>
- b) <PROP-2'> could be expected as a (default) consequence of <PROP-1> (or in other words: (BECAUSE-OF <PROP-1> <PROP-2'>) could be verified).

In coherent texts the contradiction between expected and actual development given with an ALTHOUGH-schema will demand further explanation. "Understanding" an ALTHOUGH-explanation thus involves answering the following questions:

- A1: What was the unfulfilled expectation <PROP-2'> contrary to <PROP-2>?
- A2: Why did the expectation(s) <PROP-2'> fail?
- A3: What caused the fact(s) of <PROP-2> to happen?

Until we cannot sufficiently resolve these explanation tasks, the ALTHOUGH-schema will keep active and guide the processing of further input.

4. A detailed example

In order to clarify our approach, let us trace the processing of the flow of argumentation in an actual newspaper article (taken from "Stuttgarter Nachrichten", March 7, 1979).

S1: TROTZ DES ANHALTENDEN WINTERWETTERS IST IN DER BUNDESREPUBLIK DIE ARBEITSLILOSENZAHLE IM FEBRUAR LEICHT ZURUECKGEGANGEN. (Engl.: In spite of continuing winter weather the number of unemployed in the FRG decreased slightly in february.)

Input to the inference machine is written in a surface-oriented frame notation (which could e.g. be produced by a semantic ATN-grammar). The representation of S1 is:

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(ALTHOUGH-1
  PROP-1: (WEATHER TYP: WINTER
           MOD: *(ANHALTEND)*)
  PROP-2: (CHANGE-1
           QUANTITY: (NR-UNEMPLOYED
                     AREA: BRD)
           TIME: *(IM FEBRUAR)*
           VALUE: (DECREASE
                  MOD: *(LEICHT)*))
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(Slot-fillers with "*" have been taken literally from the given sentence and are processed by "specialists", e.g. IM FEBRUAR is interpreted - according to a default text convention - as publication year's february.)

The first step in processing ALTHOUGH-1 is to construct PROP-2' as a negation of PROP-2.

In this case, the "subject" of PROP-2 is "CHANGE-1 NR-UNEMPLOYED (IN THE FRG IN FEBRUARY ..)", whereas the "predicate" is the filler of the VALUE-slot, i.e. SLIGHT-DECREASE. The procedure for generating a candidate PROP-2' preserves the "subject", but negates the "predicate".

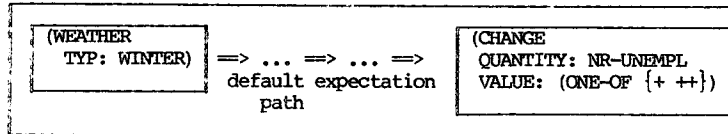
What is the negation of a SLIGHT-DECREASE? For purposes of qualitative reasoning, we take VALUES for CHANGES from a five point scale from "+" (LARGE-INCREASE) to "-" (LARGE-DECREASE), i.e. "-" corresponds to SLIGHT-DECREASE. Interpreting negation of SLIGHT-DECREASE as simply taking the complement of {-} with respect to the set of all VALUES = {+, 0, -, -} would yield {LARGE-DECREASE UNCHANGED SLIGHT-INCREASE LARGE-INCREASE}, but a constraint for surface constructs allows us to exclude LARGE-DECREASE in this case.

If a larger value had been expected (and not the opposite direction of change), then this would have been indicated by a modifier like "NUR" (Engl. "ONLY") as in: TROTZ DER SAISONWENDE IM OKTOBER STIEG DIE ARBEITSLILOSENQUOTE IN DEM MONAT NUR UM 0.1 AUF 3.3 PROZENT AN (from "Stuttgarter Nachrichten", Nov. 7, 1979). (Engl.: In spite of change of season in October the unemployment rate only increased by 0.1 to 3.3 percent during this month.)

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Thus: the structural analysis yields
PROP-2': (CHANGE-2
         QUANTITY: NR-UNEMPLOYED
         VALUE: (ONE-OF {0 + ++}))
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The next step in order to answer A1 is: Can PROP-2' be expected given PROP-1?

Indeed: we find a (generic) default rule in our dependency net, that relates WINTER WEATHER with a CHANGE of NR-UNEMPLOYED.



The next two sentences only give further details of the change and are not interesting for the present discussion.

S2 & S3: SIE VERRINGERT SICH UM 37.300 AUF 1.134.100. DAS ENTSPRICHT EINER ARBEITSLÖSENQUOTE VON RUND FÜNF PROZENT. (Engl.: It decreases by 37.300 to 1.134.100. This corresponds to an unemployment rate of about five percent.) Argumentation is continued in S4:

DER PRAESIDENT DER NUERNBERGER BUNDESANSTALT FUER ARBEIT, JOSEF STINGL, FUEHRTE DIESE ENTWICKLUNG AM DIENSTAG DARAUFG ZURUECK, DASS DIE ZAHL DER ARBEITSLÖSEN IN DEN AUSSENBERUFEN NICHT MEHR ANSTIEG. (Engl.: The president of the Federal Labor Agency, J.Stingl, attributed this development to the fact that the number of unemployed in outdoor jobs did no longer increase).

"FUEHRTE .. DARAUFG ZURUECK, DASS .." indicates a BECAUSE-OF-schema as part of someone's DECLARATION:

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(DECLARATION-1
  SPEAKER: STINGL
  STATEMENT: (BECAUSE-OF-1
    PROP-1: (CHANGE-3
      QUANTITY: (NR-UNEMPLOYED GROUP: OUTDOOR-JOBS)
      VALUE: NON-INCREASE)
    PROP-2: (DEVELOPMENT-1 *THIS*)))
  
```

The first step in processing BECAUSE-OF-1 is looking for the referent of PROP-2. (DEVELOPMENT-1 *THIS*) may match all preceding frames denoting any kind of development. Since a CHANGE is a kind of DEVELOPMENT, the definite phrase "DIESE ENTWICKLUNG" (this development) is interpreted as referring to the already mentioned changes: the actually happened SLIGHT-DECREASE (CHANGE-1) and the expected, but unfulfilled INCREASE of the (global) NR-UNEMPLOYED (CHANGE-2). This "reference by abstraction" is often found in newspaper texts [Rosenberg 1977].

Next step: Can we infer any of these changes from BECAUSE-OF-1's PROP-1? More specifically: How may NON-INCREASE of NR-UNEMPLOYED in OUTDOOR-JOBS explain CHANGE-1 or CHANGE-2?

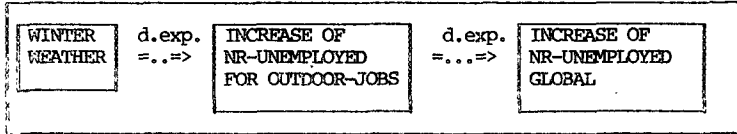
Since S4 gave no contrary information, CHANGE-3's TIME-slot is filled with FEBRUARY which is the context default established by the preceding sentences.

If taken in isolation, NON-INCREASE for OUTDOOR-JOBS gives no direct way to infer the overall SLIGHT-DECREASE stated with CHANGE-1. But: Since these two changes are given as facts and since outdoor-jobs are a subset of all jobs, we conclude, that there must have been an interfering DECREASE in (an)other part(s) of the jobmarket, and therefore create an expectation E1 for subsequent information of this kind, by the rule

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IF (global result is: DECREASE)
  & (local change is: INCREASE or NON-DECREASE)
  THEN (expect: local DECREASE in other parts).
  
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With regards to CHANGE-2, we take a "blow-up" (using a shorthand notation) of our default expectation path between winter weather and global increase:



Once the dependency net is built in various levels of detail, any "non-primitive" relation can be "blown up", i.e. be looked at in more detail.

Searching through possible paths relating WINTER WEATHER to expected INCREASE NR-UNEMPLOYED GLOBAL, the blow-up procedure selects the one with an intermediate node concerning CHANGE-3's QUANTITY, i.e. NR-UNEMPLOYED for OUTDOOR-JOBS.

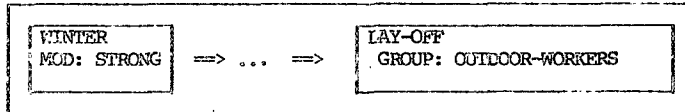
Now, in BECAUSE-OF-1 a NON-INCREASE for OUTDOOR-JOBS' NR-UNEMPLOYED is given as fact. This has two consequences:

- 1) The expectation path based on INCREASE of this number is made invalid. This answers question A2 still pending from ALTHOUGH-1: Why did PROP-2' fail?
- 2) Since an INCREASE of this number was expected by default, we create a new explanation task (that affects processing of subsequent input): What are the reasons for CHANGE-3 (NON-INCREASE of NR-UNEMPLOYED OUTDOOR-JOBS in FEBRUARY)?

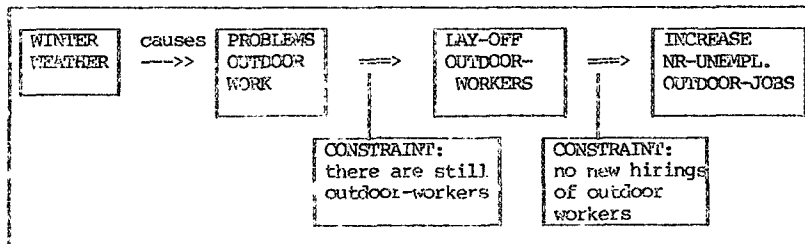
DE: "SIE WURDEN WEGEN DES UNGEWÖHNLICH STRENGEN WINTERS BEREITS IM JANUAR LAY-OFF GEMACHT." (Engl: "Due to the unusually strong winter they had been layed off already in January".)

BECAUSE-OF-2
 PROP-1: (WINTER MOD: *(UNGEWÖHNLICH STRENG)*)
 PROP-2: (LAY-OFF-1 GROUP: *THIS*
 TIME: *(IM JANUAR)*))

In order to accept BECAUSE-OF-2, we have to show, that its PROP-1 leads to the expectation of its PROP-2. Searching through our domain knowledge for relations between WINTER and LAY-OFF of a GROUP of persons gives:



In order to use this generic rule we should be able to resolve the missing reference from LAY-OFF-1's GROUP-slot (*THIS*) with OUTDOOR-WORKERS. This choice is indeed supported by the fact that OUTDOOR-JOBS are under discussion in CHANGE-3. Since CHANGE-3 (the NON-INCREASE of NR-UNEMPLOYED of OUTDOOR-JOBS) is not yet explained, we use an appropriate blow-up of dependencies again:



For JANUARY we have an instantiated BECAUSE-OF-relation between WINTER and a stated LAY-OFF of OUTDOOR-WORKERS. An inference rule for LAY-OFF is:

IF there are lay-offs (and no information about interfering new hirings),
THEN the number of workers in the respective region, branch etc. decreases.

As a consequence of the JANUARY LAY-OFFS we thus conclude, that the "THERE ARE STILL OUTDOOR-WORKERS"-CONSTRAINT may no longer hold in FEBRUARY. This invalidates the inference path above, thus sufficiently explaining CHANGE-3. This in turn allows us to finish processing of BECAUSE-OF-1. Recall: Question A3 from ALTHOUGH-1 and its subtask expectation E1 are still pending.

ES: DARUEBER HINAUS KOENNE MAN IM ZWEITEN MONAT DES QUARTALS UEBLICHERWEISE EINEN RUECKGANG DER ARBEITSLOSIGKEIT IN DEN ANGESTELLTENBERUFEN BEOBACHTEN. (Engl.: Moreover one usually observes a decrease in unemployment of white collar workers in the second month of the quarter.)

(MOREOVER-1

PROP: (CHANGE-4

QUANTITY: (NR-UNEMPLOYED

SUBGROUP: WHITE-COLLAR-JOBS)

TIME:*(IM ZWEITEN MONAT DES QUARTALS)*

VALUE: DECREASE

MOD: *UEBLICHERWEISE*)

If a proposition is modified with "UEBLICHERWEISE" (engl: by default) we process it as stating a fact. The abstract description for the TIME period matches FEBRUARY, which is also the filler of the TIME-slot of the still unexplained CHANGE-1.

The function of the PROP of a MOREOVER is to give additional information that helps answering open questions.

In fact, CHANGE-4's information answers ALTHOUGH-1's question A3. DECREASE of NR-UNEMPLOYED for WHITE-COLLAR-JOBS in FEBRUARY matches expectation E1 (DECREASE in NON-OUTDOOR-parts of the job-market). E1 on the other hand has been set up when processing BECAUSE-OF-1 in looking for reasons for ALTHOUGH-1's PROP-2: the (up to this point unexplained) SLIGHT-DECREASE of NR-UNEMPLOYED GLOBAL.

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