C O N N O T A T I O N A S A F O R M O F I N F E R E N C E

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Abstract

Story-processing systems have to deal, or avoid dealing, with INFERENCE CONTROL[6, 11, 13]; when designing one such system[2], we were greatly helped by the "(ERC)RC" expression for connotation[1]. Our system is specialised in multi - faceted descriptions of characters (not, however, in the most difficult problems of beliefs about beliefs[4 and 8]): here we present another aspect of the story character processing, namely the recursive EXPLANATION of inconsistencies appearing in the description of a character.

We give a very schematic system overview, then some details about the CONNOTATION rules and an example of their application to a story.

Introduction

The allusiveness of human languages, in addition to being quite convenient in social life, justifies the use of variable amounts of i n t e l l i g e n c e in processing a sentence, according to the number of reasoning steps leading to a position where a satisfactory reaction becomes possible, like "to redefine 'substance'[14] when reading Spinoza". Let us represent a first step by "ERC" i.e. "an expression is related to a content"[1], which Barthes calls the denotation: the second reasoning step will be represented in the connotation formula: " (ERC) RC". It does not determine exactly where the reasoning step leads to: if we write E's content as C(E), we may have quite general connotations like ("cheese"RC("cheese"))RC("english") as opposed to ("fromage" RC("cheese")) RC("french"), but also situation-specific ones, as ("cheese" RC("cheese as geological stuff") RC("bizarre"), in the processing of a robot who asked what the moon is made of. As Barthes then remarks, connotations may be based on a set of initial expressions rather than on a single one, which is expressed by $(E_1RC_1, E_2RC_2, \ldots, E_nRC_n)$ R C . This seems to be an essential feature of connotations, since it allows emphasis on 'connoted' contents by means of an accumulation of signifiers. Another feature, elegantly illustrated in 'l'envers des signes'[10] by the two steps (("voile" RC("navire"))RC("poësie"))RC("rhétorique"), is their recursivity.

As a beginning we made an attempt to express this in AI terms by writing a program, BAQUIL, which finds the connotations with structure$(E_1 RC_1, E_2RC_2)$RC in a recursive way. The interest of such connotations can be shown by[15]:

.a doctor asks:"how is he feeling ?"

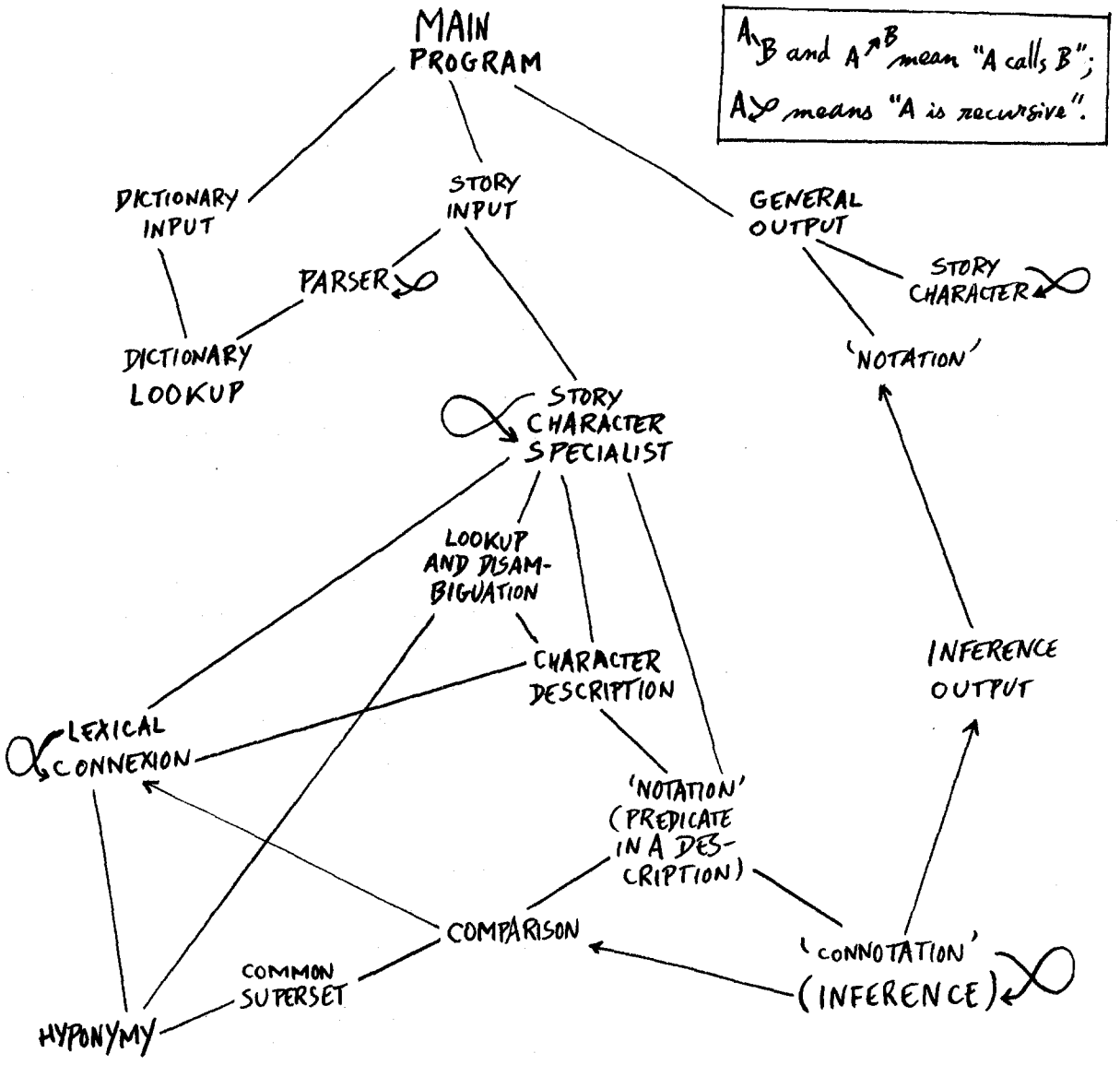
.the nurse answers:"he is groaning."

where the nurse means, by connotation,that the patient is suffering: ("groaning" RC("groaning") RC("suffering)), but our understanding is directed by the previous interrogation, so that the definitive result we expect from our system will be ("feeling"RC("feeling"), "groaning"RC("groaning"))RC("suffering"). This result shall be reached by consulting a semantic network and observing that 'groaning' is not exactly a case of 'feeling', but an expression of it. Thus " the nurse means he is suffering" is both a connotation and an inference, and seemingly a useful one: compare with Charniak's[6] "demon-demon in-

teraction, 'want to buy candies' and 'shake piggy-bank' together trigger 'need money'; but BAQUIL has no such extended world-knowledge. It is specialised in DISCOURSE ATTITUDES like 'errors', 'lies', 'jokes' etc. This also means it can run without an elaborate model[5] of personalities, and so deal with fables and folktales about foxes and sparrows, which would perhaps fail to have goals 'common to most people', although they are meant as human in a way.

System overview

Before explaining how it works, we give an idea of BAQUIL's construction (i.e. its hierarchy).



Schematic explanation of how the system runs

1) the dictionary input procedure builds, from a file whose structure is shown in the ' sample session ', a classical semantic network[7,9]...

2) the story specialist submits sentences to a parser[12] and the resulting case structures to the story character specialist, whose actions include the c o m p a r i s o n s and i n f e r e n c e s detailed here.

3) output procedures express the inferences in English and, on request, detail the representation of each character in the story.

Metarules of BAQUIL

(this page and the following three will develop what rules are applied by the story character specialist: this includes METARULES, RULES OF COMPARISON and INFERENCE RULES.)

M1 BAQUIL starts a connotation or inference only when a comparison rule has been applied to a pair of predicates which are related to the set of descriptors of one character: the predicates are versions of the semantic case structure in terms of the current character description, and are called 'NOTATIONS'.

M2 Except when specified otherwise (inference rules R6, R7), the inference is expressed by a 'notation' whose verb is a subcategory of either CHANGE or INCONSISTENCY.

M3 Those subcategories are examined in the dictionary order and the first one which permits the application of an inference rule is selected.

To sum up: (M1) comparison and then inference about (M3) subcategories of (M2) change or inconsistency. The metarules are represented in BAQUIL by instructions: M1 in the NOTATION procedure, M2 and M3 in the CONNOTATION procedure.

The latter also contain the instruction corresponding to the inference rules, while the comparison rules form the comparison procedure.

Discussion of the metarules

M1 expresses the hypothesis that many interesting antinomies can be detected during the pairwise matching of predicates concerning one story character.

M2 aims to expres a more or less syntactic finding about the description of a character (co-presence of two antinomic 'notations') in terms of the 'notations' themselves.

M3 means "use the lexical taxonomy when trying to recognize a situation"; as a result it introduce a distinction between natural languages, for the subcategories of (for instance) "inconsistency" are not the same in different dictionaries. Consider French and English, "error" and "mistake" vs. "erreur" and "méprise", or worse: the two cases of "to tell a lie" in Russian, i.e. "vrat'" vs. "l'gat'". Still it is perhaps acceptable to allow for important pragmatic divergences between languages (and, indeed, dialects or sociolects.) Moreover, we did not represent the vocabulary of other languages than French and English in our system, so we lack precisions about how "whorfian" it would turn out.

Although a similar discussion of the comparison and inference rules would be necessary, we will simply present them here along with some examples. The examples are taken from a set of 20 stories (4 to 200 sentences) which were dealt with by the system at Essex in 1979-1980.

Comparison rules	Examples.
Their object is to tell whether an inference must be started, or not.	
C1 the predicates differ only by a negation in one of them (i.e. same environment, verb etc. and none was inferred.)	C1 Confucius is handsome, Confucius is not handsome (in which case 'handsome' need not be a priori present in the lexicon.).
C2 similar to C1 but there is a hyponymy between the verbs.	C2 Confucius is horrible, Confucius is not ugly.
C3 lexical exclusion between the verbs of two affirmative predicates.	C3 Confucius is rich, Confucius is broke.
C4 transgression of lexical interdiction, or lexical necessity ignored.	C4 Confucius is human and flies away. (interdiction) Confucius flies away, he does not exist. (necessity)
C5 C1, C2 or C3 applies and the first predicate expresses an inference.	C5 the system inferred Confucius is lying, the story reveals he is joking (like C3).
C6 a predicate confirms an inference.	C6 in the situation above, Lao-tsu says that Confucius is lying BEFORE the story disconfirms it.
C7 a predicate confirm a discarded inference. (this occurs after a C5 situation led to the application of the relevant inference rule.)	C7 Lao-tsu's remark comes AFTER the revision of the inference.
The predicate or 'notation' structure, which permits the comparison, is (affirmat.-or-neg., case frame, char. descr.) and the connotation has the same structure augmented by reference to premises (2, 3 or a list of pairs if an inference has been confirmed.)	The lexicon element has following slots in its structure: (list of subcategories, are-they-mutually-exclusive-or-not, supercategory, property list) and the property list contain references to other lexical elements.

Connotation rules: examples

As the rules by themselves do not suggest the situations which make them useful, let's have some examples first.

R1 ...the servant said: "that cow is not going to eat you." (...) The next morning, she sees one of them is missing and says: "Oh my God ! the grey cow ate one of these men".
.INFERENCE ABOUT THE SERVANT'S VIEW OF THE COW.

R2 (same example as R1)
.ACCORDING TO THE SERVANT, THE COW UNDERWENT A CHANGE.

R3 A teacher quoting Krylov said that God sent a cheese to a raven; a child objects that there is no God.
.INFERENCE ABOUT AN INCONSISTENCY; USING THE LEXICAL CONNEXION BETWEEN THE TOPIC 'God' AND 'religious discourse', BAQUIL SELECTS THAT KIND OF INCONSISTENCY.

R4 the peasant believes that the tree will be hit by other rabbits. But it is not.
.INFERENCE: ERROR OF THE PEASANT.

R5 (continuation of example for R3)
the teacher answers that there is no cheese either.
.INFERENCE ABOUT AN INCONSISTENCY; USING THE LEXICAL CONNECTION BETWEEN 'Krylov' AND 'author', AND ONE FROM 'author' TO 'fiction', BAQUIL SELECTS THE LATTER SUBCATEGORY OF INCONSISTENCY.

While the other rules exploit comparisons between levels of discourse independently of which character the inference is about, R3 and R5 make use of some knowledge associated either, as in the examples, with the name of the character, or with previous sentences about it, e.g. 'Krylov is an author' could be part of the beginning of the story.

R3 and R5, which connect the inference with a previously observed detail, are "causality" rules: in addition to references to the two premises whose comparison started it, the inference has one reference to the predicate that justified the choice of a more precise verb like 'fiction' or 'joke'.

A difficulty (which we provisionnally avoided) is that some lexical connections could represent 'necessary truths' that are just sometimes true, as "teachers are sometimes igorant"; what R5 should do with them is not clear. However, if one considers folktales and fables, the dictionnary connection one uses are almost always

"foxes are sly, full stop"

so the question does not arise.

A difficulty for R3 is that a 'topic' could be connected both to 'religious discourse' and 'joke', so in the present state of the system one of the connections would be systematically ignored: but for the time being, there are very few lexical connections, the reason being that we cannot decide which necessary truths really belong in a lexicon.

BAQUIL's connotation rules

'references' are the two initial premises of the inference; 'hypotheses come from the list of subcategories of the initial verb, i.e. the different cases of 'change' or 'inconsistency' as represented in the lexicon.

R1 if both references are about the same character descriptor, the inference is also about that descriptor. (this allows for stories inside the story).

R2 if the inference's verb is not yet specified and the inference is about the descriptor of the second reference, BAQUIL tries the cases of 'change'.

R3 if the verb of a hypothesis is connected to the name of the character in a reference by a 'be about' link, the hypothesis is selected.

R4 if one reference comes from a 'belief' and the other from the 'story-telling', the verb of the inference should be 'error'.

R5 if the verb of a hypothesis is connected to its character's name by a 'tendency' link, the hypothesis is selected.

R6 if a character's discourse matches an inference, BAQUIL checks whether the character is clever or has made a lucky guess etc.

R7 and R8 if the story-telling contradicts an inference, the inference is 'discarded'; if the discarded inference is matched by a discourse, one looks for an 'error' or 'trick' etc.

Rules R6 and R7 are illustrated by the story of the vegetarian wolf: given a dictionary which connects 'wolf' to 'bad action', hence to 'lie', the system first infers from the beginning of the story, where the wolf is contradicted by someone, that it lies; later, the story-telling warns the reader about it, telling explicitly that it does not. The inference is NOT erased, but earmarked as fallacious; so R7 applies when a character says: this wolf is lying; but, if the story had not denied the possibility of a lie, R6 would have applied. One can see that R6, R7 and R8 are not quite satisfying. I suspect them of being in need of some refinement. The set of situations 'clever character or lucky guess or etc.' is not clearly defined, and I do not know what to do with the Liar's Paradox.

On the contrary, R3 and R5 give less trouble. This is shown by the 'sample session' next page, representing approximately 1.8 second CPU (using about 25K core) on a PDP-10.

RULES APPLIED: C4 "lexical necessity"

R3 "topic"

R5 "tendency"

C3 "lexical exclusion"

Sample session

(DICTIONARY INPUT)

WORDS
FOOD ISA SUBSTANCE
SHORT ISA STATE
TEACHER ISA MAN
QUOTE ISA DISCOURSE
AUTHOR ISA MAN
KRYLOV ISA AUTHOR
WRITE ISA DISCOURSE
SAY ISA DISCOURSE
GOD ISA PUTATIVE BEING
CHEESE ISA FOOD
RAVEN ISA BIRD
CHILD ISA MAN
PRODUCE INCONSISTENCY ISA DISCOURSE
(comment: abbreviated PRODINC)
LIE ISA PRODINC
MISTAKE ISA PRODINC
JOKE ISA PRODINC
ILLUSION ISA PRODINC
RELIGIOUS DISCOURSE ISA PRODINC
FICTION ISA PRODINC
BE ABOUT ISA DISCOURSE
MEAN ISA DISCOURSE
IGNORANT ISA STATE
END WORDS

LINKS
USUAL(AUTHOR, FICTION)
USUAL(CHILD, IGNORANT)
USUAL(IGNORANT, MISTAKE)
BE ABOUT(RELIGIOUS DISCOURSE, GOD)
FORBIDE(RELIGIOUS DISCOURSE, QUOTE)
comment: that is to account for the location being Soviet Russia.
NECESSITY(ACTION, EXIST)
NECESSITY(ACTION, AVAILABLE)

END LINKS

(STORY INPUT)

Food was short.
A teacher quoted Krylov.
He said that Krylov wrote:
'God sent a cheese to the raven.'
A child said:
'There is no God ! '
but the teacher replied
'there is no cheese,
either ...'
THE END

(INFERENCES)

(God sent a cheese
1(there is no God
C4 in description of God and R3/God:
"the child means Krylov has a religious discourse".

(Krylov has a religious discourse
2(the teacher quotes Krylov
C4 in description of Krylov and default:
"the child means the teacher has an inconsistent discourse".

(God sent a cheese
3(there is no cheese
C4 in description of cheese and R5/Krylov:
"the teacher means Krylov's discourse is fiction".

(Krylov has a religious discourse
4(Krylov's discourse is fiction
C3 in description of Krylov and R5/child:
"the teacher means the child is mistaken".

END OF INFERENCES

END OF SESSION

Conclusion

While not achieving much by itself, Bæquil is an important component of the larger system [2] currently built at Paris 6, and could probably also be integrated in a large AI MT system as an expert of indirect descriptions of characters, for instance it could recognize the use of a nationality adjective suggesting a character trait (Cretan for liar, etc.), which is helpful in many cases: when the nationality adjective is not familiar in the target language (Chines texts about the ancient kingdoms), but also when there are several possible interpretations for the nationality adjective in terms of personality ('qua' ambiguity).

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IJCAI-4 and IJCAI-6 refer to the Proceedings of the International Joint Conferences on Artificial Intelligence.

The story in the sample session is adapted from "The Big Red Joke Book" by Benton and Loomes, Pluto Press, London, 1979.