Chapter 12

Story grammars

Return of a theory

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Introduction

This chapter describes a declarative model for simple narratives. The model characterizes event sequences that constitute a story when reported in natural language. Previous work in story generation has followed one of two tracks: (1) declarative, or isolating the structure of stories and then creating text conforming to that structure, and (2) procedural, or modeling and recreating the processes used by human authors. Researchers in the first track often were unable to implement their model; but implementations arising from the second track did not directly address what constitutes a story. By implementing a story grammar, we address both these issues and constructively demonstrate the viability of utilizing formal grammars to describe stories.

Background

Anthropology and linguistics intersect when attention focuses on the folklore pertaining to a culture. In the early nineteenth century, Wilhelm and Jakob Grimm published their collections of traditional domestic tales of the German people (Grimm 1987). Subsequently, Aleksandr Afanasev published his collection of Russian folk tales (Afanasev 1974, 1975), which Vladimir Propp used in the 1920s in his investigations into the morphology of the folktale (Propp 1968). Contemporary investigations into story structure reached a watershed in 1973, when B. N. Colby published a grammar for Eskimo folktales

(Colby 1973). Colby was the first to use formal grammars to describe linguistic phenomenon beyond single sentences.

A variety of questions motivated researchers to employ formal grammars as a way of describing stories. Some were interested in the cognitive mechanisms used by people to summarize and recall stories and proposed that story grammars were an integral part of human language ability. Others were attempting to discern the common structure of stories and turned to formal grammars as a knowledge representation device. Our own interest is closer to the latter; and we do not make any cognitive claims concerning what human beings do when creating or reading a story. We use a formal grammar to describe narratives; to this end, we have developed a set of structural components along with rules for their composition. Our model is (1) general enough to apply to folklore compilations of the sort described above, and (2) sufficiently detailed to rule out constructions of non-stories. Below, we briefly review previous work in story modeling.

Previous work in Declarative Story Modeling

Rumelhart develops a model for the organization that takes place in connected discourse but is absent in strings of sentences (Rumelhart 1975). In general, it is almost always necessary to infer (unstated) causal relationships to understand groups of sentences. These causal relationships relate sentences to each other. Rumelhart presents a grammar describing the inter-sentence bindings that arise in simple stories. The grammar is context-free and consists of syntactic rewrite rules each of which has a corresponding semantic interpretation rule. The primitives are meta-sentence components such as setting, episode, and event. Below are two rules from David Rumelhart's story grammar.

1. Attempt → Plan + Application
   ⇒ *MOTIVATE*(*Plan*, *Application*)
2. Application → (Preaction)* + Action + Consequence
   ⇒ *ALLOW*(*AND*(*Preaction*, *Preaction*, ...),
   {CAUSE | INITIATE | ALLOW} (Action, Consequence))

In Rumelhart's grammar (and those derived from his grammar), the relationship a component has to other components is expressed in "semantic" annotations accompanying the "syntactic" rules. Scare quotes distinguish the story grammar use of the terms "syntactic" and "semantic" from conventional use. In story grammars, the terms are intended to mean something like "structural" and “extra-structural,” but in fact mean rather “captured by the grammar” and “not captured by the grammar.” If the “syntactic” structure of a portion of a text makes a particular rule applicable, then the relationship of this component to others is gleaned from the annotation to the rule. Unfortunately, the “syntax” given in story grammars doesn’t rule out many constructions; while the “semantic” annotations are inadequately defined. This deficiency leaves the grammars open to wishful parsing and generation, a serious flaw which proponents of story grammars were unable to overcome. A major part of this work is a rigorous, formal framework used in relating story components to one another (Goldman & Lang 1993; Lang 1997).

Following Rumelhart’s “Notes on a Schema for Stories,” other researchers expanded on Rumelhart’s grammar (Bower 1976; Frisch & Perlis 1981; Johnson & Mandler 1980; Mandler & Johnson 1977; Stein & Glenn 1979) while others attacked the foundations of the possibility of a “grammar for stories” (Black & Bower 1980; Black & Wilensky 1979; Garnham 1983; Wilensky 1982). Eventually, the story grammars project was abandoned as unsuccessful, largely due to the crude state of formal techniques available at the time, but also due to the excessive demands made of story grammars as a cognitive mechanism.

Story Generation by Author Modeling

Around the same time as Rumelhart’s seminal paper on schemas for stories, Meehan published his dissertation on story generation (Meehan 1976). His system, Tale-Spin, inspired work in story generation from the perspective of author modeling, that is, by modeling the cognitive processes of a human author of stories. Turner’s Minstrel (Turner & Dyer 1985; Turner 1990, 1991a, b) and the system described by Okada and Endo (Okada & Endo 1992) are representative samples of author-modeling systems for stories.

Meehan’s Tale-Spin is a simulation of a forest world, producing natural language output describing the interactions of characters pursuing goals such as eating and drinking in a context where duplicity and hostility occur along with honesty and friendliness. Although Tale-Spin provides access to the meanings (conceptual dependency forms, in this case) from which the natural language text is constructed, the model by which the meanings themselves are generated is left implicit; and the relationships among the components of a story are deeply entwined in the procedures which drive the simulation.

Michael Lebowitz develops a model of story telling based upon an extensible library of plot fragments (Lebowitz 1985). These plot fragments serve the goals of the author, which may be nonsensical from the point of view of the characters. For example, an author may have a goal to keep lovers apart; and, in pursuit of this goal, he will insert into a story elements that prevent lovers from meeting. It would be absurd for lovers themselves to seek obstacles to their meeting; but as a device for enhancing a story's dramatic interest, it makes perfect sense for the author to devise such obstacles. Lebowitz's Universe program generates plot outlines using an algorithm very similar to that used in Tale-Spin except that author goals rather than character goals drive the mechanism. The research issue addressed by Lebowitz treats the realization of an author's goals in a story.

Scott Turner and Michael Dyer describe Minstrel (1985), a story-telling program which generates believable and logically consistent stories that make a point. Turner describes further development of Minstrel in subsequent papers (Turner 1990, 1991a, b). Turner's primary interest is in modeling human creativity and human story-telling behavior, and he uses King Arthur-style tales as his domain. Although we are working in a domain bearing superficial resemblances to Turner's, our objective is a model that is independent of the process human authors undertake when writing a story.

A new grammar for stories

This section describes selected features from our formal model for simple narratives (Lang 1997). The model takes the form of a definite clause grammar, hereafter referred to as "the-grammar". The nonterminals are metacomponents such as setting, episode, outcome, etc. The terminals are first-order predicate calculus schemas for the events, states, goals, and beliefs which, when instantiated and rendered into natural language, are the content of a simple narrative. The language described by the-grammar consists of lists of FOPC expressions. Each list is an ordered representation of the facts and events contained in some tale; but the list does not specify the relations among the various terms in it. The example below shows an event list representing a portion of "The Bad Wife." The list adequately captures the states and events in the story; but it does not represent the relationships among them. For example, nothing in the list indicates that the trick carried out by the peasant at time int(x7, x8) serves the goal held during time int(x10, x8) that his wife be in the pit. The information about the relationships among the elements of the event list is specified in the rules of the-grammar.

```
[holds(lives(peasant), int(x1, x2)),
holds(married_to(peasant, wife), int(x1, x2)),
holds(disobeys(wife, peasant), int(x1, x2)),
occurs(quarrel(peasant, wife), int(x2, x12)),
occurs(do(peasant, walk(in(woods))), int(x4, x5)),
occurs(finds(peasant, pit, under(bush)), int(x5, x6)),
goal(peasant, holds(loc(wife, in(pit)), int(x8, x9)), int(x10, x8)),
occurs(do(peasant, trick(wife)), int(x7, x8)),
holds(loc(wife, in(pit)), int(x8, x9)),
holds(alone(peasant), int(x8, x9)),
occurs(time_passes, int(x9, x20)),
...]
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The story rule

We model a story as having two sub-components, a setting and an episode list, each having temporal intervals such that the setting interval must meet that of the episode list. *Starting rule for stories.*

```
story(story(Setting, Ep_list)) –>
    setting(Setting, S_time),
    episodes(Ep_list, E_time),
    {meets(S_time, E_time)}.
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The left hand side of the rule states that a story is a labeled pair story(Setting, Ep_list). The right hand side states (1) that Setting and the temporal interval S_time must satisfy the rule for a setting; (2) Ep_list and the temporal interval E_time must satisfy the rule for episodes; and (3) the temporal intervals S_time and E_time must satisfy the constraint meets.

Rules for episodes

The episodes rule shown below defines this component as a non-empty list of components of the form ep(Ev,ER,A,O). The subcomponents of the episode are as follows:

Ev, an initiating event
ER, an emotional response on the part of the protagonist
A, an action response on the part of the protagonist
O, an outcome or state description which holds at the conclusion of the episode.