Temporal Information in Intensional Contexts

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We present a system aimed at representing and interpreting the temporal information in intensional contexts, focusing particularly on the representation task. Take as an example the piece of discourse below.

(1) 1998-03-03. Thousands of people began gathering in the capital Abuja early Tuesday for the two day rally supporting General Sani Abacha's candidacy (...). But as supporters of the military leader gathered in the north, riot police deployed in Nigeria's southern commercial capital Lagos, to break up a protest rally called by the political opposition.

The problem is how to represent temporal information about the *break up* event, which was introduced by a purpose clause in a syntactic subordination pattern. We use TimeML ([3]), an annotation language for temporal information to obtain a TimeNet, a directed cyclic graph representing the temporal information in a text. TimeML uses a basic ontology of expressions denoting temporally relevant entities: time expressions are identified by the TIMEX3 tag and events are identified by the EVENT tag. The ontology also includes relations between events and time expressions. TLINKs encode temporal relations proper and SLINKs can be used to encode the relation between the two events in purpose clause.

TimeNets provide the necessary information for allowing the interpretation mechanism to be sensitive to intensional contexts, where irrealis events, and therefore the temporal connections stated about them, have to be qualified as uncertain. We illustrate TimeNet capabilities based on a potential QA system. A fragment of the TimeNet for (1) is printed below.

(2) <TIMEX3 tid=t1>early Tuesday</TIMEX3>
<EVENT eid=e1>deployed</EVENT>
<EVENT eid=e2>break up</EVENT>
<SLINK eid=e1 subordinatedEvent=e2 relType=MODAL/>

<TLINK eid=e1 relatedTo=e2 relType=BEFORE/>
<TLINK eid=e1 relatedTo=t1 relType=IS_INCLUDED/>

We have no space to discuss in detail how this TimeNet was obtained. Suffice to say that he annotation was created partly manually, partly by using high precision pre-processing modules ([1, 2, 4]), and partly by employing a deductive temporal closure engine called SputLink ([5]).

Temporal relations in TimeNets are represented in a totally extensional way, that is, the network of temporal connections that we obtain is established at a single, extensional level. Nonetheless, TimeML marks intensional contexts independently of the temporal information by using the SLINK relation. The search algorithm can then be designed to be sensitive to these intensional links. Take for instance the query in (3). For this query, we can create a TimeNet with a time expression, an event, and a temporal relation between the time and event. The information in this TimeNet can be joined into a single statement, as in (4). Similarly, event and time information can be joined into the TLINKs and SLINKs of the TimeNet in (2).

(3) Did the police break up the protest rally on Tuesday?

(4) <QUERY reltype=IS_INCLUDED event="break_up" time="Tuesday">

The adequate answer to (3) is not a Yes or No, but a reply expressing the uncertainty of the event. In order to deal with these intensional contexts we propose a procedure that subsumes the treatment of extensional contexts.

First we need to check whether the event in a query is intensional. For query (3) we would check whether *break up* is the subordinated event in any SLINK.[1] Second, regardless of whether *break up* is intensional or not, we match the query in (4) to the joined TLINKs in the TimeNet. If there is a match, the answer needs to be qualified in those cases where the event is intensional. Now, as it happens, there is no fact in the TimeNet fragment in (2) that temporally links *Tuesday* to *break up*. In this case, and only for intensional contexts, the query can be updated by replacing the subordinated event with the subordinating event, as in (5) and query (3) can be answered by (6).

[1] This begs the question of what to do when the intensionality of an event is later removed by further discourse. Our approach needs to be extended to deal with this. The solution is to separate the representation of intensionality of events from the representation of subordinating links that introduce an intensional context.

(5) <QUERY reltype=IS_INCLUDED event="deploy" time="early Tuesday">

(6) We don't know, but the police were deployed on Tuesday.

To recap, we have presented an approach using TimeML, an annotation scheme for temporal information. TimeML supports adequate representations of the temporal information in texts. These representations, called TimeNets, provide the necessary information for allowing the interpretation mechanism to be sensitive to intensional contexts, thus guaranteeing that irrealis events and their temporal connections are qualified as uncertain. We illustrated TimeNet capabilities based on a potential QA system.

References

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