ANALOGY RECOGNITION AND COMPREHENSION IN EDITORIALS

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ABSTRACT

The widespread use of analogy in human communication underscores the need for a system which can recognize and understand analogies. This paper presents a theory of analogy recognition and comprehension, using as a domain letters to the editors of weekly news magazines. Our theory relies on lexical clues and the comparison of conceptual similarities to trigger recognition of the analogies in these letters. Our conceptual representation of an analogy in memory utilizes comparison links to map analogous elements to each other, and to tie together parallel arguments. Question-answer categories and heuristics specific to analyzing analogies in this domain are discussed. We demonstrate application of this theory to a prototypical letter. Initial work on a program implementing this theory is reviewed, and work in progress is discussed, along with ideas for future extensions.

1. Introduction

Our research addresses the role of analogy in editorial comprehension, in argumentation, and in question-answer processing, using the domain of editorial letters. The theory presented here is implemented in JULIP, a computer program which accepts as input a conceptual representation of a prototypical editorial letter. JULIP is part of the OpEd project [ALVA85]. The goal of OpEd is to develop a theory about the process of reasoning comprehension in the domain of editorials. The focus of JULIP is on the role of analogy in argumentation. The objective of this task is to recognize the presence of the analogy in the letter to the editor, map analogous elements together, and perform any

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transformations needed to complete the analogy. Understanding of the analogies presented to JULIP is demonstrated via a question-answer session with the user.

2. Analogical Reasoning in Natural Language Processing -- Some Background

Analogical reasoning is an important part of human intelligence. We often employ it as a vehicle for conveying ideas, and we rely upon it whenever we make a decision about a new situation [STER77]. Researchers in linguistics, education, psychology and other academic disciplines have studied this use of analogy and metaphor in depth [LAKO80] [ORTO79] [STER77]. Recent investigations by AI researchers into computational models of analogical reasoning include [CARB83], in which Carbonell outlines extensions to means-ends analysis which make use of past experience in solving new problems, integrating skill refinement and plan acquisition processes. One area of analogical reasoning for which few computational theories exist is the study of analogy from the point of view of its use in editorials, arguments, conversation, debates, narratives, or other aspects of natural language text. Our work falls into this category. Two examples of related work are Winston's work on learning by analogy [WINS82] and Lebowitz' IPP [LEBO80].

2.1. Winston: Learning By Analogy

In Winston's system [WINS82], a teacher uses precedents and exercises to teach the system rules about relations in a particular domain. First, the teacher gives the system a precedent-setting story. Next, the system is given an exercise consisting of a second story and a conclusion which the system is to demonstrate is true of this second story. The system forms an analogy between the second story and the specified precedent by pairing off situation parts using acts and other relations as evidence to support the analogy. Using a brute force pattern match, the system searches the space of all possible matches between parts of the two stories to determine how the stories should be mapped to each other. While Winston's system is able to perform some analogical reasoning on the narratives, it does not recognize the narratives as being analogous without the assistance of the teacher. Also, the ability to make analogical mappings relies upon the existence of a common ancestor in the AKO hierarchy of the situation parts to be mapped [WINS78] [WINS80] [WINS82].

2.2. Lebowitz: IPP

IPP [LEBO80] compared new wire service stories to similar events previously stored in memory. Lebowitz used frame-like structures [MINS75] to index events in memory according to their similarities and differences. IPP was successful in finding events similar to the new one and was able to form generalizations allowing it to learn about its domain. However, IPP did not form specific analogical mappings and did not deal with disputes, arguments, or beliefs.

2.3. The Objective of JULIP

In contrast to the work by Winston and Lebowitz, JULIP deals with the role of analogy in arguments. The objectives of JULIP include being able to have the system recognize the presence of an analogy in the input without it being identified as such by the user. The objectives also include representing the analogy itself, utilizing specific analogical mappings to show how the components of the analogy are related to one another, and being able to reason about the purpose of and basis for the analogy itself, as well as its role in an argument.

3. The Issues Facing JULIP

Consider the following hypothetical letter to an editor:

HIGH-TECH-1

> Some people are against computers because computers eliminate people's jobs. However, the automobile industry did the same thing to people in the horse carriage industry. Yet consumer demand for autos was strong enough that eventually more jobs were created in the auto industry than were lost in the horse carriage industry. In the end, the economy benefitted by the introduction of the new technology.

Informal protocols show that readers give the following answers when questioned on their understanding of this text:

Q1: To what is the computer industry being compared?

A1: THE COMPUTER INDUSTRY IS BEING COMPARED TO THE AUTOMOBILE INDUSTRY.

Q2: What did the auto industry do to people in the horse carriage industry?

A2: PEOPLE IN THE HORSE CARRIAGE INDUSTRY LOST JOBS.

Q3: Why is the computer industry being compared to the auto industry?

A3: BOTH INDUSTRIES INITIALLY ELIMINATED JOBS BUT ULTIMATELY CREATED MORE JOBS THAN THEY ELIMINATED.

Q4: What will happen as computers eliminate jobs?

A4: AN EVEN GREATER NUMBER OF NEW JOBS WILL BE CREATED.

3.1. What Are the Issues?

What are the issues that must be addressed in developing a system that can read and understand an analogy in this domain? The author of this letter is arguing that the introduction of computer technology will eventually improve the economy by increasing the number of positions available in the job market. This point is never explicitly made in the text. Instead, it is argued by analogy to a similar situation resulting from the introduction of the automobile. We can

identify three basic issues central to the theory encompassed by JULIP:

1) the ability to understand analogies:
   - to recognize them
   - to map together the source or familiar domain and the target or unfamiliar domain
   - to transform information available in one domain to fill gaps in the information available about the other domain
2) the ability to understand arguments
   - to identify propositions
   - to relate propositions in support or attack relationships
3) the ability to understand the role that analogy plays in the structure of arguments

Examples from HIGH-TECH-1 illustrate why each of these areas is important.

3.2. Understanding Analogies

How does the reader recognize the presence of the analogy in HIGH-TECH-1? The letter begins with a discussion of the computer industry. This is suddenly contrasted with a discussion of the automobile industry. Yet the reader is able to identify that at an abstract, conceptual level the topic underlying the discussion has not changed. By reference to "the same thing", the author has directed the reader to relate the two topics. To map the topics, the reader must first understand how a computer can eliminate a job. She can then transform that knowledge into the inference that the automobile industry caused people in the horse carriage industry to lose jobs. In making this inference, the reader has drawn upon a great deal of world knowledge, such as how computers are used in industry, that automobiles and horse carriages are transportation vehicles, and that as automobiles were introduced the demand for horse carriages fell off, causing people who made horse carriages to lose their jobs.

3.3. Following Arguments

As HIGH-TECH-1 begins, the author states that the use of computers causes people to lose jobs. How is this statement identified as a belief? The reader's familiarity with the structure of arguments enables her to view the statement as a claim that computers are bad because they eliminate jobs.

The reader's knowledge of the strategies used to support and attack beliefs enable her to anticipate that the author will disprove the initial claim about computers. Lexical clues in the text of the letter help her in this task. For example, "however" and "yet" in HIGH-TECH-1 signal the reader to expect the following thought to contrast with the previous one [ALVA85a].

This knowledge of argument strategies again comes into play in the final sentence of HIGH-TECH-1, when the reader draws upon her knowledge of the relationship between the job market and the economy and their impact on

individuals to understand how and why the economy improved after the manufacture of automobiles began. She uses this information to develop the alternate argument that automobile manufacturing was actually good, because it led to the creation of more new jobs.

3.4. The Role of Analogy in Arguments

In arguing a point, an author can set aside the domain of the original point and argue in another domain that is similar to the first. The analogy supports the transfer of information across the domains.

Once the reader of HIGH-TECH-1 has followed the argument in the domain of the automobile industry, she must transfer that argument back to the domain of the computer industry. How does she do this? By analogy, she infers that the introduction of computer-aided manufacturing must also be good, since by the same line of reasoning applied in the case of automobile manufacturing, computer-aided manufacturing will also lead to the creation of more new jobs.

3.5. How Will JULIP Handle These Issues?

How can all these elements -- analogical reasoning, editorial comprehension, and argumentation -- be combined with natural language understanding? Our approach is to base the natural language comprehension component on BORIS [DYER83], an integrated natural language understanding system for narratives. Flowers' work on representation of beliefs and the structure of arguments is a key part of our representation of an editorial letter [FLOW82]. Argument units [ALVA85] [ALVA85a] are used to support belief recognition and inferencing about beliefs. Memory organization and causal reasoning components are based upon Schank's work [SCHA82] [SCHA77]. Our implementation of JULIP'S question-answer processing draws upon Lehnert's work in this area [LEHN78].

4. Recognizing Analogies in Editorials

How is the presence of an analogy in an editorial recognized? Unless the existence of the analogy is recognized, the information associated with it is not available, and the reader will have difficulty following the author's argument.

Analogy recognition mechanisms can be activated in either of two ways. First,

> Analogy recognition mechanisms can be expectation driven.

In this case, the reader anticipates that the author will use an analogy, and actively seeks it out in the text. Second,

> Analogy recognition mechanisms can be data driven.

In this case, the analogy is indicated by the text of the letter, or by the similarity of concepts directly presented in the letter. Both components are necessary for accurate identification of analogies. If recognition were activated only top down, the reader would miss analogies not specifically identified as such in the text. On the other hand, if recognition were only bottom up, the reader would spend a lot of time processing analogies that were never intended.

4.1. Expectation-Driven Analogy Recognition

Understanding an editorial requires that the reader identify the dispute being presented, and the technique being used to support or refute the author's arguments. Analogy is one of these techniques. Consider the following letter:

HIGH-TECH-5

> Would those who complain about computer-related job loss care to do without their cars? Buggy whip makers undoubtedly voiced similar concerns in their heyday. And I wonder how many of those complainers are employed in the auto industry.

A subject shown just the first sentence of this letter keyed in on the complainers, and drew an analogy between the introduction of the automobile industry and the introduction of computer technology. Yet nothing in the text of the first sentence directly relates the two. The subject's familiarity with the arguments in favor of the introduction of new technology enabled him to immediately focus in the comparison of the two events in the author's rhetorical question and caused him to anticipate that the author would argue the point by analogy.

4.2. Data-Driven Analogy Recognition

There are two main data driven indicators of the presence of an analogy:

1. Textual clues.
2. Conceptual similarities.

JULIP relies upon both of these indicators to identify the presence of an analogy.

4.2.1. Textual Clues

Consider the following letter:

GENOCIDE-1

> Hilter tried to annihilate the Jews. The Turks did the same thing to the Armenians. So why does so much more effort go into avenging one crime than the other?

In GENOCIDE, the reader is explicitly called upon to map Hitler's campaign to annihilate the Jews to the Turks' campaign to annihilate the Armenians by the author's use of the phrase "the same as". This use of a textual clue provides the most direct technique for introducing an analogy into an editorial letter. Other phrases often used to directly link the source to the target are "the same thing", "similar to", and "so it is with".

4.2.2. Conceptual Similarities

People can readily detect the presence of an analogy even in the absence of textual clues, as seen in the following example:

DESTRUCTION-1

> The Soviets are bombing people in Afganistan. The U.S. killed people in Vietnam. What does labelling the Soviet's actions as despicable say about our own action?

A reader identifies both events as instances of destruction. This indicates that the concepts represented in the text are categorized in memory by type. To provide this capability in a computer program, conceptual representations must be categorized as they are built, and linked together in the order in which they are encountered. The contents of these groups must be checked as new elements are added to them. When similar conceptual representations are encountered, similarity measures and other heuristics must be employed to determine whether an analogy is intended.

4.3. Constraining Comparisons: Where Does Mapping Begin and End?

Once a reader realizes that the author might be using analogy to argue a point, she must decide what elements of each domain form the basis for a mapping between the two domains, and what that mapping tells her about the author's point. Mapping of the analogy is driven by the similarities and differences between the domains of the analogy. Aspects of the domains which are similar and related to the point of the analogy support the analogy and are mapped together. Aspects of the domains which stand in contrast to each other and are unrelated to the point of the analogy do not support the analogy and are not mapped together. In DESTRUCTION-1, the Soviets and the U.S. are each agents of destruction, causing them to be mapped together for purposes of the analogy. They are similar because each is a world power involved in the destruction of a less powerful foreign country. Their ideological differences do not stand in the way of this mapping, although knowledge of these differences is essential in understanding the point being argued. Afganistan is mapped to Viet Nam here because each has suffered destruction at the hands of a foreign superpower. Cultural, climatic, and topographical similarities and differences do *not* come into play because they are not related to the point of the analogy.

5. Representing the Analogy in an Editorial Letter

5.1. Analogy in Argumentation -- Some Background

The ability to argue by analogy presumes an ability to argue in general. What framework enables people to argue? Familiarity with basic argument strategies gives people a basis around which to build arguments in support of the points they wish to convey. Alvarado et al. refer to the structure underlying arguments as argument units, and describe techniques for recognizing these units and reasoning about them [ALVA85] [ALVA85a]. The argument unit underlying HIGH-TECH-1 is captured in the argument unit AU-ACTUAL-EFFECT [ALVA85], shown in figure 5-1.

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If X expresses that:
      . PLAN P by Y thwarts GOAL G-1,
        but achieves higher level GOAL G-2.

We understand that:
     . X believes that P thwarts G-1 and achieves G-2.
       (X's specific belief)

And we infer that:
      . Y believes that P achieves G-2.
      . X believes that P is good.   (X's general belief)
      . X's specific belief supports Y's belief.
      . X's specific belief supports X's general belief.
```

Figure 5-1. AU-ACTUAL-EFFECT.

X represents the author of the editorial, and Y represents the person implementing the plan P which is at issue.

An argument unit organizes the support and attack relations in an argument, and conveys implicit information about beliefs in an arguments. Information attributing beliefs to their beholders is included in this structure. Argument units are indexed by the conceptualizations of what the author expresses, and are applied when conceptualizations from the editorial match the indices of an argument unit.

When an author argues by analogy, each of the arguments employed shares the same underlying structure, and the indication that propositions are to be viewed as analogous can be either implicit or explicit.

5.2. JULIP's Treatment of HIGH-TECH-1

HIGH-TECH-1 serves as a typical editorial letter containing an analogy in service of an argument. Here we present the analysis that JULIP is being designed to perform in building the representation of HIGH-TECH-1 in memory.

5.3. Sentence 1

> Some people are against computers because computers eliminate people's jobs.

Here the author brings up the issue (ARG-1 in figure 5-2) of introduction of computers into manufacturing, where robots are being used on the assembly lines. She makes the point that this automation is causing people who would normally work on the assembly lines to lose their jobs. This is understood as a belief that computer-aided manufacturing (CAM) is bad. This belief is justified by the fact that computers cause people to suffer job loss, and that losing a job is something bad.

The author's argument strategy begins to unfold in the second sentence, when the conjunction "however" provides a lexical clue that a dispute regarding the argument is about to be introduced.

5.4. Sentence 2

> However, the automobile industry did the same thing to people in the horse carriage industry.

In sentence 2, JULIP is introduced to a new topic, the automobile industry and its relationship to the horse carriage industry. Encountering the phrase "did the same thing" causes JULIP to search memory for the most recent causal structure (CAM leads to job loss) that can be transformed into a similar and plausible relationship between the auto industry and the horse carriage industry. JULIP maps the auto industry to CAM and infers that the auto industry caused people in the horse carriage industry to lose jobs. Comparison links between the first causal structure and the second, and between the antecedents of both and the consequents of both are added to these structures to reflect the mapping. By analogy to ARG-1, JULIP forms a second argument, ARG-2, reflecting the belief that manufacturing of automobiles was bad. ARG-1 and ARG-2 and their mappings to each other are depicted in the diagram of figure 5-2.

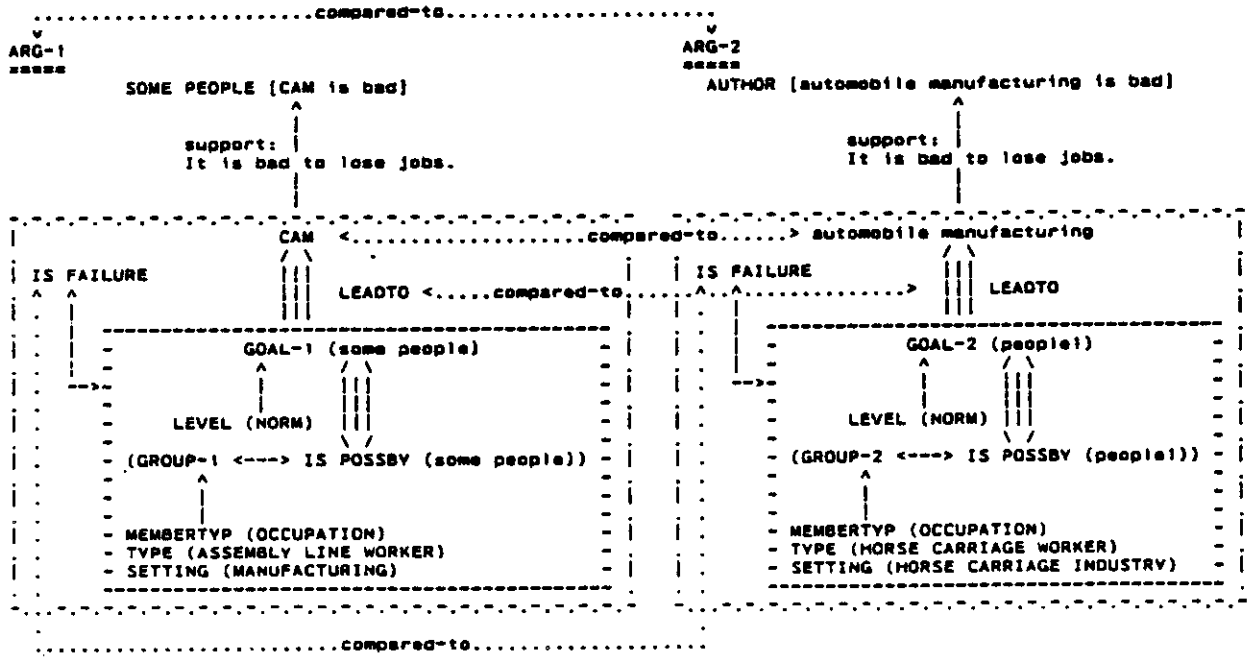

Figure 5-2. Mapping of ARG-1 and ARG-2, HIGH-TECH-1.

Recall that "however" at the beginning of sentence two suggested that a dispute regarding ARG-1 would be introduced. Since a contrast to the belief in ARG-1 has not been encountered, JULIP continues to expect it.

5.5. Sentence 3

> Yet consumer demand for autos was strong enough that eventually more jobs were created in the auto industry than were lost in the horse carriage industry.

"Yet" causes the expectation that the concepts presented in sentence 3 will contradict ARG-2. Flowers et al. note that an argument can be contradicted by an attack on the belief espoused, by attack on the justification given for that belief, or by attack on the claim that the justification supports the belief [FLOW82]. JULIP's knowledge of the consumer demand/manufacturer supply cycle and its relationship to an increased job market guides it to the realization that manufacturing automobiles actually led to the creation of additional new jobs.

At this point, JULIP recognizes and instantiates AU-ACTUAL-AFFECT for ARG-2. The contradiction of the justification given for ARG-2 represents an attack on ARG-2. The comparison links indicate that ARG-2 is parallel to ARG-1. This causes JULIP to consider ARG-1 as attacked, also. This fulfills the expectation for a contradiction to ARG-1 initiated by "however" in sentence one.

5.6. Sentence 4

> In the end, the economy benefitted by the introduction of the new technology.

After reading sentence 4, JULIP builds ARG-2' as an alternate to ARG-2, reflecting the belief that manufacturing of automobiles is good, and justified by the fact that the economy ended up actually improving as a result of the introduction of automobiles to the marketplace. By analogy, a representation for an alternate argument to ARG-1 is now built, reflecting the belief that computer-aided manufacturing is actually good, since it too will lead to new jobs and a new economy (ARG-1'). Thus the conceptual representation for this analogy has been completed in memory. A completed argument graph for HIGH-TECH-1 is shown in figure 5-3.

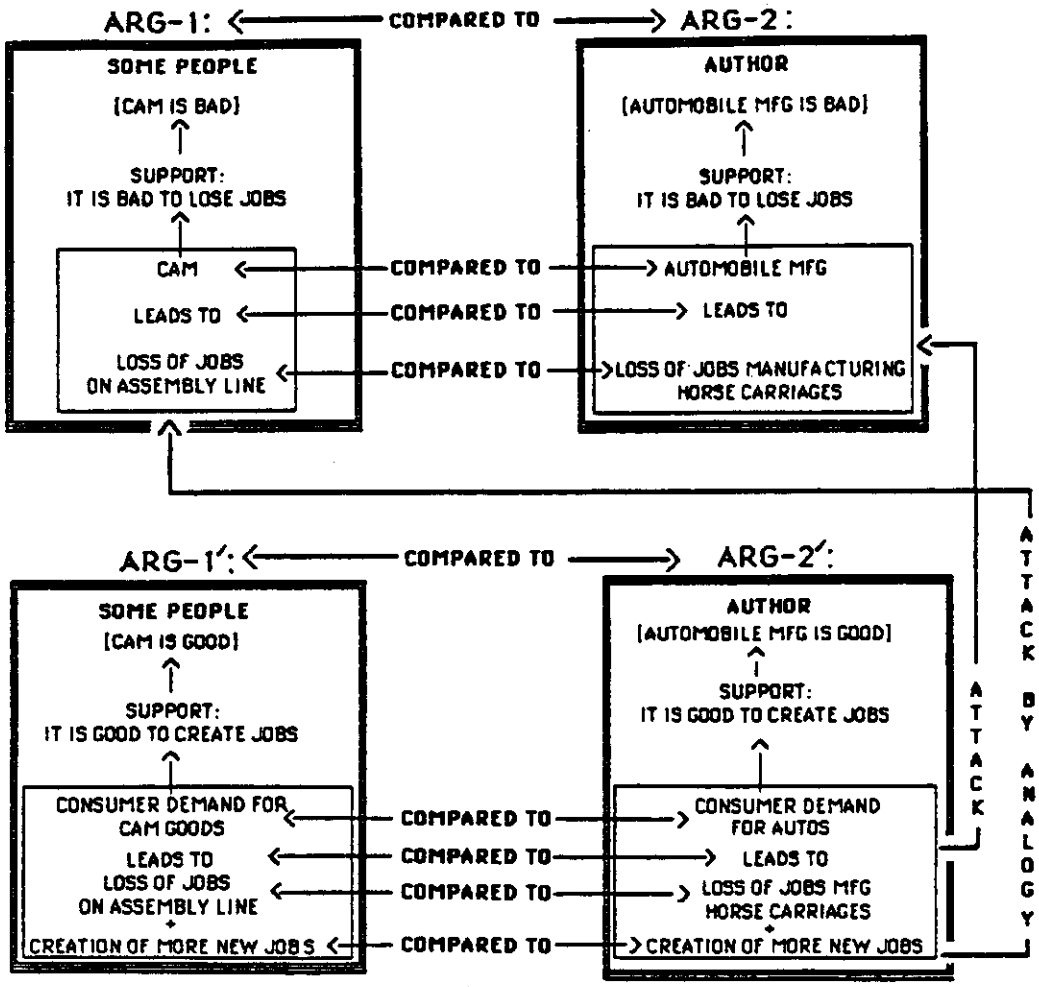

Figure 5-3. Completed Argument Graph for HIGH-TECH-1.

6. Analogy and Question Answer Processing

Demonstrating that an analogy has been completed and understood requires answering three categories of question:

1) Mapping: Were the key features of the source and target domains linked together?

2) Transforms: Were important features missing from one domain supplied by transforming information available from the other domain?

3) Basis: What was the purpose of the analogy? Why was the comparison made?

This section discusses the heuristics needed to categorize and perform a memory search for questions in each of these categories. These heuristics are based upon and extensions to the theory developed in Lehnert's QUALM, a computational model of question answering running in conjunction with comprehensive story-understanding systems [LEHN78]. The heuristics implemented in JULIP depart from Lehnert's for two reasons. First, the concepts in an editorial revolve around arguments, rather than around script instantiations. JULIP's

memory search heuristics take this into account. Secondly, JULIP's representation scheme utilizes memory links that are not considered by Lehnert in QUALM.

6.1. Mapping Questions

Mapping questions demonstrate whether those similarities in the source and target domains which are related to the point of the analogy have been linked to one another. In JULIP, mapping is noted in a new kind of link, the comparison or COMPARED-TO link, not considered by Lehnert. The memory search heuristics for mapping questions require retrieving the value found in the COMPARED-TO slot of the named concept.

Recall Q1/A1 for HIGH-TECH-1:

Q1: To what is the computer industry being compared?

A1: THE COMPUTER INDUSTRY IS BEING COMPARED TO THE AUTOMOBILE INDUSTRY.

To answer Q1, JULIP looks in the COMPARED-TO slot of MANUFACTURE0, representing the computer industry, and retrieves MANUFACTURE1, representing the automobile industry. Figure 6-1 indicates how these concepts are represented in memory.

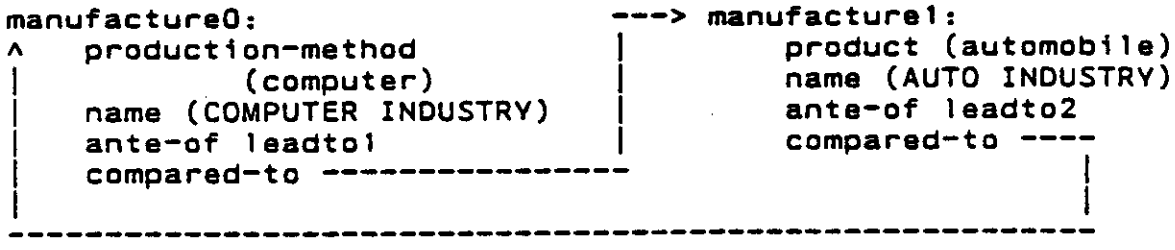

Figure 6-1. Analogical mapping via COMPARED-TO links.

6.2. Transform Questions

6.2.1. Filling in the Blanks

Understanding an analogy often requires inferring information not explicitly mentioned in the text regarding one domain by transforming information available from the other domain. Transform questions demonstrate that this inferencing has taken place. Q2/A2 displays JULIP's completion of a transform in HIGH-TECH-1:

Q2: What did the auto industry do to people in the horse carriage industry?

A2: PEOPLE IN THE HORSE CARRIAGE INDUSTRY LOST JOBS.

The relationship between the auto and horse carriage industries is never explicitly mentioned in the text of HIGH-TECH-1. It is inferred from the previously understood relationship between the computer industry and job loss of

people on assembly lines.

Question Q2 falls into Lehnert's Causal Consequent question category [LEHN78]. Memory search heuristics for causal consequent questions cause the system to check whether the concept in question is the antecedent of a causal structure, and if so to retrieve the consequent of that causal structure as the answer to the question. This is simple in JULIP, because whenever the ANTE slot of a LEADTO is filled in with some concept X, JULIP notes in the structure for X that it is the antecedent of that particular causal structure.

6.2.2. Completing the Analogy

In arguing by analogy, an author states a belief in one domain, then proceeds to argue the point in a second domain. She might or might not repeat the argument in the original domain. When the author does not return to the original domain, the reader has the job of completing the analogy by creating a parallel argument in the original domain. To demonstrate successful comprehension of the author's actual point, a reader should be able to answer questions regarding the completion of the analogy.

Q4 in HIGH-TECH-1 is such a question:

Q4: What will happen as computers eliminate jobs?

and A4 reflects the reader's successful comprehension of the analogy:

A4: AN EVEN GREATER NUMBER OF NEW JOBS WILL BE CREATED.

The reader has followed the argument in support of automobile manufacturing, and has constructed an analogous argument regarding the use of computers in industry.

Q4 is a request for an event that occurred at the same time that computers eliminated jobs, a question category not considered in Lehnert's work. JULIP's memory search heuristics for a co-temporal event cause it to search from the most recent memory backwards.

6.3. Basis Questions

Questions about the basis of the analogy in an editorial do not fit neatly into Lehnert's question categories. Q3, asking for the basis of the HIGH-TECH-1 analogy, is such a question:

Q3: Why is the computer industry being compared to the auto industry?

These questions are related to the Goal Orientation question category of QUALM, in that they ask "For what purpose ...". Basis questions differ from Goal Orientation questions, however, because they address the analogy itself, which has to do with the author's goal of communicating with the reader, rather than having something to do with the events, plans, and goals associated with the components of the analogy themselves.

In HIGH-TECH-1, the computer industry and the auto industry are tied to beliefs in arguments. So a question about why they are being compared is

actually a request for the justification of the beliefs in the arguments concerning these industries. The basic heuristic for retrieving the answer is to generalize the justification or support for the two beliefs. Note that this is not sufficient, since it could result in the following answer A3':

A3': BOTH INDUSTRIES ELIMINATED JOBS.

While this answer is true, it does not reflect the reason for making the analogy.

Recall that each industry has been associated with two beliefs: the computer industry with those in ARG-1 and ARG-1' and the automobile industry with those in ARG-2 and ARG-2'. Recall also that ARG-1 and ARG-2 were attacked, and updated with ARG-1' and ARG-2', as reflected in figure 5-3. To retrieve the correct answer, an additional heuristic comes into play:

> Retrieve the justification from arguments that still hold or were not attacked.

This heuristic leads to the correct answer to A3:

> A3: BOTH INDUSTRIES INITIALLY ELIMINATED JOBS BUT ULTIMATELY CREATED MORE JOBS THAN THEY ELIMINATED.

7. Future Work

7.1. Current Status

JULIP currently works on a hand-coded representation of HIGH-TECH-1, developed by following the parsing strategies described in this paper. Our current objective is to demonstrate understanding of editorial analogies given to the program in English through a natural language question-answer session with the user. The most immediate plan for JULIP is to develop the parsing and generation components of JULIP that will enable it to handle verbatim input. Our approach will be to translate the theory presented here into the demons and lexical entries needed to support analogy recognition and comprehension in DYPAR, the parsing component of BORIS [DYER83]. The theory will continue to develop as additional editorial letters containing analogies and human protocols for understanding them are analyzed.

7.2. Problems for the Future

Many issues still need to be addressed in JULIP. This section identifies some of the questions left unanswered and suggests areas for future research.

7.2.1. QA Processing on the Role of Analogy in Arguments

The question categories currently supported in JULIP relate mainly to the completion of the analogy presented to the system. Additional question-answering heuristics need to be developed to deal with the role of an analogy in an argument. This would enable JULIP to answer, for example, the following questions relating to HIGH-TECH-1:

Why was the auto industry mentioned in the argument?

Why doesn't the letter's author agree with the argument that CAM is bad?

7.2.2. Learning from Analogies in Editorial Letters

Work on JULIP has concentrated on representation of the analogy in the letter, leaving unanswered the following questions which deal with the issue of learning by analogies from the editorial domain:

What conclusion is drawn from the analogy and learned, or retained in LTM?

Why is this learned?

How does JULIP's prior knowledge state affect the conclusion?

How does question-answer processing affect the conclusion?

How does the conclusion affect future comprehension?

7.2.3. Generating Analogies

Future work will explore the possibility of reversing the process of analogy comprehension in order to fulfill a long range goal of this research: to build a system which can generate arguments by analogy on its own.

8. Conclusions

JULIP draws upon knowledge of editorial comprehension, argumentation, and integrated natural language understanding systems to develop a theory of analogy comprehension in the domain of letters to the editor. We have shown how both lexical clues and comparison of conceptual similarities trigger recognition of analogies in editorials letters. Our conceptual representation of an analogy in memory utilizes comparison links to map analogous elements to each other and to tie together parallel arguments. These links must be created and traversed during understanding as the representation of the completed analogy is built in memory. Question-answer processing utilizes these links to demonstrate the system's understanding of the completed analogy.

JULIP provides a foundation for adding the ability to support analogy recognition and comprehension in the integrated natural language parser OpEd [ALVA85].

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