Reasoning about the Temporal Structure of Narrative Texts

by

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Abstract

The process of determining the temporal structure of a narrative text is extremely complex. In this paper, we examine a small but central part of this process: the roles of aspectual class and the progressive/non-progressive distinction. A standard set of aspectual classes is presented and the temporal effects of each of these classes is discussed. Finally, we briefly discuss an implementation of a system which can read a simple narrative text and construct a model of the temporal structure of that text.

1. Introduction.

We are investigating the process of determining the temporal structure of narrative texts. This entails an investigation into the many factors which operate together within a narrative to indicate the temporal relations which hold between the events and situations mentioned in the text. Among these factors are tense, the progressive/non-progressive distinction, time-adverbials, world-knowledge, and aspectual class. In this paper, we will examine the roles of aspectual class and the progressive/nonprogressive distinction in this process.

We are using an essentially interval-based approach (similar to that proposed in Allen [1]) to the representation of temporal information. We do, however, use some time-points. Whether these are "really" points or just very small intervals is a question which we do not address.

2. The Narrative Now-Point.

Within a narrative, the most important temporal reference point is the point which represents the "present" moment within the narrative. When the time adverbial now is used in a narrative, it is this point of time which is being referred to. For this reason, we refer to this reference point as the narrative now-point, or, more briefly, as the now-point.

This now-point functions within a narrative more or less the way that the present (the "real" now) functions in the real world. That is, everything which comes before the now-point is in the past (in the world of the story) and everything that comes after the now-point is in the

future from the perspective of that moment in the story. Thus, as the story progresses in time, the now-point is moved forward in time. Uncovering, and then modeling, the ways in which different temporal devices interact with, and sometimes affect, this now-point is one of the major goals of our research.

3. Aspectual Class.

The notion of aspectual class plays a central role in the determination of the temporal structure of a narrative. One of the earliest detailed discussions of the concept of aspectual class was given in Vendler [7]. This work has since been refined and expanded upon in Dowty [2], Vlach [8], and Steedman [6], among others. The basic idea is that propositions can be shown to fall into one of a small number of categories (sometimes called aspectual classes) based on a number of properties of these propositions. The exact number of such classes, along with the catalog of properties associated with each class, varies with the researcher. Vendler distinguished the following four:

3.1. Achievements.

Examples of this class are: "Mary fell asleep at 12 o'clock", and "John reached the top of the hill". The principle temporal properties of this class are (1) the simple, i.e. non-progressive, forms are true only at time points; and (2) the truth of the progressive form (if it exists at all) does not imply the truth of the simple form, so that for instance, "John was falling asleep" does not necessarily imply that "John fell asleep".

3.2 Accomplishments.

Examples of this class are: "John ran a mile" and "Mary played a sonata". Typically, accomplishments involve a goal or an outcome of some sort. The principle temporal properties of this class are: (1) the simple form is true at an interval of time, i.e. accomplishments are not point-like; and (2) like achievements, the truth of the progressive form does not imply the truth of the simple form, so that for instance, "Mary was painting a picture" does not mean that "Mary painted a picture", i.e. that she completed it. Dowty [2] refers to this property of both accomplishments and achievements as the "imperfective paradox". That we are aware of, the first person within A.I. who dealt with this problem was McDermott [3]. He used an "in-progress" operator to mark the progressive forms. Vlach [8] also argues for the use of a PROCESS operator and this is the approach that we are also using. On the other hand, the simple form of an accomplishment does imply the progressive form, so that if "John ran a mile" then "John was running a mile".

The class of propositions consisting of the union of the achievements and the accomplishments (both in their simple forms) has been referred to as the class of events [4]. The way events typically behave can be seen in the following example. Imagine we are reading a text and we come across the following sequence of sentences:

> John got out of bed. He wrapped his blanket about his head and shoulders.

The meaning of this particular example seems to be that first John got out of bed and **then** he wrapped the blanket about his head and shoulders. We interpret these sentences this way because (1) we know we are reading a narrative; (2) the sentences appear in a particular order; and (3) these sentences describe events. Notice that world-knowledge is not helpful in this example. Typically, an event sentence in the simple past tense describes an event which occurs AFTER the previously established now-point, and it has the effect of updating this now-point to just AFTER the time-interval of the event described.

3.3. **States**.

Examples of states are: "John knew the answer" and "The jar was on the table". The principle temporal properties of states are: (1) if a state is true for some interval of time then it is true for all points and subintervals of that interval; and (2) states are always viewed imperfectively, i.e., from within.

As a demonstration of the effect of the second property, consider the following example which consists of an event sentence followed by a stative:

John awoke. It was dark in the room.

The most likely interpretation of this example is that the state of its being dark held not only for some interval after John awoke but also for some interval before he awoke. What we believe happens in such an example is that the event (John awoke) establishes a new now-point in the usual manner, and then the state is viewed imperfectively from that now-point, that is, the now-point is DURING the time-interval associated with the state. Typically, a state does not move the now-point. If we were to add one or more additional stative sentences to this example, then all of these states would relate in this same way to this one now-point. This sort of "piling on" of states is common in descriptive sections of narratives.

Notice that the belief that the state actually overlaps the preceding event does not directly follow from the mere fact that the state is viewed imperfectively from the now-point, but is in fact an inference that we would probably want the system to make in this case. In the majority of such cases this seems to be a proper inference to make.

As a case in which this inference does not go through, consider the following example:

John turned off the light. It was dark in the room.

In this case the state is still viewed imperfectively from the now-point established by the event, but this time, the system should infer that the state of its being dark has a start-time after the event's end-time, but of course, still before the now-point. And so the state does not overlap the event which is apparently its cause.

In both cases, the basic way in which states behave with respect to the now-point is the same, but the system can then make additional inferences based on world-knowledge (assuming that it has this

knowledge) which further decide whether or not there is overlap.

3.4. Activities.

The fourth and last category of propositions distinguished by Vendler is the class of activities. Examples of activities are: "John listened to music", and "Mary played the piano". Unlike accomplishments, activities do not have an intrinsic goal or expected outcome.

The principal temporal properties of activities are: (1) they are true at intervals of time, i.e., they are not point-like; and (2) the truth of the progressive form of an activity does imply the truth of the simple form, so that, for instance, "John was listening to music (but was interrupted)" allows us to infer that "John listened to music". Also, of course, the simple form does imply the progressive form.

In a narrative, simple activities behave in a way which is intermediate between that of events and states. For example in:

John walked into the office. The secretary typed at her desk.

The secretary's typing (an activity) possibly overlaps the preceding event, and in addition, may still be continuing. However, unlike states, simple activities cause the now-point to move forward. Thus, successive simple activities may or may not overlap each other.

4. The Progressive.

Vlach [8] proposes that the function of the progressive operator is to change non-statives into statives. Certainly the temporal behavior of progressives is in many (but probably not all) circumstances the same as that of states. In the absence of time adverbials, the progressive forms of the three non-stative aspectual classes behave with respect to the now-point in exactly the same way as states do.

5. An Implementation.

We have implemented a system which can read a simple narrative text and construct a model of the temporal structure of that text. The system works as follows:

1) a sentence is parsed, a representation of the tenseless proposition is built, and the proposition's aspectual class is determined.

2) depending on the aspectual class and whether the sentence is simple or progressive, the proposition is related to its associated time-interval or point by one or both of the following case frames: (1) PROPTIME-PROP : which means that the simple form of the proposition is true at (or in the case of states, for) that interval; (2) PROGTIME-PROG : which means that the progressive form of the proposition is true for that interval.

3) this time-interval (or point) is then related to the current now-point in one of the manners described earlier in this paper, and then finally,

4) in the case of events and simple activities, the now-point is updated to a position AFTER the just added time-interval.

5) the next sentence is now read.

The parser is implemented as an ATN and the representations are in the form of semantic networks implemented in the SNePS semantic network processing system (5). The current implementation will only accept sentences in the simple past or the past progressive tense. In addition, the system does not handle time adverbials or do any inferencing. We expect to expand and improve the system as our research progresses.

6. Conclusion.

We have discussed some of the major temporal properties of the various aspectual classes and we have indicated how, in conjunction with the progressive/non-progressive distinction, we believe these classes behave in a narrative text. We have also briefly discussed our implementation of these ideas.

7. References.

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